ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

Instruction Manual

Bulletin 1332 Adjustable Frequency AC Motor Drive

230, 460, 575V AC

Price: $25.00

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, equipment or software described in this text.

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Warnings tell readers where people may be hurt if procedures are not followed properly.

Cautions tell them where machinery may be damaged or economic loss can occur if procedures are not followed properly.

Both of these:

- Identify a possible trouble spot.
- Tell what causes the trouble.
- Give the result of improper action.
- Tell the reader how to avoid trouble.

Repair or Repair/Exchange Procedure

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

A Product Service Report (P.S.R.) number is required to return any equipment for repair. This may be obtained from your local Allen-Bradley Distributor, Sales Office or Area Support Center.

Return any equipment to be repaired to the Area Support Center nearest you. Be sure to reference the P.S.R. 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 Support Centers may be found in Publication CSS GI 1.1 or by calling your local Allen-Bradley Distributor or Sales Office.

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Chapter

1

Introduction

1.0 Manual Objectives

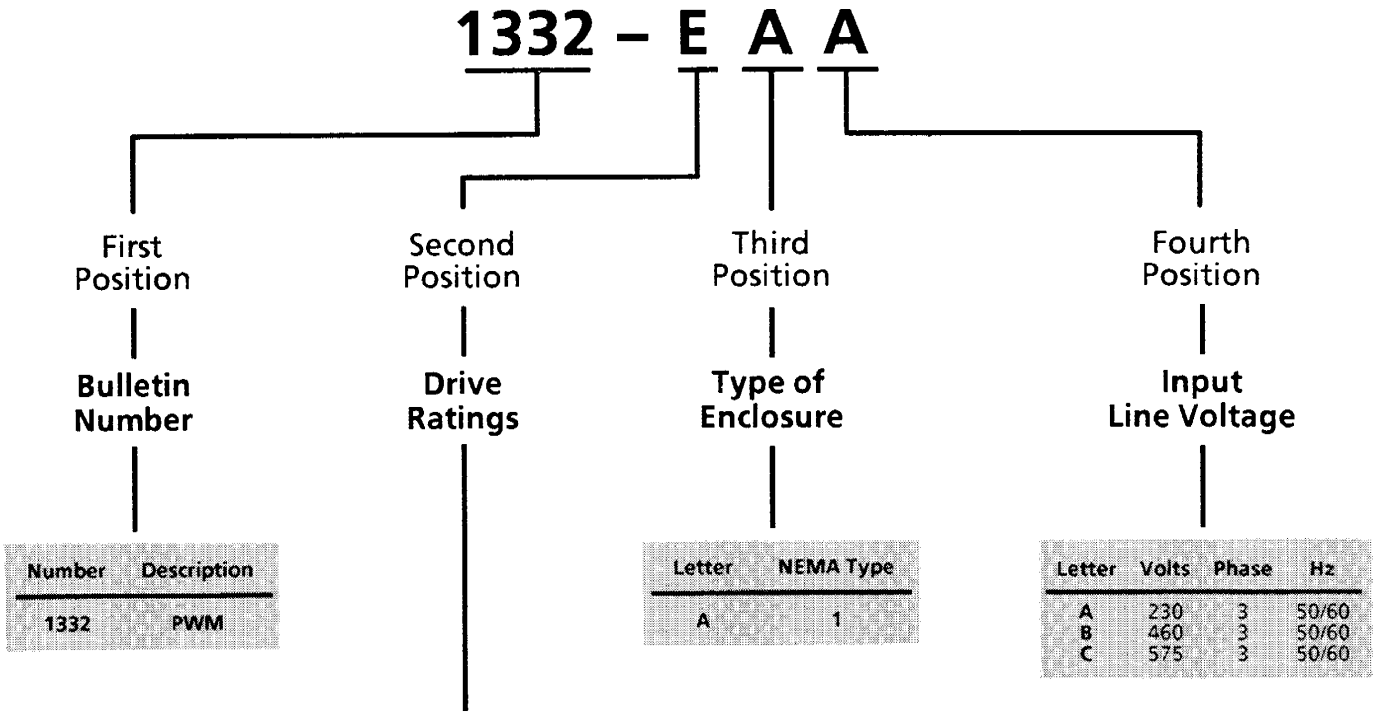
The purpose of this manual is to provide the user with the information necessary to install, start-up, maintain and troubleshoot the Bulletin 1332 Adjustable Frequency AC Drive. Specifications, installation instructions and operation of the Bulletin 1332 Modifications are also provided in this manual.

1.1 Chapter Objectives

In addition to the Manual Objectives, Chapter 1 provides an explanation of the catalog numbering system for the Bulletin 1332. The catalog number listing and explanation is provided for the standard Drive as well as the modifications available for the Drive.

1.2 Drive Catalog Listing

The following diagram represents the catalog listing for the Bulletin 1332 Drive.



Number	Description
1332	PWM

Letter	NEMA Type
A	1

Letter	Volts	Phase	Hz
A	230	3	50/60
B	460	3	50/60
C	575	3	50/60

Letter	Nominal HP	Input Volts	Max. Con. Amps	Output kVA	Input Volts	Max. Con. Amps	Output kVA	Input Volts	Max. Con. Amps	Output kVA
Z	3/4	230	3	1.2	–	–	–	–	–	–
A	1	230	5	2	460	2.1	1.7	575	1.4	1.4
Y	2	230	8	3.2	460	4	3.2	575	2.7	2.7
B	3	230	11	4.4	460	6	4.8	575	3.9	3.9
C	5	230	17	6.8	460	9.4	7.5	575	6.1	6.1
D	7.5	230	24	9.6	–	–	–	575	9.0	9.0
E	10	230	33	13.1	–	–	–	575	11.0	11.0
F	15	230	45	17.9	–	–	–	575	17.0	17.0
G	20	230	61	24.3	–	–	–	–	–	–

1.3 Modifications

Bulletin 1332 modifications are supplied separately for field installation. The modifications are identified as Bulletin 1332 – MOD – (letter).

1332 – MOD – (letter)

Letter	Nominal Voltage	Description	
F	All	Remote Operator Station	
F2	230	Preset Speeds	
F3	460		
F4	575		
N	230	Adjustable Min. / Max. Frequency (0 to 10V DC Input)	
N3	460		
N5	575		
N2	230	Adjustable Min. / Max. Frequency (4 to 20 mA Input)	
N4	460		
N6	575		
G4	All	BCD Interface	
K	230	3/4-5 HP	Dynamic Brake
K2	230	7.5-20 HP	
K3	460	1-5 HP	
K4	575	1-5 HP	
K5	575	7.5-15 HP	

Chapter

2

Specifications

2.0 Chapter Objectives

Chapter 2 provides the electrical and environmental specifications for the Bulletin 1332 Adjustable Frequency AC Drive.

2.1 Specification Tables

The following tables list the specific specifications for the 230, 460 and 575 volt Bulletin 1332. General specifications for all Drives are presented at the end of the chapter.

1332 - xxA (230V Series B Drives)

Drive Ratings

Nominal HP	3/4 - 20 HP
Input Voltage	Standard: 230V AC, 3ϕ, 50/60 Hz Alternate: 208V AC, 3ϕ, 230/208V AC, 1ϕ, 50/60 Hz
Output Voltage	0 to Nominal Input Voltage - 0 to 230V Typical
Output Volts per Hz	Standard: 230V Input - 3.83 V/Hz, 0 to 60 Hz in Auto Boost (230V at 60 Hz) 3.83 V/Hz, +40%/-20% in Manual Alternate: 230V Input - 4.6 V/Hz (230V at 50 Hz) 208V Input - 3.46 V/Hz (208V at 60 Hz) or 4.16 V/Hz (208V at 50 Hz)
Overvoltage Trip	Trip and diagnostic display when DC bus rises above 450V due to high AC line or motor regeneration to DC bus.
Decel Stall Protection	Stops decel ramp on DC bus voltage rise over 380V DC.

Input Voltage	Model	Nominal HP	Input A	230V kVA	208V kVA	Output A	230V kVA	208V kVA	Watts Dissip. ①
230V/208V, 3ϕ, 50/60 Hz	ZAA	3/4	4.1	1.7	1.5	3.0	1.2	1.1	200
	AAA	1	6.8	2.7	2.4	5.0	2.0	1.8	200
	YAA	2	11.2	4.5	4.1	8.0	3.2	2.9	350
	BAA	3	16.4	6.6	6.0	11.0	4.4	4.0	450
	CAA	5	25.9	10.3	9.3	17.0	6.8	6.1	550
	DAA	7.5	33.5	13.3	12.0	24.0	9.6	8.7	300
	EAA	10	46.2	18.4	16.6	33.0	13.1	11.8	375
	FAA	15	64.0	25.5	23.1	45.0	17.9	16.2	450
	GAA	20	86.6	34.5	31.2	61.0	24.3	22.0	550
230V/208V, 1ϕ, 60 Hz	ZAA	1/2	6.2	1.4	1.3	2.6	1.0	0.9	200
	AAA	3/4	9.0	2.1	1.9	3.8	1.5	1.4	200
	YAA	1	11.9	2.7	2.5	4.9	2.0	1.8	350
	BAA	1.5	15.2	3.5	3.2	5.9	2.4	2.1	450
	CAA	2	22.2	5.1	4.6	8.4	3.4	3.0	550
	DAA	3	29.0	6.7	6.0	12.0	4.8	4.3	300
	EAA	5	38.8	8.9	8.1	16.0	6.4	5.7	375
	FAA	7.5	56.7	13.0	11.8	23.0	9.1	8.3	450
	GAA	10	76.2	17.5	15.9	31.0	12.3	11.2	550
230V/208V, 1ϕ, 50 Hz	ZAA	1/2	5.7	1.3	1.2	2.4	1.0	0.9	200
	AAA	3/4	8.0	1.8	1.7	3.4	1.4	1.2	200
	YAA	1	10.9	2.5	2.3	4.5	1.8	1.6	350
	BAA	1.5	13.9	3.2	2.9	5.4	2.2	2.0	450
	CAA	2	20.3	4.7	4.2	7.7	3.1	2.8	550
	DAA	3	26.6	6.1	5.5	11.0	4.4	4.0	300
	EAA	5	36.4	8.4	7.6	15.0	6.0	5.4	375
	FAA	7.5	51.7	11.9	10.8	21.0	8.4	7.6	450
	GAA	10	68.9	15.8	14.3	28.0	11.2	10.1	550

Recommended Drive Input Fuse Sizes ② ③	Model	Fuse Size	Model	Fuse Size
	ZAA	KTK-8	DAA	JKS-50
	AAA	KTK-12	EAA	JKS-70
	YAA	KTK-15	FAA	JKS-100
	BAA	KTK-20	GAA	JKS-125
	CAA	KTK-30		

① Heat dissipation is estimated based on operating a typical design B induction motor at rated load and 60 Hz.

