VTAC 9 AC Drive

Firmware Version 3.xx

User Manual

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/vtac/**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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

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

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

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

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

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

The information below summarizes the changes to the VTAC 9 User Manual since the June 2007 release.

Manual Updates

Description of New or Updated Information	Page
Additional documentation needed when installing Bypass Package (Style B) Drives.	1-1, 1-23, 1-30
Suggested Analog Signal Wiring section added.	1-23, 1-30
Interlock Connection Considerations added.	1-24, 1-31
Important statement regarding the two types of I/O Terminal Blocks added.	1-25, 1-32
Parameter 178 [Sleep Wake Mode] description updated.	3-38
Sleep Wake Mode definitions updated.	C-11

Table of Contents

Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the VTAC 9 Adjustable Frequency AC Drive Packages.

Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

What Is Not in this Manual

The VTAC 9 *User Manual* is designed to provide basic start-up and drive operation information. For detailed installation information, please refer to the VTAC 9 *Installation Instructions*, publication 9VT-IN001. Manuals are available online at **http://www.rockwellautomation.com/vtac/**.

Getting Assistance from Rockwell Automation

If you have any questions or problems with the products described in this instruction manual, contact your authorized Rockwell Automation VTAC drive representative.

For technical assistance, call 1-440-646-7271.
Before calling, please review the troubleshooting section of this manual and for additional information visit VTAC Drives online at **http://www.rockwellautomation.com/vtac/**.
When you call this number, you will be asked for the drive model number and this instruction manual number.

Manual Conventions

- In this manual we refer to the VTAC 9 Adjustable Frequency AC Drive as; drive, VTAC 9 or VTAC 9 Drive.
- To help differentiate parameter names and LCD display text from other text, the following conventions will be used:
  - Parameter Names will appear in [brackets].
    For example: [DC Bus Voltage].
  - Display Text will appear in “quotes.” For example: “Enabled.”
- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not recommended

General Precautions

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point (refer to Chapter 1 for locations). The voltage must be zero.

VTAC 9 Catalog Numbers

Each VTAC 9 drive can be identified by its catalog number. There are two distinct catalog numbers associated with each rating: the System (VTAC Builder/Order) Catalog Number and the Model Number.

System (VTAC Builder/Order) Catalog Number Explanation

The System (VTAC Builder/Order) Catalog Number is used for ordering and may appear on shipping or order documentation.

Position

9VT	–	50	4	1	H	0	N	–	D	0	0
a		b	c	d	e	f	g		h	i	j

a

Drive	
Code	Type
9VT	VTAC 9

b1

Horsepower Rating 208V, 60 Hz Input		
Code	Hp	Drive Frame
2	2	B
3	3	B
5	5	C
7	7.5	D
10	10	D
15	15	D
20	20	E
25	25	E
30	30	4
40	40	5
50	50	5
60	60	6
75	75	6
100	100	6

b2

Horsepower Rating 480V, 60 Hz Input		
Code	Hp	Drive Frame
3	3	B
5	5	B
7	7.5	C
10	10	C
15	15	D
20	20	D
25	25	D, 2
30	30	D, 3
40	40	E, 3
50	50	E, 3
60	60	4
75	75	5
100	100	5
125	125	6
150	150	6
200	200	6

b3

Horsepower Rating 650V dc Input		
Code	Hp	Drive Frame
75	75	5
100	100	5
125	125	6
150	150	6
200	200	6

c

Voltage Rating			
Code	Voltage	Phase	Precharge
2	208V ac	3	–
4	480V ac	3	–
R	650V dc	–	Yes

d

Enclosure	
Code	Enclosure
1	Panel Mount - NEMA Type 1
F *	Flange Mount - Front Chassis NEMA Type 1, Rear Heatsink UL Type 4X/12 for Indoor/Outdoor Use

* Drive Frame B, C, D, E only.

e

OIM	
Code	OIM
H	LCD OIM

f

Communications	
Code	Communications
0	None

g

Control and I/O			
Code	Control	I/O	Drive Frame
N	Standard	24V	B, C, D, E
A	Standard	24V	2, 3, 4, 5, 6

h

Option Enclosure	
Code	Option
D	Drive Only

i

Input Power	
Code	Option
0	None

j

Reactor	
Code	Type
0	None

Model Number Explanation

The Model Number is located on the actual drive nameplate.

Position										
9VT	2	01	–	017	H	T	A	N	N
a	*b*	*c*		*d*	*e*	*f*	*g*	*h*	*i*

a

Drive	
Code	Type
9VT	VTAC 9

b

Voltage Rating			
Code	Voltage	Phase	Precharge
2	208V ac	3	–
4	480V ac	3	–
R	650V dc	–	Yes

c

Enclosure	
Code	Enclosure
01	NEMA Type 1
1F ⋆	Flange Mount - Front Chassis NEMA Type 1, Rear Heatsink UL Type 4X/12 for Indoor/Outdoor Use

⋆ Drive Frame B, C, D, E only.

d1

Horsepower Rating		
208V, 60 Hz Input		
Code	Hp	Drive Frame
007	2	B
011	3	B
017	5	C
025	7.5	D
032	10	D
043	15	D
062	20	E
078	25	E
092	30	4
120	40	5
130	50	5
177	60	6
221	75	6
260	100	6

d2

Horsepower Rating		
480V, 60 Hz Input		
Code	Hp	Drive Frame
005	3	B
008	5	B
011	7.5	C
014	10	C
022	15	D
027	20	D
034	25	D
034	25	2
040	30	D
040	30	3
052	40	E
052	40	3
065	50	E
065	50	3
077	60	4
096	75	5
125	100	5
156	125	6
180	150	6
248	200	6

d3

Horsepower Rating		
650V dc Input		
Code	Hp	Drive Frame
096	75	5
125	100	5
156	125	6
180	150	6
248	200	6

e

OIM	
Code	OIM
B	None
H	LCD OIM

f

Braking Transistor	
Code	Brake
N	None
T	Braking Transistor

g

DC Bus	
Code	DC Bus Inductor
A	Yes
N	None

h

Communications	
Code	Communications
N	None

i

Control and I/O			
Code	Control	I/O	Drive Frame
N	Standard	24V	B, C, D, E
A	Standard	24V	2, 3, 4, 5, 6

VTAC 9 NEMA 1 Catalog Number Explanation

Drive Ratings				System Number (Order Number)
Voltage	HP	Frame	Model Number	
208V AC	2	B	9VT201-007HTNNN	9VT-221H0N-D00
	3	B	9VT201-011HTNNN	9VT-321H0N-D00
	5	C	9VT201-017HTANN	9VT-521H0N-D00
	7.5	D	9VT201-025HTANN	9VT-721H0N-D00
	10	D	9VT201-032HTANN	9VT-1021H0N-D00
	15	D	9VT201-043HTANN	9VT-1521H0N-D00
	20	E	9VT201-062HTANN	9VT-2021H0N-D00
	25	E	9VT201-078HTANN	9VT-2521H0N-D00
	30	4	9VT201-092HNANA	9VT-3021H0A-D00
	40	5	9VT201-120HNANA	9VT-4021H0A-D00
	50	5	9VT201-130HNANA	9VT-5021H0A-D00
	60	6	9VT201-177HNANA	9VT-6021H0A-D00
	75	6	9VT201-221HNANA	9VT-7521H0A-D00
	100	6	9VT201-260HNANA	9VT-10021H0A-D00
480V AC	3	B	9VT401-005HTNNN	9VT-341H0N-D00
	5	B	9VT401-008HTNNN	9VT-541H0N-D00
	7.5	C	9VT401-011HTANN	9VT-741H0N-D00
	10	C	9VT401-014HTANN	9VT-1041H0N-D00
	15	D	9VT401-022HTANN	9VT-1541H0N-D00
	20	D	9VT401-027HTANN	9VT-2041H0N-D00
	25	D	9VT401-034HTANN	9VT-2541H0N-D00
	25	2	9VT401-034HTANA	9VT-2541H0A-D00
	30	D	9VT401-040HTANN	9VT-3041H0N-D00
	30	3	9VT401-040HTANA	9VT-3041H0A-D00
	40	E	9VT401-052HTANN	9VT-4041H0N-D00
	40	3	9VT401-052HTANA	9VT-4041H0A-D00
	50	E	9VT401-065HTANN	9VT-5041H0N-D00
	50	3	9VT401-065HTANA	9VT-5041H0A-D00
	60	4	9VT401-077HNANA	9VT-6041H0A-D00
	75	5	9VT401-096HNANA	9VT-7541H0A-D00
	100	5	9VT401-125HNANA	9VT-10041H0A-D00
	125	6	9VT401-156HNANA	9VT-12541H0A-D00
	150	6	9VT401-180HNANA	9VT-15041H0A-D00
	200	6	9VT401-248HNANA	9VT-20041H0A-D00
650V DC	75	5	9VTR01-096HNANA	9VT-75R1H0A-D00
	100	5	9VTR01-125HNANA	9VT-100R1H0A-D00
	125	6	9VTR01-156HNANA	9VT-125R1H0A-D00
	150	6	9VTR01-180HNANA	9VT-150R1H0A-D00
	200	6	9VTR01-248HNANA	9VT-200R1H0A-D00

VTAC 9 Flange Mount Catalog Number Explanation

Drive Ratings		Frame	Model Number	System Number (Order Number)
Voltage	HP			
208V AC	2	B	9VT21F-007HTNNN	9VT-22FH0N-D00
	3	B	9VT21F-011HTNNN	9VT-32FH0N-D00
	5	C	9VT21F-017HTANN	9VT-52FH0N-D00
	7.5	D	9VT21F-025HTANN	9VT-72FH0N-D00
	10	D	9VT21F-032HTANN	9VT-102FH0N-D00
	15	D	9VT21F-043HTANN	9VT-152FH0N-D00
	20	E	9VT21F-062HTANN	9VT-202FH0N-D00
	25	E	9VT21F-078HTANN	9VT-252FH0N-D00
480V AC	3	B	9VT41F-005HTNNN	9VT-34FH0N-D00
	5	B	9VT41F-008HTNNN	9VT-54FH0N-D00
	7.5	C	9VT41F-011HTANN	9VT-74FH0N-D00
	10	C	9VT41F-014HTANN	9VT-104FH0N-D00
	15	D	9VT41F-022HTANN	9VT-154FH0N-D00
	20	D	9VT41F-027HTANN	9VT-204FH0N-D00
	25	D	9VT41F-034HTANN	9VT-254FH0N-D00
	30	D	9VT41F-040HTANN	9VT-304FH0N-D00
	40	E	9VT41F-052HTANN	9VT-404FH0N-D00
	50	E	9VT41F-065HTANN	9VT-504FH0N-D00

Notes:

Installation/Wiring

This chapter provides information on mounting and wiring the VTAC 9 Drive.

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Bypass Package (Style B) Drives

Important: If you are intalling a Bypass Package (Style B) Drive, also refer to VTAC 9 AC Drive Installation Instructions, publication 9VT-IN001 in addition to this publication.

Opening the Cover

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been removed. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

Drive Frames B, C, D, and E have removable covers.
Drive Frames 2, 3, 4, 5, and 6 have hinged covers.

Drive Frames B Through E

Follow these steps for Drive Frames B…E.

❑ Step 1. Loosen the drive cover screw(s) (refer to Figure 1.1).

❑ Step 2. Lift the cover straight off the drive to avoid damaging the connector pins.

Figure 1.1 Removing the Drive Cover (Frames B...D)

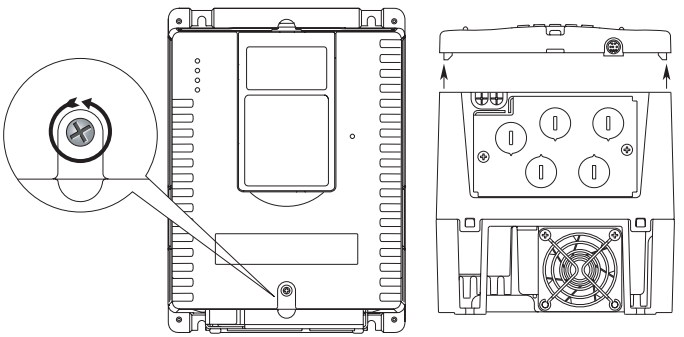
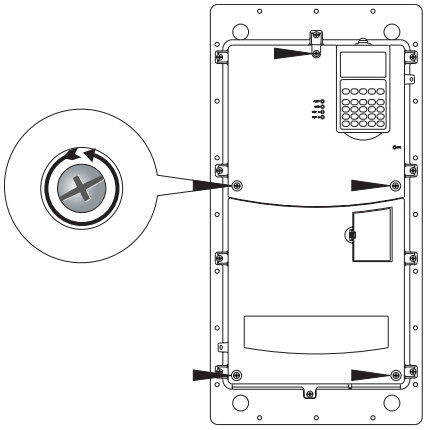


Figure 1.2 Removing the Drive Cover (Frame E)



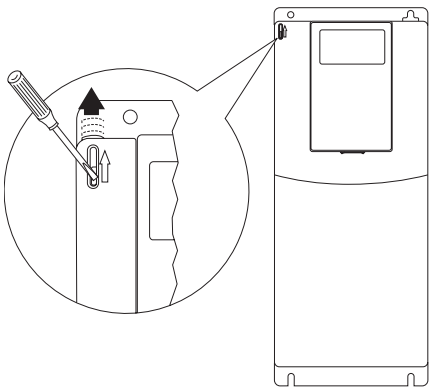
Drive Frames 2 Through 6

Follow these steps for Drive Frames 2…6.

❑ Step 1. Locate the slot in the upper left hand corner of the drive (refer to Figure 1.3).

❑ Step 2. Slide the locking tab up and swing the door open.

Figure 1.3 Opening the Drive Cover (Frames 2...6)



Mounting Considerations

Maximum Surrounding Air Temperature

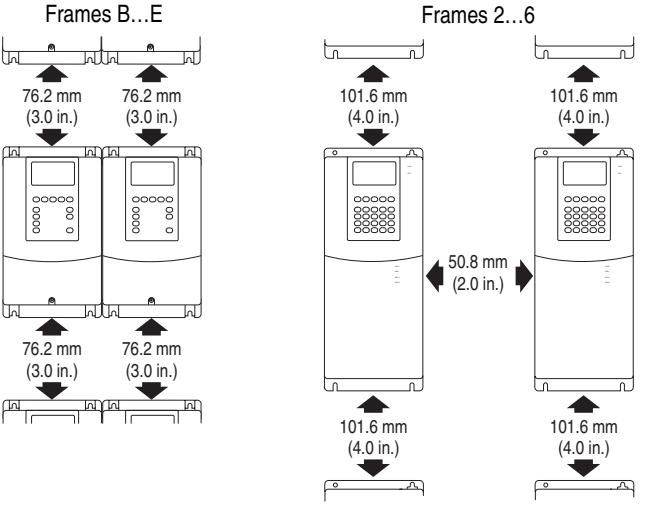
Drive Frames	HP	IP20, NEMA Type 1[1]	IP20, NEMA Type Open *Top Label Removed*[2]
B, C, D, & E	3…25 @ 208V 2…50 @ 460V	50 degrees C (122 degrees F)	NA
2, 3, & 4	30 @ 208V 25…60 @ 460V	40 degrees C (104 degrees F)	50 degrees C (122 degrees F)
5 & 6	40…75 @ 208V 75…150 @ 480V	50 degrees C (122 degrees F)	NA
6	100 @ 208V 200 @ 480V	45 degrees C (113 degrees F)	NA

(1) IP20, NEMA Type 1 general purpose enclosures are intended for indoor use primarily to provide a degree of protection against contact with equipment. These enclosures offer no protection against airborne contaminants such as dust or water.

(2) Removing the adhesive top label from the drive changes the NEMA enclosure rating from Type 1 to Open Type.

Minimum Mounting Clearances

Specified vertical clearance requirements are intended to be from drive to drive. Other objects can occupy this space; however, reduced airflow may cause protection circuits to fault the drive. In addition, inlet air temperature must not exceed the product specification.



AC Supply Source Considerations

VTAC 9 drives are suitable for use on a circuit capable of delivering up to a maximum of 200,000 rms symmetrical amperes, and a maximum of 480 volts.

ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in Appendix A.

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Unbalanced or Ungrounded Distribution Systems

If phase to ground voltage will exceed 125% of normal line to line voltage or the supply system is ungrounded, refer to the *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.

ATTENTION: VTAC 9 drives contain protective MOVs and common mode capacitors that are referenced to ground. These devices should be disconnected if the drive is installed on an ungrounded distribution system. See page 1-18 for jumper locations.

Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life. These conditions are divided into 2 basic categories:

1. **All drives**
   - The power system has power factor correction capacitors switched in and out of the system, either by the user or by the power company.
   - The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
   - The power source has frequent interruptions.
2. **5 HP or Less Drives (in addition to "1" above)**
   - The nearest supply transformer is larger than 100kVA or the available short circuit (fault) current is greater than 100,000A.
   - The impedance in front of the drive is less than 0.5%.

If any or all of these conditions exist, it is recommended that the user install a minimum amount of impedance between the drive and the source. This impedance could come from the supply transformer itself,

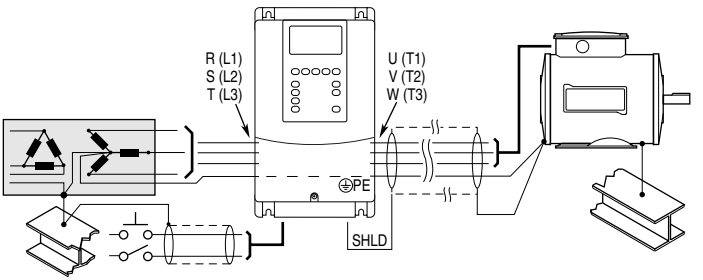
the cable between the transformer and drive or an additional transformer or reactor. The impedance can be calculated using the information supplied in *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.

General Grounding Requirements

The drive Safety Ground - PE must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

Figure 1.4 Typical Grounding



Safety Ground - PE

This is the safety ground for the drive that is required by code. This point must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar (see above). Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Shield Termination - SHLD

The Shield terminal (see Figure 1.6 on page 1-11) provides a grounding point for the motor cable shield. The **motor cable** shield should be connected to this terminal on the drive (drive end) and the motor frame (motor end). A shield terminating cable gland may also be used.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using an optional RFI filter may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked. Refer to the instructions supplied with the filter.

Fuses and Circuit Breakers

The VTAC 9 can be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations. Refer to Appendix A for recommended fuses/circuit breakers.

ATTENTION: The VTAC 9 does not provide branch short circuit protection. Specifications for the recommended fuse or circuit breaker to provide protection against short circuits are provided in Appendix A.

Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in “Wiring and Grounding Guidelines for PWM AC Drives,” publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Table 1.A Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

EMC Compliance

Refer to EMC Instructions on page 1-37 for details.

Cable Trays and Conduit

If cable trays or large conduits are to be used, refer to guidelines presented in *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives*.

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

Motor Cable Lengths

Typically, for 480V AC systems, motor lead lengths less than 150 meters (approximately 500 feet) are acceptable if using an inverter rated motor with 1600 volt insulation. However, if your application dictates longer lengths, or if you are using a different motor, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (publication VTAC-IN002) for details.

AC Input Phase Selection (Frames 5 & 6 Only)

ATTENTION: To avoid a shock hazard, ensure that all power to the drive has been removed before performing the following.

Moving the "Line Type" jumper shown in Figure 1.5 will allow single or three-phase operation.

Important: When selecting single-phase operation, input power must be applied to the R (L1) and S (L2) terminals only.

Selecting/Verifying Fan Voltage (Frames 5 & 6 Only)

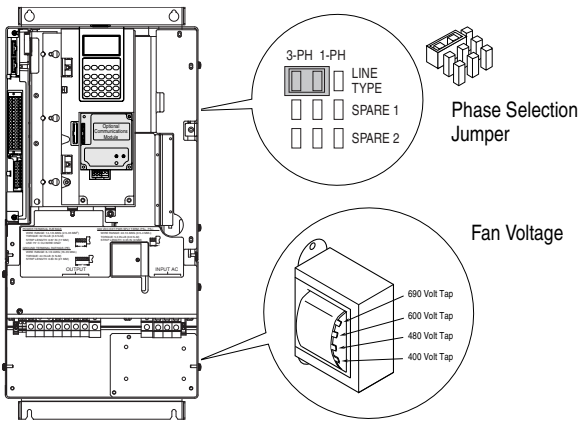
Important: **Read Attention** statement above!

Frames 5 & 6 utilize a transformer to match the input line voltage to the internal fan voltage. If your line voltage is different than the voltage class specified on the drive nameplate, it may be necessary to change transformer taps as shown below. Common Bus (DC input) drives require user supplied 120 or 240V AC to power the cooling fans. The power source is connected between "0 VAC" and the terminal corresponding to your source voltage (see Figure 1.11).

Table A Fan VA ratings (DC Input Only)

Frame	Rating *(120V or 240V)*
5	100 VA
6	138 VA

Figure 1.5 Typical Locations - Phase Select Jumper & Transformer (Frame 5 shown)



Frame 6 Transformer Tap Access

The transformer is located behind the Power Terminal Block in the area shown in Figure 1.5. Access is gained by releasing the terminal block from the rail. To release terminal block and change tap:

1. Locate the small metal tab at the bottom of the end block.
2. Press the tab in and pull the top of the block out. Repeat for next block if desired.
3. Select appropriate transformer tap.
4. Replace block(s) in reverse order.

Power Terminal Block (Frames B…E)

Table 1.B Power Terminal Block Specifications (Frames B…E)

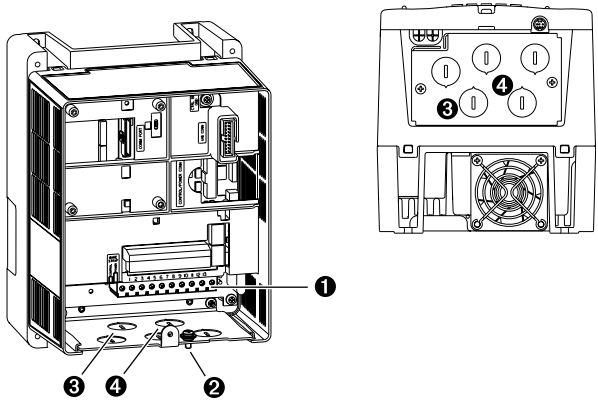
No.	Name	Frame	Description	Wire Size Range[1]		Torque	
				Maximum	Minimum	Maximum	Recommended
❶	Power Terminal Block	B & C	Input power and motor connections	3.5 mm^2 (12 AWG)	0.3 mm^2 (22 AWG)	0.66 N-m (5.5 lb.-in.)	0.6 N-m (5 lb.-in.)
		D		8.4 mm^2 (8 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
		E		25.0 mm^2 (3 AWG)	2.5 mm^2 (14 AWG)	2.71 N-m (24 lb.-in.)	2.71 N-m (24 lb.-in.)
❷	SHLD terminal	B…E	Terminating point for wiring shields	—	—	1.6 N-m (14 lb.-in.)	1.6 N-m (14 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Table 1.C Wire Routing Recommendations

No.	Description
❸	Suggested entry for incoming line wiring.
❹	Suggested entry for motor wiring.

Figure 1.6 Typical Frame B…E Power Terminal Block Location (B Frame Shown)



Cable Entry Plate Removal

If additional wiring access is needed, the Cable Entry Plate on Frames B…E can be removed. Simply loosen the screws securing the plate to the heat sink and slide the plate out.

Figure 1.7 Frame B Power Terminal Blocks

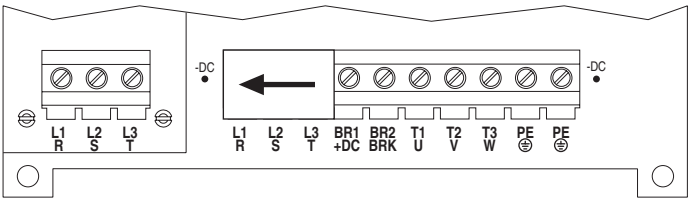


Figure 1.8 Frames C & D Power Terminal Block and DC Bus Test Points

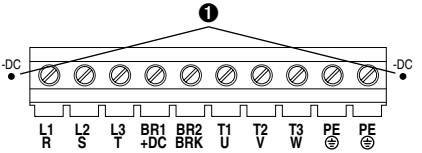
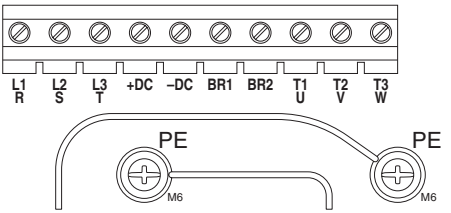


Figure 1.9 Frame E Power Terminal Block



Terminal	Description	Notes
R	R (L1)	AC Line Input Power
S	S (L2)	AC Line Input Power
T	T (L3)	AC Line Input Power
BR1	DC Brake	DB Resistor Connection - **Important:** Do not connect both an internal and external DB resistor at the same time. This may violate the minimum allowed DB resistance and cause drive damage.
BR2	DC Brake	
U	U (T1)	To Motor
V	V (T2)	To Motor
W	W (T3)	To Motor
PE	PE Ground	
PE	PE Ground	
-DC	DC Bus (–)	❶ Test point on Frames B…D located to the left or right of the Power Terminal Block. Frame E has a dedicated terminal.
+DC	DC Bus (+)	

Power Terminal Block (Frames 2…6)

Table 1.D Power Terminal Block Specifications

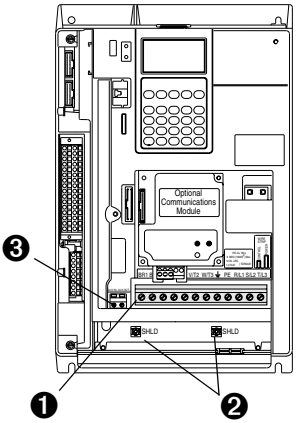
No.	Name	Frame	Description	Wire Size Range[1]		Torque	
				Maximum	Minimum	Maximum	Recommended
❶	Power Terminal Block	2	Input power and motor connections	10.0 mm^2 (6 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
		3	Input power and motor connections	25.0 mm^2 (3 AWG)	2.5 mm^2 (14 AWG)	3.6 N-m (32 lb.-in.)	1.8 N-m (16 lb.-in.)
			BR1, 2 terminals	10.0 mm^2 (6 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
		4	Input power and motor connections	35.0 mm^2 (1/0 AWG)	10 mm^2 (8 AWG)	4.0 N-m (35 lb.-in.)	4.0 N-m (35 lb.-in.)
		5 40 HP @ 208V, 75 HP @ 480V	Input power, BR1, 2, DC+, DC– and motor connections	50.0 mm^2 (1/0 AWG)	2.5 mm^2 (14 AWG)	See Note [2]	
			PE	50.0 mm^2 (1/0 AWG)	16.0 mm^2 (6 AWG)		
		5 50 HP @ 208V, 100 HP @ 480V	Input power, DC+, DC– and motor	70.0 mm^2 (2/0 AWG)	25.0 mm^2 (4 AWG)		
			BR1, 2, terminals	50.0 mm^2 (1/0 AWG)	2.5 mm^2 (14 AWG)		
			PE	50.0 mm^2 (1/0 AWG)	16.0 mm^2 (6 AWG)		
		6	Input power, DC+, DC–, BR1, 2, PE, motor connections	120.0 mm^2 (4/0 AWG)	2.5 mm^2 (14 AWG)	6 N-m (52 lb.-in.)	6 N-m (52 lb.-in.)
❷	SHLD Terminal	2-6	Terminating point for wiring shields	—	—	1.6 N-m (14 lb.-in.)	1.6 N-m (14 lb.-in.)
❸	AUX Terminal Block	2-4	Auxiliary Control Voltage PS+, PS–[3]	1.5 mm^2 (16 AWG)	0.2 mm^2 (24 AWG)	—	—
		5-6		4.0 mm^2 (12 AWG)	0.5 mm^2 (22 AWG)	0.6 N-m (5.3 lb.-in.)	0.6 N-m (5.3 lb.-in.)
❹	Fan Terminal Block (CB Only)	5-6	User Supplied Fan Voltage (page 1-10)	4.0 mm^2 (12 AWG)	0.5 mm^2 (22 AWG)	0.6 N-m (5.3 lb.-in.)	0.6 N-m (5.3 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

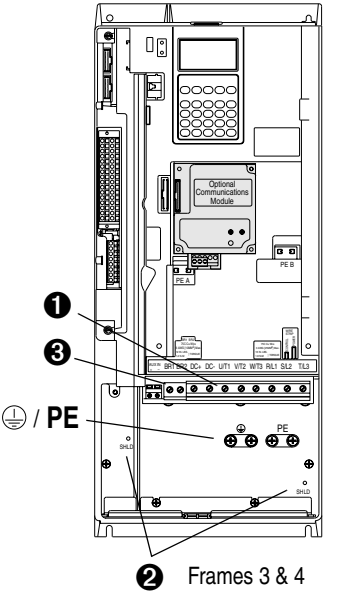
(2) Refer to the terminal block label inside the drive.

(3) External control power: UL Installation-300V DC, ±10%, Non UL Installation-270-600V DC, ±10% 2 & 3 Frame - 40 W, 165 mA, 5 Frame - 80 W, 90 mA.

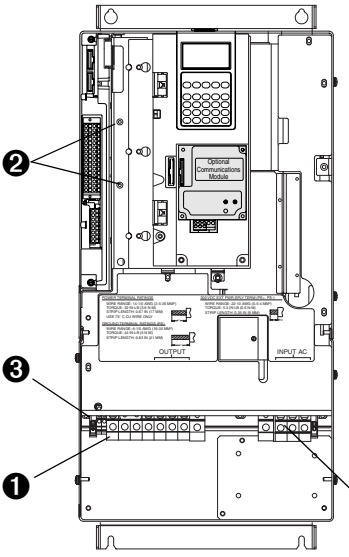
Figure 1.10 Typical Power Terminal Block Location, Frames 2…6



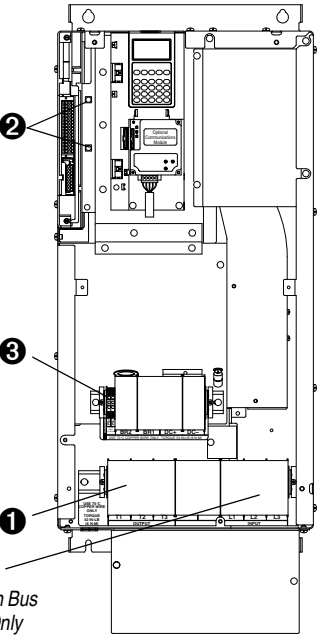
Frame 2



Frames 3 & 4



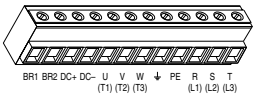
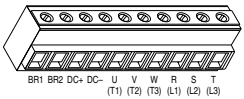
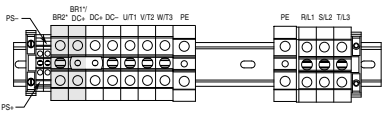
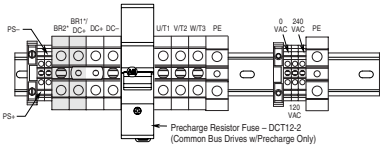
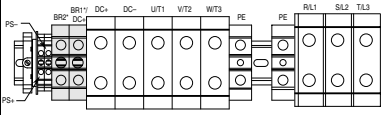
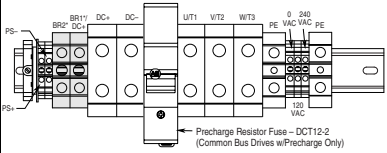
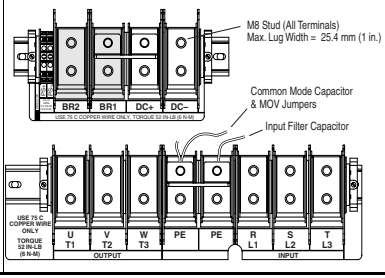
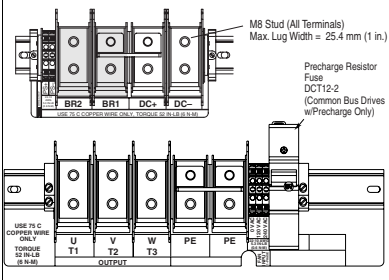
Frame 5



Common Bus Drives Only

Frame 6

Figure 1.11 Frames 2…6 Power Terminal Block

Frame	Terminal Block	
2		*** Note:** Shaded BR1 & BR2 Terminals will only be present on drives ordered with the Brake Option.
3 + 4		
	208V AC or 480V AC Input	**650V DC Input**
5	40 HP @ 208V AC 75 HP @ 480V AC 	75 HP @ 650V DC 
	50 HP @ 208V AC 100 HP @ 480V AC 	100 HP @ 650V DC 
6	60…100 HP @ 208V AC 125…200 HP @ 480V AC 	125…200 HP @ 650V DC 

Terminal	Description	Notes
BR1	DC Brake (+)	DB Resistor Connection - **Important:** Only one DB resistor can be used with Frames 2 & 3. Connecting an internal & external resistor could cause damage.
BR2	DC Brake (–)	
DC+	DC Bus (+)	
DC–	DC Bus (–)	
PE	PE Ground	Refer to Figure 1.10 for location on 3 Frame drives
⏚	Motor Ground	Refer to Figure 1.10 for location on 3 Frame drives
U	U (T1)	To motor
V	V (T2)	To motor
W	W (T3)	To motor
R	R (L1)	AC Line Input Power Three-Phase = R, S & T Single-Phase = R & S Only
S	S (L2)	
T	T (L3)	
PS+	AUX (+)	Auxiliary Control Voltage (see Table 1.D)
PS–	AUX (–)	Auxiliary Control Voltage (see Table 1.D)

Using Input/Output Contactors

Input Contactor Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor/Disconnect Precaution

ATTENTION: To guard against drive damage when using output contactors or disconnects, the following information must be read and understood. One or more output contactors or disconnects may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor or disconnect is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor or disconnect) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor or disconnect should be wired to a drive digital input that is programmed as "Enable." This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor or disconnect is opened.

Bypass Contactor Precaution

ATTENTION: An incorrectly applied or installed bypass system can result in component damage or reduction in product life. The most common causes are:

- Wiring AC line to drive output or control terminals.
- Improper bypass or output circuits not approved by Rockwell Automation.
- Output circuits which do not connect directly to the motor.

Contact Rockwell Automation for assistance with application or wiring.

Disconnecting MOVs and Common Mode Capacitors

VTAC 9 drives contain protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices should be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove all the jumper(s) shown in the figure and table below. See *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001 for more information on ungrounded system installation.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before removing/installing jumpers. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point. The voltage must be zero.

Figure 1.12 Typical Frame B - E Jumper Locations (C Frame Shown)

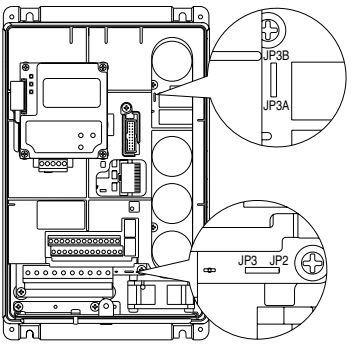
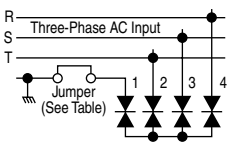
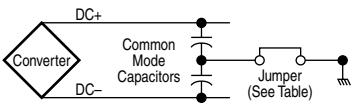


Figure 1.13 Phase to Ground MOV Removal (Frame B…E)



Frame	Jumper	Removes
B, C & D	JP3 – JP2	MOV to Ground
E	JP2 – JP1	MOV and Line to Line Capacitors to Ground

Figure 1.14 Common Mode Capacitors to Ground Removal (Frame B…E)



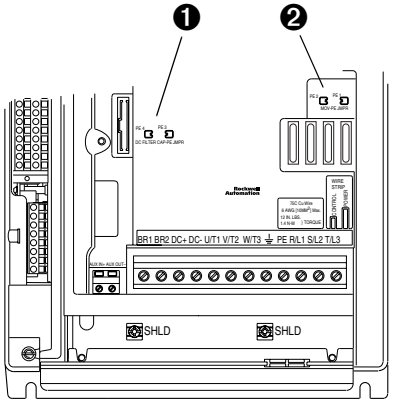
Frame	Jumper	Removes
B	JP6 – JP5	Common Mode Capacitors to Ground
C and D	JP3B – JP3A	Common Mode Capacitors to Ground
E	JP3 – JP4	Common Mode Capacitors to Ground

Table 1.E Frame 2 - 6 Jumper Removal(1)

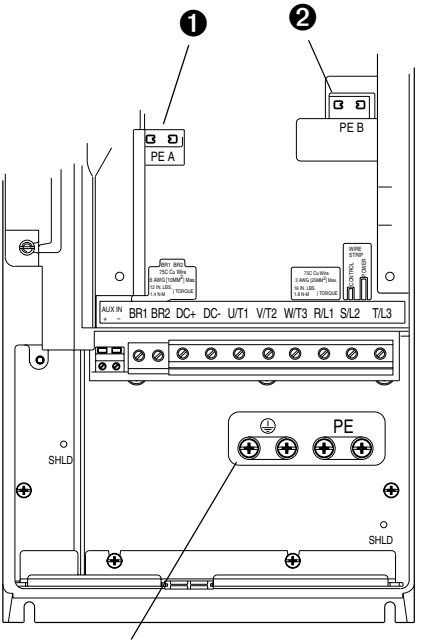
Frames	Jumper	Component	Jumper Location	No.
2-4	PEA	Common Mode Capacitors	Jumpers are located above the Power Terminal Block (see Figure 1.15).	❶
	PEB	MOV's		❷
5	Wire	Common Mode Capacitors	Remove the I/O Cassette as described on page 1-28. The green/yellow jumper is located on the back of chassis (see Figure 1.15 for location). Disconnect, insulate and secure the wire to guard against unintentional contact with chassis or components.	❸
		MOV's Input Filter Capacitors	Note location of the two green/yellow jumper wires next to the Power Terminal Block (Figure 1.15). Disconnect, insulate and secure the wires to guard against unintentional contact with chassis or components.	❹
6	Wire	Common Mode Capacitors MOV's Input Filter Capacitors	Remove the wire guard from the Power Terminal Block. Disconnect the three green/yellow wires from the two "PE" terminals shown in Figure 1.11. Insulate/secure the wires to guard against unintentional contact with chassis or components.	

(1) **Important:** Do Not remove jumpers if the distribution system is grounded.

