

# Trusted TMR Interface

## Introduction

The Trusted® TMR Interface provides the interface between the Trusted Controller and the Regent and Regent+Plus I/O sub-systems. The Trusted TMR Interface supports the existing Regent I/O Safetybus, and the use of all Regent and Regent+Plus I/O modules as part of an I/O sub-system. For existing Regent+Plus systems, the module provides an upgrade path for these systems by replacing the Regent+Plus controller chassis with a Trusted Controller chassis.

## Features:

- Triplicated interfaces to Trusted TMR Processor and Regent/ Regent+Plus I/O modules.
- Use of proven Hardware Implemented Fault Tolerant (HIFT) principles.
- Maintains Regent VDE 0801 AK5 certification
- Certified as non-interfering for use in IEC 61508 SIL 3 systems
- Retains DIN19250/AK5 certification of the original Regent and Regent+Plus I/O
- 'Proven-in-use' design
- Hot replaceable
- Front panel status and fault indication.

Page intentionally left blank

## PREFACE

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. The examples given in this manual are included solely for illustrative purposes. Because of the many variables and requirements related to any particular installation, Rockwell Automation does not assume responsibility or reliability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, with respect to use of information, circuits, equipment, or software described in this manual.

All trademarks are acknowledged.

### DISCLAIMER

It is not intended that the information in this publication covers every possible detail about the construction, operation, or maintenance of a control system installation. You should also refer to your own local (or supplied) system safety manual, installation and operator/maintenance manuals.

### REVISION AND UPDATING POLICY

This document is based on information available at the time of its publication. The document contents are subject to change from time to time. The latest versions of the manuals are available at the Rockwell Automation Literature Library under "Product Information" information "Critical Process Control & Safety Systems".

### TRUSTED RELEASE

This technical manual applies to **Trusted Release: 3.6.1**.

### LATEST PRODUCT INFORMATION

For the latest information about this product review the Product Notifications and Technical Notes issued by technical support. Product Notifications and product support are available at the Rockwell Automation Support Center at

<http://rockwellautomation.custhelp.com>

At the Search Knowledgebase tab select the option "By Product" then scroll down and select the Trusted product.

Some of the Answer ID's in the Knowledge Base require a TechConnect Support Contract. For more information about TechConnect Support Contract Access Level and Features please click on the following link:

[https://rockwellautomation.custhelp.com/app/answers/detail/a\\_id/50871](https://rockwellautomation.custhelp.com/app/answers/detail/a_id/50871)

This will get you to the login page where you must enter your login details.

---

**IMPORTANT** A login is required to access the link. If you do not have an account then you can create one using the "Sign Up" link at the top right of the web page.

---

## DOCUMENTATION FEEDBACK

Your comments help us to write better user documentation. If you discover an error, or have a suggestion on how to make this publication better, send your comment to our technical support group at <http://rockwellautomation.custhelp.com>

## SCOPE

This manual specifies the maintenance requirements and describes the procedures to assist troubleshooting and maintenance of a Trusted system.

## WHO SHOULD USE THIS MANUAL

This manual is for plant maintenance personnel who are experienced in the operation and maintenance of electronic equipment and are trained to work with safety systems.

## SYMBOLS

In this manual we will use these notices to tell you about safety considerations.



**SHOCK HAZARD:** Identifies an electrical shock hazard. If a warning label is fitted, it can be on or inside the equipment.



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



**ATTENTION:** Identifies information about practices or circumstances that can cause injury or death.



**CAUTION:** Identifies information about practices or circumstances that can cause property damage or economic loss.



**BURN HAZARD:** Identifies where a surface can reach dangerous temperatures. If a warning label is fitted, it can be on or inside the equipment.



This symbol identifies items which must be thought about and put in place when designing and assembling a Trusted controller for use in a Safety Instrumented Function (SIF). It appears extensively in the Trusted Safety Manual.

### IMPORTANT

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

### NOTE

Provides key information about the product or service.

### TIP

Tips give helpful information about using or setting up the equipment.

**WARNINGS AND CAUTIONS**

---

**WARNING: EXPLOSION RISK**

Do not connect or disconnect equipment while the circuit is live or unless the area is known to be free of ignitable concentrations or equivalent

---

**AVERTISSEMENT - RISQUE D'EXPLOSION**

Ne pas connecter ou déconnecter l'équipement alors qu'il est sous tension, sauf si l'environnement est exempt de concentrations inflammables ou équivalente

---

**MAINTENANCE**

Maintenance must be carried out only by qualified personnel. Failure to follow these instructions may result in personal injury.

---

**CAUTION: RADIO FREQUENCY INTERFERENCE**

Most electronic equipment is influenced by Radio Frequency Interference. Caution should be exercised with regard to the use of portable communications equipment around such equipment. Signs should be posted in the vicinity of the equipment cautioning against the use of portable communications equipment.

---

**CAUTION:**

The module PCBs contains static sensitive components. Static handling precautions must be observed. DO NOT touch exposed connector pins or attempt to dismantle a module.

---

**ISSUE RECORD**

Issue	Date	Comments
8	Oct 05	Format
9	Nov 06	Specifications
10	Feb 08	Available positions
11	Nov 08	Supported modules
12	Oct 12	Supported modules
13	May 13	Supported modules T3402 and T3462 added
14	July 14	Change Module supported 3478 to 3480
15	July 2015	Converted document to Rockwell branding layout Clarified Regent certification status, corrected Operating Temperature and Relative Humidity Range statements, also added support for 3402, 3461/7461 and 3462 modules
16	Jun 16	Updated to incorporate IEEE standards and correct typographical errors

Page intentionally left blank



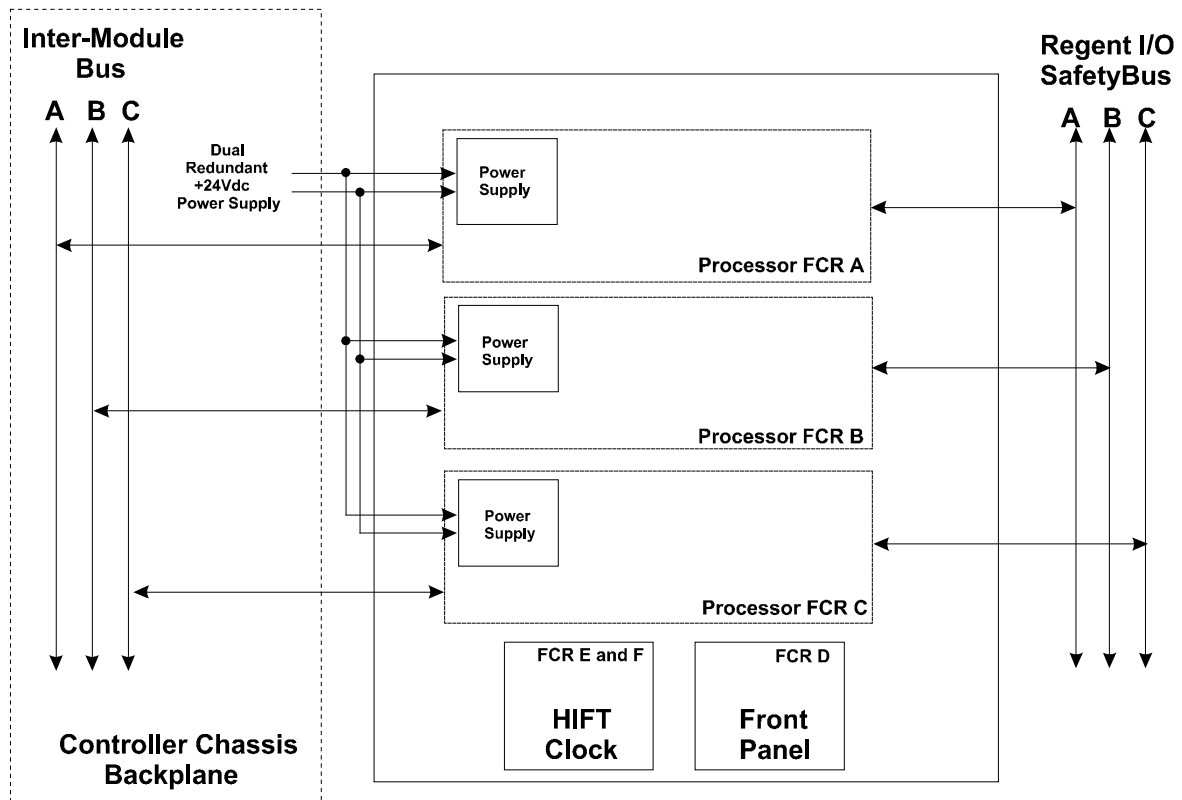
# Table of Contents

<b>1.</b>	<b>Description .....</b>	<b>3</b>
<b>2.</b>	<b>Installation .....</b>	<b>5</b>
2.1.	Module Insertion/Removal .....	5
2.2.	PCBs and Connectors .....	5
2.3.	Module Pinout Connections.....	6
2.3.1.	I/O Connector (PL 1).....	6
2.4.	Trusted Module Polarization/Keying .....	7
<b>3.</b>	<b>Application .....</b>	<b>9</b>
3.1.	Module Management .....	9
3.2.	Communication Buses.....	9
3.2.1.	Inter-Module Bus.....	9
3.2.2.	Processor Memory Voting Bus .....	9
3.2.3.	Processor Control Voting Bus .....	9
3.3.	Isolation.....	10
3.4.	I/O Modules Supported .....	10
<b>4.</b>	<b>Configuration .....</b>	<b>13</b>
4.1.	I/O Complex Equipment 'TTMRI' .....	13
4.2.	I/O Complex Equipment 'TTMRI_II' .....	15
4.3.	I/O Complex Equipment 'SX7401' .....	17
4.4.	I/O Complex Equipment 'TX7401' .....	18
4.5.	I/O Complex Equipment 'TX7401_P' .....	19
4.6.	I/O Complex Equipment 'SX3402' .....	20
4.7.	I/O Complex Equipment 'SX7402' .....	21
4.8.	I/O Complex Equipment 'TX3402' .....	22
4.9.	I/O Complex Equipment 'TX7402' .....	23
4.10.	I/O Complex Equipment 'TX7402_P' .....	24
4.11.	I/O Complex Equipment 'SX7404' .....	25
4.12.	I/O Complex Equipment 'TX7404' .....	26
4.13.	I/O Complex Equipment 'DX7411F' .....	27
4.14.	I/O Complex Equipment 'SX7411' .....	29
4.15.	I/O Complex Equipment 'SX7411F' .....	30
4.16.	I/O Complex Equipment 'SX7418F' .....	32
4.17.	I/O Complex Equipment 'F7419' .....	33
4.18.	I/O Complex Equipment 'SX7420A' .....	34
4.19.	I/O Complex Equipment 'SX7420D' .....	35
4.20.	I/O Complex Equipment 'S7420_PP' .....	36
4.21.	I/O Complex Equipment 'T3420AF' .....	37
4.22.	I/O Complex Equipment 'SX7431' .....	38
4.23.	I/O Complex Equipment 'SX7431A' .....	39

4.24.	I/O Complex Equipment 'SX7431AP and SX7431PP'	40
4.25.	I/O Complex Equipment 'TX3432'	41
4.26.	I/O Complex Equipment 'DX7441A'	43
4.27.	I/O Complex Equipment 'SX7441A'	44
4.28.	I/O Complex Equipment 'SX7444'	44
4.29.	I/O Complex Equipment 'SX7444'	45
4.30.	I/O Complex Equipment 'DX7444'	46
4.31.	I/O Complex Equipment 'SX7446'	47
4.32.	I/O Complex Equipment 'DX7446'	48
4.33.	I/O Complex Equipment 'DX7461'	49
4.34.	I/O Complex Equipment 'SX7462'	50
4.35.	I/O Complex Equipment 'DX7462'	50
4.36.	I/O Complex Equipment 'DX3462A'	51
4.37.	I/O Complex Equipment 'SX3462A'	52
4.38.	I/O Complex Equipment 'SX7464'	53
4.39.	I/O Complex Equipment 'DX7464'	54
4.40.	I/O Complex Equipment 'SX7480'	55
4.41.	I/O Complex Equipment 'SX7481'	56
4.42.	I/O Complex Equipment 'DX7481'	57
4.43.	I/O Complex Equipment 'DX7481PP'	58
4.44.	I/O Complex Equipment 'SX7481_P'	59
4.45.	I/O Complex Equipment 'SX7484'	60
4.46.	I/O Complex Equipment 'SX7484_P'	61
4.47.	I/O Complex Equipment 'DX7484'	62
4.48.	I/O Complex Equipment 'DX7484_P'	63
4.49.	I/O Complex Equipment 'SX7485'	64
4.50.	I/O Complex Equipment 'DX7485'	65
4.51.	I/O Complex Equipment 'SX7488'	66
4.52.	I/O Complex Equipment 'DX7488'	67
4.53.	I/O Complex Equipment 'M7491'	68
4.54.	I/O Complex Equipment 'M7491_IP'	69
4.55.	I/O Complex Equipment 'M7491_I'	70
4.56.	I/O Complex Equipment 'M7491_OP'	71
4.57.	I/O Complex Equipment 'M7491_O'	72
<b>5.</b>	<b>Operation</b>	<b>74</b>
5.1.	I/O Processor	75
5.2.	Watchdog Operation	75
5.3.	Front Panel	76
5.4.	Module Status LEDs	77
<b>6.</b>	<b>Fault Finding and Maintenance</b>	<b>78</b>
6.1.	Fault Reporting	78
6.2.	Testing and Diagnostics	78
<b>7.</b>	<b>Specifications</b>	<b>80</b>

# 1. Description

Figure 1 shows a block diagram of the Trusted TMR Interface.