② These fuses are not intended to satisfy NEC requirements for branch circuit protection.

③ Use Bussman fuse or equivalent, UL listed fuses and fuse holders.

1332 - xxB (460V Drives)

Drive Ratings

Nominal HP	1 – 5 HP
Input Voltage	Standard: 460V AC, 3ϕ, 50/60 Hz Alternate: 415 or 380V AC, 3ϕ, 50/60 Hz
Output Voltage	0 to Nominal Input Voltage - 0 to 460V Typical
Output Volts per Hz	Standard: 460V Input - 7.6 V/Hz, 0 to 60 Hz in Auto Boost (460V at 60 Hz) 7.6 V/Hz, + 40%/–20% in Manual Alternate: 460V Input - 9.2 V/Hz (460V at 50 Hz) 415V Input - 6.92 V/Hz (415V at 60 Hz) or 8.3 V/Hz (415V at 50 Hz) 380V Input - 6.3 V/Hz (380V at 60 Hz) or 7.6 V/Hz (380V at 50 Hz)
Overvoltage Trip	Trip and diagnostic display when DC bus rises above 800V due to high AC line or motor regeneration to DC bus.
Decel Stall Protection	Stops decel ramp on DC bus voltage rise over 740V DC.

Input Voltage	Model	Nominal HP	Input A	Input kVA	Output A	Output kVA	Watts Dissip. ①
460V, 3ϕ, 50/60 Hz	AAB	1	3.4	2.7	2.1	1.7	200
	YAB	2	6.0	4.8	4.0	3.2	350
	BAB	3	9.7	7.7	6.0	4.8	350
	CAB	5	14.2	11.3	9.4	7.5	500
415V, 3ϕ, 50/60 Hz	AAB	1	3.4	2.4	2.1	1.5	200
	YAB	2	6.0	4.3	4.0	2.9	350
	BAB	3	9.7	6.9	6.0	4.8	350
	CAB	5	14.2	10.2	9.4	6.8	500
380V, 3ϕ, 50/60 Hz	AAB	1	3.4	2.2	2.1	1.4	200
	YAB	2	6.0	4.0	4.0	2.6	350
	BAB	3	9.7	6.4	6.0	4.0	350
	CAB	5	14.2	9.3	9.4	6.2	500

Recommended Drive Input Fuse Sizes ② ③	Model	Fuse Size
	AAB	KTK-5
	YAB	KTK-10
	BAB	KTK-15
	CAB	KTK-20

① Heat dissipation is estimated based on operating a typical design B induction motor at rated load and 60 Hz.

② These fuses are not intended to satisfy NEC requirements for branch circuit protection.

③ Use Bussman fuse or equivalent, UL listed fuses and fuse holders.

1332 - xxC (575V Drives)

Drive Ratings

Nominal HP	1 to 15 HP
Input Voltage	Standard: 575V AC, 3ϕ, 50/60 Hz Alternate: 575V AC, 1ϕ, 50/60 Hz
Output Volts per Hz	Standard: 9.58 V/Hz, 0 to 60 Hz in Auto Boost (575V at 60 Hz) 9.58 V/Hz, +40%/–20% in Manual Alternate: 11.5 V/Hz (575V at 50 Hz)
Overvoltage Trip	Trip and diagnostic display when DC bus rises above 975V DC due to high AC line or motor regeneration to DC bus.
Decel Stall Protection	Stops decel ramp on DC bus voltage rise over 920V DC.

Input Voltage	Model	Nominal HP	Input A	Input kVA	Output A	Output kVA	Watts Dissip. ①
575V, 3ϕ, 50/60 Hz	AAC	1	1.9	1.9	1.4	1.4	200
	YAC	2	3.8	3.8	2.7	2.7	350
	BAC	3	5.5	5.5	3.9	3.9	350
	CAC	5	9.3	9.3	6.1	6.1	500
	DAC	7.5	12.5	12.5	9.0	9.0	300
	EAC	10	15.3	15.3	11.0	11.0	375
	FAC	15	24.0	24.0	17.0	17.0	450
575V, 1ϕ, 50/60 Hz	AAC	3/4	2.4	1.4	1.0	1.0	200
	YAC	1	3.5	2.2	1.6	1.6	350
	BAC	1.5	5.2	3.0	2.1	2.1	350
	CAC	2	7.0	4.0	3.0	3.0	500
	DAC	3	12.0	7.0	5.0	5.0	300
	EAC	5	14.0	8.0	5.6	5.6	375
	FAC	7.5	20.0	11.3	8.0	8.0	450

Recommended Drive Input Fuse Sizes ② ③	Model	Fuse Size
	AAC	KTK-3
	YAC	KTK-7
	BAC	KTK-10
	CAC	KTK-15
	DAC	KTK-20
	EAC	KTK-30
	FAC	JKS-50

① Heat dissipation is estimated based on operating a typical design B induction motor at rated load and 60 Hz.

② These fuses are not intended to satisfy NEC requirements for branch circuit protection.

③ Use Bussman fuse or equivalent, UL listed fuses and fuse holders.

All Units

Incoming Line Voltage	**Allowable Variation**	Input Voltage, ± 10% Input Frequency, ± 3Hz
Control Specifications	**Frequency Setting**	Output Frequency Range: 3 to 50 Hz, 3 Hz to 60 Hz, 6 Hz to 120 Hz, 12 Hz to 240 Hz
	Output Waveform Control Scheme	Sine Weighted PWM Control
	Output Switching Device	Transistor
	Output Voltage	0 to Nominal Input Voltage (0-60 Hz Typical)
	Frequency Regulation	± 0.5%
	Operator Control Voltage	17V DC
	Overload Capability	150% of Rated Current for 1 Minute
	Starting Torque	150% (Nominal)
Standard Controls and Adjustments	**DC Boost Selection**	Auto / Manual
	START / STOP	Selector Switch Mounted in Enclosure Control Panel
	Speed Adjustment	Local Pot on Control Panel or Optional 10KΩ, 2W, 0 to 10V DC or 4 to 20 mA
	ACCEL/DECEL Rate Adjustment	1 to 50 Seconds (0 – 100% Speed) Independently Adjustable (3/4 to 10 HP Units) 5 to 150 Seconds (15 & 20 HP Units) 1 to 30 Seconds on 230V, Series A Drives
	Stop Mode Selection	Coast to Stop or Ramp to Stop
Protection Circuits and Devices	**Ride Through Time**	15 ms Supply Interruption
	Undervoltage Trip	Supply Voltage below 90% of Rated Input
	Overvoltage Trip	Trip by Overvoltage by Sensing DC Bus
	Overcurrent Trip	Trips at 200% of Rated Current
	Overload Capacity	150% of Rated Current for 1 Minute
	Stall Protection (No Trip) (Accel / Decel)	On Acceleration: 140% of Rated Current On Deceleration: at Approximately 115% of Nominal Bus Voltage
	Temperature	Blocked Heat Sink, High Ambient or Continuous Overload of Drive
	External Signal Trip	Accepts Customer Supplied Interlock (N.C. Open to Stop Drive)
Signal Output	**Trip Signal**	Relay 1 Form C Contact (120V AC, 0.8A Inductive, 3 A Resistive)
	Run Signal	Relay 1 Form A Contact (120V AC, 0.8A Inductive, 3 A Resistive)
Diagnostics	**Overcurrent**	LED Indication when Output Section is subjected to High Current Spikes
	Overvoltage	LED Indication when DC Bus Reaches Excessive Level
	Low Voltage	LED Indication when Input Voltage Drops below 90% or Rated Input
	Temperature	LED Indication when Heat sink Temperature reaches Maximum Allowable
	Aux (External Interlocks)	LED Indication when External Contact Opens
	Power	LED Indication when Input Line Power is applied to the Drive
	Run	LED Indication when Drive is in the Running Mode
Operating Environment	**Vibration (Normal Mounting Position)**	Below 0.5G, Amplitude 0.8mm P – P, Direction X, Y, Z
	Shock (Normal Mounting Position)	16G Peak for 11 ms duration
	Noise Immunity	Showering Arc Transients from 350 to 2,000 Volts
	Operating Temperature	– 10 to + 50°C
	Relative Humidity	5 to 95%, Non-Condensing
	Elevation	3,300 Feet (1,000 m) without Derating
Storage Environment	**Ambient Storage Temperature**	–25 °C to 65 °C
	Relative Humidity	5 to 95%, Non-Condensing
Construction	**Enclosed**	NEMA Type 1
	Open Chassis	Cover Removed

Chapter

3

Installation

3.0 Chapter Objectives

Chapter 3 provides the general requirements, dimensions and wiring procedures required to install the Bulletin 1332.

3.1 Initial Inspection

Upon receipt of your Bulletin 1332 Drive, careful inspection for shipping damage should be made. If any items are obviously damaged, it is the responsibility of the user not to accept delivery until the freight agent has noted the damage on the freight bill.

After unpacking, check the items received against the bill of lading to verify that the nameplate description of each item agrees with the material ordered.

If the Drive will not be installed when unpacked, it should be stored in a clean, dry area, where:

- the ambient temperature is between –25°C and +65°C.
- the relative humidity is between 5% to 95%, non-condensing
- the equipment will not be exposed to a corrosive atmosphere

3.2 General Requirements

The Bulletin 1332 shall be installed in an area where:

- Cabinet mounting is upright, leaving room for a minimum clearance of the specified distance given in Figure 3–1.
- The ambient atmosphere is free of corrosive gases and temperature extremes (–10 to +50°C).
- Metallic conduit is recommended for all signal and control wiring due to the radiation of high frequency noise from power switching components.
- An input transformer, in general, is not required for normal Drive operation. However, if the use of an input transformer is desired, **only** an "isolation" type transformer should be used.
- Connection of any type of transformer to the Drive output is not recommended. Contact your local Allen-Bradley Sales Office for further information.