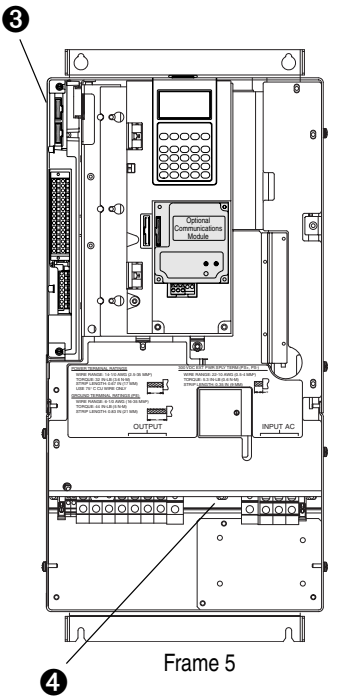
Figure 1.15 Typical Frame 2 - 5 Jumper Locations (see Table 1.E for description)



Frame 2



Frames 3 & 4



Frame 5

Important: Do Not discard or replace grounding hardware.

I/O Wiring

Important points to remember about I/O wiring:

- Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

ATTENTION: Configuring an analog input for 0-20mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Signal and Control Wire Types

Table 1.F Recommended Signal Wire

Signal Type/ Where Used	Belden Wire Type(s) *(or equivalent)*	Description	Min. Insulation Rating
Analog I/O & PTC	8760/9460	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain (1)	300V, 75-90° C (167-194° F)
Remote Pot	8770	0.750 mm^2 (18 AWG), 3 cond., shielded	

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 1.G Recommended Control Wire for Digital I/O

	Wire Type(s)	Description	Minimum Insulation Rating
Unshielded	Per US NEC or applicable national or local code	—	300V, 60 degrees C (140 degrees F)
Shielded	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	

I/O Terminal Block (Frames B…E)

Figure 1.16 Typical Frame B…E I/O Terminal Block Location (B Frame Shown)

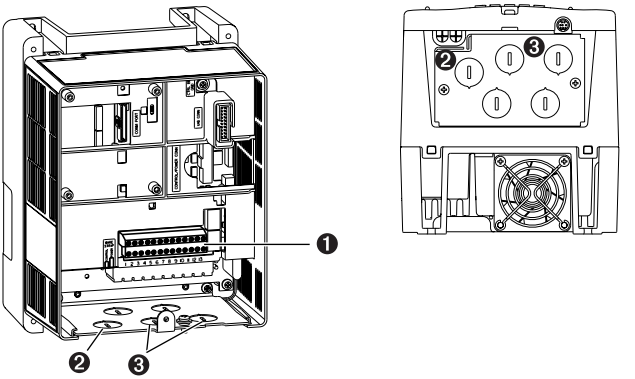


Table 1.H I/O Terminal Block Specifications

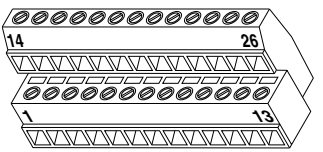
No.	Name	Description	Wire Size Range[1]		Torque	
			Maximum	Minimum	Maximum	Recommended
1	I/O Terminal Block	Signal & control connections	1.5 mm^2 (16 AWG)	0.05 mm^2 (30 AWG)	0.55 N-m (4.9 lb.-in.)	0.5 N-m (4.4 lb.-in.)

(1) Maximum / minimum that the terminal block will accept - these are not recommendations.

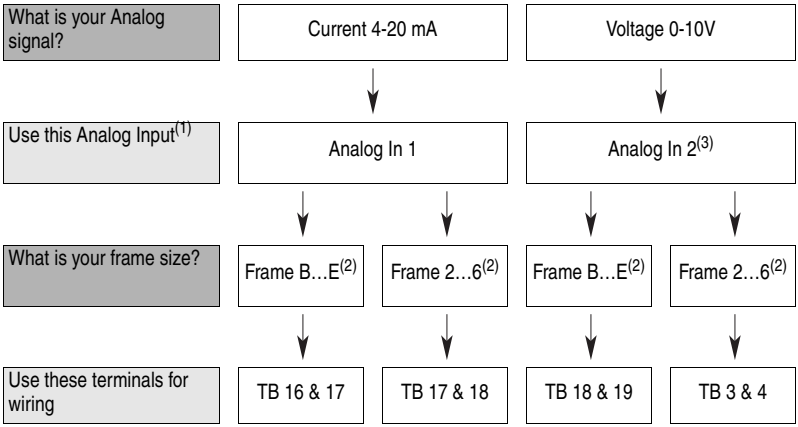
Table 1.I Wire Routing Recommendations

No.	Description
2	Suggested entry for communication wiring.
3	Suggested entry for I/O and control wiring.

Figure 1.17 I/O Terminal Positions (Frames B…E)



Suggested Analog Signal Wiring



(1) If a different Analog Input selection is required:
- Parameter 320 bit values will have to be configured
- Parameters 325 and 326 or 322 and 323 will have to be configured

See Chapter 3 for details on programming parameters.

(2) Frame size can be determined by the number of terminals on the I/O Terminal Block:
- Frames B...E have 26 I/O terminals
- Frames 2...6 have 32 I/O terminals

(3) If Analog Input 2 is used for speed reference, parameter 90 will have to be programmed to select option 2 “Analog In 2”.

Bypass Package (Style B) Drives

Important: If you are intalling a Bypass Package (Style B) Drive, also refer to VTAC 9 AC Drive Installation Instructions, publication 9VT-IN001 in addition to this publication.

Interlock Connection Considerations

A “Freeze/Fire Stat” input is typically connected to I/O Terminal 3 on drives with 26 terminals (Frames B…E) or I/O Terminal 29 on drives with 32 terminals (Frames 2…6). Factory default parameter settings cause the drive to fault on an F2 “Function Loss” if the “Freeze/Fire Stat” input opens or if there is a momentary loss of power to the drive. A manual reset to restart is required once the input closes or power is restored.

To restart the drive automatically when the “Freeze/Fire Stat” input closes or power is restored, the F2 “Function Loss” fault can be automatically cleared by one of the following methods.

1. Jumper I/O Terminals 2 (Clear Faults) and 3 (Function Loss) on drives with 26 terminals (Frames B…E) or jumper I/O Terminals 28 (Clear Faults) and 29 (Function Loss) on drives with 32 terminals (Frames 2…6).
2. Set parameter 363 [Digital In3 Sel] to option 1 “Enable” which will start the drive on an enable command if the “Freeze/Fire Stat” input is closed and a Run or Start digital input is present.

If a purge command is intended to follow a “Freeze/Fire Stat” input trip/reset without requiring a manual reset to restart, the above alternate customer connections should be used.

Table 1.J I/O Terminal Designations (Frames B...E)

Important: Frame B…E drives can be identified by a horizontally oriented I/O Terminal Block which has 26 terminals. See Figure 1.16.

No.	Signal	Factory Default	Description	Related Param.
1	Digital In 1	Run	11.2 mA @ 24V DC	361 - 366
2	Digital In 2	Clear Faults	19.2V minimum on state	
3	Digital In 3	Function Loss	3.2V maximum off state	
4	Digital In 4	Enable	Important: Use only 24V DC, not suitable for 115V AC circuitry.	
5	Digital In 5	OIM Control	Inputs can be wired as sink or source.	
6	Digital In 6	Purge		
7	24V Common	–	Drive supplied power for Digital In1-6 inputs. See examples on page 1-26. 150mA maximum load.	
8	Digital In Common	–		
9	+24V DC	–		
10	+10V Pot Reference	–	2 k ohm minimum load.	
11	Digital Out 1 – N.O.(1)	NOT Fault	Max Resistive Load: 250V AC / 30V DC, 50 VA / 60 Watts; Max Inductive Load: 250V AC / 30V DC, 25 VA / 30 Watts; Minimum DC Load: 10 µA, 10 mV DC	380 - 387
12	Digital Out 1 Common			
13	Digital Out 1 – N.C.(1)	Fault		
14	Analog In 1 (– Volts)	(2) Voltage – Reads value at 14 & 15	Non-isolated, 0 to +10V, 10 bit, 100k ohm input impedance.(3)	320 - 327
15	Analog In 1 (+ Volts)			
16	Analog In 1 (– Current)		Non-isolated, 4-20mA, 10 bit, 100 ohm input impedance.(3)	
17	Analog In 1 (+ Current)			
18	Analog In 2 (– Volts)	(2) Voltage – Reads value at 18 & 19	Isolated, bipolar, differential, 0 to +10V unipolar (10 bit) or ±10V bipolar (10 bit & sign), 100k ohm input impedance.(4)	
19	Analog In 2 (+ Volts)			
20	Analog In 2 (– Current)		Isolated, 4-20mA, 10 bit & sign, 100 ohm input impedance.(4)	
21	Analog In 2 (+ Current)			
22	10V Pot Common Analog Out (– Volts)	(2) Output Freq	0 to +10V, 10 bit, 10k ohm (2k ohm minimum) load. Referenced to chassis ground. Common if internal 10V supply (terminal 10) is used.	340 - 344
23	Analog Out (+ Volts)			
24	Digital Out 2 – N.O.(1)	Run	See description at No.s 11-13.	380 - 387
25	Digital Out 2 Common			
26	Digital Out 2 – N.C.(1)	NOT Run		

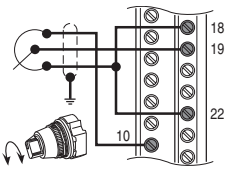
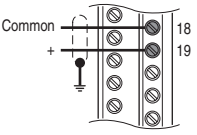
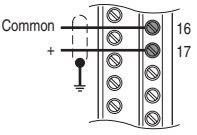
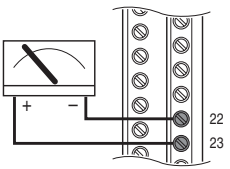
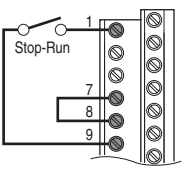
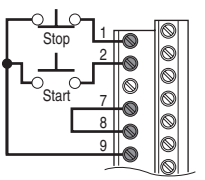
(1) Contacts shown in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

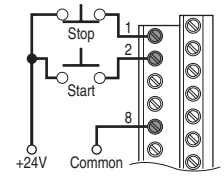
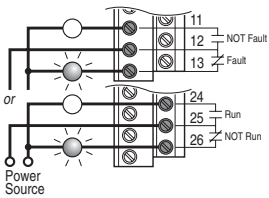
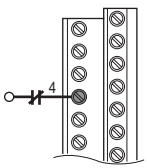
(2) These inputs/outputs are dependent on a number of parameters. See "Related Parameters."

(3) Differential Isolation - External source must be less than 10V with respect to PE.

(4) Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

I/O Wiring Examples (Frames B…E)

Input/Output	Connection Example	Required Parameter Settings
Potentiometer Unipolar Speed Reference 10k Ohm Pot. Recommended (2k Ohm minimum)		Select Speed Reference source: Param. 090 = 2 “Analog In 2” Configure Input for Voltage Param. 320, Bit #1 = 0 “Voltage” Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 0 to +10V Input		Select Speed Reference source: Param. 090 = 2 “Analog In 2” Configure Input for Voltage Param. 320, Bit #1 = 0 “Voltage” Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 4-20 mA Input		Select Speed Reference source: Param. 090 = 1 “Analog In 1” Configure Input for Current: Param. 320, Bit #0 = 1 “Current” Adjust Scaling: Param. 091, 092, 322, 323 Check Results: Param. 016
Analog Output Unipolar 0 to +10V Output. Can Drive a 2k Ohm load (25 mA short circuit limit)		Select Source Value: Param. 342 Adjust Scaling: Param. 343, 344
2 Wire Control Non-Reversing	Internal Supply 	Set Digital Input 1: Param. 361 = 1 “Run”
3 Wire Control	Internal Supply 	Set Digital Input 1: Param. 361 = 4 “Stop – CF” Set Digital Input 2: Param. 362 = 5 “Start”

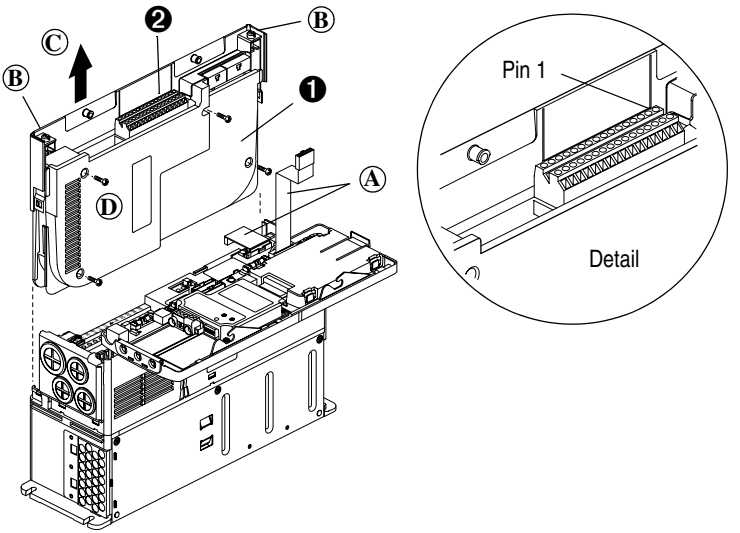
Input/Output	Connection Example	Required Parameter Settings
3 Wire Control	External Supply 	Set Digital Input 1: Param. 361 = 4 “Stop – CF” Set Digital Input 2: Param. 362 = 5 “Start”
Digital Output Form C Relays Energized in Normal State.		Select Source: Param. 380, 384
Enable Input Shown in enabled state.		Configure with parameter 364

The I/O Control Cassette (Frames 2...6)

Figure 1.18 shows the I/O Control Cassette and terminal block locations. The cassette provides a mounting point for the various VTAC 9 I/O options. To remove the cassette, follow the steps below. Cassette removal will be similar for all frames (0 Frame drive shown).

Step	Description
Ⓐ	Disconnect the two cable connectors shown in Figure 1.18.
Ⓑ	Loosen the two screw latches shown in Figure 1.18.
Ⓒ	Slide the cassette out.
Ⓓ	Remove screws securing cassette cover to gain access to the boards.

Figure 1.18 Typical Cassette & I/O Terminal Blocks (Frames 2...6)



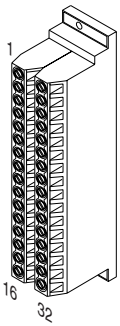
I/O Terminal Blocks

Table 1.K I/O Terminal Block Specifications

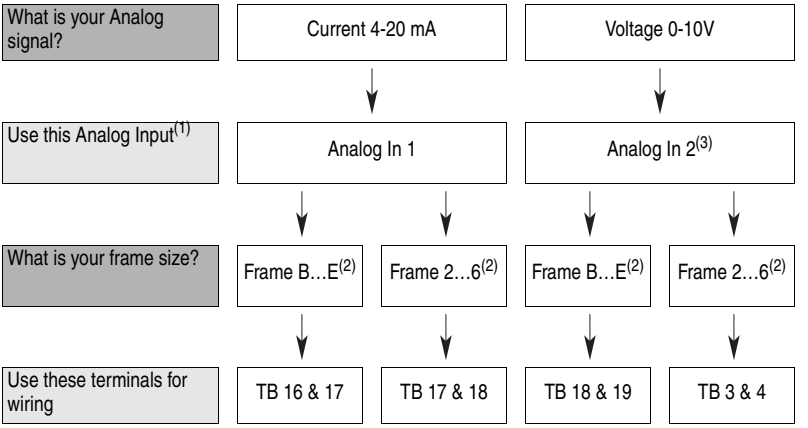
No.	Name	Description	Wire Size Range[1]		Torque	
			Maximum	Minimum	Maximum	Recommended
❶	I/O Cassette	Removable I/O Cassette				
❷	I/O Terminal Block	Signal & control connections	2.1 mm^2 (14 AWG)	0.30 mm^2 (22 AWG)	0.6 N-m (5.2 lb.-in.)	0.6 N-m (5.2 lb.-in.)

(1) Maximum/minimum that the terminal block will accept - these are not recommendations.

Figure 1.19 I/O Terminal Positions (Frames 2…6)



Suggested Analog Signal Wiring



(1) If a different Analog Input selection is required:
- Parameter 320 bit values will have to be configured
- Parameters 325 and 326 or 322 and 323 will have to be configured

See Chapter 3 for details on programming parameters.

(2) Frame size can be determined by the number of terminals on the I/O Terminal Block:
- Frames B…E have 26 I/O terminals
- Frames 2…6 have 32 I/O terminals

(3) If Analog Input 2 is used for speed reference, parameter 90 will have to be programmed to select option 2 “Analog In 2”.

Bypass Package (Style B) Drives

Important: If you are intalling a Bypass Package (Style B) Drive, also refer to VTAC 9 AC Drive Installation Instructions, publication 9VT-IN001 in addition to this publication.

Interlock Connection Considerations

A “Freeze/Fire Stat” input is typically connected to I/O Terminal 3 on drives with 26 terminals (Frames B…E) or I/O Terminal 29 on drives with 32 terminals (Frames 2…6). Factory default parameter settings cause the drive to fault on an F2 “Function Loss” if the “Freeze/Fire Stat” input opens or if there is a momentary loss of power to the drive. A manual reset to restart is required once the input closes or power is restored.

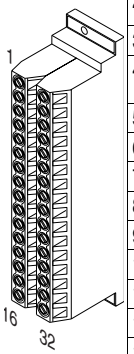
To restart the drive automatically when the “Freeze/Fire Stat” input closes or power is restored, the F2 “Function Loss” fault can be automatically cleared by one of the following methods.

1. Jumper I/O Terminals 2 (Clear Faults) and 3 (Function Loss) on drives with 26 terminals (Frames B…E) or jumper I/O Terminals 28 (Clear Faults) and 29 (Function Loss) on drives with 32 terminals (Frames 2…6).
2. Set parameter 363 [Digital In3 Sel] to option 1 “Enable” which will start the drive on an enable command if the “Freeze/Fire Stat” input is closed and a Run or Start digital input is present.

If a purge command is intended to follow a “Freeze/Fire Stat” input trip/reset without requiring a manual reset to restart, the above alternate customer connections should be used.

Table 1.L I/O Terminal Designations (Frames 2…6)

Important: Frame 2…6 drives can be identified by a vertically oriented I/O Terminal Block which has 32 terminals. See Figure 1.19.



No.	Signal	Factory Default	Description	Related Param.
1	Anlg Volts In 1 (–)	(2)	Isolated (3), bipolar, differential, ±10V, 11 bit & sign, 88k ohm input impedance.	320 - 327
2	Anlg Volts In 1 (+)			
3	Anlg Volts In 2 (–)	(2)	Isolated (4), bipolar, differential, ±10V, 11 bit & sign, 88k ohm input impedance.	
4	Anlg Volts In 2 (+)			
5	Pot Common	–	For (+) and (–) 10V pot references.	
6	Anlg Volts Out 1 (–)	(2)	Bipolar, ±10V, 11 bit & sign, 2k ohm minimum load.	340 - 344
7	Anlg Volts Out 1 (+)			
8	Anlg Current Out 1 (–)	(2)	4-20mA, 11 bit & sign, 400 ohm maximum load.	
9	Anlg Current Out 1 (+)			
10	Reserved for Future Use			
11	Digital Out 1 – N.C. (1)	Fault	Max. Resistive Load: 240V AC/30V DC – 1200VA, 150W Max. Current: 5A, Min. Load: 10mA Max. Inductive Load: 240V AC/30V DC – 840VA, 105W Max. Current: 3.5A, Min. Load: 10mA	380 - 387
12	Digital Out 1 Common			
13	Digital Out 1 – N.O. (1)	NOT Fault		
14	Digital Out 2 – N.C. (1)	NOT Run		
15	Digital Out 2 Common			
16	Digital Out 2 – N.O. (1)	Run		
17	Anlg Current In 1 (–)	(2)	Isolated (3), 4-20mA, 11 bit & sign, 124 ohm input impedance.	320 - 327
18	Anlg Current In 1 (+)			
19	Anlg Current In 2 (–)	(2)	Isolated (4), 4-20mA, 11 bit & sign, 124 ohm input impedance.	
20	Anlg Current In 2 (+)			
21	–10V Pot Reference	–	2k ohm minimum.	
22	+10V Pot Reference	–		
23	Reserved for Future Use			
24	+24V DC (5)	–	Drive supplied logic input power. (5)	
25	Digital In Common	–		
26	24V Common (5)	–	Common for internal power supply.	
27	Digital In 1	Run	Opto isolated Low State: less than 5V AC/DC High State: greater than 20V AC/DC 11.2 mA DC	361 - 366
28	Digital In 2	Clear Faults		
29	Digital In 3	Function Loss		
30	Digital In 4	Enable		
31	Digital In 5	OIM Control		
32	Digital In 6	Purge		

(1) Contacts in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

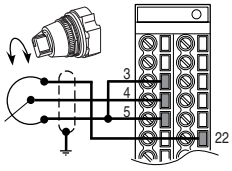
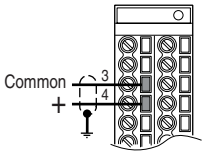
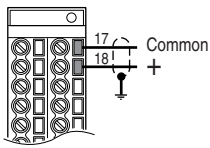
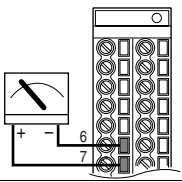
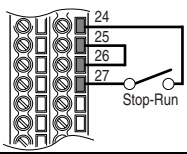
(2) These inputs/outputs are dependant on a number of parameters. See “Related Parameters.”

(3) Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

(4) Differential Isolation - External source must be less than 10V with respect to PE.

(5) 150mA maximum Load.

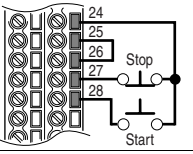
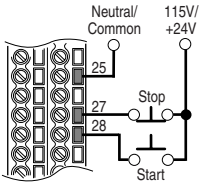
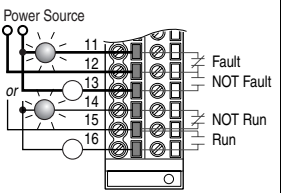
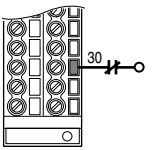
I/O Wiring Examples (Frames 2…6)

Input/Output	Connection Example	Required Parameter Changes
Potentiometer Unipolar Speed Reference(1) 10k Ohm Pot. Recommended (2k Ohm Minimum)		• Select Speed Reference Source: Parameter 090 = 2 “Analog In 2” • Configure Input for Voltage: Parameter 320, Bit 1 = 0 “Voltage” • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Voltage Input Unipolar Speed Reference 0 to +10V Input		• Select Speed Reference Source: Parameter 090 = 2 “Analog In 2” • Configure Input for Voltage: Parameter 320, Bit 1 = 0 “Voltage” • Adjust Scaling: Parameters 91/92 and 325/326 • Check results: Parameter 017
Analog Current Input Unipolar Speed Reference 4-20 mA Input		• Select Speed Reference Source: Parameter 090 = 1 “Analog In 1” • Configure Input for Current: Parameter 320, Bit 0 = 1 “Current” • Adjust Scaling: Parameters 91/92 and 325/326 • Check Results: Parameter 017
Analog Output +10V Unipolar *(shown)* 4-20 mA Unipolar *(use term. 8 & 9)*		• Configure with Parameter 340 • Select Source Value: Parameter 342, [Analog Out1 Sel] • Adjust Scaling: Parameters 343/344
2-Wire Control Non-Reversing(2) 24V DC internal supply		Set Digital Input 1: Parameter 361 = 1 “Run”

(1) Refer to the Attention statement on page 1-21 for important bipolar wiring information.

(2) **Important:** Programming inputs for 2 wire control deactivates all OIM Start buttons.

I/O Wiring Examples (continued)

Input/Output	Connection Example	Required Parameter Changes
3-Wire Control Internal supply		• Set Digital Input #1: Param. 361 = 4 “Stop – CF” • Set Digital Input #2: Param. 362 = 5 “Start”
3-Wire Control External supply (I/O Board dependent). Requires 3-wire functions only ([Digital In1 Sel]). Using 2-wire selections will cause a type 2 alarm (page 4-10).		• Set Digital Input #1: Param. 361 = 4 “Stop – CF” • Set Digital Input #2: Param. 362 = 5 “Start”
Digital Output Relays shown in powered state with drive faulted. See page 1-32.		• Select Source to Activate: Parameters 380/384
Enable Input		• Configure with parameter 364

Speed Reference Control

"Auto" Speed Sources

The drive speed command can be obtained from a number of different sources. The source is determined by drive programming and the condition of the Speed Select digital inputs, Auto/Manual digital inputs or reference select bits of a command word.

The default source for a command reference (all speed select inputs open or not programmed) is the selection programmed in [Speed Ref A Sel]. If any of the speed select inputs are closed, the drive will use other parameters as the speed command source.

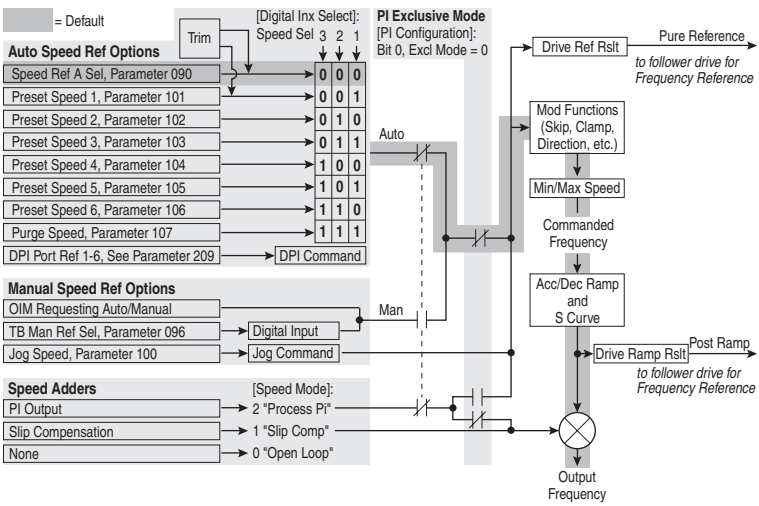
"Manual" Speed Sources

The manual source for speed command to the drive is either the OIM requesting manual control or the control terminal block (analog input) if a digital input is programmed to "Auto/Manual".

Changing Speed Sources

The selection of the active Speed Reference can be made through digital inputs, DPI command or Hand/Auto OIM operation.

Figure 1.20 Speed Reference Selection Chart



Auto/Manual Examples

Building Automation Controller = Auto, OIM = Manual

A process is run by a Building Automation Controller when in Auto mode and requires manual control from the OIM during set-up. The Auto speed reference is issued by the Building Automation Controller through a communications module installed in the drive. Since the internal communications is designated as Network, [Speed Ref A Sel] is set to “Network” with the drive running from the Auto source.

Attain Manual Control

- Press the Hand button on the OIM.
  When the OIM attains manual control, the drive speed command comes from the OIM speed control keys.

Release to Auto Control

- Press the Auto button on the OIM.
  When the OIM releases manual control, the drive speed command returns to the Building Automation Controller.

Building Automation Controller = Auto, Terminal Block = Manual

A process is run by a Building Automation Controller when in Auto mode and requires manual control from an analog potentiometer wired to the drive terminal block. The auto speed reference is issued by the Building Automation Controller through a communications module installed in the drive. Since the internal communications is designated as Network, [Speed Ref A Sel] is set to “Network” with the drive running from the Auto source. Since the Manual speed reference is issued by an analog input (“Analog In 1 or 2”), [TB Man Ref Sel] is set to the same input. To switch between Auto and Manual, [Digital In5 Sel] is set to “Auto/ Manual”.

Attain Manual Control

- Close the digital input. With the input closed, the speed command comes from the potentiometer.

Release to Auto Control

- Open the digital input. With the input open, the speed command returns to the Building Automation Controller.

Auto/Manual Notes

1. Manual control is exclusive. If a OIM or Terminal Block takes manual control, no other device can take manual control until the controlling device releases manual control.
2. If a OIM has manual control and power is removed from the drive, the drive will return to Auto mode when power is reapplied.

EMC Instructions

CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. VTAC 9 Drives comply with the EN standards listed below when installed according to the User and Reference Manuals.

CE Declarations of Conformity are available online at: **http://www.ab.com/certification/ce/docs**.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

General Notes

- If the adhesive label is removed from the top of the drive, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- VTAC 9 drives may cause radio interference if used in a residential or domestic environment. The installer is required to take measures to prevent interference, in addition to the essential requirements for CE compliance provided in this section, if necessary.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine or installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- VTAC 9 drives generate conducted low frequency disturbances (harmonic emissions) on the AC supply system.

General Notes (continued)

- When operated on a public supply system, it is the responsibility of the installer or user to ensure, by consultation with the distribution network operator and Rockwell Automation if necessary, that applicable requirements have been met.

Essential Requirements for CE Compliance

Conditions 1-6 listed below **must be** satisfied for VTAC 9 drives to meet the requirements of **EN61800-3**.

1. Standard VTAC 9 CE compatible Drive.
2. Review important precautions/attention statements throughout this manual before installing the drive.
3. Grounding as described on page 1-7.
4. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit, or equivalent attenuation.
5. All shielded cables should terminate with the proper shielded connector.
6. Conditions in Table 1.M.

Table 1.M VTAC 9 – EN61800-3 EMC Compatibility – Second Environment

Frame	HP @ 480V	Restrict Motor Cable to:	External Filter Required	Common Mode Core Required
B	3	40m (131 ft)	–	–
B	5	40m (131 ft)	–	–
C	7.5	40m (131 ft)	–	–
C	10	40m (131 ft)	–	–
D	15	40m (131 ft)	–	–
D	20	40m (131 ft)	–	–
D	25	40m (131 ft)	–	–
D	30	40m (131 ft)	–	–
E	40	40m (131 ft)	–	–
E	50	40m (131 ft)	–	–
2	25	30m (98 ft)	–	–
3	30	30m (98 ft)	–	–
3	40	30m (98 ft)	–	–
3	50	30m (98 ft)	–	–
4	60	30m (98 ft)	–	–
5	75	30m (98 ft)	–	–
5	100	30m (98 ft)	–	–
6	125	30m (98 ft)	–	–
6	150	30m (98 ft)	–	–

Table 1.N VTAC 9 – EN61800-3 EMC Compatibility – First Environment Restricted

Frame	HP @ 480V	Restrict Motor Cable to:	External Filter Required	Common Mode Core Required	Restrict Motor Cable to:	External Filter Required	Common Mode Core Required
B	3	12m (40 ft)	–	–	100m (328 ft)	RF3-0006-4	–
B	5	12m (40 ft)	–	–	100m (328 ft)	RF3-0010-4	–
C	7.5	12m (40 ft)	–	1321-M048	150m (492 ft)	RF3-0018-4	–
C	10	12m (40 ft)	–	1321-M048	150m (492 ft)	RF3-0018-4	–
D	15	12m (40 ft)	–	–	150m (492 ft)	RF3-0025-4	–
D	20	12m (40 ft)	–	–	150m (492 ft)	22-RFD036	–
D	25	12m (40 ft)	–	–	150m (492 ft)	22-RFD050	–
D	30	12m (40 ft)	–	–	150m (492 ft)	22-RFD050	–
E	40	30m (98 ft)	22-RFD070	–	–	–	–
E	50	30m (98 ft)	22-RFD070	–	–	–	–
2	25	150m (492 ft)	22-RFD036	–	–	–	–
3	30	150m (492 ft)	22-RFD050	–	–	–	–
3	40	150m (492 ft)	22-RFD070	–	–	–	–
3	50	150m (492 ft)	22-RFD070	–	–	–	–
4	60	150m (492 ft)	22-RFD100	–	–	–	–
5	75	150m (492 ft)	22-RFD100	–	–	–	–
5	100	150m (492 ft)	22-RFD150	–	–	–	–
6	125	150m (492 ft)	22-RFD180	–	–	–	–
6	150	150m (492 ft)	22-RFD180	–	–	–	–

FCC Instructions

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules when installed according to the User Manual. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the User Manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

Essential Requirements for FCC Compliance

Conditions 1-4 listed below must be satisfied for VTAC 9 drives to meet the requirements of FCC Part 15 Subpart B.

1. Grounding as described in Figure 1.4. Refer to page 1-6 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. All shielded cables should terminate with the proper shield connector.
4. Conditions in Table 1.O.

Table 1.O Maximum Motor Cable Length for FCC Compliance Note: Use of these filters assumes that the drive is mounted in an EMC enclosure.t

Frame	HP @ 480V	Restrict Motor Cable to:	External Filter Required	Common Mode Core Required	Restrict Motor Cable to:	External Filter Required	Common Mode Core Required
B	3	12m (40 ft)	–	–	100m (328 ft)	RF3-0006-4	–
B	5	12m (40 ft)	–	–	100m (328 ft)	RF3-0010-4	–
C	7.5	12m (40 ft)	–	1321-M048	150m (492 ft)	RF3-0018-4	–
C	10	12m (40 ft)	–	1321-M048	150m (492 ft)	RF3-0018-4	–
D	15	12m (40 ft)	–	–	150m (492 ft)	RF3-0025-4	–
D	20	12m (40 ft)	–	–	150m (492 ft)	22-RFD036	–
D	25	12m (40 ft)	–	–	150m (492 ft)	22-RFD050	–
D	30	12m (40 ft)	–	–	150m (492 ft)	22-RFD050	–
E	40	30m (98 ft)	22-RFD070	–	–	–	–
E	50	30m (98 ft)	22-RFD070	–	–	–	–
2	25	150m (492 ft)	22-RFD036	–	–	–	–
3	30	150m (492 ft)	22-RFD050	–	–	–	–
3	40	150m (492 ft)	22-RFD070	–	–	–	–
3	50	150m (492 ft)	22-RFD070	–	–	–	–
4	60	150m (492 ft)	22-RFD100	–	–	–	–
5	75	150m (492 ft)	22-RFD100	–	–	–	–
5	100	150m (492 ft)	22-RFD150	–	–	–	–
6	125	150m (492 ft)	22-RFD180	–	–	–	–
6	150	150m (492 ft)	22-RFD180	–	–	–	–

Notes:

Start Up

This chapter describes how you start up the VTAC 9 Drive. Refer to Appendix B for a brief description of the LCD OIM (Operator Interface Module).

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this chapter in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Incorrect values for some of the parameters in the Start-Up routines can cause the drive to operate improperly. Verify that the values of these parameters are appropriate for your application. Failure to observe this precaution could result in bodily injury.

Prepare For Drive Start-Up

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that control power voltage is correct.

The remainder of this procedure requires that a OIM be installed. If an operator interface is not available, remote devices should be used to start up the drive.

Important: When power is first applied, the OIM may require approximately 5 seconds until commands are recognized (including the Stop key).

Applying Power to the Drive

❑ **4.** Apply AC power and control voltages to the drive.

If any of the six digital inputs are configured to "Stop – CF" (CF = Clear Fault) or "Enable," verify that signals are present or the drive will not start. Refer to Alarm Descriptions on page 4-10 for a list of potential digital input conflicts.

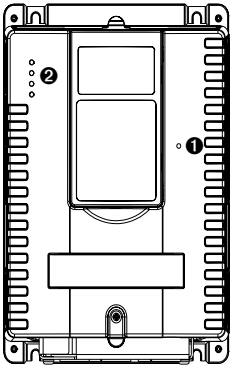
If a fault code appears, refer to Chapter 4.

If the Ready LED is not flashing green at this point, refer to Status Indicators and their indications below.

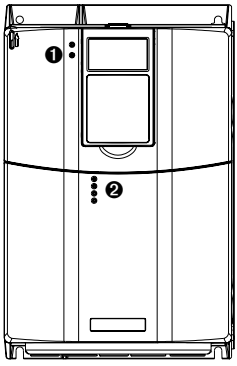
❑ **5.** Proceed to Running the Start-Up Routines.

Status Indicators

Figure 2.1 Drive Status Indicators (Typical)



Frames B…E



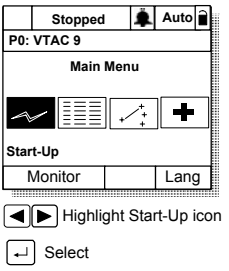
Frames 2…6

#	Name	Color	State	Description
❶	Ready	Green	Flashing	Drive ready, but not running and no faults are present.
			Steady	Drive running, no faults are present.
		Yellow See page 4-10	Flashing, Drive Stopped	An inhibit condition exists, the drive cannot be started. Check parameter 214 [Start Inhibits].
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check parameter 211 [Drive Alarm 1].
			Steady, Drive Running	A continuous type 1 alarm condition exists. Check parameter 211 [Drive Alarm 1].
		Red See page 4-4	Flashing	A fault has occurred.
			Steady	A non-resetable fault has occurred.
❷	Drive	Refer to the Communication Adapter User Manual.		Status of DPI port internal communications (if present).
	MS			Status of communications module (when installed).
	NET A			Status of network (if connected).
	NET B			Status of secondary network (if connected).

Running the Start-Up Routines

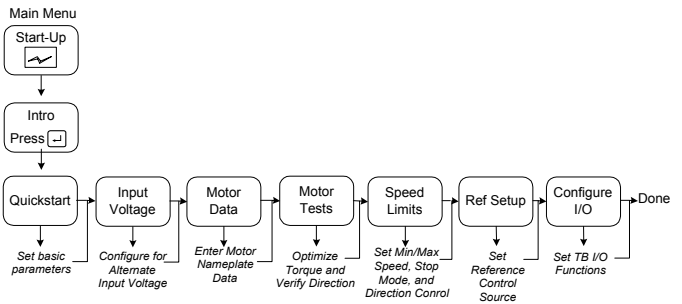
To access the Start-Up routines, select the Start-Up icon from the main menu as shown in figure Figure 2.2.

Figure 2.2 Accessing the Start-Up Routines



The Start-Up menu screen contains 8 selections. The first 7 menu items contain the most commonly used parameters associated with each function. See figure Figure 2.3.

Figure 2.3 Start-Up Menu



The Start-Up routine automates the process of entering values of selected parameters by taking you to the next parameter after you accept a parameter value. As each item in the list is completed, you are automatically advanced to the next step.

Important: Parameter values are saved as they are changed.

Pressing ESC/PROG or aborting the Start-Up routine will not undo the changes.

You do not have to configure all of the parameters in all 7 menus. The first menu selection, Quickstart, contains the minimum basic parameters that must be configured before running the drive. These are listed in table Table 2.A.

Table 2.A Quickstart Parameters

Parameter No.	Parameter Name
155	Stop Mode A
42	Motor NP FLA
81	Minimum Speed
82	Maximum Speed
140	Accel Time 1
142	Decel Time 1
90	Speed Ref A Sel
362	Digital In2 Sel

If your application requires adjustment to parameters beyond those listed in table Table 2.A, you can adjust the parameters in any or all of the next 6 selections in the Start-Up menu, or you can adjust parameters individually through the Parameters menu.

When you have completed adjusting all of the parameters in the Start-Up routines that your application requires, select the last item in the menu, Done.

Important: The drive is shiped with a default configuration of control from the keypad. For drive control from the terminal block inputs, parameter 89, Logic Source Sel, must be set to 0.