**Figure 1 Block Diagram of the Trusted TMR Interface**

The Trusted TMR Interface is a Triple Modular Redundant (TMR), fault tolerant design containing six Fault Containment Regions (FCRs):

1. FCRs A, B, and C are processor sub-systems, each containing a processor, an I/O Processor logic unit, a Bus Interface, an I/O Safetybus interface and a power supply. The processor sub-systems work in lock-step synchronisation with each other.
2. Fault Containment Region (FCR) D is the front panel interface.
3. FCRs E and F are the master and secondary master oscillators of the HIFT system clocks.

Each module processor sub-system has interfaces to the Inter-Module Bus and the Regent I/O Safetybus. These interfaces consist of an input voter, discrepancy detector logic, and an output driver.

The voting and fault detection circuits allow the processor sub-systems to identify and isolate transient, intermittent, and permanent faults as they occur. All faults are recorded in the system's fault history.

The module's triplicated processor and Regent+Plus I/O interfaces ensure that no failure in the module will affect the operation of Trusted or Regent+Plus systems.

The triplicated power supply unit receives dual redundant +24 Vdc from the Controller chassis backplane, and converts the supply to the logic levels required by the module circuits. The module is capable of operating with a failure of either of the redundant power feeds.

The Trusted TMR Interface has three external interfaces:

1. Trusted Inter-Module Bus. Triplicated, high-speed interface to the Trusted TMR Processor.
2. Regent I/O Safetybus Interface. Fully triplicated, synchronised RS-485, 8-bit parallel data with clock and sync signals to the Regent and Regent+Plus I/O sub-system.
3. Front Panel Facilities. Status and fault indicators.

## 2. Installation

### 2.1. Module Insertion/Removal

**CAUTION:**

The module contains static sensitive parts. Static handling precautions must be observed. Specifically ensure that exposed connector pins ARE NOT TOUCHED. Under no circumstances should the module housing BE REMOVED.

---

Before installation, visually inspect the module for damage. Ensure that the module housing appears undamaged and inspect the I/O connector at the back of the module for bent pins. If the module appears damaged or any pins are bent, do not install the module. Do not try to straighten bent pins. Return the module for replacement.

Ensure that the module is of the correct type.

Record the module type, revision and serial number of the module before installation.

To install the module:

1. Ensure that the field cable assembly is installed and correctly located.
2. Release the ejector tabs on the module using the release key. Ensure that the ejector tabs are fully open.
3. Holding the ejectors, carefully insert the module into the intended slot.
4. Push the module fully home by pressing on the top and bottom of the module fascia.
5. Close the module ejectors, ensuring that they click into their locked position.

The module should mount into the chassis with a minimum of resistance. If the module does not mount easily, do not force it. Remove the module and check it for bent or damaged pins. If the pins have not been damaged, try reinstalling the module.

### 2.2. PCBs and Connectors

The Trusted TMR Interface has two main PCB assemblies:

1. The processor board, which contains the three processor sub-systems
2. The main board, which provides the Inter-module bus connection and Front Panel facilities.

## 2.3. Module Pinout Connections

### 2.3.1. I/O Connector (PL 1)

This connector provides a number of discrete input and outputs. These provide the Trusted TMR Interface with the connections for the Regent/ Regent+Plus I/O Safetybus. PL 1 is a 96 way DIN 41612 C type connector. See Table 1 for connector pin-out details.

Pin	Rows			Description
	A	B	C	
1	RS_485_SEATED_AN	RS_485_SEATED_BN	RS_485_SEATED_CN	Signal
2	Nc	Nc	Nc	No connection
3	Nc	Nc	Nc	No connection
4	SFTY_PD_A0	SFTY_PD_B0	SFTY_PD_C0	Signal (RS485)
5	SFTY_PDN_A0	SFTY_PDN_B0	SFTY_PDN_C0	Signal (RS485)
6	GND	GND	GND	0V
7	SFTY_PD_A1	SFTY_PD_B1	SFTY_PD_C1	Signal (RS485)
8	SFTY_PDN_A1	SFTY_PDN_B1	SFTY_PDN_C1	Signal (RS485)
9	GND	GND	GND	0V
10	SFTY_PD_A2	SFTY_PD_B2	SFTY_PD_C2	Signal (RS485)
11	SFTY_PDN_A2	SFTY_PDN_B2	SFTY_PDN_C2	Signal (RS485)
12	GND	GND	GND	0V
13	SFTY_PD_A3	SFTY_PD_B3	SFTY_PD_C3	Signal (RS485)
14	SFTY_PDN_A3	SFTY_PDN_B3	SFTY_PDN_C3	Signal (RS485)
15	GND	GND	GND	0V
16	SFTY_PD_A4	SFTY_PD_B4	SFTY_PD_C4	Signal (RS485)
17	SFTY_PDN_A4	SFTY_PDN_B4	SFTY_PDN_C4	Signal (RS485)
18	GND	GND	GND	0V
19	SFTY_PD_A5	SFTY_PD_B5	SFTY_PD_C5	Signal (RS485)
20	SFTY_PDN_A5	SFTY_PDN_B5	SFTY_PDN_C5	Signal (RS485)

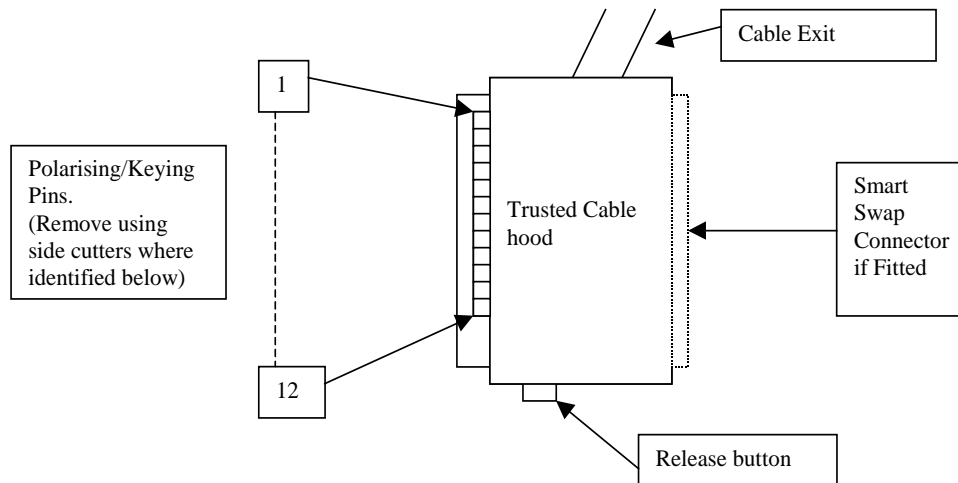
Pin	Rows			Description
	A	B	C	
21	GND	GND	GND	0V
22	SFTY_PD_A6	SFTY_PD_B6	SFTY_PD_C6	Signal (RS485)
23	SFTY_PDN_A6	SFTY_PDN_B6	SFTY_PDN_C6	Signal (RS485)
24	GND	GND	GND	0V
25	SFTY_PD_A7	SFTY_PD_B7	SFTY_PD_C7	Signal (RS485)
26	SFTY_PDN_A7	SFTY_PDN_B7	SFTY_PDN_C7	Signal (RS485)
27	GND	GND	GND	0V
28	SYNC_A	SYNC_B	SYNC_C	Signal (RS485)
29	SYNC_AN	SYNC_BN	SYNC_CN	Signal (RS485)
30	GND	GND	GND	0V
31	CLK_A	CLK_B	CLK_C	Signal (RS485)
32	CLK_AN	CLK_BN	CLK_CN	Signal (RS485)

Table 1 I/O Connector - Pin Out

## 2.4. Trusted Module Polarization/Keying

All Trusted Modules have been keyed to prevent insertion into the wrong position within a chassis. The polarization comprises two parts, the module and the associated field cable.

Each module type has been keyed during manufacture. The organization responsible for the integration of the Trusted system must key the cable by removing the keying pieces from the cable so that they correspond with the bungs fitted to the associated module prior to fitting.



**Figure 2 Module Polarization**

For cables with companion slot installations, both keying strips must be polarized.

For this module (T8160) remove keying pins 1, 2 and 7.



## 3. Application

### 3.1. Module Management

The module is configured automatically by the Trusted TMR Processor.

Configuration information in the module's memory is compared with the physical I/O sub-system. Any discrepancies are identified and reported.

Changeover between active and standby modules (in dual module configurations) is controlled by the Trusted TMR Processor, when the active Trusted TMR Interface either fails or is removed

### 3.2. Communication Buses

#### 3.2.1. Inter-Module Bus

The processor sub-system fault containment regions contain the Bus Interface for the Inter-Module Bus. The Bus Interface provides communication between modules in the Controller chassis.

The Inter-Module Bus contains the following triplicated signals:

- 6.5 V                      IMB power
- DATA                     8 bit, bi-directional bus
- CMND/RESP               bus direction control
- IOM\_SEL                  I/O module select signal
- IOM\_CLK                  I/O module clock signal
- SYS\_WDOG                indicates the operability of the associated TMR Processor fault containment region
- PWR\_FAIL                 indicates a power fault in the associated TMR Processor fault containment region.

Additionally, a CHASSIS CONNECTION signal is provided for grounding the module electromagnetic interference shield.

#### 3.2.2. Processor Memory Voting Bus

The memory voting bus is 8 bits wide and provides real-time voting of memory read cycles.

#### 3.2.3. Processor Control Voting Bus

The control voting bus is used to vote the necessary control signals for the Regent+Plus I/O Processor design.

### 3.3. Isolation

All signals exchanged between fault containment regions are protected to prevent the propagation of faults between independently powered regions.

The processor and front-panel interface fault containment regions provide isolation for the 24 Vdc power feed in addition to the POWER WARNING signal.

### 3.4. I/O Modules Supported

The T8160 interface provides the following support for the Regent (3xxx) and Regent+Plus I/O (7xxx) modules. The Regent and Regent+Plus module ranges share the same PCB hardware and are only distinguishable by their identity and plastic housing, the latter representing a development of the original plastic housing made to allow the module's front face to sit flush with a new chassis design. The descriptions relating to Regent+Plus I/O (7xxx) module identities used in this document may be assumed to also apply to the Regent I/O (3xxx) modules.

Module	Single module	Dual set	Triple set
3401/7401	Yes		Yes
3402/7402	Yes	Yes	Yes
3404/7404	Yes		Yes
3408/7408	No support		
3411/7411	Yes		
3411F/7411F	Yes	Yes	
3418F/7418F	Yes		
3419/7419	Yes		
3420A/7420A	Yes		
3420AF/7420AF	Yes – see below	Yes	Yes
3431/7431	Yes		
3431A/431A	Yes		
3432/7432	Yes – see below	Yes	Yes
3441A/7441A	Yes	Yes	
3444/7444	Yes	Yes	
3446H/7446H	Yes	Yes	

Module	Single module	Dual set	Triple set
3446L/7446L	Yes	Yes	
3454/7454	No support		
3461A/7461A	Yes	Yes	
3462A/7462A	Yes	Yes	
3464/7464	Yes	Yes	
3468A/7468A	No support		
3470A/7470A	Yes		
3480/7480	Yes		
3481/7481	Yes	Yes	
3481A/7481A	Yes	Yes	
3484/7484	Yes	Yes	
3485/485	Yes	Yes	
3488/7488	Yes	Yes	
3488A/7488A	Yes	Yes	
3491/7491	Yes		

**Table 2 Supported I/O Modules**

The 3420AF/7420AF and 3432/7432 are not supported in Toolset / processor firmware TÜV 3.5.1. They have since been added. Contact <http://www.rockwellautomation.com/support> for details if these modules are required.

Page intentionally left blank

## 4. Configuration

The creation of a system with an interface between a Trusted processor and Regent I/O chassis and modules requires an entry in the System INI Configuration and appropriate complex I/O definitions in the Toolset application I/O Connection Table.

The Trusted system will support the T8160 in any I/O module slot in the first ten Trusted chassis. However, the system configuration tool restricts its placement to the processor chassis.

The System INI configuration requires an entry for the T8160 TMR Interface in the appropriate chassis and slot. This has no configuration options to set. Details of how to design a System INI Configuration are described in PD-T8082.