3.2 General Requirements *(Continued)*

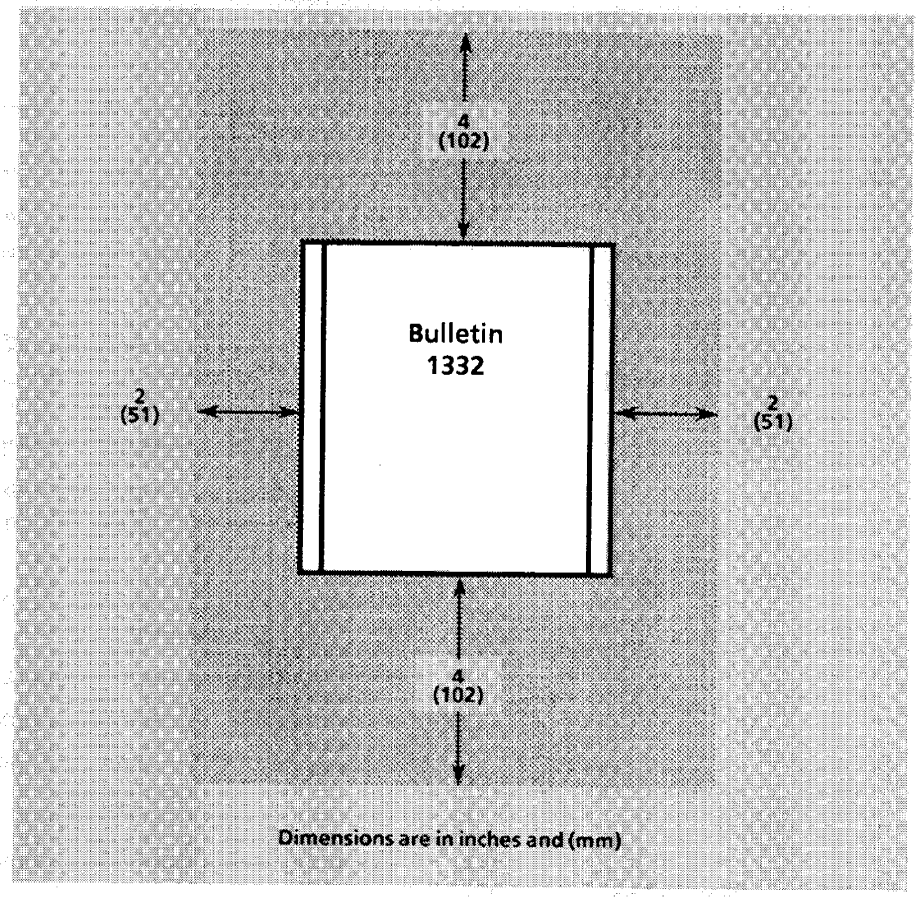


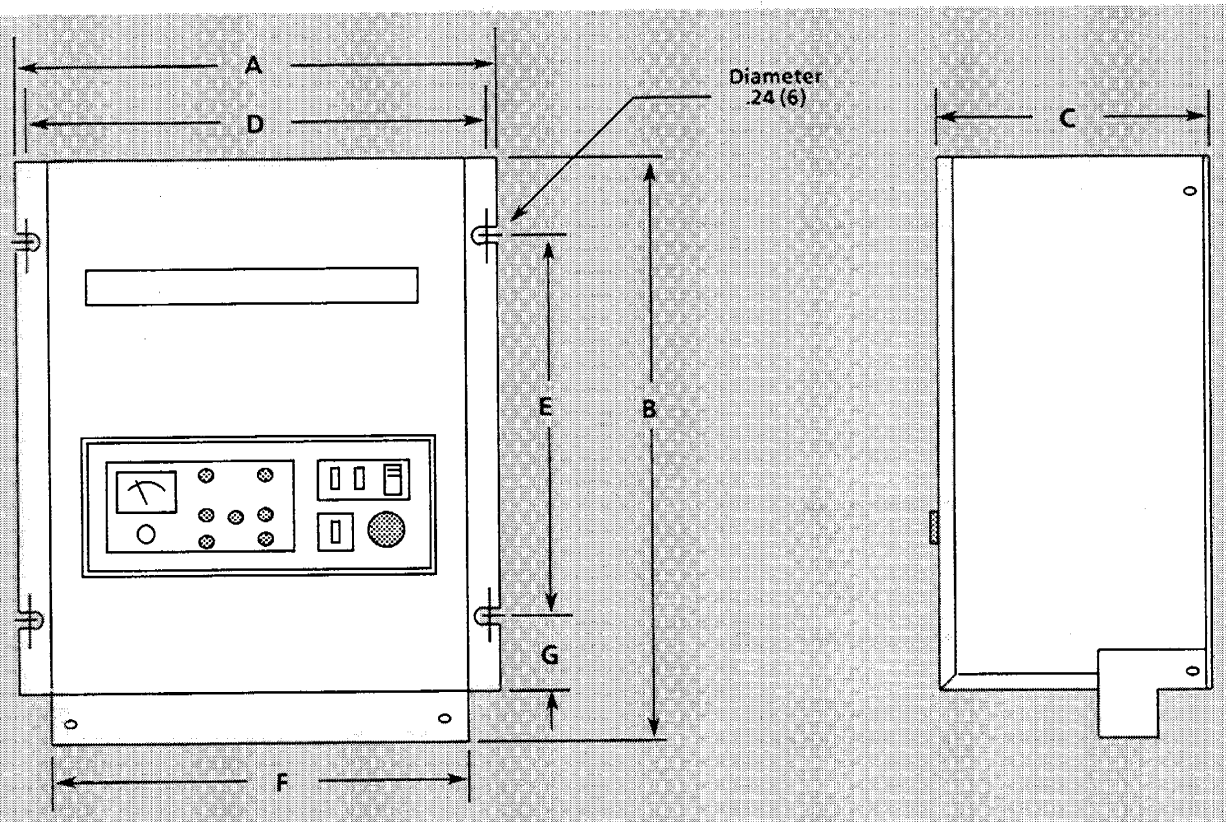
Figure 3–1. Minimum Mounting Clearances

Before actual installation, remove all packing material, wedges or braces from within and around the Drive. Remove all packing material from the heat sink and cooling fans (7.5 to 20 HP Units).

IMPORTANT: Before the installation and start-up of the Drive, a general inspection of mechanical integrity (i.e. loose parts, wires, connections, packing materials, etc.) should be made.

3.3 Dimensions, Weights & Conduit Entry

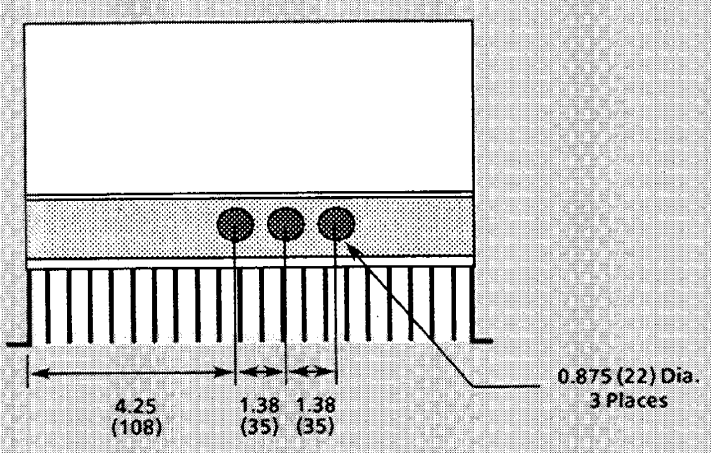
Figures 3–2A through 3–2F show the dimensions, weights and conduit entry locations for each of the Bulletin 1332 Adjustable Frequency Drives.



Dimensions in inches (mm)

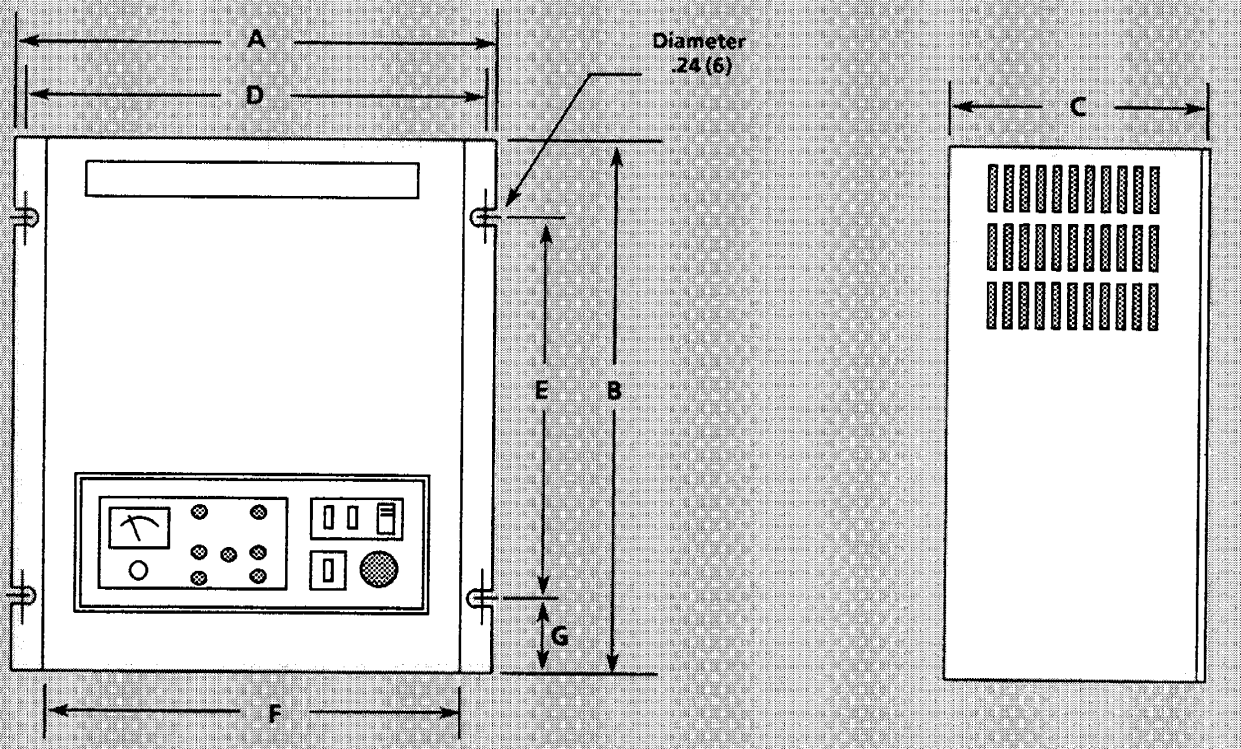
Model	HP	A	B *	C	D	E	F	G	Weight lbs. (kg)
ZAA	3/4	10.63 (270)	11.81 (300)	6.89 (175)	10.24 (260)	6.69 (170)	9.92 (252)	1.57 (40)	11.0 (5)
AAA	1	10.63 (270)	11.81 (300)	6.89 (175)	10.24 (260)	6.69 (170)	9.92 (252)	1.57 (40)	11.3 (5.1)
YAA	2	10.63 (270)	12.99 (330)	6.89 (175)	10.24 (260)	7.87 (200)	9.92 (252)	1.57 (40)	16.8 (7.6)
BAA	3	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	20.5 (9.3)
CAA	5	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	20.7 (9.4)

* For open subpanel, the Drive cover and conduit box can be removed. Subtract 2" from the "B" dimension.



