



**ALLEN-BRADLEY**

# **Bulletin 1333 3/4–20 HP (.55–15 kW) Adjustable Frequency AC Drive**

(Series D)

User Manual



## Important User Information

Because of the variety of uses for this equipment and because of the differences between this solid-state equipment and electromechanical equipment, the user of and those responsible for applying this equipment must satisfy themselves as to the acceptability of each application and use of the equipment. In no event will Allen-Bradley Company be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The illustrations shown in this manual are intended solely to illustrate the text of this manual. Because of the many variables and requirements associated with any particular installation, the Allen-Bradley Company cannot assume responsibility or liability for actual use based upon the illustrative uses and applications.

No patent liability is assumed by Allen-Bradley Company with respect to use of information, circuits or equipment described in this text.

Reproduction of the content of this manual, in whole or in part, without written permission of the Allen-Bradley Company is prohibited.

The information in this manual is organized in numbered chapters. Read each chapter in sequence and perform procedures when you are instructed to do so. Do not proceed to the next chapter until you have completed all procedures.

Throughout this manual we use notes to make you aware of safety considerations:



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

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Attentions help you:

- Identify a hazard.
- Avoid the hazard.
- Recognize the consequences.

**Important:** Identifies information that is especially important for successful application and understanding of the product.



**Shock Hazard** labels may be located on or inside the drive to alert people that dangerous voltage may be present.

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## Summary of Changes

### Summary of Manual Changes

This release of the 1333-5.2 User Manual contains some new and corrected information. The new and corrected information is summarized in the table below. For further information, refer to the page numbers provided.

Description of New or Corrected Information	Page	Type
Drive Input Terminals	4-8	Correction
Recommended Wire Size and Torque	4-15	Correction
SW2 Factory Setting -- Figure 4-5	4-20	New
Terms 6 & 3 Analog Meter Output Meter Load Impedance	4-22	Correction
Terms 13 & 14 -- S1/4SP Terms 13 & 14 -- S2/4SP SW2 Factory Setting	4-24	New
Parameter 02 -- Deceleration Time 1		
From 00.01-1000 seconds . . . sets the decel time . . .	5-9	Correction
From 1000-1600 seconds . . . sets the decel time . . .	5-9	Correction
Local/Remote Control Enable		
If set to 0 . . . w Local Jog can be selected by . . . the Shift button.	5-14	Correction
If set to 2 . . . w Local Jog can be selected by . . . the Shift button.	5-15	Correction
1. SW2 Factory Setting	5-24	New
As shown in Figure 4-5 in Chapter 4		
If Parameter 19 = 0 When Control Board Switch SW2 is Set to . . .	5-25	Correction
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As shown in Figure 4-5 in Chapter 4		
If Parameter 19 = 0 and Parameter 20 = 0 When Control Board Switch SW2 is Set to . . .	5-26	Correction
If Parameter 19 = 1 and Parameter 20 = 0 When Control Board Switch SW2 is Set to . . .	5-26	Correction
If Parameter 19 = 2 and Parameter 20 = 0 When Control Board Switch SW2 is Set to . . .	5-26	Correction
As shown in Figure 4-5 in Chapter 4		
If Parameter 19 = 0 and Parameter 20 = 1 When Control Board Switch SW2 is Set to . . .	5-27	Correction
If Parameter 19 = 1 and Parameter 20 = 1 When Control Board Switch SW2 is Set to . . .	5-27	Correction
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## Manual Objective

This manual defines the installation, operation, startup and fault codes for the Allen-Bradley 1333 Series D Adjustable Frequency AC Drive. It is intended for use by personnel familiar with the functions of solid-state drive equipment. Also provided are interconnection drawings for 1333 options in Appendix A, and Bulletin 1333 Series D application data in Appendix D.

The 1333 Series D User Manual is designed to be read and used like an ordinary textbook. Read the manual once from the beginning in the order presented to gain basic knowledge about your drive. Each chapter builds upon information presented in the previous chapter. The majority of the information presented is arranged and written by drive function. Individual parameters in Chapter 5 are grouped under functional sub-headings (such as Accel and Decel Settings or Volts-per-Hertz Curve Settings), as is the startup procedure in Chapter 6. Appendix C provides paired parameter tables which are also grouped by function to graphically show parameter interaction.

To assure successful installation and operation, the material presented in each chapter must be thoroughly read and understood before proceeding to the next chapter. Particular attention should be directed to the Attention and Important statements contained within. Become familiar with tasks that must be performed in a sequence for safety and successful completion.

### Important Information about this Manual

This manual has been prepared primarily to support this product in a single application. It is a standard document that is intended to help the user understand the individual operating characteristics and limitations of this equipment including hazards associated with installation and setup procedures. Note the following points:

- This equipment has been designed to meet the requirements of a component in an integrated system.
- It must be noted that special considerations are to be given to characteristics of other peripheral solid-state control equipment and the cumulative impact on safety.
- Manufacturers and engineering groups responsible for specification or design of electrical control equipment must refer to applicable industry standards and codes for specific safety guidelines and interface requirements.
- In the actual factory environment, the user is responsible to assure compliance with applicable machine and operator safety codes or regulations which are beyond the scope and purpose of this document.

### General Precautions

In addition to the precautions listed throughout this manual, the following statements which are general to the system must be read and understood.



**ATTENTION:** Only personnel familiar with the 1333 AC Drive 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:** This assembly may contain parts and sub-assemblies that are sensitive to electrostatic discharge. Static control precautions are required when testing, servicing or repairing this assembly. Component damage may result if you ignore electrostatic discharge control procedures. If you are not familiar with static control procedures, reference Allen-Bradley Publication 8000-4.5.2, Guarding Against Electrostatic Damage or any other applicable ESD protection handbook.



**ATTENTION:** An incorrectly applied or installed system can result in component damage or 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.

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## **Repair or Repair/Exchange Procedure**

For your convenience, the Allen-Bradley Standard Drives Division, and the Allen-Bradley Support Division, provide an efficient and convenient method of returning equipment eligible for repair or repair/exchange.

A product service report number is required to return any equipment for repair. This may be obtained from your local Allen-Bradley Distributor or Area Sales/Support Office.

Return any equipment to be repaired to the Area Sales/Support Center nearest you. Be sure to reference the product service report number on the carton and packing slip. Include your company name and address, your repair purchase order number and a brief description of the problem. This will facilitate quick return of your equipment.

A complete listing of Area Sales/Support Centers is available from your local Allen-Bradley Distributor or Sales Office.

## Pre-Installation Care

Before installing and operating your 1333 Series D drive, carefully read this manual and observe all precautions. The catalog number of your drive as explained in Chapter 2 — Drive Identification lists the drive rating, type of enclosure, nominal line voltage, phase and frequency. Specifications for all drives including standard controls, adjustment range, diagnostics and environmental qualifications are listed in Chapter 3 — Specifications.

### Receiving

Once you have received your drive, careful inspection for shipping damage must be made. Damage to the shipping carton is usually a good indication that it has received improper handling. Any and all damage should be immediately reported to the freight carrier and your nearest Allen-Bradley Area Sales/Support Center.

Carefully unpack the drive, taking care to save the shipping carton and any packing material should return be necessary. Verify that the items on the packing list or bill of lading agree with your order.

### Storage

If the drive will not immediately be installed, it should be stored in a clean, dry area where the ambient temperature is not less than  $-25^{\circ}\text{C}$  nor more than  $+65^{\circ}\text{C}$ . The drive must not be stored in a corrosive environment nor subject to conditions in excess of the storage environment parameters stated in Chapter 3 — Specifications.

### Shipping

The carton and materials that came with your drive have been designed and tested to provide reasonable protection against damage during transit. Should the drive be shipped to another location, it is recommended that the original shipping carton and packing material be used to protect the drive from damage in transit.





**ATTENTION:** This assembly contains parts and sub-assemblies that are sensitive to electrostatic discharge. Static control precautions are required when servicing this assembly. Component damage may result if you ignore electrostatic discharge control procedures. If you are not familiar with static control procedures, reference Allen-Bradley Publication 8000-4.5.2, Guarding Against Electrostatic Damage, or any other applicable ESD protection handbook.

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## **Electrostatic Discharge Precautions**

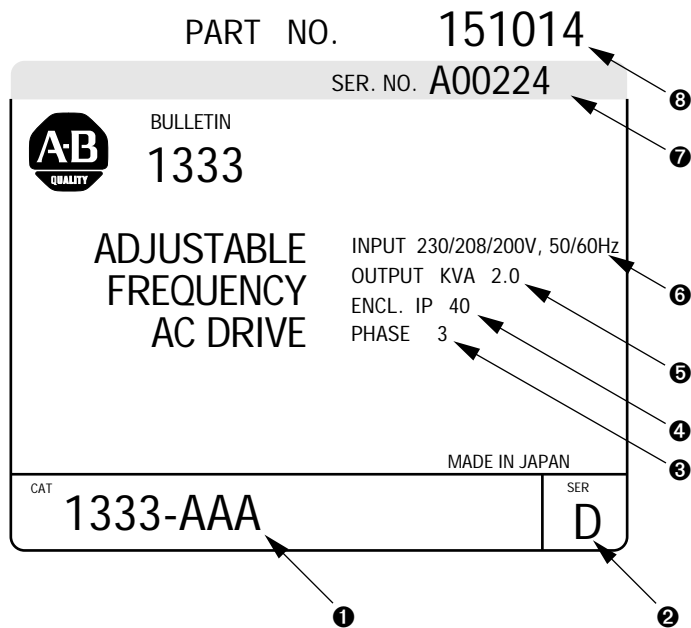
Electrostatic discharge generated by static electricity can damage the complimentary metallic oxide semiconductor devices on various drive boards. It is recommended that you perform these procedures to guard against this type of damage when circuit boards are removed or installed:

- Wear a wrist type grounding strap that is grounded to the drive chassis.
- Attach the wrist strap before removing the new circuit board from the conductive packet.
- Remove boards from the drive and immediately insert them into their conductive packets.

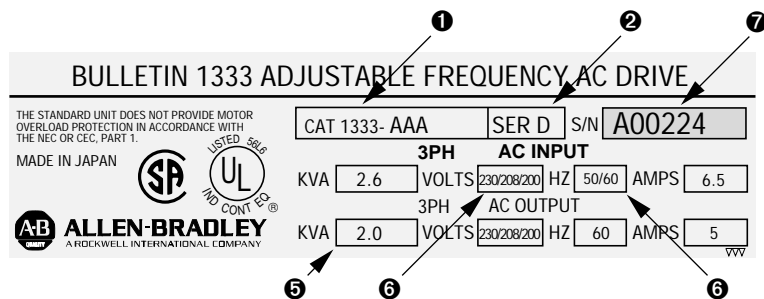
## Drive Identification

The following is an explanation of the catalog numbering system and information provided on the Bulletin 1333 Series D shipping carton label and drive nameplate.

### The 1333 Shipping Carton Label



### The 1333 Drive Nameplate



## ① Drive Catalog Numbers

1333	—	Z	—	A	—	A
Bulletin Number		Drive Rating		Enclosure Type		Input Voltage

The first letter indicates the drive rating.

200/208/230V AC, 3-Phase, 50/60 Hertz Input Voltage

Rating Code	Nominal HP	Nominal kW
ZAA	3/4	.55
AAA	1	.75
YAA	2	1.5
BAA	3	2.2
CAA	5	4
DAA	7 1/2	5.5
EAA	10	7.5
FAA	15	11
GAA	20	15

380/415/460V AC, 3-Phase, 50/60 Hertz Input Voltage

Rating Code	Nominal HP	Nominal kW
AAB	1	.75
YAB	2	1.5
BAB	3	2.2
CAB	5	4

The second letter indicates the type of enclosure as initially shipped from the factory.

A — NEMA Type 1 (IP20).

The third letter indicates drive input voltage.

Drives with the code "A" are suitable for operating from any one of the following voltage inputs:

200/208/230V AC, 50/60 Hz, 3-phase Nominal Voltage.

200/208/230V AC, 50/60 Hz, 1-phase Derated Voltage.

Drives with the code "B" are suitable for operating from any one of these voltage inputs: 380/415/460V AC, 50/60 Hz, 3-phase.

② Drive Series Number

Series D.

③ Drive Input/Output Power

3-Phase.

④ Drive Enclosure Rating

NEMA Type 1 (IP 20).

⑤ Drive Output kVA

Listed in Chapter 3, pg. 3-2.

⑥ Drive Input Voltage Rating

Explained above.

⑦ Drive Serial Number

Internal factory code.

⑧ Drive Part Number

Internal factory code.

## Specifications

### Operating Environment

Temperature:	-10 to + 50°C (+14 to +122°F).
Relative Humidity:	5 to 95% non-condensing.
Altitude:	3,300 feet (1,000 meters) maximum without derating.
Vibration:	Below 0.5G, 0.8 mm peak-to-peak amplitude, x-y-z direction.
Shock:	16G peak for 11ms duration.

### Storage Environment

Temperature:	-25 to +65°C (-13 to +149°F)
Relative Humidity:	5 to 95% non-condensing.

### Enclosure

NEMA Type 1 (IP20).  
Indicated by catalog number.

### Input Power Specifications

Drive Rating	ZAA-GAA	AAB-CAB
Voltage: ± 10%	200-230V AC, ± 10%	380-460V AC,
Frequency:	50/60 Hz, ± 5%	50/60 Hz, ± 5%
Phase:	1 or 3-phase	3-phase
Bus Overvoltage Trip:	430V DC	820V DC
Bus Undervoltage Trip:	160V DC	310V DC
Bus Overcurrent Trip:	200% IET	
Power Ride-Thru:	15 ms or longer depending on the load.	
Control Ride-Thru:	100 ms or longer depending on the load.	
Control Logic Noise Immunity:	Showering arc transients from 350 to 2,000 volts.	

**Standard Three-Phase Data  
Input Current, Output Current  
and kVA**

**200/208/230V AC, 3-Phase, 50/60 Hertz Input Voltage**

Rating Code	Nominal HP	Nominal kW	200V AC 208V AC 230V AC				200V AC 208V AC 230V AC				Total Heat Dissipated Watts (BTU/hr)	
			Input Amps	Input kVA	Input kVA	Input kVA	Output Amps	Output kVA	Output kVA	Output kVA		
ZAA	3/4	.55	4.1	1.4	1.5	1.6	3.2	1.1	1.2	1.3	80	273
AAA	1	.75	6.5	2.3	2.4	2.6	5.0	1.7	1.8	2.0	100	341
YAA	2	1.5	9.0	3.1	3.2	3.6	8.0	2.8	2.9	3.2	170	580
BAA	3	2.2	14.0	4.8	5.0	5.6	11.0	3.8	4.0	4.4	250	853
CAA	5	4	22.0	7.6	7.9	8.8	17.5	6.1	6.3	7.0	360	1228
DAA	7 1/2	5.5	27.0	9.3	9.7	10.8	24.0	8.3	8.7	9.7	425	1449
EAA	10	7.5	37.0	12.8	13.3	14.7	33.0	11.5	11.9	13.3	480	1637
FAA	15	11	47.0	16.3	16.9	18.8	45.0	15.6	16.2	18.1	565	1927
GAA	20	15	62.0	21.5	22.3	24.7	61.0	21.1	22.0	24.6	610	2080

**380/415/460V AC, 3-Phase, 50/60 Hertz Input Voltage**

Rating Code	Nominal HP	Nominal kW	380V AC 415V AC 460V AC				380V AC 415V AC 460V AC				Total Heat Dissipated Watts (BTU/hr)	
			Input Amps	Input kVA	Input kVA	Input kVA	Output Amps	Output kVA	Output kVA	Output kVA		
AAB	1	.75	3.3	2.2	2.4	2.6	2.1	1.4	1.5	1.7	100	341
YAB	2	1.5	4.5	3.0	3.2	3.6	4.0	2.6	2.9	3.2	170	580
BAB	3	2.2	8.0	5.3	5.8	6.4	6.0	3.9	4.3	4.8	250	853
CAB	5	4	13.0	8.6	9.3	10.4	9.4	6.2	6.8	7.5	370	1262

**Derated Single-Phase Data ①  
Input Current, Output Current  
and kVA**

**200/208/230V AC, 1-Phase, 50 Hertz Input Voltage**

Rating Code	Nominal HP	Nominal kW	200V AC 208V AC 230V AC				200V AC 208V AC 230V AC				Total Heat Dissipated Watts (BTU/hr)	
			Input Amps	Input kVA	Input kVA	Input kVA	Output Amps	Output kVA	Output kVA	Output kVA		
ZAA	1/2	.37	5.7	1.1	1.2	1.3	2.4	0.8	0.9	1.0	80	273
AAA	3/4	.55	7.7	1.5	1.6	1.8	3.4	1.2	1.2	1.4	100	341
YAA	1	.75	8.8	1.8	1.8	2.0	4.5	1.6	1.6	1.8	170	580
BAA	1 1/2	1.1	11.9	2.4	2.5	2.7	5.4	1.9	1.9	2.2	250	853
CAA	2	1.5	17.3	3.5	3.6	4.0	7.7	2.7	2.8	3.1	360	1228
DAA	3	2.2	21.4	4.3	4.5	4.9	11.0	3.8	4.0	4.4	425	1449
EAA	5	4	29.1	5.8	6.1	6.7	15.0	5.2	5.4	6.0	480	1637
FAA	7 1/2	5.5	38.0	7.6	7.9	8.7	21.0	7.3	7.6	8.4	565	1927
GAA	10	7.5	49.3	9.9	10.3	11.3	28.0	9.7	10.1	11.2	610	2080

**200/208/230V AC, 1-Phase, 60 Hertz Input Voltage**

Rating Code	Nominal HP	Nominal kW	200V AC 208V AC 230V AC				200V AC 208V AC 230V AC				Total Heat Dissipated Watts (BTU/hr)	
			Input Amps	Input kVA	Input kVA	Input kVA	Output Amps	Output kVA	Output kVA	Output kVA		
ZAA	1/2	.37	6.2	1.2	1.3	1.4	2.6	0.9	0.9	1.0	80	273
AAA	3/4	.55	8.6	1.7	1.8	2.0	3.8	1.3	1.4	1.5	100	341
YAA	1	.75	9.5	1.9	2.0	2.2	4.9	1.7	1.8	2.0	170	580
BAA	1 1/2	1.1	13.0	2.6	2.7	3.0	5.9	2.0	2.1	2.4	250	853
CAA	2	1.5	18.8	3.8	3.9	4.3	8.4	2.9	3.0	3.3	360	1228
DAA	3	2.2	23.4	4.7	4.9	5.8	12.0	4.2	4.3	4.8	425	1449
EAA	5	4	31.1	6.2	6.5	7.1	16.0	5.5	5.8	6.4	480	1637
FAA	7 1/2	5.5	41.6	8.3	8.7	9.6	23.0	10.0	8.3	9.2	565	1927
GAA	10	7.5	54.6	10.9	11.4	12.6	31.0	10.7	11.2	12.3	610	2080

① .200/208/230V AC units may be derated for single phase input power The single phase will not appear on the shipping carton label or the drive nameplate.

## Load Requirements

A balanced 3-phase inductive motor load is typical. Other motor loads may require application assistance.

## Output Power Specifications

Waveform:	Sine coded pulse width modulated waveform.
Voltage: 208V AC,  AC,	<p><b>Drive Rating ZAA-GAA</b> 0 to applied input voltage, 200V AC,  or 230V AC — maximum output voltage cannot exceed applied input voltage.</p> <p><b>Drive Rating AAB-CAB</b> 0 to applied input voltage, 380V AC, 415V  or 460V AC — maximum output voltage cannot exceed applied input voltage.</p>
Frequency Range:	<p>Programmable Min and Max Limits 0 to 400 Hz remote frequency command. 0.5 to 400 Hz local frequency command.</p>
Frequency Regulation:	± 0.5% of selected maximum output frequency –10 to +50°C ambient temperature range.
Accel/Decel:	Four independently programmable accel times. Four independently programmable decel times. Each time may be programmed over a range from 0.1 to 1600 seconds. If 0 is entered, the drive will default to 40 ms.
Accel Stall Protection:	140% of rated current.
Decel Stall Protection:	380V DC for 230V AC drive input voltage. 760V DC for 460V AC drive input voltage.
Volts-per-Hertz:	Selectable constant or square v/Hz curves.
DC Boost:	0-40% of maximum output voltage adjustable in 1% increments.

Starting Torque:	150% nominal at 5 Hz.
Braking Torque:	DC Brake: 20% of rated torque (standard) programmable duration and voltage Heavy Duty Dynamic Brake: 100% of rated torque.
Stopping Frequency:	0.5-60 Hz
Intermittent Overload Capability:	Standard: 140% of rated output current for 1 minute. Inverse Trip: 125% of programmable overload trip level for one minute.
Drive Overload Trip:	Programmable overload trip function set to motor nameplate value.
Ground Fault:	Current sensors detect output ground fault at drive output leads.

### Frequency Control Inputs

Digital Input Frequency Resolution:	<b>Local Speed Control</b> 0.01 Hz up to 100 Hz. 0.1 Hz over 100 Hz.
Analog Input Frequency Resolution:	<b>Remote Speed Pot</b> (Control Terminal Block, Terminals 1, 2 and 3) 0.1 Hz up to 100 Hz. 0.2 Hz up to 200 Hz. 0.5 Hz over 200 Hz.
	<b>0-5V DC Input</b> (Control Terminal Block, Terminals 3 and 4) 0.1 Hz up to 100 Hz. 0.2 Hz up to 200 Hz. 0.5 Hz over 200 Hz.
	<b>0-10V DC Input</b> (Control Terminal Block, Terminals 3 and 4) 0.1 Hz up to 100 Hz. 0.2 Hz up to 200 Hz. 0.5 Hz over 200 Hz.
	<b>4-20 mA Input</b> (Control Terminal Block, Terminals 3 and 5) 0.1 Hz up to 100 Hz. 0.2 Hz up to 200 Hz. 0.5 Hz over 200 Hz.

## Required Control Inputs

As a minimum requirement for drive operation, the following four control inputs must be present to operate the drive:

### Start

A momentary contact closure will start the drive. The drive will continue to run until a stop input is issued or a drive fault occurs. A start input may come from:

- Either of the Local Control Panel directional start pushbuttons.
- A user supplied N.O. contact or start switch connected to the Control and Signal Wiring Terminal Block.

### Stop

A momentary open contact will stop the drive. A N.C. contact will permit the drive to run or jog. A stop input may come from:

- The Local Control Panel stop pushbutton.
- A user supplied N.C. contact or stop switch connected to the Control and Signal Wiring Terminal Block.

### Auxiliary Interlock

A maintained closed contact will permit the drive to start, run, or jog. A momentary open contact will disable drive output. An auxiliary input may come from:

- The factory installed metal jumper between terminals 16 and 17 of the Control and Signal Wiring Terminal Block.
- A user supplied N.C. contact or switch wired to terminals 16 and 17 when the factory supplied jumper is removed.

### Speed Reference

A speed reference sets the drive operating frequency. A speed reference input may come from:

- Either of the Local Control Panel directional start pushbuttons.
- A user supplied 10k $\Omega$ , 2W remote speed potentiometer connected to the Control and Signal Wiring Terminal Block.
- A 0-5V DC analog signal connected to the Control and Signal Wiring Terminal Block.
- A 0-10V DC analog signal connected to the Control and Signal Wiring Terminal Block.
- A 4-20 mA analog signal connected to the Control and Signal Wiring Terminal Block.
- 1-3 programmable preset speed switches connected to the Control and Signal Wiring Terminal Block. Through programming, a total of seven preset speeds may be selected.



### Optional Remote Control Inputs

The following optional inputs may be connected to the Series D Bulletin 1333 drive at the Control and Signal Wiring Terminal Block.

Two or Three-Wire Start/Stop Control

Forward Reverse Control

Jog

Three Programmable Preset Speed Select Switches

Auxiliary Interlock

### Contact Outputs

The following contact outputs are available as standard. Contacts are isolated from Logic Common and other drive circuitry and have the following ratings.

Resistive rating: 120V AC or 30V DC, 1 Amp.

Inductive rating: 120V AC or 30V DC, 0.5 Amps.

At Speed: 1 N.O. contact, closed when the drive is at or above command speed

Run or Overload: 1 N.O. contact closed when the drive is running, at programmed speed, at 140% of rated output current, or over the programmable overload level.

No Fault/Fault: 1 set of Form C contacts that change state to indicate that the drive has received a fault or that a fault is present when the drive is powered up.

### Analog Outputs

0-10V DC or 0-1 mA output programmable from 75-125% of running frequency.

### Drive Displays

Local Programming and Display Panel: Displays drive output frequency, equivalent motor speed, drive output amps and drive control source. May be toggled to program and display 62 drive parameters. Should a fault occur while the drive is running, the panel will display the fault code.

Bus Charged: Internal neon display to indicate bus voltage is greater than 50V DC.

## Installation and Wiring

### General Input Power Conditioning

The Series D 1333 is suitable for direct connection to a correct voltage AC power line. There are however certain power line conditions which may introduce the possibility of drive input power component malfunction. To reduce the possibility of these malfunctions, a line reactor or isolation type transformer may be required. If the use of an input transformer is desired, only an isolation type transformer should be used.

The basic rules for determining if a line reactor or isolation type transformer is required are as follows:

1. If the AC line supplying the drive has power factor correction capacitors connected, an AC line reactor or isolation type transformer must be connected between the capacitor bank and the input to the drive.
2. If the AC line frequently experiences transient power interruptions or significant voltage spikes, an AC line reactor or isolation type transformer should be used.

### General Installation Requirements



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

- Wiring the AC line to the drive output or control terminals.
- Improper bypass or output circuits.
- Output circuits which do not connect directly to the motor.
- Incorrect or inadequate AC supply.
- Excessive ambient temperature.

Contact Allen–Bradley for assistance with application or wiring.

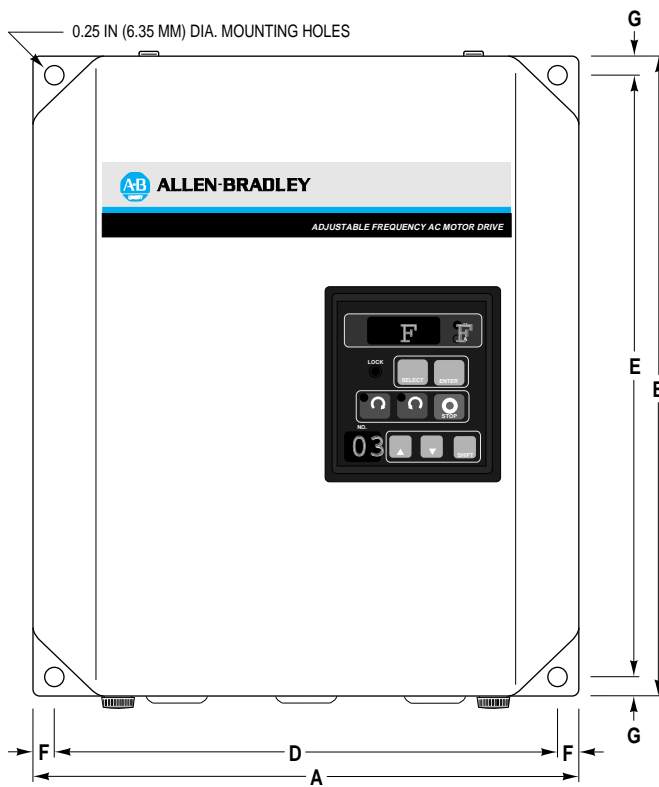
Before actual installation, remove all packing material, wedges or braces from within and around the drive. The 1333 must be installed in an area where the following installation and environmental guidelines are met.

- Cabinet mounting must be upright, leaving room for a minimum clearance of 4 inches (102 mm) on the top and bottom and 2 inches (51 mm) on the sides for proper ventilation.
- The drive should be easily accessible for maintenance and troubleshooting.
- The rated altitude must not exceed 3,300 feet (1,000 meters).
- Vibration must be within the ratings outlined in Chapter 3 – Specifications.
- The ambient atmosphere must not contain volatile or corrosive gas, vapors or dust.
- The relative humidity must not exceed 95% for all drive ratings.
- The ambient temperature for the drive must be kept within  $-10$  to  $+50^{\circ}\text{C}$  for all ratings.

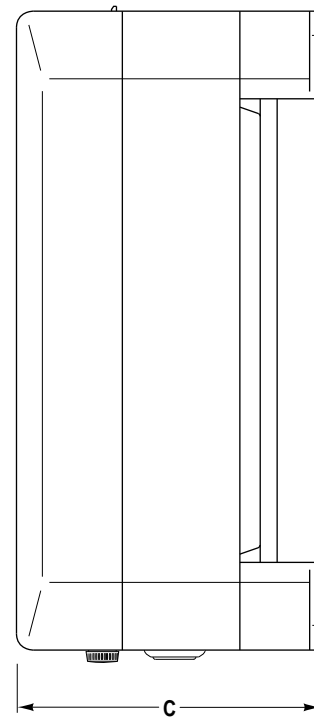
### ZAA-CAA 230V Dimensions, Weights and Conduit Entry Locations

Nominal Dimensions and Weights in Inches (Millimeters) and Pounds (Kilograms)

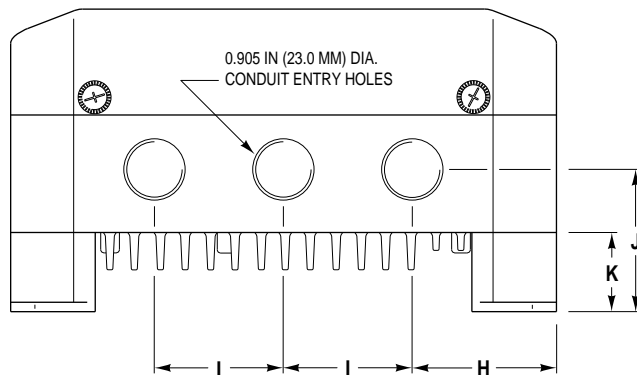
HP	kW	Rating Code	A	B	C	D	E	F	G	H	I	J	K	Weight
3/4, 1	.55, .75	ZAA, AAA	8.90 (226)	10.04 (255)	4.72 (120)	8.27 (210)	9.45 (240)	0.30 (8)	0.30 (8)	2.48 (63)	1.97 (50)	2.24 (57)	1.26 (32)	6.0 (2.7)
2	1.5	YAA	8.90 (226)	11.26 (286)	5.31 (135)	8.27 (210)	10.63 (270)	0.30 (8)	0.30 (8)	2.48 (63)	1.97 (50)	2.83 (72)	1.85 (47)	8.0 (3.6)
3, 5	2.2, 4	BAA, CAA	10.20 (259)	13.54 (344)	6.90 (175)	9.45 (240)	12.80 (325)	0.30 (8)	0.30 (8)	3.13 (80)	1.97 (50)	4.13 (105)	2.80 (71)	20.0 (9.1)



(NEMA Type 1 — Front)



(NEMA Type 1 — Side)

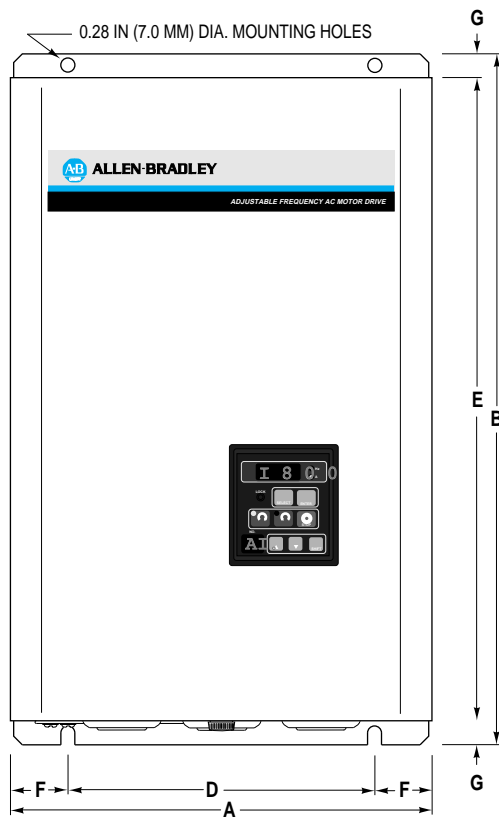


(NEMA Type 1 — Bottom)

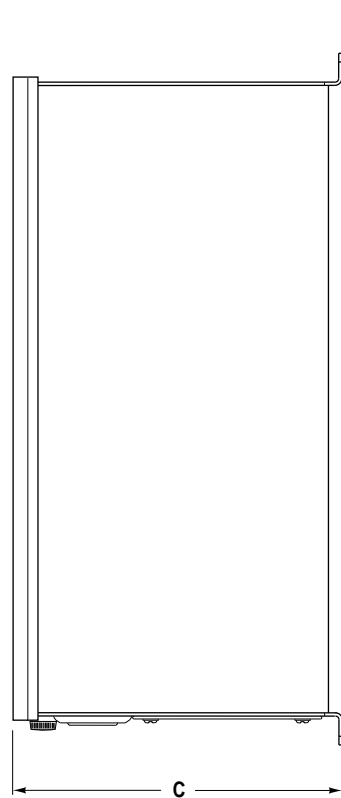
### DAA-GAA 230V Dimensions, Weights and Conduit Entry Locations

Nominal Dimensions and Weights in Inches (Millimeters) and Pounds (Kilograms)

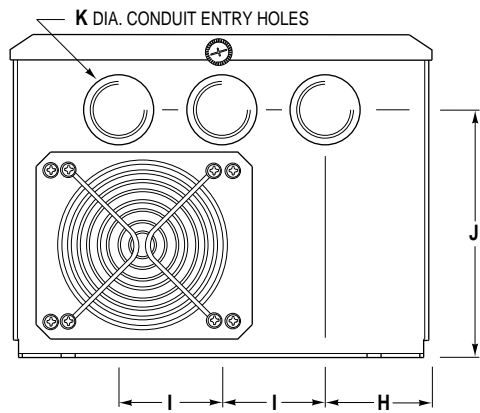
HP	kW	Rating Code	A	B	C	D	E	F	G	H	I	J	K	Weight
7 1/2, 10	5.5, 7.5	DAA, EAA	10.63 (270)	17.72 (450)	8.27 (210)	7.87 (200)	17.13 (435)	1.38 (35)	0.30 (8)	2.76 (70)	2.56 (65)	6.31 (160)	1.38 (35)	30.0 (13.6)
15, 20	11, 15	FAA, GAA	10.63 (270)	21.65 (550)	8.27 (210)	7.87 (200)	21.06 (535)	1.38 (35)	0.30 (8)	2.76 (70)	2.56 (65)	6.31 (160)	1.72 (43.8)	43.0 (19.5)



(NEMA Type 1 — Front)



(NEMA Type 1 — Side)



(NEMA Type 1 — Bottom)

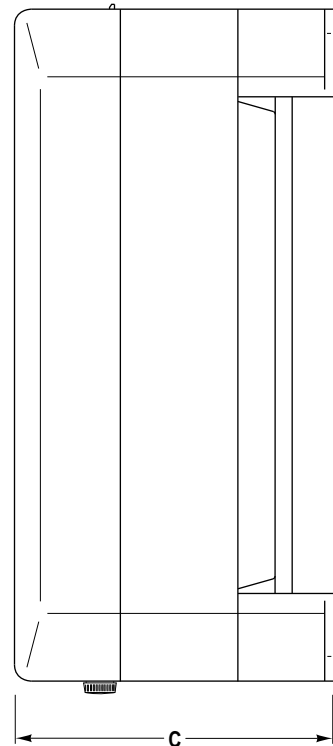
### AAB-CAB 460V Dimensions, Weights and Conduit Entry Locations

Nominal Dimensions and Weights in Inches (Millimeters) and Pounds (Kilograms)

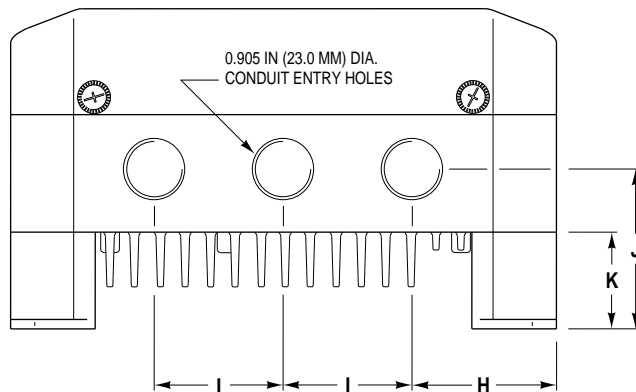
HP	kW	Rating Code	A	B	C	D	E	F	G	H	I	J	K	Weight
3/4, 1	.55, .75	AAB	8.90 (226)	11.26 (286)	5.31 (135)	8.27 (210)	10.63 (270)	0.30 (8)	0.30 (8)	2.48 (63)	1.97 (50)	2.83 (72)	1.85 (47)	9.0 (4.1)
2	1.5	YAB	8.90 (226)	11.26 (286)	5.31 (135)	8.27 (210)	10.63 (270)	0.30 (8)	0.30 (8)	2.48 (63)	1.97 (50)	2.24 (57)	1.26 (32)	9.0 (4.1)
3, 5	2.2, 4	BAB, CAB	10.20 (259)	13.54 (344)	6.90 (175)	9.45 (240)	12.80 (325)	0.30 (8)	0.30 (8)	3.13 (80)	1.97 (50)	4.13 (105)	2.80 (71)	20.0 (9.1)



(NEMA Type 1 — Front)



(NEMA Type 1 — Side)



(NEMA Type 1 — Bottom)

## General Wiring Procedures



**ATTENTION:** Do not proceed without reading the information on this page. Failure to understand procedures and hazards may result in personal injury or equipment damage.