Exiting Before Completing the Start-Up Routines

To exit the Start-Up routines, press the F4 key (Exit). When you select the Start-Up icon from the main menu again, you will be prompted to either continue or restart the Start-Up routines. If you select “continue,” you will be returned to the point at which you exited.

Notes:

Programming and Parameters

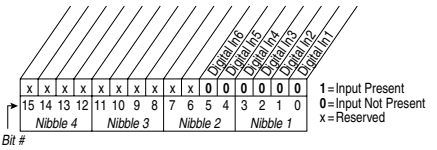
Chapter 3 provides a complete parameter listing and descriptions. The parameters can be programmed (viewed/edited) using the LCD OIM (Operator Interface Module).
As an alternative, programming can also be performed using VS Utilities software and a personal computer. Refer to Appendix B for brief descriptions of the LCD Operator Interface Module.

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM Parameters**
  ENUM parameters allow a selection from 2 or more items. The LCD OIM will display a text message for each item.
- **Bit Parameters**
  Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).

The example on the following page shows how each parameter type is presented in this manual.

❶ File	❷ Group	❸ No.	❹ Parameter Name & Description	❺ Values	❻ Related
UTILITY (File E)	Drive . . .	198	**[Load Frm Usr Set]** Loads a previously saved set of parameter values from a selected user set location in drive nonvolatile memory to active drive memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	199
	Diagnostics	216	**[Dig In Status]** Status of the digital inputs.		
MOTOR . . .	Torq . . .	059	**[SV Boost Filter]** Sets the amount of filtering used to boost voltage during Sensorless Vector operation.	Default: 500 Min/Max: 0/32767 Units: 1	

No.	Description		
❶	**File** – Lists the major parameter file category.		
❷	**Group** – Lists the parameter group within a file.		
❸	**No.** – Parameter number. = Parameter value can not be changed until drive is stopped. = 32 bit parameter. = Drive Frames 2, 3, 4, 5 & 6.		
❹	**Parameter Name & Description** – Parameter name as it appears on an LCD OIM, with a brief description of the parameters function.		
❺	**Values** – Defines the various operating characteristics of the parameter. Three types exist.		
	ENUM	Default:	Lists the value assigned at the factory. "Read Only" = no default.
		Options:	Displays the programming selections available.
	Bit	Bit #:	Lists the bit place holder and definition for each bit.
	Numeric	Default:	Lists the value assigned at the factory. "Read Only" = no default.
		Min/Max: Units:	The range (lowest and highest setting) possible for the parameter. Unit of measure and resolution as shown on the LCD OIM.
		Important: Some parameters will have two unit values. For example, analog inputs can be set for current or voltage with 320 [Anlg In Config].	
		Important: When sending values through DPI ports, simply remove the decimal point to arrive at the correct value (i.e. to send "5.00 Hz," use "500").	
❻	**Related** – Lists parameters (if any) that interact with the selected parameter. The symbol "i" indicates that additional parameter information is available in Appendix C.		

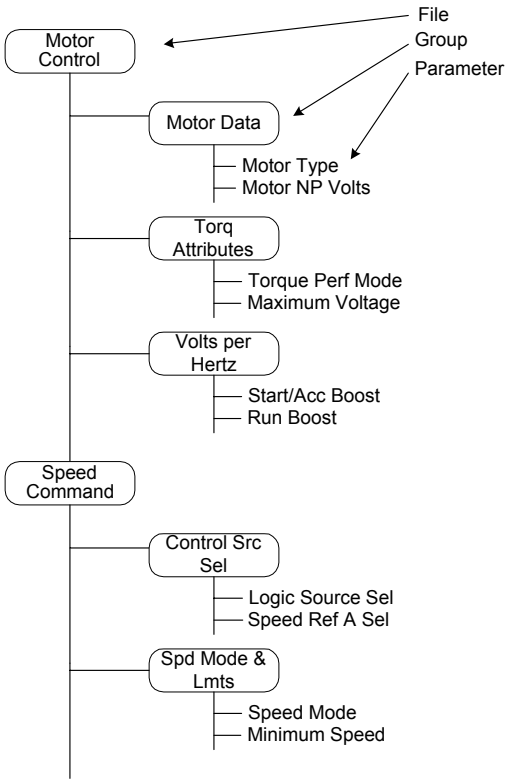
How Parameters are Organized

Parameters are organized into seven files:

- Monitor
- Motor Control
- Speed Command
- Dynamic Control
- Utility
- Communication
- Inputs & Outputs

Each file contains parameters that are grouped by their function. A file can contain several groups of parameters. See Figure 3.1.

Figure 3.1 Example of Parameter Organization



Accessing the Parameters

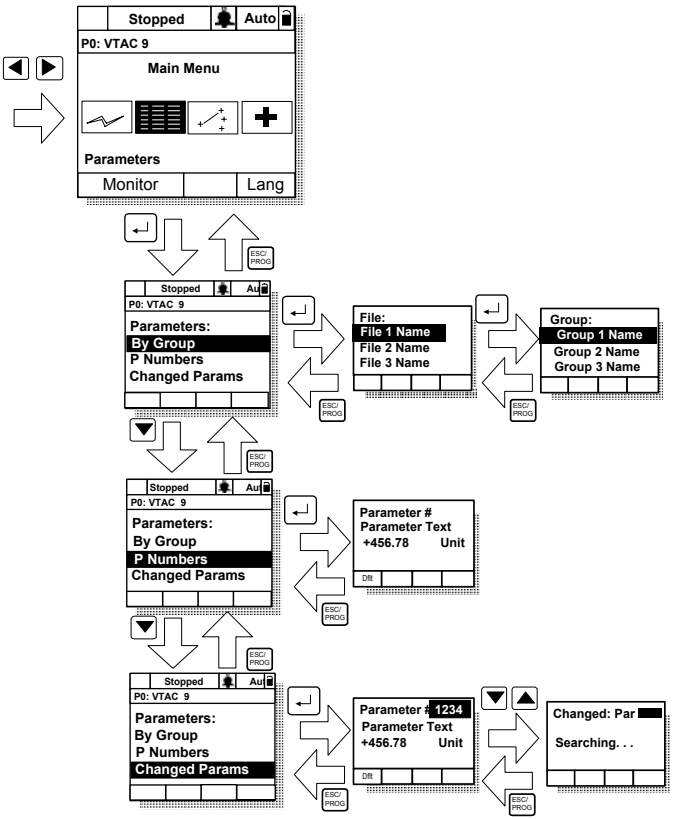
Parameters are programmed and viewed using the LCD OIM or VS Utilities software.

The LCD OIM displays parameters by group, by individual parameter number, and parameters that have changed from their default value.

To access parameters using the LCD OIM, select the Parameters icon from the main screen. See Figure 3.2.

See Appendix B for information on modifying parameters using the LCD OIM.

Figure 3.2 Accessing the Parameters Using the LCD OIM



Selecting the Parameter Access Level

The VTAC 9 drive provides two levels of access to the parameters: Standard (1) and Advanced (2).

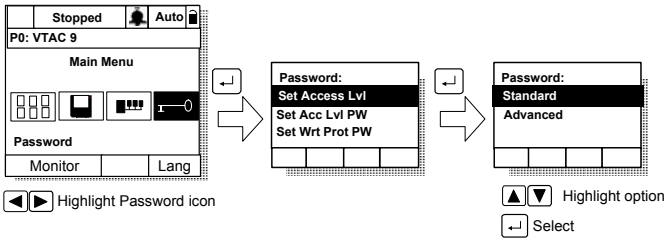
The Advanced level allows access to all of the parameters and is used for more sophisticated applications.

The Standard level allows access to a subset of the Advanced level and contains only the most commonly used parameters. See Appendix C for a list of the parameters available at the Standard level.

The active access level is displayed in Parameter Access Level (196).

To select the parameter access level using the LCD OIM, select the Password icon from the main menu. See Figure 3.3.

Figure 3.3 Selecting the Parameter Access Level



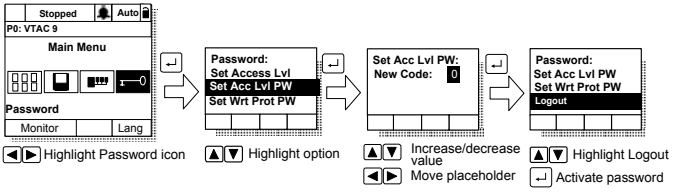
Restricting Access to the Advanced Parameter Level

ATTENTION: It is the user's responsibility to determine how to distribute the access level password. Rockwell Automation is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

The LCD OIM provides the option to restrict access to the Advanced parameter level. This feature requires the use of a user-defined password when an attempt to change the access level is made.

To set the access level password, select the Password icon from the main menu. See Figure 3.4. The password value can range from 1 to 9999. A value of 0 disables the password (factory default). You must either select Logout or return to the process display screen to activate the password.

Figure 3.4 Setting the Access Level Password



When you enter the password, you can change access levels until you select Logout or return to the process display screen, which re-activates the password. Refer to section B.8 in Appendix B for information about the process display screen.

Note that once the password is enabled, you will also be prompted to enter the password to access the Set Acc Lvl PW option.

If There is More Than One OIM Connected to the Drive

Note that setting or changing the access level password on one OIM will set or change the access level password for all OIMs connected to the drive.

Ensuring Program Security

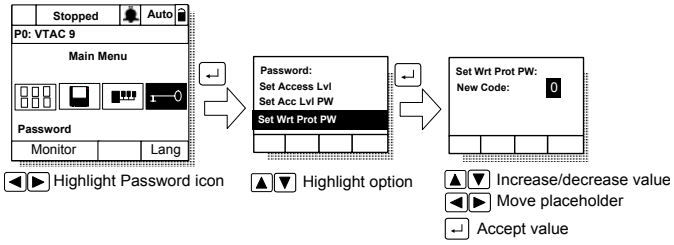
ATTENTION: It is the user's responsibility to determine how to distribute the write-protect password. Rockwell Automation is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

Parameter values can be password-protected using the LCD OIM. When the password is enabled, parameter values can be displayed. However, if there is an attempt to change a parameter value, a password pop-up box will appear on the OIM screen to prompt for the user-defined password.

To set the write-protect password, select the Password icon from the main menu. See Figure 3.5. The password value can range from 1 to 9999. A value of 0 disables the password (factory default).

When the password is enabled, the lock symbol on the screen changes from 🔓 to 🔒.

Figure 3.5 Setting the Write-Protect Password



When you enter the password, you can adjust parameters until you select Logout or return to the process display screen, which re-activates the password. Refer to Appendix B for information about the process display screen.

If There is More Than One OIM Connected to the Drive

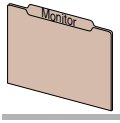
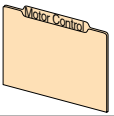
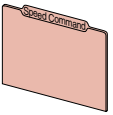
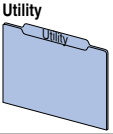
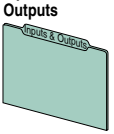
Important: Setting the write-protect password value to zero on one OIM will disable the write-protect password on all connected OIMs.

Setting the write-protect password in one OIM will not affect any other OIM connected to the drive unless a write-protect password has also been set in the other OIMs. In this case, the last password value entered becomes the password value for all password-protected OIMs. (Each OIM cannot have a different password value.)

For example, if the write-protect password has been set to 5555 for the local OIM, someone using a remote OIM with no write-protect password set can still program all of the parameters. If the write-protect password is then set to 6666 on the remote OIM, you will be required to enter 6666 on the local OIM to program the parameters.

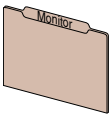
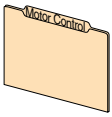
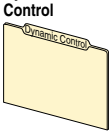
Standard Parameter View

Parameter 196 [Param Access Lvl] set to option 1 “Standard.”

File	Group	Parameters					
Monitor 	Metering	Output Freq Commanded Freq Output Current Torque Current	001 002 003 004	Output Voltage Output Power Elapsed MWh Elapsed Run Time	006 007 009 010	MOP Frequency DC Bus Voltage Analog In1 Value	011 012 016
	Drive Data	Rated kW Rated Volts	026 027	Rated Amps Control SW Ver	028 029		
Motor Control 	Motor Data	Motor NP Volts Motor NP FLA	041 042	Motor NP Hertz Motor NP RPM	043 044	Motor NP Power Mtr NP Pwr Units	045 046
	Torq Attributes	Maximum Voltage	054	Maximum Freq	055		
	Volts per Hertz	Run Boost	070				
Speed Command 	Spd Mode & Limits	Speed Mode	080	Minimum Speed Maximum Speed	081 082	Skip Frequency 1 Logic Source Sel	084 089
	Speed References	Speed Ref A Sel	090	Speed Ref A Hi Speed Ref A Lo	091 092		
	Discrete Speeds	Purge Speed	107				
Dynamic Control 	Ramp Rates	Accel Time 1 Decel Time 1	140 142	S Curve %	146		
	Load Limits	Current Lmt Val Drive OL Mode	148 150	CarrierFrequency	151		
	Stop/Brake Modes	Stop Mode A Stop Mode B	155 156				
	Restart Modes	LevelSense Start	168	Auto Rstrt Tries Auto Rstrt Delay	174 175		
Utility 	Drive Memory	Param Access Lvl Reset To Defalts Reset Meters	196 197 200				
Inputs & Outputs 	Analog Inputs	Anlg In Config Anlg In Sqr Root	320 321	Analog In1 Hi Analog In1 Lo Analog In 1 Loss	322 323 324		
	Analog Outputs	Anlg Out Config	340	Analog Out1 Sel	342	Analog Out1 Hi Analog Out1 Lo	343 344
	Digital Outputs	Digital Out1 Sel Dig Out1 Level	380 381	Digital Out2 Sel Dig Out2 Level	384 385		

Advanced Parameter View

Parameter 196 [Param Access Lvl] set to option 2 “Advanced.”

File	Group	Parameters					
Monitor 	Metering	Output Freq Commanded Freq Output Current Torque Current Flux Current	001 002 003 004 005	Output Voltage Output Power Output Powr Fctr Elapsed MWh Elapsed Run Time	006 007 008 009 010	MOP Frequency DC Bus Voltage DC Bus Memory Analog In1 Value Analog In2 Value	011 012 013 016 017
	Drive Data	Rated kW Rated Volts	026 027	Rated Amps Control SW Ver	028 029		
Motor Control 	Motor Data	Motor Type Motor NP Volts Motor NP FLA Motor NP Hertz	040 041 042 043	Motor NP RPM Motor NP Power Mtr NP Pwr Units	044 045 046	Motor OL Hertz Motor OL Factor	047 048
	Torq Attributes	Torque Perf Mode Maximum Voltage Maximum Freq	053 054 055	Compensation Flux Up Mode Flux Up Time SV Boost Filter	056 057 058 059	Autotune IR Voltage Drop Flux Current Ref Ixo Voltage Drop	061 062 063 064
	Volts per Hertz	Start/Acc Boost Run Boost	069 070	Break Voltage Break Frequency	071 072		
Speed Command 	Spd Mode & Limits	Speed Mode Minimum Speed Maximum Speed Overspeed Limit	080 081 082 083	Skip Frequency 1 Skip Frequency 2 Skip Frequency 3	084 085 086	Skip Freq Band Logic Source Sel	087 089
	Speed References	Speed Ref A Sel Speed Ref A Hi Speed Ref A Lo	090 091 092	TB Man Ref Sel TB Man Ref Hi TB Man Ref Lo	096 097 098		
	Discrete Speeds	Preset Speed 1-6	101-106	Purge Speed	107		
	Speed Trim	Trim In Select Trim Out Select	117 118	Trim Hi Trim Lo	119 120		
	Slip Comp	Slip RPM @ FLA Slip Comp Gain	121 122	Slip RPM Meter	123		
	Process PI	PI Configuration PI Control PI Reference Sel PI Setpoint PI Feedback Sel	124 125 126 127 128	PI Integral Time PI Prop Gain PI Lower Limit PI Upper Limit PI Preload	129 130 131 132 133	PI Status PI Ref Meter PI Fdback Meter PI Error Meter PI Output Meter	134 135 136 137 138
Dynamic Control 	Ramp Rates	Accel Time 1 Accel Time 2	140 141	Decel Time 1 Decel Time 2	142 143	S Curve %	146
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	Stop/Brake Modes	Stop Mode A Stop Mode B	155 156	DC Brake Lvl Sel DC Brake Level DC Brake Time	157 158 159	Bus Reg Ki Bus Reg Mode A Bus Reg Mode B DB Resistor Type Bus Reg Kp Bus Reg Kd	160 161 162 163 164 165
	Restart Modes	LevelSense Start Flying Start En Flying StartGain	168 169 170	Auto Rstrt Tries Auto Rstrt Delay	174 175	Sleep-Wake Mode Sleep-Wake Ref Wake Level Wake Time Sleep Level Sleep Time	178 179 180 181 182 183
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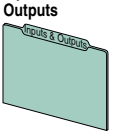
Inputs & Outputs 	Analog Inputs	Anlg In Config Anlg In Sqr Root	320 321	Analog In 1 Hi Analog In 1 Lo Anlg In 1 Loss	322 323 324	Analog In 2 Hi Analog In 2 Lo Anlg In 2 Loss	325 326 327
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Monitor File

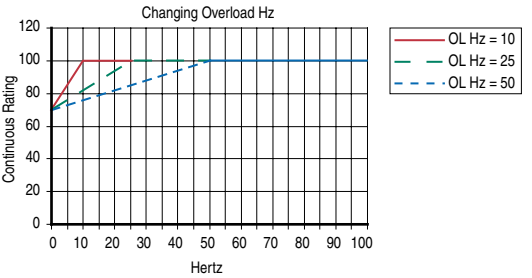
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MONITOR	Metering	001	**[Output Freq]** Output frequency present at T1, T2 & T3 (U, V & W). Value includes reference, slip comp and IR compensation.	Default: Read Only Min/Max: –/+400 Hz Units: 0.1 Hz	
		002	**[Commanded Freq]** Value of the active frequency command.	Default: Read Only Min/Max: –/+400 Hz Units: 0.1 Hz	
		003	**[Output Current]** The total output current present at T1, T2 & T3 (U, V & W). Includes torque and flux components.	Default: Read Only Min/Max: 0.0/Drive Rated Amps × 2 Units: 0.1 Amps	
		004	**[Torque Current]** The amount of current that is in phase with the fundamental voltage component. This is the torque producing component of the output current.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps	
		005	**[Flux Current]** The amount of current that is out of phase with the fundamental voltage component. This is the magnetizing component of the output current.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps	
		006	**[Output Voltage]** Output voltage present at terminals T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated Volts Units: 0.1 VAC	
		007	**[Output Power]** Output power present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated kW × 2 Units: 0.1 kW	
		008	**[Output Powr Fctr]** Output power factor.	Default: Read Only Min/Max: 0.00/1.00 Units: 0.01	
		009	**[Elapsed MWh]** 32 Accumulated output energy of the drive.	Default: Read Only Min/Max: 0.0/429496729.5 MWh Units: 0.1 MWh	
		010	**[Elapsed Run Time]** 32 Accumulated time drive is outputting power.	Default: Read Only Min/Max: 0.0/429496729.5 Hrs Units: 0.1 Hrs	
		011	**[MOP Frequency]** Value of the signal at MOP (Motor Operated Potentiometer).	Default: Read Only Min/Max: –/+400 Hz Units: 0.1 Hz	

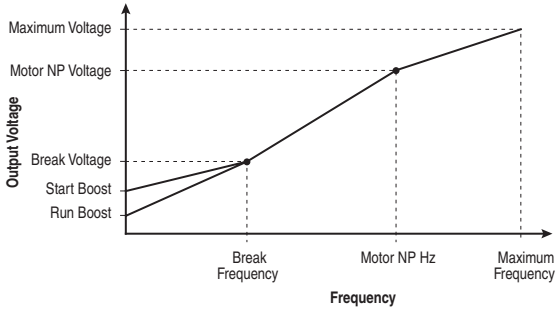
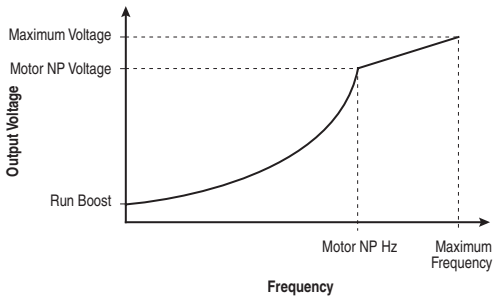
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MONITOR	Metering	012	**[DC Bus Voltage]** Present DC bus voltage level.	Default: Read Only Min/Max: 0.0/Drive Rating Based Units: 0.1 VDC	
		013	**[DC Bus Memory]** 6 minute average of DC bus voltage level.	Default: Read Only Min/Max: 0.0/Drive Rating Based Units: 0.1 VDC	
		016 017	**[Analog In1 Value]** **[Analog In2 Value]** Value of the signal at the analog inputs. Does not include scaling information programmed by user (e.g. Analog In 1 Hi). Terminals monitored according to 320 [Analog In Config].	Default: Read Only Min/Max: 0.000/20.000 mA 10.000V Units: 0.001 mA 0.001 Volt	
	Drive Data	026	**[Rated kW]** 32 Drive power rating.	Default: Read Only Min/Max: 0.37/3000.00 kW Units: 0.01 kW	
		027	**[Rated Volts]** The drive input voltage class (208, 240, 400 etc.).	Default: Read Only Min/Max: 0.0/6553.5 Volt Units: 0.1 VAC	
		028	**[Rated Amps]** The drive rated output current.	Default: Read Only Min/Max: 0.0/6553.5 Amps Units: 0.1 Amps	
		029	**[Control SW Ver]** Main Control Board software version.	Default: Read Only Min/Max: 0.000/65.535 Units: 0.001	196

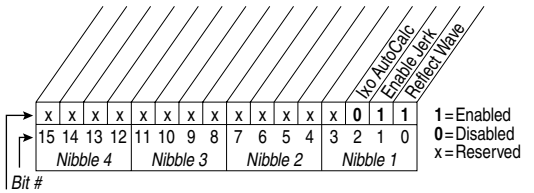
Motor Control File

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Motor Data	040	**[Motor Type]** Set to match the type of motor connected.	Default: 0 "Induction" Options: 0 "Induction" 1 "Synchr Reluc" 2 "Synchr PM"	
		041	**[Motor NP Volts]** Set to the motor nameplate rated volts. Motor nameplate base voltage defines the output voltage when operating at rated current, rated speed and rated temperature.	Default: Drive Rating Based Min/Max: 0.0/[Rated Volts] Units: 0.1 VAC	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Motor Data	042	**[Motor NP FLA]** Set to the motor nameplate rated full load amps. Defines the output amps when operating at rated voltage, rated speed, and rated temperature. It is used in the motor thermal overload and in the calculation of slip. Set to the motor nameplate rated frequency. The motor nameplate base frequency defines the output frequency when operating at rated voltage, rated current, rated speed, and rated temperature. The motor thermal overload cannot distinguish individual currents in a multimotor application. Set 238 [Fault Config 1], bit 3 to "0" to disable the motor thermal overload for applications of this type. The operation of the overload is based on three parameters: 042 [Motor NP FLA], 048 [Motor OL Factor], and 047 [Motor OL Hertz]. The motor nameplate full load amps is multiplied by the motor overload factor to define the continuous level of current allowed by the motor thermal overload. Parameter 048 [Motor OL Factor] is used to adjust the response of the motor thermal overload to lower motor speeds (lower output frequencies) where a higher degree of protection may be required due to decreased motor cooling.	Default: Drive Rating Based Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	047 048
		043	**[Motor NP Hertz]** Set to the motor nameplate rated frequency. The motor nameplate base frequency defines the output frequency when operating at rated voltage, rated current, rated speed and rated temperature.	Default: 60 Hz Min/Max: 5.0/400.0 Hz Units: 0.1 Hz	
		044	**[Motor NP RPM]** Set to the motor nameplate rated RPM. The motor nameplate RPM defines the rated speed when operating at motor nameplate base frequency, rated current, base voltage and rated temperature. This is used to calculate slip.	Default: 1740 RPM Min/Max: 60/24000 RPM Units: 1 RPM	
		045	**[Motor NP Power]** Set to the motor nameplate rated power. 32 The motor nameplate rated power is used with the other nameplate values to calculate default values for motor parameters to assist the commissioning process. This may be entered in horsepower or in kilowatts as selected in parameter 046.	Default: Drive Rating Based Min/Max: 0.00/1000.00(1), 0.00/5000.00(2) Units: 0.01 kW/HP See [Mtr NP Pwr Units] (1) Frame B, C, D, & E (2) Frames 2, 3, 4, 5, & 6	046
		046	**[Mtr NP Pwr Units]** Selects the motor power units to be used by parameter 045.	Default: Drive Rating Based Options: 0 "Horsepower" 1 "kiloWatts"	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Motor Data	047	**[Motor OL Hertz]** Selects the output frequency below which the motor operating current is derated. The motor thermal overload will generate a fault at lower levels of current. For all settings of overload Hz other than zero, the overload capacity is reduced to 70% when output frequency is zero.  	Default: Motor NP Hz/3 Min/Max: 0.0/400.0 Hz Units: 0.1 Hz	042 220
		048	**[Motor OL Factor]** Sets the operating level for the motor overload. This parameter can be used to raise the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of parameters 047 and 048. Motor FLA x OL Factor = Operating Level	Default: 1.00 Min/Max: 0.20/2.00 Units: 0.01	042 220

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Torq Attributes	053	**[Torque Perf Mode]** Sets the method of motor torque production. • Sensrls Vect maintains consistent magnetizing current up to base speed, and voltage increases as a function of load. • SV Economize allows the drive to automatically adjust output voltage as the load changes to minimize current supplied to the motor. The voltage is adjusted by means of flux current adaption. • Custom V/Hz allows for tailoring the volts/hertz curve by adjusting parameters 054, 055, 070, 071, and 072.  • Fan/Pmp V/Hz mode sets a fan load volts per hertz curve profile exponential to base frequency and linear from base to maximum frequency). Run boost can offset the low speed curve point.  	Default: 3 "Fan/Pmp V/Hz" Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz"	062 063 069 070
		054	**[Maximum Voltage]** Sets the highest voltage the drive will output.	Default: Drive Rated Volts Min/Max: Rated Volts × 0.25/Rated Volts Units: 0.1 VAC	

File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values	Related
MOTOR CONTROL	Torq Attributes	055	**[Maximum Freq]** Sets the highest frequency the drive will output. Note that this is not maximum speed which is set in 083 [Overspeed Limit]. Refer to Appendix C.	Default: 130.0 Hz Min/Max: 5.0/400.0 Hz Units: 0.1 Hz	083
		056	**[Compensation]** Enables/disables correction options.  *Factory Default Bit Values* Option Descriptions Reflect Wave — Enables/disables reflected wave overvoltage protection for long cable lengths. Enable this option for cable lengths longer than 300 feet. Enable Jerk — Enables/disables the jerk limit in the current limiter that helps to eliminate overcurrent trips on fast accelerations. In non-FVC Vector modes, disabling jerk removes a short S-curve at the start of the accel/decel ramp. Disable if application requires acceleration time less than 25 seconds. Ixo AutoCalc — Frame 2, 3, 4, 5, & 6 drives only. Calculates voltage drop due to leakage inductance. See 064 [Ixo Voltage Drop].		
		057	**[Flux Up Mode]** Amount of DC current equal to current limit to establish full motor stator flux before acceleration. "Manual" (0) = Flux is established for [Flux Up Time] before acceleration. "Automatic" (1) = Flux is established for a calculated time period based on motor nameplate data. [Flux Up Time] is not used.	Default: 0 "Manual" Options: 0 "Manual" 1 "Automatic"	053 058
		058	**[Flux Up Time]** Sets the amount of time the drive will use to try and achieve full motor stator flux. When a Start command is issued, DC current at current limit level is used to build stator flux before accelerating.	Default: 0.00 Secs Min/Max: 0.00/5.00 Secs Units: 0.01 Secs	053 058
		059	**[SV Boost Filter]** (2...6) Sets the amount of filtering used to boost voltage during Sensorless Vector operation.	Default: 500 Min/Max: 0/32767 Units: 1	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Torq Attributes	061	**[Autotune]** Provides a manual or automatic method for setting [IR Voltage Drop] and [Flux Current Ref], which affect sensorless vector performance. Valid only when parameter 53 is set to "Sensrls Vect," "SV Economize" or "FVC Vector" "Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune." It also permits manually setting [IR Voltage Drop] and [Flux Current Ref]. "Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be rotated. "Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure. **ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding. "Calculate" (3) = This setting uses motor nameplate data to automatically set [IR Voltage Drop] and [Flux Current Ref].	Default: 3 "Calculate" Options: 0 "Ready" 1 "Static Tune" 2 "Rotate Tune" 3 "Calculate"	053 062
		062	**[IR Voltage Drop]** Value of voltage drop across the resistance of the motor stator at rated motor current. Used only parameter 53 is set to "Sensrls Vect", "SV Economize" or "FVC Vector."	Default: [Motor NP Volts] × 0.25 Min/Max: 0.0/[Motor NP Volts]×0.25 Units: 0.1 VAC	053 061
		063	**[Flux Current Ref]** Value of amps for full motor flux. Used only when parameter 53 is set to "Sensrls Vect", "SV Economize" or "FVC Vector."	Default: Drive Rating Based Min/Max: 0.00/[Motor NP FLA] Units: 0.01 Amps	053 061
		064	**[Ixo Voltage Drop]** Value of voltage drop across the leakage inductance of the motor at rated motor current. Used only when parameter 53 is set to "FVC Vector."	Default: Drive Rating Based Min/Max: 0.0/Motor NP Volts Units: 0.1 VAC	

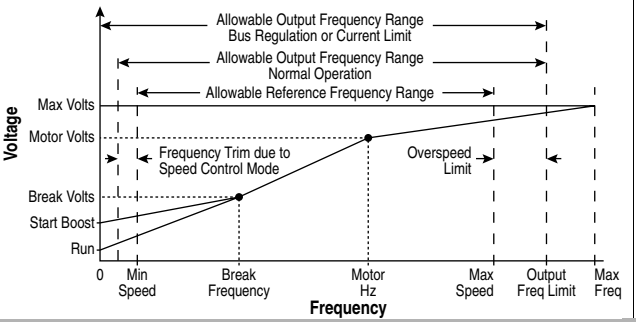
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL	Volts per Hertz	069	**[Start/Acc Boost]** Sets the voltage boost level for starting and acceleration when "Custom V/Hz" mode is selected. Refer to parameter 083 [Overspeed Limit].	Default: [Motor NP Volts] × 0.25 Min/Max: 0.0/[Motor NP Volts] × 0.25 Units: 0.1 VAC	053 070
		070	**[Run Boost]** Sets the boost level for steady state or deceleration when "Fan/Pmp V/Hz" or "Custom V/Hz" modes are selected. Refer to the diagram at parameter 083.	Default: [Motor NP Volts] × 0.25 Min/Max: 0.0/[Motor NP Volts] × 0.25 Units: 0.1 VAC	053 069
		071	**[Break Voltage]** Sets the voltage the drive will output at [Break Frequency]. Refer to parameter 083 [Overspeed Limit].	Default: [Motor NP Volts] × 0.25 Min/Max: 0.0/[Motor NP Volts] Units: 0.1 VAC	053 072
		072	**[Break Frequency]** Sets the frequency the drive will output at [Break Voltage]. Refer to parameter 083 [Overspeed Limit].	Default: [Motor NP Hertz] × 0.25 Min/Max: 0.0/400.0 Units: 0.1 Hz	053 071

Speed Command File

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Spd Mode & Limits	080	**[Speed Mode]** Sets the method of speed regulation. • Open Loop provides no speed compensation due to load variations. This is strict volts per hertz output as a function of the speed reference. • Slip Comp provides for frequency output adjustment as a function of load. The amount of compensation is defined by the value of 121 [Slip RPM @ FLA]. • Process PI allows for the output motor speed (frequency) to be adjusted based on the outer control loop regulator. Refer to Appendix C.	Default: 0 "Open Loop" Options: 0 "Open Loop" 1 "Slip Comp" 2 "Process PI"	121 thru 138

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Spd Mode & Limits	081	**[Minimum Speed]** Sets the low limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit]. **ATTENTION:** Drive can operate at and maintain zero speed. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audible or visual alarms, or other devices to indicate that the drive is operating or may operate at or near zero speed. Failure to observe this precaution could result in severe bodily injury or loss of life.	Default: 0.0 Hz Min/Max: 0.0/[Maximum Speed] Units: 0.1 Hz	083 092
		082	**[Maximum Speed]** Sets the high limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit]. **ATTENTION:** The user is responsible for ensuring that driven machinery, all drive-train mechanisms, and application material are capable of safe operation at the maximum operating speed of the drive. Overspeed detection in the drive determines when the drive shuts down. See parameter 083 [Overspeed Limit]. Failure to observe this precaution could result in bodily injury.	Default: 60.0 Hz Min/Max: 5.0/400.0 Hz Units: 0.1 Hz	055 083 091 202

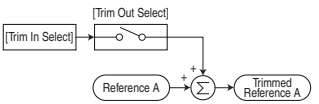
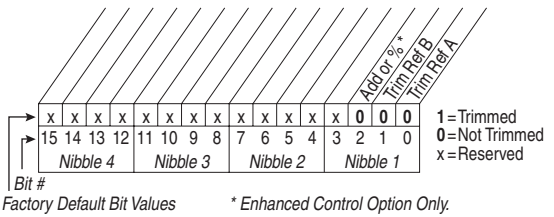
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Spd Mode & Limits	083	**[Overspeed Limit]** Sets the incremental amount of the output frequency (above [Maximum Speed]) allowable for functions such as slip compensation. [Maximum Speed] + [Overspeed Limit] must be ≤ [Maximum Freq]	Default: 10.0 Hz Min/Max: 0.0/20.0 Hz Units: 0.1 Hz	055 082
		084 085 086	**[Skip Frequency 1]** **[Skip Frequency 2]** **[Skip Frequency 3]** Sets a frequency at which the drive will not operate.	Default: 0.0 Hz Default: 0.0 Hz Default: 0.0 Hz Min/Max: –/+400.0 Hz Units: 0.1 Hz	087
		087	**[Skip Freq Band]** Determines the bandwidth around a skip frequency. [Skip Freq Band] is split, applying 1/2 above and 1/2 below the actual skip frequency. The same bandwidth applies to all skip frequencies.	Default: 1.0 Hz Min/Max: 0.0/30.0 Hz Units: 0.1 Hz	084



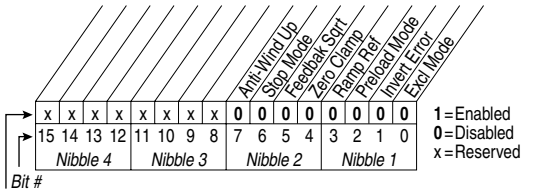
File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values			Related
SPEED COMMAND	Spd Mode & Limits	089	**[Logic Source Sel]** Selects the control source for the following logic commands: • Start (Run) • Clear Faults • Stop The All Ports selection allows ports to control the logic command simultaneously. **Important:** The drive is shipped with a default configuration of control from the keypad. For drive control from the terminal block inputs, set this parameter to option 0 “Terminal Blk”. **Important:** Asserting the terminal block input OIM Control overrides parameter 089. **Important:** Asserting the Purge input overrides OIM Control and parameter 089.  **ATTENTION:** Setting parameter 089 to “Terminal Blk” or “Network” while 168 [LevelSense Start] is enabled may start the drive if a start command is on from the newly selected logic source. **ATTENTION:** When 168 [LevelSense Start] is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life. **ATTENTION:** Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1] and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury. **ATTENTION:** Note the following about stop commands: • A stop command from any attached OIM will always be enabled regardless of the value of [Logic Source Sel]. • Network stop commands are effective only when [Logic Source Sel] is set to option 5 “Network” or 7 “All Ports”. • Terminal block stop commands are effective only when [Logic Source Sel] is set to 0 “Terminal Blk” or 7 “All Ports”. Failure to observe this precaution could result in severe bodily injury or loss of life.	Default: Options:	1 0 1 2 3 4 5 6 7	“Local OIM” “Terminal Blk” “Local OIM” “DPI Port 2” “DPI Port 3” “Reserved” “Network” “Reserved” “All Ports”	090

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Speed References	090	**[Speed Ref A Sel]** Selects the source of the speed reference to the drive unless [Speed Ref B Sel] or [Preset Speed 1-7] is selected. Note that the manual reference command and inputs OIM Control and Purge can override the reference control source. For more information on selecting a speed reference source, see Figure 1.20 on page 1-35.	Default: 1 "Analog In 1" Options: 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Reserved" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Purge" 18 "Local OIM 19 "DPI Port 2" 20 "DPI Port 3" 21 "Reserved" 22 "Network" 23 "Reserved"	002 091 092 101 thru 106 117 thru 120 192 thru 194 213 272 273 320 361 thru 366
			ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1] and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.		
		091	**[Speed Ref A Hi]** Scales the upper value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	082 092
		092	**[Speed Ref A Lo]** Scales the lower value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	081

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Speed Reference	096	**[TB Man Ref Sel]** Sets the manual speed reference source when a digital input is configured for "Auto/Manual." (1) "Analog In 2" is not a valid selection if it was selected for any of the following: - [Trim In Select] - [PI Feedback Sel] - [PI Reference Sel] - [Current Lmt Sel]	Default: 1 "Analog In 1" Options: 1 "Analog In 1" 2 "Analog In 2"(1) 3-8 "Reserved" 9 "MOP Level"	097 098
		097	**[TB Man Ref Hi]** Scales the upper value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	096
		098	**[TB Man Ref Lo]** Scales the lower value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	096
	Discrete Speeds	101 102 103 104 105 106	**[Preset Speed 1]** **[Preset Speed 2]** **[Preset Speed 3]** **[Preset Speed 4]** **[Preset Speed 5]** **[Preset Speed 6]** Provides an internal fixed speed command value. In bipolar mode direction is commanded by the sign of the reference.	Default: 5.0 Hz 10.0 Hz 20.0 Hz 30.0 Hz 40.0 Hz 50.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	090
		107	**[Purge Speed]** Provides a fixed internal speed similar to [Preset Speed x]. It is also the frequency the drive uses when the Purge digital input is closed.	Default: 5.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Speed Trim	117	**[Trim In Select]** Specifies which analog input signal is being used as a trim input. The trim input signal is added to the Reference A signal. If an analog input is used as the trim signal, two scaling parameters are provided. 	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Reserved" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Purge" 18 "Local OIM 19 "DPI Port 2" 20 "DPI Port 3" 21 "Reserved" 22 "Network" 23 "Reserved"	090
		118	**[Trim Out Select]** Specifies which speed references are to be trimmed.  *Factory Default Bit Values* ** Enhanced Control Option Only.*	117 119 120
		119	**[Trim Hi]** Scales the upper value of the [Trim In Select] selection when the source is an analog input.	Default: 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	082 117
		120	**[Trim Lo]** Scales the lower value of the [Trim In Select] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	117

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Slip Comp		**Important:** Parameters in the Slip Comp Group are used to enable and tune the Slip Compensation Regulator. In order to allow the Slip Compensation Regulator to control drive operation, parameter 080 must be set to 1 "Slip Comp".		
		121	**[Slip RPM @ FLA]** Sets the amount of compensation to drive output at motor FLA. If the value of parameter 061 [Autotune] = 3 "Calculate" changes made to this parameter will not be accepted.	Default: Based on [Motor NP RPM] Min/Max: 0.0/1200.0 RPM Units: 0.1 RPM	061 080 122 123
		122	**[Slip Comp Gain]** Sets the response time of slip compensation.	Default: 40.0 Min/Max: 1.0/100.0 Units: 0.1	080 121 122
		123	**[Slip RPM Meter]** Displays the present amount of adjustment being applied as slip compensation.	Default: Read Only Min/Max: –/+300.0 RPM Units: 0.1 RPM	080 121 122

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Process PI		**Important:** Parameters in the Process PI Group are used to enable and tune the PI Loop. To allow the PI Loop to control drive operation, parameter 080 must be set to 2 "Process PI".		
		124	**[PI Configuration]** Sets configuration of the PI regulator.  *Factory Default Bit Values* Option Descriptions **Excl Mode** — Enabled: Selects speed regulation (PI output used as speed command). Disabled: Selects trim regulation (PI output summed with speed command). **Invert Error** — Enables/disables the option to invert the sign of the PI error signal. Enabling creates a decrease in output for an increasing error and an increase in output for a decreasing error. **Preload Mode** — Enabled: Initializes the PI integrator to the commanded speed while the PI is disabled. Disabled: The PI integrator is loaded with the PI Pre-load (133) while PI is disabled. **Ramp Ref** — Enables/disables ramping the PI reference using PI Feedback as the starting point and ramping to the selected PI Reference after PI is enabled. The active accel time is used for the PI ramp reference slew rate. The ramping is bypassed when the reference equals the setpoint. The ramp used is set by the active ramps (parameters 140 to 143). **Zero Clamp** — Enables/disables option to limit operation so that the output frequency at the PI regulator always has the same sign as the master speed reference. This limits the possible drive action to one direction only. Output from the drive will be from zero to maximum frequency forward or zero to maximum frequency reverse. **Feedback Sqrt** — Enables/disables the option of using the square root of the feedback signal as the PI feedback. **Stop Mode** — Enabled: PI loop continues to operate during the decel ramp after a stop command is issued. (Frame 2, 3, 4, 5, & 6) Disabled: Drive performs a normal stop. **Anti Wind Up** — Enabled: The PI loop automatically prevents the integrator from creating an excessive error that could cause instability. The integrator will be controlled without the need for PI Reset or PI Hold inputs. (Frame 2, 3, 4, 5, & 6)	124 thru 138

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Process PI	125	**[PI Control]**		080

Controls the PI regulator. You can use a Datalink parameter or an assigned digital input to write to this parameter.

