User Manual

Original Instructions

Allen-Bradley

Dynamix -1444 Series Monitoring System

Catalog Numbers 1444-DYN04-01RA, 1444-TSCX02-02RB, 1444-RELX00-04RB, and 1444-AOFX00-04RB

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Chapter 10

Operate the Module

CIP Objects

Appendix A

Notes:

Introduction

This manual describes the Dynamix™ 1444 Series dynamic measurement module. The information in the following chapters discusses installation, configuration, and operation of the module.

The module measures dynamic inputs such as vibration, pressure, and static inputs such as thrust, eccentricity, and rod drop. The 1444-DYN04-01RA module is designed specifically for integration with Allen-Bradley® Logix controllers that are connected across an industrial Ethernet network.

Who Should Use This Manual

This manual is intended for anyone who uses industrial machinery that needs a monitoring system for inputs such as vibration, pressure, and static.

Terminology

You must have an understanding of the following:

- Ethernet networks
- Logix controllers

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation®.

Resource	Description
Dynamix 1444 Series Monitoring System Specifications Technical Data, publication 1444-TD001	Provides system specifications for the Dynamix 1444 Series Monitoring System.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

About the Dynamix 1444 Series Dynamic Measurement Module

Applications

The Dynamix™ 1444 Series dynamic measurement module is a four-channel, general-purpose monitor that can serve almost any industrial machinery protection or application that monitors condition. The module supports measurements of dynamic inputs such as vibration, pressure, and static inputs such as thrust, eccentricity, and rod drop. The module is used to monitor shaft, casing, and pedestal vibration, shaft and rod position, expansion of the casing, and other critical dynamic and position measurements on machinery that rotates.

To achieve this degree of adaptability, the module marries an extraordinarily flexible firmware and an incredibly powerful multi-processor hardware platform.

The 1444-DYN04-01RA module is designed specifically for integration with Allen-Bradley® Logix controllers that are connected across an industrial Ethernet network. This design makes the 1444 Series unequaled in its ability to serve as a synergetic member of larger total facility control and information management systems.

The 1444 Series includes the main module (1444-DYN04-01RA) plus three optional expansion modules. The expansion modules, a tachometer signal conditioner, a relay module and an analog output module, are configured and managed from their host "main" module. Therefore configuration of these capabilities is included in the AOP for the main dynamic measurement module.

The main module also manages errors that are associated with any expansion module. The behavior of the expansion modules themselves on the failure of its host main module, or loss of communication to the main module, can also be defined.

The module supports the EtherNet/IP communication protocol and includes two RJ45 Ethernet ports. These ports can be applied as either standard Ethernet connections, where modules are daisy chained one to the next, or implemented by using Device Level Ring (DLR).

Main Features

The DYN module offers the following major features:

- Distributed vibration module with direct EtherNet/IP network connectivity
- Multifunction: configurable for eddy current probes, accelerometers, velocimeters, and all common dynamic measurement sensors that output voltages from -24V to +24V DC
- Four measurement channels and two tacho (TTL) circuits
- Transducer supply configurable per channel, as one of:
  – Constant Current Mode: +24 V/4 mA
  – Constant Voltage Mode: +24 V/25 mA
  – Constant Voltage Mode: -24 V/25 mA
- Buffered signal outputs (output current limited)
- Measurement bandwidth up to 20 kHz (4-channels), 40 kHz (2-channels)
- Digital filtering and signal analysis, including integration
- Supports Spike Energy (gSE) measurements
- Implements HP and LP filters (4-pole Butterworth), with infinitely variable -3 dB points
- Sophisticated and flexible alarm logic
- Protection alarm checks, typically every 40 ms
- Relay output (SPDT) rated for 30V DC and 250V AC
- FFT analysis capability
- Configurable for specialist measurements such as:
  – Rod drop
  – Ramp or complementary differential expansion
  – Eccentricity
  – Absolute shaft vibration

- Over 20 different measurement parameters per measurement channel, such as RMS, peak, FFT band RMS, order magnitudes, phase, and speed
- On-board storage of:
  – Trend data (discrete and dynamic data records)
  – Alarm/Event data (discrete and dynamic data records)
  – Transient data (discrete and dynamic data records)
- Expansion modules available to enhance system capabilities:
  – 4-channel Relay output module (up to three per each DYN module)
  – 2-channel Tacho Signal Conditioning module
  – 4-channel 4…20 mA output module

Product Description/System Overview

The Dynamix series consists of six core part numbers and various accessories for connectors and cables.

A minimum Dynamix 1444 Series monitoring system consists of the following:

- One DYN module, which is composed of a terminal base, a module, and either spring or screw clamp removable plug connectors for both the module and terminal base.
- Appropriate enclosure
- Sensors
- Power supply unit

Expansion modules provide enhanced or optional I/O capabilities that are application-dependent:

- 4-channel relay output modules (RELX)
- 4-channel 4…20 mA output module (AOFX)
- 2-channel Tacho Signal Conditioning module (TSCX)

Up to three RELX modules and one each AOFX and TSCX module can be connected to one DYN module. Interconnections between a DYN module and its expansion module (and to extend the tacho bus from one such group to further DYN modules) are by ribbon cable assembly.

The following parts listings conform to this hierarchical structure:

- Assembly level (of module and base, not including connectors)
  – Connector level (choice of screw or spring clamp type)
  – Component level (module or base as spare/replacement item)

Table 1 - 1444 Series Catalog Numbers

Type	Module	Catalog Number
Measurement modules	Dynamic measurement module	1444-DYN04-01RA
Speed modules	Tachometer signal conditioner expansion module	1444-TSCX02-02RB
Relay modules	Relay expansion module	1444-RELX00-04RB
Analog output modules	4…20 mA expansion module	1444-AOFX00-04RB
Terminal bases	Dynamic measurement module terminal base	1444-TB-A
	Expansion module terminal base	1444-TB-B

Table 2 - Removable Plug Connector Sets

Module	Spring Connector	Screw Connector
1444-DYN04-01RA	1444-DYN-RPC-SPR-01	1444-DYN-RPC-SCW-01
1444 -TSCX02-024B	1444-TSC-RPC-SPR-01	1444-TSC-RPC-SCW-01
1444-RELX00-04RB	1444-REL-RPC-SPR-01	1444-REL-RPC-SCW-01
1444-AOFX00-04RB	1444-AOF-RPC-SPR-01	1444-AOF-RPC-SCW-01
Terminal Base	**Spring Connector**	**Screw Connector**
1444-TB-A	1444-TBA-RPC-SPR-01	1444-TBA-SCW-01
1444-TB-B	1444-TBB-RPC-SPR-01	1444-TBB-SCW-01

Table 3 - 1444 Series Interconnect Cable Accessories

Catalog Number	Description
1444-LBIC-04	Local bus interconnect cable (qty 4)
1444-BXC-0M3-01	Local bus extender cable, 0.3 m (11.8 in.)
1444-LBXC-1M0-01	Local bus extender cable, 1.0 m (39.4 in.)

Each main and expansion module terminal base includes one standard ribbon cable connector. This connector is sufficient to interconnect all main and expansion modules in a system.

System Enclosure

An IP54 weatherproof enclosure is recommended for general applications and required for use in hazardous area locations.

Use of a metal enclosure is recommended to enhance EMC and thermal system performance.

Cable, Connector, and Mounting Accessories

Local Bus (Module to Module, Interconnect Cables)

1444 series modules are connected through a local bus and implemented by using a simple ribbon cable that spans one module to the next. The packaging for each terminal base includes a cable that is designed to the exact length necessary to connect two adjacent modules.

The extended interconnect cables provide a means to extend the local bus between terminal bases on different DIN rails or in different areas of a cabinet.

Extended interconnect cables are rated to 300V and from -40…105 °C (-40…221 °F).

The accessory list also includes a package of four standard length interconnect cables (catalog number 1444-LBIC-04). These cables can be used to replace the cable included with each terminal base.

Ethernet Cables

The 1444 products are designed to operate in harsh industrial environments and possibly close to electrically noisy or high-voltage devices and wiring. You must consider the environment, over the entire run of the cable, when determining an appropriate cable for the application.

Channel Class and Category

Dynamix 1444 Series monitors can be used with shielded or unshielded Ethernet media. For cables longer than 3 m (9.8 ft), use shielded cable or cable that is entirely enclosed within a shielded environment, such as an electrical enclosure or metal conduit. This consideration helps ensure EMC compliance.

See Rockwell Automation® documents 1585-BR001B-EN-P Industrial Ethernet Media and ENET-RM002C-EN-P Ethernet design considerations for information on selection of the appropriate Ethernet media for your application.

Recommended Cables

Only straight connectors are recommended for use with the 1444 products. Verify that the temperature rating of the selected cable is appropriate to the environment in which the 1444 product is installed, up to and including 70 °C (158 °F).

Compatible Sensors

The following types of sensors can be connected to a DYN module:

- 2-wire piezoelectric acceleration sensor
- 3-wire piezoelectric acceleration sensor with temperature sensing
- 2-wire piezoelectric dynamic pressure sensor
- 2-wire piezoelectric velocity sensors
- 2-wire self-generating velocity sensors
- 3-wire piezoelectric acceleration sensor
- 3-wire eddy current probe (ECP) systems
- Buffered voltage outputs
- Process proportional voltage signals (such as temperature, pressure, and flow)

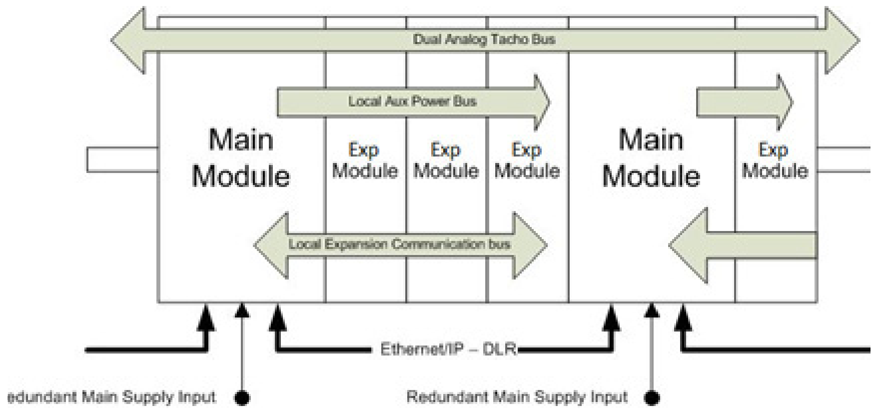
A transducer supply is available for each channel. The transducer supply can be independently enabled and configured for negative or positive operation (25 mA at 24V) or as a positive constant current source at 4 mA, 24V. The transducer power supply output is made available at a separate terminal so that, by appropriate wiring, it is possible to connect either two or three wire transducers.

System Components

The Dynamix 1444 series is a machinery protection system that is composed of the following:

- At least one DYN module with four channels for vibration or related measurements
- Two TTL speed inputs
- One relay output

Expansion modules then provide more output and input capacity that cannot be accommodated within that DYN module. The use of expansion modules is entirely optional and dependent on the specific application requirements.



For critical applications, the DYN modules support EtherNet/IP communication, including Device Level Ring (DLR) configurations and accept a wide range of (18…32 V, 24V nominal) redundant power inputs.

When expansion modules are used, the following apply:

- Any expansion modules are fitted to the right of their host DYN module.
- Expansion modules provide more relays, 4…20 mA outputs, and tachometer signal conditioning facilities.
- A local bus (ribbon cable) connects the main to its expansion modules, providing:
  – Current limited (fuse protected) power for the expansion modules
  – Local communication (main with expansion)
  – A dual tacho bus that distributes the TSCX modules TTL outputs
- The tacho bus can be extended to other DYN modules. Fit a bus cable from the end of the expansion module group or from the left side of the associated DYN module, as required.

The expansion relay module can initiate an alarm or place the machine in a safe state if it detects that the DYN module is not responding correctly, or that the DYN module is not responding in a timely manner.

Network Connectivity and Considerations

Within the system, the DYN module uses an RS-485 proprietary local bus for communication with its expansion modules. The DYN module interfaces to the EtherNet/IP network as an adapter device using single-node addressing.

Given the presence of two Ethernet RJ45 ports and integrated network switch, the system can be used in different network topologies:
- Linear
- Star
- DLR

Given an available internal switch, a linear module-to-module Ethernet connection can be established without the need for a local Ethernet router/switch. A linear topology is not the preferred solution since any module or cable failure results in loss of communication to that part of the network, downstream of the fault.

The star topology uses a multi-port Ethernet router/switch to establish point-to-point connections to DYN modules in the network. This topology increases network reliability, although it doesn't offer point-to-point connection redundancy.

IMPORTANT	The Dynamix 1444 Series is essentially a one-port device with a 2-port switch. Normal star topology redundancy that uses the Spanning Tree Protocol (STP – IEEE 802.1D or its newer and faster recovery variant RSTP – IEEE 802.1w) does not work for this EtherNet/IP application.

Most preferred from the perspective of performance, support, and ease of installation is the use of the Device Level Ring (DLR) redundancy method. The DLR redundancy mode lets you make a simple ring-based module-to-module connection to achieve a network with excellent reliability and fast recovery in the presence of one failure. This topology is recommended for machine protection applications.

Under control of one of the ring devices that are configured to act as ring supervisor, a network disruption (cable or module) can be detected. This disruption causes communication flow direction that is reversed in a few 100 ms to become a star connection of two linear connections.

IMPORTANT	The Dynamix DYN module cannot provide the required Ring Supervisor capability; therefore, an EtherNet/IP controller interface with DLR functionality is required (direct interface to Controller system). However, for downstream networks, a separate 1783-ETAP (3-port EtherNet/IP tap) can be used to act as Ring Supervisor for multiple EtherNet/IP adapters and provide connection to the higher-level EtherNet/IP network.

Multiple rings are either part of a further ring topology or connected with a star topology. In the latter case, the trunking method can be used where multiple parallel cables can be connected between switches such to increase bandwidth. For supported products, the redundancy level is increased.

Install the Dynamix 1444 Series Monitoring System

Environment and Enclosure

ATTENTION: This equipment is intended for use in a Pollution Degree 2 industrial environment, in Overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and does not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment for indoor use. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that are present. It must be appropriately designed to help prevent personal injury that results from accessibility to live parts. The enclosure must have suitable flame-retardant properties to help prevent or minimize the spread of flame. The enclosure must comply with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication contain more information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

For additional information, see:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

Prevent Electrostatic Discharge

ATTENTION: This equipment is sensitive to Electrostatic Discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

Electrical Safety Considerations

WARNING: To comply with the CE Low Voltage Directive (LVD), all power connections to this equipment must be powered from a source compliant with the following:
- Safety Extra Low Voltage (SELV), or
- Protected Extra Low Voltage (PELV)

To comply with UL/CUL requirements, this equipment must be powered from a source compliant with the following:
- Limited Voltage Supply

If the input power supply is restricted to 8 A, no additional protection is necessary. However, for supplies with higher current ratings that serve multiple groups of main modules, the first module of the daisy chain requires an 8 A current limiting fuse for protection.

WARNING: All wiring must comply with applicable electrical installation requirements (for example, N.E.C. article 501-4(b)).

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations:	**Informations sur l'utilisation de cet équipement en environnements dangereux:**
Products that are marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, hazardous locations, and nonhazardous locations only. Each product is supplied with markings on the rating nameplate to indicate the hazardous location temperature code. When products are combined within a system, the most adverse temperature code (lowest "T" number) can be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: **Explosion Hazard -** • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means that are provided with this product. • Substitution of components can impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area that is known to be nonhazardous.	**AVERTISSEMENT:** **Risque d'Explosion -** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Do not replace components or disconnect equipment unless power has been switched off or the area is known to be free of ignitable concentrations.

WARNING: Consider the following:

- If you insert or remove the module while Backplane power is on, an electric arc can occur, and could cause an explosion in hazardous location installations.

  Be sure that power is removed or the area is nonhazardous before proceeding.
- When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electric arc can occur. This arc could cause an explosion in hazardous location installations.

  Be sure that power is removed or the area is nonhazardous before proceeding.
- If you connect or disconnect wiring while the field-side power is on, an electric arc can occur. This arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- Exposure to some chemicals degrade the sealing properties of materials that are used in the following devices:
- Relay RL1, Epoxy.

  We recommend that you periodically inspect these devices for any degradation of properties and replace the module if degradation is found.

ATTENTION: If you use this equipment in a manner that the manufacturer has not specified, the protection that is provided by the equipment can be impaired.

Before you install, configure, operate, or maintain this product, read this document and the documents that are listed in the additional resources section. The documents provide additional information about how to install, configure, or operate the equipment. You must familiarize yourself with installation instructions and instructions for wiring, and requirements of all applicable codes, laws, and standards.

Suitably trained personnel must install, adjust, implement, use, assemble, disassemble, and maintain the equipment in accordance with applicable code of practice. If there is a malfunction or damage, do not attempt to make a repair. The module must be returned to the manufacturer for repair. Do not dismantle the module.

This equipment is certified for use only within the surrounding air temperature range of -25…70 °C (-13…158 °F). The equipment must not be used outside of this range.

Solid-state equipment has operational characteristics that differ from electromechanical equipment operational characteristics.

Publication SGI-1.1, Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Controls, is available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature. This publication describes some important differences between solid-state equipment and hard-wired electromechanical devices.

WARNING: This equipment is not resistant to sunlight or other sources of UV radiation.

Exposure to some chemicals can degrade the sealing properties of materials that are used in the following devices:

- DYN module – Relay RL1, Epoxy
- Expansion Relay Module – Relay RL1 through RL4, Epoxy

European/IECex Hazardous Location Approval

The following applies to products marked II 3 G. Such modules:

- Are Equipment Group II, Equipment Category 3, and comply with the Essential Health and Safety Requirements
- Relating to the design and construction of such equipment given in Annex II to Directive 94/9/EC. See the EC Declaration of Conformity at http://www.rockwellautomation.com/products/certification for details.
- The type of protection is Ex nA IIC T4 Gc according to EN 60079-15.
- Comply to Standards: EN 60079-0:2012+A11:2013, EN 60079-15:2010, reference certificate number DEMKO14ATEX1365X.
- Are intended for use in areas in which explosive atmospheres caused by gases, vapors, mists, or air are unlikely to occur, or are likely to occur only infrequently and for short periods. Such locations correspond to Zone 2 classification according to ATEX directive 1999/92/EC.

The following applies to products with IECEx certification. Such modules:

- Are intended for use in areas in which explosive atmospheres caused by gases, vapors, mists, or air are unlikely to occur, or are likely to occur only infrequently and for short periods. Such locations correspond to Zone 2 classification to IEC 60079-0.
- The type of protection is Ex nA IIC T4 Gc according to IEC 60079-15.
- Such modules comply to Standards IEC 60079-0:2011, IEC-60079-15:2010, reference IECEx certificate number IECExUL14.0082X.

WARNING: Special Conditions for Safe Use

- This equipment is not resistant to sunlight or other sources of UV radiation.
- This equipment shall be mounted in an ATEX/IECEx Zone 2 certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in EN/IEC 60529) and used in an environment of not more than Pollution Degree 2 (as defined in EN/IEC 60664-1) when applied in Zone 2 environments. The enclosure must be accessible only by the use of a tool.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 140% of the rated voltage when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

API-670 Compliance

The 1444 series is designed in accordance with the relevant sections of the 5th Edition of the American Petroleum Institutes (API) standard 670,[1] "Machinery Protection Systems".

(1) Whether a system complies is dependent on the specific components that are provided, the various optional elements of the standard that you require, and the configuration of the installed system.

Removal or Insertion Under Power (RIUP)

Removal or Insertion Under Power (RIUP) of any 1444 series main or expansion module is permitted only in a nonhazardous area.

ATTENTION:
- In a hazardous area, the module must be powered down before removal.
- Always consider the consequences for the system and the monitored machine before you power down or remove any module from service.

Design Considerations

The Dynamix™ modules must be placed in a protective metal enclosure with a minimum recommended protection class of IP54.

Multiple modules can be placed in one housing, providing proper consideration has been given to the following:
- System design and planning
- Mounting
- Module and connection accessibility
- Wiring, cabling, and routing
- System operating temperature and reliability

Electro Magnetic Compatibility (EMC) Precautions

While the module has been thoroughly tested for EMC compliance, performance in real world situations depends on the care that is taken during system design and installation. Follow the preferred practices listed.

Table 4 - EMC Precautions

Verify that metal parts are well grounded.	• Connect all inactive metal parts, like cabinet walls and doors, to ground. • Verify that the entire surface area is grounded and the connection to ground is low impedance. • Applies to the enclosure and any additional cable junction boxes. • Avoid using aluminum parts whenever possible for grounding. Aluminum oxidizes easily, which causes its resistance to vary.
Route cables with care.	• Divide the wiring into categories (power supply, sensors, and control signals). • Use sufficient separation between the wire groups. • Always run any high current/high-voltage lines and signal/data lines in separate conduits or bundles. • Run the signal lines as closely as possible to the ground areas (for example, bus bar, metal rails and cabinet metal). • Further details about the wiring category and routing are provided in the following sections, and the wiring category identifications are provided in the applicable specifications section.

Table 4 - EMC Precautions

Use shielded/screened cables	• For the analog sensor input, each channel must be separately shielded (one shield for each channel in a multi-core cable).
Properly terminate the shield wires	• Keep the unshielded part of the cables as short as possible. It is ideal if only the last 100 mm (3.94 in) of the cable is unshielded. • Preferably, use an EMC cable gland to obtain a 360° ground connection to the enclosure. Alternatively, connect the shielded wire directly after entering the cabinet or the enclosure on a grounded bus bar and fix it with a cable clamp. – The modules provide SHIELD terminals that can be used for shield wire termination. However, from a performance perspective, the previously described methods are preferred. The SHIELD terminals are connected together, but otherwise isolated from all module circuitry and the DIN rail. The installer uses one or more of the SHIELD terminals to connect to a ground of their choosing • Use a direct connection from the cable shield to the protective conductor. • Connect only one end of the shield to ground; for hazardous area systems, preferably at the field end. For known EMI hot-spots, use of overall conduit or double-shielded cabling with shield that is grounded at both ends is preferred. • When an additional junction box is used for dividing a multi-core cable into separate cables, verify that the cable shields are isolated from the metal enclosure of the distribution box. (The distribution box must be made of metal.)
Make a uniform reference potential (reference ground)	Avoid ground loops by connecting the installations and cabinets to a central ground conductor

Wiring Categories and Routing

The following wiring categories are defined to help with proper segregation of wires and cables as part of the planning process for system layout and installation to promote noise immunity.

Category	Group Description	Examples
1	Control and AC Power – High-power conductors that are more tolerant of electrical noise than category 2 conductors and can also cause more noise to be picked up by adjacent conductors.	• AC power lines for power supplies and I/O circuits • High-power digital AC I/O lines • High-power digital DC I/O lines
2	Signal and Communication – Low-power conductors that are less tolerant of electrical noise than category 2 conductors. They also cause less noise to be picked up by adjacent conductors (they connect to sensors and actuators relatively close to the I/O modules).	• Analog I/O lines and DC power lines for analog circuits • Low-power digital AC/DC I/O lines • Low-power digital DC lines • Communication cables
3	Intra-enclosure – Interconnect the system components within an enclosure.	• Low voltage DC power cables • Communication cables

To guard against coupling noise from one conductor to another, the following general guidelines when routing wires and cables (both inside and outside of an enclosure) apply.

Category	Routing Guidelines
1	These conductors can be routed in the same cable tray or raceway with machine power conductors of up to 600V AC.
2	If it must cross power cabling, cross at right angles. • Route at least 1.5 m/5 ft. from high-voltage enclosures or sources of RF/microwave radiation. • If the conductor is in a metal wireway or conduit, each segment of that wireway or conduit must be bonded to each adjacent segment so that it has electrical continuity along its entire length. Also, the wireway or conduit must be bonded to the enclosure at the entry point. • Properly shield where applicable and route in a raceway separate from category 1 conductors. • If in a continuous metallic wireway or conduit, route at least 0.08 m/3 in. from category 1 conductors of less than 20 A; 0.3 m/1 ft. from AC power lines of 20 A or more, but only up to 100 kVA; 0.6 m/2 ft. from AC power lines of greater than 100 kVA. • If not in a continuous metallic wireway or conduit, route at least 0.15 m/6 in. from category 1 conductors of less than 20 A; 0.3 m/1 ft. from AC power lines of 20 A or more, but only up to 100 kVA; 0.6 m/2 ft. from AC power lines of greater than 100 kVA.
3	Where possible, route conductors external to all raceways in the enclosure or in a raceway separate from any category 1 conductors with the same spacing as listed for category 2 conductors.

Use the spacing that is given in these general guidelines with the following exceptions:

- Where connection points (for conductors of different categories) on a device are closer together than the specified spacing
- Application-specific configuration for which the spacing is described in a publication for that specific application

These guidelines are for noise immunity only. Follow all local codes for safety requirements.

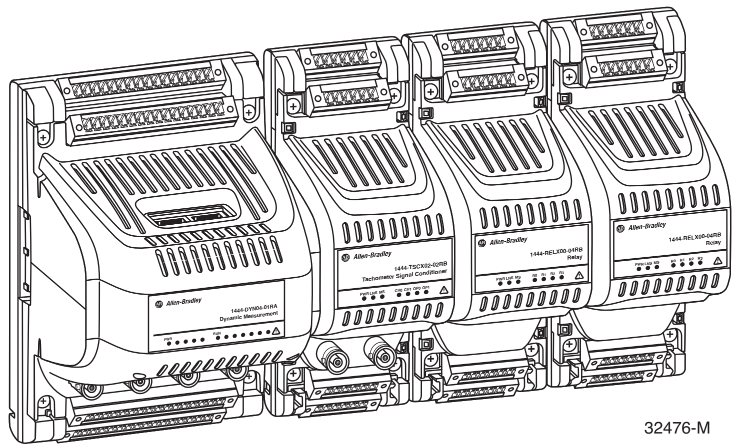
Given the Dynamix 1444 series system component top and bottom I/O access, we recommend that you use cable ducts to organize and provide separation of I/O wiring.

If there is high-voltage relay contact wiring (120/250V AC) and/or high current load, assign top or bottom relay contacts. Or, use Expansion bus extension cables to position applicable relay modules in a more suitable location within the overall system.

Temperature Considerations

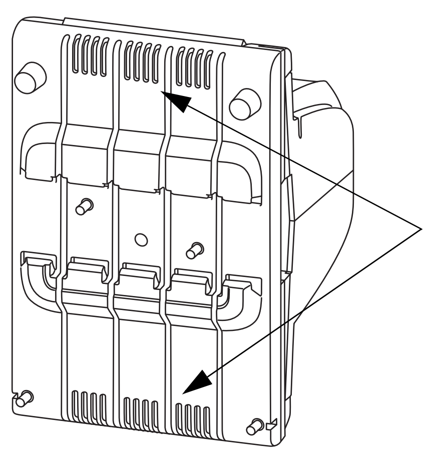
While the 1444 series modules operate at rated temperature when mounted vertically or horizontally, the system components have been designed for cooling by natural convection based on a horizontal orientation. Therefore, to make sure that there is optimal heat dissipation, the recommended mounting orientation is horizontal (in an upright / vertical position) as shown in Figure 1.

Figure 1 - Module Mounting Position



The module plastics design enables natural convection or unducted airflow by its ventilation slots on both sides of the module such to support a “chimney effect” from bottom to top.

IMPORTANT	Although the terminal base of expansion modules has a fully passive nature, some electronics are present within the DYN module terminal base. Despite low-power dissipation, the main terminal base is also equipped with ventilation slots and some level of internal airflow ducting from bottom to top. We recommend that you verify these ventilation slots are not blocked.



An estimate can be made of total internal power dissipation within the enclosure. This estimate is based on maximum current load models, including internal module power dissipation of its DC power and externally connected power sources. This estimate can provide guidance to select an enclosure or plan for required temperature control measures inside your enclosure.

Module Type	Maximum Power Dissipation
Main	9.0 W
Relay	2.3 W
4…20 mA	3.6 W
Tacho Signal Conditioning	3.0 W

Together with known (maximum) system heat dissipation from all used components that are planned for your enclosure, the following approximate equations. They are based on the use of no active method of heat dissipation control (like fans or air conditioning). The equations can be used to calculate either cooling surface requirement for enclosure and/or internal cabinet temperature rise.

Metric	English
$A := \frac{0.38 \cdot Q}{1.8 \cdot T - 1.1}$	$A := \frac{4.08 \cdot Q}{T - 1.1}$
$T := \frac{0.21 \cdot Q}{A} + 0.61$	$T := \frac{4.08 \cdot Q}{A} + 1.1$
Where: • T is the temperature difference between inside air and outside ambient (°C) • Q is heat that is generated in enclosure (W) • A is enclosure surface area (m2) The exterior surface of all six sides of an enclosure is calculated as follows. A = 2dw + 2dh +2wh Where d (depth), w (width) and h (height) are in meters.	Where: • T is the temperature difference between inside air and outside ambient (°F) • Q is heat that is generated in enclosure (W) • A is enclosure surface area (ft2) The exterior surface of all six sides of an enclosure is calculated as follows. A = (2dw + 2dh +2wh)/144 Where d (depth), w (width) and h (height) are in inches.

The system components are designed for internal enclosure surrounding air temperatures of up to a maximum of 70 °C (158 °F) (measured 1 inch below the main module). These designs are based on natural convection cooling and specified air space clearances around the Dynamix 1444 series system.

Outcome of calculations can show that it is more efficient to provide a means of cooling rather than increase cabinet size. Contact your cabinet manufacturer for options available to cool your cabinet.

All system components can measure and monitor internal operating temperatures, a feature that is highly recommended to be used to control overall system operating temperature during normal use.

Module specifications indicate a maximum-internal operating temperature reference for each module type.

Although the amount of (maximum) heat dissipation remains unchanged, use of slightly assisted cooling, also called unducted airflow, has a considerable impact (5…10 °C) (9…18 °F) on internal operating temperatures of system components.

There is one configuration aspect that can reduce the dissipation load of each DYN module by about 0.8 W, despite that typically the maximum heat dissipation is fixed. (And actual dissipation heat dependent on module configuration and operating state.)

When powered, the buffered outputs consume a significant amount of quiescent operating power (approximately 0.8 W), which also imparts more heat. Because the buffered outputs are infrequently used in most applications, it is recommended that the buffered outputs not be powered during routine operation.

See Buffered Outputs on page 62 for information on how to enable/disable the outputs.

Reliability Considerations

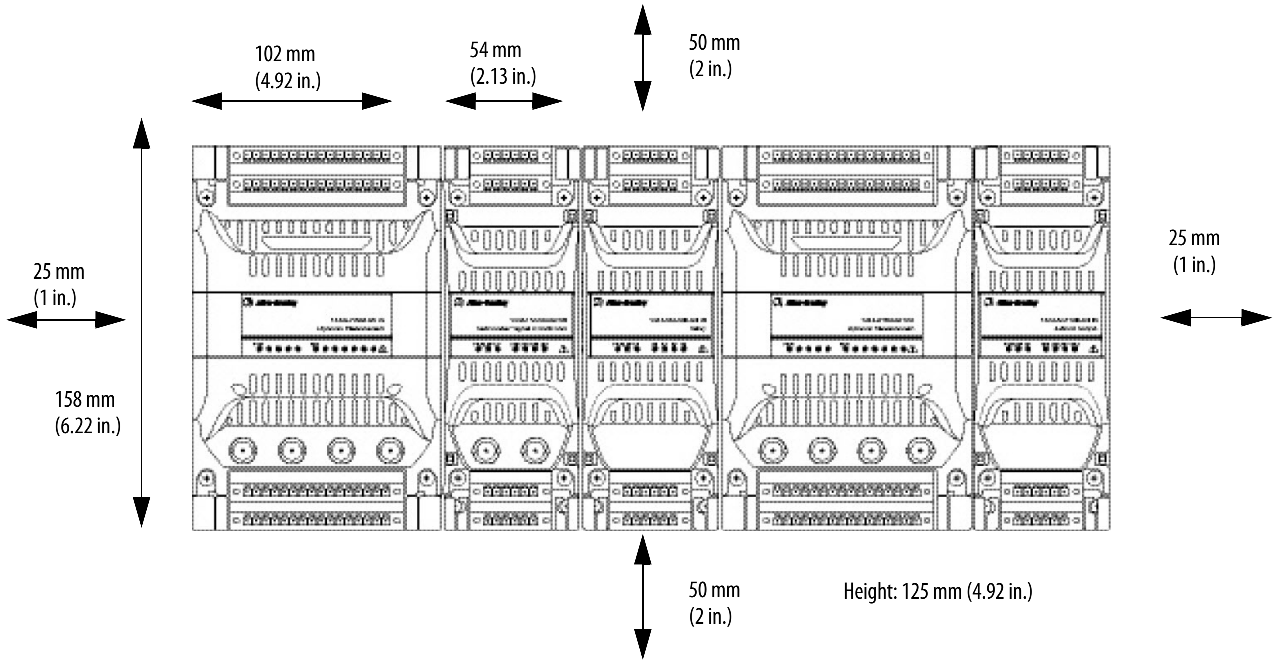
Closely related to the previous section, overall system reliability is greatly affected by operating temperatures. Therefore, it is highly recommended to minimize the internal operating temperatures of the modules.

System Space and Clearance Requirements

Design and layout of the system enclosures is a key consideration in any installation. Verify that there is sufficient space for access to (and fitting/removal of) the top and bottom connectors, and a wiring/cable ducting scheme that maintains appropriate separations.

For proper airflow and installation of the module, the following minimum-air space requirements must be maintained around the system.

Figure 2 - Clearance Requirements



The 50 mm/2 in. clearance above and below the modules, in combination with 45° angled, pluggable connections, provides for:

- Use of tooling to make/remove electrical connections
- Visible wire identification
- Sufficient physical space to insert/remove pluggable connections
- Optimized air volume per module in relation to thermal performance

Wiring Requirements

WARNING: All wiring must comply with applicable electrical installation requirements (for example, N.E.C. article 501-4(b)).

All modules (whether main or Expansion) have four removable connectors where the field wiring is made. They come in a choice of spring cage or screw connection. Both types benefit from the following:

- Screwdriver axis parallel to conductor axis
- Positive connector retention (captive screws)
- Test connections for 1.2 mm (0.047 in.) diameter test pins or 1 mm (0.039 in.) test plugs

The DYN module connectors are 16 way and the expansion module connectors are 6 way. Each is keyed appropriate to location and module type.

Manufacturer technical data for these connectors is as follows.

Attribute	Value
Tightening torque, min- max (screw type only)	0.22…0.25 N•m (0.16…0.18 ft·lbf)
Normal cross-section	1.5 mm^2 (0.002 in^2)
Stripping length	9 mm (0.35 in)
Conductor cross-section solid or stranded min- max	0.14…1.5 mm^2 (0.0002…0.002 in^2)
Conductor cross-section stranded with ferrule without plastic sleeve min- max	0.25…1.5 mm^2(0.0003…0.002 in^2)
Conductor cross-section stranded with ferrule with plastic sleeve min- max	0.25…0.5 mm^2 (0.0003…0.0007 in^2)
Conductor cross-section AWG/kcmil min- max - screw clamp type	28…16 mm^2
Conductor cross-section AWG/kcmil min- max - spring clamp type	26…16 mm^2
AWG according to ULL/CUL min- max -screw clamp type	30…16 mm^2
AWG according to ULL/CUL min- max -spring clamp type	28…16 mm^2

Use solid or stranded wire. All wiring must meet the following specifications:

- Minimum insulating rating of 300V
- You are not allowed to solder the conductor
- Wire ferrules can be used with stranded conductors; copper ferrules recommended
- Single wire per connection

Removable Connector Keyring

Each terminal block on each module is numbered with its corresponding pin numbers, which match the pin numbers on its Removable Plug Connector (RPC). Additionally, each terminal block on each module and base also includes two keys that make sure that only its matching RPC can be plugged into it. However, with sufficient force it is possible to defeat the keys. If the keys are defeated, then when the RPC is later removed it is possible that the key becomes dislodged from its pin location.

If a key is removed from its connector, it isn't necessary to replace it as it only serves to help match the RPC to its connector. However, the key can be readily inserted back into its connector. When doing so, make sure that the key is placed into the correct pin location as shown in Table 5.

Table 5 - RPC Pin Numbers and Key Locations

Catalog Number	Description	Terminal	RPC Catalog Number(1)	Pin Numbers	Key Locations
1444-DYN04-01RA	Dynamic Measurement Module	Upper	1444-DYN-RPC-xxx-01	33…48	34, 47
		Lower		1…16	3,14
1444-TSCX02-02RB	Tachometer Signal Conditioner Expansion Module	Upper	1444-TSC-RPC-xxx-01	13…18	16, 17
		Lower		1…6	2, 6
1444-RELX00-04RB	Relay Expansion Module	Upper	1444-REL-RPC-xxx-01	13…18	13, 17
		Lower		1…6	3, 5
1444-AOFX00-04RB	4-20mA Expansion Module	Upper	1444-AOF-RPC-xxx-01	13…18	14, 16
		Lower		1…6	2, 5
1444-TB-A	Terminal Base for 1444-DYN04-01RA	Upper	1444-TBA-RPC-xxx-01	49…64	49, 64
		Lower		17…32	20, 29
1444-TB-B	Terminal Base for 1444 Series Expansion Modules	Upper	1444-TBB-RPC-xxx-01	19…24	21, 24
		Lower		7…12	7, 10

(1) Each RPC includes two connectors, each numbered and keyed to match either the upper or lower terminal connector of the module or base that it is associated with.

Module Power Supply Requirements

The Dynamix 1444 series system is powered by single or redundant, 18…32V DC supplies as follows:

- To comply with the CE Low Voltage Directive (LVD), all power connections to this equipment must be powered from a source compliant with the following:
  - Safety Extra Low Voltage (SELV), or
  - Protected Extra Low Voltage (PELV)
- To comply with UL/CUL requirements, this equipment must be powered from a source compliant with the following:
  - Limited Voltage Supply

If the input power supply is restricted to 8 A, no additional protection is necessary. However, for supplies with higher current ratings that serve multiple groups of main modules, the first module of the daisy chain requires an 8 A current limiting fuse for protection.

The power return line of the main-system power supply must be grounded for electrical safety reasons.

The required power supply rating can be calculated based on the following (per module) allowances.

Module Type	Power Load	18V Supply	24V Supply	32V Supply
Main	11.5 W	640 mA	480 mA	360 mA
Expansion relay	1.6 W	90 mA	70 mA	50 mA
Expansion 4…20 mA	0.76 W	40 mA	30 mA	22 mA
Expansion TSC	4 W	225 mA	170 mA	125 mA

Each redundant supply must be able to provide the full load, no facility for load sharing is provided, and the higher of the two applied voltages powers the module.

There are internal protective (non-replaceable) fuses on each of the power inputs and on the bus supply to the expansion modules. In addition, there is similar protection on each of the (main and expansion) modules.

The expansion modules are only powered by the bus and from a main module base. Removal of any module (main or expansion) does not affect power distribution to any other module in a system.

Grounding Scheme

The system is isolated from ground and to maintain isolation between multiple interconnected modules, whether they are main or expansion modules.

Shield connections are common to one another for each module and its terminal base, but otherwise isolated from the module circuitry. These connections are provided as a termination point for cable screens/shields and, where applicable, for protective ground connections to accessible metal parts. One or more must be used to connect the Shield bus to a local ground as the base module is not grounded to the DIN rail.

Use these grounding requirements to verify the safest electrical operating circumstances and to help avoid EMI and ground noise that can cause unfavorable operating conditions for the system:

- Module Grounding - Provide AWG 16 connection to ground for each Dynamix 1444 Series system module to an available Shield connection terminal.
- 24V Common Grounding - Given that module power supplies are galvanically isolated, it is recommended that the DC voltage supply return line to the Dynamix modules is grounded.
- Transducers – Verify that transducers are electrically isolated from ground. Cable shields must be grounded at one end of the cable and the other end not connected. It is recommended, where possible, to ground the cable shield at the instrument side (PE terminals, protective Earth Ground bar, or cable glands) and not at the transducer end.

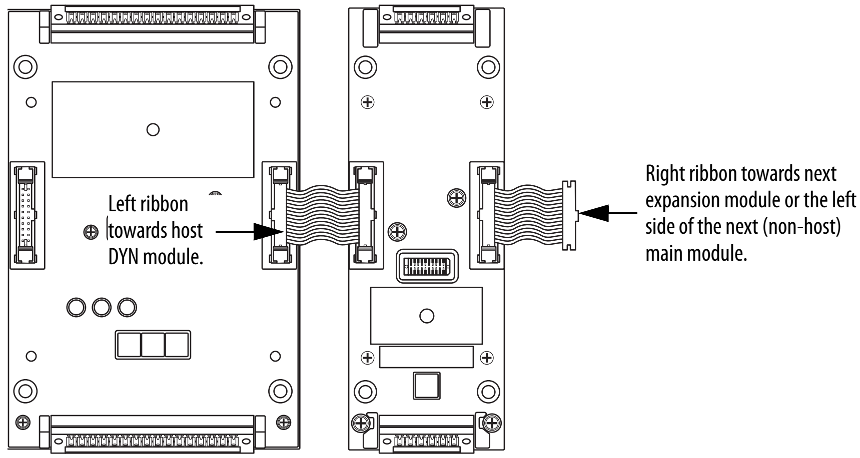
Local Bus Connection (Main/Expansion)

A Common-bus runs along the base parts of the main and its associated expansion modules, which interconnect with ribbon cable. It integrates the following:

- Serial (communication) bus - between the main and its associated expansion modules
- Power bus - expansion modules are powered from the module base
- Tacho bus - the TSC provides up to two tacho signal outputs(1)

The system is installed with an associated expansion module that is fitted to the right side of the module. The base-mounted headers are latched and, for additional security, cannot be removed (or inserted) while there is a module in place on that base.

Figure 3 - Expansion Base Part with Left and Right Ribbon Cable Fitted



The DIP switch towards the bottom of Figure 3 contributes to the expansion module bus address so that a like-for-like expansion module replacement retains the earlier address.

Only the Relay Expansion module uses the DIP switch address. Up to three relay modules can be used per main (host) module.

To install, join the bases of a module and its associated expansion modules by connecting the right side of one to the left side of the next by using the supplied ribbon cables. These cables are included with each main and expansion module terminal base. Continue these interconnections across all modules that are intended to share the tacho bus of a TSC module, and note the following:

- One tacho bus can support a maximum of six main modules
- One (and only one) TSC Expansion module can be used per tacho bus

(1) While the serial and power buses are specific to one DYN module and its associated expansion modules, the tacho bus extends to serve tacho signals to multiple main modules.

Using Local Bus Extension Cables

The Dynamix 1444 series implements a Local Bus that connects modules to:

- Provide power and communication between an expansion module and its host module.
- Pass the Speed Signals (TTL) from a Tachometer Signal Conditioner module to other main modules on a network.

If no expansion modules are used in a system, then the modules do not need to be connected.

In cases where it is necessary to separate modules, two extension cables are provided:

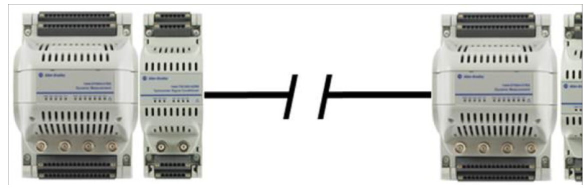
1444-LBXC-0M3-01	Local Bus Extender Cable (0.3 m/.98 ft)
1444-LBXC-1M0-01	Local Bus Extender Cable (1.0 m/3.28 ft)

IMPORTANT The extension cables are intended for IN CABINET use only. The ribbon cables are only minimally shielded. Consequently, care must be taken to verify that cables are not routed across or near to high voltage or other cables that can induce noise into the network.

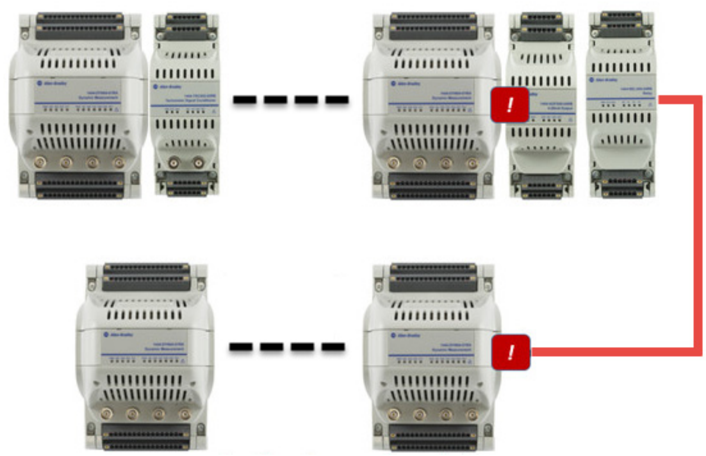
When connecting the modules, be sure that the right sides of two main modules are never connected. While the connectors are keyed to help prevent this connection, it is possible to defeat the keying by twisting the cable or by removing the keys.

WARNING: Connecting the RIGHT sides of two main modules could result in damage to the modules and unexpected or improper operation of any connected expansion modules.

The Local Bus Extension cables are designed (keyed) to allow connection of the RIGHT side of any main module to the LEFT side of any main or expansion module as shown in this image.



Any other connection that results in the RIGHT sides of two MAIN MODULES (1444-DYN02-01RA) being connected is not allowed, including when one or more expansion modules are between them.



Improper arrangement: Connects the right side of two main modules.

Relay Contact Protection

Measures to limit contact wear and arcing across the contacts of a mechanical relay are highly dependent on the following:

- The current and voltage being switched and whether AC or DC
- The load type (resistive or inductive)
- System factors such as wiring

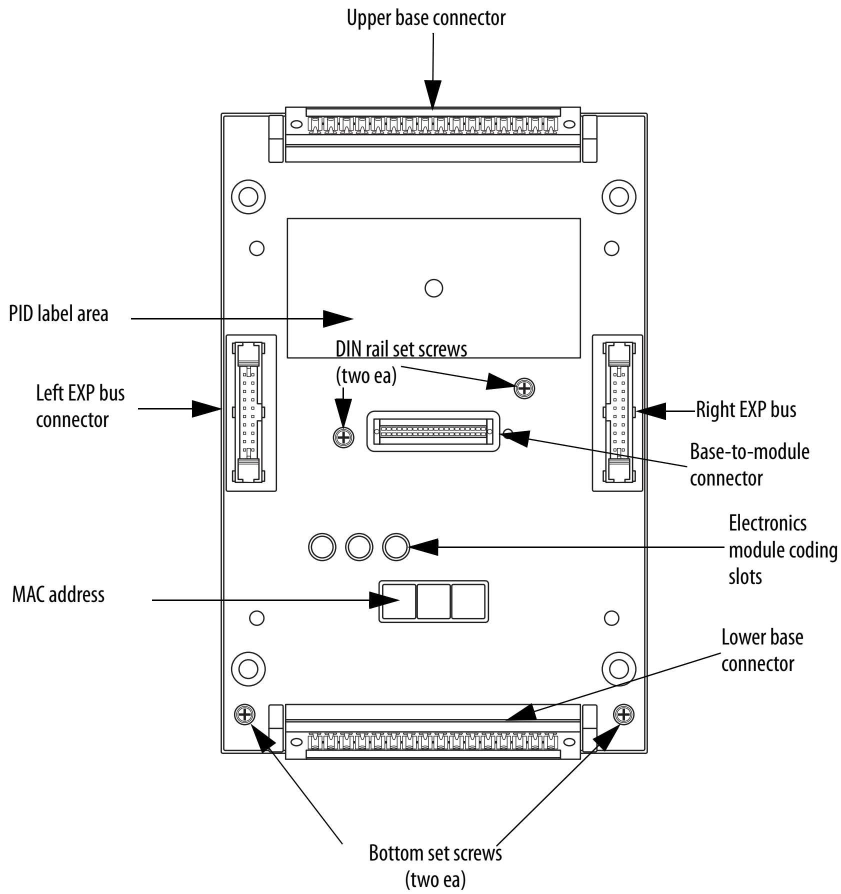
Due to this application dependency, it is not possible to integrate contact protection circuitry within the Dynamix hardware. It remains the system designer's/installer's responsibility to take appropriate external measures to mitigate these risks that are based on the reliability and functional safety requirements that can apply. Commercial surge suppressors (often DIN rail mounting) can be based on RC, MOV, or Diode protection methods. In general, it is recommended to provide protection equipment close to its originating source.

Installation Overview

Installation of the Dynamix 1444 Series system is based on one or more main modules and associated expansion modules. The mounting arrangement, from left to right, can be summarized as follows:

- Main module
  - Expansion modules
- Main module
  - Expansion modules

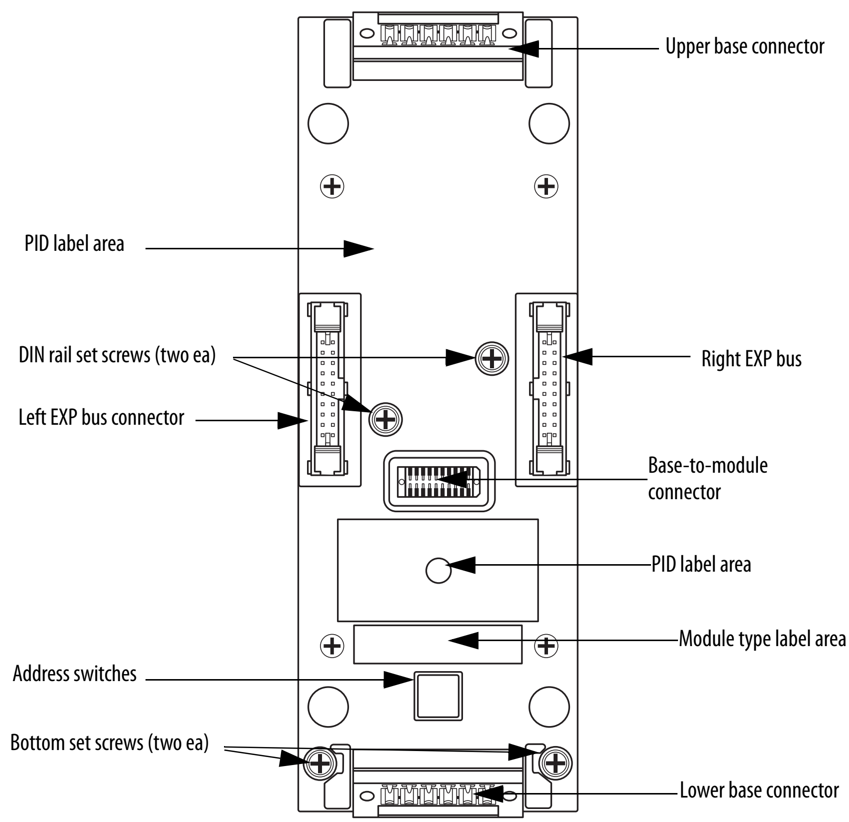
Figure 4 - Main Terminal Base – Overview



When you install the system, follow these instructions and install/configure the components in this order.

1. Review the safety instructions.
2. Review the network connectivity considerations.
3. Review the system design guidelines, considerations, and requirements.
4. Mount the terminal base.
5. Establish expansion bus connections between modules.
6. Configure the main terminal base.
7. Configure the Auxiliary relay terminal base.
8. Configure the Auxiliary 4…20 mA terminal base.
9. Configure the Auxiliary TSC terminal base.
10. Install the module.
11. Configure the main module connectors.
12. Configure the main module transducers.
13. Configure the expansion module connectors.
14. Start the module and perform a self-test.

Figure 5 - Expansion Terminal Base – Overview



Mount the Terminal Base Unit

The following generic DIN rail mounting scheme applies to all terminal base mounting.

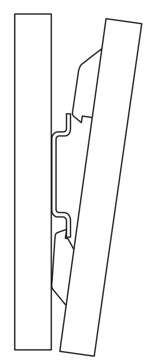
Dynamix 1444 Series terminal bases are mounted using two pairs of screws, the "DIN rail set screws" and the "Bottom set screws" (see Figure 5). The screws that are included are as follows:

Table 6 - Dynamix 1444 Series Terminal Base Screws

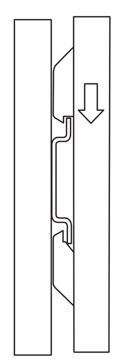
Application	Type	Thread	Length	Phillips Drive
DIN rail set screws	DIN7985	M3x0.5 mm	20 mm (0.787 in)	#1
Bottom set screws	DIN7985	M3x0.5 mm	22 mm (0.866 in)	#1

The screw lengths are designed to accommodate mounting to standard 35 x 7.5 mm (1.38 x .30 in.) DIN rail. If mounting directly to a panel, or otherwise require another length screw, then the screws that are provided can be replaced.

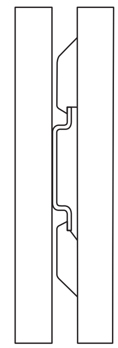
1. Hook the base assembly from the bottom under the DIN rail. The presence of coding switches identifies the bottom side of the terminal base.



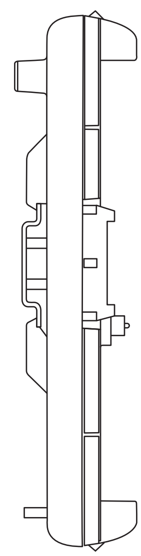
2. Hook over the top and let gravity drop the terminal base into place.



3. The terminal base is in the center position to the DIN rail. Once hooked, fasten the two center (set) screws to secure the base to the rail.



4. Tighten the two bottom set screws to secure the terminal base to the base plate to help prevent a rocking effect while applying mechanical pressure to the base.



Reverse the process to remove a base. Loosen the screws to create sufficient clearance for removal of the terminal base.

Establish Bus Connections

Before you configure the terminal base and install the main module, establish the Expansion bus connections between modules. The Expansion bus provides power and communication from a DYN module to associated expansion modules positioned to the right and distributes the tacho bus to up to six main modules. These modules include the TSCX modules host, and mounted to the left or right of the TSCX module.

Based on system design, the required module-to-module connections can be made with interconnect cables (refer to the Local Bus module to module, interconnect cables) section in Local Bus Connection (Main/Expansion) on page 38). These ribbon cable assemblies can then be fitted between various module types.

We recommend that you combine the installation of the ribbon interconnect cables with the process of mounting the terminal bases. This way, the bases can be clamped to the DIN rail and the interconnect cable can easily be fitted without subjecting it to excessive mechanical stress.

1. Install and secure the first terminal base.
2. Install the interconnection cable to the first module (right side).
3. Install the second terminal base.
4. Connect the interconnection cable to the second module (left side).
5. Secure the second terminal base.

Verify that the ribbon cable interfaces are properly locked down in the headers. Access to the connector interfaces is further protected once the main modules are installed.

Configure the Terminal Bases

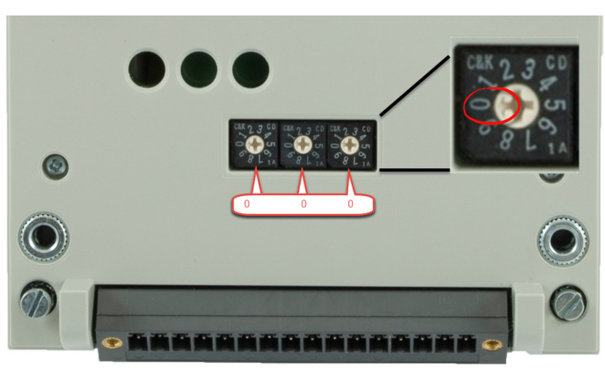
The following configuration settings must be made or validated on the terminal bases before installation of the designated modules.

Configure the Main Terminal Base

The module terminal base provides three decimal coded switches used to define the last octet of the TCP/IP address of the module.

The IP address of the main module is composed of four suboctets that are separated by dots to conform to the IPv4 structure. Each suboctet can be configured with a number from 1 to 254. As shipped from the factory, the default IP address of a module is 192.168.1.0.

IMPORTANT	Only the final octet of the address can be set via the hardware switches. When set in hardware, the address is 192.168.1.xx where "xx" is the number set with the three switches. See Setting the IP Address on page 253 for more information.



Use these switches for automatic configuration or definition of the last octet of a static (Class C) IP address.

Setting	Description
000	Automatic address assignment (default)
001…254	Static IP address setting (for example, 192.168.1.xxx
255…887	Automatic address assignment
888	Out-of-box reset
	When set, after power-up, the module immediately executes an out-of-box reset. See Resetting the Module on page 241 for further information.
889…999	Automatic address assignment

To adjust the rotary switches, use a small screwdriver.

Configure the Relay Terminal Base

The two pole DIP switch setting on the Expansion Relay terminal base is used to define the Expansion Relay module offset address. Given that up to three Relay modules can be fitted per main module, the following configurations can be defined.

These settings, from left to right, are on the bottom:
- 00: Not allowed
- 01: Relay Module 1
- 10: Relay Module 2
- 11: Relay Module 3

IMPORTANT	A base switch address setting of (00) is illegal for a relay module and causes the relay module to display a critical error (solid red Module Status indicator).

Configure the 4…20 mA Terminal Base

The two pole DIP switch setting on the expansion 4…20 mA terminal base is used to define the expansion bus address for the single 4…20 mA module that can be fitted per main module.

These settings, from left to right, are on the bottom:
- 00: 4…20 mA Analog Expansion Module
- 01…11: Not used

Settings for the AOFX module include**:**
- The AOFX module applies a fixed (internal) address that requires the terminal base switch to be set to 00.
- A DYN module can only host one AOFX module.

Configure the Tacho Signal Conditioning Terminal Base

The two pole DIP switch setting on the expansion TSC terminal base is used to define the expansion bus address for the single TSC module that can be fitted per main module.

These settings, from left to right, are on the bottom:
- 00: Tacho Signal Conditioner Expansion (TSCX) Module
- 01…11: Not used

TSCX:

- The TSCX module applies a fixed (internal) address that requires the terminal base switch to be set to 00.
- A DYN module can only host one TSCX module.
- Only one TSCX module can be connected to the same 1444 Series Expansion bus.

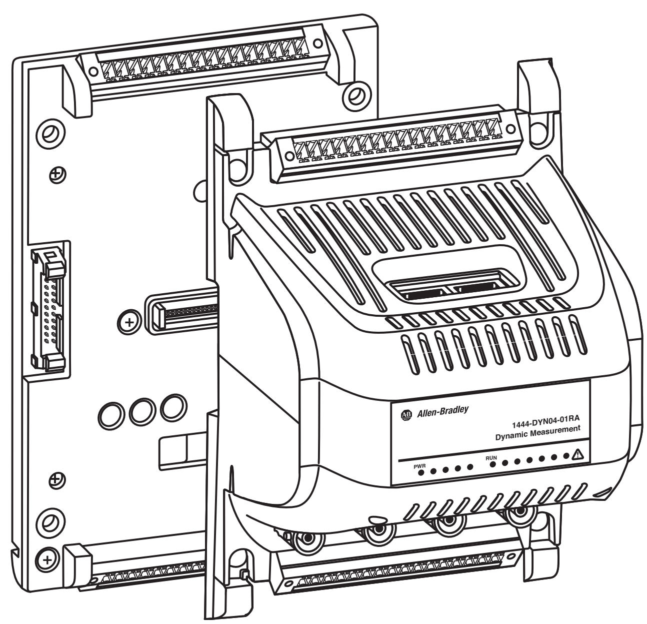
Install the Module

Main and expansion modules are readily fitted to their respective bases, with correct alignment, and connector engagement supported by the following features:

- Module coding pin (main module only)
- Base module upper and lower connector guidance
- Module to base connector guidance and alignment

Before installing the module, check that there is no damage (bent pins) on the main/Expansion module to base connector.

Figure 6 - Module-to-Base Position



Once the main module is fitted onto the base, use the four captive quarter-turn screws, one at each corner, to secure the module to its base. Use a #1 Phillips screwdriver to secure the screws.

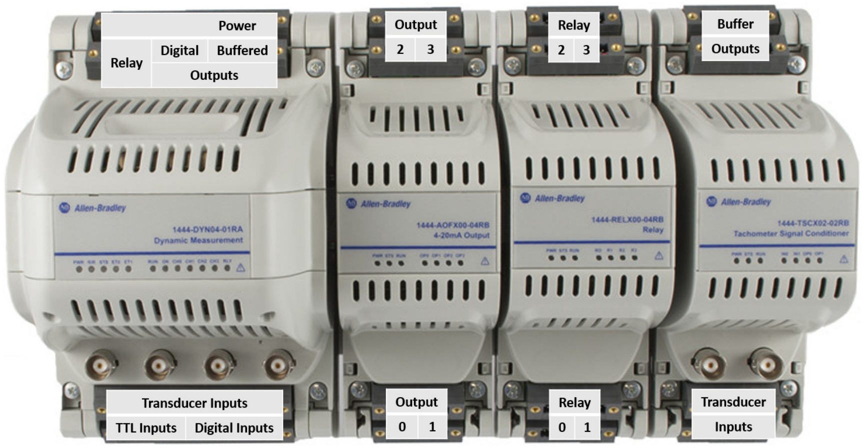
Wiring Overview

General Module Connector Arrangements

The 1444 series requires that wiring is routed to both above and below the modules. So particular attention and planning of cabinet wire routing is essential for an efficient, well-organized, and therefore maintainable, cabinet.

Use Figure 7 when planning wire routing for the cabinet. Figure 7 provides an overview of the locations of the connectors that are associated with the significant function of each module.

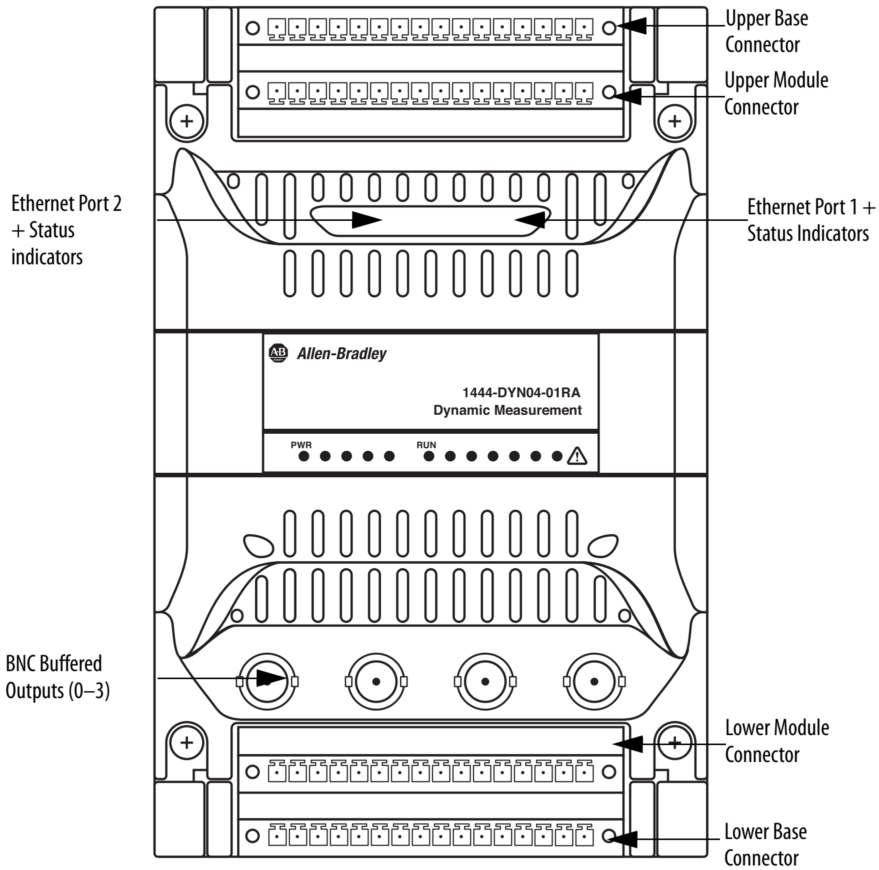
Figure 7 - General Module



Wiring the Main Module

An installed system has four removable 16-way terminal connectors, two interfacing directly to the removable module, and two to the terminal base. The base and module-mounted headers are able to accept either a screw or spring terminal connector.

Figure 8 - Main Module Connectors



Allocations to the base or module are broadly based on the following functional requirements:

- Wide-range 24V DC power connections are direct to the base so that they are unaffected by module removal.
- Main signal inputs/outputs and relay connections are direct to the module to minimize connection length and number of interfaces.

Each connector is keyed to its respective mating header (two per connector) and each of the terminals is uniquely numbered. Some external links can be made between terminals, depending on application requirements, to enable, for example, a transducer power supply for a 2-wire transducer connection.

Upper Base Connector

Terminal	Name	Application	Description
49	RET_1	Module Power	Supply 1 Return
50	RET_1		
51	+24V_1		Supply 1 +24V
52	+24V_1		
53	RET_0		Supply 0 Return
54	RET_0		
55	+24V_0		Supply 0 +24V
56	+24V_0		
57	OVR	Buffered Outputs	Override High
58	OVR		Override Low
59	Shield	Shield	Cable shield connection points
60	Shield		
61	Shield		
62	Shield		
63	Shield		
64	Shield		

Main Module Connectors

These connections provide duplicate terminals for twin, wide ranging DC supplies (24V nominal).

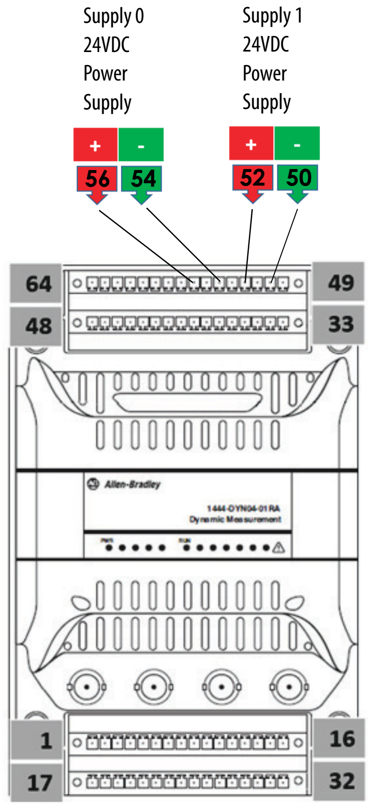
56	55	54	53	52	51	50	49
+24V-0	+24V-0	RET_0	RET_0	+24V-1	+24V-1	RET_1	RET_1

You can use the duplicate terminals to daisy chain the power from one base to the next (subject to an overall current limit and using a star connection to avoid excessive voltage drop). There is internal diode protection against reverse polarity and for the purposes of automatic supply selection when redundant sources are connected to inputs 0 and 1. The supply side connections are isolated from the remainder of the module circuitry.

Wiring the Power

Figure 9 connects positive and negative power to the first (from left) of two identical connectors for each. See Main Module Connectors on page 51 for the list of power connections.

Figure 9 - Typical Wiring for Single and Redundant Power Solutions



Wiring the Power to Multiple Modules

Figure 10 shows positive and negative power IN connected to the first of two identical connectors for each, and power OUT from the second of two identical connectors. See Upper Base Connector on page 51 for the list of power connections.

Figure 10 - Typical Wiring for Single Power Solutions to Multiple Module

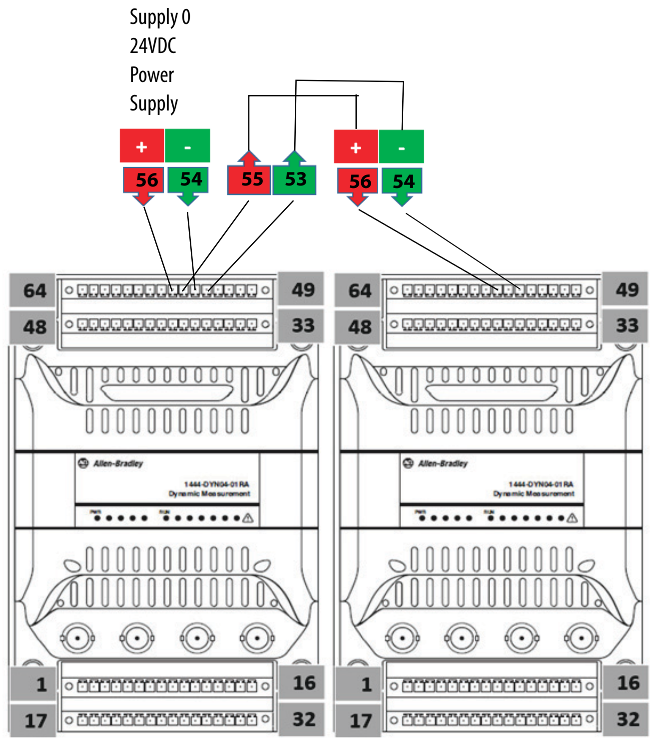
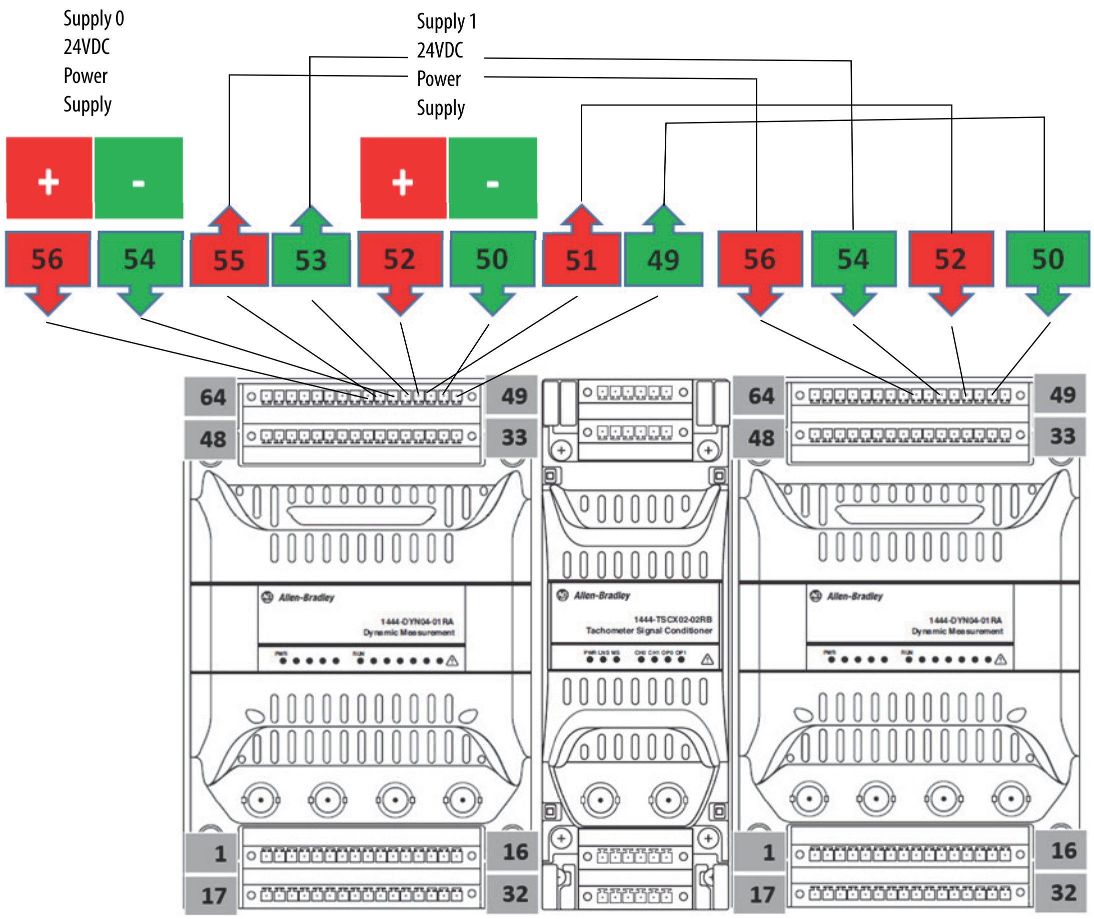


Figure 11 shows positive and negative power IN connections to the first of two identical connectors for each, and power OUT from the second of two identical connectors. See Upper Base Connector on page 51 for the list of power connections.

Figure 11 - Typical Wiring for Redundant Power Solutions to Multiple Modules



Buffered Output Override

The Buffered Output 'Override' connections, pins 57 and 58 on the 1444-TB-A terminal base, are used to enable/disable the buffered outputs.

58	57
OVR	OVR

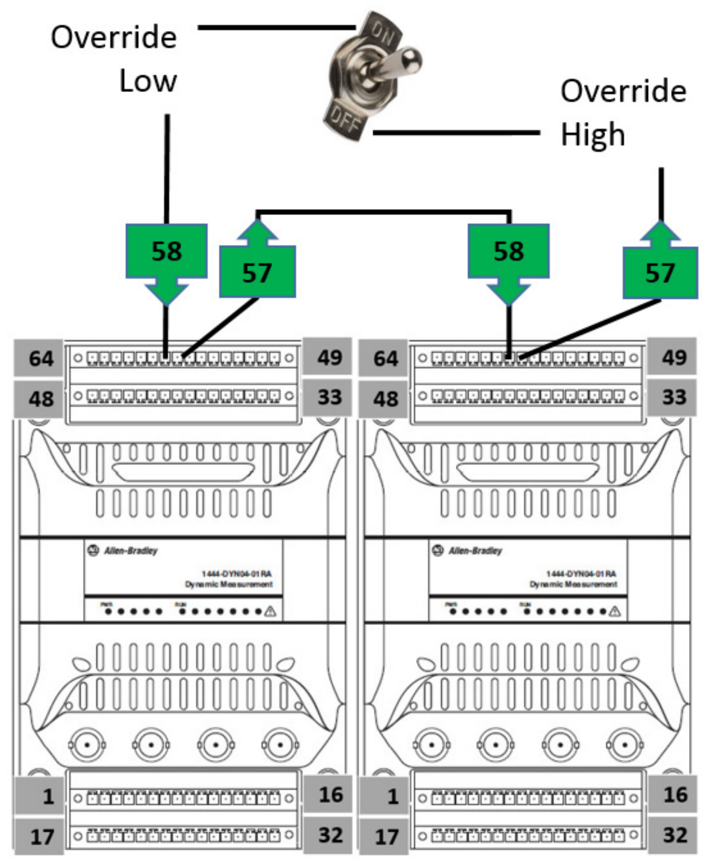
The buffered outputs are enabled (powered) when no connection is present between pins 57 and 58.

The buffered outputs are disabled (not powered) when a connection is present between pins 57 and 58.

In applications where the buffered outputs are infrequently used, a switch can be installed between pins 57 and 58. When installed, open the switch to enable the buffered outputs, and close the switch to disable the outputs.

It is possible to use a common switch to manage the buffered outputs of multiple modules as the override pins are opto-isolated from the module circuitry. When a common switch is required, wire one contact to pin 57 of the module nearest the switch and the other to pin 58 of each module to be managed.

Figure 12 - Wiring Buffer Outputs Override



Consider the following with the module:

- When you connect pin 58 from multiple modules to pin 57 on one module, allow for a maximum 3 mA current sink for each connected override input.
- See Temperature Considerations on page 30 for further information.

Shield Connections

By design, the module is isolated from ground. All shield connections on this connector and the lower base connector are common to one another (a "shield bus"), but otherwise isolated.

64	63	62	61	60	59
Shield	Shield	Shield	Shield	Shield	Shield

Shield connections are provided as a termination point for cable screens/shields, one or more can be used to connect the shield bus to a local ground of your choice.

IMPORTANT When working with the shield bus, remember the following:
- The shield bus of each main and expansion module must be individually connected to ground by at least one shield pin that is wired directly to ground.
- For installations where EMI problems are identified, or are anticipated, wire cable shields directly to ground rather than to the shield bus of the module.

Upper Module Connector

Terminal	Name	Application	Description
33	NO	Relay Outputs	Normally Open
34	C		Common
35	NC		Normally Closed
36	SPARE	Do not connect	
37	O1L	Opto-isolated Outputs	Output 1 Low
38	O1H		Output 1 High
39	O0L		Output 0 Low
40	O0H		Output 0 High
41	RET	Buffered Outputs	Channel 3 Return
42	BUFF3		Channel 3 Signal
43	RET		Channel 2 Return
44	BUFF2		Channel 2 Signal
45	RET		Channel 1 Return
46	BUFF1		Channel 1 Signal
47	RET		Channel 0 Return
48	BUFF0		Channel 0 Signal

Relay Output

There is one single pole double throw (SPDT) relay that is included in the DYN module with the three contact connections being made available at the terminals. A typical purpose for this module relay is to signal module status. See Figure 84 on page 209.

35	34	33
NC	C	NO

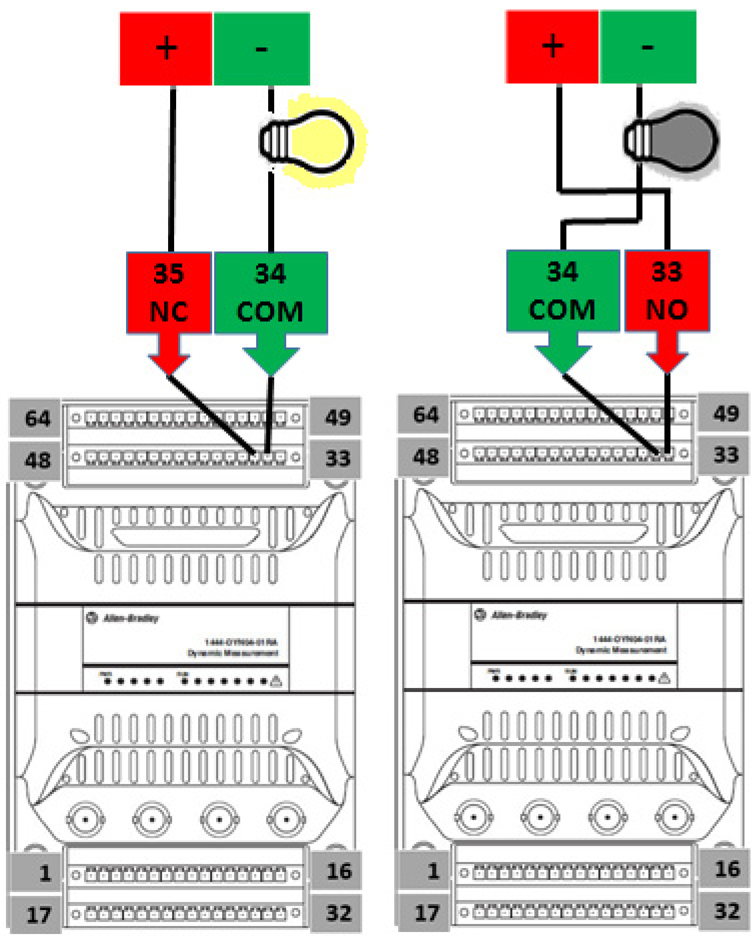
NC – Normally closed

C – Common

NO– Normally open

'Normal' is the relay contact state when unpowered.

Figure 13 - Wiring Relays



Spare

Terminal 36 is left unused for isolation reasons. Do not make any connections to this terminal.

Opto-isolated (Open Collector) Outputs

The DYN module includes two opto-isolated outputs, 0 and 1.

40	39	38	37
O0H	O0L	O1H	O1L

The connections are functionally polarity sensitive and are designated H (High) and L (Low). As the name suggests, these connections are isolated from any others on the module. These opto-isolated outputs support reverse connection protection within defined current load specifications.

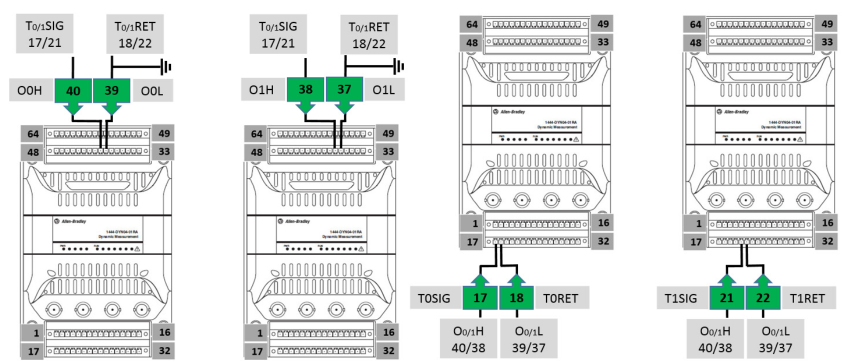
The opto-isolated outputs are applied in either of two applications:

- Speed Signal Replication
- High/Low Signal Output

Speed Signal Replication

When either of the TTL speed input signals are to be replicated, and are input to the TTL inputs (pins 17/18 or 21/22) of a module, apply the wiring as shown in Figure 14.

Figure 14 - Speed Signal Replication Wiring



IMPORTANT

- Speed signals that are replicated by an opto-isolated output result in a 180 degree phase shift.
- Some amount of signal delay and phase lag occurs, and is cumulative per series connected module. See Table 7.

Table 7 - Signal Delay and Phase Lag

Speed		Trigger Source			
		Rising Edge		Falling Edge	
RPM	Hz	Delay	Phase Lag	Delay	Phase Lag
6,000	100	40 µs	1.44	4 µs	0.144
30,000	500		7.2		0.7
120,000	2,000		28.8		2.88

- For the same speed signal, configure the trigger slope (positive or negative) the same on all modules including when using the opto-isolated output to replicate the signal between modules.

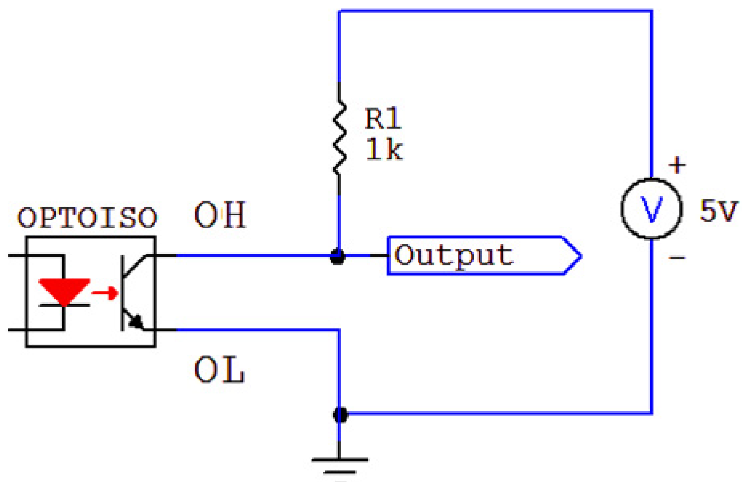
  To minimize phase error, we recommend that the trigger slope is set as the falling edge of the signal (negative).
- The recommended method of communicating speed signals is to use the TSC over the module local bus (terminal base interconnect) or from the TSCX buffered outputs, as that source adds zero signal delay and no phase lag.

High/Low Signal Output

An appropriate circuit must be implemented when any of the outputs, other than the TTL speed signals, are selected.

Because the outputs are not internally powered, pull up circuitry must be applied when a voltage (digital) output is required. See Figure 15 for an example of an appropriate circuit.

Figure 15 - Circuit Example



In the Figure 15 example, when the output is open or low, the voltage across pins OH and OL is the supply voltage, and the voltage drop across the resistor is 0V DC. When the output is high, the pin output drops to zero, and the voltage drop across the resistor is approximately 3.3V DC with a 5V DC input, due to the flow of current through the isolating resistor.

The example in Figure 15 illustrates a 5V supply, with a typical current of 5 mA, a maximum supply voltage of 32V DC, and a maximum circuit current per output is 15 mA.

IMPORTANT	• The opto-isolated outputs are not protected. Excess current or voltage could damage the output. The output, and possibly the module, could be unusable. Make sure that the circuit cannot exceed 32V, or a 6V reverse voltage and 15 mA current. • The intent of this output is to provide signal where the output is wired to an input device that draws low current. The output is not intended for use to power a relay coil.

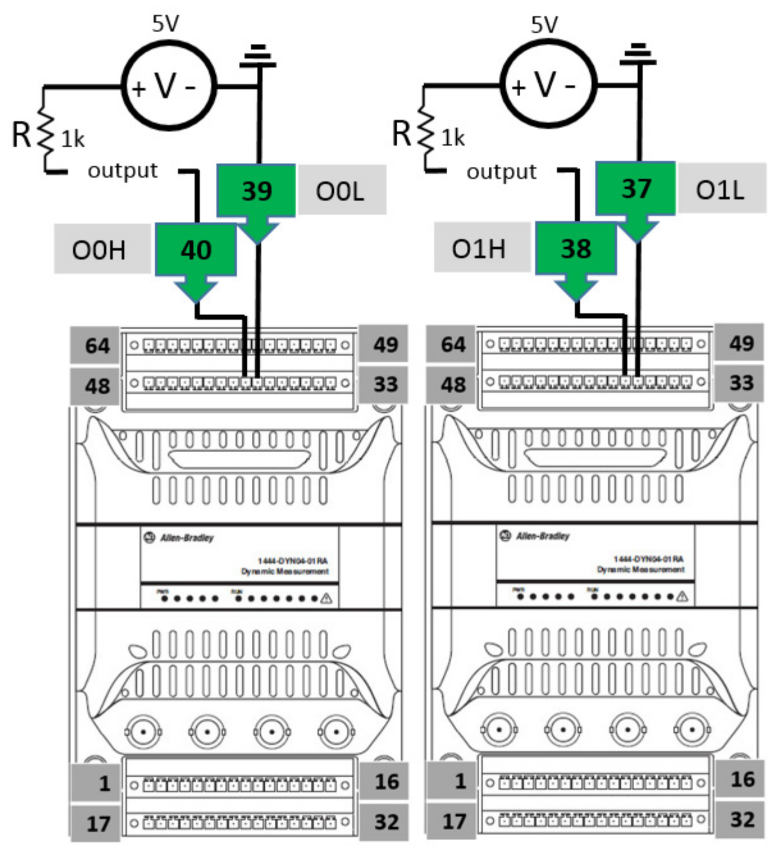
While the example shown in Figure 15 would provide a TTL class (0-5V) signal, other voltage outputs can be achieved by applying an appropriate power supply and resistor. Table 8 provides examples, one of which should suit most common automation system inputs.

Table 8 - Power Supply and Resistor Examples

Source Voltage	Minimum Resister Value	Typical Voltage When	
		Low	High
32V DC	2.2K ohm ½ watt	<0.5	32
24V DC	1.6k ohm ½ watt		24
12V DC	800 ohm ½ watt		12
5V DC	334 ohm ½ watt		5

Figure 16, similar to Figure 15 on page 60, illustrates the specific pin connections and circuit arrangement necessary for applying a typical ON/OFF class circuit.

Figure 16 - Circuit Arrangement for Typical ON/OFF Class Circuit



Buffered Outputs

Along with the BNC outputs, a buffered output is provided for each channel (0…3) on the upper module connector.

48	47	46	45	44	43	42	41
BUFF0	RET	BUFF1	RET	BUFF2	RET	BUFF3	RET

Although having independent resistive current limiting, the buffered and BNC outputs of any one channel share drive circuitry. All signal-related inputs and outputs, unless otherwise indicated, share analog ground/return.

Table 9 - Buffered Output Resistance

Buffered Output	Resistance (Ω)	Protection		Use/Application
		ESD/EFT	Surge	
BNC	100	Yes	No	For temporary connection to instruments such as portable data collectors or analysis systems over short distances (10 m/32 ft).
Terminal Pins	100	Yes	Yes	For permanent connections to instruments or when long cable runs (100 m/328 ft) are required.
Notes	All outputs are single ended and have no isolation.			
	Buffered output is not representative of input when no load (sensor) is connected to the associated measurement channel.			
	Confirm that the connected instrumentation does not provide power, such as if to power an accelerometer, to the buffer output.			

Lower Module Connector

The following are functions of the lower module connector.

Sensor Connections

The sensor connections are made on the lower module connector.

Terminal	Name	Application	Description
1	TXP0	Sensor 0	Transducer 0 Power
2	SIG0		Transducer 0 Signal
3	SIG0		
4	RET0		Transducer 0 Return
5	TXP1	Sensor 1	Transducer 1 Power
6	SIG1		Transducer 1 Signal
7	SIG1		
8	RET1		Transducer 1 Return

Terminal	Name	Application	Description
9	TXP2	Sensor 2	Transducer 2 Power
10	SIG2		Transducer 2 Signal
11	SIG2		
12	RET2		Transducer 2 Return
13	TXP3	Sensor 3	Transducer 3 Power
14	SIG3		Transducer 3 Signal
15	SIG3		
16	RET3		Transducer 3 Return

For each channel (0…3), there is a set of four connections:

- Transducer power (configurable per channel for negative or positive supply, or constant current)
- Duplicate signal input connections
- Signal return connection

Provide duplicated input signal connections to accommodate various 2-wire and 3-wire transducers. For 2-wire constant current sensors, the appropriate supply is configured and an external link is made to connect signal and power output connections. A further signal connection and associated return connects the sensor without placing multiple wires in one terminal.

All signal inputs are single-ended with a ±24V range and designed for transducers that provide an output voltage proportional to the measured physical parameter. The transducer power is individually configurable per channel for one of the three following outputs: +24V, 4 mA constant current or +24V or -24V at up to 25 mA. Additionally, the transducer power output can be configured as disabled.

Lower Base Connector

Terminal	Name	Application	Description
17	T0SIG	Tach 0	Tach 0 Signal
18	T0RET		Tach 0 Return
19	Shield	Shield	Shields
20	Shield		
21	T1SIG	Tach 1	Tach 1 Signal
22	T1RET		Tach 1 Return
23	Shield	Shield	Shields
24	Shield		
25	L0SIG	Logical Input	Input 0 Signal
26	L0RET		Input 0 Return
27	Shield	Shield	Shields
28	Shield		
29	L1SIG	Logical Input	Input 1 Signal
30	L1RET		Input 1 Return
31	Shield	Shield	Shields
32	Shield		

Shield

Shield connections are provided as a termination point for cable screens/ shields; one or more can be used to connect Shield to a local ground of your choosing.

IMPORTANT	There is no internal connection between the Shield Bus and ground. A separate connection must be made between one terminal shield pin and a suitable ground location.

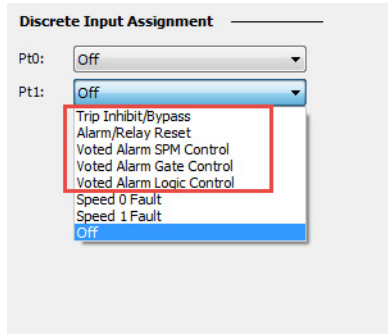
Logic Inputs

The DYN module includes two logic inputs, 0 and 1.

25	26	27	28	29	30
L0SIG	L0RET			L1SIG	L1RET

For any of the first five selections that are shown in Figure 17, when used as a control, the digital inputs are TRUE (high) when the circuit between the controls pins (25 and 26 or 29 and 30) is OPEN.

Figure 17 - Discrete Input Assignment



See Figure 18 and Figure 19 f or examples.

Figure 18 - Wiring Pt0 for Logic Alarm Control

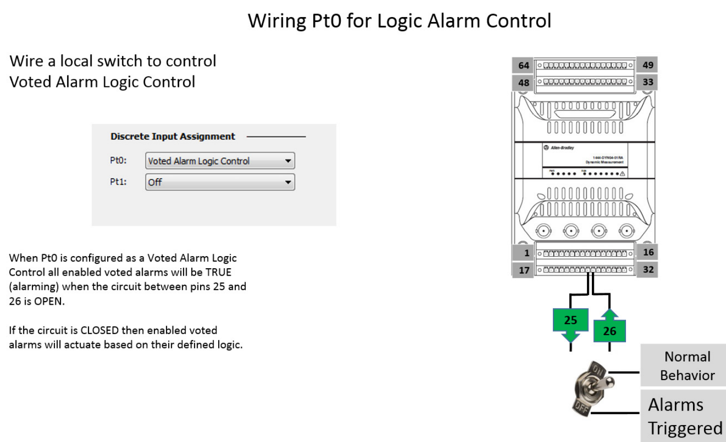
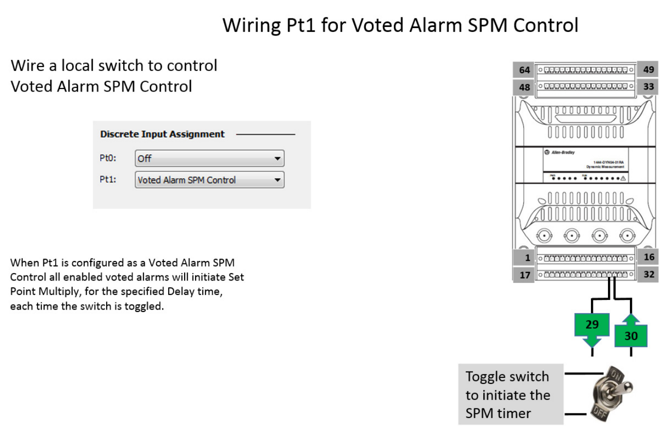


Figure 19 - Wiring Pt1 for Voted Alarm SPM Control



These inputs are not isolated from other module circuitry; the signal input has a resistive pull-up to 5V and the return connection is analog ground/return. Logic inputs have various possible uses (configuration-dependent), including alarm gating and SPM controls.

Tacho Inputs

The DYN module includes two local tacho inputs, 0 and 1.

17	18	19	20	21	22
T0SIG	T0RET			T1SIG	T1RET

These inputs are not isolated from other module circuitry; the signal input has a resistive pull-up to 5V and the return connection is analog ground/return. These local inputs are designed for when one of the following is available:

- a TTL level tacho signal
- a tacho sensor with an open collector output (such as NPN type)
- a connection to an Opto output on another Dynamix module
- the TTL output from an XM-220 Dual Speed module (1440-SPD02-01RB)

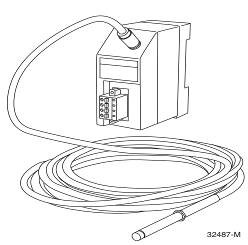
In most situations, the preferred method of providing tacho signals to the module is through the TSC Expansion module.

DYN Module Transducers

Proximity Probes

The following are examples of proximity probes.

Figure 20 - ECP Connections

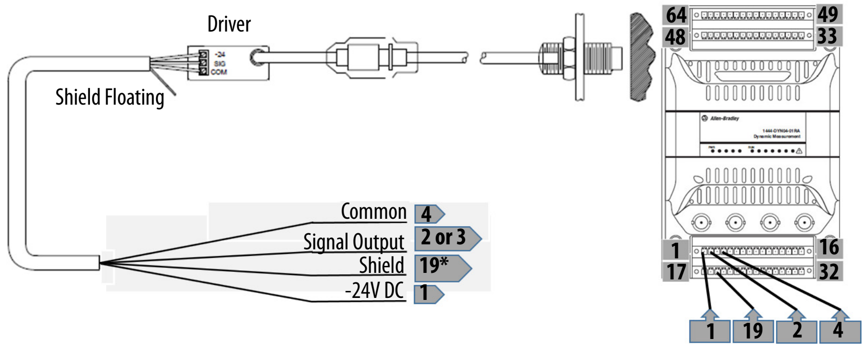


ECP Driver	Module Channel			
	0	1	2	3
Output	2 or 3	6 or 7	10 or 11	14 or 15
Common	4	8	12	16
-24V	1	5	9	13
Shield	any terminal base shield pin upper: 59…64 lower: 19, 20, 23, 24, 27, 28, 31, 32			

The channel must be configured for a negative 24V supply and either of the two signal connections can be used as in Figure 20.

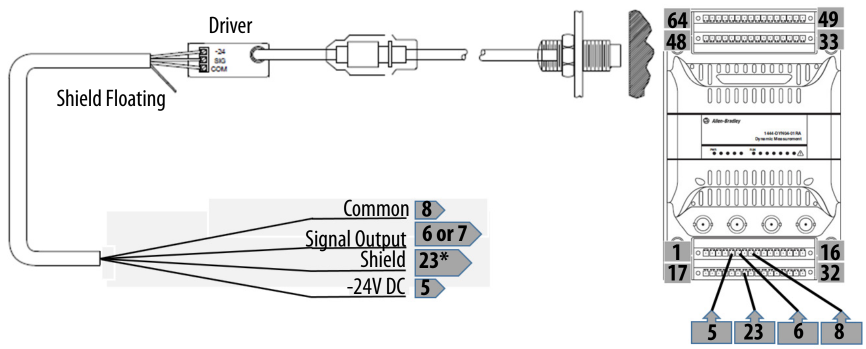
Figures 21...24 show typical wiring diagrams for channels 0...3 of an eddy current probe sensor.

Figure 21 - Channel 0 Wiring



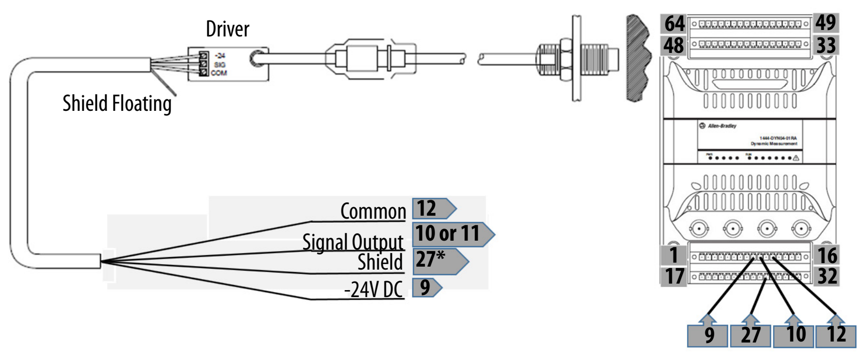
*Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 22 - Channel 1 Wiring



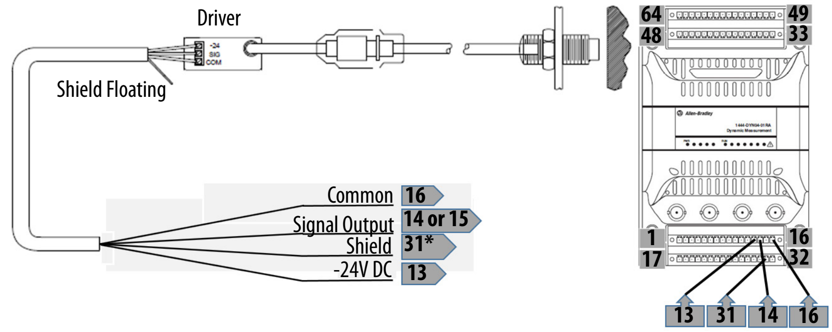
* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 23 - Channel 2 Wiring



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 24 - Channel 3 Wiring



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

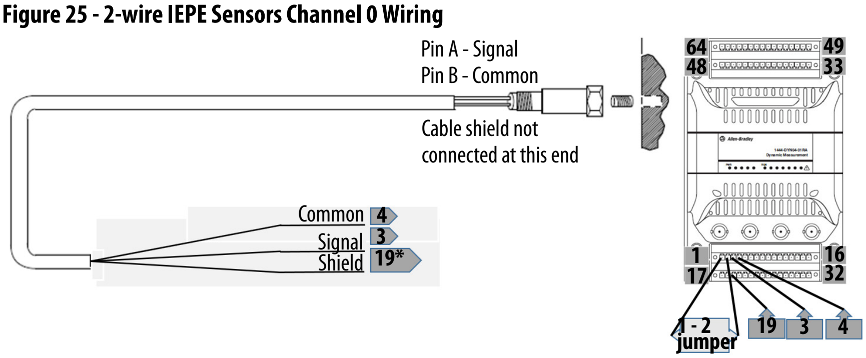
2-wire Acceleration, Pressure, or Piezoelectric Velocity Sensors

The channel must be configured for a positive, constant current supply and the transducer power output must be connected to the spare signal connection (link terminals 1 and 2 in channel 0, see Figure 24). A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
SIG (+)	3	7	11	15
Return (-)	4	8	12	16
Then link these terminals:	1 and 2	5 and 6	9 and 10	13 and 14

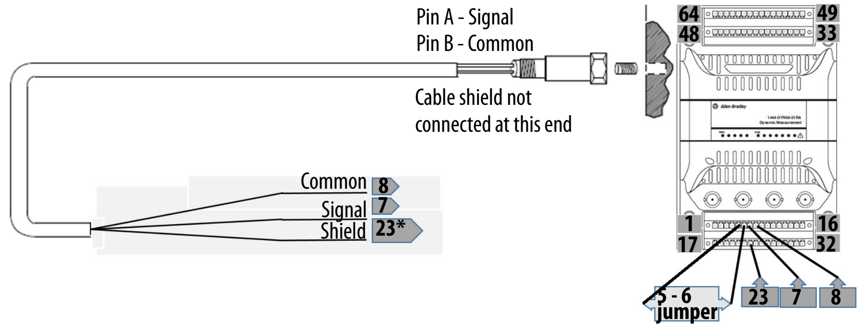
Figures 25...28 show typical wiring for 2-wire constant current sensors including IEPE Acceleration, Velocity, and Pressure Sensors.

Figure 25 - 2-wire IEPE Sensors Channel 0 Wiring



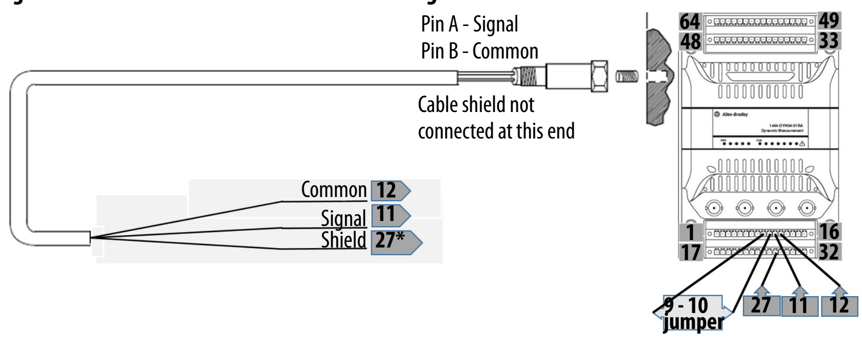
* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 26 - 2-wire IEPE Sensors Channel 1 Wiring



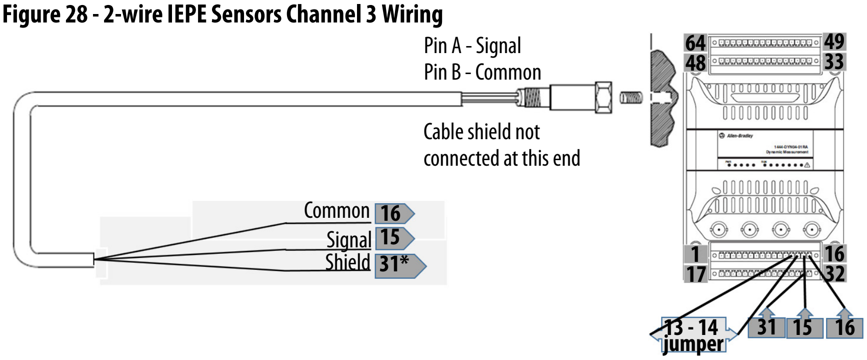
* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 27 - 2-wire IEPE Sensors Channel 2 Wiring



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

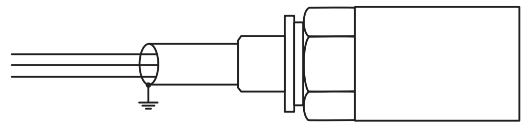
Figure 28 - 2-wire IEPE Sensors Channel 3 Wiring



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

3-wire Acceleration Sensors or Other 3-wire Transducer Systems

Figure 29 - 3-wire Acceleration Sensor



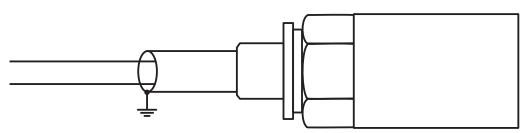
Configure the channel for the appropriate polarity supply (+25V or -25 V). A list of appropriate terminals for each channel follows. See Figure 29.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Power Supply	1	5	9	13
SIG (+)	2 or 3	6 or 7	10 or 11	14 or 15
Return (-)	4	8	12	16

In general, most 3-wire transducer systems requiring +25V or -25V at no more than 25 mA can be accommodated by connecting like.

3-wire sensors are wired identically to eddy current probes (power polarity is set in module configuration). See Figure 21...Figure 24 for wiring illustrations.

2-wire Self-generating Velocity Sensors

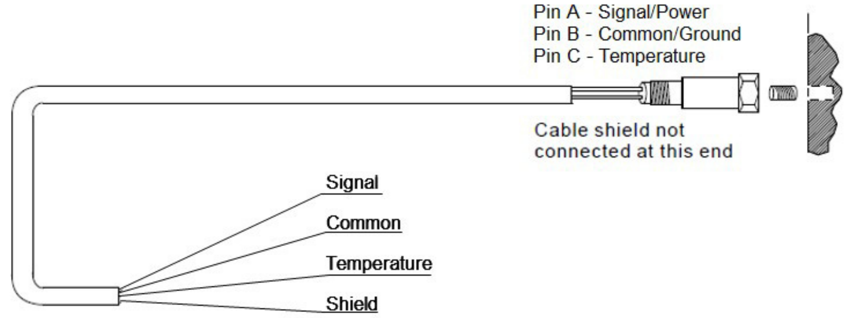


If self-generating, no transducer power connection is required. A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
SIG (+)	2 or 3	6 or 7	10 or 11	14 or 15
Return (-)	4	8	12	16

Also use this wiring solution for externally powered 2-wire sensors.

3-wire Acceleration and Temperature Sensor



IMPORTANT The wire colors that are used to connect the pins for 3-wire cables are not always consistent between cable that is supplied by different manufacturers, or across different series of sensors and accessories (See Table 10).

Table 10 - Cable Comparison

Cable	Pin A Signal	Pin B Common	Pin C Temperature
1443-CBL-MS3IBC-16S, 1443-CBL-MS3IBC-64S, 1443-CBL-MS3IBC-112S	Red	White	Black
EK-46803I, EK-46805I, EK-46807I, EK-47774	Black	White	Red

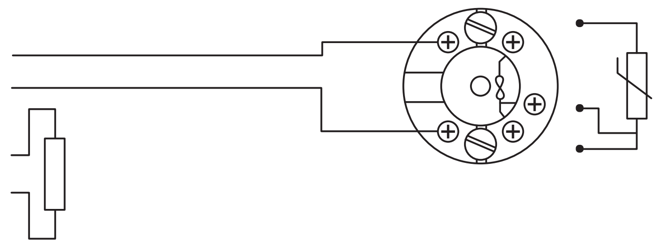
Such a sensor has two outputs and therefore occupies two input channels of a DYN module. The acceleration and temperature signals are allocated to channels in separate channel pairs so that the module configuration can be optimized.

The vibration channel must be configured for a positive, constant current supply and the transducer power output that is connected to the spare signal connection. (Link terminals 1 and 2 in channel 0/2, see the example in the preceding graphic.) Depending on the transducer that is used, the sensor can power both the vibration and the temperature sensing circuitry from one constant current supply. For sensor types that require a separate power supply for each, repeat power linking and configuration for the temperature channel as well.

A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Acceleration SIG (+)	3	7	-	-
Return (-)	4	8	-	-
Then link these terminals:	1 and 2	5 and 6	-	-
Temperature SIG (+)	-	-	11	15

Temperature Transmitter



Configure the channel for a +24V supply. A load resistor is required at the input terminals to provide the necessary current/voltage conversion. In addition to resistance value and precision (functional requirements), consider resistor power rating as it pertains to heating and maximum surface temperature under normal and fault conditions.

A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Power	1	5	9	13
Return (-)	2	6	10	14
Fit Load Resistor	3 and 4	7 and 8	11 and 12	15 and 16

Complete the configuration as follows:

- Configure the sensitivity as: Load R * 16/TX Range (millivolt/degree)(1)
- Set an appropriate offset so 4 mA = 0°

(1) For slightly higher accuracy, include the effect of the channel input resistance.