1. The National Electrical Code requires that a circuit breaker or fusible disconnect switch be provided in the drive branch circuit. Providing drive input fusing alone is not sufficient to meet NEC guidelines. The 1333 does not provide this requirement. Selection of a branch circuit breaker or fusible disconnect should be based on the drive input current rating. Refer to the 3-Phase and 1-Phase Power Terminal Block Wiring sections in this chapter for mandatory AC input fusing recommendations for drive short circuit protection.
2. The National Electrical Code requires that motor overload protection be provided in the motor branch circuit. Parameter 6 when used with Parameter 7 provides motor overload protection. NEC however, recognizes this protection as being provided by eutectic alloy or bi-metal overload relays. If it necessary to meet NEC motor branch protection approval, eutectic alloy, bi-metal overload relays or an equivalent should be installed. Refer to article 430 of the NEC and any additional codes for specific requirements and additional information.
3. The National Electrical Code and local regulations govern the installation and wiring of the 1333. All input and output power wiring, control wiring and conduit must be brought through the drive conduit entry holes provided on the enclosure. Connections to the drive must be made as shown in the following sections and in accordance with the drive nameplate, National Electrical Code requirements and any additional interconnection diagrams packed with the drive.
4. The voltage on each phase of the incoming line to the drive must match the drive input rating. Verify the drive rating by referring to the input voltage listed on the drive nameplate. If the incoming line voltage is out of this tolerance, equipment may be damaged or fail to operate.
5. If multiple drives are used, do not use common cabling for AC input or output leads. If multiconductor cable is used, separate 3-conductor input and output cable for each drive must be used.
6. All signal wiring must be run separate from power or control wiring. Verify that shielded cable and/or conduit is used if indicated on any interconnection diagrams or in the following sections. If shielded cable is required, shields must be grounded at the drive end only at one of the drive ground lugs provided.
7. Nearby relays, solenoids or brake coils can produce electrical noise transients and cause erratic drive behavior. Transient suppression networks must be added across the coils of these devices.
8. Since most startup difficulties result from incorrect wiring, every precaution should be taken to assure that the wiring is as indicated on the diagrams and information packed with the drive.

**Wire Group Numbers**

The following chart identifies general wire categories that will be encountered when installing the 1333 and other AC drives. Each category has an associated wire group number that is used in the following sections to identify the wire to be used. Application and signal examples along with the recommended type of cable for each group is provided. A matrix providing the recommended minimum spacing between different wire groups run in the same tray or separate conduit is also provided.

Wire Category	Wire Group	Application	Signal Example	Recommended Cable	For Tray: Recommended minimum spacing between different wire groups in the same tray						
					Wire Group	Power 1	Power 2	Control 3	Control 4	Signal 5	Signal 6
Power	1	AC Power (> 600 V AC)	2.3 kV, 3j AC Lines	3-Conductor Cable Per NEC Local Codes and Application Requirements	In Tray	9.00 (228.6)	9.00 (228.6)	9.00 (228.6)	9.00 (228.6)		
					Between Conduit	3.00 (76.2) Between Conduit					
	2	AC Power (to 600 V AC)	480V, 3j ❶	Per NEC Local Codes and Application Requirements	In Tray	9.00 (228.6)	9.00 (228.6)	6.00 (152.4)	6.00 (152.4)		
					Between Conduit	3.00 (76.2) Between Conduit					
Control	3	115V AC or 115V DC Logic	Relay Logic PLC I/O	Per NEC Local Codes and Application Requirements	In Tray	9.00 (228.6)	6.00 (152.4)	9.00 (228.6)	6.00 (152.4)		
		115V AC Power	Power Supplies Instruments		Between Conduit	3.00 (76.2) Between Conduit					
	4	24V AC or 24V DC Logic	PLC I/O	Per NEC Local Codes and Application Requirements	In Tray	9.00 (228.6)	6.00 (152.4)	6.00 (152.4)	9.00 (228.6)		
					Between Conduit	3.00 (76.2) Between Conduit					
Signal	5	Analog Signals DC Supplies	5-24V DC Supplies	Belden 8760 Belden 8770 Belden 9460	All signal wiring must be run in separate steel conduit. A wire tray is not suitable.  The minimum spacing between conduit containing different wire groups is 3.00 inches (78.2 mm).						
		Digital (Low Speed)	Power Supplies TTL Logic Level								
	6	Digital (High Speed)	Pulse Train Input	Belden 8760 Belden 9460							

❶ Refer to precautions in General Wiring Procedures concerning multi-conductor cables.

Belden 8760 — 18 AWG, twisted pair, shielded.

Belden 8770 — 18 AWG, 3 conductor, shielded.

Belden 9460 — 18 AWG, twisted pair, shielded.

Note 1 Steel conduit is recommended for all 1333 power or control wiring and required for all 1333 signal wiring. All input and output power wiring, control wiring or conduit should be brought through the drive conduit entry holes provided. Use appropriate connectors to maintain the environmental rating of the enclosure.

Note 2 Spacing between wire groups is the recommended minimum for parallel runs of 200 feet or less.

Note 3 All shields for shielded cable must be grounded at the drive end only, at one of the ground terminal lugs provided -- The other end must be insulated and remain floating. Shields for cables from one enclosure to another must be grounded only at the enclosure nearest the drive. If splicing of shielded cables is required, the shield must remain continuous and insulated from ground.

Note 4 AC and DC circuits must be run in separate conduit or trays.

Note 5 A voltage drop in motor leads may adversely affect motor starting and running performance. Installation and application requirements may dictate larger wire sizes than indicated in the NEC guidelines.

## Terminal Block Power Wiring

### Important:

1. The 1333 does not provide input power short circuit fusing. Specifications for the recommended fuse size and type to provide drive input power protection against short circuits are provided on the following pages. Branch circuit breakers or disconnect switches cannot provide this level of protection for drive components.
2. Each Bulletin 1333 must have its own dedicated input and output power leads. If multiconductor cable is used, separate 3-conductor input and output cable for each drive must be used.
3. For multimotor operation, the combined total of motor full load current must not exceed the rated output current of the drive.
4. Verify that the motor windings are properly connected to receive the full drive output voltage rating.



### ATTENTION:

1. Any disconnecting means wired to drive output terminals  $U_{/T1}$ ,  $V_{/T2}$  and  $W_{/T3}$  must be capable of stopping the drive if opened during drive operation. If opened during drive operation, the drive will continue to produce output voltage into an open motor circuit causing a potential shock hazard.
2. The start/stop control circuitry in the 1333 includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hard wired stop circuit is required to remove AC line power to the drive. When AC input power is removed, there will be a loss of inherent regenerative braking effect and the motor will coast to a stop. An auxiliary braking method may be required.

The 1333 is intended to be controlled by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies line power to the drive for the purpose of starting and stopping the motor must not be used. After a hard wired stop has been initiated, allow at least five minutes before reapplying input power to the drive. The allowable number of hard wired start/stops are 1 cycle within a 5 minute period. Wait 5 minutes before attempting the next hard wired stop cycle to allow the drive precharge resistors to cool.

Refer to codes and standards applicable to your particular system for specific requirements and additional information.

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**3/4-5 HP (.55-4 kW)  
Terminal Block Power Wiring**

Input and output power connections are marked on the drive Power Terminal Block. The Power Terminal Block is an eight position terminal block located at the bottom of the Main Control Board. For maintenance and setup procedures, the drive may be operated without a motor connected.

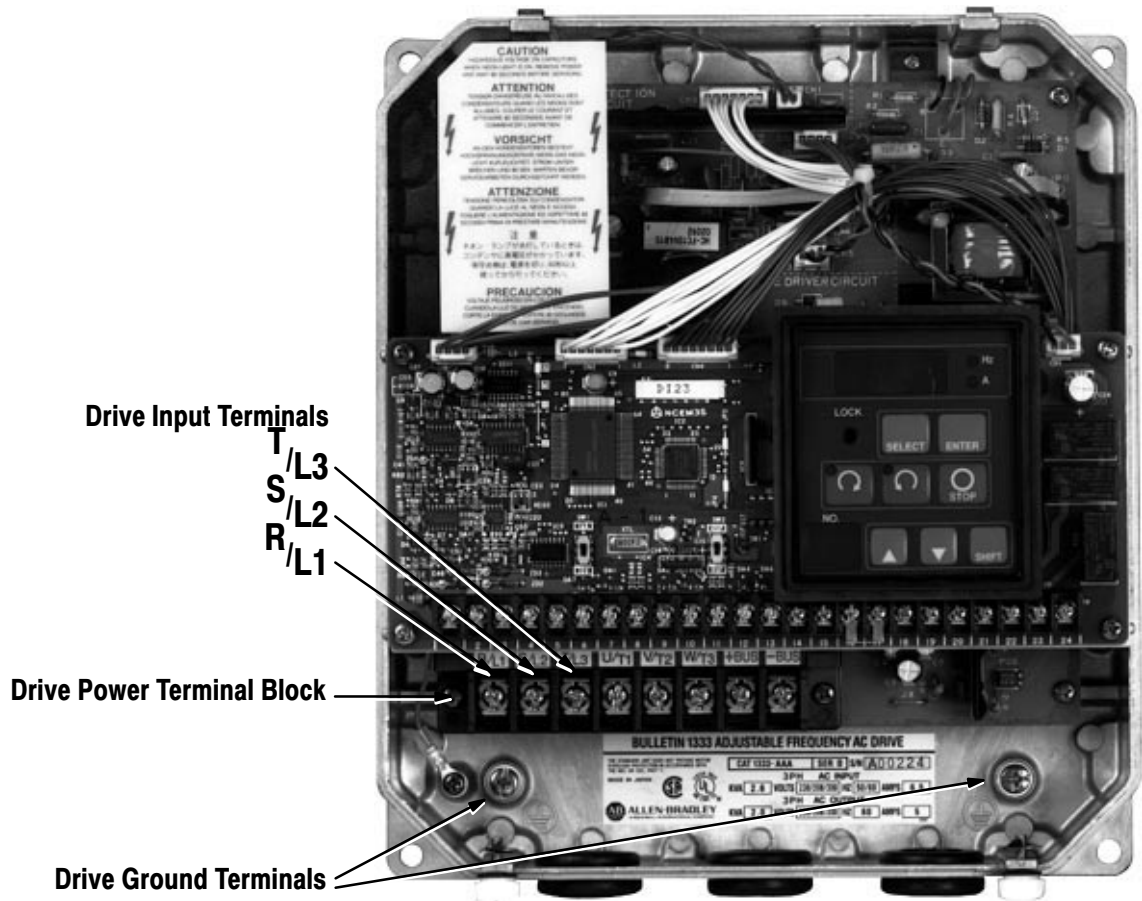


Figure 4-1 -- 3/4-5 HP (.55-4 kW) Terminal Block Power Wiring

**7 1/2-20 HP (5.5-15 kW)  
Terminal Block Power Wiring**

Input and output power connections are marked on the drive Power Terminal Block. The Power Terminal Block is an eight position terminal block located at the bottom of the drive. For maintenance and setup procedures, the drive may be operated without a motor connected.

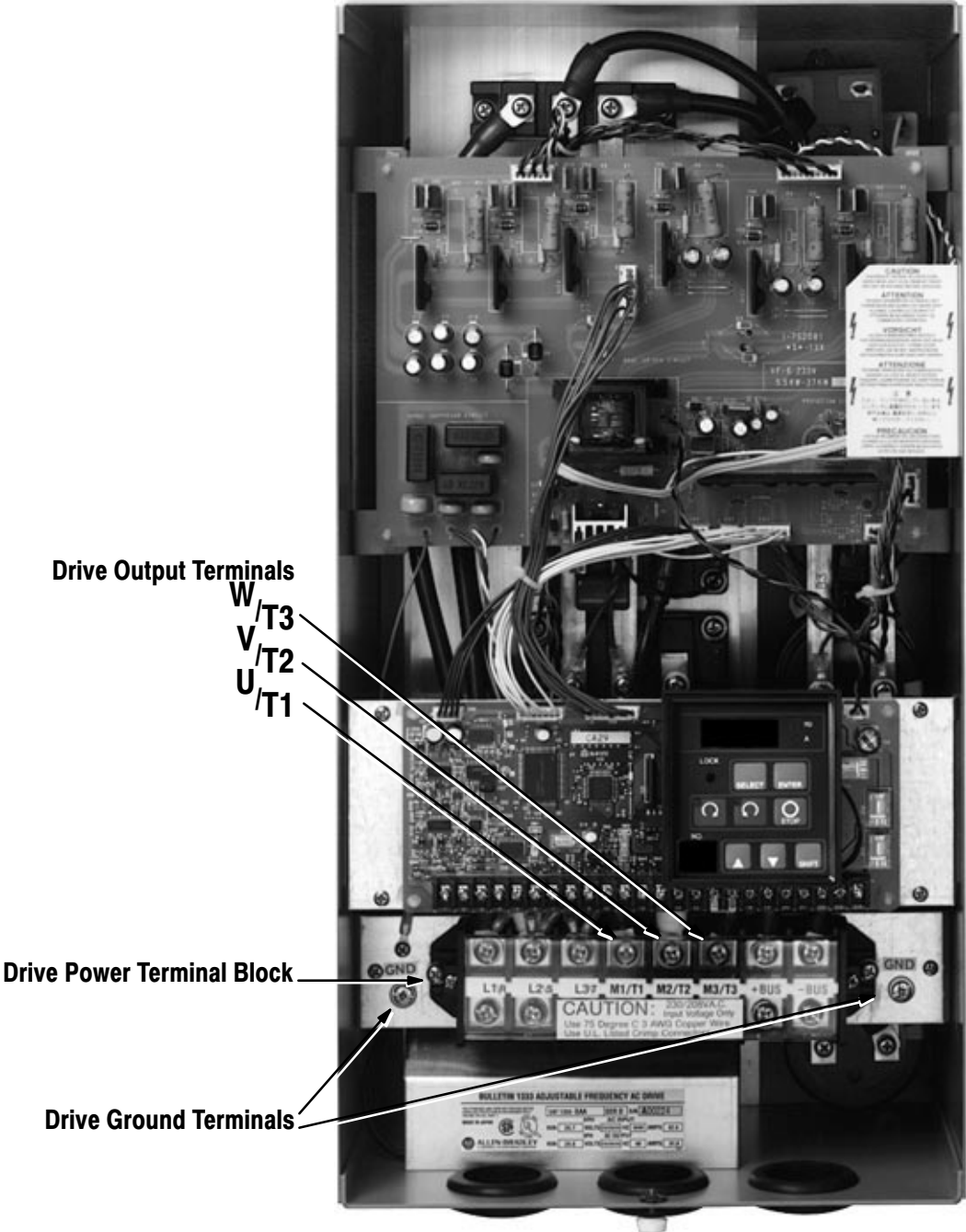
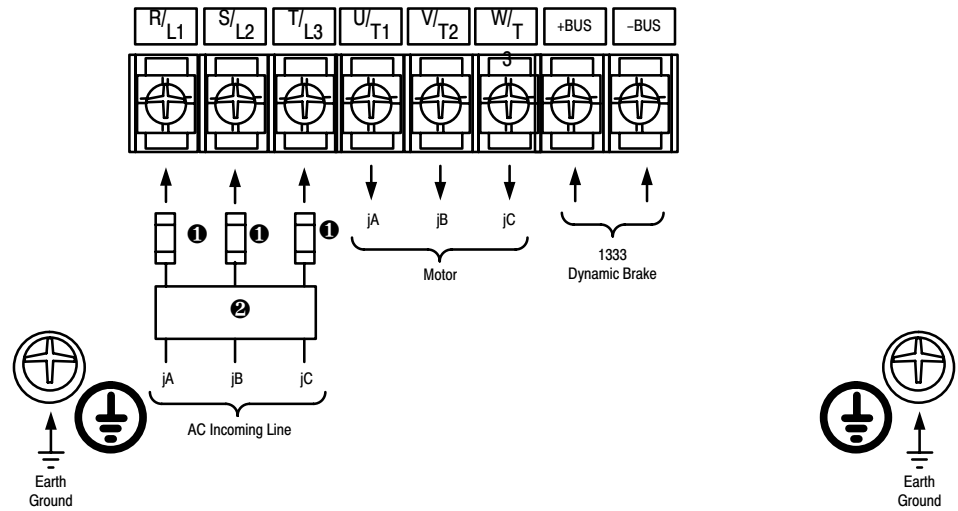


Figure 4-2 -- 7 1/2-20 HP (5.5-15 kW) Terminal Block Power Wiring

## ZAA-EAA 3-Phase Power Terminal Block Wiring



- ❶ User supplied drive input fuses.
- ❷ Motor disconnecting means including branch circuit, short circuit, and ground-fault protection.

### R/L1, S/L2, T/L3

Input AC line Terminals are not phase sensitive.

For drives rated ZAA-EAA, nominal 3-phase input voltage is 200/208/230V AC, 50/60 Hz.

For drives rated AAB-CAB, nominal 3-phase input voltage is 380/415/460V AC, 50/60 Hz.

Branch disconnect and short circuit protection is not part of the standard 1333 and must be supplied by the user. Drive input fuses are required to provide component protection against malfunction of electronic circuits.

### U/T1, V/T2, W/T3

Connect the motor leads to these terminals.

### + BUS, - BUS

DC bus terminals are reserved for the 1333 dynamic brake option. Refer to the 1333 dynamic brake option instructions for installation and connection details.

### GND

Two ground terminals have been provided in the drive. Either one of these terminals must be connected to earth ground or the ground of the building electrical system. The motor frame must also be connected to earth ground. Refer to the motor manufacturer's installation instructions for specific details.

**If You Use  
200/208/230V AC, 3-Phase Input Voltage**

**CAUTION** 230/208V A.C.  
Input Voltage Only  
Use 75 Degree C ② AWG Copper Wire  
Torque to ③ Lb-in

(Power Terminal Block Cover)

Power Rating Code	Wire Group ①	Recommended Wire Size ②	Recommended Torque ③
ZAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
AAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
YAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
BAA	2	12 AWG (4.0mm <sup>2</sup> )	9 In-lbs (1.02N-m)
CAA	2	10 AWG (6.0mm <sup>2</sup> )	9 In-lbs (1.02N-m)
DAA	2	8 AWG (10.0mm <sup>2</sup> )	10 In-lbs (1.13N-m)
EAA	2	8 AWG (10.0mm <sup>2</sup> )	10 In-lbs (1.13N-m)

① Wire group number chart, page 4-6.

Select from the following drive input fuses.

Drive Rating ZAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating AAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating YAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating BAA	Fuse Size 30A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating CAA	Fuse Size 40A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating DAA	Fuse Size 70A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating EAA	Fuse Size 80A Fuse Type 600V Class K5 UL Listed or Equivalent

**If You Use  
380/415/460V AC, 3-Phase Input Voltage**

**CAUTION** 460/415/380V A.C.  
Input Voltage Only  
Use 75 Degree C ② AWG Copper Wire  
Torque to ③ Lb-in

(Power Terminal Block Cover)

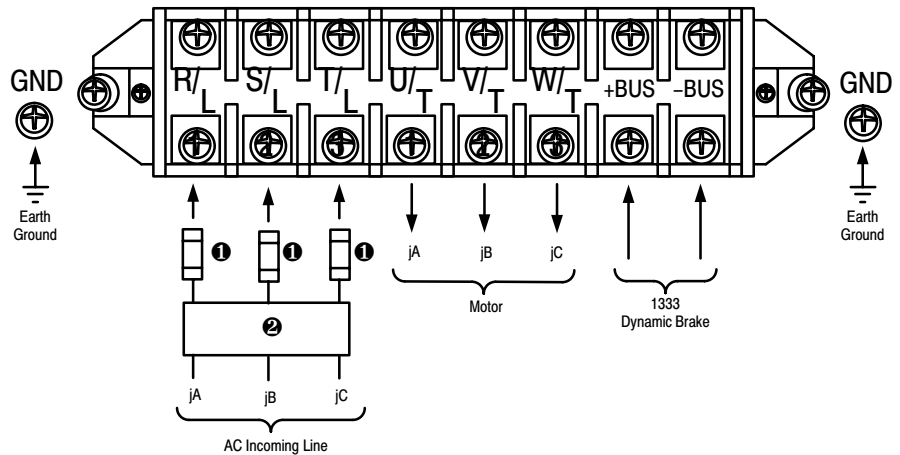
Power Rating Code	Wire Group ①	Recommended Wire Size ②	Recommended Torque ③
AAB	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
YAB	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
BAB	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
CAB	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)

① Wire group number chart, page 4-6.

Select from the following drive input fuses.

Drive Rating AAB	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating YAB	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating BAB	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating CAB	Fuse Size 20A Fuse Type 600V Class K5 UL Listed or Equivalent

### FAA or GAA 3-Phase Power Terminal Block Wiring



- ❶ User supplied drive input fuses.
- ❷ Motor disconnecting means including branch circuit, short circuit, and ground-fault protection.

#### **R/L1, S/L2, T/L3**

Input AC line Terminals are not phase sensitive.

For drives rated FAA or GAA, nominal 3-phase input voltage is 200/208/230V AC, 50/60 Hz.

Branch disconnect and short circuit protection is not part of the standard 1333 and must be supplied by the user. Drive input fuses are required to provide component protection against malfunction of electronic circuits.

#### **U/T1, V/T2, W/T3**

Connect the motor leads to these terminals.

#### **+ BUS, - BUS**

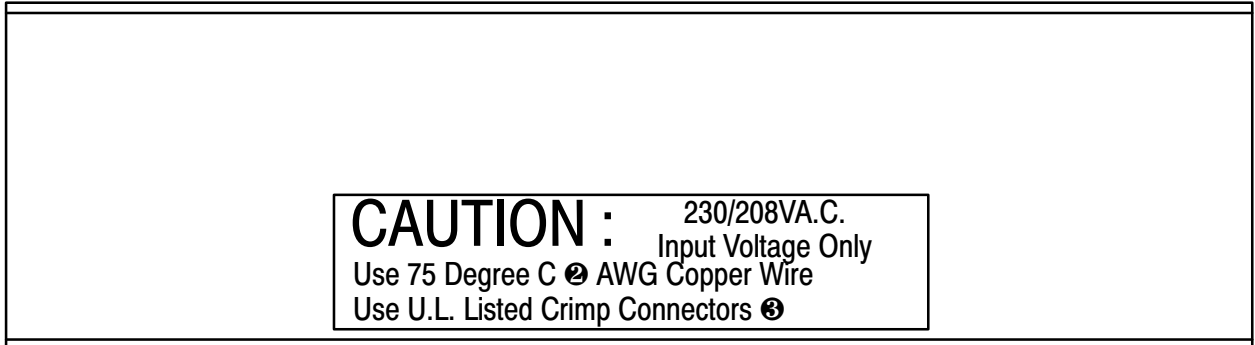
DC bus terminals are reserved for the 1333 dynamic brake option. Refer to the 1333 dynamic brake option instructions for installation and connection details.

#### **GND**

Two ground terminals have been provided in the drive. Either one of these terminals must be connected to earth ground or the ground of the building electrical system. The motor frame must also be connected to earth ground. Refer to the motor manufacturer's installation instructions for specific details.

**If You Use  
FAA or GAA Units**

Lugs are required to terminate wires for FAA or GAA units at the Power Terminal Block.



**(Power Terminal Block Cover)**

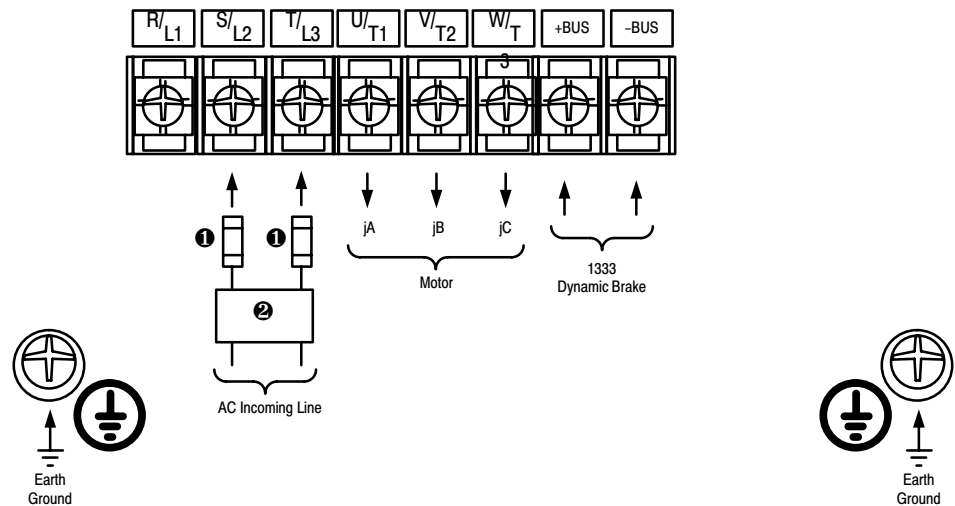
Power Rating Code	Wire Group ①	Recommended Wire Size ②
FAA	2	6 AWG (16.0mm <sup>2</sup> )
GAA	2	3 AWG (30.0mm <sup>2</sup> )

- ① Wire group number chart, page 4-6.
- ② UL Listed crimp connectors are required and must be installed using the proper crimping tool. Crimp connectors must be sized to the wire size chosen. When using crimp connectors on terminal studs that are not isolated from each other, a minimum spacing of 0.4 Inches (10.16 mm) is required.

Select from the following drive input fuses.

- Drive Rating FAA Fuse Size 100A Fuse Type 600V Class K5 UL Listed or Equivalent
- Drive Rating GAA Fuse Size 125A Fuse Type 600V Class K5 UL Listed or Equivalent

## ZAA-EAA 1-Phase Power Terminal Block Wiring



- ❶ User supplied drive input fuses.
- ❷ Motor disconnecting means including branch circuit, short circuit, and ground-fault protection.

### S/L<sub>2</sub> and T/L<sub>3</sub>

Input AC line Terminals are not phase sensitive.

For drives rated ZAA-EAA, nominal 1-phase input voltage is 200/208/230V AC, 50/60 Hz.

Branch disconnect and short circuit protection is not part of the standard 1333 and must be supplied by the user. Drive input fuses are required to provide component protection against malfunction of electronic circuits.

### U/T<sub>1</sub>, V/T<sub>2</sub>, W/T<sub>3</sub>

Connect the motor leads to these terminals.

### + BUS, - BUS

DC bus terminals are reserved for the 1333 Dynamic Brake Option. Refer to the 1333 Dynamic Brake Option instructions for installation and connection details.

### GND

Two ground terminals have been provided in the drive. Either one of these terminals must be connected to earth ground or the ground of the building electrical system. The motor frame must also be connected to earth ground. Refer to the motor installation instructions for specific details.

**If You Use  
200/208/230V AC, 1-Phase Input Voltage**

**CAUTION :** 230/208V A.C.  
Input Voltage Only  
Use 75 Degree C ② AWG Copper Wire  
Torque to ③ Lb-in

(Power Terminal Block Cover)

Power Rating Code	Wire Group ①	Recommended Wire Size ②	Recommended Torque ③
ZAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
AAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
YAA	2	14 AWG (2.5mm <sup>2</sup> )	9 In-lbs (1.02N-m)
BAA	2	12 AWG (4.0mm <sup>2</sup> )	9 In-lbs (1.02N-m)
CAA	2	10 AWG (6.0mm <sup>2</sup> )	9 In-lbs (1.02N-m)
DAA	2	8 AWG (10.0mm <sup>2</sup> )	10 In-lbs (1.13N-m)
EAA	2	8 AWG (10.0mm <sup>2</sup> )	10 In-lbs (1.13N-m)

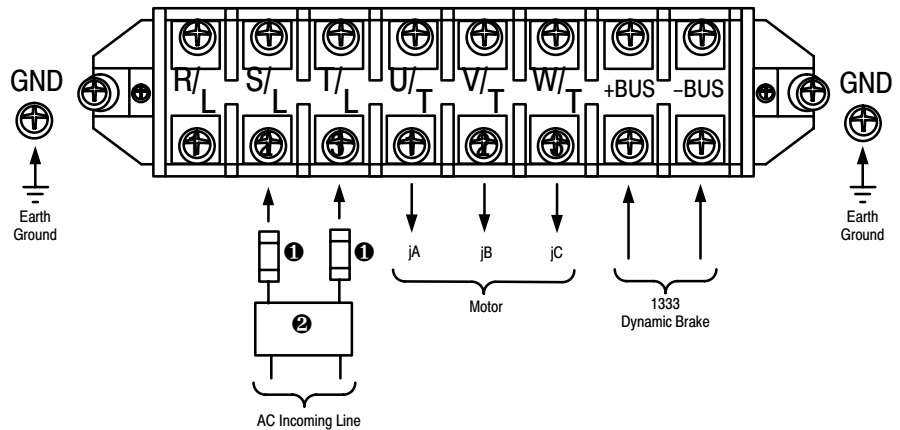
② Wire group number chart, page 4-6.

Select from the following drive input fuses.

Drive Rating ZAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating AAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating YAA	Fuse Size 15A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating BAA	Fuse Size 30A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating CAA	Fuse Size 40A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating DAA	Fuse Size 70A Fuse Type 600V Class K5 UL Listed or Equivalent
Drive Rating EAA	Fuse Size 80A Fuse Type 600V Class K5 UL Listed or Equivalent



### FAA or GAA 1-Phase Power Terminal Block Wiring



- ❶ User supplied drive input fuses.
- ❷ Motor disconnecting means including branch circuit, short circuit, and ground-fault protection.

### S/L<sub>2</sub> and T/L<sub>3</sub>

Input AC line Terminals are not phase sensitive.

For drives rated FAA or GAA, nominal 1-phase input voltage is 200/208/230V AC, 50/60 Hz.

Branch disconnect and short circuit protection is not part of the standard 1333 and must be supplied by the user. Drive input fuses are required to provide component protection against malfunction of electronic circuits.

### U/T<sub>1</sub>, V/T<sub>2</sub>, W/T<sub>3</sub>

Connect the motor leads to these terminals.

### + BUS, - BUS

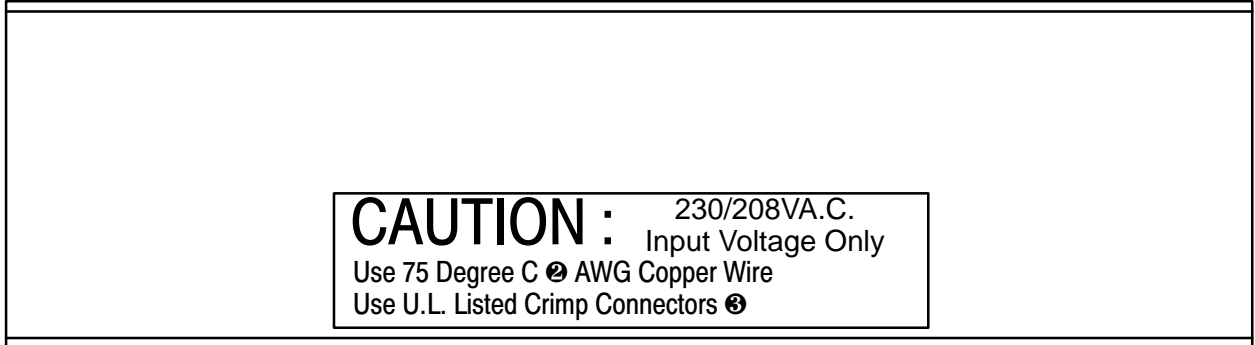
DC bus terminals are reserved for the 1333 Dynamic Brake Option. Refer to the 1333 Dynamic Brake Option instructions for installation and connection details.

### GND

Two ground terminals have been provided in the drive. Either one of these terminals must be connected to earth ground or the ground of the building electrical system. The motor frame must also be connected to earth ground. Refer to the motor installation instructions for specific details.

**If You Use  
FAA or GAA Units**

Lugs are required to terminate wires for FAA or GAA units at the Power Terminal Block.



**CAUTION** : 230/208V.A.C.  
Input Voltage Only  
Use 75 Degree C ② AWG Copper Wire  
Use U.L. Listed Crimp Connectors ③

**(Power Terminal Block Cover)**

Power Rating Code	Wire Group ①	Recommended Wire Size ②
FAA	2	6 AWG (16.0mm <sup>2</sup> )
GAA	2	3 AWG (30.0mm <sup>2</sup> )

- ① Wire group number chart, page 4-6.
- ③ UL Listed crimp connectors are required and must be installed using the proper crimping tool.  
Crimp connectors must be sized to the wire size chosen.  
When using crimp connectors on terminal studs that are not isolated from each other, a minimum spacing of 0.4 Inches (10.16 mm) is required.

Select from the following drive input fuses.

- Drive Rating FAA Fuse Size 100A Fuse Type 600V Class K5 UL Listed or Equivalent
- Drive Rating GAA Fuse Size 125A Fuse Type 600V Class K5 UL Listed or Equivalent

### Control and Signal Wiring Terminal Block

The Control and Signal Wiring Terminal Block is located at the bottom of the Control Board. The Control and Signal Wiring Terminal Block is a twenty-four position terminal block with markings of 1 to 24. The drive is capable of operating from the Local Control and Programming Panel without any external control or signal connections provided the factory installed jumper at terminals 16 and 17 is installed. When required, external operator elements may be connected to provide remote control of the drive. Several additional drive control functions and status outputs are also available for use at this terminal block.