PI control allows the drive to take a reference signal (setpoint) and an actual signal (feedback) and automatically adjust the speed of the drive to match the actual signal to the reference.

Proportional control (P) adjusts the output based on the size of the error (larger error = proportionally larger correction).

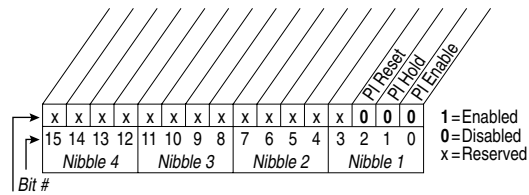
Integral control (I) adjusts the output based on the duration of the error. The integral control by itself is a ramp output correction. This type of control gives a smoothing effect to the output and will continue to integrate until zero error is achieved.

By itself, integral control is slower than many applications require, and, therefore, is combined with proportional control (PI).

The purpose of the PI regulator is to regulate a process variable such as position, pressure, temperature, or flow rate, by controlling speed.

There are two ways the PI regulator can be configured to operate (see parameter 124):

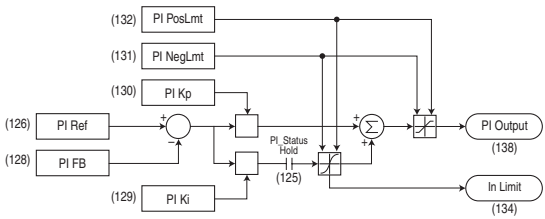
- Process trim, which takes the output of the PI regulator and sums it with a master speed reference to control the process.
- Process control, which takes the output of the PI regulator as the speed command. No master speed reference exists, and the PI output directly controls the drive output.



Factory Default Bit Values

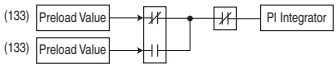
Option Descriptions

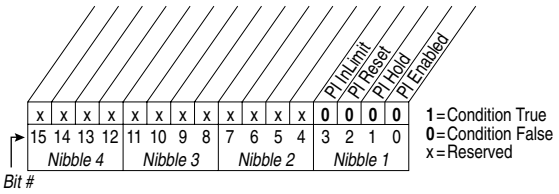
PI Enable	Enables/disables operation of the PI loop.
PI Hold	Enabled: Integrator for the outer control loop is held at the current level (will not increase).
PI Reset	Enabled: Integrator for the outer control loop is reset to zero. Disabled: Integrator for the outer control loop integrates normally.



File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Process PI	126	**[PI Reference Sel]** Selects the source of the PI reference.	Default: 0 "PI Setpoint" Options: 0 "PI Setpoint" 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Master Ref" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Purge" 18 "Local OIM" 19 "DPI Port 2" 20 "DPI Port 3" 21 "Reserved" 22 "Network" 23 "Reserved"	124 thru 138
		127	**[PI Setpoint]** Provides an internal fixed value for process setpoint when [PI Reference Sel] is set to "PI Setpoint."	Default: 50.00% Min/Max: –/+100.00% of Maximum Process Value Units: 0.01%	124 thru 138
		128	**[PI Feedback Sel]** Selects the source of the PI feedback.	Default: 2 "Analog In 2" Options: See [PI Reference Sel].	124 thru 138
		129	**[PI Integral Time]** Time required for the integral component to reach 100% of [PI Error Meter]. Not functional when the PI Hold bit of [PI Control] = "1" (enabled). A value of zero disables this parameter	Default: 2.00 Secs Min/Max: 0.00/100.00 Secs Units: 0.01 Secs	124 thru 138
		130	**[PI Prop Gain]** Sets the value for the PI proportional component. PI Error × PI Prop Gain = PI Output	Default: 1.00 Min/Max: 0.00/100.00 Units: 0.01	124 thru 138
		131	**[PI Lower Limit]** Sets the lower limit of the PI output.	Default: –[Maximum Freq] Min/Max: –/+400.0 Hz Units: 0.1 Hz	124 thru 138
		132	**[PI Upper Limit]** Sets the upper limit of the PI output.	Default: +[Maximum Freq] Min/Max: –/+400.0 Hz Units: 0.1 Hz	124 thru 138

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND	Process PI	133	**[PI Preload]** Sets the value used to preload the integral component on start or enable.	Default: 0.0 Hz Min/Max: –/+400.0 Hz Units: 0.1 Hz	124 thru 138
		134	**[PI Status]** Status of the Process PI regulator.	Read Only	124 thru 138
		135	**[PI Ref Meter]** Present value of the PI reference signal.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138
		136	**[PI Fdback Meter]** Present value of the PI feedback signal.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138
		137	**[PI Error Meter]** Present value of the PI error.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138
		138	**[PI Output Meter]** Present value of the PI output.	Default: Read Only Min/Max: –/+100.0 Hz Units: 0.1 Hz	124 thru 138





Option Descriptions

PI Enabled	Indicates whether or not the PI loop is enabled.
PI Hold	Set to 1 to indicate when a digital input is configured for PI Hold and is turned on, or the PI Hold bit is set in 125 [PI Control].
PI Reset	Set to 1 to indicate when the PI Integrator is being set to zero.
PI InLimit	Set to 1 to indicate when the PI output equals positive limit or negative limit.

Dynamic Control File

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Ramp Rates	140 141	**[Accel Time 1]** **[Accel Time 2]** Sets the rate the drive ramps to its output frequency after a start command or during a speed change. $\frac{\text{Max Speed}}{\text{Accel Time}} = \text{Accel Rate}$ Two accel times are provided to allow acceleration rate changes "on the fly" using a building automation system command, digital input, or F-Key if configured (see Appendix B).	Default: 20.0 Secs 20.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs	142 143 146 361 thru 366
		142 143	**[Decel Time 1]** **[Decel Time 2]** Sets the rate of decel for all speed decreases. $\frac{\text{Max Speed}}{\text{Decel Time}} = \text{Decel Rate}$ Two decel times are provided to allow acceleration rate changes "on the fly" using a building automation system command, digital input, or F-Key if configured (see Appendix B).	Default: 20.0 Secs 20.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs	140 141 146 361 thru 366
		146	**[S Curve %]** Sets the percentage of accel or decel time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.	Default: 20% Min/Max: 0/100% Units: 1%	140 thru 143
	Load Limits	147	**[Current Lmt Sel]** Selects the source for the adjustment of current limit (i.e. parameter, analog input, etc.).	Default: 0 "Cur Lim Val" Options: 0 "Cur Lim Val" 1 "Analog In 1" 2 "Analog In 2"	146 149
		148	**[Current Lmt Val]** Defines the current limit value when [Current Lmt Sel] = "Cur Lim Val."	Default: [Rated Amps] × 1.5 (Equation approximates default value.) Min/Max: Drive Rating Based Units: 0.1 Amps	147 149
		149	**[Current Lmt Gain]** Sets the responsiveness of the current limit.	Default: 200 Min/Max: 0/5000 Units: 1	147 148
		150	**[Drive OL Mode]** Selects the drive's response to increasing drive temperature.	Default: 3 "Both–PWM 1st" Options: 0 "Disabled" 1 "Reduce CLim" 2 "Reduce PWM" 3 "Both–PWM 1st"	219

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Load Limits	151	**[CarrierFrequency]** Sets the carrier frequency for the PWM output. Drive derating may occur at higher carrier frequencies. For derating information, refer to Appendix A.	Default: 4 kHz Min/Max: 2/10 kHz Units: 1 kHz	
		155 156	**[Stop Mode A]** **[Stop Mode B]** Active stop mode. [Stop Mode A] is active unless [Stop Mode B] is selected by inputs. Allows switching between two stop modes using external logic. (1) When using options 1 or 2, refer to the Attention statements at [DC Brake Level].	Default: 0 "Coast" Default: 1 "Ramp" Options: 0 "Coast" 1 "Ramp"(1) 2 "Ramp to Hold"(1) 3 "DC Brake"	157 158 159

ATTENTION: If a hazard of injury do to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

ATTENTION: The user must provide an external, hard wired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Stop/Brake Modes	157	**[DC Brake Lvl Sel]** Selects the source for [DC Brake Level].	Default: 0 "DC Brake Lvl" Options: 0 "DC Brake Lvl" 1 "Analog In 1" 2 "Analog In 2"	155 156 158 159
		158	**[DC Brake Level]** Defines the DC brake current level injected into the motor when "DC Brake" is selected as a stop mode. The DC braking voltage used in this function is created by a PWM algorithm and may not generate the smooth holding force needed for some applications. **ATTENTION:** If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used. Failure to observe this precaution could result in severe bodily injury or loss of life. **ATTENTION:** This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking. Failure to observe this precaution could result in damage to, or destruction of, equipment.	Default: [Rated Amps] Min/Max: 0/[Rated Amps] × 1.5 (Equation yields approximate maximum value.) Units: 0.1 Amps	
		159	**[DC Brake Time]** Sets the amount of time DC brake current is "injected" into the motor.	Default: 0.0 Secs Min/Max: 0.0/90.0 Secs Units: 0.1 Secs	155 thru 158
		160	**[Bus Reg Ki]** (Bus Reg Gain) Sets the responsiveness of the bus regulator.	Default: 450 Min/Max: 0/5000 Units: 1	161 162

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Stop/Brake Modes	161 162	**[Bus Reg Mode A]** **[Bus Reg Mode B]** Sets the method and sequence of the DC bus regulator voltage. Choices are dynamic brake, frequency adjust or both. Sequence is determined by programming or digital input to the terminal block. Dynamic Brake Setup If a dynamic brake resistor is connected to the drive, both these parameters must be set to either option 2, 3 or 4.	Default: 1 "Adjust Freq" 0 "Disabled" Options: 0 "Disabled" 1 "Adjust Freq" 2 "Dynamic Brak" 3 "Both-DB 1st" 4 "Both-Frq 1st"	160 163

ATTENTION: The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or the protective circuit shown in Figure C.1 on page C-1 (or equivalent) must be supplied.

ATTENTION: The adjust freq portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault. However, it can also cause either of the following two conditions to occur:

- Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes; however, an OverSpeed Limit fault will occur if the speed reaches Max Speed + Overspeed Limit. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive, and 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the adjust freq portion of the bus regulator function must be disabled (see parameters 161 and 162).
- Actual deceleration times can be longer than commanded deceleration times; however, a Decel Inhibit fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the adjust freq portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Note that these faults are not instantaneous and have shown test results that take between 2 and 12 seconds to occur.

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Stop/Brake Modes	163	**[DB Resistor Type]** Selects whether the internal or an external DB resistor will be used. If a dynamic brake resistor is connected to the drive, [Bus Reg Mode x], A, B or Both (if used), must be set to either option 2, 3 or 4. **ATTENTION:** The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or the protective circuit shown in Figure C.1 on page C-1, or equivalent, must be supplied. **ATTENTION:** Equipment damage may result if a drive mounted (internal) resistor is installed and this parameter is set to "External Res." Thermal protection for the internal resistor will be disabled, resulting in possible device damage.	Default: 0 "Internal Res" Options: 0 "Internal Res" 1 "External Res" 2 "None"	161 162
		164 2...6	**[Bus Reg Kp]** Proportional gain for the bus regulator. Used to adjust regulator response.	Default: 1200 Min/Max: 0/10000 Units: 1	
		165 2...6	**[Bus Reg Kd]** Derivative gain for the bus regulator. Used to control regulator overshoot.	Default: 1000 Min/Max: 0/10000 Units: 1	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	168	**[LevelSense Start]** Enables/disables a feature to issue a Start or Run command and automatically resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.	Default: 1 "Enabled" Options: 0 "Disabled" 1 "Enabled"	

Enables/disables a feature to issue a start or run command and automatically run at the commanded speed when drive input power is applied.

Disabled: The drive starts on the open-to-closed transition of the control source start input when no start inhibit conditions are present (edge-sensitive detection).

Enabled: The drive starts when the control source start input is closed, no start inhibit conditions are present, and power is applied (level-sensitive detection).

Note that this feature (LevelSense Start) requires a digital input configured for run or start and a valid start contact.

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

ATTENTION: Be aware of the following:

- Setting parameter 168 to 1 (Enabled) immediately applies output power to the motor when all start conditions are met.
- If the drive is running from the terminal block, LevelSense Start is enabled, and a fault occurs, the drive coasts to rest and generates a fault. In this case, resetting and clearing the fault immediately restarts the drive without any change to the start or stop input states.

When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Disabling this function will alter the operation of the drive or, for drives with the bypass option, inhibit the drive from starting. Do not disable this function. Failure to observe this precaution could result in severe bodily injury or loss of life.

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	169	**[Flying Start En]** Enables/disables the function which reconnects to a spinning motor at actual RPM when a start command is issued. When a drive is started in its normal mode, it initially applies a frequency of 0 Hz and ramps to the desired frequency. If the drive is started into an already spinning motor in this manner, without Flying Start enabled, large currents will be generated and an overcurrent trip may result. In Flying Start mode, the drive's response to a start command will be to identify the motor's speed and apply a voltage that is synchronized in frequency, amplitude and phase to the counter emf of the spinning motor. The motor will then accelerate to the desired frequency.	Default: 1 "Enabled" Options: 0 "Disabled" 1 "Enabled"	170
		170	**[Flying StartGain]** Sets the response of the flying start function.	Default: 4000 Min/Max: 20/32767 Units: 1	169

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	174	**[Auto Rstrt Tries]** Sets the maximum number of times the drive attempts to reset a fault and restart.	Default: 0 Min/Max: 0/9 Units: 1	175

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

ATTENTION: The drive may start immediately after a fault is auto-reset when 168 [LevelSense Start] is enabled.

When LevelSense Start is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Important: The drive will re-start after a reset if the start input is still asserted.

Specifies the maximum number of times the drive attempts to reset a fault and restart when the auto restart feature is enabled.

The auto restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. Only certain faults are permitted to be reset, see chapter 12 for more information.

When the auto restart feature is enabled (that is, Auto Rstrt Tries is set to a value greater than zero), and an auto-resettable fault occurs, the drive will stop. After the number of seconds in [Auto Restrt Delay] has elapsed, the drive will automatically reset the faulted condition. The drive will then issue an internal start command to start the drive.

If another auto-resettable fault occurs, the cycle will repeat up to the number of attempts specified in Auto Rstrt Tries.

If the drive faults repeatedly for more than the number of attempts specified in Auto Rstrt Tries with less than five minutes between each fault, the drive will remain in the faulted state. The fault Auto Rstrt Tries will be logged in the fault queue.

The auto restart feature is disabled when the drive is stopping and during autotuning. Note that a DC Hold state is considered stopping.

The following conditions will abort the reset/run process:

- Issuing a stop command from any control source. (Note that removal of a 2-wire run-fwd or run-rev command is considered a stop command.)
- Issuing a fault reset command from any active source.
- Removing the enable input signal.
- Setting Auto Restrt Tries to zero.
- Occurrence of a fault that is not auto-resettable.
- Removing power from the drive.
- Exhausting an auto-reset/run cycle.

Note that two autotuning status bits are provided in [Drive Status 2]: an active status bit and a countdown status bit.

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	175	**[Auto Rstrt Delay]** Sets the time between restart attempts when [Auto Rstrt Tries] is set to a value other than zero.	Default: 30.0 Secs Min/Max: 0.5/30.0 Secs Units: 0.1 Secs	174
		178	**[Sleep Wake Mode]** Enables/disables the Sleep/Wake function. **Important:** When enabled, the following conditions must be met: • A proper value must be programmed for [Sleep Level] & [Wake Level]. • A speed reference must be selected in [Speed Ref A Sel]. • At least one of the following must be programmed (and input closed) in [Digital Inx Sel]; "Enable," "Stop=CF," "Run," "Run Forward," "Run Reverse."	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Direct"	

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Equipment damage and/or personal injury can result if this parameter is used in an inappropriate application. Do Not use this function without considering the information below. Failure to observe this precaution could result in personal injury or damage to equipment.

Conditions Required to Start Drive

Important: P089 [Logic Source Sel] = 0 "Terminal Blk"

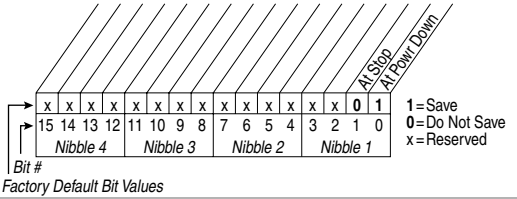
Input	After Power-Up	After a Drive Fault		After a Stop Command
		Reset by Stop-CF, OIM or TB	*Reset by Clear Faults (TB)*	*OIM or TB*
Stop	Stop Closed Wake Signal	Stop Closed Wake Signal New Start or Run Cmd.	Stop Closed Wake Signal	Stop Closed Direct Mode Analog Sig. > Wake Level
Enable	Enable Closed Wake Signal	Enable Closed Wake Signal New Start or Run Cmd.	Enable Closed Wake Signal	Enable Closed Direct Mode Analog Sig. > Wake Level
Run Run For. Run Rev.	Run Closed Wake Signal	New Run Cmd. Wake Signal	Run Closed Wake Signal	New Run Cmd. Wake Signal

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	*Cont.* 178	Sleep-Wake Operation The normal operation of this function is to start (wake) the drive when the selected analog signal is greater than or equal to a user-specified wake level and stop the drive when an analog signal selected by [Logic Source Sel] is less than or equal to a user-specified sleep level. Assuming all drive permissive conditions are met, the drive will start when [Sleep-Wake Mode] is enabled (= Direct) and the absolute value of the [Sleep-Wake Ref] is greater than the programmed [Wake Level] for longer than the programmed [Wake Time]. The drive will stop when the absolute value of the [Sleep-Wake Ref] is less than the programmed [Sleep Level] for longer than the programmed [Sleep Time]. While the drive is measuring the time above [Wake Level], it will indicate a “Waking” alarm at [Drive Alarm] bit 10 “Waking.” If [Sleep-Wake Ref] goes above [Sleep Level] or below [Wake Level] the corresponding timer is reset (Wake timer and Sleep timer, respectively). Any active Stop commands will be honored immediately (i.e. no Sleep Timer). However, after a Stop or Fault, a new Start/Run command is required to reset Sleep-Wake control. There are two ways to override the normal Sleep-Wake operations: (1) Sleep Override - starting with Analog Input < Sleep Level. This mode prevents the Analog Input from being able to stop the drive. (2) Wake Override - starting with Analog Input > Sleep Level & < Wake Level. This mode still allows the drive to be stopped when Analog Input goes below [Sleep Level]. The capability of Sleep-Wake to be overridden depends on the value selected by [Logic Source Sel]. When the Logic Source is “All Ports” only a “Wake Override” is possible. When the Logic Source is DPI Ports (i.e. Local OIM, DPI Ports, or Network) both Sleep and Wake Overrides are possible. When the Logic Source is “Terminal Blk” no override of Sleep-Wake is possible. If starting via Sleep-Wake override, it remains in effect until the next stop command. [Sleep Level] and [Wake Level] are adjustable while the drive is “awake”. If these levels are set incorrectly, the “Sleep Config” alarm is set. If the current configuration is not corrected, the drive will stop after the programmed [Sleep Time]. Even though the Sleep-Wake feature is enabled, the operation of other start modes is unchanged (e.g. if Level Sense Start is set to Enabled, Logic Source Select is set to All Ports, and a start command is asserted, the drive will start immediately after [Sleep-Wake Ref] reaches the sleep level) due to Sleep Override. The Sleep-Wake feature can also be overridden in the following ways: • The Purge digital input overrides all Sleep-Wake operations. Asserting Purge will start the drive even if [Sleep-Wake Ref] is below [Sleep Level]. Negating Purge will cause the drive to stop if no valid Start/Wake signal is present. While Purge is active, the Sleep-Wake analog input will not be able to start or stop the drive. • The OIM Control digital input allows an attached OIM (DPI port) to start the drive by overriding the Sleep-Wake Sleep signal (i.e. the analog input is below the Sleep level). Once overridden by the OIM, the Sleep-Wake analog input will no longer be able to start or stop the drive until it is restarted while the analog input is above the Sleep level. Purge will override OIM control.		

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL	Restart Modes	179	**[Sleep Wake Ref]** Selects the source of the input controlling the Sleep-Wake function.	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2"	
		180	**[Wake Level]** Defines the analog input level that will start the drive.	Default: 6.000 mA, 6.000 Volts Min/Max: [Sleep Level]/20.000 mA [Sleep Level]/10.000 Volts Units: 0.001 mA 0.001 Volts	181
		181	**[Wake Time]** Defines the amount of time at or above [Wake Level] before a Start is issued.	Default: 1.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	180
		182	**[Sleep Level]** Defines the analog input level that will stop the drive.	Default: 5.000 mA, 5.000 Volts Min/Max: 4.000 mA/[Wake Level] 0.000 Volts/[Wake Level] Units: 0.001 mA 0.001 Volts	183
		183	**[Sleep Time]** Defines the amount of time at or below [Sleep Level] before a Stop is issued.	Default: 1.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	182
	Power Loss	184	**[Power Loss Mode]** Sets the reaction to a loss of input power. Power loss is recognized when: • DC bus voltage is ≤ 73% of [DC Bus Memory] and [Power Loss Mode] is set to "Coast". • DC bus voltage is ≤ 82% of [DC Bus Memory] and [Power Loss Mode] is set to "Decel".	Default: 0 "Coast" Options: 0 "Coast" 1 "Decel" 2 "Continue"(1), 3 "Coast input"(1), 4 "Decel input"(1), (1) Frames 2, 3, 4, 5, & 6	013 185
		185	**[Power Loss Time]** Sets the time that the drive will remain in power loss mode before a fault is issued.	Default: 0.5 Secs Min/Max: 0.0/60.0 Secs Units: 0.1 Secs	184
		186	**[Power Loss Level]** Sets the level at which the Power Loss Mode selection will occur.	Default: 0.0 VDC Min/Max: 0.0/999.9 VDC Units: 0.1 VDC	

Utility File

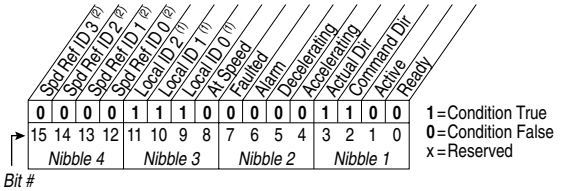
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Direction Config	190	**[Direction Mode]** Selects the method for changing drive direction. **Mode** / **Direction Change** Unipolar / Drive Logic Bipolar / Sign of Reference Reverse Dis / Not Changable **ATTENTION:** Setting parameter 190 to option 0 "Unipolar" or 1 "Bipolar" may cause unwanted motor direction. Verify driven machinery cannot be damaged by reverse rotation before changing the setting of this parameter to 0 or 1. Failure to observe this precaution could result in damage to, or destruction of, equipment. **Unipolar:** Drive receives unsigned reference signal and a separate direction command from a logic source such as digital inputs or a DPI port. **Bipoloar:** Drive receives signed reference. **Reverse Disable:** Drive receives signed reference; however, regardless of the reference, the drive is not permitted to reverse.	Default: 2 "Reverse Dis" Options: 0 "Unipolar" 1 "Bipolar" 2 "Reverse Dis"	320 thru 327 361 thru 366
	OIM Ref Config	192	**[Save OIM Ref]** Enables a feature to save the present frequency reference value issued by the OIM to Drive memory on power loss. Value is restored to the OIM on power up. At Powr Down x x x x x x x x x x x x x x x **1** 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Nibble 4 Nibble 3 Nibble 2 Nibble 1 Bit # Factory Default Bit Values **1** = Save at Power Down **0** = Do Not Save x = Reserved		
		193	**[Man Ref Preload]** Enables/disables a feature to automatically load the present "Auto" frequency reference value into the OIM when "Manual" is selected. Allows smooth speed transition from "Auto" to "Manual."	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	MOP Config	194	**[Save MOP Ref]** Enables/disables the feature that saves the present MOP frequency reference at power down or at stop.  *Factory Default Bit Values*		
		195	**[MOP Rate]** Sets rate of change of the MOP reference in response to a digital input.	Default: 1.0 Hz/s Min/Max: 0.2/400.0 Hz/s Units: 0.1 Hz/s	
	Drive Memory	196	**[Param Access Lvl]** Selects the parameter display level. Basic = Reduced param. set Advanced = Full param. set	Default: Read Only Options: 1 "Standard" 2 "Advanced"	
		197	**[Reset To Defalts]** Resets all parameter values (except parameters 196, 201 & 202) to defaults. Option 1 resets drive to factory settings. Options 2 and 3 will reset drive to alternate voltage and current rating. Low Voltage = 400V class defaults High Voltage = 480V class defaults **Important:** Internal fan voltage on frame 5 drives may need to be changed when using option 2 or 3.	Default: 0 "Ready" Options: 0 "Ready" 1 "Factory" 2 "Low Voltage" 3 "High Voltage"	
		198	**[Load Frm Usr Set]** Loads a previously saved set of parameter values from a selected user set location in drive non-volatile memory to active drive memory. An F-Key on the LCD OIM can be configured for this function. Refer to Appendix B.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	199
		199	**[Save To User Set]** Saves the parameter values in active drive memory to a user set in drive nonvolatile memory. An F-Key on the LCD OIM can be configured for this function. Refer to Appendix B.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	198
		200	**[Reset Meters]** Resets selected meters to zero.	Default: 0 "Ready" Options: 0 "Ready" 1 "MWh" 2 "Elapsed Time"	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values			Related
UTILITY	Drive Memory	201	**[Language]** Selects the display language when using an LCD OIM.	Default: Options:	0 0 1 2 3 4 5 6 7	"Not Selected" "Not Selected" "English" "Français" "Español" "Italiano" "Deutsch" "Reserved" "Português"	
		202	**[Voltage Class]** Configures the drive current rating and associates it with the selected voltage (i.e. 400 or 480V). This parameter is normally used when downloading parameter sets.	Default: Options:	 2 3	Based on Drive Cat. No. "Low Voltage" "High Voltage"	
		203	**[Drive Checksum]** Provides a checksum value that indicates whether or not a change in drive programming has occurred.	Default: Min/Max: Units:	Read Only 0/65535 1		

File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values	Related
UTILITY	Diagnostics	209	**[Drive Status 1]**	Read Only	210

Present operating condition of the drive.



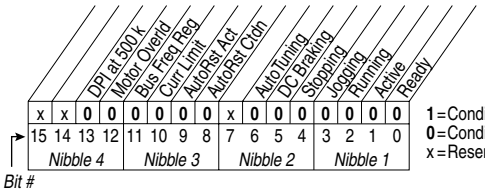
Bit	Function	Description
0	Ready	Drive ready; no faults or inhibits
1	Active	Drive outputting voltage
2	Commanded Dir	
3	Active Dir	Motor direction = setpoint direction
4	Accelerating	Motor accelerating
5	Decelerating	Motor decelerating
6	Alarm	Alarm active
7	Faulted	Drive faulted
8	At Speed	Output frequency = setpoint frequency

Bits (2)				
15	14	13	12	Description
0	0	0	0	Ref A Auto
0	0	0	1	Preset 1 Auto
0	0	1	0	Preset 2 Auto
0	0	1	1	Preset 3 Auto
0	1	0	0	Preset 4 Auto
0	1	0	1	Preset 5 Auto
0	1	1	0	Preset 6 Auto
0	1	1	1	Preset 7 Auto
1	0	0	0	TB Manual
1	0	0	1	Port 1 Manual
1	0	1	0	Port 2 Manual
1	0	1	1	Port 3 Manual
1	1	0	0	Port 4 Manual
1	1	0	1	Port 5 Manual
1	1	1	0	Port 6 Manual

Bits (1)			
11	10	9	Description
0	0	0	Port 0 (TB)
0	0	1	Port 1
0	1	0	Port 2
0	1	1	Port 3
1	0	0	Port 4
1	0	1	Port 5
1	1	0	Port 6
1	1	1	No Local Control

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	210	**[Drive Status 2]**	Read Only	209

Present operating condition of the drive.

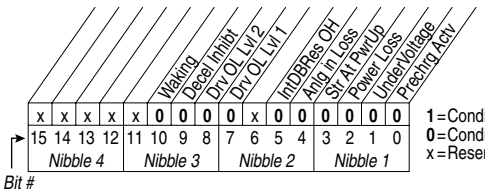


Bit	Function	Description
0	Ready	No start inhibits are active
1	Active	Drive is generating output voltage to the motor
2	Running	Drive is generating output voltage to the motor, run has been selected
3	Jogging	Drive is in jog mode
4	Stopping	Drive is stopping
5	DC Braking	DC braking is active
6	Auto Tuning	Tuning function is active
8	AutoRst Ctdn	Auto restart countdown. Refer to param 174
9	AutoRst Ac	Auto restart active. Refer to param 174
10	Curr Limit	Drive is in current limit
11	Bus Freq Reg	Drive is regulating bus frequency
12	Motor Overld	Motor overload is active
13	DPI @ 500 K	DPI communications is operating at (1) 500 kbaud, (0) 125 kbaud

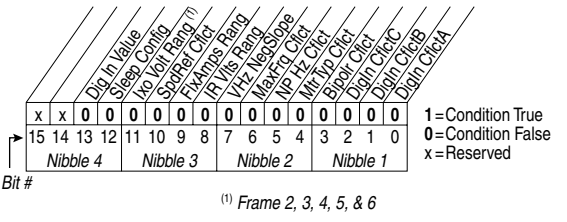
UTILITY	Diagnostics	211	**[Drive Alarm 1]**	Read Only	212

Type 1 alarm conditions that currently exist in the drive. Note that for alarm conditions not configured in parameter 259 [Alarm Config 1], the status indicated will be zero.

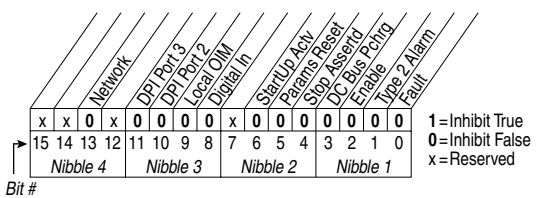
Refer to Chapter 4 for more information about alarms.

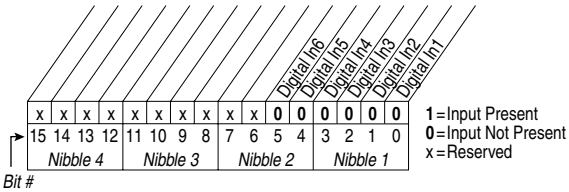
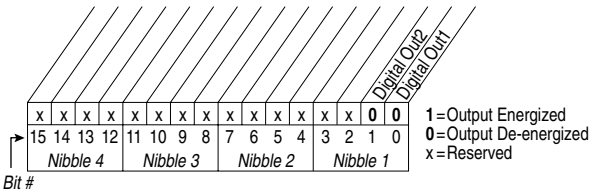


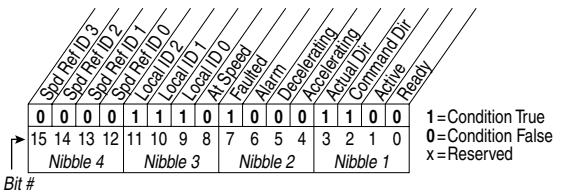
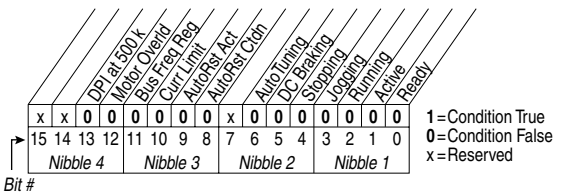
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	212	**[Drive Alarm 2]** Type 2 alarm conditions that currently exist in the drive. Refer to Chapter 4 for more information about alarms.	Read Only	211
		213	**[Speed Ref Source]** Displays the source of the speed reference to the drive.	Default: Read Only Options: 0 "PI Output" 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Jog Speed" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Purge" 18 "Local OIM" 19 "DPI Port 2" 20 "DPI Port 3" 21 "Reserved" 22 "Network" 23 "Reserved"	090 101
		214	**[Start Inhibits]** Displays the inputs currently preventing the drive from starting.	Read Only	

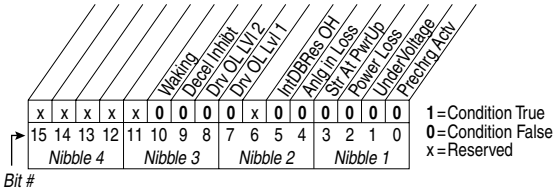
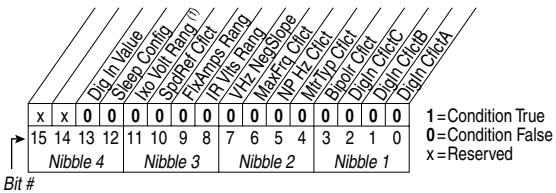


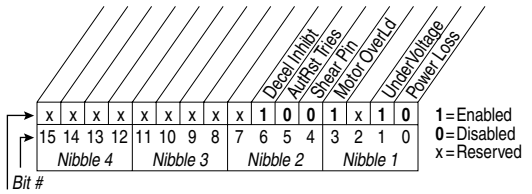
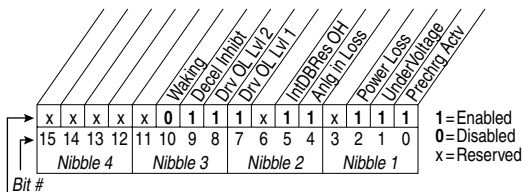
(1) *Frame 2, 3, 4, 5, & 6*



File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	215	**[Last Stop Source]** Displays the source that initiated the most recent stop sequence. It will be cleared (set to 0) during the next start sequence.	Default: Read Only Options: 0 "Pwr Removed" 1 "Local OIM" 2 "DPI Port 2" 3 "DPI Port 3" 4 "Reserved" 5 "Network" 6 "Reserved" 7 "Digital In" 8 "Fault" 9 "Not Enabled" 10 "Sleep" 11 "Jog"	361 362 363 364 365 366
		216	**[Dig In Status]** Status of the digital inputs.  	Read Only	361 thru 366
		217	**[Dig Out Status]** Status of the digital outputs.  	Read Only	380 thru 384
		218	**[Drive Temp]** Present operating temperature of the drive power section.	Default: Read Only Min/Max: –/+100 degC Units: 1.0 degC	
		219	**[Drive OL Count]** Accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase this value to 100% and cause a drive fault or foldback depending on the setting of [Drive OL Mode].	Default: Read Only Min/Max: 0.0/100.0% Units: 0.1%	150

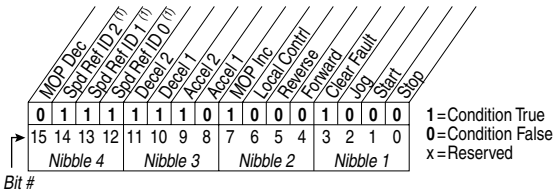
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	220	**[Motor OL Count]** Accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase this value to 100% and cause a drive fault.	Default: Read Only Min/Max: 0.0/100.0% Units: 0.1%	047 048
		224	**[Fault Frequency]** Captures and displays the output speed of the drive at the time of the last fault.	Default: Read Only Min/Max: –/+400.0 Hz Units: 0.1 Hz	225 thru 230
		225	**[Fault Amps]** Captures and displays motor amps at the time of the last fault.	Default: Read Only Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	224 thru 230
		226	**[Fault Bus Volts]** Captures and displays the DC bus voltage of the drive at the time of the last fault.	Default: Read Only Min/Max: 0.0/Max Bus Volts Units: 0.1 VDC	224 thru 230
		227	**[Status 1 @ Fault]** Captures and displays [Drive Status 1] bit pattern at the time of the last fault.  	Read Only	209 224 thru 230
		228	**[Status 2 @ Fault]** Captures and displays [Drive Status 2] bit pattern at the time of the last fault.  	Read Only	210 224 thru 230