The complex I/O definitions are described on the following pages. The TTMRI or TTMRI\_II definition must appear first in the list. Details of how to design the I/O Connection Table are given in PD-T8082.

### 4.1. I/O Complex Equipment 'TTMRI'

#### DESCRIPTION

Trusted TMR Interface to Regent equipment (simplex module).

#### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed. Chassis 1 is recommended for priority operation.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	

#### CONFIGURATION

##### Physical Module

RACK 1:	1 ANALOGUE Input	TMR Interface status. See "TMR Interface Status word format" in EXTRA INFORMATION for description of data
RACK 2:	16 ANALOGUE Inputs	Each variable contains data on the transceivers connected to the TMR Interface. Variable 1 is Regent chassis 1, Variable 16 is Regent chassis 16. See "Transceiver variable" in EXTRA INFORMATION for detailed data structure.

#### EXTRA INFORMATION

##### TMR Interface Status word format

Bit No.	Description	State
0	TMR Interface Slice A status	See TMR Interface Slice status information.
1	TMR Interface Slice A status	See TMR Interface Slice status information.

**TMR Interface Status word format**

Bit No.	Description	State
2	TMR Interface Slice B status	See TMR Interface Slice status information.
3	TMR Interface Slice B status	See TMR Interface Slice status information.
4	TMR Interface Slice C status	See TMR Interface Slice status information.
5	TMR Interface Slice C status	See TMR Interface Slice status information.
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	
10	Not Used	
11	Active/Standby	0 – Standby, 1 - Active
12	Educated	0 – uneducated, 1 - educated.
13	Impending Module Removal tabs status.	0 – ejectors open, 1 - ejectors closed
14	Module online	0 – TMR Interface offline, 1 - TMR Interface online
15	Permissible Slot	0 – Invalid Slot, 1 - Permitted

**TMR Interface Slice status information.**

Bit n+1	Bit n	State
0	0	Healthy slice
0	1	Transient fault
1	0	Hard fault
1	1	Unknown

**Transceiver variable**

Each of the 16 variables has the following configuration

Transceiver A bits 0,1

Transceiver B bits 2,3

Transceiver C bits 4,5

Bit n+1	Bit n	State
0	0	Transceiver Healthy
0	1	Transceiver transient fault
1	0	Transceiver hard fault
1	1	Unknown

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. This module must appear before any attached Regent modules in the rack list.
3. The Permissible Slot status bit is 1 when the TMR Interface module has been correctly configured in the I/O Connections and in the System Configuration Tool, even if the module is not present.
4. If the Module On-line status bit is zero, the other status bits should not be used.

## 4.2. I/O Complex Equipment 'TTMRI\_II'

### DESCRIPTION

Trusted TMR Interface (dual module).

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the first (left) TMR Interface module is placed. Chassis 1 is recommended for priority operation.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	

### CONFIGURATION

#### Physical Module

RACK 1:	2 ANALOGUE Inputs	TMR Interface status. Variable 1 contains data on the first TMR Interface, the second variable contains information on the second TMR Interface. See "TMR Interface Status word format" in EXTRA INFORMATION for description of data
RACK 2:	16 ANALOGUE Inputs	Each variable contains data on the transceivers connected to the TMR Interface. Variable 1 is Regent chassis 1, Variable 16 is regent chassis 16. See "transceiver variable" in EXTRA INFORMATION for detailed data structure

### EXTRA INFORMATION

#### TMR Interface Status word format

Bit No.	Description	State
0	TMR Interface Slice A status	See TMR Interface Slice status information.
1	TMR Interface Slice A status	See TMR Interface Slice status information.
2	TMR Interface Slice B status	See TMR Interface Slice status information.
3	TMR Interface Slice B status	See TMR Interface Slice status information.
4	TMR Interface Slice C status	See TMR Interface Slice status information.

**TMR Interface Status word format**

Bit No.	Description	State
5	TMR Interface Slice C status	See TMR Interface Slice status information.
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	
10	Not Used	
11	Active/Standby	0 – Standby, 1 - Active
12	Educated	0 – uneducated, 1 - educated.
13	Impending Module Removal tabs status.	0 – ejectors open, 1 - ejectors closed
14	Module online	0 – TMR Interface offline, 1 - TMR Interface online
15	Permissible Slot	0 – Invalid Slot, 1 - Permitted

**TMR Interface Slice status information.**

Bit n+1	Bit n	State
0	0	Healthy slice
0	1	Transient fault
1	0	Hard fault
1	1	Unknown

**Transceiver variable**

Each of the 16 variables has the following configuration

Transceiver A bits 0,1

Transceiver B bits 2,3

Transceiver C bits 4,5

Bit n+1	Bit n	State
0	0	Transceiver Healthy
0	1	Transceiver transient fault
1	0	Transceiver hard fault
1	1	Unknown

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. This module must appear before any attached Regent modules in the rack list.
3. The Permissible Slot status bit is 1 when the TMR Interface module has been correctly configured in the I/O Connections and in the System Configuration Tool, even if the module is not present.
4. If the Module On-line status bit is zero, the other status bits should not be used.



### 4.3. I/O Complex Equipment 'SX7401'

#### DESCRIPTION

T7401 DC Digital Input Module, 24 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 24 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 14 Vdc to 32 Vdc. This board definition is for a module used in a simplex configuration.

Product Description reference: PD-T7011 DC Digital Input Modules.

#### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

#### CONFIGURATION

16 input channels, Boolean, simplex 1 status channel Boolean.

##### Physical Module

1 (board) X 16 input channels, Boolean, simplex.

##### Logical Module

RACK 1:	16 BOOLEAN inputs	States of the module channel inputs identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE - channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE - board OK, TRUE – board fault.

#### Note:

Board channels are numbered 1 (LSB = bit 0) to 16 (MSB = bit 15).

#### PROGRAMMING NOTE

All channels for both real and virtual boards MUST have a variable attached regardless.

#### Notes:

- All parameters must be supplied, even for virtual boards.
- Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.4. I/O Complex Equipment 'TX7401'

### DESCRIPTION

T7401 DC Digital Input Module, 24 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 24 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 14 Vdc to 32 Vdc. This board definition is for modules used in a triplicated configuration.

Product Description reference: PD-T7011 DC Digital Input Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
REG_CHASSIS2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed.
REG_SLOT2	1 – 10	
REG_CHASSIS3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the third Module is placed.
REG_SLOT3	1 – 10	

### CONFIGURATION

#### Physical Module

3 (boards) X 16 digital input channels, Boolean, triplex.

#### Logical Module

RACK 1:	16 BOOLEAN inputs	Voted data for input channels TRUE – channel high, FALSE - channel low
RACK 2:	3 BOOLEAN inputs	Input reflecting the board status of the module specified. First channel is board status for board 1. Second channel is board status for board 2. Third channel is board status for board 3. FALSE – board ok, TRUE - board fault.
RACK 3:	16 BOOLEAN inputs	Data reflecting the discrepancy status of the last vote performed for the channel Channel 1 contains data for module channel 1, Channel 16 contains data for module channel 16. TRUE - A discrepancy has occurred, FALSE - All channels agree. The variable is not latched.

---

#### Note:

The value will be TRUE if any of the channels is different to the others. I.e. a discrepancy is present. The discrepancy value is not latched or filtered in any way.

---

**PROGRAMMING NOTE**

ALL channels for both real and virtual boards MUST have a variable attached regardless. Assign the same CHASSIS/SLOT user parameter values to each board as allocated.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.5. I/O Complex Equipment 'TX7401\_P'****DESCRIPTION**

T7401 DC Digital Input Module, 24 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 24 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 14 Vdc to 32 Vdc. This board definition has packed channel statuses for each board and is recommended for use with medium to high input count systems.

Product Description reference: PD-T7011 DC Digital Input Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
REG_CHASSIS2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
REG_SLOT2	1 – 10	
REG_CHASSIS3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the third Module is placed
REG_SLOT3	1 – 10	

**CONFIGURATION****Physical Module**

3 (boards) X 16 digital input channels, Boolean, triplex.

**Logical Module**

RACK 1:	16 BOOLEAN inputs	Voted data for input channels TRUE – channel high, FALSE – channel low
RACK 2:	3 BOOLEAN inputs	Input reflecting the board status of the module specified. First channel is board status for board 1. Second channel is board status for board 2. Third channel is board status for board 3. FALSE – board ok, TRUE – board fault.

---

RACK 3:	1 ANALOGUE input	Data reflecting the discrepancy status of the last vote performed for the channel Bit 0 contains data for channel 1, bit 15 contains data for channel 16. 1 - A discrepancy has occurred, 0 - All channels agree. The variable is not latched.
---------	------------------	--

---

**Note:**

The value will be 1 if any of the channels is different to the others. i.e. a discrepancy is present. The discrepancy value is not latch or filtered in any way.

---

**PROGRAMMING NOTE**

ALL channels for both real and virtual boards MUST have a variable attached regardless of whether the channel is used or not. Assign the same CHASSIS/SLOT user parameter values to each board.

---

**Notes:**

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

**4.6. I/O Complex Equipment 'SX3402'****DESCRIPTION**

T3402 DC Digital Input Module 48V dc. The DC Digital Input module provides input sensing for 16 field input switches. The digital inputs are interfaced to the triplicated I/O Safetybus. Field power for the inputs is arranged in two 8-point groups with separate common power return terminals for each group.

Product Description reference: PD-6011 DC Digital Input Modules

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION**

Digital input modules provide a suitable interface to non-critical input signals. Many of the circuits in the digital input modules are automatically tested and annunciated but some logic circuits and all of the field circuits are simplex and non-tested.

**Physical Module**

16 digital input channels, Boolean, triplex.

**Logical Module**

RACK 1:	16 BOOLEAN Inputs	Voted data for input channels. TRUE - channel high, FALSE - channel low
---------	-------------------	--

**Notes:**

1. Board channels are numbered 1 (LSB = bit 0) to 16 (MSB = 15).
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.7. I/O Complex Equipment 'SX7402'****DESCRIPTION**

T7402 DC Digital Input Module, 48 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 48 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 38 Vdc to 58 Vdc. This board definition is for a module used in a simplex configuration.

Product Description reference: PD-T7011 DC Digital Input Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION**

16 input channels, Boolean, simplex 1 status channel Boolean.

**Physical Module**

1 (board) X 16 input channels, Boolean, simplex.

**Logical Module**

RACK 1:	16 BOOLEAN inputs	States of the module channel inputs identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE - channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE - board OK, TRUE – board fault.

**Note:**

Board channels are numbered 1 (LSB = bit 0) to 16 (MSB = bit 15).

**PROGRAMMING NOTE**

All channels for both real and virtual boards MUST have a variable attached regardless.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.8. I/O Complex Equipment 'TX3402'

### DESCRIPTION

T3402 DC Digital Input Module 48 Vdc. The DC Digital Input module provides input sensing for 16 field input switches. The digital inputs are interfaced to the triplicated I/O Safetybus. Field power for the inputs is arranged in two 8-point groups with separate common power return terminals for each group.

Product Description reference: PD-6011 DC Digital Input Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

Redundant modules are used in a 2oo3 or 1oo2 fault tolerant configuration. Redundant modules are connected to single or multiple sensors. If redundant sensors are installed in the field, redundant modules are connected so that each sensor connects to one of the redundant modules. Each DC digital input module is hot replaceable, when one module is removed the system will continue to sense the inputs from the remaining two input modules.

#### Physical Module

3 (boards) X 16 digital input channels, Boolean, triplex.

#### Logical Module

RACK 1:	16 BOOLEAN Inputs	Voted data for input channels. TRUE - channel high, FALSE - channel low
RACK 2:	16 BOOLEAN Inputs	Voted data for input channels. TRUE - channel high, FALSE - channel low

---

RACK 3:	16 BOOLEAN Inputs	Voted data for input channels. TRUE - channel high, FALSE - channel low
---------	-------------------	--

---

**Notes:**

1. Board channels are numbered 1 (LSB = bit 0) to 16 (MSB = 15).
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

## 4.9. I/O Complex Equipment 'TX7402'

### DESCRIPTION

T7402 DC Digital Input Module, 48 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 48 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 38 Vdc to 58 Vdc. This board definition is for modules used in a triplicated configuration.

Product Description reference: PD-T7011 DC Digital Input Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
REG_CHASSIS2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed.
REG_SLOT2	1 – 10	
REG_CHASSIS3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the third Module is placed.
REG_SLOT3	1 – 10	

### CONFIGURATION

#### Physical Module

3 (boards) X 16 digital input channels, Boolean, triplex.

#### Logical Module

RACK 1:	16 BOOLEAN inputs	Voted data for input channels TRUE – channel high, FALSE - channel low
RACK 2:	3 BOOLEAN inputs	Input reflecting the board status of the module specified. First channel is board status for board 1. Second channel is board status for board 2. Third channel is board status for board 3. FALSE – board ok, TRUE - board fault.
RACK 3:	16 BOOLEAN inputs	Data reflecting the discrepancy status of the last vote performed for the channel. Channel 1 contains data for module channel 1, Channel 16 contains data for module channel 16.