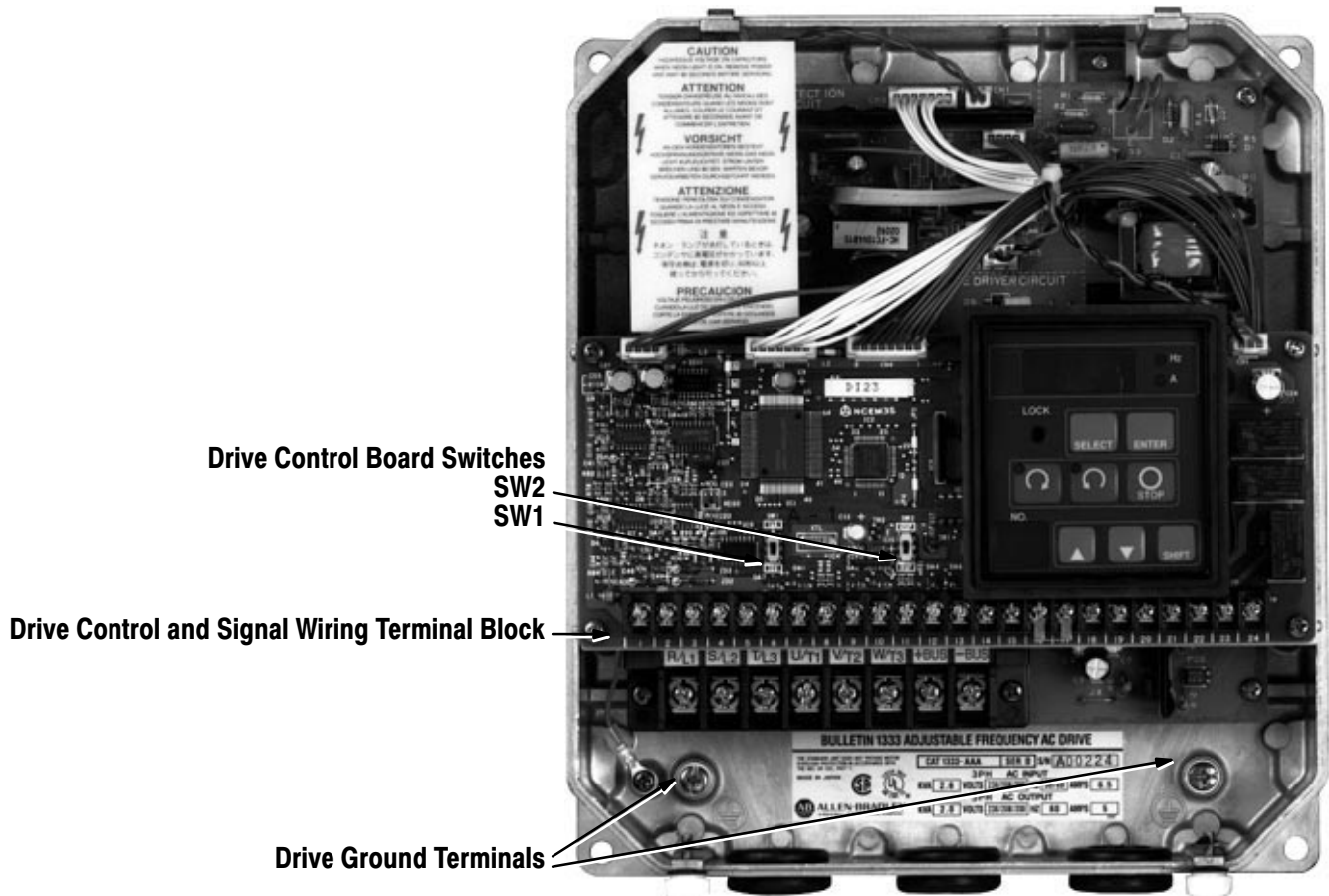


Figure 4-3 -- 3/4-5 HP (.55-4 kW) Control and Signal Wiring Terminal Block

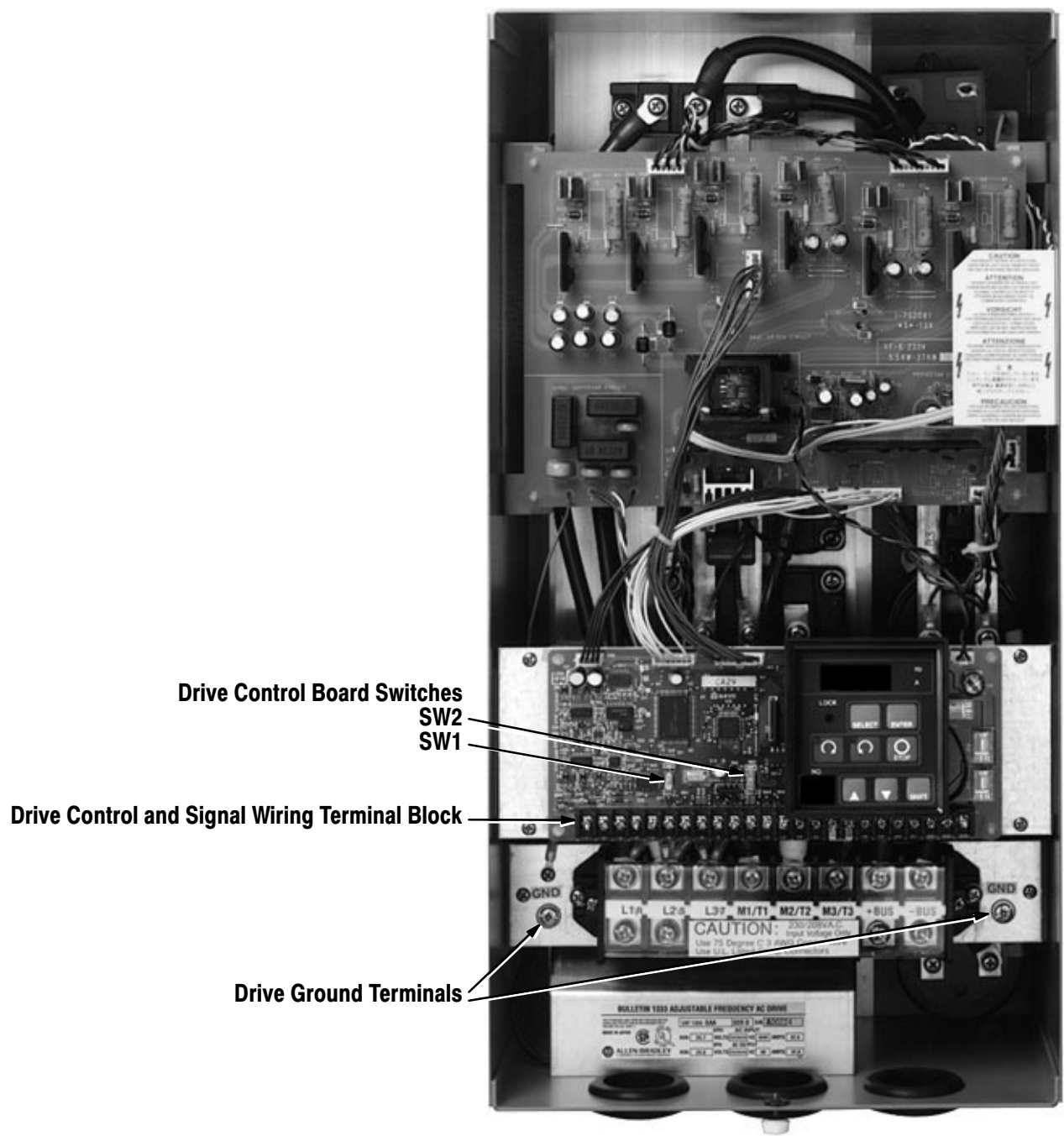
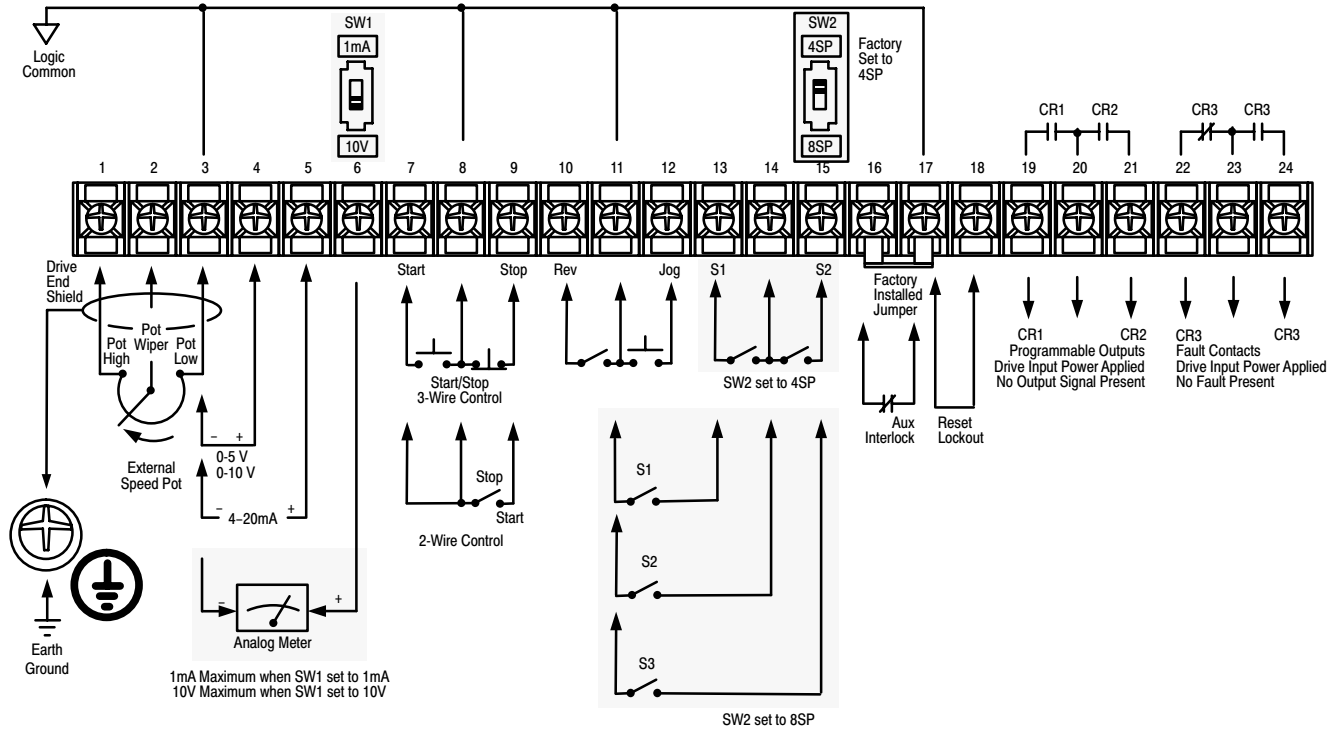


Figure 4-4 -- 7 1/2-20 HP (5.5-15 kW) Control and Signal Wiring Terminal Block

Figure 4-5 -- Control and Signal Wiring Terminal Block Interconnection Diagram



Input Signal Terminals	Input Signal	Wire Group ❶	Recommended Wire Size	Recommended Torque
Terminals 1, 2, 3	External Speed Potentiometer	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 3, 8, 11 and 17	Logic Common	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 4 and 3	0-5 or 0-10V DC	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 5 and 3	4-20mA	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 7 and 8	Start	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 9 and 8	Stop	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 10 and 11	Reverse	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 12 and 11	Jog	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 13 and 14	S1/4SP Position	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 14 and 15	S2/4SP Position	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 11 and 13	S1/8SP Position	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 11 and 14	S2/8SP Position	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 11 and 15	S3/8SP Position	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 16 and 17	Auxiliary Interlock	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 17 and 18	Reset Lockout	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)

Output Signal Terminals	Output Signal	Wire Group ❶	Recommended Wire Size	Recommended Torque
Terminal 6 and Logic Common	0-1mA or 0-10V Meter	5	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 19 and 20	CR1 Programmable Contact	3	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 20 and 21	CR2 Programmable Contact	3	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 22 and 23	CR3 Fault Contact	3	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)
Terminals 23 and 24	CR3 Fault Contact	3	16 AWG (1.5mm <sup>2</sup> )	7 In-Lbs (.791 N-m)

❶ Wire group number chart, page 4-6.

**Important:** Control and signal functions affected by drive parameter selection and programming are indicated on the following pages. Refer to the Programming section in Chapter 5 for detailed parameter operating descriptions.

### **Terminals 1, 2 and 3**

These terminals are provided for connecting a remote 10k $\Omega$ , 2W potentiometer. To enable a potentiometer to be connected to these terminals, Parameter 9 must be set to 1, 2 or 3. The potentiometer frequency control range is the range between minimum and maximum drive frequency as set by Parameters 15, 16, 50, 51, 53 and/or 54. The frequency resolution is 0.1 Hz up to 100 Hz, 0.2 Hz up to 200 Hz, and 0.5 Hz if over 200 Hz.

#### **Terminal 1**

##### **Potentiometer High**

Full CW or high side external potentiometer connection.

#### **Terminal 2**

##### **Potentiometer Wiper**

Wiper external potentiometer connection.

#### **Terminal 3**

##### **Potentiometer Low**

Full CCW or low side external potentiometer connection.

### **Terminals 3, 8, 11, and 17**

#### **Logic Common**

These terminals are provided to terminate both minus and drive common signals to the Control and Signal Wiring Terminal Block.

### **Terminals 4 and 3**

#### **0-5 or 0-10V DC**

This terminal is provided to terminate a 0 to +5 or +10V DC speed reference signal. The minus signal is terminated at Logic Common. Parameter 9 enables the speed reference signal and selects either a 0-5V input signal (when set to 1), or a 0-10V input signal (when set to 2). Parameters 52, 53 and 54 sets the output signal to be either directly or inversely proportional. The input impedance from Terminal 4 to logic common is approximately 40k $\Omega$ . The range of frequency control is between the minimum and maximum drive frequency settings or frequency clamps as set by Parameters 15, 16, 50, 51, 53 and/or 54. The frequency resolution is 0.1 Hz up to 100 Hz, 0.2 Hz up to 200 Hz, and 0.5 Hz if over 200 Hz.



**ATTENTION:** Unexpected machine acceleration can cause injury or death.

If Parameter 9 is set to a value other than 0, a loss of the potentiometer low reference signal at terminal 3 of the drive terminal block will allow the drive to immediately accelerate to maximum frequency if the drive is running or a start command has been received.

Ensure that remote potentiometer connection integrity is maintained and inspected in accordance with NFPA 70B standards for maintenance of electrical equipment.

---



**ATTENTION:** Terminals 4, 5 and 6 are internally protected from reverse polarity signals or input signals rising above 120% of the maximum input signal. If reverse polarity or levels are maintained above 120%, signals may be degraded and component damage may result.

---

### **Terminals 5 and 3**

#### **4-20 mA Input**

This terminal is provided to terminate a +4 to 20 mA DC speed reference signal. The minus signal is terminated at Logic Common. Parameter 9 enables and selects the 4-20mA input signal. Parameters 52, 53 and 54 sets the input signal to be either directly or inversely proportional. The input impedance from Terminal 5 to logic common is approximately 390Ω. The range of frequency control is between the minimum and maximum drive frequency settings or frequency clamps. The frequency resolution is 0.1 Hz up to 100 Hz, 0.2 Hz up to 200 Hz, and 0.5 Hz if over 200 Hz.

### **Terminals 6 and 3**

#### **Analog Meter Output**

This terminal provides a 0-1mA or 0-10V DC signal that may be used with a user supplied analog meter. The minus signal is terminated at logic common. Switch SW1, a 1mA/10V switch on the Control Board, sets the output signal to either 0-1mA or 0-10V.

For a 0–1mA voltage output, the load impedance of the meter must be 10kΩ or less.

For a 0–10V voltage output, the load impedance of the meter must be 300Ω or less.

Parameter 55 is used to set the 1mA output signal to equal 75-125% of maximum output frequency while the drive is running. Parameter 56 is used to adjust the 10V to equal 75-125% of maximum output frequency while the drive is running.

## Terminals 7 and 8

### Start

This remote input will command the drive to start if all hardwired interlocks are closed and Parameter 8 is set to 1 or 3. The drive will continue to run until a stop command is received, an interlock is opened, or a fault is detected.

**Important:** As shown in Figure 4-4, for external two wire start/stop control, terminals 7 and 8 must be jumpered.

## Terminals 9 and 8

### Stop

This remote input will command the drive to stop if Parameter 8 is set to 1 or 3. The drive will then either ramp-to-stop or coast-to-stop as selected by Parameter 11.

**Important:** If ramp-to-stop is selected, refer to Parameters 11 and 18 if the drive will be subjected to an overhauling load. If Parameter 18 Decel Frequency Hold is set to 1 (On), an overhauling load may cause the decel ramp to hold at one frequency for an extended period, causing ramp-to-stop commands to appear to be non-functional.

## Terminals 10 and 8

### Reverse

This remote input will command the drive to reverse direction if Parameter 8 is set to 1 or 3 and Parameter 10 is set to 0. Both the local and remote reverse will be locked out if Parameter 10 is set to 1.

## Terminals 12 and 11

### Jog

This remote input will jog the drive if Parameter 8 is set to 1 or 3. When jogged:

- The drive will jog to the frequency range set by Parameter 26
- Within the accel time set by Parameter 27
- In the direction determined by Parameter 10.

When the jog pushbutton is released, the drive will decelerate within the time set by Parameter 28.



**Terminals 13 and 14 -- S1/4SP**

**Terminals 15 and 14 -- S2/4SP**

Switch SW2 on the Control Board is factory set to 4SP. When set to 4SP, two external switches may be connected to the drive as shown in Figure 4-3. In addition to the standard accel and decel rates set by Parameters 1 and 2, these switches may then be used to select;

- Three additional accel rates
- Four preset speeds

As programmed by Parameters 19, 29-31 and 36-41.

**Terminals 13 and 11 -- S1/8SP**

**Terminals 14 and 11 -- S2/8SP**

**Terminals 15 and 11 -- S3/8SP**

When switch SW2 on the Control Board is set to 8SP, a total of three external switches may be connected to the drive as shown in Figure 4-3. In addition to the standard accel and decel rates set by Parameters 1 and 2, these switches may then be used to select three additional accel rates, three additional decel rates, and seven preset speeds, as programmed by Parameters 19-20 and 29-41.

**Important:** If parameter 20 is set to 1, switch S1 and S2 will select the four preset speeds defined by Parameters 29-31. Switch S3 is reserved for remotely setting a drive fault.

**Terminals 16 and 17**

**Auxiliary Interlock**

These factory jumpered terminals are used to install an auxiliary external interlock when the jumper is removed. The interlock contact must be closed to allow the drive to operate. The contact must be open for a minimum of 100mS to sense an auxiliary fault. Parameter 21 will allow an open contact to generate either:

A no-fault coast-to-stop sequence displaying AS — Auxiliary Stop.

A drive fault coast-to-stop sequence displaying AU — Auxiliary Interlock — which will cause the CR3 fault contacts to change state.

**Important:** A 5V DC or 5mA signal requires a gold contact relay.

### Terminals 18 and 17

#### Reset Lockout

These terminals may be jumpered or not jumpered to determine how the 1333 is reset after a fault.

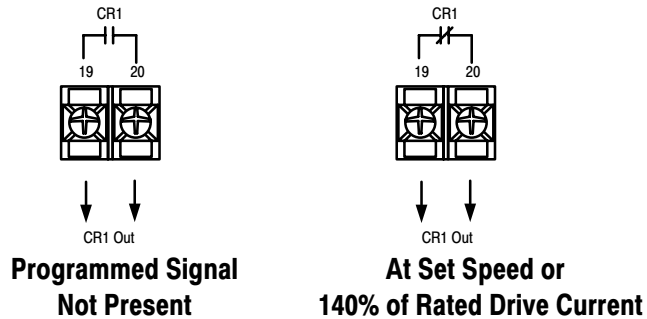
When the terminals are jumpered, a drive may only be reset and restarted by removing then re-applying input power to the drive.

When these terminals are left open, the drive will be reset and restarted as programmed by Parameters 47 and 48.

### Terminals 19 and 20

#### Programmable Contact CR1

These terminals allow drive supplied relay contact CR1 to be used in external circuits. When power is applied to the drive, the N.O. contact will remain N.O. until a programmed signal is received. The contact is programmed by Parameters 22 and 24 to signal that the drive is at the programmed set speed or 140% of rated drive current. The contact is isolated from Logic Common and other drive circuitry.



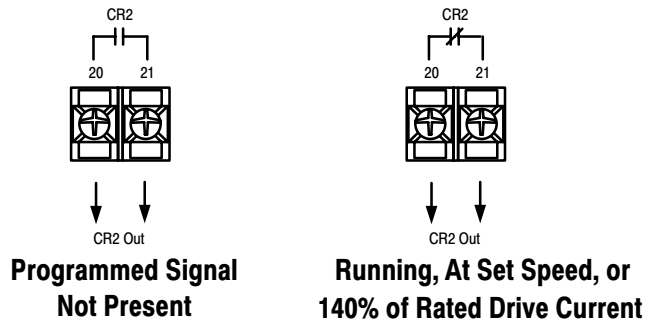
Resistive rating: 120V AC or 30V DC, 1 Amp.

Inductive rating: 120V AC or 30V DC, 0.5 Amps.

### Terminals 21 and 20

#### Programmable Contact CR2

These terminals allow drive supplied relay contact CR2 to be used in external circuits. When power is applied to the drive, the N.O. contact will remain N.O. until a programmed signal is received. The contact is programmed by Parameters 23 and 25 to signal that the drive is at the programmed set speed or 140% of rated drive current. The contact is isolated from Logic Common and other drive circuitry.



Resistive rating: 120V AC or 30V DC, 1 Amp.

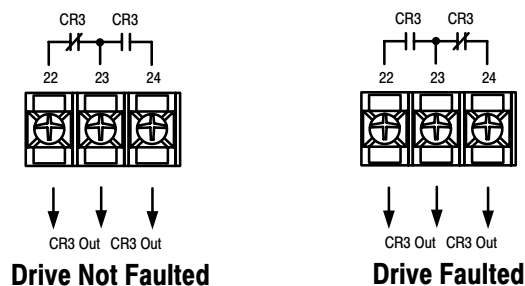
Inductive rating: 120V AC or 30V DC, 0.5 Amps.

### Terminals 22 and 23

### Terminals 24 and 23

#### Fault Contacts -- CR3

These terminals allow drive supplied CR3 relay contacts to be used in external circuits. The contacts are shown with power applied to the drive. When power is first applied to the drive, the contacts will change state — 22 to 23 will close, 23 to 24 will open. Should a fault occur 22 to 23 will open, 23 to 24 will close. The contacts are isolated from Logic Common and other drive circuitry.



Resistive rating: 120V AC or 30V DC, 1 Amp.

Inductive rating: 120V AC or 30V DC, 0.5 Amps.

## Operation and Programming

### Local Control and Programming Panel

The Local Control and Programming Panel provides a convenient means to locally control the operating functions of the Series D Bulletin 1333 drive including start/stop, forward/reverse, and speed. The Local Control and Programming Panel also contains two digital displays. A Main Display to show drive running values, codes, and parameter values, and a Mode Display to show the drive mode and control source. Finally, the Local Control and Programming Panel includes the controls necessary to program the various parameters that will define your drive.



**Figure 5-1 -- The Bulletin 1333 Series D**

With two exceptions, the drive must always be stopped to allow drive programming.

- A 0-1 mA Analog Output Meter may be calibrated while the drive is running by accessing Parameter 55.
- A 0-10V DC Analog Output Meter may be calibrated while the drive is running by accessing Parameters 56.

## The Controls

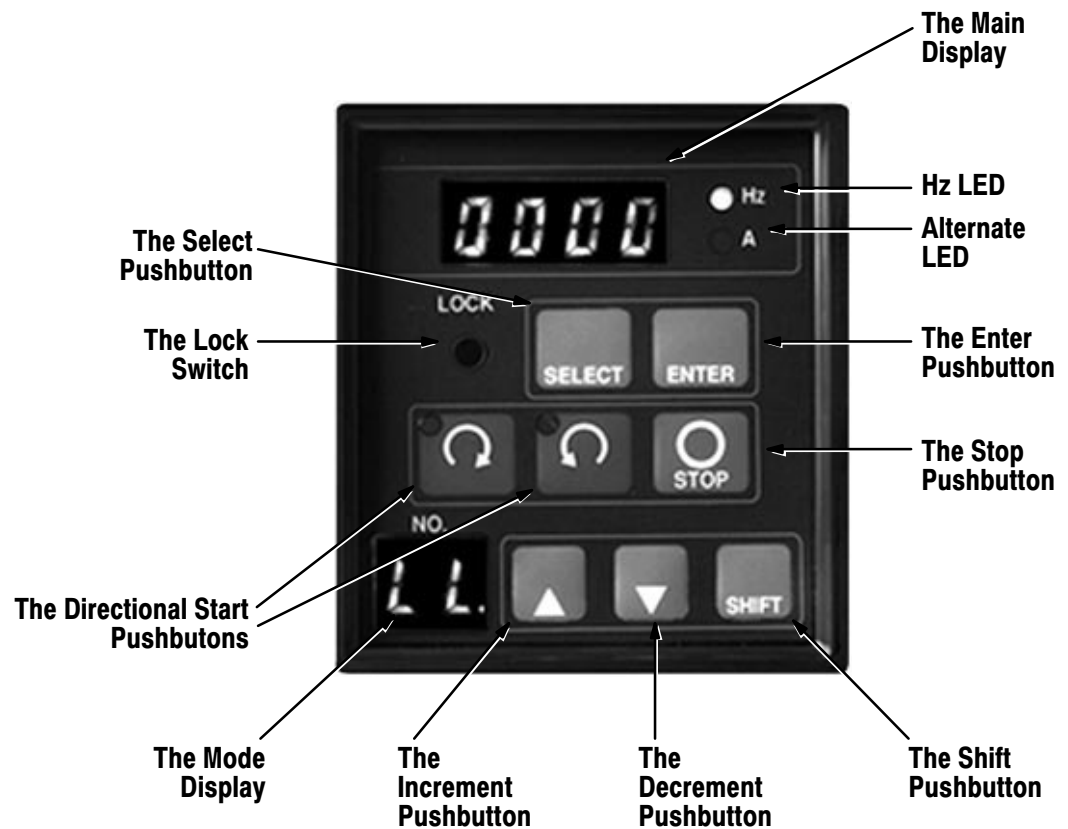


Figure 5-2 -- Bulletin 1333 Series D Controls

### The Select Pushbutton

**In the Programming Mode** is used to toggle between the parameter number and the parameter value.

**In the Monitoring and Operating Mode** is used to select the mode to be monitored.

- Drive parameters.
- Drive output frequency.
- One of three alternate running displays.

**The Lock Switch** is used to switch between the Programming Mode and the Monitoring Mode.

### **The Directional Start Pushbuttons**

**In the Programming Mode** are not functional.

In the Monitoring and Operating Mode are used to start or jog the drive whenever drive speed is controlled from the Local Control Panel.

### **The Increment and Decrement Pushbuttons**

**In the Programming Mode** are used to select parameters or increase and decrease parameter values.

**In the Monitoring and Operating Mode** are used to increment or decrement drive speed whenever drive speed is controlled from the Local Control Panel.

### **The Shift Pushbutton**

**In the Programming Mode** is used to shift between display segments in both the Main and Mode Displays.

**In the Monitoring and Operating Mode** is used to shift between segments in the Main display, or between jog and run in the Mode display when the drive is stopped.

### **The Stop Pushbutton**

**In the Programming Mode** is not functional.

**In the Monitoring and Operating Mode** will always stop the drive as described in The Displays section that follows.

### **The Enter Pushbutton**

**In the Programming Mode** is used to enter the parameter value.

**In the Monitoring and Operating Mode** is used to enter changes.

- Enter changes in drive speed whenever drive speed is controlled from the Local Control Panel.
- Enter adjustment values to calibrate a 0-1 mA or 0-10V DC analog output meter.

## The Displays

### The Main Display

**In the programming mode** this display will show the current value of the parameter selected, flash when the value is being changed, and finally remain steady once the new value is entered. Neither the Hz nor Alternate LED will be lit in the programming mode.

**In the monitoring and operating mode** this display can be toggled to show four operational modes. Either the Hz or Alternate LED will be lit or will flash to indicate the monitoring or operational mode.

Your are:

- Monitoring drive output frequency when the Hz LED is lit.
- Changing drive output frequency when the Hz LED is flashing.
- Monitoring drive output current or equivalent motor RPM when the Alternate LED is lit.
- Monitoring drive output parameters or viewing preset parameter value when no LED is lit.

Should a drive operating error occur while the drive is running, **OP** will be shown.

Should the drive receive an auxiliary stop while the drive is running, **A5** will be shown.

Should a fault occur at any time, the Main Display will shown one of seven faults that can be stored in drive memory.

1. **OC** A drive overcurrent or ground fault.
2. **OL** A drive overload fault.
3. **OU** A drive overvoltage fault.
4. **AU** A drive auxiliary interlock fault.
5. **LU** A drive low voltage fault.
6. **OH** A drive overtemperature fault.
7. **CPU** An internal software communications error.

## The Mode Display

**In the programming mode** the smaller two-digit display shows the parameter number selected — **01** to **62**. Whenever the drive is in the programming mode, three display items will change.

1. The display will flash.
2. The decimal point normally shown in the lower right hand corner will disappear.
3. Neither the Hz nor Alternate LED in the Main Display will be lit.

In the monitoring and operating mode the smaller two-digit display shows the monitoring mode selected —

- **01 - 62** View drive parameters.
- **AO** Monitor drive output current.
- **A1** View equivalent motor RPM.
- **A2** Monitor drive control frequency.
- **LL, LE, LJ, EE, EL or EJ** The local or remote control source currently controlling the drive.

**LL** To indicate:

1. Drive start, jog, speed and forward/reverse is controlled from the Local Control Panel.
2. The Local Control Panel stop pushbutton will stop the drive as programmed by Parameters 11-14.
3. An auxiliary interlock wired to the Control and Signal Wiring Terminal Block will stop the drive and display either **AU** or **A5**, as set by Parameter 21.

**LE** To indicate:

1. Drive start, jog and forward/reverse is controlled from the Local Control Panel.
2. The Local Control Panel stop pushbutton will stop the drive as programmed by Parameters 11-14.
3. Drive speed is controlled from a remote reference signal wired to the Control and Signal Wiring Terminal Block.
4. An external stop signal wired to the Control and Signal Wiring Terminal Block will allow the drive to coast-to-stop and display **OP**.



5. An auxiliary interlock wired to the Control and Signal Wiring Terminal Block will stop the drive and display either **AU** or **A5**, as set by Parameter 21.

**LJ** To indicate the local jog function has been selected.

**EE** To indicate:

1. Drive start, jog, speed and forward/reverse is controlled by external devices or logic wired to the Control and Signal Wiring Terminal Block.
2. An external stop signal wired to the Control and Signal Wiring Terminal Block will stop the drive as programmed by Parameters 11-14.
3. An auxiliary interlock wired to the Control and Signal Wiring Terminal Block will stop the drive and display either **AU** or **A5**, as set by Parameter 21.
4. The Local Control Panel stop pushbutton will allow the drive to coast-to-stop and display **OP**.

**EL** To indicate:

1. Drive start, jog and forward/reverse is controlled by external devices or logic wired to the Control and Signal Wiring Terminal Block.
2. Drive speed is controlled from the Local Control Panel.
3. An external stop signal wired to the Control and Signal Wiring Terminal Block will stop the drive as programmed by Parameters 11-14.
4. The Local Control Panel stop pushbutton will allow the drive to coast-to-stop and display **OP**.
5. An auxiliary interlock wired to the Control and Signal Wiring Terminal Block will stop the drive and display either **AU** or **A5**, as set by Parameter 21.

**EJ** To indicate an external jog signal is being sent.

## Programming the Drive

62 parameters are available for adjusting the drive. All Series D 1333 parameters interact with each other to provide optimum drive performance. Some specific parameters however, require that other parameters be set to coordinated values if they are to function. Others require that they be set to specific values to function with Bulletin 1333 options.

All parameters along with a detailed explanation are listed in the remaining pages of this chapter. Parameters are grouped under sub-headings by function, such as **Accel and Decel Settings** or **Volts-per-Hertz Curve Settings**. An interactive matrix has been provided in Appendix C to graphically show which parameters must be set to provide coordinated control of the Bulletin 1333.

## Accel and Decel Settings

### Parameter 01 -- Acceleration Time 1

Units = Seconds

Range = 0000/1600

Factory Setting = 005.0

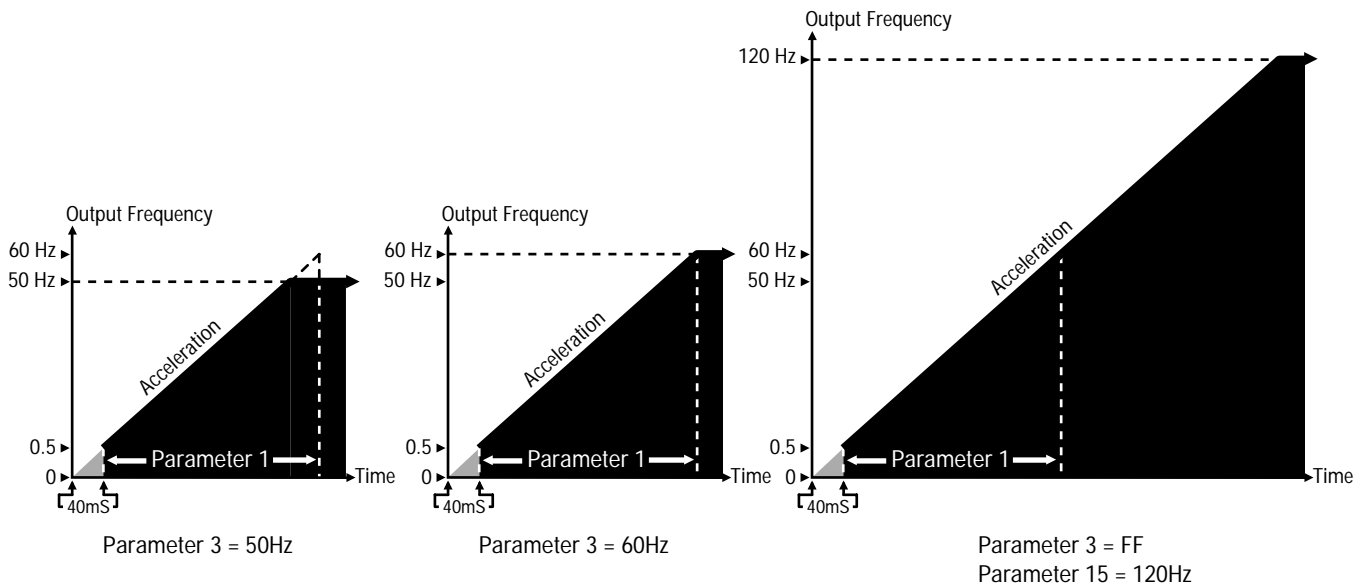
This parameter determines the time that it will take the drive to accelerate over a 60 Hz change in frequency. From 0 to 0.5 Hz, the accel rate is effectively zero. From 0.5 Hz to maximum output frequency, the accel rate set by Parameter 1 will remain constant. The total time it will take the drive to accelerate from 0 to maximum drive output frequency is:

Total time = (Maximum Drive Output Frequency × Parameter 1) ÷ 60.

If set to 0000, the drive will enter 40 ms but display 0000.

From 00.10-1000 seconds, this parameter sets the accel time value in 0.1 second increments.

From 1000-1600 seconds, this parameter sets the accel time value in 1 second increments.



### Accel Settings

### Parameter 02 -- Deceleration Time 1

Units = Seconds

Range = 0000 to 1600

Factory Setting = 005.0

**Important:** Parameter 11 must be set to 0 to allow the drive to ramp-to-stop

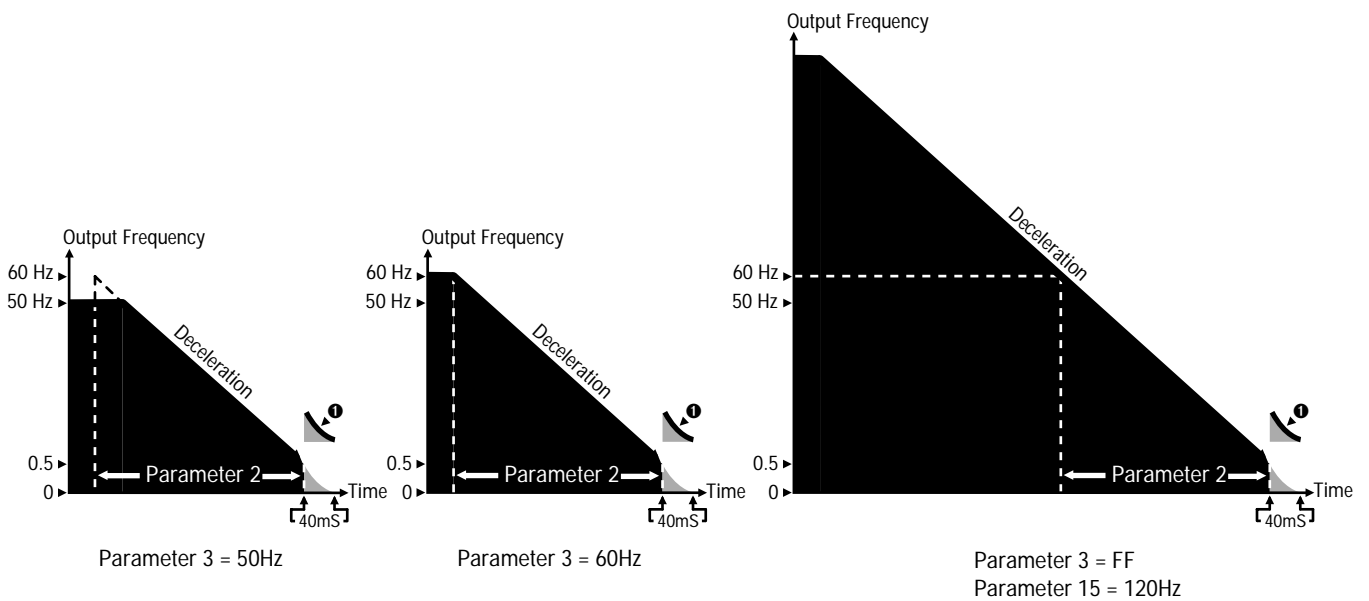
This parameter determines the time that it will take the drive to decelerate and ramp-to-stop over a 60 Hz change in frequency. From 0.5 to 0 Hz, the accel rate is non-linear and set by either DC injection braking or the DC dynamic brake if it is installed. From maximum output frequency to 0.5 Hz, the accel rate set by Parameter 2 will remain constant. The total time it will take the drive to decelerate from maximum drive output frequency to 0.5 Hz is:

$$\text{Total time} = (\text{Maximum Drive Output Frequency} \times \text{Parameter 2}) \div 60.$$

If set to 0000, the drive will enter 40 ms but display 0000.