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Diagnostics	229	**[Alarm 1 @ Fault]** Captures and displays [Drive Alarm 1] at the time of the last fault.  	Read Only	211 224 thru 230
		230	**[Alarm 2 @ Fault]** Captures and displays [Drive Alarm 2] at the time of the last fault.  (1) *Frame 2, 3, 4, 5, & 6*	Read Only	212 224 thru 230
		234 236	**[Testpoint 1 Sel]** **[Testpoint 2 Sel]** Selects the function whose value is displayed value in [Testpoint x Data]. These are internal values that are not accessible through parameters. See Diagnostic Parameters on page 4-12 for a listing of available codes and functions.	Default: 499 Min/Max: 0/65535 Units: 1	
		235 237	**[Testpoint 1 Data]** **[Testpoint 2 Data]** The present value of the function selected in [Testpoint x Sel].	Default: Read Only Min/Max: 0/4294697295 Units: 1	

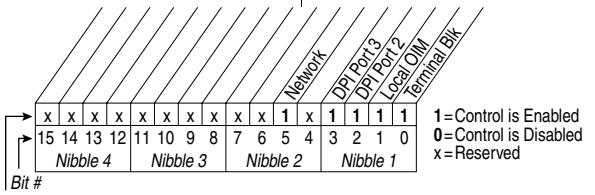
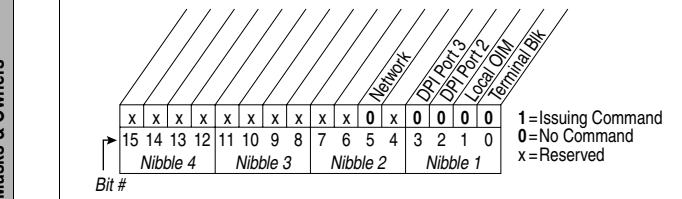
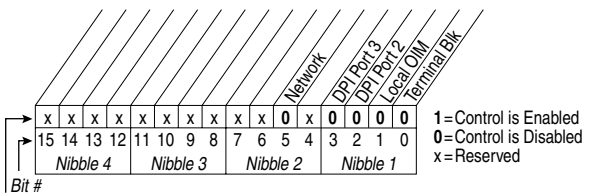
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY	Faults	238	**[Fault Config 1]** Enables/disables annunciation of the listed faults.  *Factory Default Bit Values*		
		240	**[Fault Clear]** Resets a fault and clears the fault queue.	Default: 0 "Ready" Options: 0 "Ready" 1 "Clear Faults" 2 "Clr Flt Que"	
		241	**[Fault Clear Mode]** Enables/disables a fault reset (clear faults) attempt from any source. This does not apply to fault codes which are cleared indirectly via other actions.	Default: 1 "Enabled" Options: 0 "Disabled" 1 "Enabled"	
		242 32	**[Power Up Marker]** Elapsed hours since initial drive power up. This value will rollover to 0 after the drive has been powered on for more than the max value shown.	Default: Read Only Min/Max: 0.0000/429496.7295 Hrs Units: 0.0001 Hrs	
	Alarms	259	**[Alarm Config 1]** Enables/disables alarm conditions that will initiate an active drive alarm. Refer to Chapter 4 for more information about alarms.  *Factory Default Bit Values*		

Communication File

File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values	Related
COMMUNICATION	Comm Control	271	**[Drive Logic Rslt]** The final logic command to the drive resulting from the combination of all port requests and masking functions. Each bit or set of bits represent a command to the drive or follower device. For VTAC 9 drives, bits 2 and 6 will always = 0.	Read Only	
		272	**[Drive Ref Rslt]** Present frequency reference scaled as a DPI reference for peer to peer communications. The value shown is the value prior to the accel/decel ramp and any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	
		273	**[Drive Ramp Rslt]** Present frequency reference scaled as a DPI reference for peer to peer communications. The value shown is the value after the accel/decel ramp but prior to any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	

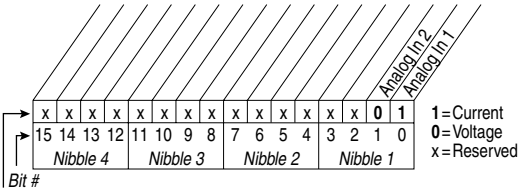
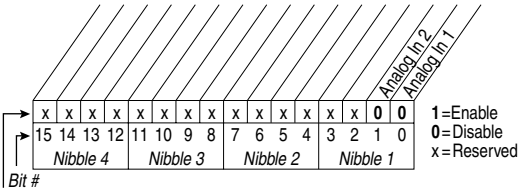


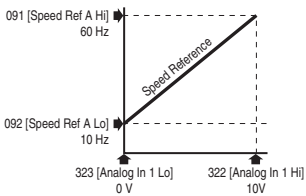
Bits(1)			
14	13	12	Description
0	0	0	No Command - Man. Mode
0	0	1	Ref A Auto
0	1	0	Preset 2 Auto
0	1	1	Preset 3 Auto
1	0	0	Preset 4 Auto
1	0	1	Preset 5 Auto
1	1	0	Preset 6 Auto
1	1	1	Preset 7 Auto

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION	Masks & Owners	286	**[Manual Mask]** Disables manual requests at the port corresponding to bit number.	 *Factory Default Bit Values*	
		288	**[Stop Owner]** Inputs that are presently issuing a valid stop command.	Read Only  Source / Location Terminal Block — Logic I/O DPI Port 1 — Local OIM DPI Port 2 — DIN port at base of drive DPI Port 3 — Split DIN port DPI Port 5 (Network) — Network option	
		298	**[Manual Owner]** Indicates the port in manual control.	 *Factory Default Bit Values*	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Datalinks	300 301	**[Data In A1] -** Link A Word 1 **[Data In A2] -** Link A Word 2 Parameter number whose value will be written from a communications device data table. Parameters that can only be changed while drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will "Disable" the link. Refer to your communications option manual for datalink information.	Default: 0 (0 = "Disabled") Min/Max: 0/387 Units: 1	
		302 303	**[Data In B1] -** Link B Word 1 **[Data In B2] -** Link B Word 2	See [Data In A1] - Link A Word 1.	
		304 305	**[Data In C1] -** Link C Word 1 **[Data In C2] -** Link C Word 2	See [Data In A1] - Link A Word 1.	
		306 307	**[Data In D1] -** Link D Word 1 **[Data In D2] -** Link D Word 2	See [Data In A1] - Link A Word 1.	
		310 311	**[Data Out A1] -** Link A Word 1 **[Data Out A2] -** Link A Word 2 Parameter number whose value will be written to a communications device data table.	Default: 0 (0 = "Disabled") Min/Max: 0/387 Units: 1	
		312 313	**[Data Out B1] -** Link B Word 1 **[Data Out B2] -** Link B Word 2	See [Data Out A1] - Link A Word 1.	
		314 315	**[Data Out C1] -** Link C Word 1 **[Data Out C2] -** Link C Word 2	See [Data Out A1] - Link A Word 1.	
		316 317	**[Data Out D1] -** Link D Word 1 **[Data Out D2] -** Link D Word 2	See [Data Out A1] - Link A Word 1.	

Inputs & Outputs File

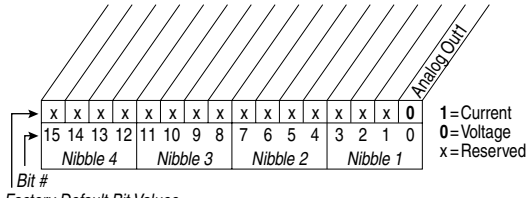
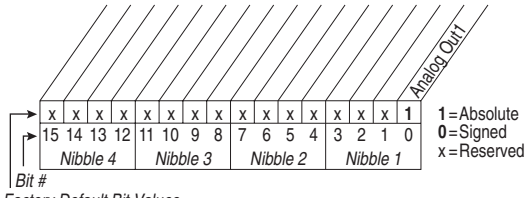
File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Inputs	320	**[Anlg In Config]** Selects the type of input signal being used for [Analog In 1] and [Analog In 2]. Note: If bit 1 is set to 0 "Voltage" you must set parameters 322 and 323 to rescale voltage.  *Factory Default Bit Values*	322 323
		321	**[Anlg In Sqr Root]** Enables/disables the square root function for each input. This function should be enabled if the input signal varies with the square of the quantity (i.e., drive speed) being monitored. The square root function is scaled such that the input range is the same as the output range. For example, if the input is setup as a unipolar voltage input, then the input and output ranges of the square root function will be 0-10 volts.  *Factory Default Bit Values*	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Inputs	322	**[Analog In 1 Hi]** Sets the highest input value to the analog input 1 scaling block. The drive scales the value read from the analog input and converts it to units usable for the application. The user controls the scaling by setting parameters that associate the low and high point in the input range with a low and high point in the target range **Note:** If bit 0 of 320 [Anlg In Config] is set to 0 "Voltage", you must use this parameter to rescale voltage. Analog Input Scaling Example 090 [Speed Ref A Sel] = Analog In 1 091 [Speed Ref A Hi] = 60.0 Hz 092 [Speed Ref A Lo] = 10.0 Hz 322 [Analog In 1 Hi] = 10.0 V 323 [Analog In 1 Lo] = 0.0 V This is the default setting where minimum input (0.0 V) represents low reference and maximum input 10.0 V represents high reference  	Default: 20.000 mA Min/Max: 4.000/20.000 mA, 0.000/10.000V(1), –/+10.000V(2) Units: 0.001 mA, 0.001 Volt (1) Frame B, C, D, & E (2) Frame 2, 3, 4, 5, & 6	091 092
		323	**[Analog In 1 Lo]** Sets the lowest input value to the analog input 1 scaling block. Note: If bit 0 of 320 [Anlg In Config] is set to 0 "Voltage", you must use this parameter to rescale voltage.	Default: 4.000 mA Min/Max: 4.000/20.000 mA, 0.000/10.000V(1), –/+10.000V(2) Units: 0.001 mA, 0.001 Volt (1) Frame B, C, D, & E (2) Frame 2, 3, 4, 5, & 6	091 092
		324	**[Analog In 1 Loss]** Selects drive action when an analog signal loss is detected. 1.6V/3.2 mA = Signal Loss 1.9V/3.8 mA = End Signal Loss Option 1 "Fault" stops the drive on signal loss. All other options permit the input signal to return to a usable level while the drive continues to run. **ATTENTION:** Setting parameter 324 to a value greater than 1 allows the input signal to return to a usable level while the drive is running. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1], and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury. **Important:** Signal loss detection does not occur in bipolar voltage mode.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Fault" 2 "Hold Input" 3 "Set Input Lo" 4 "Set Input Hi" 5 "Goto Preset1" 6 "Hold OutFreq"	091 092

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Inputs	325	**[Analog In 2 Hi]** Sets the highest input value to the analog input 2 scaling block. The drive scales the value read from the analog input and converts it to units usable for the application. The user controls the scaling by setting parameters that associate the low and high point in the input range with a low and high point in the target range Note: If bit 1 of 320 [Anlg In Config] is set to 1 "Current", you must use this parameter to rescale current.	Default: 10.000 Volt Min/Max: 4.000/20.000 mA, –/+10.000V, Units: 0.001 mA, 0.001 Volt	091 092
		326	**[Analog In 2 Lo]** Sets the lowest input value to the analog input 2 scaling block. Note: If bit 1 of 320 [Anlg In Config] is set to 1 "Current", you must use this parameter to rescale current.	Default: 0.000 Volt Min/Max: 4.000/20.000 mA, –/+10.000V 0.0/10.0V, Units: 0.001 mA, 0.001 Volt	091 092
		327	**[Analog In 2 Loss]** Selects drive action when an analog signal loss is detected. 1.6V/3.2 mA = Signal Loss 1.9V/3.8 mA = End Signal Loss Option 1 "Fault" stops the drive on signal loss. All other options permit the input signal to return to a usable level while the drive continues to run.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Fault" 2 "Hold Input" 3 "Set Input Lo" 4 "Set Input Hi" 5 "Goto Preset1" 6 "Hold OutFreq"	091 092

ATTENTION: Setting parameter 327 to a value greater than 1 allows the input signal to return to a usable level while the drive is running. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1], and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Important: Signal loss detection does not occur in bipolar voltage mode.

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Analog Outputs	340	**[Anlg Out Config]** (2...6) Selects the mode for the analog outputs.  *Factory Default Bit Values*		
		341	**[Anlg Out Absolut]** Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output.  *Factory Default Bit Values*		342
		342	**[Analog Out1 Sel]** Selects the source of the value that drives the analog output.	Default: 0 "Output Freq" Options: See Table	001 002 003 004 005 007 006 012 135 136 137 138 220 219

Options		[Analog Out1 Lo] Value *Param. 341= Signed*	 *Param. 341 = Absolute*	[Analog Out1 Hi] Value
0	"Output Freq"	–[Maximum Speed]	0 Hz	+[Maximum Speed]
1	"Command Freq"	–[Maximum Speed]	0 Hz	+[Maximum Speed]
2	"Output Amps"	0 Amps	0 Amps	200% Rated
3	"Torque Amps"	–200% Rated	0 Amps	200% Rated
4	"Flux Amps"	0 Amps	0 Amps	200% Rated
5	"Output Power"	0 kW	0 kW	200% Rated
6	"Output Volts"	0 Volts	0 Volts	120% Rated
7	"DC Bus Volts"	0 Volts	0 Volts	200% Rated
8	"PI Reference"	–100%	0%	100%
9	"PI Feedback"	–100%	0%	100%
10	"PI Error"	–100%	0%	100%
11	"PI Output"	–100%	0%	100%
12	"%Motor OL"	0%	0%	100%
13	"%Drive OL"	0%	0%	100%
14	"Post Ramp Ref"	–[Maximum Speed]	0 Hz	+[Maximum Speed]

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values		Related
INPUTS & OUTPUTS	Analog Outputs	343	**[Analog Out1 Hi]** Sets the analog output value when the source value is at maximum.	Default: Min/Max: Units: (1) Frame B, C, D, & E (2) Frame 2, 3, 4, 5, & 6	10.000 Volts(1) 20.000 mA/10.000 Volts(2) 0.00/10.00 Volts(1) 4.000/20.000 mA(2) –/+10.000 Volts(2) 0.01 Volt(1) 0.001 mA(2) 0.001 Volt(2)	340 342
		344	**[Analog Out1 Lo]** Sets the analog output value when the source value is at minimum.	Default: Min/Max: Units: (1) Frame B, C, D, & E (2) Frame 2, 3, 4, 5, & 6	0.00 Volts(1) 0.000 Volts/4.000 mA(2) 0.00/10.00 Volts(1) 4.000/20.000 mA(2) –/+10.000 Volts(2) 0.01 Volt(1) 0.001 mA(2) 0.001 Volt(2)	340 342

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values			Related
INPUTS & OUTPUTS	Digital Inputs	361 362 363 364 365 366	**[Digital In1 Sel]** **[Digital In2 Sel]** **[Digital In3 Sel]** **[Digital In4 Sel]** **[Digital In5 Sel]** **[Digital In6 Sel]**	Default: Default: Default: Default: Default: Default:	7 2 3 1 25 31	"Run" "Clear Faults" "Function Loss" "Enable" "OIM Control" "Purge"	
			Selects the function for the digital inputs. (1) When [Digital Inx Sel] is set to option 2 "Clear Faults" the Stop button cannot be used to clear a fault condition. (2) (3) (4) Typical 3-Wire Inputs - Requires that only 3-wire functions are chosen. Including 2-wire selections will cause a type 2 alarm. (5) Typical 2-Wire Inputs - Requires that only 2-wire functions are chosen. Including 3-wire selections will cause a type 2 alarm.	Options:	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	"Not Used" "Enable" "Clear Faults"(1) "Function Loss" "Stop – CF"(1)(4) "Start" "Fwd/ Reverse"(4) "Run"(5) "Run Forward"(3)(5) "Run Reverse"(3)(5) "Reserved" "Reserved" "Reserved" "Stop Mode B" "Bus Reg Md B" "Speed Sel 1"(2) "Speed Sel 2"(2) "Speed Sel 3"(2) "Auto/Manual" "Reserved" "Acc2 & Dec2" "Accel 2" "Decel 2" "MOP Inc" "MOP Dec" "OIM Control" "PI Enable" "PI Hold" "PI Reset" "Pwr Loss Lvl" "Precharge En" "Purge"	156 162 140 194 380 124

(2)

3	2	1	"Speed Sel 1-3"
0	0	0	Reference A
0	0	1	Preset Speed 1
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Purge Speed

To access Preset Speed 1, set [Speed Ref A Sel] or [Speed Ref B Sel] to "Preset Speed 1".

(3)

3	2	1	"Spd/Trq Sel1-3"
0	0	0	Zero Torque
0	0	1	Spd Reg
0	1	0	Torque Reg
0	1	1	Min Spd/Trq
1	0	0	Max Spd/Trq
1	0	1	Sum Spd/Trq
1	1	0	Absolute
1	1	1	Zero Trq

File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values	Related
INPUTS & OUTPUTS	Digital Inputs	*Cont.* 361 362 363 364 365 366	Option Descriptions Enable If the input is closed, the drive can run (start permissive). If the input is open, the drive will not start. If the drive is already running when this input is opened, the drive will coast and indicate “not enabled” on the OIM (if present). This is not considered a fault condition, and no fault will be generated. If multiple enable inputs are configured, the drive will not run if any of them are open. Clear Faults This function allows an external device to reset drive faults through the terminal block if 089 [Logic Source Sel] is set to 0 “Terminal Blk” or 7 “All Ports”. An open-to-closed transition on this input will reset the current fault (if any). If this input is configured at the same time as 4 “Stop – CF”, then only the 2 “Clear Faults” input can cause faults to be reset. Function Loss If the function loss input is open, a fault is generated. The function loss input is active at all times regardless of the selected logic control source. The function loss input is not intended for a fast output power kill. The drive will not fault until the software detects the change of state of this input. If this input function is not configured, the fault will not occur. Stop – CF (Stop – Clear Faults) An open input will assert a stop command if the terminal block is the control source. While the stop is asserted, the drive ready status will be off. A closed input will allow the drive to start. An open-to-closed transition is interpreted as a clear faults request. The drive will clear any existing faults. If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition. Stop-Clear Faults is optional in all other circumstances. Start An open-to-closed transition generates a run command if the terminal block is the control source. If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition. Fwd/Reverse An open input sets the direction to forward if the terminal block is the control source. A closed input sets the direction to reverse. If the state of the input changes and the drive is running, the drive will change direction. If the Fwd/Rev input function is assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted. Run An open-to-closed transition on this input generates a a run command if the terminal block is the control source. If the input is open, the drive will stop.		

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Digital Inputs	*Cont.* 361 362 363 364 365 366	Run Forward	and Run Reverse. If the terminal block is the control source, an open-to-closed transition on one or both inputs while the drive is stopped will cause the drive to run unless the Stop – CF input function is configured and open. If one or both of these input functions are assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted.	
			Stop Mode B	This digital input selects between two different drive stop modes. If the input is open, then Stop Mode A selects which stop mode to use. If the input is closed, the Stop Mode B selects which stop mode to use. If this input function is not configured, then Stop Mode A selects which stop mode to use.	
			Bus Reg Md B	This digital input function selects how the drive will regulate excess voltage on the DC bus. If the input is open, then Bus Reg Mode A selects which bus regulation mode to use. If the input is closed, then Bus Reg Mode B selects which bus regulation mode to use. If this input function is not configured, then Bus Reg Mode A selects which bus regulation mode to use.	
			Speed Sel 1-3	One, two, or three digital input functions can be used to select the Speed Select input function used by the drive. The open/closed state of all Speed Select input functions combine to select the speed reference. There are seven possible combinations of open/closed states for the three input functions: Speed Ref A Sel, Preset Speed 1-6, and Purge Speed. If the Speed Select input functions select Speed Ref A Sel, then the value of that parameter further selects a reference source. There are a large number of possible selections, including all five presets. If the input functions directly select one of the preset speed parameters, then the parameter contains a frequency that is to be used as the reference. The Speed Select input function configuration process involves assigning the functionality of the three possible Speed Select input functions (Speed Sel 1-3) to physical digital inputs. The table below describes the various reference sources that can be selected using all three of the Speed Select input functions. If any of the three Reference Select input functions are not configured, then the software will still follow the table, but will treat the unconfigured inputs as if they are permanently open.	

3	2	1	"Speed Sel 1-3"
0	0	0	Reference A
0	0	1	Preset Speed 1
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Purge Speed

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Digital Inputs	*Cont.* 361 362 363 364 365 366	Auto/Manual	The Auto/Manual facility is essentially a higher priority reference select. It allows a single control device to assume exclusive control of reference select, irrespective of the reference select digital inputs, reference select DPI commands, the reference mask, and the reference owner. If the “Auto/Manual” input function is closed, then the drive will use one of the analog inputs (defined by [TB Man Ref Sel]) as the reference, ignoring the normal reference selection mechanisms. This mode of reference selection is called “Terminal Block Manual Reference Selection Mode”. If this input function is open, then the terminal block does not request manual control of the reference. If no control device (including the terminal block) is currently requesting manual control of the reference, then the drive will use the normal reference selection mechanisms. This is called “Automatic Reference Selection” mode. The drive arbitrates among manual reference requests from different control devices, including the terminal block.	
			Acc2 & Dec2	A single input function is used to select between Accel Time 1/ Decel Time 1 and Accel Time 2/Decel Time2. If the function is open, the drive will use Accel Time 1 as the acceleration rate and Decel Time 1 as the deceleration rate. If the function is closed, the drive will use Accel Time 2 as the acceleration rate and Decel Time 2 as the deceleration rate.	
			Accel 2, Decel 2	One input function (called Accel 2) selects between Accel Time 1 and Accel Time 2, and another input function (called Decel 2) selects between Decel Time 1 and Decel Time 2. The open state of the function selects Accel Time 1 or Decel Time 1, and the closed state selects Accel Time 2 or Decel Time 2.	
			MOP Inc	and MOP Dec. The MOP is a reference setpoint (called the MOP Value) that can be incremented and decremented by external devices. These inputs are used to increment and decrement the Motor Operated Potentiometer (MOP) value inside the drive. The MOP value will be retained through a power cycle. While the MOP Increment input is closed, the MOP value will increase at rate contained in MOP Rate. Units for rate are Hz per second. While the MOP Decrement input is closed, MOP value will decrease at rate contained in MOP Rate. Units for rate are Hz per second. If both the MOP Increment and MOP Decrement inputs are closed, the MOP value will stay the same. In order for the drive to use the MOP value as the current speed reference, either Speed Ref A Sel must be set to MOP.	

File	Group	No.	Parameter Name and Description See page 3-2 for symbol descriptions	Values	Related
INPUTS & OUTPUTS	Digital Inputs	*Cont.* 361 362 363 364 365 366	OIM Control	This input provides a mean to override the logic control source selection and can be used to override control from any port, including the All Ports selection. An open-to-closed transition of this input sets the control source to the local OIM. If no local OIM is present, the control source is set to the remote OIM. If no OIM is present at all, the drive stops. When control is set to the OIM, the OIM is granted Hand (manual) reference (the Man Ref Preload (193) configuration is enforced). Subsequent Auto/Hand commands will toggle the OIM in and out of Hand (manual) mode. The drive's active or stopped state is not affected unless no OIM is present. On a closed-to-open transition, manual control is released if active, and the selected auto reference is used. The logic source select override is removed. The edge/level-sense start configuration is imposed (LevelSense Start).	
			PI Enable	If this input function is closed, the operation of the Process PI loop will be enabled. If this input function is open, the operation of the Process PI loop will be disabled.	
			PI Hold	If this input function is closed, the integrator for the Process PI loop will be held at the current value; that is, it will not increase. If this input function is open, the integrator for the Process PI loop will be allowed to increase.	
			PI Reset	If this input function is closed, the integrator for the Process PI loop will be reset to 0. If this input function is open, the integrator for the Process PI loop will integrate normally.	
			Pwr Loss Lvl	When the DC bus level in the drive falls below a certain level, a "powerloss" condition is created in the drive logic. This input allows the user to select between two different "power loss" detection levels dynamically. If the physical input is closed, then the drive will take its power loss level from a parameter. If the physical input is open (de-energized), then the drive will use a power loss level designated by internal drive memory, typically 82% of nominal. If the input function is not configured, then the drive always uses the internal power loss level.	
			Precharge En	This input function is used to manage disconnection from a common DC bus. If the physical input is closed, this indicates that the drive is connected to common DC bus and normal precharge handling can occur, and that the drive can run (start permissive). If the physical input is open, this indicates that the drive is disconnected from the common DC bus, and thus the drive should enter the precharge state (precharge relay open) and initiate a coast stop immediately in order to prepare for reconnection to the bus. If this input function is not configured, then the drive assumes that it is always connected to the DC bus, and no special precharge handling will be done.	

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Digital Inputs	*Cont.* 361 362 363 364 365 366	Purge This function provides a means of starting the drive at a preset speed (Purge Speed) regardless of the selected control source. The drive is typically configured for level-sense control (LevelSense Start = Enabled) when using this function. Purge supersedes the OIM Control function as well as any other control command to take control of the drive. Purge can occur, and is operational, at any time whether the drive is running or stopped regardless of the selected logic source selection. Note that if any start inhibit condition is present, the drive will not start on the purge input transition. Type 2 Alarms Some digital input programming may cause conflicts that result in a Type 2 alarm. Type 2 alarm prevent the drive from starting. For example 361 [Digital In1 Sel] set to option 5 “Start” in 3-wire control and 362 [Digital In2 Sel] set to option 7 “Run” in 2-wire control. Refer to Chapter 4 for more information on alarms.		
	Digital Outputs	380 384	**[Digital Out1 Sel]** **[Digital Out2 Sel]** Selects the drive status that will energize a (CRx) output relay. (1) Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed. Refer to page 1-25. (2) Activation level is defined in [Dig Outx Level] below.	Default: 1 “Fault” 4 “Run” Options: 1 “Fault”(1) 2 “Alarm”(1) 3 “Ready” 4 “Run” 5 “Forward Run” 6 “Reverse Run” 7 “Auto Restart” 8 “Reserved” 9 “At Speed” 10 “At Freq”(2) 11 “At Current”(2) 12 “At Torque”(2) 13 “At Temp”(2) 14 “At Bus Volts”(2) 15 “At PI Error”(2) 16 “DC Braking” 17 “Curr Limit” 18 “Economize” 19 “Motor OverId” 20 “Power Loss” 21 “Input 1 Link” 22 “Input 2 Link” 23 “Input 3 Link” 24 “Input 4 Link” 25 “Input 5 Link” 26 “Input 6 Link” 27 “TB in Manual”	381 385 382 383 002 001 003 004 218 012 137 157 147 053 048 184

File	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS	Digital Outputs	*Cont.* 380 384	Option Descriptions Fault — A fault has occurred and stopped the drive. Alarm — A Type 1 or Type 2 alarm condition exists. Ready — Drive is powered, enabled, and no start inhibits exist. Run — Outputting voltage and frequency to motor (indicates 3-wire control, either direction). Forward Run — Outputting voltage and frequency to motor (indicates 2-wire control in forward). Reverse Run — Outputting voltage and frequency to motor (indicates 2-wire control in reverse). Auto Restart — Executing an “Auto Restart” or “Run at Power Up”. At Speed — Commanded speed equals or exceeds programmed limit. At Freq — Output frequency equals or exceeds programmed limit. At Current — Total output current exceeds programmed limit. At Torque — Output torque current component exceeds programmed limit. At Temp — Operating temperature exceeds programmed limit. At Bus Volts — Bus voltage exceeds programmed limit. At PI Error — Process PI Loop error exceeds programmed limit. DC Braking — Executing a “DC Brake” or “Ramp to Hold” and DC braking voltage is being applied to motor. Curr Limit — Drive is limiting output current. Economize — Drive is eliminating excess output voltage. Motor OverId — Drive is eliminating excess output voltage. Power Loss — Detected loss of AC input power that caused DC bus voltage to fall below fixed limit. Input x Link — Digital input value outputting on [Dig Outx Level]. TB in Manual — Terminal block has manual reference control.		
		381 385	**[Dig Out1 Level]** **[Dig Out2 Level]** Sets the relay activation level for options 10 – 15 in [Digital Outx Sel]. Units are assumed to match the above selection (i.e. “At Freq” = Hz, “At Torque” = Amps).	Default: 0.0 0.0 Min/Max: 0.0/819.2 Units: 0.1	380
		382 386	**[Dig Out1 OnTime]** **[Dig Out2 OnTime]** Sets the “ON Delay” time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.	Default: 0.00 Secs 0.00 Secs Min/Max: 0.00/600.00 Secs Units: 0.01 Secs	380
		383 387	**[Dig Out1 OffTime]** **[Dig Out2 OffTime]** Sets the “OFF Delay” time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.	Default: 0.00 Secs 0.00 Secs Min/Max: 0.00/600.00 Secs Units: 0.01 Secs	380

Parameter Cross Reference – by Name

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Notes:

Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the VTAC 9. Included is a listing and description of drive faults (with possible solutions, when applicable) and alarms.

Drive Faults

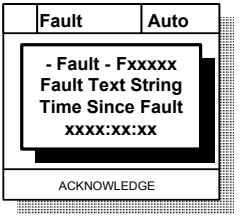
A fault is a condition that stops the drive. There are three fault types.

Type	Fault Description	
①	Auto-Reset Run	When this type of fault occurs, and [Auto Rstrt Tries] (see page 3-37) is set to a value greater than "0," a user-configurable timer, [Auto Rstrt Delay] (see page 3-38) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resettable	This type of fault normally requires drive or motor repair. The cause of the fault must be corrected before the fault can be cleared. The fault will be reset on power up after repair.
③	User Configurable	These faults can be enabled/disabled to annunciate or ignore a fault condition.

The drive indicates faults in the following ways:

- Ready LED on the drive cover.
- Parameters 209 [Drive Status 1] and 210 [Drive Status 2].
- Fault queue entries.
- Pop-up screen on the LCD OIM. The screen displays:
  - Fault number
  - Fault name
  - Time that has elapsed since fault occurred.

Figure 4.1 Sample Fault Screen on the LCD OIM



Press any F Key to Acknowledge the Fault

The fault screen is displayed until it is acknowledged by pressing any F-key or cleared in the drive by other means.

Fault Queue

The drive automatically retains a history of faults that have occurred in the fault queue. The fault queue is accessed using the OIM or PC software.

The fault queue holds the most recent faults. Frames B, C, D, & E hold four faults and Frames 2, 3, 4, 5, & 6 hold eight faults. The last fault to occur is indicated in queue entry #1. As new faults are logged into the queue, existing fault entries are shifted (for example, entry #1 will move to entry #2). Once the queue is full, older faults are discarded from the queue as new faults occur.

All entries in the fault queue are retained if power is lost.

The Time Stamp

For each entry in the fault queue, the system also displays a fault code and time stamp value. The time stamp value is the value of an internal drive-under-power timer at the time of the fault. The value of this timer is copied to 242 [PowerUp Marker] when the drive powers up. The fault queue time stamp can then be compared to the value in [PowerUp Marker] to determine when the fault occurred relative to the last drive power up.

The time stamp is cleared when the fault queue is cleared.

Refer to page 4-16 for information on accessing the fault queue using the LCD OIM.

Manually Clearing Faults

A fault condition can be cleared by the following:

Step 1. Press ESC/PROG or any F-Key to acknowledge the fault and remove the fault pop-up from the LCD OIM screen.

Step 2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.

Step 3. After corrective action has been taken, clear the fault using one of the following:

- Set parameter 240 [Fault Clear] to 1 “Clear Faults”.
- Press F1 (Cflt) from the fault queue screen.
- Issue a Stop – CF command from the control source.

Resetting faults will clear the faulted status indication. If any fault condition still exists, the fault will be latched, and another entry made in the fault queue.

Note that performing a fault reset does not clear the fault queue. Clearing the fault queue is a separate action. See parameter 240 [Fault Clear].

Fault Descriptions

Table 4.A Fault Types, Descriptions and ActionsActions

Fault	No.	Type(1)	Description	Action
Analog In Loss	29	① ③	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with [Anlg In 1, 2 Loss] on page 3-55.	1. Check parameters. 2. Check for broken/loose connections at inputs.
Anlg Cal Chksum	108	②	The checksum read from the analog calibration data does not match the checksum calculated.	Replace drive.
Auto Rstrt Tries	33	③	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of [Flt RstRun Tries]. Enable/Disable with [Fault Config 1] on page 3-50.	Correct the cause of the fault and manually clear.
AutoTune Aborted	80		Autotune function was canceled by the user or a fault occurred.	Restart procedure.
DB Resistance	69		Resistance of the internal DB resistor is out of range.	Replace resistor.

Fault	No.	Type(1)	Description	Action
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time.
Drive OverLoad	64		Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
Excessive Load	79		Motor did not come up to speed in the allotted time during autotune.	1. Uncouple load from motor. 2. Repeat Autotune.
FluxAmpsRef Rang	78		The value for flux amps determined by the Autotune procedure exceeds the programmed [Motor NP FLA].	1. Reprogram [Motor NP FLA] with the correct motor nameplate value. 2. Repeat Autotune.
Function Loss	2		Function loss input is open.	Check remote wiring.
Ground Fault	13	①	A current path to earth ground greater than 25% of drive rating.	Check the motor and external wiring to the drive output terminals for a grounded condition.
Heatsink OvrTemp	8	①	Heatsink temperature exceeds 100% of [Drive Temp].	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excess load.
HW OverCurrent	12	①	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
Incompat MCB-PB	106	②	Drive rating information stored on the power board is incompatible with the main control board.	Load compatible version files into drive.
I/O Comm Loss	121		I/O Board lost communications with the Main Control Board.	Check connector. Check for induced noise. Replace I/O board or Main Control Board.
I/O Board Fail	122		Board failure.	Cycle power. If fault repeats, replace I/O board.
I/O Mismatch	120		Incorrect I/O board identified.	Restore I/O board to original configuration, or if new configuration is desired, reset fault.
IR Volts Range	77		"Calculate" is the autotune default and the value determined by the autotune procedure for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
Motor OverLoad	7	① ③	Internal electronic overload trip. Enable/Disable with [Fault Config 1] on page 3-50.	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by [Motor NP FLA].

Fault	No.	Type[1]	Description	Action
Overspeed Limit	25	①	Functions such as Slip Compensation or Bus Regulation have attempted to add an output frequency adjustment greater than that programmed in [Overspeed Limit].	Remove excessive load or overhauling conditions or increase [Overspeed Limit].
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
Parameter Chksum	100	②	The checksum read from the board does not match the checksum calculated.	1. Restore defaults. 2. Reload User Set if used.
Params Defaulted	48		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
Phase Imbalance	37		Phase current displayed in Imbalance Display (221) > percentage set in Imbalance Limit (49) for time set in Imbalance Time (50).	Clear fault.
Phase U to Grnd	38		A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive.
Phase V to Grnd	39			
Phase W to Grnd	40			
Phase UV Short	41		Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive.
Phase VW Short	42			
Phase UW Short	43			
Port 1-6 DPI Loss	81-86		DPI port stopped communicating. A SCANport device was connected to a drive operating DPI devices at 500k baud.	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters, Main Control Board or complete drive as required. 2. Check HIM connection. 3. If an adapter was intentionally disconnected and the [Logic Mask] bit for that adapter is set to “1”, this fault will occur. To disable this fault, set the [Logic Mask] bit for the adapter to “0.”
Port 1-6 Net Loss	71-76		The communications card has a fault.	Check DPI device event queue and corresponding fault information for the device.

Fault	No.	Type[1]	Description	Action
Power Loss	3	① ③	DC bus voltage remained below 85% of nominal for longer than [Power Loss Time]. Enable/ Disable with [Fault Config 1] on page 3-50.	Monitor the incoming AC line for low voltage or line power interruption.
Power Unit	70		One or more of the output transistors were operating in the active region instead of desaturation. This can be caused by excessive transistor current or insufficient base drive voltage.	1. Check for damaged output transistors. 2. Replace drive.
Pwr Brd Chksum1	104		The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.	Clear the fault or cycle power to the drive.
Pwr Brd Chksum2	105	②	The checksum read from the board does not match the checksum calculated.	1. Cycle power to the drive. 2. If problem persists, replace drive.
Replaced MCB-PB	107	②	Main Control Board was replaced and parameters were not programmed.	1. Restore defaults. 2. Reprogram parameters.
Shear Pin	63	③	Programmed [Current Lmt Val] has been exceeded. Enable/ Disable with [Fault Config 1] on page 3-50.	Check load requirements and [Current Lmt Val] setting.
SW OverCurrent	36	①	Drive output current has exceeded the 1ms current rating. This rating is greater than the 3 second current rating and less than the hardware overcurrent fault level. It is typically 200-250% of the drive continuous rating.	Check for excess load, improper DC boost setting. DC brake volts set too high.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excessive load.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 509V DC at 600V input, 407V DC at 400/ 480V input or 204V DC at 200/ 240V input. Enable/Disable with [Fault Config 1] on page 3-50.	Monitor the incoming AC line for low voltage or power interruption.
UserSet1 Chksum	101	②	The checksum read from the user set does not match the checksum calculated.	Re-save user set.
UserSet2 Chksum	102	②		
UserSet3 Chksum	103	②		

(1) See page 4-2 for a description of fault types.

Table 4.B Fault Cross Reference

No.(1)	Fault
2	Function Loss
3	Power Loss
4	UnderVoltage
5	OverVoltage
7	Motor Overload
8	Heatsink OvrTemp
9	Trnsistr OvrTemp
12	HW OverCurrent
13	Ground Fault
24	Decel Inhibit
25	OverSpeed Limit
29	Analog In Loss
33	Auto Rstrt Tries
36	SW OverCurrent
37	Phase Imbalance

No.(1)	Fault
38	Phase U to Grnd
39	Phase V to Grnd
40	Phase W to Grnd
41	Phase UV Short
42	Phase UW Short
43	Phase VW Short
48	Params Defaulted
63	Shear Pin
64	Drive Overload
69	DB Resistance
70	Power Unit
71-76	Port 1-6 Net Loss
77	IR Volts Range
78	FluxAmpsRef Rang
79	Excessive Load

No.(1)	Fault
80	AutoTune Aborted
81-86	Port 1-6 DPI Loss
100	Parameter Chksum
101	UserSet1 Chksum
102	UserSet2 Chksum
103	UserSet3 Chksum
104	Pwr Brd Chksum1
105	Pwr Brd Chksum2
106	Incompat MCB-PB
107	Replaced MCB-PB
108	Anlg Cal Chksum
120	I/O Board Mismatch
121	I/O Comm Loss
122	I/O Board Fail

(1) Fault numbers not listed are reserved for future use.

Drive Alarms

An alarm is a condition that, if left untreated, may stop the drive. There are two alarm types.

Type	Alarm Description	
①	User Configurable	These alarms can be enabled or disabled by 259 [Alarm Config 1]. The status of these alarms is shown in 211 [Drive Alarm 1].
②	Non-Configurable	These alarms are always enabled. The status of these alarms is shown in 212 [Drive Alarm 2].