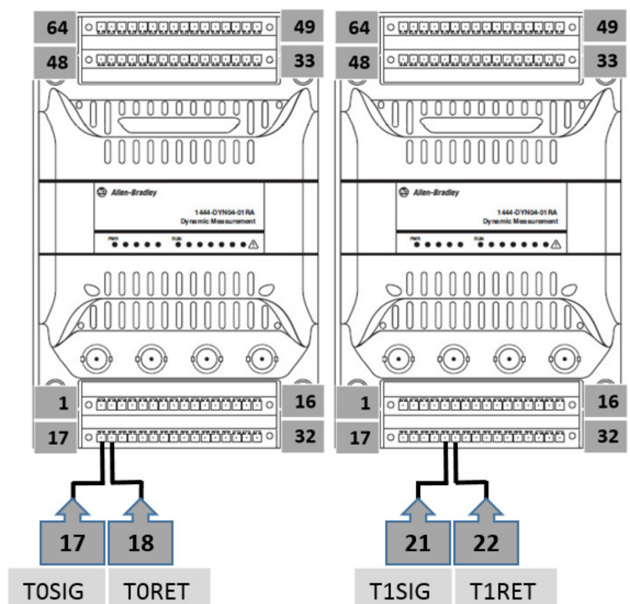
Tacho Signal from a Directly Connected Source

It is expected that a TSC Expansion module is the normal source of a tacho signal for a system, however, each DYN module can accept up to two 'local' or 'direct' tacho inputs.

IMPORTANT	It is not recommended that multiple tacho inputs from across different 1444 Series DYN modules are connected to the same tacho source. The tacho inputs are not isolated from other module circuitry.

The local inputs are designed for situations where there is a TTL level tacho signal available, a tacho sensor with an open collector output (such as NPN type) or a connection to an opto output on another module. For any of the three signal source types, connect the signal to terminal 17 and the common/return connection to terminal 18.

Figure 30 - TTL Output* Transducer Connection

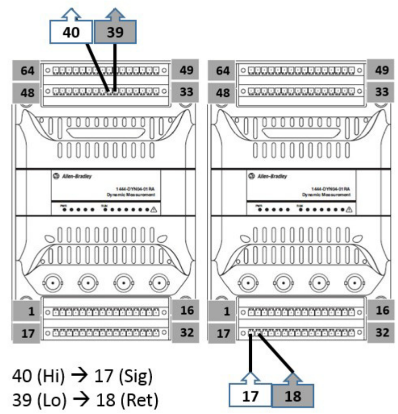


*Speed input signals must indicate "Low" by a voltage of 0V…2V and "High" by a voltage of 3V…5V.

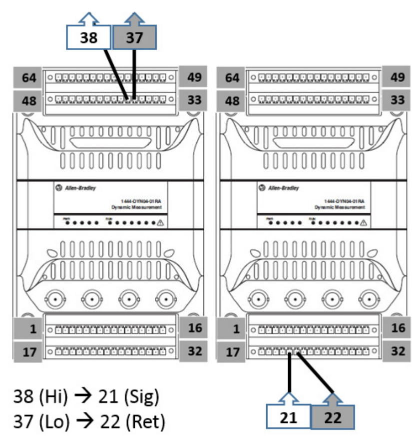
Connecting Speed Signals across Modules

When an external signal is used to serve multiple DYN modules, the recommended wiring solution is as follows.

1. Wire the source signal to the TTL inputs on the first module, per Tacho Inputs on page 66.
2. On the first module, wire one of its outputs to the TTL inputs. (#1) on the next module per Opto-isolated (Open Collector) Outputs on page 58.



Example of wiring Discrete Output 0 to Tacho Input 0



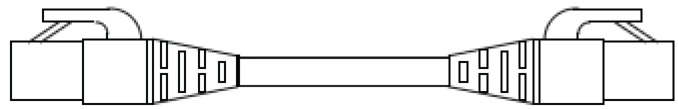
Example of wiring Discrete Output 1 to Tacho Input 1

3. Daisy chain additional modules by repeating step 1 and step 2.
4. To output the TTL signal the wired opto-isolated output must be configured to replicate the “Local TTL Tach 0 Input” or “Local TTL Tach 1 Input”, as appropriate. See Hardware Configuration Page on page 111.

Use this method to daisy chain the external TTL signal to be sure that there is isolation between modules. See Speed Signal Replication on page 58 for more information.

EtherNet/IP Connector

Typically, Ethernet network connections are made with pre-assembled (standard) patch cords to interconnect modules according to the desired network topology.



Each module has an integrated switch and two functionally equal (Port 1 and Port 2) RJ45 connectors.

The total length of Ethernet cable connecting main-to- main, main-to-controller, or main-to-switch must not exceed 100 m (328 ft.).

If the entire channel is constructed of stranded cable (no fixed cable), then calculate maximum length as follows:

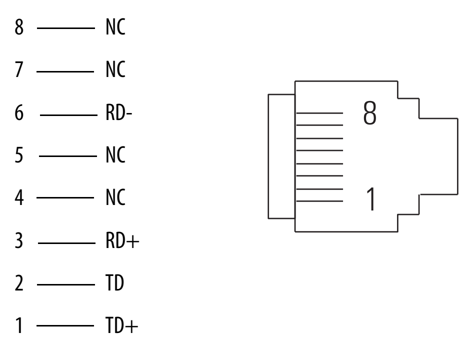
Maximum Length = (113-2N)/y, meters

Where:

- N = the number of connections in the channel
- y = the loss factor that is compared to fixed cable (typically 1.2…1.5)

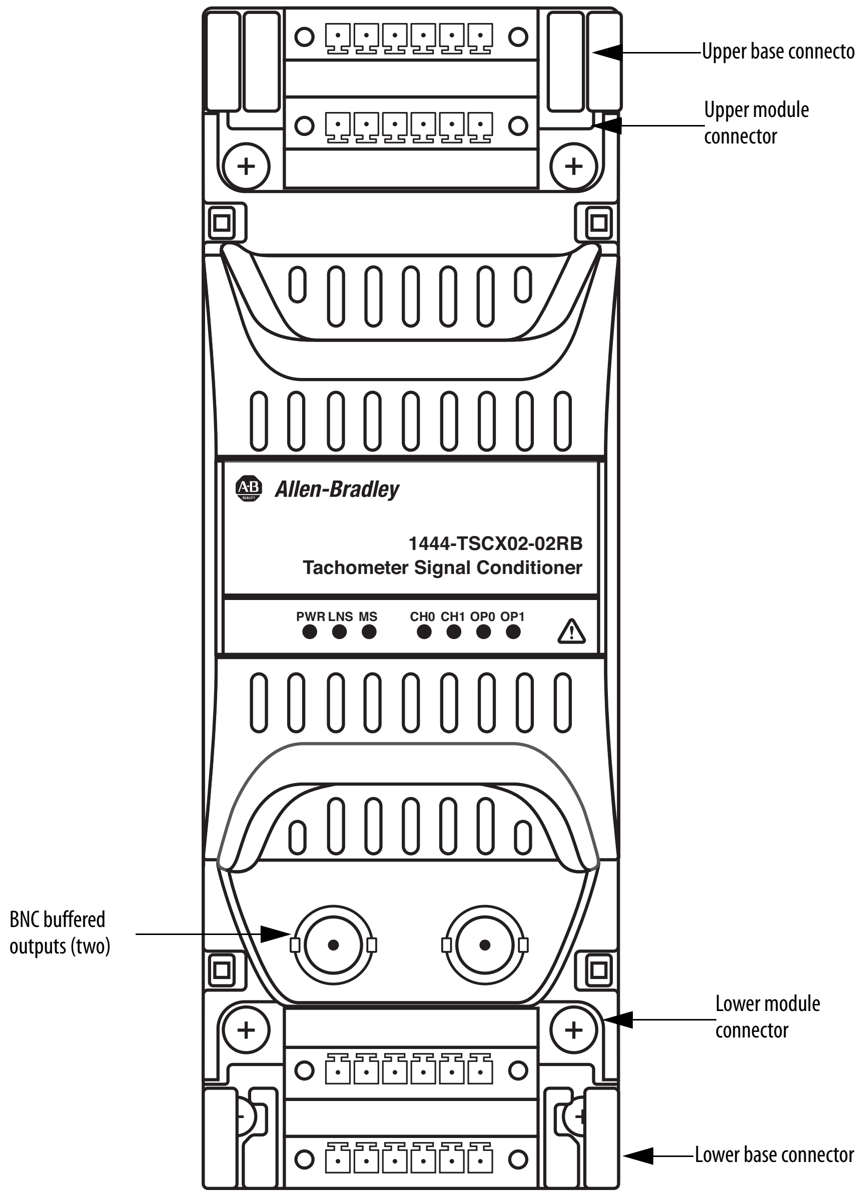
IMPORTANT See Ethernet Cables, channel class and category and recommended cables under “Cable, Connector, and Mounting Accessories on page 17,” for additional information on Ethernet connectivity.

Wire the RJ45 connector as shown.



Wiring Expansion Modules

An expansion module has four removable 6-way terminal connectors, two interfacing directly to the removable module and two to the terminal base. The base and module-mounted headers are able to accept either a screw or spring terminal connector.



IMPORTANT	BNC outputs apply only to the TSC Expansion module type.

Allocations to the base or module are broadly based on the following functional requirements:

- Signal inputs/outputs and relay connections are direct to the module to minimize connection length and number of interfaces.
- The base connectors provide mainly Shield connections. Notice that the same base part is used across all three types of expansion module.

Each connector is keyed to its respective mating header (two per connector) and each of the terminals is uniquely numbered.

Relay Expansion Module

There are four SPDT relays included in the relay output module (0…3) with the three contact connections for each being made available at the module terminals.

NC – Normally closed

C – Common

NO – Normally open

'Normal' is the relay contact state when unpowered.

The relay connections can carry high voltage.

The base part carries mainly Shield connections that are provided as a termination point for cable screens/shields. In addition, one or more must be used to connect Shield to a local ground of your choice.

Do not make any connections to terminals 9, 10, 19 or 24.

Upper Base Connector	Terminal	24	23	22	21	20	19
	Name	NOT USED	SH	SH	SH	SH	NOT USED
	Application		Shield				
	Description	Do not connect	Cable shield connection points				Do not connect

Upper Module Connector							
	Terminal	18	17	16	15	14	13
	Name	REL 2 NC	REL 2 COM	REL 2 NO	REL 3 NC	REL 3 COM	REL 3 NO
	Application	Relay 2			Relay 3		
	Description	Normally closed	Common	Normally open	Normally closed	Common	Normally open

1444-RELX00-04RB Relay Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector							
	Terminal	1	2	3	4	5	6
	Name	REL 0 NC	REL 0 COM	REL 0 NO	REL 1 NC	REL 1 COM	REL 1 NO
	Application	Relay 0			Relay 1		
	Description	Normally closed	Common	Normally open	Normally closed	Common	Normally open

Lower Base Connector							
	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

4…20 mA Expansion Module

The Analog Output module provides four channels of 4...20 mA output. For each output, specific High (HI) and Low (LO) signal connections are provided (despite the High/Low description these connections are polarity insensitive). Eight electrically connected shield connections are provided.

The 4...20 mA expansion module requires loop power, a supply in the range of 18V to 32V DC at 26 mA, to be provided to each output.

Supplying Loop Power

When loop power is not provided by other devices, a 24V supply must be provided.

The output connections are isolated from one another and the remainder of the module circuitry. While individual supplies can be applied per channel output, it is possible to deploy a common supply for multiple channels if maintaining inter-channel isolation is not important.

Figure 31 - Wiring Scheme

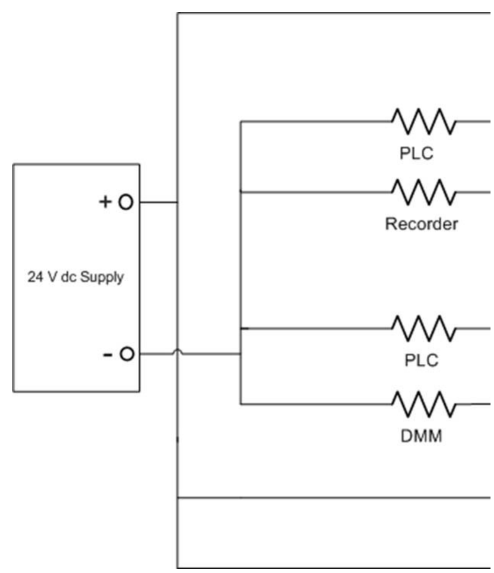


Figure 31: Example wiring scheme where PLC, DMM, Recorder represent the 4...20 mA load.

As shown in the preceding graphic:

- Connect the positive (+) power to the module output high connections (pins 1, 5, 14, and 18).
- Connect the negative (-) power to the module output low connections (pins 2, 6, 13, and 17).
- Do not make any connections to terminals 3, 4, 9, 10, 15, 16, 19, or 24.

Use of the same power supply that serves the Dynamix module to power other devices is allowed if it can serve the additional loads. However, when powering multiple devices it is important to make sure that the supply can serve the startup surge currents of the device. The startup surge currents can be greater than their normal operating load requirements. If the supply isn't adequate during startup of another device, it could affect current provided for Loop Power. As a result, there can be unexpected changes in the measured current levels on the system.

Upper Base Connector	Terminal	24	23	22	21	20	19
	Name	NOT USED	SH	SH	SH	SH	NOT USED
	Application		Shield				
	Description	Do not connect	Cable shield connection points				Do not connect

Upper Module Connector	Terminal	18	17	16	15	14	13
	Name	OUTPUT 2 HI	OUTPUT 2 LO	NOT USED	NOT USED	OUTPUT 3 HI	OUTPUT 3 LO
	Application	4…20 mA Output 2				4…20 mA Output 3	
	Description	High	Low	Do not connect		High	Low

1444-AOFX00-04RB Analog Output Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector							
	Terminal	1	2	3	4	5	6
	Name	OUTPUT 0 HI	OUTPUT 0 LO	NOT USED	NOT USED	OUTPUT 1 HI	OUTPUT 1 LO
	Application	4…20 mA Output 3				4…20 mA Output 2	
	Description	High	Low	Do not connect		High	Low

Lower Base Connector							
	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

Tacho Signal Conditioning Expansion Module

The lower module connector carries the tacho sensor inputs, while the upper module connector carries the local tacho outputs. Also, the TSC module has two additional buffered outputs made available at the BNC connectors.

For each of the two input channels, there is a separate signal and return connection and, if needed, a transducer power supply connection. The polarity of that supply output is configurable on a per channel basis.

When the input to a TSC module is a multiple event per revolution pulse, there are choices to what some of the outputs represent.

The first of the two outputs that are provided on the upper module terminals (18 and 14) is automatically configured to be the same as the output provided on the tacho bus (expected to be one event per revolution).

The second of the two outputs that are provided on the upper module terminals (17 and 13) is configurable to be the same frequency as the input, or as a processed/divided down output.

All of these outputs are TTL level.

The output that is provided on the BNC is always a buffered version of the respective input tacho signal. When the input signal is known to be multiple events per revolution, the TSC module sets either status indicator 6 or 7 blue. The blue status indicator is a warning that the BNC output of that channel carries a multiple event per revolution signal. This indicator serves as a warning to a local analyst.

A signal return, one connection for the two terminal outputs of each channel, is provided on the upper base connector.

Otherwise, the base part carries mainly Shield connections that are provided as a termination point for cable screens/shields. In addition, one or more must be used to connect Shield to a local ground of your choice.

Do not make any connections to terminals 9 or 10.

Tacho input connections:

Upper Base Connector							
	Terminal	24	23	22	21	20	19
	Name	RET	SH	SH	SH	SH	RET
	Application	Tacho Return	Shield				Tacho Return
	Description	Return	Cable shield connection points				Return

Upper Module Connector							
	Terminal	18	17	16	15	14	13
	Name	T0 OUT 0	T0 OUT 1	RET	RET	T1 OUT 0	T1 OUT 1
	Application	Tacho 0 Outputs		Tacho Returns		Tacho 1 Outputs	
	Description	1/Rev	N/Rev	Return	Return	1/Rev	N/Rev

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector	Terminal	1	2	3	4	5	6
	Name	TXP 0	SIG 0	RET 0	TXP 1	SIG 1	RET 1
	Application	Tach 0 Input			Tach 1 Input		
	Description	Transducer 0 Power	Transducer 0 Signal	Transducer 0 Return	Transducer 1 Power	Transducer 1 Signal	Transducer 1 Return

Lower Base Connector	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

TSCX Module Transducers

The TSCX supports four types of speed sensor inputs:

- Eddy Current Probe
- NPN/PNP Proximity Switch
- Self-Generating Magnetic Sensors
- TTL Signal Input

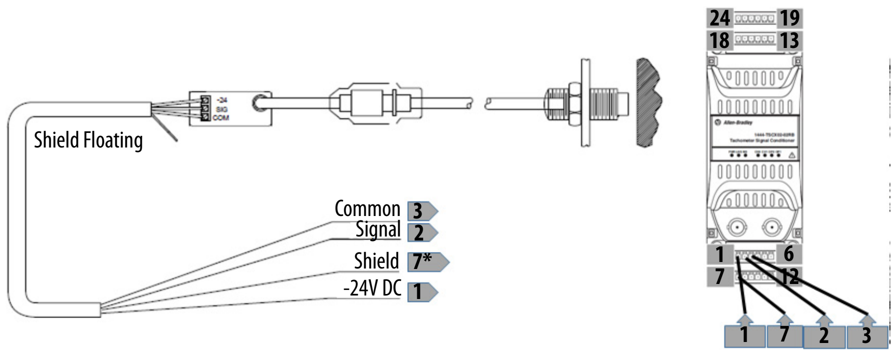
Proximity Probes

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = Eddy Current Probe System, and
- Transducer Power = -24V DC

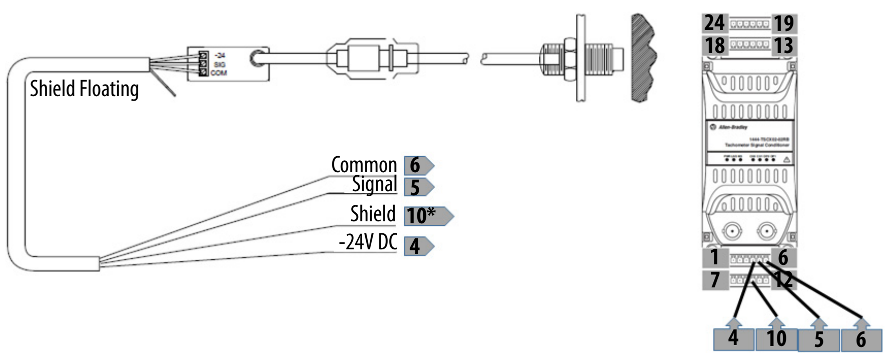
Wire the eddy current probe as illustrated.

Figure 32 - Channel 0 Wiring for an Eddy Current Probe Sensor



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 33 - Channel 1 Wiring for an Eddy Current Probe Sensor



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

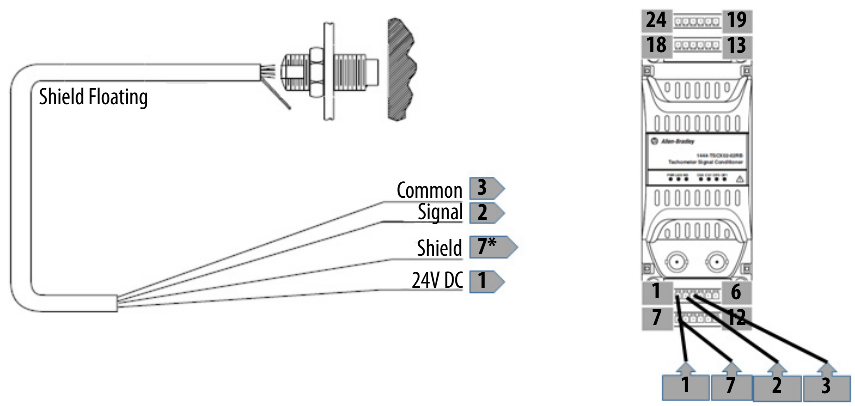
NPN/PNP Proximity Switch

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = NPN Proximity Switch, or
- Transducer Type = PNP Proximity Switch, and Transducer Power = 24V DC

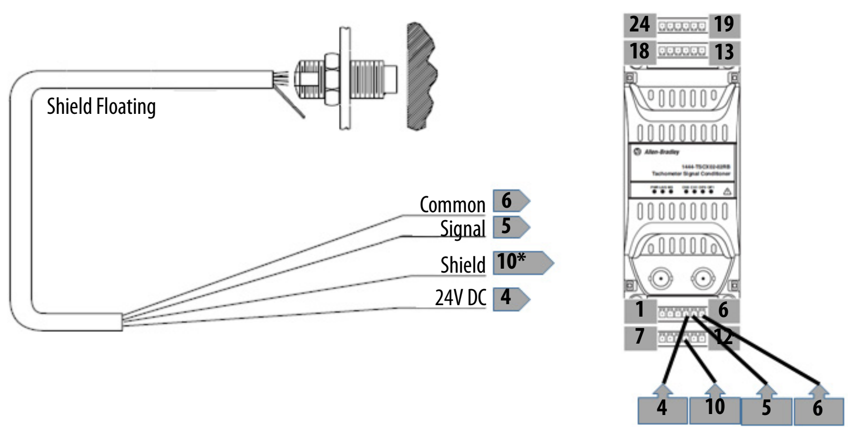
Wire the proximity switch as illustrated.

Figure 34 - Channel 0 Wiring for an NPN/PNP Proximity Switch



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 35 - Channel 1 Wiring for an NPN/PNP Proximity Switch



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

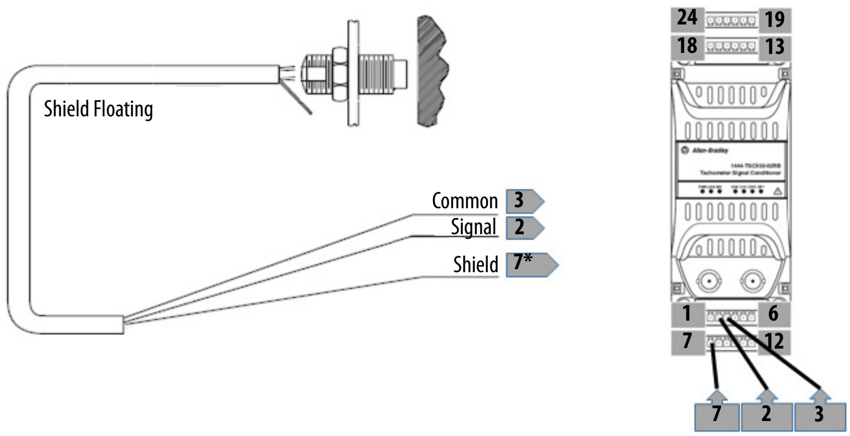
Self-generating Magnetic Sensor

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = Self-generating Magnetic Pickup, and
- Transducer Power = OFF

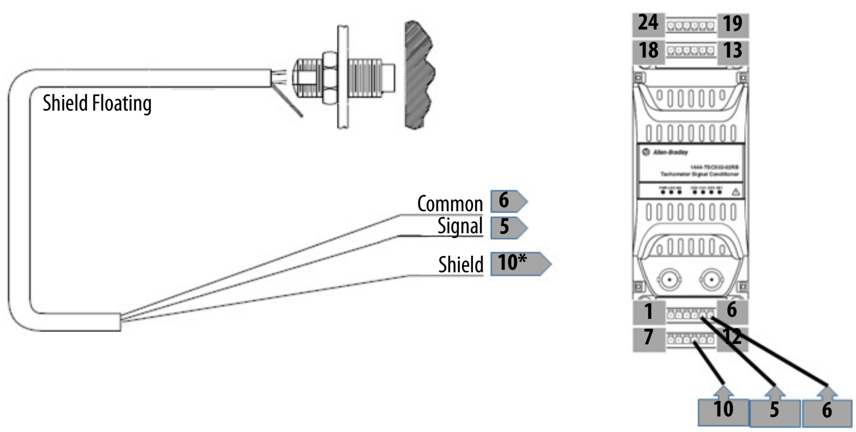
Wire the pickup as illustrated.

Figure 36 - Channel 0 Wiring for a Self-generating Magnetic Sensor



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 37 - Channel 1 Wiring for a Self-generating Magnetic Sensor



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

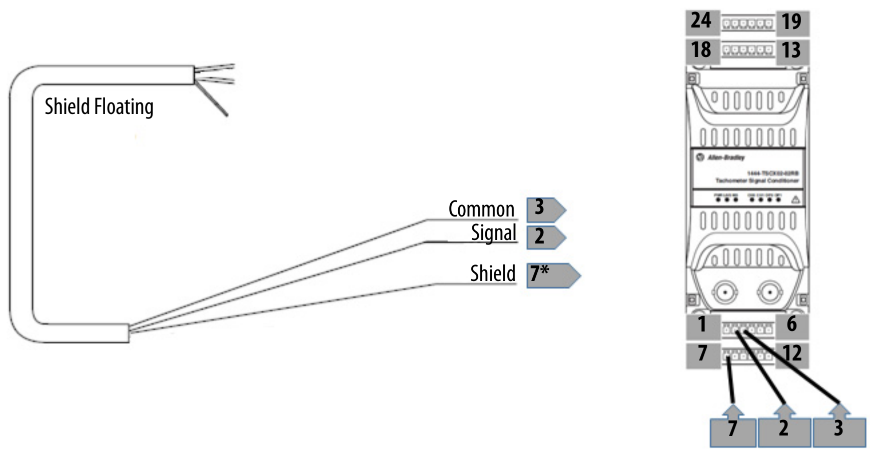
TTL Output Sensor

For any sensor or device that provides a TTL signal, such as a Hall Effect sensor, the connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = TTL Signal, and
- Transducer Power = OFF

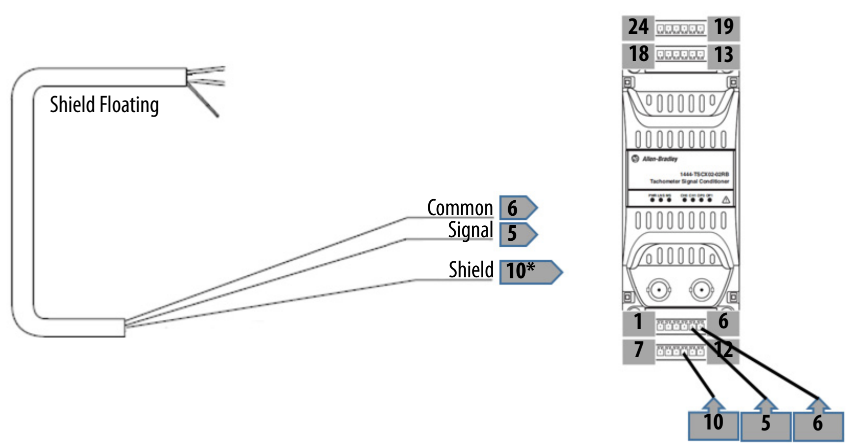
Wire the pickup as illustrated.

Figure 38 - Channel 0 Wiring for a TTL Signal



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Figure 39 - Channel 1 Wiring for a TTL Signal



* Shield can be landed to any available shield connection. See the IMPORTANT note on page 56 for additional information.

Start the Module and Perform a Self-test

After the modules are wired, power can be applied to test the installation. At power-up, each module performs an initial Self-test.

After the Self-test cycle the modules move to an idle state until a configuration is downloaded, and a connection is made to a controller. Table 11 describes the status indicators:

Table 11 - Dynamic Measurement Module

Status Indicator	Color	Behavior
PWR	Green	Solid
RUN	Green	Flashing
MS	Green	Solid
NS	Green	Solid or Flashing
OS	Green	Solid

Status Indicator	Color	Behavior
DSP	Green	Flashing
OK	Green	Solid
CH0	Green	Solid
CH1	Green	Solid
CH2	Green	Solid
CH3	Green	Solid
RLY	Green	Solid

If the status indicators are not as shown in Table 11, see Table 79 on page 308.

Expansion Module Startup Behavior

During power-up, Expansion Module Status indicators provide the address setting of the module. See Startup Behavior on page 315 for more information.

Table 12 - Tacho Signal Conditioner Expansion Module

Status Indicator	Color	Behavior
PWR	Green	Solid
LNS	Green	Solid
MS	Green	Flashing

Status Indicator	Color	Behavior
CH0	Green or Blue	Solid
CH1	Green or Blue	Solid
OP0	Green	Solid
OP1	Green	Solid

If the status indicators are not as shown in Table 12, see Table 61 on page 276.

Table 13 - Relay Expansion Module

Status Indicator	Color	Behavior
PWR	Green	Solid
LNS	Green	Solid
MS	Green	Flashing

Status Indicator	Color	Behavior
R0	Green	Solid
R1	Green	Solid
R2	Green	Solid
R3	Green	Solid

If the status indicators are not as shown in Table 13, see Table 59 on page 276.

Table 14 - Analog Output Expansion Module

Status Indicator	Color	Behavior
PWR	Green	Solid
LNS	Green	Solid
MS	Green	Flashing

Status Indicator	Color	Behavior
OP0	OFF	
OP1	OFF	
OP2	OFF	
OP3	OFF	

If the Status Indicators are not as shown in Table 14, see Table 71 on page 291.

Notes:

Configure the 1444 Dynamic Measurement Module

This chapter details how to define and configure the 1444 dynamic measurement module and set associated parameters.

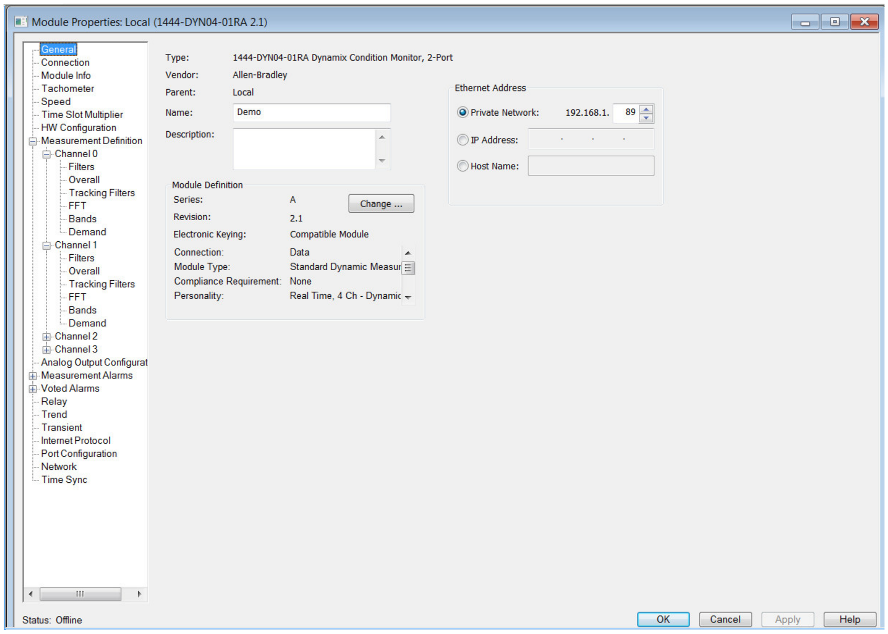
IMPORTANT Many parameters within the AOP are named differently than the objects within the module that they refer to. Consequently, some parameter names that are listed in the CIP™ Objects Library (CIP Objects on page 317), do not match the parameters that are presented on the AOP.

See the cross-reference at the beginning of the CIP Objects Library to determine the specific names of parameters as presented on the AOP, stored in the configuration assembly, and held in the various objects in the module.

General Page

The General page contains controls to name, describe, and define the system. You can also set the EtherNet/IP address or host name from the General page.

Figure 40 - The General Page



Module Definition

The Module Definition pages provide high-level definitions of module application and channel function. You must define the module at this level once during initial installation. The entries on this page are used throughout the configuration to enable, disable, or qualify further configuration attributes, selections, and options.

IMPORTANT	If parameters are changed in Module Definition, any dependent module configuration parameters are reset to default values. Any change to Module Definition "checks" the "Use Unicast Connection over EtherNet/IP" control on the connection page. If the application requires Multi-cast mode, then be sure to uncheck the control after changes are applied to Module Definition.

Module Definition Versus Module Configuration

In the Logix environment there are two steps to configure a new device:

- Define the instance of the specific connected device
- Configure the device

Module Definition

Module Definition is performed by using the various dialogs that are accessed through the General Page Change button.

At minimum, the attributes that are defined in Module Definition include any that affect the structure of the configuration, input, or output assemblies. The Add-on Profile (AOP) constructs these assemblies when the Module Definition is applied.

The 1444 series controller input assembly can be as simple as one measurement from each of four DC channels, or as sophisticated as over 100 values that are measured from dynamic signals. In either case, in Module Definition, specific measures must be selected to include in the input assembly. To simplify the selection and to minimize errors further along in configuration, Module Definition then includes additional dependent attributes. These attributes are used to filter the selection of the input assembly attributes based on the application and the types of inputs to each channel.

Other attributes that are controlled in Module Definition include specification of connected expansion modules, which define the complete hardware available for configuration. Also, other high-level attributes that are not expected to be edited once the device is initially defined are controlled in Module Definition.

IMPORTANT	• When Module Definition is applied, the AOP creates instances of the Configuration, Input, and Output assemblies. After editing an existing Module Definition, the AOP resets only configuration parameters that have a dependency on a changed Module Definition parameter. • For example, if a Channel Input Type is changed then only the parameters that are associated with the changed channel are set to their default values. If you change an existing Module Definition, thoroughly review the configuration.

Module Configuration

Module configuration consists of all "normal configuration" pages that are added to the tree below the standard General, Connections, and Module Info pages.

For the Dynamix™ 1444 Series, much of what is enabled in these pages is determined based on the selections in Module Definition.

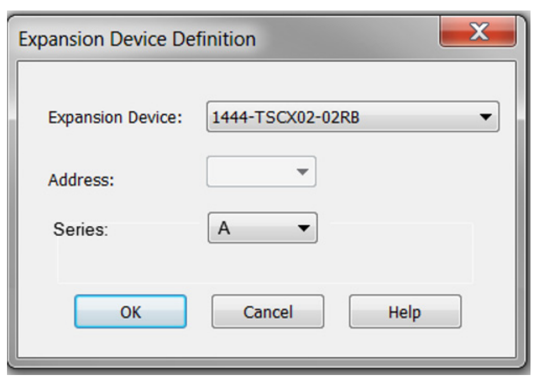
Configuration attributes can be changed without concern for the physical device definition (connected expansion modules and sensor types) such as alarm limits, measurement definitions, and trend configuration. In many cases, the available selections are limited by those attributes, within the available selections for that type of device.

Expansion Device Definition Dialog

Part of defining a 1444 series module is specifying any connected expansion modules. It can make sense to specify modules before working through the other Module Definition dialogs because it defines the physical installation. The expansion device definition dialog is used to add any expansion modules that the selected 1444-DYN04-01RA module hosts.

The tool provides controls to select a device, with hardware series number, and assign an address.

Figure 41 - Expansion Device Definition

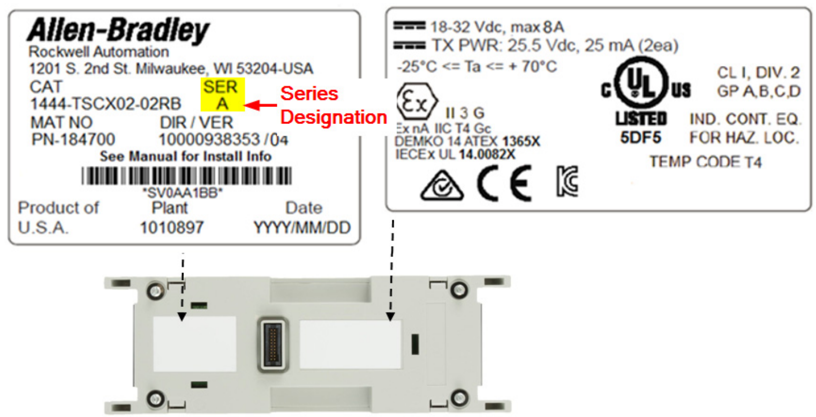


From the Expansion Device pull-down menu, select the type of expansion module to add to the tree, and connect to the selected dynamic measurement module.

Select the series of the hardware installed. Relay and analog output modules are available only in series A. The tachometer signal conditioner module is at series B. The series B tachometer signal conditioner module enables auto trigger (auto threshold) level detection. See Configure the Tachometer Expansion Module on page 193.

The module series designation is on the underside of the module as shown in Figure 42.

Figure 42 - Series Designation

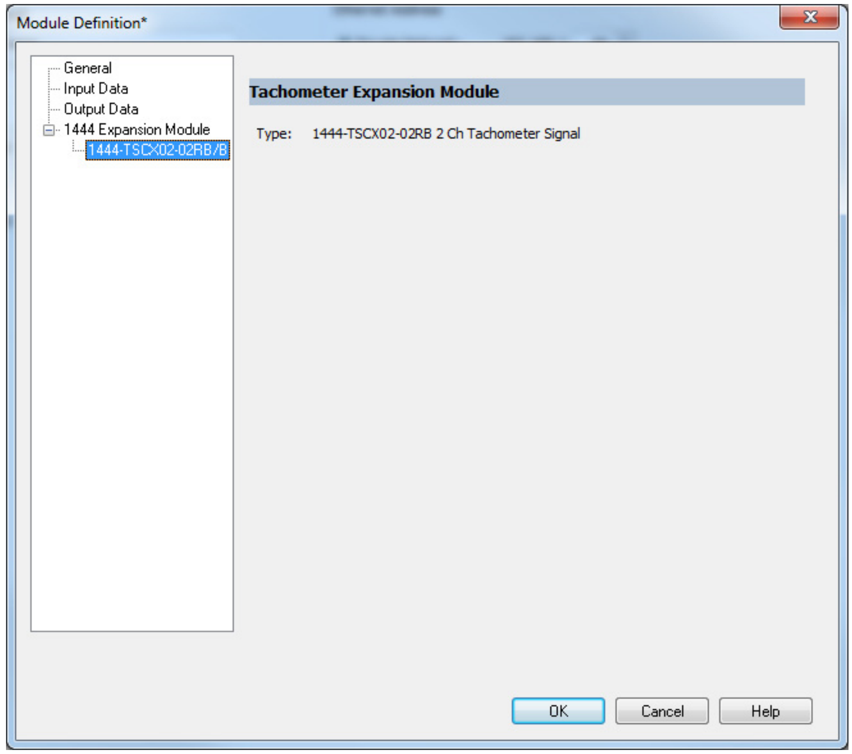


Use the Address pull-down menu to select an address (0, 1, 2) for a connected relay module (1444-RELX00-04RB). See Relay Expansion Module on page 203:

- Configuration of expansion modules is included in the configuration of the host module of the expansion module.
- Addresses are set automatically for connected Tachometer Signal Conditioner (1444-TSCX02-02RB) and 4…20 mA analog (1444-AOFX00-04RB) expansion modules.

Relay Expansion Module

Figure 43 - The Relay Expansion Module Page



Use the parameters on this page to edit the address of a connected relay expansion module for the selected 1444-DYN04-01RA dynamic measurement module.

Verify that the physical address set in the relay expansion module terminal base matches the value that is entered here.

General Page

Use the Module Definition General page to specify the high-level application of the module. This page is also where the general measurement definitions for the module and each channel are made. The selections that are made here are used throughout the tool, including on other Module Definition pages and the configuration pages, to guide further selections.

In configuration the relays are numbered as follows:

- 1444-DYN04-01RA onboard Relay: relay #0
- 1444-RELX00-04RB at address 0: relays #1…4
- 1444-RELX00-04RB at address 1: relays #5…8
- 1444-RELX00-04RB at address 2: relays #9…12

IMPORTANT	If edits are made to the module configuration, all other configurations are reset to their default values.

Figure 44 - The Module Definition General Page

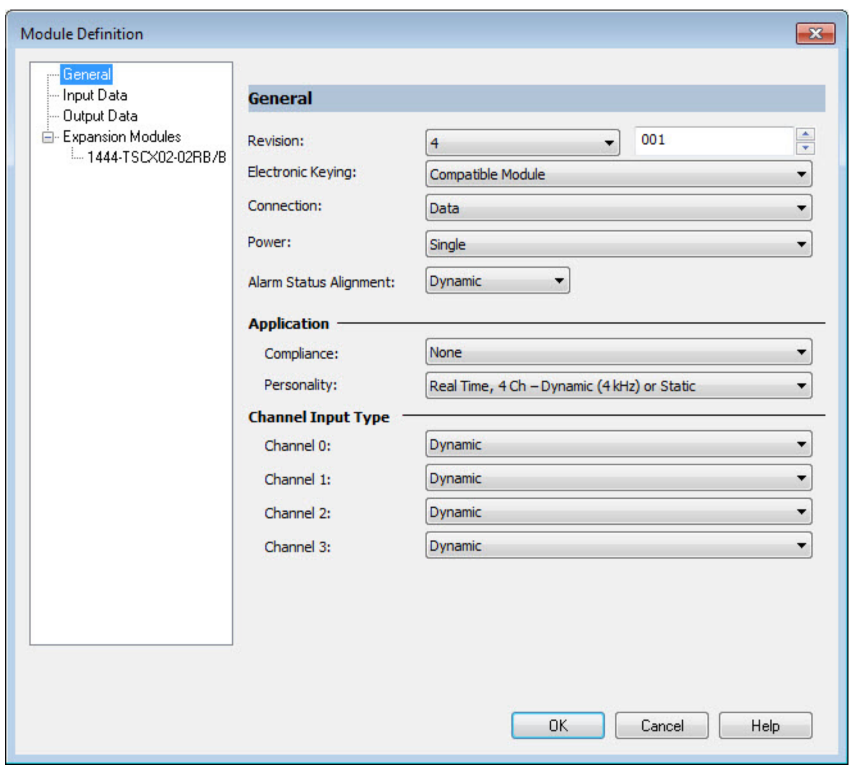


Table 15 - Module Functionality

Parameter	Values	Comment
Revision	Major Revision Minor Revision	**Major Revision** Choose the Major Revision of the firmware that is installed in the module. This field displays major revisions 2, 3 and 4. When applied, the profile creates Input, Output, and Configuration data structures appropriate to the selected major revision. This attribute cannot be edited, and appears dimmed, when online.
		IMPORTANT It is possible to choose a Major version number that is earlier than the revision of firmware that is currently installed on the module. To choose a Major version number that is earlier than the revision of firmware that is currently installed on the module causes the module to use the assemblies that are defined for the earlier version of firmware.
		Minor Revision Sets the minor revision of the module. The valid range is 1…255. This field is enabled while offline, and while in the Program, Remote Program, and Remote Run modes. It appears dimmed when in Run mode, or when electronic keying is set to Disable Keying. See Table 78, Firmware and AOP Revisions on page 306 for a listing of the released firmware revisions for this module.

Table 15 - Module Functionality

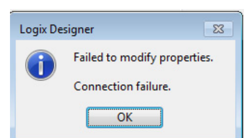
Parameter	Values	Comment
Keying	Exact Match Compatible Module Disable Keying	Valid values are Exact Match, Compatible Module (default), or Disable Keying. **Exact Match** When Keying is set to Exact Match, the module accepts the connection only when the module firmware major and minor revision numbers are the same as the Major and Minor Revision numbers in the Revision parameter. **Compatible Module** When Keying is set to Compatible Module the module accepts the connection when the module firmware, as compared to the Revision parameter Major and Minor Revision numbers, is: • The same or higher Major Revision and • The Minor Revision is as follows: – If the Major Revision is the same, the Minor Revision must be the same or higher. – If the Major Revision is higher, the Minor Revision can be any number. **Disable Keying** When Keying is set to Disable Keying the keying attributes are not considered when attempting to communicate with the module. **ATTENTION:** Be cautious when using Disable Keying. If used incorrectly, the module configuration may not match the configuration in the Profile and/or returned data and status information may be incorrect or misinterpreted. We strongly recommend that you do not use Disable Keying. If you use Disable Keying, you must take full responsibility for understanding whether the module can fulfill the functional requirements of the application. Electronic Keying can be edited while online or offline. For more detailed information on Electronic Keying, see *Electronic Keying in Logix5000 Control Systems Application Technique*, publication LOGIX-AT001. **IMPORTANT** To change Electronic Keying parameters online requires that the connection to the module is broken and re-established. Consequently: • Until a new connection is established module I/O is interrupted. • When the connection is dropped a "Failed to Modify Properties" dialog box is presented. 
Connection	Data	Displays the connection type for your module. Currently the only choice is Data.
Power Supply	Single Redundant	Specify if the module is powered by one or dual power supplies. When powered by dual supplies (redundant mode), the module monitors each power supply input and signal its status by using bit 15 of input tag member AuxProcesorStatus. The status bit is set (1) if this parameter is set to Redundant (1) and either of the supply voltages is less than 17V DC. Redundant power is required for all API applications (ComplianceMode not equal to "None"). **Using External Redundant Supplies** If the application requires API-670 compliance and power redundancy is being implemented externally, then it is necessary to connect power to both power inputs on the module. If power is landed to only one input, and the Power Supply mode is set to Redundant, then a fault indication is given.

Table 15 - Module Functionality

Parameter	Values	Comment
Alarm Status Alignment	<table><tr><th>Setting</th><th>Alignment Mode</th></tr><tr><td>Dynamic</td><td>0</td></tr><tr><td>Static</td><td>1</td></tr></table>	The module output (controller input) Status Assembly includes an array of 13 Alarm Status records. Each record provides the status of a Voted Alarm. This control determines how this array associates with the Voted Alarms. Dynamic: If set to Dynamic, the Alarm Status records are allocated based on relays. Choose Dynamic Association if multiple relays are assigned to the same voted alarm, but for different outputs (alert, danger, transducer fault). Static: Static association allocates Alarm Status records to Voted Alarms in sequence. AlarmStatus[0] presents the status of VotedAlarm[0], AlarmStatus[1] presents the status of VotedAlarm[1], and so on. Choose Static Association if relays are not used, or is always assigned to unique Voted Alarms, and the application requires Voted Alarms to be routinely added (enabled) or removed (disabled). When Alarm Status Alignment is static each voted alarm can have just one output, "Alarm Status to Activate On" defined (Alert, Danger, Transducer Fault). If multiple statuses are selected for any Voted Alarm, the control is set to Dynamic and disabled. See Alarm System Overview on page 211 and Alarm Status Structure on page 277 for further detail and examples of Alarm Status alignment.
Compliance Requirement	<table><tr><th>Setting</th><th>Compliance Mode</th></tr><tr><td>None</td><td>0</td></tr><tr><td>API-670 Compliant</td><td>1</td></tr></table>	For general monitoring applications that do not apply protection requirement, select "None". Select API-670 Compliant or higher to apply restrictions to the configuration that help to define an API-670 machinery Protection Systems standard-compliant configuration. • The API-670 standard allows a great deal of variation in many aspects of the configuration. So setting this attribute to API-670 Compliant or higher does not by itself help to make sure that a configuration is API-670 compliant. API -670 compliance levels require real-time measurements. So the multiplexed personalities are not enabled when compliance levels greater than None are selected. When the Compliance Requirement is set to API-670, the ProtectionLoopTimeWarning status is considered in the ModuleSummary status. The ProtectionLoopTimeWarning status bit is set when DSP critical alarms loop cycle time is >100 milliseconds, which means that the module cannot satisfy the performance requirements of API-670.

Table 15 - Module Functionality

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Personality</td><td><table><tr><th>Setting</th><th>Personality</th></tr><tr><td>Real Time, 4 Ch – Dynamic (4 kHz) or Static</td><td>1</td></tr><tr><td>Real Time, 2 Ch – Dynamic (20 kHz), 2 Ch Static</td><td>2</td></tr><tr><td>Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path</td><td>32</td></tr><tr><td>Real Time, 2 Ch – Dynamic (40 kHz)</td><td>64</td></tr><tr><td>Multiplexed, 4 Ch – Dynamic (40 kHz) or -Static – Paired</td><td>-128</td></tr></table></td><td>Module Personality defines the general measurement configuration of the module, including which channels are used, at what maximum frequency (or DC).
Two categories of Personality are provided – Real-Time and Multiplexed. Real-Time personalities provide continuous measurements that update at rates of not slower than once every 40 milliseconds. The Multiplexed personalities update measurements in channel pairs, although they do not necessarily alternate equally (see Time Slot Multiplier).
The available selections are as follows.
1: Real Time, 4 Ch – Dynamic (4 kHz) or Static
All channels are available. Each channel pair can be defined for either Static (DC) or Dynamic (AC) measurements. Dynamic channels can be configured for an Fmax up to 4578 Hz (274.7 kCPM).
2: Real Time, 2 Ch – Dynamic (20 kHz), 2 Ch Static
Channels 0 and 1 can be configured for Dynamic (AC) measurements with an Fmax of up to 20.6 kHz (1236 kCPM). Channels 2 and 3 can be used for Static (DC) measurements.
32: Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path
For measurements, this is the same as “1: Real Time, 4 Ch – Dynamic (4 kHz) or Static”. What is different is that the module internally connects the channel 0 and 2 inputs and the channel 1 and 3 inputs.
64: Real Time, 2 Ch – Dynamic (40 kHz)
Channels 0 and 1 (pair) can be configured for Dynamic (AC) measurements with a measurement Fmax of 40 kHz*, or as gSE. Channels 2 and 3 are disabled (off).
-128: Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired
Channels can be configured in pairs (0 and 1, 2 and 3) for Dynamic (AC) measurements with a measurement Fmax of 40 kHz*, as gSE, as Static (DC) measurements, or off.
Channel Pair measurements alternate based on the Time Slot Multiplier setting.
* The 40 kHz personality provides high frequency overall and gSE measurements. The maximum possible FFT FMAX available from a 40 kHz personality is 2747 Hz (164.8 kCPM).</td></tr>
</table>

Table 15 - Module Functionality

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Ch0, Ch1, Ch2, Ch3</td><td>0: Off
1: Dynamic
2: gSE
3: Static</td><td>Channel Type is a high-level selection that is used by the AOP (not the module) to filter / manage further user selections in Module Definition and in Configuration.
The Channel Types that are enabled are based on the Module Personality selected. The selections are as follows.
<table>
<tr><td>Personality</td><td>Ch0</td><td>Ch1</td><td>Ch2</td><td>Ch3</td></tr>
<tr><td>Real Time, 4 Ch – Dynamic (4 kHz) or Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td></tr>
<tr><td>Real Time, 2 Ch – Dynamic (20 kHz), 2 Ch Static</td><td>Off, Dynamic</td><td>Off,
Ch0 Setting</td><td>Off,
Static</td><td>Off,
Static</td></tr>
<tr><td>Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path</td><td>Off,
Dynamic,
Static</td><td>Off,
Ch0 Setting</td><td>Off,
Dynamic,
Static</td><td>Off,
Ch2 Setting</td></tr>
<tr><td>Real Time, 2 Ch – Dynamic (40 kHz)</td><td>Off,
Dynamic,
gSE</td><td>Off,
Ch0 Setting</td><td>Off</td><td>Off</td></tr>
<tr><td>Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired</td><td>Off,
Dynamic,
gSE,
Static</td><td>Off,
Ch0 Setting</td><td>Off,
Dynamic,
gSE,
Static</td><td>Off,
Ch2 Setting</td></tr>
<tr><td>Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Individual</td><td>Off,
Dynamic,
gSE,
Static</td><td>Off,
Dynamic,
gSE,
Static</td><td>Off,
Dynamic,
gSE,
Static</td><td>Off,
Dynamic,
gSE,
Static</td></tr>
</table>
</td></tr>
</table>

Input Data Page

Use the Input Data Page to specify the measurements to be included in the module input assembly. The input assembly is constructed to include a fixed Status Assembly followed by a table that consists of the selected measurements. See Assembly Object on page 517.

Measurements must be selected and configured appropriately for the module to produce them. See Measurement Definition on page 123.

Figure 45 - The Input Data Page

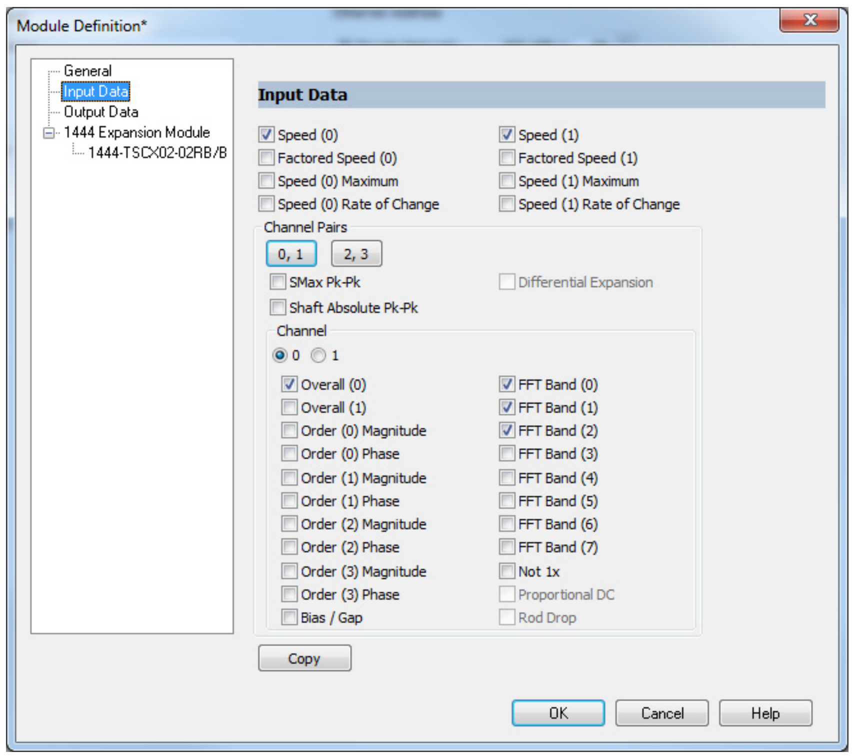


Table 16 - Input Data

Parameter	Values	Comments
Speed (0)	Checked (1) Unchecked (0)	Check this parameter to include the Speed0 member to the input tag. The speed is the value that is measured from the TTL input (0 or 1) or from the controller output (I/O), and without applying any Speed Multiplier that can be configured. Tag Member: Speed0
Speed (1)	Checked (1) Unchecked (0)	Check this parameter to include the Speed1 member in the input tag. The speed is the value that is measured from the TTL input (0 or 1) or from the controller output (I/O), and without applying any Speed Multiplier that can be configured. Tag Member: Speed1
FactoredSpeed (0)	Checked (1) Unchecked (0)	Check this parameter to include the Factored Speed0 member to the input tag. The Factored Speed is the measured speed that is multiplied by the Multiplier (specified on the Speed page). Tag Member: FactoredSpeed0
FactoredSpeed (1)	Checked (1) Unchecked (0)	Check this parameter to include the Factored Speed1 member to the input tag. The Factored Speed is the measured speed that is multiplied by the Multiplier (specified on the Speed page). Tag Member: FactoredSpeed1

Table 16 - Input Data

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Speed (0) maximum</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Speed0 max member to the input tag.
Speed maximum is the maximum observed speed measurement since last reset. This value is the maximum Speed, not Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
The maximum speed value does not update when the tachometer is in fault. See “Behavior” for the Dynamix Tacho and Speed Measurement Object, page 384, for further information.
Tag Member: Speed0 max</td></tr>
<tr><td>Speed (1) maximum</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Speed1 max member to the input tag.
Speed maximum is the maximum observed speed measurement since last reset. This value is the maximum Speed, not Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
The maximum speed value does not update when the tachometer is in fault. See “Behavior” for the Dynamix Tacho and Speed Measurement Object, page 384, for further information.
Tag Member: Speed1 max</td></tr>
<tr><td>Speed (0) Rate of Change</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Speed0RateOfChange member to the input tag. This value is the Rate of Change of the Speed, not of the Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
Tag Member: Speed0RateOfChange</td></tr>
<tr><td>Speed (1) Rate of Change</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Speed1RateOfChange member to the input tag. This value is the Rate of Change of the Speed, not of the Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
Tag Member: Speed1RateOfChange</td></tr>
<tr><td>SMax pk-pk</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the SMAX magnitude and phase members for the selected channel pair to the input tag.<table><tr><td>Channel Pair</td><td>Tag Member</td></tr><tr><td>0, 1</td><td>Ch0_1SMAXMAg</td></tr><tr><td>2, 3</td><td>Ch2_3SMAXMAg</td></tr></table>There are several different ways the SMAX measurement can be made. The 1444 performs the SMAX measurement per standard ISO 7919/1, Annex A “Derivation of Measurements” Method A.</td></tr>
<tr><td>Shaft Absolute pk-pk</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Shaft Absolute pk-pk member for the selected channel pair to the input tag.<table><tr><td>Channel Pair</td><td>Tag Member</td></tr><tr><td>0, 1</td><td>Ch0_1Shaft AbsolutePk_Pk</td></tr><tr><td>2, 3</td><td>Ch2_3Shaft AbsolutePk_Pk</td></tr></table></td></tr>
<tr><td>Differential Expansion</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Differential Expansion member for the selected channel pair to the input tag.<table><tr><td>Channel Pair</td><td>Tag Member</td></tr><tr><td>0, 1</td><td>Ch0_1DifferentialExpansion</td></tr><tr><td>2, 3</td><td>Ch2_3DifferentialExpansion</td></tr></table>If the channel type is DC, then only one DC member can be selected (Differential Expansion, DC Proportional, or Rod Drop). The mode for calculating the Differential Expansion measurement can be set to either Axial (Complimentary) or Radial (Ramp). Use the Measurement Type control on the Hardware Configuration Page to select the mode.</td></tr>
<tr><td>Overall (n)</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Overall (n) member for the selected channel to the input tag.<table><tr><td>Channel</td><td>Tag Member</td></tr><tr><td>0</td><td>Ch0Overall[n]</td></tr><tr><td>1</td><td>Ch1Overall[n]</td></tr><tr><td>2</td><td>Ch2Overall[n]</td></tr><tr><td>3</td><td>Ch3Overall[n]</td></tr></table></td></tr>
</table>

Table 16 - Input Data

Parameter	Values	Comments		
Order (n) magnitude	Checked (1) Unchecked (0)	Check this parameter to include the Order (n) magnitude member for the selected channel to the input tag.		
			Channel	Tag Member
			0	Ch0Order[n]Mag
			1	Ch1Order[n]Mag
			2	Ch2Order[n]Mag
			3	Ch3Order[n]Mag
Order (n) Phase	Checked (1) Unchecked (0)	Check this parameter to include the Order (n) Phase member for the selected channel to the input tag.		
			Channel	Tag Member
			0	Ch0Order[n]Phase
			1	Ch1Order[n]Phase
			2	Ch2Order[n]Phase
			3	Ch3Order[n]Phase
Bias / Gap	Checked (1) Unchecked (0)	Check this parameter to include the Bias / Gap (DC Volts) member for the selected channel to the input tag.		
			Channel	Tag Member
			0	Ch0DCV
			1	Ch1DCV
			2	Ch2DCV
			3	Ch3DCV
FFT Band (n)	Checked (1) Unchecked (0)	Check this parameter to include the FFT Band n member for the selected channel to the input tag.		
			Channel	Tag Member
			0	Ch0FFTBand[n]
			1	Ch1FFTBand[n]
			2	Ch2FFTBand[n]
			3	Ch3FFTBand[n]

Table 16 - Input Data

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Not 1x</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Not 1x member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0Not1X</td></tr>
<tr><td>1</td><td>Ch1Not1X</td></tr>
<tr><td>2</td><td>Ch2Not1X</td></tr>
<tr><td>3</td><td>Ch3Not1X</td></tr>
</table></td></tr>
<tr><td>Proportional DC</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Proportional DC member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0DC</td></tr>
<tr><td>1</td><td>Ch1DC</td></tr>
<tr><td>2</td><td>Ch2DC</td></tr>
<tr><td>3</td><td>Ch3DC</td></tr>
</table>
• The tag value displays in the specified engineering units for the proportional value.
• If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
<tr><td>Rod Drop</td><td>Checked (1)
Unchecked (0)</td><td>Check this parameter to include the Rod Drop member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0RodDrop</td></tr>
<tr><td>1</td><td>Ch1RodDrop</td></tr>
<tr><td>2</td><td>Ch2RodDrop</td></tr>
<tr><td>3</td><td>Ch3RodDrop</td></tr>
</table>
If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
</table>

Select Input Data for Input Tag

The parameters on this page are used to specify measurements to be included in the Input Tag. When a control is checked, the corresponding member is included in the input tag.

The page is organized into top (Module level), middle (Input Pair level) and bottom (Input level) sections.

Module Level Parameters

The parameters in the top section are all associated with speed so they are not dependent on the configuration or availability of any measurement channel.

Channel Pair Level Parameters

The parameters in this section are measurements that are made from two measurement channels. The two channel measurements are made from channels that are grouped into either of two pairs; channels 0 and 1 or channels 2 and 3.

There are two versions of each of the parameters that are shown in this section, one associated with each channel pair. Click the button for pair 0, 1 or pair 2, 3 to select the measurements for either pair.

Channel Level Parameters

The parameters in this section are measurements that are made from individual channels.

There are four versions of each of the parameters that are shown in this section, one associated with each channel. Click the button for channel 0 or 1, for channel pair 0/1, or 2 or 3, for channel pair 2/3, to select the measurements for each channel:

- The parameters on this page are used only by the AOP.
- The Module Personality and Channel Type selections of the Define Module Functionality page filter the presented measurements.
- To select measurements on this page forces related configuration definition/selections but cannot verify that the configuration of the measurement is appropriate for the application and the applied signals.
- Use the Copy button to copy the Channel Pairs and Channel selections that are visible to the other Channel Pair and Channels.

Output Page

The parameters on this page are used to specify data to be included in the Output Tag.

The module output assembly consists of one Control value and two optional arrays of floats; two speed values and 16 alarm limit values. The optional items are defined on this page.

Figure 46 - Module Definition - Select Data for Output

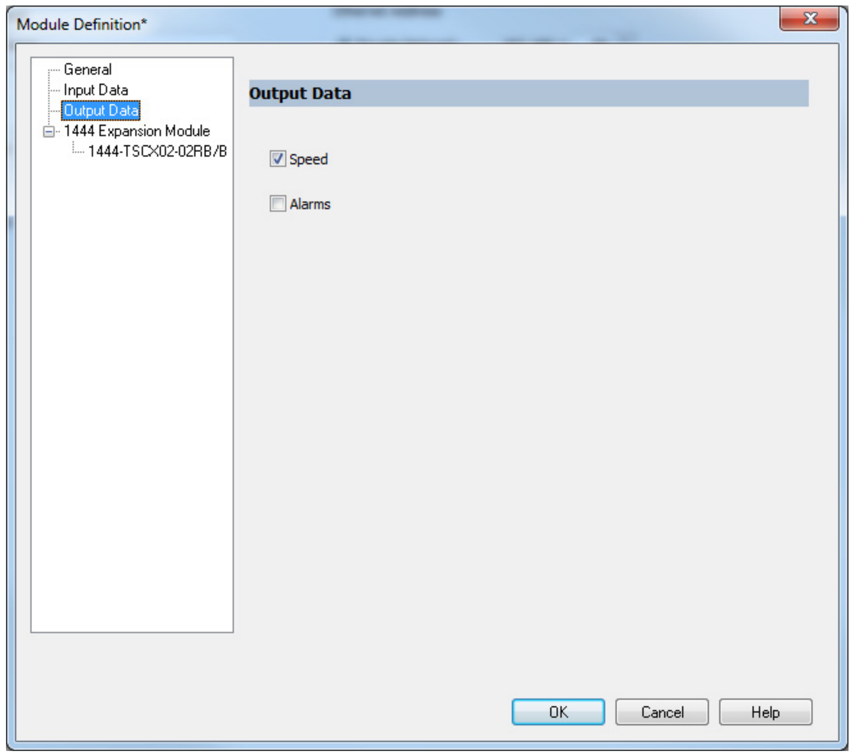


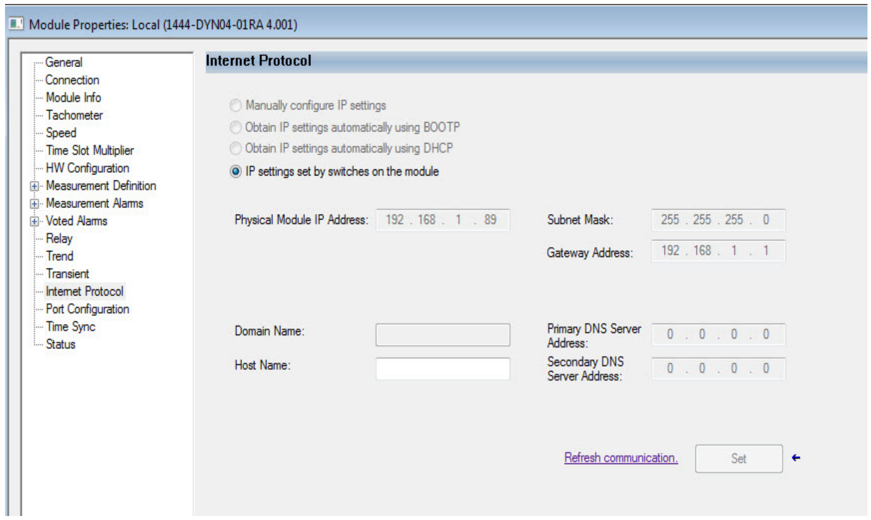
Table 17 - Data for Output Tag

Parameter	Values	Comments
Speed	Checked (1) Unchecked (0)	Check this parameter to include two speed members in the output tag. • Speed values written to the output tag can be used to manage FFT Bands, Alarm Gating, and other speed-related functions in the module. • Sometimes a machine does not have a speed sensor (tachometer) available for the module to consume directly. But often the controller knows the speed from a drive or other system / device. While the module requires a “trigger” type signal for some speed functions such as Order Tracking, it needs only an RPM value for others, such as Alarm Gating.
Alarms	Checked (1) Unchecked (0)	Check this parameter to include 16 alarm members in the output tag. • Alarm limit values written to the output tag can be used as Alert or Danger limit levels in one or more Measurement Alarms. • For some applications, static alarm values are insufficient because the behavior of the measured value changes “normally” as a function of the process. For example, the “profile” of vibration through the cycle of cutting by a machine tool follows a unique, but repeatable, pattern as the cutting tool is at rest, moves forward, engages, cuts, disengages, retracts, and then rests again. In other cases, the vibration response can vary “normally” based on the type of fluid being pumped, or the type of metal being worked. In all these cases, and many more, the controller can be programmed to serve appropriate alarm limits to the module as standard I/O. This capability helps to make sure that any deviant behavior, regardless of where the process is within the profile or what material is being processed, is detected.

Internet Protocol Page

The Internet Protocol page parameters provide controls for connecting the module to a network. See ENET-UM001 for more information.

Figure 47 - The Internet Protocol Page



IMPORTANT	The module must be ONLINE for the Internet Protocol page to update.

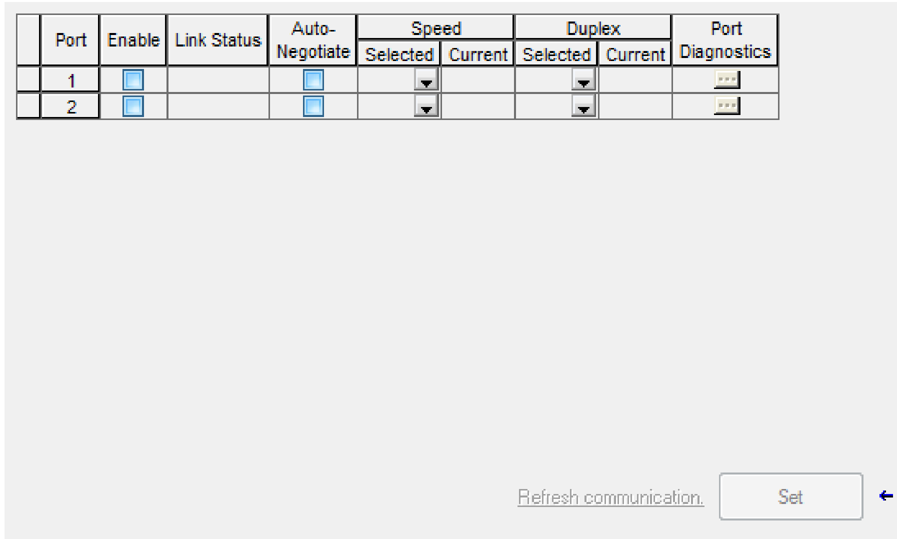
Table 18 - Internet Protocol

Parameter	Values	Comments
Internet Protocol Settings	Manually configure IP settings Use BOOTP to obtain IP settings automatically Use DHCP to obtain IP settings automatically IP settings set by switches on the module	
Physical Module IP address	—	Type an IP address for the system.
Domain Name	—	
Host Name	—	
Subnet Mask	—	
Gateway Address	—	
Primary DNS Server Address	—	
Secondary DNS Server Address	—	

Port Configuration Page

Use the Port Configuration page to enable and configure module ports.

Figure 48 - The Port Configuration Page

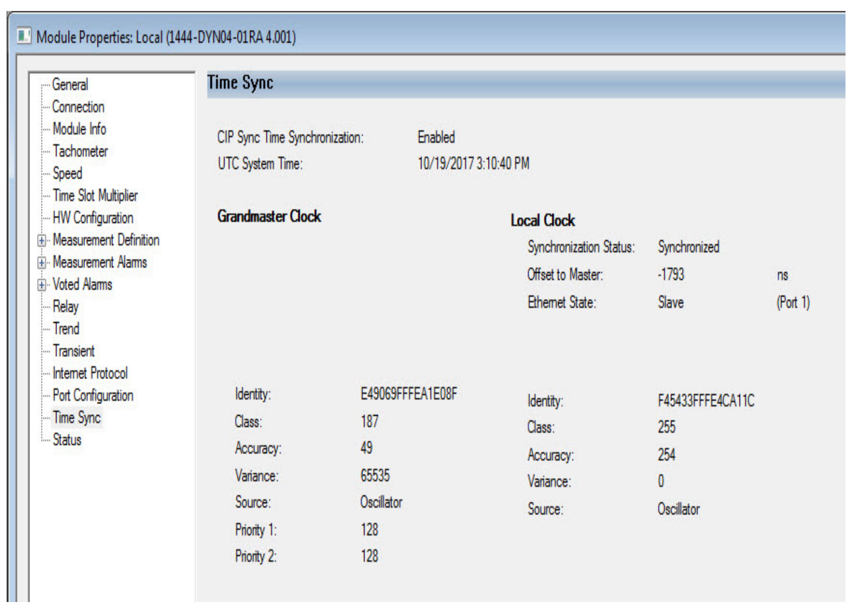


See the online help for the parameter Port Configuration values.

Time Sync Page

See ENET-UM001 for more information.

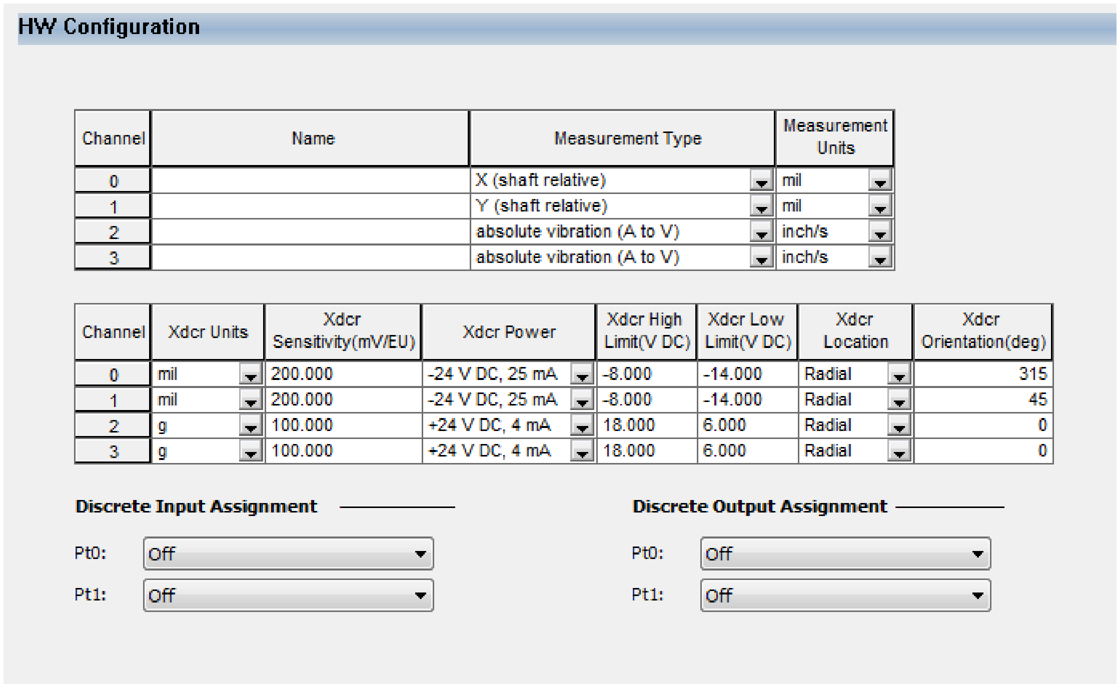
Figure 49 - The Time Sync Page



IMPORTANT	The module must be ONLINE for the Time Sync page to update.

Hardware Configuration Page

Figure 50 - Hardware Configuration Page



The Hardware Configuration page includes parameters that are associated with the physical inputs and outputs of the module. The page is divided into four general sections:

- Channel Definition: Parameters that define the integration and filtering requirements for each channel.

TIP The measurement type selection sets appropriate defaults for many of the parameters in the sensor definition group. So, in most cases, set the measurement type before making other changes.

- Sensor Definition: Parameters that define the sensor that is physically connected to each channel of the module.
- Digital I/O Definition: Parameters that define how the discrete input and output channels of the module are used.

Table 19 - Hardware Configuration

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Name</td><td>0…32 characters*</td><td>Name must start with a letter or underscore ("_"). All other characters can be letters, numbers, or underscores. Name cannot contain two contiguous underscore characters and cannot end in an underscore.
The module does not use Transducer Name but retains it for reference by higher-level systems.
*If the channel name is used to create and name a measurement Location in Emonitor®, then note that the Emonitor Location name is limited to 16 characters.
If the channel name is greater than 16 characters, the TRAILING 16 characters are used by the Emonitor Extraction Manager (EEM) utility to create data locations in the Emonitor database for 1444 Series monitor data.</td></tr>
<tr><td>Measurement Type</td><td>See following table. Also see Table 90 on page 340 in Dynamix Configuration Manager Object.</td><td>Measurement Type selections are intended to simplify configuration of various common applications. It defines what filtering is applied (LP/HP), the quality of the filtering (roll off), and if the measurement is integrated or double integrated.
Displays the engineering units that results from applying the Measurement Type (function) to the selected Transducer Units. This engineering unit is associated with dynamic measures that are read from the Post Filter signal source (see Filters on page 124).</td></tr>
<tr><td>Measurement Units</td><td>—</td><td>Displays the engineering units that results from applying the Measurement Type (function) to the selected Transducer Units. This engineering unit is associated with dynamic measures that are read from the Post Filter signal source (see Filters on page 124).</td></tr>
<tr><td>Xdcr Units</td><td>The supported engineering units include the following.
<table>
<tr><td>V</td><td>inch/s</td><td>bar</td><td>kW</td><td>UK g/min</td></tr>
<tr><td>mV</td><td>m/s^2</td><td>mbar</td><td>MW</td><td>m^3/min</td></tr>
<tr><td>m</td><td>mm/s^2</td><td>psi</td><td>VA</td><td>gSE</td></tr>
<tr><td>mm</td><td>$inch/s^2$</td><td>A</td><td>kVA</td><td>RPM</td></tr>
<tr><td>micron</td><td>g</td><td>mA</td><td>VAR</td><td>RPM/min</td></tr>
<tr><td>inch</td><td>mg</td><td>K</td><td>kVAR</td><td>EU</td></tr>
<tr><td>mil</td><td>Pa</td><td>°C</td><td>l/min</td><td></td></tr>
<tr><td>m/s</td><td>kPa</td><td>°F</td><td>cfm</td><td></td></tr>
<tr><td>mm/s</td><td>MPa</td><td>W</td><td>US g/min</td><td></td></tr>
</table>
The Engineering Units cannot be set or changed if the Channel Type is OFF or gSE.</td><td>Select the Engineering Units the sensor measures and to which the transducer sensitivity is referenced (in mV/Engineering Unit).
The Channel Type (Module Definition) and the Measurement Type determine the available selections.</td></tr>
<tr><td>Xdcr Sensitivity</td><td>Any real number between 1 and 20,000.</td><td>Enter the sensitivity of the connected sensor in mV/Engineering Unit (EU as specified in Xdcr Units in the preceding table).</td></tr>
<tr><td>Xdcr Power</td><td>Select from the following.
• Off
• +24V DC, 4 mA
• +24V DC, 25 mA
• -24V DC, 25 mA
Select the power option appropriate for the connected sensor.</td><td>• Select OFF for any self-powered sensor, or for sensors that are powered from another source (including a barrier).
• +24V DC, 4 mA: This is a constant current (CC) source. It is required for standard IEPE (ICP) accelerometers and other sensors that require a 4 mA CC source.
• +24V DC, 25 mA: This is a regulated positive voltage source. Many position measurement sensors such as LVDTs and some vibration sensors require a +24V supply.
• -24V DC, 25 mA: This is a regulated negative voltage source. It is suitable for all API-670 compliant eddy current probes and other sensors that require a -24V supply.</td></tr>
</table>

Table 19 - Hardware Configuration

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Xdcr High Limit (V DC)</td><td>-24.000…24.000</td><td>High-voltage threshold for the TX OK monitoring window. A sensor bias voltage greater than this value forces a transducer fault condition.
To help detect transducer failure, the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias that is applied is automatically selected based on the power supply that is configured for that channel:
<table><tr><th>Power</th><th>Typical Bias Voltage at Input</th></tr><tr><td>OFF</td><td>1.7 VDC</td></tr><tr><td>+24V DC, 4 mA</td><td>-3.9 VDC</td></tr><tr><td>+24V DC, 25 mA</td><td>-3.9 VDC</td></tr><tr><td>-24V DC, 25 mA</td><td>13 VDC</td></tr></table>
Within a channel pair (0 and 1, 2 and 3), there are slight differences in the bias voltages (noticeable on the positive bias, where it is approximately 1.3V). This is by design and has no effect on functionality.</td></tr>
<tr><td>Xdcr Low Limit (V DC)</td><td>-24.000…24.000</td><td>Low voltage threshold for the TX OK monitoring window. A sensor bias voltage less than this value forces a transducer fault condition.
To help detect transducer failure, the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias that is applied is automatically selected based on the power supply that is configured for that channel:
<table><tr><th>Power</th><th>Typical Bias Voltage at Input</th></tr><tr><td>OFF</td><td>1.7 VDC</td></tr><tr><td>+24V DC, 4 mA</td><td>-3.9 VDC</td></tr><tr><td>+24V DC, 25 mA</td><td>-3.9 VDC</td></tr><tr><td>-24V DC, 25 mA</td><td>13 VDC</td></tr></table>
Within a channel pair (0 and 1, 2 and 3), there are slight differences in the bias voltages (noticeable on the positive bias, where it is approximately 1.3V). This is by design and has no effect on functionality.</td></tr>
<tr><td>Xdcr Location</td><td>Select from the following:
• Unknown
• Radial
• Axial</td><td>Select the location of the transducer that pertains to the alignment of the sensor with the monitored shaft.
Use Radial if the most sensitive direction of measurement is perpendicular to the shaft.
Use Axial of the most sensitive direction of measurement is parallel to the shaft.
The module does not use Transducer Location but retains it for reference by higher-level systems.</td></tr>
<tr><td>Xdcr Orientation (deg).</td><td>0…359, in 1° increments</td><td>Degrees are referenced (0) to the vertical top dead center (TDC) of the shaft and increment in the clockwise direction when viewed from the driver end of the machine train.
• The direction of shaft rotation does not affect orientation.
• Transducer orientation is used in the Absolute Shaft Vibration calculations and for reference by higher-level systems.</td></tr>
</table>

Table 19 - Hardware Configuration

Parameter	Values	Comment	
Discrete Inputs			
Parameter	**Values**	**Comment**	
Pt0/1)	Set bit 0 for Pt0 or bit 1 for Pt 1 in the attribute that is associated with the selected control.	The 1444 DYN04-01RA includes two discrete TTL class input channels. These let users physical wire an input to the module that can be used in any of several described manners.	
		Function	**Description**
		Trip Inhibit/ Bypass	Inhibits trips with all voted alarms that define the Logical Input as its control
		Alarm/Relay Reset	Resets all latched voted alarms where the alarm condition has cleared, which resets any associated physical relays.
		Voted Alarm SPM Control	Manages Setpoint Multiplication for measurement alarms that are inputs to the associated voted alarm.
		Voted Alarm Gate Control	Manages Alarm Gating for the associated voted alarm.
		Voted Alarm Logic Control	Use this to wire an external input that, when actuated, forces the associated Voted Alarm to actuate, and therefore any relays associated with it. See I/O Control on the Voted Alarm page for further information.
		Speed 0 Fault	If wiring a TTL tacho source to the terminal base, rather than via the local bus, this input can be used to communicate the tacho channel status.
		Speed 1 Fault	

Table 19 - Hardware Configuration

Parameter	Values	Comment	
Discrete Outputs			
Parameter	**Values**	**Comment**	
Pt0/1	-	The 1444-DYN04-01RA includes two discrete opto-isolated outputs. These provide output of selected status conditions or replication of selected input signals. i	
	-	**Function**	**Description**
	0	OFF	Output is not used.
	1…13	Voted Alarm Instance 1...13 Alarm Alert Status	The status of the selected Voted Alarm when the alarm is configured to activate on an alert condition.
	17…29	Voted Alarm Instance 1...13 Danger Alert Status	The status of the selected Voted Alarm when the alarm is configured to activate on danger conditions.
	33…45	Voted Alarm Instance 1...13 Fault Alert Status	The status of the selected Voted Alarm when the alarm is configured to activate on a transducer fault condition.
	48…49	Local TTL Tacho 0...1 Input	Replicated from the TTL signal that is connected to the terminal pins.
	50…51	Tacho Bus 0...1	Replicated from the TTL signal that is communicated over the Local Bus.
	52…53	Tacho Bus 0...1 Fault	The Local Bus Tacho status.
	54…55	Pt0...1 Discrete Input	Replicated from the Discrete Input.
	56…59	Transducer 0...3 Fault	Transducer Status.
	127	Module Status	Module Status.

Channel Type:	**gSE**	
Input Tag	**Measurement Type Selections**	**Comment**
	gSE	Spike Energy (gSE) is a processing technique capable of detection of low energy impacts. The measure is suitable for early detection of faults in rolling element bearings or gears and detection of other periodic or random low energy impact events.

Channel Type:	**Static (DC)**	
Input Tag	**Measurement Type Selections**	**Comment**
Rod Drop	Rod Drop	A triggered position (rod-drop) measurement that is taken at a fixed (consistently the same) position of the rod during the stroke.
Differential Expansion	Comp. Differential Exp. A/B (Axial)	The measurement of shaft axial displacement using a pair of axial eddy-current-probe monitoring a shaft collar target such that the measurement range is optimally the sum of the ranges of the individual probes.
Differential Expansion	Ramp Differential Exp. A/B (Radial)	The measurement of differential expansion with axial/radial eddy-current-probe pair viewing concave or convex ramp shaft.

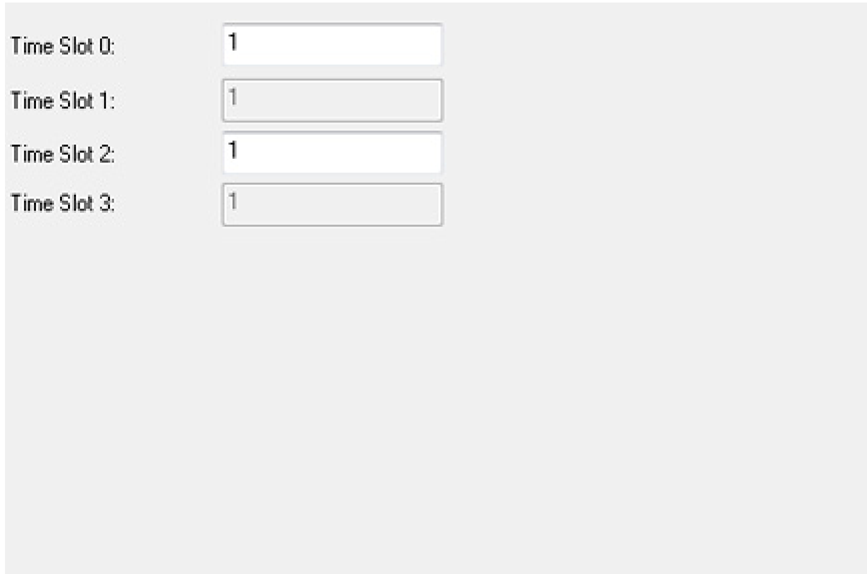
Proportional DC	Transmitter Temperature °F	Proportional voltage measurements.
	Transmitter Temperature °C	
	Transmitter Temperature °K	
	DC Current	
	DC Voltage	
	Position	Common thrust/axial position measurement. Measures the offset and direction of movement.
	Accelerometer Temperature °F	Proportional voltage measurements.
	Accelerometer Temperature °C	
	Accelerometer Temperature °K	
	Eccentricity	The measurement of shaft bow (the shaft peak to peak displacement) at slow roll speed by either of two methods (with or without a speed input).

Channel Type	**Dynamic (AC)**	
Input Tag	**Measurement Type Selections**	**Comment**
Shaft Absolute pk-pk	Shaft Relative (LP/HP filtered)	Calculates the peak to peak shaft absolute radial displacement measured from the sum of: A shaft to case relative displacement (eddy current probe) measurement, and A case absolute displacement measurement from an integrated velocity transducer or double integrated accelerometer that is mounted in-line with the eddy current probe. The first channel of the pair must be the accelerometer or velocity sensor and its Measurement Type must be one of: absolute vibration (A to D) absolute vibration (AV to D) absolute vibration (V to D) The second channel of the pair must be the displacement sensor and its Measurement Type set to Shaft Relative (LP/HP).

Channel Type	Dynamic (AC)	
Input Tag	**Measurement Type Selections**	**Comment**
Tags that require dynamic measurements can be processed using any of these Measurement Types.	Aeroderivative(AV - V)	Applies 60 dB/octave low pass (LP) and high pass (HP) filters. Limits the maximum frequency that the module can measure to approximately 1665 Hz. The tracking filter 0 measurement is the gas generator vibration, and the tracking filter 1 measurement is the power turbine vibration.
	X (shaft relative)	One eddy current probe, or the eddy current probe that is mounted in the X-direction for an XY pair. Applies a -24 dB/octave LP filter.
	Y (shaft relative)	An eddy current probe that is mounted in the Y direction for an XY pair. Applies -24 dB/octave filters.
	X (shaft relative) – Filtered	One eddy current probe, or the eddy current probe that is mounted in the X- direction for an XY pair. Applies -24 dB/octave LP and HP filters.
	Y (shaft relative) - Filtered	One eddy probe, or the eddy current probe that is mounted in the Y-direction for an XY pair. Applies a -24 dB/octave LP filter.
	Aeroderivative(AV - D)	Applies 60 dB/octave LP and HP filters. Specifies one level of integration (velocity to displacement). Limits the maximum frequency that the module can measure to approximately 1665 Hz. The tracking filter 0 measurement is the gas generator vibration, and the tracking filter 1 measurement is the power turbine vibration.
	absolute vibration (A to A)	Non-integrated acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (A to V)	Integrated (to velocity) acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (A to D)	Double-integrated (to displacement) acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (AV to V)	Non-integrated measurements from an integrating (velocity output) accelerometer. Applies -24 dB/octave LP and HP filters.
	absolute vibration (AV to D)	Integrated (to displacement) measurements from an integrating (velocity output) accelerometer. Applies -24 dB/octave LP and HP filters.
	absolute vibration (V to V)	Non-integrated velocity measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (V to D)	Integrated (to displacement) velocity measurements. Applies -24 dB/octave LP and HP filters.
	Dynamic Pressure	Dynamic pressure measurements. Applies -24 dB/octave LP and HP filters.
	AC Current	Dynamic current measurements. Applies -24 dB/octave LP and HP filters.
	AC Voltage	Dynamic voltage measurements Applies -24 dB/octave LP and HP filters.
	40 kHz absolute vibration (A to A)	High frequency acceleration measurement. Applies -24 dB/octave LP and HP filters.
	40 kHz absolute vibration (A to V)	High frequency acceleration measurement that is integrated to velocity. Applies -24 dB/octave LP and HP filters.

Time Slot Multiplier Page

Figure 51 - Configuration for Data Acquisition Time Slot Multiplier



Parameter	Values	Comment
Time Slot 0	0…255	Enter the Time Slot Multiplier for channel 0 (or channel pair 0,1). See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 1 *	0…255	Enter the Time Slot Multiplier for channel 1. See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 2	0…255	Enter the Time Slot Multiplier for channel 2 (or channel pair 2,3). See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 3*	0…255	Enter the Time Slot Multiplier for channel 3. See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.

*Multiplexing is allowed only in channel pairs (0 and 1, 2 and 3). Time Slot 1 always equals Time Slot 0 and Time Slot 3 always equals Time Slot 2.

The Time Slot Multiplier Page is accessible when the Module Personality is set to the multiplexed measurement selections:

- Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired

IMPORTANT	• Module Personality is specified on the Module Definition >Define Module Functionality page. • The Time Slot Multipliers are applied per channel pair (channels 0 and 1 and channels 2 and 3).

When using the Multiplexed Personality to monitor, the Time Slot Multipliers are used when it is necessary for some channels to update more frequently than other channels.

When using the Multiplexed Personality, the module does not continuously measure each channel. Rather, measurements are made on one channel pair at a time. Once it completes each measurement, it moves to the channel pair that is "next" on the schedule as determined by the Time Slot Multiplier values.

If all channels have the same multiplier value, then the measurements cycle one to the next and back to the first. But if any of the multipliers are greater than the others, then that channel or channel pair is sampled more frequently, by the ratio of the multipliers, than the channels with lower multiplier values. Table 20 provides examples of how the channels update with various multiplier values specified.

IMPORTANT	Determining how long it takes to cycle through the channels in a multiplexed application can be estimated by considering the measurement definition for each channel or channel pair. In general, the time it takes to measure a channel is equal to the period of the specified time waveform.

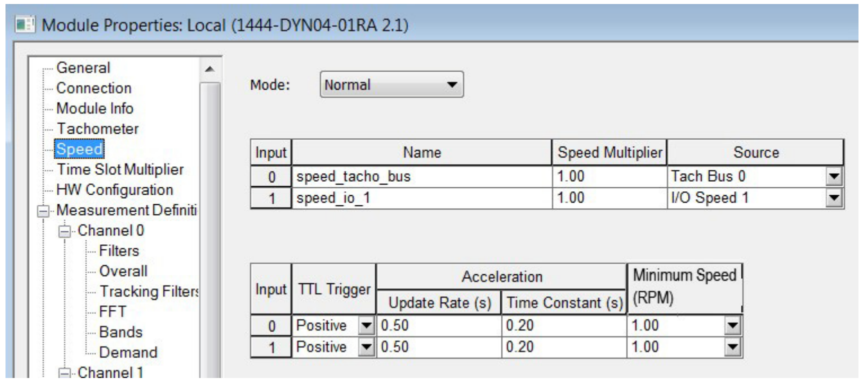
Table 20 - Multiplier Examples for Module Personality: Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired

	Example 1		**Example 2**		**Example 3**	
Multiplier	1	1	1	2	1	3
Meas. Number	Channel Pair					
	0,1	2,3	0,1	2,3	0,1	2,3
0	(0,1)			(2,3)		(2,3)
1		(2,3)		(2,3)		(2,3)
2	(0,1)		(0,1)			(2,3)
3		(2,3)		(2,3)	(0,1)	
4	(0,1)			(2,3)		(2,3)
5		(2,3)	(0,1)			(2,3)
6	(0,1)			(2,3)		(2,3)
7		(2,3)		(2,3)	(0,1)	

Speed Page

The Speed page parameters define the source and processing that is applied to the two speed measurements of the module.

Figure 52 - Configure Speed Inputs



Parameter	Values	Comments
Mode	Normal (0) Redundant (1)	In Normal mode, the speed inputs are independent. In Redundant mode, if Tach 0 is in Fault (Not OK), then Tacho 1 is used for all functions that are specified for Tacho 0.
Name	Blank or must start with a letter or underscore ("_"), however, all other characters can be letters, numbers, or underscores. Cannot contain two contiguous underscore characters and cannot end in an underscore.	Enter a name of up to 32 characters for the selected tachometer.
Speed Multiplier	Support for values <> 1	Enter a multiplier for the Factored Speed value. • There are two speed measurements available, Speed and Factored Speed. This parameter is used to calculate the Factored Speed. • Factored Speed is used when the required speed is that of a shaft that is mechanically connected to the shaft to which the tachometer is applied.
Source	Local TTL Tach Input 0 (1) Local TTL Tach Input 1 (2) Tach Bus 0 (3) Tach Bus 1 (4) I/O Speed 0 (5) I/O Speed 1 (6)	Each speed measurement can be processed from any type source. • Synchronous measurements (Filters page) and Order Tracking (Tracking Filters pages) require speed that is measured from a triggered signal source, so must be either a Local TTL or Tacho Bus source. • I/O Speed selections require that Speed is included in the Controller Output assembly (in Module Definition).
TTL Trigger	Positive (0) Negative (1)	Trigger the measurement on the positive or negative going side of the TTL signal. Select Positive to trigger on the "leading edge", or Negative to trigger on the "trailing edge". Applicable only for speeds with a Local TTL or Tacho Bus source. IMPORTANT: To be sure that there are accurate phase measurements from any configured Tracking Filters, the trigger point on the TTL signal must align with the trigger point on the tachometer signal. If the TTL source is a Tachometer Signal Conditioner Expansion (TSCX) module, then to be sure that there are accurate phase measurements, match this parameter to the Trigger Slope defined in the Tachometer configuration for the TSCX.

Parameter	Values	Comments
Update Rate	0.1…20.0 seconds	Enter the time, in seconds, between each speed measurement that is used to calculate the acceleration (rate of change) value. Speed measurements are updated at a rate not slower than once per 40 milliseconds but dependent on module configuration and the overall module processing requirements. The delta time between samples that are used for the rate of change calculation is adjusted to the nearest interval based on the actual measurement update rate.
Time Constant	0.1…20.0 seconds	Enter a time constant for use in the rate of change calculation. The time constant calculation effectively smooths the measurements as it behaves similarly to a high pass filter. The smaller the time constant the more responsive the measurement is to rapid changes (or noise).
Minimum Speed	Minimum Speed 0 1 3 5 10 25	Select the minimum speed for which RPM and RPM dependent tags are set to zero. When the machine speed is less than the selected minimum speed any associated RPM tags, and all tags that require RPM to perform the measurement, are fixed at zero (0).

Measurement Definition

The Input data page within Module Definition allows selection of measurements for inclusion in the controller input assembly. However, while that reserves a spot in the table, it doesn't define how the measurements must be calculated. You can define the measurements in the group of pages under Module Definition, including filters, overall, tracking filters, gSE, bands, DC, and demand.

Filters

The Filters page defines the digital signal processing that is applied to each of the channel's two independent signal paths. You can select the output from each path and from specific intermediate processing points as the source to calculate measurements such as Overall levels, FFTs, and FFT Bands.

Figure 53 - Filter Configuration for Channel

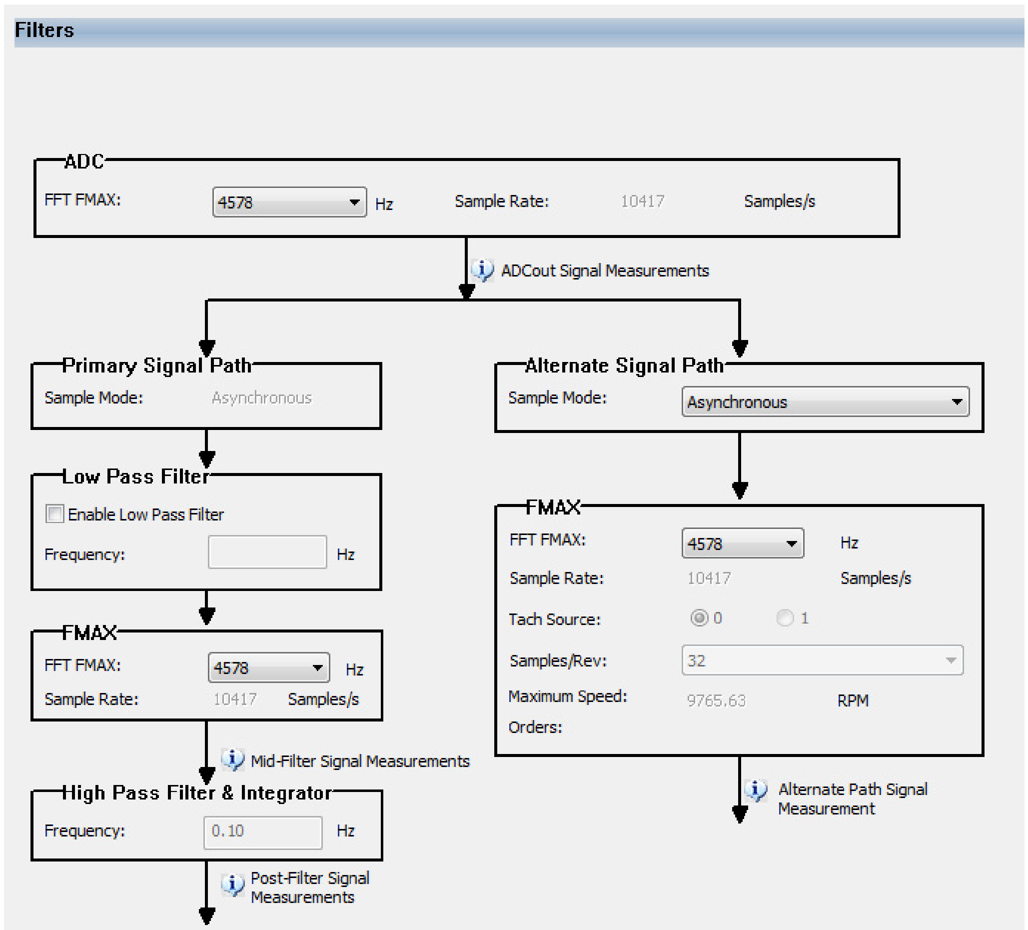


Table 21 - Filters

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>FMAX</td><td>The available FMAX selections are as follows:
<table>
<tr><th>FMAX</th><th>SRD</th><th>Conditions</th></tr>
<tr><td>41200*</td><td>1</td><td>Available for 40 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is one of “40 kHz absolute vibration (A to A)”, “40 kHz absolute vibration (A to V)” or “gSE”
*40 kHz measurements allow for ONLY an overall measurement on the 40 kHz signal at the ADC out signal source. FFTs that are read using this FMAX must be from a subsequently reduced FMAX on the primary path, with a maximum FMAX available of 2747 Hz.</td></tr>
<tr><td>20600</td><td>2</td><td rowspan="6">Available for the 20 kHz Module Personality (Module Definition), and if the Measurement Type (Hardware Page) is NOT any of the “40 kHz…”, or either of the absolute vibration (A to A)”, “40 kHz absolute vibration (A to V)” or “gSE”</td></tr>
<tr><td>13733</td><td>3</td></tr>
<tr><td>10300</td><td>4</td></tr>
<tr><td>8240</td><td>5</td></tr>
<tr><td>6866</td><td>6</td></tr>
<tr><td>5866</td><td>7</td></tr>
<tr><td>4578</td><td>9</td><td rowspan="4">Available for all 4 kHz and 20 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is NOT a “40 kHz…” type or either of the aeroderivative types.</td></tr>
<tr><td>3433</td><td>12</td></tr>
<tr><td>2289</td><td>18</td></tr>
<tr><td>2060</td><td>20</td></tr>
<tr><td>1873</td><td>22</td><td rowspan="5">Available for all 4 kHz and 20 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is NOT a “40 kHz…” type.</td></tr>
<tr><td>1717</td><td>24</td></tr>
<tr><td>1585</td><td>26</td></tr>
<tr><td>1471</td><td>28</td></tr>
<tr><td>1373</td><td>30</td></tr>
</table>
If the Channel measurement type = Aeroderivative the Range is limited to 22…36. A divisor is allowed per channel for Individually Multiplexed channels only.</td><td>Select the desired FMAX[1] to be processed from the analog-to-digital converter (ADC) of the hardware for this channel pair[2]. Except when using the 40 kHz personality[3], the selected value is the maximum frequency that is available in an FFT that is not further decimated by applying a lower FMAX in the primary path, or by applying a lower FMAX or synchronous sampling in the alternate path.
1. The value that is written to the configuration assembly is the Sample Rate Divisor, not the FMAX. Values from 1…36 are allowed. Not all 36 selections are provided in the FMAX menu.
2. The module provides two ADCs, one for channels 0 & 1, and one for channels 2 & 3. Each ADC samples at 93,750 samples per second (187,500 for 40 kHz personalities) and then divides that by a configurable Sample Rate Divide (SRD) value, settable from 2…36. This calculation results in the measured sample rate. The divided stream then is what is read from the hardware and defines the effective FMAX for the selected channel pair (both channels must use the same SRD).
3. It is not possible to process an FFT at the full 40 kHz bandwidth. When the 40 kHz personality is selected, the primary path FMAX must be set at no greater than 2747 Hz.
Because the module applies the SRD in hardware, rather than firmware, specify the lowest FMAX practical to minimize load on the processor, which can improve performance for other tasks.</td></tr>
<tr><td>Sample Rate</td><td>Displays the sample rate from the ADC based on the selected FMAX.</td><td>The displayed value is the calculated value from:
$\frac{93750}{\text{Sample Rate Divisor}}$</td></tr>
<tr><td>Primary Path Processing Mode</td><td>Asynchronous</td><td>This mode is the sampling mode for the Primary Signal Path. It is not editable.</td></tr>
<tr><td>FFT FMAX (Primary)</td><td>Select the desired Maximum Frequency (FMAX) for the primary signal path.
See the following Decimation Tables for available selections.</td><td>The primary signal path includes a decimation stage that further divides the sample rate (in firmware) from the output of the ADC.
The value that is written to the configuration assembly is the Primary Path Decimation, not the FMAX. Values from 1…255 are possible. Not all selections are provided in the FMAX menu.
The available FMAX selections are dependent on, and vary based on, the selected ADC Out FMAX.</td></tr>
<tr><td>Sample Rate (Primary)</td><td>Displays the sample rate of the data in the Primary Signal Path.</td><td>The displayed value is the calculated value from:
$\frac{93750}{(\text{SRD x Primary Path Decimation})}$</td></tr>
<tr><td>Enable Low Pass Filter</td><td>Check to enable the Primary Path Low Pass Filter (LPF)</td><td>When checked, an LPF corner frequency can be applied to the primary signal path.
The LPF is available when:
• The primary path is not decimated (FMAX = ADC out FMAX)
• The measurement type is not dynamic pressure (unfiltered version)</td></tr>
</table>

Table 21 - Filters (continued)

Parameter	Values	Comments
Low Pass Filter	Enter a corner frequency between 10 Hz and the Max Cut off Frequency (default).	Enter the frequency where the filter has attenuated the signal by 3 dB. Frequencies higher than 3 dB are attenuated -24 dB/octave (-60 dB/octave if the channel measurement type is aeroderivative).
High Pass Filter (Primary) Frequency	0.1…1000 Hz	Enter the frequency where the filter has attenuated the signal by 3 dB. Any frequency lower than this frequency is attenuated -24 dB/octave (-60 dB/octave if the channel measurement type is aeroderivative). • The HPF is not available when the channel measurement type is set to X (shaft relative), Y (shaft relative), or dynamic pressure (unfiltered). • For channel measurement types that specify integration, it is performed at the outlet of the high pass filter. • If a signal includes a DC offset, it is only removed (AC coupled) within the high pass filter. If no HPF is applied, the signal includes any DC offset *DC coupled).
Alternate Processing Path Processing Mode	Processing Mode • OFF • Synchronous • Asynchronous	Select the sampling mode to apply to the alternate signal path data. • Alternate Path is available when the ADC out FMAX is less than or equal to 4578 Hz. • Synchronous measurement modes are available only when a physical speed signal is available (see Speed Page). Source can be from any of Tacho Bus 0/1 or Local TTL Tach Input 0/1.
FFT FMAX (Alternate)	Select the desired Maximum Frequency (FMAX) for the alternate signal path. See the following Decimation Tables for available selections.	When asynchronously sampling, the alternate signal path provides a decimation stage that further divides the sample rate (in firmware) from the output of the ADC. This selection presents selected FMAX values that are based on the Module Personality (Module Definition) and the sample rate out of the ADC. The value that is written to the configuration assembly is the Alternate Path Decimation, not the FMAX. Values from 1…255 are possible. Not all selections are provided in the FMAX menu.
Sample Rate (Alternate)	Displays the sample rate of the data in the Primary Signal Path.	The displayed value is the calculated value from: $\frac{93750}{\text{(SRD x Alternate Path Decimation)}}$
Fmax (Alternate) Tacho Source	0, 1	Select the speed source for the tacho input to be used in the synchronous measurement. • Tacho Source is applicable only to synchronous measurement Processing Modes. • Available Tacho Sources are only those sources that are defined from a Tacho Bus or a TTL Input (see Speed Page). • Synchronous measurements require a 1/rev signal. If the Pulses Per Revolution attribute is set, the TSC module outputs a 1/rev TTL to the Tacho Bus. You must help verify that a Local TTL Input source is a 1/rev signal.
Fmax (Alternate) Samples Per Revolution	Select from: • 8 • 16 • 32 • 64 • 128	Select the number of samples to be measured per shaft revolution. • Samples per Revolution is applicable only to synchronous measurement Processing Modes. • As Samples Per Revolution is increased: – The synchronous sample rate increases, the measurement (FFT) bandwidth increases, and there are more orders available for analysis. – A particular FFT has lower resolution (lines per order) or bandwidth/number of lines. – The maximum machine rpm that can be measured reduces (sampling frequency = rpm x samples per rev).

Table 21 - Filters (continued)

Parameter	Values	Comments
Fmax (Alternate) maximum Speed	Displays the result of: (60 x 93750 / x Sample Rate Divisor) / (Samples Per Revolution x 2)	Displays the maximum speed (RPM) at which the machine can operate while measuring synchronously with the specified filter performance (number of orders). • If the machine speed exceeds this RPM while in Synchronous Mode, the measurement does not stop. Rather, the performance of the Low Pass Filter degrades until the speed increases above a "hard stop" filter value. • When synchronous measurements are taken while at speeds greater than the calculated maximum, some signal attenuation occurs at the higher frequencies. Attenuation is greatest at FMAX, with decreasing attenuation at lower frequencies. The frequency where attenuation begins goes lower as speed increases further above the maximum. • The accuracy of signals at frequencies up to the 2x order frequency are verified at speeds up to 2x the calculated maximum. • As machine speed decreases, there is no point at which the filter performance degrades. But there is a hard stop limit to how low the LPF cutoff can be set. **Low Pass Filter Hard Stop Limits** When measuring synchronously the module is limited in how high, or low, it can set the Low Pass Filter corner. So, if the calculated filter corner (per the previous) exceeds the hard stop limit (high or low) the filter corner no longer increases (or decreases). The Hard Stop Limits are based only on the Sample Rate Divide value and are calculated as: High Limit = 32000 / SRD Low Limit = 32 / SRD The following table shows the hard limits for selected SRD values: **Low Pass Hard Stop Limits (Hz)** ADC out FMAX (SRD): 4578 (9), 3433 (12), 1717 (24), 1287 (32), 1144 (36) Low: 3.6, 2.7, 1.3, 1.0, 0.9 High: 3556, 2667, 1333, 1000, 889
Orders	Displays the number of orders that are available in an FFT processed from the synchronous data.	The number of orders is equal to: $\frac{\text{Samples Per Revolution} * 0.625}{2.56}$ The order values are: Samples/Rev – Orders 8 – 2.0 16 – 3.9 32 – 7.8 64 – 15.6 128 – 31.3

Low Pass Hard Stop Limits (Hz)

ADC out FMAX (SRD)	4578 (9)	3433 (12)	1717 (24)	1287 (32)	1144 (36)
Low	3.6	2.7	1.3	1.0	0.9
High	3556	2667	1333	1000	889

Samples/Rev	Orders
8	2.0
16	3.9
32	7.8
64	15.6
128	31.3

The Primary and Alternate signal paths originate from the output of the Analog-to-Digital Converter (ADC). The ADC samples each channel at 93750 samples/second for all 4 kHz and 20 kHz Module Personalities or 187500 Hz for the 40 kHz personalities
(See General Page on page 97).