From 00.10-1000 seconds, this parameter sets the decel time value in 0.1 second increments.

From 1000-1600 seconds, this parameter sets the decel time value in 1 second increments.



① DC injection braking or DC dynamic braking (if installed).

### Decel Settings

## Volts-per-Hertz Curve Settings

**Important:** The maximum allowable drive output frequency will be determined by the lowest programmed value of any of the following parameters:

- Parameter 3 Frequency Range
- Parameter 15 Maximum Frequency
- Parameter 51 Upper Frequency Clamp
- Parameter 53 Bias Frequency — If Parameter 53 is Higher Than Parameter 54
- Parameter 54 Gain Frequency — If Parameter 54 is Higher Than Parameter 53

### Parameter 03 -- Frequency Range

Units = Code  
Range = 50, 60 or FF  
Factory Setting = 60

This parameter permits the selection of three linear volts-per-Hertz ramps. The maximum frequency settings of these ramps are 50 Hz, 60 Hz, or FF. If the BCD Interface option is installed, Parameter 3 must be set to match the scaling jumper on the BCD Interface Board — Either 60 for 60 Hz operation, or FF for 120/200 Hz operation.

If set to 50, 50 Hz will be the maximum drive frequency — The absolute maximum output speed that the drive can reach. If set to 60, 60 Hz will be the maximum drive frequency — The absolute maximum output speed that the drive can reach. Parameter 15 will have no effect on maximum output speed, but Parameter 51 will. When Parameter 3 is set to 50 or 60, the drive will use the lower of the values set by Parameter 3 and 51. Parameter 16 will have no effect on base speed.

If set to FF, the value set by Parameter 15 or 51 will be the maximum drive frequency — The absolute maximum output speed that the drive can reach. When Parameter 3 is set to FF, the drive will use the lower of the values set by Parameters 15 and 51. The value set by Parameter 16 Base Frequency will be the point where maximum output voltage is applied to the motor.

**Important:** Applications where volts-per-Hertz curves are required to reach maximum voltage other than at 50 or 60 Hz are primarily provisions for operating custom motors. For application assistance in these special ranges, contact your nearest Allen-Bradley representative.

### Parameter 04 -- Volts-per-Hertz Curve

Units = Code

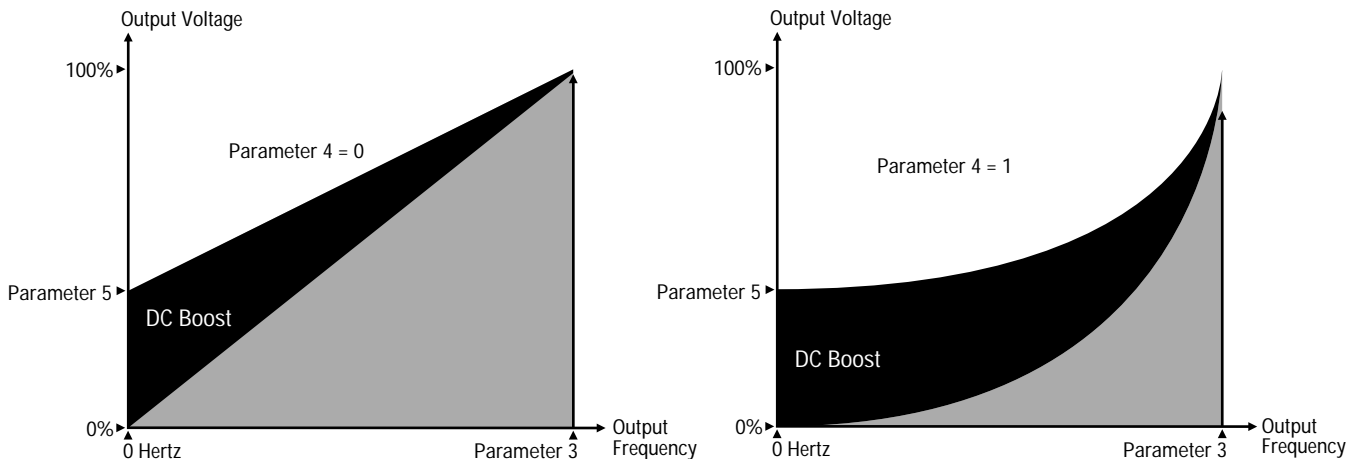
Range = 0/1

Factory Setting = 0

This parameter sets the shape of the volts-per-Hertz ramp, either constant or curved.

If set to 0, the volts-per-Hertz ramp will be linear producing a constant rate of increase from 0 to base frequency. This setting will be the setting required for most constant torque applications.

If set to 1, the volts-per-Hertz ramp will be curved, producing a rate of increase that will gradually curve upward as it increases from 0 to base frequency. This setting will be required for most variable torque applications where full rated motor torque is not required at reduced speeds.



**Volts-per-Hertz Curve Settings + DC Boost Settings**

### DC Boost Settings

### Parameter 05 -- DC Boost Select

Units = % of Output Voltage

Range = 00/40

Factory Setting = 00

This parameter adds from 0 to 40% of the drive output voltage to the motor at low drive frequencies in 1% increments, boosting motor torque at startup. DC boost can be added to any volts-per-Hertz curve. The optimum DC boost setting is the lowest level that will permit satisfactory starting torque for the motor and drive. Higher than optimum boost may produce unnecessary motor current at low frequencies and contribute to motor overheating. Excessive boost may even force the drive into an overcurrent condition.

## Overload Protection Settings

**Important:** Parameters 6 and 7 are intended for use on single motor applications. For multiple motor applications, Parameter 6 must be set to 0 to help avoid nuisance tripping.

### Parameter 06 -- Motor Duty

Units = Code

Range = 0/1/2/3

Factory Setting = 2

Parameter 6 provides three thermal overload functions. When used in conjunction with Parameter 7, a thermal overload function that matches the motor nameplate amps can be used.

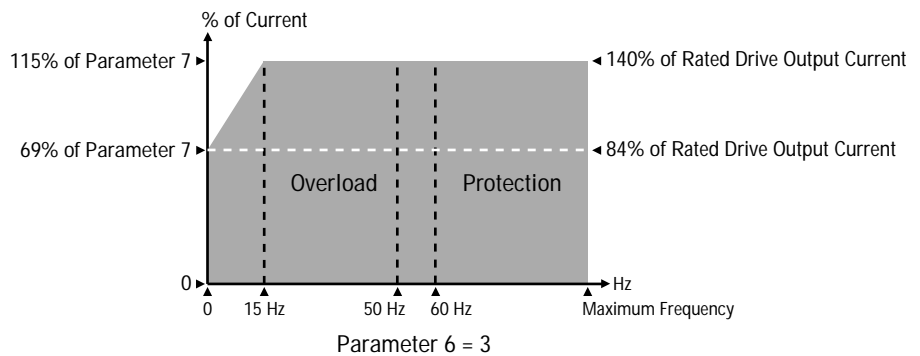
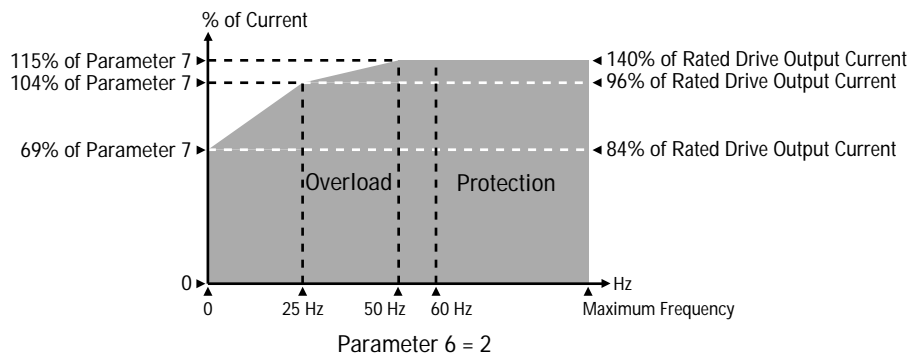
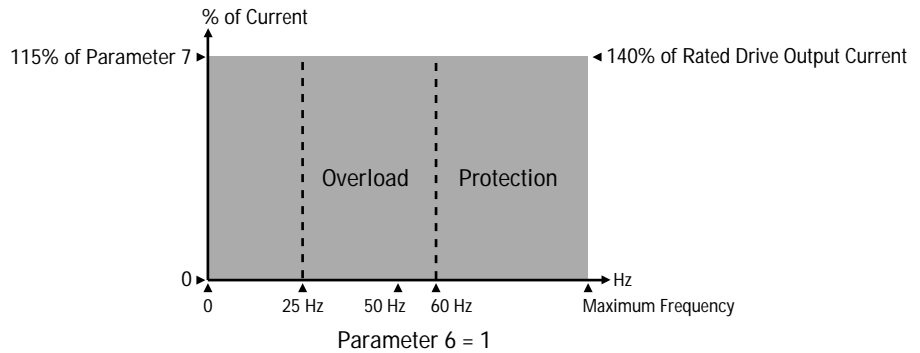
If set to 0, the overload function will not include thermal protection and the drive will trip at its standard setting of 140% of rated drive output current after 60 seconds. If set to 1, 2 or 3, the thermal overload function is enabled and will function as described below.

If set to 1, the drive will trip at 115% of the current set in Parameter 7, or 140% of rated drive output current (whichever is lower) after 60 seconds. When set to 1, the thermal overload trip point is constant across the entire speed range of the motor. This performance is typical with A-B Bulletin 1329 10:1 speed range motors.

If set to 2, the drive will trip at 115% of the current set in Parameter 7, or 140% of rated drive output current (whichever is lower) after 60 seconds. When set to 2, the thermal overload curve generated is derated below 50 Hz for use with motors having a 4:1 speed range. This performance is typical with A-B Bulletin 1329 4:1 speed range motors.

If set to 3, the drive will trip at 115% of the current set in Parameter 7, or 140% of rated drive output current (whichever is lower) after 60 seconds. When set to 3, the thermal overload curve generated is derated below 15 Hz for use with motors having a 4:1 speed range. This performance is typical with A-B Bulletin 1329 4:1 speed range motors.

**Important:** The National Electrical Code requires that motor overload protection be provided in the motor branch circuit. Parameter 6 when used with Parameter 7 provides motor overload protection. NEC however, recognizes this protection as being provided by eutectic alloy or bi-metal overload relays. If it necessary to meet NEC motor branch protection approval, eutectic alloy, bi-metal overload relays or an equivalent should be installed. Refer to article 430 of the NEC and any additional codes for specific requirements and additional information.



### Overload Protection Settings

Parameter 07 -- Overload Current

Units = Amps

Range = 000.1/500.0

Factory Setting = None

Parameters 6 and 7 will work in conjunction if Parameter 7 matches the rated amps located on the motor nameplate, and Parameter 6 is set to 1, 2 or 3. When Parameter 6 is set to 0, the setting of Parameter 7 will have no effect on drive operation. The overload current value for Parameter 7 may be set in 0.1A increments.



## Local/Remote Control Enable

**Important:** If the Remote Operator Station option is installed, Parameter 8 must be set to 1 or 3 to allow remote control.

Parameter 08 -- Local/Remote Control

Units = Code

Range = 0/1/2/3

Factory Setting = 0

This parameter enables or disables the drive start, jog, and forward/reverse functions as follows. The stop button on the Local Control and Programming Panel will always be functional, but may generate an **OP** error for certain settings detailed below. If installed at the Control and Signal Wiring Terminal Block, auxiliary input switches S1, S2 and/or S3 will always function as programmed by Parameters 19 and 20 when a valid start command is present.

If set to 0, local control has been selected. An **L** will be the left-hand letter shown in the Mode Display. A maintained start command or jumper is not required at terminals 7 and 8 of the Control and Signal Wiring Terminal Block.

- Both directional start pushbuttons on the Local Control and Programming Panel will be functional.
- Local jog can be selected by pressing the Shift button.
- If Parameter 10 Reverse Lockout is on, only one directional start pushbutton will be available for jogging or running the drive.
- The local stop button will stop the drive as programmed by Parameters 11-14.
- An auxiliary interlock signal will stop the drive and display either **AU** or **AS** as programmed by Parameter 21.

If set to 1, external 2-wire control has been selected. An **E** will be the left-hand letter shown in the Mode Display.

- Drive start, jog and forward/reverse is controlled externally through the Control and Signal Wiring Terminal block. Neither directional start pushbutton on the Local Control and Programming Panel will be functional.
- An external jog signal will jog the drive and display **EJ**. Local jog cannot be selected.
- If Parameter 10 Reverse Lockout is on, only one direction is available for jogging or running the drive.
- The local stop button will allow the drive to coast-to-stop and display **OP**.

- An auxiliary interlock signal will stop the drive and display either **AU** or **AS** as programmed by Parameter 21.

If set to 2, local control has been selected, but a maintained stop command or jumper must also be present at terminals 8 and 9 of the Control and Signal Wiring Terminal Block. If not present, all of the following commands will generate an **OP** error. An **L** will be the left-hand letter shown in the Mode Display.

- Both directional start pushbuttons on the Local Control and Programming Panel will be functional.
- Local jog can be selected by pressing the Shift button.
- If Parameter 10 Reverse Lockout is on, only one directional start pushbutton will be available for jogging or running the drive.
- The local stop button will stop the drive as programmed by Parameters 11-14.
- An auxiliary interlock signal will stop the drive and display either **AU** or **AS** as programmed by Parameter 21.
- An external stop signal at terminals 8 and 9 of the Control and Signal Wiring Terminal Block will allow the drive to coast-to-stop but display an **OP** error.

If set to 3, external 3-wire control has been selected. An **E** will be the left-hand letter shown in the Mode Display.

- Drive start, jog and forward/reverse is controlled externally through the Control and Signal Wiring Terminal block. Neither directional start pushbutton on the Local Control and Programming Panel will be functional and local jog cannot be selected.
- An external jog signal will jog the drive and display **EJ**. Local jog cannot be selected.
- If Parameter 10 Reverse Lockout is on, only one direction is available for jogging or running the drive.
- The local stop button will allow the drive to coast-to-stop and display **OP**.
- An auxiliary interlock signal will stop the drive and display either **AU** or **AS** as programmed by Parameter 21.

## Local/Remote Speed Enable

**Important:** If the Remote Operator Station option is installed, Parameter 9 must be set to a value other than 0 to allow remote control. If the BCD Interface option is installed, Parameter 9 must be set to 2 to allow BCD control.

### Parameter 09 -- Local/Remote Frequency

Units = Code

Range = 0/1/2/3

Factory Setting = 0

**Important:** If installed at the Control and Signal Wiring Terminal Block, auxiliary input switches S1, S2 and/or S3 will always function as programmed by Parameters 19 and 20 to control drive speed when a valid start command is present.

If set to 0, local control has been selected. An **L** will be the right-hand letter shown in the Mode Display.

- Both the increment and decrement pushbuttons on the Local Control and Programming Panel will set drive speed. The select and enter pushbuttons are used to enter the drive set speed.

If set to 1, 2 or 3, external control has been selected. An **E** will be the right-hand letter shown in the Mode Display. If an external speed pot is connected, all other drive speed signals (except from auxiliary switches S1, S2 and/or S3) will be ignored. Both the increment and decrement pushbuttons on the Local Control and Programming Panel will be disabled. The select and enter pushbuttons cannot be used to enter the set drive speed.

- If set to 1, drive speed is controlled externally through the Control and Signal Wiring Terminal Block. A 0-5V DC signal connected to the Control and Signal Wiring Terminal Block will control drive speed unless an external speed pot is connected.
- If set to 2, drive speed is controlled externally through the Control and Signal Wiring Terminal Block. A 0-10V DC signal connected to the Control and Signal Wiring Terminal Block will control drive speed unless an external speed pot is connected.
- If set to 3, drive speed is controlled externally through the Control and Signal Wiring Terminal Block. A 4-20 mA DC signal connected to the Control and Signal Wiring Terminal Block will control drive speed unless an external speed pot is connected.

## Reverse Enable

### Parameter 10 -- Reverse Lockout

Units = Off/On

Range = 0/1

Factory Setting = 0

This parameter enables or disables both local and remote drive direction control.

If set to 0, both local and remote direction control is enabled and motor rotation can be selected in either direction.

If set to 1, both local and remote direction control is locked out and motor rotation in only one direction can be selected.

## Stop Settings

**Important:** If the drive's internal DC brake is enabled and/or if the Heavy Duty Dynamic Brake option is installed, Parameter 11 must be set to 0.

### Parameter 11 -- Stop Select

Units = Code

Range = 0/1

Factory Setting = 0

This parameter allows the motor to either ramp-to-stop or coast-to-stop when a stop signal is received either from the Local Control and Programming Panel, or from terminals 8 and 9 at the Control and Signal Wiring Terminal Block.

If set to 0, a stop command will ramp the drive to a stop before shutting off output frequency. The ramp followed is set by Parameter 2, Decel Time 1, unless DC braking is used (Parameters 13-15).

**Important:** If ramp-to-stop is selected, refer to Parameter 18 if the drive will be subjected to an overhauling load. If Parameter 18 Decel Frequency Hold is set to 1 (On), an overhauling load may cause the decel ramp to hold at one frequency for an extended period, causing ramp-to-stop commands to appear to be non-functional.

If set to 1, a stop command will shut off drive output frequency to the motor and the motor will coast to a stop.

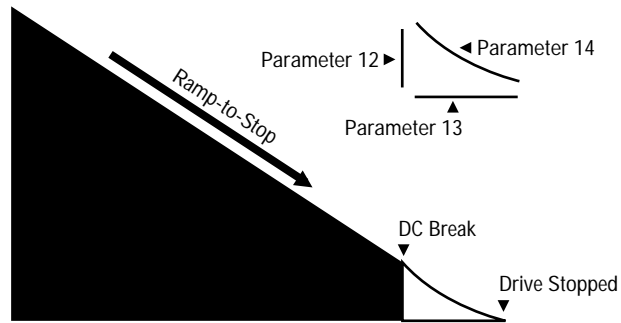


**ATTENTION:** The user has the ultimate responsibility to determine which stopping mode is best suited to the application and which stopping mode will meet applicable standards for operator safety on a particular application

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## DC Brake Settings

Parameters 12, 13 and 14 sets the DC braking action that will occur when the drive is ramped-to-stop or programmed to change direction while the drive is operating for both local and remote control. If DC braking is to be used, Parameter 11 must be set to 0, ramp-to-stop.



DC Brake Settings

### Parameter 12 -- DC Hold Frequency

Units = Hertz  
Range = 00.50/60.00  
Factory Setting = 00.50

Parameter 12 sets the braking frequency of the internal DC brake in .01 Hz increments.

### Parameter 13 -- DC Hold Time

Units = Seconds  
Range = 000/10.0  
Factory Setting = 000

Parameter 13 will set the braking time of the internal DC brake when used in conjunction with parameters 12 and 14. Parameter 13 will set the hold-at-zero time for changes in direction or stop commands when Parameter 14 is set to 0 (disabled). Parameter 13 may be programmed in 0.1 second increments.

### Parameter 14 -- DC Hold Volts

Units = Code  
Range = 0/10  
Factory Setting = 0

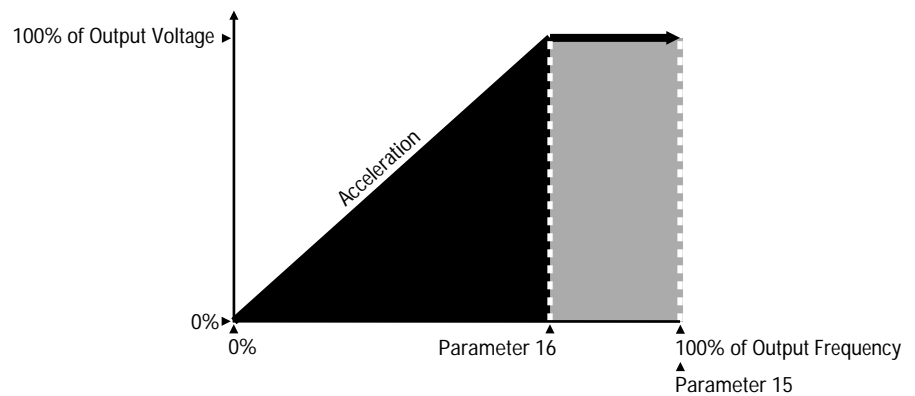
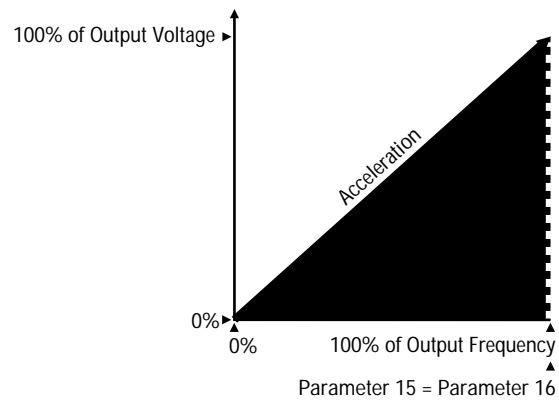
If set to 0, the DC brake function will be disabled and Parameters 12 and 14 will have no effect on drive operation.

If set to a value of 1-10, the DC brake function will be enabled. Parameters 12 and 13 along with Parameter 14 will then set the DC brake function. The value of Parameter 14 determines the level or strength of the braking that occurs, with 1 being the lowest, 10 the highest.

## Max Speed Settings

**Important:** The maximum allowable drive output frequency will be determined by the lowest programmed value of any of the following parameters:

- Parameter 3 Frequency Range
- Parameter 15 Maximum Frequency
- Parameter 51 Upper Frequency Clamp
- Parameter 53 Bias Frequency — If Parameter 53 is Higher Than Parameter 54
- Parameter 54 Gain Frequency — If Parameter 54 is Higher Than Parameter 53



**Max Speed Settings**

### **Parameter 15 -- Maximum Frequency**

Units = Hertz  
Range = 50.00/400.0  
Factory Setting = 60.00

If Parameter 3 is set to 50 or 60, the drive will use the lower of the values set by Parameters 3 and 51 as the maximum drive output frequency. Parameter 15 will have no effect on drive operation.

If Parameter 3 is set to FF, the drive will use the lower of the values set by Parameters 15 and 51 as the maximum drive output frequency.

From 50.00-100.0 Hz, this parameter sets the value of Maximum Frequency in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Maximum Frequency in 0.1 Hz increments.

### **Parameter 16 -- Base Frequency**

Units = Hertz  
Range = 50.00/250.0  
Factory Setting = 60.00

The value set by Parameter 16 Base Frequency will be the point where maximum output voltage is applied to the motor when Parameter 3 is set to FF. If Parameter 3 is set to either 50 or 60 Hz, that will be the base frequency that the drive uses.

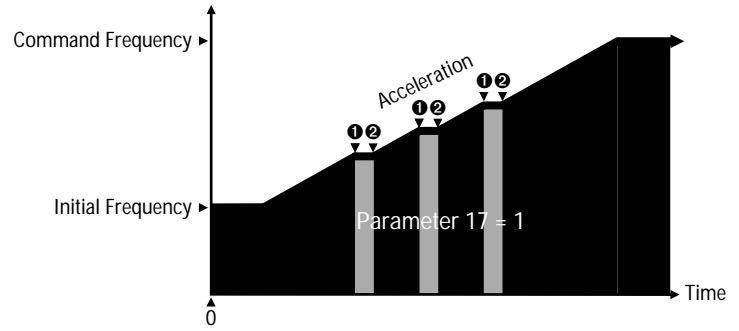
From 50.00-100.0 Hz, this parameter sets the value of Base Frequency in .01 Hz increments.

From 100.0-250.0 Hz, this parameter sets the value of Base Frequency in 0.1 Hz increments.

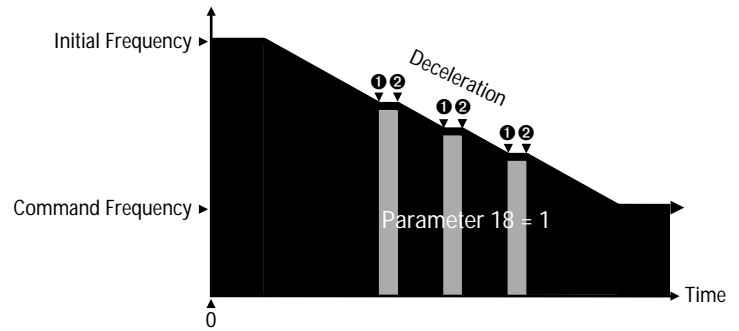


### Accel and Decel Hold Enable

**Important:** If the Heavy Duty Dynamic Brake option is installed, decel frequency hold must be disabled by setting Parameter 18 to 0.



- ① Drive output current = 140% of rated output current.
- ② Drive output current below 140% of rated output current.



- ① Drive bus voltage = bus overvoltage trip.
- ② Drive bus voltage below bus overvoltage trip.

### Accel and Decel Hold Enable

### Parameter 17 -- Accel Frequency Hold

Units = Off/On

Range = 0/1

Factory Setting = 1

To help avoid drive nuisance trips, this parameter enables or disables drive acceleration during high current conditions.

When set to 0, accel stall protection is off. During drive acceleration, should drive output current rise above 140% of rated drive output current, the drive will trip.

When set to 1, accel stall protection is on. During acceleration, the drive will hold the accel ramp for 60 seconds should drive output current rise above 140% of rated drive output current. If output current does not fall below 140% after 60 seconds, the drive will trip.

### Parameter 18 -- Decel Frequency Hold

Units = Off/On

Range = 0/1

Factory Setting = 1

To help avoid drive nuisance trips, this parameter enables or disables drive deceleration during overvoltage conditions.

When set to 0, decel stall protection is off. During drive deceleration, should drive bus voltage rise above the **Over Voltage** values listed below, the drive will trip.

<b>Drive Input Voltage</b>	<b>Decel Stall</b>	<b>Over Voltage Trip</b>
200/208/230V AC	380V DC	430V DC
380/415/460V AC	760V DC	820V DC

When set to 1, decel stall protection is on. During deceleration, the drive will hold the decel ramp at one frequency until bus voltage drops below the **Decel Stall** values listed above.

**Important:** If Parameter 18 Decel Frequency Hold is set to 1 (On), an overhauling load may cause the decel ramp to hold at one frequency for an extended period. This may cause ramp-to-stop commands to appear to be non-functional.

## Preset Frequency and Aux Accel/Decel Enable

### Parameter 19 -- Frequency Select

Units = Code

Range = 0/1/2

Factory Setting = 0

This parameter enables or disables the selection of preset drive frequencies, auxiliary drive preset accel and decel times, or both. To allow drive preset frequencies and/or aux accel and decel times to be selected, external switches must be connected to the Control and Signal Wiring Terminal Block as detailed in Chapter 4.

Preset frequencies are set by Parameters 29-35. Auxiliary accel and decel times are set by Parameters 36-41. External switches connected to the Control and Signal Wiring Terminal Block are enabled or disabled as explained below and in the Preset Frequency and Aux Accel/Decel Enable Tables on pages 5-20 — 5-22.

1. Switch **SW2** on the Control Board is factory set to 4SP. When set to 4SP, two external switches may be connected to the drive. In addition to the standard accel and decel rates set by Parameters 1 and 2, switches S1 and S2 may then be used to select three additional accel rates, three additional decel rates, and four preset speeds, as programmed by Parameters 29-31 and 36-41.
2. When switch **SW2** on the Control Board is set to 8SP, a total of three external switches may be connected to the drive. In addition to the standard accel and decel rates set by Parameters 1 and 2, switches S1, S2 and S3 may then be used to select three additional accel rates, three additional decel rates, and seven preset speeds, as programmed by Parameters 20 and 29-41.

#### Parameter 19 settings.

When set to 0, only the preset frequency function is enabled. External switches connected to the Control and Signal Wiring Terminal Block can only be used to select preset frequencies.

When set to 1, only the auxiliary accel and decel function is enabled. External switches connected to the Control and Signal Wiring Terminal Block can only be used to select auxiliary accel and decel times.

When set to 2, both the preset frequency function and the auxiliary accel and decel function is enabled. External switches connected to the Control and Signal Wiring Terminal Block can be used to select both preset frequencies and auxiliary accel and decel times.

**Parameter 20 -- TB15 Preset/Reset**

Units = Code

Range = 0/1

Factory Setting = 0

This parameter selects the control function of switch S3 when three external switches are connected to the Control and Signal Wiring Terminal Block.

**Parameter 20 settings.**

When set to 0, external switches S1, S2 and S3 connected to the Control and Signal Wiring Terminal Block can be used to select Preset Frequencies 2-8 and Accel/Decel Times 2-4.

When set to 1, external switches S1 and S2 connected to the Control and Signal Wiring Terminal Block can be used to select Preset Frequencies 2-4 and Accel/Decel Times 2-4. If a third switch is installed, switch S3 is used to remotely reset the drive should a drive fault occur.

As shown in Figure 4-5 in Chapter 4 —

**If Parameter 19 = 0**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	The Parameters Selected are
4SP	OFF	OFF	None
4SP	ON	OFF	Preset Frequency 2
4SP	OFF	ON	Preset Frequency 3
4SP	ON	ON	Preset Frequency 4

**If Parameter 19 = 1**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	The Parameters Selected are
4SP	OFF	OFF	None
4SP	ON	OFF	Accel Time 2 + Decel Time 2
4SP	OFF	ON	Accel Time 3 + Decel Time 3
4SP	ON	ON	Accel Time 4 + Decel Time 4

**If Parameter 19 = 2**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	The Parameters Selected are
4SP	OFF	OFF	None
4SP	ON	OFF	Preset Frequency 2 + Accel Time 2 + Decel Time 2
4SP	OFF	ON	Preset Frequency 3 + Accel Time 3 + Decel Time 3
4SP	ON	ON	Preset Frequency 4 + Accel Time 4 + Decel Time 4

As shown in Figure 4-5 in Chapter 4 —

**If Parameter 19 = 0 and Parameter 20 = 0**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Preset Frequency 2
8SP	OFF	ON	OFF	Preset Frequency 3
8SP	ON	ON	OFF	Preset Frequency 4
8SP	OFF	OFF	ON	Preset Frequency 5
8SP	ON	OFF	ON	Preset Frequency 6
8SP	OFF	ON	ON	Preset Frequency 7
8SP	ON	ON	ON	Preset Frequency 8

**If Parameter 19 = 1 and Parameter 20 = 0**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Accel Time 2 + Decel Time 2
8SP	OFF	ON	OFF	Accel Time 3 + Decel Time 3
8SP	ON	ON	OFF	Accel Time 4 + Decel Time 4
8SP	OFF	OFF	ON	Accel Time 1 + Decel Time 1
8SP	ON	OFF	ON	Accel Time 1 + Decel Time 1
8SP	OFF	ON	ON	Accel Time 1 + Decel Time 1
8SP	ON	ON	ON	Accel Time 1 + Decel Time 1

**If Parameter 19 = 2 and Parameter 20 = 0**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Preset Frequency 2 + Accel Time 2 + Decel Time 2
8SP	OFF	ON	OFF	Preset Frequency 3 + Accel Time 3 + Decel Time 3
8SP	ON	ON	OFF	Preset Frequency 4 + Accel Time 4 + Decel Time 4
8SP	OFF	OFF	ON	Preset Frequency 5 + Accel Time 1 + Decel Time 1
8SP	ON	OFF	ON	Preset Frequency 6 + Accel Time 1 + Decel Time 1
8SP	OFF	ON	ON	Preset Frequency 7 + Accel Time 1 + Decel Time 1
8SP	ON	ON	ON	Preset Frequency 8 + Accel Time 1 + Decel Time 1

As shown in Figure 4-5 in Chapter 4 —

**If Parameter 19 = 0 and Parameter 20 = 1**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Preset Frequency 2
8SP	OFF	ON	OFF	Preset Frequency 3
8SP	ON	ON	OFF	Preset Frequency 4
8SP	OFF	OFF	ON	Remote Fault Reset
8SP	ON	OFF	ON	Preset Frequency 2 + Remote Fault Reset
8SP	OFF	ON	ON	Preset Frequency 3 + Remote Fault Reset
8SP	ON	ON	ON	Preset Frequency 4 + Remote Fault Reset

**If Parameter 19 = 1 and Parameter 20 = 1**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Accel Time 2 + Decel Time 2
8SP	OFF	ON	OFF	Accel Time 3 + Decel Time 3
8SP	ON	ON	OFF	Accel Time 4 + Decel Time 4
8SP	OFF	OFF	ON	Remote Fault Reset
8SP	ON	OFF	ON	Accel Time 2 + Decel Time 2 + Remote Fault Reset
8SP	OFF	ON	ON	Accel Time 3 + Decel Time 3 + Remote Fault Reset
8SP	ON	ON	ON	Accel Time 4 + Decel Time 4 + Remote Fault Reset

**If Parameter 19 = 2 and Parameter 20 = 1**

When Control Board Switch SW2 is Set to	and External Switch S1 is Set to	and External Switch S2 is Set to	and External Switch S3 is Set to	The Parameters Selected are
8SP	OFF	OFF	OFF	None
8SP	ON	OFF	OFF	Preset Frequency 2 + Accel Time 2 + Decel Time 2
8SP	OFF	ON	OFF	Preset Frequency 3 + Accel Time 3 + Decel Time 3
8SP	ON	ON	OFF	Preset Frequency 4 + Accel Time 4 + Decel Time 4
8SP	OFF	OFF	ON	Remote Fault Reset
8SP	ON	OFF	ON	Preset Frequency 2 + Accel Time 2 + Decel Time 2 + Remote Fault Reset
8SP	OFF	ON	ON	Preset Frequency 3 + Accel Time 3 + Decel Time 3 + Remote Fault Reset
8SP	ON	ON	ON	Preset Frequency 4 + Accel Time 4 + Decel Time 4 + Remote Fault Reset

## Aux Interlock Enable

### Parameter 21 -- Auxiliary Interlock

Units = Code

Range = 0/1

Factory Setting = 0

To enable drive operation, terminal 16 and logic common at the Control and Signal Wiring Terminal Block must be jumpered. This parameter sets the function of terminal 16 and logic common when a normally closed auxiliary interlock is installed in its place.

If set to 0, when the auxiliary contact opens:

- The drive will coast-to-stop, display fault **AU**, and store the fault in Fault Buffer Parameters 59-62.
- Fault Contact CR3 on the Control Board will change state to provide a fault signal at terminals 22-24 at the Control and Signal Wiring Terminal Block.

If set to 1, when the auxiliary contact opens:

- The drive will coast-to-stop and display **AS**. Since **AS** is not a fault, it will not be stored in Fault Buffer Parameters 59-62.
- Since **AS** is not a fault, Fault Contact CR3 on the Control Board will not change state to provide a fault signal at terminals 22-24.

## Drive Supplied Contact Settings

### Parameter 22 -- CR1 Select

Units = Code

Range = 1/2/3

Factory Setting = 1

This parameter sets the function of drive supplied contact CR1. CR1 is a normally open contact located at terminals 19 and 20 on the Control and Signal Wiring Terminal Block.

If set to 1, the N.O contact will close when the drive is within  $\pm 2$  Hz of the run or jog set speed.

If set to 2, the N.O contact will close when the drive is at 140% of rated drive output current or 125% of the current set in Parameter 7.