The drive indicates alarm conditions in the following ways:

- Ready LED on the drive cover (see Status Indicators on page 2-3).
- Alarm name and bell graphic on the LCD OIM (see Appendix B). The alarm is displayed as long as the condition exists. The drive automatically clears the alarm when the condition causing it is removed.
- Status parameters 211 [Drive Alarm 1] and 212 [Drive Alarm 2] indicate the status of type 1 and type 2 alarms, respectively. Refer to Chapter 3 for the parameter descriptions.

Alarm Queue

Important: This information applies only to drive Frames 2, 3, 4, 5, & 6.

The drive automatically retains a history of alarms that have occurred in the alarm queue. The alarm queue is accessed using the OIM or PC software.

The alarm queue holds the eight most recent alarms. The last alarm to occur is indicated in queue entry #1. As new alarms are logged into the queue, existing alarm entries are shifted (for example, entry #1 will move to entry #2). Once the queue is full, older alarms are discarded from the queue as new alarms occur.

All entries in the alarm queue are retained if power is lost. Alarms are automatically cleared when the alarm condition goes away.

Clearing Alarms

The alarm queue can be cleared using the OIM by selecting “Clr Alarm Queue”, or by using a PC software tool.

Alarms are automatically cleared when the condition that caused the alarm is no longer present.

Alarm Descriptions

Table 4.C Alarm Descriptions and Actions

Alarm	No.	Type(1)	Description
Analog in Loss	5	①	An analog input is configured for “Alarm” on signal loss and signal loss has occurred.
Bipolar Conflict	20	②	Parameter 190 [Direction Mode] is set to “Bipolar” or “Reverse Dis” and one or more of the following digital input functions is configured: “Fwd/Reverse”, “Run Forward” or “Run Reverse”.
Decel Inhibit	10	①	Drive is being inhibited from decelerating.
Dig In ConflictA	17	②	Digital input functions are in conflict. Combinations marked with a “ ” will cause an alarm.
Dig In ConflictB	18	②	A digital Start input has been configured without a Stop input or other functions are in conflict. Combinations that conflict are marked with a “ ” and will cause an alarm.
Dig In ConflictC	19	②	More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions.
Drive OL Level 1	8	①	The calculated IGBT temperature requires a reduction in PWM frequency. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.
Drive OL Level 2	9	①	The calculated IGBT temperature requires a reduction in Current Limit. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.
FluxAmpsRef Rang	26	②	The calculated or measured Flux Amps value is not within the expected range. Verify motor data and rerun motor tests.
IntDBRes OvrHeat	6	①	The drive has temporarily disabled the DB regulator because the resistor temperature has exceeded a predetermined value.

Dig In ConflictA

	Acc2/Dec2	Accel 2	Decel 2	Fwd/Rev
Acc2 / Dec2		■	■	
Accel 2	■			
Decel 2	■			
Fwd / Rev				

Dig In ConflictB

	Start	Stop–CF	Run	Run Fwd	Run Rev	Fwd/ Rev
Start			■	■	■	
Stop–CF						
Run	■			■	■	
Run Fwd	■		■			■
Run Rev	■		■			■
Fwd / Rev				■	■	

Dig In ConflictC

Forward/Reverse	Run	Bus Regulation Mode B
Speed Select 1	Stop Mode B	Acc2 / Dec2
Speed Select 2	OIM Control	Accel 2
Speed Select 3	Purge	Decel 2
Run Forward	Stop Mode B	

Alarm	No.	Type(1)	Description
IR Volts Range	25	②	The drive auto tuning default is “Calculate” and the value calculated for IR Drop Volts is not in the range of acceptable values. This alarm should clear when all motor nameplate data is properly entered.
Ixo Vlt Rang	28	②	Motor leakage inductance is out of range.
MaxFreq Conflict	23	②	The sum of [Maximum Speed] and [Overspeed Limit] exceeds [Maximum Freq]. Raise [Maximum Freq] or lower [Maximum Speed] and/or [Overspeed Limit] so that the sum is less than or equal to [Maximum Freq].
Motor Type Cflct	21	②	Parameter 040 [Motor Type] has been set to 1 “Synchr Reluc” or 2 “Synchr PM” and one or more DC functions (for example DC Boost, DC Brake, etc.) have been activated. DC injection functions are incompatible with synchronous motors and may demagnetize them.
NP Hz Conflict	22	②	Fan/pump mode is selected in [Torq Perf Mode] and the ratio of [Motor NP Hertz] to [Maximum Freq] is greater than 26.
Power Loss	3	①	Drive has sensed a power line loss.
Prechrg Actv	1	①	Drive is in the initial DC bus precharge state.
Sleep Config	29	②	Sleep/Wake configuration error. With [Sleep-Wake Mode] = “Direct,” possible causes include: drive is stopped and [Wake Level] < [Sleep Level]. “Stop=CF,” “Run,” “Run Forward,” or “Run Reverse.” is not configured in [Digital Inx Sel].
Speed Ref Cflct	27	②	[Speed Ref x Sel] or [PI Reference Sel] is set to “Reserved”.
UnderVoltage	2	①	The bus voltage has dropped below a predetermined value.
VHz Neg Slope	24	②	[Torq Perf Mode] = “Custom V/Hz” and the V/Hz slope is negative.
Waking	11	①	The Wake timer is counting toward a value that will start the drive.

(1) See page 4-2 for a description of alarm types.

Table 4.D Alarm Cross Reference

No.(1)	Alarm
1	Prechrg Actv
2	UnderVoltage
3	Power Loss
5	Analog in Loss
6	IntDBRes OvrHeat
8	Drive OL Level 1
9	Drive OL Level 2

No.(1)	Alarm
10	Decel Inhibit
11	Waking
17	Dig In ConflictA
18	Dig In ConflictB
19	Dig In ConflictC
20	Bipolar Conflict
21	Motor Type Cflct

No.(1)	Alarm
22	NP Hz Conflict
23	MaxFreq Conflict
24	VHz Neg Slope
25	IR Volts Range
26	FluxAmpsRef Rang
27	Speed Ref Cflct
28	Ixo Vlt Rang
29	Sleep Config

(1) Alarm numbers not listed are reserved for future use.

Diagnostic Parameters

The diagnostic parameters listed in Table 4.E are not accessible using the OIM. These parameters can only be accessed by using a PC software tool. Access Device Properties then the Diagnostic tab.

Table 4.E Diagnostic Parameter Names

Diagnostic Parameter	Name
1	DPI Error Status
2	Heatsink Temperature
3	Active Current Limit
4	Active PWM Frequency
5	Lifetime MegaWatt Hours(1)
6	Lifetime Run Time
7	Lifetime Powered Up Time
8	Lifetime Power Cycles
9	Life MegaWatt Hours Fraction(1)
10	Life MegaWatt Hours Fraction Units(1)
11-99	Reserved for Factory Use

(1) Use the equation below to calculate total Lifetime MegaWatt Hours.

$$\left(\frac{\text{Value of Code 9}}{\text{Value of Code 10}} \times 0.1\right) + \text{Value of Code 5} = \text{Total Lifetime MegaWatt Hours}$$

Common Symptoms and Corrective Actions

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is faulted.	Flashing red Ready LED	Clear fault. • Press Stop • Cycle power • Set [Fault Clear] to 1 (See page 3-50) • "Clear Faults" on the OIM Diagnostic menu
Incorrect input wiring. See page 1-25 for wiring examples. • 2 wire control requires Run, Run Forward or Run Reverse. • 3 wire control requires Start and Stop inputs • Jumper from terminal 7 to 8 is required.	None	Wire inputs correctly and/or install jumper.
Incorrect digital input programming. • Mutually exclusive choices have been made. • 2 wire and 3 wire programming may be conflicting. • Exclusive functions (i.e, direction control) may have multiple inputs configured. • Stop is factory default and is not wired.	None	Program [Digital Inx Sel] for correct inputs. (See page 3-59) Start or Run programming may be missing.
	Flashing yellow Ready LED and "DigIn CflctB" indication on LCD OIM. [Drive Status 2] shows type 2 alarm(s).	Program [Digital Inx Sel] to resolve conflicts. (See page 3-59) Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Drive does not Start from OIM.

Cause(s)	Indication	Corrective Action
Drive is programmed for 2 wire control. OIM Start button is disabled for 2 wire control.	None	If 2 wire control is required, no action is necessary. If 3 wire control is required, program [Digital Inx Sel] for correct inputs. (See page 3-59)
Active fault.	Flashing or steady red Ready LED	Reset fault.
Enable input is open.	Flashing yellow Ready LED.	Close terminal block enable input.
Terminal block stop input is open and control source is set to All Ports.		Close terminal block stop input.
Start inhibit bits are set.		Check status in 214 [Start Inhibits].
Parameter 089 [Logic Source Sel] is not set to the desired OIM (Local OIM, DPI Port 2, or DPI Port 3).	209 [Drive Status 1] indicates logic control source.	Verify setting of 089 [Logic Source Sel]. The OIM Control digital input effectively sets the control source to the lowest attached OIM port.

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	LCD OIM Status Line indicates “At Speed” and output is 0 Hz.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check [Commanded Freq] for correct source. (Param #002, page 3-11)
Incorrect reference source has been programmed.	None	3. Check [Speed Ref Source] for the source of the speed reference. (Param #213, page 3-46) 4. Reprogram [Speed Ref A Sel] for correct source. (Param #090, page 3-22)
Incorrect Reference source is being selected via remote device or digital inputs.	None	5. Check [Drive Status 1], bits 12 and 13 for unexpected source selections. (Param #209, page 3-44) 6. Check [Dig In Status] to see if inputs are selecting an alternate source. (Param #216, page 3-47) 7. Reprogram digital inputs to correct “Speed Sel x” option. (See page 3-59)

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram [Accel Time x]. (See page 3-30)
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Check [Drive Status 2], bit 10 to see if the drive is in Current Limit. (See page 3-45) Remove excess load or reprogram [Accel Time x]. (See page 3-30)
Speed command source or value is not as expected.	None	Check for the proper Speed Command using Steps 1 through 7 above.
Programming is preventing the drive output from exceeding limiting values.	None	Check [Maximum Speed] (Param #082, page 3-19) and [Maximum Freq] (Param #055, page 3-16) to assure that speed is not limited by programming.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered or Autotune was not performed.	None	1. Correctly enter motor nameplate data. 2. Perform “Static” or “Rotate” Autotune procedure. (Param #061, page 3-17)

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel] (See page 3-59). Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-24)
Direction mode parameter is incorrectly programmed.	None	Reprogram [Direction Mode] for analog "Bipolar" or digital "Unipolar" control. (Param #190, page 3-41)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
A bipolar analog speed command input is incorrectly wired or signal is absent.	None	1. Use meter to check that an analog input voltage is present. 2. Check wiring. (See page 1-25) Positive voltage commands forward direction. Negative voltage commands reverse direction.

Stopping the drive results in a Decel Inhibit fault.

Cause(s)	Indication	Corrective Action
The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	Decel Inhibit fault screen. LCD Status Line indicates "Faulted".	1. See Attention statement on Preface-3. 2. Reprogram bus regulation (parameters 161 and 162) to eliminate any "Adjust Freq" selection. 3. Disable bus regulation (parameters 161 and 162) and add a dynamic brake. 4. Correct AC input line instability or add an isolation transformer. 5. Reset drive.

Troubleshooting Using the LCD OIM

The LCD OIM provides immediate visual notification of alarm or fault conditions as well as the following diagnostic information:

- Entries in the fault queue
- Fault parameters
- Drive status parameters
- Selected device version and status information
- OIM version information

Accessing the Fault Queue

As described on page 4-3, the drive automatically retains a history of the last four faults (eight in Frame 2, 3, 4, 5, & 6 Drives) that have occurred in the fault queue.

To access the fault queue, press the F4 key at the process display screen, or see Figure 4.2 to access the fault queue from the Main Menu.

Figure 4.2 Accessing the Fault Queue

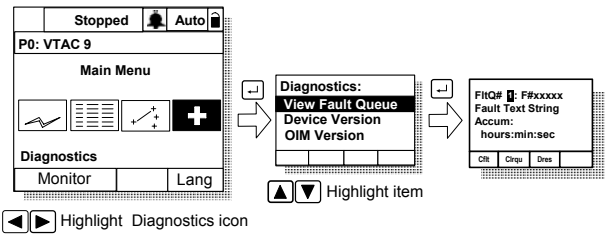
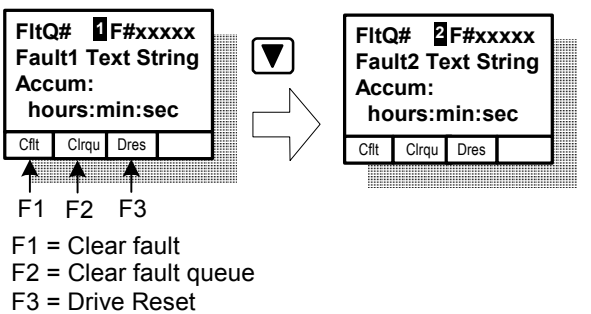


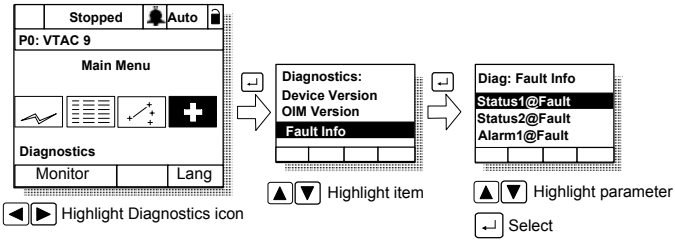
Figure 4.3 Sample Fault Queue Entry



Accessing the Fault Parameters

The LCD OIM provides quick access to the drive's fault parameters by grouping them in the Fault Info submenu. To access these parameters, see Figure 4.4.

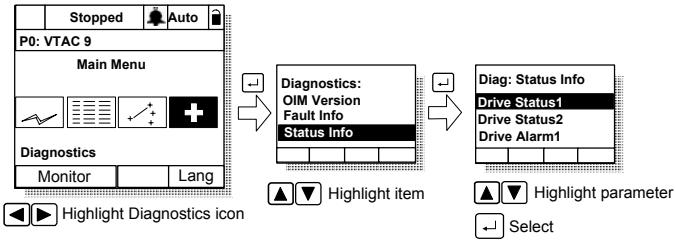
Figure 4.4 Accessing the Fault Parameters



Accessing the Drive Status Parameters

The LCD OIM provides quick access to the drive status parameters by grouping them in the Status Info submenu. To access these parameters, see Figure 4.5.

Figure 4.5 Accessing the Drive Status Parameters



Determining the Product Version

The LCD OIM provides hardware and firmware version information for connected devices, including the OIM, down to the component level.

Device Version

To access the device version information, refer to Figure 4.6 and Figure 4.7.

Figure 4.6 Accessing the Device Version Information

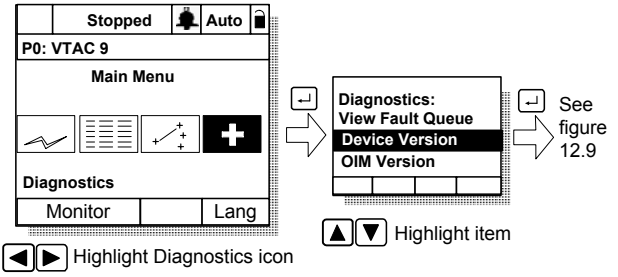
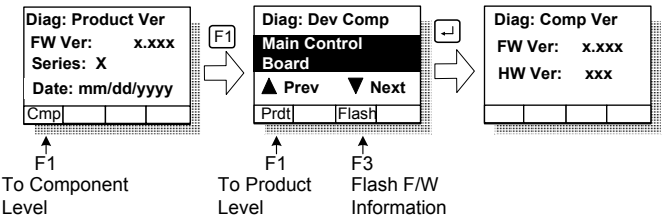


Figure 4.7 Device Version Screens at Product and Component Levels



OIM Version

The OIM Version selection provides information on the OIM you are using to access this data. See Figure 4.8 and Figure 4.9.

Figure 4.8 Accessing the OIM Version Information

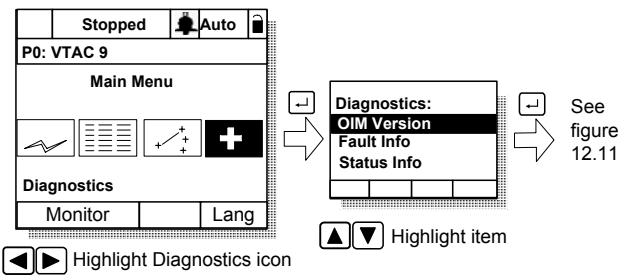
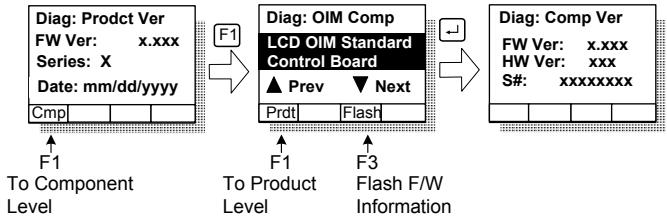


Figure 4.9 OIM Version Screens at the Product and Component Levels

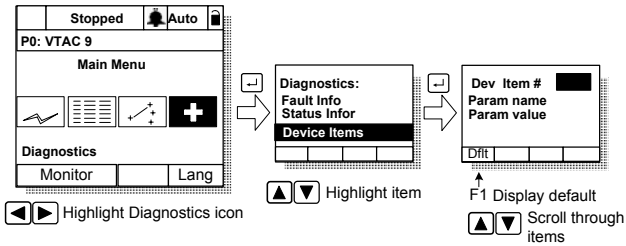


Device Items

The Device Items selection provides access to a list of diagnostic parameters. These parameters should be adjusted by qualified personnel only. See Figure 4.10.

ATTENTION: The parameters in the Device Items menu must be set by a qualified person who understands the significance of setting them accurately. Failure to observe this precaution could result in bodily injury.

Figure 4.10 Accessing the Device Item Information



Notes:

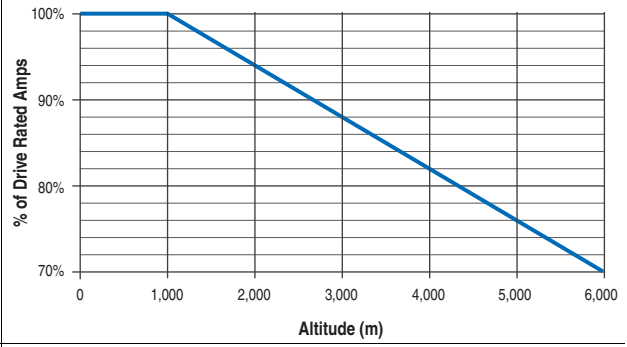
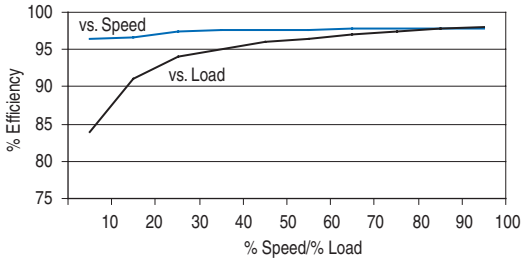
Supplemental Drive Information

Specifications

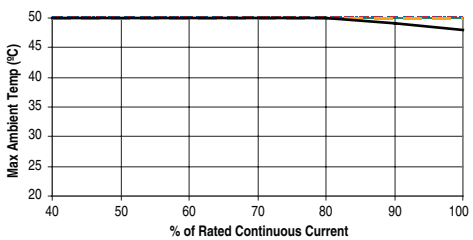
Category	Specification			
Protection	**Drive**	**208V**	**480V**	
	AC Input Overvoltage Trip:	247VAC	570VAC	
	AC Input Undervoltage Trip:	120VAC	280VAC	
	Bus Overvoltage Trip:	405VDC	810VDC	
	Bus Undervoltage Output Shutoff:	300VDC	407V DC	
	Bus Undervoltage Fault Level:	160VDC	300VDC	
	Nominal Bus Voltage:	281VDC	648VDC	
	All Drives			
	Heat Sink Thermistor:	Monitored by microprocessor overtemp trip		
	Drive Overcurrent Trip Software Current Limit: Hardware Current Limit: Instantaneous Current Limit:	 20-160% of rated current 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)		
	Line transients:	up to 6000 volts peak per IEEE C62.41-1991		
	Control Logic Noise Immunity:	Showering arc transients up to 1500V peak		
	Power Ride-Thru:	15 milliseconds at full load		
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical		
	Ground Fault Trip:	Phase-to-ground on drive output		
	Short Circuit Trip:	Phase-to-phase on drive output		
Environment	Altitude:	1000 m (3300 ft) max. without derating		
	Maximum Surrounding Air Temperature without derating IP30, NEMA Type 1:	 0 to 50 degrees C (32 to 122 degrees F), typical. See pages A-22 through A-25 for exceptions.		
	Storage Temperature (all const.):	–40 to 70 degrees C (–40 to 158 degrees F)		
	Atmosphere	**Important:** Drive **must** **not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.		
	Relative Humidity:	5 to 95% non-condensing		
	Shock:	15G peak for 11ms duration (±1.0 ms)		
	Vibration:	0.152 mm (0.006 in.) displacement, 1G peak		

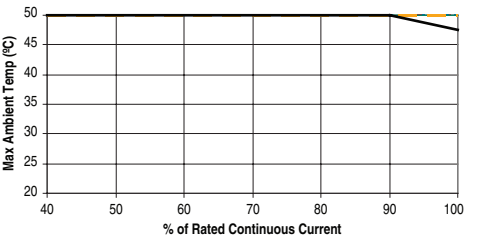
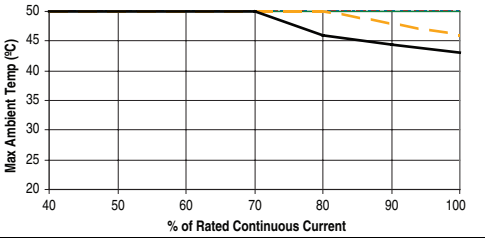
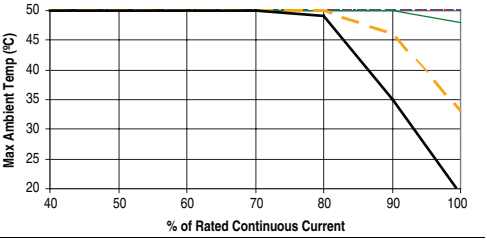
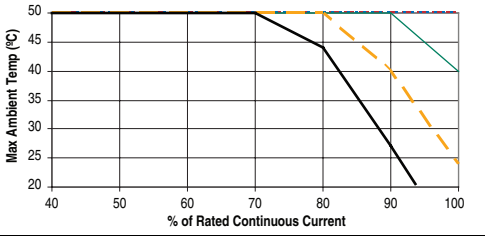
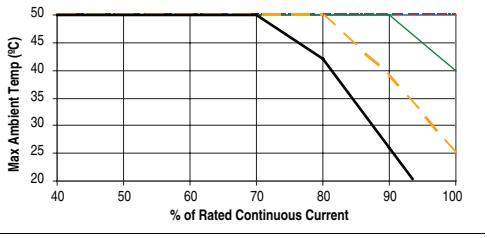
Category	Specification	
Agency Certification	c UL us	Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
	The drive is also designed to meet the appropriate portions of the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code.	
Electrical	Voltage Tolerance:	–10% of minimum, +10% of maximum.
	Frequency Tolerance:	47-63 Hz.
	Input Phases:	Three-phase input provides full rating for all drives. Single-phase operation provides 50% of rated current.
	Displacement Power Factor:	0.98 across speed range.
	Efficiency:	97.5% at rated amps, nominal line volts.
	Maximum Short Circuit Rating:	200,000 Amps symmetrical.
	Actual Short Circuit Rating:	Determined by AIC rating of installed fuse/circuit breaker.
Control	Method:	Sine coded PWM with programmable carrier frequency. Ratings apply to all drives.
	Carrier Frequency:	2…10 kHz. Drive rating based on 4 kHz.
	Output Voltage Range:	0 to rated motor voltage
	Output Frequency Range:	0 to 400 Hz.
	Frequency Accuracy Digital Input: Analog Input:	 Within ±0.01% of set output frequency. Within ±0.4% of maximum output frequency.
	Speed Regulation - Open Loop with Slip Compensation:	±0.5% of base speed across a 40:1 speed range.
	Selectable Motor Control:	Sensorless Vector with full tuning. Standard V/Hz with full custom capability.
	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
	Accel/Decel:	Two independently programmable accel & decel times. Each time may be programmed from 0-3600 seconds in 0.1 sec. increments
	Intermittent Overload:	110% Overload capability for up to 1 minute 150% Overload capability for up to 3 seconds
	Current Limit Capability:	Proactive Current Limit programmable from 20 to 160% of rated output current. Independently programmable proportional and integral gain.
	Electronic Motor Overload Protection:	Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.

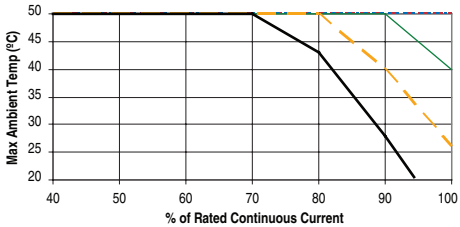
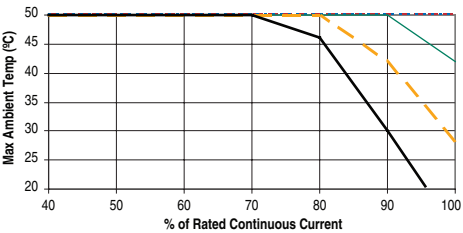
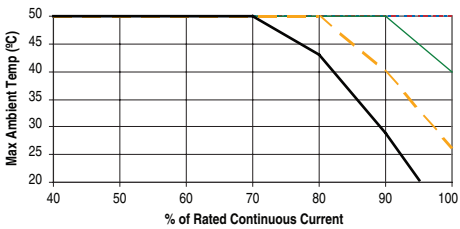
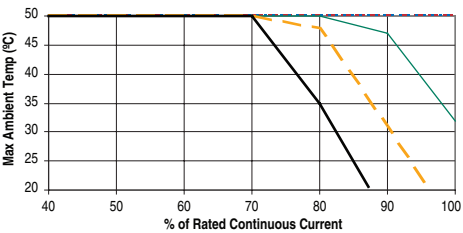
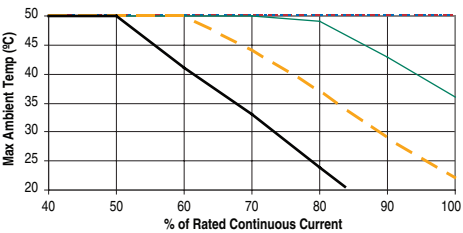
Altitude and Efficiency

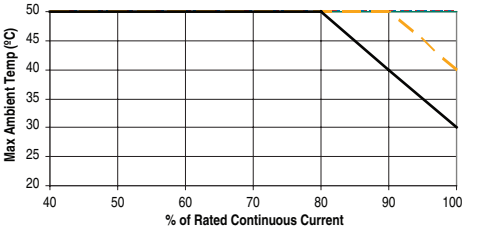
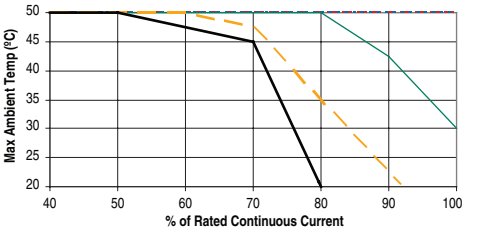
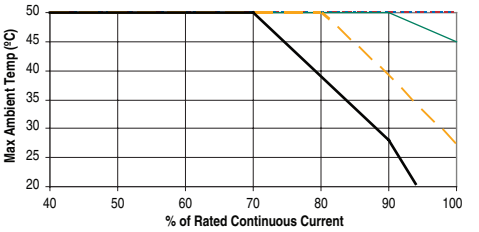
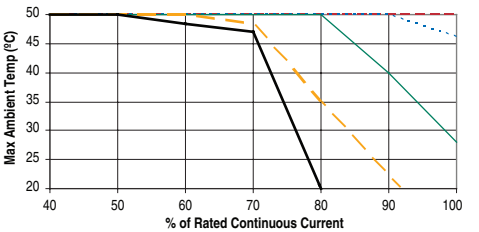
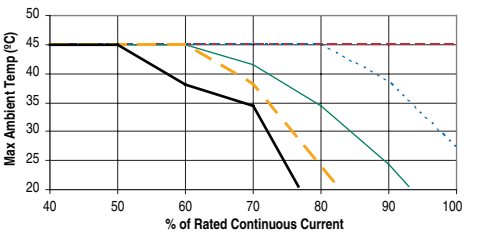
Frame	Type	Derate
All	Altitude	
	Efficiency (typical)	

Ambient Temperature/Load

VTAC 9 Power Rating		Derating
HP	Frame	2 kHz 4 kHz 6 kHz 8 kHz 10 kHz
480 Volt		
0.5 - 7.5	B/C	None
10	C	

VTAC 9 Power Rating		Derating
HP	Frame	2 kHz 4 kHz 6 kHz 8 kHz 10 kHz
480 Volt		
15	D	
20	D	
25	D	
25	2	
30	D	
30	3	None

VTAC 9 Power Rating		Derating
HP	Frame	2 kHz 4 kHz 6 kHz 8 kHz 10 kHz
480 Volt		
40	E	
40	3	
50	E	
50	3	
60	4	

VTAC 9 Power Rating		Derating
HP	Frame	2 kHz 4 kHz 6 kHz 8 kHz 10 kHz
480 Volt		
75	5	
100	5	
125	6	
150	6	
200	6	

Watts Loss (Rated Load, Speed & PWM)(1)

Voltage	Frame	ND HP	External Watts	Internal Watts	Total Watts Loss
208V	B	2.0	44.6	22.6	67.2
		3.0	67.3	25.4	92.7
	C	5.0	141.3	33.2	174.5
	D	7.5	205.7	34.2	239.9
		10	270.4	48.1	318.5
		15	385.6	40.3	425.9
	E	20	494.6	44.9	539.5
		25	650.7	51.6	702.3
	4	30	780	96	876
	5	40	860	107	967
		50	1132	138	1270
	6	60	1296	200	1496
		75	1716	277	1993
		100	1837	418	2255
480V	B	3.0	64.6	24.0	88.6
		5.0	99.5	28.2	127.7
	C	7.5	140.0	27.8	167.8
		10	193.3	32.0	225.3
	D	15	305.4	34.2	339.6
		20	432.9	42.9	475.8
		25	363.8	40.5	404.3
		30	396.8	41.5	438.3
	2	25	339	102	441
	3	30	357	103	459
	E	40	500.8	50.0	550.8
		50	632.0	57.7	689.7
	3	40	492	117	610
		50	568	148	717
	4	60	722	207	930
	5	75	821	286	1107
		100	1130	397	1527
	6	125	1402	443	1845
		150	1711	493	2204
		200	1930	583	2513

(1) Worst case condition including OIM and Communication Module

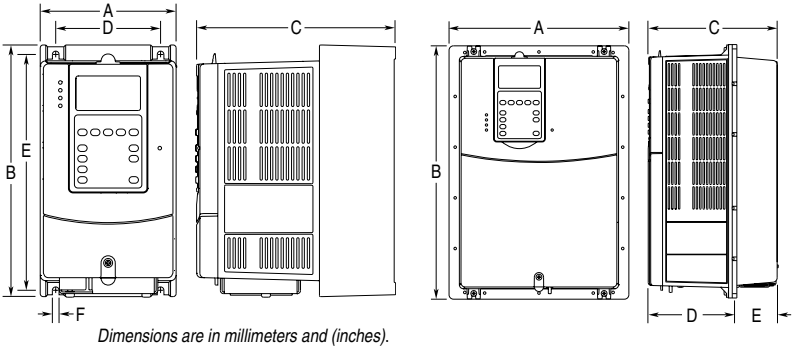
Dimensions

Table A.A VTAC 9 Frames

Output Power	Frame Size	
HP	208V AC Input	480V AC Input
2	B	–
3	B	B
5	C	B
7.5	D	C
10	D	C
15	D	D
20	E	D
25	E	D, 2
30	4	D, 3
40	5	E, 3
50	5	E, 3
60	6	4
75	6	5
100	6	5
125	–	6
150	–	6
200	–	6

Figure A.1 VTAC 9 Frames B...E

NEMA Type 1 **Flange Mount**



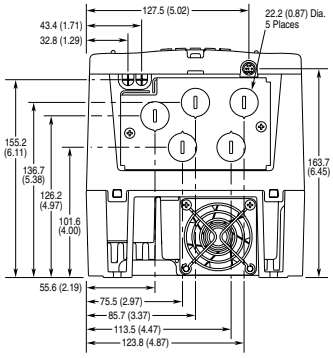
Dimensions are in millimeters and (inches).

Frame	A	B	C	D	E	F	Weight (1) *kg (lbs.)*
NEMA Type 1							
B	171.7 (6.76)	234.6 (9.24)	179.8 (7.08)	122.7 (4.83)	220.2 (8.67)	5.8 (0.23)	3.60 (7.9)
C	185.0 (7.28)	300.0 (11.81)	179.8 (7.08)	137.6 (5.42)	285.6 (11.25)	5.8 (0.23)	6.89 (15.2)
D	219.9 (8.66)	350.0 (13.78)	179.8 (7.08)	169.0 (6.65)	335.6 (13.21)	5.8 (0.23)	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	200.0 (7.87)	491.0 (19.33)	6.9 (0.27)	18.60 (41.0)
Flange Mount							
B	205.2 (8.08)	234.6 (9.24)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	3.60 (7.9)
C	219.0 (8.62)	300.0 (11.81)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	6.89 (15.2)
D	248.4 (9.78)	350.0 (13.78)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	117.2 (4.61)	89.9 (3.54)	–	18.60 (41.0)

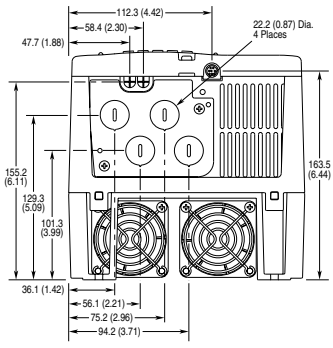
(1) Weights include OIM and Standard I/O.

Figure A.2 VTAC 9 Frame B…E NEMA Type 1 Bottom View Dimensions

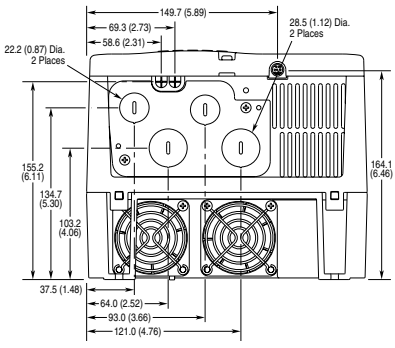
Frame B



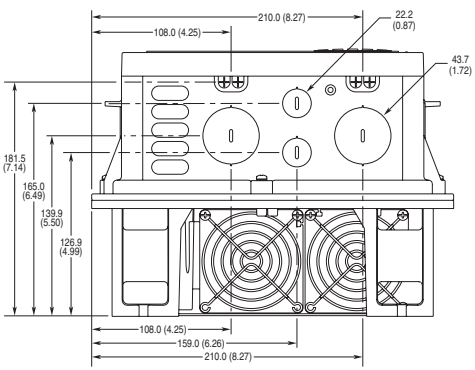
Frame C



Frame D



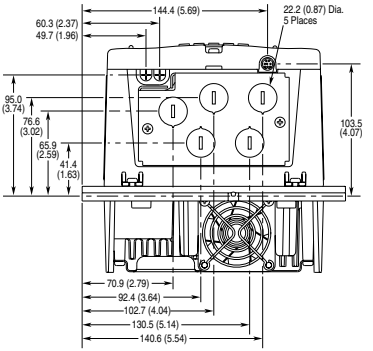
Frame E



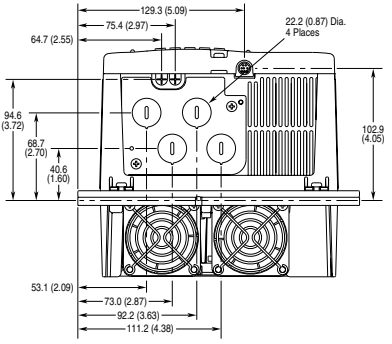
Dimensions are in millimeters and (inches).