---

TRUE - A discrepancy has occurred, FALSE - All channels agree. The variable is not latched.

**Note:**

The value will be TRUE if any of the channels is different to the others. I.e. a discrepancy is present. The discrepancy value is not latched or filtered in any way.

**PROGRAMMING NOTE**

ALL channels for both real and virtual boards MUST have a variable attached regardless. Assign the same CHASSIS/SLOT user parameter values to each board as allocated.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.10. I/O Complex Equipment 'TX7402\_P'****DESCRIPTION**

T7402 DC Digital Input Module, 48 Vdc. The Digital Input Module interfaces 16 discrete field devices into a triplicated I/O Safetybus. Field power for the input is arranged in two 8-point groups. The 48 Vdc digital input module provides 16 sinking input circuits capable of sensing digital inputs that switch field power ranging from 38 Vdc to 58 Vdc. This board definition is for modules used in a triplicated configuration.

Product Description reference: PD-T7011 DC Digital Input Modules

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface is placed.
TICS_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_CHASSIS	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the second Module is placed.
REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the third Module is placed.

**CONFIGURATION****Physical Module**

3 (boards) X 16 digital input channels, Boolean, triplex.

**Logical Module**

RACK 1:	16 BOOLEAN inputs	Voted data for input channels TRUE – channel high, FALSE - channel low
---------	-------------------	---



RACK 2:	3 BOOLEAN inputs	Input reflecting the board status of the module specified. First channel is board status for board 1. Second channel is board status for board 2. Third channel is board status for board 3. FALSE – board ok, TRUE - board fault.
RACK 3:	1 ANALOGUE input	Data reflecting the discrepancy status of the last vote performed for the channel Bit 0 contains data for channel 1, bit 15 contains data for channel 16. 1 - A discrepancy has occurred, 0 - All channels agree. The variable is not latched.

**Note:**

The value will be 1 if any of the channels is different to the others. i.e. a discrepancy is present. The discrepancy value is not latch or filtered in any way.

**PROGRAMMING NOTE**

ALL channels for both real and virtual boards MUST have a variable attached regardless. Assign the same CHASSIS/SLOT user parameter values to each board as allocated.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.11. I/O Complex Equipment 'SX7404'****DESCRIPTION**

T7404 AC Digital Input Module 110 Vac. The AC Digital Input module provides input sensing for 16 field input switches. The digital inputs are interfaced to the triplicated I/O Safetybus. This board definition is used in a simplex configuration.

Product Description reference: PD-T7013 AC Digital Input Module 110 Vac.

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN Inputs	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE = channel high, FALSE = channel low
RACK 2:	1 BOOLEAN Input	Input reflecting the board status of the module specified. FALSE = board ok, TRUE = board fault.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.12. I/O Complex Equipment 'TX7404'

### DESCRIPTION

T7404 AC Digital Input Module 110 Vac. The AC Digital Input module provides input sensing for 16 field input switches. The digital inputs are interfaced to the triplicated I/O Safetybus. This board definition is used in a triplicated configuration. The inputs to the modules are voted on a 2oo3 basis. The data presented is in unpacked form with each discrepancy having a single BOOLEAN variable.

Product Description reference: PD-T7013 AC Digital Input Module 110 Vac.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN Inputs	Voted data for input channels. TRUE = channel high, FALSE = channel low
RACK 2:	3 BOOLEAN Inputs	Input reflecting the board status of the module specified. First channel is board status for board 1 Second channel is board status for board 2 Third channel is board status for board 3 FALSE = board ok, TRUE = board fault.
RACK 3:	16 BOOLEAN Inputs	Data reflecting the discrepancy state of the last vote performed for the channel. Channel 1 contains data for module channel 1. Channel 16 contains data for module channel 16. TRUE = a discrepancy has occurred, FALSE = all channels agree. The variable is not latched.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.13. I/O Complex Equipment 'DX7411F'

### DESCRIPTION

T7411F Monitored Digital Input Module, 24 Vdc. The Monitored Digital Input Module interfaces to 16 field input devices. The Type F module connects to field inputs that switch the 'hot' side of field power ranging from 15 Vdc to 80 Vdc. The module performs complete testing of the input module electronics. This board definition is used in a voted dual 2oo2 input configuration.

Product Description reference: PD-T7031 Monitored Digital Input Modules.

### OEM PARAMETERS:

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
PARTNER_CHASSIS PARTNER_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Entered as a 16 bit word. Bit 0 will mask channel 1 bit 15 will mask channel 16. This field will mask the implementation of the fault LEDS on the module. Input status is not affected.
OPEN_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch open. The data is entered in the form of a decimal number in the range 0 – 255, however 240 is the maximum the user can enter to accommodate test ranges within the module.
ON_OFF_VOLTAGE	0 – 240	Voltage at which to indicate a transition from Low/High or High/Low has taken place. It is again entered as a decimal value the range 0 – 255, however 240 is the maximum the user can enter to accommodate test ranges within the module.
SHORT_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch close. The data is entered in the form of a decimal number in the range 0 – 255, however 240 is the maximum the user can enter to accommodate test ranges within the module.
MSEC	0 – any	This parameter is the number of milliseconds that the user wishes to mask the error status bits in rack 1. This accommodates the potential initial disagreement between the two modules when a channel state changes.

### CONFIGURATION

#### Physical Module

RACK 1: 16 BOOLEAN inputs. Voted states of the two 7411F boards as identified by the OEM parameters.

RACK 2:	3 ANALOGUE inputs	<p>Channel 1 – Error status. i.e. 1 bit per pair of channels. LSB = first channel. This is set when the corresponding channels of the two boards disagree after the number of milliseconds configured in the OEM parameter MSEC.</p> <p>Channel 2 – Channel Faults (1 bit per channel) for the first module of the pair. 1 – channel ok, 0 - channel fault</p> <p>Channel 3 – Channel Faults (1 bit per channel) for the second module of the pair. 1 - channel ok, 0 - channel fault</p>
RACK 3:	2 BOOLEAN inputs	<p>Inputs reflecting the board status of the two 7411F boards specified. Channel 1 is module 1 and Channel 2 is module 2. FALSE - board ok, TRUE - board fault</p>

**Notes:**

All parameters must be supplied, even for virtual boards.

Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**EXTRA INFORMATION****Error Status**

The error status bits are only set IF channels disagree AND each channel is NOT in a channel fault condition after MSEC has been exceeded.

The algorithm for the calculation of the error bits is:

Channel state	Channel state	Channel Fault	Channel Fault	Voted input	Error bit
Board 1	Board 2	Board 1	Board 2	After MSEC	Exceeded
Low	Low	In range	In range	Low	0
Low	Low	In range	Fault	Low	0
Low	Low	Fault	In range	Low	0
Low	Low	Fault	Fault	Low	0
Low	High	In range	In range	High	1
Low	High	In range	Fault	Low	0
Low	High	Fault	In range	High	0
Low	High	Fault	Fault	High	1
High	Low	In range	In range	High	1
High	Low	In range	Fault	High	0
High	Low	Fault	In range	Low	0
High	Low	Fault	Fault	High	1
High	High	In range	In range	High	0
High	High	In range	Fault	High	0
High	High	Fault	In range	High	0
High	High	Fault	Fault	Low	0

### Entering the Threshold Data

At present the threshold values have to be entered as a count between 0 and 255, (8 bit word), e.g. on a -5 Vdc to 32 Vdc system:

$$\text{COUNTS} = ((\text{VOLTAGE} + 5) / 37) * 255$$

16 V would be represented by:

$$(16+5)/37 = 0.567.$$

$$0.567 * 255 = 145 \text{ counts}$$

0 Vdc would be represented by:

$$(0+5)/37 = 0.135$$

$$0.135 * 255 = 34 \text{ counts}$$

## 4.14. I/O Complex Equipment 'SX7411'

### DESCRIPTION

T7411 Monitored Digital Input Module, 24 Vdc. The Monitored Digital Input Module interfaces to 16 field input devices. The module performs line monitoring of the field wiring connections and automatic testing of the input module electronics. The module is designed to operate from field power ranging from 15 Vdc to 80 Vdc. This board definition is used in a simplex configuration.

Product Description reference: PD-T7031 Monitored Digital Input Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed.
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
OPEN_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch open. The data is entered in the form of a decimal number in the range 0 – 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.
ON_OFF_VOLTAGE	0 – 240	Voltage at which to indicate a transition from Low/High or High/Low has taken place. It is again entered as a decimal value the range 0 – 255, however 240 is the maximum the user can enter to accommodate test ranges within the module.

OEM parameter	Valid numbers	Description
SHORT_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch close. The data is entered in the form of a decimal number in the range 0 – 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.

## CONFIGURATION

### Physical Module

RACK 1:	16 BOOLEAN inputs	Input states of the module as identified by the OEM parameters.
RACK 2:	1 ANALOGUE input	Channel Faults (1 bit per channel) for the module. 1 - channel ok, 0 – channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE - board ok, TRUE – board fault

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## EXTRA INFORMATION

### Entering the Threshold Data

At present the threshold values have to be entered as a count between 0 and 255, (8bit word), e.g. on a -5 Vdc to 32 Vdc systems:

$$\text{COUNTS} = (( \text{VOLTAGE} + 5 ) / 37) * 255$$

16 V would be represented by:

$$(16+5)/37 = 0.567$$

$$0.567 * 255 = 145 \text{ counts}$$

0 Vdc would be represented by:

$$(0+5)/37 = 0.135$$

$$0.135 * 255 = 34 \text{ counts}$$

## 4.15. I/O Complex Equipment 'SX7411F'

### DESCRIPTION

T7411F Monitored Digital Input Module, 24 Vdc. The Monitored Digital Input Module interfaces to 16 field input devices. The Type F module connects to field inputs that switch the 'hot' side of field power ranging from 15 Vdc to 80 Vdc. The module performs complete testing of the input module electronics. This board definition is used in a simplex configuration.

Product Description reference: PD-T7031 Monitored Digital Input Modules.

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
OPEN_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch open. The data is entered in the form of a decimal number in the range 0 - 55. However 240 is the maximum the user can enter to accommodate test ranges within the module.
ON_OFF_VOLTAGE	0 – 240	Voltage at which to indicate a transition from Low/High or High/Low has taken place. It is again entered as a decimal value the range 0 - 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.
SHORT_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch close. The data is entered in the form of a decimal number in the range 0 - 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN inputs	Input states of the module as identified by the OEM parameters.
RACK 2:	1 ANALOGUE input	Channel Faults (1 bit per channel) for the module. 0 - channel ok, 1 - channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE - board ok, TRUE – board fault

**Notes:**

- All parameters must be supplied, even for virtual boards.
- Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- The single analogue input channel returned provides the T7411F channel status in packed notation. Channel 1 status will be in bit zero. Channel 16 status will be bit 15.
- The single BOOLEAN input channel returned provides the T7411F board status.

**EXTRA INFORMATION****Entering the Threshold Data**

At present the threshold values have to be entered as a count between 0 and 255, (8bit word), e.g. on a -5 Vdc to 32 Vdc systems:

$$\text{COUNTS} = (( \text{VOLTAGE} + 5 ) / 37) * 255$$

16 V would be represented by:

$$\begin{aligned}(16+5)/37 &= 0.567 \\ 0.567 * 255 &= 145 \text{ counts}\end{aligned}$$

0 Vdc would be represented by:

$$\begin{aligned}(0+5)/37 &= 0.135 \\ 0.135 * 255 &= 34 \text{ counts}\end{aligned}$$

## 4.16. I/O Complex Equipment 'SX7418F'

### DESCRIPTION

T7418F Monitored Digital Input Module, 120 Vac/dc. The Monitored Digital Input Module interfaces to 16 field input devices. The Type F module connects to field inputs that switch the 'hot' side of field power ranging from 90 Vac/dc to 150 Vac/dc. The module performs complete testing of the input module electronics. This board definition is used in a simplex configuration.

Product Description reference: PD-T7031 Monitored Digital Input Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
MONITOR_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
OPEN_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch open. The data is entered in the form of a decimal number in the range 0 - 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.
ON_OFF_VOLTAGE	0 – 240	Voltage at which to indicate a transition from Low/High or High/Low has taken place. It is again entered as a decimal value the range 0 - 255. However, 240 is the maximum the user can enter to accommodate test ranges within the module.
SHORT_VOLTAGE	0 – 240	Voltage at which to indicate failure at switch close. The data is entered in the form of a decimal number in the range 0 - 255, however 240 is the maximum the user can enter to accommodate test ranges within the module.