For 20 kHz modes, the output of both ADC channels can be decimated in its hardware by a factor of 2…36. It is important to apply the divider with as large a factor as practical for the application. The lower the data rate from the ADC, the less time the module spends processing the digital samples. This divider leaves more time available to perform other functions.

Out of the ADC the signal is split into its two paths:

- The Primary Path applies the low and high pass filtering and integration that is required of the application, and defined in part by the Channel Measurement Type. See Hardware Configuration Page on page 111. The signal processing in this path is defined in two distinct steps (Mid-Filter, and Post-Filter) where each can serve as the data source for various measurements. See Table 19.

- The Alternate Path is available for applications that require more measurements with another Fmax or synchronously sampled data. Data from this path is available only at its conclusion.

Table 22 - Data Source Options for Each Measurement

Measurement	Signal Sources			
	ADC Out	Primary Path		Alternate Path(2)
		Mid-Filter	Post-Filter	
gSE				
Tracking Filters				
Overall		(2)	(3)	
Not 1x				
SMAX				
Shaft Absolute				
TWF	(1)(1)	(3)	(4)	(5)
FFT	(1)(1)	(3)	(4)	(5)
FFT Bands	(1)(1)	(3)	(4)	(5)
Demand Data	(1)(1)	(3)	(4)	(5)

(1) ADC Out is not available for 40 kHz personalities.

(2) Alternate Path is available only when enabled (not "Off")

Table 23…Table 27 include the Decimation menu selections for each of the selectable Sample Rate Divide (SRD) values (selected by the ADC FMAX menu). The table shows the decimation value that is written to the configuration assembly, and the FFT **FMAX** that the measurement can output.

The menus do not provide selections for the 255 possible decimation values. Rather, the menus present only selected decimated values that represent relatively uniform increments from about 30 Hz to the ADC FMAX.

If the Measurement Type (Hardware Configuration page) is either of the Aeroderivative types, then the Primary Path FMAX selections are the same as the types that are for listed for the Alternate Path. This similarity is due to the applied -60 dB/octave filter, vs. the standard -24 dB/octave primary path filter that is used for the aeroderivative measurement type.

Table 23 - Primary Path Decimation Menu: SRD 1…5

Primary Path									
Dec	FMAX	Dec	FMAX	Dec	FMAX	Dec	FMAX	Dec	FMAX
SRD = 1		SRD = 2		SRD = 3		SRD = 4		SRD=5	
Dec < 5 is not allowed	-	1	20600	1	13733	1	10299	1	8240
5	2747	2	3433	2	2289	2	1717	2	1373
6	2289	3	2289	3	1526	3	1144	3	916
9	1526	4	1717	4	1144	4	858	4	687
12	1144	5	1373	5	916	5	687	5	549
13	1056	6	1144	6	763	6	572	6	458
14	981	7	981	7	654	7	490	7	392
15	916	8	858	8	572	9	381	9	305

Table 23 - Primary Path Decimation Menu: SRD 1…5 (continued)

Primary Path									
Dec	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**
SRD = 1		**SRD = 2**		**SRD = 3**		**SRD = 4**		**SRD=5**	
16	858	9	763	10	458	11	312	12	229
18	768	10	687	12	381	15	229	18	153
20	687	11	624	15	305	22	156	24	114
22	624	15	528	20	229	30	114	36	76
26	528	15	458	30	153	46	75	49	56
30	458	18	381	40	114	61	56	73	38
36	381	22	312	61	75	91	38	-	-
45	305	30	229	81	57	-	-	-	-
61	225	45	153	121	38	-	-	-	-
91	151	61	113	-	-	-	-	-	-
122	113	92	75	-	-	-	-	-	-
183	75	122	56	-	-	-	-	-	-
243	57	182	38	-	-	-	-	-	-

Table 24 - Primary Path Decimation Menu Selections: SRD 6…20

Primary Path											
Dec	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**
SRD = 6		**SRD = 7**		**SRD = 9**		**SRD = 12**		**SRD = 18**		**SRD = 20**	
1	6867	1	5886	1	4578	1	3434	1	2289	1	2060
2	1144	2	981	2	763	2	572	2	381	2	343
3	763	3	654	3	509	3	381	3	254	3	229
4	572	4	490	4	381	5	229	4	191	4	172
5	458	5	392	5	305	7	163	5	153	6	114
6	381	6	327	6	254	10	114	6	127	9	76
7	327	8	245	10	153	15	76	10	76	12	57
10	229	13	151	13	117	20	57	13	59	18	38
15	153	17	115	20	76	30	38	20	38	-	-
20	114	26	75	27	57	-	-	-	-	-	-
30	76	35	56	41	37	-	-	-	-	-	-
40	57	52	38	-	-	-	-	-	-	-	-
61	38	-	-	-	-	-	-	-	-	-	-

Table 25 - Primary Path Decimation Menu: SRD 22…36

Primary Path													
Dec	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**
SRD = 22		**SRD = 24**		**SRD = 26**		**SRD = 28**		**SRD = 30**		**SRD = 32**		**SRD = 36**	
1	1873	1	1717	1	1585	1	1472	1	1374	1	1287	1	1144
2	312	2	286	2	264	2	245	2	229	2	215	2	191
3	208	3	191	3	176	3	163	3	153	3	143	3	127
4	156	4	143	4	132	4	123	4	114	4	107	4	95
5	125	5	114	7	75	6	82	6	76	5	86	5	76
8	78	7	82	10	53	9	54	8	57	8	54	7	54
11	57	10	57	14	38	13	38	12	38	11	39	11	35
16	39	15	38	-	-	-	-	-	-	-	-	-	-

Table 26 - Alternate Path Decimation Menu: SRD 9…24

Alternate Path											
Dec	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**
SRD = 9		**SRD = 12**		**SRD = 18**		**SRD = 20**		**SRD = 22**		**SRD = 24**	
1	4578	1	3434	1	2289	1	2060	1	1873	1	1717
2	1271	2	954	2	636	2	573	2	520	2	476
3	848	3	636	3	424	3	381	3	346	3	318
4	636	5	381	5	318	4	286	4	260	4	239
5	509	7	273	5	254	6	191	5	208	5	191
6	424	10	191	6	213	9	128	8	130	7	136
10	254	15	128	10	128	12	95	11	95	10	95
13	196	20	95	43	98	18	64	16	65	15	64
20	128	30	64	20	64	36	31	33	31	30	31
27	94	60	31	40	31	-	-	-	-	-	-
41	63	-	-	-	-	-	-	-	-	-	-
80	31	-	-	-	-	-	-	-	-	-	-

Table 27 - Alternate Path Decimation Menu: SRD 26…36

Alternate Path									
Dec	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**	**Dec**	**FMAX**
SRD = 26		**SRD = 28**		**SRD = 30**		**SRD = 32**		**SRD = 36**	
1	1585	1	1472	1	1374	1	1287	1	1144
2	440	2	409	2	381	2	358	2	318
3	294	3	273	3	254	3	239	3	212
4	220	4	204	4	191	4	179	4	159
7	126	6	136	6	128	5	143	6	106
10	88	9	91	8	95	8	90	8	79
14	63	13	63	12	64	11	65	12	53
28	31	26	31	24	31	23	31	21	30

Overall

The Dynamic Measurement module of the Dynamix™ 1444 Series can measure two Overall values per channel: Overall (0) and Overall (1). This page is used to configure these measurements.

For non-multiplexed Module Personalities, see General Page on page 97.
Overall measurements update at a rate of not slower than every 40 milliseconds.

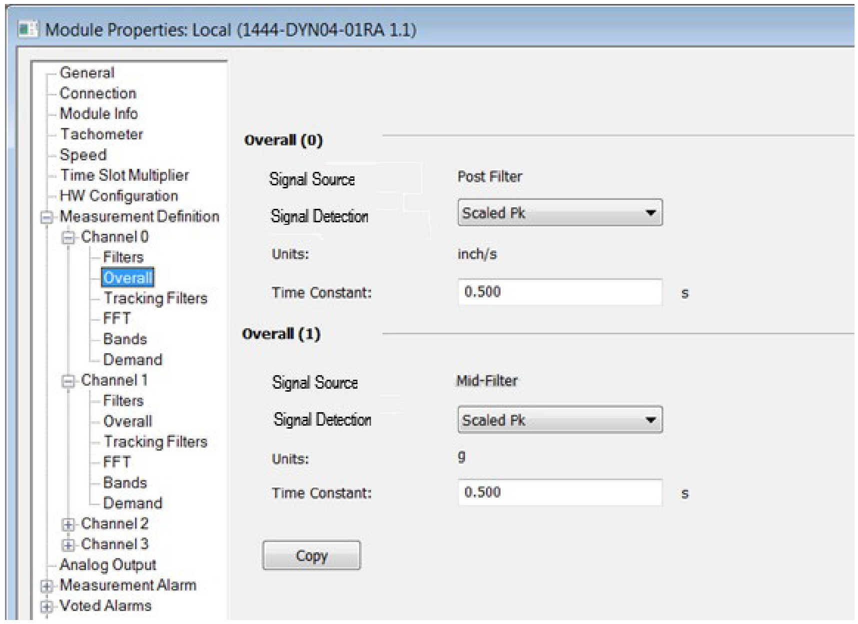


Table 28 - Overall

Parameter	Values	Comment
Overall (0) Signal Source	Value is fixed as "Post Filter"	The signal source for the first Overall measurement is fixed at the output of the Primary Signal Path (Post-Filter). Overall (0) Signal Source is the fully filtered (LP and HP) and (if necessary) integrated signal (see Filters page).
Overall (1) Signal Source	Value is fixed at "Mid Filter"	The signal source for the second Overall measurement is fixed at the output of the primary path FMAX (decimation) function (Mid-Filter). The signal is reduced to any selected new sample rate (FMAX), and has been low pass filtered (if defined). It has not been high pass filtered or integrated.

Table 28 - Overall (continued)

Parameter	Values	Comment
Overall (0/1) Signal Detection	Select from: • True pk • True pk-pk • RMS • Scaled pk • Scaled pk-pk	Select the signal detection method for the Overall magnitude measurement. • True measurements are measurements that are based on the actual peak or peak-to-peak values in the signal. These values are recommended when the measurement must consider the actual maximum of the measurement (such as maximum displacement) or when non-sinusoidal signals, such as impacts, must be detected. Note though that this method is also more sensitive to noise. • Scaled measurements are calculated as the Square Root of 2 x the RMS value (2x if pk-pk), or approximately 1.707 (or 2.414) x the RMS value. These values are recommended when the measurement must consider the total energy in the signal
Overall (0/1) Units	Displays the Engineering Units for the measurement	The Units for Overall (0) are the units after any integration is applied and are the same as “Measurement Units” shown on the Hardware Configuration page. The Units for Overall (1) are the same as the “Xdcr Units” specified in the Hardware Configuration page as this measurement is always taken from the signal before any required integration is applied.
Overall (0/1) Time Constant	0.100…60.000	Enter the time constant for the overall measurement. • The time constant is written to the RMS or the PEAK tag value depending on the selected Signal Detection method. • The detection time constant defines the output smoothing filter for RMS-based detection methods, or the decay rate of the peak detection methods. Set longer time constants to reduce the responsiveness of the measurement to rapid changes (spikes / noise), or shorter to increase the responsiveness. See Overall Time Constant on page 133 for more information about the effect of time constant measurements.

Overall Time Constant

Regardless of the signal detection method, the basic function of the overall time constant is to make the measurement more or less responsive to sudden changes in magnitude. Often “very responsive” is the natural inclination. However, the general feeling that “faster is better” isn’t always the case when the consequence of too fast a response could be an unexpected and unnecessary machine trip.

This section provides guidance for how the time constant affects the measurement. However, the provided data is specific to the test cases applied, and includes any inaccuracies that are associated with the signal source and other factors (see Accuracy on page 292). Actual response behavior varies, depending on the specifics of the measurement, the starting signal level and behavior, and the magnitude and duration of the spike or step change.

Consider the expected measurement behavior during steady state, signal spike, and step change events when determining Overall measurement-based alarm and trip settings, including alarm limits, time delays, and voting logic.

True Peak and True Peak to Peak Measurements

True Peak behavior for steady state data is illustrated in Figure 54 and Figure 55. As illustrated, to apply the minimum time constant (0.1) can significantly reduce measurement accuracy. While there are applications that require this level of responsiveness, to apply a time constant of less than about 0.3 to True Peak measurements is not recommended.

Figure 54 - Time Constant Effect: True Peak Signal Detection, Steady State – Absolute

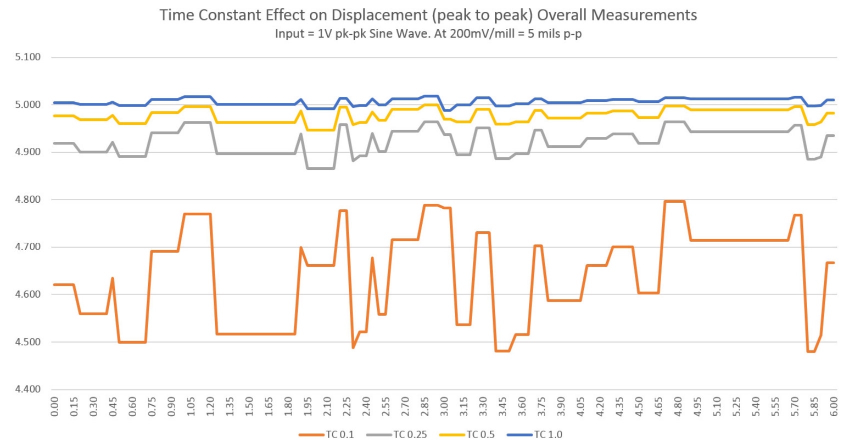
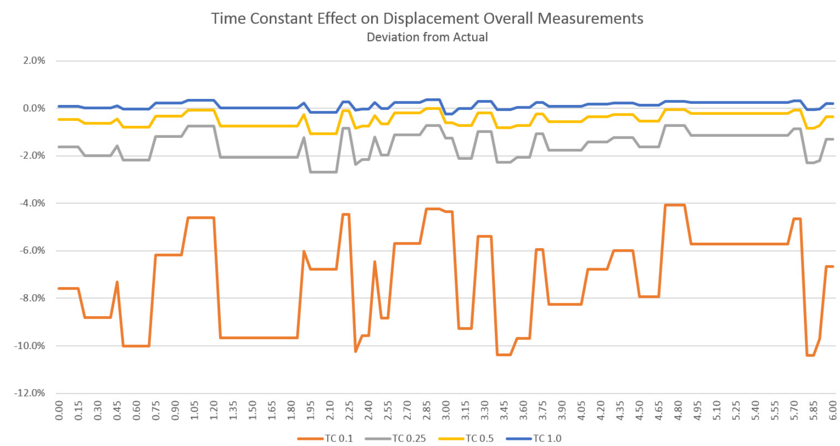


Figure 55 - Time Constant Effect: True Peak Signal Detection, Steady State – Percent Deviation

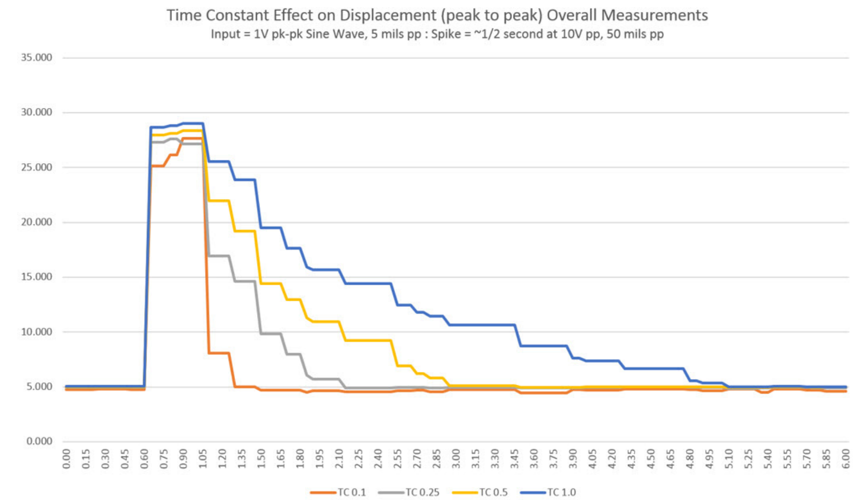


A signal spike can be the result of an actual process or machine-related event. However, in most cases a spike is more likely the result of an electrical or mechanical anomaly.

When a spike occurs a true peak measurement detects it almost instantly, regardless of the setting of the time constant. The TC setting affects how quickly the signal decays back to the actual measured value following the spike as shown in Figure 56.

While a rapid decay back to the actual measured value is desirable, the consequence relative to measurement accuracy must be considered. As the TC increases, the decay time does as well. While an additional few seconds of decay time are not a problem in how operators and engineers use the measurement, it could be problematic if alarm delays are short, so could be triggered by a spike.

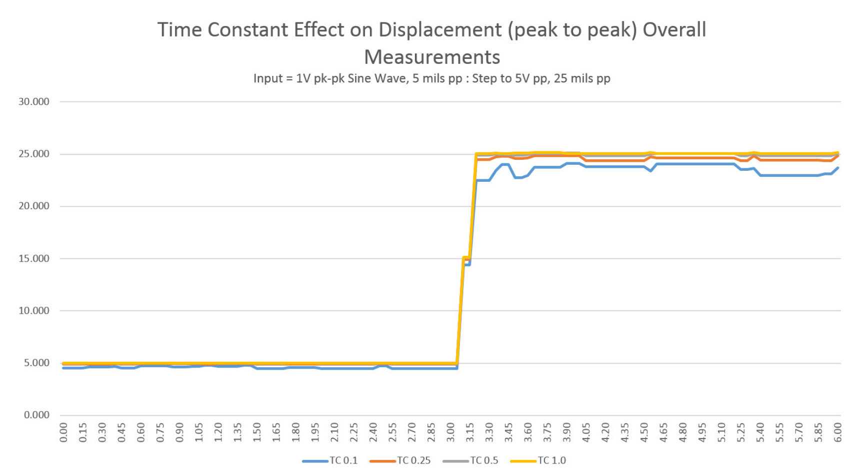
Figure 56 - Time Constant Effect: True Peak Signal Detection, Signal Spike



A step change in a signal, as illustrated in Figure 57, can indicate a real change in machine condition, such as from a loss of mass event. In such a case the change could be significant, possibly cause damage, and can require immediate action by operators or the protection system itself.

As with a signal spike, a True Peak measurement reacts almost instantaneously to the stepped increase in magnitude. And within milliseconds after the measurement, resolves to the same behavior of a steady state signal as described previously.

Figure 57 - Time Constant Effect: True Peak-Peak Signal Detection, Step Change



RMS and Scaled Peak Measurements

The behavior of steady state measurements that apply RMS-based signal detection is illustrated in Figure 58 and Figure 59. As illustrated, applying the minimum time constant (0.1) can somewhat reduce measurement accuracy. However, for RMS measurements, while a low TC does result in greater variability in the measurement, the amount of the potential error, compared to higher TC settings, is minimal.

Figure 58 - Time Constant Effect: RMS Signal Detection, Steady State – Absolute

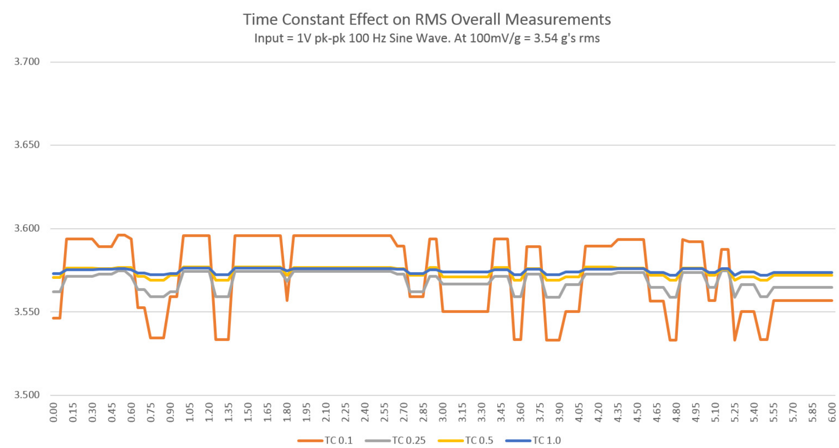
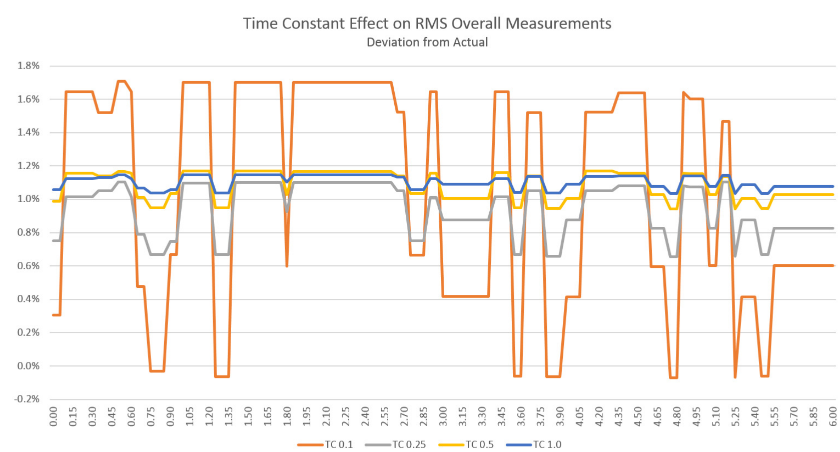


Figure 59 - Time Constant Effect: RMS Signal Detection, Steady State – Percent Deviation



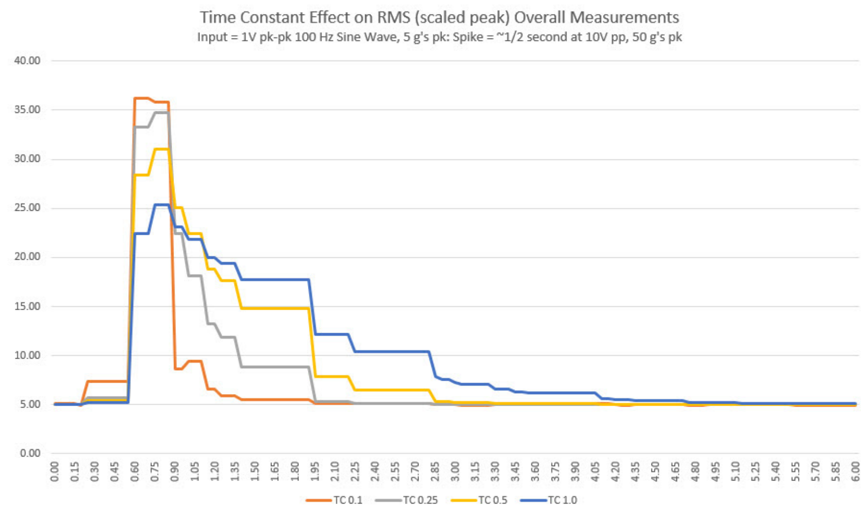
A signal spike can be the result of an actual process or machine-related event. However, in most cases a spike is more likely the result of an electrical or mechanical anomaly.

When a spike occurs, a measurement that uses RMS signal detection reacts to it quickly, regardless of the setting of the time constant. However, a measurement that uses a large TC may not have time to resolve the actual magnitude of the spike before the measurement begins to decay.

Figure 60 illustrates how quickly measurements with various TC values react to a spike, and how quickly the signal decays back to the actual measured value following the spike.

As the TC increases, the decay time does as well. While an additional few seconds of decay time are not a problem in how operators and engineers use the measurement, it could be problematic if alarm delays are short, so could be triggered by a spike.

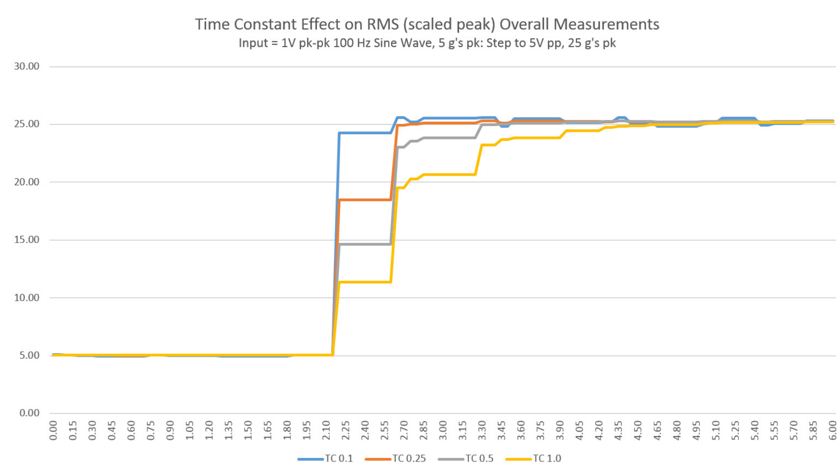
Figure 60 - Time Constant Effect: RMS Signal Detection, Signal Spike



A step change in a signal, as illustrated Figure 61, can indicate a real change in machine condition, such as from a loss of mass event. In such a case the change could be significant, possibly cause damage, and requires immediate action by operators or the protection system itself.

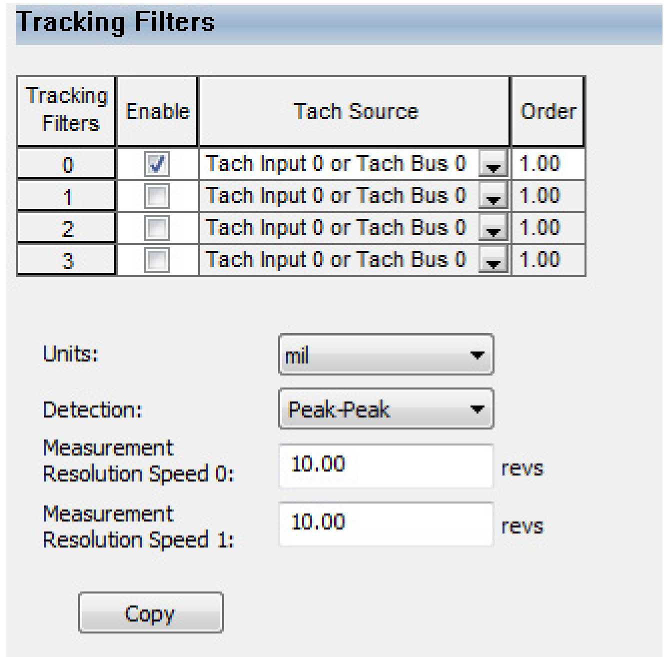
As with a signal spike, an RMS-based measurement reacts quickly, but not instantaneously, to the stepped increase in magnitude.

Figure 61 - Time Constant Effect: RMS Signal Detection, Step Change



Tracking Filters

The dynamic measurement module of the Dynamix™ 1444 Series can apply up to four tracking filters per channel. This page is used to configure these filters and their measurements when at least one of the speed inputs is a TTL source (Tacho Bus or TTL Input).



Tracking filters can be applied only for Module Personalities of:

- Real Time, 4 Ch – Dynamic (4 kHz) or Static
- Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path

Additionally, the channel must be configured for Dynamic Measurements.

Up to four tracking filters can be configured per channel. Each filter can be configured to track any order, from 0.25x to 32.0x, referenced to either of the two tachometer inputs. Tracking filters apply a constant Q bandwidth (changes with speed) and provide accurate measurements at any speed greater than approximately 15 RPM.

Aeroderivative Measurements

For Aeroderivative measurement types (Hardware Page) the following fixed assignment must be configured:

- Order 0 must be set to Tachometer Input 0 (gas generator tacho) and a 1x order
- Order 1 must be set to Tachometer Input 1 (power turbine tacho) and a 1x order

The Aeroderivative measurement types provide fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x. It is not necessary to configure the mode specially or filter definition parameters to achieve this result.

Not-1X Measurement

Implement the Not-1X measurement by setting:

- Tracking filter 0 must be set to 1x (either tacho can be used)
- The same measurement Engineering Units for both the order and the overall (1) (Overall Page) measurements

The Not-1X measurement then calculates the difference between the Overall (1) measurement and the first order result. The Not-1X functionality is primarily provided for XY applications. And while the tracking filters can be used to provide integrated measurement data, the Not-1X measurement is not usable in these applications.

The Not-1X measurement data is always presented in the same detection type as the order measurement, this measurement does not rely on the overall (1) being configured similarly.

The Not-1X measurement can, if desired, provide a "Not-2x", or other, indication by simply changing the order configuration of the first tracking filter on any particular channel. The 'Not-1X' is calculated whenever the first tracking filter is enabled, irrespective whether it is configured for order 1 (1x).

Order Phase

The order phase is measured from the trigger edge to the maximum/positive signal peak, which is known as phase lag convention.

In the following illustration where the pulse represents the tacho signal and the sine-wave the signal:

- A negative or falling edge trigger results in a phase angle of 60°
- A positive or rising edge trigger results in a phase angle of 90°

In order configurations that are integrating, the reported phase angle reflects that integration, for example, velocity lags acceleration by 90° and displacement lags acceleration by 180°.

Influence of Sample Rate and Tracking Filter Definition Settings

The Tracking filter definition is specified in terms of a number of revolutions (for the measurement). The higher the number of revolutions configured:

- The sharper the tracking filter
- The more accurate/stable the assessment
- The longer the measurement acquisition time

Accuracy and stability also improve when more samples are being considered and so are sensitive not only to the Tracking Filter Definition but also to the ADC FMAX setting. The higher the FMAX, the better.

The filter response is similar to one FFT bin (rectangular/no windowing). So for a more objective benchmark a similar FFT case can be considered such as a 200 line FFT, based on 512 samples.

For an order measurement at a given ADC FMAX, the equivalent maximum number of revolutions can be calculated as follows:

$$Max\ Number\ of\ Revolutions = \frac{Numberof\ FFT\ Lines * Speed(Hz)}{ADC\ FMAX}$$

Ex.: For a speed of 3600 rpm, FMAX = 1287:

$$Max\ Number\ of\ Revolutions = \frac{225 * \frac{3600}{60}}{1287} = \mathbf{10}$$

If the speed was 60,000 RPM, then first increase the FMAX as much as is allowed or is practicable.

For the purposes of this example, assume setting the FMAX to 4578 (the maximum that is allowed when tracking filters are being used). Then the equivalent number of revolutions in the tracking filter definition can be recalculated:

$$Max\ Number\ of\ Revolutions = \frac{225 * \frac{60{,}000}{60}}{4578} = \mathbf{49}$$

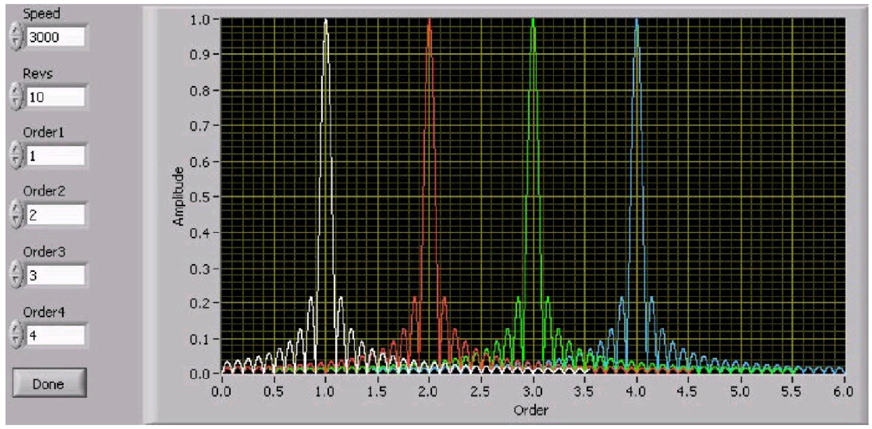
When you define a tracking filter, first make sure that the tracked frequency is well within the bandwidth (the ADC FMAX). Then adjust the number of revolutions in the filter definition, according to the machine speed and the configured number of FFT lines, as shown in the preceding formula.

The number of revolutions determines the bin width and the spread of the response, side lobes. To quantify that, the following expression can be used (where at the calculated bin width the response is approximately 3 dB down):

$$Bin\ Width\ (orders) = \frac{1}{Number\ of\ Revolutions}$$

$$Bin\ Width\ (Hz) = \frac{Speed(Hz)}{Number\ of\ Revolutions}$$

The following graphic is a comparison of the normalized filter response, which is configured for 10 and 100 revolutions. The graphic illustrates how you can configure a higher number of revolutions to minimize the influence of other components at near frequencies:



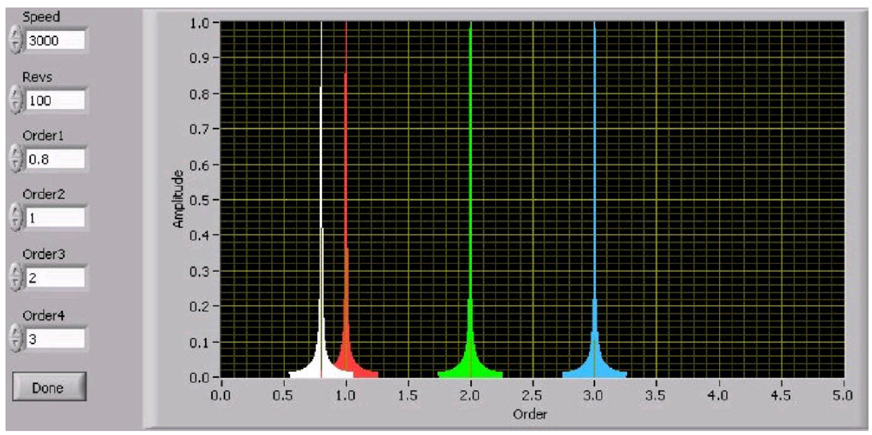


Table 29 - Tracking Filters

Parameter	Values	Comment
Enable (0…3)	Enable (checked) / Disabled (not checked)	Check the box of the tracking filters that are used. Tracking filters impart a significant performance demand on the module. To enable tracking filters that are not necessary adversely affects module performance that is related to non-protection related measurements and functions.
Tacho Source (0…3)	Select from: • Tach Input 0/Tach Bus 0 • Tach Input 1/Tach Bus 1	Select the TTL signal source to use as the trigger for the selected tracking filter. The signal source must be a TTL source and must be assigned to the corresponding speed input (0/1).
Order (0…3)	0.25…32.0	Enter the order that the selected filter is to track. • The tracked order is the entered multiple of the running speed of the selected input tacho. • Integer values (1.0, 2.0…) return both magnitude and phase values, non-integer values return only magnitude values (phase is set to 0).

Table 29 - Tracking Filters (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Measurement Units</td><td>See Help comments</td><td>
Select the Engineering Units for the Tracking Filter measurements. These measurements are the units that are applied to all enabled tracking filters for the channel.
The rules for Units selection, which is based on the Xdcr Units, are provided in the following table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature</td><td>No change</td></tr>
<tr><td>Pressure</td><td rowspan="8">Change in class only</td></tr>
<tr><td>Flow</td></tr>
<tr><td>Angle</td></tr>
<tr><td>Current</td></tr>
<tr><td>Energy</td></tr>
<tr><td>Frequency</td></tr>
<tr><td>Power</td></tr>
<tr><td>Voltage</td></tr>
<tr><td>Acceleration</td><td rowspan="3">Selections per following table</td></tr>
<tr><td>Velocity</td></tr>
<tr><td>Length</td></tr>
</table>
For any acceleration, velocity or displacement (length) units the measurement can include any required integration (or differentiation) simply by selecting the appropriate output units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td rowspan="5">← →</td><td>m/s</td><td rowspan="5">← →</td><td>m/s^2</td></tr>
<tr><td>mm</td><td>mm/s</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>inch/s</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td></td><td>g</td></tr>
<tr><td>mil</td><td></td><td>mg</td></tr>
</table>
</td></tr>
<tr><td>Signal Detection</td><td>Select from:
• Peak
• Peak to Peak
• RMS</td><td>
Select the signal detection method for all Tracking Filter magnitude measurements for this channel.
A Tracking Filter is measured over a number of cycles or shaft revolutions, not from an instantaneous sample. It isn’t possible to measure the actual “true” deflection of any single cycle. Consequently, the selections are (scaled) Peak, (scaled) Peak to Peak, and RMS.
However, if the filtered signal is such that only the sine-wave of the order of interest remains, then the “scaled” RMS equates to the “true” peak, or peak to peak measurement. The key difference remains that the Tracking Filter is resolved from an extended data set, so the result does not equate to the “true” peak or peak to peak measure of a signal that is not consistent throughout the sample.
</td></tr>
<tr><td>Measurement Resolution Speed 0/1</td><td>1…256</td><td>
Enter the number of revolutions (bandwidth) to be applied to all tracking filters on this channel that are defined for use with this tacho (0/1).
• The Number of Revolutions (over which the order results are calculated) determines the narrowness of the filter, with more revolutions resulting in a sharper/narrower, more effective, filter. However:
– A high number of revolutions results in an accurate measurement of the specified order. However, at low speeds a high number of revolutions settings can slow the measurement response to changes.
– A low number of revolutions results in a broad filter that passes signals other than the specified order value. However, the lower the number of orders the more responsive it is to changes.
• A typical value is 10 (the default). A high value is 30, but values up to 256 are possible.
</td></tr>
</table>

Tracking filters are used to provide real-time magnitude and phase measures of shaft-speed relative signals. Each tracking filter applies a -48 dB/octave band pass filter that is centered on the specified order frequency. The module measures the magnitude of each filtered signal and, when whole integer orders are specified, the phase of the filtered value.

For non-multiplexed module personalities, tracking filter measurements update at a rate of not slower than every 40 milliseconds. See General Page on page 97.

FFT

This page is used to define the FFT measurement configuration for the channel.

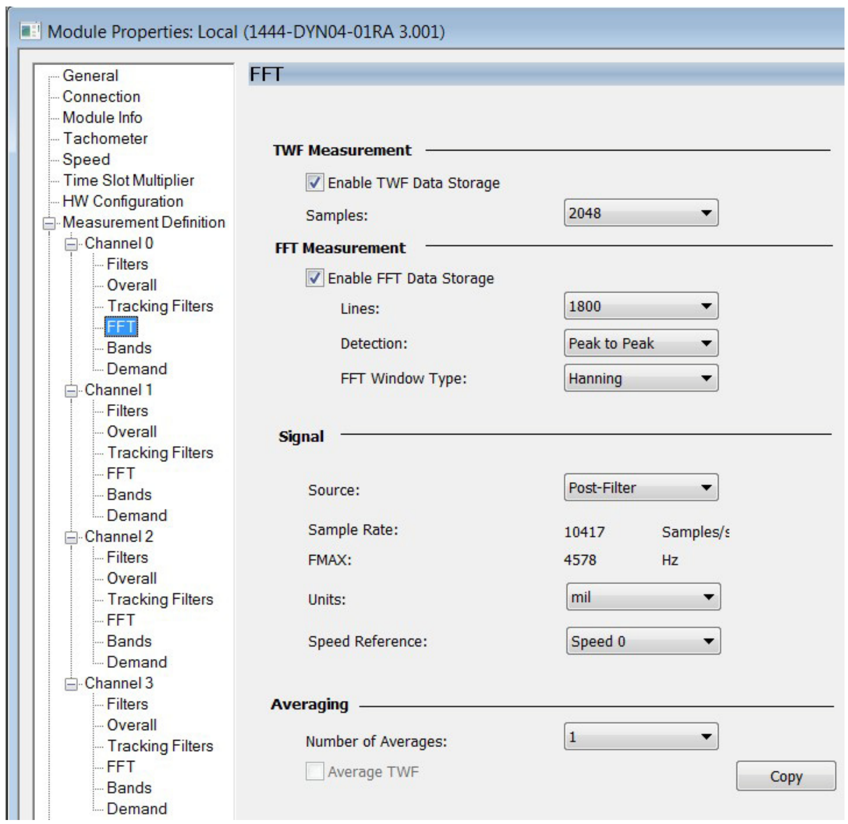


Table 30 - FFT

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Enable TWF Data Storage</td><td>Enable (checked) / Disabled (not checked)</td><td>Select the checkbox to save the time waveform (TWF). The module saves the TWF to any defined Trend buffers, and makes the most recent sample available for external access.
Tip: External access to “Live” TWF and FFT data, as defined on this page, requires that the TWF and/or FFT be enabled here.
Clear the checkbox so the waveform does not save.
FFT processing requires that the module measure a TWF using the TWF attributes defined on this properties page); however, saving the FFT does not require saving the TWF. If you do not choose to save the TWF, the module discards it after the calculating the FFT.</td></tr>
<tr><td>Number of Samples</td><td>Select from:
• 256
• 512
• 1024
• 2048
• 4096
• 8192</td><td>Select the number of samples to be captured in the TWF. While this TWF and the TWF that the module uses to calculate the FFT begin with the same sample, it is not necessary that they have the same number of samples. Therefore the Number of Spectrum Lines (for the FFT) is not related to this Number of Samples (for the TWF).</td></tr>
<tr><td>Enable FFT Data Storage</td><td>Enable (checked) / Disabled (not checked)</td><td>Select the checkbox to make the module process and save the FFT so it is available to be read externally from the module. The module also saves the FFT in the Trend buffers.
Tip: External access to “Live” TWF and FFT data, as defined on this page, requires that the TWF and/or FFT be enabled here, AND that Dynamic Data be enabled on the TREND page.
Clear the checkbox so the FFT does not process in the module.</td></tr>
<tr><td>Number of Spectrum Lines</td><td>Select the number of lines for the FFT.<table><tr><th colspan="3">Decimation</th></tr><tr><th>None</th><th>Alternate Path(1)</th><th>Primary Path</th></tr><tr><td>1800</td><td>1000</td><td>600</td></tr><tr><td>900</td><td>500</td><td>300</td></tr><tr><td>450</td><td>250</td><td>150</td></tr><tr><td>225</td><td>125</td><td>75</td></tr></table>(1) Or if the Measurement Type (See Hardware Configuration Page) is either of the aeroderivative selections.</td><td>The available number of FFT Lines that are displayed depends on the signal source and if the measurement is decimated (the FMAX is lower than the ADC out FMAX).</td></tr>
<tr><td>Signal Detection</td><td>Select from:
• Peak
• Peak to Peak
• RMS</td><td>Select the scaling (detection) method for the FFT line (bin) values.
An FFT is calculated from a set of samples that contain many signal cycles of the various signals that are present. While the shape of the waveform reflects the interaction between the various signal components, it isn’t possible to discern, from an FFT, the “true” deflection of a signal. The amplitude results from the FFT are representative RMS values that are calculated from the whole sample set. One result is calculated that can be presented as RMS, or (scaled) peak, or (scaled) peak to peak for each discrete frequency line or bin.</td></tr>
</table>

Table 30 - FFT (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>FFT Window Type</td><td>Select from:
• Rectangular
• Flat top
• Hanning
• Hamming</td><td>Select the window function to apply in the FFT signal processing. This table lists the available FFT window types.
<table>
<tr><th>Window type</th><th>Description</th></tr>
<tr><td>Rectangular</td><td>• No window is applied.
• Also called Normal, Uniform.
• Gives poor peak amplitude accuracy, best peak frequency accuracy.
• When amplitude accuracy and repeatability are important, use Rectangular for transient signals, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data).</td></tr>
<tr><td>Flat Top</td><td>• Also called Sinusoidal.
• Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components.
• Use Flat Top when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak.</td></tr>
<tr><td>Hanning</td><td>• A general-purpose window that is similar to a Hamming window.
• Gives fair peak amplitude accuracy, fair peak frequency accuracy.
• Use Hanning on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance.</td></tr>
<tr><td>Hamming</td><td>• A general-purpose window that is similar to a Hanning window.
• Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window.
• Use Hamming to separate closely spaced frequency components when compared to Hanning, while providing better peak amplitude accuracy than a Rectangular window</td></tr>
</table></td></tr>
<tr><td>Signal Source</td><td>Select from:
• Mid-Filter
• Post-Filter
• Alternate Path</td><td>Select the signal source for TWF and the FFT. See the Filters page properties for a description of the various stages of signal processing where you can get the processed data.
Signal Source selections for FFTs (FFT Page) and Demand data (Demand Page), for the same channel, cannot be set to different primary path sources:
• Both can be set to the same source, or. . .
• One must be set to Alternate Path</td></tr>
<tr><td>Sample Rate</td><td></td><td>Displays the Sample Rate from the Filters properties page for the selected data source.</td></tr>
<tr><td>Maximum Frequency (Fmax)</td><td></td><td>Displays the maximum Frequency from the Filters properties page for the selected data source.</td></tr>
</table>

Table 30 - FFT (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Measurement Units</td><td>Select from:
inch/s
m/s
mm/s</td><td>Select the engineering units for the TWF and FFT.
The rules for units selection, which are based on the transducer units (see the HW Configuration properties page), are provided in this table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature
Bearing Defect Units</td><td>No change allowed</td></tr>
<tr><td>Pressure
Flow
Current
Frequency
Power
Voltage
Acceleration
Velocity
Length</td><td>Change in class only</td></tr>
</table>
For any acceleration, velocity or displacement (length) units, the module can convert the measurement between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td></td><td>m/s</td><td></td><td>m/s^2</td></tr>
<tr><td>mm</td><td>↑</td><td>mm/s</td><td>↑</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>|</td><td>inch/s</td><td>|</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td>↓</td><td></td><td>↓</td><td>g</td></tr>
<tr><td>mil</td><td></td><td></td><td></td><td>mg</td></tr>
</table></td></tr>
<tr><td>Speed Reference</td><td>Select from:
Speed 0
Speed 1
Factored Speed 0
Factored Speed 1</td><td>Select the reference speed source.
When TWFs and FFTs are read from the module, the value of this RPM is included with the data.</td></tr>
<tr><td>Number of Averages</td><td>Select from:
1
2
3
6
12
23
45
89
178</td><td>Select the number of averages for the FFT or TWF (see Average TWF later in this topic).
If you select Average TWF, the module performs in the average time domain (available when you define the measurement to use synchronous sampling). Otherwise the module performs with an average on the linear FFT data.
When averaging, the module updates the individual TWFs (and FFTs) as quickly as possible. How fast updating occurs depends on the overall processing demands on the module, which is a function of the module configuration and the current load. This factor, along with the fact that the module always captures TWFs with maximum overlap, makes it impossible to define precisely how long (in time) it takes for the module to acquire any specific number of samples to use in the averaging.
Averaging is exponential. Once the module has acquired the specified number of samples, then the averaged sample (result) is available after each subsequent update.</td></tr>
<tr><td>Average TWF</td><td>Enable (checked) / Disabled (not checked)</td><td>Select the checkbox to perform the averaging in the time domain (on the TWFs). The module can average time waveforms only if they are synchronously sampled. Set the Signal Source to Alternate Path, and set the Alternate Path Processing Mode to Synchronous.
Clear the checkbox to average the FFTs instead of the TWFs.</td></tr>
</table>

gSE

The dynamic measurement module is also capable of Spike Energy measurement.

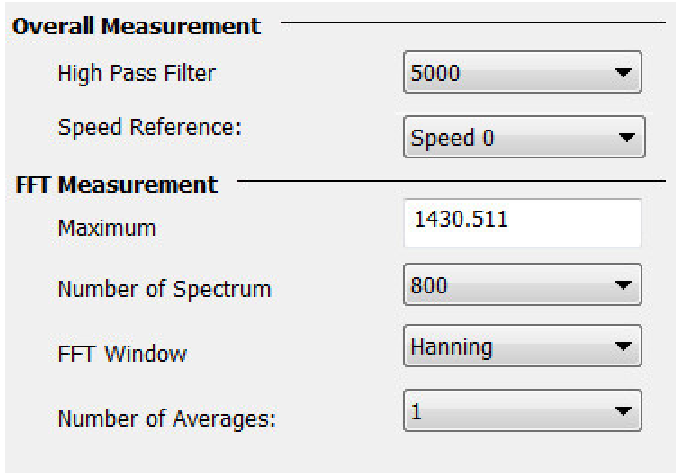


Table 31 - gSE

Parameter	Values	Comment
High Pass Filter Frequency	Select from: • 2000 Hz • 5000 Hz	Select the -3 dB point for the gSE measurements High Pass filter. The high pass filter is useful in removing low frequency signal components that can otherwise dominate the signal. The high pass filter attenuates signals at frequencies below a defined frequency and passes signals at frequencies above the defined frequency. The frequency that is selected is the -3 dB point of the filter.
Speed Reference	Select from: • Off • Speed 0 • Speed 1 • Factored Speed 0 • Factored Speed 1	Select the reference speed source. When TWFs and FFTs are read from the module, the value of this RPM is included with the data.
Maximum Frequency		Enter a value that is greater than or equal to 100, and is less than the High Pass Filter frequency.

Table 31 - gSE (continued)

Parameter	Values	Comment
Number of Spectrum Lines	Select from: • 100 • 200 • 400 • 800 • 1600	Select the number of lines of resolution to be provided in the FFT.
FFT Window Type	Select from: • Rectangular • Flat top • Hanning • Hamming	Select the window function to apply in the FFT signal processing. • FFT Windows Purpose: FFT Windows are applied to address the problem of signals that occur at frequencies that are not centered within a frequency bin. In these cases, energy from the signal can be dispersed among adjacent bins such that the amplitude of neither bin represents the actual magnitude of the signal. For example: If no window is applied (the Rectangular Window): If the frequency of a signal is precisely centered between bins, with no other signals present, then the magnitude of each bin is precisely ½ that of the actual signal. When viewing the FFT, two adjacent bins are presented with equal and comparatively small peak amplitudes, rather than one bin with 2x that amplitude, which is the actual amplitude of the signal. As the frequency of the signal moves across a bin, the proportion of its energy that “bleeds” into adjacent bins changes. For example, if you use a Rectangular Window, and a signal with a constant amplitude moves 50…60 Hz (10 bins), then a Waterfall display shows the bins enlarging as the signal enters the bin. The display grows to a maximum that is equal to the actual signal amplitude when the signal is centered in the bin, and then shrinks to zero as the signal moves above the bin. FFT Windows are used to “smooth” this effect such that the amplitude of the signal, as represented by the amplitude of the bin that it is in, is better represented. But there are trade-offs as these techniques all tend to make it more difficult to ascertain the specific frequency of a signal (which bin is it). So when selecting an FFT Window the key is to understand the intent: Is it more important to know the exact amplitude of the signals that the FFT measures, or is it more important to know the exact frequencies of the signals within the FFT? • Available FFT Windows: Rectangular – Description: No window is applied – Other Terms: Normal, Uniform – Performance: Gives poor peak amplitude accuracy, good peak frequency accuracy. – Usage: Only for transient signals that die out before the end of the time sample, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data). Flat Top – Other Terms: Sinusoidal – Performance: Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components. – Use when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak. **Tip**: The Bands FFT is exclusive to the bands function, so is not stored or communicated externally in any way; the Flat Top FFT Window is recommended to verify the best possible measurement accuracy. Hanning – Description: A general-purpose window that is similar to a Hamming window. – Performance: Gives fair peak amplitude accuracy, fair peak frequency accuracy. – Usage: It is used on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance. Hamming – Performance: A general-purpose window that is similar to a Hanning window. – Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window. – Usage: Use it to separate close frequency components.
Number of Averages	Select from: • 1 • 2 • 3 • 6 • 12 • 23 • 45 • 89 • 178	Select the number of averages for the gSE FFT or Time Waveform (Average TWF on page 320) • When averaging, the individual gSE FFTs are updated as quickly as possible. The timing of the update is dependent on the overall processing demands on the module, which is a function of the module configuration and, to some degree, the circumstance of the moment. This factor, along with the fact that the waveforms are always captured without respect to an overlap requirement (so always “max overlap”), makes it impossible to define precisely how long (in time) it takes to acquire any specific number of samples that are used in the averaging. • Averaging is exponential, meaning that once the specified number of samples has been acquired that the averaged sample (result) is available upon each subsequent update.

Spike Energy is a measure of the intensity of energy that repetitive transient mechanical impacts generate. Repetitive transient mechanical impacts typically occur as a result of surface flaws in rolling-element bearings, gear teeth, or other devices where metal-to-metal contact repeatedly occurs by design. But such contact can also occur as a consequence of abnormal conditions such as rotor rub or insufficient bearing lubrication. Spike Energy is also sensitive to other ultrasonic signals, such as pump cavitation, high-pressure steam or airflow, turbulence in liquids, or control valve noise. Spike Energy is also capable of detecting random impact events, singular cases of mechanical impact that can occur at any time, and that impart low energies.

This page is presented when the channel is configured for Spike Energy (gSE) measurements. See Channel Type selection, General Page on page 97.

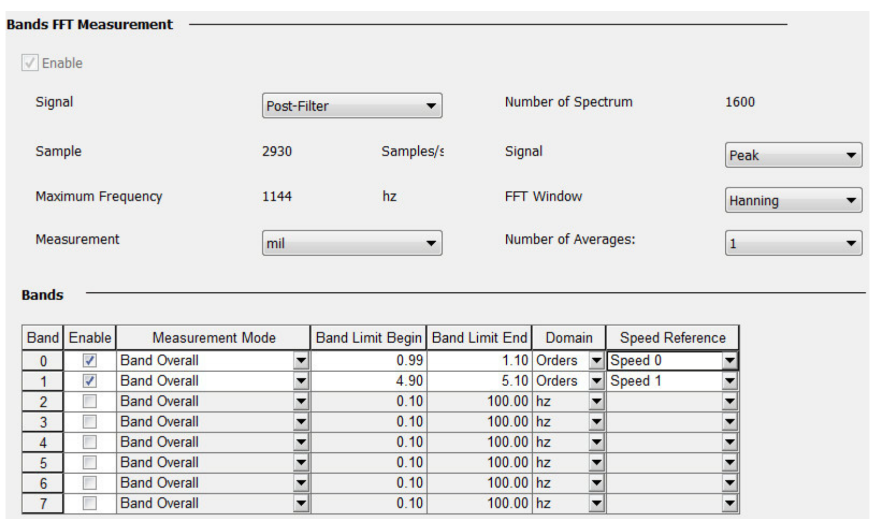
Bands

The FFT Band is a powerful tool that is commonly used in condition-monitoring applications. It is also useful in process applications such as detecting the presence of cavitation in a pump or for monitoring the combustion in a gas turbine. An FFT Band either calculates the total energy or returns the maximum amplitude, or its frequency, between two frequencies of an FFT.

The Bands can be calculated from a unique FFT, defined on this page, or from the gSE FFT if a gSE Channel.

If measuring from a gSE channel then:

- The FFT definition parameters (Sample Source or Number of Lines) are not used.
- The gSE FFT used for the band measurement is processed using the parameters that are provided on the gSE page.



Band	Enable	Measurement Mode	Band Limit Begin	Band Limit End	Domain	Speed Reference
0	☑	Band Overall	0.99	1.10	Orders	Speed 0
1	☑	Band Overall	4.90	5.10	Orders	Speed 1
2	☐	Band Overall	0.10	100.00	hz	
3	☐	Band Overall	0.10	100.00	hz	
4	☐	Band Overall	0.10	100.00	hz	
5	☐	Band Overall	0.10	100.00	hz	
6	☐	Band Overall	0.10	100.00	hz	
7	☐	Band Overall	0.10	100.00	hz	

Table 32 - Bands

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Enable</td><td>Enable (checked) / Disabled (not checked)</td><td>Check the box if the FFT Bands is calculated from this channel.</td></tr>
<tr><td>Signal Source</td><td>Select from:
• ADCout
• Mid-Filter
• Post-Filter
• Alternate Path</td><td>Select the signal source for the FFT to be used in the Bands measurements. See Filters for a description of the various signal source locations.</td></tr>
<tr><td>Sample Rate</td><td>See Help</td><td>Displays the Sample Rate as shown in the Filters page for the selected data source.</td></tr>
<tr><td>Maximum Frequency</td><td>See Help</td><td>Displays the maximum Frequency as shown in the Filters page for the selected data source.</td></tr>
<tr><td>Measurement Units</td><td>See Help</td><td>Select the Engineering Units for the FFT to be used in FFT Band measurements.
The rules for Units selection, which is based on the Engineering Units of the selected Data Source, are provided in this table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature</td><td>No change</td></tr>
<tr><td>Pressure</td><td rowspan="11">Change in class only</td></tr>
<tr><td>Flow</td></tr>
<tr><td>Angle</td></tr>
<tr><td>Current</td></tr>
<tr><td>Energy</td></tr>
<tr><td>Frequency</td></tr>
<tr><td>Power</td></tr>
<tr><td>Voltage</td></tr>
<tr><td>Acceleration</td></tr>
<tr><td>Velocity</td></tr>
<tr><td>Length</td></tr>
</table>
• For any acceleration, velocity or displacement (length) units the measurement can be converted between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td></td><td>m/s</td><td></td><td>m/s²</td></tr>
<tr><td>mm</td><td></td><td>mm/s</td><td></td><td>mm/s²</td></tr>
<tr><td>micron</td><td></td><td>inch/s</td><td></td><td>inch/s²</td></tr>
<tr><td>inch</td><td></td><td></td><td></td><td>g</td></tr>
<tr><td>mil</td><td></td><td></td><td></td><td>mg</td></tr>
</table>
</td></tr>
</table>

Table 32 - Bands (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Number of Spectrum Lines</td><td>Fixed at 1800, 1000, or 600.</td><td>The Bands FFT is calculated from a fixed sample size time waveform. Therefore the number of spectrum lines is fixed and dependent on the decimation and filtering applied.
<table>
<tr><th colspan="3">Decimation</th></tr>
<tr><th>None</th><th>Alternate Path[1]</th><th>Primary Path</th></tr>
<tr><td>1800</td><td>1000</td><td>600</td></tr>
</table>
Synchronous sampling (alternate path) is also a form of decimation, so it processes a1000 line FFT (over the specified number of orders).
[1]Or if the Measurement Type (See Hardware Configuration Page) is either of the aeroderivative selections.</td></tr>
<tr><td>Signal Detection</td><td>Select from:
• Peak
• Peak to Peak
• RMS</td><td>Select the scaling (detection) method for the FFT line / bin values.</td></tr>
</table>

Table 32 - Bands (continued)

Parameter	Values	Comments
FFT Window Type	Select from: • Rectangular • Flat top • Hanning • Hamming	Select the window function to apply in the FFT signal processing. • FFT Windows Purpose: FFT Windows are applied to address the problem of signals that occur at frequencies that are not centered within a frequency bin. In these cases, energy from the signal can be dispersed among adjacent bins such that the amplitude of neither bin represents the actual magnitude of the signal. For example: If no window is applied (the Rectangular Window): If the frequency of a signal is precisely centered between bins, with no other signals present, then the magnitude of each bin is precisely ½ that of the actual signal. When viewing the FFT, two adjacent bins are presented with equal and comparatively small peak amplitudes, rather than one bin with 2x that amplitude, which is the actual amplitude of the signal. As the frequency of the signal moves across a bin the proportion of its energy that “bleeds” into adjacent bins changes. So, if using a Rectangular Window, and a signal with a constant amplitude were to move 50…60 Hz (for example10 bins) then a Waterfall display shows the bins growing as the signal enters the bin, to a maximum equal to the actual signal amplitude, when the signal was centered in the bin, and then falling to zero as the signal moved above the bin. FFT Windows are used to “smooth” this effect such that the amplitude of the signal, as represented by the amplitude of the bin that it is in, is better represented. But there are trade-offs as these techniques all tend to make it more difficult to ascertain the specific frequency of a signal (which bin is it). So when selecting an FFT Window the key is to understand the intent: Is it more important to know the exact amplitude of the signals that the FFT measures, or is it more important to know the exact frequencies of the signals within the FFT? • Available FFT Windows: Rectangular – Description: No window is applied – Other Terms: Normal, Uniform – Performance: Gives poor peak amplitude accuracy, good peak frequency accuracy. – Usage: Use this method only for transient signals that die out before the end of the time sample, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data). Flat Top – Other Terms: Sinusoidal – Performance: Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components. – Use this method when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak. Hanning – Description: A general-purpose window that is similar to a Hamming window. – Performance: Gives fair peak amplitude accuracy, fair peak frequency accuracy. – Usage: It is used on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance. Hamming – Performance: A general-purpose window that is similar to a Hanning window. – Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window. – Usage: Use it to separate close frequency components.

Table 32 - Bands (continued)

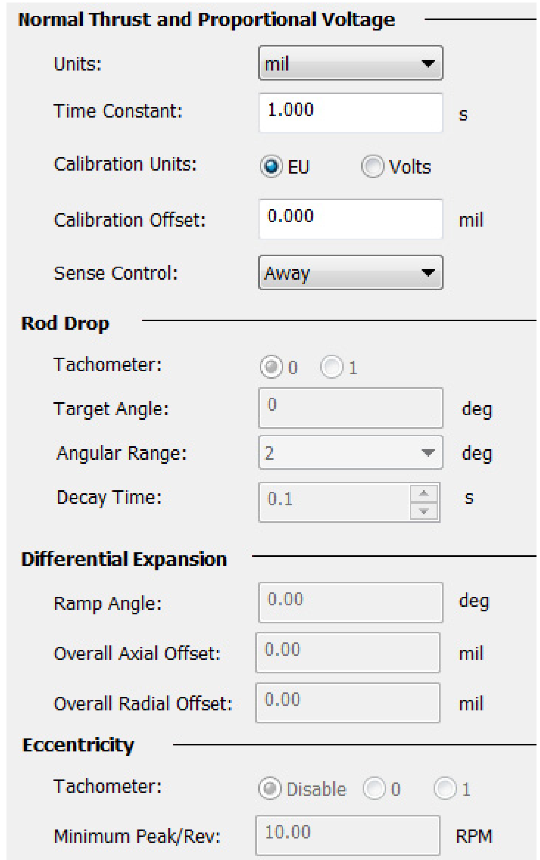
<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Number of Averages</td><td>Select from:
• 1
• 2
• 3
• 6
• 12
• 23
• 45
• 89
• 178</td><td>Select the number of averages for the FFT that is used in FFT Band measurements.
• When averaging, the individual FFTs are updated as quickly as possible. How fast this update occurs is dependent on the overall processing demands on the module, which is a function of the module configuration and, to some degree, the circumstance of the moment. This, along with the fact that the waveforms are always captured without respect to an overlap requirement (so always “max overlap”), makes it impossible to define precisely how long (in time) it takes to acquire any specific number of samples that are used in the average.
• Averaging is Exponential, meaning that once the specified number of samples has been acquired that the averaged sample (result) is available, for FFT Bands to be calculated, upon each subsequent update.</td></tr>
<tr><td>Band 0…7 Enable</td><td>Enable (checked) / Disabled (not checked)</td><td>Check the box if the FFT Band (0…7) is calculated from this channel.
The module (object) lets you define any of the 32 total bands to any channel. So the “Channel Source” attribute specifies to the module on which channel this band processes from (or = -128 if unused/disabled). The AOP however simply applies eight bands per channel and automatically associates (when Enabled) the bands to their respective channels.</td></tr>
<tr><td>Band 0…7 Measurement Mode</td><td>Select from:
• Band Overall
• Band maximum pk
• Freq of Band maximum pk</td><td>Select the type of measurement to be provided by the band.
• Band Overall: Returns the calculated RMS value of the band.
• Band maximum pk: Returns the magnitude of the bin with the highest amplitude within the band. This value is in Peak, Peak-to-Peak, or RMS value as defined by the signal detection that is defined for the bands FFT.
• Freq of Band maximum pk: Returns the frequency (in Hz) of the bin that contains the highest amplitude within the band.</td></tr>
<tr><td>Band 0…7 Band Limit Begin and End</td><td><table>
<tr><th>Mode for Selected Data Source</th><th>Band Domain</th><th>Begin Limit[1]</th><th>End Limit[2]</th></tr>
<tr><td>Asynchronous</td><td>Hz</td><td>0.1</td><td>Selected FMAX</td></tr>
<tr><td></td><td>Order</td><td>0.5</td><td>40000[3]</td></tr>
<tr><td>Synchronous</td><td>Hz</td><td>0.1</td><td>ADC-out FMAX[3]</td></tr>
<tr><td></td><td>Order</td><td>0.5</td><td>Selected Orders[4]</td></tr>
</table></td><td>1. Begin limit must be less than the end limit.
2. The end limit is the value of FMAX presented at the top of the page.
3. If the calculated FFT bin for the band begin is greater than the processed FFT FMAX, then the band returns a 0.0.
4. Based on selected samples per rev.</td></tr>
<tr><td>Band 0…7 Domain</td><td>Select from:
• Hz
• Orders</td><td>Select the domain that the limits are entered in.
If set to order domain, then begin and end limits are calculated with each sample.</td></tr>
<tr><td>Band 0…7 Speed Reference</td><td>Select from:
• OFF
• Speed 0
• Speed 1
• Factored Speed 0
• Factored Speed 1</td><td>Select the source for the speed to be used in the band limit calculation if Do main = Orders.
See the Speed Page for further information on speed sources.</td></tr>
</table>

For standard dynamic channels, the dynamic measurement module calculates FFT bands from a unique FFT that is calculated specifically for the band measurements. This calculation enables optimization of the definition of the FFT bands for this purpose. It provides a higher-performance solution than the common FFT or gSE FFT measurement by configuring the band measurements to update faster in most cases.

This page is presented when the channel is configured for dynamic or Spike Energy (gSE) measurements (see Channel Type selection, General Page on page 97).

DC

While the dynamic measurement module is designed for measuring dynamic signals, such as vibration, it is also capable of many types of static (DC) type measurements, such as thrust, differential expansion, or rod drop. This page is where these values are configured.



This page is available only for channels that are defined for Static measurements (see Channel Type, General Page on page 97).

The following statements are important to remember when working with DC measurements:

- While the parameters associated with all supported DC measurements are presented, only those parameters appropriate to the measurement taken must be configured.
- Measurements such as thrust, differential expansion, and valve position are critical to the safe operation of the machine. Care must be taken to make sure the sense control and calibration offset are correctly configured for the DC measurements being monitored, and reflect the conditions as expected when monitoring the machines.

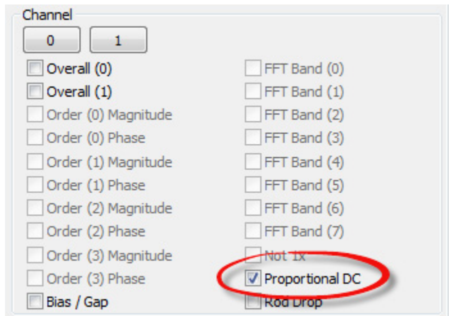
The following is a summary overview of each of the DC measurements the module can do and that are configured on this page.

Normal Thrust

Also referred to as “rotor position” or “axial position”, the thrust measurement is used to monitor thrust bearing wear and to help protect against, or provide warning of, axial rubs.

To output this value to the controller, via the input assembly, select the “Proportional DC” value on the Input Data page for the configured channel. See Select Input Data for Input Tag on page 106.

Figure 62 - Input Data Page



Only use single-thrust motion detection (one channel) when the machine does not have to be shut down and there is another means of verifying thrust bearing failure. Use dual (redundant) thrust position measurements for applications where exceeding the thrust position limits forces a machine shutdown. In this case, the voted alarm logic is defined such that both measurements must be in Danger before a shutdown (relay actuation) is executed.

On steam turbines, thrust position measurements are taken within approximately 30 cm (12 in.) of the thrust bearing. The measurements monitor the thrust collars movement between the active and inactive thrust shoes and their subsequent wear.

The rotors thermal expansion and an increase in the required dynamic measurement range affect measurements that are taken outside of the thrust bearing area (greater than 30 cm [12 in.]).

Configuring Thrust Measurements

Thrust measurements are configured using the controls in Figure 63.

Figure 63 - Normal Thrust and Proportional Voltage

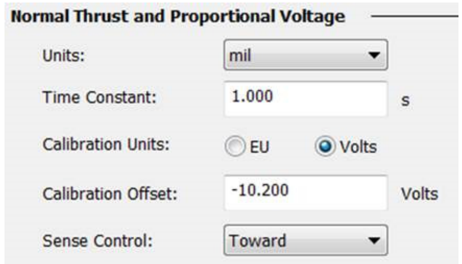


Table 33 - Configure Parameters for Normal Thrust Measurements

Parameters	Values	Comments
Units	Select from displacement units	When units are changed, the Calibration Offset value is converted to the selected units. **IMPORTANT:** It is possible to lose precision when converting to/from various EU selections, particularly when converting from a small range, such as a "mil" to a large range such as "m". When you change units, verify that the converted offset is as expected.
Time Constant	0.1…60.0 seconds	The time constant calculation effectively smooths the measurements as it behaves similarly to a high pass filter. The smaller the time constant the more responsive the measurement is to rapid changes (or noise).

Table 33 - Configure Parameters for Normal Thrust Measurements (continued)

<table>
<tr><th>Parameters</th><th>Values</th><th>Comments</th></tr>
<tr><td>Calibration Units</td><td>EU (0)
Volts(1)</td><td>Specifies the units for the Calibration Offset. When toggling between Volts and EU, the value of the Calibration Offset is converted based on the selected Units (top of page) and the sensitivity that is defined on the HW Configuration page.</td></tr>
<tr><td>Calibration Offset</td><td>-50,000…50,000</td><td>
Thrust Position is calculated as:
Thrust Position = measured position + offset
See the text following the table for a further discussion of how to set the offset value.
Presented Value:
To simplify setting the offset for normal thrust measurements, the AOP presents the offset value differently than how the value is stored in the configuration assembly, and communicated to the module (see Saved Value).
The AOP allows you to specify that the Offset is presented in Engineering Units or Volts. Use the Calibration Units control to choose. When in Volts, the value entered must always match precisely what is read by a common voltmeter if connected to the sensor, including the values sign. When in EU, the value is always entered as a positive value.
<table>
<tr><th colspan="3">Presented Value</th></tr>
<tr><th rowspan="3">EU</th><th colspan="2">Volts</th></tr>
<tr><td colspan="2">Xdcr High Limit</td></tr>
<tr><td>≤0</td><td>>0</td></tr>
<tr><td>positive</td><td>negative</td><td>positive</td></tr>
</table>

Regardless of the units of the entered Offset or the method that is used to determine the Offset, the goal is to set the DC Voltage output of the tag to zero. After setting the calibration offset, the tag must be checked for the expected value at or near zero; note the starting point of the measurement.
In most cases thrust measurements are made using negatively biased, API-670 compliant, eddy current probes. Consequently the Transducer High Limit must always be negative, to reflect the expected high value of the sensors bias.
Positive bias probes can be used by making sure that the Transducer High Limit is set to a positive value and then verifying that the sense control is set properly for the expected behavior.
IMPORTANT: The module requires that the voltage output from any positive bias probe increase as the probe moves away from the target material.

Saved Value:
The Calibration Offset saved in the configuration assembly and communicated to the module is in the Engineering Units that are specified at the top of the page. It is saved with its sign set as shown in the following table.
When a configuration is applied, if the Offset is in Volts, the AOP converts it to Engineering Units. The sign of the saved EU value is also forced, based on the Sense Control.
<table>
<tr><th colspan="3">Saved Value in (EU)</th></tr>
<tr><th rowspan="2">Sense</th><td colspan="2">Xdcr High Limit</td></tr>
<tr><td>≤0</td><td>>0</td></tr>
<tr><th>Away</th><td>negative</td><td>positive</td></tr>
<tr><th>Toward</th><td>positive</td><td>negative</td></tr>
</table>
In the above the Transducer High Limit, which is specified on the Hardware Configuration Page, is used to determine if the bias of sensor. All standard, API-670 compliant, eddy current probes are negative biased sensors.
</td></tr>
<tr><td>Sense Control</td><td>Away (0)
Toward (1)</td><td>
The module uses this parameter for axial position and thrust measurements. Select the direction in which the target surface moves, relative to the sensor, to cause a more positive displacement. The direction of a more positive displacement depends on the type of installation. The module also uses this parameter for head-to-head type differential expansion measurements.
<table>
<tr><th>Installation Type</th><th>Positive Displacement Direction</th><th>Description</th></tr>
<tr><td>Active/Normal</td><td>Away</td><td>Displacement is considered positive when the target moves away from probe. As the target moves away from an eddy current probe (ECP), the system output becomes more negative.</td></tr>
<tr><td>Inactive/Counter</td><td>Toward</td><td>Displacement is considered positive when the target moves toward the probe. In this case, an ECP output becomes less negative.</td></tr>
</table>
</td></tr>
</table>

IMPORTANT	If you are updating from a Firmware Revision 1 system to Revision 2 system, refer to Updating a System from Revision 1 AOP and Firmware to Revision 2 on page 163.

Before we can configure the module for thrust measurement we must understand the relationship between the position of the rotor, the thrust bearings, and probe locations. The thrust bearing consists of two sets of thrust pads, the active pads and the inactive pads. The rotor thrust collar runs against the active pads during normal operation.

There is clearance between the two sets of pads. You must know this clearance amount to configure the thrust setup. Under ambient conditions, with the machine stopped, this clearance or "float" is referred to as the "Cold Float" and can be anywhere between 0.15…0.5 mm (6mils to 20mils). When the machine is running at normal temperature and normal load, this clearance or float increases by potentially up to 50% and is referred to as the "Hot Float".

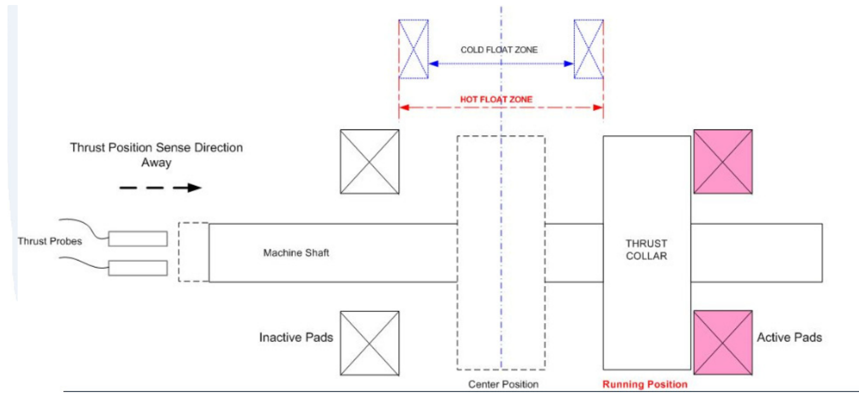
Normal practice is to establish the Cold Float by "bumping" the rotor shaft between the inactive and active pads and then measuring this distance. Use bumping to push the rotor (it requires the coupling spacer to be removed and can require jacking equipment) first against one set of pads and then against the other. This process establishes the Cold Float. The Hot Float can only be determined by reference to the machine OEM.

The two most common applications where thrust monitoring is encountered are steam turbines and compressors.

IMPORTANT	The following information of setting normal thrust measurements on steam turbines and compressors, monitoring thrust position with an HMI, and setting alarm setpoints, assumes the use of standard negative-bias eddy-current probes.

Steam Turbines

Steam turbines normally "Thrust" toward the Exhaust End of the machine. For example, from the High-pressure end toward the Low-pressure end. The turbines normally have the thrust bearing positioned at the HP end of the machine as shown in the following diagram.



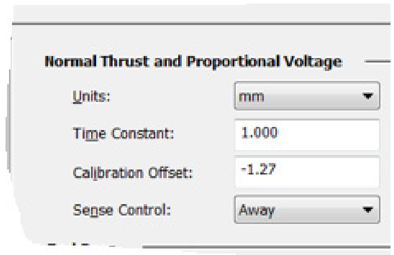
The thrust probes are also at this end of the machine, therefore, the direction of normal thrust is **away** from the probes.

It is difficult, if not impossible, to set the rotor in the middle of the float. Normal practice is to locate the rotor hard against the active thrust pads and use it as the zero position.

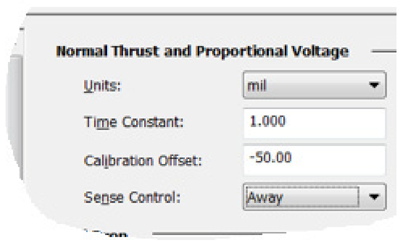
The probe gap is then adjusted to the middle of its linear range typically setting the gap to -10 Vdc, which is equivalent to 1.27 mm (50mils), for a probe sensitivity of 7.87 V/mm (200mv/mill).

The offset value is entered as 10V DC in this example when using the Volts selection, or 1.27 mm (50 mils) when using the EU selection. This assumes a probe sensitivity of 7.87 V/mm (200 mv/mil). The sense control is set to Away. This setup also means that movement toward the active pads results in increasingly negative gap voltage.

Example S.I. units:

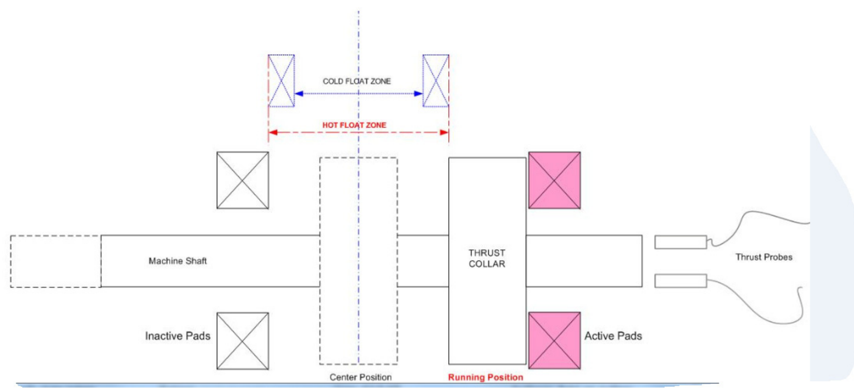


Example Imperial units:



Compressors

A compressor normally "Thrusts" toward the suction end of the machine, which is often at the non-drive end, and the thrust bearing is also typically installed at this location.



In this situation, the direction of normal thrust is **TOWARD** the probes.

The normal practice is again to set the rotor against the active pads and use it as the zero position, adjusting the probe gap to -10 V DC. This value is equivalent to 1.27 mm (50mils), for a probe sensitivity of 7.87 V/mm (200mv/mill).

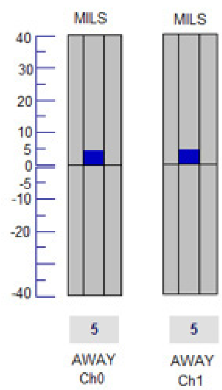
The offset value is entered as 10V DC in this example when using the Volts selection, or 1.27 mm (50 mils) when using the EU selection. This assumes a probe sensitivity of 7.87 V/mm (200 mv/mil). The sense control is set to Toward. This setup also means that movement toward the active pads results in decreasingly negative gap voltage. The minus sign for the Volts selection is included in the AOP for simplicity but can also be added during configuration.

Monitoring Thrust Position with an HMI

The typical approach in setting the HMI to visualize the rotor thrust position is to configure the monitor to show a plus value for thrust against the active pads (sometimes referred to as "normal"). Also, the monitor can show a minus value for thrust against the inactive pads (sometimes referred to as "counter").

The monitor zero value must be set with the rotor hard against the active thrust pads, or at a setting that is provided by the machine OEM who can advise on the Hot Float.

Example: Steam Turbine application (imperial units) with Rotor displaying five mils of movement against the active thrust pads.



This movement could represent the normal running position for this rotor due to the effect of the increased Hot Float with the machine at running temperature and load.

IMPORTANT	Do not change the probe gap setting or the monitor zero position when the machine is running otherwise all reference to rotor position is lost. Always refer to the machine OEM for specific instructions about setting the zero position of the rotor, which can differ from the preceding information.

A Guide to Setting Alarm and Trip Setpoints

The objective of thrust monitoring is to help protect the machine, not the thrust bearing. For example, to help prevent the rotating element from coming into contact with the stationary parts of the machine, which results in considerable damage, lost production and repair costs.

Some wear of the thrust bearing pads is acceptable to avoid unnecessary alarms and machine trips.

A typical thrust pad has around 0.75 mm to 1.00 mm (30…40 mils) of "white metal" or "Babbitt' (inspection of the thrust pads confirms it) material. Taking the preceding steam turbine application as an example with plus 5 mils (0.127 mm) as the normal running position, we could set the Alarm setting at 6 mils and 11 mils and the trip setting at 12mils and17mils (+0.28 mm and +0.43 mm).

These settings can help verify that the thrust pads can suffer some wear before the machine was tripped but before any damage to the machine itself.

The same logic is applied for thrust against the inactive pads, so here we have to consider the float to determine the alarm and trip points in the counter direction.

In all cases, refer to the machine OEM for specific advice on the setting of alarm and trip points.

Updating a System from Revision 1 AOP and Firmware to Revision 2

If the existing system has the initial release AOP (V053) and Firmware (V2.1.3) and:

a. The firmware in the 1444 Module is updated to a later version such as 2.1.7 no changes to the configuration are necessary.
b. If both the AOP and firmware revisions are updated to version 2, then the configuration must be modified as follows. For an AWAY configuration, the OFFSET must be changed to a Minus value and for a TOWARD configuration the OFFSET value must be changed to a Plus value. (The earlier version 1 AOP and Firmware required the opposite to these settings).

Proportional Voltage

Proportional (DC) Voltages are output from various sensors and systems, representing pressure, amperage, flow, and other attributes. When it is necessary to measure these values with the 1444 dynamic measurement module, one or more channels can be defined for Static inputs. And if it is necessary to provide this measure to the controller via the input assembly then the measured "Proportional DC" value can be selected for module output. See Select Input Data for Input Tag on page 106.

Proportional voltage measurements are calculated as y = mx + b where:

- m = the channel sensitivity in mV/EU (See Hardware Configuration on page 112.)
- x = the measured value in Volts.
- b = the calibration offset, in the selected engineering units

Proportional Voltage measurements are configured using the controls in Figure 64.

Figure 64 - Normal Thrust and Proportional Voltage

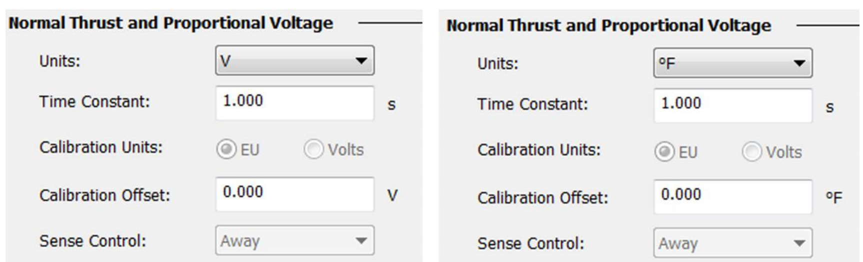


Table 34 - Configurable Parameters for Proportional Voltage Measurements

Parameters	Values	Comments
Units	Select from presented units	The specific unit selections that are presented depend on the Measurement Type setting (Hardware Configuration Page). For proportional measures, other than temperature (voltage or current), the module does not associate units. In these cases, the units must be managed in the controller or software.
Time Constant	0.1…60.0 seconds	The time constant calculation effectively smooths the measurements as it behaves similarly to a high pass filter. The smaller the time constant the more responsive the measurement is to rapid changes (or noise).
Calibration Offset	-50,000…50,000	Is the "b" parameter in the proportional formula (y = mx + **b**). In most cases, the offset is associated with the type of signal that is provided, such as "1...5 V" (offset = -1) or "4…20 mA" (offset = -4). However in some cases the required offset is not so obvious. Consult the specific sensor documentation to verify that an appropriate offset is applied. For accelerometers that provide a proportional voltage temperature measurement as an additional output see Configuring Temperature Measurements from Dual Output Accelerometers.

Configuring Temperature Measurements from Dual Output Accelerometers

The temperature signal from a combination acceleration and temperature (AT) accelerometer is a proportional voltage value. In some cases all that is required to configure measurements from these values is the calibration factor (ex. “10 mV/°C”). However, due to variation in the designs of the temperature circuits of AT sensors, and to the precision measurement capabilities and sensitivity of the 1444 monitor, it is possible for impedance differences between sensors to result in temperature measurements that are offset from actual by several degrees. While this offset has little effect on the accuracy of the measurement regarding change, it does have to be considered when configuring the sensor.

The following describes how to configure a 1444 monitor to measure temperature from AT sensors.

Module Definition - Define Module Functionality Page

Define two channels for the sensor. One must be a Dynamic channel for the vibration measurement, the other a Static channel, which is used to read the temperature measurement.

The Dynamix 1444-DYN04-01RA module includes two Analog-to-Digital Converters. One ADC is connected to channels 0 and 1 and the other is connected to channels 2 and 3. While the module allows significant individuality in channel configuration, the rate the ADC samples must be the same for both channels in the pair it serves. Consequently it can be advantageous to use the same pair for both vibration and temperature measurements. Use of both measurements allows greater flexibility to define the dynamic channels since they then do not share ADC. For example, if two AT sensors are connected to the module, then wire the vibration signals to channels 0 and 2, and the temperature signals to channels 1 and 3. As a result, the sample rate (FMAX) for each of the two vibration channels can be set independently.

Module Definition - Define Module Functionality Page

Define two channels for the sensor. One must be a Dynamic channel for the vibration measurement, the other a Static channel, which is used to read the temperature measurement.

The Dynamix 1444-DYN04-01RA module includes two Analog-to-Digital Converters. One ADC is connected to channels 0 and 1 and the other is connected to channels 2 and 3. While the module allows significant individuality in channel configuration, the rate the ADC samples must be the same for both channels in the pair it serves. Consequently it can be advantageous to use the same pair for both vibration and temperature measurements. Use of both measurements allows greater flexibility to define the dynamic channels since they then do not share ADC. For example, if two AT sensors are connected to the module, then wire the vibration signals to channels 0 and 2, and the temperature signals to channels 1 and 3. As a result, the sample rate (FMAX) for each of the two vibration channels can be set independently.

Module Definition - Input Data Page

It is not necessary to configure a tag to communicate the temperature value to the controller*. However, if a tag is required, then for the static channel that is used with the sensor, select the Proportional DC tag for input.

*Add this tag if a specific calibration offset is measured rather than a nominal value entered.

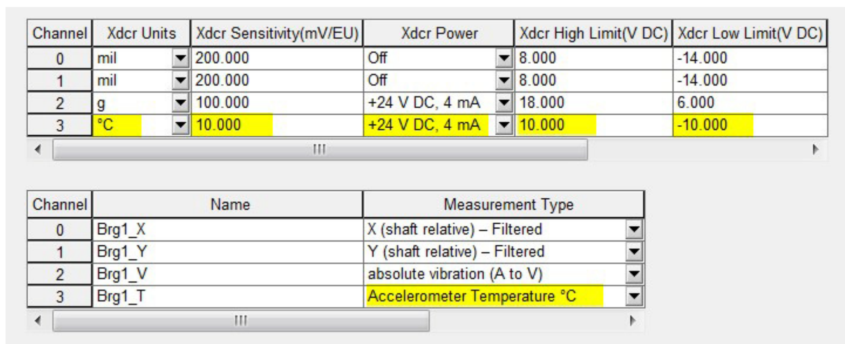
Module Configuration – HW Configuration Page

On the Hardware Configuration page, for the channel that measures the temperature:

1. Set the measurement type and transducer sensitivity as follows:

Measurement Type	Transducer Sensitivity
Accelerometer Temperature °C	10 mV/°C
Accelerometer Temperature °F	5.56 mV/°F

2. Set the Transducer Power to “+24V DC, 4 mA”.
3. Set the Transducer High and Low limits to -10 V DC to +10V DC.



Channel	Xdcr Units	Xdcr Sensitivity(mV/EU)	Xdcr Power	Xdcr High Limit(V DC)	Xdcr Low Limit(V DC)
0	mil	200.000	Off	8.000	-14.000
1	mil	200.000	Off	8.000	-14.000
2	g	100.000	+24 V DC, 4 mA	18.000	6.000
3	°C	10.000	+24 V DC, 4 mA	10.000	-10.000

Channel	Name	Measurement Type
0	Brg1_X	X (shaft relative) – Filtered
1	Brg1_Y	Y (shaft relative) – Filtered
2	Brg1_V	absolute vibration (A to V)
3	Brg1_T	Accelerometer Temperature °C

Measurement Definition – DC Page

For Proportional DC measurements only three attributes are enabled on the DC page – Units, Time Constant and Calibration Offset. For temperature measurements, in most cases, only the Calibration Offset must be entered.

The value to enter for an offset can be determined either of two ways: a “Nominal Offset” value can be entered, or a “Specific Offset” can be determined and entered.

Nominal Offset

A nominal offset is similar to the "nominal" sensitivity of the sensor, such as "100 mV/g", which is often used in place of the provided specific sensitivity of the sensor, such as "98.4 mV/g". You can enter a nominal value when a precise measurement is not necessary, when the precise sensitivity is not known, or when it is desired or necessary to be able to replace a sensor without having to modify the configuration.

Nominal offset values are available only for sensors that are provided by Rockwell Automation and as provided in the following table. For other sensors, a Specific Offset must be provided.

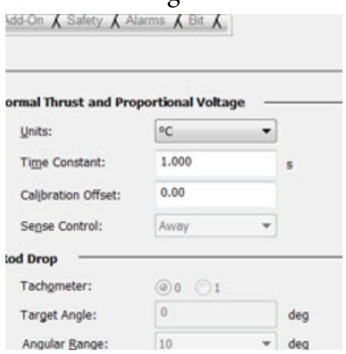
For the installed sensor, enter the offset as provided in the following table for the selected engineering units.

Catalog	°C	°F	Comments
EK-43811I	16	60.8	Expected accuracy is within 2 °C (2%)
1443-ACC-AT-x	13	55.4	

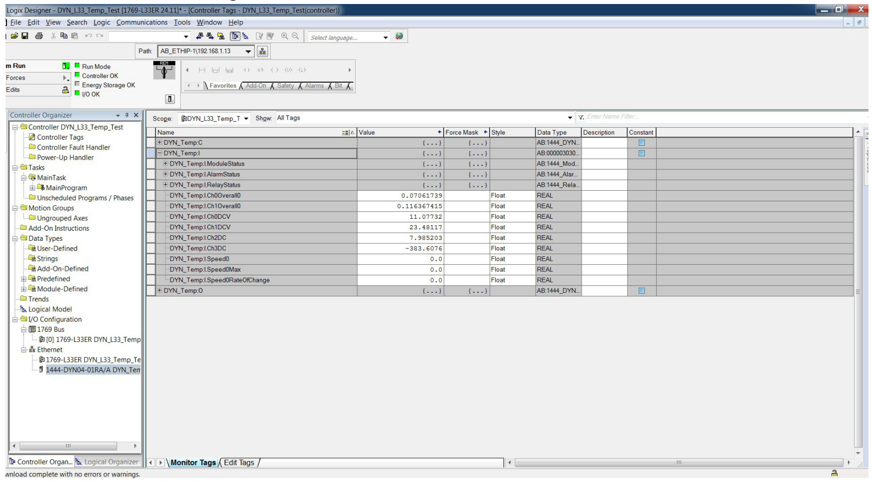
Specific Offset

When a nominal offset is not known, or if a more precise measurement is necessary, then a specific offset can be determined as follows.

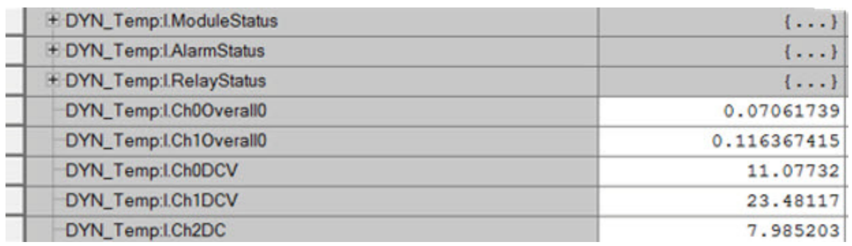
On the DC Page for each AT sensor, verify that the Calibration Offset is 0.00.



Download the configuration to the module.



Note the DC value or the static channel.



In this example, the sensor is wired to channel 2, which is reading 7.98 (approx. 8) degrees.

To measure the actual output of the accelerometer temperature channel in mV, use a digital volt meter.

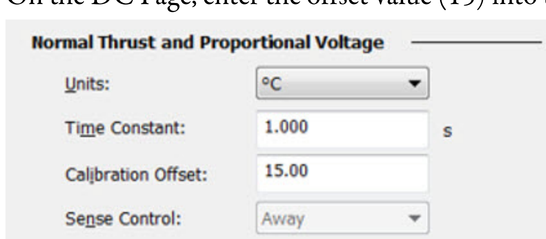
Use the sensor calibration, mV/°C, to convert the measured mV value to degrees.

Example: Output = 228 mV so for 10mv/C sensitivity the temperature is 22.8 C (228/10), or approximately 23 C.

To get the calibration offset, subtract the Ch2 measured value (8) from the actual temperature (23).

Calibration offset = 23 minus 8 = 15

On the DC Page, enter the offset value (15) into the Calibration Offset.



Download the new configuration and observe the measured value.

	0.08238697
DYN_Temp:I.Ch1Overall0	0.116367415
DYN_Temp:I.Ch0DCV	11.076113
DYN_Temp:I.Ch1DCV	23.48043
DYN_Temp:I.Ch2DC	23.2504

Make sure that it displays the correct temperature.

The preceding example shows that the measured output from the accelerometer temperature channel was 230.9 mV or 23.1 °C. So the observed value, 23.2504, is correct.

Rod Drop

Used in reciprocating compressors, Rod Drop is a measure of the position of the piston rod relative to the proximity probe mounting location. Rod Drop provides an indirect measurement of wear of the piston rider band.

Because the distance between the probe and the piston rod varies over the length of the stroke of the rod, the measurement must be triggered such that it is performed consistently at the same point in the stroke. To accommodate this feature, when you configure a Rod Drop measurement, the tachometer trigger signal is used to trigger when the measurements are taken on each piston rod (channel).

The relationship between the position of each reciprocating piston rod and the rotating trigger position (tachometer trigger) is a function of the specific mechanical design of the machine. Therefore, before defining the Rod Drop measurements, determine, for each piston:

- What the mechanical relationship is between the tachometer trigger point and the position of the rod in its stroke.
- Where to take the measurement along the piston rod. The Rod Drop measurement is the average of the samples that are taken between the Start and Stop positions, as defined by the Trigger Angle and the Angular Range.
- The minimum speed for rod drop measurements is 10 rpm. Below 10 rpm the measurement defaults to a normal DC measurement.
- The maximum speed for rod drop measurements is calculated and based on sample rate and the selected Angular Range:

  Maximum rpm = (2929 * Angular Range) / 6

In Table 35, the maximum RPM values available for each Angular Range selection are presented.

Table 35 - Maximum RPM for Angular Range

Angular Range	Max RPM
2	976
4	1953
6	2929
8	3905
10	4882
12	5858
14	6834
16	7811
18	8787
20	9763

Configuring Rod Drop Measurements

Rod drop measurements are configured using the controls in Figure 65.

Figure 65 - Rod Drop Measurements

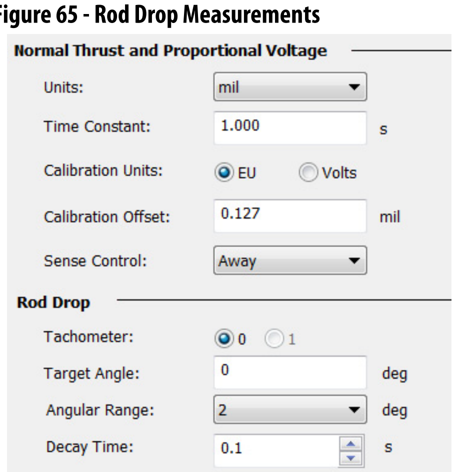


Table 36 - Configurable Parameters for Rod Drop Measurements

Parameters	Values	Comments
Units	Select from presented displacement units	Rod drop measurements are made using eddy current probes. Configuration of the units, time constant, calibration offset, and sense control are the same as for Normal Thrust measurements.
Time Constant	0.1…60.0 seconds	
Calibration Units	EU (0) Volts (1)	
Calibration Offset	-50,000…50,000	
Tachometer	0 (Tacho/Speed 0) 1 (Tacho/Speed 1)	Select the source for the tachometer that is used in the rod drop measurement. Value that is written to the assembly is 1 or 2, 0 = off (to the module).

Table 36 - Configurable Parameters for Rod Drop Measurements (continued)

Parameters	Values	Comments
Target Angle	0…359 degrees	The target angle for the rod drop measurement (the mid-point of the range).
Angular Range	2…20 degrees in 2 degree steps	The angular range of the rod drop measurement. This is the allowed range, around the target angle, in which the measurement can be taken.
Decay Time	1…60.0 seconds	Represents the time for the measured value to move 50% nearer the target/new value. Increases and decreases, and the magnitude of the change, have no effect on the behavior. For example, if a step change occurs, the measurement moves 50% of the way to the new value in the initial time constant period. In the next TC period, it moves another 50%, totaling 75% of the step change, etc.

Differential Expansion

Used in steam turbine monitoring, Differential Expansion is the measure of the difference between the thermal growth of the rotor and the thermal growth of the case. During machine startup, it is used by operators to help verify that the heat up is managed so that the rotating and stationary components of the machine do not touch.

In a steam turbine, the rotating blades are affixed to the turbine rotor while its stationary blades are connected to the machine casing. As steam turbines operate at high temperatures, these components experience significant thermal growth from their non operating (cold/shutdown) state. Because of differences in the mass, material, and construction of the rotor and case, the rate of thermal growth of each as the machine heats during startup is different. A rotor always expands faster than the case. This difference in thermal growth rates manifests in a varying distance between the rotating and stationary blades, with the potential for the distance to reduce until the rotating and stationary components touch. So when starting these machines it is important to do so in a manner that makes sure that the differential between rotor and case expansion never exceeds design tolerances.

To monitor Differential Expansion, transducers are mounted to a fixture attached to the machine case and measure the distance to a collar or ramp that is machined onto the turbine rotor. Consequently the difference in expansion between the two structures is merely the measured distance.

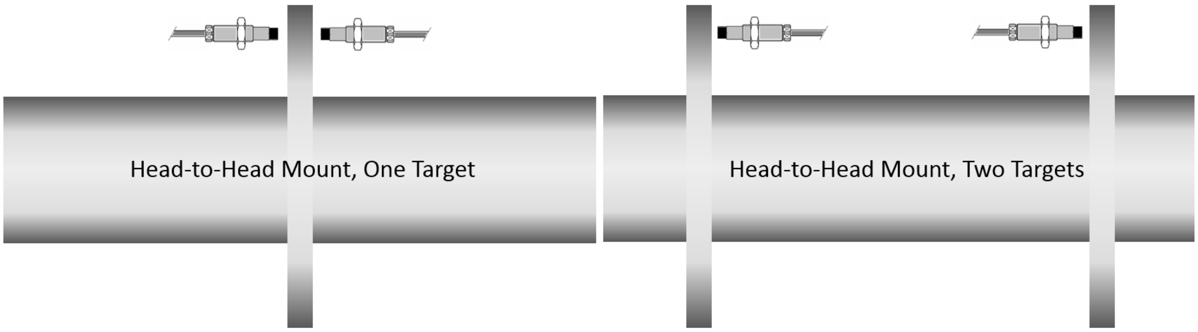
Because the distance necessary to measure is further than the range of small diameter probes, in most cases two probes are applied. In these cases, for complementary measurements, the combined ranges of the two probes, minus some overlap range, is considered. Or, for ramp measurements, the change in distance to a ramp, which is always increasing for one probe while decreasing for the second probe, is considered. For either method, the Differential Expansion measurement provides the functions necessary to measure one distance by using two probes that are mounted in either of the two ways – complementary or ramp.

Differential Expansion is measured using either an Axial or a Radial method. The terms “Axial” and “Radial” refer to the orientation of the sensors relative to the shaft, either in line axially, or are oriented radially to the shaft.

Complementary Differential Expansion Measurements

Complementary, also called "Axial" or "Head-to-Head", Differential Expansion is performed by placing two sensors facing a target that is aligned axially, along the shaft, facing the same or separate targets as illustrated in Figure 66.

Figure 66 - Complementary Differential Expansion Probe Arrangements



The head-to-head mode enables extended range operation by using two probes in a "back-to-back" arrangement, as illustrated. This mode can be used when the machine does not have enough space for larger diameter probes.

Sensors must be mounted and input to the channel pair such that the short (side) probe is measuring its minimum gap when the rotor is cold (Figure 67), and that the long (side) probe is measuring its minimum gap when the rotor is hot (Figure 68).

Figure 67 - Rotor Cold/ Zero Position

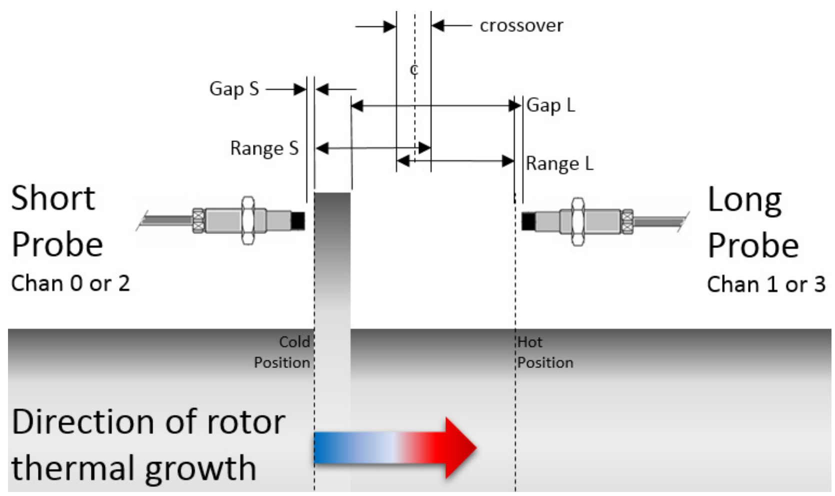
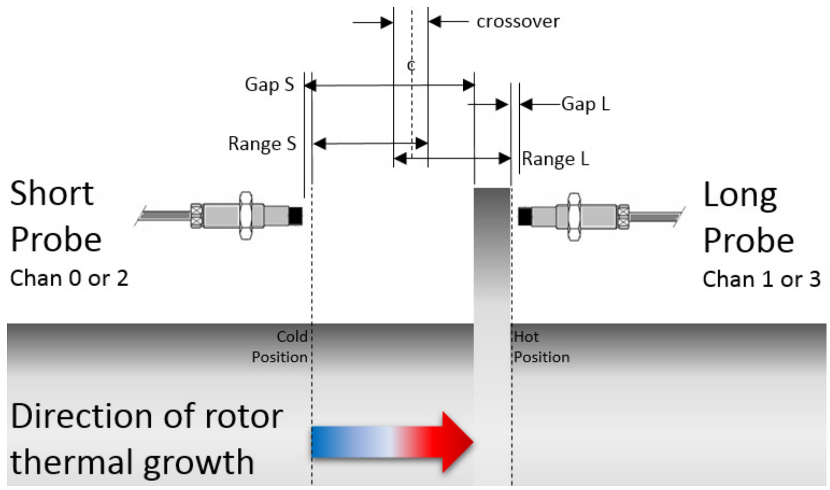


Figure 68 - Rotor Hot Position



Definitions

See Figure 67 and Figure 68.

Short Probe

The probe that is mounted at the rotor short end, which is oriented toward rotor long. Rotor short is the zero or cold position of the turbine rotor.

This probe must be input to the first channel of the pair that is used for the measurement (channel 0 or 2).

Long Probe

As the rotor grows in length, it is toward the rotor long position. The probe that is located where the rotor is growing toward is the long probe, and is oriented toward rotor short.

This probe must be input to the second channel of the pair that is used for the measurement (channel 1 or 3).

Gap S

The gap between the short probe and the rotor short side of the target.

During installation, the probe is “gapped” (positioned) such that the gap is near to the minimum of its usable linear range. This gap assumes that the rotor is at its cold / zero position.

Range S

As the rotor grows due to steam heating, the target surface moves away from the rotor short probe, and toward the rotor long probe. As it expands, the short side target eventually moves beyond the usable (linear) range of the short side probe – Range S.

The module uses the settings for the “Xdcr High Limit (V DC)” and “Xdcr Low Limit (V DC)”, on the HW Configuration page, to define the limits of the range for each probe.

Gap L

The gap between the rotor long probe and the rotor long side of the target.

Range L

As the rotor grows due to steam heating, the target surface moves toward the rotor long probe, and away from the rotor short probe. Until the rotor has expanded sufficiently, the long side target is beyond the usable (linear) range of the long side probe – Range L.

The module uses the settings for the “Xdcr High Limit (V DC)” and “Xdcr Low Limit (V DC)”, on the HW Configuration page, to define the limits of the range for each probe.

Crossover

The crossover range is the area where both probes are measuring within their linear ranges.

While the crossover range can reduce the total possible range of the combined sensors, it is important in that it helps prevent large jumps in the expansion measurement as the target moves out of the range of one probe and into the range of the second probe.

Sense Control

Sense Control indicates the direction of movement of the rotor target surface relative to the sensor tip as the rotor expands or contracts during heating and cooling. Movement away means that during heating, the rotor target surface is away from the sensor tip. Movement toward indicates that during heating, rotor growth is toward the sensor.

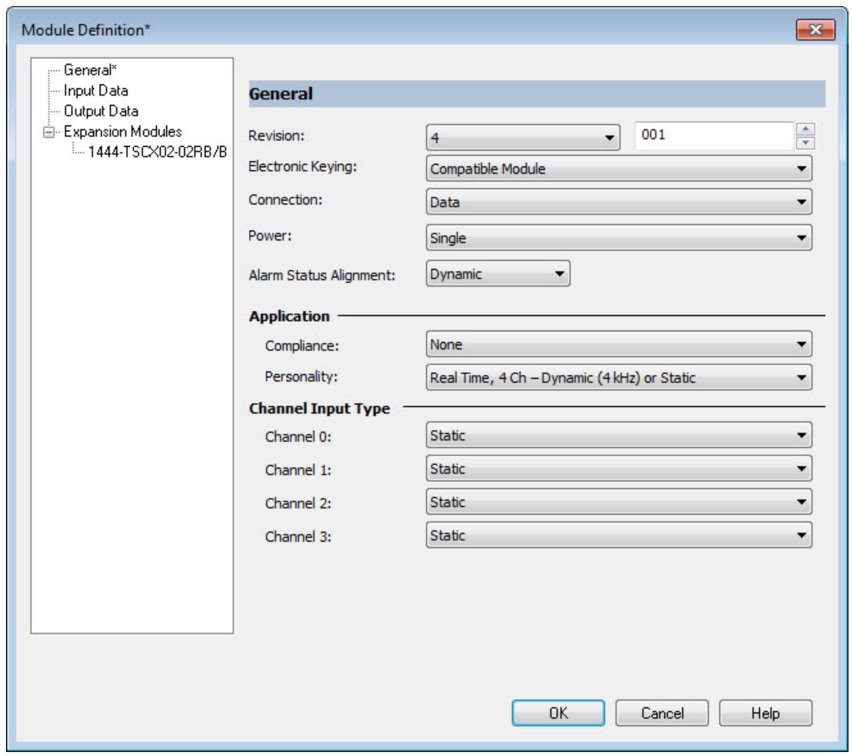
Configuring Complementary Differential Expansion Measurements

Complementary Differential Expansion requires that two static channels, in pairs, be used. These pairs are either Channels 0/1 or Channels 2/3, with the short side probe input to the first channel of the pair.