Figure A.3 VTAC 9 Frame B…E Flange Mount Bottom View Dimensions

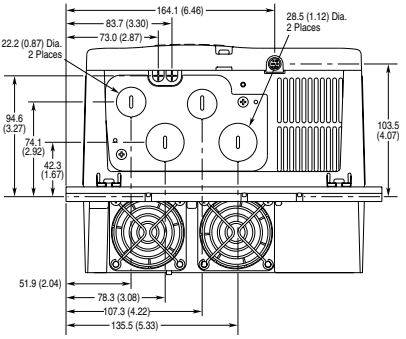
Frame B



Frame C



Frame D



Frame E

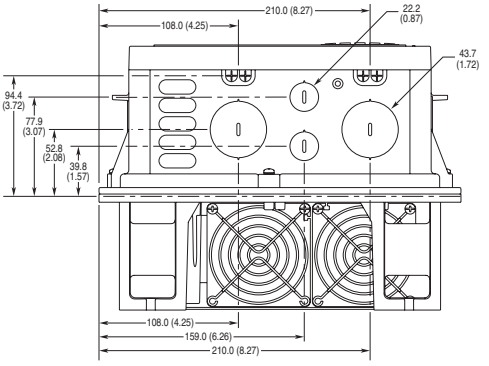
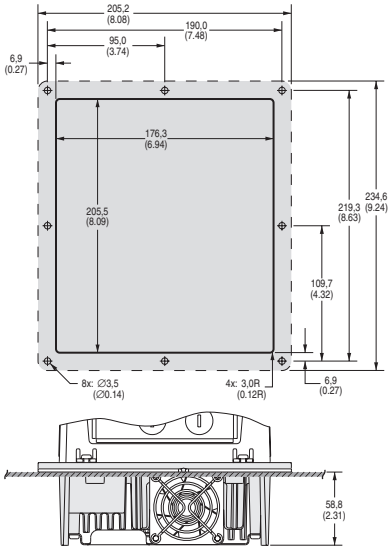
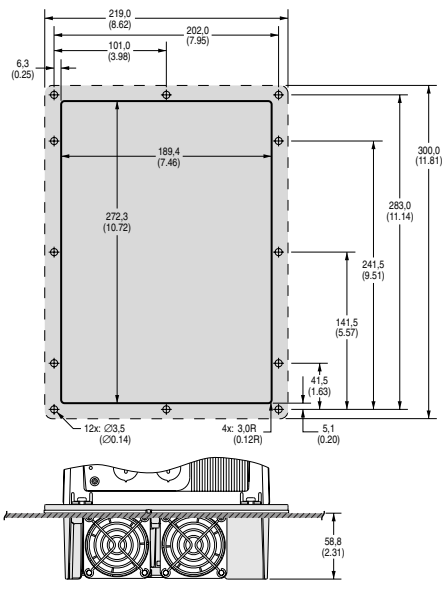


Figure A.4 VTAC 9 Frame B…E Flange Mount Cutout Dimensions

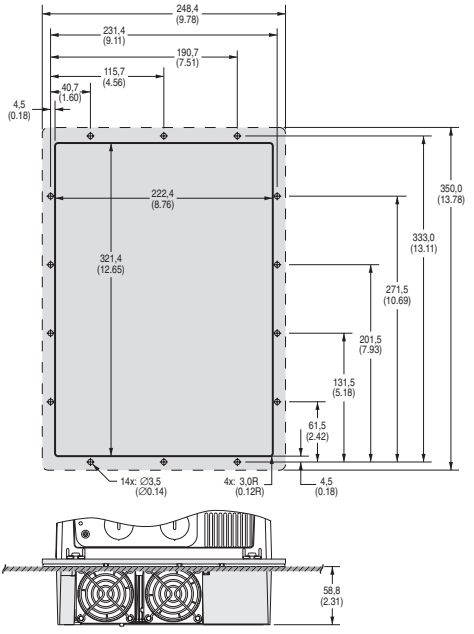
Frame B



Frame C



Frame D


248,4
(9.78)
231,4
(9.11)
190,7
(7.51)
115,7
(4.56)
40,7
(1.60)
4,5
(0.18)
222,4
(8.76)
321,4
(12.65)
350,0
(13.78)
333,0
(13.11)
271,5
(10.69)
201,5
(7.93)
131,5
(5.18)
61,5
(2.42)
14x: Ø3,5
(Ø0.14)
4x: 3,0R
(0.12R)
4,5
(0.18)
58,8
(2.31)

Frame E

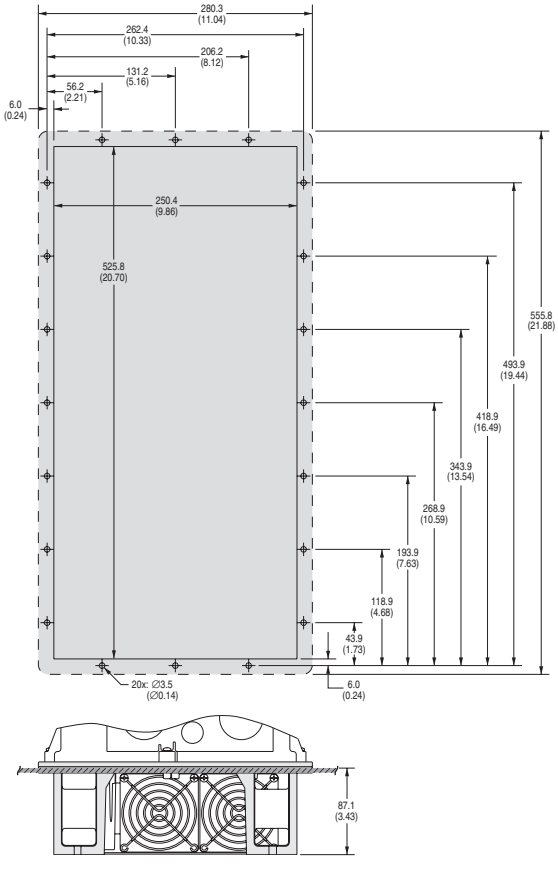
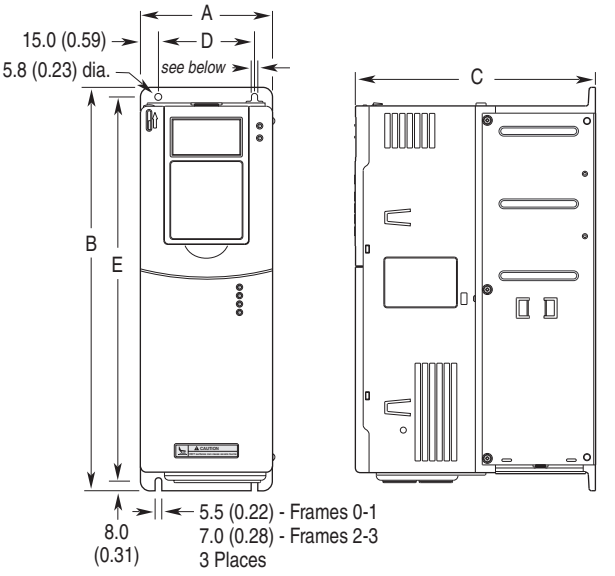

280.3
(11.04)
262.4
(10.33)
206.2
(8.12)
131.2
(5.16)
56.2
(2.21)
6.0
(0.24)
250.4
(9.86)
525.8
(20.70)
555.8
(21.88)
493.9
(19.44)
418.9
(16.49)
343.9
(13.54)
268.9
(10.59)
193.9
(7.63)
118.9
(4.68)
43.9
(1.73)
20x: Ø3.5
(Ø0.14)
6.0
(0.24)
87.1
(3.43)

Figure A.5 VTAC 9 Frames 2…3



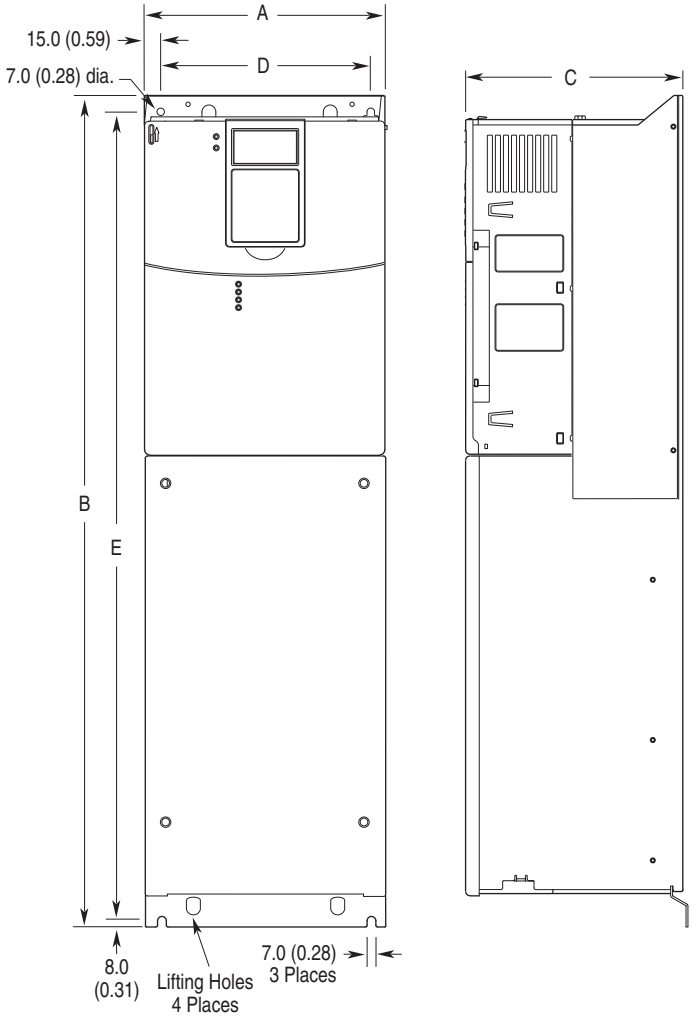
Dimensions are in millimeters and (inches).

Frame (1)	A	B	C	D	E	Weight (2) *kg (lbs.)*	
						Drive	Drive & Packaging
2	222.0 (8.74)	342.5 (13.48)	200.0 (7.87)	192.0 (7.56)	320.0 (12.60)	12.52 (27.6)	15.20 (33.5)
3	222.0 (8.74)	517.5 (20.37)	200.0 (7.87)	192.0 (7.56)	500.0 (19.69)	18.55 (40.9)	22.68 (50)

(1) Refer to Table A.A for frame information.

(2) Weights include OIM and Standard I/O.

Figure A.6 VTAC 9 Frame 4



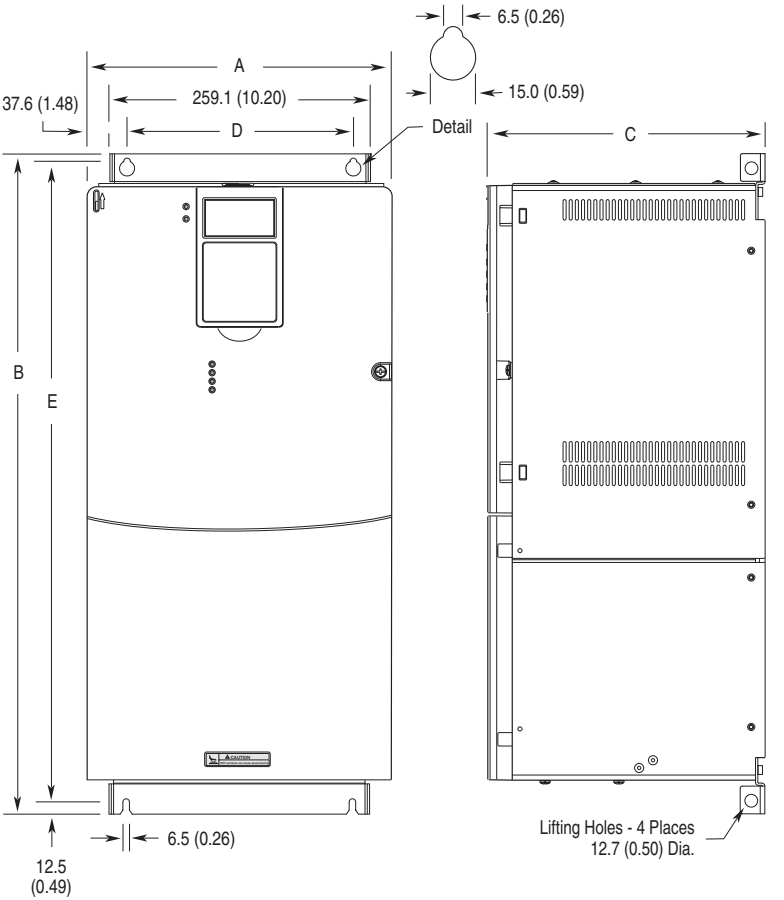
Dimensions are in millimeters and (inches)

Frame(1)	A *(Max.)*	B	C *(Max.)*	D	E	Approx. Weight (2) *kg (lbs.)*	
						Drive	Drive & Packaging
4	220.0 (8.66)	758.8 (29.87)	201.7 (7.94)	192.0 (7.56)	738.2 (29.06)	24.49 (54.0)	29.03 (64.0)

(1) Refer to Table A.A for frame information.

(2) Weights include OIM and Standard I/O.

Figure A.7 VTAC 9 Frame 5



Dimensions are in millimeters and (inches).

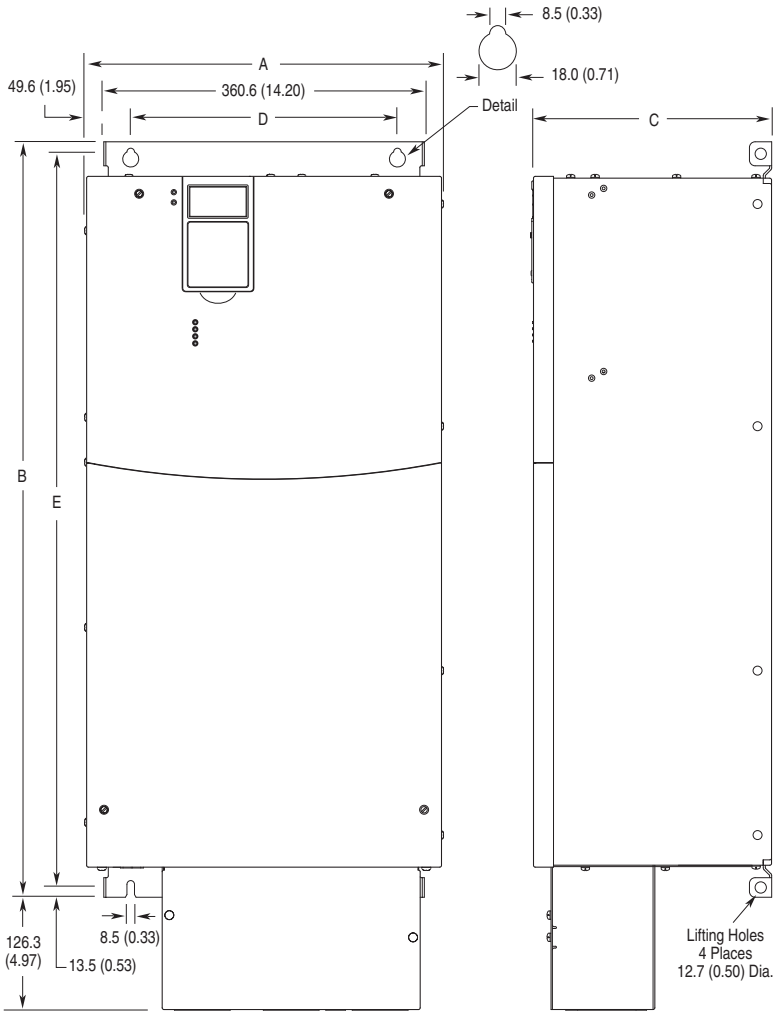
Frame (1)	A *(Max.)*	B	C *(Max.)*	D	E	Approx. Weight (2) *kg (lbs.)*	
						Drive	Drive & Packaging
5	308.9 (12.16)	644.5 (25.37) (3)	275.4 (10.84)	225.0 (8.86)	625.0 (24.61)	37.19 (82.0)	49.50 (109.0)

(1) Refer to Table A.A for frame information.

(2) Weights include OIM and Standard I/O.

(3) When using the supplied junction box (100 HP drives Only), add an additional 45.1 mm (1.78 in.) to this dimension.

Figure A.8 VTAC 9 Frame 6



Dimensions are in millimeters and (inches)

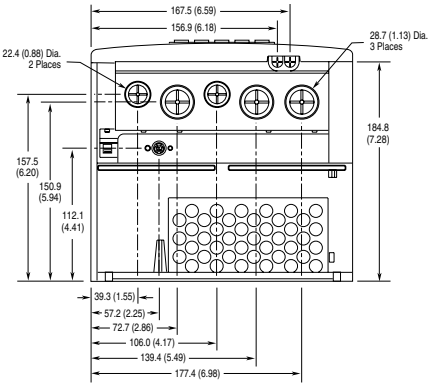
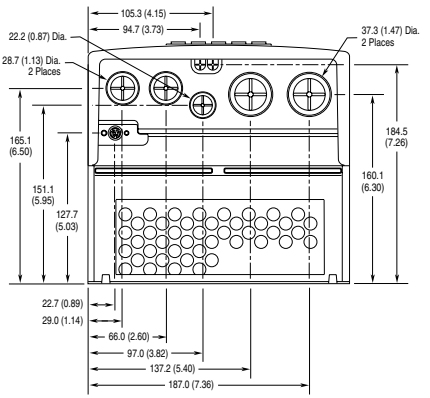
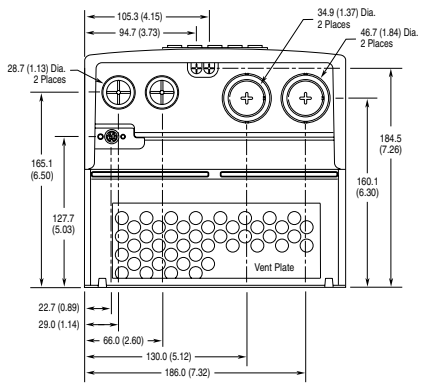
Frame(1)	A *(Max.)*	B(2)	C *(Max.)*	D	E	Approx. Weight(3) *kg (lbs.)*	
						Drive	Drive & Packaging
6	403.9 (15.90)	850.0 (33.46)	275.5 (10.85)	300.0 (11.81)	825.0 (32.48)	71.44 (157.5)	100.9 (222.0)

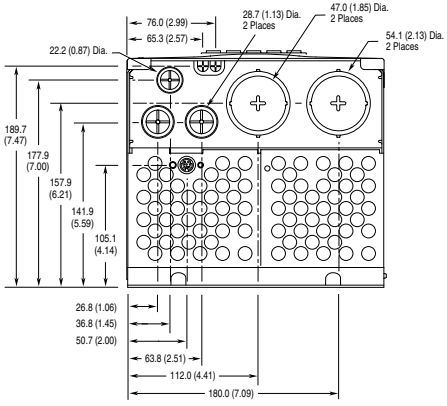
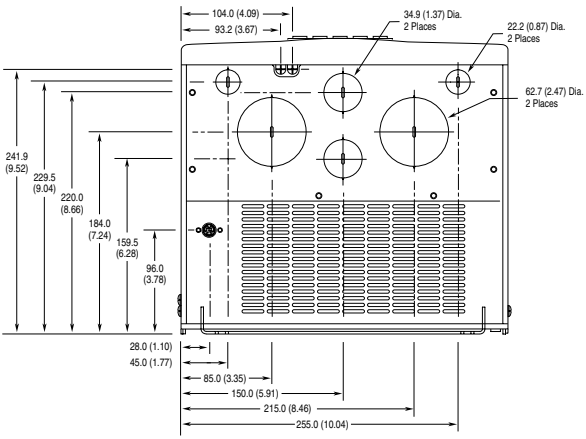
(1) Refer to Table A.A for frame information.

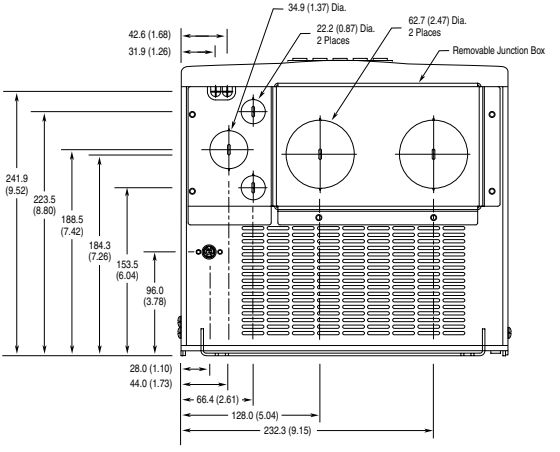
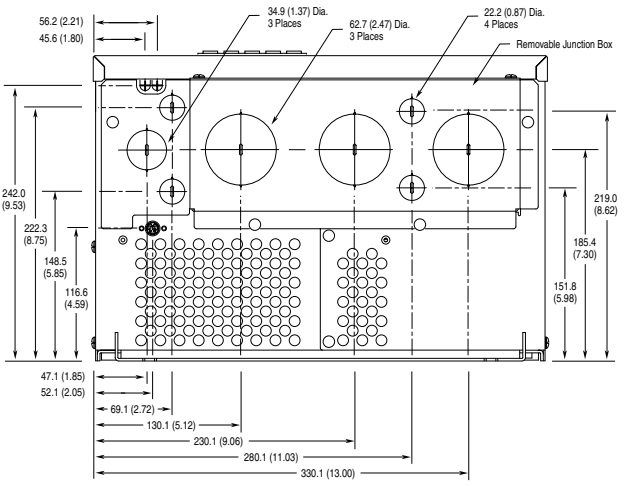
(2) Junction Box can be removed if drive is mounted in a cabinet.

(3) Weights include HIM and Standard I/O. Add 13.60 kg (30.0 lbs.) for the 100HP @ 208V AC and 200HP @ 480V AC Drive.

Figure A.9 VTAC 9 Bottom View Dimensions

Frame	Rating	Dimensions
2	All	
3	30…40 HP @ 480V	
	50 HP @ 480V	

Frame	Rating	Dimensions
4	All	
5	40 HP @ 208V 75 HP @ 480V	

Frame	Rating	Dimensions
5	50 HP @ 208V 100 HP @ 480V	
6	All	

Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings (including continuous, 1 minute and 3 second) and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2[(1)], EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T, RK1 or J must be used.

Circuit Breakers

The “non-fuse” listings in the following tables include both circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters. **If one of these is chosen as the desired protection method**, the following requirements apply.

- IEC and UL – Both types of devices are acceptable for IEC and UL installations.

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

Table A.B 208 Volt AC Input Protection Devices (See page A-24 for Notes)

Nameplate Catalog Number 9VT201-	Frame	HP Rating	Temp.	Input Ratings		Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker[4]	Motor Circuit Protector[6]	140M Motor Starter with Adjustable Current Range[7] [8]			
			°C	Amps	kVA	Cont.	1 Min.	3 Sec.	Min.[2]	Max.[3]	Min.[2]	Max.[3]	Max.[5]	Max.[5]	Available Catalog Numbers[9]			
208 Volt AC Input																		
007	B	2	50	10	3.6	7.8	10.3	13.8	15	15	15	30	30	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
011	B	3	50	14	5.1	11	12.1	16.5	20	25	20	40	40	30	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
017	C	5	50	16	5.8	17.5	19.2	26.6	20	35	20	70	70	30	140M-C2E-C20	140M-D8E-C20	140M-F8E-C20	–
025	D	7.5	50	23.3	8.3	25.3	27.8	37.9	30	50	30	100	100	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	140-CMN-2500
032	D	10	50	29.8	10.7	32.2	37.9	50.6	40	70	40	125	125	50	–	–	140M-F8E-C32	140-CMN-4000
043	D	15	50	39.8	14.3	43	55.5	74	60	100	60	175	175	70	–	–	140M-F8E-C45	140-CMN-6300
062	E	20	50	57.5	20.7	62.1	72.4	96.6	80	125	80	200	200	100	–	–	–	140-CMN-6300
078	E	25	50	72.3	26.0	78.2	93.1	124	90	175	90	300	300	100	–	–	–	140-CMN-9000
092	4	30	40/50[1]	84.7	30.5	92	117	156	110	200	110	350	350	150	–	–	–	140-CMN-9000
120	5	40	50	113	40.7	120	132	175	150	250	150	475	350	150	–	–	–	–
130	5	50	50	141	44.1	130	143	175	175	275	175	500	375	250	–	–	–	–
177	6	60	50	167	60.1	177	195	266	225	350	225	500	500	250	–	–	–	–
221	6	75	50	208	75.0	221	243	308	300	450	300	600	600	400	–	–	–	–
260	6	100	45	255	91.9	260	286	390	300	575	300	600	750	400	–	–	–	–

Table A.C 480 Volt AC Input Protection Devices (See page A-24 for Notes).

Nameplate Catalog Number	Frame	HP	Temp.	Input Ratings		Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker[4]	Motor Circuit Protector[6]	140M Motor Starter with Adjustable Current Range[7] [8]			
9VT401-		Rating	*°C*	*Amps*	*kVA*	*Cont.*	*1 Min.*	*3 Sec.*	*Min.[2]*	*Max.[3]*	*Min.[2]*	*Max.[3]*	*Max.[5]*	*Max.[5]*	*Available Catalog Numbers[9]*			
480 Volt AC Input																		
005	B	3	50	5.6	4.7	5	5.5	7.5	10	10	10	20	20	15	140M-C2E-B63	140M-D8E-B63	–	–
008	B	5	50	9.8	8.4	8	8.8	12	15	15	15	30	30	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
011	C	7.5	50	9.5	7.9	11	12.1	16.5	15	20	15	40	40	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
014	C	10	50	12.5	10.4	14	16.5	22	20	30	20	50	50	20	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
022	D	15	50	19.9	16.6	22	24.2	33	25	45	25	80	80	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	–
027	D	20	50	24.8	20.6	27	33	44	35	60	35	100	100	50	–	–	140M-F8E-C32	140-CMN-2500
034	D	25	50	31.2	25.9	34	40.5	54	40	70	40	125	125	50	–	–	140M-F8E-C45	140-CMN-4000
034	2	25	40/50[1]	31.2	25.9	34	40.5	54	40	70	40	125	125	50	–	–	140M-F8E-C45	140-CMN-4000
040	D	30	50	36.7	39.7	40	51	68	50	90	50	150	150	50	–	–	140M-F8E-C45	140-CMN-4000
040	3	30	40/50[1]	36.7	30.5	40	51	68	50	90	50	150	150	50	–	–	140M-F8E-C45	140-CMN-4000
052	E	40	50	47.7	39.7	52	60	80	60	110	60	200	200	70	–	–	–	140-CMN-6300
052	3	40	40/50[1]	47.7	39.7	52	60	80	60	110	60	200	200	70	–	–	–	140-CMN-6300
065	E	50	50	59.6	49.6	65	78	104	80	125	80	250	250	100	–	–	–	140-CMN-9000
065	3	50	40/50[1]	59.6	49.6	65	78	104	80	125	80	250	250	100	–	–	–	140-CMN-9000
077	4	60	40/50[1]	72.3	60.1	77	85	116	100	170	100	300	300	100	–	–	–	140-CMN-9000
096	5	75	50	90.1	74.9	96	106	144	125	200	125	350	350	125	–	–	–	–
125	5	100	50	117	97.6	125	138	163	150	250	150	500	375	150	–	–	–	–
156	6	125	50	147	122	156	172	234	200	350	200	600	450	250	–	–	–	–
180	6	150	50	169	141	180	198	270	225	400	225	600	500	250	–	–	–	–
248	6	200	45	233	194	248	273	372	300	550	300	700	700	400	–	–	–	–

Publication 20P-UM001B-EN-P

(1) 40°C rating for NEMA Type 1. 50°C rating is achived by removing the adhesive top label from the drive. NEMA enclosure rating changes from Type 1 to Open Type when top label is removed.

(2) Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.

(3) Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(4) Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(5) Maximum allowable rating by US NEC. Exact size must be chosen for each installation.

(6) Motor Circuit Protector - instantaneous trip circuit breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(7) Bulletin 140M with adjustable current range should have the current trip set to the minimum range that the device will not trip.

(8) Manual Self-Protected (Type E) Combination Motor Controller, UL listed for 208 Wye or Delta, 240 Wye or Delta, 480Y/277 or 600Y/347. Not UL listed for use on 480V Delta/Delta systems.

(9) The AIC ratings of the Bulletin 140M Motor Protector may vary. See publication 140M-SG001B-EN-P.

Table A.D 650 Volt DC Input Protection Devices

Drive Catalog Number	Frame	HP Rating	Temp.	DC Input Ratings		Output Amps			Fuse	Bussmann Style Fuse
			°C	*Amps*	*kVA*	*Cont.*	*1 Min.*	*3 Sec.*		
650 Volt DC Input										
9VT401-034	2	25	50	36.4	23.6	34	40.5	54	70	BUSSMANN_JKS-70
9VT401-040	3	30	50	42.9	27.8	40	51	68	80	BUSSMANN_JKS-80
9VT401-052	3	40	50	55.7	36.1	52	60	80	100	BUSSMANN_JKS-100
9VT401-065	3	50	50	69.7	45.4	65	78	104	150	BUSSMANN_JKS-150
9VT401-077	4	60	50	84.5	54.7	77	85	116	150	BUSSMANN_JKS-150
9VTR01-096	5	75	50	105.3	68.3	96	106	144	200	BUSSMANN_JKS-200
9VTR01-125	5	100	50	137.1	88.9	125	138	163	250	BUSSMANN_JKS-250
9VTR01-156	6	125	50	171.2	110.9	156	172	234	300	BUSSMANN_JKS-300
9VTR01-180	6	150	50	204.1	132.2	180	198	270	400	BUSSMANN_JKS-400

Notes:

Using the LCD OIM

External and Internal Connections

The LCD OIM can be used in the following ways:

Drive mounted - OIM connects directly to the drive using DPI port 1.

Hand-held - A cable (RECBL-LCD) must be used to convert the OIM for hand-held use. The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

Remote mounted - A cable (RECBL-LCD) must be used to convert the OIM for remote-mounted use. The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

The LCD Operator Interface Module (OIM) is a keypad/display that enables you to program, monitor, and control the drive.

Figure B.1 VTAC 9 LCD OIM

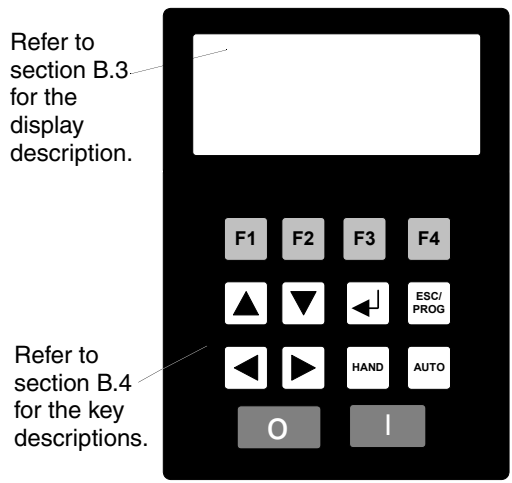
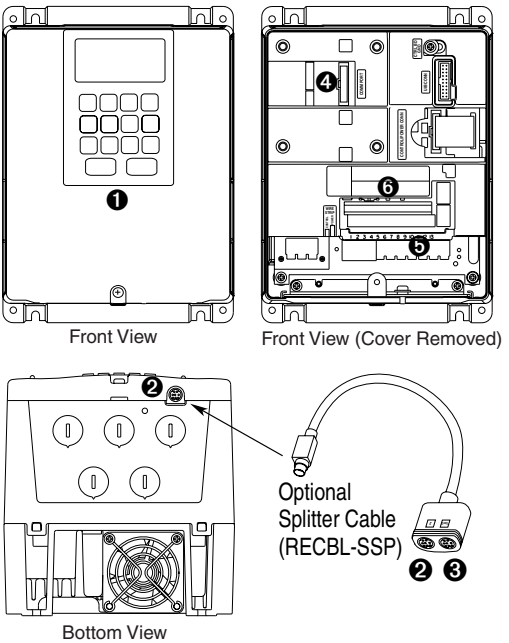


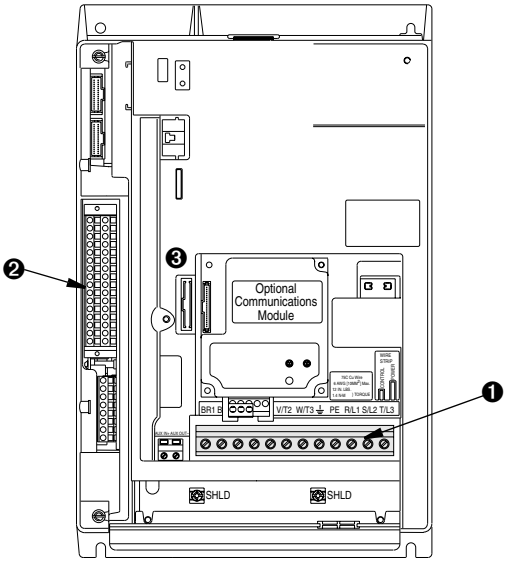
Figure B.2, Figure B.3 and Figure B.4 show the locations of the drive terminal blocks and connectors used to set up and operate the drive.

Figure B.2 Drive Only Connections - 1 to 20 HP



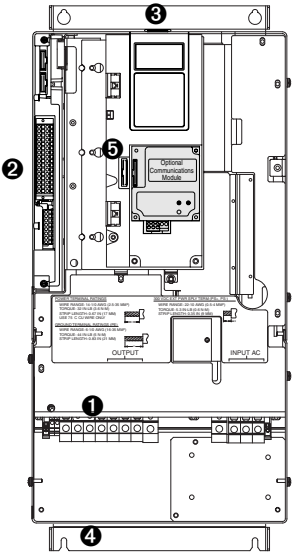
No.	Connector	Description
❶	DPI Port 1	OIM connection when installed in cover.
❷	DPI Port 2	Cable connection for remote OIM or PC Software.
❸	DPI Port 3	Cable connection for remote OIM or PC Software.
❹	DPI Port 5	Connection for optional communications module.
❺	Power Terminal Block	Connections for input and output power wiring.
❻	Signal and I/O Terminal Block	Connections for signal and I/O wiring.

Figure B.3 Drive Only Connections - 25 to 50 HP



No.	Connector	Description
❶	Power Terminal Block	Connections for input and output power wiring.
❷	Signal and I/O Terminal Block	Connections for signal and I/O wiring.
❸	DPI Port 5	Connection for optional communications module.

Figure B.4 Drive Only Connections - 60 to 150 HP



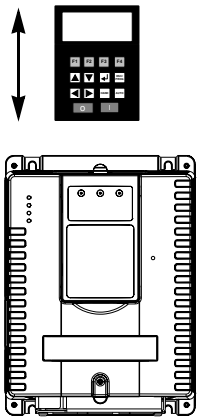
No.	Connector	Description
❶	Power Terminal Block	Connections for input and output power wiring.
❷	Signal and I/O Terminal Block	Connections for signal and I/O wiring.
❸	DPI Port 1	OIM connection.
❹	DPI Port 2	Connection for remote OIM or RECOMM-232 serial interface.
❺	DPI Port 5	Connection for optional communications module.

Install/Remove the Local LCD OIM

To **install** the local LCD OIM, slide the OIM into the slot on the front of the drive until it clicks into place.

To **remove** the local LCD OIM, press the tab at the top of the drive to release the OIM while pushing the OIM from the bottom to slide it out of the drive.

Figure B.5 Installing and Removing the Local LCD OIM



Removing the Local LCD OIM While the Drive is Powered

If the local LCD OIM is the selected control source, removing the OIM while the drive is powered will cause a drive fault.

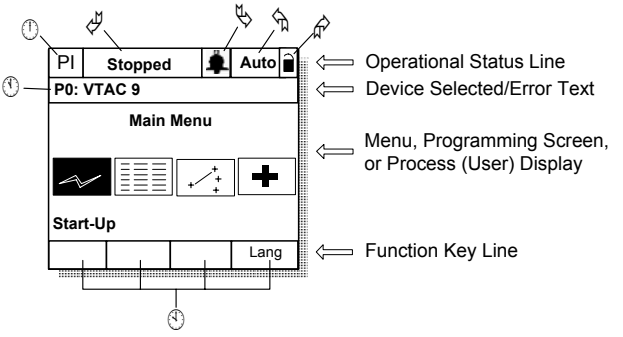
If the local LCD OIM is not the selected control source, but is the reference source, removing the OIM while the drive is powered will result in a zero reference value. When the OIM is replaced, the drive will ramp to the reference level supplied by the OIM.

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1] and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

If the local LCD OIM is not the selected control source or reference source, removing the OIM while the drive is powered will have no effect on drive operation.

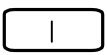
Display Description

Figure B.6 The Display (Main Menu Shown)



①	Function Key (F1, F2, F3, F4) definitions
②	Port/peripheral identification. Identifies port or peripheral on DPI about which the OIM is displaying information.
③	PI loop status: PI = PI control is active.
④	Operating status (for example, Running, Stopped, etc.)
⑤	Alarm annunciation. = Alarm has occurred.
⑥	Auto/Hand mode status.
⑦	Write-protect password status: (unlocked) = password disabled; (locked) = password enabled. See Chapter 3.

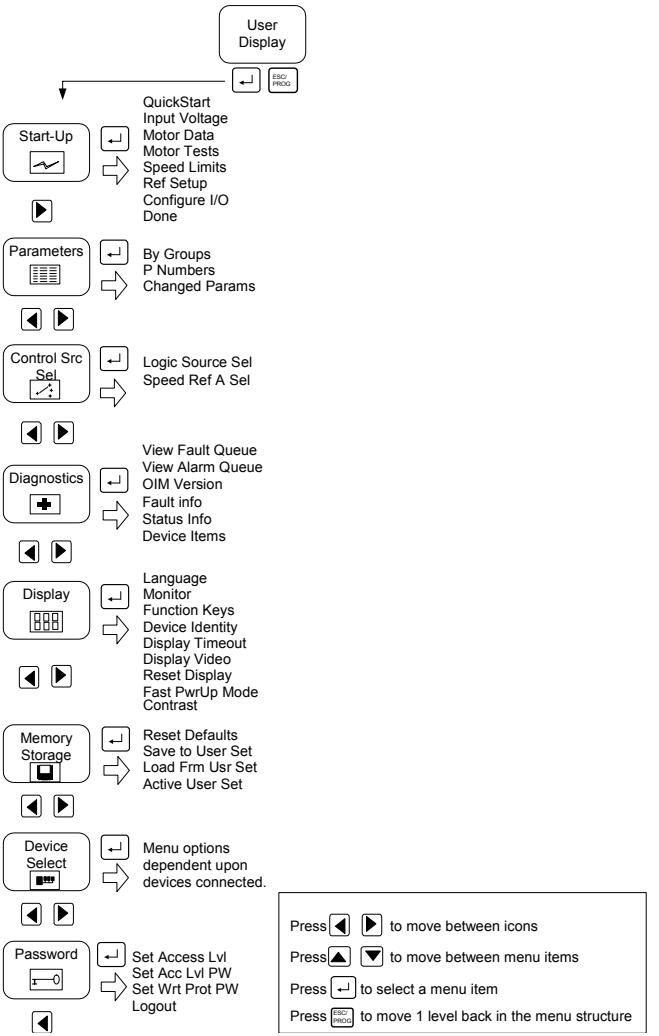
Key Descriptions

Key	Function
	Scroll through options or user function keys, move cursor to the left.
	Scroll through options or user functions keys, move cursor to the right.
	Scroll through options, increase a value, or toggle a bit.
	Scroll through options, decrease a value, or toggle a bit.
	Exit a menu, cancel a change to a parameter, or toggle between program and process (user) display screens.
	Enter a menu, select an option, or save changes to parameter value
	Enable Hand (manual) reference control.
	Release Hand (manual) reference control.
	Stop the drive. Clear a fault if the OIM is the control source.
	Start the drive if the OIM is the control source.
	F1 though F4: Predefined or user-configured functions. The definition of each key is shown directly above the key on the display. See item ① in figure Figure B.6.

ATTENTION: When switching from Auto to Hand, or Hand to Auto, the drive will ramp to the reference level provided by the new source at the rate specified in 140 [Accel Time 1], 142 [Decel Time 1], 141 [Accel Time 2], or 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

LCD OIM Menu Structure

Figure B.7 LCD OIM Menu Structure



Power Up and Adjust the LCD OIM

The first time the LCD OIM is powered up, you will be prompted to select a language for the display text. If the Start-Up routine has not been completed, the Start-Up menu is displayed immediately following the language selection screen.

On subsequent power ups, if both of these requirements have been met, the Main Menu is displayed after the initialization screen.

Selecting the Fast Power Up Feature

The fast power up feature bypasses the initialization screen at power up, and the Main Menu is displayed immediately. To select this feature, select Fast PwrUp Mode from the Display menu.