**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN inputs	Input states of the module as identified by the OEM parameters.
RACK 2:	1 ANALOGUE input	Channel Faults (1 bit per channel) for the module. 0 - channel ok, 1 - channel fault (channel status will always be 0 for the ac version)
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE – board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**EXTRA INFORMATION****Entering the Threshold Data**

At present the threshold values have to be entered as a count between 0 and 255, (8bit word), e.g. on a -5 Vdc to 32 Vdc systems:

$$\text{COUNTS} = (( \text{VOLTAGE} + 5 ) / 37) * 255$$

55 V would be represented by:

$$\begin{aligned} 55/120 &= 0.458. \\ 0.458 * 255 &= 117 \text{ counts} \end{aligned}$$

The maximum count that can be entered is 16535, however the ISaGRAF kernel will limit any variable to 240.

**4.17. I/O Complex Equipment 'F7419'****DESCRIPTION**

T7419 Fire Detector Input Module. The Fire Detector Input Module occupies one slot in the Regent+Plus I/O chassis and provides 16 line monitored input channels designed to interface to remote fire input devices. This board definition will open a single module. All inputs are presented in unpacked form (Boolean). Channel status is, however, presented packed form. Each channel has a single bit of the variable.

Product Description reference: PD-T7032 Fire Detector Input Module.

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

MONITOR_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
OPEN_CURRENT	-2 to 24 mA	Current at which to indicate failure at switch open. The data is entered in the form of actual current, in milliamps with resolution of 1 mA.
ON_OFF CURRENT	-2 to 24 mA	Current at which to indicate a transition from Low/High or High/Low has taken place. The data is entered in the form of actual current, in milliamps with resolution of 1 mA.
SHORT_CURRENT	-2 to 24 mA	Current at which to indicate failure at switch close. The data is entered in the form of actual current, in milliamps with resolution of 1 mA.

## CONFIGURATION

### Physical Module

RACK 1:	16 BOOLEAN inputs	Input states of the module as identified by the OEM parameters.
RACK 2:	1 ANALOGUE input	Channel faults (1 bit per channel) for the module. 0 – channel ok, 1 – channel fault
RACK 3	16 BOOLEAN outputs	These channels will force the input LEDs. Channel 1 is module channel 1, Channel 16 is module channel 16. Actual input via rack 1 is not affected. TRUE – LED on, FALSE – LED off. This function is called every time the board is scanned. Therefore initialization is needed at these outputs.
RACK 4	16 BOOLEAN outputs	These channels will rest the input of the relevant channel. Channel 1 is module channel 1, Channel 16 is module channel 16. TRUE – reset channel, FALSE – no reset. This function is called every time the board is scanned. Therefore initialization is needed at these outputs.
RACK 5	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE – board ok, TRUE – board fault.

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## EXTRA INFORMATION

The threshold settings are range checked in the ISaGRAF kernel and if they exceed the specified limits, they are made to equal the maximum/minimum limit.

## 4.18. I/O Complex Equipment 'SX7420A'

### DESCRIPTION

T7420A Analogue Input Module. The Analogue Input module provides high noise immunity analogue to digital conversion of 8 differential or 16 single-ended field input voltages or currents. The digitally converted values are interfaced to the triplicated I/O Safetybus. This board definition is used in a simplex configuration for single-ended inputs.

Product Description reference: PD-T7023 Analogue Input Modules.

## OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

## CONFIGURATION

### Physical Module

RACK 1:	16 ANALOGUE Inputs	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16.
RACK 2:	16 BOOLEAN Inputs	Channel range status. Channel 1 is module channel 1, Channel 16 is module channel 16. TRUE = channel is in range, FALSE = channel out of range.
RACK 3:	16 BOOLEAN Inputs	Channel power status. Channel 1 is module channel 1, Channel 16 is module channel 16. TRUE = channel OK, FALSE = channel fault.
RACK 4:	1 BOOLEAN input	Module status. TRUE = Board fail, FALSE = board OK.

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.19. I/O Complex Equipment 'SX7420D'

### DESCRIPTION

T7420A Analogue Input Module. The Analogue Input module provides high noise immunity analogue to digital conversion of 8 differential or 16 single-ended field input voltages or currents. The digitally converted values are interfaced to the triplicated I/O Safetybus. This board definition is for differential inputs and is used in a simplex configuration.

Product Description reference: PD-T7023 Analogue Input Modules.

#### OEM PARAMETERS:

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	8 ANALOGUE Inputs	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8.
RACK 2:	8 BOOLEAN Inputs	Channel range status. Channel 1 is module channel 1, Channel 8 is module channel 8. TRUE = channel is in range, FALSE = channel out of range.
RACK 3:	16 BOOLEAN Inputs	Channel power status. Channel 1 is module channel 1, Channel 8 is module channel 8. TRUE = channel OK, FALSE = channel fault.
RACK 4:	1 BOOLEAN input	Module status. TRUE = Board fail, FALSE = board OK.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.20. I/O Complex Equipment 'S7420\_PP'****DESCRIPTION**

T7420A Analogue Input Module. The Analogue Input module provides high noise immunity analogue to digital conversion of 8 differential or 16 single-ended field input voltages or currents. The digitally converted values are interfaced to the triplicated I/O Safetybus. This board definition is used in a simplex configuration, has packed channel statuses for each board and is recommended for use with medium to high input count systems.

Product Description reference: PD-T7023 Analogue Input Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1)	
	1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1: Variables 1- 16:	16 ANALOGUE Inputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16.
RACK 1: Variable 17	1 ANALOGUE input	Range status. Bit 0 is Channel 1, Bit 15 is Channel 16. 1 = channel is in range, 0 = channel is out of range.

RACK 1: Variable 18	1 ANALOGUE input	Power status. Bit 0 is Channel 1, Bit 15 is Channel 16. 1 = channel is ok, 0 = channel is faulted.
RACK 1: Variable 19	1 ANALOGUE input	Module status on first bit of variable 1 = board fault, 0 = Board ok.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.21. I/O Complex Equipment 'T3420AF'

### DESCRIPTION

T3420AF Analogue Input Module - Fast Response. The Analogue Input Module - Fast Response provides low noise immunity analogue to digital conversion of 16 single-ended or 8 differential, field input voltages or currents. The converted digital values are interfaced to the triplicated I/O Safetybus. Field inputs are arranged in two 8-point groups, each group having its own ground reference connection (AREF1 and AREF2), separate from the external I/O analogue signal ground (AGND). In differential mode, AREF1 and AREF2 are not used. This board definition is used in simplex or triplex configurations.

Product Description reference (Regent document): PD-6023: "Analog Input Modules".

### OEM PARAMETERS:

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

#### Analogue Input Range Selection

Voltage Ranges	Current Ranges (with external 250 $\Omega$ resistors)
0 Vdc to +5 Vdc	0 mA to 20 mA
+1 Vdc to +5 Vdc	4 mA to 20 mA
-5 Vdc to +5 Vdc	-20 mA to +20 mA
0 Vdc to +10 Vdc	0 mA to 40 mA
-10 Vdc to +10 Vdc	-40 mA to +40 mA

It is possible to mix current and voltage measurements on the same module providing they can work with the same voltage range selected. In the case of single-ended measurements, this requires that either both the current and voltage measurements are referenced to the same reference point (AREF1 or AREF2), or that the voltage inputs are applied to one set of eight inputs and the current inputs are applied to the other set of eight inputs.

Redundant modules are used in a 2oo3 or 1oo2 fault tolerant configuration. Redundant modules are connected to single or multiple sensors. If redundant sensors are installed in the field, redundant modules are connected so that each sensor connects to one of the redundant modules. Each analogue input module is hot replaceable, when one module is removed the system will continue to sense the inputs from the remaining two input modules.

### Physical Module

Standard Field Termination Blocks can be replaced with optional Analogue Input Termination Blocks for any mode of operation. These optional blocks fit on the 10-position barrier strips of the Regent I/O chassis without affecting or interfering with adjacent I/O slot terminals.

### Logical Module

RACK 1: Variables 1- 16:	16 ANALOGUE Inputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16.
-----------------------------	--------------------	--

#### Notes:

1. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
2. For current inputs, 250  $\Omega$  resistors must be fitted, external to the module.
3. The absolute working voltage range for any analogue input signal is from -10.3 V to +10.3 V with regard to analogue ground (AGND).
4. Analogue Input Modules do not provide loop power for the analogue input signals. Interfacing to two-wire transmitters that require loop power requires an external 24 Vdc power source in the input loop.
5. In fault tolerant configurations, where redundant Analogue Input Modules interface to single sensors, the analogue input signal is connected in parallel across the redundant Input Modules. In current input configurations, the three Modules are connected in parallel across the single external 250  $\Omega$  resistor.
6. There are four different Analogue Input Module types listed in the Set Module Type dialogue. The appropriate Module type must be selected.
7. During calibration, the Analogue Input Module is disconnected from the field devices. Take appropriate precautions to ensure that such disconnections do not pose a risk to plant safety.

## 4.22. I/O Complex Equipment 'SX7431'

### DESCRIPTION

T7431 Thermocouple Input Equipment. The thermocouple input equipment includes a termination panel/multiplexer assembly and an input module that plugs into, and interfaces with, a triplicated I/O Safetybus. The termination panel/multiplexer provides connection points for 24 thermocouples and is cabled to the plug-in module. The plug-in module provides 24 channel high noise immunity analogue to digital conversion. This board definition is used in a simplex configuration.

Product Description reference: PD-T7024 Thermocouple Input Assembly.

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	24 ANALOGUE Inputs	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 24 is module channel 24.
RACK 2:	24 BOOLEAN Inputs	Channel range status. Channel 1 is module channel 1, Channel 24 is module channel 24. TRUE = channel is in range, FALSE = channel out of range.
RACK 3:	1 BOOLEAN input	Module status. TRUE = Board fail, FALSE = board OK.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.23. I/O Complex Equipment 'SX7431A'****DESCRIPTION**

T7431 Thermocouple Input Equipment. The thermocouple input equipment includes a termination panel/multiplexer assembly and an input module that plugs into, and interfaces with, a triplicated I/O Safetybus. The termination panel/multiplexer provides connection points for 24 thermocouples and is cabled to the plug-in module. The plug-in module provides 24 channel high noise immunity analogue to digital conversion. This board definition is used in a simplex configuration. Input data is unscaled.

Product Description reference: PD-T7024 Thermocouple Input Assembly.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	24 ANALOGUE Inputs	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 24 is module channel 24.
RACK 2:	24 BOOLEAN Inputs	Channel range status. Channel 1 is module channel 1, Channel 24 is module channel 24. TRUE = channel is in range, FALSE = channel out of range.
RACK 3:	1 BOOLEAN input	Module status. TRUE = Board fail, FALSE = board OK.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.24. I/O Complex Equipment 'SX7431AP and SX7431PP'****DESCRIPTION**

T7431A and T7431 Thermocouple Input Equipment. The thermocouple input equipment includes a termination panel/multiplexer assembly and an input module that plugs into, and interfaces with, a triplicated I/O Safetybus. The termination panel/multiplexer provides connection points for 24 thermocouples and is cabled to the plug-in module. The plug-in module provides 24 channel high noise immunity analogue to digital conversion. These board definitions are used in a simplex configuration.

Product Description reference: PD-T7024 Thermocouple Input Assembly.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	27 ANALOGUE Inputs	
	Variables 1 – 24	Input channel states of module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 24 is module channel 24.
	Variable 25	Channel range status. Bit 0 is the range status for Channel 1, Bit 16 is the range status for Channel 16. 1 = channel is in range, 0 = channel out of range.



Variable 26	Channel range status. Bit 0 is the range status for Channel 17, Bit 7 is the range status for Channel 24. Bits 8 - 15 are set to zero. 1 = channel is in range, 0 = channel out of range.
Variable 27	Board status information. Status is contained in bit 0. 1 - board failed, 0 - Board OK.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
3. Data is presented in unscaled format.
4. SX7431PP is for T7431. SX7431AP is for T7431A.

## 4.25. I/O Complex Equipment 'TX3432'

### DESCRIPTION

T3432 RTD Input Module. The RTD Input Module occupies one slot in the Regent+Plus I/O chassis and provides one serial communications port interface to a remote Termination Panel providing excitation, multiplexing, signal conditioning, and A/D conversion for 16 RTD channels. Field power at  $\pm 15$  Vdc is provided to power the Termination Panel. This board definition is used in simplex, duplex or triplex configurations.

Product Description reference: n/a.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 2	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
REGENT_CHASSIS 3	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

Redundant RTD Input Modules are used in a 1oo2 or 2oo3 fault tolerant configuration. Each RTD Input Module is hot replaceable, when one module is removed the system will continue to sense the inputs from the remaining module(s).

#### Logical Module

Serial data received from the MUX RTD in the Termination Panel uses an asynchronous protocol of 53 message types, numbered 0 to 52. Messages are sent sequentially in bursts of 128 message packets for each message types, i.e. 128 message packets of message type 0, followed by 128 message packets of message type 1, followed by 128 message packets of message type 2, etc.