The Complementary Differential Expansion measurement requires edits to pages in Module Definition and, in normal Module Configuration, the HW Configuration, and the DC page for each channel of the pair.

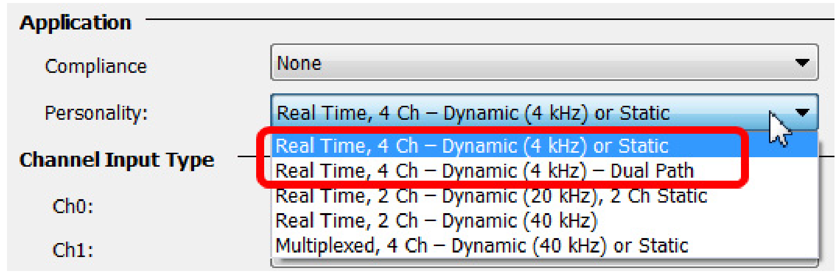
Module Definition - Define Module Definition

Figure 69 - Module Definition



In Module Definition on the Define Module Functionality, set the Personality to either of the Real Time 4 kHz selections.

Figure 70 - Real Time Selection

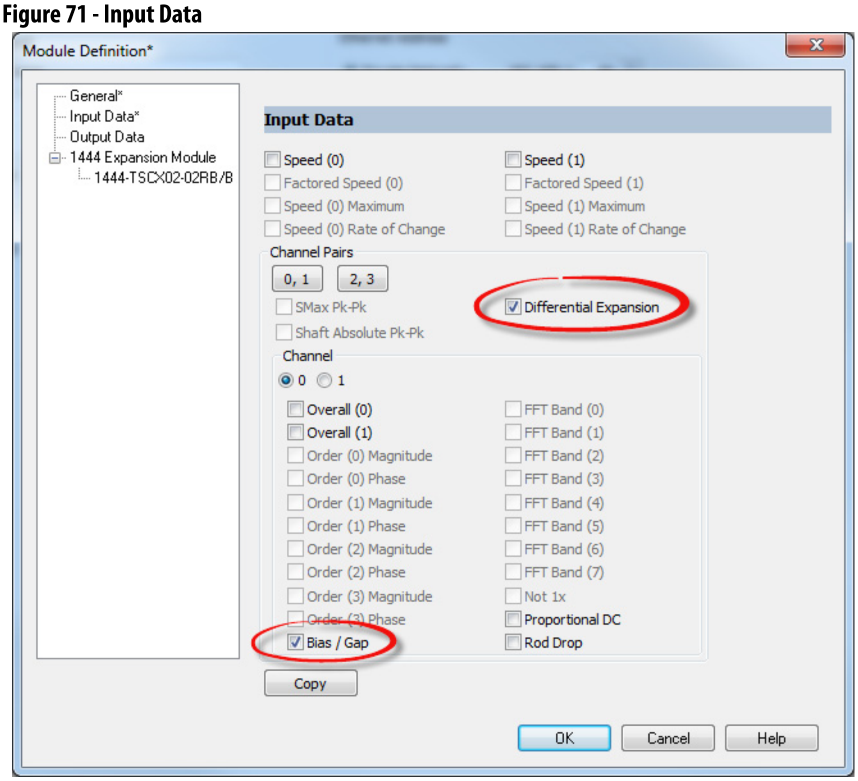


And for each channel of the pair to be used for the measurement, select "Static" for the Channel type.

Module Definition – Input Data

On the Input Data page, in the Channel Pairs section, select Differential Expansion for the channel pair to be used. Also, for each channel of the pair, select the Bias/Gap data input as a way to verify gap settings during initial set-up of the probes on the machine.

Figure 71 - Input Data

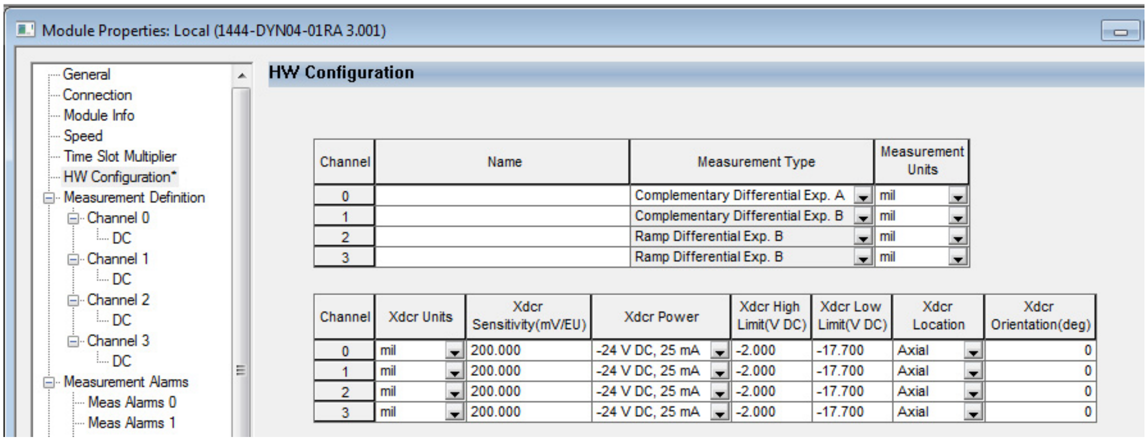


No other selections are necessary in Module Definition for the Differential Expansion measurement. Configure the other channels, inputs, outputs, and add expansion modules as appropriate.

HW Configuration

On the Hardware Configuration Page, set the Measurement Type for both channels of the pair, to "Complementary Differential Expansion A (Axial)".

Figure 72 - HW Configuration



For each of the channels, edit the Xdcr attributes as appropriate to the sensor input.

Example:

If you use an 8 mm probe from Allen-Bradley® 1442 Series Eddy Current Probes:

- Set or verify that the transducer (Xdcr) units are "mil", or "mm", and the sensitivity is "200" or "7.87" respectively.
- Set or verify that Xdcr power is "-24V DC, 25 mA".
- Set the "Xdcr High Limit (V DC)" to -2.
- Set the "Xdcr Low Limit (V DC)" to -17.7.
  The high and low limits for the sensors correspond the published linear range for them, which for the 1442 Series 8 mm probe is 9.8…88.6 mils (0.25…2.25 mm).

  In normal monitoring, the module uses these limits to indicate that the sensor could be faulted, so can be set outside the linear range of the sensor. For differential expansion, the module uses these limits to know when the target is within the linear range of the sensors. Which sensor is within its linear range, or if both sensors are, determines the measurement behavior:

  - One sensor within its linear range: Output measurement from that sensor.
  - Both sensors are measuring within its linear range: Output is the average of the measurements from both sensors.

  For this example, the transducer bias values are set as shown in Figure 72.

DC

The remaining configurations are applied on the DC page for each channel of the pair. How each channel is configured depends on which is the sensor for the short side measurement, and which is the long side measurement.

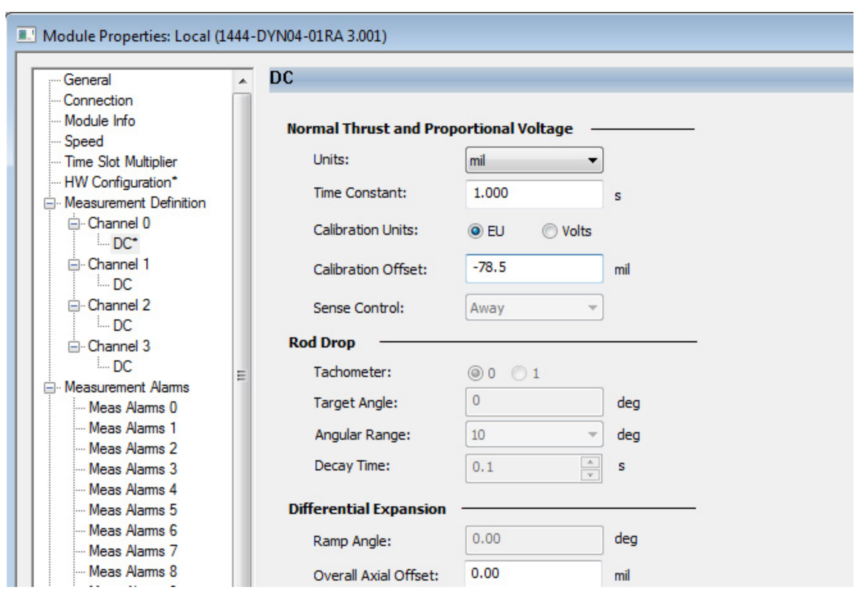
Channel 0/2 DC Page Configuration

The 1444 monitor requires that the short side sensor is input to the first channel of the pair.

Table 37 - Complementary Differential Expansion Configuration - Short Side Sensor

Parameters	Values	Comments
Units	Select from presented displacement units	Differential Expansion measurements are made using eddy current probes. Configuration of the units, time constant, and calibration units are the same as for Normal Thrust measurements (page 156). Sense control is fixed at “Away” for the short side probe.
Time constant	0.1…60.0 seconds	
Calibration units	EU (0) Volts (1)	
Calibration offset	-50000…50000	For the short side probe, the offset is the measured offset when the shaft is at its cold / zero position. Always use the actual, initial gap of the probe. The gap can be measured with a DMM at the ECP system probe driver. Or the gap can be measured in the tag output upon start-up of the Dynamix 1444, and can then be entered into the system and the system reconfigured later.
Overall axial offset	-50000…50000	No value must be entered into the Overall Axial Offset entry box unless the starting value for the expansion measurement is required to start at other than a zero value due to DCS or other control system requirements.

Figure 73 - Module Properties - Short Side Sensor



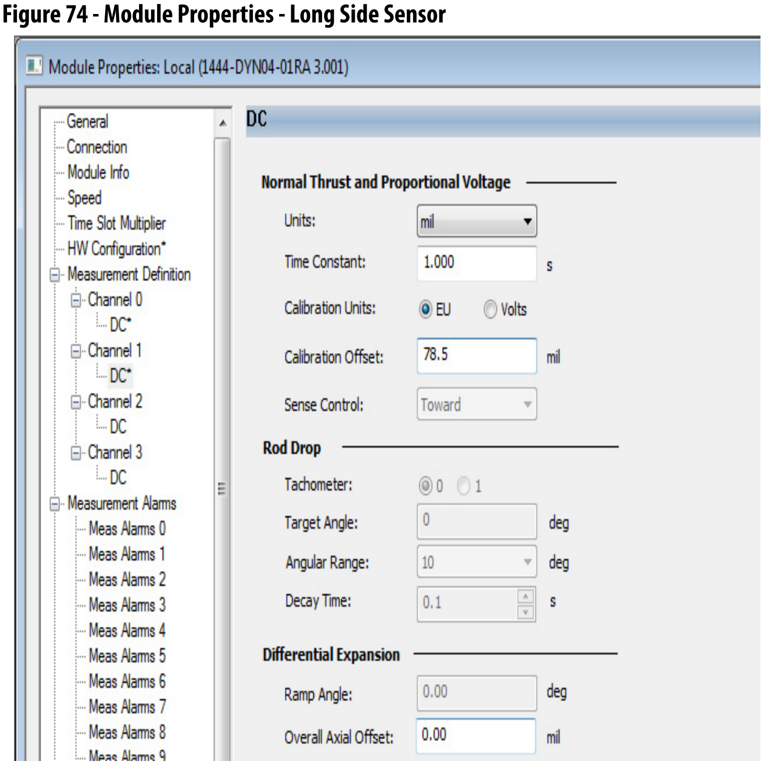
Channel 1/3 DC Page Configuration

The 1444 monitor requires that the long side sensor is input to the second channel of the pair.

Table 38 - Axial Differential Expansion Configuration - Long Side Sensor

Parameters	Values	Comments
Units	Select from presented displacement units	Differential Expansion measurements are made using eddy current probes. Configuration of the units, time constant, and calibration units are the same as for Normal Thrust measurements (page 156). Sense control is fixed at "Toward" for the long side probe.
Time constant	0.1…60.0 seconds	
Calibration Units	EU (0) Volts (1)	Select EU
Calibration offset	-50000…50000	For the long side probe, the offset is a combination of the entire measured range of channel 0/2, as well as the entire offset of channel 1/3. The latter is due to the measurement starting at the lowest voltage, so the range from 0 to -17.7 (in the example) must be accounted for. Using the above 8 mm probe example: 9.8...88.6 mils (0.25...2.25 mm) gives a measurement range of 78.8 mils (2.0 mm) from the short side sensor channel (channel 0/2). Add to that the measured distance from total range of the long side sensor, 88.6 mils (2.25 mm) to get a combined total of 167.4 mils (4.25 mm). With the Calibration Units set to EU, the offset can be entered directly.
Overall axial offset	-50000…50000	No value must be entered into the Overall Axial Offset entry box unless the starting value for the expansion measurement is required to start at other than a zero value due to DCS or other control system requirements.

Figure 74 - Module Properties - Long Side Sensor



Output

The Complementary Differential Expansion measurement, in mils (mm), or other EU, is output to the associated tag as shown in Figure 75. The individual channel DC volt values are provided in their respective tags.

Figure 75 - Differential Expansion Tag (Channels 2 and 3)

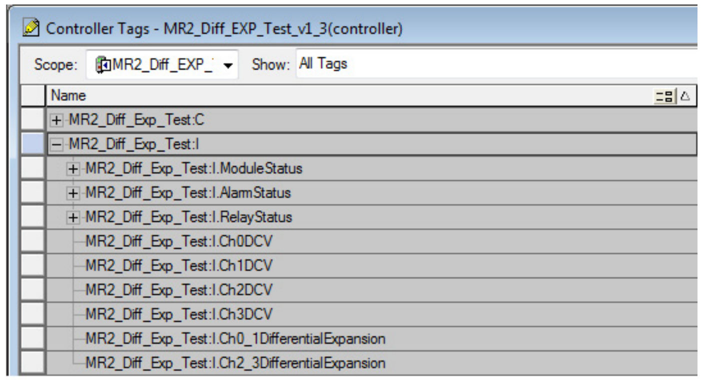


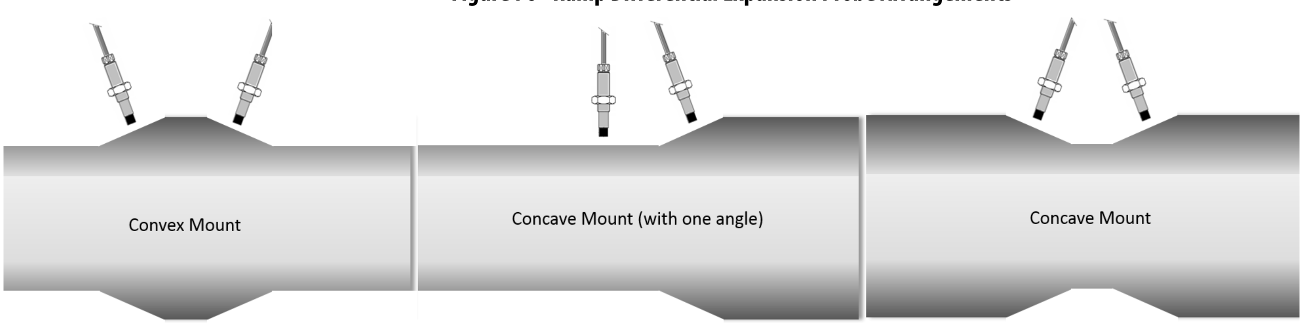
Figure 75 illustrates the tag that is created for a channel 2/3 measurement. If a channel 0/1 measurement is defined, the tag is "Ch0_1DifferentialExpansion". Figure 75 also shows the Bias/Gap tags for the channels, which have been added on the Inputs page, for the Differential Expansion channel pair.

Ramp Differential Expansion Measurements

Ramp/Differential Expansion is used when one or both of the sensors are installed such that they monitor the movement of an angled surface, or "ramp".

This method can be applied using either of three orientations, as illustrated in Figure 76.

Figure 76 - Ramp Differential Expansion Probe Arrangements



In ramp mode, the movement of the shaft is detected by measuring the gap between the probe tip and a ramp of known and consistent angle to the center line of the shaft. If two ramps are present, measure them as shown.

> When measuring a ramp, any "lift" of the shaft, typically due to jacking oil pressure, must be accounted for. Using two probes makes sure that this lift error is minimized in the module calculations. However, where only one ramp is available, the "lift" error must be corrected by using a second probe operating on a portion of the shaft that is parallel to the center line (center image Figure 76).

IMPORTANT	For single ramp applications, the first channel of the pair (channel 0/2) must be mounted facing the ramp while the second channel (1/3) must be mounted facing the shaft.

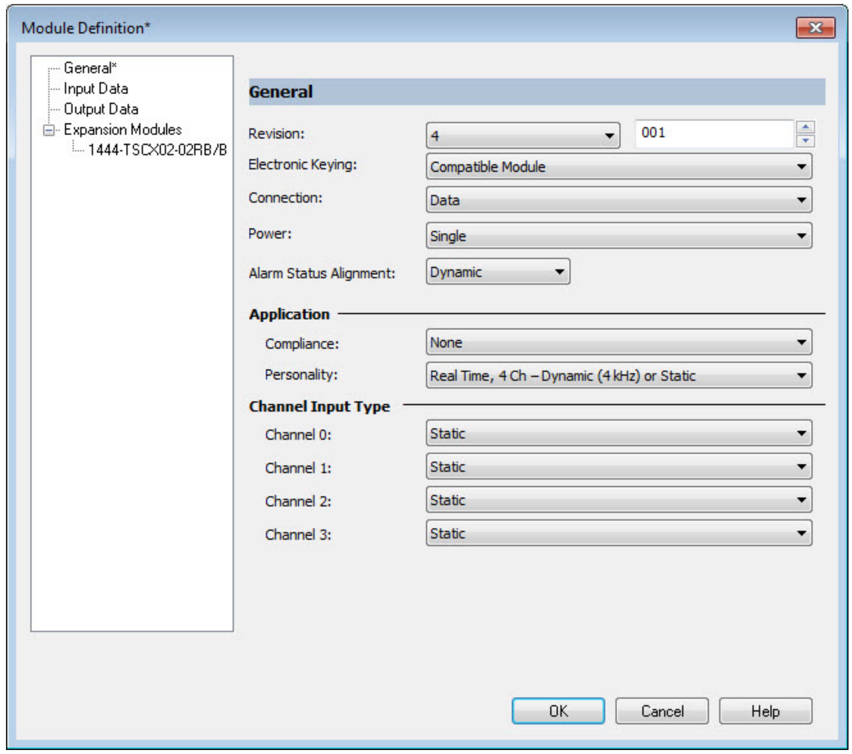
Configuring Ramp Differential Expansion Measurements

Ramp Differential Expansion requires that two static channels, in pairs, be used. These pairs are either Channels 0/1 or Channels 2/3. If one of the pair is not facing a ramp, then that probe must be input to the second channel of the pair.

The Ramp Differential Expansion measurement requires editing the pages in Module Definition, and in normal Module Configuration, the HW Configuration, and the DC page for each channel of the pair.

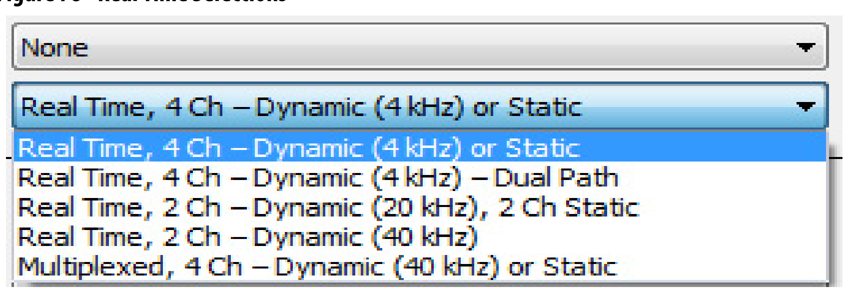
Module Definition - Define Module Definition

Figure 77 - Define Module Functionality



In Module Definition on the Define Module Functionality, set the Personality to either of the Real Time 4 kHz selections.

Figure 78 - Real Time Selections

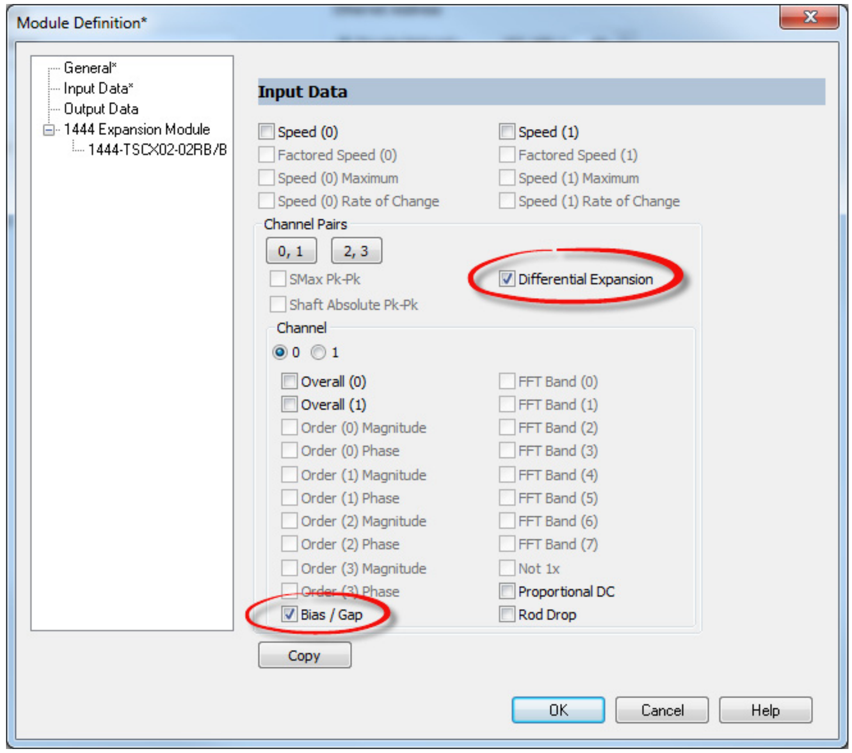


And for each channel of the pair to be used for the measurement, select “Static” for the Channel type.

Module Definition – Input Data

On the Input Data page, in the Channel Pairs section, select Differential Expansion for the channel pair to be used. Also, for each channel of the pair, select the Bias/Gap data input as a way of verifying gap settings during initial setup of the probes on the machine.

Figure 79 - Input Data

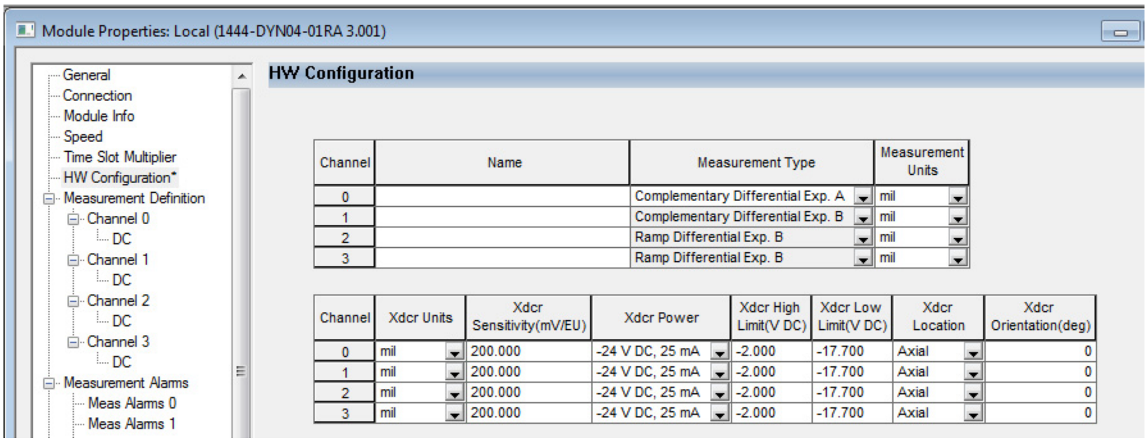


No other selections are necessary in Module Definition for the Ramp Differential Expansion measurement. Configure the other channels, inputs, outputs, and add expansion modules as appropriate.

HW Configuration

On the Hardware Configuration Page, set the Measurement Type for both channels of the pair to “Ramp Differential Expansion A/B” and the sensor definitions are defaulted as shown in Figure 80.

Figure 80 - Hardware Configuration Defaults



For each of the channels, edit the Xdcr attributes as appropriate to the sensor input.

DC

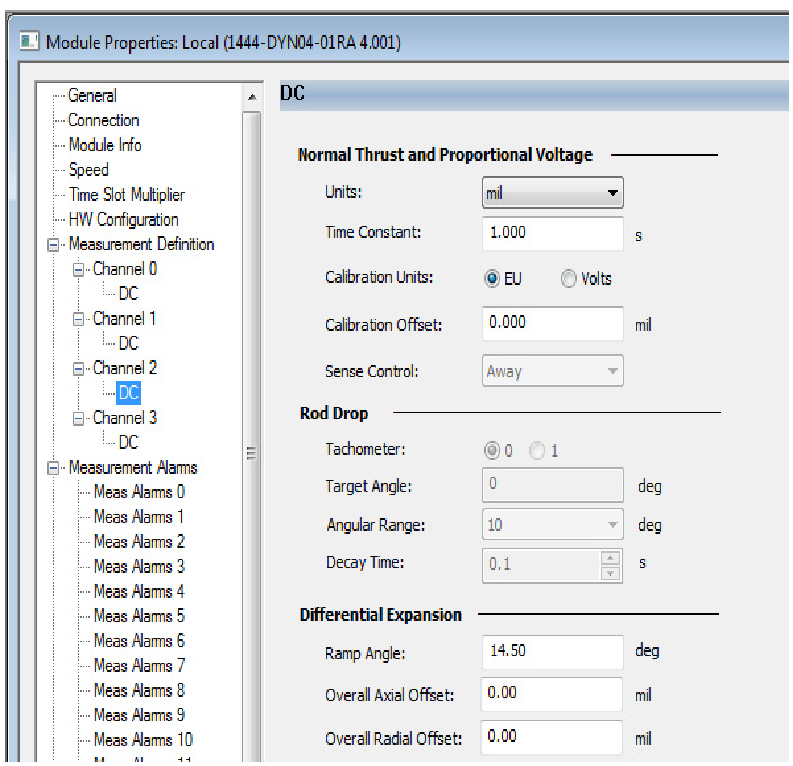
The remaining configurations are applied on the DC page for each channel of the pair.

Ramp Differential Expansion measurements are configured using the following controls.

Table 39 - Radial Ramp Differential Expansion Measurement Controls

Parameters	Values	Comments
Units	Select from present displacement units	Differential Expansion measurements are typically made using eddy current probes or linear voltage differential transformers (LVDT). Configuration of the units, time constant, Calibration Offset (there is no sense control) are the same as for Normal Thrust measurements (page 156).
Time constant	0.1…60.0 seconds	
Calibration units	EU (0) Volts (1)	
Calibration offset	-50000…50000	
Ramp angle	-45.000…45.000	Enter the angle of the ramp. A 'normal' probe with a plain target has a ramp angle of 0°. Ramp angle applies for both probes A and B. Typical ramps have angles that range from about 9.5°…14.5° but can be up to 45°. Ramp angles can be positive or negative.
Overall axial offset	-50000…50000	No value must be entered into the Overall Axial Offset entry box unless the starting value for the expansion measurement is required to start at other than a zero value due to DCS or other control system requirements.
Overall radial offset	-25000…25000	Radial offset is not used.

Figure 81 - Ramp Angle



Eccentricity

Used in steam turbine monitoring, Eccentricity is a measurement of the amount of sag or bow in a rotor. It can also provide indication of a bent shaft. This measurement is used by the operator during startup to indicate when the machine can safely be brought up to speed without causing rubs or damage to the seals.

Steam turbine rotors are long shafts, supported at the ends, with heavy loads in between. So when shut down (cold and not rotating) the weight of the rotor causes the shaft to bow over time. If the machine is then brought to speed, the imbalance that is caused by the bow could damage the machine. Startup procedures are provided to bring the turbine to speed slowly, and temperature, so that rotors have time to straighten out on their own. Key to this process is monitoring the amount of bow (eccentricity) so that a machine can be safely started.

The eccentricity measurement is similar to the common overall measurement in that it is the measure of the difference between the maximum and minimum peaks in a signal. However, a normal overall measurement is measured by sampling rapidly while continually updating the minimum and maximum values and calculating the difference. This process is done without consideration of shaft rotation. So, when the shaft is spinning rapidly, the measure could span multiple revolutions, and when spanning slowly can be measured from less than one revolution.

For eccentricity measures, this latter case result in a misleading reading. As the measurements are made, the overall value grows and shrinks depending on the position of the shaft relative to the sensor. To solve this problem the eccentricity measure can be defined so that it is made on a per revolution basis, regardless of how long that revolution takes to complete. For this reason, a tachometer can be associated with the eccentricity measurement.

When using a tachometer for eccentricity, the minimum pk/revolution (RPM) parameter is used to define a speed where the measurement method transitions from the “single peak per revolution” method to the normal fast sampling method.

Configuring Eccentricity Measurements

Eccentricity measurements are configured using the control in Figure 82.

Figure 82 - Eccentricity Controls

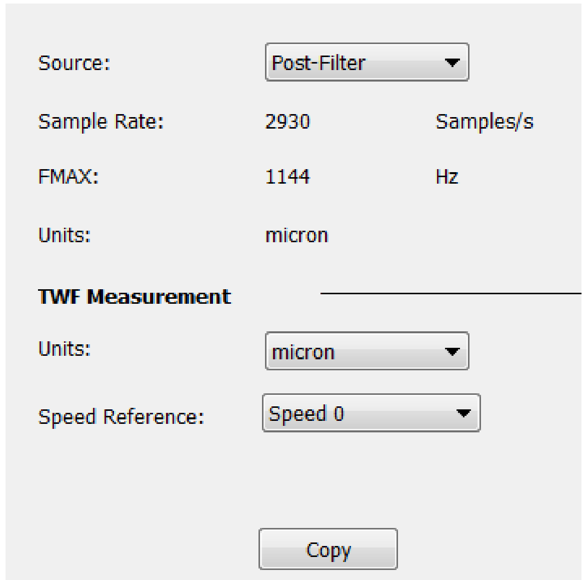
Table 40 - Configurable Parameters for Eccentricity Measurements

Parameters	Values	Comments
Tachometer	0 Disabled 1 (Tacho/Speed 0) 2 (Tacho/Speed 1)	Select the source for the tachometer that is used in the eccentricity measurement. When set to Disable the eccentricity measurement is performed using the normal overall measurement.
Minimum Peak/ Rev	4…600	Enter the minimum RPM that the eccentricity measurement is made per revolution. When speed is less than the minimum, the eccentricity measurement is made using the normal overall measurement function.

TIP When the speed is less than specified, or the tachometer is disabled so only a normal overall measurement is performed, consideration should be made to programming the controller to capture the maximum, and perhaps minimum, eccentricity values per revolution – which it can calculate based on speed. This is a useful capability as it allows operators to, using a jacking gear, rotate the shaft to where the bow is vertical, which can help to straighten the shaft while not in rotation.

Demand

The 1444-DYN04-01RA dynamic measurement module can serve additional data "on demand". Demand data is accessed by using explicit data requests to the Demand Data Objects.



Demand data is not used in the module. It is provided as an additional data source to software applications that offers the following advantages.

Independent Signal Source

You can define the Demand data signal source separate from what is specified on the FFT Page. This separation allows software to access data that is processed differently for the same channel. Differences could include integrated vs. not integrated, differences in the sample rate or FMAX, or in the measurement mode – asynchronous vs. synchronous.

Sample Resolution

While the TWF and FFT defined on the FFT Page are limited in size to a maximum of 8192 TWF Samples and 1800 FFT Lines, far higher resolution data can be read from the demand buffer. The following table provides the size selections available from the demand buffer.

FFT Lines				
TWF Samples	**Base FFT Lines(1)**	**Decimation**		
		None	**Alternate Path(2)**	**Primary Path**
65536	-	-	-	-
32768	12800	14400	8000	4800
16384	6400	7200	4000	2400
8192	3200	3600	2000	1200
4096	1600	1800	1000	600
2048	800	900	500	300
1024	400	450	250	150
512	200	225	125	75
256	-	-	-	-

(1) The Base FFT Lines can potentially be the selections that are provided by the software application as how the selections are presented is a function of the application software. However, the actual number of FFT Lines served by the module is dependent on the decimation and filtering applied as shown.

(2) Or if the measurement type (See Hardware Configuration Page) is either of the aeroderivative selections.

Cross Module Synchronized Measurements

The Demand buffer allows for reading the measurements from multiple modules that were sampled simultaneously. Besides the raw channel data that is sampled from the specified signal source location, the buffer also retains each of the two TTL tachometer signals. As a result, software can request data from different modules that start at the same tachometer pulse, so long as the modules share the TTL signal.

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Signal Source</td><td>Select from:
• Mid-Filter
• Post-Filter
• Alternate Path</td><td>Select the signal source for TWF and the FFT. (See Filters for a description of the various stages of signal processing where you can get the processed data.)
Signal Source selections for FFTs (FFT Page) and Demand data (Demand Page), for the same channel, cannot be set to different primary path sources:
• Both can be set to the same source, or. . .
• One must be set to Alternate Path</td></tr>
<tr><td>Measurement</td><td>Select from:
• inch/s
• m/s
• mm/s</td><td>Select the engineering units for the TWF and FFT.
• The rules for units selection, which are based on the transducer units (the HW Configuration properties page), are provided in this table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature
Bearing Defect Units</td><td>No change allowed</td></tr>
<tr><td>Pressure
Flow
Current
Frequency
Power
Voltage
Acceleration
Velocity
Length</td><td>Change in class only</td></tr>
</table>
•For any acceleration, velocity or displacement (length) units, the module can convert the measurement between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td></td><td>m/s</td><td></td><td>m/s^2</td></tr>
<tr><td>mm</td><td>↑</td><td>mm/s</td><td>↑</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>|</td><td>inch/s</td><td>|</td><td>inch/s^2</td></tr>
<tr><td>inch</td><td>↓</td><td></td><td>↓</td><td>g</td></tr>
<tr><td>mil</td><td></td><td></td><td></td><td>mg</td></tr>
</table>
</td></tr>
<tr><td>Speed Reference</td><td>Select from:
• Off
• Speed 0
• Speed 1
• Factored Speed 0
• Factored Speed 1</td><td>Select the reference speed source.
When TWFs and FFTs are read from the module, the value of this RPM is included with the data.</td></tr>
</table>

The Demand page defines the acquisition of time waveform data for demand, or advanced, condition monitoring data requests. Available services enable data requests "on demand" from the demand (advanced) data buffers with each request uniquely definable per the requester specifications, which can include various post-processing tasks, including FFT processing.

This page is presented when the channel is configured for Dynamic measurements.

Demand data lets you define a deep data buffer at any one of the enabled data sources (See Filters on page 124). Once defined the demand Buffer updates continuously in the background while imparting minimal additional loading to the module processors.

Configure the Tachometer Expansion Module

Tachometer Expansion Module

The 1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module is a two-channel monitor that converts input signals from common speed-sensing transducers into a once-per-revolution TTL class signal. The expansion module is suitable for use by up to six connected 1444-DYN04-01RA dynamic measurement modules.

The tachometer signal conditioner commonly serves speed signals to main modules other than its host. So, unlike other expansion modules, and except for configuration services, the 1444-TSCX02-02RB module operates independently of its host module. Therefore, once configured, the tachometer expansion module continuously serves TTL speed signals, regardless of the state or availability of its host module or local bus.

Tachometer Page

Page Overview

The Tachometer page includes parameters that are transmitted to a connected tachometer expansion (1444-TSCX02-02RA) module for use in processing the raw speed signals.

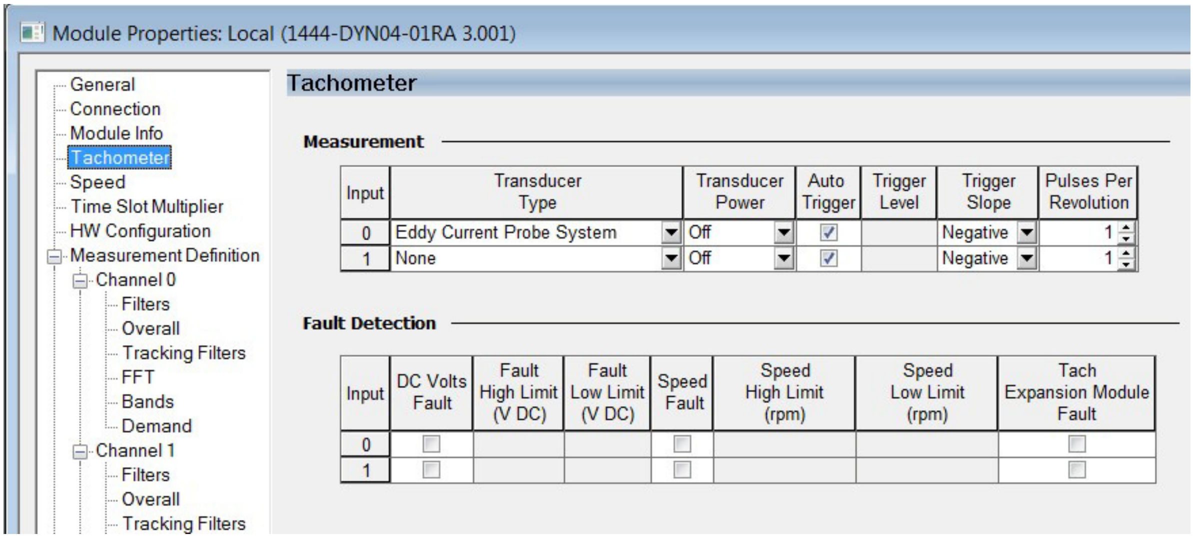


Table 41 - Tachometer

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Transducer Type</td><td><table><tr><th>Sensor Type</th><th>Value</th></tr><tr><td>Off</td><td>0</td></tr><tr><td>TTL Signal</td><td>1</td></tr><tr><td>NPN Proximity Switch</td><td>2</td></tr><tr><td>PNP Proximity Switch</td><td>3</td></tr><tr><td>Eddy Current Probe System</td><td>4</td></tr><tr><td>Self-Generating Magnetic Pickup</td><td>5</td></tr></table></td><td>Select the type of speed sensor that is connected to the input channel of the tachometer signal conditioner.</td></tr>
<tr><td>Transducer Power</td><td><table><tr><th>Transducer Power</th><th>Value</th></tr><tr><td>Off</td><td>0</td></tr><tr><td>+24V DC</td><td>1</td></tr><tr><td>-24V DC</td><td>2</td></tr></table></td><td>Select the power requirement for the connected sensor.
Set to “Off” if the sensor is self-powered, such as a Magnetic Pickup, or if it is powered from a separate source, including a barrier or isolator.</td></tr>
<tr><td>Auto Trigger</td><td>Checked (1)
Unchecked (0)

Auto Trigger is not available for Series A tachometer signal conditioner expansion module hardware. Hardware series is specified in Module Definition.
If a series A module is installed, but identified as a series B module, and auto trigger is enabled in configuration, the tachometer module:
Defaults to manual mode
Indicates non-configured status (also see Status Page)
Indicates failed communications status (Expansion bus or module fault status)
Indicates overall expansion module fail status (Exp Module Summary status)</td><td>When checked, the tachometer signal conditioner automatically determines the trigger threshold. The function behavior, dependent on transducer type, is as follows:<table><tr><th>Sensor Type</th><th>Behavior</th></tr><tr><td>Off</td><td>—</td></tr><tr><td>TTL Signal</td><td rowspan="3">Fixed trigger level</td></tr><tr><td>NPN Proximity Switch</td></tr><tr><td>PNP Proximity Switch</td></tr><tr><td>Eddy Current Probe System</td><td>Trigger level that is continuously adjusted</td></tr><tr><td>Self-Generating Magnetic Pickup</td><td>Fixed level</td></tr></table>When the Transducer Type is Eddy Current Probe System, Auto trigger requires a signal pulse level of not less than 2.0 volts peak to peak.</td></tr>
</table>

Table 41 - Tachometer (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Trigger Level</td><td>-23.000 ≤ Trigger Level ≤ 23.000</td><td>Enter the desired trigger level in Volts (ex. -2.4).
IMPORTANT: The trigger signal is not AC coupled, so DC offset (gap) must be considered.
The Tachometer Signal Conditioner module trigger function applies a fixed hysteresis of 800 mV. Consequently the minimum pulse height that can be triggered is approximately 1 volt.
Enter a trigger level that is near the mid-point of the trigger pulse delta voltage, and in the same direction. An example:
When using a common 200mV/mil eddy current probe:
If the probe is gapped to -10.5 volts relative to the target shaft, and uses a keyway is the target, then the gap voltage is -21 volts when the keyway is encountered. This provides a negative slope, the voltage is inherently negative (-), and the mid-point is around -16 volts. These measurements can yield a trigger level of -16 volts, negative slope.
When using a typical magnetic sensor: If the sensor has a total pulse offset of 7 volts, when encountering a trigger protrusion on the shaft, then set a trigger level of 3.5 volts and a positive slope.
Where practical, it is best to observe a time waveform of the pulse to verify the proper direction and amplitude are selected for the trigger level and slope.
The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level yields a -2400 (millivolt) tag value.</td></tr>
<tr><td>Trigger Slope</td><td><table><tr><th>Trigger Slope</th><th>Value</th></tr><tr><td>Positive</td><td>0</td></tr><tr><td>Negative</td><td>1</td></tr></table></td><td>Enter the direction of the desired trigger slope.
The trigger is “leading edge” if the slope is the same as the direction as the pulse (positive slope for a positive going pulse). It is “trailing edge” if the slope is opposite the direction of the pulse (positive slope on a negative going pulse).</td></tr>
<tr><td>Pulses per Revolution</td><td>1…255</td><td>Enter the number of signal pulses per revolution of the shaft.</td></tr>
<tr><td>DC Volts Fault</td><td>Checked (1)
Unchecked (0)</td><td>When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault High / Fault Low limits.</td></tr>
<tr><td>Fault High Limit (V DC)</td><td>-32.000 ≤ Fault High Limit ≤ 32.000</td><td>Enter the bias fault high level in Volts (ex. -2.4). The value must be greater than the Fault Low Limit.
When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault High / Fault Low limits.
The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level is a -2400 (millivolt) tag value.</td></tr>
<tr><td>Fault Low Limit (V DC)</td><td>-32.000 ≤ Fault Low Limit ≤ 32.000</td><td>Enter the bias fault low level in Volts (ex. -2.4). The value must be less than the Fault High Limit.
When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault Low / Fault Low limits.
The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level is a -2400 (millivolt) tag value.</td></tr>
<tr><td>Speed Fault</td><td>Checked (1)
Unchecked (0)</td><td>When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Fault High / Fault Low limits.</td></tr>
</table>

Table 41 - Tachometer (continued)

Parameter	Values	Comments
Speed High Limit	0.0 ≤ Speed High Limit	Enter the high-speed limit. The value must be greater than the Speed Low Limit. When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Speed High / Speed Low limits.
Speed Low Limit	0.0 ≤ Speed Low Limit	Enter the low speed limit. The value must be lower than the Speed High Limit. When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Speed High / Speed Low limits.
Tach Expansion Module Fault	Checked (1) Unchecked (0)	When enabled (checked), the tachometer signals a fault when the tachometer expansion module is in fault. If a module fault is detected, if possible, the TSC module continues to provide a signal to its various tacho outputs. For example, as a communication link timeout, which does not preclude the function of the module. Set the Tach Expansion Module Fault to communicate these detected module faults as a tacho sensor fault.

Notes:

Configure Analog Outputs

Analog Expansion Module

The addition of a 1444-AOFX00-04RB Analog Output Expansion Module enables analog outputs of 4…20 mA. The Dynamix™ 1444 series Analog Output Expansion Module is a four-channel module that outputs 4…20 mA signals. These signals are proportional to measured values of the host 1444-DYN04-01RA dynamic measurement module.

The 1444-AOFX00-04RB module is designed for use with a dynamic measurement module that acts as its host, serves its power, and manages the analog configuration of the module.

The analog output expansion module is designed to act as an extension of its host module. Therefore, the operation of the 1444-AOFX00-04RB module is dependent on the availability of its host.

Output Configuration Page

Page Overview

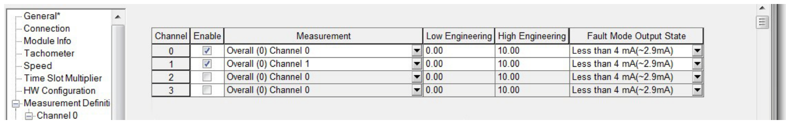


Table 42 is a list of the different output configurations.

Table 42 - Output Configuration

Parameter	Values	Comment
Enable	Enabled (checked) or Not Enabled (not checked)	Check the box to enable output from each respective 4…20 mA output channel.
Measurement	Available selections are dependent on the Channel Type and the Channel Measurement Type for the channel that is associated with each measurement. See Define Module Functionality page in Module Definition on page 92 and Hardware Configuration on page 112. See Table 43 on page 201 to view all available settings.	Select the measurement to be output on the referenced Analog Module channel.
Low Engineering	Any	Enter the value, in Engineering Units, which is to correspond to an output magnitude of 4 mA.
High Engineering	Any	Enter the value, in Engineering Units, which is to correspond to an output magnitude of 20 mA.
Units	—	Displays the Engineering Units for the selected measurement.
Fault Mode Output State	Select from: • No action • < 4 mA • > 20 mA	Select the desired behavior on fault. Outputs the measured value, regardless of the fault condition. If "< 4 mA" the output is driven to 2.9 mA. If "> 20 mA" the output goes to ~21 mA. Faults that result in the defined behavior include: • Transducer Fault (for the channel that is associated with the measurement) • Expansion Bus Failure • Expansion Module Self-Check Fail

Table 43 - Output Configuration Page Measurement Selection Options

Measurement	Channel Type	Measurement Type
Overall (0/1), Channel 0…3	Dynamic, gSE	Any
	Static	Eccentricity
DC(V), Channel 0…3	Dynamic, gSE	Any
Order magnitude (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled	
Order Phase (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled Order value is an integer (no fractions)	
FFT Band (0…8), Channel 0…3	Dynamic, gSE	Any
	FFT Band is Enabled	
Not 1X, Channel 0…3	Dynamic	Any
	Order 0 is Enabled Order 0 value = 1.0	
DC Channel 0…3	Static	Any
SMAX magnitude, Channel Pair 0/1, 2/3	Dynamic	X (shaft relative), Y (shaft relative), Aeroderivative. Shaft Relative (LP/HP filtered)
SMAX Phase, Channel Pair 0/1, 2/3		
Shaft Absolute pk-pk, Channel Pair 0/1, 2/3	Dynamic	CH A = Shaft Relative (LP/HP filtered) CH B = Std. case absolute vibration (AV to D) or Std. case absolute vibration (V to D)
Speed (0/1)	If Speed input is Enabled	Any
Factored Speed (0/1)		
Speed maximum (0/1)		
Speed Rate of Change (0/1)		
Axial Differential Expansion, Channel Pair 0/1, 2/3	Static	CH A = Complementary Differential Expansion A CH B = Complementary Differential Expansion B
Ramp Differential Expansion, Channel Pair 0/1, 2/3	Static	CH A = Ramp Differential Expansion A CH B = Ramp Differential Expansion B
Rod Drop 0…3	Static	Rod Drop

The Dynamix 1444 Series 1444-DYN04-01RA dynamic measurement module can output analog representations of measured data in the 4…20 mA format. The functionality is suitable for driving strip chart recorders, output to analog meters, or to replace previous communication solutions that were available in legacy systems. While 4…20 mA outputs are available, they are not the preferred medium for data communication from the Dynamix system.

This page is presented only when an Analog Output Expansion Module (1444-AOFX00-04RB) is present (See Expansion Device Definition Dialog on page 94). When available, one per measurement module, this page is used to configure the outputs.

Configure Relays

Relay Expansion Module

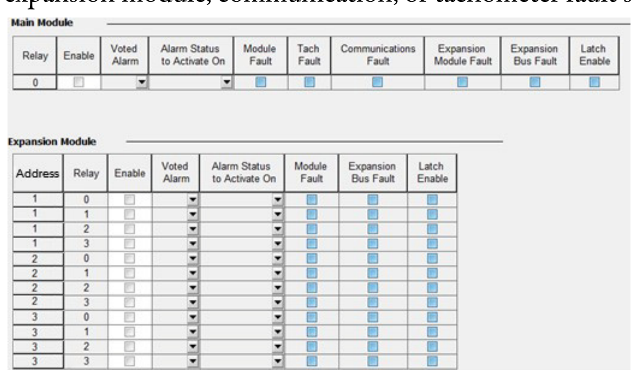
The Dynamix™ 1444 series relay expansion module is a four-relay module that serves to add relays to its host 1444-DYN04-01RA dynamic measurement module.

The 1444-RELX00-04RB module is designed for use with a dynamic measurement module that acts as its host, serves its powers, and manages the relay module configuration.

The relay expansion module acts as an extension of its host module. So 1444-RELX00-04RB module operation is dependent on the availability of its host. However, the relay module can actuate relays independently of its host if communications to the host fail or are lost.

Relay Page

Relays generally mimic the output logic of a referenced voted alarm. Relays can also be configured to act independently of the voted alarm on module, expansion module, communication, or tachometer fault status.



Configuration options for expansion relay module relays are shown only for connected expansion relay modules (so either 4, 8 or 12 expansion relay module relays can be configured).

Table 44 - Relays

Parameter	Values	Help
Main Module Relay – Enable	Checked (1) / Unchecked (0)	Check to enable the relay.
Main Module Relay – Voted Alarm Number	Blank or 0…12 presented in a list of enabled Voted Alarms	This value is the Voted Alarm that is associated with the main module relay. If blank, then at least one fault must be selected to act on.
Main Module Relay – Alarm Status to Activate On	Select from: • Alert • Danger • Xdcr Fault • Disarm • Module Fault	Alert, Danger, and Transducer Fault are states that the Voted Alarm can actuate on (see Voted Alarms Page). If Disarm is selected, the relay is in Bypass mode. If Module Fault is selected, then the relay actuates only on the specified faults (not just Module Fault).
Main Module Relay – Module Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a fault in the main module. When Fail-Safe Enable is checked for the selected Voted Alarm, if Alarm Status to Activate On is set to Module Fault this control is checked and disabled. If the relay is configured to actuate on Module Fault only, so no associated voted alarm, then the relay is configured Fail Safe (normally energized).
Main Module Relay – Tach Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a tachometer fault. This fault actuates if a tachometer fault is indicated on any enabled speed input (see Speed Page).
Main Module Relay – Communication Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on an Ethernet network fault.
Main Module Relay – Expansion Module Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a fault reported by in any connected expansion module.
Main Module Relay – Expansion Bus Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a fault of the Expansion Bus.
Main Module Relay – Latch Enable	Checked (1) / Unchecked (0)	Check this value when the relay must latch after having actuated on any of the selected fault conditions. Latch control for the alarm input is included in the Voted Alarm definition.
Expansion Module Relay – Enable	Checked (1) / Unchecked (0)	Check to enable the relay.
Expansion Module Relay – Voted Alarm Number	Blank or 0…12 presented in a list of enabled Voted Alarms	This value is the Voted Alarm that is associated with the expansion module relay. If blank, then at least one fault must be selected to act on.
Expansion Module Relay – Alarm Status to Activate On	Select from: • Alert • Danger • Xdcr Fault • Disarm • Module Fault	Alert, Danger, and Transducer Fault are states that the Voted Alarm can actuate on (see Voted Alarms Page). If Disarm is selected, the relay is in Bypass mode. If Module Fault is selected, then the relay actuates only on the specified faults (not just Module Fault).

Table 44 - Relays (continued)

Parameter	Values	Help
Expansion Module Relay – Module Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a fault in either the main Module or the Relay expansion module. When Fail-Safe Enable is checked for the selected Voted Alarm, if Alarm Status to Activate On is set to Module Fault this control is checked and disabled. If the relay is configured to actuate on Module Fault only, so no associated voted alarm, and it is the first relay on the expansion module that is configured for Module Fault, then the relay is configured Fail Safe (normally energized).
Expansion Module Relay – Expansion Bus Fault	Checked (1) / Unchecked (0)	Check this value when the relay must actuate on a fault of the Expansion Bus.
Expansion Module Relay – Latch Enable	Checked (1) / Unchecked (0)	Check this value when the relay must latch after having actuated on any of the selected fault conditions. Latch control for the alarm input is included in the Voted Alarm definition.

Relay Management Overview

Relays are commonly used in a monitoring system to provide annunciation of a change in machine condition, trip a machine, preclude start of a machine.

The relay management system provides a flexible implementation where relays can be defined to act on:

- Any voted alarm output, which includes any faults that are implicit in the voted alarm definition
- Any voted alarm output, which includes any faults that are implicit in the voted alarm definition, and selected system faults
- Any selected system faults (a dedicated fault relay)

Alarm Output

Each relay can reference one voted alarm. Because the status of the voted alarm could be an alert, danger, transducer fault, disarm, or module fault, you must also define the specific status necessary to actuate the relay.

A voted alarm can be configured to actuate on alert, danger, and/or transducer fault. You can also define how the measurement alarms input to the voted alarm behaves if a transducer fault occurs. This flexibility provides the tools necessary to define systems with relays that, for example:

- Actuate only when the voted logic is based on actual alarm level measurements
- Actuate when the voted logic is based on alarm level or faulted measurements
  In this case, the measurement alarms are defined such that a transducer fault is treated as “in alarm”.
- Actuate on transducer fault

Main Module Fault Output

Relays can also be configured to actuate on various fault conditions. Fault conditions can be selected in addition to a voted alarm input, or independently of (so acts only on faults) and any or all faults can be selected for notification by the relay.

The available faults that can be detected and acted on by the dynamic measurement module relay differ from those faults that are available to the expansion module relays. The available faults that the main module relay can be configured to act on are as follows:

Module Fault

The module fault is a fault reported by the main module itself on failure of any of the following:

- Startup tests
- RAM (memory) test
- Code CRC check
- Runtime tests
- RAM (memory) test (Runtime version)
- Code CRC check (Runtime version)
- Relay drive test (tests the internal relay drive circuitry when the relay configuration is fail-safe)

The level of the compliance requirement determines how, which, and how frequently the runtime tests are performed. See General Page on page 97.

Tachometer Fault

A tachometer fault condition is communicated to the main module by any of:

- The local bus from the tachometer signal conditioner expansion module (1444-TSCX02-02RB)
- The tachometer fault status inputs (terminal connections) from the tachometer signal conditioner expansion module (1444-TSCX02-02RB) or other source
- The SpeekOK0/1 bits in the controller output control tag

See Tachometer Page on page 194 for further information on how to define fault detection for a tachometer signal conditioner expansion module.

Communication Fault

A communication fault is reported if a fault occurs with the Ethernet link from the module.

Expansion Module Fault

An expansion module fault is reported if any of the connected expansion modules report a module fault.

Each expansion module performs start-up tests of memory and function similar to the main module.

The relay expansion module performs the relay drive test on its relays when commanded by the main module.

Expansion Bus Fault

A timeout function is implemented that requires that a "Heartbeat™" from each expansion module is provided to help verify that each module is communicating and that the bus is functioning.

If the heartbeat period times out, bus fault is reported in case communication between the main and any of its expansion modules fails.

Expansion Module Fault Output

The following faults can be detected and acted on by any of the 1444 series expansion relay module (1444-RELX00-04RB) relays.

Module Fault

The relay expansion module itself reports this fault.

Each expansion module performs start-up tests of memory and function similar to the main module.

The relay expansion module performs the relay drive test on its relays when commanded by the main module.

Expansion Bus Fault

A timeout function is implemented that requires that a “Heartbeat™” from each expansion module is provided to help verify that each module is communicating and that the bus is functioning.

A bus fault is reported if communication between the expansion module and its host (main module) fails - the heartbeat period times out.

Latching

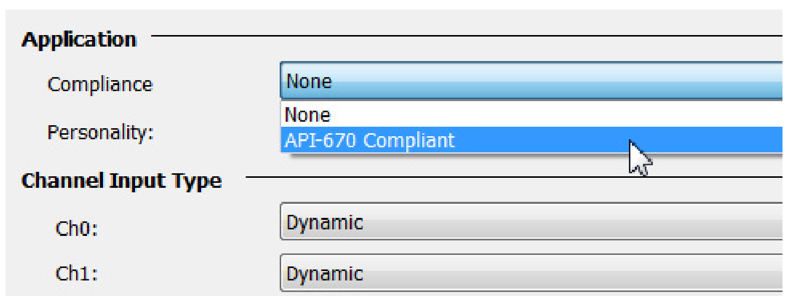
Configuration of each relay of the main and expansion relay module also includes a Latch Enable control. This control differs from the Latch Enable of the Voted Alarm in that this Latch definition is associated only with relay behavior that is related to the Fault detection. See Voted Alarms Page on page 222.

Reset of a latched relay remains the same as for the standard alarm reset function.

Relay Drive Testing

The module routinely performs a test of the drive circuit on all expansion module relays that are defined as fail-safe when the module compliance requirement is set API-670 Compliant. See Voted Alarms Page on page 222 and General Page on page 97.

Figure 83 - API-670 Compliant



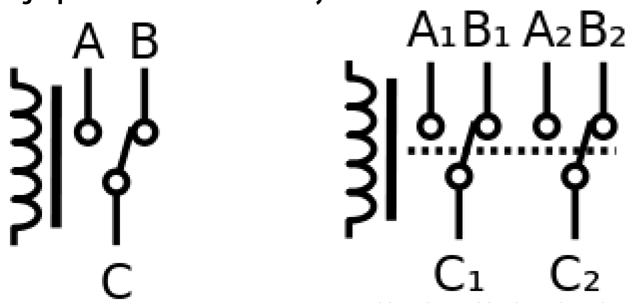
ATTENTION: The specific frequency of the testing for the configured application can be read from the module. See the Dynamix™ Relay Module Object in the Object Library documentation for further information.

Failure of a routine drive circuit test constitutes a “module fault” condition for expansion module.

Double-pole, Double-throw (DPDT) Relay Solutions

All 1444 Series module and expansion module relays are identical single-pole, double-throw (SPDT) type as in Figure 84. When a double-pole, double-throw (DPDT) relay is required it is possible to combine two SPDTs to act as a DPDT.

Figure 84 - Single-pole and Double-throw Relays



Single-Pole, Double-Throw (SPDT) Relay   Double-Pole, Double-Throw (DPDT) Relay

Each single-pole, double-throw relay includes one input pin (common) and individual pin connections for the normally open and normally closed positions of the relay.

Each double-pole, double-throw relay includes two common pins (connections) and, for each, independent connections for the normally open and normally closed positions of the poles.

The 1444 series supports DPDT relay solutions by use of two identically configured standard SPDT relays. Each SPDT relay that is used in a DPDT solution can be on the same or different expansion relay module but exclude the SPDT on the main module (1444-DYN04-01RA). That relay includes (slightly) different functionality than the expansion module relays.

Notes:

Configure Alarms

The Dynamix™ 1444 Series 1444-DYN04-01RA dynamic measurement module includes a sophisticated alarming system. This alarming system can meet the alarm detection, voting, and relay management requirements of any application that monitors alarm conditions. Three linked elements define the alarm system: measurement alarms, voted alarms, and relays.

Alarm System Overview

The Alarm System comprises configurable Measurement Alarms, Voted Alarms and Relays, and their associated Alarm Statuses. The number of each and their associations are as follows:

Element	Quantity	Associations	Comments
Measurement Alarm	24	• Each measurement alarm can be associated with any number of voted alarms.	• Measurement alarms are used as input to voted alarms and are evaluated only when a voted alarm that references it is evaluated. • Because voted alarms manage setpoint multiply and gating controls, it is possible to configure one measurement alarm that is applied to multiple voted alarms. This alarm, when evaluated, can indicate in-alarm to one voted alarm and not in-alarm to another voted alarm. • Measurement alarm status is available only indirectly, via an associated voted alarm status.
Voted Alarm	13	• Each voted alarm can reference 1…4 measurement alarms. • Each voted alarm can be associated with any number of relays.	• When Alarm Alignment (Module Definition, General page) is configured as Dynamic (default), one Voted Alarm can define outputs for any or all of Alert, Danger and Transducer Fault. • If Alarm Alignment is configured as Static, then a Voted Alarm can specify only one output - Alert, Danger, or Transducer Fault. • Voted Alarm status is provided for each enabled output by an Alarm Status (see Alarm Status Alignment on page 212).

Element (continued)	Quantity	Associations	Comments
Relay	1, 5, 9, 13	• A relay can be associated with a specific output of a voted alarm, and/or one or more Fault conditions	• When a relay is associated with an output of a voted alarm, the associated voted alarm implements the relay logic. • When a relay is configured to actuate on one or more Fault conditions, then the fault detection logic is independent of any associated voted alarm. • Relay status is provided in the relay status structure of the controller input assembly. See Relay Status Structure on page 286.
Alarm Status	13	• Dynamic Alignment – One per Relay that is not enabled – One per Relay that is configured to actuate on Fault (only) – One per enabled Voted Alarm Output	• When Alarm Alignment is configured as Dynamic (default), the module makes sure that an Alarm Status is assigned to, or left reserved for, each Relay in the system. See Alarm Status Alignment on page 212. • Alarm Statuses are assigned as follows: **For each Relay**: – If not enabled then reserve an Alarm Status for it – If enabled but only for Fault (so does not reference a voted alarm output), then assign an Alarm Status and set its voted alarm instance to 14 – Assign an alarm status to the voted alarm output referenced by the relay • Assign any remaining Alarm Statuses to any remaining enabled voted alarm outputs.
		• Static Alignment – One per enabled Voted Alarm	• When Alarm Alignment (see Alarm Status Alignment on page 212) is configured as **Static**, the module assigns an Alarm Status to each voted alarm output. • When Alarm Alignment is Static, a Voted Alarm can specify only one output: Alert, Danger, or Transducer Fault. • Alarm Statuses are assigned to each Voted Alarm. – Alarm Status 0 --> Voted Alarm 0 – Alarm Status 1 --> Voted Alarm 1 … – Alarm Status 12 --> Voted Alarm 12 • A Relay has an associated Alarm Status only if the relay references a voted alarm.

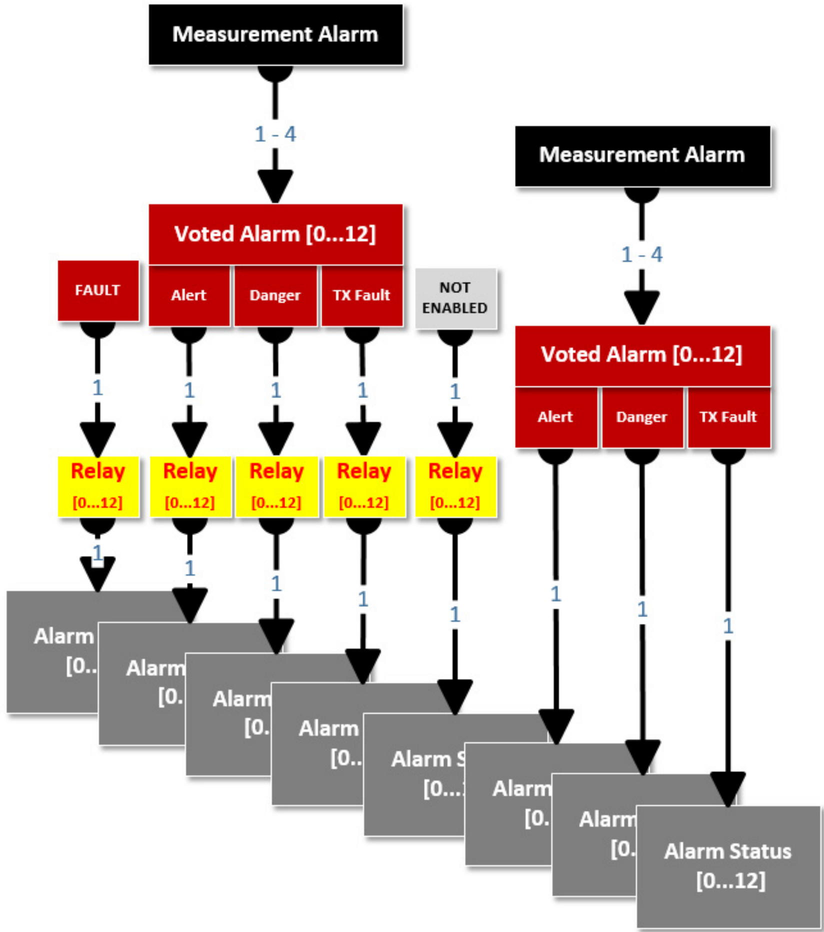
Alarm Status Alignment

There are 13 instances of Alarm Status. Alarm Status Alignment (Module Definition, General page) configuration determines how they are allocated and associated with relays and voted alarms.

Dynamic Alignment

Dynamic alignment makes sure that an Alarm Status is assigned to each relay. Because Relay Status provides only an indication that a relay is energized, further detail such as Alarming, Actuated, Bypass must be read from an associated Alarm Status.

Figure 85 - Alarm Status Dynamic Alignment



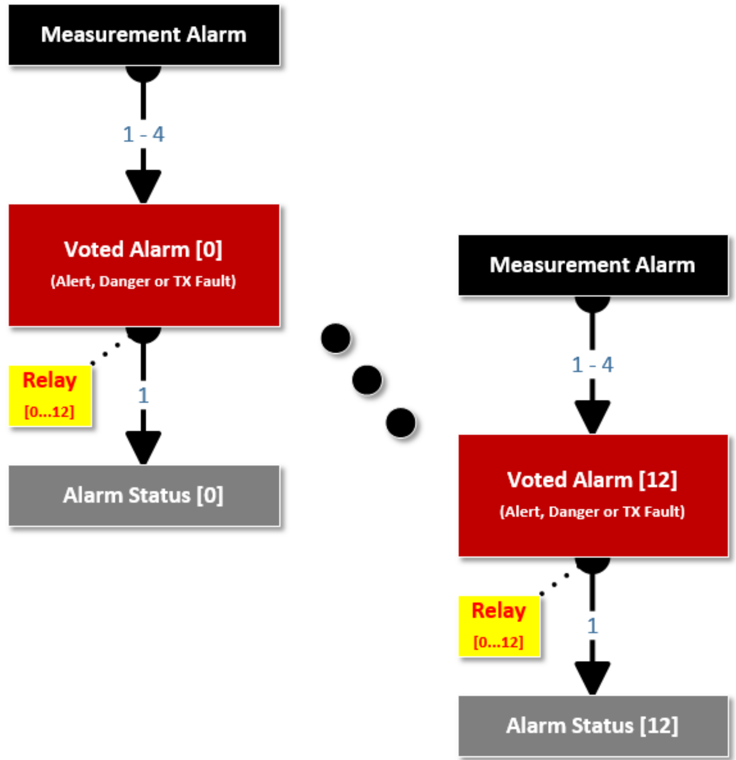
Dynamic alignment makes sure that every relay has an assigned Alarm Status. Voted Alarms can define multiple outputs. Voted Alarms, when not referenced by a relay, are associated with Alarm Statuses only after all Relays are assigned.

IMPORTANT	Every DYN module includes one onboard relay. When using Dynamic Alignment, the first Alarm Status is always assigned to the Voted Alarm that is referenced by the onboard relay (Relay 0), or the first Alarm Status is reserved for use by that relay.

Static Alignment

Static alignment assigns an Alarm Status to each Voted Alarm, which can have only one output. This method is often simpler to use as it is apparent which Voted Alarm each Alarm Status associates with. However, in this mode it is left to the user to know which Voted Alarm and Alarm Status associates with each Relay. Also, if a relay is configured to actuate only on Fault then there is no associated Alarm Status.

Figure 86 - Alarm Status Static Alignment



Static alignment assigns Voted Alarm N to Alarm Status N. So the status of Voted Alarm 4 is in Alarm Status 4, Voted Alarm 7 is in Alarm Status 7, and so on. A Voted Alarm can have only one output. Any relay, 0 … 12, can reference any Voted Alarm.

Measurement Alarms Page

Page Overview

The following overview describes the dynamic measurement module.

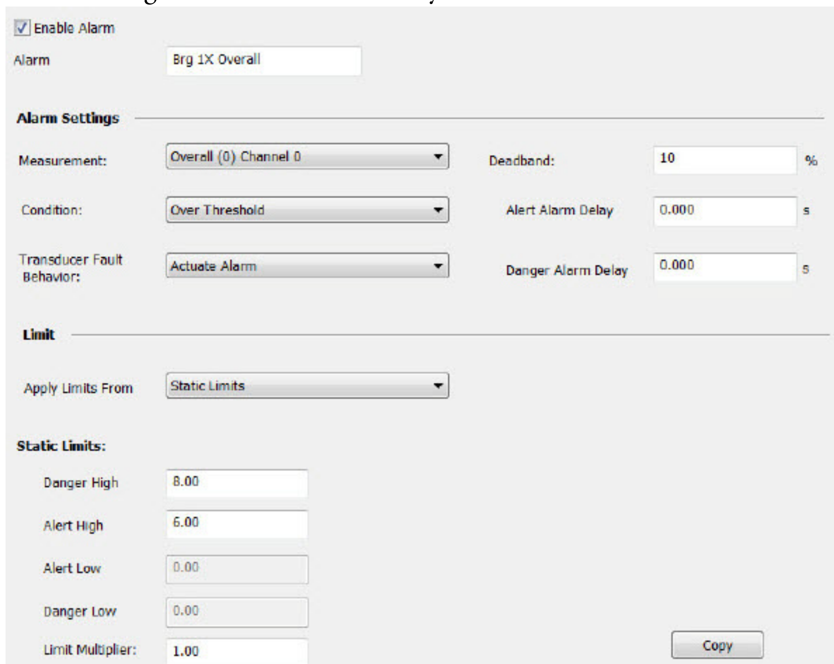


Table 45 - Alarms

Parameter	Values	Help
Enable Alarm	Checked (1) / Unchecked (0)	Check to enable the alarm.
Alarm Name	Characters	Enter a name of up to 32 characters. There are no rules for the name content or uniqueness. However, the name is used when you select Measurement Alarms as input to other functions, such as Voted Alarm definition, so unique names are recommended. Additionally the name: • Must start with a letter or underscore ("_"). • Must consist of letters, numbers, or underscores. • Cannot contain two contiguous underscore characters. • Cannot end in an underscore.
Measurement	Available selections are dependent on the Channel Type and the Channel Measurement Type for the channel that is associated with each measurement. See General Page on page 97. See Hardware Configuration Page on page 111. See Table 46 on page 218 to view all available settings.	Select the measurement for the selected Measurement Alarm to evaluate.
Condition	Select from: • Greater Than • Less Than • Inside Range • Outside Range	Select the desired condition.

Table 45 - Alarms (continued)

<table>
<tr><th>Parameter</th><th>Values</th><th>Help</th></tr>
<tr><td>Transducer State Behavior</td><td>Select from:
• Transducer Fault Considered
• Transducer Fault Monitored
• Transducer Fault Not Considered</td><td>This selection specifies the behavior of the Measurement Alarm if a transducer fault occurs.
<table>
<tr><th>Option</th><th>Behavior</th></tr>
<tr><td>Transducer Fault Considered</td><td>The Alarm is not evaluated (so never TRUE) if the transducer is in a Fault condition.
Any alarm that was TRUE (actuated) clears if the associated transducer goes into fault.</td></tr>
<tr><td>Transducer Fault Monitored</td><td>The Alarm is forced to TRUE (actuated) when the transducer is in a Fault condition, regardless of the value of the measured parameter.</td></tr>
<tr><td>Transducer Fault Not Considered</td><td>The behavior of the alarm remains strictly defined by the measurement.
Depending on the nature of a transducer fault and the specifics of the measurement, a fault can force the measurement high, or low.</td></tr>
</table>
Also consider:
<table>
<tr><td>Dual Channel Measurements</td><td>The preceding table information applies if either sensor faults.</td></tr>
<tr><td>Speed Measurements</td><td>The preceding table information applies if the speed transducer faults.</td></tr>
<tr><td>Speed Dependent Measurements</td><td>The preceding table information applies if the associated transducer faults OR if the speed transducer faults.</td></tr>
</table></td></tr>
<tr><td>Deadband</td><td>0…20</td><td>Enter a deadband (hysteresis) as a percentage of the alarm limit or alarm window range. This value is the amount that the measured value must increase above or fall below (the non-alarm state direction) the limit after exceeding it before the alarm condition clears.
The intent of the deadband is to minimize “chatter”, where a measurement oscillates around the alarm limit and causes the alarm condition to set and unset repeatedly.
For window alarms, the deadband is the stated percentage of the range of the window (high - low).</td></tr>
<tr><td>Alert Alarm Delay Time</td><td>0.000…65.500 seconds</td><td>Enter the time that the measured value must persist at an Alert level before an Alert Alarm condition is set.
The intent of an alarm delay is to help prevent random electronic or mechanically generated noise. This noise can create rapid, short-lived signal spikes, from being interpreted, and acted on, as if an actual alarm condition.</td></tr>
<tr><td>Danger Alarm Delay Time</td><td>0.000…65.500 seconds</td><td>Enter the time that the measured value must persist at a Danger level before a Danger Alarm condition is set.
The intent of an alarm delay is to help prevent random electronic or mechanically generated noise. This noise can create rapid, short-lived signal spikes, from being interpreted, and acted on, as if an actual alarm condition.</td></tr>
<tr><td>Apply Limits From</td><td>Select from:
• Static Limits
• Static Limits with Adaptive Multipliers
• Output Tag Limits</td><td>Select the source for the alarm limits and any applicable multipliers.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Static Limits</td><td>The normal mode. The limits are entered directly (so are static), along with one (static) multiplier that the Setpoint Multiplier function manages.</td></tr>
<tr><td>Static Limits with Adaptive Multipliers</td><td>The limits are entered directly (so are static), but uses up to five multipliers that are applied depending on a control parameter.</td></tr>
<tr><td>Output Tag Limits</td><td>The limits are passed to the module in the Controller Output assembly. No multiplication is provided.</td></tr>
</table></td></tr>
<tr><td>Adaptive Limits</td><td>—</td><td>When the Limit Source is “Static Limits w/ Adaptive Multipliers”, click this option to access the Adaptive Multipliers editor.
Adaptive Multipliers are uniquely defined for each Measurement Alarm.</td></tr>
<tr><td>Danger High Limit</td><td rowspan="2">Any</td><td rowspan="2">Enter a value to specify the limit that when the measurement is above/below (unsafe direction) defines a Danger Alarm condition.</td></tr>
<tr><td>Danger low Limit</td></tr>
</table>

Table 45 - Alarms (continued)

Parameter	Values	Help
Alert High Limit	Any	Enter a value to specify the limit that when the measurement is above/below (unsafe direction) defines an Alert Alarm condition.
Alert Low Limit		
Danger High Output Tag Limit	Select from: • 0.AlarmLimit[0] • 0.AlarmLimit[1] • … • 0.AlarmLimit[15]	Select the controller output tag for the alarm limit that is referenced. Select the controller output tag for the alarm limit that is referenced.
Alert High Output Tag Limit		
Alert Low Output Tag Limit		
Danger Low Output Tag Limit		
Limit Multiplier	≥0…1000.000	For Static Limits (normal mode), enter the multiplier that is applied when the Setpoint Multiplier function is set. The Limit Multiplier field does not display if you select “Static Limits Without Adaptive Multipliers” from the Apply Limits From pull-down menu.

Table 46 - Measurement Alarm Measurement Selection Options

Measurement	Channel Type	Measurement Type
Overall (0/1), Channel 0…3	Dynamic, gSE	Any
	Static	Eccentricity
DC(V), Channel 0…3	Dynamic, gSE	Any
Order magnitude (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled	
Order Phase (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled Order value is an integer (no fractions)	
FFT Band (0…8), Channel 0…3	Dynamic, gSE	Any
	FFT Band is Enabled	
Not 1X, Channel 0…3	Dynamic	Any
	Order 0 is Enabled Order 0 value = 1.0	
DC Channel 0…3	Static	Any
SMAX magnitude, Channel Pair 0/1, 2/3	Dynamic	X (shaft relative), Y (shaft relative), Aeroderivative. Shaft Relative (LP/HP filtered)
SMAX Phase, Channel Pair 0/1, 2/3		
Shaft Absolute pk-pk, Channel Pair 0/1, 2/3	Dynamic	CH A = Shaft Relative (LP/HP filtered) CH B = Std. case absolute vibration (AV to D) or Std. case absolute vibration (V to D)
Speed (0/1)	If Speed input is Enabled	Any
Factored Speed (0/1)		
Speed maximum (0/1)		
Speed Rate of Change (0/1)		
Axial Differential Expansion, Channel Pair 0/1, 2/3	Static	CH A = Complementary Differential Expansion A CH B = Complementary Differential Expansion B
Ramp Differential Expansion, Channel Pair 0/1, 2/3	Static	CH A = Ramp Differential Expansion A CH B = Ramp Differential Expansion B
Rod Drop 0…3	Static	Rod Drop

Measurement Alarms provide the usual >, ≥, ≤ and < comparison checks between a measured value, such as "Channel 1 Overall", and a set of Danger and Alert level limits.

Alarm Measurement Definition

Each Measurement Alarm can be uniquely defined to compare any of the measured values in the module. The measurement is not necessary in the controller input assembly. (See Select Input Data for Input Tag on page 106). However, the module must be configured to measure the value before it can be selected as input to a Measurement Alarm.

Alarm Limit Definition

Each Measurement Alarm can be uniquely defined to apply limits that are either entered as static values that are part of the measurement alarm definition. Each Measurement Alarm can also be passed to the module as I/O in the controller output table.

IMPORTANT	When using profile alarms, so the alarm limits are provided on controller output, there can be some short period of time after the module begins measurements, and before the controller updates the output alarm limit values. To accommodate this, the module does not apply the alarm limits from the controller output until the limit is made non-zero. Until then the module uses the Static Limits configured for the alarm. You must set the Static Limits for the alarms at appropriate initial values.

Static Alarm Limits

Limits for high and low alert and danger levels can be entered. When used, the module compares the measured value with the limits each time the measurement is updated. The limits can also be multiplied, either by a set limit multiplier, or by any of up to five 'Adaptive Multipliers'.

Limit Multiplier

Typically an alarm limit multiplier is used for alarms that are applied to machines that operate above their first critical (natural) frequency. During startup, these machines experience vibration excursions that can exceed the (normal) alarm limits, as the speed of the machine traverses the critical frequency. Without applying this multiplier, the vibration levels can exceed danger setpoints, which can force a machine trip, during a normal machine startup.

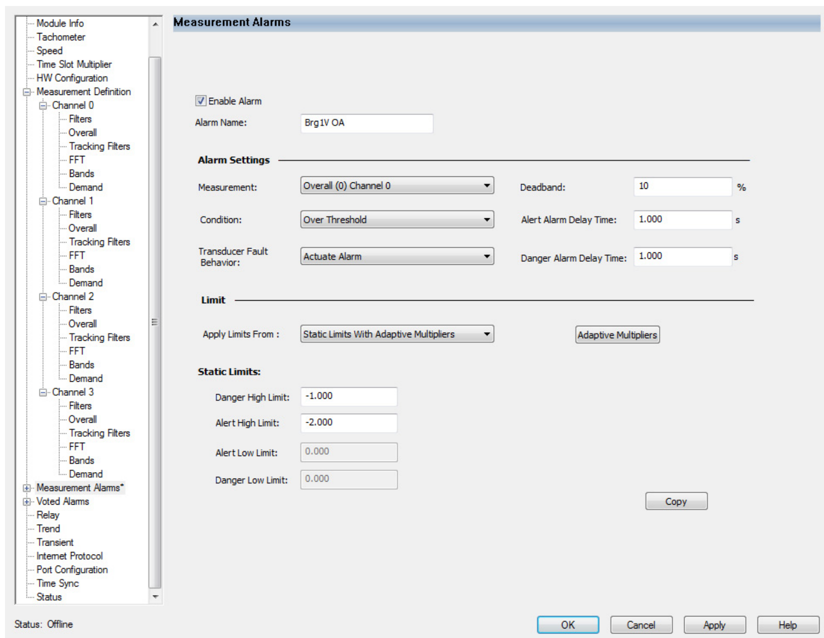
Control of the limit multiplier (on/off) is provided through the Setpoint Multiplier (SPM) function. A bit on the controller output assembly or by a physical input (switch) to the module manages the SPM. SPM is defined as part of any voted alarm definition that uses the measurement alarm (See Voted Alarms Page on page 222).

Adaptive Multipliers

The five adaptive multipliers are alternatives to the single SPM-managed static limit multiplier. Adaptive multipliers enable a method for the automatic application of an alarm limit multiplier that is based on a measured attribute (such as speed). When using adaptive multipliers, each of the multipliers is associated with a range of whatever the control parameter is. If the value of the control parameter is outside of the specified ranges, such that no multiplier is applicable, then a multiplier of 1.0 is used.

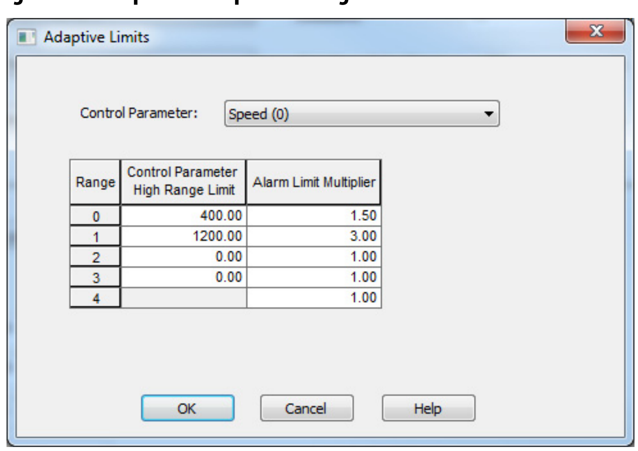
Adaptive Multipliers is implemented via a dialog that is accessed from the “Adaptive Multipliers” button on the Measurement Alarms page.

Figure 87 - Measurement Alarms Page



The “Adaptive Multipliers” button is only visible when “Apply Limits From” is set to “Static Limits With Adaptive Multipliers”.

Figure 88 - Adaptive Multipliers Dialog



In this example (shown) the multipliers are set based on Speed(0). The table, as entered, results in the following:

- From 0…400 RPM, the alarm limits are multiplied by 1.5
- From 400…1200 RPM, the alarm limits are multiplied by 3.0
- Above 1200 RPM, the alarm limits are not multiplied (x1.0)

Adaptive Limits page parameters are:

Parameter	Values	Help
Control Parameter	Select from list of measured values	While the complete list of measured values is presented, in almost all cases the multipliers are based on one of the four possible speed selections: Speed(0), Factored Speed(0), Speed(1), Factored Speed(1),
Control Parameter High Range Limit	0.00 … 50000.00	The respective multiplier is applied when the control parameter is greater than the previous entry high limit (or 0) and is less than or equal to this value.
Alarm Limit Multiplier	0.01 … 100.00	The value that the alarm limits are multiplied by.

Output Tag Limits

A third alternative to how limits are defined is to use output tag limits. Output tag limits are enabled in Module Definition on the select data to be added to the output tag page. In the controller output assembly,16 values (REALs) are included for use as alarm limits. When 'output tag limits' is selected as the alarm limits source, the high/low, danger/alert limits are mapped to selected output tag locations.

When in this mode, the module applies the alarm limits as read from the controller output tag. This mode then enables programmatic control of the limits from the Logix controller, which provides a far more powerful alarm management capability.

When output tag limits are applied, the limits read from the output assembly are used directly and never multiplied.

Profile Alarms

In addition to managing the alarms similarly to the included static limits with multipliers solutions (if programmed to do that), the output tag limits solution offers an ability to apply Profile Alarms.

Profile Alarms are used for applications where a machine performs a fixed, repetitive cycle over a defined time period or range of another control parameter. A Profile Alarm likely requires many limits with each correlated to a specific time, or control parameter range, during the cycle. Profile Alarm limits create a moving envelope or 'profile' of the expected behavior of the measurement. The controller then loads the appropriate limits to the output assembly depending on where the machine is in the cycle. Then the controller observes the input assembly status information to determine status.

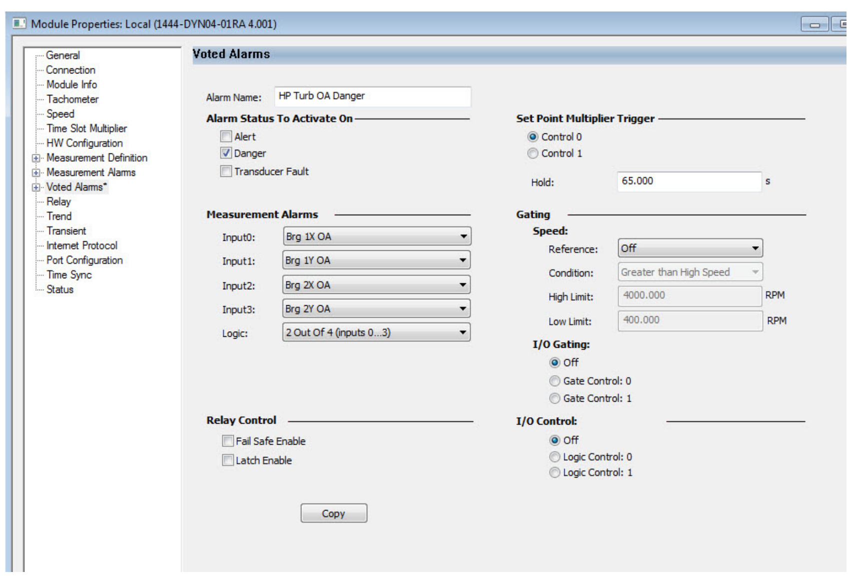
In these cases, the module detects and acts or notifies as appropriate when the measured value falls outside the expected envelope, or profile.

Profile Alarms can be useful in any application where the measurement (vibration, strain, dynamic pressure) varies normally, and often significantly, through a repeating process. Typical of these alarms are machine tools and other non-continuous cutting applications, robotic, or other cyclic motion applications.

Voted Alarms Page

Voted Alarms are where Measurement Alarms are applied. They provide a means to verify that a condition warrants an intended action.

Figure 89 - Voted Alarms



The module provides 13 voted alarms.

As with any alarm, a voted alarm is configured with specific inputs and logic that assesses to a simple true/false (1/0) condition.

Table 47 - Voted Alarms

Parameter Name	Values	Comments
Alarm Name	Characters	Enter a name up to 32 characters. There are no rules for the names content or uniqueness. However, the name is used when selecting Voted Alarms as input to other functions, such as Relay definitions, so unique names are recommended. Additionally the name: • Must start with a letter or underscore ("_") • Must consist of letters, numbers, or underscores • Cannot contain two contiguous underscore characters • Cannot end in an underscore
Alarm Status to Activate On – Alert	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Alert are evaluated as TRUE when used as inputs to this Voted Alarm. If Alarm Status Alignment is set to Static (Module Definition, General Page), then a Voted Alarm can specify just one Alarm Status to Activate On.
Alarm Status to Activate On – Danger	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Danger are evaluated as TRUE when used as inputs to this Voted Alarm. If Alarm Status Alignment is set to Static (Module Definition, General Page), then a Voted Alarm can specify just one Alarm Status to Activate On.
Alarm Status to Activate On – Transducer Fault	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Transducer Fault are evaluated as TRUE when used as inputs to this Voted Alarm. If Alarm Status Alignment is set to Static (Module Definition, General Page), then a Voted Alarm can specify just one Alarm Status to Activate On.
Measurement Alarm – Input 0	All Measurement Alarms	Select the Measurement Alarm to use in Instance 0 of the Voted Alarm logic. If the Voted Alarm is enabled and this input is included in the specific Logic, then the Measurement Alarm that is referenced by this Input must be enabled.
Measurement Alarm – Input 1	All Measurement Alarms, except the Measurement Alarm that is selected for Input 0	Select the Measurement Alarm to use in Instance 1 of the Voted Alarm logic. If the Voted Alarm is enabled and this input is included in the specific Logic, then the Measurement Alarm that is referenced by this Input must be enabled.
Measurement Alarm – Input 2	All Measurement Alarms, except the Measurement Alarms selected for Inputs 0 and 1	Select the Measurement Alarm to use in Instance 2 of the Voted Alarm logic. If the Voted Alarm is enabled and this input is included in the specific Logic, then the Measurement Alarm that is referenced by this Input must be enabled.
Measurement Alarm – Input 3	All Measurement Alarms, except the Measurement Alarms selected for Inputs 0, 1 and 2	Select the Measurement Alarm to use in Instance 3 of the Voted Alarm logic. If the Voted Alarm is enabled and this input is included in the specific Logic, then the Measurement Alarm that is referenced by this Input must be enabled.

Table 47 - Voted Alarms (continued)

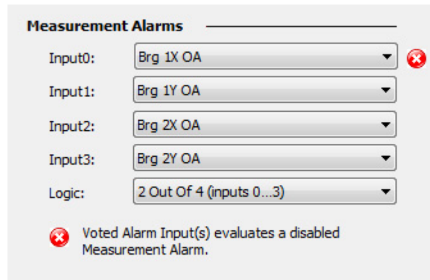
Parameter Name	Values	Comments
Logic	Select from: 1 Out Of 1 | 1 Out Of 4 1 Out Of 2 | 2 Out Of 4 2 Out Of 2 | 3 Out Of 4 1 Out Of 3 | 4 Out Of 4 2 Out Of 3 | 1 Out Of 2 AND 1 Out Of 2 3 Out Of 3 | 2 Out Of 2 OR 2 Out Of 2 1 Out Of 2 AND 2 Out Of 2 2 Out Of 2 AND 1 Out Of 2 The Logic control uses the form "A out of B". In all cases, the number "B" refers to the first B entries in the Measurement Alarm Input list.	For the Voted Alarm to evaluate to TRUE, the requisite number of its inputs* must have a status of any of the types that are enabled per Alarm Status to Activate On. *Per this Logic definition IMPORTANT: The selected logic must reference only enabled Measurement Alarms. For example, if the selected logic is "1 Out of 3" then the Measurement Alarms referenced by inputs 0, 1 and 2 must be enabled.
Setpoint Multiplier Trigger – Control 0/1	Select Control 0 or 1	Select Control 0 to use Controller Output Control Tag SPM 0 to manage the Setpoint Multiplier function. Select Control 1 to use Controller Output Control Tag to manage the Setpoint Multiplier function. To use Logic (Discrete) Inputs, the specific input must also be defined to apply to the SPM function (See Hardware Configuration Page on page 111).
Setpoint Multiplier Trigger –Hold	0.000…65.500 seconds	The time that the alarm (threshold) multiplier is applied after the control is toggled. The SPM control, either a physical switch or the specified bit on controller output, starts (or restarts) the TIMER each time the control toggles. A toggle occurs when the state changes, such as when the control changes from OFF/UNSET to ON/SET, or ON/SET to OFF/UNSET. **IMPORTANT**: When SPM is used, the hold time must be set to ≥1 second.
Gating Speed – Reference	Select from: • Off • Speed 0 • Speed 1 • Factored Speed 0 • Factored Speed 1 Speed 0/1 is presented only if defined and Factored Speed 0/1 is presented only if the factor value is >0 (see Speed Page).	Select the speed source to use as the reference in speed gating of this Voted Alarm.
Gating Speed – Condition	Select from: • Greater Than High Speed • Less than Low Speed • Inside Window • Outside Window	Select the condition to apply in the speed gating logic.
Gating Speed – High Limit	>0	The high-speed threshold.
Gating Speed – Low Limit	>0	The low speed threshold. Must be less than the High-Speed limit.

Table 47 - Voted Alarms (continued)

<table>
<tr><th>Parameter Name</th><th>Values</th><th>Comments</th></tr>
<tr><td>Output Tag Gate Control</td><td>Select Off, Alarm Control 0 or Alarm Control 1</td><td>Enables a control to be used to manage the enabling (control set) and the disabling (control unset) of the Voted Alarm.
Control inputs are normally implemented using one of the two Alarm Control output tags (control 0 = bit 5, control 1 = bit 6). Alternatively, control can be provided using either of the discrete inputs (See Hardware Configuration on page 112).</td></tr>
<tr><td>Output Tag Override Control</td><td>Select Off, Alarm Control 0 or Alarm Control 1</td><td>Enables a control to be used to manage activating a Voted Alarm, regardless of other definition and the state of any defined measurement alarm inputs. If defined, when the selected control is set, the voted alarm actuates. The capability can provide either of:
• A means to test the relay / output behavior of the voted alarm without having to satisfy the defined alarm conditions.
• A means to use the controller to manage associated relays directly. In this condition, the remainder of the voted alarm definition is inconsequential as it is used only to map relays for direct controller management.
Control inputs are normally implemented using one of the two Alarm Control output tags (control 0 = bit 5, control 1 = bit 6). Alternatively, control can be provided using either of the discrete inputs (See Hardware Configuration Page on page 111).</td></tr>
<tr><td>Relay Control – Fail-Safe Enable</td><td>Checked (1) / Unchecked (0)</td><td>Check to enable Fail-Safe for any relay that is assigned to this Voted Alarm.
<table><tr><td rowspan="2">Fail-Safe Behavior</td><td colspan="2">Relay Coil Status</td></tr><tr><td>In Alarm</td><td>Not in Alarm</td></tr><tr><td>Non-Fail-Safe</td><td>energized</td><td>de-energized</td></tr><tr><td>Fail-Safe</td><td>de-energized</td><td>energized</td></tr></table>Fail-Safe is applicable only to physical relays that are assigned to the Voted Alarm.
Fail-Safe is used to help make sure that if a loss of power occurs to the relay that it fails in a ‘safe’ state. The safe state is generally the same as the Alarm state.</td></tr>
<tr><td>Relay Control – Latch Enable</td><td>Checked (1) / Unchecked (0)</td><td>Check to enable Latching on this Voted Alarm.
Latching is applied to the Voted Alarm and is extended to any relays that are assigned to the alarm.
A latched Voted Alarm (and associated relay) can be reset after the alarm condition has cleared. Set the AlarmReset bit (bit 7) in the controller Control tag output, or if a discrete input is assigned this function, then by signaling that input. (See Hardware Configuration Page on page 111).</td></tr>
</table>

If an Input that is included in the specific Logic references a Measurement Alarm that is not enabled, then an error symbol is presented next to the Input, along with a notice following the Measurement Alarms selections. See Figure 90.

Figure 90 - Measurement Alarms



Inputs

There are two elements to the inputs of a voted alarm including the measurement alarm status and a list of measurement alarms. The status definition provides the specific conditions that this voted alarm acts on; alert and/or danger and/or transducer fault. The other input is a list of up to four enabled measurement alarms to use as input to the voting logic. (For example, 1 out of 2, 3 out of 4).

Logic

Logic is the “A out of B” voting that is applied to the inputs. Selections are provided which support various combinations of four inputs and include:

Logic	
1 Out Of 1	1 Out Of 4
1 Out Of 2	2 Out Of 4
2 Out Of 2	3 Out Of 4
1 Out Of 3	4 Out Of 4
2 Out Of 3	1 Out Of 2 AND 1 Out Of 2
3 Out Of 3	2 Out Of 2 OR 2 Out Of 2
	1 Out Of 2 AND 2 Out Of 2
	2 Out Of 2 AND 1 Out Of 2

For the AND and/or combinations, the inputs are grouped in the order they are entered. That is, inputs 0 and 1 for the BEFORE the and/or statement logic and inputs 2 and 3 for the AFTER the and/or statement logic.

For a vote to resolve to TRUE (1), the logic must be satisfied with inputs that are all in the same condition, and as defined for the voted alarm (alert/danger/fault).

Voted alarms enable definition of several control attributes, and the condition and inputs for the logical assessment are also defined. These include managing setpoint multiplication, gating controls, and relay controls.

Setpoint Multiplication

SPM enables application of the limit multiplier to any measurement alarms that are linked to the voted alarm, where the measurement alarm is applying only static limits. SPM control includes two items: the input to use and any hold period required.

SPM Control Input

The SPM function can be controlled from either of two inputs. These inputs can be either the SPM bits included in the controller output assembly (bits 1 and 2), or either of the physical discrete inputs to the module (Pt0, Pt1) that can be assigned to this function (See Hardware Configuration Page on page 111). The selection lets either controller output tag SPM 0/Pt0 or controller output tag SPM 1/Pt1 be used.

A second attribute, hold time, is also provided for SPM control. This value is used to define how long the SPM function remains active AFTER the SPM control has changed state. The timer starts (or restarts) each time the output assembly control bit, SetPointMultiplier0En/ SetPointMultiplier0En, is set or cleared. Or, if you use the digital inputs, the timer starts (or restarts) each time Pt(0) / Pt(1) is closed or opened. This behavior is intended to force continued positive assertion of the function, which precludes users from inadvertently leaving the SPM function enabled.

As an alternative to the timer, the module provides speed-based multiplication. See Adaptive Multipliers on page 220.

Gating

Gating is used to specify when a voted alarm is applied. While the gate condition is TRUE, the voted alarm is evaluated. If the gate condition is FALSE, the voted alarm is not evaluated.

Any defined gate condition must be satisfied as a prerequisite to the voted alarm. If the voted alarm is TRUE when the gate condition becomes FALSE, then the voted alarm transitions to FALSE, unless it is latched. See Latching on page 228. And, unless latched, any relays that are assigned to the voted alarm are also transitioned.

The module provides two methods of gating: speed and I/O (Logic) gate control.

Speed gating lets you select either of the two speed inputs, either the direct or factored speed value, a high and/or low speed limit, and the customary conditional (<, ≤, ≥, >). The gate is TRUE and the voted alarm that is applied when the measured speed satisfies the condition (evaluates to TRUE).

For I/O (Logic) gate control, the control signal can be provided either from the controller, via its control output tag, or from either of the discrete inputs when properly assigned. (See Hardware Configuration Page on page 111.)

For controller-based gate management, 2 bits are provided in the controller output control tag (bits 5 and 6). Either control (0/1) can be specified for each voted alarm. When the control bit is set (1), then the gate is TRUE and the voted alarm is evaluated.

Use of either of the discrete inputs also controls gating. The assigned discrete input must be configured on the Hardware Configuration page, and must also be selected (0/1) in the specific voted alarm definition.

Relay Control

When a relay is assigned a voted alarm as its input, it inherits the voted alarm latching and fail-safe definitions.

Latching

Latching applies to both the (logical) voted alarm and to any associated physical relay. When an alarm is latched, it cannot be reset until the condition has cleared (is no longer in the alarm state). Once the condition has cleared, the latch is reset using either the Output Assembly Alarm Reset bit or a physical reset switch that is wired to the one of the discrete inputs (see Hardware Configuration Page on page 111).

There are four methods available to reset a voted alarm, and all relays that reference it:

- Controller Output: 2 bits are included in the control tag of the controller output.
- Discrete Inputs: Either of the two discrete inputs can be assigned to reset alarms. (See Hardware Configuration Page on page 111.)
- Either of two alarm reset service requests can be sent to the module.
- The AOP status page, which executes the service request.

Each voted alarm includes a control selection that defines which of the two inputs (of any of the previous types) is used to reset the alarm. In this way, it is possible to define a more discrete control over which voted alarms are reset on command.

Fail-Safe

The voted alarm fail-safe definition is not used by the voted alarm (logic). Rather, it is inherited by any relays that reference the alarm (see Relay Page on page 203).

When defined as fail-safe, the coil of the relay is energized when not in an alarm condition, and de-energized when it is in the alarm condition. This provision is to make sure that upon loss of power that the relay moves to its "safe" condition, which is assumed to be its position when in alarm.

Relays

Relays are the final element of the 1444 series Alarm Management System. While the voted alarm can act as a "virtual relay", it cannot switch off power to a motor. Also, the voted alarm cannot route power to a light or other annunciator, or control a solenoid valve that can trip a turbine.

Also, in applications that require API-670 compliance, relays are the only approved interface between the monitor system and the emergency shutdown system or final actor when used to initiate a forced shutdown.

See Relay Page on page 203 for an overview on how to use relays in the 1444 series system.

Notes:

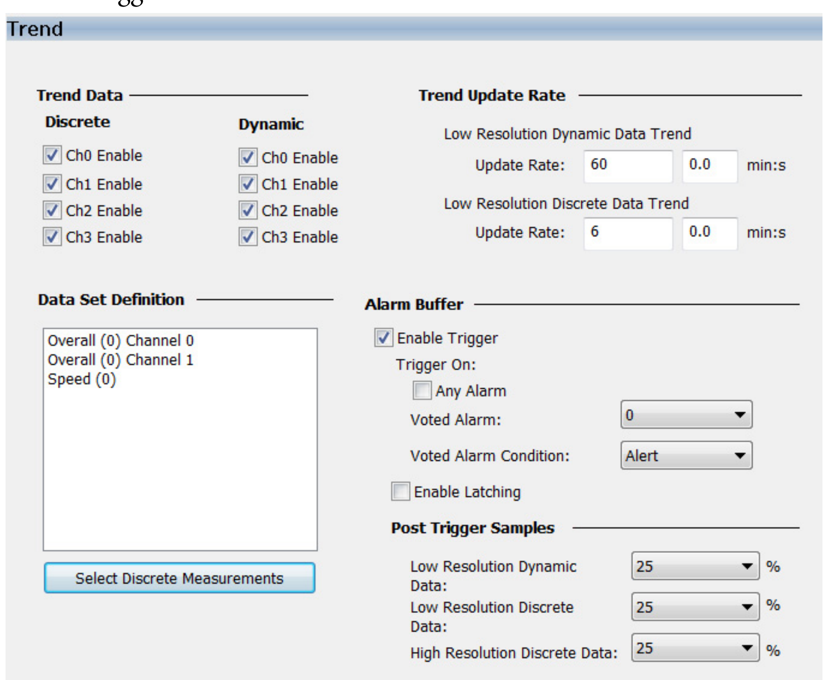
Trend and Transient Capture

This chapter explains trends and transient capture.

Trend Page

Page Overview

The dynamic measurement module includes a trend buffer capability that captures a set of internal data records. The internal data records are sampled at a defined periodicity and they span a defined amount of time. The module also supports an Alarm Buffer, a copy of the trend buffer, with additional high-resolution data at the trigger point, which is saved and held upon a user-defined trigger.



The Trend Page is used to configure both the Trend and the Alarm Capture functions.

Discrete Data Buffers

The trend definition includes selections that are associated with discrete and dynamic data.

Dynamic data refers to time waveforms and FFT. Discrete data are any single value data, including DC measurements, speeds, and values that are processed from a dynamic signal such as overall or 1x magnitude.

The module updates data to the discrete buffer at two different rates:

- High-Resolution ALARM buffer

  The Alarm Buffer includes 320 discrete data records that update at a fixed rate of approximately 100 milliseconds.

  The update rate can vary, from the defined 100 milliseconds, as higher priority processor demands take precedence. These variations can occur as routine functions, dependent on configuration, or as a consequence of circumstance; any higher priority immediate processor demands such as an action taken on alarm or a host data request.

- Low-Resolution TREND buffer

  The Trend Buffer includes 640 discrete data records. The update rate is set in minutes and seconds to a minimum (fastest) rate of 0.1 seconds, and to a maximum (slowest) rate of 54 minutes, 59.0 seconds. Seconds can be entered with a resolution of 0.1 (100 milliseconds).

  Low-Resolution samples are updated independent of the High-Resolution data. Therefore, even if the timers were to trigger at the same millisecond, the measurements read to the two buffers can be different. This result occurs because the measurement tasks of the module execute at a higher priority than buffer management.

Trend Buffer

The trend buffer is composed of 640 records that are sampled at the low-resolution rate and that overwrite in a circular, first-in-first-out manner. The buffer updates continuously when the module is in RUN mode.

Dynamic Buffer

Similar to the discrete measurement buffer, the trend function can also hold a buffer of dynamic data records. The dynamic data buffer is composed of 64 records, each containing a time waveform and/or FFT for each channel, as defined on the FFT page.

The Dynamic Buffer update rate is set in minutes and seconds to a minimum (fastest) rate of 0.1 seconds, to a maximum (slowest) rate of 546 minutes, 59.0 seconds. Seconds can be entered with a resolution to 0.1 (100 milliseconds).

Dynamic data records are sampled in the same manner as the Low-Resolution discrete data, by using its own 100 millisecond multiplier. However, regardless of the multiplier setting, how fast dynamic data updates depend on module performance, which is a function of module configuration and circumstances.

IMPORTANT	The discrete data is not processed from the same TWF or FFT that is captured in the dynamic data buffer. • FFT derived measurements (FFT Bands) are processed from an independent FFT. The DSP of the module calculates the independent FFT, specifically for that purpose. See Bands on page 150. This FFT is different than the one defined on the FFT page and calculated in the microprocessor of the module. • Non-FFT derived measurements, such as Overall, 1x magnitude, DC values are processed from the data stream, with possible different filtering, sampling, or integration selections, so also do not necessarily correlate with the captured TWF or FFT. See Filters on page 124.

Alarm Buffer

The alarm buffer consists of a copy of the trend buffer's 640 discrete and 64 dynamic records that are sampled at their user-specified rates. Also, there is a second "high resolution" 320 record discrete buffer that is sampled at a fixed 100 millisecond update rate.

For each of the data sets, the low and high-resolution discrete buffers and the dynamic data buffer, provide independent definition of how much of the buffer to capture post trigger. This capability lets any portion of the 640, 320 and 64 record buffers be updated after the trigger.

Triggering the Alarm Buffer

The alarm buffer "triggers" on an event that can be any of:

- Voted Alarm

  Voted Alarm is the 'normal' method. You can select any unique alarm and the alarm status: alert, danger, or fault. See Voted Alarms Page on page 222.

- Any Voted Alarm

  When defined, this triggers alarm buffer capture when any voted alarm actuates, regardless of the status, such as alert, danger, or fault.

- Controller Output Tag

  Regardless of the trigger on selection, the alarm buffer always triggers when the AlarmBufferTrigger, bit 8 of the control tag, in the controller output assembly is set.

- Service Request

  Regardless of the trigger on selection, the alarm buffer always triggers upon receipt of the Dynamix™ data manager object alarm buffer trigger service.

Latch the Alarm Buffer

A latch capability is provided for the alarm buffer. When the latch is enabled, once triggered and saved, the alarm buffer does not update on subsequent trigger events until the latch has been reset.

Reset the Alarm Buffer

Reset a buffer, whether it is latched or not, as a way to determine when new data is available.