If set to 3, the N.O contact will close when the run or jog output frequency is greater than the CR1 Frequency set by Parameter 24.

### Parameter 23 -- CR2 Select

Units = Code

Range = 0/1/2/3

Factory Setting = 0

This parameter sets the function of drive supplied contact CR2. CR2 is a normally open contact located at terminals 20 and 21 on the Control and Signal Wiring Terminal Block.

If set to 0, the N.O contact will close when the drive receives a run or jog start signal.

If set to 1, the N.O contact will close when the drive is within  $\pm 2$  Hz of run or jog set speed.

If set to 2, the N.O contact will close when the drive is at 140% of rated drive output current or 125% of the current set in Parameter 7.

If set to 3, the N.O contact will close when the run or jog output frequency is greater than the CR2 Frequency set by Parameter 25.



**Parameter 24 -- CR1 Frequency**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 00.50

This parameter sets the frequency that will cause drive supplied contact CR1 to close when Parameter 22 is set to 3.

From 00.50-100.0 Hz, this parameter sets the value of CR1 Frequency in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of CR1 Frequency in .1 Hz increments.

**Parameter 25 -- CR2 Frequency**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 00.50

This parameter sets the frequency that will cause drive supplied contact CR2 to close when Parameter 23 is set to 3.

From 00.50-100.0 Hz, this parameter sets the value of CR2 Frequency in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of CR2 Frequency in .1 Hz increments.

## Jog Settings

### Parameter 26 -- Jog Frequency

Units = Hertz  
Range = 00.50/20.00  
Factory Setting = 10.00

This parameter sets the jog frequency (speed) that the drive will use when it receives either a local or remote jog command. Jog frequency may be set in .01 Hz increments. Whenever the drive receives a jog command, Accel Frequency Hold, Decel Frequency Hold, and Current Limit functions are disabled.

### Parameter 27 -- Jog Accel Time

Units = Seconds  
Range = 0000/1600  
Factory Setting = 00.50

This parameter sets the time it takes the drive to accelerate to the jog frequency set in Parameter 26. If set to 0000, the drive will enter 40 ms but display 0000.

From 000.1-1000 seconds, sets the Jog Accel Time in 0.1 second increments.

From 1000-1600 seconds, sets the Jog Accel Time in 1 second increments.

### Parameter 28 -- Jog Decel Time

Units = Seconds  
Range = 0000/1600  
Factory Setting = 00.50

This parameter sets the time it takes the drive to decelerate to 0. If set to 0000, the drive will enter 40 ms but display 0000.

From 000.1-1000 seconds, sets the Jog Decel Time in 0.1 second increments.

From 1000-1600 seconds, sets the Jog Decel Time in 1 second increments.

## Preset Frequency Settings

Auxiliary Preset Frequencies are enabled or disabled by Parameters 19 and 20. Individual Preset Frequency settings are selected by setting switches S1, S2 and/or S3 as shown in Parameters 19 and 20.

### **Parameter 29 -- Preset Frequency 2**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 20.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 2 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 2 in 0.1 Hz increments.

### **Parameter 30 -- Preset Frequency 3**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 30.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 3 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 3 in 0.1 Hz increments.

### **Parameter 31 -- Preset Frequency 4**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 40.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 4 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 4 in 0.1 Hz increments.

**Parameter 32 -- Preset Frequency 5**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 15.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 5 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 5 in 0.1 Hz increments.

**Parameter 33 -- Preset Frequency 6**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 25.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 6 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 6 in 0.1 Hz increments.

**Parameter 34 -- Preset Frequency 7**

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 35.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 7 in .01 Hz increments.

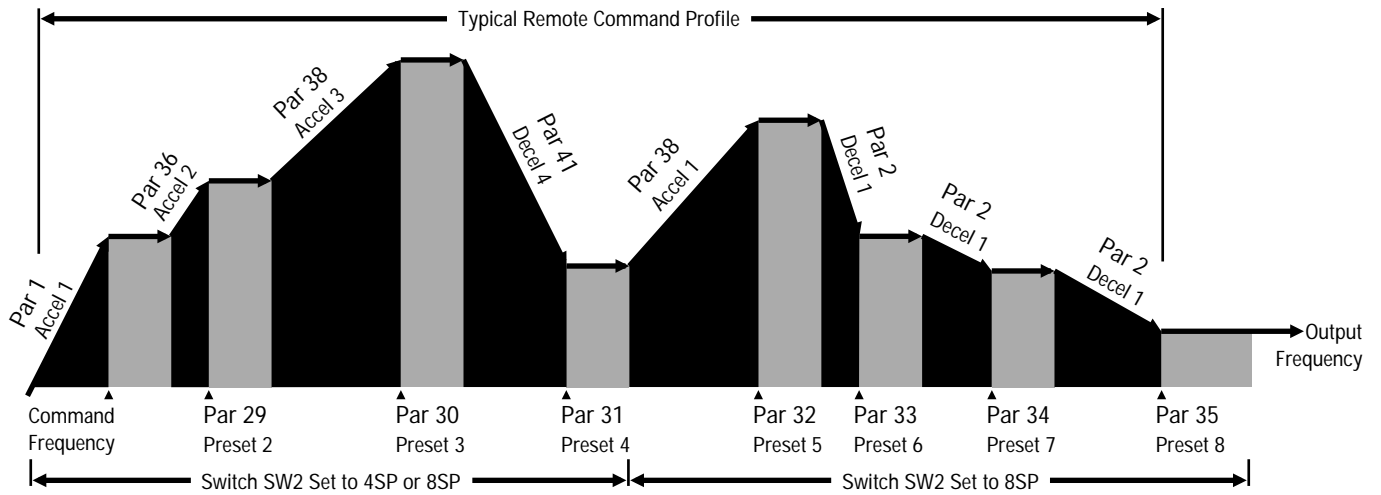
From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 7 in 0.1 Hz increments.

**Parameter 35 -- Preset Frequency 8**

Units = Hertz  
 Range = 00.50/400.0  
 Factory Setting = 45.00

From 00.50-100.0 Hz, this parameter sets the value of Preset Frequency 8 in .01 Hz increments.

From 100.0-400.0 Hz, this parameter sets the value of Preset Frequency 8 in 0.1 Hz increments.



**Preset Frequency Settings  
 Auxiliary Accel and Decel Settings**

**Auxiliary Accel and Decel Settings** Auxiliary Accel and Decel Times are enabled or disabled by Parameters 19 and 20. Individual Accel and Decel Parameter settings are selected by setting switches S1, S2 and/or S3 as shown in Parameters 19 and 20

**Parameters 36, 38 and 40 -- Accel Times 2, 3 and 4**

Units = Seconds  
Range = 000.1/1600  
Factory Setting = 005.0

Each auxiliary accel time determines a time that it will take the drive to accelerate over a 60 Hz frequency change. From 0 to 0.5 Hz, any auxiliary accel rate set is effectively zero. From 0.5 Hz to maximum output frequency, the accel rate set by each auxiliary accel time will remain constant. For each accel time, the total time it will take the drive to accelerate from an initial frequency to a new command frequency is:  
Total time = (New Command Frequency – Initial Frequency) × (Accel Time) ÷ 60.

From 000.1-1000 seconds, these parameters set the values of Accel Time 2, 3 and 4 in 0.1 second increments.

From 1000-1600 seconds, these parameters set the value of Accel Time 2, 3 and 4 in 1 second increments.

**Parameters 37, 39 and 41 -- Decel Times 2, 3 and 4**

Units = Seconds  
Range = 000.1/1600  
Factory Setting = 005.0

Each auxiliary decel time determines a time that it will take the drive to decelerate and ramp-to-stop over a 60 Hz change in frequency. From 0.5 to 0 Hz, the accel rate is non-linear and set by either DC injection braking or the DC dynamic brake if it is installed. From maximum output frequency to 0.5 Hz, the accel rate set by Parameter 2 will remain constant. For each decel time, the total time it will take the drive to decelerate from an initial frequency to a new command frequency is:

Total time = (New Command Frequency – Initial Frequency) × (Accel Time) ÷ 60.

From 000.1-1000 seconds, these parameters set the values of Decel Time 2, 3 and 4 in 0.1 second increments.

From 1000-1600 seconds, these parameters set the value of Decel Time 2, 3 and 4 in 1 second increments.

### Skip Frequency Settings

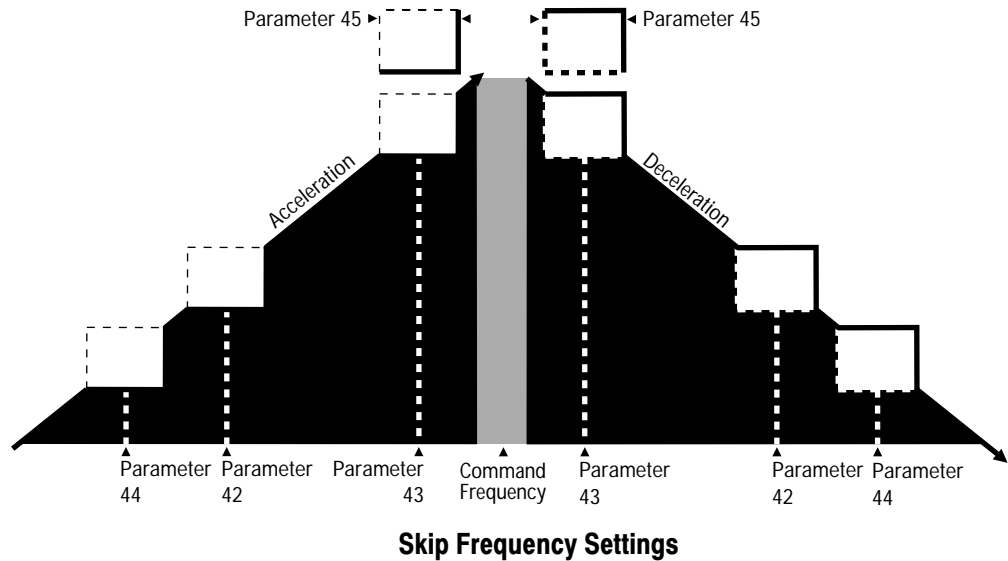
#### Parameters 42, 43 and 44 -- Skip Frequencies 1, 2 and 3

Units = Hertz  
 Range = 0000/400.0  
 Factory Setting = 0000

To help avoid undesirable mechanical resonance, Parameters 42-44 prevents the drive from running at one, two or three specific frequencies. Although the drive will use these frequencies when accelerating or decelerating, they cannot be set as "running" frequencies by any drive parameter. The drive will stay slightly above or slightly below these frequencies if the frequency values are entered. If a Skip Frequency value of 0000 is selected, the skip frequency function of that parameter is disabled.

From 00.50-100.0 Hz, Parameters 42-44 sets the Skip Frequencies in .01 Hz increments.

From 100.0-400.0 Hz, Parameters 42-44 sets the Skip Frequencies in 0.1 Hz increments.



### **Parameter 45 -- Skip Frequency Band**

Units = Code

Range = 0/10

Factory Setting = 0

Parameter 45 allows each of the individual Skip Frequencies set in Parameters 42-44 to be expanded into three bands of skip frequencies in 2-20 Hz increments.

Setting a Skip Frequency Band value of 0 will disable the Skip Frequency Band function, but not individual Skip Frequency values set by Parameters 42-44.

Setting a Skip Frequency Band value other than 0 will enable Skip Frequency values and expand their range by 2 Hz. For example, if Parameter 45 is set to 1, a Skip Frequency value set by Parameter 42, 43 or 44 will expand to a band that includes the Skip Frequency value with an additional 1 Hz band on either side. If set to 10, a Skip Frequency value set by Parameter 42, 43 or 44 will expand to a band that includes the Skip Frequency value with an additional 10 Hz band on either side.

#### **Important:**

1. If the drive is programmed with a Parameter 3 Frequency Range and/or Parameter 15 Maximum Frequency value that falls within a skip frequency bandwidth, the drive will operate only through the non-skip frequencies below Parameters 3 and 15.
2. If the drive is programmed with a Parameter 51 Upper Frequency Clamp value that falls within a skip frequency bandwidth, the drive will operate only through the non-skip frequencies below Parameter 51, then jump to the Parameter 51 value at a maximum speed command.
3. If Parameters 3, 15 and 51 are all within the skip frequency bandwidth, the drive will operate only through the non-skip frequencies below the lowest value set by Parameters 3, 15 and 51.



## Current Limit Setting

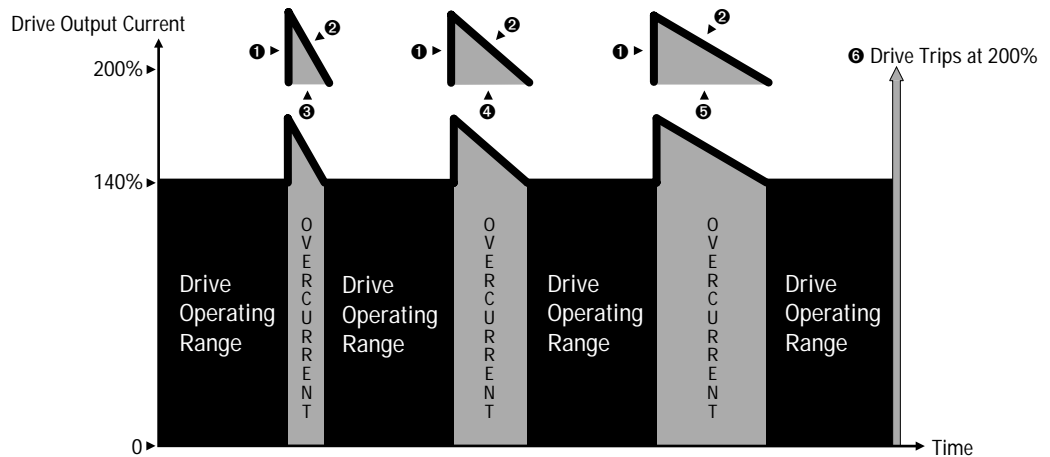
### Parameter 46 -- Current Limit

Units = Seconds

Range = 00/1.5

Factory Setting = 00

Should drive current rise above 140% of rated drive output current, the drive will attempt to limit current for one minute. Parameter 46 sets the frequency foldback rate used to decrease current in .1 second increments. Frequency foldback allows the drive to ramp output frequency down far enough to temporarily eliminate an overcurrent condition. When Parameter 46 is set to 00, the Current Limit function set by Parameter 46 is disabled and the drive's overcurrent feature will trip the drive should current rise above 200%.



- ❶ % of Drive Overcurrent
- ❷ Drive Output Frequency Decel Ramp
- ❸ Parameter 46 = 0.5 Seconds
- ❹ Parameter 46 = 1.0 Seconds
- ❺ Parameter 46 = 1.5 Seconds
- ❻ Parameter 46 = 0.0 Seconds

### Current Limit Setting

## Auto Restart Settings



**ATTENTION:** Auto restart operation may only be used as outlined in NFPA79, Paragraph 6-14 (exceptions 1-3) for specialized applications. Equipment damage and/or personal injury may result if the settings of Parameters 47-49 are used in an inappropriate application.

### Parameter 47 -- Power Loss Restart

Units = Code

Range = 0/1/2/3

Factory Setting = 1

This parameter selects the drive restart action taken if input power is interrupted and restored within 100 ms — However — restart settings 1 and 2 in Parameter 48 will override any settings made in Parameter 47.

- When set to 0, the drive will restart and ramp to the last selected speed — but only for 2-wire external control.
- When set to 1, Power Loss Restart is disabled for both 2 and 3-wire control schemes. The drive will not restart until the fault is cleared by first issuing a stop command, then a start command. The drive will then restart and ramp to the last selected speed.
- 2 defines the drive restart action for 2-wire external control. Once the drive receives a start command, the drive will start and ramp to the last selected speed but only after the initial waiting time set by Parameter 49. Should an **LU** fault occur or **OP** message appear, the drive will restart and ramp to the last selected speed after the initial waiting time set by Parameter 49 without reissuing a start command.
- 3 defines the drive restart action for both 2 and 3-wire control. Once the drive receives a start command, the drive will start and ramp to the last selected speed but only after the initial waiting time set by Parameter 49. Should an **LU** fault occur or **OP** message appear, the drive will not restart until the fault or message has been cleared by first issuing a stop command, then a start command. Once cleared, the drive will start and ramp to the last selected speed after the initial waiting time set by Parameter 49.

### Parameter 48 -- Ride-Thru Restart

Units = Code

Range = 0/1/2

Factory Setting = 0

For all control schemes, this parameter selects the drive restart action taken if input power is interrupted and restored within 100 ms. Restart settings 1 and 2 in Parameter 48 will override any settings made in Parameter 47.

- When set to 0, if power is removed for 15 ms, Ride-Thru Restart is disabled and the drive will generate an **LU** fault. The drive will not restart until the fault is cleared by first issuing a drive stop command, then a start command. The drive will then restart and ramp to the last selected speed.
- When set to 1, if power is removed for 15 ms, the drive will generate an **LU** fault. If power is restored within 100 ms (or longer depending on load), the drive will restart from zero speed, then ramp to the last selected speed after the initial waiting time set by Parameter 49.
- When set to 2, if power is removed for 15 ms, the drive will generate an **LU** fault. If power is restored within 100 ms (or longer depending on load), the drive will continue to operate at the selected speed. If longer than 100 ms, the drive will restart only after the initial waiting time set by Parameter 49.

### Parameter 49 -- Restart Time Select

Units = Seconds

Range = 000.1/100.0

Factory Setting = 000.1

This parameter sets the time the drive will wait before acting on a restart command after an **LU** fault has occurred. The value of Parameter 49 is selectable in 0.1 second increments.

## Lower and Upper Frequency Clamp Settings

**Important:** The maximum allowable drive output frequency will be determined by the lowest value programmed into the following parameters:

- Parameter 3 Frequency Range
- Parameter 15 Maximum Frequency
- Parameter 51 Upper Frequency Clamp
- Parameter 53 Bias Frequency — If Parameter 53 is Higher Than Parameter 54
- Parameter 54 Gain Frequency — If Parameter 54 is Higher Than Parameter 53

### Parameter 50 -- Lower Frequency Clamp

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 00.50

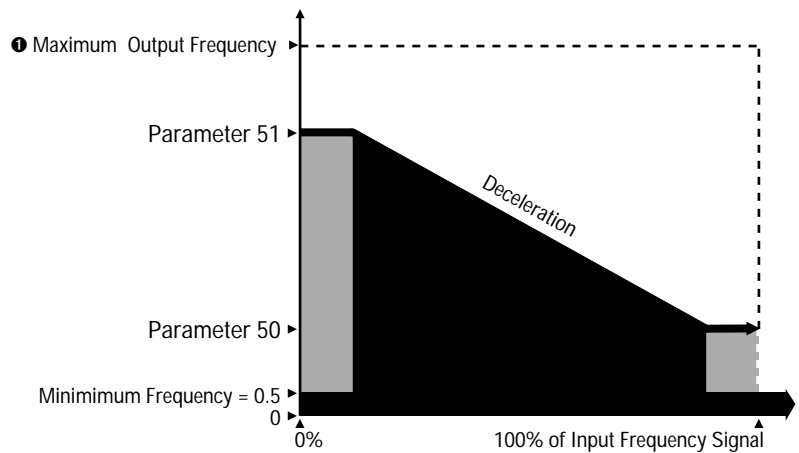
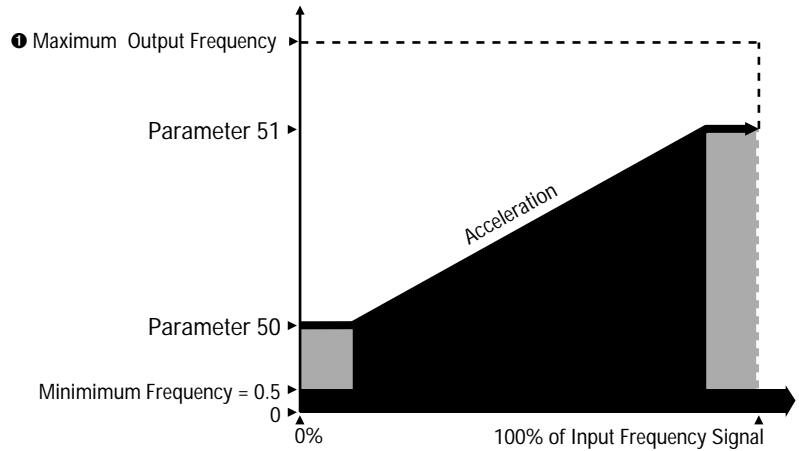
This parameter sets the minimum frequency or speed that the drive can be set to by any input control signal.

From 00.50-100.0 Hz, Parameter 50 sets the Lower Frequency Clamp in .01 Hz increments.

From 100.0-400.0 Hz, Parameter 50 sets the Lower Frequency Clamp in 0.1 Hz increments.

**Important:** If an external potentiometer, a 0-5V DC, a 0-10V DC or a 4-20mA frequency reference is required:

- For directly proportional applications, enable Parameter 52 and enter a minimum value of 00.50 for Parameter 53 if the Lower Frequency Clamp is to set the minimum frequency.
- For inverse follower applications, enable Parameter 52 and enter a minimum value of 00.50 for Parameter 54 if the Lower Frequency Clamp is to set the minimum frequency.



- Maximum Output Frequency = 50 Hz if Parameter 3 = 50  
60 Hz if Parameter 3 = 60  
Parameter 15 if Parameter 3 = FF

### Lower and Upper Frequency Clamp Settings

#### Parameter 51 -- Upper Frequency Clamp

Units = Hertz

Range = 00.50/400.0

Factory Setting = 400.0

This parameter sets the highest frequency or speed that the drive can be set to by any input control signal, unless Parameter 15 (Maximum Frequency) or Parameter 3 (Frequency Range) has been set lower. If set to a value higher than Parameter 3 or 15, the value will be entered, but the drive will default to the lowest value set by Parameter 3 or 15 when operating.

From 00.50-100.0 Hz, Parameter 51 sets the Upper Frequency Clamp in .01 Hz increments.

From 100.0-400.0 Hz, Parameter 51 sets the Upper Frequency Clamp in 0.1 Hz increments.

## Bias and Gain Settings

**Important:** The maximum allowable drive output frequency will be determined by the lowest programmed value of any of the following parameters:

- Parameter 3 Frequency Range
- Parameter 15 Maximum Frequency
- Parameter 51 Upper Frequency Clamp
- Parameter 53 Bias Frequency — If Parameter 53 is Higher Than Parameter 54
- Parameter 54 Gain Frequency — If Parameter 54 is Higher Than Parameter 53

### Parameter 52 -- Bias and Gain Enable

Units = Code

Range = 0/1

Factory Setting = 0

This parameter enables or disables both the Bias and Gain Frequencies set by Parameters 53 and 54. Bias and Gain Frequencies allows a remote speed signal to be used within a specific minimum and maximum frequency range. The Bias and Gain Frequencies may be used to provide a directly or inversely proportional 0-5V DC, 0-10V DC, 4-20 mA, or external speed pot signal at the Control and Signal Wiring Terminal Block.

If set to 0, the bias and gain function is disabled.

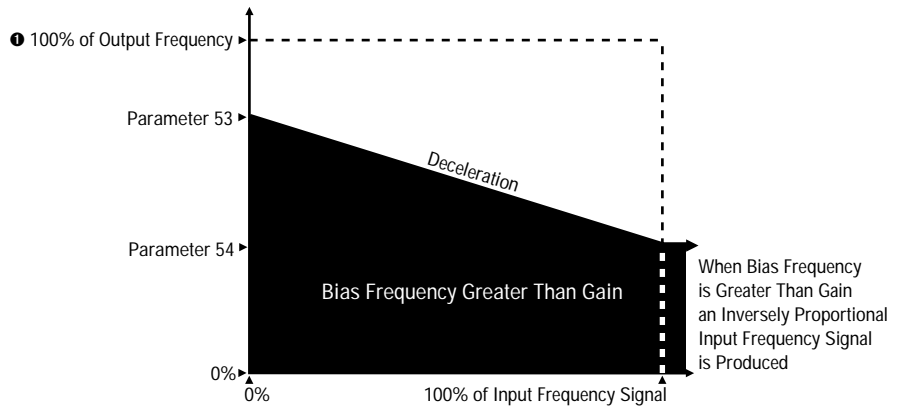
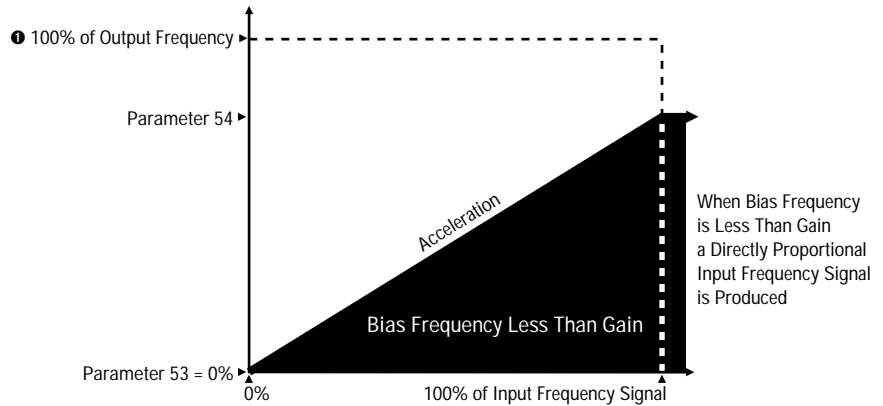
If set to 1, the bias and gain function is enabled.

If the 1333 is to produce 0 output speed at 0 external input signal:

- Parameter 9 Local/Remote Frequency must be set to remote.
- Parameter 52 Bias and Gain Enabled must be enabled.
- Parameter 53 Bias Frequency must be set to the minimum output frequency required.
- Parameter 54 Gain Frequency must be set to the maximum output frequency required.

If the 1333 is to produce maximum output speed at 0 external input signal:

- Parameter 9 Local/Remote Frequency must be set to remote.
- Parameter 52 Bias and Gain Enabled must be enabled.
- Parameter 53 Bias Frequency must be set to the maximum output frequency required.
- Parameter 54 Gain Frequency must be set to the minimum output frequency required.



- 100% of Output Frequency = 50 Hz if Parameter 3 = 50  
60 Hz if Parameter 3 = 60  
Parameter 15 if Parameter 3 = FF

### Bias and Gain Settings

#### Parameter 53 -- Bias Frequency

Units = Hertz  
Range = 00.00/400.0  
Factory Setting = 00.00

From 00.50-400.0 Hz, Parameter 53 sets the Bias Frequency in .01 Hz increments.

From 100.0-400.0 Hz, Parameter 53 sets the Bias Frequency in 0.1 Hz increments.

#### Parameter 54 -- Gain Frequency

Units = Hertz  
Range = 00.50/400.0  
Factory Setting = 60.00

From 00.50-400.0 Hz, Parameter 54 sets the Gain Frequency in .01 Hz increments.

From 100.0-400.0 Hz, Parameter 54 sets the Gain Frequency in 0.1 Hz increments.

## Output Meter Settings

### Parameter 55 -- Frequency Output (Amps)

Units = % of Maximum Output Signal  
Range = 075/125  
Factory Setting = 100

This parameter is used to calibrate an output frequency ammeter while the drive is running. It may be set from 75-125% of the maximum output signal, 1 mA. The 1 mA signal is selected by setting switch SW1 on the Control Board to the 1 mA position.

### Parameter 56 -- Frequency Output (Volts)

Units = % of Maximum Output Signal  
Range = 075/125  
Factory Setting = 100

This parameter is used to calibrate an output frequency voltmeter while the drive is running. It may be set from 75-125% of the maximum output signal, 10V DC. The 10V DC signal is selected by setting switch SW1 on the Control Board to the 10V DC position.

## Monitoring Mode Settings

### Parameter 57 -- Monitor Display Select

Units = Code  
Range = 0/1/2  
Factory Setting = 0

This parameter sets one of three alternate monitoring modes that may be selected while the drive is running.

When set to 0, **A0** — monitor equivalent drive output current.

When set to 1, **A1** — monitor equivalent motor RPM.

When set to 2, **A2** — monitor drive control frequency.

### Parameter 58 -- Motor Pole Select

Units = Code  
Range = 2/4/6/8/10  
Factory Setting = 4

To allow motor RPM to be calculated and displayed when monitoring mode **A1** is selected, this parameter is used to enter the number of motor poles.



## Drive Fault Memory

### Parameters 59, 60, 61 and 62 -- Fault Buffer 0, 1, 2, and 3

Units = None

Range = None

Factory Setting = None

Parameters 59-62 will store the last (4) faults that the drive has encountered in a cascading mode.

- Fault Buffer 0 will store the new fault.
- Fault Buffer 1 will store the fault from Fault Buffer 0.
- Fault Buffer 2 will store the fault from Fault Buffer 1.
- Fault Buffer 3 will store the fault from Fault Buffer 2.

## Startup

### The Startup Process

The following startup procedure uses the Local Control and Programming Panel to setup the drive. To guard against damage to equipment caused by incorrect or inappropriate parameter settings, steps 1-28 must be followed in order. Step 29 is provided to allow you to incorporate an external 2 or 3-wire control scheme into your application.



**ATTENTION:** Power must be applied to the drive with the cover removed to perform certain startup procedures. Voltages on many components are at incoming line potential or bus voltage. To avoid electric shock hazard or damage to equipment, do not touch any drive component other than those specified in the startup procedure.

---



**ATTENTION:** Become familiar with the equipment and read through the wiring, speed selection and adjustment sections before attempting to perform the startup procedures. Adjustments may be required to meet specific load characteristics or operator preference.

Exercise extreme care when performing any task on the drive. Failure to do so may result in electric shock or equipment damage.

As shown on the next page, a DC bus neon light at the top of the 1333 has been provided to provide visual indication that bus voltage is present. Bus voltage may be verified by using a voltmeter and measuring the voltage between +BUS and –BUS on the Power Terminal Block. Do not attempt to service the drive until 2 minutes after the neon light has extinguished and bus voltage has discharged to zero volts.

---

**Important:**

1. Power must be applied to the drive when viewing or changing 1333 parameters. Previous programming may effect the drive status when power is applied.
2. Remote circuits may be connected to the Control and Signal Wiring Terminal Block on the Main Control Board. Confirm that all circuits are in a de-energized state before applying power.
3. User supplied voltages may exist at the Control and Signal Wiring Terminal Block even when power is not applied to the drive.
4. If you cannot complete a procedure, immediately refer to Appendix B — Preventive Maintenance and Troubleshooting Common Drive Problems. Do not proceed. Determine the cause of the problem and correct the problem first, then return to the startup procedure.

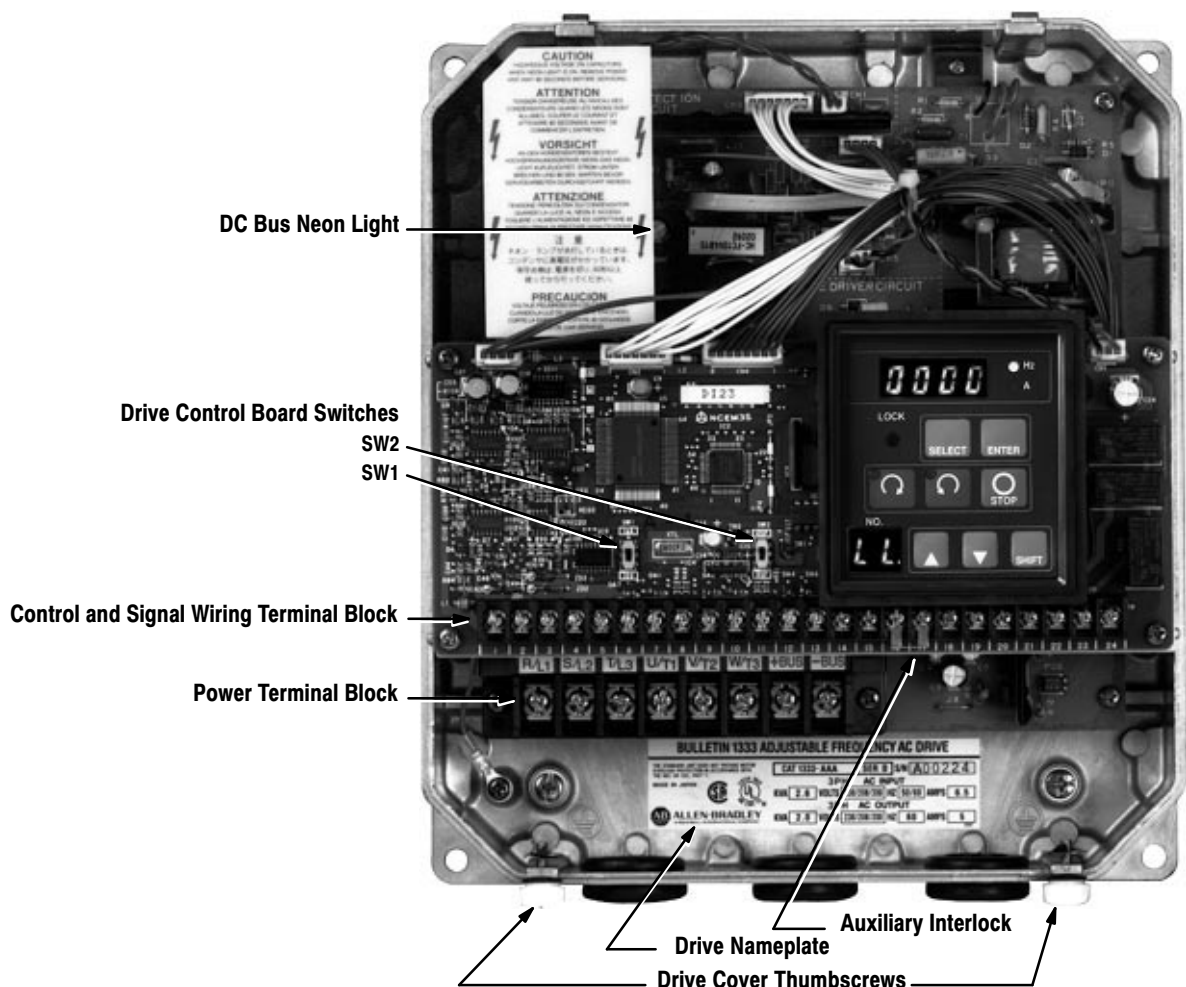


Figure 6-1 -- 3/4-5 HP (.55-4 kW) Drive

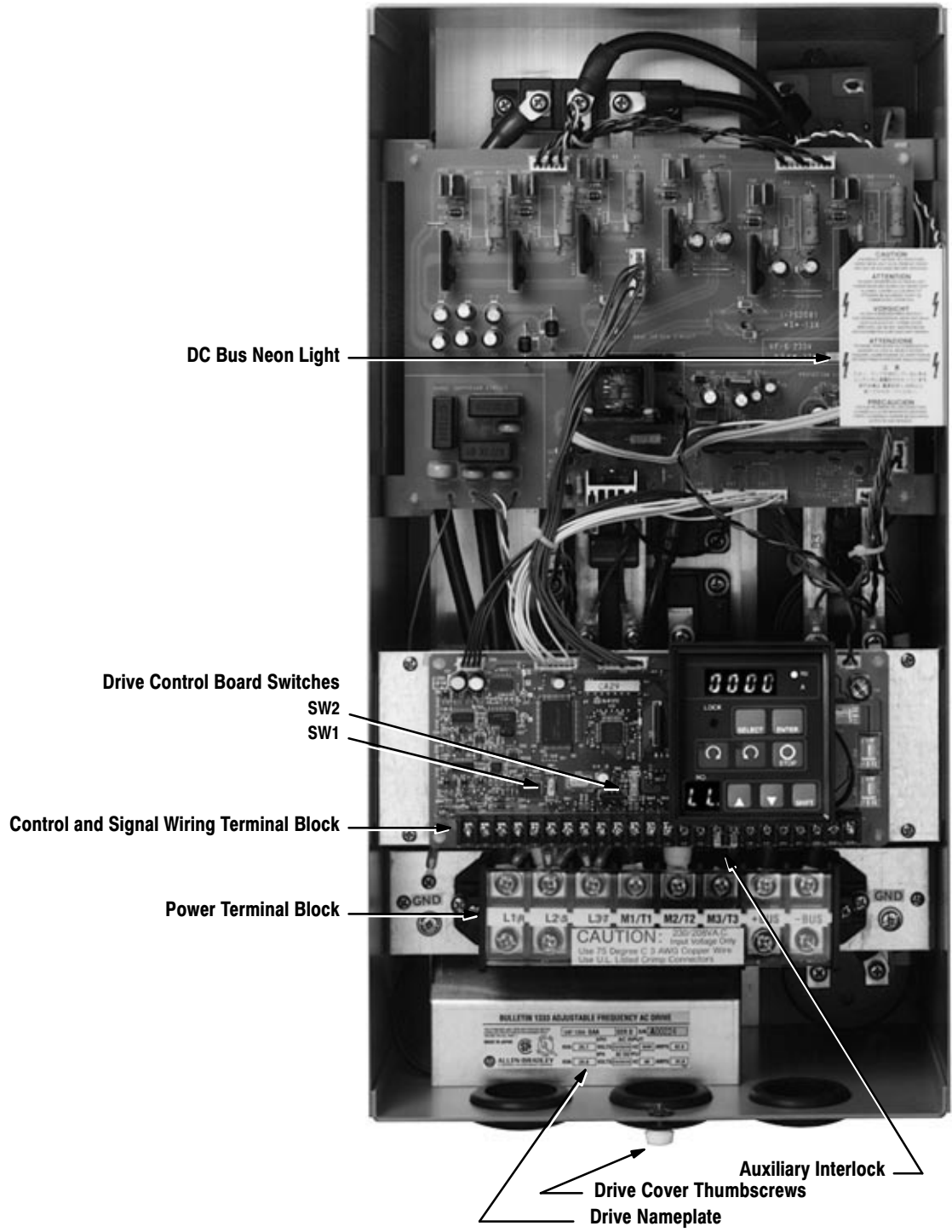


Figure 6-2 -- 7 1/2-20 HP (5.5-15 kW) Drive

1333 parts, switches and terminal blocks shown in Figures 6-1, 6-2 and 6-3 are referenced throughout the Initial Operation, Function Checks, Function and Final Settings Sections of this chapter.