MESSAGE #	MESSAGE DATA
0	V #16 RTD
1	V #16 Wire
2	V #16 Current
3	V #15 RTD
4	V #15 Wire
5	V #15 Current
6	V #14 RTD
7	V #14 Wire
8	V #14 Current
9	V #13 RTD
10	V #13 Wire
11	V #13 Current
12	V #12 RTD
13	V #12 Wire
14	V #12 Current
15	V #11 RTD
16	V #11 Wire
17	V #11 Current
18/	V #10 RTD
19	V #10 Wire
20	V #10 Current
21	V #9 RTD
22	V #9 Wire
23	V #9 Current
24	V #8 RTD
25	V #8 Wire
26	V #8 Current

MESSAGE #	MESSAGE DATA
27	V #7 RTD
28	V #7 Wire
29	V #7 Current
30	V #6 RTD
31	V #6 Wire
32	V #6 Current
33	V #5 RTD
34	V #5 Wire
35	V #5 Current
36	V #4 RTD
37	V #4 Wire
38	V #4 Current
39	V #3 RTD
40	V #3 Wire
41	V #3 Current
42	V #2 RTD
43	V #2 Wire
44	V #2 Current
45	V #1 RTD
46	V #1 Wire
47	V #1 Current
48	V REF
49	+5 V Power Monitor
50	-5 V Power Monitor
51	+/-12 V Power Monitor
52	Configuration Jumpers

**Notes:**

1. Conversion tables are provided for handling American and European type RTDs.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.26. I/O Complex Equipment 'DX7441A'

### DESCRIPTION

T7441A Digital Output Module, 24 Vdc. The Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 24 Vdc digital output circuits are 'sourcing' outputs that switch field power ranging from 18 Vdc to 32 Vdc. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a dual module configuration.

Product Description reference: PD-T7015 DC Digital Output Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE - channel low
RACK 2:	2 BOOLEAN inputs	Inputs reflecting the board status of the two modules specified. Channel 1 is the state of the first module, Channel 2 is the state of the second. FALSE – board ok, TRUE - board fault

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.27. I/O Complex Equipment 'SX7441A'

### DESCRIPTION

T7441A Digital Output Module, 24 Vdc. The Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 24 Vdc digital output circuits are 'sourcing' outputs that switch field power ranging from 18 Vdc to 32 Vdc. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a simplex configuration.

Product Description reference: PD-T7015 DC Digital Output Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the two modules specified. FALSE - board ok, TRUE – board fault

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.28. I/O Complex Equipment 'SX7444'

### DESCRIPTION

T7444 AC Digital Output Module. The AC Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 110 Vac digital output circuits are 'sourcing' outputs that switch field power ranging from 90 Vac to 130 Vac. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a simplex configuration.

Product Description reference: PD-T7016 AC Digital Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the two modules specified. FALSE - board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.29. I/O Complex Equipment ‘SX7444’****DESCRIPTION**

T7444 AC Digital Output Module. The AC Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 110 Vac digital output circuits are ‘sourcing’ outputs that switch field power ranging from 90 Vac to 130 Vac. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a simplex configuration.

Product Description reference: PD-T7016 AC Digital Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the two modules specified. FALSE - board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.30. I/O Complex Equipment ‘DX7444’****DESCRIPTION**

T7444 AC Digital Output Module. The AC Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 110 Vac digital output circuits are ‘sourcing’ outputs that switch field power ranging from 90 Vac to 130 Vac. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a dual configuration.

Product Description reference: PD-T7016 AC Digital Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.31. I/O Complex Equipment 'SX7446'****DESCRIPTION**

T7446 Relay Output Module. The Relay Output Module provides relay outputs for controlling eight field loads. This board definition is used in a simplex configuration.

Product Description reference: PD-T7017 Relay Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the two modules specified. FALSE - board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.32. I/O Complex Equipment 'DX7446'

### DESCRIPTION

T7446 Relay Output Module. The Relay Output Module provides relay outputs for controlling eight field loads. This board definition is used in a dual configuration. Each module can be located in any Regent rack or slot.

Product Description reference: PD-T7017 Relay Output Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

---

#### Notes:

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
-



## 4.33. I/O Complex Equipment 'DX7461'

### DESCRIPTION

T7461 DC Guarded Digital Output Module 24 Vdc. The DC Guarded Digital Output Module provides digitally switched outputs for controlling eight field loads. Field power for the outputs is arranged in two triplicated inputs. This board definition is used in a dual configuration. Each module can be in any Regent rack or slot. All data attached to this definition is unpacked with BOOLEAN variables used.

Product Description reference: PD-7019 Regent+ Guarded 24 Vdc, 48 Vdc, 120 Vdc.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.34. I/O Complex Equipment 'SX7462'

### DESCRIPTION

T7462 DC Guarded Digital Output Module 48 Vdc. The DC Guarded Digital Output Module provides digitally switched outputs for controlling eight field loads. Field power for the outputs is arranged in two triplicated inputs. This board definition is used in a simplex configuration.

Product Description reference: PD-7019 Regent+ Guarded 24 Vdc, 48 Vdc, 120 Vdc.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

### CONFIGURATION

#### Physical Module

1 (board) x 8 Output channels, BOOLEAN, Simplex.

#### Logical Module

RACK 1:	8 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE – channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module. FALSE – board ok, TRUE – board fault

#### Notes:

- All parameters must be supplied, even for virtual boards.
- Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.35. I/O Complex Equipment 'DX7462'

### DESCRIPTION

T7462 DC Guarded Digital Output Module 48 Vdc. The DC Guarded Digital Output Module provides digitally switched outputs for controlling eight field loads. Field power for the outputs is arranged in two triplicated inputs. This board definition is used in a dual configuration. Each module can be in any Regent rack or slot. All data attached to this definition is unpacked with BOOLEAN variables used.

Product Description reference: PD-7019 Regent+ Guarded 24 Vdc, 48 Vdc, 120 Vdc.

**OEM PARAMETERS:**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

2 (boards) x 8 output channels, BOOLEAN, Dual.

**Logical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.36. I/O Complex Equipment 'DX3462A'****DESCRIPTION**

T3462A DC Guarded Digital Output Module 48 Vdc. The DC Guarded Digital Output module provides guarded switching of user supplied DC voltages to a maximum of eight field loads. Field power for the outputs is arranged in two isolated groups of four points. This board definition is used in a dual module configuration.

Product Description reference: PD-6019 DC Guarded Digital Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

**CONFIGURATION**

Guarded digital output modules provide a suitable interface to safety critical output devices, including solenoids, actuators, or other process interlock outputs.

For fault tolerant operation, two Guarded modules are connected in parallel. In this configuration, correct operation continues even if one module fails. Each Guarded module is hot replaceable, when one module is removed the system will continue to operate the loads without interruption.

**Logical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

**Notes:**

1. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
2. When redundant actuators are installed in the field, the level of fault protection can be extended to include the field wiring and actuators. Each actuator should be connected to an individual Guarded output module.
3. The two field effect transistors (FETs) of each output circuit are connected in series with the load; one on the positive side, and one on the negative side.
4. Output loads must not connect to the field power supply return out in the field. Such connections bypass the negative side FET in the Guarded output and defeat the purpose of the series connected FETs for fail safe or fault tolerant control.

**4.37. I/O Complex Equipment 'SX3462A'****DESCRIPTION**

T3462A DC Guarded Digital Output Module 48 Vdc. The DC Guarded Digital Output module provides guarded switching of user supplied DC voltages to a maximum of eight field loads. Field power for the outputs is arranged in two isolated groups of four points. This board definition is used in a simplex configuration.

Product Description reference: PD-6019 DC Guarded Digital Output Module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION**

Guarded digital output modules provide a suitable interface to safety critical output devices, including solenoids, actuators, or other process interlock outputs.

For fail safe operation, a single Guarded module is used. In this configuration, the worst case failure will cause the output to fail to the off state. Removing the Guarded module disables all outputs.

**Logical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE - channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module. FALSE - board ok, TRUE – board fault

**Notes:**

1. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
2. The two field effect transistors (FETs) of each output circuit are connected in series with the load; one on the positive side, and one on the negative side.
3. Output loads must not connect to the field power supply return out in the field. Such connections bypass the negative side FET in the Guarded output and defeat the purpose of the series connected FETs for fail safe or fault tolerant control.

**4.38. I/O Complex Equipment 'SX7464'****DESCRIPTION**

T7464 AC Guarded Digital Output Module 110 Vac. The AC Guarded Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 110 Vac digital output circuits are 'sourcing' outputs that switch field power ranging from 90 Vac to 130 Vac. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a simplex configuration.

Product Description reference: PD-T7021 AC Guarded Digital Output Module 110 Vac.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module. FALSE – board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.39. I/O Complex Equipment 'DX7464'****DESCRIPTION**

T7464 AC Guarded Digital Output Module 110 Vac. The AC Guarded Digital Output Module provides digitally switched outputs for controlling 16 field loads. The 110 Vac digital output circuits are 'sourcing' outputs that switch field power ranging from 90 Vac to 130 Vac. Field power for the outputs is arranged in two isolated groups of 8 points. This board definition is used in a dual configuration. Each module can be in any Regent rack or slot. All data attached to this definition is unpacked with BOOLEAN variables used.

Product Description reference: PD-T7021 AC Guarded Digital Output Module 110 Vac.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PARTNER_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	2 BOOLEAN inputs	Input reflecting the board status of the two modules specified. Channel 1 is the state of the first module. Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.40. I/O Complex Equipment 'SX7480'****DESCRIPTION**

T7480 Guarded Analogue Output Module. The Guarded Analogue Output Module provides six 4 mA – 20 mA current output sources for driving user loads. The outputs are 12-bit D-to-A converted values driven from a triplicated I/O Safetybus interface. The module requires external power from a nominal 24 Vdc field power source to power the optically isolated analogue field-side circuits. This board definition is for a simplex configuration.

Product Description reference: PD-T7026 Guarded Analogue Output module.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	6 ANALOGUE outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 6 is module channel 6.
---------	--------------------	---

---

RACK 2: 1 BOOLEAN inputs      Module status.  
FALSE – board ok, TRUE - board fault

---

**Notes:**

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

**4.41. I/O Complex Equipment 'SX7481'****DESCRIPTION**

T7481 Monitored Guarded Output Module, 24 Vdc. The Monitored Guarded Output Module provides switching of 18 Vdc to 36 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a simplex configuration.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high FALSE – channel low
RACK 2:	1 INTEGER input	Inputs reflecting the channel status of the module specified. Bit 0 is the state of module channel 1, bit 15 is the state of module channel 16. 0 – channel ok, 1 – channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE – board ok, TRUE - board fault.

---

**Notes:**

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
-



## 4.42. I/O Complex Equipment 'DX7481'

### DESCRIPTION

T7481 Monitored Guarded Output Module, 24 Vdc. The Monitored Guarded Output Module provides switching of 18 Vdc to 36 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a dual module configuration.

Product Description reference: PD-T7033 Monitored Guarded Output Modules

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 – 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60Hz, 1 Hz - 50Hz.

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE – channel low
RACK 2:	16 BOOLEAN inputs	Inputs reflecting the channel status of first module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE – channel ok, TRUE – channel fault
RACK 3:	16 BOOLEAN inputs	Inputs reflecting the channel status of second module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE - channel ok, TRUE – channel fault
RACK 4:	2 BOOLEAN inputs	Inputs reflecting the board status of the two modules specified. Channel 1 is the state of the first module, Channel 2 is the state of the second. FALSE - board ok, TRUE - board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.43. I/O Complex Equipment 'DX7481PP'****DESCRIPTION**

T7481 Monitored Guarded Output Module, 24 Vdc. The Monitored Guarded Output Module provides switching of 18 Vdc to 36 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a dual module configuration, has packed channel status' for each board and is recommended for use with medium to high output count systems.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 - 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 - 10	
PARTNER_CHASSIS	1 - 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 - 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 - 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE – channel low
---------	--------------------	---

RACK 2:	4 ANALOGUE inputs	
Variable 1	Inputs reflecting the channel status of first module of the two modules specified. Bit 0 is the state of Channel 1, Bit 15 is the state of Channel 16. 0 - channel ok, 1 – channel fault	
Variable 2	Inputs reflecting the channel status of second module of the two modules specified. Bit 0 is the state of Channel 1, Bit 15 is the state of Channel 16. 0 - channel ok, 1 – channel fault	
Variable 3	Inputs reflecting the board status of first module of the two modules specified 0 - channel ok, 1 – channel fault	
Variable 4	Inputs reflecting the board status of second module of the two modules specified 0 - channel ok, 1 – channel fault	

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

---

#### Notes:

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

## 4.44. I/O Complex Equipment 'SX7481\_P'

### DESCRIPTION

T7481 Monitored Guarded Output Module, 24 Vdc. The Monitored Guarded Output Module provides switching of 18 Vdc to 36 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a simplex configuration, has packed channel status' for each board and is recommended for use with medium to high output count systems.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 - 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 - 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.