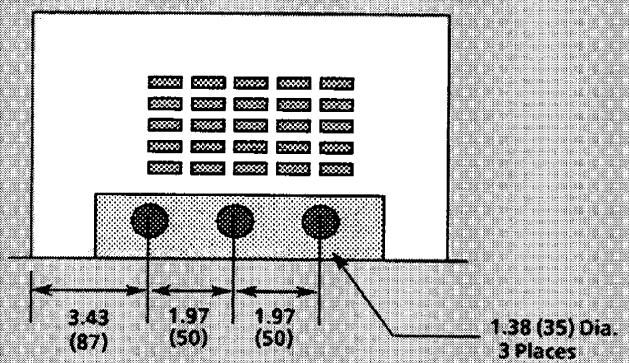
Bottom View of Enclosure

Figure 3–2A. Approximate Dimensions, Weights and Conduit Entry for 230V Drives *(3/4 - 5 HP)*



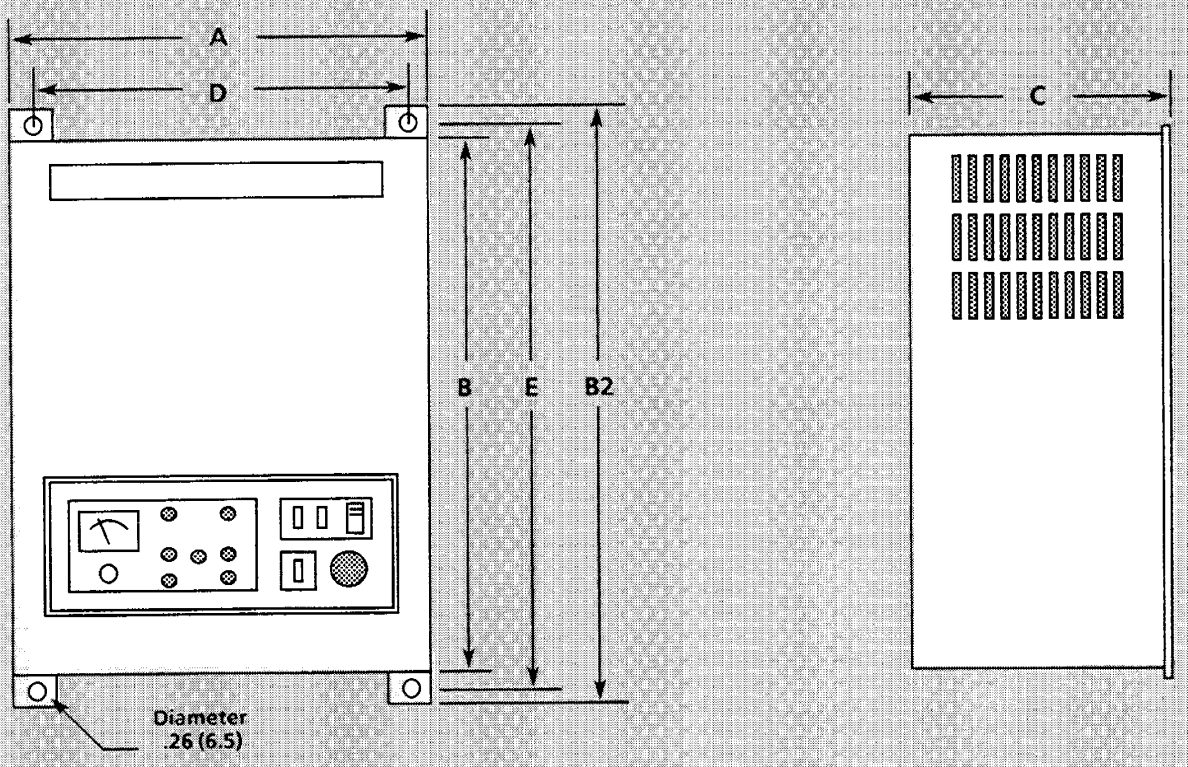
Dimensions in inches (mm)

Model	HP	A	B	C	D	E	F	G	Weight lbs. (kg)
DAA	7.5	12.20 (310)	25.59 (650)	8.26 (210)	11.42 (290)	16.14 (410)	10.78 (274)	4.72 (120)	44.1 (20)
EAA	10	12.20 (310)	25.59 (650)	8.26 (210)	11.42 (290)	16.14 (410)	10.78 (274)	4.72 (120)	44.1 (20)



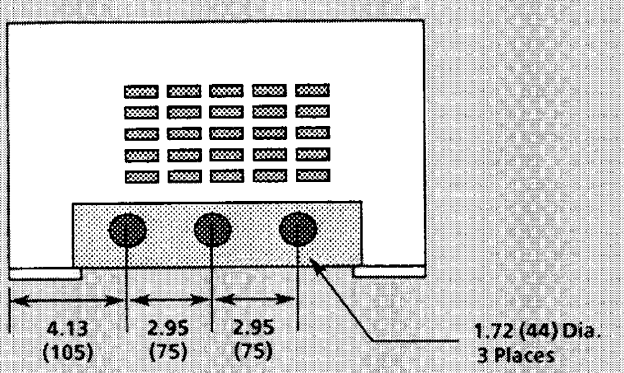
Bottom View of Enclosure

Figure 3–2B. Approximate Dimensions, Weights & Conduit Entry for 230V Drives *(7.5 - 10 HP)*



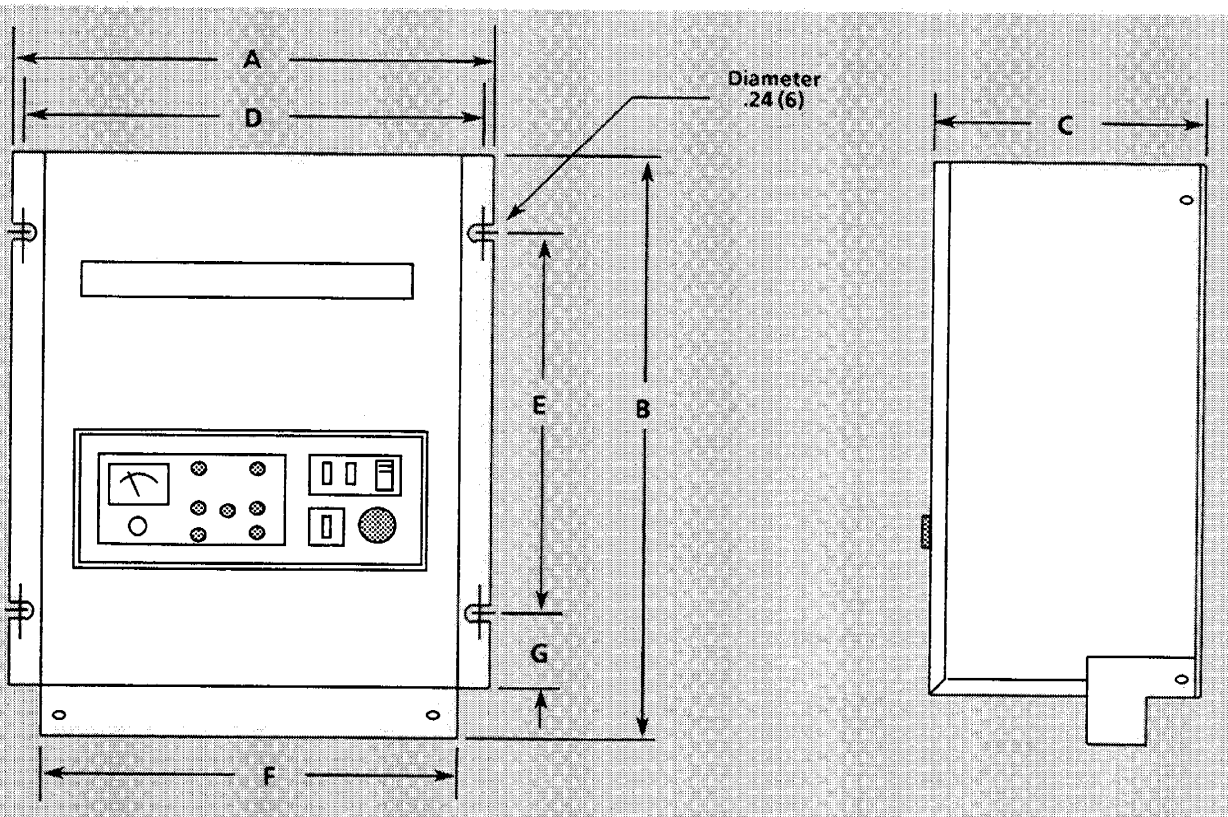
Dimensions in inches (mm)

Model	HP	A	B	B2	C	D	E	Weight lbs. (kg)
FAA	15	14.17 (360)	32.28 (820)	33.46 (850)	8.26 (210)	12.20 (310)	32.87 (835)	64.0 (29)
GAA	20	14.17 (360)	32.28 (820)	33.46 (850)	8.26 (210)	12.20 (310)	32.87 (835)	66.2 (30)



Bottom View of Enclosure

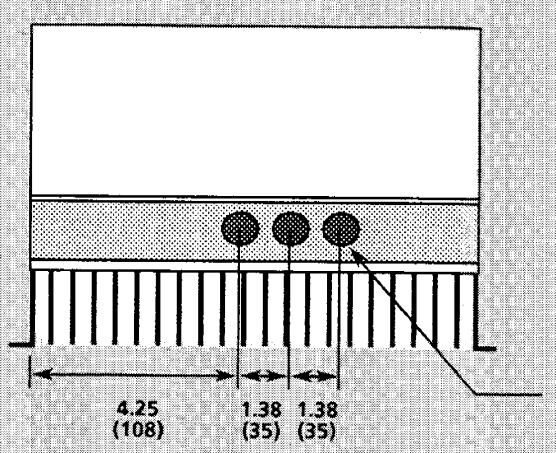
Figure 3–2C. Approximate Dimensions, Weights & Conduit Entry for 230V Drives *(15 - 20 HP)*