## Initial Operation – Motor Disconnected

### Step 1

Verify that AC line power at the disconnect device is within the rated value of the drive nameplate data. Drive nameplate and alternate voltage ratings are explained in Chapter 2 — Drive Identification.

### Step 2

Remove and lock out all incoming power to the drive. Remove the drive cover and disconnect the motor leads from terminals  $U/T_1$ ,  $V/T_2$ ,  $W/T_3$  at the Power Terminal Block. Insulate the exposed wires to prevent accidental contact with other drive components.

### Step 3

If an auxiliary interlock is not installed at the Control and Signal Wiring Terminal Block, verify that the spare jumper provided with the drive is installed between terminals 16 and 17.

### Step 4

Replace the drive cover and tighten both thumbscrews. Apply power to the drive and verify that no faults are displayed.

- Both the main and mode displays should immediately light.
- The main display should read **0000**. If the main display indicates **OU** or **LU**, an incorrect voltage is being applied to the drive.
- The mode display should read **LL**. to allow control of the drive from the Local Control and Programming Panel. If not, refer to Chapter 5 — Operation and Programming to change Parameters 8 and 9 to local control.

**Important:** Steps 5-15d are **Function Checks** based on factory parameter settings. The function groups listed, reference the same parameters as grouped in Chapter 5 and Appendix C. If the drive has been previously commissioned, parameter settings may not be compatible with this startup procedure. Drive status and fault conditions will be unpredictable when power is first applied.

To obtain the proper results, initially change all parameter values to the factory settings listed on the drive cover label. If it is required to change a parameter, you will be instructed to do so.

## Function Checks - Motor Disconnected

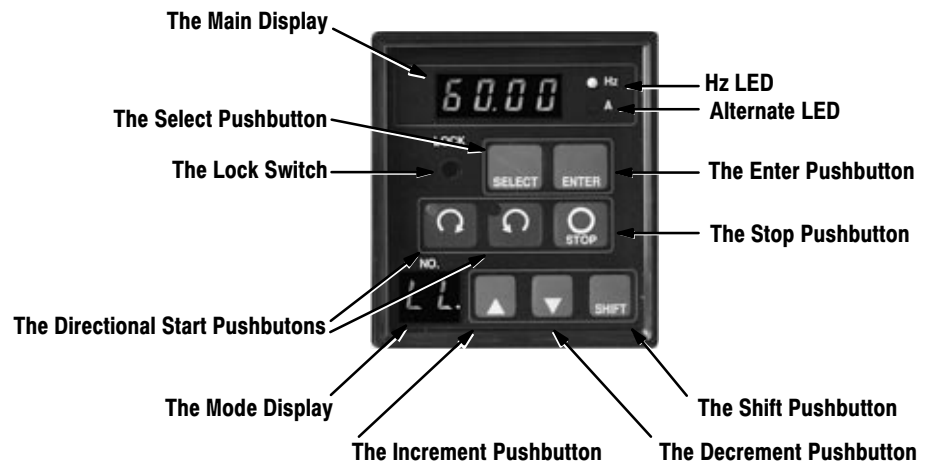


Figure 6-3 -- 3/4-20 HP (.55-15kW) Controls

### Step 5 -- Local/Remote Control Enable Check Max Speed Settings Check

Start the drive by pressing either directional start pushbutton. The pushbutton will light. Press and hold the increment pushbutton and watch the display increase. Release the pushbutton when the display reaches **60.00** Hz or maximum speed.

### Step 6 -- Monitor Mode Settings Check

Press the select pushbutton once. The main display will flash and show the last manual set speed entered.

Press the select pushbutton again. **A0.** will be shown in the mode display, drive output amps in the main display, as set by Parameter 57.

Press the select pushbutton again. The mode display will flash and show **01.** to indicate the parameter being viewed, and the main display will show **005.0**, the accel time set by Parameter 1.

Press the pushbutton again and **60.00** Hz will again be displayed.

### Step 7 -- Reverse Enable Check Accel and Decel Settings Check

Press the other directional start pushbutton. The pushbutton will light and the drive display will ramp down to **0.00** Hz within the decel time set by Parameter 2, then immediately ramp up to **60.00** Hz, the maximum speed presently programmed by Parameter 3, within the accel time set by Parameter 1. Reversing is enabled or disabled by Parameter 10.

## Function Checks - Motor Disconnected

### Step 8 -- Local/Remote Speed Enable Check Lower and Upper Frequency Clamp Settings Check

Press the select pushbutton once. The main display will again flash and show the last manual set speed entered. Using the increment, decrement and shift pushbuttons, any value between 00.50 (the lower frequency clamp set by Parameter 50), and 60.00 Hz can be selected.

Select a value and press the enter key. The drive will either accel within the accel time set by Parameter 1, or decel within the decel time set by Parameter 2, to a value within these limits. Had Parameter 51 been set to a value lower than 60.00 Hz, the upper frequency clamp would be the highest frequency the drive could reach.

### Step 9 -- Stop Setting Check

Press the stop pushbutton to stop the drive. The drive display will ramp down to zero within the decel time set by Parameter 2. Had Parameter 11 been set to 1, the drive would have been set to coast-to-stop and Parameter 2 would have no affect on stopping time.

### Step 10 -- Jog Settings Check

Press the shift pushbutton once and **LJ** will be shown in the mode display. Press and hold either directional start pushbutton. The pushbutton will light and the drive display will ramp up to **I 0.00** Hz, or the maximum jog speed set by Parameter 26, within the jog accel time set by Parameter 27. Release the directional start pushbutton and the drive will ramp back down to **0.00** Hz at the jog decel time set by Parameter 28. Once fully stopped, the drive will display **0000**.

### Step 11 -- Auxiliary Interlock Enable Check Drive Fault Memory Check

Start the drive. If an external auxiliary interlock has been installed between terminals 16 and 17 at the Control and Signal Wiring Terminal Block, open the interlock. **AU** will be shown at the main display, indicating an auxiliary interlock fault.

- Press the stop pushbutton to clear the fault.
- Press the select pushbutton three times to access the parameter display.
- Select Parameter 59. Fault Buffer 0 will display **AU**, the last fault received by the drive.

If Parameter 21 had been set to 1, the drive would have displayed **AS** at the main display, indicating an auxiliary stop. An **AS** is not a fault, and therefore not stored in memory.

**Function Checks**  
**- Motor Disconnected**

**Step 12 -- Drive Supplied Contact Settings Check**

Stop the drive. Remove and lock out all incoming power to the drive, then remove the drive cover.

Reapply power and start the drive. N.O. contact CR2 (terms. 20 & 21 on the Control and Signal Wiring Terminal Block) will close as presently programmed by Parameter 23. Once the drive is within  $\pm 2$  Hz of set speed, N.O. contact CR1 (terminals 19 & 20 on the Control and Signal Wiring Terminal Block) will close since Parameter 24 is presently set to 1.

**Step 13a -- Auto Restart Settings Check**



**ATTENTION:** Auto restart operation may only be used as outlined in NFPA79, Paragraph 6-14 (exceptions 1-3) for specialized applications. Equipment damage and/or personal injury may result if the settings of Parameters 47-49 are used in an inappropriate application.

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To properly program the drive to restart when required demands that Parameters 47-49 be coordinated correctly. When Parameter 48 is set to 1 or 2, it will override any setting made in Parameter 47. Likewise the restart time set in Parameter 49 will affect the restart actions taken by both Parameters 47 and 48.

**Step 13b -- Auto Restart Settings Check**

**If Power Loss Restart is required, set Parameters 1 and 3.**

Stop the drive.

- Change Parameter 47 from 1 to 3.
- Change Parameter 49 from 000.1 seconds to 10.00 seconds.

Press the start pushbutton. The directional start pushbutton LED will immediately light. After 10 seconds the drive will ramp up to 60 Hz and the main display will show **60.00**.

Remove then reapply incoming power to the drive at the disconnect device within 100 ms. **LU** will be shown at the main display indicating a power fault. Press the stop pushbutton to clear the fault, then the start pushbutton to start the drive. Since Parameter 49 has been changed, the drive will not restart for 10 seconds.

- Had the drive been configured for 2-wire control and Parameter 47 set to 0, without clearing the fault, the drive would have automatically restarted and ramped up to 60 Hz without a waiting time.
- Had the drive been configured for 2-wire control and Parameter 47 set to 3, without clearing the fault, the drive would have automatically restarted and ramped up to 60 Hz after 10 seconds.



## Function Checks – Motor Disconnected

### Step 13c -- Auto Restart Settings Check

If Ride-Thru Restart is required, set Parameters 1 and 3.

Stop the drive.

- Change Parameter 48 from 0 to 1.

Remove then reapply incoming power to the drive at the disconnect device within 100 ms. **LU** will be shown at the main display indicating a power fault. The directional start pushbutton LED will immediately light. After 10 seconds, the drive will ramp up to 60 Hz and the main display will show **60.00**.

Stop the drive.

- Change Parameter 48 from 1 to 2.

Remove then reapply incoming power to the drive at the disconnect device within 100 ms. **LU** will be shown at the main display indicating a power fault. The directional start pushbutton LED will immediately light. After 10 seconds, the main display will immediately show **60.00**. The drive accel ramp has been eliminated and the drive will restart at the last commanded speed, 60 Hz.

Stop the drive and return Parameters 47-49 to their factory settings.

### Step 14 -- Bias and Gain Settings Check

If an external 10k $\Omega$ , 2W potentiometer, 0-5V DC, 0-10V DC or 4-20 mA signal is connected to the drive, the bias and gain settings should be verified.

- Change Parameter 52 from 0 to 1 to enable the bias and gain function.
- Change Parameter 53 from 00.50 to 60.00.
- Change Parameter 54 from 60.00 to 00.50.

With zero speed signal applied to the drive, start the drive. Apply the smallest speed signal possible. The drive display will immediately ramp up to **60.00** Hz. Apply maximum signal to the drive. The drive display will ramp down to **0.50** Hz. This is because an inversely proportional signal has been sent to the drive. Stop the drive and return Parameters 52-54 to their factory settings.

### **Step 15a -- Preset Frequency and Aux Accel/Decel Enable Check**

If external switches have been connected to the Control and Signal Wiring Terminal Block as detailed in Chapter 5, preset frequencies as well as auxiliary accel and decel times can be checked.

### **Step 15b -- Preset Frequency and Aux Accel/Decel Enable Check**

#### **Enable Auxiliary Accel/Decel Settings**

Stop the drive and depress the lock button to allow programming. Set Parameter 19 to 2. By setting Parameter 19 to 2, auxiliary accel/decel times will be enabled and can be checked simultaneously with preset speeds.

### **Step 15c -- Preset Frequency and Aux Accel/Decel Enable Check**

**If two preset speed switches have been installed, verify that switch SW2 is set to 4SP.**

- Closing switch S1 and opening switch S2 will force the drive to 20.00 Hz, the Preset Frequency 2 value set by Parameter 29, within the 2nd auxiliary accel time set by Parameter 36, or the 2nd auxiliary decel time set by Parameter 37.
- Opening switch S1 and closing switch S2 will force the drive to 30.00 Hz, the Preset Frequency 3 value set by Parameter 30, within the 3rd auxiliary accel time set by Parameter 38, or the 3rd auxiliary decel time set by Parameter 39.
- Closing switches S1 and S2 will force the drive to 40.00 Hz, the Preset Frequency 4 value set by Parameter 31, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.

**Function Checks**  
**- Motor Disconnected**

**Step 15d -- Preset Frequency and Aux Accel/Decel Enable Check**

**If three preset speed switches have been installed, verify that switch SW2 is set to 8SP.**

- Closing switch S1 and opening switches S2 and S3 will force the drive to 20.00 Hz, the Preset Frequency 2 value set by Parameter 29, within the 2nd auxiliary accel time set by Parameter 36, or the 2nd auxiliary decel time set by Parameter 37.
- Opening switches S1 and S3 and closing switch S2 will force the drive to 30.00 Hz, the Preset Frequency 3 value set by Parameter 30, within the 3rd auxiliary accel time set by Parameter 38, or the 3rd auxiliary decel time set by Parameter 39.
- Closing switches S1 and S2 and opening switch S3 will force the drive to 40.00 Hz, the Preset Frequency 4 value set by Parameter 31, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.
- Opening switches S1 and S2 and closing switch S3 will force the drive to 15.00 Hz, the Preset Frequency 5 value set by Parameter 32, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.
- Opening switch S2 and closing switches S1 and S3 will force the drive to 25.00 Hz, the Preset Frequency 6 value set by Parameter 33, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.
- Opening switch S2 and closing switches S1 and S3 will force the drive to 35.00 Hz, the Preset Frequency 7 value set by Parameter 34, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.
- Closing switches S1, S2 and S3 will force the drive to 45.00 Hz, the Preset Frequency 8 value set by Parameter 35, within the 4th auxiliary accel time set by Parameter 40, or the 4th auxiliary decel time set by Parameter 41.

**Function Settings**  
- Motor Connected  
- No-Load Condition



**ATTENTION:** The following steps may cause motor rotation in an unknown direction. To guard against equipment damage, always disconnect the motor from the load before proceeding.

**Important:** The remaining steps are Function Settings that reference the same parameters as grouped in Chapter 5 — Operation and Programming.

**Step 16**

Stop the drive and remove and lock out all incoming power to the drive. Remove the drive cover and reconnect the motor leads at terminals  $U/T1$ ,  $V/T2$ ,  $W/T3$  at the Power Terminal Block.

**Step 17**

Replace the drive cover and tighten both thumbscrews. Apply power to the drive and verify that no faults are displayed.

- Both the main and mode displays should immediately light.
- The main display should read **0000**. If the main display indicates **OU** or **LU**, an incorrect voltage is being applied to the drive.
- The mode display should read **LL**. to allow control of the drive from the Local Control and Programming Panel. If not, refer to Chapter 5 to change Parameters 8 and 9 to local control.

**Step 18 -- Volts-per-Hertz Curve Settings**

**Overload Protection Settings**

Set Parameters 3 and 4 to match your volts-per-Hertz curve and drive frequency range requirements as detailed in Chapter 5.

If overload protection is not required, leave Parameter 6 set to 0. If overload protection is required:

- Set Parameter 6 to correspond to the motor duty as outlined in Chapter 5.
- Set Parameter 7 to correspond to the rated amps on your motor nameplate.

## Function Settings

- Motor Connected
- No-Load Condition

### Step 19

Press the shift pushbutton once and **LJ**. will be shown in the mode display. Press and release the directional start pushbutton that will be your forward motor direction. If the direction of motor rotation is incorrect:

- Remove input power, wait until the displays are no longer lit, then remove the drive cover.
- Verify that the DC bus neon light is no longer lit and that bus voltage at the +Bus and –Bus terminals of the power terminal block is zero.
- Interchange any two of the three motor leads at terminals  $U/T1$ ,  $V/T2$ ,  $W/T3$  at the Power Terminal Block.
- Replace the drive cover and tighten both thumbscrews. Apply power to the drive and verify that no faults are displayed.

### Step 20 -- Output Meter Settings

If an external output ammeter or voltmeter is connected to the Control and Signal Wiring terminal block, the meter should be calibrated and switch SW1 should be set as detailed by Parameters 55 or 56 in Chapter 5.

**Final Settings**  
– Motor Connected  
– Load Connected



**ATTENTION:** To avoid hazards of electrical shock or injury from moving equipment, product, or process ingredients:

- Alert all personnel.
- Install all guards.
- Check operation of all safety devices.
- Be prepared to stop the motor immediately.

### Step 21

Disconnect and lock-out all power. Connect the motor to the load.

Before applying power, review the parameter descriptions in Chapter 5. Each parameter may have a significant effect on fundamental drive and motor operation regardless of the control method used.

Apply power. Prepare to operate the drive and motor under actual control and load conditions. It is recommended to begin at low torque and speed.

Start the motor and run the machine or process to determine if parameter settings are acceptable for the application. If not, stop the drive and reset parameters. Refer to Chapter 5 to make parameter changes and record the changes in Appendix C.

### Step 22

#### **If Increased Motor Torque is Required at Startup**

Increase the value of Parameter 5 in small increments.

Parameter 5 adds from 0 to 40% of the drive output voltage to the motor at low drive frequencies, boosting motor torque at startup. DC boost can be added to any volts-per-Hertz curve. The optimum DC boost setting is the lowest level that will permit satisfactory starting torque for the motor and drive. Higher than optimum boost may produce unnecessary motor current at low frequencies and contribute to motor overheating. Excessive boost may even force the drive into an overcurrent condition.

### Step 23

#### **If DC Braking is Required for Speed Changes, Reversing or to Stop the Motor**

Set Parameter 14 to 1 first.

When Parameter 14 is set to a value of 1-10, the drive's DC brake function will be enabled. Parameters 12 and 13 along with Parameter 14 will then set the DC brake function. The value of Parameter 14 determines the level or strength of the braking that occurs, with 1 being the lowest, 10 the highest.

## **Final Settings**

- Motor Connected**
- Load Connected**

### **Step 24**

#### **If Heavy Duty Dynamic Braking is to be Installed**

If Heavy Duty Dynamic braking is required, set Parameters 11 and 14 to 0.

### **Step 25**

#### **If Machine Resonance is Encountered**

Set Parameters 42-45 to skip those frequencies which cause the machine to resonate.

### **Step 26**

#### **If Nuisance Tripping is Encountered**

Enable Parameters 17 and/or 18 to disable drive acceleration or deceleration during high Bus current or voltage conditions.

### **Step 27**

#### **If the Connected Load is an Overhauling Load**

Set Parameter 18 to 0 to disable Decel Frequency Hold.

### **Step 28**

#### **If a Different Running Monitor Mode is Required**

Change Parameter 57 to:

- 0 to monitor drive output current.
- 1 to monitor equivalent motor RPM.
- 2 to monitor drive control frequency.

### **Step 29**

#### **If an External 2 or 3-Wire Control Scheme is to be Used**

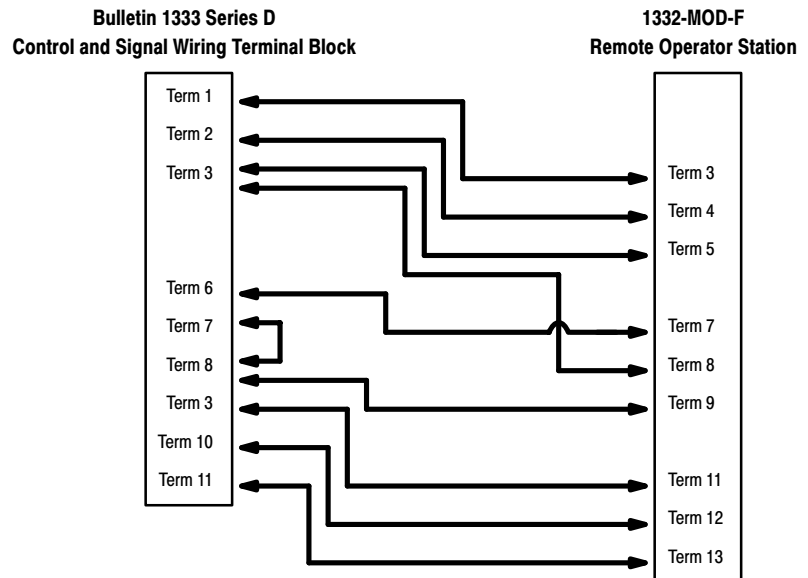
- Connect the 2 or 3-wire controls as shown in Figure 4-3 and described in Chapter 4.
- Set Parameter 8 to 1 for 2-wire control, 3 for 3-wire control.
- Repeat the startup procedure starting from step 1.

## Bulletin 1333 Options

### Using Bulletin 1332 and 1333 Options with Bulletin 1333 Series D Drives

Bulletin 1332 and 1333 Options can be used with Series D drives. Point-to-point interconnections and the required Series D parameter settings are detailed below and on the following pages. Refer to the individual option kit instructions for installation procedures and the additional information required to setup each option.

### 1332-MOD-F Remote Operator Station



### Start/Stop and Forward/Reverse Control

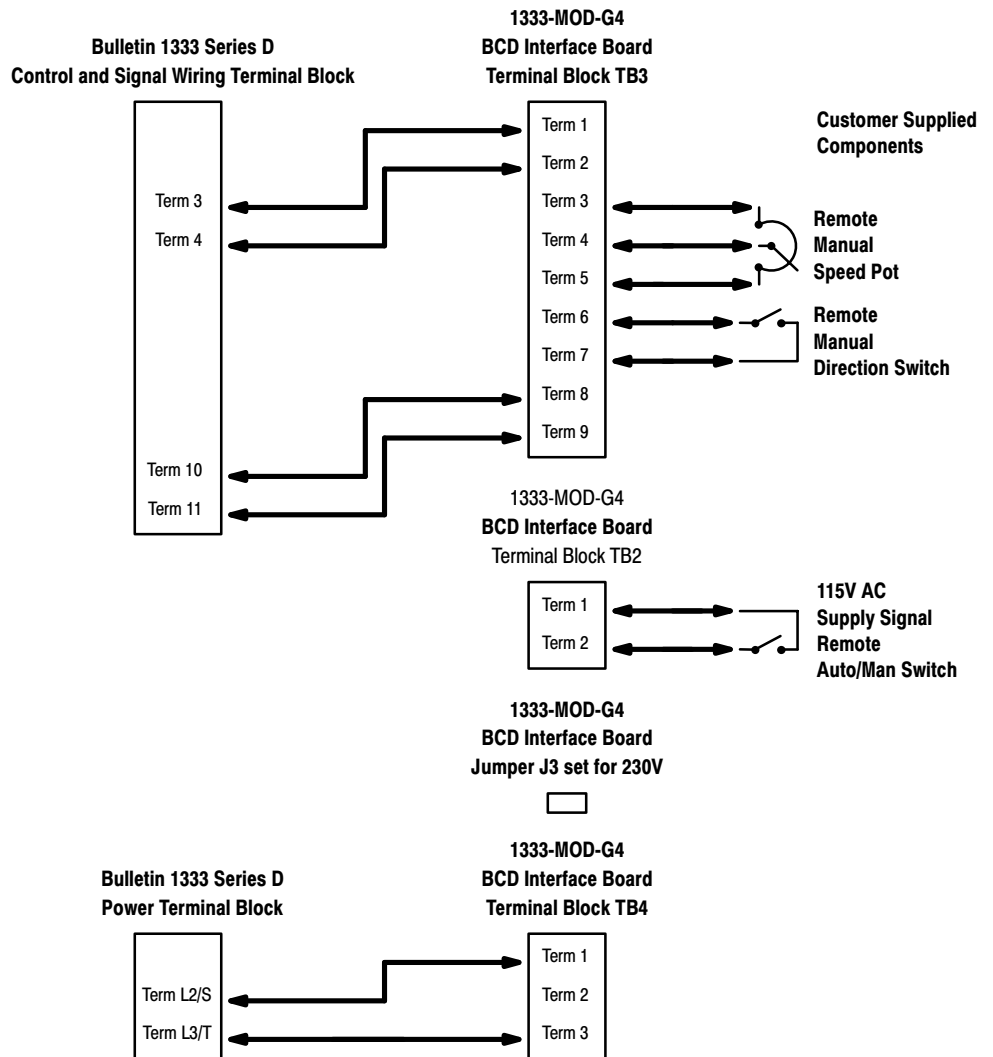
To allow the 1333 Series D to accept 1332-MOD-F start/stop and forward/reverse commands, Parameter 8 Local/Remote Control Enable must be set to 1 or 3.

### Speed Control

To allow the 1333 Series D to accept the 1332-MOD-F speed potentiometer signal, Parameter 9 Local/Remote Speed Enable must be set to 1, 2 or 3.



**1333-MOD-G4  
BCD Interface  
Drive Ratings ZAB-CAA**



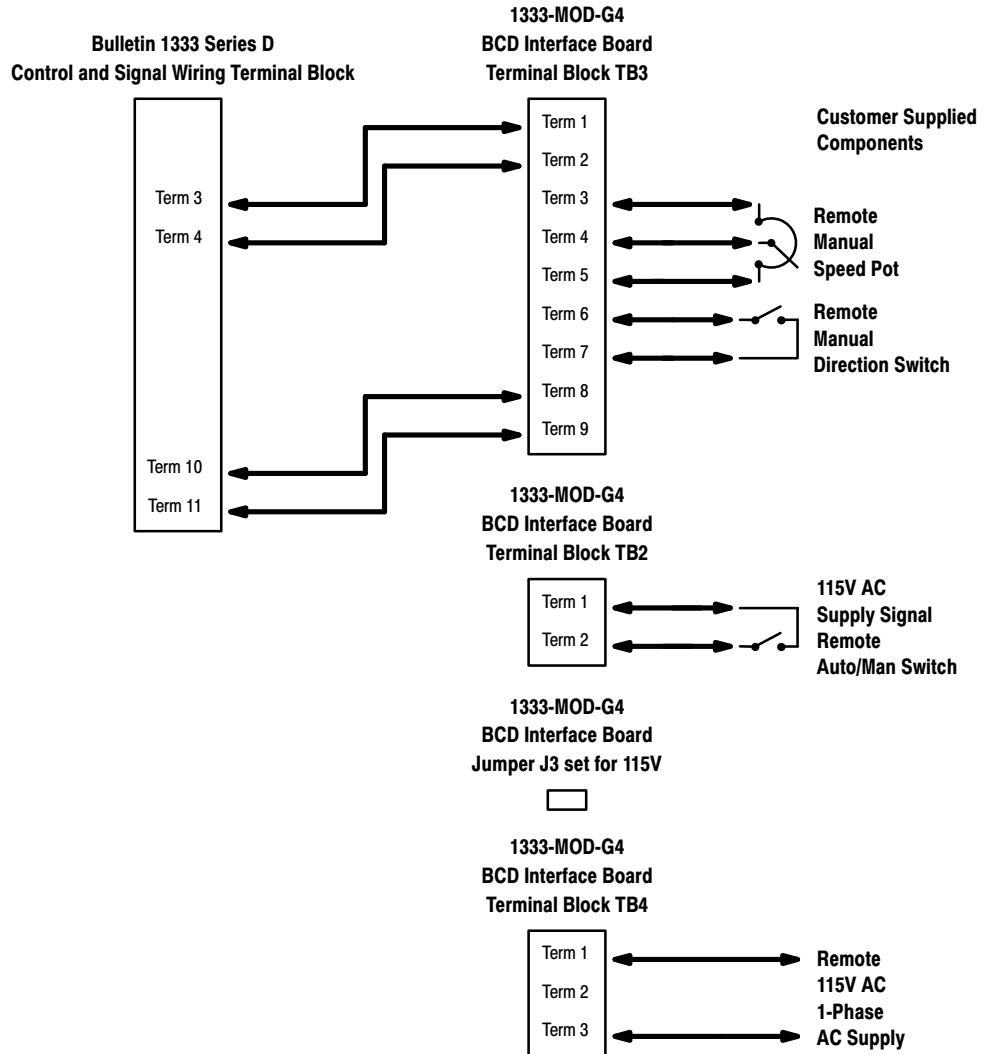
**Volts-per-Hertz, Maximum Frequency and Base Frequency**

The frequency range of the 1333-MOD-G4 BCD Interface Board and the Bulletin 1333 Series D drive must match. Once the scaling jumper on the BCD Interface Board has been set, Parameter 3 Frequency Range must be set to either 60 or FF. If set to FF, both Parameter 15 Maximum Frequency and Parameter 16 Base Frequency must also be set.

BCD Interface Scaling Jumper	Parameter 3	Parameter 15	Parameter 16
60 Hz	60	--	--
120 Hz	FF	60 Hz	120 Hz
200 Hz	FF	60 Hz	200 Hz

**Important:** When Parameter 3 is set to FF, the drive volts-per-Hertz output will reach the maximum voltage at the value set by Parameter 16. Applications where volts-per-Hertz curves are required to reach maximum voltage other than at 50 or 60 Hz are primarily provisions for operating custom motors. For application assistance in these special ranges, contact your nearest Allen-Bradley representative.

**1333-MOD-G4  
BCD Interface  
Drive Ratings AAB-CAB**



**Speed Control**

To allow the 1333 Series D to accept the 1333-MOD-G4 0-10V DC speed signal, Parameter 9 Local/Remote Speed Enable must be set to 2.

**Forward/Reverse Control**

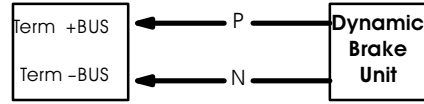
If the 1333 Series D is to have its forward/reverse operation controlled from the Local Control and Programming Panel, Parameter 8 Local/Remote Control Enable must be set to 0 or 2.

If the 1333 Series D is to have its forward/reverse operation controlled by the BCD Interface Board, Parameter 8 Local/Remote Control Enable must be set to 1 or 3.

**Important:** If Parameter 8 is set to 1 or 3, an external means of start/stop control must be connected to the Control and Signal Wiring Terminal Block. Refer to Chapter 4 for additional information.

## 1333-MOD-KA1, KA2, KB1, KB2 Heavy Duty Dynamic Braking

Bulletin 1333 Series D  
Power Terminal Block



### Stop Setting

If Heavy Duty Dynamic Braking is installed, Parameters 11 and 14 must be set to 0.

## Preventive Maintenance and Troubleshooting Common Drive Problems

### Preventive Maintenance

The Bulletin 1333 is convection cooled by air flowing through the heat sink slots. The slots must never be allowed to become obstructed with dirt or foreign matter. Periodically check and clean the heat sink slots.

### Problems with Your Drive? Check the Following First

The following descriptions indicate the operation of protective circuitry in the Series D Bulletin 1333. What is thought to be a drive operational problem, may in reality be normal protection circuit operation. Refer to the following precheck procedures and Chapter 5 — Operation and Programming before attempting to troubleshoot your drive.

### Precheck Procedures

#### Acceleration Stall Protection -- No Fault is Displayed

**The Reason** During motor acceleration, if current exceeds 140% of rated Drive current or 125% of Parameter 7, the overcurrent stall protection circuit operates. In order to guard against currents in excess of these values and prevent an overcurrent trip, this circuit temporarily stops drive acceleration. When load current is again below these values, the circuit lets the drive continue to accelerate to set frequency.

**Precheck Procedure** If the application does not require this function it can be deactivated by setting Parameter 17 to 0.

#### Deceleration Stall Protection -- No Fault is Displayed

**The Reason** During motor deceleration, if current exceeds 140% of rated Drive current or 125% of Parameter 7, the overcurrent stall protection circuit operates. In order to guard against currents in excess of these values and prevent an overcurrent trip, this circuit temporarily stops drive deceleration. When load current is again below these values, the circuit lets the drive continue to decelerate to set frequency.

**Precheck Procedure** Both Parameters 18 and 46 will protect the drive from nuisance trips during motor deceleration. If the application does not require this function it can be deactivated by setting Parameters 18 and/or 46 to 0.

## Over Current Protection -- OC is Displayed

**The Reason** If overcurrent exceeds 200% of rated Drive current or if a ground fault occurs at the drive output leads, this protective circuit will shut off the drive transistors.

### Precheck Procedure

1. Load inertia is excessively large and programmed acceleration time is extremely short. Setting Parameter 17 to 1 or increasing the value of Parameter 1 will guard against OC nuisance trips.
2. The motor experienced an excessive overload condition. If the drive tripped on acceleration, setting Parameter 7 to a higher current limit setting may avoid OC nuisance trips. If the drive trips only on deceleration, enabling Parameter 46 may avoid OC nuisance trips on deceleration.
3. A short circuit exists in the drive output leads or in the motor windings.
4. A ground fault exists in the drive output leads or in the motor windings.
5. A device in the Drive output inverter section has shorted.

## Over Load Protection -- OL is Displayed

**The Reason** If Parameter 6 is set to 0 and current exceeds 140% of rated Drive current for 60 seconds, this protective circuit will shut off the drive transistors.

If Parameter 6 is set to a value other than 0 and current exceeds 115% of Parameter 7 for 60 seconds, this protective circuit will shut off the drive transistors.

### Precheck Procedure

1. The starting load is above 140%. The Drive is attempting to start the load, but Parameter 17 is preventing it. Disable Parameter 17.
2. The running load has been above 140% for one minute. The Drive may be in accel frequency hold if below the current limit set by Parameter 7, or in accel frequency hold if at the current limit set by Parameter 7. Check Parameters 17 and 6. If neither accel frequency hold nor overload protection is selected, the Drive has been between 140% and 180% of rated current for one minute, tripped out, and is functioning normally.
3. The running load has been above 115% of Parameter 7 for 60 seconds causing the motor to overheat and the drive to trip. Check Parameters 17 and 7, then check to see if Parameter 6 is set to a value other than 0.

## Over Voltage Protection -- OU Displayed

**The Reason** When DC bus voltage rises above a preset level due to high incoming line voltage or excessive regenerative energy, this protective circuit stops transistor operation and annunciates the condition as shown.

### Precheck Procedure

1. Check and correct the incoming line voltage. Refer to Chapter 3 — Specifications for acceptable voltage levels.
2. An extremely short deceleration time is the primary cause of excessive regenerative line energy. Setting Parameter 18 to 1 or increasing Parameter 2 will guard against OU nuisance trips. It may also be necessary to add the Heavy Duty Dynamic Braking option.

## Low Voltage Protection -- LU is Displayed

**The Reason** When incoming line voltage falls below 90% for 15 ms, this protective circuit stops transistor operation to guard against incorrect drive operation.

**Precheck Procedure** If the momentary power failure is less than 15 ms, operation is not interrupted. If more than 15 ms, the drive will trip and line voltage must be restored by cycling power. If automatic restart of the drive is required, set Parameter 48 to 1 or 2 as detailed in Chapter 5.

## Over Temperature Protection -- OH is Displayed

**The Reason** When heat sink temperature rises above + 50°C, this protective circuit stops transistor operation and annunciates the condition as shown.

**Precheck Procedure** Check the drive ambient temperature. For 7 1/2-20 HP (5.5-15 kW) units, check the cooling fan.

### **Auxiliary Interlock Trip -- AU is Displayed**

**The Reason** It is possible that the drive was stopped by an external interlock. External interlocks (a thermal overload relay or an external sequence circuit for example), are connected to terminals 16 and 17 at the Control and Signal Wiring Terminal Block.