FREQUENCY	0 - 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.
-----------	-------	---

## CONFIGURATION

### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE – channel low
RACK 2:	1 ANALOGUE input	Input reflecting the channel status of the module specified. Bit 0 is the state of Channel 1, Bit 15 is the state of Channel 16 0 - channel ok, 1 – channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE – board ok, TRUE - board fault

#### Notes:

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.45. I/O Complex Equipment 'SX7484'

### DESCRIPTION

T7484 Simplex Monitored Guarded Digital Output Module, 110 Vac. The Monitored Guarded Output Module provides switching of 90 Vac to 130 Vac power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a simplex configuration.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 - 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 - 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 - 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE – channel low
RACK 2:	16 BOOLEAN inputs	Inputs reflecting the channel status of the module specified. Bit 0 is the state of Channel 1, bit 15 is the state of Channel 16. FALSE – channel ok, TRUE – channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified. FALSE – board ok, TRUE - board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.46. I/O Complex Equipment 'SX7484\_P'****DESCRIPTION**

T7484 Simplex Monitored Guarded Digital Output Module, 110 Vac. The Monitored Guarded Output Module provides switching of 90 Vac to 130 Vac power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a simplex configuration, has packed channel status' for each board and is recommended for use with medium to high output count systems.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	Module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE - channel low
---------	--------------------	--

RACK 2:	1 ANALOGUE input	Input reflecting the channel status of the module specified. Bit 0 is the state of Channel 1, bit 15 is the state of Channel 16. 0 - channel ok, 1 – channel fault
RACK 3:	1 BOOLEAN input	Input reflecting the board status of the module specified FALSE – board ok, TRUE - board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.47. I/O Complex Equipment 'DX7484'

### DESCRIPTION

T7484 Simplex Monitored Guarded Digital Output Module, 110 Vac. The Monitored Guarded Output Module provides switching of 90 Vac to 130 Vac power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a dual module configuration.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 – 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	First module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high, FALSE - channel low
RACK 2:	16 BOOLEAN inputs	Inputs reflecting the channel status of first module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE - channel ok, TRUE – channel fault

RACK 3:	16 BOOLEAN inputs	Inputs reflecting the channel status of second module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE – channel ok, TRUE – channel fault
RACK 4:	2 BOOLEAN inputs	Inputs reflecting the board of the two modules specified. Channel 1 is the state of the first module, Channel 2 is the state of the second. FALSE - board ok, TRUE – board fault

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

---

#### Notes:

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

## 4.48. I/O Complex Equipment 'DX7484\_P'

### DESCRIPTION

T7484 Simplex Monitored Guarded Digital Output Module, 110 Vac. The Monitored Guarded Output Module provides switching of 90 Vac to 130 Vac power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a dual module configuration, has packed channel status' for each board and is recommended for use with medium to high output count systems.

Product Description reference: PD-T7033 Monitored Guarded Output Modules.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1)	
	1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 – 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	First module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high FALSE - channel low
RACK 2:	1 ANALOGUE input Variable 1	Inputs reflecting the channel status of the first module of the two modules specified. Bit 0 is the state of Channel 1, bit 15 is the state of Channel 16. 0 - channel ok, 1 - channel fault
RACK 3:	1 ANALOGUE input Variable 1	Inputs reflecting the channel status of the second module of the two modules specified. Bit 0 is the state of Channel 1, bit 15 is the state of Channel 16. 0 - channel ok, 1 - channel fault
RACK 4:	2 BOOLEAN inputs	Inputs reflecting the board of the two modules specified. Channel 1 is the state of the first module, Channel 2 is the state of the second FALSE – board ok, TRUE - board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.49. I/O Complex Equipment 'SX7485'****DESCRIPTION**

T7485 Isolated Guarded Digital Output Module 24 Vac/dc to 120 Vac/dc. The Isolated Guarded Digital Output Module provides digitally switched outputs for controlling eight field loads. The digital output circuits are 'sourcing' outputs that switch field power ranging from 24 Vac/dc to 120 Vac/dc. This board definition is used in a simplex configuration.

Product Description reference: PD-T7034 Isolated Guarded Digital Output Module 24 Vac/dc to 120 Vac/dc.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	



**CONFIGURATION****Physical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE – channel high, FALSE – channel low
RACK 2:	1 BOOLEAN input	Input reflecting the board status of the module. FALSE – board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.50. I/O Complex Equipment 'DX7485'****DESCRIPTION**

T7485 Isolated Guarded Digital Output Module 24 Vac/dc to 120 Vac/dc. The Isolated Guarded Digital Output Module provides digitally switched outputs for controlling eight field loads. The digital output circuits are 'sourcing' outputs that switch field power ranging from 24 Vac/dc to 120 Vac/dc. This board definition is used in a dual configuration.

Product Description reference: PD-T7034 Isolated Guarded Digital Output Module 24 Vac/dc to 120 Vac/dc.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed.
PARTNER_SLOT	1 – 10	

**CONFIGURATION****Physical Module**

RACK 1:	8 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 8 is module channel 8. TRUE – channel high, FALSE – channel low
RACK 2:	2 BOOLEAN input	Inputs reflecting the board status of the modules. Channel 1 is the first module, channel 2 is the second module. FALSE – board ok, TRUE – board fault

**PROGRAMMING NOTE**

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

**4.51. I/O Complex Equipment 'SX7488'****DESCRIPTION**

T7488 Monitored Guarded Digital Output Module, 120 Vdc. The Monitored Guarded Output Module provides switching of 90 Vac to 130 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a simplex module configuration.

**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	First module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz – 60 Hz, 1 Hz – 50 Hz.

**CONFIGURATION****Physical Module**

RACK 1:	16 BOOLEAN outputs	States to be written to the module identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE – channel high, FALSE – channel low
RACK 2:	16 BOOLEAN inputs	Inputs reflecting the channel status of module specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE – channel ok, TRUE – channel fault
RACK 3:	16 BOOLEAN inputs	Inputs reflecting the board status of the module specified. FALSE – board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.

## 4.52. I/O Complex Equipment 'DX7488'

### DESCRIPTION

T7484 Monitored Guarded Digital Output Module, 120 Vdc. The Monitored Guarded Output Module provides switching of 95 Vdc to 140 Vdc power to 16 field outputs. The outputs are arranged in two groups of 8 outputs, where each group is powered from a common power source. This board definition is for a dual module configuration. Each module can be in any Regent rack or slot. All data attached to this definition is unpacked with BOOLEAN variables used.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the first Module is placed.
REGENT_SLOT	1 – 10	
PARTNER_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the second Module is placed
PARTNER_SLOT	1 – 10	
MONITER_MASK	1 = mask fault LEDs 0 = enable fault LEDs	First module fault LED mask. Entered as a 16 bit word. Bit 0 will mask channel 1, bit 15 will mask channel 16. This field will mask the implementation of the fault LEDs on the module. Input status is not affected.
FREQUENCY	0 – 1	Frequency of the module. 0 Hz - 60Hz, 1 Hz – 50Hz.

### CONFIGURATION

#### Physical Module

RACK 1:	16 BOOLEAN outputs	States to be written to the two modules identified by the OEM parameters. Channel 1 is module channel 1 and Channel 16 is module channel 16. TRUE - channel high FALSE - channel low
RACK 2:	16 BOOLEAN inputs	Inputs reflecting the channel status of the first module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE - channel ok, TRUE - channel fault
RACK 3:	16 BOOLEAN inputs	Inputs reflecting the channel status of the second module of the two modules specified. Channel 1 is the state of module channel 1, Channel 16 is the state of module channel 16. FALSE - channel ok, TRUE - channel fault

RACK 4: 2 BOOLEAN inputs      Inputs reflecting the board of the two modules specified.  
 Channel 1 is the state of the first module, Channel 2 is the state of the second.  
 FALSE – board ok, TRUE - board fault

### PROGRAMMING NOTE

Writing to a channel of board 1 will cause physical writes to be made to both boards as identified by the parameters associated with the board. Both boards must be managed by the same TMR Interface module.

---

#### Notes:

1. All parameters must be supplied, even for virtual boards.
  2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- 

## 4.53. I/O Complex Equipment 'M7491'

### DESCRIPTION

T7491 Multiplexed I/O Module. The Multiplexed I/O Module occupies one slot in the Regent+Plus I/O chassis and provides two serial communications port interfaces to remote multiplexed digital I/O and addressable loop devices. The module provides an economical interface to inputs and outputs for matrix and mimic displays in fire and gas systems. Other applications include remote digital I/O and addressable loop devices (fire detectors). The serial communications support connection to equipment in the MIU and FGS product ranges.

Product Description reference: PD-T7035 Multiplexed I/O Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 - 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 - 10	
MD0-MD7	0 - 2	This implementation allows up to eight Matrix drivers to be attached to this module. MDn defines which Communication link is to be used for each particular matrix driver.  0 = Present 1 = Port 1 2 = Port 2

### CONFIGURATION

#### Physical Module

RACK 1: 1 BOOLEAN input      Input reflecting the board status of the module specified  
 FALSE - board ok, TRUE – board fault

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
3. The single input channel returned provides the T7491 board status.
4. This module MUST appear in the I/O configuration BEFORE the associated M7491\_I(P) and M7491\_O(P) modules.

## 4.54. I/O Complex Equipment 'M7491\_IP'

### DESCRIPTION

T7491 Multiplexed Input Module. The Multiplexed Input Module occupies one slot in the Regent+Plus I/O chassis and provides two serial communications port interfaces to remote multiplexed digital inputs. This module is used to declare a Matrix Driver Input Unit. All data is presented in packed form.

Product Description reference: PD-T7035 Multiplexed I/O Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed.
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PROC_ID	0 – 7	The matrix driver processor number that controls this input unit. (This value selects which of the MDn parameters in the definition of the T7491 module is used.)
UNIT_ID	0 – 3	Up to 4 Input/output units may be attached to each matrix driver. This parameter is used to indicate the identity of this unit.

### CONFIGURATION

#### Physical Module

RACK 1:	4 ANALOGUE inputs
Variable 1:	Bit 0 is the state of channel 1. bit 15 is the state of channel 16. 1 - channel high, 0 – channel low.
Variable 2:	Bit 0 is the state of channel 17. bit 15 is the state of channel 32. 1 - channel high, 0 – channel low.
Variable 3:	Bit 0 is the state of channel 33. bit 15 is the state of channel 48. 1 - channel high, 0 – channel low.
Variable 4:	Bit 0 is the state of channel 49. bit 15 is the state of channel 64. 1 - channel high, 0 – channel low.

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
3. The single input channel returned provides the T7491 board status.
4. The associated M7491 module **MUST** appear in the I/O configuration **BEFORE** this module.

## 4.55. I/O Complex Equipment 'M7491\_I'

### DESCRIPTION

T7491 Multiplexed Input Module. The Multiplexed Input Module occupies one slot in the Regent+Plus I/O chassis and provides two serial communications port interfaces to remote multiplexed digital inputs and addressable loop devices. This module is used to declare a Matrix Driver Input Unit.

Product Description reference: PD-T7035 Multiplexed I/O Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed.
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 – 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PROC_ID	0 – 7	The matrix driver processor number that controls this input unit. This value selects which of the MDn parameters in the definition of the T7491 module is used.
UNIT_ID	0 – 3	Up to 4 Input/output units may be attached to each matrix driver. This parameter is used to indicate the identity of this unit.

### CONFIGURATION

#### Physical Module

RACK 1:	64 BOOLEAN inputs	
Variable 1:	Channel 1, TRUE – channel high, FALSE - channel low.	
Variable 64:	Channel 64, TRUE – channel high, FALSE - channel low.	

**Notes:**

1. All parameters must be supplied, even for virtual boards.
2. Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
3. The single input channel returned provides the T7491 board status.
4. The associated M7491 module **MUST** appear in the I/O configuration **BEFORE** this module.

## 4.56. I/O Complex Equipment 'M7491\_OP'

### DESCRIPTION

T7491 Multiplexed Output Module. The Multiplexed Output Module occupies one slot in the Regent+Plus I/O chassis and provides two serial communications port interfaces to remote multiplexed digital outputs. This module is used to declare a Matrix Driver Output Unit. All data is presented in packed form.

Product Description reference: PD-T7035 Multiplexed I/O Module.

### OEM PARAMETERS

OEM parameter	Valid numbers	Description
TICS_CHASSIS	1 – 10	The TICS chassis & slot number where the TMR Interface module is placed.
TICS_SLOT	1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	
REGENT_CHASSIS	1 – 16	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
REGENT_SLOT	1 – 10	
PROC_ID	0 – 7	The matrix driver processor number that controls this input unit. This value selects which of the MDn parameters in the definition of the T7491 module is used.
UNIT_ID	0 – 3	Up to 4 Input/output units may be attached to each matrix driver. This parameter is used to indicate the identity of this module.