Dimensions in inches (mm)

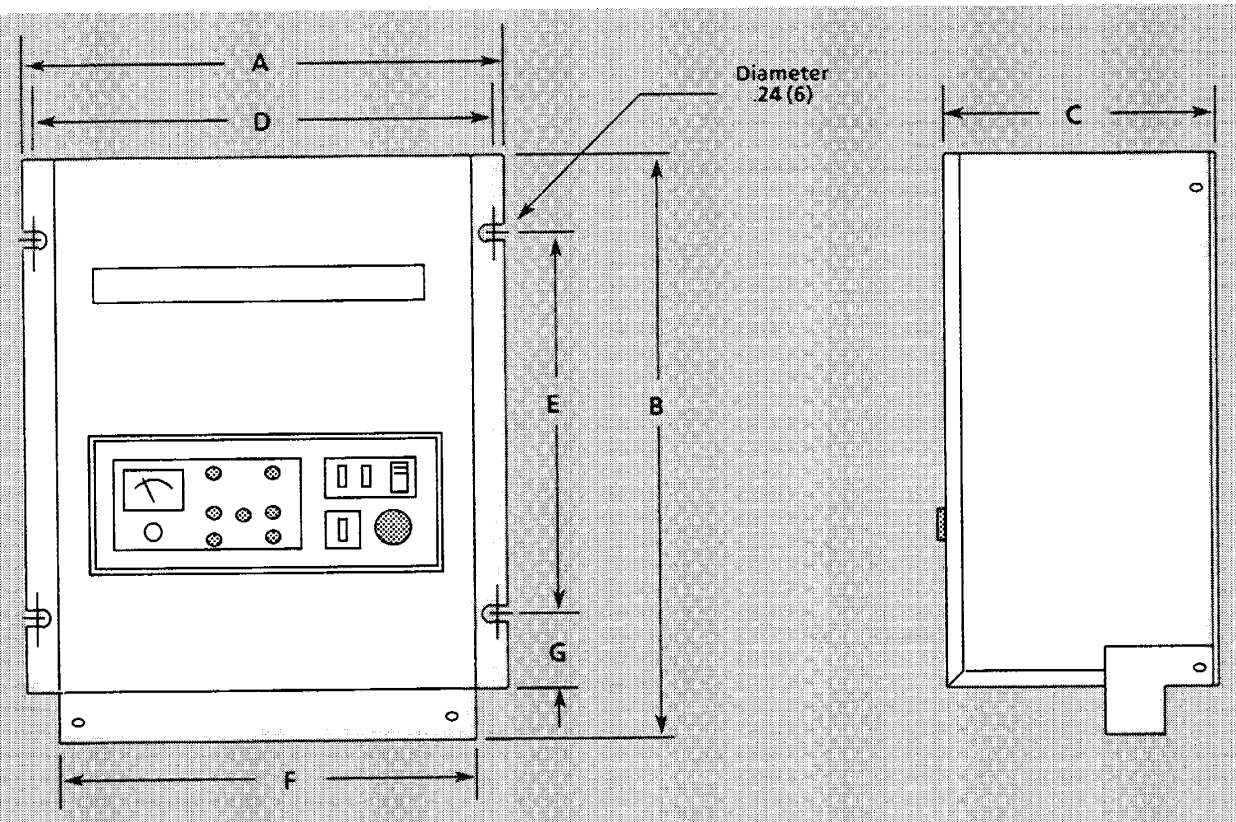
Model	HP	A	B *	C	D	E	F	G	Weight lbs. (kg)
AAB	1	10.63 (270)	11.81 (300)	6.89 (175)	10.24 (260)	6.69 (170)	9.92 (252)	1.57 (40)	11.3 (5.1)
YAB	2	10.63 (270)	12.99 (330)	6.89 (175)	10.24 (260)	7.87 (200)	9.92 (252)	1.57 (40)	16.8 (7.6)
BAB	3	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	20.5 (9.3)
CAB	5	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	20.7 (9.4)

* For open subpanel, the Drive cover and conduit box can be removed. Subtract 2" from the "B" dimension



Bottom View of Enclosure

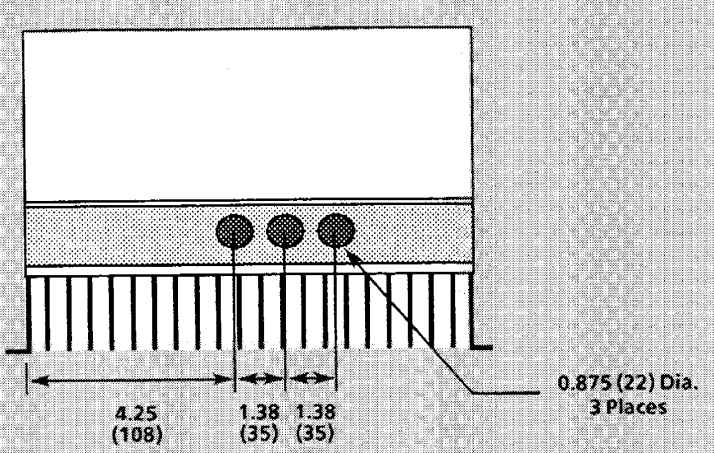
Figure 3–2D. Approximate Dimensions, Weights and Conduit Entry for 460V Drives *(1 - 5 HP)*



Dimensions in inches (mm)

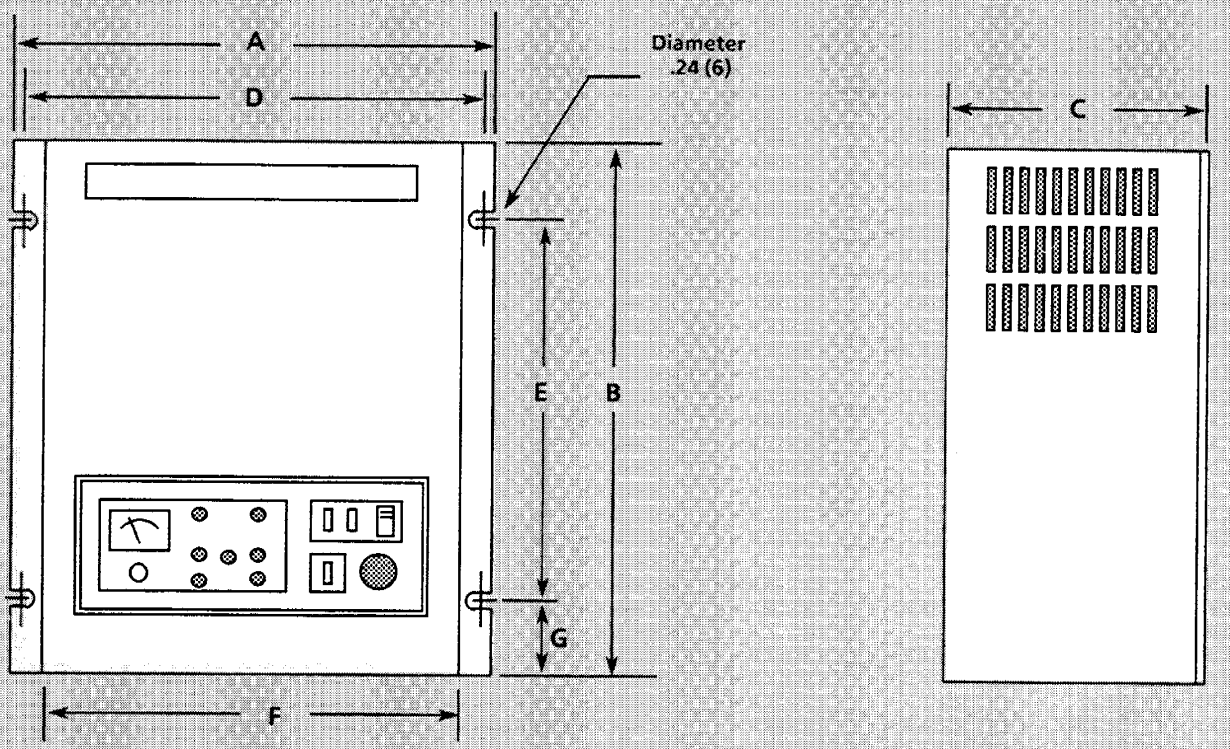
Model	HP	A	B *	C	D	E	F	G	Weight lbs. (kg)
AAC	1	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	18.7 (8.5)
YAC	2	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	18.7(8.5)
BAC	3	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	19.4 (8.8)
CAC	5	10.63 (270)	14.96 (380)	6.89 (175)	10.24 (260)	9.85 (250)	9.92 (252)	1.57 (40)	19.8 (9.0)

* For open subpanel, the Drive cover and conduit box can be removed. Subtract 2" from the "B" dimension.



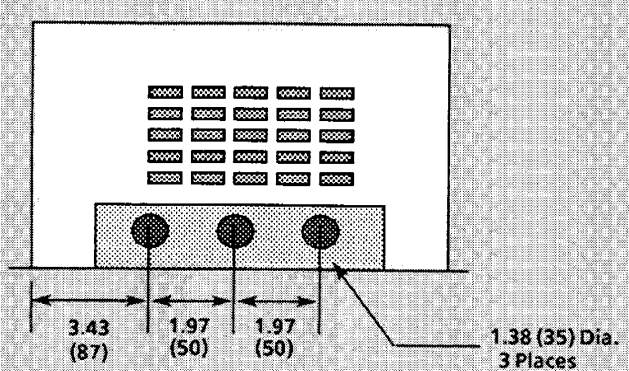
Bottom View of Enclosure

Figure 3–2E. Approximate Dimensions, Weights and Conduit Entry for 575V Drives *(1 - 5 HP)*



Dimensions in inches (mm)

Model	HP	A	B	C	D	E	F	G	Weight lbs. (kg)
DAC	7.5	12.20 (310)	25.59 (650)	8.26 (210)	11.42 (290)	16.14 (410)	10.78 (274)	4.72 (120)	38.6 (17.5)
EAC	10	12.20 (310)	25.59 (650)	8.26 (210)	11.42 (290)	16.14 (410)	10.78 (274)	4.72 (120)	39.0 (17.7)
FAC	15	12.20 (310)	25.59 (650)	8.26 (210)	11.42 (290)	16.14 (410)	10.78 (274)	4.72 (120)	40.8 (18.5)



Bottom View of Enclosure

Figure 3–2F. Approximate Dimensions, Weights & Conduit Entry for 575V Drives *(7.5 - 15 HP)*

3.4 Wiring Procedures

IMPORTANT: The National Electrical Code (NEC), requires that motor overload protection be provided in the motor branch circuit. The standard Bulletin 1332 does not provide this protection.