Reset a latched alarm buffer by either of the following:

- Set the AlarmBufferReset bit (bit 9) of the controller output assembly control tag
- Send the reset service to the Dynamix data manager object 3

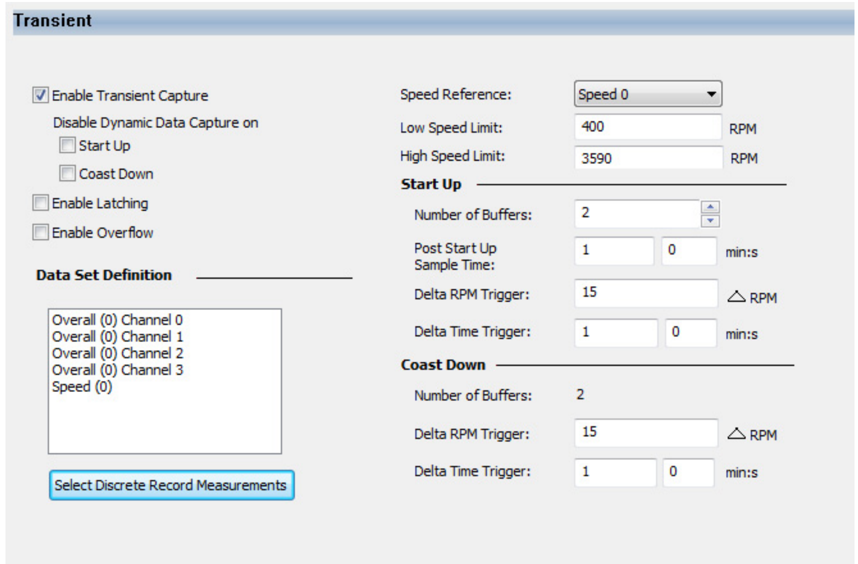
When a buffer is reset, even if it is not configured to latch, the status is set to 'Armed' and with 'Zero Stored Records'.

ATTENTION: After an alarm buffer is reset, any existing stored data is no longer available.

Transient Capture Page

Page Overview

Figure 91 - Transient Capture Page



The transient capture page enables definition of the transient data management facility of the module. The capabilities that are provided are intended to help verify the capture of critical data necessary to diagnose machine condition during its run up (start) and run down (stop) events. The capabilities are designed to help verify the capture of critical data regardless of whether;

- the event is scheduled or occurs unexpectedly,
- is a long or short duration event,
- or if the acceleration/deceleration of the machine is fast, slow, or varying.

Observe, compare, and diagnose the behavior of machines, as their speed changes often, to provide unique insight into the condition of the machine that is impossible to obtain during its normal operating, constant speed, state. When the speed of a machine changes, the dynamic forces that are applied to its bearings and structure change, both in magnitude and in frequency. Non-dynamic forces also change; thermal growth/contraction as the machine heats up or cools down, bearing load as the machine load is increased or shed, condenser vacuum pressure changes impart forces. These, and other start up/coast down-specific changes, can help find otherwise unknown faults and conditions before the fault propagates.

The controls on this page are active only when at least one speed input is enabled. See Speed Page on page 121.

Buffers

The dynamic measurement module implements transient data capture by the application of four configurable buffers where each buffer contains 640 discrete data records and 64 dynamic data records.

The structure (content) of the discrete data record is user-defined and can contain any measured values, such as speed, 1x magnitude, bias, overall, and many others from any channel.

The dynamic record content can include a time waveform and/or an FFT that are processed from any enabled data source. See Filters on page 124 and Bands on page 150.

- Can be allocated to hold either start-up or coast down data.
- A buffer can contain data from only one transient event.

Overflow

When overflow is enabled, if a buffer is filled before a transient is concluded, then the data acquisition moves to the next available (not latched) buffer of the same type, and effectively enables definition of:

- One start-up or coast down buffer with 2560 discrete and 256 dynamic records.
- One start-up and one coast down buffer each with 1280 discrete and 128 dynamic records.
- One start-up or coast down buffer with the standard 640 discrete and 64 dynamic records, and one coast down or start-up buffer with 1920 discrete and 192 dynamic records.

Initiating a Transient Event

A transient event is initiated as the referenced speed crosses below the high or above the low speed thresholds. The transient data acquisition is begun to the first available buffer of the applicable type (start up or coast down) that is not latched.

Dynamic Data

To include TWF and FFT data with the transient data, enable the measurements on the FFT Page of each channel. The FFT and TWF saved are as defined on the FFT Pages but with a maximum TWF size of 2048 points and a maximum FFT size of 900 lines.

When the TWF sample size or FFT line size that is specified on the FFT Page is larger than can be accommodated in the Transient Buffer, the lower sizes are applied only to the Transient data. All other uses remain as specified. The TWF and FFT saved to the Transient Buffer is always at the same sample rate and FMAX specified by the signal source.

Transient Buffer Storage	TWF Samples	FFT Lines			
		Base FFT Lines	Decimation		
			None	Alternate Path(2)	Primary Path(3)
Not available(1)	4096	1600	1800	1000	600
Available	2048	800	900	500	300
	1024	400	450	250	150
	512	200	225	125	75
	256	100	112	67	32

(1) When the TWF or FFT is defined at this level, the data that is written to the Transient buffer is reduced to the 2048 TWF samples and equivalent FFT lines. Data retains the same sample rate and FMAX.

(2) Or if -60 dB filter is applied (Aeroderivative Measurement Type)

(3) And the standard -24 dB/octave filter is applied

Sampling during a Transient Event

During a transient event, while the reference speed remains between the low and high-speed thresholds, the executing buffer updates at prescribed delta RPM(1) and delta time triggers. For startups, delta RPM updates trigger only in the increasing speed direction while for coast downs, delta RPM updates trigger in either increasing or decreasing speed directions.

- Independent delta RPM and delta time triggers can be defined for startup and coast down.
- If the delta RPM is set to 0, then no samples are taken on speed change.
- The delta RPM triggers can be set from 1…1000 RPM, or 0 if disabled, and the delta time triggers from 1…3600 seconds (1 hour).
- A discrete data record is saved on each trigger.
- A dynamic data record is captured on every tenth trigger, and considers both delta RPM and delta TIME triggers.

(1) The module evaluates speed at 96 millisecond intervals. Consequently, measurements are not necessarily captured at precisely the specified delta RPM.

Concluding a Transient Event

A start-up transient concludes when the referenced speed crosses above the high-speed threshold. If during the startup, the speed falls below the low threshold, then the transient is suspended, so the sampling stops.

A coast down transient concludes when the referenced speed falls below the low speed threshold. If during the coast down the speed crosses above the high threshold, then the transient is suspended, so the sampling stops.

If the sampling stops due to a suspended startup or coast down, then the data from the event is retained anyway if at least 20% of the discrete data records was collected. If less than 20% of the data was collected, then the event data is discarded.

Latching

If latch capability is enabled, then a buffer latches once it has been filled, so has no remaining empty records. A latched buffer is not available for update until it is reset.

In the event a transient event occurs when no buffers are available, the data manager functions as if a buffer was available and triggers samples and monitors status. However, no data is stored.

Reset a transient buffer latch by any of the following:

- Controller Output: The TransientBufferReset bit (bits 10…13) of the controller output assembly control tag, where x is the number of the buffer (0…3)
- Dynamix transient data manager object service
- Uploading the transient Buffer

The data manager automatically resets a buffer after it has been uploaded to a host.

Notes:

Operate the Module

This chapter describes the reset types that the module offers.

Resetting the Module

Supported Reset Types

The module supports three forms of resets including types 0, 1 and 2.

Reset Type Methods	Hardware	Remote Reset Service (Code 5)
		Remote Reset is not allowed while a class 1 connection is active, or if the class 1 connection was closed abnormally.
		Send data value
Common Reset (0)	Power cycle	0 (or blank)
Out of Box Reset (1)	Power cycle with 888 address	1
Hard Reset (2)	—	2

Type 0: Common Reset

A common reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller. After reset, the module loads the configuration that is stored in nonvolatile memory and restarts monitoring.

A common reset does not delete data in nonvolatile memory, which includes its saved configuration, the module event log and its connection information, including any saved IP address.

A type 0 common reset is executed by sending a type 0 reset service or by cycling module power.

Because a module immediately loads its configuration from nonvolatile memory and begins monitoring, a module does not persist in its common reset state.

Type 1: Out of Box Reset

An out of box reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller. It also deletes any saved configuration from nonvolatile memory.

An out of box reset also deletes the connection information of the module, including any IP address that is saved in memory.

A type 1 out of box reset is executed by sending a type 1 reset service or by powering up the module with its terminal base IP address set to "888".

A module persists in its out-of-box reset state until a configuration has been downloaded to the module. Until a valid configuration is received, the module operates in its default out of box configuration (a basic voltmeter with no defined measurements, alarms, or any configured output).

Type 2: Hard Reset

A hard reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller.

A hard reset does not delete the module connection information, including any saved IP address or the saved configuration.

A type 2 hard reset is executed by sending a type 2 reset service.

Because a module immediately loads its configuration from nonvolatile memory and begins monitoring, a module does not persist in its hard reset state.

Reset Procedures

The following table summarizes the information that is held in the volatile and nonvolatile memories, and indicates what each type of reset deletes.

<table>
<tr><th>Delete on Reset</th><th>Common
(Type 0)</th><th>Out of Box
(Type 1)</th><th>Hard Reset
(Type 2)</th></tr>
<tr><td>Trend and Transient Data
Alarm Trend Data
Host Controller ID
Executing Configuration</td><td colspan="3">Yes</td></tr>
<tr><td>Saved Configuration
Connection Information</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>Event Log</td><td colspan="3">No</td></tr>
</table>

Hardware Type 0 Common Reset

To perform a type 0 common reset, follow this procedure:

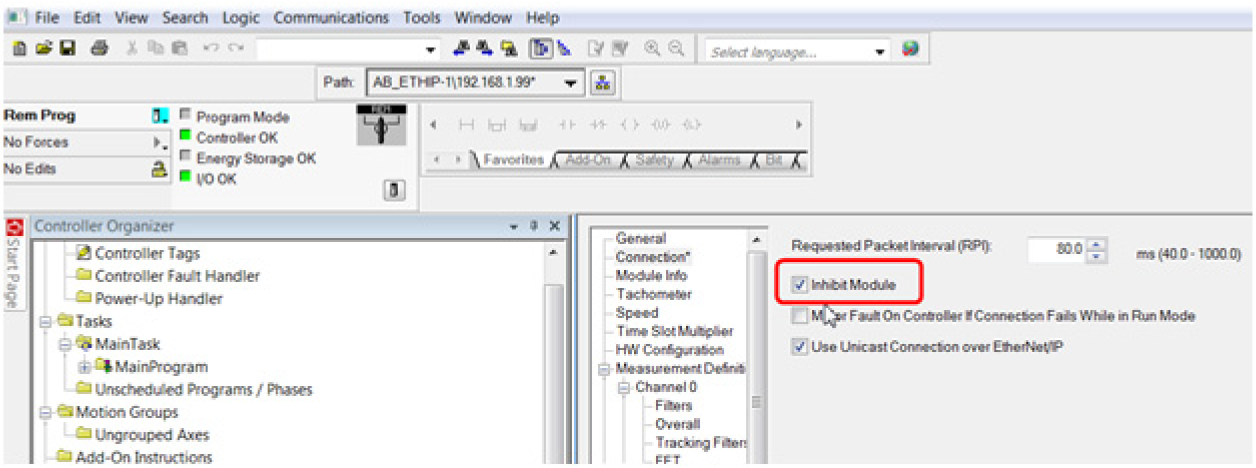
1. Disconnect power from the module.
2. Wait at least 2 seconds.
3. Restore power to the module.

The module powers up and connects to the network that uses the connection information previously established. After completing its self-test procedure, the module loads the configuration that is saved in nonvolatile memory and begins monitoring.

Hardware Type 1 Out of Box Reset

To perform a type 1 out-of-box reset follow this procedure:

1. In Studio 5000 Logix Designer®, go to the connection page of the module properties and inhibit the module.



2. Remove the module from its base.

ATTENTION: You cannot remove a module from its base while powered (hot swap) when operating in a hazardous area.

---

3. Note the current setting of the IP address switches.
4. Set the IP address switches to '888'.
5. Replace the module and let it power up.
6. Wait until Status Indicator behavior stabilizes.

   The module is not able to communicate over Ethernet.
7. Remove the module from its base.
8. Set the IP address switches to their original setting.
9. Replace the module and let it power up.

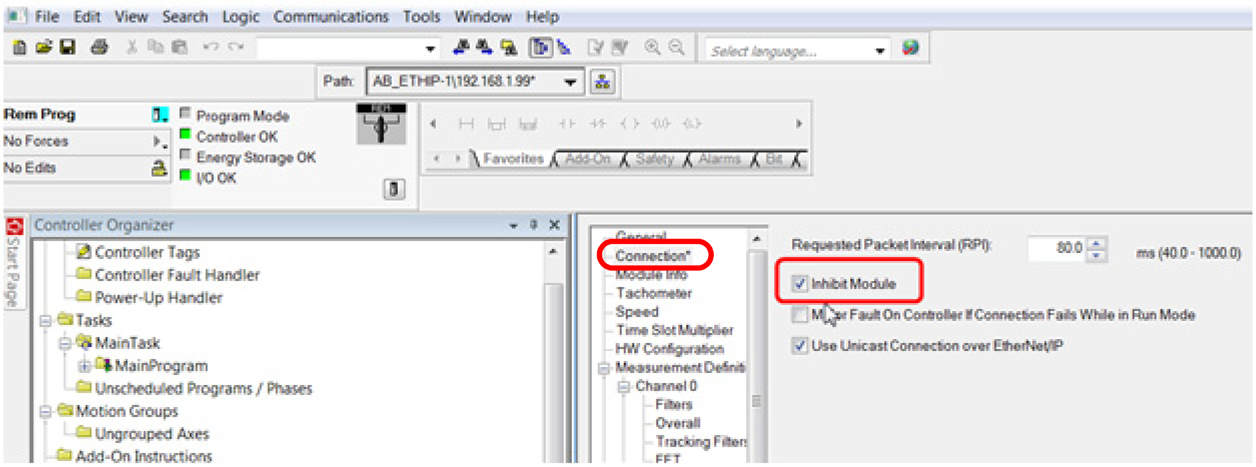
The module is now in its out-of-box reset state. Uninhibiting the module forces a connection to be re-established and a configuration to be downloaded, after which it is no longer be in its out of box reset state.

Remote Reset

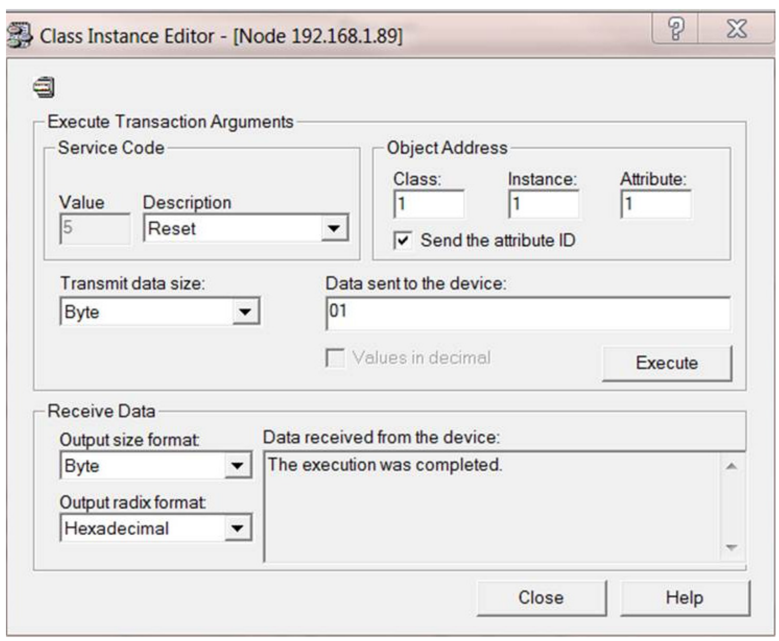
The identity object of the module includes a 'reset' service that can be used to execute any type reset.

To execute a reset service, follow this procedure:

1. In Studio 5000 Logix Designer®, select Connection and check Inhibit Module.



2. Execute the reset service.



Send a type 1 reset service by using the class instance editor of RSNetWorx™ for EtherNet/IP to a Dynamix™ module at address 192.168.1.89. If the "data sent to the device:" is blank (default) a type 0 common reset is sent.

3. When ready, re-establish the connection by uninhibiting the module.

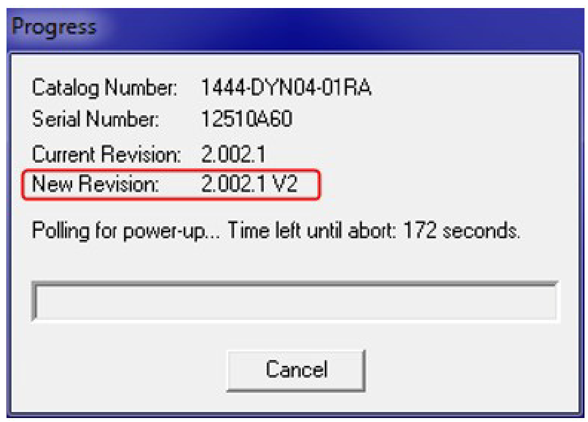
   When the connection is re-established, the controller updates the module with the current configuration.

Updating Module Firmware

To update the firmware in the 1444 series main module and any connected expansion modules, use ControlFLASH™.I

IMPORTANT	Requires ControlFLASH version 14.01 or greater.

TIP To identify the firmware revisions that are currently installed in Dynamix™ Main and expansion modules, see Status Page.



When it is necessary to update firmware in connected expansion modules a separate, unique, firmware update must be executed. If firmware updates are provided using standard ControlFLASH update packages, see Updating Expansion Module Firmware on page 249.

To update the firmware in a Dynamix 1444 Series (main) module, follow these steps.

1. A reset is used for the module before updating the firmware, depending on the current firmware revision.

Table 48 - Reset Requirements

Installed Version	Reset Requirement		
	Type	Hardware	Remote
2.001.x	Out-of-Box	"888"	Types 1 or 2
2.002.1			
3.002.x+	Not Required		

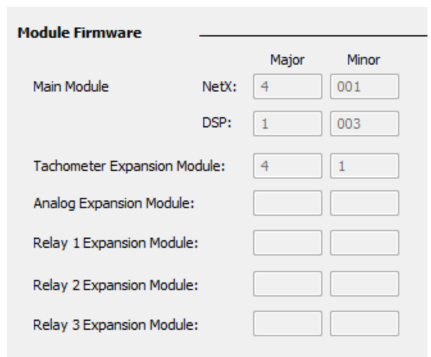
If a reset is required, see Resetting the Module on page 241. Make sure that the module is inhibited and does not have any established connections.

2. Update the firmware using ControlFLASH.
   - An established class 1 connection must be normally closed. To close the connection, you inhibit the module by executing a normal shutdown of the controller, or cycle power on the module.
   - After updating the module, verify that the module firmware has been successfully updated.

     While ControlFLASH reports the new version, the version reported is only that of the auxiliary processor. However, the module has two processors; an auxiliary processor and a Digital Signal Processor (DSP), which also has firmware.

     Firmware revisions are shown in Table 78 on page 306. The firmware revision of both processors, and of any connected expansion modules, can be viewed from the AOP Status page.

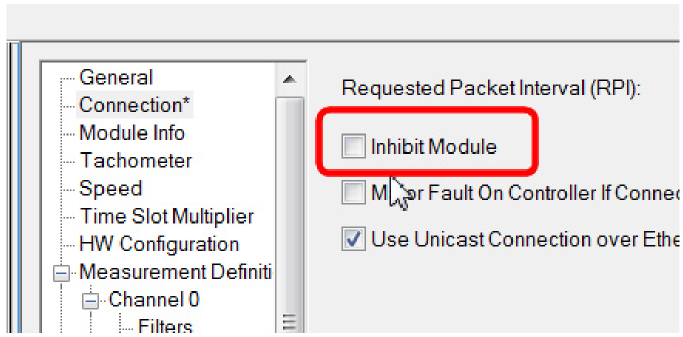
Figure 92 - Module Firmware



IMPORTANT	The Status page is only updated when the AOP is in RUN mode.

See Firmware Update Error Handling on page 248 for information on how errors in firmware updates are handled.

3. From Studio 5000 Logix Designer, from the connection page of the module properties, clear the Inhibit Module checkbox to uninhibit the module.



When the module is uninhibited, the controller establishes a connection to the module and downloads its configuration.

Firmware Update Error Handling

If updating the module firmware, or any connected expansion module firmware, fails then the firmware reports as the current firmware minor version +100. For example, if an error occurs while updating a module from version 2.002 to 3.002, then the module later reports version v2.102 (v2.002 + 0.100).

This process is to make sure that the ControlFLASH detects a failed update when, for the main module, the auxiliary processor firmware updates correctly but the DSP firmware does not. Or, if an update of a connected expansion module firmware fails.

In these cases, the module that was being updated, the main module, or a connected expansion module, continues to use its current installed version.

The reported error version (ex. v2.102) resumes reporting the initial installed firmware revision (ex. v2.002) following a subsequent Out of box reset, or a subsequent successful firmware update.

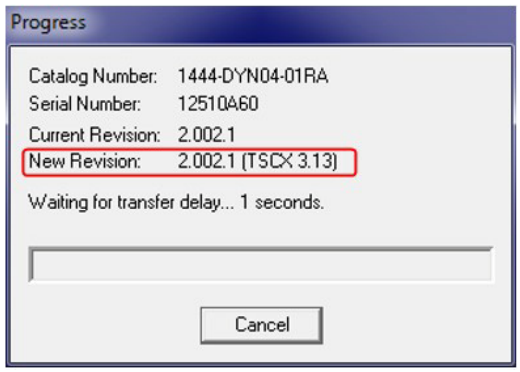
Updating Expansion Module Firmware

The firmware for 1444 Series expansion modules is updated via its host module. When necessary, a unique firmware update for the main module is provided. The update includes the expansion module firmware. The update name that is shown in ControlFLASH identify these updates, which follow this nomenclature:

<Main Module FW> + "("+ <Expansion Module Type> + <Expansion Module Firmware> + ")"

Figure 93 is an example of the firmware update.

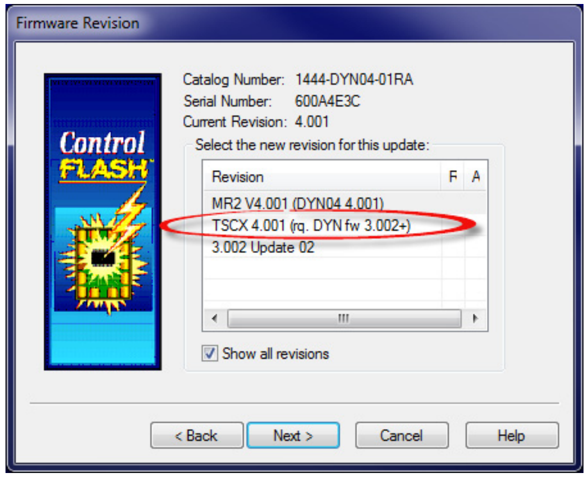
Figure 93 - Firmware Update Example



Before updating the expansion module firmware, make sure that the host module is at a firmware revision that is equal to or greater than the version indicated. For example, in Figure 93 the host module of the tachometer signal conditioner must be at firmware revision 2.002, or greater.

If the host module firmware is not at or greater than the stated version, it is possible that the update does not execute successfully. And even if the update executes properly, a ControlFLASH error can be presented. In all cases after the update is complete, verify the expansion module firmware revision by using the AOP (Status page) or by querying the device using RSNetWorx™ for EtherNet/IP.

This example indicates that the update contains firmware revision 4.001 for the Tachometer Signal Conditioner Expansion Module. To install, it requires that the DYN module is at firmware v3.002 or greater.



Tachometer Signal Condition Expansion Module is abbreviated as "TSCX". Table 49 shows the abbreviations for each of the expansion modules.

Table 49 - Expansion Module Abbreviations

Expansion Module	Description	Abbreviation
1444 -TSCX02-024B	Tachometer Signal Conditioner Expansion Module	TSCX
1444-RELX00-04RB	Relay Expansion Module	RELX
1444-AOFX00-04RB	4…20 mA Expansion Module	AOFX

Updating expansion module firmware is done using ControlFLASH to "update" the firmware of the host module of the expansion module with the procedure that is provided in Updating Module Firmware on page 246. However, the expansion module firmware update package excludes new firmware for the host module. Host module firmware is updated independently and must be updated before updating any connected expansion modules.

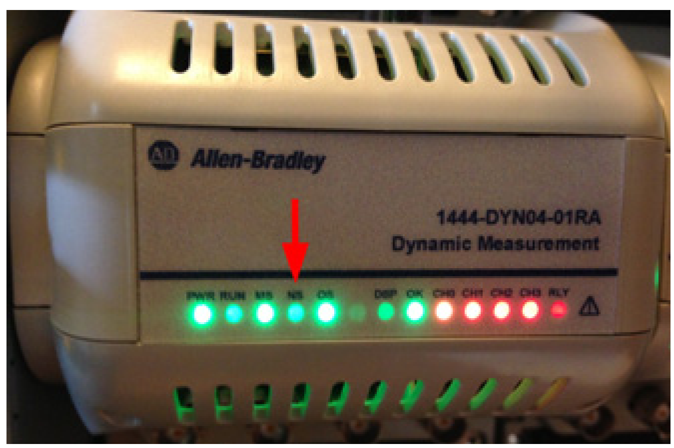
Managing GET and SET Service Access

The initiating device must access data and manage module configuration to communicate SET and GET commands to the various objects as defined in the CIP™ Objects Library. However, while GET commands are allowed from any device, for security reasons the module places restrictions on the use of SET commands.

SET

SET service commands are used to change the module configuration. A change to the configuration can pose a security risk. Therefore, the module does not accept a SET command from any device other than the controller with which the module has established a (CIP™ transport) class 1 connection, even if that device is not accessible:

- When a class 1 connection is established, the module remembers the ID of the connected controller. Class 3 connections include the ID of the host device that is sending the command. If the IDs do not match, the module compares the ID communicated with the Class 3 connection request to that of its host controller, and disallows the connection.
- The module accepts a class 3 connection SET command only if it does not hold a host ID. The module captures the host ID of a controller when it establishes a class 1 connection. The ID is later removed only when the host controller normally closes the connection, typically by inhibiting the module, or when the module is reset.
- While not unique to a class 1 connection, the Network Status (NS) Indicator shows the module connection status.



IMPORTANT	If the host controller of the module fails such that the connection closes unexpectedly, the module cannot be configured until that same controller is restored or until the module has been power-cycled (type 0 or 1 reset).

GET Services

GET service commands, which use a (Common Industrial Protocol transport) class 3 connection, are allowed from any device.

A maximum of three, class 3 connections, other than one from its host controller, can be connected at any one time. This limit is the number of devices that can simultaneously access data from the module, and its host controller.

Managing Nonvolatile Memory Configuration

The Dynamix 1444 Series main module maintains a copy of its valid, executing configuration in its nonvolatile memory. At power-up, if a valid configuration is held in this memory, it is loaded and executed. This setting makes sure that on power cycle that the module immediately begins functioning as required, even if communication to its host controller is not available.

The following sections describe the processes to save the configuration to the nonvolatile memory of the module, and to delete the configuration from the memory.

Saving a Configuration to Nonvolatile Memory

The communication of a configuration to the module involves several steps.

- Communicate the data

  The remote device sends the necessary configuration data by using the SET Service of the modules configuration manager object.

  During the transmission if an error is detected the module aborts the process.

- Evaluate Attributes

  Upon receipt of configuration data, the module evaluates each attribute concerning its allowed range. If any attribute is not within its allowed range, the module transmits a failure message.

- Apply the configuration

  Once the configuration is communicated successfully, the host device sends an Apply message to command the module to implement the changes.

  When an apply service is received, the module further evaluates the data to detect dependency errors – violations of limitations to parameters due to their dependency on other parameter settings.

If an error occurs in values of dependent parameters, the apply service responds with a failure.

If no errors are detected, then the module applies the changes to the executing configuration. It also then saves the updated configuration to nonvolatile memory.(1)

Deleting a Saved Configuration from Nonvolatile Memory

Once a configuration is saved in nonvolatile memory, it can only be deleted by executing an out of box (type 1) reset. See Resetting the Module on page 241.

Only one configuration is retained in nonvolatile memory. The saved configuration is automatically updated each time that a valid configuration is applied.

Setting the IP Address

The Dynamix 1444 Series supports both static and automatic IP address configuration.

IMPORTANT	When a static IP is used, the address is fixed to the terminal base. But when automatic, the address is held in the module itself. This distinction drives different behaviors when you replace or move modules to help troubleshoot a problem or for other reasons.

Static IP Configuration

The main module terminal base (1444-TB-A) includes three switches that set the last octet of the address. See Configure the Terminal Bases on page 45 for information on the using the terminal base address switch.

Automatic IP Configuration

Dynamix supports both BOOTP and DHCP methods of setting the module address. To use either of these methods set the three IP address switches to "000".

Use BOOTP to Set the IP Address

The BOOTP utility is a standalone program in one of the following directories:

- RSLinx® Tools directory in the Rockwell Software® program folder on the Start menu

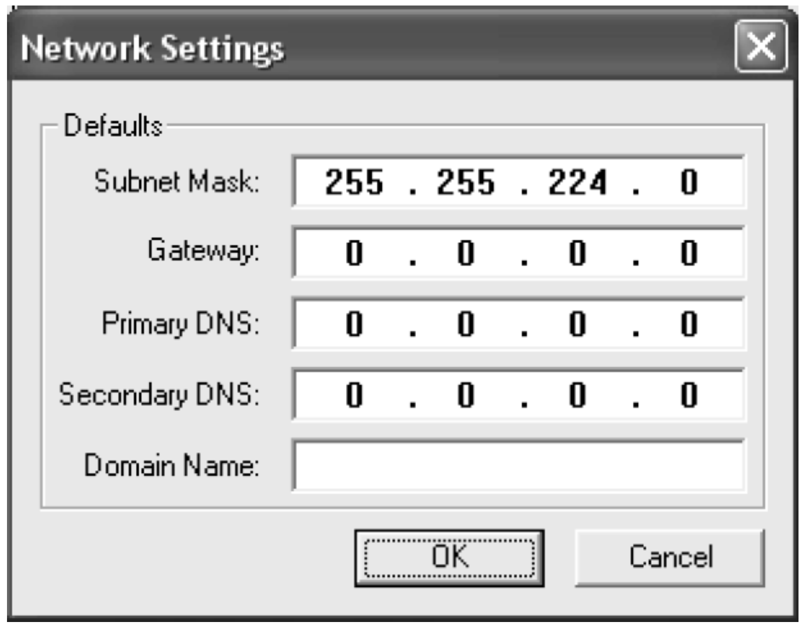
(1) Before writing the configuration to nonvolatile memory, the configuration is compared to the currently saved configuration. If it is unchanged, then it is not saved.

The utility is automatically installed when you install RSLinx software.

- Utils directory on the RSLogix 5000 software installation CD

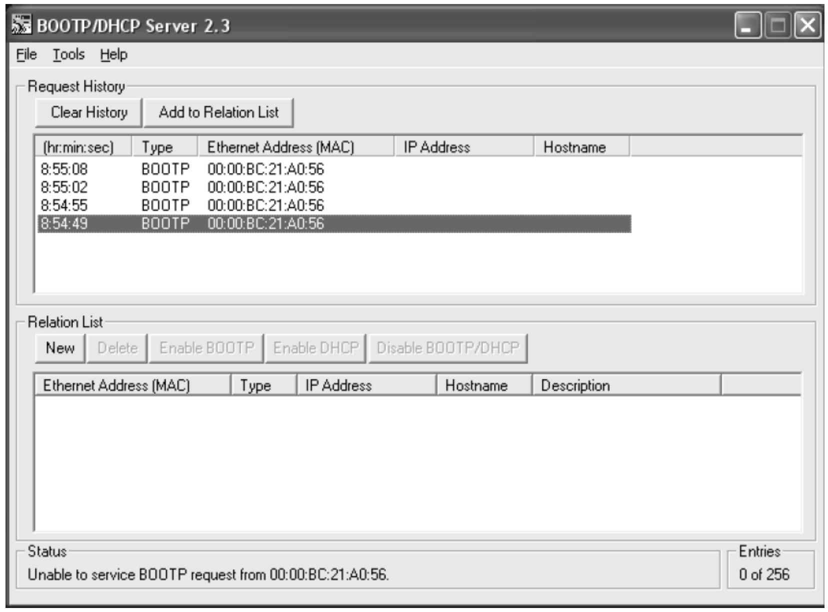
Follow this procedure to use the BOOTP utility.

1. Start the BOOTP software.
2. Select Tools>Network Settings.
3. Enter the Ethernet mask and gateway.
4. Click OK.



In the BOOTP Request History dialog box, you see the hardware addresses of devices that issue the BOOTP requests.

5. Double-click the hardware address of the device you want to configure.

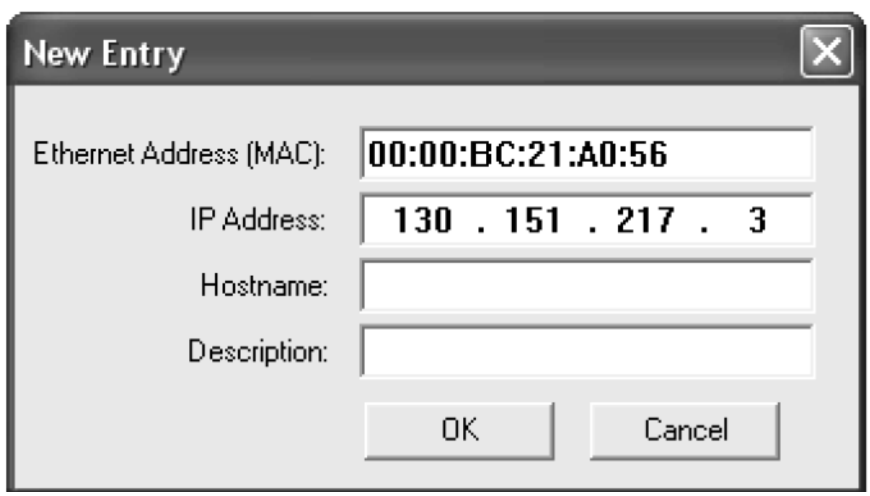


TIP The hardware address is on the sticker on the left-side circuit board of the controller next to the battery.

The hardware address is in this format: 00-0b-db-14-55-35.

The New Entry dialog box shows the media access control address (MAC ID) of the device.

6. Enter the IP address.
7. Click OK.



8. To assign this configuration to the device permanently, select the device and choose Tools>Disable BOOTP/DHCP.
9. Cycle the power. The device uses the configuration that you assigned and does not issue another BOOTP request.

Default Gateway Address

The gateway[1] address is by default 192.168.1.1. However, if a Static IP address is used and set to that same address, then the gateway address defaults to 0.0.0.0.

Time Management

The Dynamix 1444 Series modules include an onboard real-time clock[2]. The clock, which has a maximum drift accuracy of 100 ms per year, maintains time in Coordinated Universal Time[3] (UTC) format. The clock is set by synchronizing with the controller time and uses the IEEE-1588 standard version 2 based CIP Sync protocol.

The Dynamix 1444 primarily uses time for captured data. This data includes event log entries, demand data, trend, and alarm trend data and transient data. It also stamps the current time to any "live" FFT and TWF data returned as "live" data by the Normal CM Object. Data that are returned on the input assembly of the controller are not time-stamped. Consequently, if the module is used only to serve "level" data to the controller or other devices, then it is not always required to manage accurate time.

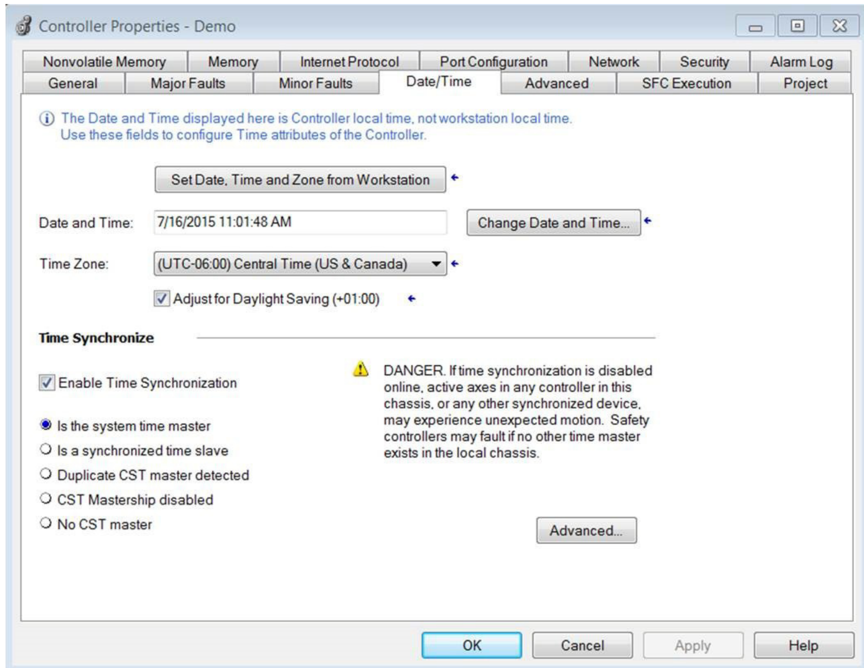
While CIP Sync is designed to update time continuously (synchronize) between the controller and the module, continuous synchronization with the controller is not required. Once the time is set in the module, it retains that time until the next power cycle. Consequently, if communication with the controller is lost, the module continues to manage and report accurate time.

(1) A gateway connects individual physical networks into a system of networks. When a node must communicate with a node on another network, a gateway transfers the data between the two networks.

(2) Module Time is a 64-bit integer value in units of microseconds with a power-up value of 0, which corresponds to an epoch of January 1, 1970.

(3) Coordinated Universal Time (UTC) is the time standard for `civil time', and represents time at the Prime Meridian. The time excludes time zone or daylight savings time offsets. Module Time is based on UTC.

For module time management to operate correctly CIP Sync must be configured in the host controller.



See publication IA-AT003B, "Integrated Architecture® and CIP Sync Configuration", for further information on how to configure CIP Sync in your controller.

Module Inputs

The Dynamix 1444 Series Monitor Systems accepts the following inputs.

1444-DYN04-01RA Dynamic Measurement Module

Eight inputs of three types are provided.

Channel Inputs

Four inputs are provided to connect common dynamic measurement sensors such as eddy current probes, accelerometers, velocimeters, strain, pressure, and other electrically compatible dynamic sensors.

Transducer Fault Detection

Transducer fault detection is based on bias voltage level, and current if the sensors are powered eddy current probes.

Bias Level Fault Detection

For most sensors, when operating normally the bias level of the sensor is at an expected level that falls within the default bias limits shown in the following table.

Measurement Type		Sensor Type	Default Sensor Power	Default Bias Limits*	
Name	**Index**			**Low Limit**	**High Limit**
absolute vibration (A to A)	84	Accelerometer	24V DC, 4 mA	6	18
absolute vibration (A to V)	85	Accelerometer	24V DC, 4 mA	6	18
absolute vibration (A to D)	86	Accelerometer	24V DC, 4 mA	6	18
20 kHz absolute vibration (A to A)	160	Accelerometer	24V DC, 4 mA	6	18
20 kHz absolute vibration (A to V)	161	Accelerometer	24V DC, 4 mA	6	18
40 kHz absolute vibration (A to A)	225	Accelerometer	24V DC, 4 mA	6	18
40 kHz absolute vibration (A to V)	226	Accelerometer	24V DC, 4 mA	6	18
gSE	227	Accelerometer	24V DC, 4 mA	6	18
Position	6	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Rod Drop	7	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Eccentricity	79	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
X (shaft relative)	81	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Y (shaft relative)	82	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. A (Axial)	193	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. B (Axial)	194	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. A (Radial)	195	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. B (Radial)	196	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Shaft Relative (LH/HP) filtered	198	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
X (shaft relative) - Filtered	77	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Y (shaft relative) - Filtered	78	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Aeroderivative (AV to D)	83	Integrating Accelerometer	24V DC, 4 mA	6	18
absolute vibration (AV to V)	87	Integrating Accelerometer	24V DC, 4 mA	6	18
absolute vibration (AV to D)	88	Integrating Accelerometer	24V DC, 4 mA	6	18
Aeroderivative (AV to V)	80	Integrating Accelerometer	24V DC, 4 mA	6	18
Dynamic Pressure	93	Pressure Transducer	4V DC, 4 mA	-1	1
DC Current	4	Proportional Signal	Off	-1	1
DC Voltage	5	Proportional Signal	Off	-1	1
AC Current	95	Proportional Signal	Off	-1	1
AC Voltage	96	Proportional Signal	Off	-1	1
absolute vibration (V to V)	89	Velocimeter	Off	6	18
absolute vibrations (V to D)	90	Velocimeter	Off	6	18

*Bias levels assume that the sensor is powered as shown. If the sensor is not powered as shown, then the observed bias level can be different.

When a sensor fails, the external circuit can go to an open condition. It can also be driven towards zero or the provided source power voltage (typically ±24V), depending on the nature of the fault. For an open condition, the circuit design forces the bias to move rapidly to a 'fault' state. How quickly the bias level transitions to its fault state depends on the specified failure mode, the bias level at the time of the fault, and the bias limits entered. It is not possible to verify that for every possible fault mode, limit selection, and signal conditioning solution that the bias transitions past its fault limits within a known time. Consequently it is recommended that alarms be defined with not less than 1 second delay. This delay makes sure that if a transducer fault occurs, then the fault is detected before the alarm is enunciated.

Current Based Fault Detection

For negatively powered eddy current probes (only), the Dynamix 1444 Series includes dedicated hardware to monitor the current being provided to the probe driver and the bias level returned. This feature provides fast detection of supply current that drops below 2 mA or a positive bias voltage being detected. Either or both detections trigger a 'wire-off' state to be declared which is normally then an input to the TX OK state.

Clearing a Fault

When monitoring a wire-off condition for powered eddy current probes, measurements that are made on the associated channel can spike as they transition to their normal state. For example, when a faulted sensor is replaced or a loose wire is reconnected. As wires are connected and tightened in place, momentarily intermittent (on/off) connections often exacerbate this condition.

To help prevent further alarms due to these transitory events, the module latches any 'wire-off' state for 30 seconds after the fault condition has cleared before transitioning a faulted transducer to its normal, non-faulted state.

Speed Inputs

Two inputs are provided to accept transistor-transistor logic (TTL) signals. TTL signals need a clear distinction between ‘low’ and ‘high’ values such that a trigger threshold of 2.5V does not falsely trigger on high or low signal level or noise.

These inputs are designed to sample sufficiently fast to satisfy the module speed measurement specifications.

Speed Input Fault Detection

Speed input fault detection is dependent on the type of input provided. The following table lists each of the supported types of speed input and how the module manages fault detection for each of them.

Source	Fault Detection
Local TTL Tach Input	No fault detection is associated with TTL signal input. However, an associated tachometer status signal, a TTL, can be wired to the associated digital input for the selected speed input. When the local Logic Inputs are used as described in the preceding statement, leave open for a Tacho OK state and short the appropriate input to trigger a Tacho Fail condition.
Tach Bus	No fault detection is associated with the TTL signal itself. However, the tachometer signal conditioner module communicates transducer status via additional signal lines on the Local Bus.
I/O Speed	When speed is communicated from the controller, as tags in the controller output assembly, the module reads speed input status from output assembly bits 3 (Speed 0 OK) and 4 (Speed 1 OK). When used, set the Speed OK bit (= 1) for FAULT, or 0 for NORMAL.

Tachometer Signal Condition Input Fault Detection

Transducer fault detection is based on bias voltage level, measured speed or on tachometer signal conditioner module fault as follows:

Fault Detection Method	Description
Bias Fault	Bias level fault detection functions similarly to bias fault detection for the normal channel inputs (see the preceding information).
Speed Fault	Considers the transducer is in fault of the pulse rate (equivalent) is slower or faster than the specified speed.
Module Fault	The Tachometer Signal Conditioner expansion module detects a module fault.

When a fault is detected, it is communicated as simply “Transducer Fault” on the local bus. Further detail is available in the Tachometer Signal Conditioner Module Status assembly structure on controller input (see I/O message formats, module status structure).

Digital Inputs

Two inputs are provided to accept TTL signals. TTL signals need a clear distinction between ‘low’ and ‘high’ values such that a trigger threshold of 2.5V does not falsely trigger on high or low signal level or noise.

These inputs are intended for control functions, such as a switch for turning ON/OFF startup multiplier function.

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module

Two inputs are provided to connect common eddy current probes/PNP proximity switches, self-generating magnetic speed sensors or TTL speed signals.

1444-RELX00-04RB Relay Expansion Module

The relay expansion module does not accept analog inputs.

1444-AOFX00-04RB 4…20 mA Output Expansion Module

The 4…20 mA output expansion module does not accept analog inputs.

Module Outputs

The Dynamix 1444 Series Monitor Systems accepts the following outputs.

1444-DYN04-01RA Dynamic Measurement Module

Six outputs of two types are provided.

Channel Buffer Outputs

Four outputs, one per channel, are provided via ESD and short circuit protected +/-20V supplies. The outputs are accessible by BNC connectors or terminal pins that are independently resistive current limiting protected.

Opto-isolated Outputs

Two opto-isolated open-collector circuits provide TTL signals. The outputs are suitable for use in providing simple status (on/off)(1) indication or for replicating and transmitting a TTL speed input(2) to another 1444-DYN04-01RA module.

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module

Four outputs are provided to allow raw and conditioned buffer outputs.

Raw Buffer Outputs

Two outputs, one per channel, are provided via BNC connectors. These outputs provide an ESD and short-circuit protected replica of the raw input signals.

These signals are N/rev. If the BNC output is a multiple event per revolution signal, the associated status indicator (6 or 7)illuminates blue.

(1) Circuit must include a pull up resistor. See page 60.

(2) Using speed signals communicated by an opto-isolated output on one module to a TTL input on another module results in a 180 degree shift in phase measurements on the second module. See Speed Signal Replication on page 58 for more information about using the output to replicate speed signals between modules.

Conditioned Buffer Outputs

Two outputs, one per channel, are provided via terminal pin connectors. These outputs provide an ESD, EFT, and surge-protected replica of the signals that are output to the local Expansion bus, and provided to any dynamic measurement modules on the bus.

These signals are presumed to be 1/revolution.

1444-RELX00-04RB Relay Expansion Module

The relay expansion module has no analog outputs.

1444-AOFX00-04RB 4…20 mA Output Expansion Module

Four ESD- and EFT-protected outputs. Each output is a 4…20 mA proportional signal that represents a selected measurement.

The outputs are not powered, require independent loop power, and are opto-isolated from the module and each other.

Services

See CIP Objects on page 317, for available common and object-specific services.

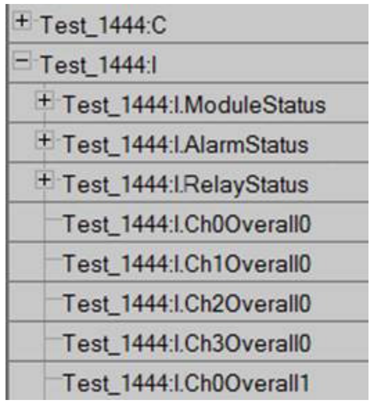
I/O Message Formats

Assemblies are created in Logix and defined by the 1444 Add-on Profile (AOP) of the module. The AOP for the 1444 dynamic measurement module creates assemblies for input, output, and configuration. The structure, content, and meaning of the parameters of each of the assemblies, except configuration, is provided in the following.

Input Assembly

The input assembly consists of four structures; three fixed Status data structures, and a variably defined data structure.

In the Studio 5000® Tag Monitor, the structures are presented similarly as shown in the following graphic (replacing 'Test' with the module name).



Module Status

The structures are defined as follows:

Input Assembly Structure		
Module Status Structure	ModuleStatus	Fixed
Alarm Status Structure	AlarmStatus[13]	Fixed
Relay Status Structure	RelayStatus	Fixed
Input Data Structure	Input Data Parameters	Variable

Module Status Structure

The status structure consists of these parameters:

DINT	AuxiliaryCommunicationProcessor
INT	TrendBuffer
INT	AlarmBuffer
INT	Transient
DINT	DSP
INT	ChannelTransducer
SINT	TachoSpeed
SINT	AtoDStatus
INT	RelayModule0
INT	RelayModule1
INT	RelayModule2
INT	ExpModuleResponseCodes
INT	AOFModule
INT	TachoSignalConditionerModule

Module Status is composed of a set of assemblies that communicate a comprehensive hardware and functional status of a Dynamix monitor system. While this communication allows tremendous capability and insight into the module performance, it can be more than is necessary for some applications. And if the intent is to present Status on an HMI, it can be difficult to determine exactly what to present. The following table provides guidance on three different solutions to how to "monitor status".

Method	Values	Description
Summary status bits	Bits 27 and 28 of DSP Status (Table 54)	Module status includes two summary bits, one for the Dynamic Measurement Module and one for any connected expansion modules. See Summary Status Tags on page 265.
	Processor Status (Table 55)	In many cases, monitoring just these two bits is sufficient to provide indication of the general status of the module and any connected expansion modules.
Discrete status bits	As listed in the individual status assemblies	In some applications, it is necessary or appropriate to present one or more of the discrete status bits. In most cases, the discrete bits needn't be monitored except if there is a problem. When there is a problem, the discrete bits aid in the investigation or the assessment of the problem.

The data type for each attribute is either a 'SINT' (8 bits), an 'INT' (16 bits), or a 'DINT' (32 bit). In each case, the state of the individual bits as provided in Table 51 defines status. It is possible for multiple bits to be set.

Summary Status Tags

The two summary tags are intended to provide a simple presentation solution that gives meaningful indication of fault for any given module application.

The Summary Tags do not simply roll up the status of some subset of other fault bits because many fault indicators (the other tags) are dependent on the specific configuration applied (so can be set or unset normally). Consequently, the logic that is used to drive the Summary Tags is determined at configuration.

Also, in many cases a physical hardware problem can cause an issue where it is the symptom rather than the cause that is indicated. And in some cases there can be multiple causes that can result in the same symptom. Consequently, when fault indication is provided by a summary tag it can be necessary to interrogate other status indicators to resolve a specific problem.

Table 50 - Auxiliary Processor Status

Tag	Description (if = 1)
AuxiliaryCommunicationsProcessor *Aux Processor Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
ConnectionFaulted *Connection Faulted*	Set when there is no connection to the module. ConnectionFaulted is set by the controller when the connection to the module is lost.
NetworkFault *Network Fault*	This tag is managed by the controller and the module: • NetworkFault is set by the controller coincident with setting the ConnectionFault. • The module sets NetworkFault when: – The device is powered off – No IP address is configured – A Network cable is not detected – An exclusive owner connection has timed out If NetworkFault is set by the module*, it is unlikely to be observed by the controller as it is likely that the connection is also faulted. *The module event log records when the tag was set and the reason why.
NetworkAddressFault *Network Address Fault*	Indicates an IP addressing conflict (address in use by another device). When set, this error contributes to an "EIP communication fail." in the context of a module fault relay.
RecoverableFault *Recoverable Fault*	Can be cleared by updating the configuration or cycling of power.
NonRecoverableFault *Non Recoverable Fault*	If cycling power does not clear the tag, then a non-recoverable hardware problem is indicated.
RedundantPowerFault *Redundant Power Fault*	One of the power supply inputs is at less than 17 Volts and the module is configured for redundant power in Module Definition (see Power Supply, page 99).

Table 51 - Trend Buffer Status

Tag	Description (if = 1)
DiscreteLowResBufferRollover *Trend Low Resolution Buffer Cycling*	Discrete low resolution (user-defined update rate) trend buffer is full and is now cycling.
DiscreteHighResBufferRollover *Trend High Resolution Buffer Cycling*	Discrete high resolution (100 ms update rate) trend buffer is full and is now cycling.
DynamicFFTBufferRollover *Trend FFT Buffer Cycling*	Dynamic FFT buffer is fully populated and is cycling.
DynamicTWFBufferRollover *Trend TWF Buffer Cycling*	Dynamic TWF buffer is fully populated and is cycling.

Table 52 - Alarm Buffer Status

<table>
<tr><th>Tag</th><th colspan="3">Description (if = 1)</th></tr>
<tr><td rowspan="7">DiscreteLowResCaptureStatus
Low Resolution Alarm Buffer Status</td><td colspan="3">4 bit status</td></tr>
<tr><td>Value</td><td colspan="2">Description</td></tr>
<tr><td>0</td><td>Disabled</td><td>Buffer/data type is not being captured.</td></tr>
<tr><td>1</td><td>Armed</td><td>Waiting for alarm event trigger.</td></tr>
<tr><td>2</td><td>Populating</td><td>Alarm event in progress.</td></tr>
<tr><td>3</td><td>Data Ready</td><td>Alarm data available.</td></tr>
<tr><td>4</td><td>Latched</td><td>Data available and latched until reset.</td></tr>
</table>

DiscreteHighResCaptureStatus *High Resolution Alarm Buffer Status*	Same as previous
DynamicFFTCaptureStatus *FFT Alarm Buffer Status*	
DynamicTWFCaptureStatus *TWF Alarm Buffer Status*	

Table 53 - Transient Status

Tag	Description (if = 1)		
Transient0CaptureStatus *Transient Buffer 0 Status*	4 bit status		
	Value	**Description**	
	0	Free	Available / ready for transient event.
	1	Data Ready Normal	Transient completed normally, could be overwritten by a new event.
	2	Data Latched Normal	Transient completed normally, buffer latched.
	3	Transient In Progress RPM	Delta RPM data acquisition in progress.
	4	Transient In Progress Time	Delta Time data acquisition in progress.
	5	Data Ready Aborted	Speed that is returned above/below the initiating threshold, could be overwritten by a new event.
	6	Data Latched Aborted	Speed that is returned above/below the initiating threshold, could be overwritten by a new event.
	7	Data Ready time-out	Speed that is crossed the initiating threshold that is then timed out, could be overwritten by a new event.
	8	Data Latched time-out	Speed that is crossed the initiating threshold that is then timed out, buffer latched.
Transient1CaptureStatus *Transient Buffer 1 Status*	Same as previous		
Transient2CaptureStatus *Transient Buffer 2 Status*			
Transient3CaptureStatus *Transient Buffer 3 Status*			

Table 54 - DSP Status

Tag	Description (if = 1)
DSP *Digital Signal Processor Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. The tags are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
DSPReady *DSP Ready Status*	If bits 0, 1, and 2 are 0, the DSP is ready. Anything else, the DSP is either starting up or changing configuration.
DSPCRCError *DSP Configuration Fault*	If on recalling a configuration from update the DSP finds a CRC mismatch, the configuration is considered corrupt, the module is set to its default configuration, and the bit is set.
DSPReset *DSP Reset*	Is briefly set during the module startup sequence. Otherwise indicates that the DSP has reset or that the auxiliary communication processor configuration has failed.
OverTemperature *Module Over Temperature Warning*	Indicates when the auxiliary processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on air flow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.
SetPointMultActive *Set Point Multiplier Active*	Setpoint Multiplier control 0 and/or 1 is set. Associated Alarm limits are being multiplied.
ProtectionConfigChanged *DSP Configuration Changed*	Set when a configuration is received that includes changes to DSP functions. DSP functions include all functions associated with signal conditioning, discrete measurements, alarms, and relays. Cleared at powerup or when a new configuration is sent that does not change DSP parameters.
AlarmsInhibited *Alarms Inhibited (Bypassed)*	One or more voted alarms is inhibited (bypassed).
ExpBusOrExpModuleFault *Expansion Module Fault*	Any expansion module not present, responding, or reporting a configuration failure. If an expansion module is missing or experiences a communication failure during configuration, then this bit remains set until the configuration process completes successfully following a subsequent download.
CalFault *Channel Calibration Fault*	An error or failure of one or more channels to calibrate. One or more channel calibration correction factors is too large (abnormal deviation).
CalTimeout *Calibration Timeout Fault*	Any calibration timeout. Time-out occurs if the DSP does not receive the expected samples from the ADC. Likely indicates another kind of HW error to a Calibration failure.
MainRelayInhibited *Ready Inhibited (Bypassed)*	Main Module Relay is inhibited (bypassed). Inhibited relays are held in their non-alarm state.
MainRelayFault *Relay Drive Failure*	Main Module Relay failed drive test.
ExtendedLoopTimeWarning *Loop Time Warning*	DSP critical alarms loop cycle time >47 milliseconds. When set, the module can exhibit poor performance for tasks other than alarm detection.
MultiplexingModeActive *Multiplexing Mode Active*	A multiplexed personality is being executed. Measurements are not continuous.
SpeedFault *Speed Fault*	A fault is detected on either of the main module speed inputs.

<table>
<tr><th>Tag (continued)</th><th>Description (if = 1)</th></tr>
<tr><td>SpeedOutofSyncHigh
Synchronous Sampling Warning</td><td>Set if the speed is too high to perform synchronous re-sampling with verified accuracy at all order frequencies up to FMAX.
When speed exceeds the calculated maximum speed for the configuration, the accuracies of the measurements degrade with the highest frequencies affected first. Lower-order accuracies erode as the speed increases further above maximum.
Tag is applicable when:
• This Speed Out of Sync bits are managed only when a synchronous FFT is being calculated.
• A synchronous FFT is only calculated if:
<table>
<tr><th colspan="3">On the same channel (one or more)</th></tr>
<tr><td rowspan="5">Alternate Path Sample Mode on the Filters Page is set to Synchronous</td><td rowspan="5">AND</td><td>Signal Source of the FFT Page is set to Alternate Path</td></tr>
<tr><td>OR</td></tr>
<tr><td>Signal Source of the FFT Bands Page is set to Alternate Path</td></tr>
<tr><td>OR</td></tr>
<tr><td>Signal Source of the Demand Page is set to Alternate Path</td></tr>
</table>
</td></tr>
<tr><td>SpeedOutof1xMagSync
Synchronous Sampling Warning</td><td>Set when the speed exceeds 2x the calculated maximum speed for the configuration. Above this speed, the accuracy of the measurement at the first order can be reduced.
See tag "SpeedOutofSyncRange" for information on when this tag is applicable.</td></tr>
<tr><td>SpeedOutofSyncLow
Synchronous Sampling Warning</td><td>Set if the speed is too low to perform synchronous re-sampling.
See tag "SpeedOutofSyncRange" for information on when this tag is applicable.</td></tr>
</table>

Tag (continued)	**Description (if = 1)**	
ProtectionLoopTimeWarning *Protection Loop Time Warning*	DSP critical alarms loop cycle time >100 milliseconds. If set, module does not satisfy performance requirements of API-670. Tag is considered in MainModuleSummary fault if Compliance Mode set to API-670.	
MainModuleSummary *Main Module Summary Fault*	Summary fault bit for the main module. The status bit is set if any of the following status indicators are set:	
	DSP Dual Port Memory Fault	Tag is hidden. Its state can be resolved from the DSP status tag.
	Non-recoverable Fault	
	+1.5V Power Supply OK	Tag is hidden. Its state can be resolved from the DSP status tag. Power supply status tags are normally set
	+1.6V Power Supply OK	
	DSP 3.3V Power Supply OK	
	5V Power Supply OK	
	25.5V Power Supply OK	
	+24V Power Supply OK	
	25.5 Power Supply OK	
	-24V Power Supply OK	
	AD Ch0&1 +6.5V Power Supply OK	
	AD Ch0&1 +5V Reference OK	
	AD Ch0&1 Monitored Power OK	
	AD Ch2&3 Monitored Power OK	
	DSP Memory Fault	Tag is hidden. Its state can be resolved from the DSP status tag.
	DSPCRCError	See Table 54 on page 269.
	DSPReset	
	CalFault	
	CalTimeout	
	MainRelayFault	
	ProtectionLoopTimeWarning	
	+5VA Power Supply Fault	Tag is hidden. Its state can be resolved from the DSP status tag.
	+24V Power Supply Fault	
	-24V Power Supply Fault	
	Also see Summary Status Tags on page 265.	

Tag (continued)	Description (if = 1)
ExpModuleSummary *Expansion Module Summary Fault*	Summary fault for all connected expansion modules. The status bit is set if any of the following status indicators are set:

Expansion Relay Modules	
Relay Module Not Responding	Tag is hidden. Its state can be resolved from the status tag (ex. ExpRelay0Status) for each relay module.
Relay Module Configured	
Relay Module CRC Error	
Relay Module Link / Bus Fail	
Relay Module RAM Fault	
Relay Module RAM Access Error	
ExpRelayNRelay0Fault (N=0,1,2)	See Table 58 on page 274.
ExpRelayNRelay1Fault	
ExpRelayNRelay2Fault	
ExpRelayNRelay3Fault	
ExpRelayNFaultCode	See Table 59 on page 276.
Analog Output Module	
Analog Output Module Not Responding	Tag is hidden. Its state can be resolved from the status tag, ExpAnalogStatus, described in Table 60 on page 276.
Analog Output Module Configured	
Analog Output Module CRC Error	
Analog Output Module Link / Bus Fail	
Analog Output Module RAM Fault	
Analog Output Module RAM Access Error	
ExpAnalogFaultCode	See Table 59 on page 276.
Tachometer Signal Conditioner Module	
Tachometer Signal Conditioner Module Not Responding	Tag is hidden. Its state can be resolved from the status tag, ExpTachStatus, described in Table 61 on page 276.
Tachometer Signal Conditioner Module Configured	
Tachometer Signal Conditioner Module CRC Error	
Tachometer Signal Conditioner Module Link / Bus Fail	
Tachometer Signal Conditioner Module RAM Fault	
Tachometer Signal Conditioner Module RAM Access Error	
+25.5V Power Supply Fault	
25.5V Power Supply Fault	
ExpTachFaultCode	See Table 59 on page 276.

Also see Summary Status Tags on page 265.

Table 55 - Transducer Status

Tag	Description (if=1)
Ch0Enabled *Channel 0 Enabled*	Channel is configured for dynamic or static measurements.
Ch1Enabled *Channel 1 Enabled*	Channel is configured for dynamic or static measurements.
Ch2Enabled *Channel 2 Enabled*	Channel is configured for dynamic or static measurements.
Ch3Enabled *Channel 3 Enabled*	Channel is configured for dynamic or static measurements.
Transducer0Enabled *Transducer 0 Enabled*	Set if Channel0Enabled is set, unless the sensor is self or externally powered, or is powered from Channel 2 if a Dual Path personality is used.
Transducer1Enabled *Transducer 1 Enabled*	Set if Channel1Enabled is set, unless the sensor is self or externally powered, or is powered from Channel 3 if a Dual Path personality is used.
Transducer2Enabled *Transducer 2 Enabled*	Set if Channel2Enabled is set, unless the sensor is self or externally powered, or is powered from Channel 0 if a Dual Path personality is used.
Transducer3Enabled *Transducer 3 Enabled*	Set if Channel3Enabled is set, unless the sensor is self or externally powered, or is powered from Channel 1 if a Dual Path personality is used.
Transducer0Fault *Transducer 0 Fault*	Transducer 0 fault. Indicates bias out of range and/or detected wire off condition.
Transducer1Fault *Transducer 1 Fault*	Transducer 1 fault. Indicates bias out of range and/or detected wire off condition.
Transducer2Fault *Transducer 2 Fault*	Transducer 2 fault. Indicates bias out of range and/or detected wire off condition.
Transducer3Fault *Transducer 3 Fault*	Transducer 3 fault. Indicates bias out of range and/or detected wire off condition.
Transducer0WireOffDetected *Transducer 0 Wire Off Detected*	Transducer 0 wire off condition detected.
Transducer1WireOffDetected *Transducer 1 Wire Off Detected*	Transducer 1 wire off condition detected.
Transducer2WireOffDetected *Transducer 2 Wire Off Detected*	Transducer 2 wire off condition detected.
Transducer3WireOffDetected *Transducer 3 Wire Off Detected*	Transducer 3 wire off condition detected.

Table 56 - Speed Status

Tag	Description (if=1)
Speed0Enabled *Speed 0 Enabled*	Speed 0/1 is enabled. Since the AOP does not provide an "OFF" selection, these must always be set.
Speed1Enabled *Speed 1 Enabled*	
Tach0Fault *Tach (Speed) 0 Fault*	Speed 0/1 is in fault. Fault detection / indication depends on the speed Source selection. The fault indication is associated with any type of speed input.
Tach1Fault *Tach (Speed) 1 Fault*	

Tag (continued)	Description (if=1)
MaxSpeed0Event *New Max Speed Detected Speed 0*	Max Speed 0/1 Event. A new maximum speed is detected on Speed 0/1. Bit toggles when a new event is detected.
MaxSpeed1Event *New Max Speed Detected Speed 1*	
RedundantSpeedFault *Redundant Speed Active*	Redundant tachometer mode is set and the tachometer has switched due to a tachometer failure (Speed 0/1 Fault).

Table 57 - A/D Status

Tag	Description (If=1)
Ch0CalFault *Channel 0 Calibration Fail*	Hardware fault. See Calibration on page 292.
Ch1CalFault *Channel 1 Calibration Fail*	
Ch2CalFault *Channel 2 Calibration Fail*	
Ch3CalFault *Channel 3 Calibration Fail*	

Table 58 - Relay Module Status

Tag	Description (if = 1)
Expansion Relay Module 0 (Address 1)	
ExpRelay0Status *Expansion Relay 0 (address 1) Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
ExpRelay0OverTemperature *Relay Module 0 Over Temperature Warning*	Indicates when the processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on airflow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.
ExpRelay0Relay0NotInhibited *Relay Module 0 Relay 0 Not Inhibited*	Normally set. Indicates that the relay is not inhibited. Goes unset (0) when TripInhibit = 1 or HW control Trip Inhibit/Bypass is set (all enabled relays are inhibited).
ExpRelay0Relay1NotInhibited *Relay Module 0 Relay 1 Not Inhibited*	
ExpRelay0Relay2NotInhibited *Relay Module 0 Relay 2 Not Inhibited*	
ExpRelay0Relay3NotInhibited *Relay Module 0 Relay 3 Not Inhibited*	
ExpRelay0Relay0Fault *Relay Module 0 Relay 0 Fault*	Relay drive test has failed.
ExpRelay0Relay1FaultRelay Module 0 Relay 1 Fault	
ExpRelay0Relay2Fault *Relay Module 0 Relay 2 Fault*	
ExpRelay0Relay3Fault *Relay Module 0 Relay 3 Fault*	

Tag (continued)	Description (if = 1)
	Expansion Relay Module 1 (Address 2)
ExpRelay1Status *Expansion Relay 1 (address 2) Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
ExpRelay1OverTemperature *Relay Module 1 Over Temperature Warning*	Indicates when the processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on airflow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.
ExpRelay1Relay0NotInhibited *Relay Module 1 Relay 0 Not Inhibited*	Normally set. Indicates that the relay is not inhibited. Goes unset (0) when TripInhibit = 1 or HW control Trip Inhibit/Bypass is set (all enabled relays are inhibited).
ExpRelay1Relay1NotInhibited *Relay Module 1 Relay 1 Not Inhibited*	
ExpRelay1Relay2NotInhibited *Relay Module 1 Relay 2 Not Inhibited*	
ExpRelay1Relay3NotInhibited *Relay Module 1 Relay 3 Not Inhibited*	
ExpRelay1Relay0Fault *Relay Module 1 Relay 0 Fault*	Relay drive test has failed.
ExpRelay1Relay1Fault *Relay Module 1 Relay 1 Fault*	
ExpRelay1Relay2Fault *Relay Module 1 Relay 2 Fault*	
ExpRelay1Relay3Fault *Relay Module 1 Relay 3 Fault*	
	Expansion Relay Module 2 (Address 3)
ExpRelay2Status *Expansion Relay 2 (address 3) Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
ExpRelay2OverTemperature *Relay Module 2 Over Temperature Warning*	Indicates when the processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on airflow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.
ExpRelay2Relay0NotInhibited *Relay Module 2 Relay 0 Not Inhibited*	Normally set. Indicates that the relay is not inhibited. Goes unset (0) when TripInhibit = 1 or HW control Trip Inhibit/Bypass is set (all enabled relays are inhibited).
ExpRelay2Relay1NotInhibited *Relay Module 2 Relay 1 Not Inhibited*	
ExpRelay2Relay2NotInhibited *Relay Module 2 Relay 2 Not Inhibited*	
ExpRelay2Relay3NotInhibited *Relay Module 2 Relay 3 Not Inhibited*	
ExpRelay2Relay0Fault *Relay Module 2 Relay 0 Fault*	Relay drive test has failed.
ExpRelay2Relay1Fault *Relay Module 2 Relay 1 Fault*	
ExpRelay2Relay2Fault *Relay Module 2 Relay 2 Fault*	
ExpRelay2Relay3Fault *Relay Module 2 Relay 3 Fault*	

Table 59 - Expansion Module Response Codes

<table>
<tr><th>Tag</th><th>Description</th></tr>
<tr><td>ExpRelay0FaultCode
Relay Module 0 Fault Code</td><td rowspan="5">3-bit integer with values as follows:
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Normal / no exception</td></tr><tr><td>1</td><td>Invalid command / command not recognized</td></tr><tr><td>2</td><td>Reserved</td></tr><tr><td>3</td><td>Message and message content do not agree</td></tr><tr><td>4</td><td>Reserved</td></tr><tr><td>5</td><td>No message data received</td></tr><tr><td>6</td><td>Module is not configured</td></tr></table></td></tr>
<tr><td>ExpRelay1FaultCode
Relay Module 0 Fault Code</td></tr>
<tr><td>ExpRelay2FaultCode
Relay Module 0 Fault Code</td></tr>
<tr><td>ExpAnalogFaultCode
Analog Output Module Fault Code</td></tr>
<tr><td>ExpTachFaultCode
Tachometer Signal Conditioner Module Fault Code</td></tr>
</table>

Table 60 - 4…20 mA Module Status

<table>
<tr><th>Tag</th><th>Description (if = 1)</th></tr>
<tr><td>ExpAnalogStatus
Analog Output Module Status</td><td>Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only.
See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.</td></tr>
<tr><td>ExpAnalogOverTemperature
Analog Output Module Over Temperature Warning</td><td>Indicates when the processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on airflow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.</td></tr>
<tr><td>ExpAnalogCh0Enabled
Analog Output Module Channel 0 Enabled</td><td rowspan="4">4…20mA output channel is enabled.</td></tr>
<tr><td>ExpAnalogCh1Enabled
Analog Output Module Channel 1 Enabled</td></tr>
<tr><td>ExpAnalogCh2Enabled
Analog Output Module Channel 2 Enabled</td></tr>
<tr><td>ExpAnalogCh3Enabled
Analog Output Module Channel 3 Enabled</td></tr>
</table>

Table 61 - Tachometer Signal Conditioner Module Status

Tag	Description (if = 1)
ExpTachStatus *Tachometer Signal Conditioner Module Status*	Container value allows access to hidden tags. The hidden tags provide no user actionable information. They are provided to assist device diagnostics only. See the Assembly Object (class code 0x04), on page 517, for the assembly members and bit assignments.
ExpTachOverTemperature *Tachometer Signal Conditioner Module Over Temperature Warning*	Indicates when the processor board temperature is less than -20 °C (-4 °F) or greater than 70 °C (158 °F). While the module rating is based on surrounding air temperature, depending on airflow, the board temperature can exceed the surrounding air temperature by up to 25 °C (77 °F). This difference means that it is possible that the alarm limit could be exceeded when the surrounding air temperature is as low as 45 °C (113 °F). Consequently, the indication is considered only a warning.

Tag (continued)	Description (if = 1)
ExpTachSpeed0Uncertain *Tachometer Signal Conditioner Speed 0 Uncertain*	Speed 0/1 is less than previous measured. Reported speed is estimated until a further pulse is detected, or until zero speed is determined (maximum pulse wait time exceeded).
ExpTachSpeed1Uncertain *Tachometer Signal Conditioner Speed1 Uncertain*	
ExpTachInput0Fault *Tachometer Signal Conditioner Speed 0 Fault*	Tacho sensor fault. Indicates bias out of range and/or speed out of range and/or TSCX module fault.
ExpTachInput1Fault *Tachometer Signal Conditioner Speed 1 Fault*	

Alarm Status Structure

The alarm status structure consists of an array of 13 records (Table 67) that present the status of associated voted alarms.

If Alarm Status Alignment is Dynamic, then status records are also assigned to relays that are configured to act only on fault, and to any unused (not enabled) relays.

See Alarm System Overview on page 211 and Alarm Status Alignment on page 212 for further information on how Alarm Statuses are associated with Voted Alarms and Relays.

Module status excludes an assembly for each measurement alarm. The status of a measurement alarm that is referenced by a voted alarm is included in the alarm status record that is associated with the voted alarm.

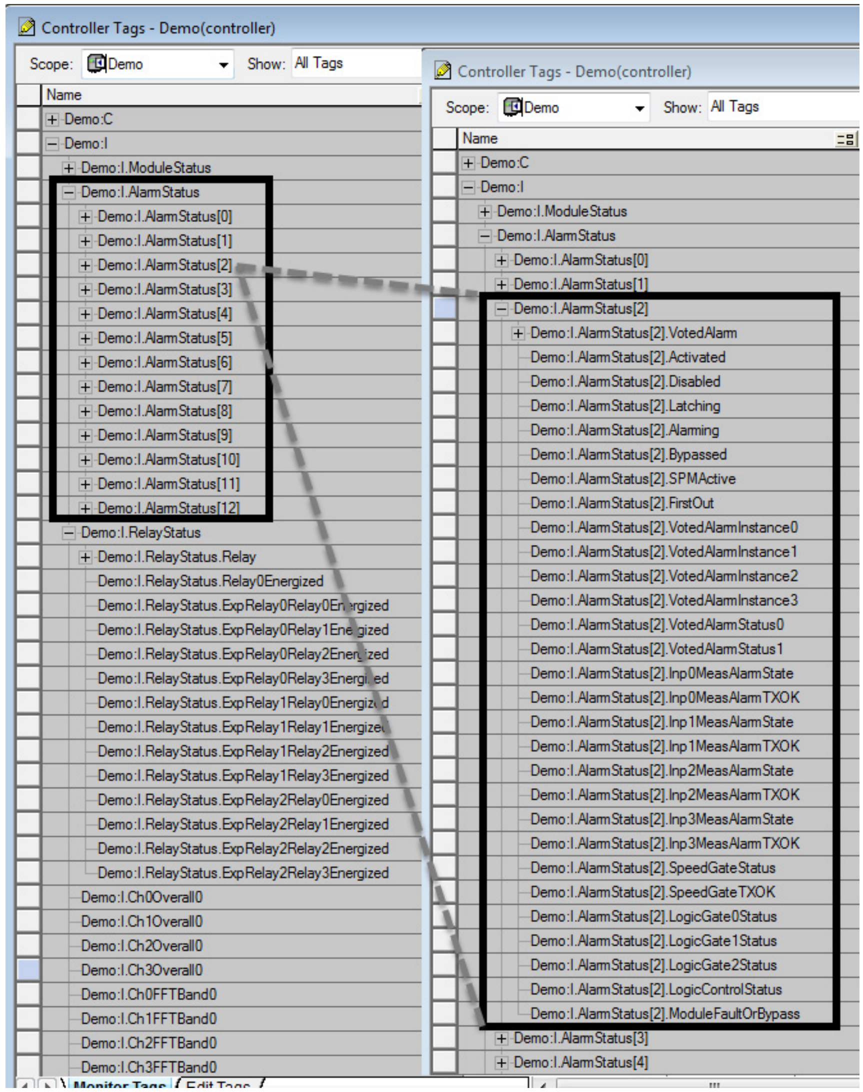
DINT	AlarmStatus[13]

The status structure consists of the parameters that are shown in Table 68.

Alarm Status to Relay and Voted Alarm Association

How Alarm Statuses (Figure 94) are allocated and assigned to voted alarms and relays varies with the selected method of alignment. (See Table 15 on page 98). The two methods of aligning the Alarm Status, Dynamic (default) and Static, are described in Alarm Status Alignment on page 212, and in this section.

Figure 94 - Alarm Status



When selecting the appropriate alignment method, consider the following:

Static Alignment:

- Each voted alarm can have only one enabled output: Alert, Danger, or Transducer Fault.
- Alarm Statuses align one-to-one with the corresponding Voted Alarm:
  - Voted Alarm 0 -- > Alarm Status 0
  - Voted Alarm 1 -- > Alarm Status 1

    …

  - Voted Alarm 12 -- > Alarm Status 12
- Relays are associated with an Alarm Status only if it references a Voted Alarm.
- Relays that are configured to actuate on Fault (only) do not have an associated Alarm Status.

Dynamic Alignment:

- Each Relay is assigned an Alarm Status:
  - If the Relay is enabled and references a Voted Alarm Output, then it associates with the Alarm Status that is associated with the Voted Alarm Output.
  - If the Relay is enabled and configured to actuate (only) on Fault, then it is assigned a unique Alarm Status. In this case, the Voted Alarm Instance indicated is 14 (VotedAlarmInstance0-3 = “1111” - 1).
  - If the Relay is not enabled, then an Alarm Status is reserved for it.
  - Alarm Status 0 is always allocated to, or reserved for use with, the main module relay (relay #0).
  - If one or more Expansion Relay modules are defined, then Alarm Status instances are allocated as follows:

    First Expansion Relay Module: Alarm Statuses 1 … 4

    Second Expansion Relay Module: Alarm Statuses 5 … 8

    Third Expansion Relay Module: Alarm Statuses 9 … 12
- Each enabled output of a Voted Alarm, including Alert, Danger and Transducer Fault, are allocated a unique Alarm Status.
- If there are more outputs that are defined than there are Alarm Statuses (13), then any unallocated voted alarm outputs are ignored.
  - The AOP does not allow configurations that specify use of greater than 13 Alarm Status instances.
  - This possibility is why Dynamic Alignment prioritizes assigning an Alarm Status to relays, even if not used. This assignment makes sure that any relay is managed.

Examples

The following tables illustrate how Dynamic and Static alignment affects Alarm Status assignments for various configurations.

Example 1

Table 62 - 4-Channels; Alert and Danger; No Relay

Dynamic Alignment	Static Alignment
Voted Alarm 0: Actuate on Alert, Danger	Voted Alarm 0: Actuate on Danger
Voted Alarm 1: Actuate on Alert, Danger	Voted Alarm 1: Actuate on Danger
Voted Alarm 2: Actuate on Alert, Danger	Voted Alarm 2: Actuate on Danger
Voted Alarm 3: Actuate on Alert, Danger	Voted Alarm 3: Actuate on Danger
Voted Alarms 4 …12: Not enabled	Voted Alarm 4: Actuate on Alert
	Voted Alarm 5: Actuate on Alert
	Voted Alarm 6: Actuate on Alert
	Voted Alarm 7: Actuate on Alert
	Voted Alarms 8 …12: Not enabled
Relay = Not Enabled	**Relay = Not Enabled**

Dynamic Alignment:

	Voted Alarm Instance					Voted Alarm Status			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	0	0	0	0	NA	0	0	0	R
1	1	0	0	0	0	1	0	1	Alert
2	1	0	0	0	0	0	1	2	Danger
3	0	1	0	0	1	1	0	1	Alert
4	0	1	0	0	1	0	1	2	Danger
5	1	1	0	0	2	1	0	1	Alert
6	1	1	0	0	2	0	1	2	Danger
7	0	0	1	0	3	1	0	1	Alert
8	0	0	1	0	3	0	1	2	Danger
9…12	0	0	0	0	NA	1	1	3	

Static Alignment:

	Voted Alarm Instance					Voted Alarm Status			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	0	1	0	0	1	0	1	2	Danger
2	1	1	0	0	2	0	1	2	Danger
3	0	0	1	0	3	0	1	2	Danger
4	1	0	1	0	4	1	0	1	Alert
5	0	1	1	0	5	1	0	1	Alert
6	1	1	1	0	6	1	0	1	Alert
7	0	0	0	1	7	1	0	1	Alert
8…12	0	0	0	0	NA	0	0	0	

R = Reserved for Main Module Relay; NA = Not Allocated

Example 2

Table 63 - 3 Channels; Alert, Danger, TX Fault; Trip on Alarm 0 Danger

Dynamic Alignment	**Static Alignment**
Voted Alarm 0: Actuate on Alert, Danger, TX Fault	Voted Alarm 0: Actuate on Danger
Voted Alarm 1: Actuate on Alert, Danger, TX Fault	Voted Alarm 1: Actuate on Danger
Voted Alarm 2: Actuate on Alert, Danger, TX Fault	Voted Alarm 2: Actuate on Danger
Voted Alarms 3 …12: Not enabled	Voted Alarm 3: Actuate on Alert
	Voted Alarm 4: Actuate on Alert
	Voted Alarm 5: Actuate on Alert
	Voted Alarm 6: Actuate on TX Fault
	Voted Alarm 7: Actuate on TX Fault
	Voted Alarm 8: Actuate on TX Fault
	Voted Alarms 9 …12: Not enabled
Relay = Voted Alarm 0, on Danger	**Relay = Voted Alarm 0, on Danger**

Dynamic Alignment:

Alarm Status #	Voted Alarm Instance					Voted Alarm Status			
	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	1	0	0	0	0	1	0	1	Alert
2	1	0	0	0	0	1	1	3	TXF
3	0	1	0	0	1	1	0	1	Alert
4	0	1	0	0	1	0	1	2	Danger
5	0	1	0	0	1	1	1	3	TXF
6	1	1	0	0	2	1	0	1	Alert
7	1	1	0	0	2	0	1	2	Danger
8	1	1	0	0	2	1	1	3	TXF
9…12	0	0	0	0	NA	0	0	0	

Static Alignment:

Alarm Status #	Voted Alarm Instance					Voted Alarm Status			
	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	0	1	0	0	1	0	1	2	Danger
2	1	1	0	0	2	0	1	2	Danger
3	0	0	1	0	3	1	0	1	Alert
4	1	0	1	0	4	1	0	1	Alert
5	0	1	1	0	5	1	0	1	Alert
6	1	1	1	0	6	1	1	3	TXF
7	0	0	0	1	7	1	1	3	TXF
8	1	0	0	1	8	1	1	3	TXF
9 …12	0	0	0	0	NA	0	0	0	

Relay Assigned Output; R = Reserved; NA = Not Allocated; TXF = Transducer Fault

Example 3

Table 64 - 4-Channels; Alert and Danger; Expansion Relays

Dynamic Alignment	Static Alignment
Voted Alarm 0: Actuate on Alert, Danger	Voted Alarm 0: Actuate on Danger
Voted Alarm 1: Actuate on Alert, Danger	Voted Alarm 1: Actuate on Danger
Voted Alarm 2: Actuate on Alert, Danger	Voted Alarm 2: Actuate on Danger
Voted Alarm 3: Actuate on Alert, Danger	Voted Alarm 3: Actuate on Danger
Voted Alarms 4 … 12: Not enabled	Voted Alarm 4: Actuate on Alert
	Voted Alarm 5: Actuate on Alert
	Voted Alarm 6: Actuate on Alert
	Voted Alarm 7: Actuate on Alert
	Voted Alarms 8 … 12: Not enabled
Relay 0 = Module Fault	**Relay 0 = Module Fault**
RELX0 Relay 0 = Voted Alarm 0, on Danger	**RELX0 Relay 0 = Voted Alarm 0, on Danger**
RELX0 Relay 1 = Voted Alarm 1, on Danger	**RELX0 Relay 1 = Voted Alarm 1, on Danger**
RELX0 Relay 2 = Voted Alarm 2, on Danger	**RELX0 Relay 2 = Voted Alarm 2, on Danger**
RELX0 Relay 3 = Voted Alarm 3, on Danger	**RELX0 Relay 3 = Voted Alarm 3, on Danger**

Dynamic Alignment:

	Voted Alarm Instance					**Voted Alarm Status**			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	1	1	1	14	0	0	0	Fault
1	1	0	0	0	0	0	1	2	Danger
2	0	1	0	0	1	0	1	2	Danger
3	1	1	0	0	2	0	1	2	Danger
4	0	0	1	0	3	0	1	2	Danger
5	1	0	0	0	0	1	0	1	Alert
6	0	1	0	0	1	1	0	1	Alert
7	1	1	0	0	2	1	0	1	Alert
8	0	0	1	0	3	1	0	1	Alert
9…12	0	0	0	0	NA	0	0	0	

Static Alignment:

	Voted Alarm Instance					**Voted Alarm Status**			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	0	1	0	0	1	0	1	2	Danger
2	1	1	0	0	2	0	1	2	Danger
3	0	0	1	0	3	0	1	2	Danger
4	1	0	1	0	4	1	0	1	Alert
5	0	1	1	0	5	1	0	1	Alert
6	1	1	1	0	6	1	0	1	Alert
7	0	0	0	1	7	1	0	1	Alert
8 …12	0	0	0	0	NA	0	0	0	

Relay Assigned Output; R = Reserved, NA = Not Allocated

Example 4

Table 65 - 4-Channels; Alert and Danger; Expansion Relays

Dynamic Alignment	**Static Alignment**
Voted Alarm 0: Actuate on Alert, Danger	Voted Alarm 0: Actuate on Danger
Voted Alarm 1: Actuate on Alert, Danger	Voted Alarm 1: Actuate on Danger
Voted Alarm 2: Actuate on Alert, Danger	Voted Alarm 2: Actuate on Danger
Voted Alarm 3: Actuate on Alert, Danger	Voted Alarm 3: Actuate on Danger
Voted Alarms 4 … 12: Not enabled	Voted Alarm 4: Actuate on Alert
	Voted Alarm 5: Actuate on Alert
	Voted Alarm 6: Actuate on Alert
	Voted Alarm 7: Actuate on Alert
	Voted Alarms 8 … 12: Not enabled
Relay 0 = Module Fault	**Relay 0 = Module Fault**
RELX0 Relay 0 = Voted Alarm 0, on Danger	**RELX0 Relay 0 = Voted Alarm 0, on Danger**
RELX0 Relay 1 = Voted Alarm 0, on Alert	**RELX0 Relay 1 = Voted Alarm 4, on Alert**

Dynamic Alignment:

	Voted Alarm Instance					**Voted Alarm Status**			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	1	1	1	14	0	0	0	Fault
1	1	0	0	0	0	0	1	2	Danger
2	1	0	0	0	0	1	0	1	Alert
3	0	0	0	0	NA	0	0	0	R
4	0	0	0	0	NA	0	0	0	R
5	0	1	0	0	1	1	0	1	Alert
6	0	1	0	0	1	0	1	2	Danger
7	1	1	0	0	2	1	0	1	Alert
8	1	1	0	0	2	0	1	2	Danger
9	0	0	1	0	3	1	0	1	Alert
10	0	0	1	0	3	0	1	2	Danger
11…12	0	0	0	0	NA	0	0	0	

Static Alignment:

	Voted Alarm Instance					**Voted Alarm Status**			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	0	1	0	0	1	0	1	2	Danger
2	1	1	0	0	2	0	1	2	Danger
3	0	0	1	0	3	0	1	2	Danger
4	1	0	1	0	4	1	0	1	Alert
5	0	1	1	0	5	1	0	1	Alert
6	1	1	1	0	6	1	0	1	Alert
7	0	0	0	1	7	1	0	1	Alert
8 …12	0	0	0	0	NA	0	0	0	

Relay Assigned Output; R = Reserved for expansion module Relays 2 and 3; NA = Not Allocated

Example 5

Table 66 - 6 Defined Alert and Danger Alarms

Dynamic Alignment	Static Alignment
Voted Alarm 0: Actuate on Alert, Danger	Voted Alarm 0: Actuate on Danger
Voted Alarm 1: Actuate on Alert, Danger	Voted Alarm 1: Actuate on Danger
Voted Alarm 2: Actuate on Alert, Danger	Voted Alarm 2: Actuate on Danger
Voted Alarm 3: Actuate on Alert, Danger	Voted Alarm 3: Actuate on Danger
Voted Alarm 4: Actuate on Alert, Danger	Voted Alarm 4: Actuate on Danger
Voted Alarm 5: Actuate on Alert, Danger	Voted Alarm 5: Actuate on Danger
Voted Alarms 6 … 12: Not enabled	Voted Alarm 6: Actuate on Alert
	Voted Alarm 7: Actuate on Alert
	Voted Alarm 8: Actuate on Alert
	Voted Alarm 9: Actuate on Alert
	Voted Alarm 10: Actuate on Alert
	Voted Alarm 11: Actuate on Alert
	Voted Alarms 12: Not enabled
Relay 0 = Voted Alarm 0, on Danger	**Relay 0 = Voted Alarm 0, on Danger**

Dynamic Alignment:

	Voted Alarm Instance					Voted Alarm Status			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	1	0	0	0	0	1	0	1	Alert
2	0	1	0	0	1	1	0	1	Alert
3	0	1	0	0	1	0	1	2	Danger
4	1	1	0	0	2	1	0	1	Alert
5	1	1	0	0	2	0	1	2	Danger
6	0	0	1	0	3	1	0	1	Alert
7	0	0	1	0	3	0	1	2	Danger
8	1	0	1	0	4	1	0	1	Alert
9	1	0	1	0	4	0	1	2	Danger
10	0	1	1	0	5	1	0	1	Alert
11	0	1	1	0	5	0	1	2	Danger
12	0	0	0	0	NA	0	0	0	

Static Alignment:

	Voted Alarm Instance					Voted Alarm Status			
Alarm Status #	0	1	2	3	Voted Alarm#	0	1	Status to Activate On	
0	1	0	0	0	0	0	1	2	Danger
1	0	1	0	0	1	0	1	2	Danger
2	1	1	0	0	2	0	1	2	Danger
3	0	0	1	0	3	0	1	2	Danger
4	1	0	1	0	4	0	1	2	Danger
5	0	1	1	0	5	0	1	2	Danger
6	1	1	1	0	6	1	0	1	Alert
7	0	0	0	1	7	1	0	1	Alert
8	1	0	0	1	8	1	0	1	Alert
9	0	1	0	1	9	1	0	1	Alert
10	1	1	0	1	10	1	0	1	Alert
11	0	0	1	1	11	1	0	1	Alert
12	0	0	0	0	NA	0	0	0	

Relay Assigned Output; NA = Not Allocated

Table 67 - Alarm Status

Tag	Description
Activated	Activated One or more associated relay outputs (and status indicators) are set
Disabled	Disabled Alarm is disabled
Latching	Latching Configured as latching
Alarming	Alarming Required conditions for the "alarm state" are true
Bypassed	Bypassed Alarm is bypassed (associated relays / status indicators that are held in non-alarm state
SetPointMultActive	Set Point Multiplier is active
FirstOut	First Out Set if the first alarm to activate since last Reset or Bypass
VotedAlarmInstance0	4 bit value. The number of the Voted Alarm that the status refers to. Value is 1…13, which references voted alarm 0…12 (so, is Voted Alarm number + 1).
VotedAlarmInstance1	
VotedAlarmInstance2	
VotedAlarmInstance3	
VotedAlarmStatus0	2 bit value. Voted Activate Status to Activate On: 0=Normal, 1=Alert, 2=Danger, 3=TX Fault
VotedAlarmStatus1	
Inp0MeasAlarmState	Input Measurement Alarm 0 State of the measurement alarm that is referenced for alarm input 0(1)
Inp0MeasAlarmXdcrOK	Input Measurement Alarm 0 TX OK TX OK status of the measurement alarm that is referenced for alarm input 0
Inp1MeasAlarmState	Input Measurement Alarm 1 State of the measurement alarm that is referenced for alarm input 1(1)
Inp1MeasAlarmXdcrOK	Input Measurement Alarm 1 TX OK TX OK status of the measurement alarm that is referenced for alarm input 1
Inp2MeasAlarmState	Input Measurement Alarm 2 State of the measurement alarm that is referenced for alarm input 2(1)
Inp2MeasAlarmXdcrOK	Input Measurement Alarm 2 TX OK TX OK status of the measurement alarm that is referenced for alarm input 2
Inp3MeasAlarmState	Input Measurement Alarm 3 State of the measurement alarm that is referenced for alarm input 3(1)
Inp3MeasAlarmXdcrOK	Input Measurement Alarm 3 TX OK TX OK status of the measurement alarm that is referenced for alarm input 3
SpeedGateActive	Speed Gate Status 0 = not gating, 1 = gating
SpeedGateXdcrOK	Speed Gate TX OK TX OK status of the input that is used for speed gating
LogixGate0Active	Indicates that the first of the up to three gate controls is set. Gate control can be defined using the output tags AlarmControl0/1 and the Discrete Inputs Pt0 and Pt1.
LogixGate1Active	Indicates that the second of the up to three gate controls is set. When multiple gate controls are defined, the gate is TRUE when all controls are set
LogixGate2Active	Indicates that the third of the up to three gate controls is set. When multiple gate controls are defined, the gate is TRUE when all controls are set
LogixControlActive	Indicates that Logic Control is set. Alarm Logic can be controlled (forced true) using output tags AlarmControl0/1 or either Discrete Input Pt0 or Pt1.
ModuleFaultOrBypass	Indicates that the relay is being bypassed, if configured to trip on bypass, or that the module is in fault, if the relay is configured to trip on module fault.

The alarm number is presented in the assembly in bit format. The alarm instance is the decimal value that is represented by the 4 bits. For example:

-test:I.AlarmStatus[0].VotedAlarmInstance0	0
-test:I.AlarmStatus[0].VotedAlarmInstance1	1
-test:I.AlarmStatus[0].VotedAlarmInstance2	0
-test:I.AlarmStatus[0].VotedAlarmInstance3	0

The example indicates the status of voted alarm number 2.

However, the voted alarm instance that is provided in the status assembly is a value from 1…13. To get the voted alarm instance, as referenced to the AOP (0…12), subtract 1 from the decimal value of the presented 4-bit value.

Table 68 - Alarm Status Structure

The status structure consists of these parameters.

DINT	AlarmStatus [13]
INT	Relay
INT	Reserved

The data type for each attribute is either an 'INT' (16 bits), or a 'DINT' (32 bit). In each case, the state of the individual bits, as provided in Table 67, define the status. It is possible for multiple bits to be set.

Relay Status Structure

The relay status structure contains the parameters that are shown in Table 69. It communicates the status of the single on-board relay (relay 0) of the dynamic measurement module. It also communicates the status of the relays in each of the up to three connected expansion relay modules (relays 1…4, 5…8 and 9…12). The table consists of discrete bits, one per relay. When set, the bit indicates that the associated relay is energized.

The status structure consists of these parameters.

Table 69 - Relay Status

Tag	Description (If=1)
Relay0Energized *Main Module Relay is Energized*	Main module relay is energized.
ExpRelay0Relay0Energized *Relay Module 0 Relay 0 is Energized*	Relay is energized. Normally 0 (not energized) when NOT configured "Fail Safe". Normally 1 (energized) when configured "Fail Safe".
ExpRelay0Relay1Energized *Relay Module 0 Relay 1 is Energized*	
ExpRelay0Relay2Energized *Relay Module 0 Relay 2 is Energized*	
ExpRelay0Relay3Energized *Relay Module 0 Relay 3 is Energized*	
ExpRelay1Relay0Energized *Relay Module 1 Relay 0 is Energized*	
ExpRelay1Relay1Energized *Relay Module 1 Relay 1 is Energized*	
ExpRelay1Relay2Energized *Relay Module 1 Relay 2 is Energized*	
ExpRelay1Relay3Energized *Relay Module 1 Relay 3 is Energized*	
ExpRelay2Relay0Energized *Relay Module 2 Relay 0 is Energized*	
ExpRelay2Relay1Energized *Relay Module 2 Relay 1 is Energized*	
ExpRelay2Relay2Energized *Relay Module 2 Relay 2 is Energized*	
ExpRelay2Relay3Energized *Relay Module 2 Relay 3 is Energized*	

Input Data Structure

The input data structure is written immediately following the status data. It consists of an array of 4 byte floating point numbers that represent the various measurements that are selected for input in Module Definition.

The parameters are some subset of the parameters that are listed in Table 70.

Table 70 - Input Data Parameters

#	Parameter	Description
0	Ch0Overall0	Overall values after integration and high pass filters
1	Ch1Overall0	
2	Ch2Overall0	
3	Ch3Overall0	
4	Ch0Overall1	Optional Overall values from selected data source
5	Ch1Overall1	
6	Ch2Overall1	
7	Ch3Overall1	
8	Ch0DCV	Channel bias (or gap) values
9	Ch1DCV	
10	Ch2DCV	
11	Ch3DCV	
12	Ch0Order0Mag	Tracking filter 0 magnitude values
13	Ch1Order0Mag	
14	Ch2Order0Mag	
15	Ch3Order0Mag	
16	Ch0Order0Phase	Tracking filter 0 phase values
17	Ch1Order0Phase	
18	Ch2Order0Phase	
19	Ch3Order0Phase	
20	Ch0Order1Mag	Tracking filter 1 magnitude values
21	Ch1Order1Mag	
22	Ch2Order1Mag	
23	Ch3Order1Mag	
24	Ch0Order1Phase	Tracking filter 1 phase values
25	Ch1Order1Phase	
26	Ch2Order1Phase	
27	Ch3Order1Phase	
28	Ch0Order2Mag	Tracking filter 2 magnitude values
29	Ch1Order2Mag	
30	Ch2Order2Mag	
31	Ch3Order2Mag	

Table 70 - Input Data Parameters (continued)

#	Parameter	Description
32	Ch0Order2Phase	Tracking filter 2 phase values
33	Ch1Order2Phase	
34	Ch2Order2Phase	
35	Ch3Order2Phase	
36	Ch0Order3Mag	Tracking filter 3 magnitude values
37	Ch1Order3Mag	
38	Ch2Order3Mag	
39	Ch3Order3Mag	
40	Ch0Order3Phase	Tracking filter 3 phase values
41	Ch1Order3Phase	
42	Ch2Order3Phase	
43	Ch3Order3Phase	
44	Ch0FFTBand0	FFT Band 0 magnitude values
45	Ch1FFTBand0	
46	Ch2FFTBand0	
47	Ch3FFTBand0	
48	Ch0FFTBand1	FFT Band 1 magnitude values
49	Ch1FFTBand1	
50	Ch2FFTBand1	
51	Ch3FFTBand1	
52	Ch0FFTBand2	FFT Band 2 magnitude values
53	Ch1FFTBand2	FFT Band 2 magnitude values
54	Ch2FFTBand2	
55	Ch3FFTBand2	
56	Ch0FFTBand3	FFT Band 3 magnitude values
57	Ch1FFTBand3	
58	Ch2FFTBand3	
59	Ch3FFTBand3	
60	Ch0FFTBand4	FFT Band 4 magnitude values
61	Ch1FFTBand4	
62	Ch2FFTBand4	
63	Ch3FFTBand4	
64	Ch0FFTBand5	FFT Band 5 magnitude values
65	Ch1FFTBand5	
66	Ch2FFTBand5	
67	Ch3FFTBand5	

Table 70 - Input Data Parameters (continued)

#	Parameter	Description
68	Ch0FFTBand6	FFT Band 6 magnitude values
69	Ch1FFTBand6	
70	Ch2FFTBand6	
71	Ch3FFTBand6	
72	Ch0FFTBand7	FFT Band 7 magnitude values
73	Ch1FFTBand7	
74	Ch2FFTBand7	
75	Ch3FFTBand7	
76	Ch0Not1X	Not 1x values
77	Ch1Not1X	
78	Ch2Not1X	
79	Ch3Not1X	
80	Ch0DC	DC measurement values
81	Ch1DC	
82	Ch2DC	
83	Ch3DC	
84	Ch0_1SMAXMag	SMAX magnitude values
85	Ch2_3SMAXMag	
86	Ch0_1SMAXPhase	SMAX Phase values
87	Ch2_3SMAXPhase	
88	Ch0_1Shaft Absolute Pk_Pk	Shaft Absolute values
89	Ch2_3Shaft Absolute Pk_Pk	
90	Speed0	Speed values
91	Speed1	
92	FactoredSpeed0	Speed values
93	FactoredSpeed1	
94	Speed0 max	Maximum speed since last reset The maximum speed value does not update when the tachometer is in fault. See Behavior for more information.
95	Speed1 max	
96	Speed0RateOfChange	Speed rate of change per minute
97	Speed1RateOfChange	
98	Ch0_1DiffExpansion	Differential Expansion values The measured expansion values are output to the same tags regardless of the selected measurement mode - axial (complementary) or radial (ramp).
99	Ch2_3DiffExpansion	
100	Reserved	
101	Reserved	
102	Ch0RodDrop	Rod Drop values
103	Ch1RodDrop	
104	Ch2RodDrop	
105	Ch2RodDrop	

Output Assembly

The output assembly consists of one control integer optionally followed by two speed values and/or an array of 16 alarm values. The speed and/or alarm limit values are present when specified in Module Definitions.

The control integer is an array of bits, and each bit manages a specific control function as defined in this table.

Table 71 - Output Assembly

Control	Description
TripInhibit *Trip Inhibit (Bypass)*	When set, Trip Inhibit (Bypass) helps prevent any alarm activation (and/or cancel standing alarms), including the associated alarm action (relay). When Inhibit is set, all relays are held in their non-alarm state.
SetPointMultiplier0En *Set Point Multiplier 0 Enable*	When toggled, the module starts (restart) the Hold timer of any voted alarm with the respective Set Point Multiplier (SPM) control enabled. While the timer is >0, the set points of any associated measurement alarms are multiplied by the configured factor for the alarm.
SetPointMultiplier1En *Set Point Multiplier 1 Enable*	
Speed0Fault *Speed 0 Fault*	When speed is passed on the output (two speed values following this) these controls allow definition of the status of the speed values. If set (1) the speed transducer status is considered in fault.
Speed1Fault *Speed 1 Fault*	
AlarmControl0 *Alarm Control 0 Active*	If the respective Alarm Control for **Output Tag Gate Control** is specified, then when set, the gate condition is satisfied and (unless other gate conditions are also specified) the alarm is applied. If the respective Alarm Control for **Output Tag Override Control** is specified, then when set, the voted alarm actuates, irrespective of other configurations for the voted alarm.
AlarmControl1 *Alarm Control 1 Active*	
AlarmReset *Alarm Reset*	Resets all latched alarms where the alarm condition is no longer present.
AlarmBufferTrigger *Trend Alarm Buffer Trigger*	When set, the Alarm Buffer captures the current Trend Buffer and high-resolution data buffer.
AlarmBufferReset *Trend Alarm Buffer Reset*	Resets the alarm buffer, if latched. When reset, existing alarm buffer content is lost.
TransientBuffer0Reset *Transient Buffer 0 Reset*	Resets the transient buffer, if latched. When reset, existing transient buffer content is lost.
TransientBuffer1Reset *Transient Buffer 1 Reset*	
TransientBuffer2Reset *Transient Buffer 2 Reset*	
TransientBuffer3Reset *Transient Buffer 3 Reset*	
MaxSpeedReset *Maximum Speed Reset*	Resets the maximum speed value. When reset, the maximum speed value is set equal to the current measured speed.
Optional Outputs	
Speed[2] *Speed Outputs*	Optional speed outputs. Provides speed (RPM) to module from the controller.
AlarmLimits[16] *Alarm Limits Output*	Optional alarm limit outputs. Provides alarm limits to module from the controller.

Calibration

The dynamic measurement module includes no adjustable components so does not require periodic calibration.

To make sure that the measurement accuracy is within specification, the digital signal processor (DSP) of the module self-calibrates at each power-up. The calibration function generates a set of coefficients that are applied to measurements.

After each calibration, these coefficients are checked against design limits. Coefficients that exceed their design limits indicate a hardware fault. If the check fails, a solid red DSP status indicator indicates a calibration failure. Also, bit 15, "Any calibration failure", is set in the DSP status value of the input status assembly.

If calibration fails, the module operates for approximately 1 minute and then forces the DSP to restart, and recalibrate. This cycle repeats until calibration passes.

Accuracy

The accuracy of a measurement is dependent on factors that are associated with hardware, firmware design, and configuration. The sensitivity and accuracy of the sensor, and the characteristics of the measured signal also affect accuracy.

Signal and Sensor

The sensor, the characteristics of the signal, and the environment have far more of an impact on measurement accuracy than the instrument. Factors include signal level relative to the sensors range, signal frequency relative to the calibration frequency, the environmental conditions relative to the sensor design conditions, and the advertised accuracy of the sensor to begin with.

Eddy Current Probes

(ECPs) are accurate within a scale factor error, typically ±5 or ±10%, when measurements are made within a specific range to target, the "Linear Range". When using an ECP, make sure that the sensor that is selected is designed such that the expected / typical range to target is as near the center of the linear range of the probe as possible.

Accelerometers

Accelerometers, and velocity-integrating accelerometers, are designed with a specified sensitivity, typically ±5 or ±10%, operating frequency range and direction of sensitivity. The sensitivity is determined based on tests that use a calibrated input signal at a specific frequency, typically at 80 Hz or 100 Hz, and does not always measure with the same sensitivity at other frequencies. Sensor accuracy is also dependent on the direction of the vibration relative to the axis of the sensor. These sensors are also commonly sensitive to temperature. When using an accelerometer, make sure that its frequency range is suitable to the expected signal. Also make sure that the sensor is mounted as close to “in line” with the shaft center as practical, and that the operating temperature is well within the rated temperature range of the sensor.

Function Generators

Function generators are commonly used to simulate signals for the testing instrumentation. These instruments are available in a wide range frequency and amplitude output capabilities and with varying accuracy specifications. Accuracy statements such as the following must be considered:

- ±2% of setting 2 mV Tektronix AFG 3022 Arbitrary / Function Generator
- Typically ±3% ±1 mV at 1 kHz into 50 Ω / 600 Ω Fluke DDS Function Generator
- Typical (1 kHz Sine, 0V Offset, >10mVpp, Auto) ± 1% of setting ± 2mVpp (Amplitude into 50 Ω) Rigol DG4000 Series Function / Arbitrary Waveform Generator

Other important considerations include the instruments output impedance, frequency and amplitude range, DC offset controls, and (perhaps) its ability to synchronize outputs[(1)]. When using a function generator, make sure that the signal that the instrument provides to the 1444 monitor is as expected, and its accuracy is considered in the results of any measurements made.

(1) Some signal generators can lock output channel frequencies together so that they remain synchronized as the output frequency changes. Other instruments synchronize their outputs when set but do not maintain them synchronized when the output frequency is then changed.

Module Configuration

After sensor and signal, module configuration has the greatest impact on measurement accuracy. Considerations here include the specific measurement that is applied. The measurement includes overall or tracking-filter magnitude, the configuration of that measurement, and the higher-level signal processing that is performed on the signal. For example, measurements such as the hardware sample rate and any of the filtering or the resampling measurements. This table provides guidance on configuration-related considerations that can affect measurement accuracy for common acceleration or displacement measurements.

Table 72 - High-level Signal Processing Considerations

High-level Signal Processing Considerations		
Page	**Parameter**	**Considerations**
HW Configuration	Xdcr Sensitivity	Enter the precise sensitivity of the sensor used. Sensors are designed to a "Nominal" sensitivity, such as 100 mV/g. However, the sensors actual sensitivity can vary from nominal by several percent, so it can be 105.6 mV/g (for example). If accuracy is more important than the ability to change out sensors easily, then enter the actual sensitivity rather than the default nominal value.
	Measurement Type	Do not select measurement types that specify integration. Integration creates a significant complexity to the measurement as the frequency of a signal has a dramatic effect on its magnitude (divides by frequency).
Filters	ADC FFT FMAX	When amplitude accuracy is most important, or if the signal of interest is not at a stable, fixed, frequency, set the ADC (hardware) FFT FMAX to the highest practical value. When frequency accuracy is most important, set the AFC FFT FMAX to the lowest practical value.
	Primary Path High Pass Filter	Do not select measurements from the Post Filter signal source if a high pass filter is applied. Filters are designed so that the cutoff frequency specified (on the Filters page) is the point where the signal is attenuated by -3 dB. This design means that some attenuation is applied on the pass band (higher frequency) side of the filter. In all cases, the amount of attenuation decreases rapidly at frequencies further away from the corner. However, some attenuation can be expected at frequencies more than twice the cutoff frequency. How much and how fast is dependent on the quality of the filter, which in the 1444 can be either -24 or -60 dB/octave depending on the selected measurement type.
	Primary Path Low Pass Filter	Do not enable a low pass filter.
	Primary Path FFT FMAX	Do not select an FMAX lower than the ADC FFT FMAX if you use any type other than the Aeroderivative Measurement Type. If the required measurement is an FFT or an FFT Band measurement, and requires a reduced FMAX, then define the FFT on the Alternate Path rather than the Primary Path. The Anti-Alias filter (required when resampling) that is applied on the Alternate Path is a higher quality than the one available to the primary path.
Measurement Function Configuration Considerations		

Table 72 - High-level Signal Processing Considerations (continued)

High-level Signal Processing Considerations		
Page	**Parameter**	**Considerations**
Overall	Detection	Select RMS or Scaled Peak signal detection. RMS-based level detection verifies the most accurate measurement possible. If True Peak or True Peak to Peak signal detection is required, then make sure that the signal of interest is at a frequency not greater than 30% of the selected FMAX. If True Peak or True Peak to Peak signal detection is required, then make sure that the signal of interest is at a frequency not greater than 30% of the selected FMAX. This action makes sure that the sampled TWF accurately represents the input signal.
	Time Constant	For the best accuracy set the Overall Time Constant to 1.0. However, in addition to accuracy, the TC affects the sensitivity and responsiveness of the overall measurement. See Overall Time Constant on page 133 for further information.
Tracking Filters	Tracking Filters provide accurate order measurement and it is recommended that they be used, vs. FFT Band measurements, when real-time measures are required or if speed is not stable. See Tracking Filters on page 138 for details and guidance on defining Tracking Filters.	