**Precheck Procedure** Refer to Chapter 4 Installation and Wiring for a detailed explanation of external interlocks.

### **Operating Error -- OP is Displayed**

**The Reason** The drive must always receive a valid stop command before it can run. This fault will be displayed and the drive will not start if:

1. The local stop pushbutton is pressed to stop the drive and Parameter 8 is set to 1 or 3.
2. A remote stop signal is sent and Parameter 8 is set to 2.
3. Parameter 8 is set to 1 or 3 and an external stop signal is not present when power is applied to the drive.

#### **Precheck Procedure**

1. Send an external stop signal to clear the fault, then try again.
2. Press the local stop pushbutton to clear the fault, then try again.
3. Ensure that an external stop signal is present before reapplying power to the drive, then try again.

### **Operating Error -- CPU is Displayed**

**The Reason** CPU is an internal software communications error. A CPU error will not be stored in the drive fault buffers.

#### **Precheck Procedure**

Clear the fault by removing then reapplying power to the drive.

## Troubleshooting Common Drive Problems

Eight common problems that may be experienced when operating the Series D Bulletin 1333 and their solutions are listed in the remaining pages of this section.

1. The motor will not run.
2. The motor will not run continuously.
3. The motor generates an excessive amount of heat
4. The drive will not reverse in local control.
5. The drive will not ramp-to-stop.
6. The drive will not accelerate to maximum speed.
7. The drive will not decelerate to minimum speed.
8. An input line fuse has blown.



**ATTENTION:** Power must be applied to the drive with the cover removed to perform certain troubleshooting checks. Voltages on many components are at incoming line potential or bus voltage. To avoid electric shock or damage to equipment, do not touch any drive components with power applied.

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**ATTENTION:** Become familiar with the equipment and read through the wiring, speed selection and adjustment sections before attempting to perform the startup procedures. Adjustments may be required to meet specific load characteristics or operator preference.

Exercise extreme care when performing any task on the drive. Failure to do so may result in electric shock or equipment damage.

As shown in Figures B-1 and B-2, a DC bus neon light at the top of the 1333 has been provided to provide visual indication that bus voltage is present. Bus voltage may be verified by using a voltmeter and measuring the voltage between +BUS and -BUS on the Power Terminal Block. Do not attempt to service the drive until 2 minutes after the neon light has extinguished and bus voltage has discharged to zero volts.

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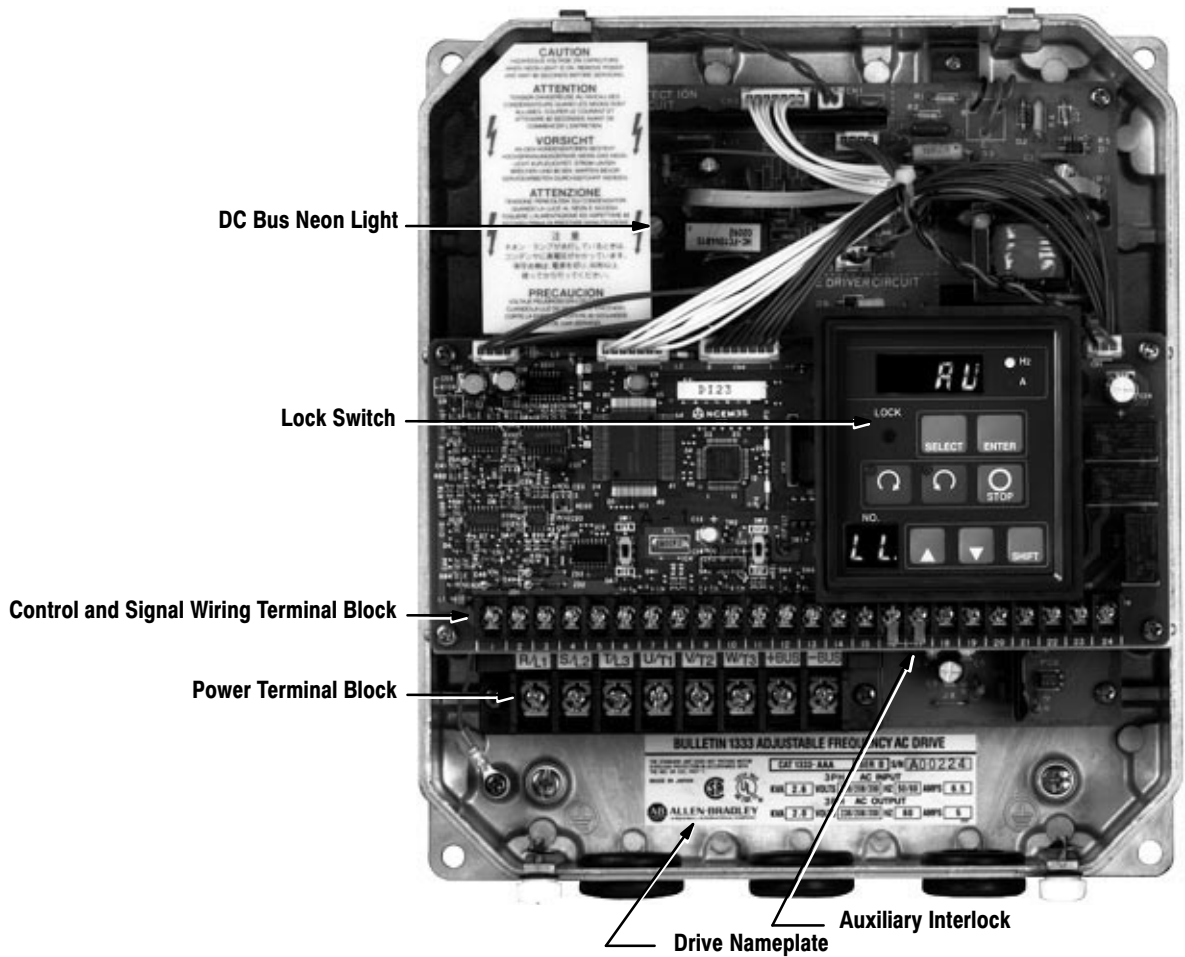
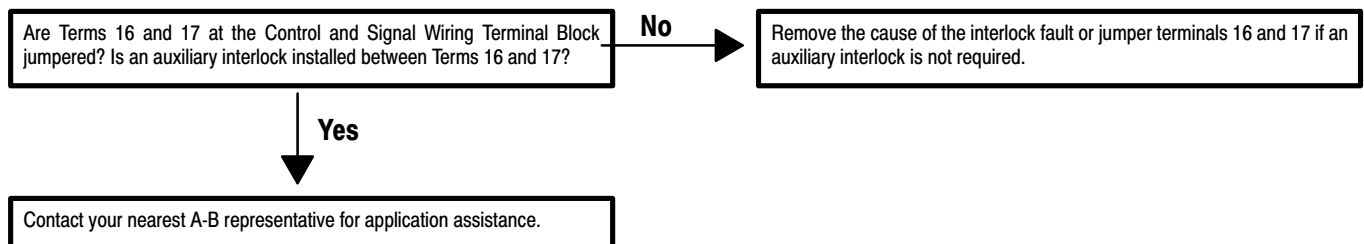


Figure B-1 -- 3/4-5 HP (.55-4kW)

1333 parts, switches and terminal blocks shown in Figures B-1 and B-2 are referenced throughout the remainder of this chapter.

**1. The motor will not run -- AU is displayed.**



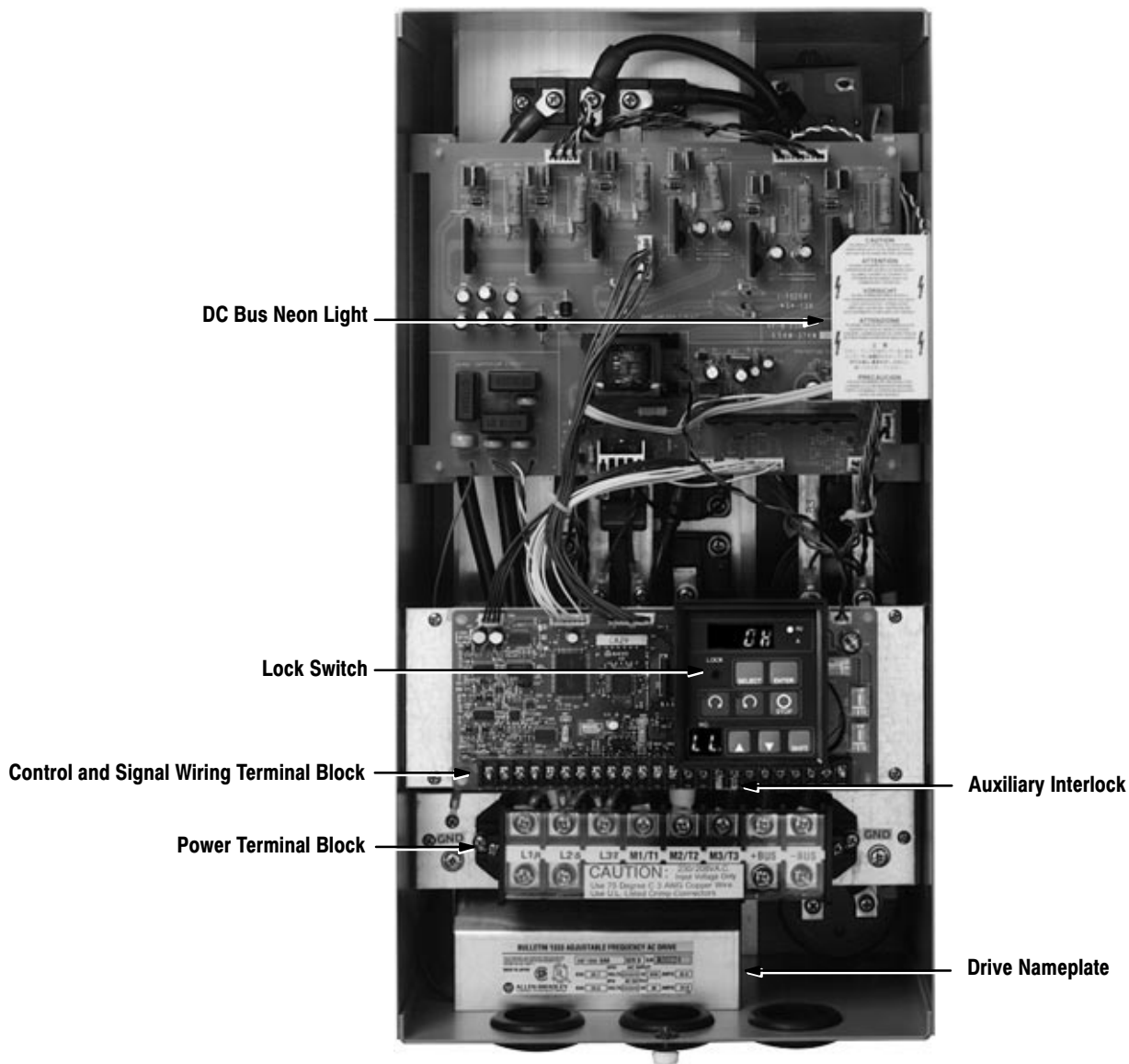
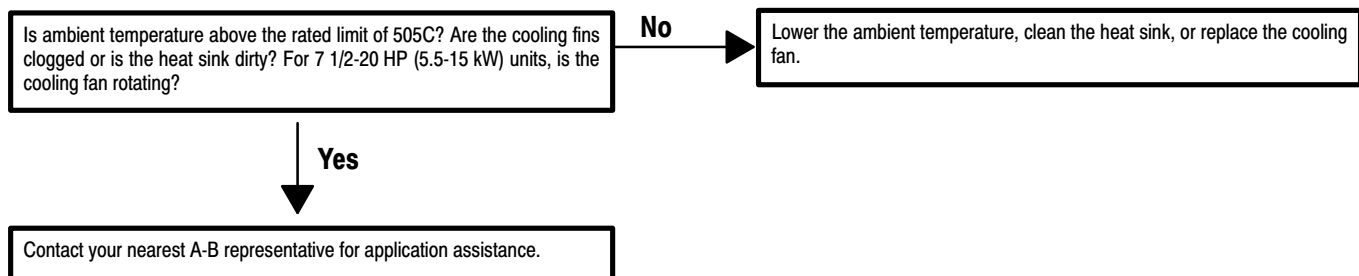


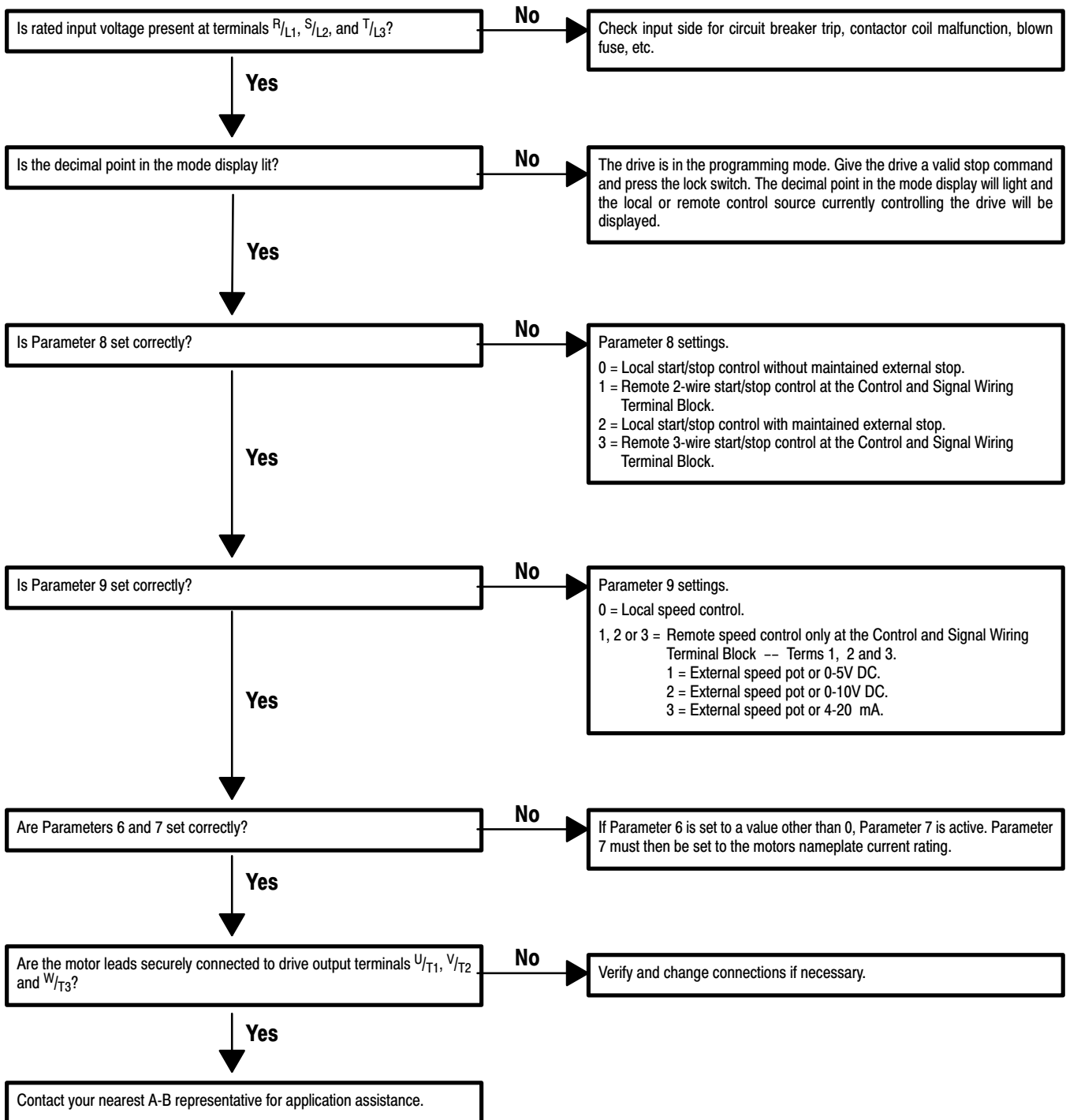
Figure B-2 -- 7 1/2-20 HP (5.5-15kW)

**1. The motor will not run -- OH is displayed.**

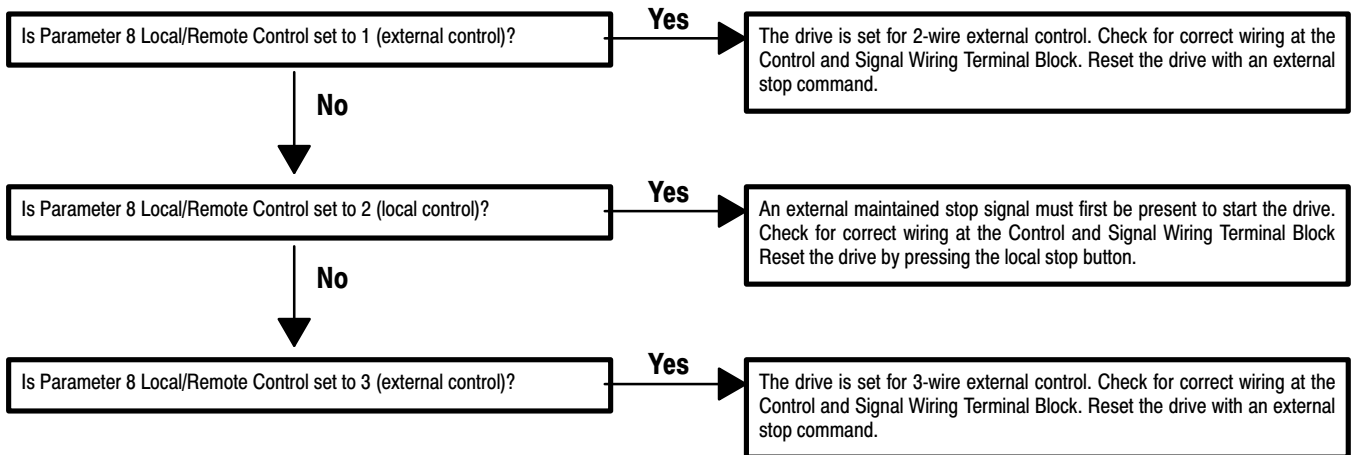


Appendix B  
Preventive Maintenance and  
Troubleshooting Common Drive Problems

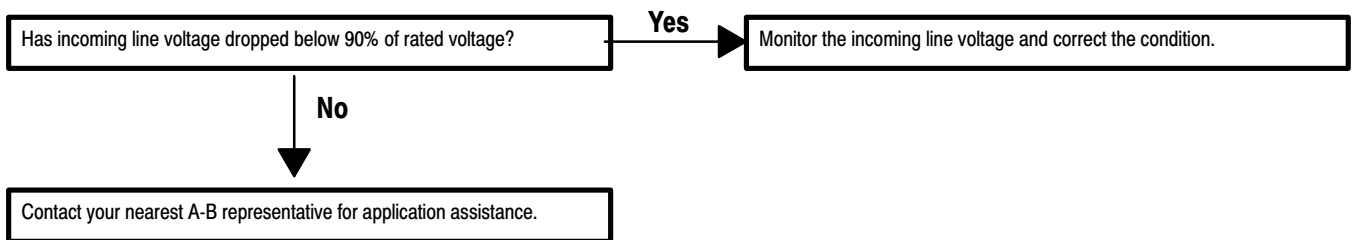
1. The motor will not run -- No fault is displayed.



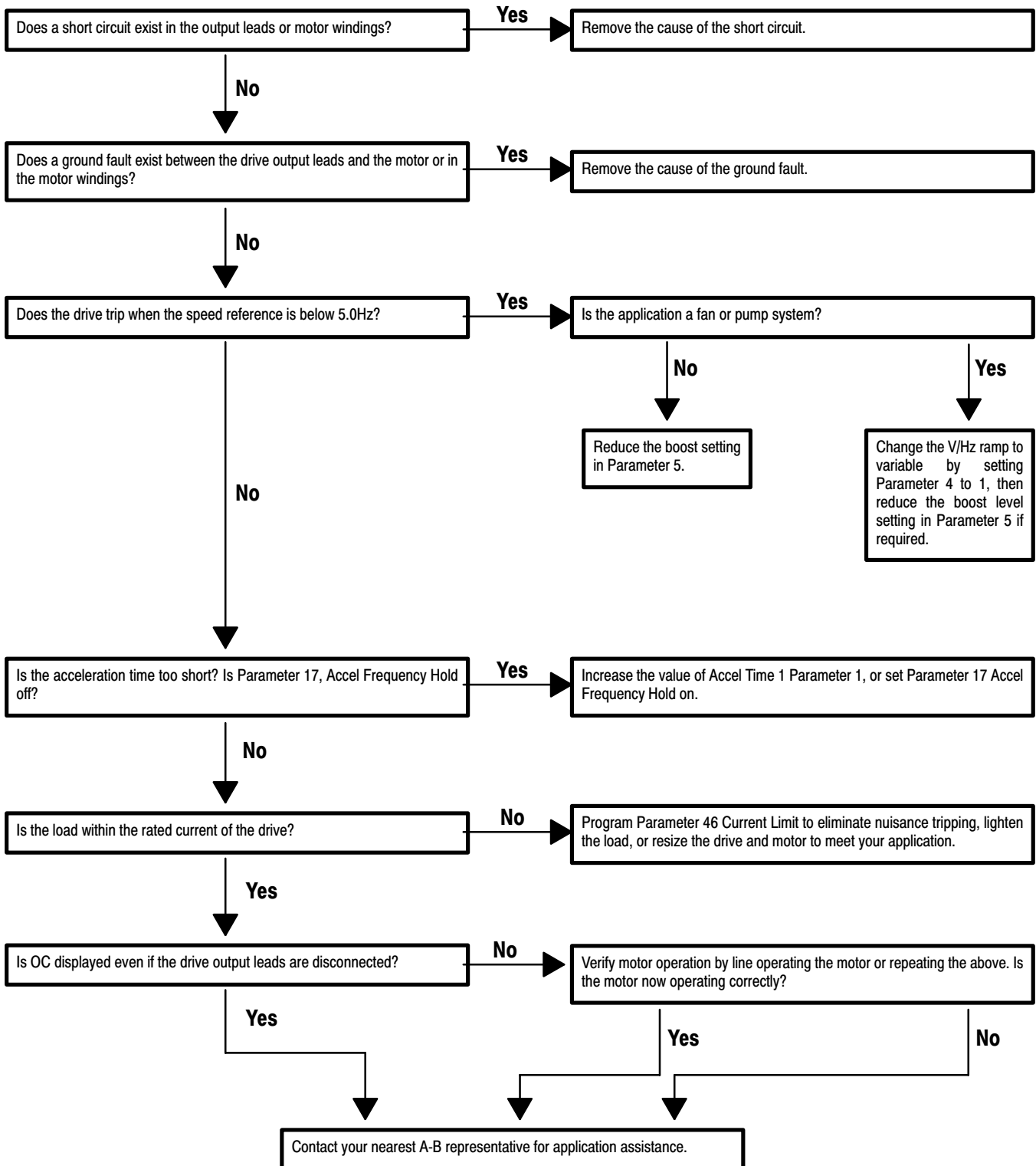
**1. The motor will not run -- OP is displayed.**



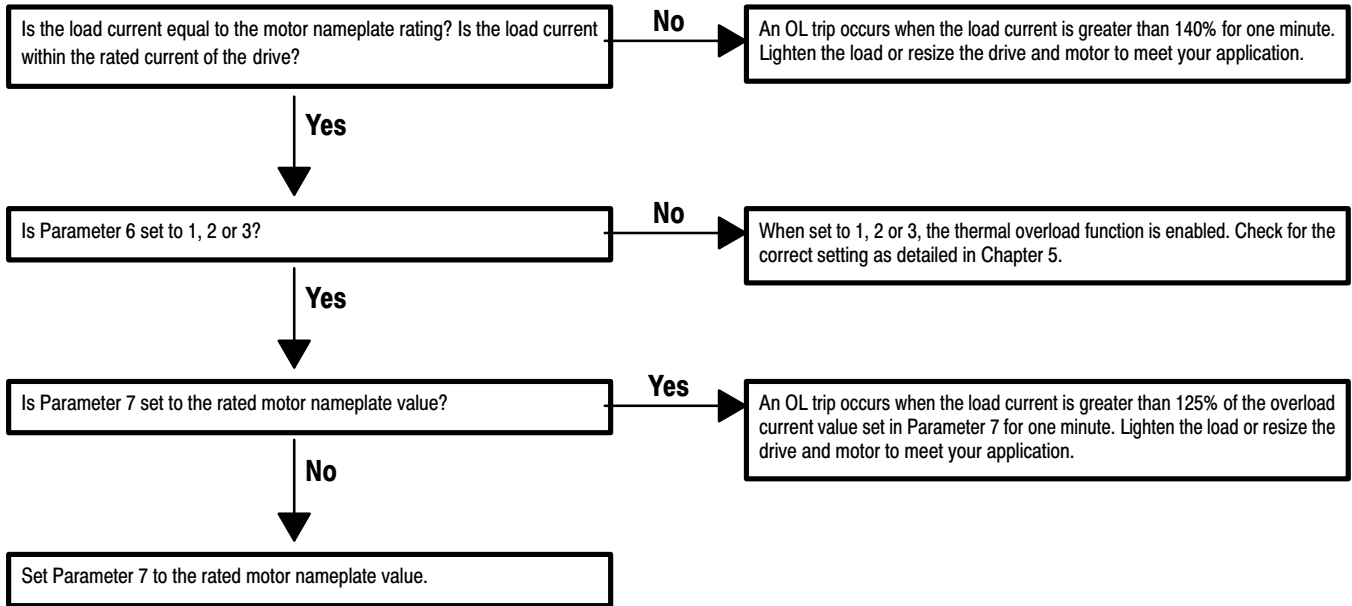
**2. The motor will not run continuously -- LU is displayed.**



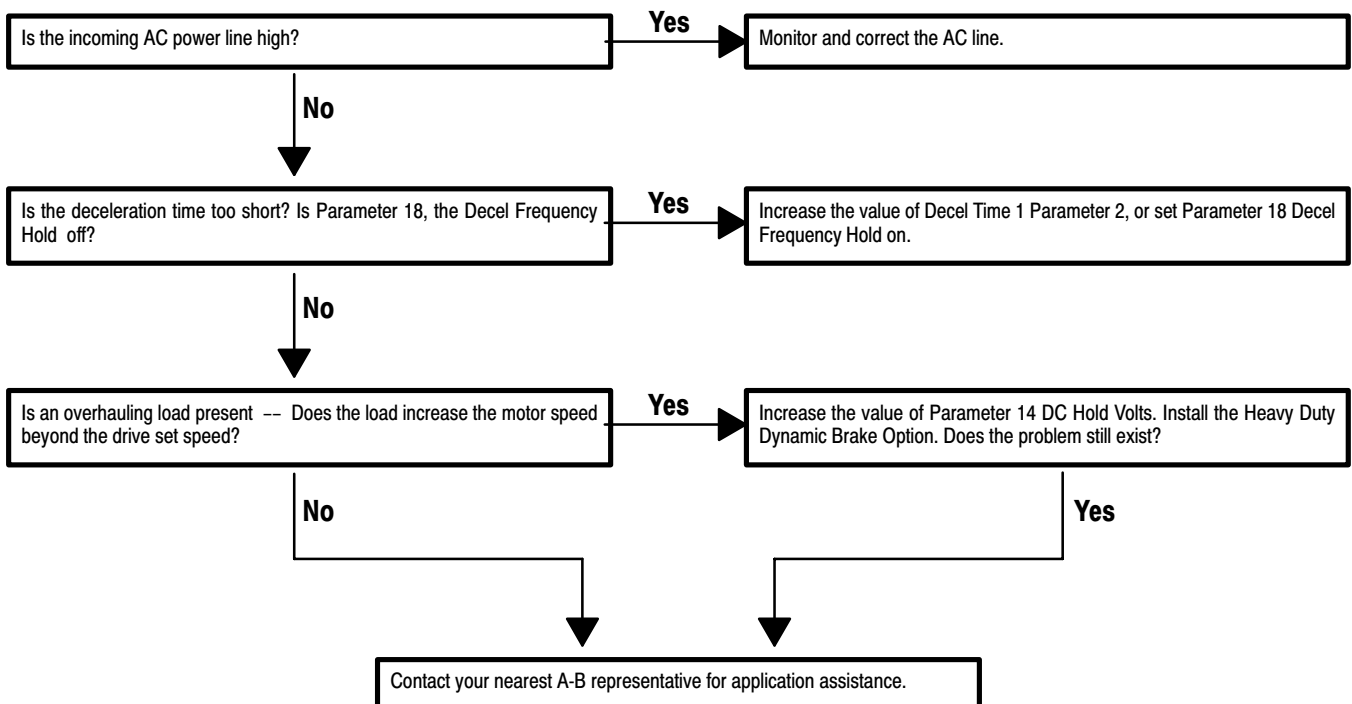
**2. The motor will not run continuously -- OC is displayed.**



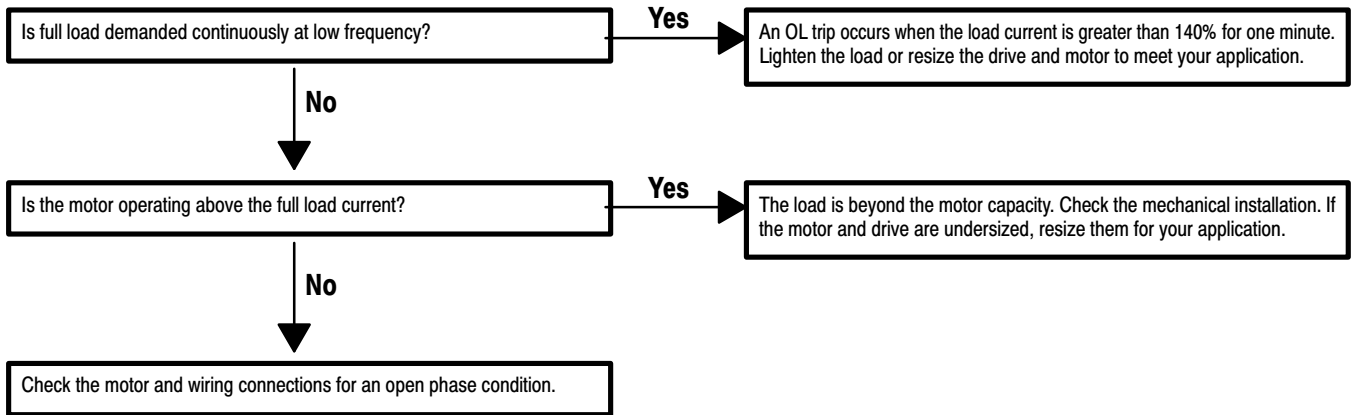
**2. The motor will not run continuously -- OL is displayed.**



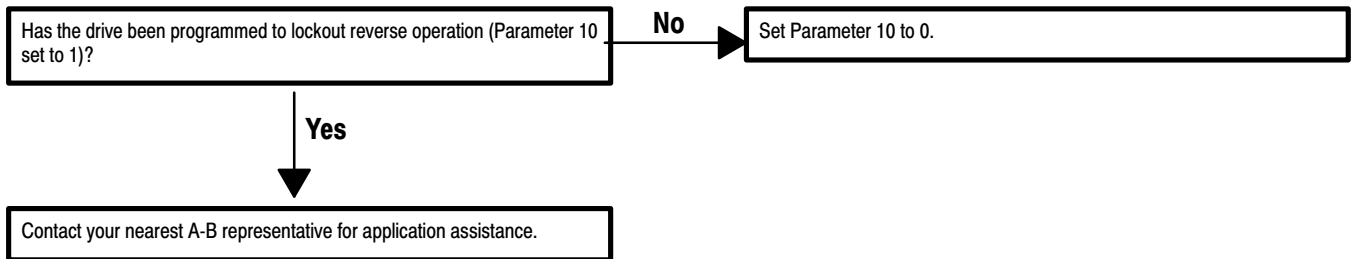
**2. The motor will not run continuously -- OU is displayed.**



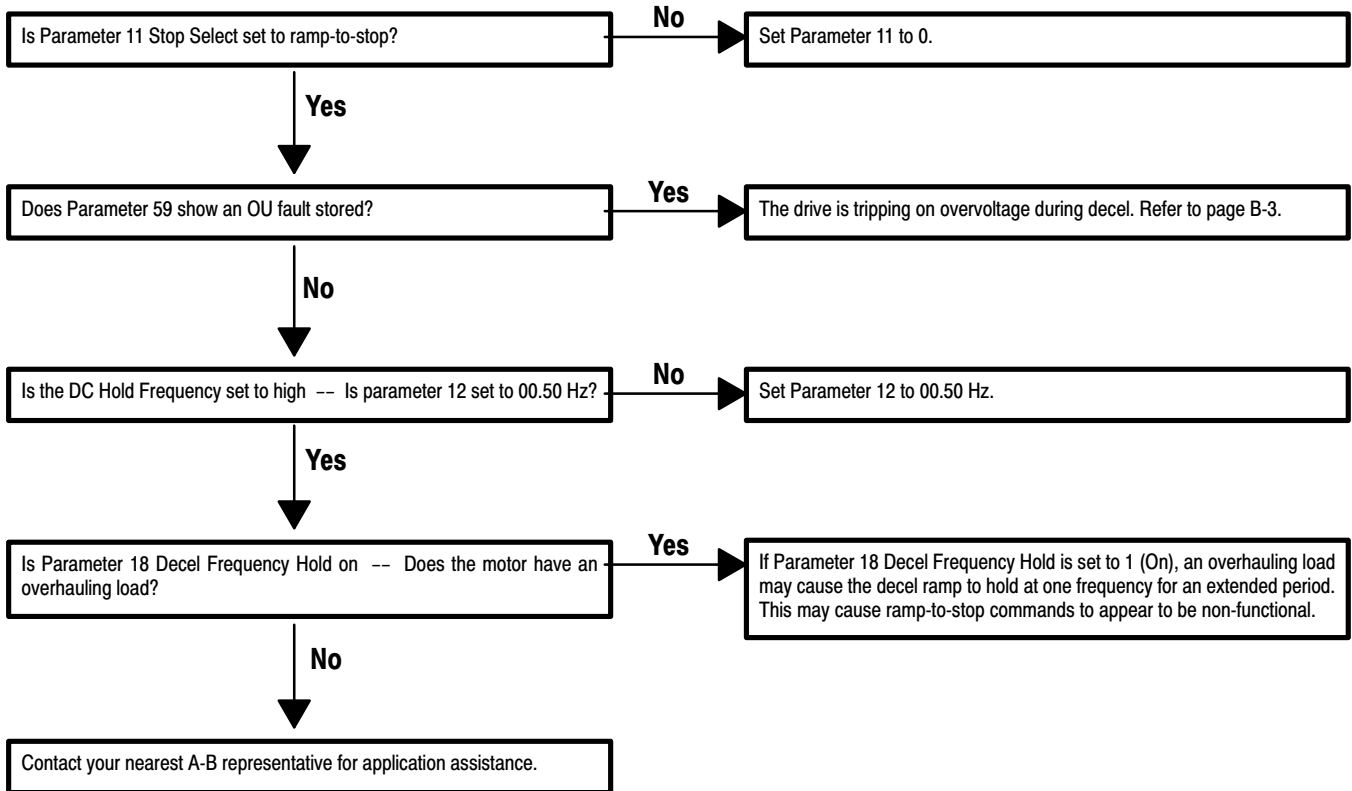
**3. The motor generates an excessive amount of heat -- No fault is displayed.**