Eutectic Alloy or bi-metal overload relays can be utilized to provide running overcurrent protection. Due to the reduced cooling capacity of motors running at low speed (full load), overload relays typically can not provide accurate protection against overheating below 50% of base speed (30 Hz).

The National Electrical Code also requires that a circuit breaker or fusible disconnect switch be provided in the Drive branch circuit. The standard Bulletin 1332 does not provide this protection.

Refer to article 430 of the NEC and any additional local codes for specific requirements and additional information.

The National Electrical Code and local regulations govern the installation and wiring of the Bulletin 1332 Adjustable Frequency Drive. Input and output power wire, control wire, and conduit should be brought through the bottom of the Drive enclosure. Connect wires to the Drive in the entry areas shown in Figures 3–2A through 3–2F and in accordance with the Drive nameplate data and the NEC.

Connections to the Drive should be made as shown in Figures 3–3 through 3–5, Appendices A, C, D, E and in accordance with any additional interconnection diagrams packed with the Drive.

All signal wiring **must** be run separate from power wiring. Verify that shielded cable and/or conduit is used if indicated on any interconnection diagram. Since most start-up difficulties result from incorrect wiring, every precaution should be taken to assure that the wiring is as shown on the diagrams.

CAUTION: 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.

3.5 Power Circuit Terminals

The power circuit terminals are located at an 8 position terminal block situated on the lower front portion of the Drive, under the enclosure cover. The following explanation indicates the function of each terminal. Refer to Appendix A for interconnection diagrams and Chapter 2 for the recommended fuse size to provide Drive input power protection against short circuits.

GND: This terminal is connected to earth ground or the ground of the building electrical system.

L1, L2, & L3: Connect these terminals to a fused 3-phase AC input. Verify that the incoming line voltage matches the voltage listed on the Drive nameplate.

M1, M2 & M3: Connect the motor leads to these terminals (M1 to T1, M2 to T2 and M3 to T3).

3.5 Power Circuit Terminals *(Continued)*

The following statements apply for multimotor operation:

- The combined total of motor kVA cannot exceed the kVA output of the Drive.
- If output contactors are used, the operating Drive must be stopped before a switching sequence is initiated to avoid overcurrent trips.

WARNING: Any disconnecting means wired to the output of the controller **must** be capable of shutting down the Drive if opened during Drive operation. The Drive will continue to run into an open motor circuit causing equipment damage and/or personal injury if some type of hard wired, normally closed, STOP contact is not interlocked between terminals 14 & 15. Refer to Figure 3–5.

IMPORTANT: Verify that the induction motor windings are properly connected to match the Drive output rating.

Alternate Power Source Operation

Bulletin 1332 Drives rated for three-phase, 230 Volt inputs may be operated from a single-phase power source in lieu of three-phase power. The Drive output rating must be derated accordingly when operating with a single-phase input. Refer to the specifications presented in section 2.1.

For single-phase operation, connect the AC power input to L2 and L3 (L1 is not used).

Alternate Voltage Operation - Bulletin 1332 Drives designed for 230 or 460 Volt inputs have the capability of being operated at voltages of 208 (Series B Drives, *Only*) or 380/415 Volts, respectively. Refer to section 5.9 for connection details. Bulletin 1332 Drives designed for 575 Volt operation are for use at that voltage **only**.

3.6 Control Terminals

WARNING: The Start/Stop control circuitry in this Drive is composed of solid-state components. If hazards due to accidental contact with moving machine components or unintentional flow of liquid, gas or solids exist, NEMA standards require that a hard wired operator Emergency Stop circuit be used with this Drive. Use a device that removes AC input power when an Emergency Stop is initiated. Refer to Appendix A. 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 control terminals are located at a 22 position terminal block situated on the lower front portion of the Drive, under the enclosure cover. The following explanation indicates the function of terminals 1 through 13. Figure 3–3 indicates the connections made to each terminal.

IMPORTANT: The Drive is capable of operation from the built–in control panel without any connections to the customer terminal block, provided that **SW3** and **SW4** are both in the "LOCAL" position.

3.6 Control Terminals *(Continued)*

All remote signal wiring **must** be run separate from power and control wiring. 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.

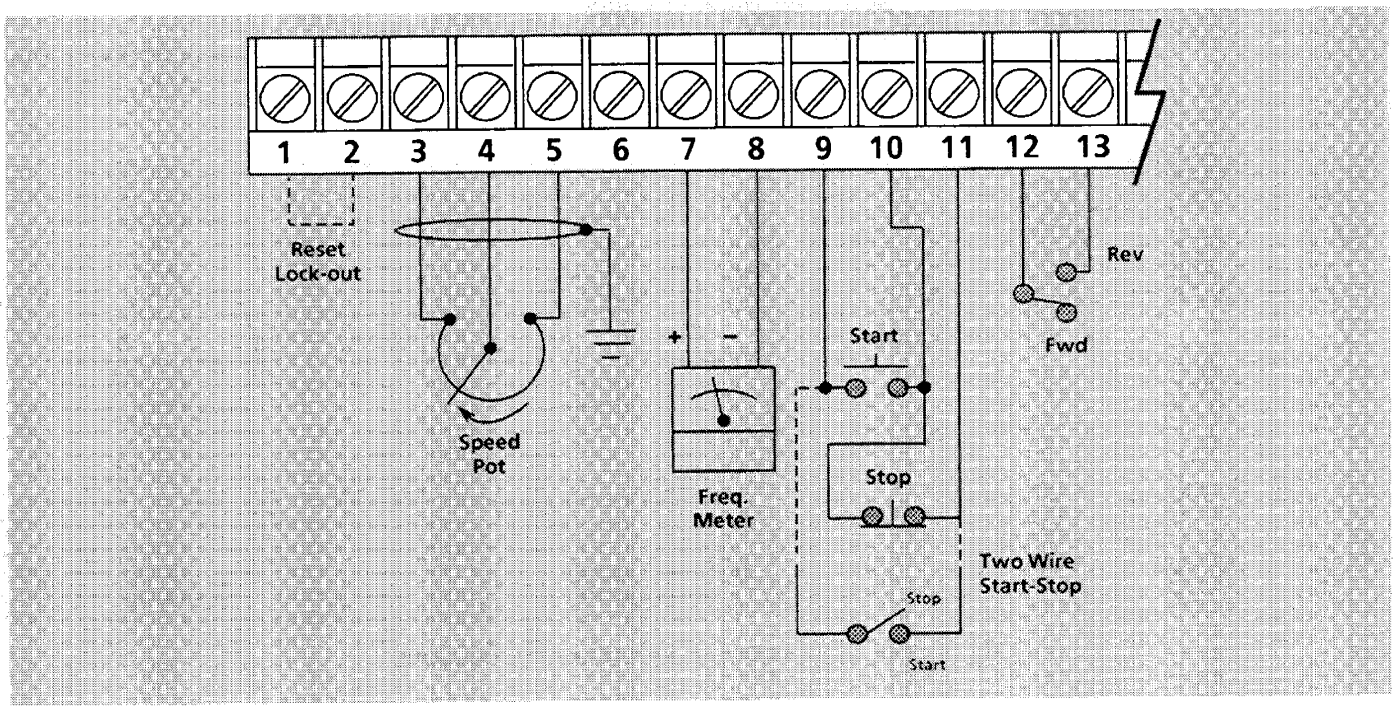


Figure 3–3. Control Terminals Interconnection (Remote Devices)

1 & 2: Connection of these terminals determines how the Drive is reset after a Fault condition. When the terminals are not jumpered, a Fault trip can be reset by pushing the STOP button, opening the remote STOP circuit or removing AC line voltage. When these terminals are jumpered, a Fault trip can only be reset by removing and re-applying incoming line voltage to the Drive.

3, 4, 5 & 6: These terminals are available for connection to a 10kΩ, 2W Speed Potentiometer, a zero to 10V DC supply (input impedance, 100k ohm) or a 4 to 20 mA supply (input impedance, 380 ohm) signal. Only one speed reference signal may be connected to the Drive remote reference terminals at a time. Figure 3–4 indicates the connections if a remote speed reference is desired. Switch SW4 must be in the REMOTE position.

WARNING: Incorrect polarity of remote inputs may cause personal injury from uncontrolled machine motion. Connect remote inputs (terminals 4 & 5 or terminals 5 & 6) only as shown in Figure 3–4.

3.6 Control Terminals *(Continued)*

IMPORTANT: Speed Pot (signal) wiring must be twisted, three conductor shielded wire, having (2) to (3) twists per inch. If the pot is remotely mounted, the wiring **must** be run in separate steel conduit to eliminate the possibility of electrical noise. The shield must be grounded at the controller end only.

For Distances less than 150 ft., use a minimum wire size of 22 AWG. For Distances between 150 and 200 ft., use a minimum of 16 AWG, or follow local codes.