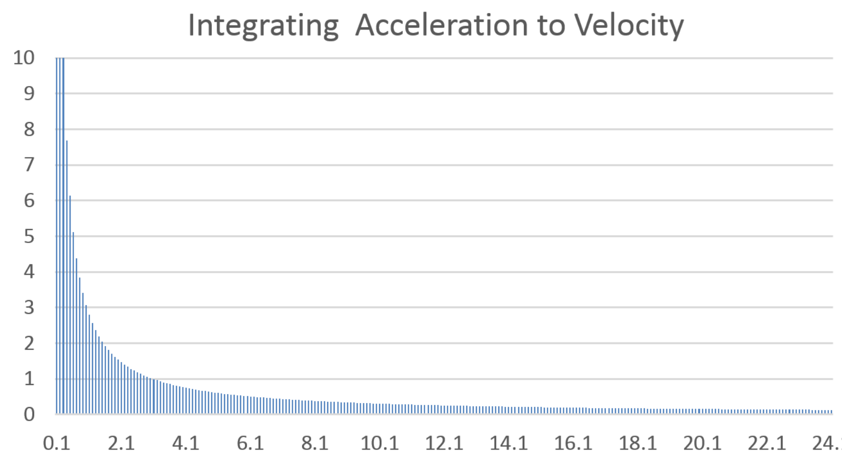
Table 72 - High-level Signal Processing Considerations (continued)

High-level Signal Processing Considerations		
Page	**Parameter**	**Considerations**
Bands	FFT Bands are used to measure component signals in complex measurements, typically from measurements where there are many different frequency signals present. In these cases, the high-level signal processing that is applied, and the configuration of the FFT, used in the bands measurement, are critical to correct measurements – and changes based on the characteristics of the signal of interest. The accuracy of FFT Band measurements can only be verified when the frequencies of included signals are stable. When signal frequencies change (or "slew") within a band, or move between bands, the FFT function effectively distributes the signal energy within multiple FFT bins. This action can result in band measurements that are lower than actual. Some signal-processing techniques can be applied to minimize these effects, for example: • Configure higher frequency measurements to increase the bin-width (Hz per bin) which reduces the amount of leakage that is associated with minor changes in signal frequency. • Sample synchronously to move the FFT bins effectively as speed changes. • Define bands in the order domain to keep the bands centered on order frequencies. While these and other techniques can reduce the effects of frequencies changing within the measurement, how effective they are depends on the following: • How rapidly the signal frequencies are changing. • The presence of other non-synchronous signals. • The type of FFT Window that is applied, and more. While it is possible to improve the accuracy of measuring synchronous signals as speed changes, doing so conversely reduces the accuracy of measuring any non-synchronous signals that are present.	
	Detection	See previously mentioned "detection" in this table.
	FFT Window	Set the window to Flat top The Flat top FFT Window provides the best possible magnitude accuracy for band measurements.
	Number of Averages	It is best to specify some amount of averaging if signal noise is expected. However, if the frequency of the signal of interest is not stable, then the averaging smears the signal unless sampling synchronously. But in that case, it smears any non-synchronous signals that are present.
	Measurement Mode	The FFT Band function provides two options for magnitude measurement: • Band Overall Use Band Overall if the measured signal includes only one frequency. This frequency verifies the best accuracy when the frequency of the signal is not centered within an FFT bin, or if its frequency changes within the band. However, accuracy can still be reduced with the frequency of the signal is at the edges of the specified Band limits. • Use Max Peak in Band Use when multiple frequencies can be present within the FFT Band limits.

Configuring Low-Frequency Measurements

Due to various signal-processing complexities, such as integration and filtering near to DC, Low Frequency is considered as measurements at frequencies less than about 10 Hz.

Figure 95 - Integrating Acceleration to Velocity



While the problems of integrating low frequency signals are readily apparent, less so are issues associated with common overall measurements.

For the overall measurements, these tables illustrate the performance of the post-filter and mid-filter overall measurements, with its time constant attribute set to its default and near to and at its high limit values. There are slight differences in the Overall Algorithm that are applied to the Post-Filter OA that become apparent at low frequency.

The results that are presented in Table 73 and Table 74 are based on a pure sine-wave input signal. Actual measurements of complex signals vary.

Table 73 - Input: Sine-wave, 2 Vpp

Input: Sine-wave, **2 Vpp** (-5 to -3V), ADC FMAX = 4578 Hz, **No filtering**

Measurements (volts RMS)

Values that are stated as "avg" are approximate as the measurement is varying by >10%

Frequency	TC=0.5 (Default)		TC=30	TC=60	Tracking Filter		RPM
	OA0	**OA1**	**OA0**	**OA1**	**1xM**	**1xP**	
60	1.98	2.02	2.02	2.02	2.02	81	3600
50	1.98	2.02	2.02	2.03	2.02	81	3000
40	1.97	2.02	2.02	2.03	2.02	81	2400
30	1.94	2.02	2.02	2.03	2.02	80	1800
20	1.91	2.03	2.02	2.03	2.02	80	1200
15	1.87	2.02	2.02	2.03	2.02	80	900
10	1.83	2.02	2.02	2.05	2.02	80	600
9	1.81 avg	2.02	2.02	2.05	2.02	80	540
8	1.81 avg	2.02	2.02	2.06	2.02	80	480
7	1.75 avg	2.01	2.02	2.05	2.02	79	420
6	1.74 avg	2.02	2.01	2.02	2.02	79	360
5	1.68 avg	2.02	2.01	2.02	2.02	79	300
4	1.60 avg	2.03	2.01	2.08	2.02	78	240
3	1.52 avg	2.02	2.01	2.01	2.02	77	180
2	1.43 avg	1.98	2.00	2.10	2.00	75	120
1	0.85 avg	2.20	1.98	2.00	1.98	69	60
0.5	0.85 avg	1.75 avg	1.94 avg	1.99 avg	1.80	342	30
0.25	0.60 avg	1.70 avg	1.94 avg	1.99 avg	1.57	40	15
	OA0 = Post Filter, OA1 = Mid-Filter						

Table 74 - Input: Sine-wave, 0.707 RMS

Input: Sine-wave, **0.707 RMS** (-5 to -3V), ADC FMAX = 4578 Hz, **0.1 Hz HPF**

Measurements (volts RMS)

Values that are stated as "avg" are approximate as the measurement is varying by >10%

Frequency	TC=0.5 (Default)		TC=30	TC=60	Tracking Filter		RPM
	OA0	OA1	OA0	OA1	1xM	1xP	
60	0.717	0.716	0.715	0.715	0.715	81	3600
50	0.715	0.715	0.715	0.715	0.715	81	3000
40	0.715	0.716	0.715	0.715	0.715	81	2400
30	0.716	0.716	0.715	0.715	0.715	81	1800
20	0.711	0.710	0.715	0.715	0.715	81	1200
15	0.717	0.717	0.715	0.715	0.715	81	900
10	0.710	0.720	0.715	0.715	0.715	80	600
9	0.710	0.710	0.715	0.715	0.715	80	540
8	0.720	0.710	0.715	0.715	0.715	80	480
7	0.715	0.715	0.715	0.715	0.715	80	420
6	0.71 avg	0.71 avg	0.715	0.715	0.715	80	360
5	0.72 avg	0.71 avg	0.715	0.715	0.715	79	300
4	0.71 avg	0.71 avg	0.715	0.714	0.715	79	240
3	0.71 avg	0.71 avg	0.714	0.714	0.714	77	180
2	0.71 avg	0.71 avg	0.715	0.711	0.712	75	120
1	0.68 avg	0.68 avg	0.715	0.697	0.702	70	60
0.5	0.64 avg	0.68 avg	0.714	0.664	0.664	57	30
0.25	0.65 avg	0.44 avg	0.708	0.573	0.556	40	15
	OA0 = Post Filter, OA1 = Mid-Filter						

Hardware and Firmware Design

The module hardware is designed to provide accurate, repeatable measurements, over a range of operating and environmental conditions. Selected components such as the precision of the 24-bit Analog to Digital converters, or the delta-sigma hardware anti-alias filters, directly affect measurement precision and accuracy. Design elements that provide sources of error or noise also affect measurement precision and accuracy.

Sources of error can include circuits that amplify or attenuate signals, which include components that have a precision tolerance, which then add to the potential error in the measurement. To minimize these errors, the 1444 design helps eliminate these circuits where the same function can be performed in firmware.

And while accuracy is important, minimizing the signal noise is equally so. The 1444 design addresses signal noise in many ways, such as:

- Signals are isolated from ground. This isolation makes sure that there are consistent, accurate measurements regardless of the quality (or presence) of the earth ground.
- Instrument ground does not connect to the DIN rail. This status minimizes the effects that other instruments can cause on the same DIN, perhaps with different ground potentials.
- Connecting the signal wiring directly to the module rather than routing the signals through a noisy terminal base and an additional pin connector (module to base).

Firmware design can also affect measurement accuracy. In most cases, verify accuracy by following industry standards and by using proven solutions in digital signal-processing function design. One aspect though is crucial to accuracy - the quality of digital filters.

In most cases, the extraordinary filtering that is available in hardware is all that is needed. When digital filtering is necessary it is essential to apply a filter that minimizes signal attenuation on the passband side of the filter, and that maximizes attenuation on the filter side. In the 1444 design, when a digital filter must be used, you have three choices to apply.

The three choices are:

- -24 dB/octave filter, available on the primary signal path
- -60 dB/octave filter, available on the primary path if the measurement type is Aeroderivative
- -48 dB/octave filter on the alternate signal processing path

Choose the best filter to apply based on the measurement requirements. This choice allows you to affect or verify the greatest possible signal accuracy when that is the most important requirement.

Full Scale Range

The module does not apply amplifiers or attenuator to the analog signals to “scale” signals to some “full scale” value. Rather the module relies on its precision 24 bit A/D and further digital processing to accommodate measurement requirements. The 1444 does not provide a “full scale range” in the same manner as older instruments.

When considering resolution and accuracy, rather than providing values referenced to a possible “full scale range”, the following reference values to a “typical range or alarm limit”, which vary with the selected engineering units and application.

Measurement Resolution

The 24 bit A/D has a theoretical resolution of 3 µV. However, for practical purposes, an input signal of 0.5 mV peak-to-peak is considered more representative of real world applications, and as a more realistic minimum resolution. Based on this assessment the following table presents typical resolutions, in Engineering Units, and as a percent of a typical range or alarm limit for various measurement types.

Table 75 - Typical Measurement Resolution

Measurement Type	Sensitivity		Typical Range or Alarm Limit		EU (at 0.5 mV Input)		Resolution (%)
Acceleration	100	mV/g	40	g RMS	0.0018	g RMS	0.0045
Velocity (integrated)	100	mV/g	25	mm/s RMS	0.0018	mm/s RMS	0.0072
	100	mV/g	1	ips RMS	0.000007	ips RMS	0.0071
Velocity	4	mV/mm/s	25	mm/s RMS	0.0442	mm/s RMS	0.18
	100	mV/ips	1	ips RMS	0.0017	ips RMS	0.18
Displacement	8	mV/micron	125	micron pk-pk	0.0625	micron pk-pk	0.05
	200	mV/mil	5	mil pk-pk	0.0025	mil pk-pk	0.05
Thrust (DC)	8	mV/micron	2	mm	0.0625	micron	0.003
	200	mV/mil	80	mil	0.0025	mil	0.003
Dynamic Pressure	100	mV/psi	2	psi RMS	0.0018	psi RMS	0.09

Measurement Accuracy

Consider the following items relative to measurement accuracy:

- Absolute Error

  Absolute error quantifies the average of the measurements that are compared to the expected result. The measurement error, for both AC and DC measurements, is less than ± 0.5%.

- Measurement Output Variation

  Output variation describes how individual measurements of the same input deviate from the average. For a given configuration, the modules output variation is related to the signal amplitude. Small AC signals experience the highest percentage deviations, example: 0.7% for signals less than 100 mV p2p typically reducing to 0.2% or less for AC signals of several volts and all DC measurements.

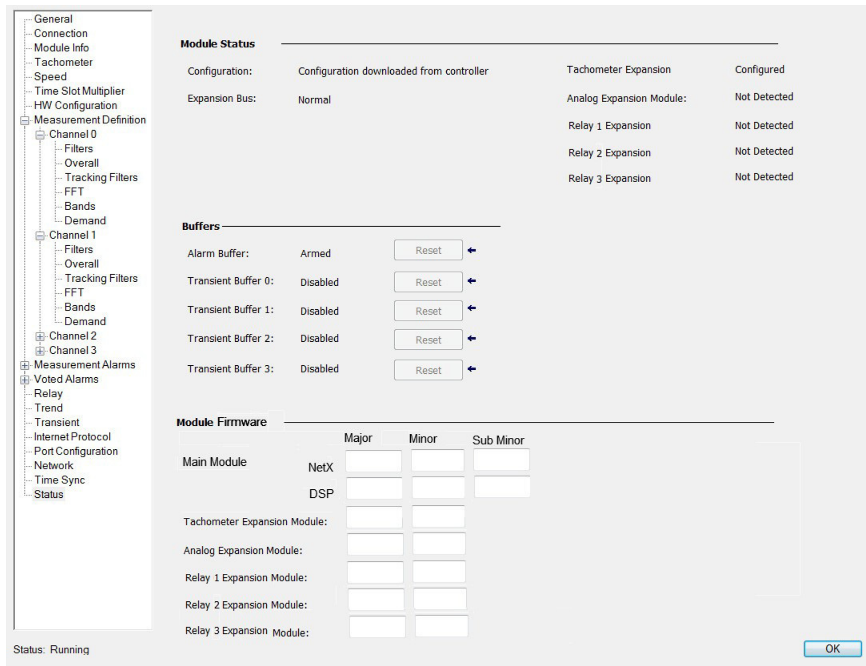
- Overall Accuracy

  Overall measurement accuracy is the combination of the absolute measurement error and measurement deviation, so it varies depending on actual signal levels. Nevertheless, it is reasonable to expect a typical overall measurement accuracy of not less than ± 1.0% of the typical range or alarm limit.

Status Page

The Add-on Profile (AOP) for the 1444 Series Dynamic Measurement Module includes a Module Status page. Unlike other AOP pages, the Status page excludes configuration parameters. When on-line with the module, the Status page reads a limited set of status data, can execute buffer reset commands, and reports the version numbers of the main module and any connected expansion modules.

While the module communicates directly with the module, rather than the controller, it only updates the page when Logix Designer is on-line. When not on-line, all page entries are blank or are dimmed.



The page is divided into three sections, presenting Module Status, Buffer Status and Reset controls, and Module firmware revision information.

Module Status

Table 76 - Module Status

Parameter	Values
Configuration	0 - Out Of Box State (not configured) The module does not have a configuration that is loaded or held in its nonvolatile memory. 1 - Configuration that is loaded from nonvolatile memory The module is executing the configuration that was in its nonvolatile memory. It has not received a configuration from the controller. 2 - Configuration that is downloaded from controller The module is executing a configuration that was downloaded from the controller.
Expansion Bus	0 - Normal Communications with all connected expansion modules is normal. 1 - Expansion Bus Failed Indicates that the Link Status with one or more of the connected expansion modules is failed.
Tachometer Expansion Module	0 - Not Detected No tachometer signal conditioner expansion module is detected connected to this module. 1 - Not Configured A tachometer signal conditioner expansion module is detected but is not configured. 2 - Configured A tachometer signal conditioner expansion module is detected, has been configured, and is operating.
Analog Output Expansion Module	0 - Not Detected No analog output expansion module is detected connected to this module. 1 - Not Configured An analog output expansion module is detected but is not configured. 2 - Configured An analog output expansion module is detected, has been configured, and is operating.
Relay Expansion Module, Address 1	0 - Not Detected No relay expansion module is detected connected to this module at address 1 1 - Not Configured A relay expansion module is detected at address 1 but is not configured 2 - Configured A relay expansion module is detected at address 1, has been configured, and is operating
Relay Expansion Module, Address 2	0 - Not Detected No relay expansion module is detected connected to this module at address 2 1 - Not Configured A relay expansion module is detected at address 2 but is not configured 2 - Configured A relay expansion module is detected at address 2, has been configured, and is operating
Relay Expansion Module, Address 3	0 -Not Detected No relay expansion module is detected connected to this module at address 3 1 - Not Configured A relay expansion module is detected at address 3 but is not configured 2 - Configured A relay expansion module is detected at address 3, has been configured, and is operating

Buffers

Table 77 - Buffers

Parameter	Values
Alarm Buffer	0 - Disabled This buffer is not being captured 1 - Armed Waiting for alarm event trigger 2 - Populating Alarm event in progress 3 - Ready Alarm data available 4 - Latched Alarm data available and is latched
Transient Buffer 0 Transient Buffer 1 Transient Buffer 2 Transient Buffer 3	0 - Free Available, ready for a transient event 1 - Populating Acquiring transient data 2 - Ready Transient data available 3 - Latched Transient data available and is latched
Reset	Pressing reset clears the latch on a latched buffer.

Module Firmware

This section presents the firmware revision for the main and all connected expansion modules.

There are dependencies that require specific revisions of module firmware, and expansion module firmware, for each revision of the AOP. The current firmware and AOP revisions are shown in Table 78. If revisions presented on this page do not match those revisions that are shown in Table 78, then the modules must be updated to the specified firmware revisions.

All module and expansion module firmware must be at the revisions that are listed when used with the indicated revision of AOP.

Table 78 - Firmware and AOP Revisions

August 2015	
AOP	1.01.79
1444-DYN04-01RA	
Aux Processor	2.002.1(1)
DSP Processor	1.02.01
1444-TSCX02-01RB	3.13
1444-RELX00-04RB	3.10
1444-AOFX00-04RB	3.10
June 2016	
AOP	1.02.05
1444-DYN04-01RA	
Aux Processor	3.002(1)
DSP Processor	1.003.2
1444-TSCX02-01RB	4.001
1444-RELX00-04RB	3.10
1444-AOFX00-04RB	3.10
July 2018	
AOP	2.01.41
1444-DYN04-01RA	
Aux Processor	4.006(1)
DSP Processor	1.004
1444-TSCX02-01RB	4.001
1444-RELX00-04RB	3.10
1444-AOFX00-04RB	3.10

(1) • If the minor revision number of the firmware is the shown value +100, then an error occurred during a subsequent firmware update. See Firmware Update Error Handling on page 248 for further information.
• The Aux Processor firmware revision is what is reported by RSLinx when that program report s the module firmware revision.
• If the Aux Processor firmware revision is 1.xxxx then the module is in its Boot Loader mode. See Boot Loader Mode on page 307 for more information.

IMPORTANT
- AOP versions earlier than 1.01.79 and module firmware earlier than v2.002.1, are not supported. Systems or modules with versions earlier than the preceding versions must be updated.
- This User Manual is for firmware 4.006 and AOP version 2.01.41.

Boot Loader Mode

Boot Loader Mode means that the module has faulted such that the executing firmware is failed and the module has reverted to its most basic operation. In this mode, the reported firmware revision is v1.xxx. The current boot loader version is v1.003.

When in Boot Loader Mode the module is limited to the basic functions necessary to support communications, firmware identification, and firmware update. In this case, the module firmware must be updated to a valid revision.

A module faults to Boot Loader Mode if its memory becomes corrupted. While unlikely, a module fault can happen if power is lost while the module is writing to its nonvolatile memory.

Status Indicators

Main Module Status Indicators

The dynamic measurement module (1444-DYN04-01RA) includes 14 status indicators. Twelve indicators are on the top of the module and one additional status indicator on each of the Ethernet connectors.

Table 79 provides descriptions of the meaning of the 12 status indicators on the top of the main module.

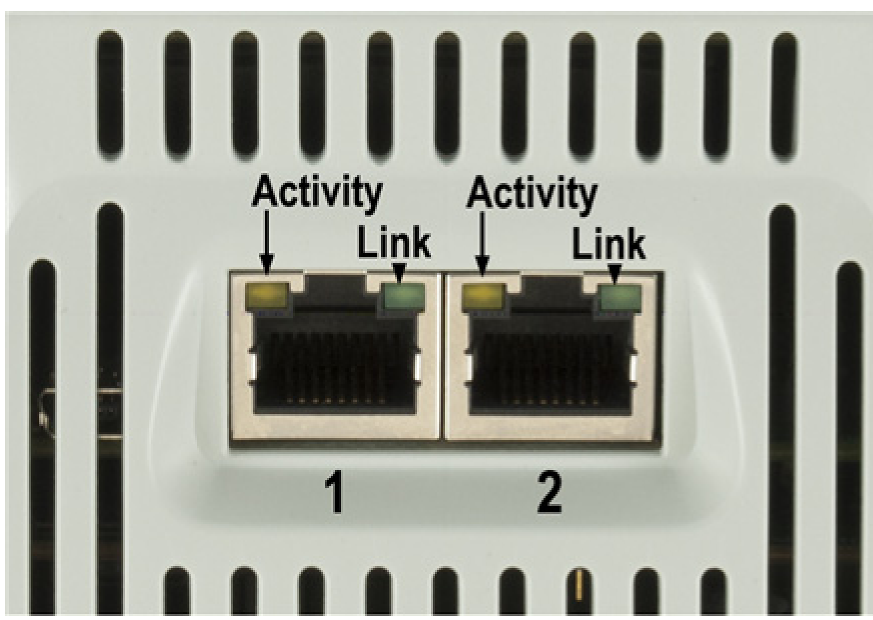
Table 79 - DYN Module Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	6.5V power not OK	6.5V power OK	—	—	—	—	—	—	—
RUN	Aux processor run status	Powered off or not running	—	Application running	O/S running	Configuratio n activity	—	—	—	—
MS	Module status	Powered off	Operational	No configuration	—	During FW, update indicates that update is being written to memory	major fault, not recoverable	Duplicate IP address	Firmware Update in process	—
NS	Network status	No network connection	Connected	No connections	—	—	Duplicate IP address	Connection timeout	Firmware Update in process	—

OS	Operating Status	Powered off	OK / Normal	Redundant power fail	If DSP Status Indicator is flashing green: Configuring If DSP Status Indicator is solid green or off: Storing to memory	—	Inhibit	—	Firmware update in process	—
DSP	DSP Run	Powered off	DSP paused or not running	DSP running	—	Setpoint Multiplier active	—	DSP is in boot loader mode	—	—
OK	DSP Status	Powered off or channels are disabled during the configuration transfer process	OK	—	—	—	Calibration, DSP, or configuration error	—	Firmware update in process	—
CH0	Channel 0 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH1	Channel 1 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH2	Channel 2 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH3	Channel 3 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
RLY	Relay status	Relay not in use	Relay not in alarm	—	Relay inhibited	—	Relay in alarm (actuated)	—	—	—

Ethernet Port Status Indicators

Each Ethernet port RJ45 jack is fitted with two status indicators.



Status Indicator (Color)	Off	On	Blinking
Activity (amber)	No network activity	—	Network activity is present
Link (green)	No link is established	Link is established	—

Expansion Module Status Indicators

When the expansion module is inserted and powered, the power status indicator shows green. The two remaining status indicators provide information as to the status of the expansion bus and the module controller.

Normal expected status indicator states for these three status indicators with a healthy system are:

- Power Status (PWR): Solid green
- Network Status (LNS): Solid green
- Processor Status (MS): Flashing green

As indication of controller faults or warnings: MS = Red - Flashing red for fault, such as cannot read valid module type code, and solid red for self-check failure.

Processor over temperature is treated as a critical self-check failure (solid red indication). A fault is signaled for temperatures over 85 °C (185 °F). MS = BLUE indicates a communication error, a warning status only. However, a communication error can ultimately result in a critical link failure.

IMPORTANT Expansion modules are not considered part of status indicator requirements set by ODVA for EtherNet/IP equipment.

The expansion modules have a total of seven status indicators, comprised of a group of three common (system) status indicators and a group of four, which are module type specific. The behavior and indication that is provided by the status indicators varies between module startup and operation.

Operating Status Indication

The following sections provide descriptions of the status indicators for each expansion module.

Tacho (TSC) Module

The first two status indicators reflect the two tacho channels and the second two the output signal available on the channel BNC connectors.

Tacho Channels

If the tacho channel is enabled, the status indicator is green. The status indicator flashes off when a pulse is detected. At low speed/event rates, the repetitive flash off reflects actual detections. However, the rate of flashing is limited to the MSP run flash rate. At higher speeds the flashing is simply an indicator of events, and not necessarily the actual time of those events.

A normal expected state for a healthy channel is flashing green (machine running). If a tacho sensor failure is detected, the blue rather than green status indicator is active.

An internal power supply fault (out of specification ±25.5V supply) triggers the red Status Indicator to be active. If both channels are enabled, both similarly indicate that fault, but whether it affects tacho operation depends on the module configuration (whether a transducer is used and which one).

BNC Connectors

If the channel is enabled and one event per revolution is configured, then the status indicator is green. If the channel is enabled and multiple events per revolution are configured, then the status indicator is blue. The indicator serves as a warning to any local analyst using that output.

Table 80 - TSCX Status Indicator

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Tacho module is not configured	Configure d and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	—	—	—
CH0	Channel 0 status	Channel not in use	Channel / TX OK	Pulse detection(1)	Channel TX fault	Pulse detection error(1)	±25.5V fail2	Pulse detection(1)	—	—
CH1	Channel 1 status	Channel not in use	Channel / TX OK	Pulse detection(1)	Channel TX fault	Pulse detection error(1)	±25.5V fail(2)	Pulse detection(1)	—	—
OP0	Output 0 status	Output not in use	Output 1 event / rev	Bus or relay drive fail(2)	Output >1 event / rev(3)	—	—	—	—	—
OP1	Output 1 status	Output not in use	Output 1 event / rev	Bus or relay drive fail(2)	Output >1 event / rev(3)	—	—	—	—	—

(1) At low speed the flash rate reflects pulse rate, but the flash rate limits at the maximum flash rate of the Status Indicator.

(2) If two channels are enabled, both show the same state as these supplies are common.

(3) Blue status indicates normal operation but signals that measurements that are taken on the buffered outputs are >1 / Rev, an important detail when connecting the buffered output to other instruments.

4…20 mA Output Status Indicators

Each status indicator represents the state of that particular channel or output. Normal expected status indicator states for a healthy system are all solid green.

For each output (channel), if the output is not enabled, the associated status indicator is off.

If enabled:

- Blue if the output is inhibited or the link is halted
- Red when the link fault output value is imposed by the expansion module
- In either case, the output is likely being held static (same value maintained)

Otherwise, the output status indicator is green.

The color is always solid, except all enabled channels flash the active color during a link fault.

Table 81 - AOFX Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Relay module not is configured	Configured and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	Processor critical error	—	—
OP0	Output 0 status	Output not in use	Host controlling(1)	Bus fail	Output state that is held(2)	Bus fail	—	Bus fail. Output that is held at fault indication level	—	—
OP1	Output 1 status	Output not in use	Host controlling(1)	Bus fail	Output state that is held(2)	Bus fail	—	Bus fail. Output that is held at fault indication level	—	—
OP2	Output 2 status	Output not in use	Host controlling(1)	Bus fail	Output state that is held(2)	Bus fail	—	Bus fail. Output that is held at fault indication level	—	—
OP3	Output 3 status	Output not in use	Host controlling(1)	Bus fail	Output state that is held(2)	Bus fail	—	Bus fail. Output that is held at fault indication level	—	—

(1) Host controlling means that the module is receiving level data for output from its host module.

(2) Output is being held due to bus halt. Halt is where the expansion module is advised to extend its link timeout temporarily.

Relay Output Module

Each status indicator represents the state of that particular channel or output. Normal expected status indicator states for a healthy system are all solid green.

If the output is not enabled, all associated status indicators are off.

If enabled: Blue if the relay is inhibited or the link is halted (output state being held).

Otherwise:
- Red when the relay contacts are in the alarm state
- Green when the relay contacts are in the non-alarm state

The active color flashes for any channel with a detected relay drive fail and for all enabled channels during a link fault.

IMPORTANT	The definition of the contact state that red or green represents is a part of the expansion module configuration.

Table 82 - RELX Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/ Green	Blue/ Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Relay module is not configured	Configured and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	Processor critical error	—	—
R0	Relay 0 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state that is held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R1	Relay 1 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state that is held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R2	Relay 2 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state that is held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R3	Relay 3 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state that is held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—

(1) Relay is held when inhibited or bus halt. Halt is where the auxiliary module is advised to extend its link timeout temporarily.

(2) ANY color flashing indicates Bus or Relay drive fail. Bus fail is indicated similarly on all enabled channels.

(3) Relay in Alarm means that the Voted Alarm that is associated with the relay is in the alarm state, or that any fault conditions that are associated with the relay are faulted.

Startup Behavior

At startup, the group of four is used to indicate the configured bus address of the expansion module.

Identification of the module address is provided by turning on one or more of the relay light-emitting diodes.

Figure 96 - Relay LEDs

The specific light-emitting diodes that are illuminated indicate the modules address:

1. Module address 1 – light-emitting diode R3 blinks blue
2. Module address 2 – light-emitting diode R2/R3 blinks blue
3. Module address 3 – light-emitting diode R1/R2/R3 blinks blue

The indication continues for approximately four seconds.

During this period, all controllable status indicators, except indicators that display the address, are unlit (the green status indicator to the left is the hardware-controlled, power status indicator).

Notes:

CIP Objects

This appendix defines the specific CIP™ Objects supported by the Dynamix™ measurement module.

Parameter – Tag – Object Attribute Cross-reference

Table 83 maps the parameters on each page of the AOP to its controller tag and to the specific object attribute of the module that it populates.

Table 83 - Parameter – Tag – Object Attribute Cross-reference

Parameter	Tag Member	Object	Attribute
Define Module Functionality			
Power Supply	ModuleControl.RedundantPowerSupply	Dynamix Module Control Object	Redundant Power Supply
Personality	Module.PersonalityApplied	Dynamix Configuration Manager Object	AOP Module Type
Speed Page			
Mode	ModuleControl.TachoMode	Dynamix Module Control Object	Tacho Mode
Name	TachName[***0…1***]	Dynamix Tacho and Speed Measurement Object	Tach 0 Name**…**Tach 1 Name
Speed Multiplier	Speed[***0…1***].Multiplier	Dynamix Tacho and Speed Measurement Object	Speed Multiplier
Source	Speed[***0…1***].TachSource	Dynamix Tacho and Speed Measurement Object	Tacho Source
TTL Trigger	Speed[***0…1***].TachTriggerSlope	Dynamix Tacho and Speed Measurement Object	Tacho Trigger
Acceleration Update Rate	Speed[***0…1***].AccelUpdateRate	Dynamix Tacho and Speed Measurement Object	ROC Delta Time
Acceleration Time Constant	Speed[***0…1***].AccelTimeConstant	Dynamix Tacho and Speed Measurement Object	ROC TC
Tachometer Page			
Transducer Type	Tach[***0…1***].SensorType	Dynamix TSC Module Object	Input Sensor Type
Transducer Power	Tach[***0…1***].Power	Dynamix TSC Module Object	Sensor Power Supply
Auto Trigger	Tach[***0…1***].AutoTrigger	Dynamix TSC Module Object	Trigger Mode
Trigger Level	Tach[***0…1***].TriggerLevel	Dynamix TSC Module Object	Trigger Threshold
Trigger Slope	Tach[***0…1***].TriggerSlope	Dynamix TSC Module Object	Trigger Slope/Edge
Pulses per Revolution	Tach[***0…1***].PulsePerRevolution	Dynamix TSC Module Object	Sensor Target, Pulses Per Revolution
DC volts Fault	Tach[***0…1***].DCVFault	Dynamix TSC Module Object	Sensor OK Definition
Fault High Limit (V DC)	Tach[***0…1***].FaultHLimit	Dynamix TSC Module Object	Sensor OK High Threshold
Fault Low Limit (V DC)	Tach[***0…1***].FaultLLimit	Dynamix TSC Module Object	Sensor OK Low Threshold
Speed Fault	Tach[***0…1***].SpeedFault	Dynamix TSC Module Object	Sensor OK Definition
Speed High Limit	Tach[***0…1***].SpeedHLimit	Dynamix TSC Module Object	High RPM Threshold
Speed Low Limit	Tach[***0…1***].SpeedLLimit	Dynamix TSC Module Object	Low RPM Threshold
Tach Expansion Module Fault	Tach[***0…1***].ExpansionModuleFault	Dynamix TSC Module Object	Sensor OK Definition

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Time Slot Multiplier Page			
Time Slot 0…3	TimeSlotMultiplier[***0…3***]	Dynamix MUX Object	Time Slot 0 DAQ Time Multiplier
HW Configuration Page			
Xdcr Units	Ch***0…3***Sensor.DCEngineeringUnits	Dynamix Transducer Object	Transducer DC Units
Xdcr Units	Ch***0…3***Sensor.ACEngineeringUnits	Dynamix Transducer Object	Transducer AC Units
Xdcr Sensitivity	Ch***0…3***Sensor.DCSensitivity	Dynamix Transducer Object	Transducer DC Sensitivity
Xdcr Sensitivity	Ch***0…3***Sensor.ACSensitivity	Dynamix Transducer Object	Transducer AC Sensitivity
Xdcr Power	Ch***0…3***Sensor.TranducerPower	Dynamix Transducer Object	TX Power Setup
Xdcr High Limit (V DC)	Ch***0…3***Sensor.HLimit	Dynamix Transducer Object	Transducer OK High Threshold
Xdcr Low Limit (V DC)	Ch***0…3***Sensor.LLimit	Dynamix Transducer Object	Transducer OK Low Threshold
Xdcr Location	Ch***0…3***Description.Location	Dynamix Transducer Object	Transducer Location
Xdcr Orientation (deg)	Ch***0…3***Description.Oreintation	Dynamix Transducer Object	Transducer Orientation
Name	Ch***0…3***Description.Name	Dynamix Transducer Object	Transducer Name
Measurement Type	Module.Ch***0…3***AppTypeApplied	Configuration Manager Object	Channel Application Type
Pt0 (1)	TripInhibitSource	Dynamix Voted Alarm Object	Trip Inhibit / Bypass source
	AlarmResetSource	Dynamix Voted Alarm Object	Alarm Reset Source
	VotedAlarm***00…12***.LogicInput	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…12***.LogicGateSource	Dynamix Voted Alarm Object	Logic Gating Source
	VotedAlarm***00…12***.LogicLogicSource	Dynamix Voted Alarm Object	Logic Control Source
	Speed[***0…1***].TachFaultSource	Dynamix Tacho and Speed Measurement Object	Tacho OK Source
Pt0 (1)	ModuleControl.Pt0***0…1***OutputAssign	Dynamix Module Control Object	Opto Output ***0…1*** Allocation
Filters Page			
FFT MAX (ADC)	Ch***0…3***Filter.SampleRateDivisor	Dynamix Channel Setup Object	SRD
FFT MAX (Primary)	Ch***0…3***Filter.FMAXDecimation	Dynamix Channel Setup Object	Decimation
Low Pass Filter (Primary) Frequency	Ch***0…3***Filter.LowPassFreq	Dynamix Channel Setup Object	LP Filter -3 dB Point
High Pass Filter (Primary) Frequency	Ch***0…3***Filter.HighPassFreq	Dynamix Channel Setup Object	HP Filter -3 dB Point
Alternate Processing Path Processing Mode	Ch***0…3***Filter.AltPathMode	Dynamix Channel Setup Object	Alternate Path control
FFT FMAX (Alternate)	Ch***0…3***Filter.AltPathFMAXDecimation	Dynamix Channel Setup Object	Decimation (attribute 23)
Alternate Path Tachometer	Ch***0…3***Filter.SyncTachoSource	Dynamix Channel Setup Object	Synchronous Tacho Source
Alternate Path Synchronous Pulses Per Revolution	Ch***0…3***Filter.SynchSamplesPerRevolution	Dynamix Channel Setup Object	Synchronous Samples Per Revolution
Overall Page			
Overall (1) Signal Source	Ch***0…3***Overall.SourceB	Dynamix AC Measurement Object	AC Overall Measurement Source
Overall (0) Signal Detection	Ch***0…3***Overall.SignalDetectionA	Dynamix AC Measurement Object	AC Overall magnitude - Detection Method
Overall (1) Signal Detection	Ch***0…3***Overall.SignalDetectionB	Dynamix AC Measurement Object	AC Overall magnitude - Detection Method
Overall (0) Time Constant	Ch***0…3***Overall.RMSTimeConstantA	Dynamix AC Measurement Object	AC Overall Measurement RMS TC
	Ch***0…3***Overall.PkTimeConstantA	Dynamix AC Measurement Object	AC Overall Measurement Peak TC

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Overall (1) Time Constant	Ch***0…3***Overall.RMSTimeConstantB	Dynamix AC Measurement Object	AC Overall Measurement RMS TC
	Ch***0…3***Overall.PkTimeConstantB	Dynamix AC Measurement Object	AC Overall Measurement Peak TC
Tracking Filters Page			
Enable (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***En	Dynamix Order Measurement Object	Order Measurement Configuration
Tacho Source (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***TachSrc	Dynamix Order Measurement Object	Order Measurement Configuration
Order (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***	Dynamix Order Measurement Object	Order ***0…3*** setup
Measurement Units	Ch***0…3***Orders.Units	Dynamix Order Measurement Object	Order Measurement Units
Signal Detection	Ch***0…3***Overall.SignalDetection	Dynamix Order Measurement Object	Order Measurement Scaling
Measurement Resolution Speed 0	Ch***0…3***Overall.Speed0FilterNumRevolutions	Dynamix Order Measurement Object	Order Filter Definition (Tacho 0)
Measurement Resolution Speed 1	Ch***0…3***Overall.Speed1FilterNumRevolutions	Dynamix Order Measurement Object	Order Filter Definition (Tacho 1)
FFT Page			
Enable TWF Data Storage	Ch***0…3***Complex.TWFEn	Dynamix Normal CM Data Object	Enable
Signal Source	Ch***0…3***Complex.Source	Dynamix Normal CM Data Object	Signal Source
Measurement Units	Ch***0…3***Complex.Units	Dynamix Normal CM Data Object	Measurement Units
Number of Samples	Ch***0…3***Complex.TWFSamples	Dynamix Normal CM Data Object	Waveform Record Length
Speed Reference	Ch***0…3***Complex.SpeedRef	Dynamix Normal CM Data Object	Associated Tacho Source
Enable FFT Data Storage	Ch***0…3***Complex.FFTEn	Dynamix Normal CM Data Object	Enable
Number of Spectrum Lines	Ch***0…3***Complex.FFTNumLines	Dynamix Normal CM Data Object	FFT Line Resolution
Signal Detection	Ch***0…3***Complex.FFTSignalDetection	Dynamix Normal CM Data Object	FFT Line Value Detection/Scaling
FFT Window Type	Ch***0…3***Complex.FFTWindowType	Dynamix Normal CM Data Object	FFT Window Function
Number of Averages	Ch***0…3***Complex.AveragesCount	Dynamix Normal CM Data Object	Number of Averages
Average TWF	Ch***0…3***Complex.AvgTWFEn	Dynamix Normal CM Data Object	Enable
gSE Page			
High Pass Filter Frequency	Ch***0…3***Filter.HighPassFreq	Dynamix Channel Setup Object	HP Filter -3 dB Point
Speed Reference	Ch***0…3***Complex.SpeedRef	Dynamix Normal CM Data Object	Associated Tacho Source
Maximum Frequency	Ch***0…3***Filter.LowPassFreq	Dynamix Channel Setup Object	LP Filter -3 dB Point
Number of Spectrum Lines	Ch***0…3***Complex.FFTNumLines	Dynamix Normal CM Data Object	FFT Line Resolution
FFT Window Type	Ch***0…3***Complex.FFTWindowType	Dynamix Normal CM Data Object	FFT Window Function
Number of Averages	Ch***0…3***Complex.AveragesCount	Dynamix Normal CM Data Object	Number of Averages
FFT Bands Page			
Enable	ModuleControl.Ch***0…3***DSP_FFT.En	Dynamix Module Control Object	Enable
Signal Source	ModuleControl.Ch***0…3***DSP_FFT.Source	Dynamix Module Control Object	Signal Source
Measurement Units	ModuleControl.Ch***0…3***DSP_FFT.Units	Dynamix Module Control Object	Measurement Units
Number of Spectrum Lines	ModuleControl.Ch***0…3***DSP_FFT.FFTNumLines	Dynamix Module Control Object	Line Resolution
Signal Detection	ModuleControl.Ch***0…3***DSP_FFT.SignalDetection	Dynamix Module Control Object	FFT Line Value Detection/Scaling
FFT Window Type	ModuleControl.Ch***0…3***DSP_FFT.WindowType	Dynamix Module Control Object	Window Function
Number of Averages	ModuleControl.Ch***0…3***DSP_FFT.AveragesCount	Dynamix Module Control Object	Number of Averages
Enable	Ch***0…3***Band***0…7***.En	Dynamix FFT Band Object	Channel Source
Measurement Mode	Ch***0…3***Band***0…7***.Type	Dynamix FFT Band Object	FFT Band magnitude - Type

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Band Limit Begin	Ch***0…3***Band***0…7***.LimitBegin	Dynamix FFT Band Object	Start frequency in Hz
		Dynamix FFT Band Object	Start frequency in orders
Band Limit End	Ch***0…3***Band***0…7***.LimitEnd	Dynamix FFT Band Object	Stop frequency in Hz
		Dynamix FFT Band Object	Stop frequency in orders
Domain	Ch***0…3***Band***0…7***.Do main	Dynamix FFT Band Object	Source of band frequency limits
Speed Reference	Ch***0…3***Band***0…7***.SpeedRef	Dynamix FFT Band Object	Tacho source for band limits
DC Page			
Normal Thrust and Proportional Voltage – Measurement Units	Ch***0…3***DC.Units	Dynamix Transducer Object	Transducer DC Units
Normal Thrust and Proportional Voltage –Time Constant	Ch***0…3***DC.TimeConstant	Dynamix DC Measurement Object	DC Measurement TC
Normal Thrust and Proportional Voltage – Calibration Offset	Ch***0…3***DC.Offset	Dynamix DC Measurement Object	DC Measurement Offset
Normal Thrust and Proportional Voltage – Sense Control	Ch***0…3***DC.SenseControl	Dynamix DC Measurement Object	DC Measurement Sense Control
Rod Drop - Tachometer	Ch***0…3***DC.RodDropTriggerSource	Dynamix DC Measurement Object	Rod Drop Trigger Source
Rod Drop – Target Angle	Ch***0…3***DC.RodDropTargetAngle	Dynamix DC Measurement Object	Rod Drop Trigger Angle
Rod Drop –Angular Range	Ch***0…3***DC.RodDropAngularRange	Dynamix DC Measurement Object	Rod Drop Measurement Range
Rod Drop – Decay Time	Ch***0…3***DC.RodDropDecayTime	Dynamix DC Measurement Object	Rod Drop Decay Time
Differential Expansion – Ramp Angle	Ch0_1.SensorAAngle when Channel 0	Dynamix Dual Measurement Object	Sensor A Ramp Angle
	Ch0_1.SensorBAngle when Channel 1	Dynamix Dual Measurement Object	Sensor B Ramp Angle
	Ch2_3.SensorAAngle when Channel 2	Dynamix Dual Measurement Object	Sensor A Ramp Angle
	Ch2_3.SensorBAngle when Channel 3	Dynamix Dual Measurement Object	Sensor B Ramp Angle
Differential Expansion – Overall Axial Offset	Ch0_1.AxialOffset when Channel 0 or 1	Dynamix Dual Measurement Object	Overall Axial Offset
	Ch2_3.AxialOffset when Channel 2 or 3	Dynamix Dual Measurement Object	Overall Axial Offset
Differential Expansion – Overall Radial Offset	Ch0_1.RadialOffset when Channel 0 or 1	Dynamix Dual Measurement Object	Overall Radial Offset
	Ch2_3.RadialOffset when Channel 2 or 3	Dynamix Dual Measurement Object	Overall Radial Offset
Eccentricity - Tachometer	Ch***0…3***Overall.ConfigurePkPerRevolution	Dynamix AC Measurement Object	Configure Peak Per Revolution
Eccentricity – Minimum pk/revolution	Ch***0…3***Overall.MinPeakPerRevolutionRPM	Dynamix AC Measurement Object	Minimum RPM
Demand Page			
Signal Source	Ch***0…3***Demand.Source	Dynamix Advanced CM Data Object	Source Selection
TWF Measurement Units	Ch***0…3***Demand.TWFUnits	Dynamix Advanced CM Data Object	Measurement Units
Speed Reference	Ch***0…3***Demand.SpeedRef	Dynamix Advanced CM Data Object	Associated Tacho Source
Analog Output Page			
Enable	Ch***0…3***AnalogOut.En	Dynamix Current Output Module Object	Current Output Enable
Measurement	Ch***0…3***AnalogOut.MeasurementID See Measurement ID Definition on page 325.	Dynamix Current Output Module Object	Current Output Measurement Identifier
Low Engineering	Ch***0…3***AnalogOut.LowEngineering	Dynamix Current Output Module Object	4 mA Output Scaling
High Engineering	Ch***0…3***AnalogOut.HighEngineering	Dynamix Current Output Module Object	20 mA Output Scaling

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Fault Mode Output State	Ch***0…3***AnalogOut.FaultValue	Dynamix Current Output Module Object	Current Output Not OK Configuration
Measurement Alarm Page			
Enable Alarm	MeasAlarm***00…23***.En	Dynamix Measurement Alarm Object	Alarm Enable
Alarm Name	MeasAlarmName00_04[***x0…4***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName05_11[***0…6***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName12_18[***0…6***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName19_23[***0…4***]	Dynamix Measurement Alarm Object	Alarm Name
Measurement	MeasAlarm***00…23***.ID See Measurement ID Definition on page 325.	Dynamix Measurement Alarm Object	Alarm Measurement Identifier
Condition	MeasAlarm***00…23***.Condition	Dynamix Measurement Alarm Object	Alarm Form
Transducer Fault Behavior	MeasAlarm***00…23***.SensorFaultAction	Dynamix Measurement Alarm Object	Alarm Type
Deadband	MeasAlarm***00…23***.AlarmDeadband	Dynamix Measurement Alarm Object	Hysteresis
Alert Alarm Delay Time	MeasAlarm***00…23***.AlertDelayTime	Dynamix Measurement Alarm Object	Delay/Sustain Time (Alert)
Danger Alarm Delay Time	MeasAlarm***00…23***.DangerDelayTime	Dynamix Measurement Alarm Object	Delay/Sustain Time (Danger)
Apply Limits From	MeasAlarm***00…23***.LimitMode	Dynamix Measurement Alarm Object	Alarm Processing Mode
Danger High Limit	MeasAlarm***00…23***.HDangerAlarmLimit	Dynamix Measurement Alarm Object	High Danger Threshold
Alert High Limit	MeasAlarm***00…23***.HAlertAlarmLimit	Dynamix Measurement Alarm Object	High Alert Threshold
Alert Low Limit	MeasAlarm***00…23***.LAlertAlarmLimit	Dynamix Measurement Alarm Object	Low Alert Threshold
Danger Low Limit	MeasAlarm***00…23***.LDangerAlarmLimit	Dynamix Measurement Alarm Object	Low Danger Threshold
Danger High Output Tag Limit	MeasAlarm***00…23***.HDangerAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for High Danger Threshold
Alert High Output Tag Limit	MeasAlarm***00…23***.HAlertAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for High Alert Threshold
Alert Low Output Tag Limit	MeasAlarm***00…23***.LAlertAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for Low Alert Threshold
Danger Low Output Tag Limit	MeasAlarm***00…23***.LDangerAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for Low Danger Threshold
Limit Multiplier	MeasAlarm***00…23***.LimitMultiplier	Dynamix Measurement Alarm Object	Alarm Multiplier
Control Parameter	MeasAlarm***00…23***.AdaptiveSource	Dynamix Measurement Alarm Object	Adaptive Monitoring Source
High Limit	MeasAlarm***00…23***.Range***0…4***HLimit	Dynamix Measurement Alarm Object	Range ***0…4*** – upper control value
Multiplier	MeasAlarm***00…23***.Range***0…4***Multiplier	Dynamix Measurement Alarm Object	Range ***0…4*** – Alarm Multiplier
Voted Alarm Page			
Alarm Name	VotedAlarmName00_01[***0…1***]	Dynamix Voted Alarm Object	Alarm Name
	VotedAlarmName02_08[***0…6***]	Dynamix Voted Alarm Object	Alarm Name
	VotedAlarmName09_12[***0…3***]	Dynamix Voted Alarm Object	Alarm Name
Alarm Status to Activate On – Alert	VotedAlarm***00…13***.AlarmOnAlert	Dynamix Voted Alarm Object	Alarm Usage
Alarm Status to Activate On – Danger	VotedAlarm***00…13***.AlarmOnDanger	Dynamix Voted Alarm Object	Alarm Usage
Alarm Status to Activate On – Transducer Fault	VotedAlarm***00…13***.AlarmOnTransducerFault	Dynamix Voted Alarm Object	Alarm Usage
Measurement Alarm – Input 0	VotedAlarm***00…13***.Alarm0Input	Dynamix Voted Alarm Object	Alarm Input 0
Measurement Alarm – Input 1	VotedAlarm***00…13***.Alarm1Input	Dynamix Voted Alarm Object	Alarm Input 1

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Measurement Alarm – Input 2	VotedAlarm***00…13***.Alarm2Input	Dynamix Voted Alarm Object	Alarm Input 2
Measurement Alarm – Input 3	VotedAlarm***00…13***.Alarm3Input	Dynamix Voted Alarm Object	Alarm Input 3
Logic	VotedAlarm***00…13***.LogicCondition	Dynamix Voted Alarm Object	Alarm Logic Configuration
Setpoint Multiplier Trigger – Control 0	VotedAlarm***00…13***.LogicInput0	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…13***.ControllerSPM0	Dynamix Voted Alarm Object	Alarm Multiplier Control
Setpoint Multiplier Trigger – Control 1	VotedAlarm***00…13***.LogicInput1	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…13***.ControllerSPM1	Dynamix Voted Alarm Object	Alarm Multiplier Control
Setpoint Multiplier Trigger – Delay	VotedAlarm***00…13***.SPMHoldTime	Dynamix Voted Alarm Object	Alarm Multiplier ON Time
Gating Speed – Reference	VotedAlarm***00…13***.SpeedGatingEnSource	Dynamix Voted Alarm Object	Speed Gating Control
Gating Speed – Condition	VotedAlarm***00…13***.SpeedGateCondition	Dynamix Voted Alarm Object	Speed Gating Detection
Gating Speed – High Limit	VotedAlarm***00…13***.HSpeedGateLimit	Dynamix Voted Alarm Object	Higher Speed Threshold
Gating Speed – Low Limit	VotedAlarm***00…13***.LSpeedGateLimit	Dynamix Voted Alarm Object	Lower Speed Threshold
I/O Gating – Gate Control	VotedAlarm***00…13***.LogicGateSource	Dynamix Voted Alarm Object	Logic gating source
I/O Control	VotedAlarm***00…13***.LogicControlSource	Dynamix Voted Alarm Object	Logic control source
Relay Control – Fail-Safe Enable	VotedAlarm***00…13***.FailSafeEn	Dynamix Voted Alarm Object	Alarm Type
Relay Control – Latch Enable	VotedAlarm***00…13***.LatchEn	Dynamix Voted Alarm Object	Alarm Behavior
Relay Page			
Main Module Relay – Enable	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Voted Alarm Number	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Alarm Status to Activate On	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Module Fault	ModuleControl.ModuleFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Tach Fault	ModuleControl.TachFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Communication Fault	ModuleControl.CommunicationFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Expansion Module Fault	ModuleControl.ExpModuleFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Expansion Bus Fault	ModuleControl.ExpBusFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Latch Enable	ModuleControl.LatchEnabled	Dynamix Module Control Object	User Local Relay Control
Expansion Module Relay – Enable	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Voted Alarm Number	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Alarm Status to Activate On	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Module Fault	ExpansionRelay***0…2***.Relay***0…3***TripOnModuleFault	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Expansion Module Relay – Expansion Bus Fault	ExpansionRelay***0…2***.Relay***0…3***TripOnExpBusFault	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Expansion Module Relay – Latch Enable	ExpansionRelay***0…2***.Relay***0…3***LatchEnabled	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Trend Page			
Discrete Data - Ch***0…3*** Enable	Trend.DiscreteData***0…3***En	Dynamix Data Manager Object	Trend Data-Set Enable

Table 83 - Parameter – Tag – Object Attribute Cross-reference (continued)

Parameter	Tag Member	Object	Attribute
Discrete Data – Update Rate	Trend.DiscreteUpdateMultiplier	Dynamix Data Manager Object	Trend Overall Update Multiplier
Dynamic Data - Ch***0…3*** Enable	Trend.DynamicData***0…3***En	Dynamix Data Manager Object	Trend Data-Set™ Enable
Dynamic Data – Update Rate	Trend.DynamicUpdateMultiplier	Dynamix Data Manager Object	Trend Dynamic Update Multiplier
Data-Set Definition	Trend.StaticParams***0…3******	Dynamix Data Manager Object	DWORD ***0…3***
Alarm Buffer – Enable Trigger	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Trigger On Any Alarm	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Voted Alarm Condition	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Enable Latching	Trend.AlarmLatchEn	Dynamix Data Manager Object	Alarm Data Storage Latching
Alarm Buffer – Post Trigger Low Resolution for Dynamic Data	Trend.DynamicLowResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for Dynamic Data Records
Alarm Buffer – Post Trigger Low Resolution for Discrete Data	Trend.DiscreteLowResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for Low-Resolution Overall Records
Alarm Buffer – Post Trigger High Resolution for Discrete Data	Trend.DiscreteHighResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for High-Resolution Overall Records
Transient Page			
Enable Transient Capture	TransientCapture.En	Dynamix Transient Data Manager Object	Transient Data Mode Control
Disable Dynamic Capture on Start Up	TransientCapture.OnStartUpDisable	Dynamix Transient Data Manager Object	Transient Data Mode Control
Disable Dynamic Capture on Coast Down	TransientCapture.OnCoastDownDisable	Dynamix Transient Data Manager Object	Transient Data Mode Control
Enable Latching	TransientCapture.LatchEn	Dynamix Transient Data Manager Object	Transient Data Mode Control
Enable Overflow	TransientCapture.OverflowEn	Dynamix Transient Data Manager Object	Transient Data Mode Control
Data-Set Definition	TransientCapture.DiscreteParams***0…3******	Dynamix Transient Data Manager Object	DWORD ***0…3***
Speed Reference	TransientCapture.ControlSpeedRef	Dynamix Transient Data Manager Object	Source of Speed Data
Low Speed Limit	TransientCapture.LowSpeedLimit	Dynamix Transient Data Manager Object	Low Speed Threshold
High-Speed Limit	TransientCapture.HighSpeedLimit	Dynamix Transient Data Manager Object	High-Speed Threshold
Start Up – Number of Buffers	TransientCapture.NumStartUpBuffers	Dynamix Transient Data Manager Object	Transient Data Mode Control
Start Up – Post Start Up Sample Time	TransientCapture.PostStartUpSample Time	Dynamix Transient Data Manager Object	Extra startup sample time
Start Up – Delta RPM Trigger	TransientCapture.StartUpDeltaRPM	Dynamix Transient Data Manager Object	Overall Delta RPM (SU)
Start Up – Delta Time Trigger	TransientCapture.StartUpDeltaTime	Dynamix Transient Data Manager Object	Overall Delta Time (SU)
Coast Down – Delta RPM Trigger	TransientCapture.CoastDownDeltaRPM	Dynamix Transient Data Manager Object	Overall Delta RPM (CD)
Coast Down – Delta Time Trigger	TransientCapture.CoastDownDeltaTime	Dynamix Transient Data Manager Object	Overall Delta Time (CD)

*See Measurement ID Definition on page 325 to interpret the contents of the StaticParams and DiscreteParams attributes.

Measurement ID Definition

Throughout the configuration, there are several parameters that are used to either indicate a specific measurement, or that indicate some set of measurements.

Measurement IDs (INT values) and Parameter Arrays (DINT[4]) refer to the parameters shown inTable 84 and Table 85. These parameters define one (ID) or multiple (Parameter Array) data values that are used in the control.

Examples

- **Measurement ID**: On the Analog Output page, four Measurement IDs are defined, one per channel, which specify the parameter to output on the channel. In these cases, the INT refers to the Index in the table to point to the measurement that is output.
- **Parameter Array**: On the Trend Page, four StaticParams attributes are defined, each is a DINT value. In this case, the specific bits that are set in the 4 DINTs define which measurements are included in the discrete data for the Trend.

The configuration includes the following Measurement ID parameters.

Table 84 - Measurement ID Parameters

Page	Parameter	Tag Member	Object	Attribute
Analog Output	Measurement	Ch0…3AnalogOut.MeasurementID	Dynamix Current Output Module Object	Current Output Measurement Identifier
Measurement Alarm	Measurement	MeasAlarm00…23.ID	Dynamix Measurement Alarm Object	Alarm Measurement Identifier

The configuration includes the following Parameter Array parameters.

Table 85 - Parameter Array Parameters

Page	Parameter	Tag Member	Object	Attribute
Trend	Data-Set Definition	Trend.StaticParams0…3	Dynamix Data Manager Object	DWORD 0…3
Transient	Data-Set Definition	Trend.DiscreteParams0…3	Dynamix Data Manager Object	DWORD 0…3

Table 86 - Discrete Parameter Bit Definition

Index	DINT	Bit	Descriptor	Tag
0		0	Overall (0) Channel 0	Ch0Overall0
1		1	Overall (0) Channel 1	Ch1Overall0
2		2	Overall (0) Channel 2	Ch2Overall0
3		3	Overall (0) Channel 3	Ch3Overall0
4		4	Overall (1) Channel 0	Ch0Overall1
5		5	Overall (1) Channel 1	Ch1Overall1
6		6	Overall (1) Channel 2	Ch2Overall1
7		7	Overall (1) Channel 3	Ch3Overall1
8		8	DC(V) Channel 0	Ch0DCV
9		9	DC(V) Channel 1	Ch1DCV
10		10	DC(V) Channel 2	Ch2DCV
11		11	DC(V) Channel 3	Ch3DCV
12	0	12	Order (0) Mag Channel 0	Ch0Order0Mag
13		13	Order (0) Mag Channel 1	Ch1Order0Mag
14		14	Order (0) Mag Channel 2	Ch2Order0Mag
15		15	Order (0) Mag Channel 3	Ch3Order0Mag
16		16	Order (0) Phase Channel 0	Ch0Order0Phase
17		17	Order (0) Phase Channel 1	Ch1Order0Phase
18		18	Order (0) Phase Channel 2	Ch2Order0Phase
19		19	Order (0) Phase Channel 3	Ch3Order0Phase
20		20	Order (1) Mag Channel 0	Ch0Order1Mag
21		21	Order (1) Mag Channel 1	Ch1Order1Mag
22		22	Order (1) Mag Channel 2	Ch2Order1Mag
23		23	Order (1) Mag Channel 3	Ch3Order1Mag
24		24	Order (1) Phase Channel 0	Ch0Order1Phase
25		25	Order (1) Phase Channel 1	Ch1Order1Phase
26		26	Order (1) Phase Channel 2	Ch2Order1Phase
27		27	Order (1) Phase Channel 3	Ch3Order1Phase
28		28	Order (2) Mag Channel 0	Ch0Order2Mag
29		29	Order (2) Mag Channel 1	Ch1Order2Mag
30		30	Order (2) Mag Channel 2	Ch2Order2Mag
31		31	Order (2) Mag Channel 3	Ch3Order2Mag
32		0	Order (2) Phase Channel 0	Ch0Order2Phase
33		1	Order (2) Phase Channel 1	Ch1Order2Phase
34		2	Order (2) Phase Channel 2	Ch2Order2Phase
35		3	Order (2) Phase Channel 3	Ch3Order2Phase
36		4	Order (3) Mag Channel 0	Ch0Order3Mag
37		5	Order (3) Mag Channel 1	Ch1Order3Mag

Index	DINT	Bit	Descriptor	Tag
38		6	Order (3) Mag Channel 2	Ch2Order3Mag
39		7	Order (3) Mag Channel 3	Ch3Order3Mag
40		8	Order (3) Phase Channel 0	Ch0Order3Phase
41		9	Order (3) Phase Channel 1	Ch1Order3Phase
42		10	Order (3) Phase Channel 2	Ch2Order3Phase
43		11	Order (3) Phase Channel 3	Ch3Order3Phase
44		12	FFT Band (0) Channel 0	Ch0FFTBand0
45		13	FFT Band (0) Channel 1	Ch1FFTBand0
46		14	FFT Band (0) Channel 2	Ch2FFTBand0
47		15	FFT Band (0) Channel 3	Ch3FFTBand0
48	1	16	FFT Band (1) Channel 0	Ch0FFTBand1
49		17	FFT Band (1) Channel 1	Ch1FFTBand1
50		18	FFT Band (1) Channel 2	Ch2FFTBand1
51		19	FFT Band (1) Channel 3	Ch3FFTBand1
52		20	FFT Band (2) Channel 0	Ch0FFTBand2
53		21	FFT Band (2) Channel 1	Ch1FFTBand2
54		22	FFT Band (2) Channel 2	Ch2FFTBand2
55		23	FFT Band (2) Channel 3	Ch3FFTBand2
56		24	FFT Band (3) Channel 0	Ch0FFTBand3
57		25	FFT Band (3) Channel 1	Ch1FFTBand3
58		26	FFT Band (3) Channel 2	Ch2FFTBand3
59		27	FFT Band (3) Channel 3	Ch3FFTBand3
60		28	FFT Band (4) Channel 0	Ch0FFTBand4
61		29	FFT Band (4) Channel 1	Ch1FFTBand4
62		30	FFT Band (4) Channel 2	Ch2FFTBand4
63		31	FFT Band (4) Channel 3	Ch3FFTBand4
64		0	FFT Band (5) Channel 0	Ch0FFTBand5
65		1	FFT Band (5) Channel 1	Ch1FFTBand5
66		2	FFT Band (5) Channel 2	Ch2FFTBand5
67		3	FFT Band (5) Channel 3	Ch3FFTBand5
68		4	FFT Band (6) Channel 0	Ch0FFTBand6
69		5	FFT Band (6) Channel 1	Ch1FFTBand6
70		6	FFT Band (6) Channel 2	Ch2FFTBand6
71		7	FFT Band (6) Channel 3	Ch3FFTBand6
72		8	FFT Band (7) Channel 0	Ch0FFTBand7
73		9	FFT Band (7) Channel 1	Ch1FFTBand7
74		10	FFT Band (7) Channel 2	Ch2FFTBand7
75		11	FFT Band (7) Channel 3	Ch3FFTBand7
76		12	Not 1X Channel 0	Ch0Not1X

Index	DINT	Bit	Descriptor	Tag
77	2	13	Not 1X Channel 1	Ch1Not1X
78		14	Not 1X Channel 2	Ch2Not1X
79		15	Not 1X Channel 3	Ch3Not1X
80		16	DC Channel 0	Ch0DC
81		17	DC Channel 1	Ch1DC
82		18	DC Channel 2	Ch2DC
83		19	DC Channel 3	Ch3DC
84		20	SMAX Mag Channels 0/1	Ch0_1SMAXMag
85		21	SMAX Mag Channels 2/3	Ch2_3SMAXMag
86		22	SMAX Phase Channels 0/1	Ch0_1SMAXPhase
87		23	SMAX Phase Channels 2/3	Ch2_3SMAXPhase
88		24	Shaft Absolute Peak-to-Peak Channels 0/1	Ch0_1ShaftAbsolutePk_Pk
89		25	Shaft Absolute Peak-to-Peak Channels 2/3	Ch2_3ShaftAbsolutePk_Pk
90		26	Speed (0)	Speed0
91		27	Speed (1)	Speed1
92		28	Factored Speed (0)	Speed0Max
93		29	Factored Speed (1)	Speed1Max
94		30	Speed (0) Maximum	Speed0RateOfChange
95		31	Speed (1) Maximum	Speed1RateOfChange
96	3	0	Speed (0) Rate of Change	FactoredSpeed0
97		1	Speed (1) Rate of Change	FactoredSpeed1
98		2	Differential Expansion Channels 0/1	Ch0_1DifferentialExpansion
99		3	Differential Expansion Channels 2/3	Ch2_3DifferentialExpansion
102		6	Rod Drop 0	Ch0RodDrop
103		7	Rod Drop 1	Ch1RodDrop
104		8	Rod Drop 2	Ch2RodDrop
105		9	Rod Drop 3	Ch3RodDrop

Reading Continuous Time Waveforms

This section provides guidance for how to assemble one continuous time waveform from two overlapped asynchronous[1] sampled waveforms. Whether overlapped samples can be read from the module is a function of the configured sample rate, the responsiveness of the module to data requests ("how busy" the module is), the throughput rate of the network, and the performance of the personal computer and software.

The efficiency of the data transfer to the personal computer increases with TWF block size (number of samples). Large TWFs require less overhead such as establishing and terminating connections and initiating data requests.

Four values are required to implement the function.

Value	Description
Sample Time	The sample time is the "TimestampSec" attribute that is included in the TWF Record. In most cases, this attribute is sufficient. However, if subsecond accuracy is required then also consider the "TimestampNanaoSec" parameter. **IMPORTANT**: The Sample Time alone cannot be used to align overlapped time waveforms due to: • If Time Synchronization is enabled (Controller Properties), then the controller is continually adjusting the modules clock. While in most cases no adjustment is made, even a millisecond change can affect absolute difference in time between TWFs measured before and after the clock update. • Effects that are associated with moving the data between the DSP, where it is sampled, to the Auxiliary processor, where the time stamp is applied, can cause the time of any calculated sample to be off by one or more samples.
TWF Period	See Reading TWF Data on page 332 for instructions on how to calculate the TWF period.
Sample Period in Microseconds	This value is the SamplePeriodInSecs parameter, included in the TWF Record, which is multiplied by 1,000,000.
Sample Relative Time	This value is the RelativeTime parameter that is included in the TWF Record. This timer runs in micro seconds, based on the clock in the DSP – so is independent of UDT time that is held by the Auxiliary processor. The value continuously increments from 0 to 16777215, then wraps back to 0. Since the module cannot sample at this rate (1 MHz), it can be used to calculate a unique time for each sample of a TWF.

(1) It is not possible to assemble continuous synchronously sampled TWFs.

Follow these steps to process one, continuous time waveform. This process assumes that overlap samples can be communicated to the personal computer and can be processed quickly enough.

1. Verify that the two time waveforms overlap.

   Check that the ending time (Sample Time + TWF Period) of the first TWF is greater than the sample time of the second TWF.

2. Calculate the position of the second TWF RelativeTime in the first TWF.

   This value is calculated as the difference in the TWF RelativeTime divided by the Sample Period in Microseconds.

3. In a new buffer, copy the samples from the first TWF up to the calculated position of the second TWF.

4. Copy the samples from the second TWF beginning at this sample number.

Engineering Units (ENGUNITS Data Type)

The Dynamix 1444 series supports the engineering units that are listed on page 448. Each unit is assigned a specific value, which is what is used to populate the member of the configuration assembly, so is communicated to the module. In the CIP Library, all attributes of type ENGUNITS require a value, as shown.

IMPORTANT	If the engineering unit values must be set programmatically, take care to confirm that the sensor units and subsequent converted or integrated units are consistent with the functionality allowed and the implemented configuration. We recommend that the desired unit entries be modeled using the AOP first to confirm that the desired unit is allowed given the specific configuration.

Reading TWF and FFT Data

The 1444 Dynamic Measurement Module can serve spectra (FFT) and time waveform (TWF) data from live, buffered, and captured (saved) data sources. While there are small differences in how the data is specified, how it is read is the same regardless of its source. The following objects allow reading FFT and TWF data.

Object	Function	Description
Dynamix Data Manager	Read live data	Returns the TWF or FFT processed from the current "live" data.
	Read trend data	Returns either the most recent TWF or FFT, or all TWFs or FFTs, from either the High or Low-Resolution Trend buffers.
	Read alarm data	Returns either the most recent TWF or FFT, or all TWFs or FFTs, from either the High or Low-Resolution Alarm buffers.
Dynamix Transient Data Manager	Read captured transient data	Returns the contents of the specified transient buffer.
Dynamix Normal CM Data	Read live data	Returns the TWF or FFT processed from the current "live" data.
Dynamix Advanced CM Data	Read demand data	Returns TWF or FFT data that is processed from the Demand buffer.

See the individual object descriptions for details on how to specify data requests.

Reading TWF Data

Processing the returned data into the TWF is merely a matter of determining the period, RPM, and number of samples (if synchronous) of the data. The data values themselves are returned as floating point values that need no further processing. The following describes how to calculate the period of the TWF.

Asynchronous Measurements

Calculate the time waveform period:

$$\text{TWF Period (sec)} = \frac{\textbf{\textit{SamplePeriodInSec}} * \textbf{\textit{ByteCount}}}{\textbf{4}}$$

Synchronous Measurements

Calculate the number of samples:

$$\text{NumSamples} = \frac{\textbf{\textit{ByteCount}}}{\textbf{4}}$$

Read the Samples per Revolution (SamplesPerRev):

> Samples per Revolution is returned in the first bye of the **SamplePeriodInSec** value

Read the RPM in Hz (RPM^{Hz}):

> RPM in Hz is returned in the last three bytes of the SamplePeriodInSec value

Calculate the time waveform period:

$$\text{TWF Period (sec)} = \frac{\textbf{\textit{NumSamples}}}{\textbf{RPM}^{\textbf{Hz}} * \textbf{SamplesPerRev}}$$

Reading FFT Data

Processing the returned data into the FFT is merely a matter of determining the FMAX and the number of lines of the data. The data values themselves are returned as floating point values that need no further processing. The following describes how to calculate the FMAX and the number of lines.

Extended and Reduced FFT Lines

When requesting and reading FFT data the module can return either a fraction of the lines of the common processed FFT, or an extended number of lines, greater than the common processed FFT, from the raw FFT data.

Reading a fraction, either 37.5% or 62.5% of the processed FFT, is necessary to account for the digital resampling and filtering that can be applied on the primary or alternate signal paths. This reading makes sure that the presented FFT is free of attenuation by the filters, or any potential aliasing effects due to resampling if a reduced FMAX, or synchronous sampling, is selected for the path. The difference in the fractions is due to the difference in the quality of the digital filters available on the primary and alternate signal paths.

Reading an extended number of lines, 112.5%, of the processed FFT, is possible and appropriate when no reduced FMAX, or synchronous sampling, is selected on the primary or alternate path, so no resampling is being performed. In this case, the highly efficient anti-alias filter that is applied within the 1444 hardware makes available a greater number of alias-free lines than the common FFT function provides.

The ***SpecialRequest*** byte of the FFT and FFT(e) FFT data request record includes a specification that the module return reduced or extended lines. It is recommended that software always specify that the reduced or extended data be returned.

The actual returned data size is derived by interrogating the applicable bits returned in the ***ucDataSelect*** byte of the FFT header record.

Phase Data

When the SR_mAG_PHASE bit of the SpecialRequest byte is set the phase data of the FFT, meaningful or not, is returned following the linear FFT data. However…

Selected sample data for any "Live" TWF/FFT always starts at the nearest sample to a tacho event irrespective of how the data is sampled (synchronous or asynchronous). Therefore, there is usable phase from both synchronous or asynchronously sampled data. In either case, it must (reasonably) agree with the tracking filter order phase - all it needs is the once per revolution signal.

On a TWF (if the signal is a simple 1x sinusoid), the phase is visible as the angle from the start of the trace to the first positive peak. On an FFT phase, values for every bin/line are provided.

The Dynamic module incorporates phase corrections for any filter on the alternate path and for the main path LP filter. However, the Primary Path HP filter is non-linear phase and cannot practically be corrected for. Therefore, the POST FILTER data source must be avoided if phase data is important (to capture) and the HP filter is enabled (dependent on Measurement Type).

Asynchronous Measurements

Determine the number of lines that are in the FFT – the number of lines configured (Nc). You must first consider if the PHASE SPECTRA is also included in the returned data. Bit 0 of the ***ucDataSelect*** byte of the FFT data header record indicates the returned data. Calculate the number of lines read (Nr) as follows:

If bit 0 of ***ucDataSelect*** is set, then:

$$Nr = \frac{ByteCount}{8}$$

Otherwise:

$$Nr = \frac{ByteCount}{4}$$

The FFT returned can be some fraction of the raw processed FFT where the specific fraction is made appropriate to the filtering that is applied, which is based on module configuration. Selections in the ***SpecialRequest*** byte of the FFT data request record specify this control. Bits 3 and 4 of the ***ucDataSelect*** byte indicate the proportion of the filtered data that is returned. Use the following to adjust the number of lines that are based on the applied filtering.

Bit		Factor
4	3	
0	0	1.000
0	1	0.375
1	0	0.625
1	1	1.125

Determine the factor per the preceding table, then calculate the number of lines configured:

$$Nc = \frac{Nr}{Factor}$$

The FMAX, in Hz, can then be calculated as follows:

$$FMAX\ (Hz) = \frac{Nr - 1}{\boldsymbol{SamplePeriodInSec} * 2.56 * Nc}$$

Synchronous Measurements

Determine the number of lines that are in the FFT – the number of lines configured (Nc). You must first consider if the PHASE SPECTRA is also included in the returned data. Bit 0 of the ***ucDataSelect*** byte of the FFT data header record indicates the returned data. Calculate the number of lines read (Nr) as follows:

If bit 0 of ***ucDataSelect*** is set, then:

$$Nr = \frac{ByteCount}{8}$$

Otherwise:

$$Nr = \frac{ByteCount}{4}$$

The FFT returned can be a fraction of the raw processed FFT where the specific fraction is made appropriate to the filtering that is applied. Bits 3 and 4 of the ***ucDataSelect*** byte indicate the proportion of the filtered data that is returned. Use the following to adjust the number of lines that are based on the applied filtering:

Bit		Factor
4	3	
0	0	1.000
0	1	0.375
1	0	0.625
1	1	—

Determine the factor per the preceding table, then calculate the number of lines configured:

$$Nc = \frac{Nr}{Factor}$$

Extract from the FFT header the number of samples per revolution and the encoded RPM (RPMe) values.

samples_per_rev = the first byte of the ***SamplePeriodInSec*** value

RPMe = the last three bytes of the ***SamplePeriodInSec*** value

Calculate the FMAX, in orders, as follows:

$$\text{FMAX (orders)} = \frac{(\text{Nr} - 1)^{*}\ \text{samples per rev}}{2.56^{*}\ \text{Nc}}$$

Calculate the FMAX, in Hz, as follows:

$$\text{FMAX (Hz)} = \frac{\text{FMAX (orders)} * \text{RPMe} * 100}{60}$$

Dynamix Configuration Manager Object

The Dynamix configuration manager object (class code 0x38A) defines the personality of the module that is based on the selected module type and channel application types. It also provides the means by which a complete configuration is downloaded to the module.

For this latter purpose, the configuration assembly of the module is 'condensed' into class attributes 9 to 37 of this object. Each of these attributes is used to transfer 1 of the 29 configuration groups, where a group often contains configuration attributes from multiple objects. A Pre-Apply Attributes service (0x4B) is then sent which causes the module to verify that configuration. Once a downloaded configuration is accepted as valid, the module populates all appropriate objects and attributes with the revised configuration. This unpacking and dissemination of the configuration information means that targeted requests can be made to ascertain specific aspects of the configuration, without needing to parse large data structures.

Instance ID	Description
0	Class Instance of the Configuration Manager Object
1	Instance 1

Class Attributes

The Configuration Manager Object supports the following class attributes.

Note that attributes 9…37 form the module configuration assembly. The total size of the configuration is 5704 bytes. The structures referred to here are defined down to their elemental data types in the behavior section. Further information on each configuration attribute can be found in their source/originating object.

Table 87 - Class Attributes

Attribute ID	Access Rule	NV	Name	Description of Attribute
1	Get	NV	Revision	Defines revision of Dynamix Configuration Manager Object
8	Get	NV	Template Revision	
9	Get/Set	NV	Configuration Group 1	See structure definition
10	Get/Set	NV	Configuration Group 2	See structure definition
11	Get/Set	NV	Configuration Group 3	See structure definition
12	Get/Set	NV	Configuration Group 4	See structure definition
13	Get/Set	NV	Configuration Group 5	See structure definition
14	Get/Set	NV	Configuration Group 6	See structure definition
15	Get/Set	NV	Configuration Group 7	See structure definition
16	Get/Set	NV	Configuration Group 8	See structure definition
17	Get/Set	NV	Configuration Group 9	See structure definition
18	Get/Set	NV	Configuration Group 10	See structure definition
19	Get/Set	NV	Configuration Group 11	See structure definition

Table 87 - Class Attributes (continued)

20	Get/Set	NV	Configuration Group 12	See structure definition
21	Get/Set	NV	Configuration Group 13	See structure definition
22	Get/Set	NV	Configuration Group 14	See structure definition
23	Get/Set	NV	Configuration Group 15	See structure definition
24	Get/Set	NV	Configuration Group 16	See structure definition
25	Get/Set	NV	Configuration Group 17	See structure definition
26	Get/Set	NV	Configuration Group 18	See structure definition
27	Get/Set	NV	Configuration Group 19	See structure definition
28	Get/Set	NV	Configuration Group 20	See structure definition
29	Get/Set	NV	Configuration Group 21	See structure definition
30	Get/Set	NV	Configuration Group 22	See structure definition
31	Get/Set	NV	Configuration Group 23	See structure definition
32	Get/Set	NV	Configuration Group 24	See structure definition
33	Get/Set	NV	Configuration Group 25	See structure definition
34	Get/Set	NV	Configuration Group 26	See structure definition
35	Get/Set	NV	Configuration Group 27	See structure definition
36	Get/Set	NV	Configuration Group 28	See structure definition
37	Get/Set	NV	Configuration Group 29	See structure definition

Table 88 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	-	Configuration Status	BYTE	Defines module configuration status.	0: Out Of Box State (no configuration loaded) 1: Configuration that is loaded from nonvolatile memory 2: Configuration that is downloaded from controller.
17	Get	NV	AOP Module Type	SINT	AOP definition module personality.	Module Type
18	Get	NV	Module Type (applied)	SINT	Defines module personality.	Module Type
25	Get	NV	Compliance Mode	SINT	0 = None, 1=API-670. Indicates whether the module is configured for a critical protection application (1), or for a general monitoring or non-critical protection application (0).	Compliance Mode
Channel Application Types						
32	Get	NV	AOP Channel 0 Application Type	INT	AOP definition - application types.	Application Index
33	Get	NV	AOP Channel 1 Application Type	INT		
34	Get	NV	AOP Channel 2 Application Type	INT		
35	Get	NV	AOP Channel 3 Application Type	INT		

Table 88 - Instance Attributes

36	Get	NV	Channel 0 Application Type	INT	Applied - application types.	Application Index
37	Get	NV	Channel 1 Application Type	INT		
38	Get	NV	Channel 2 Application Type	INT		
39	Get	NV	Channel 3 Application Type	INT		
64	Get	-	CIP Sync Support	BYTE	Availability of CIP Sync.	1: Available

Attribute Semantics

Table 89 - Module Type

Index	Description
1	RT - 4 Dynamic (4 kHz)
2	RT - 2 Dynamic (20 kHz) / 2 Static
32	RT - 2 Dynamic (4 kHz) - Dual Path
64	RT - 2 Dynamic (40 kHz)
-128	MX - 4 Dynamic (40 kHz) - Paired Channels
-96	MX - 4 Dynamic (40 kHz) - Individual Channels

The listed values are NEGATIVE 128 and NEGATIVE 64 (not dash).

Table 90 - Channel Application Type

Index	Description	Primary Path Filtering	Integration	Footnotes*
0	OFF	-	-	-
1	Temperature transmitter (F)	OFF	-	1
2	Temperature transmitter (C)	OFF	-	1
3	Temperature transmitter (K)	OFF	-	1
4	DC Current	OFF	-	1
5	DC Voltage	OFF	-	1
6	Position	OFF	-	1
7	Rod Drop	OFF	-	1
8	Bearing Temperature (F)	OFF	-	1
9	Bearing Temperature (C)	OFF	-	1
10	Bearing Temperature (K)	OFF	-	1
77	X (shaft relative) - Filtered	LP-HP (24 dB)	-	2
78	Y (shaft relative) - Filtered	LP-HP (24 dB)	-	4
79	Eccentricity	LP (24 dB)	-	3
80	Aeroderivative (AV to V)	LP-HP (60 dB)	-	3
81	X (shaft relative)	LP (24 dB)	-	4
82	Y (shaft relative)	LP (24 dB)	-	4

Table 90 - Channel Application Type (continued)

Index	Description	Primary Path Filtering	Integration	Footnotes*
83	Aeroderivative (AV to D)	LP-HP (60 dB)	Yes	3
84	Standard Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	4
85	Standard Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	4
86	Standard Case Absolute Vibration (A to D)	LP-HP (24 dB)	Yes	4
87	Standard Case Absolute Vibration (AV to V)	LP-HP (24 dB)	-	4
88	Standard Case Absolute Vibration (AV to D)	LP-HP (24 dB)	Yes	4
89	Standard Case Absolute Vibration (V to V)	LP-HP (24 dB)	-	4
90	Standard Case Absolute Vibration (V to D)	LP-HP (24 dB)	Yes	4
92	Dynamic Pressure (with filters)	LP-HP (24 dB)	-	5
93	Dynamic Pressure	OFF	-	5
95	AC Current	LP-HP (24 dB)	-	4
96	AC Voltage	LP-HP (24 dB)	-	4
160	20 kHz Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	6
161	20 kHz Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	6
193	Complementary Differential Expansion A	OFF	-	1
194	Complementary Differential Expansion B	OFF	-	1
195	Ramp Differential Expansion A	OFF	-	1
196	Ramp Differential Expansion B	OFF	-	1
198	Shaft Relative (Absolute Shaft)	LP-HP (24 dB)	-	4
225	40 kHz Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	7
226	40 kHz Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	7
227	gSE (Spike Energy)	Special HP-LP	-	8

*These notes correspond to the footnote numbers in Table 90:

1. Static/DC measurement types do not have AC (overall) measurement capabilities. In addition, no alternate path processing is available but Normal/Advanced CM data acquisition capabilities are available from main path sources.
2. Eccentricity uses a peak per revolution AC measurement assessment (see AC Measurement Object). Otherwise eccentricity falls within the 'general' dynamic category regarding capabilities, note 4.
3. Aeroderivative applications types are based on specific processing requirements.

   Generally two channels are deployed per turbine, one with a sensor positioned at the gas generator (compressor) frame, the other on the Power turbine frame. The expected input signal is velocity (AV) and type 83 integrates this signal to displacement, whereas type 80 does not.

   The tacho signals are expected to be representative of gas generator and power turbine shaft speeds. Run a tracking filter from each tacho to allow the (1x) components in the signal from each contributing source/shaft to be identified and measured.

- LP/HP filtering with 60 dB per octave characteristic
- Two fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x.
- The first order is/must be Tacho 0, the second order Tacho 1.
- Outside a speed range of 5…400 Hz, the output of the tracking filters is set to zero.
- Expected SRD is 32 (minimum that is allowed is 22).
- In this SRD range full CM capability, including synchronous sampling are available.

4. These types are applications in the 'general' dynamic category where, for up to 4 kHz bandwidth, full filtering, processing, measurement, and condition monitoring capabilities are available. SRD is adjustable from 32…9 (the latter providing the 4 kHz bandwidth).
5. Types 92 and 93 are for Dynamic Pressure applications.

   Type 93 instigates a special processing scheme that is optimized for faster update of FFT band measurement data to support gas turbine combustion monitoring. Other measurement processing, including CM data transfer, is not supported in this mode.

   Type 92 supports FFT bands but also retains primary path filter options, Overall (0) processing, and a CM data transfer capability.

   In both cases, the total processing load that is placed on the module influences the FFT band update rate. For best performance, deploy with the remaining channels that are configured for DC measurements or set OFF.
6. In 20 kHz mode, the following restrictions apply:
   - No tracking filter functionality is supported
   - Normal/Advanced CM data is only available from a main path source
   - To accommodate the 20 kHz bandwidth, the SRD for channels 0/1 is now adjustable, down to 2.
   - The SRD for channels 2/3 must be 32.
7. Due to the high sample rate invoked for '40 kHz' mode, the following restrictions apply:
   - The full 40 kHz bandwidth is available to the Overall (1) measurement (if set pre-filter)
   - FFT band and CM Data sources must relate to decimated sample streams, with a minimum decimation of 5.
   - Normal and Advanced CM data is available if their sources are both set post-filter [3]

- No alternate path processing or tracking filter functionality is supported. '40 kHz' is a special mode that is applied to both channels of a channel pair, with no SRD adjustment.
- A mixture of application types 225 and 226 is, however, allowed.

8. Due to the high sample rate and signal processing requirements of gSE measurements, the following restrictions apply:
   - Overall (1) measurement is not supported
   - FFT band and CM Data sources must relate to decimated sample streams, decimation is set automatically based on filter settings.
   - Normal and Advanced CM data is available if their sources are both set post-filter [3]
   - No alternate path processing or tracking filter functionality is supported

   gSE is a special mode that is applied to both channels of a channel pair, with no SRD adjustment.

   The dynamic pressure application type (not filtered version) instigates a special processing scheme that is optimized for faster update of FFT band measurement data. The application type includes disabling overall measurement processing, to support gas turbine combustion monitoring. Other measurement processing is not supported in the mode.

Table 91 - Compliance Mode

Index	Description
0	Open
1	API-670 only

Table 92 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0D			Apply Attributes	Applies pending configuration attributes (use any instance)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute
0x10	x	-	Set Attribute Single	Sets the specified attribute

Object Specific Services

Table 93 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B				Not implemented
0x4C	x	x	Get Configuration Signature	The module calculated configuration CRC (along with some additional data) can be obtained using this Object Specific service. No instance or attribute is required. Configuration Time/Data and (Calculated) CRC relate only to Safety Configurations and Safety-related parameters. Configuration Counter is fully general. Response:

Data Type	Name	Description
UINT32	Configuration Time	Milliseconds from previous midnight. AOP supplied. Updated and persistent only when valid.(1)
UINT16	Configuration Date	Days since 1/1/1972. AOP supplied. Updated and persistent only when valid.*
UINT32	Configuration Counter	Number of successful configurations since last power on. Not persistent (0 in Out of Box state).
UINT32	Calculated Safety CRC	The last calculated CRC. Updated and persistent only when valid.*

(1) The Time/Date/CRC fields are only updated and persistent when the configuration is in Safety Configuration (compliance mode indices 2…4) and the configuration is valid. For example, the module calculated CRC and the AOP supplied CRC match. A successful configuration download or restore of configuration from Nonvolatile Memory, irrespective of the compliance type, updates the additional data (a non-persistent Configuration Counter). A counter-value of zero indicates that the modul is in Out of box State.

Configuration Group 1

Group 1 contains configuration attributes specific to the AOP and others from these objects:

- Mux Object (0x39B)
- Configuration Manager Object (0x38A)
- Transducer Object (0x38E)

Table 94 - Configuration Group 1

Source Object	Source Instance	Source Attribute	Name	Data Type
-	-	-	CfgRevNumber	DINT
-	-	-	LocalAOP	DINT[2]
0x39B	1	16	Time Slot 0 Minimum DAQ Time Multiplier	INT
0x39B	1	17	Time Slot 1 Minimum DAQ Time Multiplier	INT
0x39B	1	18	Time Slot 2 Minimum DAQ Time Multiplier	INT
0x39B	1	19	Time Slot 3 Minimum DAQ Time Multiplier	INT
-	-	-	CRC/Time/Date for verifying a safety configuration	DINT[3]
0x38A	1	17	AOP Module Type	SINT
		18	Module Type (Applied)	SINT
		25	Compliance Mode	SINT
-	-	-	Pad	SINT
0x38A	1	32	Channel 0 AOP Application Type	INT
		33	Channel 1 AOP Application Type	INT
		34	Channel 2 AOP Application Type	INT
		35	Channel 3 AOP Application Type	INT
		36	Channel 0 Application Type	INT
		37	Channel 1 Application Type	INT
		38	Channel 2 Application Type	INT
		39	Channel 3 Application Type	INT
0x38E	1	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	1	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	1	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	1	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	2	24	Transducer AC Units	ENGUNITS
			Pad	INT
0x38E	2	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	2	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT

Table 94 - Configuration Group 1 (continued)

Source Object	Source Instance	Source Attribute	Name	Data Type
0x38E	2	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	3	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	2	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	3	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	25	Transducer AC Sensitivity	REAL
	3	26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	27	Transducer DC sensitivity	REAL
0x38E	4	28	TX Power Setup	SINT
0x38E	4	32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	4	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL

Configuration Group 2

Group 2 contains configuration attributes from these objects:

- Channel setup Object (0x38F)
- Module Control Object (0x39E)
- Tacho and Speed Measurement Object (0x395)
- TSC Module Object (0x394)

Table 95 - Configuration Group 2

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38F	1	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x38F	1	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	2	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	Pad	SINT	
-	-	Pad	INT	
0x38F	2	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	3	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 95 - Configuration Group 2 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38F	3	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	4	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x38F	4	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x39E	0	16	Configured Auxiliary Modules	BYTE
		24	Tacho Mode	SINT
		32	Opto Output 0 Allocation	SINT
		33	Opto Output 1 Allocation	SINT
		40	User Local Relay Control	BYTE
		42	Relay Source	SINT
		64	Redundant Power Supply	SINT
-	-	-	Pad	SINT
0x39E	0	72	Channel 0 DSP FFT Enable	SINT
		73	Channel 0 DSP FFT Signal Source	SINT
		74	Channel 0 DSP FFT Measurement Units	ENGUNITS
		75	Channel 0 DSP FFT Line Resolution	SINT
		76	Channel 0 DSP FFT Window Function	SINT
		77	Channel 0 DSP FFT Number of averages	SINT
		78	Channel 0 DSP FFT Line value detection/scaling	SINT
		79	Channel 1 DP FFT Enable	SINT
		80	Channel 1 DSP FFT Signal Source	SINT
		81	Channel 1 DSP FFT Measurement Units	ENGUNITS
		82	Channel 1 DSP FFT Line Resolution	SINT
		83	Channel 1 DSP FFT Window Function	SINT
		84	Channel 1 DSP FFT Number of averages	SINT
		85	Channel 1 DSP FFT Line value detection/scaling	SINT
		86	Channel 2 DP FFT Enable	SINT

Table 95 - Configuration Group 2 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39E	0	87	Channel 2 DSP FFT Signal Source	SINT
		88	Channel 2 DSP FFT Measurement Units	ENGUNITS
		89	Channel 2 DSP FFT Line Resolution	SINT
		90	Channel 2 DSP FFT Window Function	SINT
		91	Channel 2 DSP FFT Number of averages	SINT
		92	Channel 2 DSP FFT Line value detection/scaling	SINT
		93	Channel 3 DP FFT Enable	SINT
		94	Channel 3 DSP FFT Signal Source	SINT
		95	Channel 3 DSP FFT Measurement Units	ENGUNITS
		96	Channel 3 DSP FFT Line Resolution	SINT
		97	Channel 3 DSP FFT Window Function	SINT
		98	Channel 3 DSP FFT Number of averages	SINT
		99	Channel 3 DSP FFT Line value detection/scaling	SINT
0x395	1	16	Tacho source	SINT
		17	Tacho OK Source	SINT
-	-	-	Pad	INT
0x395	1	19	Speed Multiplier	REAL
		21	Tacho Trigger Slope/Edge	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x395	1	24	ROC Delta Time	REAL
		25	ROC TC	REAL
0x395	2	16	Tacho source	SINT
		17	Tacho OK Source	SINT
-	-	-	Pad	INT
0x395	2	19	Speed Multiplier	REAL
		21	Tacho Trigger Slope/Edge	SINT
-	-	-	Pad	SINT
0x395	-	-	Pad	INT
0x395	2	24	ROC Delta Time	REAL
		25	ROC TC	REAL
0x394	0	18	Mode Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x394	1	16	Input Sensor Type	SINT
		24	Sensor Power Supply	SINT
		25	Sensor Target, pulses per revolution	INT
		32	Trigger Mode	SINT
-	-	-	Pad	SINT

Table 95 - Configuration Group 2 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x394	1	33	Trigger Threshold	INT
		34	Trigger Slope/Edge	SINT
		40	Sensor OK Definition	BYTE
		41	Sensor OK High Threshold	INT
		42	Sensor OK Low Threshold	INT
		43	High RPM Threshold	REAL
		44	Low RPM Threshold	REAL
		48	Tacho Bus Output	SINT
		49	TSCX Terminal/BNC Output	SINT
-	-	-	Pad	INT
0x394	2	16	Input Sensor Type	SINT
		24	Sensor Power Supply	SINT
		25	Sensor Target, pulses per revolution	INT
		32	Trigger Mode	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x394	2	33	Trigger Threshold	INT
		34	Trigger Slope/Edge	SINT
		40	Sensor OK Definition	BYTE
		41	Sensor OK High Threshold	INT
		42	Sensor OK Low Threshold	INT
		43	High RPM Threshold	REAL
		44	Low RPM Threshold	REAL
		48	Tacho Bus Output	SINT
		49	TSCX Terminal/BNC Output	SINT
-	-	-	Pad	INT

Configuration Group 3

Group 3 contains configuration attributes from these objects:

- Relay Module Object (0x39C)
- Dual Measurement Object (0x392)
- AC Measurement Object (0x390)

Table 96 - Configuration Group 3

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39C	1	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	1	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x39C	2	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	2	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x39C	3	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	3	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x392	1	16	Sensor 0 Ramp Angle	REAL
		17	Sensor 1 Ramp Angle	REAL
		18	Overall Axial Offset 0/1	REAL
		19	Overall Radial Offset 0/1	REAL
0x392	2	16	Sensor 2 Ramp Angle	REAL
		17	Sensor 3 Ramp Angle	REAL
		18	Overall Axial Offset 2/3	REAL
		19	Overall Radial Offset 2/3	REAL

Table 96 - Configuration Group 3 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x390	1	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	1	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	1	33	Minimum RPM for Peak per revolution	REAL
0x390	2	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	2	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	3	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	3	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	3	33	Minimum RPM for Peak per revolution	REAL
0x390	4	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	4	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	5	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	5	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT

Table 96 - Configuration Group 3 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x390	5	33	Minimum RPM for Peak per revolution	REAL
0x390	6	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	6	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	7	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	7	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	7	33	Minimum RPM for Peak per revolution	REAL
0x390	8	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	8	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 4

Group 4 contains configuration attributes from these objects:

- DC Measurement Object (0x391)
- Tracking Filter Object (0x393)

Table 97 - Configuration Group 4

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x391	1	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	1	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	1	35	Rod Drop Decay Time	REAL
0x391	2	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	2	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	2	35	Rod Drop Decay Time	REAL
0x391	3	16	DC Measurement Units	ENGUNITS
-	3	-	Pad	INT
0x391	3	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT

Table 97 - Configuration Group 4 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x391	3	35	Rod Drop Decay Time	REAL
0x391	4	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	4	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	4	35	Rod Drop Decay Time	REAL
0x393	1	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	1	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	1	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	2	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	2	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	2	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	3	16	Tracking Filter Configuration	BYTE

Table 97 - Configuration Group 4 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
0x393	3	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	3	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	4	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	4	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	4	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL

Configuration Groups 5…16

The Measurement Alarm Object has 24 instances, spread across 12 groups (two instances per configuration group).

In the following table, for a particular group, N = 1 + (2*(Group- 5))

Examples
- Group 5: N = 1 (source instances 1 and 2)
  - to
- Group 16: N = 23 (source instances 23 and 24)

Table 98 - Configuration Groups 5...16

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N	16	Alarm Enable	SINT
-	-	-	Pad	SINT
0x396	N	17	Alarm Measurement Identifier	INT
		19	Alarm Form	SINT
		20	Alarm Type	SINT
		21	Alarm Processing Mode	SINT
-	-	-	Pad	SINT
0x396	N	24	Low Alert Threshold	REAL
		25	High Alert Threshold	REAL
		26	Low Danger Threshold	REAL
		27	High Danger Threshold	REAL
		32	Hysteresis	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x396	N	33	Delay/Sustain Time (Alert)	DINT
		34	Delay/Sustain Time (Danger)	DINT
		35	Alarm Multiplier	REAL
		40	Adaptive Monitoring Source	INT
-	-	-	Pad	INT

Table 98 - Configuration Groups 5...16 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N	41	Range 1 - upper control value	REAL
		42	Range 1 - Alarm Multiplier	REAL
		43	Range 2 - upper control value	REAL
		44	Range 2 - Alarm Multiplier	REAL
		45	Range 3 - upper control value	REAL
		46	Range 3 - Alarm Multiplier	REAL
		47	Range 4 - upper control value	REAL
		48	Range 4 - Alarm Multiplier	REAL
		49	Range 5 - upper control value	REAL
		50	Range 5 - Alarm Multiplier	REAL
		64	Profile mode - Reference for Low Alert Threshold	SINT
		65	Profile mode - Reference for High Alert Threshold	SINT
		66	Profile mode - Reference for Low Danger Threshold	SINT
		67	Profile mode - Reference for High Danger Threshold	SINT
0x396	N+1	16	Alarm Enable	SINT
-	-	-	Pad	SINT
0x396	N+1	17	Alarm Measurement Identifier	INT
		19	Alarm Form	SINT
		20	Alarm Type	SINT
		21	Alarm Processing Mode	SINT
-	-	-	Pad	SINT
0x396	N+1	24	Low Alert Threshold	REAL
		25	High Alert Threshold	REAL
		26	Low Danger Threshold	REAL
		27	High Danger Threshold	REAL
		32	Hysteresis	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x396	N+1	33	Delay/Sustain Time (Alert)	DINT
		34	Delay/Sustain Time (Danger)	DINT
		35	Alarm Multiplier	REAL
		40	Adaptive Monitoring Source	INT
-	-	-	Pad	INT
0x396	N+1	41	Range 1 - upper control value	REAL
		42	Range 1 - Alarm Multiplier	REAL
		43	Range 2 - upper control value	REAL
		44	Range 2 - Alarm Multiplier	REAL
		45	Range 3 - upper control value	REAL

Table 98 - Configuration Groups 5…16 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N+1	46	Range 3 - Alarm Multiplier	REAL
		47	Range 4 - upper control value	REAL
		48	Range 4 - Alarm Multiplier	REAL
		49	Range 5 - upper control value	REAL
		50	Range 5 - Alarm Multiplier	REAL
		64	Profile mode - Reference for Low Alert Threshold	SINT
		65	Profile mode - Reference for High Alert Threshold	SINT
		66	Profile mode - Reference for Low Danger Threshold	SINT
		67	Profile mode - Reference for High Danger Threshold	SINT

Configuration Group 17

Group 17 contains voted alarm object class attributes and instances 1…7.

Table 99 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	0	16	Trip Inhibit/Bypass Source	BYTE
		17	Alarm Reset Source	BYTE
-	-	-	Pad	INT
0x397	1	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	1	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT

Table 99 - Configuration Group 17 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	1	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	2	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	2	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	2	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	3	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	3	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT

Table 99 - Configuration Group 17 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	3	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	4	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	4	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	4	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
0x397	4	49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	5	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 99 - Configuration Group 17 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	5	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	5	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	6	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	6	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	6	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	7	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT

Table 99 - Configuration Group 17 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	7	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	7	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD

Configuration Group 18

Group 18 contains voted alarm object instances 8…13 and options to configure the input and output assemblies.

See Assembly Object on page 517, 0x04, for more on this configurability.

Table 100 - Configuration Group 18

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	8	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	8	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	8	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD

Table 100 - Configuration Group 18 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	9	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
0x397	9	26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	9	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	9	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	10	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	10	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT

Table 100 - Configuration Group 18 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	10	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	11	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
0x397	11	27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	11	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	11	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	12	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	12	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT

Table 100 - Configuration Group 18 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	12	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	13	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	13	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	13	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
-	-	-	Not used (Input Assembly Index)	SINT
-	-	-	Not used (Output Assembly Index)	SINT
-	-	-	Pad	INT
-	-	-	Not used (Number of input members)	UINT
-	-	-	*DWORD 0 (member list)	DWORD
-	-	-	*DWORD 1 (member list)	DWORD
-	-	-	*DWORD 2 (member list)	DWORD
-	-	-	*DWORD 3 (member list)	DWORD
-	-	-	*BYTE 0 (output member list)	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 19

Group 19 contains configuration attributes from these objects:

- Current Output Module Object (0x39D)
- Normal CM Data Object (0x398)
- Advanced CM Data Object (0x39A)
- FFT Band Object (0x399) Instances 1…4

Table 101 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39D	0	15	Current Module Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	0	16	Auxiliary Link time out	UINT
0x39D	1	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	1	17	Current Output Measurement Identifier	INT
0x39D	1	19	20 mA Output scaling	REAL
0x39D	1	20	4 mA Output scaling	REAL
0x39D	1	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	2	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	2	17	Current Output Measurement Identifier	INT
0x39D	2	19	20 mA Output scaling	REAL
0x39D	2	20	4 mA Output scaling	REAL
0x39D	2	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	3	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	3	17	Current Output Measurement Identifier	INT
0x39D	3	19	20 mA Output scaling	REAL
0x39D	3	20	4 mA Output scaling	REAL
0x39D	3	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	4	16	Current Output Enable	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
0x39D	4	17	Current Output Measurement Identifier	INT
0x39D	4	19	20 mA Output scaling	REAL
0x39D	4	20	4 mA Output scaling	REAL
0x39D	4	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x398	0	16	Synchronization enable	SINT
0x398	0	17	Waveform/FFT storage format	BYTE
-	-	-	Pad	INT
0x398	1	16	Enable	BYTE
0x398	1	17	Signal Source	SINT
0x398	1	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	1	19	Measurement Units	ENGUNITS
0x398	1	20	Associated Tacho Source	SINT
0x398	1	21	Waveform Record Length	SINT
0x398	1	25	FFT Line Resolution	SINT
0x398	1	26	FFT Window Function	SINT
0x398	1	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	2	16	Enable	BYTE
0x398	2	17	Signal Source	SINT
0x398	2	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	2	19	Measurement Units	ENGUNITS
0x398	2	20	Associated Tacho Source	SINT
0x398	2	21	Waveform Record Length	SINT
0x398	2	25	FFT Line Resolution	SINT
0x398	2	26	FFT Window Function	SINT
0x398	2	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	3	16	Enable	BYTE
0x398	3	17	Signal Source	SINT
0x398	3	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	3	19	Measurement Units	ENGUNITS
0x398	3	20	Associated Tacho Source	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x398	3	21	Waveform Record Length	SINT
0x398	3	25	FFT Line Resolution	SINT
0x398	3	26	FFT Window Function	SINT
0x398	3	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	4	16	Enable	BYTE
0x398	4	17	Signal Source	SINT
0x398	4	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	4	19	Measurement Units	ENGUNITS
0x398	4	20	Associated Tacho Source	SINT
0x398	4	21	Waveform Record Length	SINT
0x398	4	25	FFT Line Resolution	SINT
0x398	4	26	FFT Window Function	SINT
0x398	4	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x39A	0	16	Synchronized data control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39A	1	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	1	17	Measurement Units	ENGUNITS
0x39A	1	18	Associated Tacho Source	SINT
0x39A	1	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	2	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	2	17	Measurement Units	ENGUNITS
0x39A	2	18	Associated Tacho Source	SINT
0x39A	2	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	3	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	3	17	Measurement Units	ENGUNITS
0x39A	3	18	Associated Tacho Source	SINT
0x39A	3	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	4	16	Source Selection	SINT
-	-	-	Pad	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39A	4	17	Measurement Units	ENGUNITS
0x39A	4	18	Associated Tacho Source	SINT
0x39A	4	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x399	1	16	Channel Source	SINT
0x399	1	17	Data Source	SINT
0x399	1	18	Source of band frequency limits	SINT
0x399	1	23	Tacho source for band limits	SINT
0x399	1	19	Start frequency (Orders/Hz)	REAL
0x399	1	20	Stop frequency (Orders/Hz)	REAL
0x399	1	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	2	16	Channel Source	SINT
0x399	2	17	Data Source	SINT
0x399	2	18	Source of band frequency limits	SINT
0x399	2	23	Tacho source for band limits	SINT
0x399	2	19	Start frequency (Orders/Hz)	REAL
0x399	2	20	Stop frequency (Orders/Hz)	REAL
0x399	2	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	3	16	Channel Source	SINT
0x399	3	17	Data Source	SINT
0x399	3	18	Source of band frequency limits	SINT
0x399	3	23	Tacho source for band limits	SINT
0x399	3	19	Start frequency (Orders/Hz)	REAL
0x399	3	20	Stop frequency (Orders/Hz)	REAL
0x399	3	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	4	16	Channel Source	SINT
0x399	4	17	Data Source	SINT
0x399	4	18	Source of band frequency limits	SINT
0x399	4	23	Tacho source for band limits	SINT
0x399	4	19	Start frequency (Orders/Hz)	REAL
0x399	4	20	Stop frequency (Orders/Hz)	REAL
0x399	4	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x39D	0	15	Current Module Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	0	16	Auxiliary Link time out	UINT
0x39D	1	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	1	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	2	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	2	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	3	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	3	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	4	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	4	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x398	0	16	Synchronization enable	SINT
		17	Waveform/FFT storage format	BYTE
-	-	-	Pad	INT
0x398	1	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	1	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	2	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	2	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	3	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x398	3	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	4	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	4	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x39A	0	16	Synchronized data control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39A	1	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	1	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	2	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	2	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	3	16	Source Selection	SINT
-	-	-	Pad	SINT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39A	3	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	4	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	4	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x399	1	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	2	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	3	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 101 - Configuration Group 19 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	4	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
0x399	4	19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Groups 20 and 21

Group 20 contains configuration attributes from the FFT Band Object (0x399) Instances 5…18.

Group 21 contains configuration attributes from the FFT Band Object (0x399) Instances 19…32.