### CONFIGURATION

#### Physical Module

RACK 1:	8 ANALOGUE inputs
Variable 1:	Bits 0, 1 contain the state of channel 1. Bits 14, 15 contain the state of channel 8. (see EXTRA INFORMATION for state information)
Variable 2:	Bits 0, 1 contain the state of channel 9. Bits 14, 15 contain the state of channel 16. (see EXTRA INFORMATION for state information)
Variable 3:	Bits 0, 1 contain the state of channel 17. Bits 14, 15 contain the state of channel 24. (see EXTRA INFORMATION for state information)
Variable 4:	Bits 0, 1 contain the state of channel 25. Bits 14, 15 contain the state of channel 32. (see EXTRA INFORMATION for state information)
Variable 5:	Bits 0, 1 contain the state of channel 33. Bits 14, 15 contain the state of channel 40. (see EXTRA INFORMATION for state information)
Variable 6:	Bits 0, 1 contain the state of channel 41. Bits 14, 15 contain s the state of channel 48. (see EXTRA INFORMATION for state information)

Variable 7:	Bits 0, 1 contain the state of channel 49. Bits 14, 15 contain the state of channel 56. (see EXTRA INFORMATION for state information)
Variable 8:	Bits 0, 1 contain the state of channel 57. Bits 14, 15 contain the state of channel 64. (see EXTRA INFORMATION for state information)

**Notes:**

- All parameters must be supplied, even for virtual boards.
- Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- Outputs are organized as 8 x 16 bit analogues. Each output requires 2 bits. Bits within the first analogue output are allocated as follows:  
F7 S7 F6 S6 F5 S5 F4 S4 F3 S3 F2 S2 F1 S1 F0 S0  
where bit Fn represents the required flash status for output n and Sn represents the status of output n, i.e. 8 outputs are controlled per 16 bit register. The second analogue output channel controls outputs 8 through 15 etc.
- Inputs are organized as 4 x 16 bit analogues. This provides a total of 64 bits of input. The LSB of the first channel is the first input channel on the module. The LSB of the second channel is the 17th input channel on the module etc.
- The associated M7491 module MUST appear in the I/O configuration BEFORE this module.

**EXTRA INFORMATION****Input States**

Channel input is organized as follows:

Bit n+1	Bit n	Description
(F)lash	(S)tate	
0	0	Channel output low.
0	1	Channel output flash slow.
1	0	Channel output flash fast.
1	1	Channel output high

**4.57. I/O Complex Equipment 'M7491\_0'****DESCRIPTION**

T7491 Multiplexed Output Module (unpacked state version). The Multiplexed Output Module occupies one slot in the Regent+Plus I/O chassis and provides two serial communications port interfaces to remote multiplexed digital outputs and addressable loop devices. This module is used to declare a Matrix Driver Output Unit.

Product Description reference: PD-T7035 Multiplexed I/O Module.



**OEM PARAMETERS**

OEM parameter	Valid numbers	Description
TICS_CHASSIS TICS_SLOT	1 – 10 1 – 8 (Chassis 1) 1 – 12 (Expander Chassis)	The TICS chassis & slot number where the TMR Interface module is placed.
REGENT_CHASSIS REGENT_SLOT	1 – 16 1 - 10	The chassis & slot number within the Regent+Plus I/O where the Module is placed.
PROC_ID	0 – 7	The matrix driver processor number that controls this input unit. This value selects which of the MDn parameters in the definition of the T7491 module is used.
UNIT_ID	0 – 3	Up to 4 Input/output units may be attached to each matrix driver. This parameter is used to indicate the identity of this module.

**CONFIGURATION****Physical Module**

RACK 1: 64 ANALOGUE outputs Variable 1 is channel 1, variable 64 is channel 64

**Notes:**

- All parameters must be supplied, even for virtual boards.
- Trusted chassis and slot numbers start at 1, Regent+Plus I/O chassis and slot numbers start at 1.
- The associated T7491 module MUST be appear in the I/O configuration BEFORE this module.

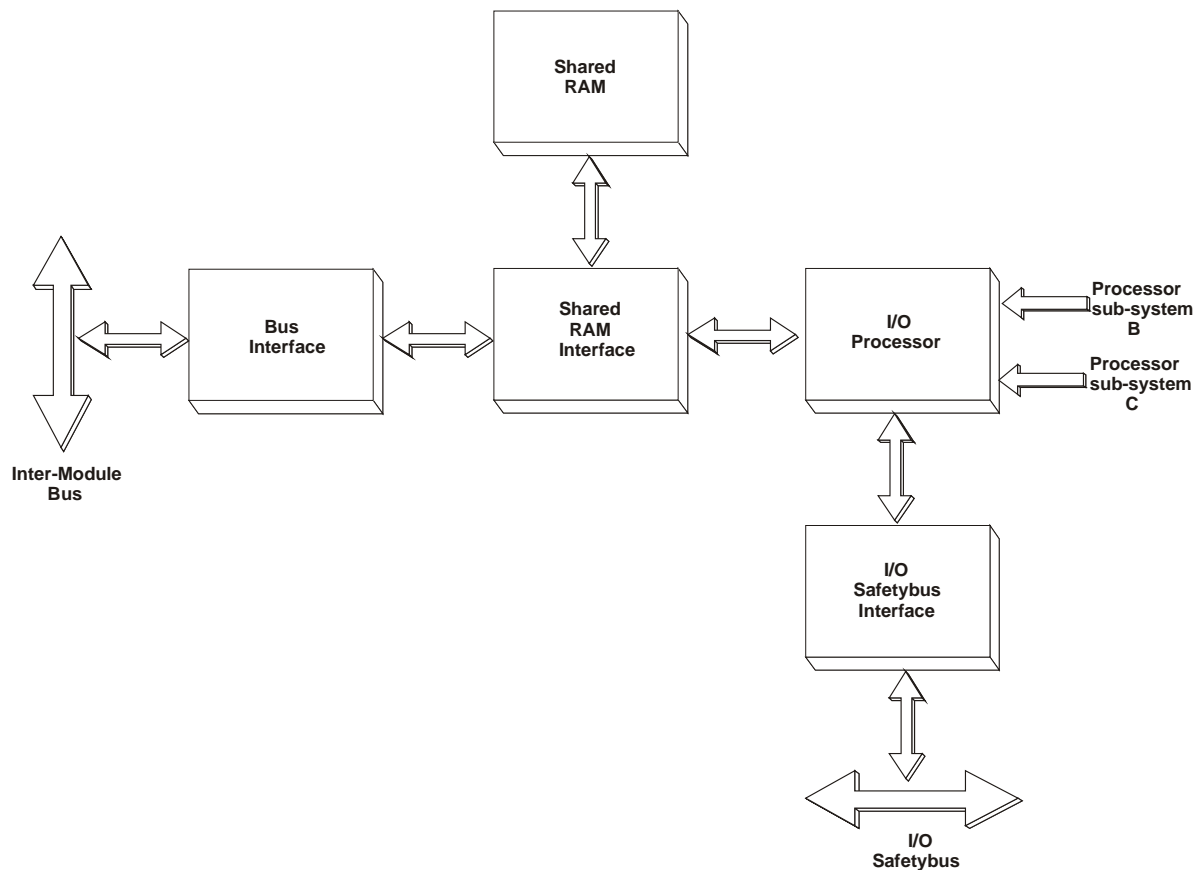
**EXTRA INFORMATION****Input States**

Channel input is organized as follows:

Bit n+1	Bit n	Description
(F)lash	(S)tate	
0	0	Channel output low.
0	1	Channel output flash slow.
1	0	Channel output flash fast.
1	1	Channel output high

## 5. Operation

Figure 3 shows the simplified architectural block diagram of a TMR Interface processor sub-system.



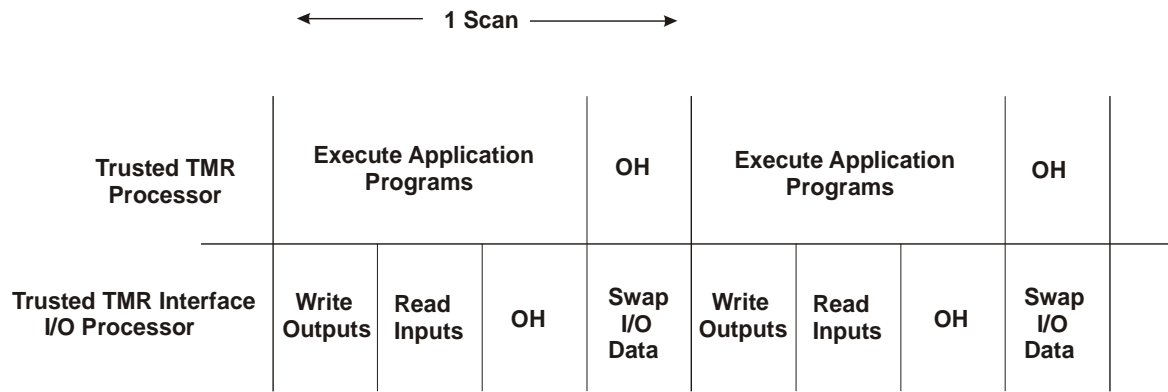
**Figure 3 Architectural Block Diagram of Processor Sub-System A**

During normal operation, module transition between 'Active' and 'Standby' modes is under the control of the Trusted TMR Processor.

The module scans the I/O sub-system via the I/O Safetybus and exchanges data with the Trusted TMR Processor. Data from inputs is read from the I/O modules in the I/O assembly. Outputs are driven by transmitting data through the I/O processor to the I/O assembly. The Trusted TMR Interface can communicate with sixteen I/O chassis', each with up to ten I/O modules.

Communications between the Trusted TMR Processor and the I/O processor are maintained through shared RAM; used as a mail box for data transfers between the two.

All three processor sub-systems operate in lock-step synchronization with each other, continuously repeating a scan cycle (Figure 4).



**Figure 4 Trusted TMR Processor / Trusted TMR Interface I/O Processor Scan Cycle**

The I/O processors in each sub-system read and write I/O synchronously. During these synchronous operations, all instructions and data are distributed across the Safetybus where automatic voting and error detection occur.

### 5.1. I/O Processor

During each scan cycle, the I/O processor votes input data into its local RAM and transfers it to the shared RAM, making it available to the Trusted TMR Processor via the Inter-Module Bus. After being processed by the Trusted TMR Processor, output data is placed into the shared RAM and read by the I/O Processor into its local RAM and written to the outputs.

- The I/O processor also shares in managing the system overhead. This overhead includes:
- Background I/O processor tests (voter tests, EPROM tests and local RAM tests).
- I/O module tests (I/O module voter tests, logic loopback tests and coordinating other I/O module tests).
- Fault filtering and reporting.

### 5.2. Watchdog Operation

The module contains two types of watchdog:

1. A triplicated module watchdog
2. A system watchdog.

The module watchdog is an individual timer watchdog, one for each processor slice. After a time-out on one processor slice, the relevant watchdog resets that slice. The module re-synchronizes all three processor slices after the reset.

The system watchdog ‘pet’ signal is controlled by the processor module. A time-out will cause the Trusted TMR Interface immediately to disable the I/O Safetybus on all three module processor slices, causing a system shut-down. The Trusted TMR Interface then assumes the ‘Standby’ mode.

### 5.3. Front Panel

Figure 5 shows the front panel of the Trusted TMR Interface.

The front panel of the module contains indicators showing overall module health and active/standby status.



Figure 5 Trusted TMR Interface Front Panel

## 5.4. Module Status LEDs

The module status LED states and their meanings are described as follows:

LED	State	Description
Healthy	On Steady Green	The Module is healthy
	Flashing	Processor sub system slice has failed
Active	On Steady Green	Module is in the Active state
Standby	On Steady Green	Module is in the Standby state
Educated	Off	Module not educated
	On Steady Green	Module configuration is valid
	Green – flashing	Module is recognized by the Processor but education is not complete
I/O Healthy	Off	I/O sub-system fault
	On Steady Green	I/O sub-system is healthy

**Table 3 Module Status LEDs**

## 6. Fault Finding and Maintenance

### 6.1. Fault Reporting

Input module faults are reported to the user through visual indicators (LEDs) on the front panel of the module. Faults are also reported via status variables which may be automatically monitored in the application programs, and external system communications interfaces. There are generally two types of faults that must be remedied by the user; external wiring and module faults. External wiring faults require corrective action in the field to repair the fault condition. Module faults require replacement of the module.

### 6.2. Testing and Diagnostics

The Trusted TMR Interface carries out background diagnostic checks, in the form of simple hardware tests, during module operation. The checks last for the duration of module operation and test the following:

- Voters
- Memory
- Fault detectors
- Processor registers
- I/O sub-system (all modules)

These diagnostic checks are contained in the module firmware and are executed after each I/O scan. The results of the checks are stored and made available for reporting back to the Trusted TMR Processor.

Page intentionally left blank

## 7. Specifications

Voltage Range:	20 Vdc to 32 Vdc
Heat Dissipation:	20 W
Operating Temperature:	0 °C to +60 °C (+32 °F to +140 °F)
Non-operating Temperature:	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity Range (operating, storage & transport):	10 % – 95 %, non-condensing
Environmental Specifications:	<a href="#">Refer to Document 552517</a>
Height:	266 mm (10.5 in)
Width:	31 mm (1.2 in)
Depth:	303 mm (12.0 in)
Weight (approx.)	1.5 kg (3.3 lb)