Adjusting the Screen Contrast

To adjust the screen contrast, select Contrast from the Display menu.

Resetting the Display

To return all the options for the display to factory-default values, select Reset Display from the Display menu.

Select a Device in the System

The LCD OIM can access and display data from any active drive or peripheral device on the network. The drive (port 0) is the default device selected.

To select a device, select the Device Select icon from the Main Menu. The options listed depend on what is connected to the network.

The name and DPI port number of the device being accessed is shown on the OIM's display.

Program the Drive

The LCD OIM enables you to view and adjust parameters in the drive or in peripheral devices connected to the drive. The parameters available for viewing or adjustment depend on the device selected.

The method of viewing and adjusting parameters is the same regardless of the device selected.

Viewing and Adjusting Parameters

Refer to Chapter 3 for information on how to access the parameters in the drive.

Each parameter screen contains the following information:

- Parameter number
- Parameter name
- Current parameter value and units
- Parameter range
- F1 key defined as a toggle to enable you to view the parameter's current value and the factory-default value

See Figure B.8 and Figure B.9 on page B-11 for instructions on how to adjust the parameter values.

Figure B.8 Adjusting Parameters

Step 1. At the parameter entry screen, press [↵] to highlight the parameter value.

(The screen shown here was accessed using the Parameters>P Numbers path)

Step 2. Adjust the parameter value (see table B.2), and then press [↵] to save the value.

If you do not want to save the value, press [ESC/PROG] to return to the initial parameter screen. You can then repeat steps 1 and 2 to change the value, or press [ESC/PROG] to back out of this menu.

The F1 key is defined as a toggle to enable you to view the parameter's current value and the factory-default value.

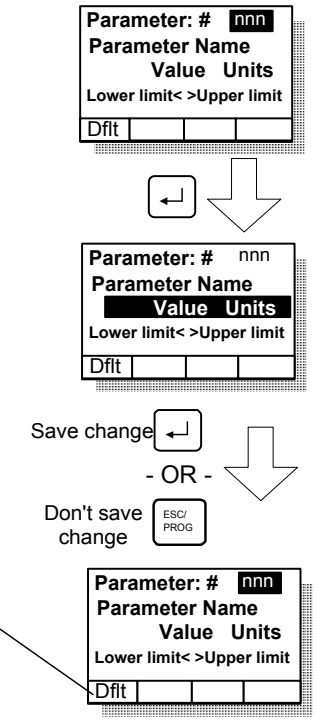


Figure B.9 How to Adjust Each Parameter Type

Parameter Type	How to Adjust
Numbered List	Use up/down arrow keys to advance through the list of options.
Bit	Use [◄] [►] to move the cursor to the bit location you want to change. Use [▲] [▼] to change the value of the bit.
Numeric	Use [◄] [►] to increase or decrease the value. - Or - Use [◄] [►] to move the cursor from digit to digit, and use [▲] [▼] to increase or decrease the value of the digit.

To restore all parameters to their factory-default values, select Reset Defaults from the Memory Storage menu.

Note that the parameter values are retained through a line dip or power shutdown.

Loading and Saving User Sets

Drive configurations, called user sets, can be saved and recalled for use at any time. Up to three user sets can be saved in the VTAC 9 drive.

To **save** the current drive configuration, select Save to User Set from the Memory Storage menu.

To recall, or **load**, a user set, select Load Frm Usr Set from the Memory Storage menu.

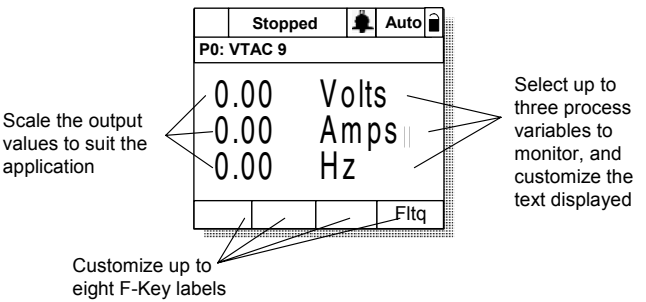
To **identify** which user set is active, select Active User Set from the Memory Storage menu. The name of the last user set to be loaded into the drive will be displayed. “Active Set” means factory defaults have been restored.

Monitor the Drive Using the Process Display Screen

The process display screen enables you to monitor up to three process variables (six on frames 2…6). Use a function key programmed as Next to toggle bwtween the process display variables). You can select the display, parameter, scale, and text for each process variable being displayed.

The ESC/PROG key toggles between the programming screen and the process display screen. From the Main Menu screen, press F1 or F2 to select the process display screen. In addition, the process display screen becomes active if no keys have been pressed before the display timeout period expires. See “Setting the Display Timeout Period” on page B-16 for information about setting the display timeout period.

Figure B.10 Process (User) Display Screen

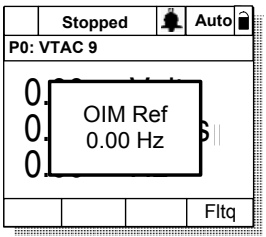


Displaying and Changing the OIM Reference

You can display the reference value that the OIM is sending to the drive by pressing the up or down arrow key once when the process display screen is active. See Figure B.11. The OIM reference can be used for the speed reference, PI reference, or trim reference.

To change the displayed reference, press and hold down either the up or down arrow key until the desired value is displayed. Release the key to return to the process display screen.

Figure B.11 OIM Reference Displayed



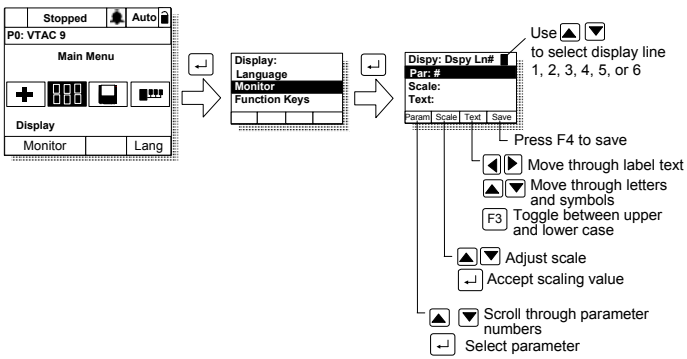
Note that changing the value of the OIM reference does not affect the value of any other port reference.

The value of the OIM reference is saved through a power cycle if parameter 192 (Save OIM Ref) is set to save at power down.

Customizing the Process Display Screen

To customize the process display screen, select Monitor from the Display menu. See Figure B.12.

Figure B.12 Customizing the Process Display Screen



Customizing the Function Keys

The function keys (F1, F2, F3, and F4, also called F-Keys) on the OIM can be customized to perform several pre-configured functions when the process display screen is active.

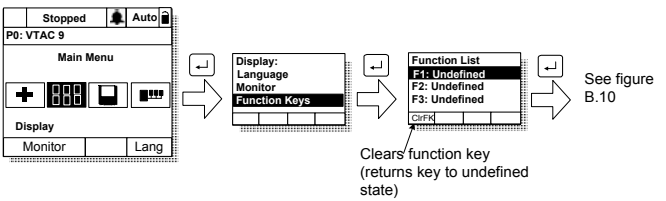
Up to eight function keys can be configured. Pressing ◄ ► while the display screen is active toggles between each set of four functions.

As shipped from the factory, the F4 key is configured for the Clear Fault Queue function.

To assign a function to an F-Key, select the Display icon from the Main Menu as shown in Figure B.13 and Figure B.14.

The F-Key definitions are the same for all OIMs connected to the drive, regardless of the port used.

Figure B.13 Accessing the Function Key Configuration Screens



Select from the list of preconfigured functions:

Undefined (default)

Load User Set 1-3: Loads the specified user set into active drive memory. The drive responds as if a value had been entered in 198 [Load Frm Usr Set], or [Load Frm Usr Set] was selected from the OIM's Memory Storage menu.

ATTENTION: Loading a user set with LevelSense Start (168) set to Enable can result in the drive starting immediately when all start conditions are met.
When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Save User Set 1-3: Saves the active configuration to drive memory. The drive responds as if a value had been entered in Save to User Set (199) or Save to User Set was selected from the OIM's Memory Storage menu.

Acc/Dec Change: Toggles between the display of Acc/Dec rate 1 and Acc/Dec rate 2 (The value the drive is configured to go to, not the current value being used by the drive). This selection is based on the active value of the rate parameters (140-143). Therefore, when any of these parameters change, the actual acc/dec rates will dynamically change.

Preset Speed 1-6: Toggles the selected preset speed on and off and grants Hand (manual) reference control. Returns to Auto reference when the function is toggled.

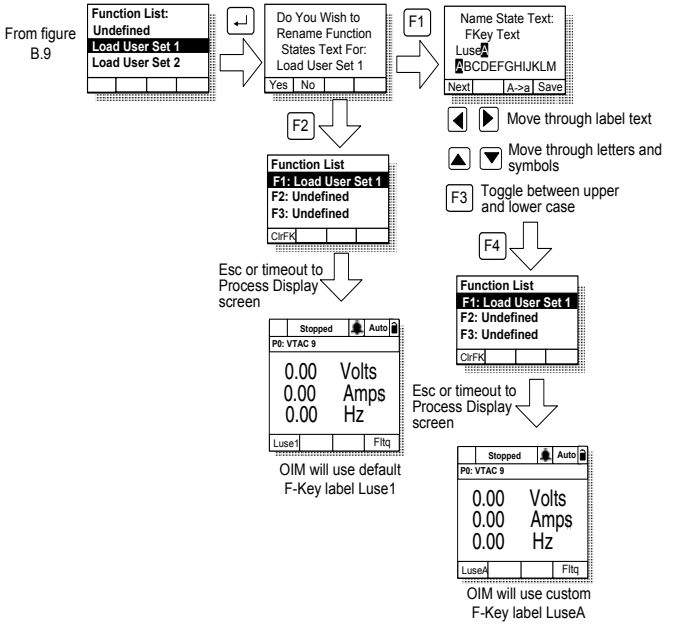
View Fault Queue: Displays the Fault Queue screen (see Chapter 4). Press ESC/PROG to return to the process display screen.

Next: (Frames 2 and 3 only) Togle to net set of three process display variables.

Customizing the Function Key Label Text

You can customize the text for each function key label (up to five characters). See Figure B.14.

Figure B.14 Customizing the Function Key Label Text



Setting the Display Timeout Period

When the OIM is inactive (that is, no keys have been pressed) for a user-specified period of time, the process display screen becomes active. To return to the previously active screen, press any key. To return to the Main Menu, press ESC/PROG.

To set the display timeout period, select Display Timeout from the Display menu. The timeout period can range from 10 to 1200 seconds (20 minutes).

This feature can also be disabled by pressing the F1 key while in the display time screen.

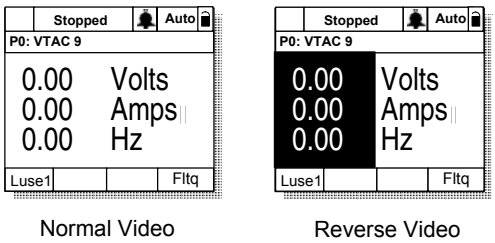
Note that each OIM connected to the drive can have a different timeout period.

Using Reverse Video for the Process Display Screen

To select normal or reverse video for the process display screen, select Display Video from the Display menu. See figure Figure B.15 for sample screens.

Note that each OIM connected to the drive can have a different display mode.

Figure B.15 Selecting Reverse Video for the Process Display Screen



Control the Drive From the LCD OIM

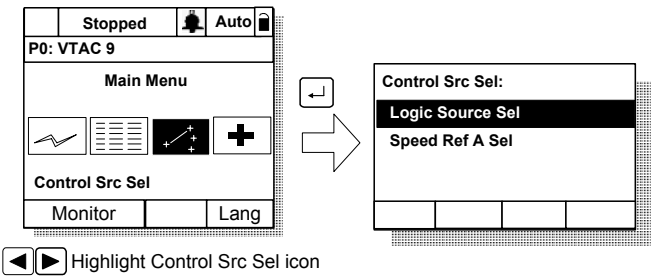
When the OIM is the selected control source, it can be used to control the drive:

- Start (Run)
- Stop
- Clear Faults

Selecting the Logic and Reference Source

Parameters 89 [Logic Source Sel] and 90 [Ref Source Sel] are used to select the drive control and speed reference sources. These parameters are grouped in the Control Src Select menu. See Figure B.16.

Figure B.16 Selecting the Control and Reference Source



ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in 140 [Accel Time 1], 141 [Accel Time 2], 142 [Decel Time 1] and 143 [Decel Time 2]. Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Both of these parameters can also be accessed individually through the Parameters menu.

Refer to Chapter 3 for descriptions of the parameters.

Starting the Drive

When the OIM is the selected control source, pressing [I] issues a start command to the drive.

Stopping the Drive

Pressing [O] will issue a stop command to the drive.

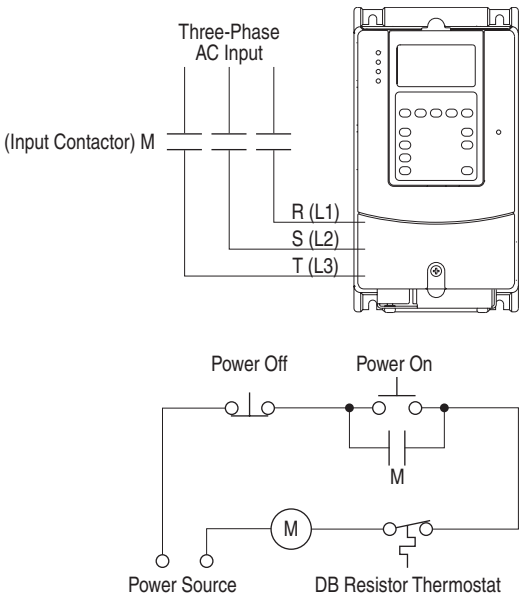
Important: Stop commands from any attached OIM will always be enabled.

Notes:

Application Notes

External Brake Resistor

Figure C.1 External Brake Resistor Circuitry



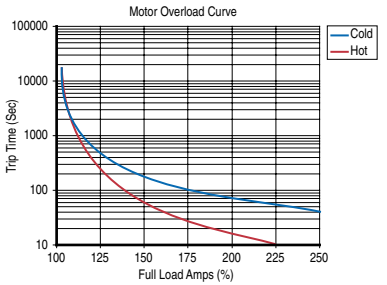
Motor Overload

For single motor applications the drive can be programmed to protect the motor from overload conditions. An electronic thermal overload I^2T function emulates a thermal overload relay. This operation is based on three parameters; [Motor NP FLA], [Motor OL Factor] and [Motor OL Hertz] (parameters 042, 048 and 047, respectively).

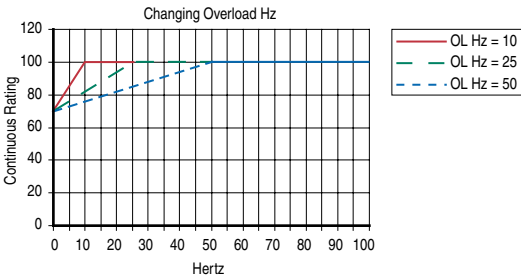
[Motor NP FLA] is multiplied by [Motor OL Factor] to allow the user to define the continuous level of current allowed by the motor thermal overload. [Motor OL Hertz] is used to allow the user to adjust the frequency below which the motor overload is derated.

The motor can operate up to 102% of FLA continuously. If the drive had just been activated, it will run at 150% of FLA for 180 seconds. If the motor had been operating at 100% for over 30 minutes, the drive will run at 150% of FLA for 60 seconds. These values assume the drive is operating above [Motor OL Hertz], and that [Motor OL Factor] is set to 1.00.

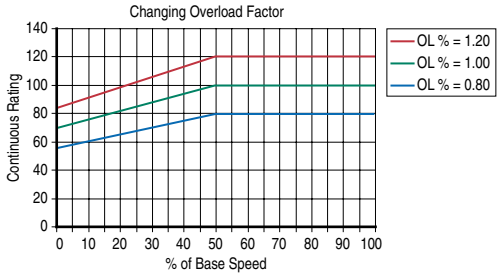
Operation below 100% current causes the temperature calculation to account for motor cooling.



[Motor OL Hertz] defines the frequency where motor overload capacity derate should begin. The motor overload capacity is reduced when operating below [Motor OL Hertz]. For all settings of [Motor OL Hertz] other than zero, the overload capacity is reduced to 70% at an output frequency of zero.



[Motor NP FLA] is multiplied by [Motor OL Factor] to select the rated current for the motor thermal overload. This can be used to raise or lower the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of [Motor OL Hertz] and [Motor OL Factor].



Motor Overload Memory Retention Per 2005 NEC

The VTAC 9 (firmware version 3.001 or greater) has the ability to retain the motor overload count at power down per the 2005 NEC motor overtemp requirement. To Enable/Disable this feature, refer to the table below. Once Enabled, the value for [Testpoint 1 Sel] may be changed.

Overload Retention	[Testpoint 1 Sel], param 234	[Testpoint 1 Data], param 235
Enable	"629"	Any non-zero value (1)
Disable	"629"	"0"

(1) Default setting.

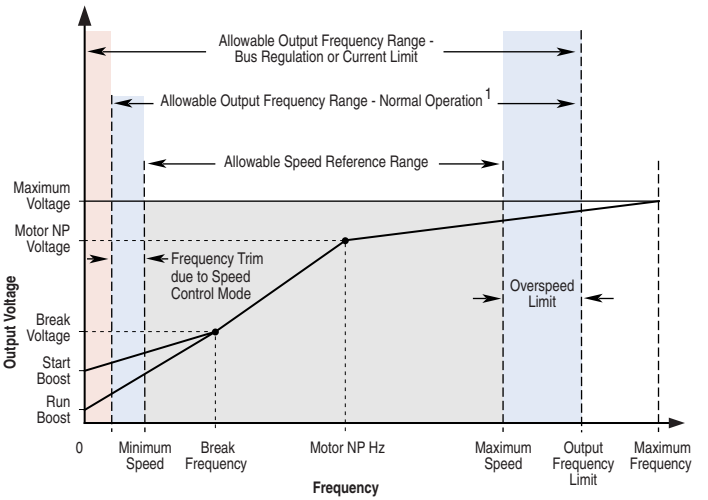
Overspeed

Overspeed Limit is a user programmable value that allows operation at maximum speed, but also provides an “overspeed band” that will allow a speed regulator such as slip compensation to increase the output frequency above maximum speed in order to maintain maximum motor speed.

The figure below illustrates a typical Custom V/Hz profile. Minimum Speed is entered in Hertz and determines the lower speed reference limit during normal operation. Maximum Speed is entered in Hertz and determines the upper speed reference limit. The two “Speed” parameters only limit the speed reference and not the output frequency.

The actual output frequency at maximum speed reference is the sum of the speed reference plus “speed adder” components from functions such as slip compensation.

The Overspeed Limit is entered in Hertz and added to Maximum Speed and the sum of the two (Speed Limit) limit the output frequency. This sum (Speed Limit) must is compared to Maximum Frequency and an alarm is initiated which prevents operation if the Speed Limit exceeds Maximum Frequency.



Note 1: The lower limit on this range can be 0 depending on the value of Speed Adder

Power Loss Ride Through

When AC input power is lost, energy is being supplied to the motor from the DC bus capacitors. The energy from the capacitors is not being replaced (via the AC line), thus, the DC bus voltage will fall rapidly. The drive must detect this fall and react according to the way it is programmed. Two parameters display DC bus voltage:

- [DC Bus Voltage] - displays the instantaneous value
- [DC Bus Memory] - displays a 6 minute running average of the voltage.

All drive reactions to power loss are based on [DC Bus Memory]. This averages low and high line conditions and sets the drive to react to the average rather than assumed values. For example, a 480V installation would have a 480V AC line and produce a nominal 648V DC bus. If the drive were to react to a fixed voltage for line loss detect, (i.e. 533V DC), then normal operation would occur for nominal line installations. However, if a lower nominal line voltage of 440V AC was used, then nominal DC bus voltage would be only 594V DC. If the drive were to react to the fixed 533V level (only –10%) for line loss detect, any anomaly might trigger a false line loss detection. Line loss, therefore always uses the 6 minute average for DC bus voltage and detects line loss based on a fixed percentage of that memory. In the same example, the average would be 594V DC instead of 650V DC and the fixed percentage, 27% for “Coast to Stop” and 18% for all others, would allow identical operation regardless of line voltage.

VTAC 9 Frames B, C, D, and E use only these fixed percentages. VTAC 9 Frames 2, 3, 4, 5, and 6 can selectively use the same percentages or the user can set a trigger point for line loss detect. The adjustable trigger level is set using [Power Loss Level] (see [Power Loss Level] on page 3-40).

Figure C.2 Power Loss Mode = Coast

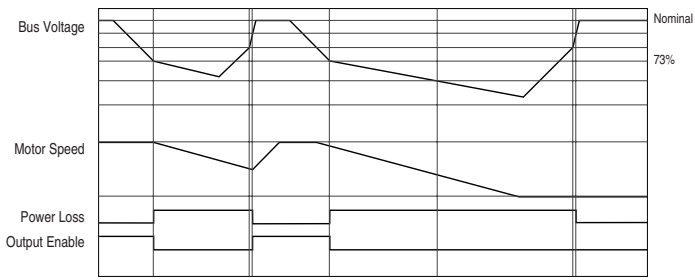
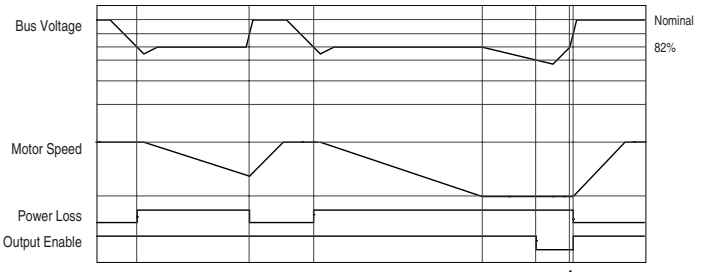


Figure C.3 Power Loss Mode = Decel

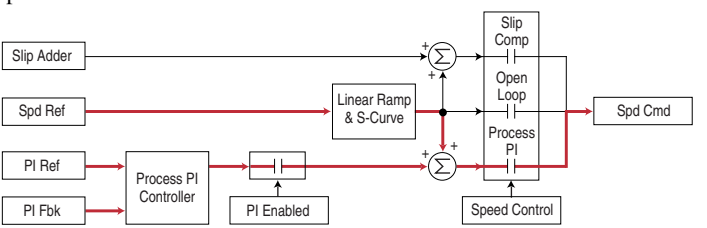


Process PI

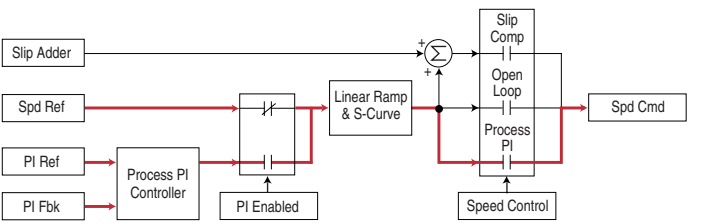
The internal PI function of theVTAC 9 provides closed loop process control with proportional and integral control action. The function is designed for use in applications that require simple control of a process without external control devices. The PI function allows the microprocessor of the drive to follow a single process control loop.

The PI function reads a process variable input to the drive and compares it to a desired setpoint stored in the drive. The algorithm will then adjust the output of the PI regulator, changing drive output frequency to try and make the process variable equal the setpoint.

It can operate as trim mode by summing the PI loop output with a master speed reference.

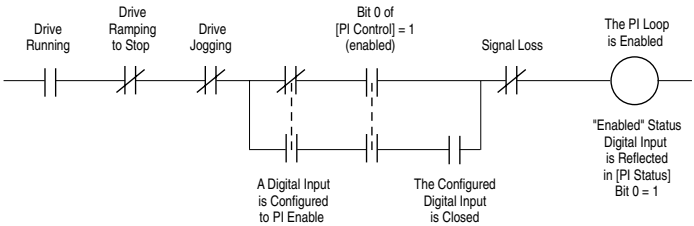


Or, it can operate as control mode by supplying the entire speed reference. This method is identified as “exclusive mode”



PI Enable

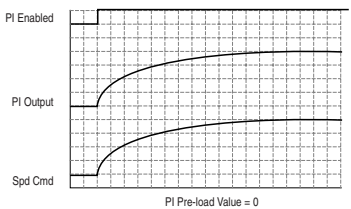
The output of the PI loop can be turned on (enabled) or turned off (disabled). This control allows the user to determine when the PI loop is providing part or all of the commanded speed. The logic for enabling the PI loop is shown in below.



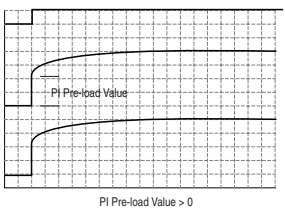
The drive must be running for the PI loop to be enabled. The loop will be disabled when the drive is ramping to a stop, jogging or the signal loss protection for the analog input(s) is sensing a loss of signal.

If a digital input has been configured to “PI Enable,” two events are required to enable the loop: the digital input must be closed AND bit 0 of the PI Control parameter must be = 1.

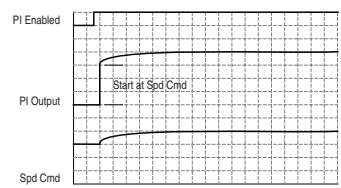
If no digital input is configured to “PI Enable,” then only the Bit 0 = 1 condition must be met. If the bit is permanently set to a “1”, then the loop will become enabled as soon as the drive goes into “run”.



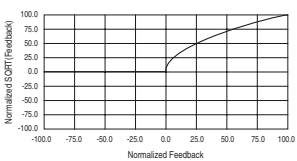
PI Pre-load Value = 0

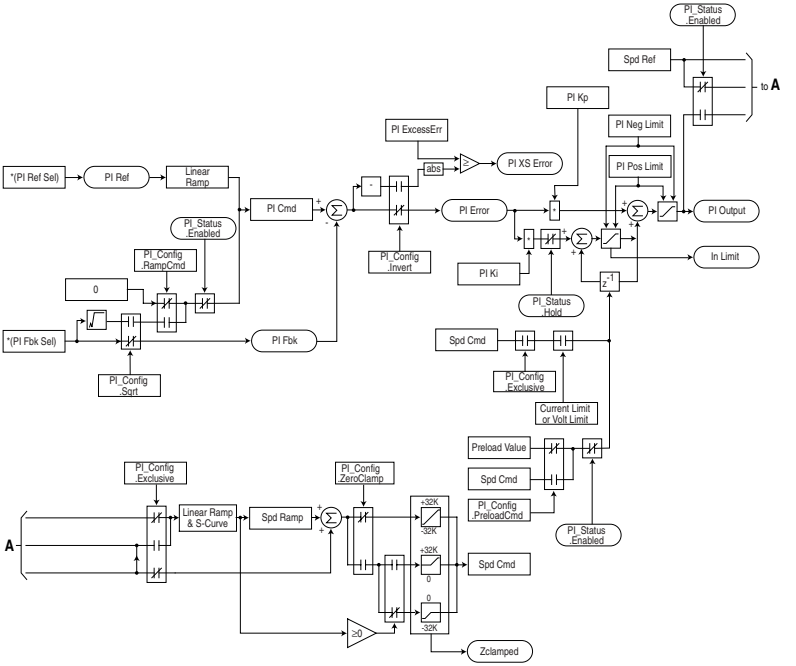


PI Pre-load Value > 0



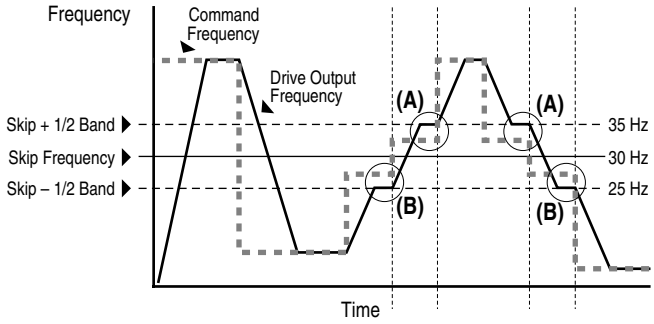
Pre-load to Command Speed




PI_Status .Enabled
Spd Ref
to A
PI Kp
PI Neg Limit
PI ExcessErr
PI Pos Limit
*(PI Ref Sel)
PI Ref
Linear Ramp
PI Cmd
PI Error
PI Output
PI XS Error
abs
PI_Status .Enabled
PI_Config .RampCmd
PI_Config .Invert
PI Ki
In Limit
0
PI_Status .Hold
*(PI Fbk Sel)
PI Fbk
Spd Cmd
PI_Config .Sqrt
PI_Config .Exclusive
Current Limit or Volt Limit
Preload Value
PI_Config .Exclusive
PI_Config .ZeroClamp
Spd Cmd
A
Linear Ramp & S-Curve
Spd Ramp
PI_Config .PreloadCmd
PI_Status .Enabled
+32K
-32K
Spd Cmd
0
Zclamped

Skip Frequency

Figure C.4 Skip Frequency



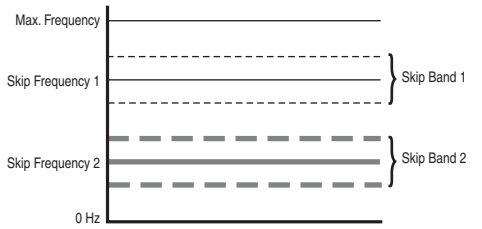
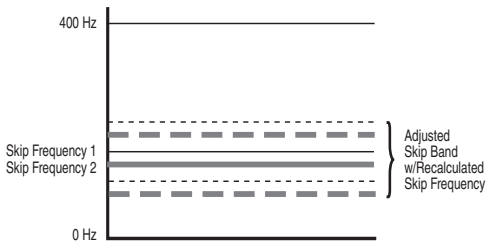
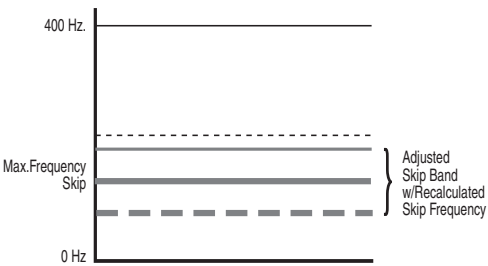
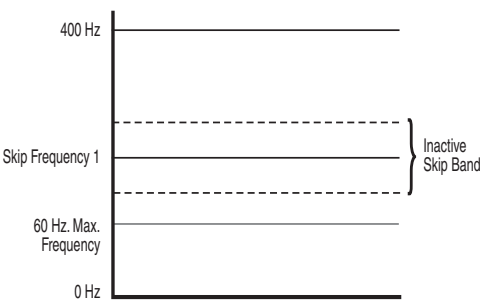
Some machinery may have a resonant operating frequency that must be avoided to minimize the risk of equipment damage. To assure that the motor cannot continuously operate at one or more of the points, skip frequencies are used. Parameters 084-086, ([Skip Frequency 1-3]) are available to set the frequencies to be avoided.

The value programmed into the skip frequency parameters sets the center point for an entire “skip band” of frequencies. The width of the band (range of frequency around the center point) is determined by parameter 87, [Skip Freq Band]. The range is split, half above and half below the skip frequency parameter.

If the commanded frequency of the drive is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive will set the output frequency to the high value of the band. See (A) in Figure C.4.

If the commanded frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive will set the output frequency to the low value of the band. See (B) in Figure C.4.

Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel will proceed through the band once the commanded frequency is greater than the skip frequency. See (A) & (B) in Figure C.4. This function affects only continuous operation within the band.

Skip Frequency Examples	
The skip frequency will have hysteresis so the output does not toggle between high and low values. Three distinct bands can be programmed. If none of the skip bands touch or overlap, each band has its own high/low limit.	
If skip bands overlap or touch, the center frequency is recalculated based on the highest and lowest band values.	
If a skip band(s) extend beyond the max frequency limits, the highest band value will be clamped at the max frequency limit. The center frequency is recalculated based on the highest and lowest band values.	
If the band is outside the limits, the skip band is inactive.	

Sleep Wake Mode

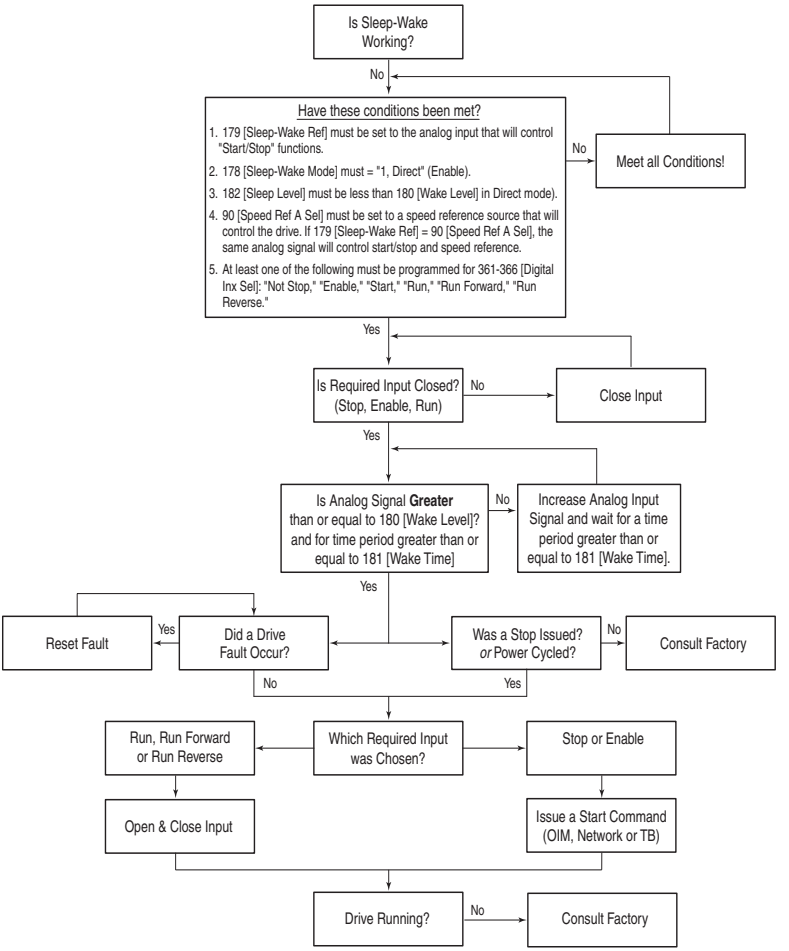
This function stops (sleep) and starts (wake) the drive based on separately configurable analog input levels rather than discrete start and stop signals. When enabled in “Direct” mode, the drive will start (wake) when an analog signal is greater than or equal to the user specified [Wake Level], and stop the drive when an analog signal is less than or equal to the user specified [Sleep Level].

Definitions

- Wake - A start command generated when the analog input value remains above [Wake Level] for a time greater than [Wake Time].
- Sleep - A Stop command generated when the analog input value remains below [Sleep Level] for a time greater than [Sleep Time].
- Speed Reference – The active speed command to the drive as selected by drive logic and [Speed Ref x Sel].
- Start Command - A command generated by pressing the Start button on the OIM, closing a digital input programmed for Start, Run, Run Forward or Run Reverse. The source is set by [Logic Source Sel].

Refer to Figure C.5.

Figure C.5 Sleep Wake Mode



Start At PowerUp

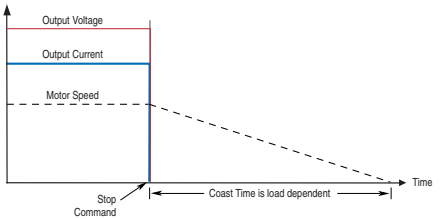
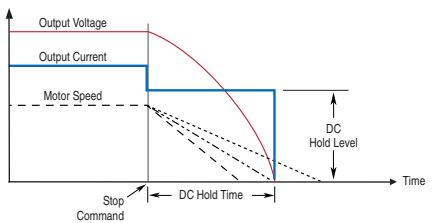
When Start At Powerup in 2 wire control is configured, the drive will start if all start permissive conditions are met (within 10 seconds of drive power being applied), and the terminal block start input (Run, Run Forward or Run Reverse for 2-wire) is closed. An alarm will be annunciated from application of power until the drive actually starts, indicating the powerup start attempt is in progress.

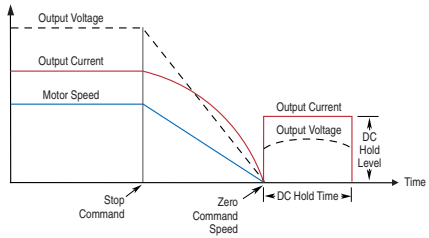
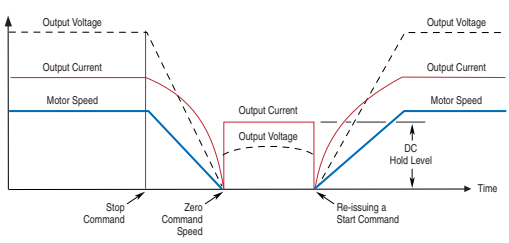
The powerup start attempt will be aborted if any of the following occurs anytime during the 10-second start interval:

- A fault condition occurs
- A Type 2 alarm condition occurs
- The terminal block programmed enable input is opened
- All terminal block run, run forward, or run reverse, inputs are canceled
- A Stop request (from any source) is received

If the drive has not started within the 10 second interval, the powerup start attempt will be terminated.

Stop Mode

Mode	Description
Coast to Stop	 This method releases the motor and allows the load to stop by friction. 1. On Stop, the drive output goes immediately to zero (off). 2. No further power is supplied to the motor. The drive has released control. 3. The motor will coast for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Brake to Stop	 This method uses DC injection of the motor to Stop and/or hold the load. 1. On Stop, 3 phase drive output goes to zero (off) 2. Drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “stopping” brake torque. If the voltage is applied for a time that is longer than the actual possible stopping time, the remaining time will be used to attempt to hold the motor at zero speed. 3. DC voltage to the motor continues for the amount of time programmed in [DC Brake Time] Par 159. Braking ceases after this time expires. 4. After the DC Braking ceases, no further power is supplied to the motor. The motor may or may not be stopped. The drive has released control. 5. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).

Mode	Description
Ramp to Stop	 This method uses drive output reduction to stop the load. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x] 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches zero the output is shut off. 4. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Ramp to Hold	 This method combines two of the methods above. It uses drive output reduction to stop the load and DC injection to hold the load at zero speed once it has stopped. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x] 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches zero 3 phase drive output goes to zero (off) and the drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “holding” brake torque. 4. DC voltage to the motor continues until a Start command is reissued or the drive is disabled. 5. If a Start command is reissued, DC Braking ceases and the drive returns to normal AC operation. If an Enable command is removed, the drive enters a “not ready” state until the enable is restored.

Notes:

E

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