Table 102 - Configuration Groups 20 and 21

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	5/19	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	6/20	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 102 - Configuration Groups 20 and 21 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	7/21	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	8/22	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	9/23	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	10/24	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 102 - Configuration Groups 20 and 21 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	11/25	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	12/26	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	13/27	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	14/28	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 102 - Configuration Groups 20 and 21 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	15/29	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	16/30	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	17/31	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	18/32	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 22

Group 22 contains configuration attributes from the following objects:

- Transducer Object (0x38E)
- Tacho and Speed Measurement Object (0x395)

Table 103 - Configuration Group 22

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38E	1	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	2	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	3	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	4	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x395	1	18	Tacho 0 Name	SINT[32]
0x395	2	18	Tacho 1 Name	SINT[32]

Configuration Group 23

Group 23 contains configuration attributes from the following objects:

- TSC Module Object (0x394)
- Measurement Alarm Object (0x396) Instances 1…5

Table 104 - Configuration Group 23

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x394	1	17	Input Name 0	SINT[32]
	2	17	Input Name 1	SINT[32]
0x396	1	18	Alarm Name	SINT[32]
	2	18	Alarm Name	SINT[32]
	3	18	Alarm Name	SINT[32]
	4	18	Alarm Name	SINT[32]
	5	18	Alarm Name	SINT[32]

Configuration Group 24

Group 24 contains configuration attributes from the Measurement Alarm Object (0x396) Instances 6…12. Configuration Group 25

Table 105 - Configuration Group 24

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	6	18	Alarm Name	SINT[32]
	7	18	Alarm Name	SINT[32]
	8	18	Alarm Name	SINT[32]
	9	18	Alarm Name	SINT[32]
	10	18	Alarm Name	SINT[32]
	11	18	Alarm Name	SINT[32]
	12	18	Alarm Name	SINT[32]

Configuration Group 25

Group 25 contains configuration attributes from the Measurement Alarm Object (0x396) Instances 13…19.

Table 106 - Configuration Group 25

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	13	18	Alarm Name	SINT[32]
	14	18	Alarm Name	SINT[32]
	15	18	Alarm Name	SINT[32]
	16	18	Alarm Name	SINT[32]
	17	18	Alarm Name	SINT[32]
	18	18	Alarm Name	SINT[32]
	19	18	Alarm Name	SINT[32]

Configuration Group 26

Group 26 contains configuration attributes from the following objects:
- Measurement Alarm Object (0x396) Instances 20…24
- Voted Alarm Object (0x397) Instances 1 and 2

Table 107 - Configuration Group 26

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	20	18	Alarm Name	SINT[32]
	21	18	Alarm Name	SINT[32]
	22	18	Alarm Name	SINT[32]
	23	18	Alarm Name	SINT[32]
	24	18	Alarm Name	SINT[32]
0x397	1	17	Voted Alarm 0 Name	SINT[32]
	2	17	Voted Alarm 1 Name	SINT[32]

Configuration Group 27

Group 27 contains configuration attributes from the Voted Alarm Object (0x397) Instances 3…9.

Table 108 - Configuration Group 27

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	3	17	Voted Alarm 2 Name	SINT[32]
	4	17	Voted Alarm 3 Name	SINT[32]
	5	17	Voted Alarm 4 Name	SINT[32]
	6	17	Voted Alarm 5 Name	SINT[32]
	7	17	Voted Alarm 6 Name	SINT[32]
	8	17	Voted Alarm 7 Name	SINT[32]
	9	17	Voted Alarm 8 Name	SINT[32]

Configuration Group 28

Group 28 contains configuration attributes from the Voted Alarm Object (0x397) Instances 10…13.

Table 109 - Configuration Group 28

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	10	17	Voted Alarm 9 Name	SINT[32]
	11	17	Voted Alarm 10Name	SINT[32]
	12	17	Voted Alarm 11Name	SINT[32]
	13	17	Voted Alarm 12Name	SINT[32]

Configuration Group 29

Group 29 contains configuration attributes from the following objects:

- Current Output Module Object (0x39D)
- Data Manager Object (0x38B)
- Transient Data Manager Object (0x38C)

Table 110 - Configuration Group 29

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39D	1	18	Current Output 0 Name	SINT[32]
	2	18	Current Output 1 Name	SINT[32]
	3	18	Current Output 2 Name	SINT[32]
	4	18	Current Output 3 Name	SINT[32]
0x38B	1	17	Trend Overall Update Multiplier	INT
-	-	-	Pad	INT
0x38B	1	18	Trend Dynamic Update Multiplier	DINT
		19	Alarm Overall Update Multiplier	INT
		24	Trend Data-Set Enable	BYTE
		32	Alarm Data Storage Trigger Source	SINT
		33	Alarm Data Storage Latching	SINT
		34	Alarm% Post Trigger for the High Resolution (100 ms) Overall Records	SINT
		35	Alarm% Post Trigger for the Low Resolution (Configured Rate) Overall Records	SINT
		36	Alarm% Post Trigger for Dynamic Data Records (10x Configured Overall Rate)	SINT
0x38B	1	48	DWORD 0 (Trend Static Data Source)	DWORD
		49	DWORD 1 (Trend Static Data Source)	DWORD
		50	DWORD 2 (Trend Static Data Source)	DWORD
		51	DWORD 3 (Trend Static Data Source)	DWORD
0x38C	1	16	Transient Data Mode Control	WORD
		18	Transient - Dynamic Data Selection	SINT
		23	Source of Speed Data	SINT
		24	Low-Speed Threshold	DINT
		25	High-Speed Threshold	DINT
		26	Overall Delta RPM (SU)	INT
		27	Overall Delta RPM (CD)	INT
		28	Overall Delta RPM (SU)	INT
		29	Overall Delta RPM (CD)	INT
		30	Disable Dynamic Data Storage	BYTE
-	-	-	Pad	SINT

Table 110 - Configuration Group 29 (continued)

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38C	1	31	Extra Startup Sample Time	INT
		64	DWORD 0 (Transient Static Data Source)	DWORD
		65	DWORD 1(Transient Static Data Source)	DWORD
		66	DWORD 2 (Transient Static Data Source)	DWORD
		67	DWORD 3 (Transient Static Data Source)	DWORD

Dynamix Data Manager Object

The Data Manager Object(class code 0x38B) defines the setup, data storage, and data access for Dynamix Trend and Dynamix Alarm data records. The Normal CM Data Object (0x398) configures which dynamic data is available to the Data Manager Object.

Table 111 - Object Instances

Instance ID	Description
0	Data Manager Class Instance
1	Data Manager Setup Instance

Table 112 - Class Attributes

Attribute ID	Access Rule	NV	Name	Description of Attribute
1	Get	NV	Revision	Defines revision of Dynamix Data Manager Object

Table 113 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Trend Data-Set Usage	BYTE	Not implemented - fixed at zero	Use attribute 24
2	Get	V	Trend Data-Set Status	BYTE	Returns the current operational mode	Bit 0 is set when the Low-Resolution Overall Trend records are cycling Bit 1 is set when the High-Resolution Overall Trend records are cycling Bit 2 is set when the FFT dynamic records are cycling Bit 3 is set when the TWF dynamic records are cycling Bits 4 to 7 are not used "Cycling" means that the buffer has filled and is now overwriting earlier entries.
3	Get	V	Trend Overall Data Records	UINT	Returns the number of static data records that the buffer	Fixed depth: 641
4	Get	V	Trend Dynamic Data Record Sets	UINT	Returns the number of dynamic data records that the buffer currently holds.	Fixed depth: 64
5	Get	V	Alarm Data-Set Usage	USINT	Not implemented	Use attribute 24
6	Get	V	Alarm Data-Set Status	WORD	Returns the current operational status.	See Alarm Data-Set Status in Attribute Semantics

Table 113 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
7	Get	V	Alarm Overall (High Resolution) Data Records	UINT	Returns the number of overall data records (at the fast update rate) that the buffer currently holds.	Fixed depth: 320
8	Get	V	Alarm Overall (Low Resolution) Data Records	UINT	Returns the number of (low resolution) overall data records that the buffer currently holds.	Fixed depth: 640
9	Get	V	Alarm Dynamic Data Records	UINT	Returns the number of dynamic data records that the buffer currently holds.	Fixed depth: 64
Update Rates				Group of 3 configuration attributes		
17	Get	NV	Trend Overall Update Multiplier	INT	The rate at which Trend Overall data records are stored, based on the fast update rate.	Multiples of 100 ms Default of 10 Range: 1…32767
18	Get	NV	Trend Dynamic Update Multiplier	DINT	The rate at which Trend Dynamic data records are stored, based on the fast update rate.	Multiples of 100 ms Default of 100 Range: 10…327670
19	Get	NV	Alarm Overall Update Multiplier	INT	Defines overall record update rate for use in alarm storage, which is based on the fast update rate.	Equal to Attribute 17 Range: 1…32767
Trend Data Storage				A configuration attribute		
24	Get	V	Trend Data-Set Enable	BYTE	Activate Trend Storage on a per channel basis	Bit enabled control. See "Trend Data-Set Enable" under Attribute Semantics.
Alarm Data Storage				Group of 5 configuration attributes		
32	Get	V	Alarm Data Storage Trigger Source	SINT	Reference to Voted Alarm Object, including OFF option.	
33	Get	V	Alarm Data Storage Latching	SINT	If latching, the alarm data buffer does not update on subsequent alarm excursions unless the latch has been reset.	0: Not latching 1: Latching
34	Get	V	Alarm % Post Trigger for the High Resolution (100 ms) Overall Records	SINT	Overall, post-trigger setting for the 100 ms update rate - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (80 / 320 records)
35	Get	V	Alarm % Post Trigger for the Low Resolution (Configured Rate) Overall Records	SINT	Overall, post-trigger setting for the user configured update rate - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (160 / 640 records)
36	Get	V	Alarm % Post Trigger for Dynamic Data Records (10x Configured Overall Rate)	SINT	Overall, post-trigger setting for the dynamic data records - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (16 / 64 records)
Static Data Source				A group of 4 DWORDs where each bit indicates whether that measurement is included or not.		
48	Get	V	DWORD 0	DWORD		Range: 0…4294967295
49	Get	V	DWORD 1	DWORD		Range: 0…4294967295
50	Get	V	DWORD 2	DWORD		Range: 0…4294967295
51	Get	V	DWORD 3	DWORD	DWORD 3 is only partially populated with measurements, hence the lower range.	Range: 0…1023

Attribute Semantics

Table 114 - Alarm Data-set Status

Bits	Description
0…3	Low-Resolution Overall Buffer
4…7	High-Resolution Overall Buffer
8…11	FFT Dynamic Data
12…15	TWF Dynamic Data

Within each section:

Value	Description
0x00	AB_STATUS_DISABLED (buffer/data type not being captured)
0x01	AB_STATUS_ARMED (waiting for alarm event trigger)
0x02	AB_STATUS_POPULATING (alarm event in progress)
0x03	AB_STATUS_DATA_READY (alarm data available)
0x04	AB_STATUS_LATCHED (as 0x03 but data is latched until reset)

Example 0x4444 is all buffers have latched alarm data available.

Trend Data-Set Enable

Bit	0	1	2	3	4	5	6	7
Type	Overall				Dynamic			
Channel	0	1	2	3	0	1	2	3

Alarm Data Storage Trigger Source

Bits	Description
0	OFF
1…13	Voted alarm instance 1…13, output type: Alert
14	Any Alert
15…16	Reserved
17…29	Voted alarm instance 1…13, output type: Danger
30	Any Danger
31…32	Reserved
33…45	Voted alarm instance 1…13, output type: TX OK
46	Any TX OK (TX Fail)
47…48	Reserved
49	Any Voted Alarm Output
Higher values	Reserved

0x00 disables any automatic storage function that is based on an alarm status.

The controller can trigger the alarm data storage via its output table or by a service. These controls and the configured trigger source are ORed.

Table 115 - Static Data Bit Allocations

Bits	DWORD 0	DWORD 1	DWORD 2	DWORD 3
0	Overall (0) Channel 0	Order (2) Phase Channel 0	FFT Band (20)	Factored Speed 0
1	Overall (0) Channel 1	Order (2) Phase Channel 1	FFT Band (21)	Factored Speed 1
2	Overall (0) Channel 2	Order (2) Phase Channel 2	FFT Band (22)	Differential Expansion Channel Pair 0
3	Overall (0) Channel 3	Order (2) Phase Channel 3	FFT Band (23)	Differential Expansion Channel Pair 1
4	Overall (1) Channel 0	Order (3)Mag Channel 0	FFT Band (24)	
5	Overall (1) Channel 1	Order (3)Mag Channel 1	FFT Band (25)	
6	Overall (1) Channel 2	Order (3)Mag Channel 2	FFT Band (26)	Rod Drop Channel 0
7	Overall (1) Channel 3	Order (3)Mag Channel 3	FFT Band (27)	Rod Drop Channel 1
8	DC(V) Channel 0	Order (3) Phase Channel 0	FFT Band (28)	Rod Drop Channel 2
9	DC(V) Channel 1	Order (3) Phase Channel 1	FFT Band (29)	Rod Drop Channel 3
10	DC(V) Channel 2	Order (3) Phase Channel 2	FFT Band (30)	
11	DC(V) Channel 3	Order (3) Phase Channel 3	FFT Band (31)	
12	Order (0)Mag Channel 0	FFT Band (0)	Not 1X Channel 0	
13	Order (0)Mag Channel 1	FFT Band (1)	Not 1X Channel 1	
14	Order (0)Mag Channel 2	FFT Band (2)	Not 1X Channel 2	
15	Order (0)Mag Channel 3	FFT Band (3)	Not 1X Channel 3	
16	Order (0) Phase Channel 0	FFT Band (4)	DC Channel 0	
17	Order (0) Phase Channel 1	FFT Band (5)	DC Channel 1	
18	Order (0) Phase Channel 2	FFT Band (6)	DC Channel 2	
19	Order (0) Phase Channel 3	FFT Band (7)	DC Channel 3	
20	Order (1)Mag Channel 0	FFT Band (8)	SMAXMag Channel Pair 0	
21	Order (1)Mag Channel 1	FFT Band (9)	SMAXMag Channel Pair 1	

Table 115 - Static Data Bit Allocations (continued)

Bits	DWORD 0	DWORD 1	DWORD 2	DWORD 3
22	Order (1)Mag Channel 2	FFT Band (10)	SMAX Phase Channel Pair 0	
23	Order (1)Mag Channel 3	FFT Band (11)	SMAX Phase Channel Pair 1	
24	Order (1) Phase Channel 0	FFT Band (12)	Shaft Absolute pk-pk Channel Pair 0	
25	Order (1) Phase Channel 1	FFT Band (13)	Shaft Absolute pk-pk Channel Pair 1	
26	Order (1) Phase Channel 2	FFT Band (14)	Speed 0	
27	Order (1) Phase Channel 3	FFT Band (15)	Speed 1	
28	Order (2)Mag Channel 0	FFT Band (16)	Speed 0 maximum	
29	Order (2)Mag Channel 1	FFT Band (17)	Speed 1 maximum	
30	Order (2)Mag Channel 2	FFT Band (18)	Speed 0 Rate of Change	
21	Order (2)Mag Channel 3	FFT Band (19)	Speed 1 Rate of Change	

Table 116 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset*	Alarm buffer reset
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

*A latched alarm buffer requires a reset to rearm it ready for a new trigger/ alarm event. (Status is set to armed, zero stored records that are indicated and earlier data is no longer available.) The reset service (or via the controller output data) sends an alarm buffer reset.

If an alarm buffer reset is sent, the buffer will resets/rearms as described, irrespective of whether latching is configured. This reset acts as a marker that the data has been read/is finished with. The reset also provides for a clear indication of when a new event has been detected.

Availability of Dynamic Data

Immediately after power cycle or configuration download, dynamic data takes some time to become available as internal sample buffers must be populated based on the new time configuration.

In most cases, the delay can be a few seconds. However, for configurations with low sample rates, the delay could be several minutes.

Object Specific Services

Table 117 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Alarm Buffer Trigger	Force the alarm data to be saved as if an alarm has occurred. This save is intended to be used when an alarm or event external to the DMx-M has occurred.
0x4C	-	x	CM Record Request(1)	Specify the Record Request parameters (defined in the following section). Since the records can be large and the request can be for many records, the Record Request usually has to be sent multiple times.

(1) Data types that consist of multiple bytes are transferred in little-endian format (least significant byte first).

A data communication session starts at the first service request and ends after the final response of the exchange. However, the session is subjected to an (inactivity) timeout of 30 seconds.

0x4C CM Record Request

CM data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value that is returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Table 118 - CM Record Request Parameters

Byte Offset Within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: • eHIGH_RES_TREND (0) • eLOW_RES_TREND (1) • eFFT (2) • eTWF (3) • eTACHO (4) • eHIGH_RES_ALARM (5) • eLOW_RES_ALARM (6) • eFFT_ALARM (7) • eTWF_ALARM (8) • eTACHO_ALARM (9) The BufferSelect does not change during a session.
2	RequestedCount	UINT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records are returned instead. The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 Bits indicating the source channel. The ChannelSelect does not change during a session (see Channel Select). This field is ignored for all overall buffer types (eHIGH_RES_TREND, eLOW_RES_TREND, eHIGH_RES_ALARM, eLOW_RES_ALARM)
6	SpecialRequest	BYTE	See Table 119 on page 391.
7	Pad	BYTE	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.

Table 119 - SpecialRequest Description (CM Record Request Parameters)

Bit		Description
0	SR_MAG_PHASE	Set to request phase (see Phase Data on page 334) and magnitude data from an FFT buffer, otherwise just magnitude data is returned.
1 and 2	Reserved	
3	SR_FILTER_LO	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 37.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines, based on applied filtering.(2)
4	SR_FILTER_HI	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 62.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines, based on applied filtering(2).
5	SR_EXTENDED	Set bit to specify that if samples are not decimated or synchronously resampled that 112.5% of the unfiltered FFT lines are returned. When not set, 100% of FFT lines are returned for samples that are not decimated nor synchronously sampled.
IMPORTANT		Recommended use is to set bits 3, 4 and 5. This setting makes sure that in all cases the maximum number of lines are returned that are, in all cases, free of any filter attenuation or potential aliasing effects.

(1) The FMAX and FFT Lines presented in the AOP assume that bits 3, 4 and 5 are set. If other selections are made, then the FMAX or the number of FFT lines of a downloaded FFT does not always reflect that presented in the AOP.

(2) When automatically deciding the factor to apply to decimated or synchronously resampled data, the firmware applies the SR_FILTER_LO (37.5%) factor when the -24 dB/octave filter is applied, and the SR_FILTER_HI (62.5 %) factor with the -48 dB/octave or the -60 dB/octave filters are applied.
Data that is decimated on the Alternate Path always applies the -48 dB/octave filter. The applied filter on the primary path is the -24 dB/octave filter except when either of the Aeroderivative Measurement Types are selected, in which case it applies the -60 dB/octave filter.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Byte Offset Within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to three instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0 though 3 are valid channels.
2	CompletedRecords	UINT	Incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UDINT	For a given session the RecordSize.

8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that are transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the responsibility of the calling application to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

High and Low-Resolution Trend (eHIGH_RES_TREND, eLOW_RES_TREND, eHIGH_RES_ALARM, eLOW_RES_ALARM)

Table 120 - Record Type Structures

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	DWORD	
12	Reserved	DWORD	
16	Params0	DWORD	Set bits indicate which parameters are included in the data array. The values in DataArray are in the order of the set bits. Value is the same as the configuration tag Trend.StaticParams0…3.
20	Params1	DWORD	
24	Params2	DWORD	
28	Params3	DWORD	
32	ByteCount	UDINT	The number of bytes in the data array. This is equal to the number of bits set in the parameters Params0…Params3 (x4).
36	DataArray	REAL	The array of parameters included in the trend data set. Is a packed array where the first value is the first set bit, the second value is the next set bit, and so on.

FFT (eFFT, eFFT_ALARM)

Table 121 - Record Type Structures

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy
4	TimestampSec	UDINT	Seconds since 1970
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution
12	identifier*	DWORD	Data source, mode, tacho source, and measurement units
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the LineArray. Otherwise, just the magnitude array. Bits 1 and 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value that is provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7.
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

If the FFT is a synchronous measurement, then the RPM value is also provided in the SamplePeriodInSecs parameter. In that case, the two RPM values are identical.

See Reading FFT Data on page 333 for details on how to calculate the FFT from the read data.

Waveform (eTWF, eTWF_ALARM)

Table 122 - Record Type Structures

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data. See Reading Continuous Time Waveforms on page 329 for information on using this parameter.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

See Reading TWF Data on page 332 for details on how to calculate the TWF from the read data.

Tacho (eTACHO, eTACHO_ALARM)

Table 123 - Record Type Structures

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

For FFT and TWF data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining three bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7DO5:
- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous, it can be determined for the identifier field with use of the following format.

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post-filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous bit 5 = 1 synchronous then bit 6 indicates which tacho was used)
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	Reserved

Behavior

Through the object-specific service 0x4C, the data manager object gives access to historical data (Trend and Alarm). See the normal CM object for access to 'Live' Dynamic data. Also for the Advanced CM data object for access to dynamically configurable analysis data (such as variable FFT lines) and to the Transient data manager object for access to stored transient event data.

CM Record Request - Recommendations for Network Side Implementation

The data is returned in multiple packets as an array of records of size RecordSize - this data amount can be a significant depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file is as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
- Second Response Packet payload
- Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels. Retrieval of any record from the file can then be accomplished as follows.

1. Open the file.
2. Read a record with size of CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Start at the address of the first Record in the Data Array in the first CM Record Response.
   a. To index to any record, use the RecordSize to seek to the correct point in the file.
   b. Read out the record of size RecordSize.

Dynamix Transient Data Manager Object

The Transient Manager Object (class code 0x38C) defines the setup of transient data acquisition mode and provides access to the associated transient data buffers. Furthermore this object allows for transient type definition, which can differentiate between normal and fast transients.

Object Instances

Instance ID	Description
0	Transient Data Manager Class Instance
1	Transient Data Manager Setup Instance

Table 124 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	NV	Revision	UINT	Defines revision of Dynamix Transient Data Manager Object
8	Get	V	Last Transient Event	STRUCT	Timestamp of the last transient event. 8 bytes*

*The last transient event timestamp comprises two UDINT - sub-second resolution to one nanosecond followed by seconds since 1970.

When transient capture is enabled it indicates the last detected transient event (since power-up) irrespective of whether this is captured or stored by the module. For example the time stamp may be updated by a more recent coast down where only run-ups are stored or by a transient event that occurs after all buffers have been used and latched.

Table 125 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Transient Static Records	STRUCT	The number of overall/static data records currently stored in each of the four transient buffers.	Four UINT Maximum: 640 per
2	Get	V	Transient Dynamic Records		The number of dynamic data records currently stored in each of the four transient buffers.	Four UINT Maximum: 64 per
3	Get	V	Run-up Data-Set Usage	BYTE	Provide information as to which of the four buffers are configured for Run-up data storage	Bits 0…3 for the four normal mode buffers.
4	Get	V	Coast-Down Data-Set Usage	BYTE	Provide information as to which of the four buffers are configured for coast down data storage	Bits 0…3 for the four normal mode buffers.
5	Get	V	Transient Buffer Status	DWORD	Coded reference to the current status of each of the four buffers such as: Free, Populating, Data Ready, Processing, and Latched conditions.	4 x4 bits for the Normal Transient buffers.
High-level Transient Operation				Group of 2 configuration attributes.		
16	Get	V	Transient Data Mode Control	WORD	Configuration of transient data-collection Mode (Normal or fast transient, buffer allocations, and so on).	Range: 0…1825
18	Get	V	Transient - Dynamic Data Source Selection	SINT	Future functionality. Default is whatever the Normal CM Data defines.	Fixed value: 0
Transient Data Acquisition				Group of 9 configuration attributes.		
23	Get	V	Source of Speed Data	SINT	Source of speed data for transient data acquisition.	Range: 1…4

Table 125 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
24	Get	V	Low Speed Threshold	DINT	Defines the speed threshold that initiates a startup transient and identifies where a coast-down transient stops.	RPM Range: 1…28000
25	Get	V	High-Speed Threshold	DINT	Defines the speed threshold that initiates a coast down transient and identifies where a start-up transient stops.	RPM Range: 50…29000
26	Get	V	Overall Delta RPM (SU)	INT	Speed interval at which the overall transient data records are stored. Separate delta RPM for run up and coast down events.	1…1000 RPM in 1 RPM steps 0: no delta RPM storage
27	Get	V	Overall Delta RPM (CD)	INT	Speed interval at which the overall transient data records are stored. Separate delta RPM for run up and coast down events.	1…1000 RPM in 1 RPM steps 0: no delta RPM storage
28	Get	V	Overall Delta Time (SU)	INT	Delta time interval that triggers overall value data storage when RPM change re mains within delta RPM value.	s Range: 1…3600
29	Get	V	Overall Delta Time (CD)	INT	Delta time interval that triggers overall value data storage when RPM change re mains within delta RPM value.	s Range: 1…3600
30	Get	V	Disable Dynamic Data Storage	BYTE	Ability to disable dynamic data storage (if it is not of interest).	Bit 0 for SU Bit 1 for CD, disable. Range: 0…3
31	Get	V	Extra Startup Sample Time	INT	Extends the time duration of a start-up event.	s Range: 0…32767
Transient Static Data Source				Group of 4 DWORDs where each bit indicates whether that measurement is included or not.		
64	Get	V	DWORD 0	DWORD		Range: 0…4294967295
65	Get	V	DWORD 1	DWORD		Range: 0…4294967295
66	Get	V	DWORD 2	DWORD		Range: 0…4294967295
67	Get	V	DWORD 3	DWORD	DWORD 3 is only partially populated with measurements, hence the lower range.	Range: 0…1023

Attribute Semantics

Transient Buffer Status

The status for the normal mode buffers occupy the first (lowest) 16 bits. The highest 16 bits are reserved.

Bits 0…3 are for Buffer 0, through to bits 12…15 for Buffer 3.

Within each section, the following values/meaning have been allocated:

- **0x00** Buffer Free (available, ready for a transient event)
- **0x01** Data Ready Normal (transient completed normally, buffer latched)
- **0x02** Data Latched Normal (transient completed normally, but could be overwritten by a new event)
- **0x03** Transient in progress RPM (delta time acquisition in progress)
- **0x04** Transient in progress Time (delta time acquisition in progress)
- **0x05** Data Ready Aborted (speed crossed back over the same threshold, but could be overwritten by a new event)
- **0x06** Data Latched Aborted (speed crossed back over the same threshold, buffer latched)
- **0x07** Data Ready timeout (speed crossed one RPM threshold then timed out, but could be overwritten by a new event)
- **0x08** Data Latched timeout (speed crossed one RPM threshold then timeout, buffer latched)
- **0x0F** Buffer not allocated/enabled

Example 0x****2222 indicates all four transient buffers that are latched with data from transient events that completed normally.

In the case where the speed crossed back over the same threshold (an incomplete transient event), a buffer that is configured as latching is still left unlatched. This condition makes it available for a new event if the amount of data that is stored is less than a fixed percentage of the buffer capacity. This function helps to make sure that an aborted transient event with little data available is automatically 'released' for potential capture of later events.

The percentage is not configurable, but is set at 20%. A completed transient event (one that crosses both speed thresholds) always latches if so configured.

Timeout refers to the situation where one speed threshold is crossed and the buffer is filled to maximum capacity before any further speed threshold crossing occurs.

Transient Data Mode

Bits	Description
0	Disable (0) or enable (1) transient mode
1	Startup: Bit set for Fast Transient Data Collection Mode. Default is Normal Transient Data Collection Mode (Sets of overall and Dynamic data)
2	Coast down: Bit set for Fast Transient Data Collection Mode. Default is Normal Transient Data Collection Mode (Sets of overall and Dynamic data)
3…5	Number of buffers that are allocated to start up in Normal Mode (referred to by RU or SU). Values 0…4, default 2.
6…8	Number of buffers that are allocated to coast down in Normal Mode (CD). Values 0…4, default 2.
9	Buffer latch control
10	Use additional available buffers for the same (extended) transient event
11…15	Reserved for future functionality (fast transient capture using long time records)

Not all bit combinations are valid; total number of buffers that are allocated must be no more than 4.

Startup buffers are allocated first, to the lower buffers.

Source of Speed Data for Transient Data Acquisition

Any one of the following can be identified as the speed reference used in transient data acquisition.

Value	Description
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

Table 126 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

The data types consisting of multiple bytes are transferred in little-endian format (least significant byte first).

Also note that a data communication session starts at the first service request and ends after the final response of the exchange. However, it is subject of an (inactivity) timeout of 30 seconds.

Table 127 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Reset transient buffer 0	Buffer-specific controls
0x4C	x	x	Reset transient buffer 1	
0x4D	x	x	Reset transient buffer 2	
0x4E	x	x	Reset transient buffer 3	
0x4F	-	x	Transient Buffer Upload	See "0x4F Transient Record Request"

0x4F Transient Record Request

Transient data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value that is returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following Transient Record Request Parameters as part of an 0x4F service request. This process is identical to the Data Manager Object (0x38B), Service 0x4C CM Buffer Upload. Both services call the same service handling code. That code is why the buffer select codes do not overlap with the codes for the Data Manager Object.

Table 128 - 0x4F Transient Record Request

Byte Offset Within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: • eOVERALL_TD0 (10), eFFT_TD0 (11), • eTWF_TD0 (12), eTACHOL_TD0 (13), • eOVERALL_TD1 (14), eFFT_TD1 (15), • eTWF_TD1 (16), eTACHOL_TD1 (17), • eOVERALL_TD2 (18), eFFT_TD2 (19), • eTWF_TD2 (20), eTACHOL_TD2 (21), • eOVERALL_TD3 (22), eFFT_TD3 (23), • eTWF_TD3 (24), eTACHOL_TD3 (25) The BufferSelect does not change during a session.
2	RequestedCount	UINT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records is returned instead. The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 Bits indicating the source channel. The ChannelSelect does not change during a session. This field is ignored for all overall buffer types (eOVERALL_TD0, eOVERALL_TD1, eOVERALL_TD2, eOVERALL_TD3)

Table 128 - 0x4F Transient Record Request

6	SpecialRequest	BYTE	Table 129 on page 402
7	Pad	BYTE	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the response must be passed here.

Table 129 - SpecialRequest Description 0x4F Transient Record Request

Bit		Description
0, 1, and 2	Reserved	
3	SR_FILTER_LO	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 37.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines, based on applied filtering.(2)
4	SR_FILTER_HI	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 62.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines, based on applied filtering(2).
5	SR_EXTENDED	Set bit to specify that if samples are not decimated or synchronously resampled that 112.5% of the unfiltered FFT lines are returned. When not set, 100% of FFT lines are returned for samples that are not decimated nor synchronously sampled.
IMPORTANT		Recommended use is to set bits 3, 4 and 5. This setting makes sure that in all cases the maximum number of lines are returned that are, in all cases, free of any filter attenuation or potential aliasing effects.

(1) The FMAX and FFT Lines presented in the AOP assume that bits 3, 4 and 5 are set. If other selections are made, then the FMAX or the number of FFT lines of a downloaded FFT does not always reflect that presented in the AOP.

(2) When automatically deciding the factor to apply to decimated or synchronously resampled data the firmware applies the SR_FILTER_LO (37.5%) factor when the -24 dB/octave filter is applied, and the SR_FILTER_HI (62.5%) factor with the -48 dB/octave or the -60 dB/octave filters are applied.
Data that is decimated on the Alternate Path always applies the -48 dB/octave filter. The applied filter on the primary path is the -24 dB/octave filter except when either of the Aeroderivative Measurement Types are selected, in which case it applies the -60 dB/octave filter.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444, as part of an 0x4F service response, return the following.

Table 130 - 0x4F Service Responses

Byte Offset Within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to 3 instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	Incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UDINT	For a given session, the RecordSize returned here is fixed.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) • eLiveMeasurementInProgress (13) For all successful requests, eSUCCESS (0) is returned. Any other value ends the session.
16	Data Array	DWORD [50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

Table 131 - Discrete Data

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	DWORD	
12	Reserved	DWORD	
16	Params0	DWORD	Set bits indicate which parameters are included in the data array. The values in DataArray are in the order of the set bits. Values are the same as configuration tag TransientCapture.DiscreteParams1…4.
20	Params1	DWORD	
24	Params2	DWORD	
28	Params3	DWORD	
32	ByteCount	UDINT	The size of the following array in bytes.
36	DataArray	REAL	The array of data.

Table 132 - FFT (eFFT_TDx)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and no of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	Not used for transient data. Only Magnitude data is available. Bit 3 is set if FFT Data Filter has been applied.
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value that is provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

See Reading FFT Data on page 333 for details on how to calculate the FFT from the read data.

Table 133 - Waveform (eTWF_TDx)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data. See Reading Continuous Time Waveforms on page 329 for information on using this parameter.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

See Reading TWF Data on page 332 for details on how to calculate the TWF from the read data.

Table 134 - Tacho (eTACHO_TDx)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

Dynamix Event Log Object

The event log object (class code 0x38D) refers to a module-based event log, where a history of key events can be held in NV memory - both alarm and system events are retained. At least the last 6,500 event entries can be retained, but note that an actual event can generate multiple log entries.

The event log referred to by this object is Dynamix module functionality, independent of any Logix functions of the same, or similar name.

Table 135 - Object Instances

Instance ID	Description
0	Event Log Class Instance

Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	NV	Revision	UINT	Current object revision.
8	Get	NV	Last Alarm Time/Date	STRUCT	Time Stamp of last Alarm logged. Can be 16 bytes. See Table 143 on page 413.
9	Get	NV	Last Event Time/Date	STRUCT	Time Stamp of last Event logged. Can be 16 bytes. See Table 143 on page 413.
10	Get	NV	Erase Cycles	UDINT	Number of update erase cycles so far. < 100,000 advised.

Table 136 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	x	-	Get Attributes All	Returns the contents of the specified attribute
0x0E	x	-	Get Attribute Single	Returns the contents of the specified attribute

Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	-	Event log upload	This service allows block upload of the Event data using a predefined format. Partial uploads (such as the last 250 events) is supported.

Data types that consist of multiple bytes are transferred in little-endian format (least significant byte first).

Also, a data communications session starts at the first service request and ends after the final response of the exchange, but is subject to an (inactivity) time-out of 30 seconds.

0x4B Event Log Record Request

Event log entries are retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value that is returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host, as part of an 0x4B service request, sends the following Request Parameters. This process is identical to the Data Manager Object (0x38B), Service 0x4C CM Buffer Upload. Both services call the same service handling code. That code is why the buffer select codes do not overlap with the codes for the data manager object.

Table 137 - Event Log Entries

Byte Offset Within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: eEVENT_LOG (26) The BufferSelect does not change during a session.
2	RequestedCount	UINT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records is returned instead. The RequestedCount does not change during a session.

Table 137 - Event Log Entries (continued)

4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in the response must be passed here.
5	Reserved	BYTE	
6	Pad	INT	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the response must be passed here.

The Dynamix 1444 return the following as part of an 0x4B service response.

Table 138 - 0x4B Service Responses

Byte Offset Within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent Record Request. Up to 3 instances are supported.
1	Reserved	USINT	
2	Completed Records	UINT	Incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UDINT	In this case, it is fixed at the size of one event log record, 16 bytes.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD [50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the responsibility of the calling application to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Generalized Event Type Structure is as follows.

Table 139 - Event Data (eEVENT_LOG)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	Event Type	BYTE	Events fall into one of these types: • SYSTEM (0x01) • ALARM (0x02) • BUFFER (0x03).
1	Event ID	BYTE	For each Event, Type a range (0 up to a maximum 256) of Event IDs are defined. See event-specific definitions.
2	Event Time Seconds	DWORD	Seconds since 1970.
6	Event Time Subsecond	WORD	Microseconds.
8…15	Event Specific Information	BYTE	Last 8 bytes - See event-specific definitions in behavior section

Behavior

Events that are stored in the log fall in to one of these types: SYSTEM (0x01), ALARM (0x02), BUFFER (0x03).

Each has a common header, followed by 8 bytes that are specific to the type. Many events (such as startup) are self-explanatory 'change events' and have no additional data that is provided in the event-specific information bytes.

Change Events

Change events are logged when there is a detected change in the status content and are not triggered directly by the actual state ('good or bad').

Table 140 - System Event Types

ID	Name	Description	Bytes 8…15 Application
01	NetX start-up	The communication processor has reset/restarted	No data bytes are used
02	Transitioned to Program Mode	Configuration activity is underway	No data bytes are used
03	Configuration Count update	A configuration activity has successfully completed	Bytes 10/11 indicate the new count
04	Transitioned to Run mode	Configuration activity is complete	No data bytes are used
05	Switch to Out Of Box Configuration	An instruction to switch the Out of Box mode is being processed (reset type 1/2)	No data bytes are used
06	I/O connection opened	Forward open for an I/O connection received	No data bytes are used
07	I/O connection closed	Forward close for an I/O connection received or connection lost	No data bytes are used

Table 140 - System Event Types (continued)

ID	Name	Description	Bytes 8…15 Application
08	Firmware Update	A Firmware Update was successfully processed	Byte 10 indicates which firmware was updated (instance number)
09...13	Not allocated		
14	Redundant power supply status	A change in the redundant power supply status has been detected	Byte 8 is previous state and 9 the current 1 is fail, 1 is OK
15	Exp Module detection	Identifies change in which expansion modules are detected	Byte 8 is previous state and 10 the current Bit set indicates that the module is missing
16	Exp Module status	A change in expansion module reported status has been logged	Byte 8 is previous state and 9 the current 1 is fail, 0 is OK
17	Internal power supply status	Internal power supply status change	Bytes 8/9 are previous NetX status bits 16...31, bytes 10/22 are the new status data
18	NetX status (other)	Detected network issues	Byte 8 is previous NetX status bits 16...31, bytes 10/11 are the new status data
19	Controller output assembly	Changes in the 16-bit output assembly control data have been detected	Bytes 8/0 are previous controller data, bytes 10/11 are the new controller data
20	Object service	Monitoring of key-object services	Byte 10 is an index indicating the action, byte 11 is used to distinguish between instances
21	DSP (reported) status	Changes in the DSP status DWORD	Bytes 8/11 are previous DSP Status DWORD, Bytes 12/15 are new DSP Status DWORD
22	Main transducer status	Changes in the Channel/Transducer status WORD	Bytes 8/9 are previous TX status bits 0...15, bytes 10/11 are the new TX status bits 0...15
23	Speed/tacho status	Changes in the Speed/tacho status Byte	Byte 8 is previous state and 10 the current
24	Relay states	Relay state change	Bytes 8/9 are previous relay status bits 0...15, bytes 10/11 are the new relay status bits 0...15
25	Exp Module Exception	A change in expansion module exception codes	Bytes 8/9 are previous exception data, bytes 10/11 are the new exception data
26	Calibration status	A change in module (channel) calibration status	Byte 8 is previous state and 10 the current
27	DSP startup response	Whether the DSP startup was judged normal or not	Byte 3 indicates the startup state: 0 - not responding, 1-normal, 2- boot loader mode detected
28	NV Configuration bad	Flash Configuration Load – CRC error detected	Bytes 8/11 are old/stored 32-bit CRC Bytes 12/15 are new/calculated 32-bit CRC
29	Active configuration CRC	CRC of the configuration being loaded during Program mode	Bytes 8/11 are the 32-bit CRC Refer also notes for Event ID 28
30…33	IP addressing mode	Whether dynamic, static or address switch addressing is being used, see notes for details.	No data bytes are used

Table 140 - System Event Types (continued)

ID	Name	Description	Bytes 8…15 Application
34	Network ACD Event	An Address Conflict has been detected (may or may not lead to a fault state)	No data bytes are used
35	Network ACD Fault	A detected address conflict has led to an addressing / network fault (the assigned address could not be 'defended').	No data bytes are used
36	Available memory	This event is triggered every transition to run-mode (after memory allocations have been made).	Bytes 10/11 indicate the free memory available (MB) Example: 180-1 = 0x1B4 = 436 MB remaining
Notes			
Expansion Module Detection			
15	• In the event log entry, byte 8 is the previous state and 10 the current • The same bit allocations are used as in Module Control Object, Class Attributes 2 & 16,for example. bit 4 is the TSCX module • Here, a bit set indicates that this module is expected but missing		
Expansion Module Status			
16	• In the event log entry, bytes 8 & 12 both indicate the particular module reporting the change. • The same bit allocations are used as in Module Control Object, Class Attributes 2 & 16, e.g. bit 4 is the TSCX module. • Bytes 9 & 13 of the event log entry are unused. • Bytes 10/11 represent the previous status, bytes 14/15 the new auxiliary module status. • Source data for the auxiliary module status is the relevant 2-byte status for that module (Assembly Object Status DWORDs 5 to 7).		
Internal Power Supply Status			
17	• Source data is the NetX Status DWORD (Assembly Object Status DWORD 0), upper 2 bytes. • Bytes 8/9 are previous NetX status bits 16-31, bytes 10/11 are the new status data. • The expected (OK state) returned values for these two bytes are 255 - 195.		
AUX Processor Status (Other) Includes			
18	• Source data is the NetX Status DWORD (Assembly Object Status DWORD 0), lowest byte. • In the event log entry, byte 8 is the previous NetX status lowest byte, byte 9 is the new status data. Examples of network issues: bit 1 (value 2) set in the case of a network fault (example: disconnected cable) bit 2 (value 4) set in the case of a network address conflict being detected		
Controller Output Assembly Change			
19	• Source data is the controller bit-level control data (Assembly Object Output Member List), bits 0 to 15. • In the event log entry, bytes 8/9 are the previous controller data, bytes 10/11 are the new controller data. • Used to detect controller initiated changes associated with gating, control, reset & trigger functions.		
Object Service			
20	In the event log entry, byte 10 is an index indicating the action 1. Alarm Buffer Trigger (Data Manager Object) 2. Alarm Buffer Reset (Data Manager Object) 3. Reset Transient Data Buffer 4. Zero DC measurement 5. Zero Dual Channel measurement In the case of 3, 4 & 5 where there are multiple measurements or buffers, byte 11 indicates the instance number.		

Table 140 - System Event Types (continued)

ID	Name	Description	Bytes 8…15 Application
DSP (Reported) Status Includes			
21	• Source data is the DSP Status DWORD (Assembly Object Status DWORD 3). • In the event log entry, bytes 8/11 are the previous DSP Status DWORD, bytes 12/15 are the new DSP Status DWORD. • The full DWORD is always stored (before/after). Examples of events in this category: Bit 7 set when the DSP is running from a configuration from its own Flash memory. Bit 10 set when the DSP has received a different configuration from the NetX, anytime since last power cycle.		
Main Transducer Status			
22	• Source data is the first two bytes of the Channel/TX/Speed DWORD (Assembly Object Status DWORD 4). • In the event log entry, bytes 8/9 are previous status bits 0-15, bytes 10/11 are the new status bits, 0-15. • Changes in enable settings, TX OK and Wire OFF Status (where applicable) are captured here.		
Speed/Tacho Status			
23	• Source data is the third byte of the Channel/TX/Speed DWORD (Assembly Object Status DWORD 4). • In the event log entry, byte 8 is the previous state and 10 the current. • Changes in enable settings, Tacho OK and the occurrence of new maximum speeds are captured here. • When operating in redundant tacho mode, this event is also triggered if a tacho failure activates a switch in tacho sources.		
Relay Status			
24	• Source data is the Relay Status DWORD (Assembly Object Status DWORD 21). • Bits 0 to 12 represent the maximum possible system relay count of 13, a bit set to 1 indicates relay energized. • In the event log entry, bytes 8/9 are the previous Relay status bits 0-15, bytes 10/11 are the new Relay status bits 0-15.		
Expansion Module Exceptions			
25	• Source data for this is the upper 2-bytes of the AuxR2/Comms Status DWORD (Assembly Object Status DWORD 6). • 15 of the 16 bits are actively used, 3 per auxiliary module, see Assembly Object. • In the event log entry, bytes 8/9 are the previous exception data, bytes 10/11 are the new exception data. • If an auxiliary module is reporting a specific type of communications error, it is reported here. • The specific error being reported is encoded using the 3-bits.		
Calibration Status			
26	• Source data is the high byte of the Channel/TX/Speed DWORD (Assembly Object Status DWORD 4). • Four bits are used there (0 to 3), a bit set indicates that channel has a calibration failure. • In the event log entry, byte 8 is the previous state and 10 the current.		
NV Configuration Bad			
28	• Configuration data is stored in NetX Flash (NV) together with a 32-bit CRC. • On recall of configuration data from Flash, the CRC is recalculated and compared. • A mismatch of the two CRC prompts a recoverable critical error condition and this event is generated. • The DSP is not reconfigured by the NetX, but continues to use the configuration data stored in its own Flash. • The DSP status reflects this (bit 7 & summary fault bit set) but this is not immediately seen in the event log (no change/start-up).		
IP Addressing			
30…33	• 30 - Network Address Configuration: Dynamic (e.g. DHCP). • 31 - Network Address Configuration: Static. • 32 - Network Address Configuration: Read from the HW Switches (returned a valid address or 888). • 33 - Network Address Configuration: HW Error (the base, address switches were not read correctly at power cycle / reset). • Report configuration status at module startup (power cycle / reset). • Report configuration changes (Dynamic to Static and/or vice versa).		

Table 141 - Alarm Event Types

ID	Name	Bytes 8...15 Application
01	Measurement Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
02	(OK) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
03	(Alert) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
04	(Danger) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
05	Special Relay Source Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
Notes		
	While the returned data is the same, the trigger is different in each case. A change in the upper 16 bits (considered 'pre-alarm' data) triggers a measurement alarm status event. A change in the overall alarm state (true or false) triggers a voted alarm status change. The voted alarm status changes are categorized as OK, Alert, or Danger, which is based on which alarm output they relate to (encoded as bits 14/15). The special relay source alarm status is used where a dedicated module fail or 'inhibit active' relay has been configured and reflects a change in status of this monitoring.	

Table 142 - Buffer Event Types

ID	Name	Bytes 8...15 Application
01	Trend Data-Set Status	Bytes 8/9 are previous Trend Buffer status, bytes 10/11 are the new Trend Buffer status
02	Alarm Data-Set Status	Bytes 8/9 are previous Alarm Buffer status, bytes 10/11 are the new Alarm Buffer status
03	Transient Data-Set Status	Bytes 8/9 are previous Transient Buffer status, bytes 10/11 are the new Transient Buffer status
Notes		
	Buffer events indicate a change in status of these buffers (example: armed to populating or population to data ready)	

Worked Example of Event Decoding

Each event log entry is a 16 byte record consisting of a number of sub structures: Example hex data on the wire: 01 15 71F53854 9600 00 00 00 00 00 40 00 00

Table 143 - Event Log Entries

Subsection	Location	Example
Event Type	Byte 0	01
Event ID	Byte 1	15
Event time (seconds)	Bytes 2...5	5438F571
Event time (subseconds)	Bytes 6...7	0096
Event Data	Bytes 8...15	00 00 00 00 00 40 00 00

Decoding Example:

- Event type 0x01: System event
- Event ID 0x15: DSP (reported) status, decimal 21.
- Event time 0x5438F571: 11 October 2014 10:16:33 (local time)
- Event time 0x0096: 15 ms (150 x 0.1 ms), so 10:16:33:015
- Event Data: up to 4 bytes of pre-event data, 4 bytes of post-event data
- For a DSP (reported) status event all 8 bytes are used.
- Pre-event status is: 0x00000000
- Post-event status is: 0x00004000

Analysis: bit 14 of the DSP status has changed from 0 to 1 (meaning a link or auxiliary module error has been detected).

Dynamix Transducer Object

The transducer object (class code 0x38E)defines the properties of the sensor that is connected to one of the four available physical inputs.

Attributes describe physical measurement parameters and transducer OK monitoring setup, as also some sensor-mounting geometry settings.

This object reports transducer DC Volts (bias) measurement and transducer status.

Table 144 - Object Instances

Instance ID	Description
0	Transducer Class Instance

Table 145 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	TX Overall Status	BYTE	Coded information to represent transducer Enabled and OK status	Bits 0…3 represent transducer enabled status (1 = enabled). Bits 4…7 represent transducer OK status (1 = OK).

Table 146 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	DC Bias	REAL	The DC level at the input in fixed units of DC Volts.	Data
2	Get	V	TX Detailed Status	BYTE	Detailed bit-coded Transducer Status (Data).	See TX OK Configuration Decoding
Transducer Descriptions				Group of four attributes that are used for reference purposes only.		
16	Get	V	Transducer Name	SINT[32]	Descriptive name.	32 characters
17	Get	V	Transducer Orientation	INT	Definition of sensor orientation angle in degrees. Orientation angle is usually a radial angular orientation.	0…359 degree input range in increments of 1 °
18	Get	V	Transducer Location	SINT	Transducer location definition.	0: Unknown 1: Radial 2: Axial
19	Get	V	Transducer Output Sense	SINT	Sensor output sense - information only. The DC measurement object has normal/counter control.	Fixed at zero
Transducer Output Definition				Group of five configuration attributes.		
24	Get	V	Transducer AC Units	ENGUNITS	Transducer measurement units that are used for AC measurement base.	Supported engineering units
25	Get	V	Transducer AC Sensitivity	REAL	TX AC Sensitivity in mV/TX AC units.	Range: 1…20000
26	Get	V	Transducer DC Units	ENGUNITS	Transducer measurement units that are used for DC measurement base.	Supported engineering units

Table 146 - Instance Attributes (continued)

27	Get	V	Transducer DC sensitivity	REAL	Transducer DC sensitivity in mV/ TX DC units.	Range: 1…20000
28	Get	V	TX Power Setup	SINT	Coded configuration for sensor power supply configuration. Definition is independent of the selected transducer/application type.	Transducer OK Configuration
TX OK Detection				Group of three configuration attributes.		
32	Get	V	Transducer OK Configuration	BYTE	Definition of which conditions are included in a TX OK assessment	Transducer OK Configuration
33	Get	V	Transducer OK High Threshold	REAL	High-voltage threshold for the TX OK monitoring window	V Range: 22…-21
34	Get	V	Transducer OK Low Threshold	REAL	Low voltage threshold for the TX OK monitoring window	V Range: 22…-21

Attribute Semantics

TX OK Configuration Decoding

Bit	Description (When bit Is Set = 1)
0	Channel enabled
1	Transducer enabled
2	Transducer fault
3	Wire off indicated

For Module Personality “Real Time - 2 Dynamic (4 kHz) - Dual Path”:

Dual path uses both channel pairs to process one pair of transducer signals without requiring external linking of the signal inputs. The sensors are connected normally to channels 0 and 1 but are processed by both channel pairs (channel 0 to channel 2, and channel 1 to channel 3). Consequently only channels 0 and 1 are used for transducer status.

'Wire off' refers to additional failure sensing applied to Eddy Current Probe systems that are powered by the module. Wire off is only incorporated into Transducer Fail when specific configuration criteria are met. If those criteria are not met and/or the capability has been disabled by setting attribute 32 to a nonzero value, then bit 3 is forced OK (zero value). If the wire off detection capability is being actively used, then if a transducer fail is indicated, the value of bit 3 confirms if a wire off has been detected. There is the possibility of multiple checks (simultaneously) triggering an indication of transducer failure.

TX Power Setup

Following transducer power-supply options apply per transducer output.

Value	Description
0	OFF
1	CC (+24V / 4 mA constant current output)
2	+CV (+24V / 25 mA voltage regulated output)
3	-CV (-24V / 25 mA voltage regulated output)

Following transducer power-supply options apply per transducer input.

To aid transducer failure detection the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias that is applied is automatically selected based on the power supply that is configured for that channel.

Value	Description
0	OFF - Bias Off (typically around 1.7 V DC at the input)
1	CC - Bias Negative (typically around -3.9 V DC at the input)
2	+CC - Bias Negative (typically around -3.9 V DC at the input)
3	-CV - Bias Positive (typically around 13 V DC at the input)

Within a channel pair, there are slight differences in the bias voltages (noticeable on the positive bias, where it is of the order of 1.3 V). This behavior is by design and has no effect on functionality.

Transducer OK Configuration

0	automatic (all relevant checks included)
1	wire-off monitoring that is excluded (any value in range 1 to 7 is treated the same)

The Transducer OK status is based on the following checks.

For the Transducer Status to be "OK" the following must be true:

- The transducer DC/bias voltage must be within the configured OK window limits (attributes 33/34)
- The channel must have passed an internal calibration check, at last startup

Where the sensor is a negatively powered Eddy Current Probe, the module performs two additional checks:

- The transducer power supply that is provided by the module is delivering at least 2 mA
- The transducer DC/bias voltage remains negative

These two checks are based on hardware monitoring, which is designed to detect any discrepancy quickly, and are referred to as 'wire-off' detection. Once a wire-off condition has been detected, this failure is latched for 30 seconds. Any recurrence that causes this timer to be restarted, such that recovery from a wire-off condition, is 30 seconds after the last detected event. This measure aims to make sure that signals have stabilized.

Table 147 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Channel Setup Object

The Channel Setup Object (class code 0x38F) defines the basic sample rate, decimation, and filter cutoff frequencies and alternate path processing for each of the channels.

Table 148 - Object Instances

Instance ID	Description
0	Channel Setup Class Instance
1…4	Instances 1…4 define the setup for channels 0…3

Table 149 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	WORD	Bit-coding of enabled instances.	Decoding information.

Table 150 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Enabled Status	BOOL	Definition of enabled status of channel setup.	0: Disabled 1: Enabled (Active)
2	Get	V	Synchronous max RPM	REAL	Highest machine speed that the synchronous configuration supports.	RPM
3	Get	V	Synchronous Min RPM	REAL	Lowest machine speed that the synchronous configuration supports.	RPM
Configuration Group				Group of nine configuration attributes.		
16	Get	V	LP Filter -3 dB Point	REAL	Low Pass Filter -3 dB corner frequency definition.	Hz Range 10…45777
17	Get	V	HP Filter -3 dB Point	REAL	High Pass Filter -3 dB corner frequency definition (this attribute is also the gSE HP Filter -3 dB).	Hz Range 0.1…39000
18	Get	V	Decimation	INT	Provides a control for specifying decimation in the main asynchronous processing stream.	Sampling Control
19	Get	V	SRD	SINT	SRD (Sample Rate Divider).	Sampling Control Range: 2…41
20	Get	V	Alternate Path Control	SINT	Alternate path control.	0: Asynchronous 1: Synchronous 2: Not Used 3: Asynchronous with independent -48 dB/octave LP filtering
21	Get	V	Synchronous Tacho Source	SINT	Only applicable when alternate path is set to option 1 or 2.	1: Tacho 0 2: Tacho 1
22	Get	V	Synchronous Samples Per Revolution	INT	Only applicable when alternate path is set to option 1 or 2.	4, 8, 16, 32, 64, 128
23	Get	V	Decimation	INT	Only applicable when alternate path is set to option 3.	Range 1…255 Constraints due to attribute 24 are as described in Sampling Control
24	Get	V	Alternate LP Filter -3 dB Point	REAL	Only applicable when alternate path is set.	Hz Range 10…5087

Attribute Semantics

Enabled Instances

The following bit-coding scheme is used to identify which channel setup instances are enabled.

Bit	Description
0…3	Measurement channels 0…3 0: disabled 1: enabled
4…7	Reserved for full multiplexing
8…12	Reserved for full multiplexing
13…15	Reserved - set to 0

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Sampling Control

The following are different aspects of Sampling Control.

Table 151 - Sampling Control

Category	Description
Fundamentals	SRD represents sample rate divide and must be set equal across a channel pair (0/1 and 2/3) unless multiplexing individual channels. Actual sample rate is the base sample rate that is divided by the SRD With the A/D in single mode (most applications), the base sample rate is 93,750 Hz. With the A/D in double mode (frequencies up to 40 kHz), the base sample rate is 187,500 Hz.
Limits (Asynchronous and Synchronous Processing)	Based on Nyquist, the setting of SRD/sample rate determines the maximum frequency that can be assessed. For synchronous sampling, the maximum frequency and the configured number of samples per revolution dictates the maximum machine speed that can be successfully processed. The module confirms a maximum machine rpm for a given configuration by way of instance attribute 2. Further guidelines are as follows: • Filter -3 dB points must always be set at less than [Sample rate] / 2.048 • Bandwidth of an FFT in the same configuration, is less and calculated by [Sample rate] / 2.56 • The center frequency of the highest line of an N line FFT is given by [Sample rate] * [N-1] / [2.56 * N] Example for SRD 32 (single mode) • Filter -3 dB must be less than 1431 Hz • FFT bandwidth (decimation = 1) is 1144.41 Hz • Corresponding center frequency of highest line of an 800 line FFT is 1142.98 Hz, 1600 line FFT is 1143.69 Hz. Note: The preceding information applies to all FFT of whatever line resolution and whether used for Condition Monitoring or FFT Band Data. The calculation of sample rate must include any decimation that is applied to the samples before the (FFT or filter) processing, see also, in the following information, decimation.

Table 151 - Sampling Control (continued)

Category	Description
Disabling a LP filter	You can disable the LP filter to use more of the available bandwidth for the overall (0) measurement. Minimizing (unnecessary) filtering is also beneficial for reducing module processing load and generally retaining the fidelity of the signal. While within a particular channel application type you cannot explicitly choose to disable an LP filter, it can be achieved by choosing to set the filter cutoff frequency at the maximum allowed: SRD / 2.048 (note that for calculation purposes, '40 kHz mode' has an SRD of '1'. On receiving the configuration, if the configuration setting is above or within 5 Hz of, the calculated maximum then the module automatically disables that LP filter. Main path and alternate path (asynchronous) filters are considered separately as appropriate to the configuration.
Decimation of asynchronous samples	A decimation of n further reduces sample rate by retaining only the nth sample. Decimation is commonly used for the following purposes to: • Provide the user with an FFT whose Fmax is lower than what is implied or attainable by the SRD • Permit internal sample transfer for CM data purposes (such transfers cannot support the 40 kHz bandwidth) • Reduce the sample rate into an HP filter, where the difference between the filter -3 dB and the sample rate is a large ratio. The latter is not considered likely to be necessary unless the ratio of sample rate to HP filter cutoff frequency significantly exceeds 3000. On a 4 kHz measurement bandwidth (SRD 9) that equates to an HP filter cutoff, lower than 3 Hz. In all cases decimation requires prior LP filtering of the samples, to avoid aliasing. Dependent on the application/path, filtering can be by -24 or -48 dB/octave filters. To avoid the possibility of aliasing, it is recommended that these maximum filter cutoff settings are imposed: • -24 dB (LP followed by an HP): 0.25 x the decimated sample rate • -48 dB (LP alternate path only): 0.36 x the decimated sample rate • -60 dB (Aeroderivativemode only):0.385 x the decimated sample rate Synchronous resampling also requires anti-alias protection and this protection is provided by a -48 dB LP filter. The difference between this and asynchronous decimation by a -48 dB LP filter is that in the synchronous case the filter -3 dB point is continually and automatically adjusted according to the machine speed.
FFT Data Filter (SR_FILTER)	When FFT data is requested that relies on a signal that has been decimated or resampled synchronously, as described previously, one of the internal LP filters must be used to provide anti- aliasing protection for the resampled stream. Due to the relatively slow roll-off of these filters, they have to be positioned well within the expected FFT FMAX. This positioning means that a proportion of the FFT lines reflect frequencies at which the signal amplitudes are significantly attenuated. If the FFT Data Filter capability is enabled (appropriate bit set in the FFT request), then if the data to be returned is affected by this then only 50% of the Normal lines are returned. This return allows for the worst case of the -24 dB/octave filter. With this control, you have the choice at the point of request whether to receive the full or the reduced (filtered) Data-Set. • If the bit is set and the data is not decimated or synchronously resampled, then 100% of the available FFT lines are returned. • A bit in ucDataSelect of the FFT header indicates if the data has been filtered. • The actual filter setting is not checked, simply whether this filter is decimated or synchronously resampled data • Where data filtering results in different number of lines being returned, the data requests are appropriately grouped, for like data lengths • This data filter can be requested on any CM data object that supports the return of FFT spectral data
Higher Frequency modes	In the 'normal' (20 kHz max) case: SRD settings are in the range 2 to 32 and are set appropriately for the channel application. The default decimation is 1. In the gSE/40 kHz case: The SRD is fixed at 2 and internally the A/D set is set at double mode (that combination is equivalent to an SRD of 1).

Table 151 - Sampling Control (continued)

Category	Description
gSE Mode	In gSE mode: • Use the HP filter setting as required (typically 100, 200, 500, 1000, 2000, or 5000 Hz but not restricted to these values) • Use the LP filter setting to indicate the required FFT FMAX (typically 25, 100, 200, 300, or 1000 Hz but again not limited to these values) Based on the preceding information, the module automatically implements suitable decimation - the configured decimation is ignored. The settings for gSE results in the filters being unusually set (HP > LP) - this setting is normal for gSE measurements.
Aeroderivative mode	When an Aeroderivativemode has been selected, the roll off the LP and HP filters are automatically increased from the standard -24 dB to the -60 dB required for that application.

Table 152 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix AC Measurement Object

The AC Measurement Object (class code 0x390) defines configuration of an AC overall measurement by selecting source, smoothing constants, and definition of measurement units. Two instances are linked to each available transducer channel.

Table 153 - Object Instances

Instance ID	Description
0	AC Measurement Class Instance
1…8	AC measurement setup and data for channels 0…3 • Instances 1…2 for transducer channel 0, AC measurements A, and B • Instances 3…4 for transducer channel 1, AC measurements A, and B • Instances 5…6 for transducer channel 2, AC measurements A, and B • Instances 7…8 for transducer channel 3, AC measurements A, and B

The second instance in each case relates to a secondary overall measurement (B) with another source, measurement units, and potentially different detection method to the primary overall. Example, primary: mm/s RMS, secondary: g peak. Currently, other instance attributes are common to the pair of instances/measurements. However, work to support the setting of independent time constants for overall (0) and overall (1) ('A and B') is ongoing.

- The gSE application supports only one overall measurement per channel, Overall (0).
- The Dynamic pressure application is FFT band focused/optimized so does not support either of the overall measurements.

Table 154 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	STRUCT	Bit-wise coding of enabled AC measurement instances.	Decoding information.
				BYTE	Active instances for channels 0…3.	
				BYTE	Reserved for full multiplexing.	
				BYTE	Reserved for full multiplexing.	

Table 155 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
8	Get	V	Magnitude Value	REAL	A magnitude value from a choice of detection methods (effectively attributes 1…7), made by configuration.	
AC Overall Measurement				Group of 8 configuration attributes.		
16	Get	V	AC Overall Measurement Source	SINT	Source selection.	Coding information
17	Get	V	AC Overall Measurement Units	ENGUNITS	AC measurement units.	Options and selection criteria
18	Get	V	AC Overall Measurement RMS TC	REAL	Time constant definition for RMS measurement (demanded).	Range: 0.1…60 s, default of 1
19	Get	V	AC Overall Measurement Peak TC	REAL	Time constant definition for Peak measurement (demanded).	Range: 0.1…60 s, default of 1
20	Get	V	AC Overall Magnitude - Detection Method	SINT	Detection method for the overall magnitude value.	Options
			Measurement Time Constants		Group of 2 configuration attributes.	
24	Get	V	Actual RMS TC	REAL	Actual implemented RMS TC value that is based on channel-data acquisition setup.	Seconds
25	Get	V	Actual Peak TC	REAL	Actual implemented Peak TC value that is based on channel-data acquisition setup.	Seconds
Peak per Revolution Assessment				Group of 2 configuration attributes.		
32	Get	V	Configure Peak per Rev	SINT	Option to enable Peak level assessment on a once per revolution basis, including tacho source selection.	Peak per Rev details
33	Get	V	Minimum RPM for Peak per Rev	REAL	Peak per revolution only active above this value.	Peak per Rev details

Attribute Semantics

Enabled Instances

The following bit-coding scheme is used to identify active static AC measurement instances. Three bytes are used to describe active instances for each subchannel.

Byte	Bit	Description
1	0…7	AC measurement instances 1…8 0. disabled 1: enabled
2	0…7	Reserved for full multiplexing
3	0…7	Reserved for full multiplexing

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Source Selection

For the overall AC measurement A, the source is fixed (the level assessment is made after the user configured low and high pass filters). For the overall AC measurement B, the source is variable.

Index	Source
1	**Pre-Filter** - before the user configured low pass filter
2	**Mid-Filter** - after the user configured low pass filter

Source selection for the overall AC measurement B configures the dual path processing capability for that channel, so that:

- in an integrating configuration, both acceleration and velocity overalls are available
- or in a non-integrating configuration to have both band pass filtered and wide band data available.

AC Units

Actual selection of AC engineering units are a subset of the master-engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

AC Magnitude Detection Method

Value	Description
0	True peak
1	True peak to peak
2	RMS
3	Rectified average
4	Peak
5	Scaled peak
6	Scaled peak to peak

Peak Per Revolution Assessment

For active eccentricity application and assessment on a per revolution basis, these attributes determine enable options and the low RPM limit where once per revolution assessment defaults to normal peak-value assessment.

Option	Description
0x00	Peak per revolution disabled
0x01	Tacho/Speed 0
0x02	Tacho/Speed 01
Higher Values	Reserved

Lower RPM limit range: 4…600 RPM, recommended default of 10 RPM.

Table 156 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix DC Measurement Object

The DC Measurement Object (0x391) defines configuration of DC overall measurement by selecting smoothing constants, and definition of measurement units. One instance is linked to each available transducer channel and is fully separate from the DC Volts overall value

Table 157 - Object Instances

Instance ID	Description
0	DC Measurement Class Instance
1…4	DC measurement setup and data for channels 0…3 • Instances 1 for transducer channel 0, DC measurement • Instances 2 for transducer channel 1, DC measurement • Instances 3 for transducer channel 2, DC measurement • Instances 4 for transducer channel 3, DC measurement

Table 158 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	STRUCT	Bit-wise coding of enabled DC measurement instances.	Decoding information.
				BYTE	Active instances for channels 0…3.	
				BYTE	Reserved for full multiplexing.	
				BYTE	Reserved for full multiplexing.	

Table 159 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	DC Value	REAL	Processed DC measurement output.	
2	Get	V	Rod Drop Value	REAL	Processed rod-drop value output.	0 when rod drop application is not active for this channel
3	Get	V	DC Bias	REAL	Measured in DC Volts. The same as attribute 1 of the Transducer Object	
DC Measurement				Group of 5 configuration attributes		
16	Get	V	DC Measurement Units	ENGUNITS	The DC measurement units.	Options and selection criteria
17	Get	V	DC Measurement TC	REAL	Time constant definition for DC measurement (demanded).	Range: 0.1…60 s, default of 1
18	Get	V	DC Measurement Offset	REAL	Measurement offset in selected measurement units.	Is added to the measurement. Range: -50000…50000
19	Get	V	DC Measurement Sense Control	SINT	Sense control of the DC measurement for axial/thrust applications.	0: Active/Normal 1: Inactive/Counter

Table 159 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
24	Get	V	Actual DC Measurement TC	REAL	Actual implemented DC TC value that is based on channel data-acquisition setup.	Seconds
Rod Drop				Group of 5 configuration attributes.		
32	Get	V	Rod Drop Trigger Source	SINT	Enable rod-drop measurement processing and identify the tacho source.	Rod-drop configuration details
33	Get	V	Rod Drop Trigger Angle	INT	The target angle for the rod drop measurement (the mid-point of the range).	0…359 degrees
34	Get	V	Rod Drop Measurement Range	SINT	The angular range of the rod drop measurement	2…20 degrees Step 2
35	Get	V	Rod Drop Decay Time	REAL	The rod-drop measurement decay time	Range: 0.1…60 s
40	Get	V	Rod Drop Maximum Machine Speed	INT	Calculated account of trigger range and sampling rate	RPM

Attribute Semantics

Enabled Instances

The following bit-coding scheme is used to identify active static DC measurement instances.

Byte	Bit	Description
1	0…3	DC measurement instances 1…8 0: disabled 1: enabled
	4…7	Reserved and set to 0
2	0…3	Not used in protective mode
	4…7	Reserved and set to 0
3	0…3	Reserved and set to 0
	4…7	Reserved and set to 0

Output Enable

Transducer disabled status overrules enabled channel processing setup.

DC Units

Actual selection of DC engineering units is a subset of the master engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Rod Drop Configuration

Rod-drop processing is assessed in parallel to normal DC measurements. Rod drop units of measurement is the same as the configured DC Measurement units.

Instance must be active and rod-drop function must be enabled to obtain access to the rod-drop measurement value.

Trigger Source

Option	Description
0x00	Rod-drop disabled
0x01	Tacho/Speed 0
0x02	Tacho/Speed 01
Higher Values	Reserved

The following section explains the rod-drop functionality in more detail:

- The rod-drop functionality is enabled / disabled by virtue of the selected channel application type. If the rod drop application has been selected, then for the configuration to be legitimate, an appropriate tacho source must be selected. If the rod drop application is not selected, then the setting of the trigger source is irrelevant. For example, in those circumstances, 0x00/Off can be used but does not have to be used.
- The rod-drop measurement is made every revolution. except in the case where the configured measurement range encompasses the trigger point itself. In that situation, the measurement is made every other revolution.
- The rod-drop measurement is only applicable at speeds greater than 10 rpm. Below 10 rpm the measurement defaults to a normal DC measurement (although the configured rod-drop TC not the DC TC still apply). This measurement also provides a means by which rod drop 'mode' is exited if the tacho pulses suddenly stop.

Rod-Drop Maximum Machine Speed

The maximum machine speed is calculated such that there is always at least one sample available to base the measurement on.

The SRD (Channel Setup Object, Attribute 19) determines sample rate, the decimation setting does not play any part.

Maximum RPM = (Sample Rate Hz * Measurement Range Degrees) / 6

Round the result down to an integer RPM.

Target Positive Direction

Allow sense control of the axial/thrust measurement for displacement transducer type based applications. The following options apply:

- Active/Normal (target movement away from probe - ECP system output more negative, is considered a positive DC output).
- Inactive/Counter (target movement towards probe - ECP system output less negative, is considered a positive DC output).

Table 160 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 161 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	x	Zero Channel	Option to take the current measurement value and assign to offset attribute (considering the current setting of this attribute value) such as to zero the measurement channel. • To satisfy security requirements, this service only executes if an alarm inhibit is being imposed via the I/O connection (output) data. • This is an instance level service (the instance that is specified dictates the particular channel 'zero'd').

Dynamix Dual Measurement Object

This Dual Measurement Object (class code 0x392) defines, in combination with the selected application type in measurement channel setup, the additional behavior of the fixed channel pairs.

It provides access to available Dual Channel measurement results and defines channel pair-specific configuration parameters for differential expansion.

Table 162 - Object Instances

Instance ID	Description
0	Dual Measurement Class Instance
1	Instance 1 for transducer pair 0…1
2	Instance 2 for transducer pair 2…3

Table 163 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 164 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	SMAX Peak	REAL	Processed SMAX Peak output.	0 output when not an XY application
2	Get	V	Phase angle of the SMAX Peak Vector	REAL	Phase angle of attribute 1.	0 output when not an XY application
5	Get	V	Axial Differential Expansion	REAL	Processed axial differential expansion output (CDE or Ramp).	0 output when not configured
6	Get	V	Radial Ramp Diff Expansion	REAL	Processed radial differential expansion output (ramp only).	0 output when not configured
8	Get	V	Shaft Abs Vib Peak	REAL	Processed shaft abs vib pk output.	0 output when not configured
9	Get	V	Shaft Abs Vib pk-pk	REAL	Processed shaft abs vib pk-pk output.	0 output when not configured
Differential Expansion				Group of four configuration attributes.		
16	Get	V	Sensor A Ramp Angle	REAL	Ramp angle for sensor input A in degrees.	Setup information
17	Get	V	Sensor B Ramp Angle	REAL	Ramp angle for sensor input B in degrees.	Setup information
18	Get	V	Overall Axial Offset	REAL	An overall (axial) offset in DC measurement units.	Applicable to Ramp and CDE applications Range: -50000…50000
19	Get	V	Overall Radial Offset	REAL	An overall (radial) offset in DC measurement units.	Ramp only Range: -25000…25000

Attribute Semantics

Output Enable

Transducer disabled status overrules the enabled channel processing setup.

Ramp Angle

Ramp angle is held explicitly for information, used to calculate required ramp differential expansion coefficients for internal processing of Ramp Differential Expansion. A 'normal' probe with a plain target has a ramp angle of 0°. Ramp angle applies to both probes A and B.

Typical ramps are around 12° (up to 45° on occasion).

Ramp angles can be positive or negative depending on whether a concave/ convex ramp is used

Allowed configuration range: -45…45.

Overall Axial Offset

The channel pair is not currently configured for a differential expansion application, read attribute requests for attribute 18 returns zero, irrespective of the actual configured value.

Table 165 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 166 - Object Specific Service

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	x	Zero Dual Channel	Option to take the current measurement value and assign to offset attribute (considering the current setting of this attribute value) such as to zero the measurement channel. • To satisfy security requirements, this service executes if an alarm inhibit is being imposed via the I/O connection (output) data. • This code is an instance level service (the instance that is specified dictates the particular channel pair 'zeroed').

Behavior

Smax Measurements

In an XY application, the Smax result (magnitude and phase) is calculated using the individual overall results and not at the sample level. Using the two (orthogonal) processed scalar values in this way corresponds to 'Method A' in the International Standards. Using method A:

- The Smax amplitude can be overestimated, but not under estimated.
- Any calculated phase angle is in the range 0 to 90°.

If the two scalar values are identical, the phase reports 45°.

If the first channel of the pair has the larger amplitude, the phase angle reads < 45°.

If the second channel of the pair has the largest amplitude, the phase angle reads > 45°.

Shaft Absolute Vibration Measurements

When configured in this mode the calculation of absolute shaft vibration is performed at a sample level. This method is necessary because any simpler method that is based on overall values could be misleading as to the actual, absolute vibration amplitudes.

CDE (Complementary Differential Expansion) Measurements

The two channels are configured with opposite sense and with suitable individual offsets such that at the nominal cross-over point their individual measurements are zero (DC Measurement Object instance attributes). While the 'normal' sense probe returns a negative displacement value then it is the lead probe for the CDE measurement, otherwise the 'counter' sense probe is used.

The implementation includes protection against one probe failure (the CDE is not based on a probe in TX Fail if the other probe of the pair is TX OK). The implementation also incorporates a progressive changeover between probes. This changeover is incorporated to avoid a sudden jump in the measurement value around the cross-over point. It is applied automatically over ±15% of the offset of the normal sense probe, about the changeover point. The following graphic illustrates the operation of these features where the yellow highlights indicate the single channel providing the CDE data.

Both probes OK				
CH0 (Normal)		CH1 (counter)		CDE mil
V	DC mil	V	DC mil	
-1.92	-20.42	-9.92	-19.59	-20.42
-2.91	-15.43	-8.92	-14.6	-15.43
-3.91	-10.44	-7.92	-9.62	-10.44
-4.91	-5.45	-6.93	-4.63	-5.41
-5.91	-0.46	-5.93	0.36	-0.08
-6.91	4.53	-4.93	5.35	5.25
-7.9	9.52	-3.93	10.35	10.35
-8.9	14.51	-2.93	15.34	15.34
-9.9	19.49	-1.93	20.33	20.33

Counter Probe failed				
CH0		CH1		CDE mil
V	DC mil	V	DC mil	
-1.91	-20.43	-9.91	-19.56	-20.43
-2.91	-15.44	-8.92	-14.58	-15.44
-3.91	-10.45	-7.92	-9.6	-10.45
-4.91	-5.45	-6.92	-4.62	-5.45
-5.91	-0.46	-5.93	0.37	-0.46
-6.91	4.53	-4.93	5.36	4.53
-7.9	9.52	-3.93	10.34	9.52
-8.9	14.5	-2.93	15.34	14.5
-9.9	19.49	-1.93	20.33	19.49

Normal Probe failed				
CH2		CH3		CDE mil
V	DC mil	V	DC mil	
-1.94	-20.28	-9.93	-19.66	-19.66
-2.94	-15.29	-8.94	-14.68	-14.68
-3.94	-10.3	-7.94	-9.7	-9.7
-4.94	-5.31	-6.94	-4.71	-4.71
-5.94	-0.32	-5.95	0.27	0.27
-6.93	4.67	-4.95	5.26	5.26
-7.93	9.66	-3.95	10.25	10.25
-8.93	14.65	-2.95	15.24	15.24
-9.93	19.65	-1.95	20.23	20.23

In the example with both probes OK, there are three CDE results shown that are based on both probe results.

- The first as the normal sense probe approaches its limit, is still weighted towards the data from that probe.
- The second, close to the cross-over point is nearly equally weighted.
- The third as the counter sense probe is taking over, is now weighted towards the data from that probe.

Final CDE value can be separately adjusted with the overall axial offset, attribute 18.

Dynamix Tracking Filter Object

The Tracking Filter Object (class code 0x393) defines configuration and provides access to Order based measurement data. One instance is linked to each available measurement channel with capability to define up to four tracking filters.

Table 167 - Object Instances

Instance ID	Description
0	Tracking Filter Class Instance
1	Instance 1 for channel 0
2	Instance 2 for channel 1
3	Instance 3 for channel 2
4	Instance 4 for channel 3

Table 168 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 169 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	magnitude 0	REAL	magnitude reading for first defined order.	0 output when not configured or no speed
2	Get	V	Phase 0	REAL	Phase reading (0…359 deg) for first defined order.	0 output when not configured or no speed
3	Get	V	magnitude 1	REAL	magnitude reading for second defined order.	0 output when not configured or no speed
4	Get	V	Phase 1	REAL	Phase reading (0…359 deg) for second defined order.	0 output when not configured or no speed
5	Get	V	magnitude 2	REAL	magnitude reading for third defined order.	0 output when not configured or no speed
6	Get	V	Phase 2	REAL	Phase reading (0…359 deg) for third defined order.	0 output when not configured or no speed
7	Get	V	magnitude 3	REAL	magnitude reading for fourth defined order.	0 output when not configured or no speed
8	Get	V	Phase 3	REAL	Phase reading (0…359 deg) for fourth defined order.	0 output when not configured or no speed
9	Get	V	Not 1X magnitude	REAL	magnitude of AC components other than 1x.	
General Tracking Filter Setup				Group of six configuration attributes.		
16	Get	V	Tracking filter Configuration	BYTE	A bit-wise coded entry that specifies if the filter is enabled and which Tacho source is used (0/1).	Coding information

Table 169 - Instance Attributes (continued)

17	Get	V	Order Measurement Units	ENGUNITS	Definition of measurement engineering units that indirectly also allow for signal integration/ differentiation.	Options and selection criteria
18	Get	V	Order Measurement Scaling	SINT	The scaled measurement detection that is used for the order assessments.	0: Peak 1: pk-pk 2: RMS
19	Get	V	Tracking Filter Mode	SINT	Define order signal processing-mode.	0: Constant Q 1: Fixed frequency
20	Get	V	Tracking Filter Definition (Tacho 0)	REAL	The filter Q factor or Frequency bandwidth that is associated with the selected processing mode.	Currently only fixed Q mode supported, by specifying a number of revolutions. Default: 10 Range: 1…256
21	Get	V	Tracking Filter Definition (Tacho 1)	REAL	The filter Q factor or Frequency bandwidth that is associated with the selected processing mode.	Separate definitions to support different settings in Fixed frequency mode. For fixed Q mode, the AOP sets 20 and 21 equal.
24	Get	V	Order Update Rate (Tacho 0)	REAL	Approximation of the anticipated order measurement update rate that is based on signal processing and order setup.	Seconds
25	Get	V	Order Update Rate (Tacho 1)	REAL	Approximation of the anticipated order measurement update rate that is based on signal processing and order setup.	Seconds
Order Requirement Definitions				Group of four configuration attributes.		
32	Get	V	Tracking filter 0 setup	REAL	Order 0 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 1.0

Table 169 - Instance Attributes (continued)

33	Get	V	Tracking filter 1 setup	REAL	Order 1 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 2.0
34	Get	V	Tracking filter 2 setup	REAL	Order 2 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 3.0
35	Get	V	Tracking filter 3 setup	REAL	Order 3 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 4.0

Attribute Semantics

Order Measurement Units

Actual selection of Order engineering units are a subset of the master engineering units list. The selection is also based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Options prompt the selection of units that indirectly enables differentiation or integration of the base signal.

Operating Mode

Current implementation only supports constant Q mode. This attribute is therefore reserved (0) to support future fixed frequency mode.

The associated configuration parameter instance is read-only until fixed frequency mode is supported.

For Aeroderivative application types (80 and 83) where fixed bandwidth tracking filters for the gas generator, 1x and power turbine 1x are required on a per channel basis. A 5 Hz fixed bandwidth mode is automatically implemented on order 0 (T0) and order 1 (T1). Outside a speed range of 5…400 Hz, the output of these tracking filters is set to zero.

General Order Setup

For one byte, bit-wise control is used to allow for enabling individual tracking filters and to assign a tacho channel.

Four 2-bit arrangements are used.

Bit	Description
0	Tracking filter 0 0: Enable; 1: Disabled Default: Enabled
1	Tracking filter 0 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
2	Tracking filter 1 0: Enable; 1: Disabled Default: Enabled
3	Tracking filter 1 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
4	Tracking filter 2 0: Enable; 1: Disabled Default: Enabled
5	Tracking filter 2 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
6	Tracking filter 3 0: Enable; 1: Disabled Default: Enabled
7	Tracking filter 3 0: Tacho 0; 1: Tacho 1 Default: Tacho 1

Table 170 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Behavior

In general,

- You can configure up to four tracking filters per channel.
- They can be configured to track any particular order, including non-integer values.
- The filter has a constant Q behavior, so it changes or adapts to speed.
- Any combination of the two tacho inputs can be used across a channel.

Some restrictions / special considerations do apply for specific measurements and applications.

For **Aeroderivative application** types (80 and 83) the following fixed assignment must be configured:

- order 0 set to T0 and 1x
- order 1 set to T1 and 1x

This assignment provides fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x. It is not necessary to configure the Mode or Filter Definition parameters specially to achieve this result.

The **Not-1X measurement** setting implements:

- order 0 at 1x (either tacho can be used)
- configure the order and the overall (0) to use the same measurement units

The Not-1X measurement then provides the difference between the Overall (1) measurement and the first order result.

The Not 1X measurement data is presented in the same detection type as the order measurement, it does not rely on the overall (1) being configured similarly.

The Not-1X measurement can if desired provide a ‘Not-2x’ indication, by simply changing the order configuration of the first tracking filter on any particular channel. The 'Not-1X' is calculated whenever the first tracking filter is enabled, irrespective whether it is configured for order 1 (1x).

Dynamix TSC Module Object

The TSC Module Object (class code 0x394) defines the setup for the Tacho Signal Conditioning expansion module and interaction of this expansion module with the main module.

Table 171 - Object Instances

Instance ID	Description
0	TSC Module Class Instance
1	Instance 1 defines setup of TSC module input 0
2	Instance 2 defines setup of TSC module input 1

Table 172 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	NV	Vendor ID	UINT		
9	Get	NV	Device Type	UINT		
10	Get	NV	Product Code	UINT		
11	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the TSC expansion module.	
			Major Version	USINT		
			Minor Version	USINT		
12	Get	V	Expansion Module Status	WORD	Coded information on TSC expansion module operational status.	TSC status
13	Get	NV	Serial Number	SHORT_STRING	Warranty Serial Number	14 character max.
14	Get	NV	Product Name	SHORT_STRING		
15	Get	V	Transducer Status	WORD	Coded information on transducer (0/1) operational status.	
17	Get	NV	Auxiliary Link-Time Out	UINT	Link time out	Fixed at 1000 ms (1 s)
18	Get	V	Mode Control	BYTE	Allows additional detection modes, supports future capability such as reverse rotation detection.	Fixed at zero.

NV status relates to nonvolatile storage in the auxiliary module, not in the main module.

Table 173 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	TSC Measured Speed Output	REAL	Actual Speed considering number of pulses per revolution.	RPM
2	Get	V	Individual Transducer Status	BYTE	Individual transducer-operating status information.	
Sensor Type Configuration				Group of four configuration attributes.		
16	Get	V	Input Sensor Type	USINT	Definition of input source that configures required inputs and signal conditioning.	Selection options
17	Get	V	Input Name	SINT[32]	Physical channel name identifier.	32 characters
24	Get	V	Sensor Power Supply	SINT	Bit-coded configuration for tacho power supply configuration.	TX power supply options
25	Get	V	Sensor Target, Pulses Per Rev	INT	The number of signal pulses per revolution of the shaft.	1…255
Trigger Configuration				Group of three configuration attributes.		
32	Get	V	Trigger Mode	SINT	Potential support for auto threshold detection on the TSC module.	0: Configured threshold 1: Auto detection (when implemented)
33	Get	V	Trigger Threshold	INT	Trigger detection threshold voltage that is specified in mV	Range: -23000…23000 (±23V)
34	Get	V	Trigger Slope/Edge	SINT	Definition of trigger detection slope.	0: Positive 1: Negative
Sensor OK Detection				Group of 5 configuration attributes.		
40	Get	V	Sensor OK Definition	BYTE	TX OK Definition that drives the appropriate OK line of the tacho bus.	Configuration options
41	Get	V	Sensor OK High Threshold	INT	High-voltage threshold for the Sensor OK monitoring window.	mV Range: -24000…24000
42	Get	V	Sensor OK Low Threshold	INT	Low voltage threshold for the Sensor OK monitoring window	mV Range: -24000…24000
43	Get	V	High RPM Threshold	REAL	High RPM Threshold for the Sensor OK monitoring window.	RPM Range: 50…30000
44	Get	V	Low RPM Threshold	REAL	Low RPM Threshold for the Sensor OK monitoring window.	RPM Range: 0.5…29000
TSC Output Configuration				Group of 2 configuration attributes.		
48	Get	V	Tacho Bus and TSCX terminal connections, output 0	SINT	Define processed signal type to be output on the Tacho bus and terminal output 0.	0: 1/rev signal 1: multi-pulse (raw) signal Fixed at 0.
49	Get	V	TSCX terminal connections, output 1	SINT	Define processed signal type to be output via terminal interface.	0: 1/rev signal 1: multi-pulse (raw) signal Fixed at 0.

Attribute Semantics

TSC Module Status

The Auxiliary TSC module reports its status as part of the normal exchanges with the main module.

The bit assignments are as follows.

Bit	Description
0	Auxiliary module is not responding
1	Auxiliary module that is configured
2	MSP code (CRC) fault
3	MSP high temperature
4	Link fail
5	Halt active
6	MSP RAM fault
7	MSP RAM access error

Bits 0…7 are common to all types of auxiliary module, bits 8 to 15 are specific to type.

The auxiliary module controls Bits 1…15, the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

If communication with an expansion module is lost, then the main module sets a status bit to indicate an expansion bus fault. If communication are restored, then normally the fault indication clears. However, if a configuration activity has failed, then the fault indication remains set until a successful reconfiguration is completed. Normally this reconfiguration is achieved by downloading the configuration from the controller to the host main module.

Bit	Description
8	Reserved for reverse rotation detected
9	Reserved for zero speed detected
10	Speed 0 is estimated
11	Speed 1 is estimated
12	+25V5 supply fail
13	-25V5 supply fail
14	Tacho 0 sensor fail
15	Tacho 1 sensor fail

Tacho Input Types

Following sensor types are supported for connection to Tacho Signal Conditioning expansion module.

Value	Description
0	OFF
1	TTL Signal Input
2	NPN Proximity Switch
3	PNP Proximity Switch
4	Eddy Current Probe System
5	Self-generating magnetic Probe

TX Power Setup

Following transducer power-supply options apply per transducer output.

Value	Description
0	OFF
1	+CV (+24V / 25 mA voltage regulated output)
2	-CV (-24V / 25 mA voltage regulated output)

TX OK Definition

Following options define the source/conditions for reporting a tachometer Not OK condition.

Bit	Description
0	Outside voltage window
1	Outside RPM window
2	SC module fault
3…7	Reserved

Bit setting of 1 defines inclusion of the specified condition, reserved bits, and non-desired configuration options are set to 0.

Multiple bit selections are valid, logical combination is OR.

0x00 value defines no tacho transducer OK monitoring.

In general, the TSC module continues to try to provide a signal to the various tacho outputs in spite of a detected failure. For example, a class attribute 17 configures the timeout value that the module uses to assess the link quality. A link timeout only causes an indication of the fault, any active tacho outputs, and their OK status continues to be maintained. Bit 2 in the preceding table, is provided to allow the facility for a TX not OK to be set in case an internal TSC module fault is detectable.

Table 174 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Tacho and Speed Measurement Object

The Tacho and Speed Measurement Object (class 0x395) defines the configuration of tacho and speed signals as processed at main module level.

One instance is linked to each available tachometer channel.

Table 175 - Object Instances

Instance ID	Description
0	Tacho and Speed Measurement Class Instance
1	Instance 1 represents measurement setup and data for tachometer input 0 and associated speeds
2	Instance 2 represents measurement setup and data for tachometer input 1 and associated speeds

Table 176 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	-	Tacho Signal Status	BYTE	Tacho signal enable and OK status	Bits 0…1 indicate tacho enabled status (1 = enabled) Bits 2…3 indicate tacho OK status (1 = fault)

Table 177 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Speed	REAL	Speed that is based directly on the tacho source (equates to a fixed multiplier of 1).	RPM
2	Get	V	Factored Speed	REAL	Processed speed output (based on a configured multiplier).	RPM
3	Get	V	Speed - max	REAL	Maximum speed (attribute 1) RPM since power cycle or last reset of stored value.	RPM
4	Get	V	Speed - ROC	REAL	Rate of change of the (attribute 1) speed output.	RPM/min
Basic Tacho/Speed Configuration				Group of 5 configuration attributes.		
16	Get	V	Tacho Source	SINT	Choice of source: local terminal inputs, tacho bus, I/O data, or OFF.	Selection options
17	Get	V	Tacho OK Source	SINT	Choice of OK source when using the local tacho inputs.	OK source options
18	Get	V	Tacho Name	SINT[32]	Tacho descriptive name.	32 characters
19	Get	V	Speed Multiplier	REAL	Definition of multiplier for the factored Speed measurement.	Default of 1. Range: 0.01…100

Table 177 - Instance Attributes (continued)

21	Get	V	Tacho Trigger Slope/Edge	SINT	main module has configurable edge detection.	0: Positive 1: Negative
			Rate of Change of Speed		Group of 2 configuration attributes.	
24	Get	V	ROC Delta Time	REAL	Delta Time: The time between speed values that are used to evaluate the rate of change	Range: 0.1…20 s Default of 0.5 s
25	Get	V	ROC TC	REAL	The time constant that is applied to the measured speed values before they are used for ROC assessment	Range: 0.1…20 s Default of 0.2 s (are not normally > ROC delta time)

Trigger threshold for the main module is fixed at 2.5V.

Attribute Semantics

Tacho Source Selection

This selection defines which source to use for this tacho and speed processing input.

Value	Description
0	OFF
1	Local TTL Tacho Input 0
2	Local TTL Tacho Input 1
3	Tacho Bus 0
4	Tacho Bus 1
5	mapped to I/O data Speed 0 (Fixed source locations for data and OK status)
6	mapped to I/O data Speed 1 (Fixed source locations for data and OK status)
Higher Values	Reserved

0x00 defines this Tacho as disabled, multiple sources not allowed.

Selection allows theoretically that an equal source can be used for both object instances.

Tacho OK Source Selection

For the main tacho sources (Bus 0, Bus 1, I/O 0 and I/O 1) a dedicated Tacho OK provision is made and is selected automatically.

For the Local Tacho inputs however, it is sometimes possible to use a local logic input to provide an OK signal.

The Tacho OK source selection can be used to configure whether this feature is enabled or not.

To use the corresponding logic input as an OK indication, set the OK source equal to the Tacho source.

Examples

Tacho source selection 1

- Tacho OK source selection = 1 (uses local Logic Input 0)
- Any other value results in permanent Tacho OK state.

Tacho source selection 2

- Tacho OK source selection = 2 (uses local Logic Input 1)
- Any other value results in permanent Tacho OK state.

When the local Logic Inputs are used as described in the previous examples, leave open for a Tacho OK state and short the appropriate input to trigger a Tacho Fail condition.

Table 178 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset	Reset the peak hold speed (RPM - max)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Behavior

The module can process two independent tacho signals from a range of sources.

For 'simple' TTL signals, the main module is equipped with two local tacho inputs. Trigger threshold for these inputs is fixed at 2.5V

For more complex signals, a TSCX module can be used. This option provides the possibility of tacho transducer power, support for a range of transducer types, variable trigger threshold, and multiple event per revolution signals. Conditioned tacho signals (TTL and one event per revolution) can then be made available to multiple main modules via the tacho bus. A TSCX module is also required to support cross module synchronization; that is the advanced (On-demand) data, which are synchronized across multiple modules. Where a TSCX module is being used, make sure that the main module tacho edge detection (the preceding attribute 21), matches that configured for the TSCX module.

To verify the validity of the Speed and the captured Maximum Speed value, the module applies the following rules:

- After power-up or configuration download, the speed value is held at zero rpm until three tacho pulses have been processed. This process is used to avoid a 'ghost' pulse that can cause a spurious high-speed measurement.
- If there is a Tacho Fault, the speed measurement continues to be performed and the speed value is presented regardless of any effect due to the fault. However, in regards the Maximum Speed value:
  - The Maximum Speed value is not updated while a Tacho Fault is present.
  - New maximum speed evaluations are implemented on slightly historic speed values (around1 second old). This evaluation makes sure that if the tacho goes into fault that any speed measure that is made during the transition is not considered for the Maximum Speed value.
  - Maximum Speed values are not considered for approximately 2 seconds, and at least four tacho events, following a Tacho Fail to OK transition.

Although the preceding process cannot completely eliminate the possibility that a faulty tacho probe or loose wire can trigger spurious maximum speed values, it is designed to minimize the likelihood of this happening.

Where no tacho signals are available, the module can accept two speed values as part of the controller output data. While unable to support tracking filters, they can (if nominated as a 'tacho' source) drive speed-related FFT bands.

For redundant tacho mode, refer to the Module Control Object, attribute 24.

Dynamix Measurement Alarm Object

The measurement alarm object (class code 0x396) defines configuration of two-stage individual measurement alarms and provides access to the associated alarm status. Defined, and enabled, measurement alarms can be used as input for logical alarms (voted) and/or be used as non-latching intermediate virtual alarm status.

Class attributes and services allow for alarm history information.

Table 179 - Object Instances

Instance ID	Description
0	Measurement Alarm Class Instance
1…24	Alarm Measurement object instances 1…24

Unused instances exist and are accessible but have a disabled state.

Table 180 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Active Instances	DWORD	Defines the active measurement alarms.	Bit coding (24 used)
9	Get	V	Common Alert	BOOL	Boolean status indicating presence of at least one alert condition.	
10	Get	V	Common Danger	BOOL	Boolean status indicating presence of at least one danger condition.	
11	Get	V	Common TX Fail	BOOL	Boolean status indicating presence of at least one TX Fail condition.	
12	Get	V	Alarm History	STRUCT	Array of events (Time Stamp, measurement output, alarm status) that represent last x number of entries. A change in the alarm status triggers an entry.	

Table 181 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Individual Alarm Status	BYTE/WORD	Bit coded individual measurement alarm status.	Status options
General Alarm Configuration				Group of six configuration attributes.		
16	Get	V	Alarm Enable	SINT	Boolean function that indicates if the alarm is enabled (and defined).	0: Not enabled 1: Enabled
17	Get	V	Alarm Measurement Identifier	INT	Defines source of measurement alarm.	Source selection
18	Get	V	Alarm Name	SINT[32]	A name to identify this alarm instance.	32 characters

Table 181 - Instance Attributes (continued)

19	Get	V	Alarm Form	SINT	Defines form of alarm.	Alarm form option
20	Get	V	Alarm Type	SINT	Defines behavior regarding TX OK state.	Alarm type options
21	Get	V	Alarm Processing Mode	SINT	Defines alarm processing mode to be Normal, Adaptive, or Profile.	Alarm processing options
Alarm Thresholds				Group of eight configuration attributes.		
24	Get	V	Low Alert Threshold	REAL	Defines low alert threshold limit that is used for Under Threshold and Window alarm types.	Range: -49000…48000
25	Get	V	High Alert Threshold	REAL	Defines high alert threshold limit that is used for Over Threshold and Window alarm types.	Range: -48000…49000
26	Get	V	Low Danger Threshold	REAL	Defines low danger threshold limit that is used for Under Threshold and Window alarm types.	Range: -50000…49000
27	Get	V	High Danger Threshold	REAL	Defines high danger threshold limit that is used for Over Threshold and Window alarm types.	Range: -49000…50000
32	Get	V	Hysteresis	SINT	The amount on the safe side of a threshold by which the value must recover to clear the alarm.	Range: 0…20 %
33	Get	V	Delay/Sustain Time (Alert)	DINT	Duration that a measurement alarm input must be continuously present before being reported as an Alert alarm event	Individual delays are an integer in ms Range: 0…65500
34	Get	V	Delay/Sustain Time (Danger)	DINT	Duration that a measurement alarm input must be continuously present before being reported as a Danger alarm event.	Individual delays are an integer in ms Range: 0…65500
35	Get	V	Alarm Multiplier	REAL	Indicates how the thresholds are adjusted when the alarm (threshold) multiplier function is invoked.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
Adaptive Monitoring				Group of eleven configuration attributes.		
40	Get	V	Adaptive Monitoring Source	INT	The data source for the control variable.	Source selection

Table 181 - Instance Attributes (continued)

41	Get	V	Range 1 - Upper Control Value	REAL	Defines first range area upper limit of control value.	Range: 0…50000
42	Get	V	Range 1 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for first range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
43	Get	V	Range 2 - Upper Control Value	REAL	Defines second range area upper-limit of control value.	Range: 0…50000
44	Get	V	Range 2 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for second range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
45	Get	V	Range 3 - Upper Control Value	REAL	Defines third range area upper-limit of control value.	Range: 0…50000
46	Get	V	Range 3 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for third range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
47	Get	V	Range 4 - Upper Control Value	REAL	Defines fourth range area upper-limit of control value.	Range: 0…50000
48	Get	V	Range 4 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for fourth range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
49	Get	V	Range 4 - Upper Control Value	REAL	Defines fifth range area upper-limit of control value.	Range: 0…50000
50	Get	V	Range 4 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for fifth range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…100
Profile Mode				Group of four configuration attributes.		

Table 181 - Instance Attributes (continued)

64	Get	V	Profile mode - Reference for Low Alert Threshold	SINT	I/O Alarm Tag Reference that defines dynamic low alert alarm threshold	Range: 0…15 No hysteresis support
65	Get	V	Profile mode - Reference for High Alert Threshold	SINT	I/O Alarm Tag Reference that defines dynamic high alert alarm threshold	Range: 0…15 No hysteresis support
66	Get	V	Profile mode - Reference for Low Danger Threshold	SINT	I/O Alarm Tag Reference that defines dynamic low-danger alarm threshold	Range: 0…15 No hysteresis support
67	Get	V	Profile mode - Reference for High Danger Threshold	SINT	I/O Alarm Tag Reference that defines dynamic high-danger alarm threshold	Range: 0…15 No hysteresis support

Attribute Semantics

Individual Alarm Status

Individual alarm status code can represent one or more of the following conditions:

- Bit 0 - Alert usage enabled
- Bit 1 - Danger usage enabled
- Bit 2 - Adaptive mode
- Bit 3 - Profile mode
- Bit 4 - Multiplier configured
- Bit 5 - Multiplier active
- Bit 6 - Alert status
- Bit 7 - Danger status

Alarm Form

The following selection choices define the measurement alarm form.

Table 182 - Alarm Form

Value	Description
0x00	(0) - Over Threshold
0x01	(1) - Outside Window
0x02	(2) - Under Threshold
0x03	(3) - Inside Window

Alarm Type

The following options define measurement alarm behavior that is related to transducer status (TX OK).

Table 183 - Alarm Type

Value	Description
0x00	TX OK Considered - requires TX OK status to report alarm condition
0x01	TX OK Monitored - forces an alarm when TX status is NOK
0x02	TX OK Not Considered - Don't care about TX OK state

Alarm Processing Mode

The following alarm processing modes are supported per alarm output.

Table 184 - Alarm Processing Mode

Value	Description
0x00	(0) - Normal, use of fixed alarm level
0x01	(1) - Adaptive Monitoring, allow on-board module configuration for 5 alarm level threshold sets that are linked to speed or other parameter
0x02	(2) - Profile Alarming, where the alarm profile is external from the main module configuration and are communicated using the I/O table

In adaptive alarming mode, a control variable is defined and the magnitude of that variable dictates a factor that is applied to the configured alarm thresholds. This action is applied in a number of discrete bands or ranges, which are defined in attributes 41…50. The control variable is often speed, but can be selected from among any measurement available to the module, refer attribute 40.

An illustrative example, which is based on speed and use of all five available ranges, is as follows:

- Range 1 < **500** rpm
- Range 2 500 to
- **1000** rpm
- Range 3 1000 to
- **1500** rpm
- Range 4 1500 to
- **2000** rpm
- Range 5 > 2000 rpm

The upper control value for each range is shown in bold (Range 5 doesn't have an upper limit). For each of the five ranges, a separate alarm threshold factor can be applied.

Hysteresis

Hysteresis is defined here as a percentage rather than a fixed deadband value:

- For threshold alarms, the deadband is the stated percentage of the threshold.
- For window alarms, the deadband is the stated percentage of the range of the window (high - low).

The following are examples of hysteresis:

- An (over) threshold alarm of 10, hysteresis 10%, gives hysteresis threshold at 9 (10% of the threshold, away from the threshold)
- An (outside) window alarm of 0 to 10, hysteresis 10%, gives hysteresis thresholds at 1 and 9 (10% of the window range, away from each threshold)
- An (outside) window alarm of -10 to 10, hysteresis 5%, gives hysteresis thresholds at -9 and 9 (5% of the window range, away from each threshold)

Source Selection

The ID is an index value that references a bit array to indicate the selected measurement. See Measurement ID Definition on page 325 for further detail.

Behavior

An instance of the Measurement Alarm Object is used to assign alarming behavior to a selected measurement.

The source measurement can be selected from any one of the measurements that the module makes available.

The different instances are used to include various measurements in the alarm scheme. Alternatively, multiple instances can refer to the same measurement where multiple behaviors are required (differing thresholds as an example).

Once the measurement alarm instances have been defined, they are available to use in the Voted Alarm Object. Then logical combinations of up to four measurement alarms can be defined.

The alarm type, the measurement alarm behavior that pertains to transducer status (TX OK), determines how TX OK state is integrated into the voting logic. When you consider just the individual measurement alarm contribution to the voted alarm or the simplest voted alarm logic, 1oo1:

- TX OK Considered - Alarm IF ([Measurement in alarm] AND [TX OK])
- TX OK Monitored - Alarm IF ([Measurement in alarm] OR [TX Fail])
- TX OK Not Considered - Alarm IF [Measurement in alarm]

The enabled outputs of the Voted Alarm Object provide the 'actual alarms' that can be assigned to relay outputs.

Dynamix Voted Alarm Object

This voted/complex alarm object (class object 0x397) defines the configuration of multiple input voted measurement alarms, the resulting alarm behavior, and provides access to the associated logical alarm status.

Class attributes and services allow for alarm history information.

Table 185 - Object Instances

Instance ID	Description
0	Voted Alarm Class Instance
1…13	Voted Alarm object instances 1…13

Unused instances exist and are accessible but have a disabled state.

Table 186 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Instances	WORD	Defines the enabled voted alarm instances.	Bit coding (13 used)
9	Get	V	Common Alert	BOOL	Boolean status indicates the presence of at least one alert condition.	
10	Get	V	Common Danger	BOOL	Boolean status indicating presence of at least one danger condition.	
11	Get	V	Common TX Fail	BOOL	Boolean status indicates the presence of at least one TX Fail condition.	
12	Get	V	First Out Alarm	STRUCT	Record of first logical alarm event (Time Stamp, measurement output, alarm status) logged after reset of First Out alarm option.	
13	Get	V	Alarm History	STRUCT	Array of events (Time Stamp, measurement output, alarm status) that represents last x number of entries. A change in the alarm status triggers an entry.	
16	Get	V	Trip Inhibit/ Bypass Source	BYTE	Source definition for Trip Inhibit/Bypass	Source selection
17	Get	V	Alarm Reset Source	BYTE	Source definition for Reset function	Source selection

Class Attribute Semantics

Source Selection

The following sources can be identified as inputs for Trip Inhibit/Bypass and Reset functionality.

Table 187 - Class Attribute - Source Selection

Bit	Description
0	Logic Input 0 - Module Hardware Digital Input
1	Logic Input 1 - Module Hardware Digital Input
2	Input I/O
3	Alarm Service Request
4…7	Reserved

Multiple selections identify OR functionality of specified inputs.

Applies to all Voted alarms and all Relays.

Where a logic input is being used, left open they are 'inactive', close/connect the pair of terminals to action a reset or an inhibit action.

That action is maintained for as long as the connection is made.

Table 188 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Voted Alarm Status	WORD	Bit coded individual voted alarm status.	Status options
Alarm Usage and Behavior				Group of four configuration attributes.		
16	Get	V	Alarm Usage	BYTE	What measurement alarm outputs are used. None used = OFF.	Alarm usage options
17	Get	V	Alarm Name	SINT[32]	A name to identify this voted alarm instance.	32 characters
18	Get	V	Alarm Behavior	SINT	Latching or non-latching.	Alarm behavior options
19	Get	V	Alarm Type	SINT	Any output designated fail-safe or Alarm Type Options non-fail-safe.	Alarm type options
Alarm Voting Logic				Group of five configuration attributes.		
24	Get	V	Alarm Logic Configuration	SINT	The high-level voting scheme that is used for the logical alarm processing.	Voted logic schemes

Table 188 - Instance Attributes (continued)

25	Get	V	Alarm Input 0	SINT	Measurement Alarm instance reference that is used for input 0.	Range: 1…24
26	Get	V	Alarm Input 1	SINT	Measurement Alarm instance reference that is used for input 1.	Range: 1…24
27	Get	V	Alarm Input 2	SINT	Measurement Alarm instance reference that is used for input 2.	Range: 1…24
28	Get	V	Alarm Input 3	SINT	Measurement Alarm instance reference that is used for input 3.	Range: 1…24
Alarm Multiplier				Group of two configuration attributes.		
32	Get	V	Alarm Multiplier Control	BYTE	Trigger Source and Enable/Disable.	AM control options
33	Get	V	Alarm Multiplier ON Time	DINT	The time that the alarm (threshold) multiplier is applied after the control is toggled.	ms Range: 0…65500
Speed Gating				Group of four configuration attributes.		
40	Get	V	Speed Gating Control	SINT	Speed gating data source selection with Enable/Disable control.	Speed gating sources
41	Get	V	Speed Gating Detection	SINT	Selection of threshold or window detection methods.	Speed range condition options
42	Get	V	Lower Speed Threshold	REAL	Low speed threshold definition.	RPM Range: 4…19000
43	Get	V	Higher Speed Threshold	REAL	High-speed threshold definition.	RPM Range: 5…20000
Logic Gating				A configuration attribute.		
48	Get	V	Logic Gating Source	WORD	Source definition for the logic gating trigger data, including OFF	Logic gating source options
Logic Control				A configuration attribute.		
56	Get	V	Logic Control Source	WORD	Source definition for the logic control trigger data	Refer logic gating source options but note that only one logic control source is allowed.

Attribute Semantics

Voted Alarm Status

Voted Alarm instance has up to three outputs that can be used (Alert, Danger, and TX OK). The Voted alarm status is bit orientated as follows, with a 'common' four bits then further sets of 4 bits for the Alert, Danger, and TX Fail outputs.

Table 189 - Voted Alarm Status

Bit	Description
0	Latching
1	Bypass/Inhibit Active
2	SPM active
3	Spare
4	Alert output state (1 = alarm conditions met)
5	Alert output disabled
6	Alert alarm state (1 = alarm)
7	Alert is a first out alarm
8	Danger output state (1 = alarm conditions met)
9	Danger output disabled
10	Danger alarm state (1 = alarm)
11	Danger is a first out alarm
12	TX Fail output state (1 = alarm conditions met)
13	TX Fail output disabled
14	TX Fail alarm state (1 = alarm)
15	TX Fail is a First out alarm

Alarm Usage

The following options define the output type of the voted alarm condition.