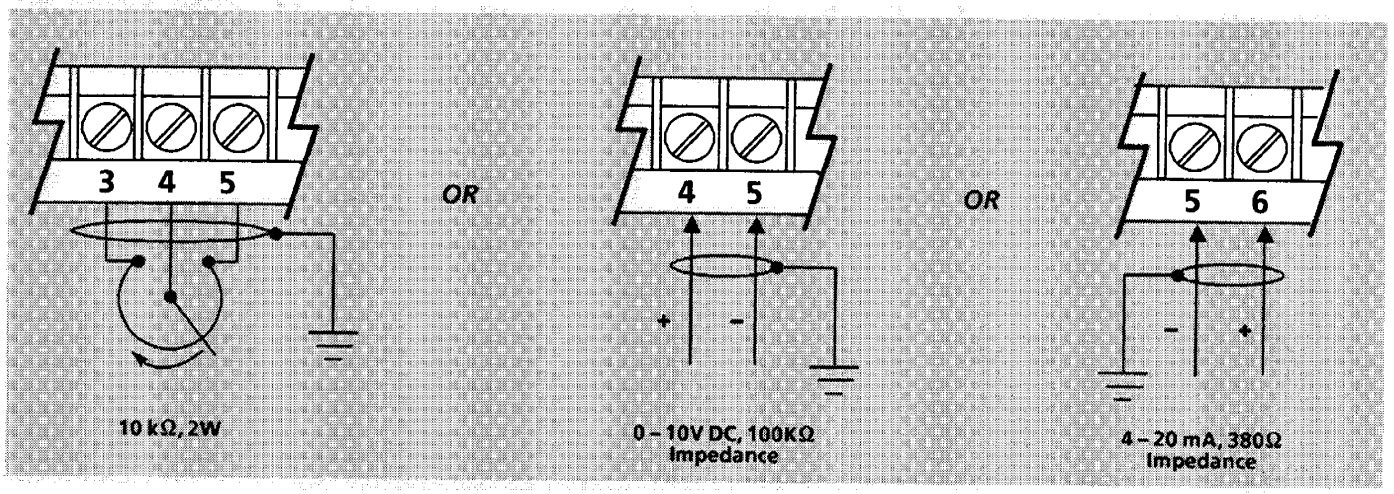


Figure 3–4. Remote Speed Reference Connections

7 & 8: These terminals provide connections for an external analog speed or frequency meter. This is calibrated for use with a 1mA full scale meter (1 mA corresponds to full speed or highest frequency).

9, 10 & 11: These terminals are designed for remote control of the Drive using either a two wire switch or three wire pushbutton scheme. Switch SW3 on the Local Control Panel must be in the Remote position to allow for Drive remote control. When using a two wire START/STOP switch, a single pole maintained switch or contact must be connected as shown in Figure 3–3.

When remotely mounted, wiring for control switches and associated control **must** be run in conduit separate from any speed reference (signal) wiring.

WARNING: If a two wire START/STOP switch is used and the switch is in the START position, the Drive will **automatically restart** after an incoming AC line power outage condition. Personal injury may occur if labels are not located at the Drive and associated machinery to warn operators / service personnel of the potential hazard. Warnings should include procedures to lock-out power at the disconnect when servicing equipment.

3.6
Control Terminals
(Continued)

12 & 13: FORWARD / REVERSE operation can be accomplished by connection of a single pole switch to these terminals. Connection to these terminals allows for operation through the controller's anti-plug reversing circuit. With SW3 in the REMOTE position and the single pole switch open, the Drive will allow motor operation in the Forward direction. A switch closure between terminals 12 and 13 will provide for Reverse motor rotation.

Fault Interlock Terminals

Terminals 14 through 22 are dedicated to Fault interlock interconnections. The following explanation indicates the function of these terminals and Figure 3–5 shows the connections made to each terminal.

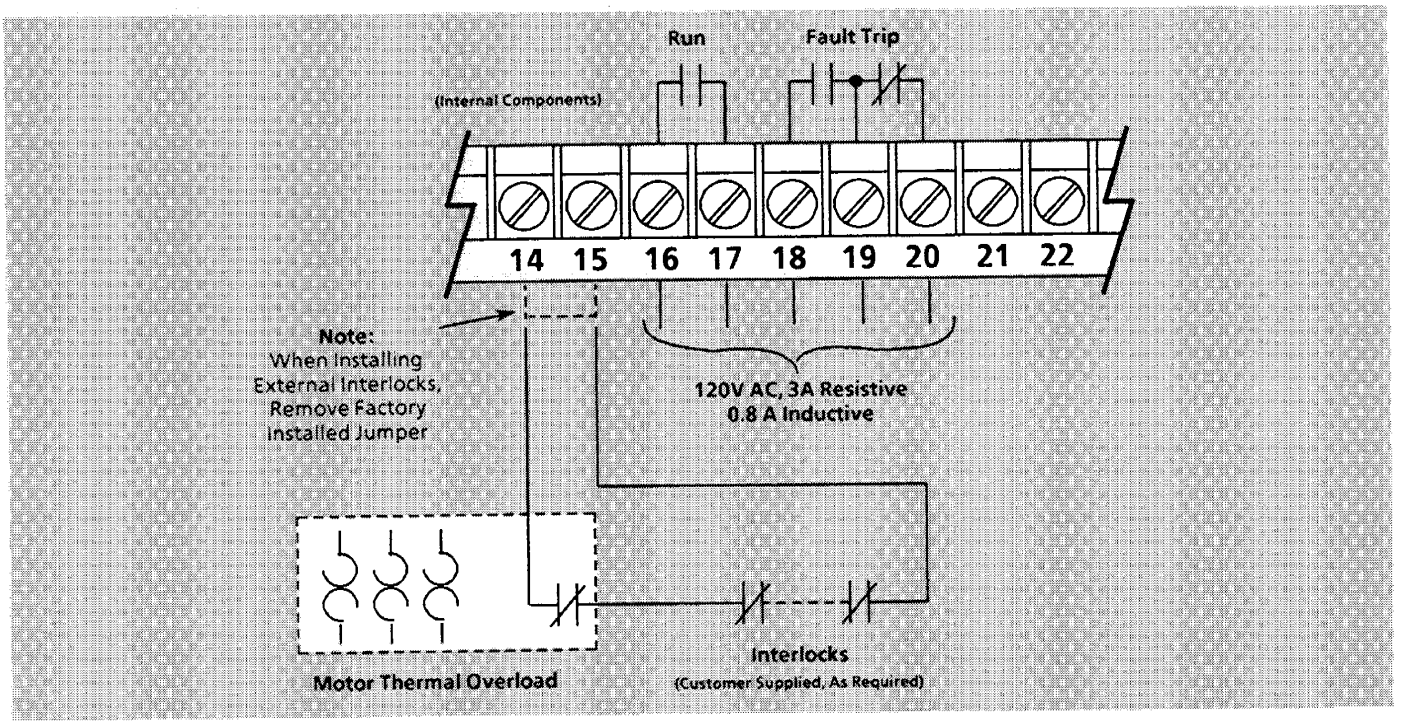


Figure 3–5. Fault Interlock Interconnection

14 & 15: These terminals are available for connection of a customer–supplied motor overload trip interlock. Typically, the N.C. pilot contacts will be wired to these terminals. An open contact will indicate an "AUXILIARY" Fault condition, and stop the Drive on a Fault trip. Additional Fault interlocks can be wired in series with the OL contact.

16 & 17: This normally open, isolated contact is available for use with an alarm, a run light or a remote indication that the Drive is in a running condition. The contact is closed in the running mode and is rated for 3 amperes resistive (0.8 amperes inductive) at 120V AC.

3.6 Control Terminals *(Continued)*

18, 19 & 20: These terminals are available for a remote Fault indication when the Drive trips due to an overcurrent, overvoltage, low voltage, overtemperature, or auxiliary Fault. The isolated Form C contacts are rated for 3 amperes resistive (0.8 amperes inductive) at 120V AC. Terminals 18 and 19 allow for connection to a N.O. contact with terminals 19 and 20 a N.C. contact.

21 & 22: These terminals are not used on the standard Drive package. **Do not** use these terminals for tie points.

Chapter

4

Options

4.0 Chapter Objectives

This chapter lists and describes the options available for the Bulletin 1332 Adjustable Frequency AC Drive.

4.1 Options

Listed below are the options for the Bulletin 1332. Refer to the Appendices (or individual Mod Instruction sheets) for installation and operation details.

- **Remote Operator Station** (Appendix C)
  MOD F

  This control panel is used to remotely control the following functions: frequency, start/stop and forward/reverse. The panel can be flush or surface mounted and must be within 328 feet (100 meters) of the Drive.

- **Preset Speeds** (Appendix D)
  MOD F2 (230V Input)
  MOD F3 (460V Input)
  MOD F4 (575V Input)

  This option provides up to (5) preset speeds, each independently adjustable over different speed ranges. Speeds are selected by one of (5) customer contact closures.

- **Adjustable Minimum /Maximum Frequency** (Appendix E)
  MOD N, N2 (230V Input)
  MOD N3, N4 (460V Input)
  MOD N5, N6 (575V Input)

  One option is available for use with a 0-10V input and one option is available for use with a 4-20mA input. When used with the specified input, this option provides an adjustable range for minimum frequency of 0% to 70% and Maximum frequency of 30% to 100%. A 15V DC power supply is included with this option.

- **BCD Interface** (Publication 1332-5.0.4)
  MOD G4

  The BCD Interface option accepts digital signals from a programmable controller or computer in a Binary Coded Decimal (BCD) format and generates frequency (speed) and direction (forward/reverse) signals for a single Bulletin 1332 Drive. Provisions are included to connect the BCD signals through a terminal block suitable for discrete wires or through a 40 pin ribbon cable connector. The ribbon cable connector input is suitable for use on multiplexed systems for independently controlling the speeds of up to 20 Drives.

4.1 Options *(Continued)*

- **Heavy Duty Dynamic Braking** (Publication 1332-5.0.6)
  MOD K (230V Input, 3/4-5 HP)
  MOD K2 (230V Input, 7.5-20 HP)
  MOD K3 (460V Input, 1-5 HP)
  MOD K4 (575V Input, 1-5 HP)
  MOD K5 (575V Input, 7.5-15 HP)

  As standard, the Bulletin 1332 Drive can provide up to 20% (approximately) braking torque. The Heavy Duty Dynamic Braking option extends this braking torque to 100%.

Chapter

5

Operation and Initial Adjustments

5.0 Chapter Objectives

Chapter 5 describes the general operation of an induction motor when operated from the Bulletin 1332 Drive. In addition, the chapter also includes a description of Drive functions, controls and adjustments that must be made prior to installation, including alternate voltage operation.

5.1 General Application

The Bulletin 1332 is an AC adjustable frequency Drive designed for use with a standard, three phase induction motor. The standard control is designed as a constant torque, soft start speed control with 150% overload capability and is adaptable through switches and potentiometer adjustments to handle a wide variety of applications.

The Bulletin 1332 provides an exceptional quality output voltage and current. However, special considerations must be taken when applying an inverter to an existing motor. At slower speeds, cooling is not as effective due to reduced fan RPM. Extended operation at full load torque at slow speeds may damage the motor due to overheating.