**4. The drive will not reverse in local control -- No fault is displayed.**

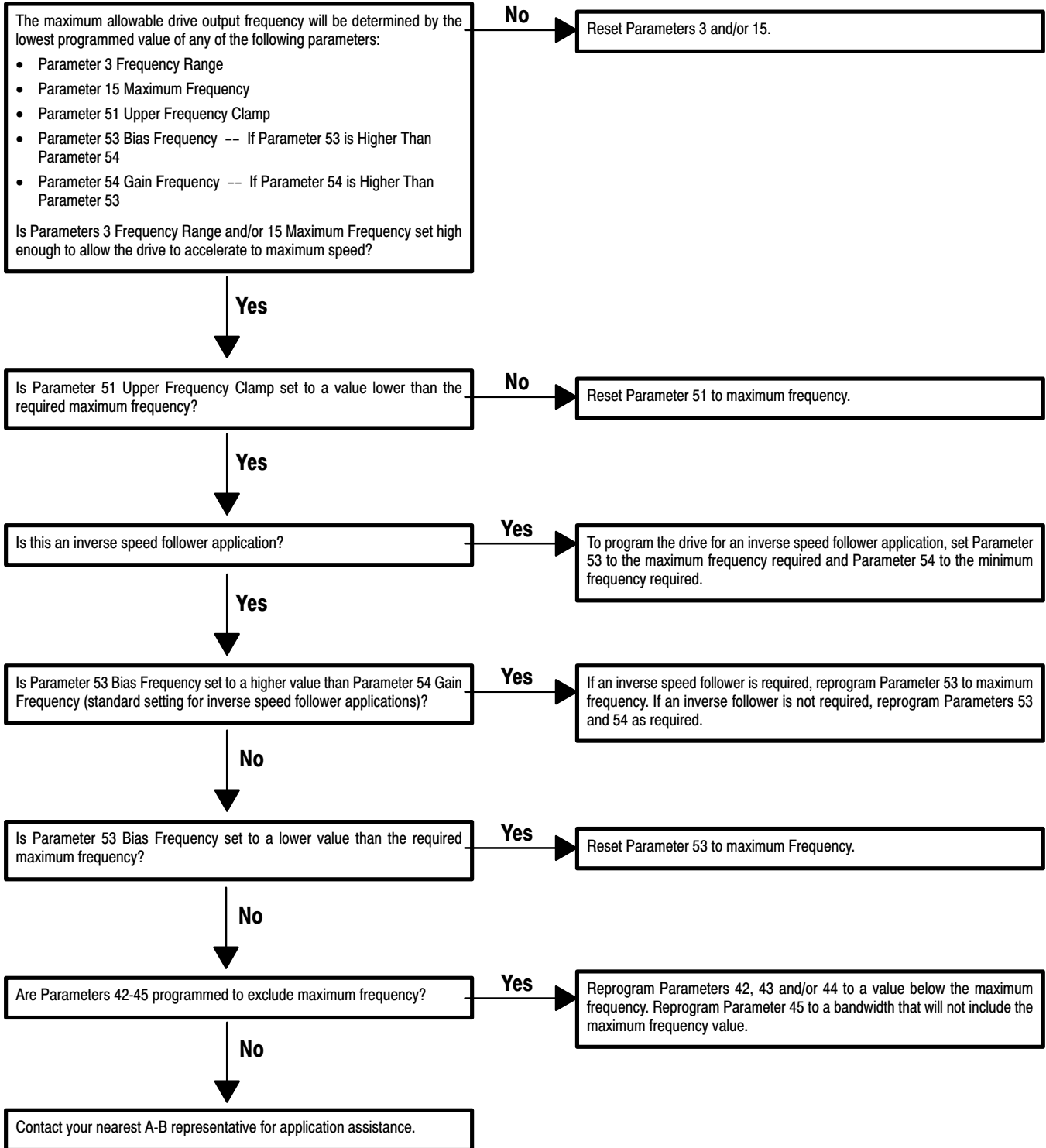


**5. The drive will not ramp-to-stop -- No fault is displayed.**

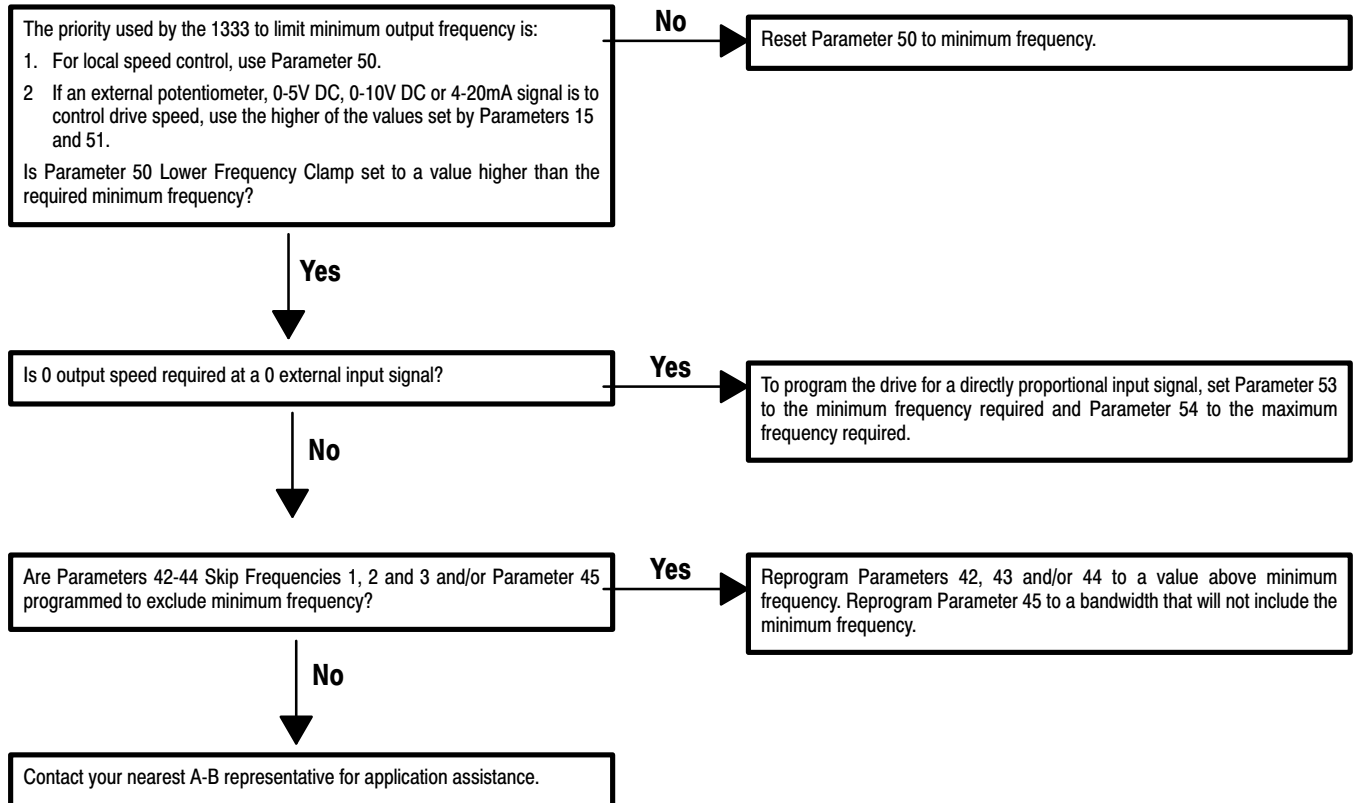




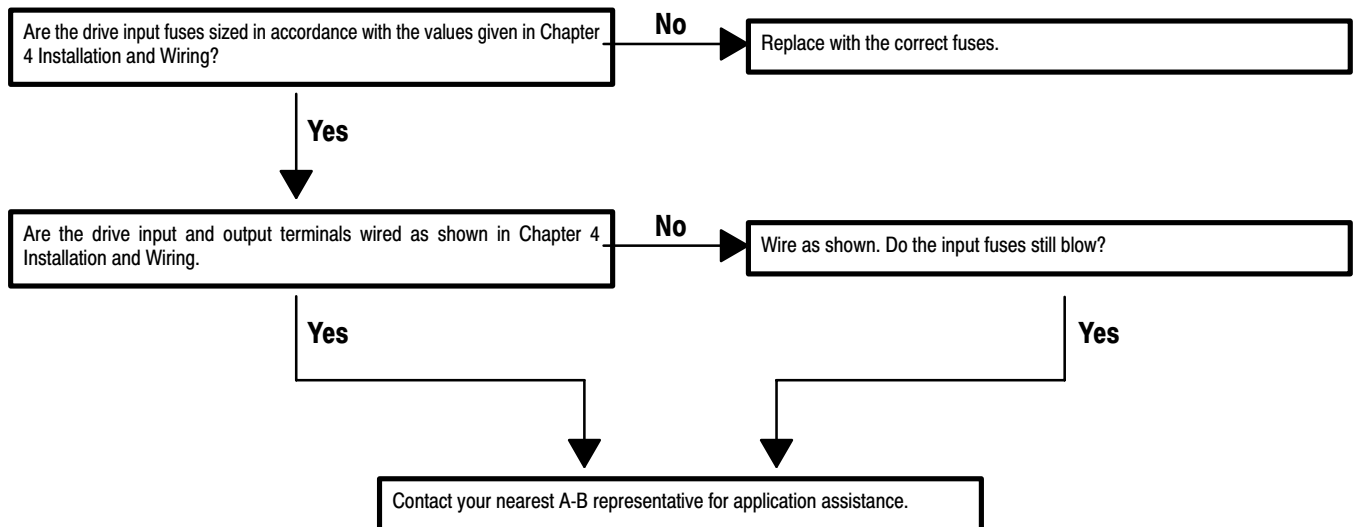
**6. The drive will not accelerate to maximum speed -- No fault is displayed.**



**7. The drive will not decelerate to minimum speed -- No fault is displayed.**



**8. An input line fuse has blown -- No fault is displayed.**



## Factory and Field Parameter Settings

### Parameters Grouped by Function

The following tables in Appendix C provide parameter data grouped by function. The function groups listed, reference the same parameters as grouped in Chapters 5 and 6 and Appendix B.

### Factory and Field Parameter Settings -- Pages C2 and C3

The table on the left provides parameter units, min/max values, factory settings and room to record field settings.

### Coordinated Parameter Settings -- Pages C4 and C5

The table on the right graphically shows which of the remaining parameters must be checked to provide coordinated control of the Bulletin 1333 for each parameter.

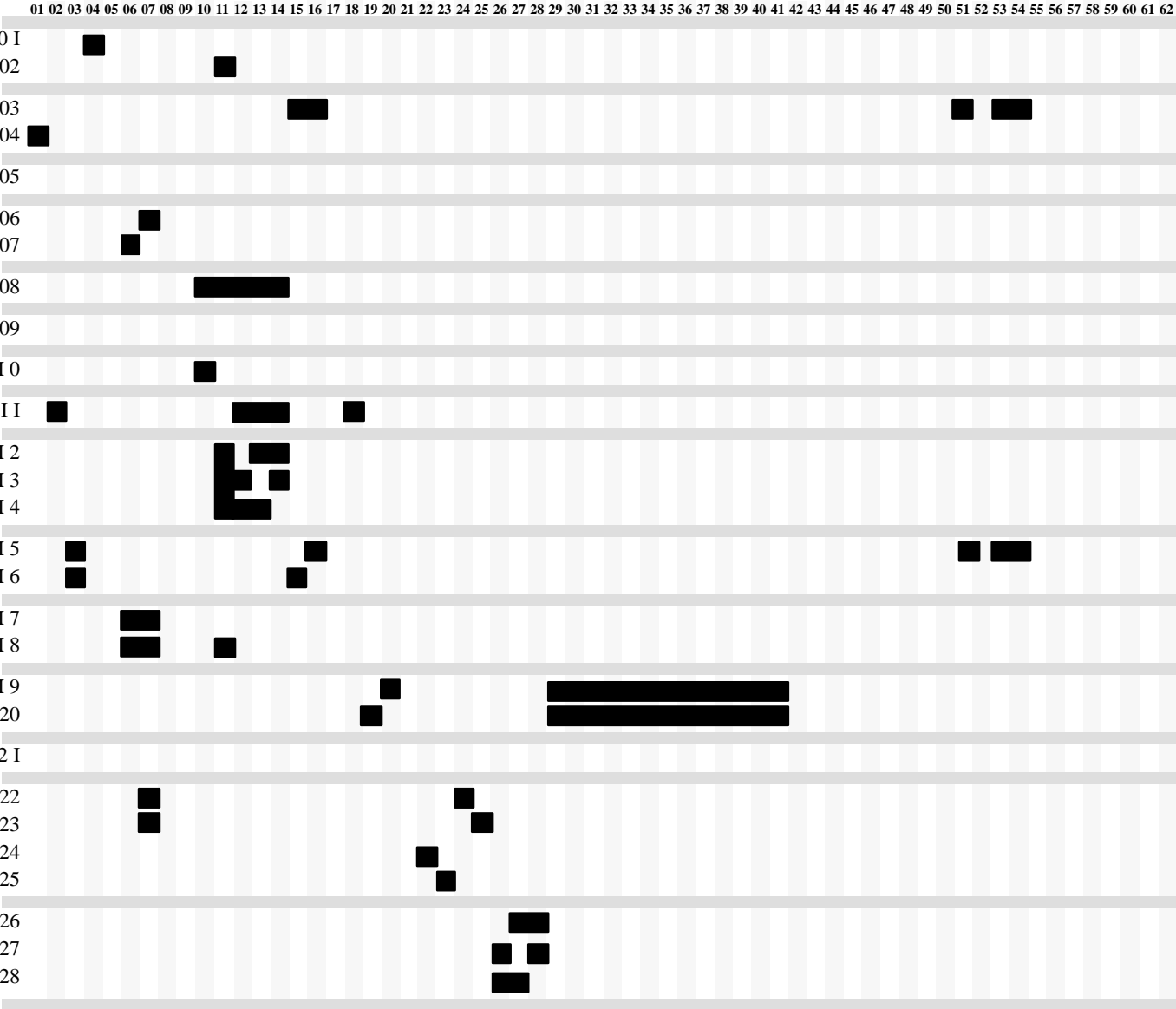
For each parameter (numbered 0 I – 62 ) in the first column, a ■ in the remaining columns (numbered 01-62) will indicate parameters that should be checked to provide coordinated drive control.

**Factory and Field Parameter Settings -- Parameters 01-28**

Function Group	Parameter Number	Parameter Name	Units	Range	Factory Setting	Field Setting
Accel and Decel Settings	01	ACCEL TIME 1	Seconds	0000/1600	005.0	
	02	DECEL TIME 1	Seconds	0000/1600	005.0	
Volts-per-Hertz Curve Settings	03	FREQUENCY RANGE	Code	50/60/FF	60	
	04	VOLTS-PER-HERTZ CURVE	Code	0/1	0	
DC Boost Setting	05	DC BOOST SELECT	% of Output Voltage	00/40	00	
Overload Protection Settings	06	MOTOR DUTY	Code	0/1/2/3	2	
	07	OVERLOAD CURRENT	Amps	000.1/500.0	①	
Local/Remote Control Enable	08	LOCAL/REMOTE CONTROL	Code	0/1/2/3	0	
Local/Remote Speed Enable	09	LOCAL/REMOTE FREQUENCY	Code	0/1/2/3	0	
Reverse Enable	10	REVERSE LOCKOUT	Off/On	0/1	0	
Stop Setting	11	STOP SELECT	Code	0/1	0	
DC Brake Settings	12	DC HOLD FREQUENCY	Hertz	00.50/60.00	00.50	
	13	DC HOLD TIME	Seconds	000/10.0	000	
	14	DC HOLD VOLTS	Code	0/10	0	
Max Speed Settings	15	MAXIMUM FREQUENCY	Hertz	50.00/400.0	60.00	
	16	BASE FREQUENCY	Hertz	50.00/250.0	60.00	
Accel and Decel Hold Enable	17	ACCEL FREQUENCY HOLD	Off/On	0/1	1	
	18	DECEL FREQUENCY HOLD	Off/On	0/1	1	
Preset Frequency and Aux Accel/Decel Enable	19	FREQUENCY SELECT	Code	0/1/2	0	
	20	TB15 PRESET/RESET	Code	0/1	0	
Aux Interlock Enable	21	AUXILIARY INTERLOCK	Code	0/1	0	
Drive Supplied Contact Settings	22	CR1 SELECT	Code	1/2/3	1	
	23	CR2 SELECT	Code	0/1/2/3	0	
	24	CR1 FREQUENCY	Hertz	00.50/400.0	00.50	
	25	CR2 FREQUENCY	Hertz	00.50/400.0	00.50	
Jog Settings	26	JOG FREQUENCY	Hertz	00.50/20.00	10.00	
	27	JOG ACCEL TIME	Seconds	0000/1600	005.0	
	28	JOG DECEL TIME	Seconds	0000/1600	005.0	

① Factory setting is determined by the output current rating shown on the drive nameplate.

**Coordinated Parameter Settings -- Parameters 01-28**



### Factory and Field Parameter Settings -- Parameters 29-62

Function Group	Parameter Number	Parameter Name	Units	Range	Factory Setting	Field Setting
Preset Frequency Settings	29	PRESET FREQUENCY 2	Hertz	00.50/400.0	20.00	
	30	PRESET FREQUENCY 3	Hertz	00.50/400.0	30.00	
	31	PRESET FREQUENCY 4	Hertz	00.50/400.0	40.00	
	32	PRESET FREQUENCY 5	Hertz	00.50/400.0	15.00	
	33	PRESET FREQUENCY 6	Hertz	00.50/400.0	25.00	
	34	PRESET FREQUENCY 7	Hertz	00.50/400.0	35.00	
	35	PRESET FREQUENCY 8	Hertz	00.50/400.0	45.00	
Auxiliary Accel and Decel Settings	36	ACCEL TIME 2	Seconds	000.1/1600	005.0	
	37	DECEL TIME 2	Seconds	000.1/1600	005.0	
	38	ACCEL TIME 3	Seconds	000.1/1600	005.0	
	39	DECEL TIME 3	Seconds	000.1/1600	005.0	
	40	ACCEL TIME 4	Seconds	000.1/1600	005.0	
	41	DECEL TIME 4	Seconds	000.1/1600	005.0	
Skip Frequency Settings	42	SKIP FREQUENCY 1	Hertz	0000/400.0	0000	
	43	SKIP FREQUENCY 2	Hertz	0000/400.0	0000	
	44	SKIP FREQUENCY 3	Hertz	0000/400.0	0000	
	45	SKIP FREQUENCY BAND	Hertz	0/10	0	
Current Limit Setting	46	CURRENT LIMIT	Seconds	00/1.5	00	
Auto Restart Settings	47	POWER LOSS RESTART	Code	0/1/2/3	1	
	48	RIDE-THRU RESTART	Code	0/1/2	0	
	49	RESTART TIME SELECT	Seconds	000.1/100.0	000.1	
Lower and Upper Frequency Clamp Settings	50	LOWER FREQUENCY CLAMP	Hertz	00.50/400.0	00.50	
	51	UPPER FREQUENCY CLAMP	Hertz	00.50/400.0	400.0	
Bias and Gain Settings	52	BIAS AND GAIN ENABLE	Off/On	0/1	0	
	53	BIAS FREQUENCY	Hertz	00.00/400.0	00.00	
	54	GAIN FREQUENCY	Hertz	00.50/400.0	60.00	
Output Meter Settings	55	FREQUENCY OUTPUT (AMPS)	% of Max Output Signal	075/125	100	
	56	FREQUENCY OUTPUT (VOLTS)	% of Max Output Signal	075/125	100	
Monitoring Mode Settings	57	MONITOR DISPLAY SELECT	Code	0/1/2	0	
	58	MOTOR POLE SELECT	Units	2/4/6/8/10	4	
Drive Fault Memory	59	FAULT BUFFER 0	Code	--	--	--
	60	FAULT BUFFER 1	Code	--	--	--
	61	FAULT BUFFER 2	Code	--	--	--
	62	FAULT BUFFER 3	Code	--	--	--



## Application Data

### Important User Information

Because of the variety of uses for this equipment and because of the differences between this solid state equipment and electromechanical equipment, the user of and those responsible for applying this equipment must satisfy themselves as to the acceptability of each application and use of the equipment. In no event will Allen-Bradley Company be responsible or legal for indirect or consequential damages resulting from the use or application of this equipment.

The illustrations shown are intended solely to illustrate the accompanying text. Because of the many variables and requirements associated with any particular installation, the Allen-Bradley Company cannot assume responsibility or liability for actual use based upon the illustrative uses and applications.

### Remote Manual and Remote Auto Speed Reference Switching

The Bulletin 1333 Series D may use the Directional Pushbuttons on the Local Control and Programming Panel or an external source as its speed reference. The method of speed control that is used is determined by parameter programming as explained in Chapter 5.

Four types of signals may be used as the external speed reference.

1. A 10k $\Omega$ , 2W potentiometer.
2. A 0-5V DC reference signal.
3. A 0-10V DC reference signal.
4. A 4-20 mA DC reference signal.

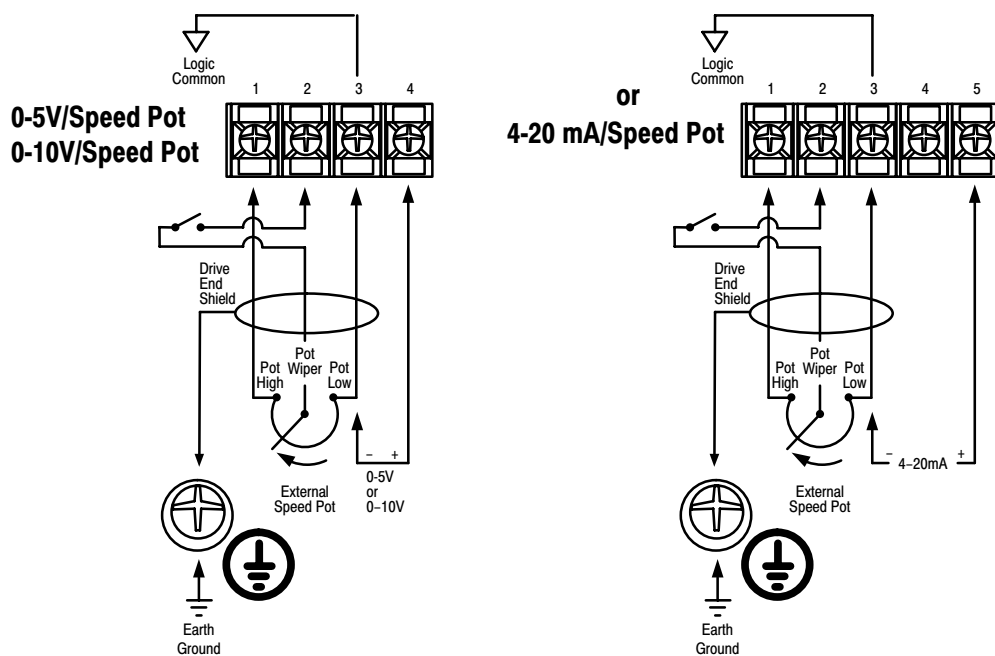
As explained in the Control and Signal Wiring section of Chapter 4, only one of these signals should be connected to the Control and Signal Wiring Terminal Block at any time.

There are times however, when a user may want the option of switching between a remote analog speed reference and a remote manual speed reference. The 1333 Series D normally will require reprogramming and reconnection to accomplish this. This application describes an alternate method of external speed selection. Users must satisfy themselves that this alternate method is safe in their particular application and that its use complies with applicable codes and standards.



The 1333 Series D has the ability to allow a single external 10kΩ, 2W manual speed potentiometer and one other reference signal to be connected to the drive at the same time. The drive may be switched from the manual potentiometer to the alternate reference signal by means of a selector switch. As shown in the Control and Signal Wiring section of Chapter 4, only one of these signals should be connected to the Control and Signal Wiring Terminal Block at any time.

Shown below is a method of switching between an external speed pot and one alternate reference signal.



The Bulletin 1333 Series D must be programmed for external speed control by setting Parameter 9 to:

- 1 if drive speed is to be controlled by a 0-5V DC signal or an external speed pot.
- 2 if drive speed is to be controlled by a 0-10V DC signal or an external speed pot.
- 3 if drive speed is to be controlled by a 4-20 mA DC signal or an external speed pot.

When the selector switch in series with the potentiometer is open, the drive will use the 0-5V DC, 0-10V DC, or 4-20 mA DC signal as the speed reference.

When the selector switch is closed, the drive will use the potentiometer signal as the speed reference.

If the selector switch is toggled while the drive is running, the drive will accelerate or decelerate to the new speed reference at the programmed accel or decel rate.

## Bulletin 1333 Heavy Duty Dynamic Braking

The Bulletin 1333 Adjustable Frequency Drive has the ability to let a connected motor generate braking torque. This ability however, is limited to approximately 20% of the drive rated braking torque. The braking torque can be increased by adding one or more Bulletin 1333 heavy duty dynamic braking kits to the drive. Typically the braking torque can be increased to 100% for 20 seconds at a duty cycle of 20%.

The following evaluation can help determine if heavy duty dynamic braking may be required for your application.

### Brake Specifications

Braking Torque:	100% Torque for 20 Seconds (typical)
Duty Cycle:	20% (typical)
Input Power:	Power from Drive DC Bus
Temperature:	-10 to + 50°C (+14 to +122°F).
Humidity:	5 to 95% Non-Condensing
Atmosphere:	No Corrosive Gas or Non-Hazardous Dust
Humidity:	3,300 Feet (1,000 Meters) Maximum without Derating
Enclosure Type:	NEMA Type 1 (IP20)

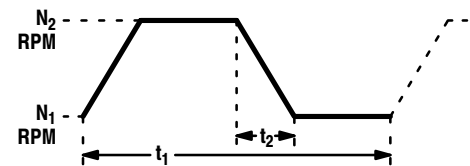
### How to Select a Brake

To begin selection, the following application information must be obtained.

The nameplate horsepower of the motor **HP**.

The nameplate base speed of the motor **N** in RPM.

The speed profile of the motor



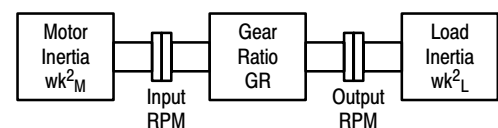
where:  **$N_1$**  = The motor's minimum speed in RPM.

**$N_2$**  = The motor's maximum speed in RPM.

**$t_1$**  = The motor's cycle time in seconds.

**$t_2$**  = The motor's decel time in seconds.

The motor inertia,  
the nameplate gear reduction  
ratio, and the load inertia.



### Step 1 -- Determine the Rated Motor Torque

$TQ_M = \frac{5250 \times HP}{N}$	<p>HP = The nameplate horsepower of the motor N = The nameplate base speed of the motor</p>
$TQ_M = \frac{5250 \times \quad}{\quad}$	<p>TQ<sub>M</sub> =            LB-FT</p>

### Step 2 -- Determine the Total Inertia

$wk^2t = wk^2_M + [wk^2_L \times (GR)^2]$	<p>wk<sup>2</sup><sub>M</sub> = The motor inertia wk<sup>2</sup><sub>L</sub> = The load inertia GR = The total reduction ratio <math>\frac{\text{Output RPM}}{\text{Input RPM}}</math></p>
$wk^2t = \quad + [ \quad \times ( \quad )^2 ]$	<p>wk<sup>2</sup>t =            LB-FT<sup>2</sup></p>

### Step 3 -- Determine the Required Braking Torque

$TQ_B = \frac{wk^2t \times [N_2 - N_1]}{308 \times t_2}$	<p>wk<sup>2</sup>t = The total inertia N<sub>2</sub> = The motor's maximum speed N<sub>1</sub> = The motor's minimum speed t<sub>2</sub> = The motor's decel time</p>
$TQ_B = \frac{[ \quad ] \times [ \quad - \quad ]}{308 \times [ \quad ]}$	<p>TQ<sub>B</sub> =            LB-FT</p>

### Step 4 -- Determine the Required Percent of Braking Torque

$TQ\% = \frac{TQ_B}{TQ_M} \times 100$	<p>TQ<sub>B</sub> = The required braking torque TQ<sub>M</sub> = The rated motor torque</p>
$TQ\% = \frac{[ \quad ]}{[ \quad ]} \times 100$	<p>TQ% =            %</p>

If TQ% is less than 20%, heavy duty dynamic braking is not required. The inherent braking of the drive should be sufficient to handle the application requirements.

If TQ% is 20% or more, a heavy duty braking kit is required. Continue to Step 5.

### Step 5 -- Determine the Maximum Generated Braking Torque

Three factors limit the application of Heavy Duty Dynamic Braking.

**The first** is the brake assembly rating  $P_T$  — The peak power the brake assembly can absorb at any instant regardless of the time limit.

**The second** is the average power that the break assembly can absorb during one braking duty cycle —  $P_A$ .

**The third** is the duty cycle or the number of times the brake assembly can be operated over a given period of time — **DC**.

$P_M = \frac{TQ_B \times N_2}{7,000}$	$TQ_B$ = The required braking torque $N_2$ = The motor's maximum speed
$P_M = \left[ \frac{\quad}{7,000} \right] \times \left[ \quad \right]$	$P_M$ =            kW

$P_M$  must be less than or equal to the **Brake Assembly Rating** listed in **table 1**. If  $P_M$  exceeds the  $P_T$  value shown, the corresponding drive/brake configuration will not be able to produce the braking torque required for your application, and the drive will trip on an overvoltage fault. Increasing the decel time  $t_2$ , reducing the load inertia  $wk^2L$ , or doing both will lower  $TQ_B$  and  $P_M$ .

**table 1**

Nominal Drive HP	To provide the maximum amount of braking torque use	To provide a brake assembly rating (PT) of
3/4	(1) KA1 for a 208/230V AC Unit (1) KB1 for a 460V AC Unit	1.2 kW
1	(1) KA1 for a 208/230V AC Unit (1) KB1 for a 460V AC Unit	1.2 kW
2	(1) KA2 for a 208/230V AC Unit (1) KB2 for a 460V AC Unit	2.4kW
3	(1) KA3 for a 208/230V AC Unit (1) KB3 for a 460V AC Unit	6 kW
5	(1) KA3 for a 208/230V AC Unit (1) KB3 for a 460V AC Unit	6kW
7 1/2	(1) KA4	12 kW
10	(1) KA4	12 kW
15	(1) KA5	24 kW
20	(1) KA5	24 kW

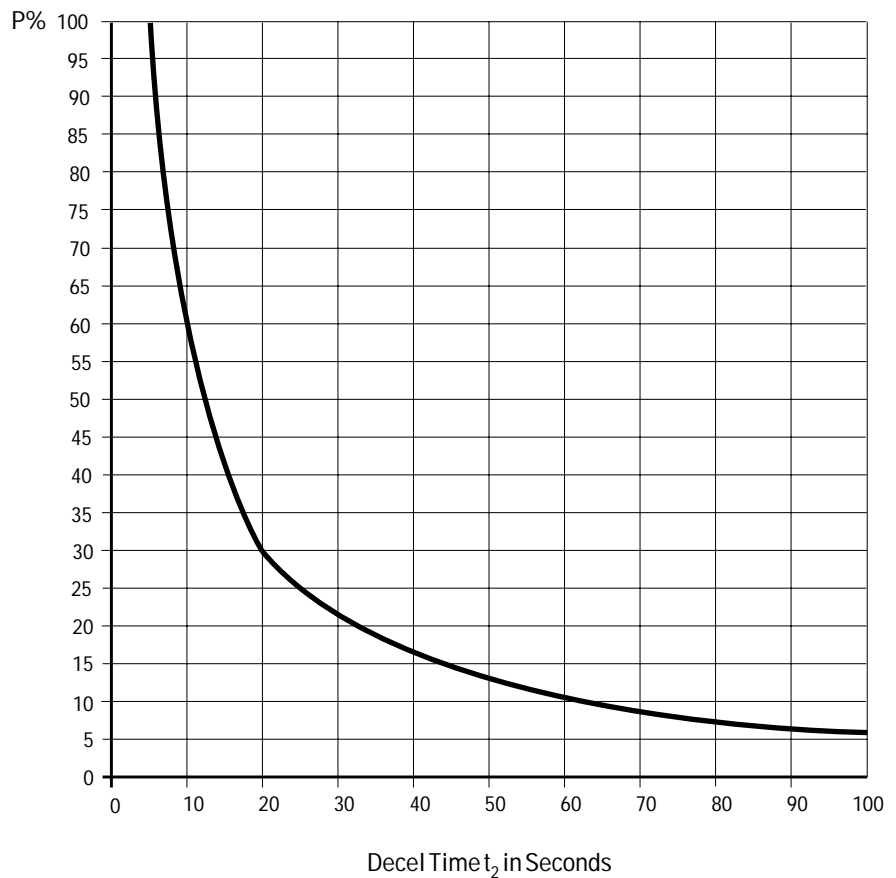
**Step 6 -- Determine the Average Power Generated in One Cycle**

$P_A = \frac{TQ_B \times [N_1 + N_2]}{14,000}$	$TQ_B$ = The required braking torque $N_1$ = The motor's minimum speed $N_2$ = The motor's maximum speed
$P_A = \left[ \frac{\quad}{14,000} \right] \times \left[ \frac{\quad}{\quad} + \frac{\quad}{\quad} \right]$	$P_A$ =            kW

**Step 7 -- Determine the Ratio of the Average Power to the Brake Assembly Rating**

$P\% = \frac{P_A}{P_T}$	$P_A$ = The average power generated in one cycle $P_T$ = The brake assembly rating from table 1
$P\% = \left[ \frac{\quad}{\quad} \right]$	$P\%$ =            %

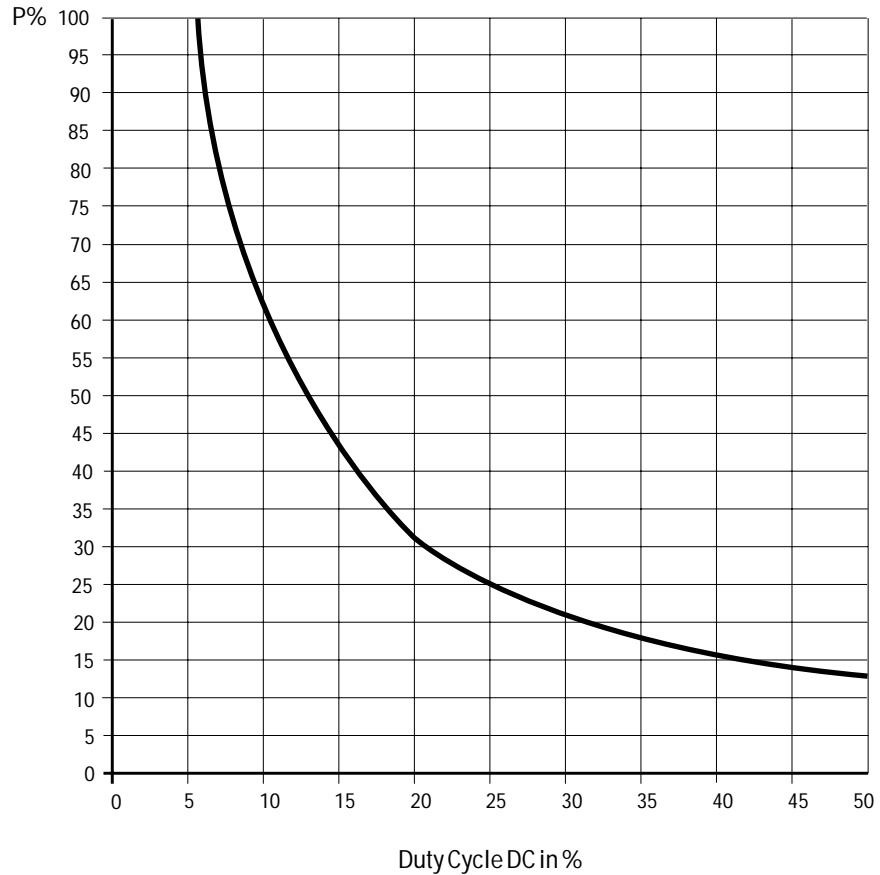
Find the intersection of  $P\%$  and the motor's decel time  $t_2$  in the chart below. If the point of intersection is below the curve, the average power of one cycle is within the brake's limits. If the point is above the curve, the average power is beyond the brake's limits but may be reduced by increasing the motor's decel time  $t_2$ , reducing the load inertia  $wk^2_L$ , or doing both.



**Step 8 -- Determine if the Duty Cycle is within the Brake's Capability**

$DC = \frac{t_2}{t_1} \times 100$	$T_1$ = The motor's cycle time
$DC = \left[ \frac{\quad}{\quad} \right] \times 100$	$T_2$ = The motor's decel time
	$DC = \quad \%$

Find the intersection of **P%** and the motor's decel time **DC** in the chart below. If the point of intersection is below the curve, the duty cycle is within the brake's limits. If the point is above the curve, the duty cycle is beyond the brake's limits but may be modified by increasing the motor's cycle time **t<sub>1</sub>**.



**Notes**



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PERSONAL COMPUTERS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NC / CNC CONTROLS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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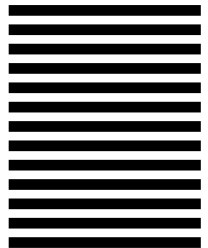
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