Table 190 - Alarm Usage

Bit	Description
0	Alert
1	Danger
2	TX Fail
3…7	Reserved

0x00 defines disabled Voted Alarm, multiple settings are allowed noting that the same voted logic is applied within and only within each output type.

Alarm Behavior

These options defined the functionality of the logical alarm output.

Table 191 - Alarm Behavior

Value	Description
0x00	(0) - Non-Latching - alarm follows actual status
0x01	(1) - Latching - alarm output retains the alarm condition, once activated, until a reset is issued while the current active safe/OK level applies

Alarm Multiply Control

The following sources can be identified as input for Alarm Multiply (SPM) trigger.

Table 192 - Apply Multiply Control

Bit	Description
0	Logic Input 0 - Module hardware digital input
1	Logic Input 1 - Module hardware digital input
2	Controller SPM 0
3	Controller SPM 1
4	Alarm Multiply Service Request (SPM 0)
5	Alarm Multiply Service Request (SPM 1)
6…7	Reserved

0x00 defines disabled Alarm Multiply function, multiple settings identify OR functionality of specified inputs.

To avoid that the SPM control can be left active, the module initiates the alarm threshold multiplier on a change of state of the control. It does not initiate on the state itself. The SPM action then times out after the time specified in the configuration has elapsed. If the control state changes further, within the timer period the SPM action continues and the timer is refreshed/restarted.

When being used, set the multiplier 'ON time' (attribute 33) to a nonzero value otherwise the feature is disabled.

Alarm Types

The following high-level functionality can be defined.

Table 193 - Alarm Types

Value	Description
0x00	0) - Non-Fail-Safe - If assigned to a relay, in the alarm condition the relay coil is energized
0x01	(1) - Fail-Safe - If assigned to a relay, in the alarm condition the relay coil is de-energized

Voting Logic

Defines the high-level voting construction that is used for the logical alarm processing. Supported high-level modes that are based on X out of Y logic and limited, more complex combinations.

Table 194 - Voting Logic

Value	Description
0x00	(0) 1oo1
0x01	(1) 1oo2
0x02	(2) 2oo2
0x03	(3) - 1oo3
0x04	(4) - 2oo3
0x05	(5) - 3oo3
0x06	(6) - 1oo4
0x07	(7) - 2oo4
0x08	(8) - 3oo4
0x09	(9) - 4oo4
0x60	(96) - 1oo2 AND 1oo2
0x61	(97) - 2oo2 OR 2oo2
0x62	(98) - 1oo2 AND 2oo2
0x63	(99) - 2oo2 AND 1oo2

Speed Gating Source

Following sources can be identified as the source of the speed gating.

Table 195 - Speed Gating Source

Value	Description
o	OFF
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

0x00 defines Speed gating is disabled, multiple sources not allowed.

Speed Range Condition

Defines speed-range assessment type.

Speed Range Condition

Value	Description
0x00	(0) - High-Level Greater than high range
0x01	(1) - Low Level Lower than low range
0x02	(2) - In Window Within defined low and high range
0x03	(3) - Out Window Outside defined low and high range

Logic Gating Source

Bit	Description
0	Local Logic Input 0
1	Local Logic Input 1
2	Logic Gating Service Request (0)
3	Logic Gating Service Request (1)
4…7	Reserved
8	gate0_control in the controller output table
9	gate1_control in the controller output table

0x00 defines Logic gating as disabled.

Up to three sources are allowed with multiple configured sources and logic applied.

Logic Gating and Control Sense

Default behavior is logic gating/control is true when:
- Local Logic Input is low (based on logic input being pulled high)
- Logic control bit is high (1)

Assumes single defined source, OR logic situations.

Table 196 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset	Reset the peak hold speed (RPM - max)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

No Object Specific Services are supported.

Behavior

The Voted Alarm Object provides for logical combinations of up to 4, referenced, measurement alarms (instance attributes 25…28 refer). The alarm logic scheme name (and logic description) applies to attributes in order, so that:

> X out of Y (where both X and Y are from 1 to 4) refers to attributes 25…28, unused attributes are ignored.

and for more complicated logic:

> 1oo2 AND 1oo2 is where the first pair refers to attributes 25 and 26 and the second pair to attributes 27 and 28.

The alarm type, the measurement alarm behavior that is related to transducer status (TX OK), determines how TX OK state is integrated into the voting logic. 2oo2 illustrates an example of how that is reflected in the final logic (so uses Alarm inputs 0 and 1):

- TX OK Considered - Alarm IF ([Alarm input 0 in alarm] AND [Associated TX OK] AND [Alarm input 1 in alarm] AND [Associated TX OK])
- TX OK Monitored - Alarm IF ((([Alarm input 0 in alarm] AND [Other TX Fail]) OR ([Alarm input 1 in alarm] AND [Other TX Fail]) OR ([Alarm input 0 in alarm] AND [Alarm input 1 in alarm]) OR [Both TX Fail])
- TX OK Not Considered - Alarm IF ([Alarm input 0 in alarm] AND [Alarm input 1 in alarm])

It is allowable for each measurement alarm to have another behavior that pertains to transducer status. However, to avoid complicating the example, it is assumed in the proceeding paragraph that both measurement alarms have the same type.

Each Voted Alarm Object has up to three outputs, which are individually enabled when required (Alert, Danger, dedicated TX OK). It is the enabled outputs of the Voted Alarm Object that provide the 'actual alarms' that can be assigned to relay outputs.

The (dedicated) TX OK output combines the relevant TX Status results in the selected logic scheme. It does not pay any attention to measurement alarm type setting (TX OK Considered, Monitored, or Not Considered).

Dynamix Normal CM Data Object

This configures the Normal CM (Condition Monitoring) Data object (class 0x398). This data is dynamic data (TWF and FFT) which is captured as part of the Trend and Alarm and Transient*Data capabilities of the module. 'Live' data can also be requested direct from this object.

Available services allow for data requests for Normal CM data according to requester specifications.

Table 197 - Object Instance

Instance ID	Description
0	Normal CM Data Class Instance
1…4	Instances 1…4 are respectively assigned to measurement channels 0…3

Table 198 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
16	Get	V	Synchronization Enable	SINT	A cross module synchronization control.	Future use Set at zero
17	Get	V	Waveform/FFT Storage Format	BYTE	Control of the way FFT/ TWF data is stored On board the module.	Storage options Fixed at 0x11

Table 199 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
TWF and Common Parameters				Group of six configuration attributes.		
16	Get	V	Enable	BYTE	Type of Normal CM data to be enabled.	Enable control
17	Get	V	Signal Source	SINT	Defines the data source. Same for both TWF and FFT.	Source selection options
18	Get	V	Number of Averages	SINT	Default is FFT averaging unless waveform averaging is enabled in attribute 16,.	Averages: 1, 2, 3, 6, 12, 23, 45, 89, or 178
19	Get	V	Measurement Units	ENGUNITS	Set the measurement units that are based on selected data source.	Engineering units options
20	Get	V	Associated Tacho Source	SINT	Tacho source selection.	For tacho events
21	Get	V	Waveform Record Length	SINT	Defines the number of samples in the Normal CM, waveform.	Index: 0…5
FFT Specific Configuration				Group of 3 configuration attributes.		

Table 199 - Instance Attributes (continued)

25	Get	V	FFT Line Resolution	SINT	Defines the FFT line resolution that is used in the Normal CM, FFTs.	FFT resolution options
26	Get	V	FFT Window Function	SINT	Definition of window function for FFT signal processing.	FFT window options
28	Get	V	FFT Line Value Detection/ Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)

Attribute Semantics

Waveform FFT Storage Format

A bit-wise control for the storage of the Normal CM Data.

Table 200 - Waveform FFT Storage Format

Bit	Description
0	FFT as Float
1	FFT as 16 bit
2	FFT as 8 bit
3	Reserved
4	Waveform as Float
5	Waveform as 16 bit
6	Waveform as 8 bit
7	Reserved

Single setting applies to all stored Normal CM data (Trend, Alarm, and Transient) for all channels.

This parameter has been made available within the configuration such as to permit (future) Smart memory allocation.

Currently the internal storage is fixed as float (shown in bold previously and represented as a return value of 0x11).

TWF/FFT data is always returned as IEEE Float/Real values across the network.

Enable

A bit-wise enable for the Normal CM Data.

Table 201 - Normal CM Data

Bit	Description
0	FFT
1	Waveform
2	Waveform Averaging
3…7	Reserved

Waveform averaging is only a valid selection if or when the Normal CM data source is set to the Alternate path and that is configured for synchronous sample generation. Refer also to the Channel Set up Object.

The Normal CM Data enable affects not only the data available via this object, but the data available to the Trend, Alarm and Transient Data objects:

Normal CM Data enable control, enables the type of dynamic data available to the downstream Objects In the downstream storage objects, dynamic data storage can be disabled per channel

(Trend/Data Manager) or by SU/CD (Transient) Normal (Live) Data is still available if dynamic data storage is disabled in the Trend/Data Manager (and Transient)

Source Selection

The Normal CM data can be taken before any filtering (1), from the alternate path (4) or from a choice of two locations (2, 3) on the main signal processing path.

Table 202 - Source Selection

Index	Description
0x01 (1)	**Pre-Filter** - Before application-specific filters
0x02 (2)	**Mid-Filter** - Selected mid Filter identifies inclusion of application Low Pass Filter
0x03 (3)	**Post-Filter** - Selected post Filter identifies inclusion of both application Low and High Pass Filter including potentially enabled integration stage.
0x04 (4)	**Alternate path** - A CM, alternate processing, path available when so configured in the Channel Set Up Object

Measurement Units

Actual selection of Measurement engineering units are a subset of the master engineering units list. It is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Source of Speed Data

Any one of the following can be identified as the speed reference for Normal CM data.

Value	Description
0	Tacho/Speed 0
1	Tacho/Speed 1

Waveform Record Length

Index	0	1	2	3	4	5
Samples	256	512	1024	2048	4096	8192

Number of samples = 256 * (2^(Index))

FFT Resolution

Defines the FFT line resolution that is used for the Normal CM data FFT. For Advanced CM data, additional line resolutions can be requested.

Index	TWF Samples	FFT Lines			
		Base FFT Lines(1)	Decimation		
			None	Alternate Path(2)	Primary Path(3)
4	4096	1600	1800	1000	600
3	2048	800	900	500	300
2	1024	400	450	250	150
1	512	200	225	125	75
0	256	100	112	67	32

(1) The Base FFT Lines represent the size of the raw processed FFT and are the number of lines returned if no adjustments are made for decimation and filtering. Control of application of relevant factors for the applied decimation and filtering is provided in the SpecialRequest member of the CM Record Request structure (Table 206).

(2) Or if -60 dB filter is applied (Aeroderivative Measurement Type)

(3) And the standard -24 dB/octave filter is applied.

The Normal CM data object specifies the transient dynamic data, note however that it is limited to a maximum of a 900 line FFT and 2048 point TWF. Normal CM data can be set to higher lines/samples and this setting reflects in Trend and Alarm data but stored Transient Data is 900 line FFT and 2048 point TWF).

FFT Window Options

The following window processing options are selectable.

Index	FFT Window	FFT Lines with Amplitudes Set to Zero
0x00 (0)	Normal/Rectangular	DC line only
0x01 (1)	Flat-Top	DC + 4 lines
0x02 (2)	Hanning	DC + 1 line
0x03 (3)	Hamming	DC + 1 line

Table 203 - Averages

Index	Number of Averages
0x00 (0)	1
0x01 (1)	2
0x02 (2)	3
0x03 (3)	6
0x04 (4)	12
0x05 (5)	23
0x06 (6)	45
0x07 (7)	89
0x08 (8)	178

Table 204 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute.

Table 205 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	-	Reserved	Reserved
0x4C	-	x	Normal CM Data Record Request	Data types consisting of multiple bytes are transferred in little-endian format (least significant byte first). Also, a data communication session starts at the first service request and ends after the final response of the exchange or after timeout of 30 seconds.

0x4C CM Record Request

Normal CM data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that are returned by the service. When the packet count down value returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Table 206 - CM Record Request Parameters (2)

0	BufferSelect	INT	Specify the buffer to retrieve the data from: eFFT (2), eTWF (3), or eTACHO (4). The BufferSelect does not change during a session.
2	RequestedCount	UINT	Set RequestedCount = 1 The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 bits indicating the source channel. The ChannelSelect does not change during a session.
6	SpecialRequest	BYTE	See Table 207 on page 469
7	Pad	BYTE	Used to align data to a 32 bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.

Table 207 - SpecialRequest Description - CM Record Request Parameters (2)

Bit		Description
0	SR_MAG_PHASE	Set to request phase (see Phase Data on page 334) and magnitude data from an FFT buffer, otherwise just magnitude data is returned.
1	SR_LIVE	Set to request 'live' data collection rather than receive the most recent data from scheduled (Trend) data acquisition.
2	Reserved	
3	SR_FILTER_LO	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 37.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines based on applied filtering.(2)
4	SR_FILTER_HI	Set bit to specify that if samples are decimated, either by specifying a lower FMAX(1) or by synchronous resampling, then 62.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines based on applied filtering(2).
5	SR_EXTENDED	Set bit to specify that if samples are not decimated or synchronously resampled that 112.5% of the unfiltered FFT lines are returned. When not set, 100% of FFT lines are returned for samples that are not decimated nor synchronously sampled.
IMPORTANT		Recommended use is to set bits 3, 4 and 5. This setting makes sure that in all cases the maximum number of lines are returned that are, in all cases, free of any filter attenuation or potential aliasing effects.

(1) The FMAX and FFT Lines presented in the AOP assume that bits 3, 4 and 5 are set. If other selections are made, then the FMAX or the number of FFT lines of a downloaded FFT does not always reflect that presented in the AOP.

(2) When automatically deciding the factor to apply to decimated or synchronously resampled data the firmware applies the SR_FILTER_LO (37.5%) factor when the -24 dB/octave filter is applied, and the SR_FILTER_HI (62.5%) factor with the -48 dB/octave or the -60 dB/octave filters are applied.
Data that is decimated on the Alternate Path always applies the -48 dB/octave filter. The applied filter on the primary path is the -24 dB/octave filter except when either of the Aeroderivative Measurement Types are selected, in which case it applies the -60 dB/octave filter.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444 as part of an 0x4C service response returns the following.

Table 208 - 0x4C Service Responses

Byte Offset Within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to 3 instances are supported except when reading Live Data. See the IMPORTANT note about the SpecialRequest structure on page 391.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	Incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UDINT	For a given session, the RecordSize returned here is fixed.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

Table 209 - FFT (eFFT)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Can be used to calculate the bandwidth for the FFT.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the returned data array. Otherwise, just the magnitude array is returned. Bits 1 and 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS. Bits 3 and 4 indicate the data filtering that has been applied. Bits 5 and 6 indicate the FFT Windowing applied: 0 Normal/Rectangular, 1 Flat-Top, 2 Hanning, 3 Hamming.
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7.
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

See Reading FFT Data on page 333for details on how to calculate the FFT from the read data.

Table 210 - Waveform (eTWF)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and no of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data. See Reading Continuous Time Waveforms on page 329 for information on using this parameter.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

See Reading TWF Data on page 332 for details on how to calculate the TWF from the read data.

FFT and TWF Data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining three bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7D05:
- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous can be known from the identifier field. This data has the following format.

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous, bit 5 = 1 synchronous then bit 6 indicates which tacho was used.
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	Reserved

Table 211 - Tacho (eTACHO)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Sub-second accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

The identifier structure contains coded information recording the source (pertaining to filters), mode (asynchronous or synchronous), related tacho source, and engineering units for the data. If the mode is indicated as being synchronous, the SamplePeriodInSecs field contains the number of samples per revolution.

Behavior

Through the Object-specific service 0x4C, the Normal CM Object gives access to 'Live' Dynamic data. See the Data Manager Object for access to historical data (Trend and Alarm). See the Advanced CM Data Object for access to dynamically configurable analysis data (variable FFT lines, and so on) and the Transient Data Manager Object for access to stored transient event data.

In general this object supports multi-user access, however, the live data option is single user only. In such a case, error code 13 is returned to any subsequent requestor [eLiveMeasurementInProgress] and that software must resubmit the request.

Normal CM Record Request - Recommendations for Network Side Implementation

The data is returned in multiple packets as an array of records of size RecordSize and can be a significant amount of data depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file is as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
  - Second Response Packet payload
  - Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels.

Complete these steps to retrieve any record from the file.

1. Open the file.
2. Read a record with size of Normal CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size Normal CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Start at the address of the first Record in the Data Array in the first Normal CM Record Response. Index to any record by using the RecordSize to seek to the correct point in the file.
7. Read out the record of size, RecordSize.

Dynamix FFT Band Object

The FFT Band Object (class code 0x399) defines the setup and holds the results for spectral bands that are calculated from Onboard FFT measurements. The FFT bands object provides a total 32 instances (an average of 8 per channel for a 4-channel protection module). The ability to select the source data for the FFT Band objects allows for future support for linking to Normal/Advanced CM data objects. Current support is for the Module Control object only (DSP-based FFT)

Table 212 - Object Instances

Instance ID	Description
0	FFT Band Class Instance
1…32	Instances 1…32 provide for flexible assignment of the FFT bands to any measurement channel (0…3 for a 4 channel protection module).

Table 213 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	DWORD	Bit-wise coding of enabled FFT Band instances (32 bits used).	Decoding information
9	Get	V	Channels with FFTBands	WORD	Bit-wise coding of channels with FFT Bands (4 bits used).	0: No FFT bands that are allocated or 1: One or more FFT bands that are allocated to this channel
10	Get	V	Channel 0 - FFT Bands	DWORD	Active instances for measurement channel 0	0: This FFT band not allocated 1: This FFT band is allocated to this channel
11	Get	V	Channel 1 - FFT Bands	DWORD	Active instances for measurement channel 1	
12	Get	V	Channel 2 - FFT Bands	DWORD	Active instances for measurement channel 2	
13	Get	V	Channel 3 - FFT Bands	DWORD	Active instances for measurement channel 3	

Table 214 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Band RMS	REAL	Overall Band RMS measurement value.	
2	Get	V	Band max	REAL	Maximum line/bin value in band.	RMS
3	Get	V	Band max Frequency	REAL	Frequency at which Band max occurs.	Hz / Order
6	Get	V	Band Value	REAL	One value from a choice of Band RMS, max, and Frequency, made by configuration.	
FFT Band Source				Group of two configuration attributes.		
16	Get	V	Channel Source	SINT	The channel FFT to which this band is applied.	Channel range 0…3 -128: OFF

Table 214 - Instance Attributes (continued)

17	Get	V	Data Source	SINT	The Module Control Object, attributes 73, 80, 87, and 94, sets the data source for FFT bands.	Fixed at 0
Demanded Band Frequency Limits				Group of four configuration attributes.		
18	Get	V	Source of Band Frequency Limits	SINT	Tacho related or fixed band limits in Hz.	Band type
19	Get	V	Start Frequency	REAL	Definition of demanded band start frequency in Hz or orders (refer 18).	Start < Stop Start > 0 Range: 0.1…39000
20	Get	V	Stop Frequency	REAL	Definition of demanded band stop frequency in Hz or orders (refer 18).	Stop > Start Stop < Fmax Range: 0.2…40000
23	Get	V	Tacho Source for Band Limits	SINT	Tacho source for band limits.	Tacho source
Transfer of Data to Controller				A configuration attribute.		
24	Get	V	FFT Band magnitude - Type	SINT	Which measurement data is transferred for this band (RMS, max, or Frequency).	0, 1, 2 Band RMS (default) max line/bin value Frequency of max line (Hz / order)

Attribute Semantics

Enabled Instances

The enable/disable state of the 32 instances, is available bit-wise from a DWORD, where at a bit level.

Table 215 - Enabled Instances

Value	Description
0	Disabled
1	Enabled

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Table 216 - Band Type

Value	Description
0	Fixed bands in Hz
1	Order related bands

When 1, attribute 23 sets tacho source.

Source of Speed Data

Any one of the following can be identified as the speed reference.

Table 217 - Speed Reference

Value	Description
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

Table 218 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Advanced CM Data Object

The Advanced CM Data Object (class code 0x39A) defines the configuration of the Advanced CM TWF data acquisition. Available services allow for data requests for Advanced CM data according to requester specifications, which can include various post-processing tasks, including FFT analysis.

Table 219 - Object Instances

Instance ID	Description
0	Advanced CM Data Class Instance
1…4	Instances 1…4 support advanced CM data for measurement channels 0…3

Table 220 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 221 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
TWF and Common Parameters				Group of four configuration attributes.		
16	Get	V	Source Selection	SINT	Defines the data source for both TWF and FFT.	Source selection options

Table 221 - Instance Attributes (continued)

17	Get	V	Measurement Units	ENGUNITS	Set the measurement units that are based on selected data source.	Engineering units options
18	Get	V	Associated Tacho Source	SINT	Tacho source selection.	For tacho events
19	Get	V	Waveform Record Length	SINT	Not used	

Attribute Semantics

Source Selection

The Advanced CM data can be read from the alternate processing path (4) or from a choice of locations on the main signal processing path.

Table 222 - Source Selection

Index	Description
0 or 1	**Pre-Filter** - before application-specific filters
2	**Mid-Filter** - after the Low Pass Filter
3	**Post-Filter** - after both application filters and any configured integration
4	**Alternate path** - can be asynchronously or synchronously sampled depending on channel set-up

Measurement Units

Actual selection of Measurement engineering units is a subset of the master engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Table 223 - Associated Tacho Source

Value	Description
0x01	Tacho/Speed 0
0x02	Tacho/Speed 1
Higher Values	Reserved

Table 224 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 225 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Advanced CM Data Request	This service specifies the data processing that is being requested. Being 'on-demand', this service triggers that processing to take place.
0x4C	-	x	Advanced CM Data Record Request	This service is used to return the requested data.
0x4D	x	x	Advanced CM Data Session Reset	This service can be used to reset (finish early) the specified session instance. Only sessions that are associated with an advanced measurement is reset. The reset request includes the advanced session instance number from the last successful Advanced CM Data Request (0x4B) response.

Data types consisting of multiple bytes are transferred in little-endian format (least significant byte first).

A data communication session starts at the first service request and ends after the final response of the exchange or after timeout of 30 seconds. Although three sessions are available, a reset remains good practice for freeing up resources for new Advanced Data transfer requests.

Expected flow is as follows: Request - Data - Data - Data (as required) - Session Reset.

0x4B Advanced CM Data Request

Advanced CM data processing is started and the results are retrieved using a two-part set of commands that are sent as a series of request/response messages (using connected messages reduce messaging overhead).

An Advanced CM data request service is used to initialize and start a session. The desired parameters are passed to the system to begin the processing of the advanced CM data. The anticipated time for the processing to be completed is returned. After the processing time expires, the requester can ask for the data using the second part of the command set.

The instance and attribute can be set to 1, but they are ignored.

The data that is sent with an Advanced CM data request is divided into two separate sections, the class section, and four instance sections. This process is similar to how EtherNet/IP classes are constructed with one class instance and multiple 'instance' instances.

The host sends the following Advanced CM Data Request Parameters as part of an 0x4B service request.

Table 226 - Advanced CM Data Request Parameters

Byte Offset Within Structure	Structure Member	Data Type	Description
Class Instance			
0	Pad	USINT	-
1	Advanced Session Timeout	USINT	Seconds to have ownership of Advanced CM setup.
2	Advanced Session Instance	UINT	Set to 0, unless restarting an existing (unexpired) request, where you'd pass in the Advanced Session Instance from the previous response.
4	Sync Data Control	UINT	Used to request synchronized data from multiples modules.
Instance 1 (Channel 0)			
6	Pad	WORD	Used to align data to a 32 bit boundary.
9	Number of Averages	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
10	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
11	FFT Line Resolution	SINT	Identical control to the control used in the Normal CM Data Object (0x30A), but with additional indices. See Table 227 on page 481.
12	FFT Window Function	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
13	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS].
14	Pad	INT	Used to align data to a 32 bit boundary.
Instance 2 (Channel 1)			
16	Enable	BYTE	A bit-wise enable control.
17	Number of Averages	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
18	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
19	FFT Line Resolution	SINT	Identical control to the control used in the Normal CM Data Object (0x30A), but with additional indices. See Table 227 on page 481.
20	FFT Window Function	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
21	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS].
22	Pad	INT	Used to align data to a 32 bit boundary.
Instance 3 (Channel 2)			
24	Enable	BYTE	A bit-wise enable control.

Table 226 - Advanced CM Data Request Parameters (continued)

25	Number of Averages	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
26	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
27	FFT Line Resolution	SINT	Identical control to the control used in the Normal CM Data Object (0x30A), but with additional indices. See Table 227 on page 481.
28	FFT Window Function	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
29	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS].
30	Pad	INT	Used to align data to a 32 bit boundary.
Instance 4 (Channel 3)			
32	Enable	BYTE	A bit-wise enable control.
33	Number of Averages	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
34	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
35	FFT Line Resolution	SINT	Identical control to the control used in the Normal CM Data Object (0x30A), but with additional indices. See Table 227 on page 481.
36	FFT Window Function	SINT	Identical control to the control used in the Normal CM Data Object (0x30A).
37	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS].
38	Pad	INT	Used to align data to a 32 bit boundary.

Table 227 - Record Length

Index	TWF Samples	Decimation			
		Base FFT Lines(1)	Decimation		
			None	Alternate Path(2)	Primary Path(3)
8	65536	-	-	-	-
7	32768	12800	14400	8000	4800
6	16384	6400	7200	4000	2400
5	8192	3200	3600	2000	1200
4	4096	1600	1800	1000	600
3	2048	800	900	500	300
2	1024	400	450	250	150
1	512	200	225	125	75
0	256	100	112	67	32

(1) The Base FFT Lines represent the size of the raw processed FFT and are the number of lines returned if no adjustments are made for decimation and filtering. Control of application of relevant factors for the applied decimation and filtering is provided in the SpecialRequest member of the CM Record Request structure (Table 230).

(2) Or if -60 dB filter is applied (Aeroderivative Measurement Type)

(3) And the standard -24 dB/octave filter is applied.

Enable

A bit-wise enable control, per instance/channel.

Table 228 - Enable

Value	Description
0	FFT
1	Waveform
2	Waveform Averaging
3	FFT Averaging
4…7	Reserved

Waveform averaging is only a valid selection when waveform is enabled, the Advanced CM data source is set to the Alternate path and is configured for synchronous sample generation. Refer also the Channel Set Up Object.

FFT Averaging is only a valid selection when FFT is enabled. If the FFT, Waveform, Waveform Averaging, and FFT Averaging bits are all set, Waveform Averaging is not performed while the other selections are performed.

It is possible to specify both FFT and Waveform for a channel. Waveform, Waveform Averaging, and FFT is also a valid combination. FFT, Waveform, and FFT Averaging is also a valid combination.

The Dynamix 1444 return the following as part of an 0x4B service response.

Table 229 - 0x4B Service Responses

Byte Offset Within Structure	Structure Member	Data Type	Description
0	Processing Time	REAL	Anticipated time for the requested CM data processing to be completed (seconds). For queued requests (multi-session), processing time also includes anticipated wait time. In extreme cases, the module is not able to calculate an accurate processing time as the estimate doesn't include any allowance for the acquisition time for additional samples that are needed. This is because in most circumstances, the internal sample buffers are sufficient to service the demand. However, when a long TWF (say 65536 samples) with two or more averages is requested, the internal circular buffer is used completely and additional samples must be acquired at the specified sample rate. Especially in the case where a slow speed synchronous source is used, this sample acquisition time could be long. In such cases, the remote system can continue to poll the module for data until it becomes available or can reset/abandon the current session.
4	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) • eDeniedRequestAlreadyInProgress (7) • eSessionAccessDenied* (8) • eAdvancedMeasurementRequestinProgress (9) • eRequestQueued (10) • eLiveMeasurementInProgress (13) * An eSessionAccessDenied status occurs when trying to change an advanced setup with the wrong Advanced Session Instance or before the timeout. For all successful requests eSUCCESS (0) is returned, any other value ends the session.
8	Synch Data Control	UINT	A synchronizing tacho event, reference for this request
10	Advanced Session Instance	UINT	Multi-session, session control

Sync Data Control

Synchronized Advanced Data can be requested from modules that share a TSCX module (use its tacho bus outputs). If the physical system is in place, no pre-configuration* is required for the cross-module synchronization. The scheme can be summarized as follows:

- The TSCX module regularly identifies a particular tacho pulse (approximately every 60 seconds)
- Main modules on the tacho bus register this identification event and start/restart a tacho event count
- Each tacho event is then similarly identified on the independent main modules (same count value is applied to the same tacho event)

To retrieve synchronized data, the following approach is used:

- An 0x4B service is sent with Sync Data Control set to zero (any of the modules)
- The module replies with Sync Data Control set to a specific value (a particular tacho event number)
- Send an 0x4B service to the remaining modules with the specific Sync Data Control value that was received from the first request
- Request the data itself with 0x4C services to all modules (see next section)

* Synchronization can be applied using either one of the two possible TSCX tacho signals but the associated Advanced CM tacho source setting on each of the channels/modules must reflect the same tacho signal.

An eDeniedRequestAlreadyInProgress status indicates that an earlier request is in progress and the data from that request has yet to be collected.

0x4C Advanced CM Data Record Request

This request is sent after the Advance CM data request has returned an anticipated processing time and that time has elapsed. If the request is made before the data is ready, a resource not available status code is returned. This can be used as a polling method if a timer is not used. When the data is ready, the data portion of the message contains the data, the other fields are also populated as defined, and the status code indicates success.

The instance and attribute can be set to 1, but they are ignored.

Table 230 - 0x4C Advanced CM Data Record Request

Byte Offset Within Structure	Structure Member	Data Type	Description
0	Buffer Select	INT	Specify the buffer to retrieve the data from: eFFT (2), eTWF (3), or eTACHO (4).The BufferSelect does not change during a session.
2	RequestedCount	INT	Set RequestedCount = 1 The Requested Count does not change during a session.
4	SessionInstance	USINT	Functionality replaced by Advanced Session Instance.
5	ChannelSelect	BYTE	Four bits indicating the source channel. The ChannelSelect does not change during a session.
6	SpecialRequest	BYTE	See Table 231 on page 485
7	Pad	BYTE	Used to align data to a 32 bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.
12	Advanced Session Instance	UINT	The Advanced Session Instance that is returned from the 0x4B Advanced CM Data request is included here.

Table 231 - SpecialRequest Description 0x4C Advanced CM Data Record Request

Bit		Description
0	SR_MAG_PHASE	Set to request phase (see Phase Data on page 334) and magnitude data from an FFT buffer, otherwise just magnitude data is returned.
1 and 2	Reserved	
3	SR_FILTER_LO	Set bit to specify that if samples are decimated, either by specifying a lower FMAX[1] or by synchronous resampling, then 37.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines based on applied filtering.[2]
4	SR_FILTER_HI	Set bit to specify that if samples are decimated, either by specifying a lower FMAX[1] or by synchronous resampling, then 62.5% of the unfiltered FFT lines are returned. If bits 3 and 4 are both set, then the firmware automatically determines the number of returned FFT lines based on applied filtering[2].
5	SR_EXTENDED	Set bit to specify that if samples are not decimated or synchronously resampled that 112.5% of the unfiltered FFT lines are to be returned. When not set, 100% of FFT lines are returned for samples that are not decimated nor synchronously sampled.
IMPORTANT		Recommended use is to set bits 3, 4 and 5. This setting makes sure that in all cases the maximum number of lines are returned that are, in all cases, free of any filter attenuation or potential aliasing effects.

(1) The FMAX and FFT Lines presented in the AOP assume that bits 3, 4 and 5 are set. If other selections are made, then the FMAX or the number of FFT lines of a downloaded FFT does not always reflect that presented in the AOP.

(2) When automatically deciding the factor to apply to decimated or synchronously resampled data the firmware applies the SR_FILTER_LO (37.5%) factor when the -24 dB/octave filter is applied, and the SR_FILTER_HI (62.5%) factor with the -48 dB/octave or the -60 dB/octave filters are applied.
Data that is decimated on the Alternate Path always applies the -48 dB/octave filter. The applied filter on the primary path is the -24 dB/octave filter except when either of the Aeroderivative Measurement Types are selected, in which case it applies the -60 dB/octave filter.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444 returns the following as part of an 0x4C Advanced CM Data Record Request.

Table 232 - 0x4C Advanced CM Data Record Request

Byte Offset Within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to three instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UDINT	For a given session, the RecordSize returned here is fixed. RecordSize is in bytes and describes the appropriate Record Type Structure.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Status codes: 0: eSUCCESS Returned after all successful requests. 1. eUnrecognizedSession 2. eMaxSessionsReached 3. ePacketCountOutOfSequence 4. eInvalidBufferSelect 5. eNoDataAvailable 6. eGeneralError 7. eDeniedRequestAlreadyInProgress 8. eSessionAccessDenied 9. eAdvancedMeasurementRequestinProgress When returned, the host can retry as often as required, until successful, although it is recommended to wait for the advised processing time before you begin polling. When a code 9 is returned, the PacketCountDown field indicates the current average count (progress towards the requested number of averages). 10. eRequestQueued Any code returned other than eSUCCESS (0) or eAdvancedMeasurementRequestinProgress (9) ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the responsibility of the calling application to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

Table 233 - FFT (eFFT)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution can be used to calculate the bandwidth for the FFT.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the returned data array. Otherwise, just the magnitude array is returned. Bits 1 and 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS. Bits 3 and 4 indicate the data filtering that has been applied. Bits 5 and 6 indicate the FFT Windowing applied: 0 Normal/Rectangular, 1 Flat-Top, 2 Hanning, 3 Hamming.
17	Reserved1	BYTE	
18	Reserved2	UINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

See Reading FFT Data on page 333 for details on how to calculate the FFT from the read data.

Reference the measurement tables.

Table 234 - Waveform (eTWF2)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data. See Reading Continuous Time Waveforms on page 329 for information on using this parameter.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

See Reading TWF Data on page 332 for details on how to calculate the TWF from the read data.

Reference the measurement tables.

Table 235 - Tacho (eTACHO)

Byte Offset Within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
34	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

For FFT and TWF data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining 3 bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7D05:

- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous can be known from the identifier field. This has the following format.

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post-filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous, bit 5 = 1 synchronous, then bit 6 indicates which tacho was used)
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	The 16-bit tacho event counter (cross module synchronization scheme)

Example, where identifier lower 16 bits are 0x 0024

- 00 indicates that measurement unit is Volt
- Bits 2 & 5 are set to indicate path 1 is in use and synchronous sampling is enabled (so data is based on synchronous sampling)

Table 236 - 0x4D Advanced CM Data Session Reset, Service Request

Byte Offset Within Structure	Structure Member	Data Type	Description
0	Advanced Session Instance	UINT	The Advanced Session Instance to be reset.
2	Pad	UINT	Used to align data to a 32 bit boundary

Response to an 0x4D service request is as follows.

Byte Offset Within Structure	Structure Member	Data Type	Description
0	Status	DINT	Status codes: 0: eSUCCESS • Returned after all successful requests. 1. eUnrecognizedSession 2. eMaxSessionsReached 3. ePacketCountOutOfSequence 4. eInvalidBufferSelect 5. eNoDataAvailable 6. eGeneralError 7. eDeniedRequestAlreadyInProgress 8. eSessionAccessDenied • Is returned if trying to reset the advanced setup with the wrong Advanced Session Instance. 9.eAdvancedMeasurementRequestInProgress 10. eRequestQueued

Behavior

Through the Object-specific services 0x4B and 0x4C, the Advanced CM Data Object gives access to dynamically configurable analysis data (variable FFT lines, and so on). The service 0x4B configures/requests the desired processing be implemented, while the service 0x4C is used to request the resulting data.

One request can include multiple channels and data types to avoid the complication of varying record sizes the resulting data can be requested on one channel and data type per session basis.

See the Data Manager Object for access to historical data (Trend and Alarm), to the Normal CM Object for access to a 'Live' version of that data. Also see the Transient Data Manager Object for access to stored transient event data.

Advanced CM Data and Record Requests - Recommendations for Network Side Implementation

- DataRequest Packet
- DataResponse Packet (with estimated processing time)
- Wait
- First RecordRequest Packet
- First RecordResponse Packet

The data is returned in multiple packets as an array of records of size RecordSize. A significant amount of data can be returned depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file is as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
  - Second Response Packet payload
  - Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels. It is not necessary to reissue a fresh DataRequest.

Record retrieval from the file can then be accomplished as follows.

1. Open the file.
2. Read a record with size of Advanced CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size Advanced CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Start at the address of the first Record in the Data Array in the first Advanced CM Record Response. To index to any record, use the RecordSize to seek to the correct point in the file.
7. Read out the record of size, RecordSize.

Dynamix MUX Object

The MUX Object (class code 0x39B) defines and controls the multiplexing capability of the main module that is based on single or multiple configurations. Up to three subchannels can be configured each based on one DSP stored configuration and each having up to four time slots for which measurement channels can be enabled in either single or parallel mode. This is as long as the DSP can process each configuration option

Main setup for multiplexing operation using single configuration or multi-parameter mode is under high-level configuration control. This determines the number of subchannels and the allocation of channels to time slots. Settling and Data Acquisition times for the time slots are automatically set at minimum acceptable values that take account of signal processing requirements.

Table 237 - Object Instances

Instance ID	Description
0	MUX Class Instance
1	Instances 1 for subchannel A MUX configuration

Table 238 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	MUX Configured	BOOL	Whether this configuration uses MUX.	
9	Get	V	Number of Enabled Subchannels	USINT	Enabled subchannels/ instances.	1
16	Get	V	Overall Cycle Time	REAL	Time that is taken to complete a MUX cycle.	

Table 239 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
Read Time Slot Configuration				Group of 9 configuration attributes.		
1	Get	V	Time Slot Channel Enables	WORD	Bit-wise channel enables for time slots 1…3.	All 16 bits used
2	Get	V	Time Slot 0 DAQ Time	REAL	Time Slot 0 DAQ Time	s
3	Get	V	Time Slot 1 DAQ Time	REAL	Time Slot 1 DAQ Time	s
4	Get	V	Time Slot 2 DAQ Time	REAL	Time Slot 2 DAQ Time	s
5	Get	V	Time Slot 3 DAQ Time	REAL	Time Slot 3 DAQ Time	s
6	Get	V	Time Slot 0 Settling Time	REAL	Time Slot 0 Settling Time	s
7	Get	V	Time Slot 1 Settling Time	REAL	Time Slot 1 Settling Time	s
8	Get	V	Time Slot 2 Settling Time	REAL	Time Slot 2 Settling Time	s

Table 239 - Instance Attributes (continued)

9	Get	V	Time Slot 3 Settling Time	REAL	Time Slot 3 Settling Time	s
Time Slot Configuration				Group of 4 configuration attributes.		
16	Get	V	Time Slot 0 DAQ Time Multiplier	INT	Time Slot 0 DAQ Time Multiplier	Range: 1…255 Default: 1
17	Get	V	Time Slot 1 DAQ Time Multiplier	INT	Time Slot 1 DAQ Time Multiplier	Range: 1…255 Default: 1
18	Get	V	Time Slot 2 DAQ Time Multiplier	INT	Time Slot 2 DAQ Time Multiplier	Range: 1…255 Default: 1
19	Get	V	Time Slot 3 DAQ Time Multiplier	INT	Time Slot 3 DAQ Time Multiplier	Range: 1…255 Default: 1

Table 240 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix MUX Object

The Dynamix MUX Object (class 0x39B) defines and controls a multiplexing capability of a main module. The appropriate choice of the Module Type enables Multiplexing.

Multiplexing is not a means to connect different signals to the inputs. Rather it is to provide a method to allow use of all four channels when the sample rate requirement is greater than the module can perform continuously on four channels.

Table 241 - Object Instances

Instance ID	Description
0	Class Instance for the MUX Object
1	Instance 1

Table 242 - Object Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	The MUX object revision	-
8	Get	NV	MUX Configured	BOOL	Yes = this configuration uses MUX	1 = Yes
9	Get	NV	Number of enabled subchannels	USINT	Not Used	Fixed at 1
10	Get	-	Overall cycle time	REAL	Time to complete to MUX cycle	s (actual measured)

Table 243 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
-	-	-	Read Time Slot Configuration	-	-	-
1	Get	V	Time slot channel enables	WORD	Bit-wise channel enables for time slots 0 to 3	All 16 bits used
2	Get	V	Time slot 0 DAQ time	REAL	Time slot 0 minimum DAQ time	s
3	Get	V	Time slot 1 DAQ time	REAL	Time slot 1 minimum DAQ time	s
4	Get	V	Time slot 2 DAQ time	REAL	Time slot 2 minimum DAQ time	s
5	Get	V	Time slot 3 DAQ time	REAL	Time slot 3 minimum DAQ time	s
6	Get	V	Time slot 0 Settling time	REAL	Time slot 0 Settling time	s
7	Get	V	Time slot 1 Settling time	REAL	Time slot 1 Settling time	s
8	Get	V	Time slot 2 Settling time	REAL	Time slot 2 Settling time	s
9	Get	V	Time slot 3 Settling time	REAL	Time slot 3 Settling time	s
-	-	-	Time Slot Configuration	-	Group of 4 configuration attributes	-
16	Get	V	Time Slot 0 DAQ time Multiplier	INT	Time Slot 0 DAQ time Multiplier	Default value: 1 Range: 1…255
17	Get	V	Time Slot 1 DAQ time Multiplier	INT	Time Slot 1 DAQ time Multiplier	Default value: 1 Range: 1…255
18	Get	V	Time Slot 2 DAQ time Multiplier	INT	Time Slot 2 DAQ time Multiplier	Default value: 1 Range: 1…255
19	Get	V	Time Slot 3 DAQ time Multiplier	INT	Time Slot 3 DAQ time Multiplier	Default value: 1 Range: 1…255

Attribute Semantics

The module calculates instance attributes 2…9 to make sure that the channel pair is active long enough for valid measurements (overall, TWF, and FFT) to be made. That DAQ (data acquisition) time represents the minimum that is required. If desired, you can then extend that time by use of the configured multipliers, attributes 16…19.

Table 244 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Behavior

Multiplexing provides a means of using all 4-channels of a module in a situation where the required processing can only be implemented on two or less channels at a time. Examples are gSE or 40 kHz modes where only one channel pair can be active due to the high sample rate and signal processing required. By using 'Paired channels' Multiplexing mode the module automatically switches between channel pairs, which makes measurements as each pair becomes active (note that module transducer power is not switched).

In paired mode the time slots are allocated as follows:
- Time slot 0 - channels 0/1
- Time slot 1 - channels 2/3
- Time slot 2 - channels 0/1
- Time slot 3 - channels 2/3

Based on the configured Normal CM data requirements (and other considerations as appropriate), the module advises and implements the minimum DAQ (Data Acquisition) Time to allow those measurements to be properly serviced. As Advanced CM data is based on ad hoc, on-demand requests (potentially for higher number of lines, different averaging) this is not automatically catered for. If it is planned to send more demanding Advanced CM Data requests, then this is allowed by suitably increasing the time multiplier to a value greater than 1 (attributes 16…19).

The module maintains circular sample buffers of much greater depth than required for the longest TWF or highest line FFT, this depth is used to advantage in Multiplexing and Cross Module Synchronization modes. Likewise there are large circular buffers for corresponding Tacho Times. The (size) relationship between these two buffers is 16:1. For example, a full set of Tacho Times is available whenever the sample rate (synchronous or asynchronous) is equivalent to at least 16 samples per revolution.

For multiplexed measurements it is possible that the available Tacho Times do not always provide full coverage for the sample data. This situation can occur when low frequency / slow speed measurements, where fewer than 16 samples per revolution and the full extent of the circular sample buffers is used. This can lead to errors in the speed measurement.

Individual mode is also implemented, where each channel is allocated to its own individual time slot. As individual mode provides little operational advantage over paired mode, the latter is recommended for all multiplexing applications.

Dynamix Relay Module Object

The Relay Module Object (class code 0x39C) configures the relay outputs of the associated relay expansion modules (1…3 units per host, each serving four mechanical relays).

The object defines the setup for the Relay Output expansion modules and the interaction of these expansion modules with the main module. The same host module can accommodate up to three Relay Output modules. There is an object instance per module.

When one or more Relay modules are included in a system, not only must the configuration aspects of this object be addressed, but the presence of each module must also be flagged by appropriate setting of the Module Control Object, class attribute 16 (Configured Auxiliary Modules).

Table 245 - Object Instances

Instance ID	Description	Address Switch Settings
0	Relay Module Class Instance	
1	First Relay Expansion Module	SWI-SW2 as 0…1
2	Second Relay Expansion Module	SWI-SW2 as 1…0
3	Third Relay Expansion Module	SWI-SW2 as 1…1

A base switch address setting of (00) is illegal for a relay module and causes it to display a critical error (solid red Status Indicator).

Table 246 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 247 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
4	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the Relay expansion module.	Firmware Revision information
4	Get	NV	major Version	USINT		
4	Get	NV	Minor Version	USINT		
5	Get	V	Expansion Module Status	WORD	Coded information on Relay Module operational status.	Relay Module status
6	Get	NV	Serial Number	SHORT_STRING	Warranty Serial Number	14 character max.
7	Get	NV	Product Name	SHORT_STRING		1444-RELX00-04RB
Individual Relay Status				Group of 4 configuration attributes.		
8	Get	V	Relay 0 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
9	Get	V	Relay 1 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
10	Get	V	Relay 2 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
11	Get	V	Relay 3 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
Relay Configuration				Group of 4 configuration attributes.		
17	Get	V	Relay 0 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
18	Get	V	Relay 1 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
19	Get	V	Relay 2 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
20	Get	V	Relay 3 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
21	Get	V	Auxiliary Link timeout	INT	Link timeout	200 ms for open compliance 100 ms otherwise
22	Get	V	Relay Drive Test Enable	BYTE	Bit coded, relay drive test enables.	Test enable
23	Get	V	Relay 0 Drive Test Interval	INT	Test interval.	ms
24	Get	V	Relay 1 Drive Test Interval	INT	Test interval.	ms
25	Get	V	Relay 2 Drive Test Interval	INT	Test interval.	ms
26	Get	V	Relay 3 Drive Test Interval	INT	Test interval.	ms
32	Get	V	Relay 0 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
33	Get	V	Relay 1 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control

Table 247 - Instance Attributes (continued)

34	Get	V	Relay 2 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
35	Get	V	Relay 3 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
Relay Configuration				Group of 4 configuration attributes.		
36	Get	V	Relay 0 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
37	Get	V	Relay 1 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
38	Get	V	Relay 2 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
39	Get	V	Relay 3 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
40	Get	V	Relay 0 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
41	Get	V	Relay 1 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
42	Get	V	Relay 2 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
43	Get	V	Relay 3 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control

NV status relates to nonvolatile storage in the auxiliary module, not the main module.

Attribute Semantics

Relay Module Status

Each Auxiliary Relay module reports its status as part of the normal exchanges with the main module. The bit assignments are as follows.

Table 248 - Relay Module Status

Bit	Description
0	Auxiliary Module Not Responding
1	Auxiliary Module Configured
2	MSP Code (CRC) Fault
3	MSP High Temperature
4	Link Fail
5	Halt Active
6	MSP RAM Fault
7	MSP RAM Access Error

Bits 0…7 are common to all types of auxiliary module, bits 8…15 are specific to type.

The auxiliary module controls Bits …15; the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

If communication with an auxiliary module are lost, then the main module sets a status bit to indicate an auxiliary bus fault. If communication are restored, then normally the fault indication clears, noting however, if a configuration activity has failed, then the fault indication remains set until a successful reconfiguration is completed. Normally this reconfiguration is achieved by downloading the configuration from the controller to the appropriate main module

If the main module is not configured to expect a particular auxiliary module, then the status of that module is always reported as zero. This status applies equally to the status data obtained via an object attribute request and to the status data in the I/O data exchange. Object attribute requests for data such as Auxiliary module firmware revision only require that the auxiliary module is present and communicating.

Bit	Description
8	Relay 0 Is Not Inhibited
9	Relay 1 Is Not Inhibited
10	Relay 2 Is Not Inhibited
11	Relay 3 Is Not Inhibited
12	Relay 0 Drive Error
13	Relay 1 Drive Error
14	Relay 2 Drive Error
15	Relay 3 Drive Error

In the unlikely event the auxiliary module is found to be in Boot Loader mode (not running operation firmware), the main module sets the auxiliary module status to a special code: Decimal: 65,534, Hexadecimal: 0xFFFE, Binary: 11111111 11111110.

Although the auxiliary module is responding, it is in a non-operational state and is classed as a failure from the perspective of a Fault Relay.

Relay Status Decoding

The relay status uses two bits to communicate whether the relay is assigned (or off) and whether it is energized or not:

- bit 0 - assigned
- bit 1 - energized

Examples of expected values:

- value 0 - Off and de-energized
- value 1 - assigned and de-energized
- value 3 - assigned and energized

Relay Control

Bit-wise setting controlling how the relay behaves under fault circumstances.

Table 249 - Relay Control

Bit	Description
0	Main Module Fault
1	Auxiliary Module Fault
2	Auxiliary Bus Communication Fail
3	E/IP Communication Failure
4	Tacho Fault
5	Reserved
6	Reserved
7	Latching

The status of bits 1 and 2 reflect conditions detectable by the auxiliary module itself, and the remainder rely on the main module.

There are three parameters that use these bit definitions.

Parameter	Description
Auto Relay Control	This parameter follows the logic that when associated with a fail-safe voted alarm a main/auxiliary module fault also activates the relay (so the appropriate bits are set). Otherwise it is zero. Read only to the user.
User Relay Control	This parameter allows the user to select from a number of faults that can also be considered.
Relay Control	This parameter is a bit-wise logical AND of the Auto and User controls, and is what is implemented and is read-only to the user.

The objective being that more faults that the relay reacts to can be added (above those faults implicit in the Voted Alarm selection) or dedicate the relay only to the indication of certain selected faults.

Relay control (like voting logic) is implemented by the main module instructing the auxiliary module on how to set its relay outputs in any particular circumstance. However, to guard against the situation where a main module or link failure prevents proper instruction from reaching it, on detecting a communication link failure the auxiliary module sets any fail-safe relays to their alarm state (de-energized). This function is an automatic/ autonomous action by the auxiliary module.

Table 250 - Relay Source Decoding

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted Alarm Instance 1…13 Output type: TX OK
Higher Values	Reserved
126	Dedicated, Bypass Active Relay
127	Dedicated, Fault Relay, Relay Control Determines Faults

As the special functions (126 and 127) are not the result of Voted alarms, there is no definition of type - suggest fail-safe is adopted for these. Local Relay Control also includes a Latching bit, to give a latching control to these special functions.

0x00 defines the relay as disabled, multiple sources not allowed.

Relay Drive Test Enable

Relay drive test enable and settings are automatic based on higher-level configuration such as Voted alarm allocations.

Bits 0…3 for relays 0…3, bit value is set to 1 if the test is enabled.

When enabled the test period configured in reflected in attributes 23, 24, 25, 26.

The routine relay drive circuit test applies only to fail-safe applications - where the drive can be momentarily de-energized.

Failure of a routine drive circuit test is flagged in the status information that is returned via the main module.

Table 251 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Dynamix Current Output Module Object

The Current Output Module Object (class code 0x39D) configures the 4…20 mA current outputs of the single supported current output expansion module.

This object defines the setup for the Current Output expansion module and interaction of this expansion module with main module.

Table 252 - Object Instances

Instance ID	Description
0	Current Output Module Class Instance
1	Instance 1 - Current Output 0
2	Instance 2 - Current Output 1
3	Instance 3 - Current Output 2
4	Instance 4 - Current Output 3

Table 253 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
11	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the current output module.	Firmware Revision information
11	Get	NV	Major Version	USINT		
11	Get	NV	Minor Version	USINT		
12	Get	V	Expansion Module Status	WORD	Coded information on TSC Analog Output Module operational status.	Analog Output Module
13	Get	NV	Serial Number	SHORT_STRING	Warranty Serial Number	14 character max.
14	Get	NV	Product Name	SHORT_STRING		1444-AOFX-00-04RB
15	Get	V	Current Module Control	BYTE	Configuration of generic current output module behavior in case of detected fault condition.	Set to zero Use only instance attribute 24, configurable per output channel.
16	Get	NV	Auxiliary Link-Time Out	UINT	Link timeout.	Fixed at 1000 ms (1s)

NV status relates to nonvolatile storage in the auxiliary module, not the main module.

Table 254 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Current Output Value	REAL	Provides processed current output value in mA	
2	Get	V	Source Measurement Value	REAL	Provides actual measurement value in engineering units	
General				Group of 3 configuration attributes.		
16	Get	V	Current Output Enable	SINT	Current output enable control.	0: Not enabled 1: Enabled
17	Get	V	Current Output Measurement Identifier	INT	Defines source of 4…20 mA signal	Source selection
18	Get	V	Current Output Name	SINT[32]	A name to identify this output instance	32 characters
Output Scaling				Group of 3 configuration attributes.		
19	Get	V	20 mA Output Scaling	REAL	Definition of measurement value that is associated with 20 mA.	Range: -40000…50000
20	Get	V	4 mA Output Scaling	REAL	Definition of measurement value that is associated with 4 mA.	Range: -50000…40000 Default: 0
24	Get	V	Current Output Not OK Configuration	SINT	The current output set when a fail condition is detected (TX Fail of associated channel, auxiliary bus failure, auxiliary module self-check fail)	Not OK configuration

Module address is fixed, as is the link between instances and current outputs.

Attribute Semantics

Current Module Status

The auxiliary output module reports its status as part of the normal exchanges with the main module. The bit assignments are as follows.

Instance ID	Description
0	Auxiliary Module Not Responding
1	Auxiliary Module Configured
2	MSP Code (CRC) Fault
3	MSP High Temperature
4	Link Fail
5	Halt Active
6	MSP RAM Fault
7	MSP RAM Access Error

Bits 0…7 are common to all types of auxiliary module, bits 8 to 15 are specific to type.

The auxiliary module controls Bits …15, and the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

Bit	Description
8	Output 0 Is Not Inhibited
9	Output 1 Is Not Inhibited
10	Output 2 Is Not Inhibited
11	Output 3 Is Not Inhibited
12	Reserved
13	Reserved
14	Reserved
15	Reserved

In the unlikely event the auxiliary module is found to be in Boot Loader mode (not running operation firmware), the main module sets the auxiliary module status to a special code: Decimal: 65,534, Hexadecimal: 0xFFFE, Binary: 11111111 11111110.

Although the auxiliary module is responding, it is in a non-operational state and is classed as a failure from the perspective of a Fault Relay.

Table 255 - Not OK Configuration

Bit	Description
0	No Action
1	Force Low (2.9 mA)
2	Force High (21 mA)

Table 256 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Dynamix Module Control Object

The Module Control Object (class code 0x39E) provides module-level controls, which are implemented in one instance.

DSP/NetX refer to the two on-board processors: the digital signal processor and the "NetX", communication and condition monitoring auxiliary processor.

Table 257 - Object Instances

Instance ID	Description
0	Module Control Class Instance

Table 258 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
Auxiliary Modules				A group of two configuration attributes.		
2	Get	V	Detected Auxiliary Modules	BYTE	Bit-wise indication of detected auxiliary modules.	Auxiliary modules
16	Get	V	Configured Auxiliary Modules	BYTE	Bit-wise configuration of expected auxiliary modules.	Auxiliary modules
17	Get	NV	Serial Number	SHORT_STRING	Warranty Serial Number	Alpha-numeric
18	Get	-	NetX CPU Usage	UINT	Percentage CPU in use	0 to 10,000 = 0 to 100%
19	Get	-	Module Mode	BYTE	Current Module Mode/ Running Status	0 startup, 1 run, 2 program mode

Table 258 - Class Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
20	Get	NV	NetX Firmware Build	SHORT-STRING	Build Date (ASCII string)	for example, length 0x0B 56, 65, 70, 20, 31, 37 Sep 17 20, 32, 30, 31, 34 2014
21	Get	NV	DSP Firmware Build	UDINT	Build Version	for example, 10034 is V1.00.34
22	Get	-	DSP Configuration CRC	UINT	16-bit CRC for the DSP and Auxiliary relevant configuration	Is unchanged if configuration changes are limited to CM features
23	Get	-	NetX/DSP Error Status	DWORD	DSP: bits 0…15 NetX: bits 16…31	Normal (no error) status = 0 Bit 0 - DSP Not responding Bit 1 - DSP in boot loader mode Bit 2 - Configuration process failed to complete Bit 16 - Corrupt object file detected
Main Module Tacho				A configuration attribute.		
24	Get	V	Tacho Mode	SINT	Individual or Redundant Mode	0: Individual else Redundant Tacho Mode
Main Module Opto Outputs 0/1				A group of two configuration attributes.		
32	Get	V	Opto Output 0 Allocation	SINT	Source configuration for this Opto-isolated output.	Opto source
33	Get	V	Opto Output 1 Allocation	SINT	Source configuration for this Opto-isolated output.	Opto source
Main Module Local Onboard Relay				A logical grouping of parameters.		
39	Get	V	Auto Local Relay Control	BYTE	Configuration of local relay behavior in case of detected fault condition, which is based on associated voted alarm.	Returns 0 if relay source is not a voted alarm Relay control
40	Get	NV	User Local Relay Control	BYTE	User configuration of local relay behavior in case of detected fault condition.	Relay control
41	Get	NV	Local Relay Control	BYTE	Actual behavior of local relay in case of detected fault condition.	Relay control
42	Get	V	Relay Source	SINT	Link to corresponding voted alarm object (instance and output type).	Relay source decoding
43	Get	V	Relay Drive Test Enable	BOOL	Whether the relay drive circuit is being routinely tested.	Automatic on fail-safe setting
44	Get	V	Relay Drive Test Interval	UINT	Test interval.	ms
64	Get	V	Redundant Power Supply	SINT	Whether the module is being powered redundantly.	0: Not redundant 1: Redundant
Channel 0 DSP FFT				Group of seven configuration attributes.		
72	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
73	Get	V	Signal Source	SINT	Defines the data source.	Source

Table 258 - Class Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
74	Get	V	Measurement Units	ENGUNITS		Measurement units
75	Get	V	Line Resolution	SINT		Fixed at 1600 lines
76	Get	V	Window Function	SINT	Definition of window function used.	Window
77	Get	V	Number of Averages	SINT	FFT averaging.	Averages
78	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 1 DSP FFT				Group of seven configuration attributes.		
79	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
80	Get	V	Signal Source	SINT	Defines the data source.	Source
81	Get	V	Measurement Units	ENGUNITS		Measurement units
82	Get	V	Line Resolution	SINT		Fixed at 1600 lines
83	Get	V	Window Function	SINT	Definition of window function used.	Window
84	Get	V	Number of Averages	SINT	FFT averaging.	Averages
85	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 2 DSP FFT				Group of seven configuration attributes.		
86	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
87	Get	V	Signal Source	SINT	Defines the data source.	Source
88	Get	V	Measurement Units	ENGUNITS		Measurement units
89	Get	V	Line Resolution	SINT		Fixed at 1600 lines
90	Get	V	Window Function	SINT	Definition of window function used.	Window
91	Get	V	Number of Averages	SINT	FFT averaging.	Averages
92	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 3 DSP FFT				Group of seven configuration attributes.		
93	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
94	Get	V	Signal Source	SINT	Defines the data source.	Source
95	Get	V	Measurement Units	ENGUNITS		Measurement units
96	Get	V	Line Resolution	SINT		Fixed at 1600 lines

Table 258 - Class Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
97	Get	V	Window Function	SINT	Definition of window function used.	Window
98	Get	V	Number of Averages	SINT	FFT averaging.	Averages
99	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)

Attributes 72...79 (Channel 0...3 DSP FFT) refer to the FFT function of the DSP that is executed exclusively to calculate FFT Band data (Object 0x399 refers). The FFT calculated in the DSP is not served externally, stored internally, or used for any other purpose than the FFT Band function.

Attribute Semantics

Auxiliary Modules

Bit-wise setting/indication of the expected/detected auxiliary modules.

Table 259 - Auxiliary Modules

Bit	Description
0	Relay Output Module 0
1	Relay Output Module 1
2	Relay Output Module 2
3	4…20 mA Analog Output Module
4	Tacho Signal Conditioner
5…7	Reserved

'Detected' auxiliary modules is limited to expected modules that are detected.

Unexpected auxiliary modules are not communicated with and therefore are always undetected.

Redundant Tacho Mode

When redundant tacho mode is enabled, the two configured tacho sources (for tacho 0 & 1) serve as redundant sources for each other.

Example

- Tacho 0 is detected as being in a Not OK state, so it is automatically switched to Tacho 1 source.
- If Tacho 0 source is OK, then Tacho 1 state is checked and if Not OK is switched to Tacho 0 source

Note the following:

- The switching process does not change the underlying configuration
- As a tacho source 'switch' has been implemented, both tacho signals appear OK
- Bit 23 of the Channel/TX/Speed, Status DWORD 4 flags that a tacho source has been actively switched.

Local Relay Control

Bit-wise setting controlling how the local relay behaves under fault circumstances.

Table 260 - Local Relay Control

Bit	Description
0	Main Module Fault
1	Auxiliary Module Fault
2	Auxiliary Bus Communication Fail
3	E/IP Communication Failure
4	Tacho Fault
5	Reserved
6	Reserved
7	Latching

There are three parameters using these bit definitions.

Parameter	Description
Auto Local Relay Control	This parameter follows the logic that when associated with a fail-safe voted alarm a main module fault also activate the relay (so the appropriate bits are set). Otherwise it is zero. Read only to the user.
User Local Relay Control	This parameter allows selection from a number of faults that can also be considered.
Local Relay Control	This parameter is a bit-wise logical AND of the Auto and User controls. This is what is implemented and is read only to the user. The objective being that more faults that the relay reacts to can be added (above those faults implicit in the Voted Alarm selection) or dedicate the relay only to the indication of certain selected faults.

Table 261 - Relay Source Decoding

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted ALARM INSTANce 1…13 Output type: TX OK
Higher Values	Reserved
126	Dedicated, Bypass Active Relay
127	Dedicated, Fault Relay, Local Relay Control

As the special functions (126 and 127) are not the result of Voted alarms, there is no definition of type - suggest fail-safe is adopted for these. Local Relay Control also includes a Latching bit, to give a latching control to these special functions.

0x00 defines the relay as disabled, multiple sources not allowed.

Opto Output Source

An index that allows for source selection.

Table 262 - Opto Output Source

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted ALARM INSTANce 1…13 Output type: TX OK
48	Local TTL Tacho Input 0
49	Local TTL Tacho Input 1
50	Tacho Bus 0
51	Tacho Bus 1
52	Tacho Bus OK 0
53	Tacho Bus OK 1
54	Local Logic Input 0
55	Local Logic Input 1
56	TX 0 Fault
57	TX 0 Fault
58	TX 0 Fault
59	TX 0 Fault
127	Module Status/OK

Indices 48…53 are routed directly in hardware, all other selections are actively controlled, based on the state of the source selected.

The local relay control allows for Module Fault to be to some extent, configurable on a per relay basis. Index 127 follows the first definition of module fault (first relay, so usually the main module relay configuration).

The designated opto output is inactive in the following circumstances:

- OFF
- No alarm
- Tacho OK
- Logic input open
- TX OK
- Module Status OK

Note therefore that as inactive equals shelf state, they are non-fail-safe.

For the local tacho inputs, the opto is inactive when the input signal is high (above the 2.5V threshold).

For the TSCX tacho inputs the opto is inactive when the input signal is LOW (below the configured threshold).

Source Selection

The DSP FFT can be sourced from one of the first four sources or the last one when those particular processing elements are configured as active (Channel Set Up Object).

Index	Source
0x00 (0)	**ADCOUT** - Select ADC output stream (raw sampled data)
0x01 (1)	**Pre-Filter** - Before application-specific filters (and potentially after application-specific signal pre-processing)
0x02 (2)	**Mid-Filter** - Selected mid Filter identifies inclusion of application Low Pass Filter
0x03 (3)	**Post-Filter** - Selected post Filter identifies inclusion of both application Low and High Pass Filter including potentially enabled integration stages
0x04 (4)	**Alternate path** - A CM, alternate processing, path available when so configured in the Channel Set Up Object

Measurement Units

Actual selection of Measurement engineering units are a subset of the master engineering units list. It is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Index	FFT Resolution
0x04 (4)	1600 lines

Index	FFT Window
0x00 (0)	Normal/Rectangular
0x01 (1)	Flat Top
0x02 (2)	Hanning
0x03 (3)	Hamming

Index	Number of Averages
0x00 (0)	1
0x01 (1)	2
0x02 (2)	3
0x03 (3)	6
0x04 (4)	12
0x05 (5)	23
0x06 (6)	45
0x07 (7)	89
0x08 (8)	178

Table 263 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 264 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Set Module Time	Allows a module time date to be set (in the absence of a system time from the network). Data: UINT32 - seconds since 1970 UINT32 - nanoseconds

Identity Object

The Identity Object (class code 0x01) provides identification and general information about the device. The first instance identifies the whole device.

It is used for electronic keying and by applications wishing to determine what devices are on the network.

Table 265 - Object Instances

Instance ID	Description
0	Identity Class Instance
1	Instance 1 of the Identity object

Class Attributes

The Identify Object supports the following Class Attributes.

Table 266 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines revision of Identify Object	Current revision: 1
2	Get	V	maximum Instance	UINT		1
6	Get	V	maximum Class Attribute	UINT		7
7	Get	V	maximum Instance Attribute	UINT		102

Table 267 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Vendor ID	UINT		1 (RA)
2	Get	NV	Device Type	UINT		109
3	Get	NV	Product Code	UINT		72
4	Get	NV	major Revision	USINT		Firmware revision. See Attribute Semantics
			Minor Revision	USINT		
5	Get	V	Status	WORD		
6	Get	NV	Serial Number	SHORT_STRING	Warranty Serial Number	Alpha-numeric
7	Get	NV	Product Name	SHORT_STRING		“1444 Dynamix”
8	Get	V	State	USINT		
9	Get	NV	Conf. Consist. Value	UINT		
101	Get	NV	Hardware Revision	USINT	Major Revision	See Attribute Semantics
				USINT	Minor Revision	
102	Get	NV	Sub Minor Revision	UDINT	Sub Minor Revision	> 0

Attribute Semantics

Firmware Revision

Identity Object instance attribute 4 (and vendor-specific attribute 102) refer directly to the netX (communication) processor firmware revision but also reflect an overall version identification for a firmware release. A breakdown of the associated Firmware Revisions included in a release is tabulated in the following table.

Release	netX	DSP	Auxiliary Relay	Auxiliary 4-20mA	Auxiliary TSCX
2.001.2	2.001.2	1.01.02	3.10	3.10	3.10
2.001.7	2.001.7	1.01.08	3.10	3.10	3.13
3.001.3	3.001.3	1.02.6	3.10	3.10	3.63

Hardware Revision

Identity Object instance attribute 101 is a vendor-specific attribute that is used to identify the hardware revision. The correlation between that revision and the product label is tabulated in the following table.

Hardware Revision (major/minor/sub-minor)	Product Label
6.3	A

Table 268 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	x	x	Get_Attributes_All	Returns the contents of the specified attributes
0x05	x	x	Reset	Invokes the reset service for the device
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Message Router Object

The Message Router Object (class code 0x02) provides a messaging connection point through which a client can address a service to any object class or instance residing in the physical device.

This object is part of the standard Hilscher netX100 EIP protocol stack.

No attributes are implemented and no services are supported.

Assembly Object

The Assembly Object (class code 0x04) binds attributes of multiple objects, which allows data to or from each object to be sent or received over one connection.

Assembly Objects can be used to bind input data or output data. I/O data connections are established between an Originator (O) and a Target (T) where in this case, O is the controller and T is this module. Output data is sent in the O-T direction and Input data is sent in the T-O direction. The input data assembly therefore comprises measurements that are made by the module while the output data assembly is used for control data being sent to the module.

Table 269 - Object Instances

Instance ID	Description
0	Class Instance for the Assembly Object
100	Instance 1 defines one, input data assembly option (O- T)
101	Instance 2 defines one, output data assembly option (T - O)

Table 270 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines the current revision of the Assembly Object	Current: 2
2	Get	V	Maximum Instance	UINT		101

Table 271 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
3	Get	-	Data	STRUCT	The input or output data	-
4	Get	V	Size	UINT	The assembly (data) size	Number of bytes

Attribute Semantics

Member List

See I/O Message Formats.

IMPORTANT	Set access for Output data is not allowed as a security measure to help prevent disruption of controlled modules.

Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Object Specific Services

The Assembly Object provides no Object specific services.

Behavior

The contents of the input and output assemblies are configurable by way of an Input and an Output member list that are a part of the device configuration (Refer to Dynamix Configuration Manager Object, Configuration Group 18). These lists are not related to any Assembly Object services and so can neither be defined nor viewed via this object.

Input Assembly

The input assembly contains a fixed status portion followed by some configurable, measurement related content.

The fixed status element is comprised of 22 (UDINT) status DWORDS:

Table 272 - Auxiliary Processor Status

Bit	Description	Bit	Description
0	Connection Fault (managed by controller)	16	+1.5V Power Supply OK
1	Network Fault	17	+1.6V Power Supply OK
2	Network Address Fault	18	DSP 3.3V Power Supply OK
3	DSP Dual Port Memory Fault	19	5V Power Supply OK
4	Recoverable Fault	20	25.5V Power Supply OK
5	Non-recoverable Fault	21	+24V Power Supply OK
6	spare	22	-25.5 Power Supply OK
7		23	-24V Power Supply OK
8		24	AD Ch0&1 +6.5V Power Supply OK
9		25	AD Ch0&1 +5V Reference OK
10		26	spare
11		27	
12		28	
13		29	
14		30	AD Ch0&1 Monitored Power OK
15	Redundant Power Fault	31	AD Ch2&3 Monitored Power OK
Notes			

Bit	Description	Bit	Description
	Bit 1 Network Fault includes the following:		
	• Device powered off or with no IP address configured.		
	• Network cable not detected.		
	• An exclusive owner connection has timed out		
	Bit 2 Network Address Fault indicates an IP addressing conflict (address in use by another device).		
	Both bits 1 and 2 contribute to an "E/IP Communications Fault" in the context of a machine fault relay.		

Table 273 - Trend / Alarm Status

Bit	Description	Bit	Description
0	Set when the (low resolution) Discrete Trend buffer is cycling.	16	Low Resolution Discrete Trend alarm buffer status.
1	Set when the (high resolution) Discrete Trend buffer is cycling.	17	
2	Set when the FFT Trend buffer is cycling.	18	
3	Set when the TWF Trend buffer is cycling.	19	
4	spare	20	High Resolution Discrete Trend alarm buffer status.
5		21	
6		22	
7		23	
8		24	FFT Trend alarm buffer status.
9		25	
10		26	
11		27	
12		28	Time waveform Trend alarm buffer status
13		29	
14		30	
15		31	
Alarm Buffer Status Definition			
0	Disabled	Buffer is not being captured.	
1	Armed	Waiting for alarm event trigger.	
2	Populating	Alarm event in progress.	
3	Data Ready	Alarm data available.	
4	Latched	Alarm data available and latched until reset.	

Table 274 - Transient Status

Bit	Description	Bit	Description
0	Transient buffer 0 status.	16	spare
1		17	
2		18	
3		19	
4	Transient buffer 1 status.	20	
5		21	
6		22	
7		23	
8	Transient buffer 2 status.	24	
9		25	
10		26	
11		27	
12	Transient buffer 3 status.	28	
13		29	
14		30	
15		31	
Alarm Buffer Status Definition			
0	Buffer Free	Buffer is available, ready for a transient event.	
1	Data Ready Normal	Transient completed normally. Could be overwritten by a new event.	
2	Data Latched Normal	Transient completed normally. Buffer latched.	
3	Transient in Progress RPM	Delta RPM acquisition in progress.	
4	Transient in Progress Time	Delta time acquisition in progress.	
5	Data Ready Aborted	Speed crossed back over the initiating threshold. Could be overwritten by a new event.	
6	Data Latched Aborted	Speed crossed back over the initiating threshold. Buffer latched.	
7	Data Ready Buffer Full	Buffer was filled before event concluded. Could be overwritten by a new event.	
8	Data Latched Buffer Full	Buffer was filled before event concluded. Buffer latched.	
9	Buffer Not Allocated	Buffer not used.	

Table 275 - DSP Processor Status

Bit	Description	Bit	Description
0	If bits 0, 1 and 2 are 0, the DSP is ready. Anything else, the DSP is either starting up or changing configuration.	16	A calibration time-out.
1		17	Main module relay inhibit is active (repeat of bit 1 Alarm 0 status).
2		18	Main module relay drive test fail.
3	Spare	19	Extended loop time warning (>47 ms).
4	DSP memory fault.	20	Multiplexing mode is active.
5	DSP FLASH/RAM CRC discrepancy.	21	Spare
6	Spare	22	Any speed fail.
7	DSP Reset/Power cycle indication – set when the DSP is running from a DSP Flash configuration.	23	Set if current speed > 1x the maximum speed for synchronous measurements.
8	High temperature warning.	24	Set if current speed > 2x the maximum speed for synchronous measurements.
9	Any SPM active.	25	Set if current speed < the minimum speed for synchronous sampling.
10	DSP New Configuration.	26	Extended loop time warning (>100 ms).
11	Spare	27	Summary Fault for main module.
12	Any alarm inhibit active.	28	Summary Fault for expansion modules.
13	Spare	29	+5VA Power Supply Fault.
14	Any expansion bus or module fault (any expansion module not present/responding or a configuration error).	30	+24V Power Supply Fault.
15	Any calibration error.	31	-24V Power Supply Fault.

Notes	
	Bit 5: If on recalling a configuration from flash the DSP finds a CRC mismatch, the configuration is considered corrupt. In this case the module sets bit 5 and load an internal default configuration from firmware. This presents a corrupt configuration from disrupting the ability to reload the required configuration from the DSP.
	Bit 7: Is briefly set during the start-up sequence but at other times may indicate the DSP has reset or that configuration by the auxiliary processor has failed (user should initiate another download action to make sure the module is correctly configured and to clear this indication).
	Bit 10: Set when the DSP receives a different configuration, unset at power-up or when it receives the same configuration gain. As the auxiliary processor helps prevent internal configuration when there are no changes. DSP receives the same data again when only configuration data has changed or irrespective of any change, if DSP or an expansion module is in fault status. So when there is a DSP configuration change, this bit usually stays set until the next power cycle or module reset.
	Bits 23-25: Full bandwidth synchronous sampling is available while the speed is between the minimum and maximum RPM. Between the maximum RPM and 2x the maximum RPM synchronous sampling is usable but has reduced bandwidth. Speeds lower than the minimum or >2x the maximum RPM are outside the operating envelope for synchronous sampling. NOTE: These are common to any channel/tacho, and therefore it is possible for bits 23/24 to be set at the same time as bit 25.

Table 276 - Channel / Tacho / Speed Status

Bit	Description	Bit	Description
0	Channel 0 Enabled.	16	Speed 0 Enabled.
1	Channel 1 Enabled.	17	Speed 1 Enabled.
2	Channel 2 Enabled.	18	Speed 0 Faulted.
3	Channel 3 Enabled.	19	Speed 1 Faulted.
4	Transducer 0 Enabled.	20	Bit toggles on new maximum speed detected on Speed 0.
5	Transducer 1 Enabled.	21	Bit toggles on new maximum speed detected on Speed 1.
6	Transducer 2 Enabled.	22	Redundant speed fault, speed source has switched.
7	Transducer 3 Enabled.	23	Spare
8	Transducer 0 Faulted.	24	Channel 0 Calibration Error.
9	Transducer 1 Faulted.	25	Channel 1 Calibration Error.
10	Transducer 2 Faulted.	26	Channel 2 Calibration Error.
11	Transducer 3 Faulted.	27	Channel 3 Calibration Error.
12	Transducer 0 Wire Off Detected.	28	Spare
13	Transducer 1 Wire Off Detected.	29	
14	Transducer 2 Wire Off Detected.	30	
15	Transducer 3 Wire Off Detected.	31	

Table 277 - Relay Expansion Module 0 / 1 Status

Bit	Description (Expansion Relay Module 0)	Bit	Description (Expansion Relay Module 1)
0	Relay module not responding. If set disregard other bits in this group.	16	Relay module not responding. If set disregard other bits in this group.
1	Module is configured (so normally expected set).	17	Module is configured (so normally expected set).
2	Code CRC fault.	18	Code CRC fault.
3	High temperature warning.	19	High temperature warning.
4	Link/bus fail.	20	Link/bus fail.
5	Halt is active.	21	Halt is active.
6	RAM fault.	22	RAM fault.
7	RAM access error.	23	RAM access error.
8	Relay 0 not inhibited (so normally set).	24	Relay 0 not inhibited (so normally set).
9	Relay 1 not inhibited.	25	Relay 1 not inhibited.
10	Relay 2 not inhibited.	26	Relay 2 not inhibited.
11	Relay 3 not inhibited.	27	Relay 3 not inhibited.
12	Relay 0 drive failure.	28	Relay 0 drive failure.
13	Relay 1 drive failure.	29	Relay 1 drive failure.
14	Relay 2 drive failure.	30	Relay 2 drive failure.
15	Relay 3 drive failure.	31	Relay 3 drive failure.

Table 278 - Relay Expansion Module 2 / Expansion Module Communications Status

Bit	Description (Expansion Relay Module 2)	Bit	Description (Expansion Relay Module 1)
0	Relay module not responding. If set disregard other bits in this group.	16	Relay module 0 (address 1) status.
1	Module is configured (so normally expected set).	17	
2	Code CRC fault.	18	
3	High temperature warning.	19	Relay module 1 (address 2) status.
4	Link/bus fail.	20	
5	Halt is active.	21	
6	RAM fault.	22	Relay module 2 (address 3) status.
7	RAM access error.	23	
8	Relay 0 not inhibited (so normally set).	24	
9	Relay 1 not inhibited.	25	Analog Output module status.
10	Relay 2 not inhibited.	26	
11	Relay 3 not inhibited.	27	
12	Relay 0 drive failure.	28	Tachometer Signal Conditioner module status.
13	Relay 1 drive failure.	29	
14	Relay 2 drive failure.	30	
15	Relay 3 drive failure.	31	Spare
Status Response Codes			
	0: Normal / no exception.		
	1: Invalid command / command not recognized.		
	2: Not used.		
	3: Message 2 and message 1 data content does not agree.		
	4: Not used.		
	5: No message 1 data was received (send only if message 2 data is received).		
	6: Module not configured.		
	7: Not used.		

Table 279 - Analog Output Module / Tacho Signal Conditioner Status

Bit	Description (Analog Output Module)	Bit	Description (Tacho Signal Conditioner)
0	Analog output module not responding. If set disregard other bits in this group.	16	Tacho signal conditioner module not responding. If set disregard other bits in this group.
1	Module is configured (so normally expected set).	17	Module is configured (so normally expected set).
2	Code CRC fault.	18	Code CRC fault.
3	High temperature warning.	19	High temperature warning.
4	Link/bus fail.	20	Link/bus fail.
5	Halt is active.	21	Halt is active.
6	RAM fault.	22	RAM fault.
7	RAM access error.	23	RAM access error.
8	Channel 0 not inhibited (so normally set).	24	Spare
9	Channel 1 not inhibited.	25	
10	Channel 2 not inhibited.	26	Speed 0 Estimated.
11	Channel 3 not inhibited.	27	Speed 1 Estimated.
12	Spare	28	+25V5 supply fail.
13		29	-25V5 supply fail.
14		30	Tacho 0 sensor fault.
15		31	Tacho 1 sensor fault.

Table 280 - Alarm Status 0-12 (1 for each of the 13 Alarm Status outputs)

Bit	Description	Bit	Description
0	Set when any associated relay outputs & light-emitting diode are set to the alarm state.	16	Indicates the current state of measurement input 0.
1	Set if the alarm is disabled.	17	Indicates the current state of the transducer associated with measurement input 0.
2	Set if the alarm is configured as latching.	18	Indicates the current state of measurement input 1.
3	Set when the conditions for the “alarm state” are true.	19	Indicates the current state of the transducer associated with measurement input 1.
4	Set when the alarm is bypassed (associated relay outputs/LED held in non-alarm state).	20	Indicates the current state of measurement input 2.
5	Set when the alarm thresholds are being applied in trip multiply mode.	21	Indicates the current state of the transducer associated with measurement input 2.
6	Not used.	22	Indicates the current state of measurement input 3.
7	Set to indicate First Out alarm (Reevaluated after Alarm Reset or Bypass).	23	Indicates the current state of the transducer associated with measurement input 3.
8	Spare	24	Indicates the current state of the speed gating measurement.
9		25	Indicates the speed used for the speed gating measurement is in fault.
10	Which voted alarm instance this Alarm Status refers to. Use the nibble to indicate the instance number, range 1-13. Special relay sources (126/127) report “instances” 14/15 respectively (and no/zero output type).	26	Indicates the state of the 1st, 2nd and 3rd gating logic inputs. Where multiple logic gating inputs are configured they are applied with AND logic.
11		27	
12		28	
13		29	Indicates the state of the configured Logic Control (1 indicates control is active, alarm is being triggered).
14	Whether the alarm status is the Alert (1), Danger (2) or Transducer Fault (2) output.	30	Used for module fault or when in bypass indicating mode (bit set to 1 indicates fault/ bypass is active/on).
15		31	Spare
Notes			
	The first byte (8 bits) provides the status of the Alarm Status instance.		
	The Alarm Status Word (the 2nd 16 bits) gives in depth information on the various conditions to the alarm and its current state. Use requires some knowledge to use but is helpful in understanding why an alarm hasn’t happened, how close to an alarm it is (number of XooY matched). Similarly it can provide information on actually what caused an alarm (sometimes difficult to ascertain in a complex voted alarm). For the alarm status word (bits 16-23 and 24-25): • For measurement bit: 1 means over threshold or outside window, 0 means under threshold or inside window. • For Transducer OK state bit: 1 means fault, 0 means okay.		

Table 281 - Relay Status

Bit	Description	Bit	Description
0	Main module relay is energized.	16	Spare
1	Relay module 0 (address 1), relay 0 energized.	17	
2	Relay module 0 (address 1), relay 1 energized.	18	
3	Relay module 0 (address 1), relay 2 energized.	19	
4	Relay module 0 (address 1), relay 3 energized.	20	
5	Relay module 1 (address 2), relay 0 energized.	21	
6	Relay module 1 (address 2), relay 1 energized.	22	
7	Relay module 1 (address 2), relay 2 energized.	23	
8	Relay module 1 (address 2), relay 3 energized.	24	
9	Relay module 2 (address 3), relay 0 energized.	25	
10	Relay module 2 (address 3), relay 1 energized.	26	
11	Relay module 2 (address 3), relay 2 energized.	27	
12	Relay module 2 (address 3), relay 3 energized.	28	
13	Spare	29	
14		30	
15		31	
Notes			
	If any of the expansion relay modules are not present, their control and indication can be configured and used as virtual relays.		

Output Assembly

The output assembly includes a fixed 2 integer “Control” tag, of which only the first integer is used. Optionally, the Control Tag may be followed by 2, 16 or 18 REALs.

Table 282 - Output Control Tag

Bit	Description	Bit	Description
0	Trip (alarm) Inhibit (Bypass).	16	Spare
1	Set Point Multiplier Enable 0.	17	
2	Set Point Multiplier Enable 1.	18	
3	Speed0 ok status.	19	
4	Speed1 ok status.	20	
5	Gate0 control.	21	
6	Gate1 control.	22	
7	Alarm reset.	23	
8	Alarm buffer trigger.	24	
9	Alarm buffer reset.	25	
10	Transient buffer0 reset.	26	
11	Transient buffer1 reset.	27	
12	Transient buffer2 reset.	28	
13	Transient buffer3 reset.	29	
14	Maximum speed measurement reset (all speeds).	30	
15	Spare	31	
Notes			
	If any of the expansion relay modules are not present, their control and indication can be configured and used as virtual relays.		

Table 283 - Output Speed Tag (Optional)

REAL	Description
0	Speed 0
1	Speed 1
Note	
	The speed tag is an optional array "Speed[2]" of two RPM values that the module can use as input to either of its speed measurements. The tag is included in the output when specified in Module Definition.

Table 284 - Output Alarm Limits Tag (Optional)

REAL	Description	REAL	Description
0	Limit 0	8	Limit 8
1	Limit 1	9	Limit 9
2	Limit 2	10	Limit 10
3	Limit 3	11	Limit 11
4	Limit 4	12	Limit 12
5	Limit 5	13	Limit 13
6	Limit 6	14	Limit 14
7	Limit 7	15	Limit 15
Notes			
	The alarm limits tag is an optional array “AlarmLimits[16]” of sixteen limit values that the module can reference as an alert or alarm, low or high, limit. The tag is included in the output when specified in Module Definition.		
	When using the alarm limits from the controller, following the module start-up or configuration download, the alarm limits provided are not applied until a nonzero alarm threshold is received. Until that time, the alarm thresholds included in the configuration are used. This is to avoid applying zero value alarm limits in the time before the controller updates the output AlarmLimits tag.		

File Object

The File object (class code 0x37) holds the EDS (Electronic Data Sheet) file of the device.

Table 285 - Object Instances

Instance ID	Description
0	Class Instance of the CIP Time Sync Object0 Class Instance
200	Module EDS file

Table 286 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
3	Get		Number of Instances	UINT	Number of instances present	0…65535
32	Get		Directory:	Array of STRUCT	Attribute 3 indicates the array depth.	For the EDS instance
			Instance Number	UINT		0xC8
			Instance Name	STRINGI		EDS and Icon Files
			File Name	STRINGI		EDS.txt

Table 287 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get		State			
2	Get		Instance name		STRINGI	EDS and Icon Files
3	Get		Instance Format Version	UINT		1
4	Get		File Name	STRINGI		EDS.txt
5	Get		File Revision	USINT	major/Minor	As within the EDS file
6	Get		File Size	UDINT		Bytes
7	Get		File Checksum	INT		
8	Get		Invocation Method	USINT		255 - Not Applicable
9	Get		File Save Parameters	BYTE		0
10	Get		File Type	USINT		1 - Read Only
11	Get		File Encoding Format	USINT		0 - Binary

Attribute Semantics

State

0 - Nonexistent

1 - No file loaded

2 - Fled loaded

3 - Transfer Upload Initiated

4 - Transfer Download Initiated

5 - Transfer Upload in Progress

6 - Transfer Download in Progress

7 - Storing

8…255 - Reserved

Table 288 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 289 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	x	Initiate Upload	Start a file upload
0x4F	-	x	Upload Transfer	Performs a file transfer upload

Time Sync Object

The Time Sync Object (class code 0x43) provides a CIP interface to the IEEE 1588 Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems. This is commonly referred to as the Precision Time Protocol or PTP.

Table 290 - Object Instances

Instance ID	Description
0	Class Instance of the CIP Time Sync Object
1	Active instance of the CIP Time Sync Object

Table 291 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Revision of Object	Revision 3
2	Get		Maximum Instance	UINT	One Instance is supported	1

Table 292 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get/Set	NV	PTPEnable	BOOL		Default = 1/Enabled
2	Get		IsSynchronized	BOOL		1: Synchronized
3	Get		SystemTimeMicroseconds	ULINT		Microseconds
4	Get		SystemTimeNanoseconds	ULINT		Nanoseconds
5	Get		OffsetFromMaster	LINT		Nanoseconds
6	Get/Set		maxOffsetFromMaster	ULINT		Nanoseconds
7	Get		MeanPathDelayToMaster	LINT		Nanoseconds
8	Get		Grand MasterClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MAC ADDR.
				UINT	ClockClass	0…255 (0: best)
				UINT	TimeAccuracy	Index values
				UINT	OffsetScaledLogVariance	lower = best
				UINT	CurrentUtcOffset	seconds
				WORD	TimePropertyFlags	
				UINT	TimeSource	Atomic, GPS, Radio
				UINT	Priority1	
				UINT	Priority2	
9	Get		ParentClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MAC ADDR.
				UINT	PortNumber	
				UINT	ObservedOffsetScaledLogVariance	
				UDINT	ObservedPhaseChangeRate	
10	Get		LocalClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MAC ADDR.

Table 292 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
				UINT	ClockClass	0…255 (0: best)
				UINT	TimeAccuracy	Index values
				UINT	OffsetScaledLogVariance	
				UINT	CurrentUtcOffset	seconds
				WORD	TimePropertyFlags	
				UINT	TimeSource	Atomic, GPS, Radio
11	Get		NumberOfPorts	UINT		1
12	Get		PortStateInfo	STRUCT		
				UINT	NumberOfPorts	1
				ARRAY		
				UINT	PortNumber	
				UINT	PortState	Index 1… 9
13	Get	NV	PortEnableCfg	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				UINT	PortEnable	1: Enabled
14	Get/Set	NV	PortLogAnnounceIntervalCfg	STRUCT		
				UINT	NumberOfPorts	1
				ARRAY		
				UINT	PortNumber	
				UINT	PortLogAnnounceInterval	log base 2 seconds
15	Get/Set	NV	PortLogSyncIntervalCfg	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				INT	PortLogSyncInterval	log base 2 seconds
18	Get/Set	NV	Do mainNumber	USINT		
19	Get		ClockType	WORD		
20	Get		manufactureIdentity	USINT(4)		
21	Get		ProductDescription	STRUCT		
				UDINT	Size	
				USINT[size]	Description	UTF-8 Unicode
22	Get		RevisionData	STRUCT		
				UDINT	Size	
				USINT[size]	Revision	UTF-8 Unicode
23	Get		UserDescription	STRUCT		
				UDINT	Size	
				USINT[size]	Description	UTF-8 Unicode

Table 292 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
24	Get		PortProfileIdentityInfo	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				USINT[8]	PortProfileIdentity	
25	Get		PortPhysicalAddressInfo	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				USINT[16]	PhysicalProtocol	
				UINT	SizeOfAddress	
				USINT[16]	PortPhysicalAddress	
26	Get		PortProtocolAddressInf	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				UINT	NetworkProtocol	E/IP = 1
				UINT	SizeOfAddress	
				USINT[16]	PortProtocolAddress	
27	Get		StepsRemoved	UINT	Local to Grandmaster	
28	Get		SystemTimeAndOffset	STRUCT		
				ULINT	SystemTimeAero	
				ULINT	SystemOffset	

Table 293 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x03	-	x	Get_Attributes_List	
0x04	-	x	Set_Attributes_List	
0x0E	x	x	Get_Attribute_Single	Returns the contents of the specified attribute
0x10	-	x	Set_Attribute_Single	Sets the specified attribute

Device Level Ring Object

The Device Level Ring Object (class code 0x47) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

This object provides the mechanism to configure a network with ring topology according to the DLR (Device Level Ring) part of the EtherNet/IP specification.

Table 294 - Object Instances

Instance ID	Description
0	Class Instance of DLR Object
1	Active instance of DLR configuration instance

Table 295 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines the current revision of the DLR Object	Current revision:

Table 296 - Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Semantics of Values
1	Get	Network Topology	USINT	0: Linear 1: Ring
2	Get	Network Status	USINT	0: Normal 1: Ring Fault 2: Unexpected loop detected 3: Partial network fault 4: Rapid fault/restore cycle
10	Get	Active Supervisor Address	STRUCT	See standard
12	Get	Capability Flags	DWORD	Module does not provide ring supervisor or redundant gateway functions. Capability flag is fixed at 130.

Table 297 - Common Services

Service Code	Implementation		Service Name
	Class	Instance	
0x01	-	x	Get_Attributes_All
0x0E	x	x	Get_Attribute_Single

Quality of Service Object

The Quality of Service Object (class code 0x48) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

Table 298 - Object Instances

Instance ID	Description
0	Class Instance of QoS Object
1	Instance 1 of the QoS Object

Table 299 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	USINT	Defines the current revision of the QoS Object	Current Revision: 1
2	Get	NV	Maximum instance	USINT		1

Table 300 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	V	802.1Q Tag Enable	USINT	Virtual LAN Tagging
4	Get	V	DSCP Urgent	USINT	Differentiated Services Code Point
5	Get	V	DSCP Scheduled	USINT	
6	Get	V	DSCP High	USINT	
7	Get	V	DSCP Low	USINT	
8	Get	V	DSCP Explicit	USINT	

Table 301 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	
0x10	-	x	Set Attribute Single	

TCP/IP Interface Object

The TCP/IP Object (class code 0xF5) is part of the auxiliary/communications processor EIP protocol stack. It holds the configuration relating to a device TCP/IP network interface.

Table 302 - Object Instances

Instance ID	Description
0	Class Instance of the TCP/IP Interface Object
1	Instance representing active TCP/IP Interface for the main module

Table 303 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	The current revision of the TCP/IP Interface Object	Current revision: 4
2	Get	V	Maximum Instance	UINT	Maximum number of available TCP/IP interface instances	1

Table 304 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get		Status	DWORD	Bits 0 -3 (value) • 0: Not configured • 1: Configuration based on BOOTP, DHCP, or NV stored configuration • 2: IP address based on the address switches (module base) Bits 4 and 5 relate to pending configuration changes in configuration attributes (see standard for details) Bit 6 - ACD Status is set when an address conflict is detected Bit 7 - ACD Fault is set when the current interface configuration cannot be used due to an ACD	
2	Get	NV	Configuration Capability	DWORD	Bit 0 set: BOOTP client capable BIT 2 set: DHCP client capable Bit 4 set: Interface Configuration attribute is settable Bit 5 set: Hardware configurable (address switches) Bit 6 Not set: A change in the Interface Configuration attribute takes place immediately Bit 7 set: The module is ACD capable	0xB5 (10110101)
3	Get/Set	NV	Configuration Control	DWORD	Configuration method, Bits 0 - 3 (value) 0: Static 1: BOOTP 2: DHCP Note: Writing 0 to the Configuration Control makes BOOTP/DHCP addresses non-volatile.	
4	Get	NV	Physical Link Object	STRUCT		
5	Get/Set	Configuration dependent	Interface Configuration	STRUCT	When the TCP/IP addressing is based on the hardware switches, the default gateway address setting is 192.168.1.1 unless the switch defined module address is itself 192.168.1.1, in which case the default gateway address reverts to the legacy setting of 0.0.0.0. The default gateway address forms part of Attribute 5, Interface configuration.	
6	Get/Set	NV	Host Name	STRING		

Table 304 - Instance Attributes (continued)

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
10	Get/Set	NV	Select ACD	BOOL	Address Conflict Detection	
11	Get/Set	NV	Last Conflict Detected	STRUCT	Structure of 35 USINT	
13	Get/Set	NV	Encapsulation Inactivity Timeout	UINT	Timeout in seconds (1-3600)	0 = Disabled Default = 120 s

Table 305 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	-	x	Get Attributes All	Returns the contents of the specified attributes
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute
0x10	-	x	Set Attribute Single	Sets the specified attribute

Ethernet Link Object

The Ethernet Link Object (class code 0xF6) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

The Ethernet Link Object maintains link-specific counters and status information for an Ethernet communication interface.

A request to access instance 1 of the Ethernet Link Object refers to the instance associated with the communication interface over which the request was received.

Table 306 - Object Instances

Instance ID	Description
0	Ethernet Link Class Instance
1	Instance representing port 1
2	Instance representing port 2

Table 307 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current revision of this Object	Current revision: 3
2	Get	V	Maximum Instance	UINT		2
3	Get	V	Number of Instances	UINT		2

Table 308 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get		Interface Speed	UDINT		0x64 (100 Mbps)
2	Get		Interface Flags	DWORD		
3	Get		Physical Address	STRUCT	Array of 6 USINT values	MAC ID
4	Get		Interface Counters	STRUCT	Array of 11 UDINT values	
5	Get		Media Counters	STRUCT	Array of 12 UDINT values	
6	Get/Set		Interface Control	STRUCT	Two control bits are supported: Bit 0: Set for (802.3) auto negotiated enabled Bit 1 - Forced duplex mode, set for full-duplex (only applicable with autonegotiation disabled. If auto-negotiate is disabled, the Forced Interface Speed parameter indicates the speed at which the interface operates in megabits per second. Examples for 10 mpbs the value is 10.	
9	Get/Set		Administrative State		Enable/disable	1: Enable 2: Disable
10	Get		Interface Label	SHORT_STRING		port 1/port 2

Table 309 - Common Services

Service Code	Implementation		Service Name
	Class	Instance	
0x0E	x	x	Get Attribute Single
0x10	-	x	Set Attribute Single

Nonvolatile Storage Object

The Nonvolatile Storage Object (class code 0xA1) is a vendor-specific object that, on the Dynamix 1444, provides a means for firmware update using ControlFLASH™ software.

Table 310 - Object Instances

Instance ID	Description
0	NVS Class Instance
1	Instance 1 of the NVS object (NetX firmware)
2	Instanc2 of the NVS object (DSP firmware)

Table 311 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current revision of this Object	Current revision: 3
2	Get	V	Maximum Instance	UINT	Maximum instance number of an object that is created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.
3	Get	V	Number of Instances	UINT	Number of object instances. The number of object instances at this class hierarchy level that is created at this class level of the device.	The number of object instances at this class hierarchy level.

Table 312 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Status	UINT	Status of the NVS object.	Status
2	Get	V	major Instance Revision	USINT	Current major revision number of this NVS instance.	
			Minor Instance Revision	USINT	Current minor revision number of this NVS instance.	
3	Get	V	Size	UDINT	Number of bytes contained in this NVS instance.	
4	Get	V	Checksum	UDINT	Checksum/CRC or similar value that is embedded within the collection of bits.	Returns the checksum/CRC value

The Status attribute reports the status that is based on the state of an instance of the object. The assignment of values to ‘r; Status’ is as follows.

Value	Description
0	Nothing new/no update
1	Success on transfer
2	Success on programming
3	Failure on transfer
4	Failure on programming
5	Faulted

Table 313 - Common Services

Service Code	Implementation		Service Name
	Class	Instance	
0x0E	x	x	Get Attribute Single

Common Codes and Structures

Table 314 - Generic CIP Status Codes

Code	Name	Description
0x00 (0)	Success	Service was successfully performed by the object specified.
0x01 (1)	Connection failure	A connection-related service failed along the connection path.
0x02 (2)	Resource unavailable	Resources are needed for the object to perform the requested service were unavailable.
0x03 (3)	Invalid parameter value	See Status Code 0x20, which is the preferred value to use for this condition.
0x04 (4)	Path segment error	The path segment identifier or the segment syntax was not understood by the processing node. Path processing stops when a path segment error is encountered.
0x05 (5)	Path destination unknown	The path is referencing an object class, instance, or structure element that is not known or is not contained in the processing node. Path processing stops when a path destination unknown error is encountered.
0x06 (6)	Partial transfer	Only part of the expected data was transferred.
0x07 (7)	Connection lost	The messaging connection was lost.
0x08 (8)	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
0x09 (9)	Invalid attribute value	Invalid attribute data detected.
0x0A (10)	Attribute list error	An attribute in the Get Attribute List or Set Attribute List response has a nonzero status.
0x0B (11)	Already in requested mode/state	The object is already in the mode/state requested by the service.
0x0C (12)	Object state conflict	The object cannot perform the requested service in its current mode/state
0x0D (13)	Object already exists	The requested instance of object to be created already exists.
0x0E (14)	Attribute not settable	A request to modify a non-modifiable attribute was received.
0x0F (15)	Privilege violation	A permission/privilege check failed.
0x10 (16)	Device state conflict	The current mode/state of the device prohibits the execution of the requested service.
0x11 (17)	Reply data too large	The data to be transmitted in the response buffer is larger than the allocated response buffer.
0x12 (18)	Fragmentation of a primitive value	The service specified an operation that is going to fragment a primitive data value, such as half a REAL data type.
0x13 (19)	Not enough data	The service did not supply enough data to perform the specified operation.
0x14 (20)	Attribute not supported	The attribute that is specified in the request is not supported.
0x15 (21)	Too much data	The service supplied more data than was expected.
0x16 (22)	Object does not exist	The object that is specified does not exist in the device.
0x17 (23)	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently active for this data.
0x18 (24)	No stored attribute data	The attribute data of this object was not saved before the requested service.
0x19 (25)	Store operation failure	The attribute data of this object was not saved due to a failure during the attempt.
0x1A (26)	Routing failure, request packet too large	The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service.
0x1B (27)	Routing failure, response packet too large	The service response packet was too large for transmission on a network in the path from the destination. The routing device was forced to abort the service.
0x1C (28)	Missing attribute list entry data	The service did not supply an attribute in a list of attributes that the service needed to perform the requested behavior.
0x1D (29)	Invalid attribute value list	The service is returning the list of attributes that are supplied with status information for those attributes that were invalid.

Table 314 - Generic CIP Status Codes (continued)

0x1E (30)	Embedded service error	A vendor-specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code only needs performed when none of the Error Codes that are presented in this table or within an Object Class definition accurately reflect the error.
0x1F (31)	Vendor-specific error	A vendor-specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code only needs performed when none of the Error Codes that are presented in this table or within an Object Class definition accurately reflect the error.
0x20 (32)	Invalid parameter	A parameter that is associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an Application Object Specification.
0x21 (33)	Write-once value or medium already written	An attempt was made to write to a write-once medium (For example, WORM drive, PROM) that has already been written, or to modify a value that cannot be changed once established.
0x22 (34)	Invalid reply received	An invalid reply is received (For example, reply Service Code does not match the request Service Code, or reply message is shorter than the minimum expected reply size). This status code can serve for other causes of invalid replies.
0x23 (35)	Buffer overflow	The message received is larger than the receiving buffer can handle. The entire message was discarded.
0x24 (36)	Message-format error	The server does not support the format of the received message.
0x25 (37)	Key failure in path	The Key Segment that was included as the first segment in the path does not match the destination module. The object-specific status indicates which part of the key check failed.
0x26 (38)	Path size invalid	The size of the path that was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included.
0x27 (39)	Unexpected attribute in list	An attempt was made to set an attribute that is not able to be set currently.
0x28 (40)	Invalid member ID	The Member ID specified in the request does not exist in the specified Class/Instance/Attribute.
0x29 (41)	Member not able to be set	A request to modify a non-modifiable member was received.
0x2A (42)	Group 2 only server general failure	This error code can only be reported by DeviceNet Group 2 Only servers with 4K or less code space and only in place of Service not supported, Attribute not supported, and Attribute not able to be set.
0x2B (43)	Unknown Modbus error	A CIP to Modbus translator received an unknown Modbus Exception Code.
0x2C (44)	Attribute not attainable	A request to read a non-readable attribute was received.
0x2D (45)… 0xCF (207)	Reserved	Reserved
0xD0 (208)… 0xFF (255)	Reserved for Object Class and service errors	This range of error codes is used to indicate Object Class specific errors. Use of this range is only performed when none of the Error Codes that are presented in this table accurately reflect the error that was encountered.

General Code	Extended Code	Description
0x02	0x0201	The maximum number of class 3 connections are already in use
0x0F	0x0F01	Intrusive services are not allowed for unconnected messages
	0x0F02	A Set Attribute Single service is only allowed when there is an active class 3 connection that belongs to the module owner determined by the Vendor ID and the Device Serial Number
	0x0F03	User attempted to access a service that is limited to Class 1 access only
	0x0F04	User attempted to access a service that is only accessible if alarm inhibit is active
0x10	0x1001	An attempt to reconfigure the module was made while the module was already in program mode or in starting mode
	0x01002	A Set Attribute service on the Configuration Manager object was attempted while the module was in Program Mode or in Starting Mode
	0x1003	Intrusive services are not allowed on the Non-Volatile Storage Object (0xA1) unless the module is in an Out of Box state without an active class 1 connection

General Code	Extended Code	Description
	0x1004	Dynamic data requests and special service requests are not allowed while the module is in Program Mode (while the module is being configured).
0x1E		Embedded service error. The requested inter-processor message exchange (NetX to DSP and/or to an auxiliary module) failed to complete so the requested data cannot be returned.
0x20	<0x1FFFFFFF	Invalid parameter in one or more configuration groups. Bits 0 to 28 represent groups 1 to 29, if a group is in error the appropriate bit is set to 0/cleared. Example: 0x1FFCFFFF 0x1FFFFFFF - 0x1FFCFFFF = 0x300000 As binary: 11 0000 0000 0000 0000 So: Groups 17/18

Engineering Units

The module supports a subset of the standard and custom CIP Engineering unit lists, appropriate to the selected Channel Application Type.

Table 315 - CIP Engineering Unit List

Value/ID	Index	Name	Description
0x1200	24	°C	Temperature measurement application types (There is no conversion between temperature units, separate application types apply to each).
0x1201	22	°F	
0x1202	23	K	
0x1300	16	psi	Dynamic pressure measurement application.
0x1307	14	bar	
0x1308	15	mbar	
0x1309	19	Pa	
0x130A	18	kPa	
0x0C00	17	MPa	
0x1500	12	m/s^2	Vibration acceleration measurement applications.
0x1502	37	$in./s^2$	
0x1504	10	g	
0x0B00	8	mm/s^2	
0x0B01	11	mg	
0x0A00	(10)	gSE	Spike energy measurement application.
0x1703	-	degree	Phase angle measurement (orders/SMAX).
0x1C00	20	A	Current measurement application types.
0x1C02	21	mA	
0x1F0F	-	RPM	Available only when the application uses one or more of the two available tacho inputs
0x0F01	-	RPM/min	

Table 315 - CIP Engineering Unit List (continued)

0x2200	4	m	Displacement measurement (all forms) including vibration and position assessments.
0x2203	5	mm	
0x2204	6	micron	
0x2207	2	in.	
0x0800	3	mil	
0x2B00	13	m/s	Vibration velocity measurement applications.
0x2B07	7	in./s	
0x0900	9	mm/s	Voltage measurement application types and sensor DC bias measurement for most other application types.
0x2D00	0	V	
0x2D01	1	mV	

The left most two characters of the units ID shown in the table indicate the class from which that unit of measurement originates. The relevant CIP Standard and Custom EU Classes are listed in Table 316 and Table 317.

Table 316 - Standard CIP Engineering Unit Classes

Value	Name
0x12	Temperature
0x13	Pressure
0x15	Acceleration
0x17	Angle
0x1C	Current
0x1F	Frequency
0x22	Length
0x2B	Velocity
0x2D	Voltage

Table 317 - Custom CIP Engineering Unit Classes

Value	Name
0x08	Length
0x09	Velocity
0x0A	Bearing Defect Units
0x0B	Acceleration
0x0C	Pressure
0x0F	Other

Data Types

Type	Description	Data
BOOL	Boolean	1 byte
SINT	Short Integer	1 byte: -128…127
INT	Integer	2 bytes: -32768…32767
DINT	Double Integer	4 bytes: $-2^{31}\dots2^{31}-1$
LINT	Long Integer	8 bytes: $-2^{63}\dots2^{63}-1$
USINT	Unsigned Short Integer	1 byte: 0…255
UINT, UINT16	Unsigned Integer	2 bytes: 0…65535
UDINT, UINT32	Unsigned Double Integer	4 bytes: $0\dots2^{32}-1$
ULINT	Unsigned Long Integer	8 bytes: $0\dots2^{64}-1$
REAL	Floating Point	4 bytes: IEEE 754
DATE	Date Only	2 bytes: 1972-01-01 + 65536 day…2151-06-06
TIME_OF_DAY (TOD)	Time of Day	4 bytes: 1 msec resolution
SHORT_STRING	Character String (1 byte per character, 1 byte length indicator)	1 byte count header + 1*count byte sequence
STRINGI	International Character String	Structure
BYTE	Bit String	8 bits
WORD	Bit String	16 bits
DWORD	Bit String	32 bits
ENGUNIT	Engineering Unit	

Numerics

A

B

C

D

E

F

G

H

I

M

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Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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