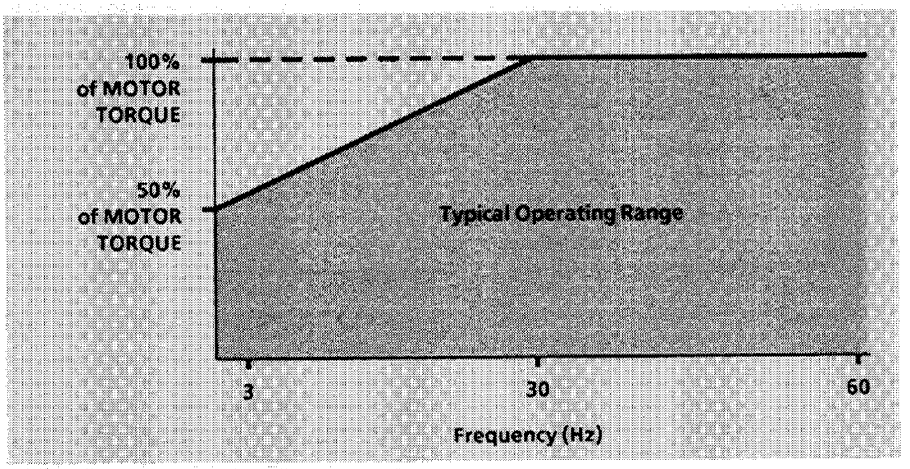


Figure 5–1. Torque vs. Frequency

Figure 5–1 shows a typical curve, plotting torque vs. speed. At slow speeds, if torque requirements continuously exceed levels shown in Figure 5–1 (10 minutes or longer), a motor rated for the required speed and torque operation should be substituted. Additionally, in order to guard against mechanical problems, it is recommended that the entire drive train machinery be checked for various limitations due to the adjustable frequency range of the Bulletin 1332.

CAUTION: Motors may overheat when operated at rated torque for long periods of time below 50% base speed due to the decreased air flow of the motor fan. Motors may require special balancing if operated at more than 125% of base speed. Refer to the motor manufacturer for proper sizing of the motor for the intended application.

5.2 Description of Operation

Refer to Figure 5–2 for the following "Description of Operation."

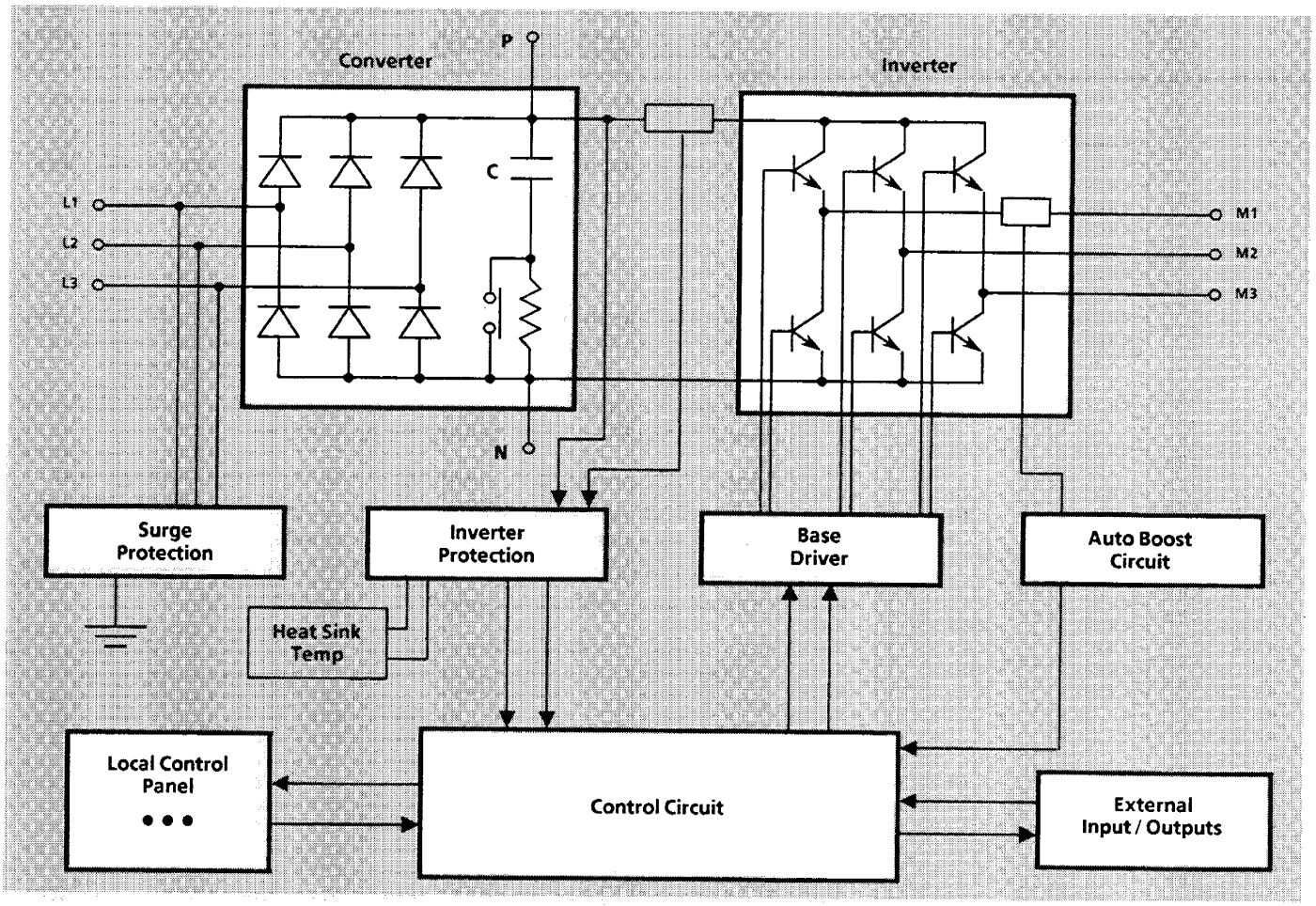


Figure 5–2. Bulletin 1332 Block Diagram

Converter Section – The six diode Converter Section of the Bulletin 1332 converts or rectifies the incoming three phase AC line. The resultant DC is smoothed by the capacitor "C" and used as in input to the Inverter Section.

Inverter Section – In the Inverter Section, the rectified DC is converted into three phase AC. The transistors repeat many switching operations to generate 1 cycle forming a sine weighted PWM output that makes current flowing through the motor approximate a sine wave.

Figures 5–3A and 5–3B show waveforms of the "M1" phase and "M2" phase outputs. The pulses generated in the Control Circuit are fed to the base of the Inverter transistors by means of the Base Driver. These pulse signals then cause the transistor to perform the switching operation according to the base driver signal. The waveform in Figure 5–3C is obtained between "M1" phase and "M2" phase outputs. The output mean voltage then becomes sinusoidal and motor current, approximate to sinusoidal, flows through the motor.

Surge Protection – Protection devices absorb power source transients superimposed on the three phase line inputs.

5.2 Description of Operation *(Continued)*

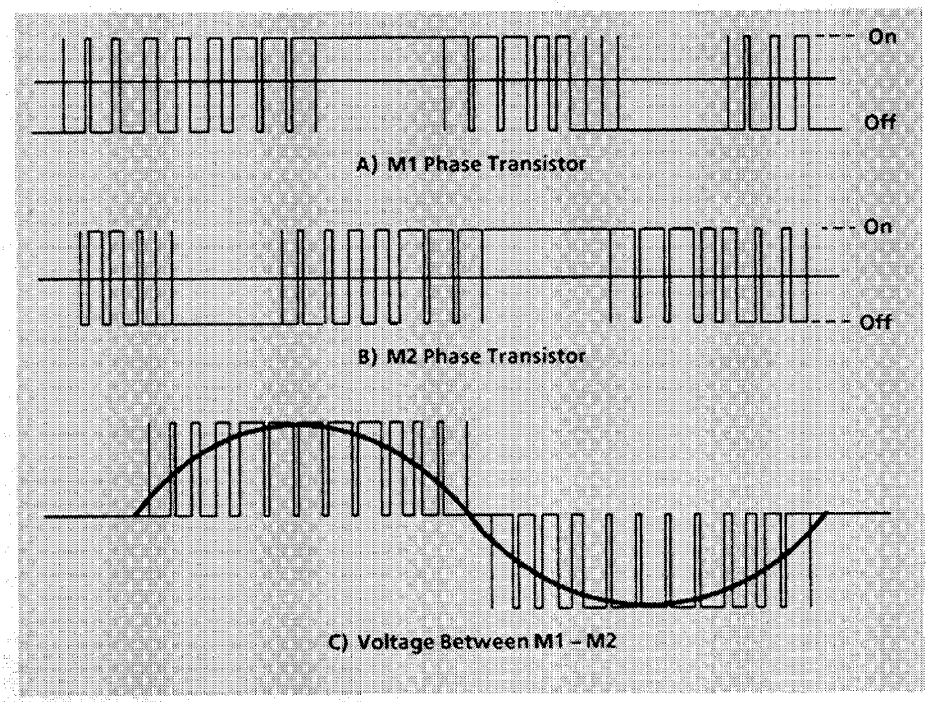


Figure 5–3. Inverter Section Output Waveforms

Inverter Protection – This circuit monitors conditions of current and voltage of the Converter and Inverter. If current or voltage values reach a predetermined protection level, signals are sent to the Control Circuit which responds to protect Drive circuitry and indicate the condition.

Base Driver – This section amplifies and isolates signals from the Control Circuit and makes inverter transistors operate in the appropriate switching scheme.

Auto Boost Circuit – This circuit detects load conditions of the motor. Once load conditions are determined, the circuit determines the optimum output voltage level that allows the motor to effectively handle the required load.

Control Circuit – The Control Circuit serves several functions:

1. It receives speed reference and operating commands from the Local Control Panel or external inputs. These commands are used to determine the frequency output voltage and phase rotational direction of the motor.
2. Generates commands (pulses) which are fed to the Base Driver which in turn generates the required output frequency and voltage as shown in Figure 5–3.
3. Generates outputs to the Local Control Panel and for terminal block external outputs to indicate Drive speed, operating status and Fault conditions.
4. Responds to abnormal conditions sensed by inverter protection circuits and performs an orderly shutdown of the Drive when necessary.

5.2 Description of Operation *(Continued)*

Local Control Panel – This panel provides a means of local control of Drive operation. In addition to control functions, it also displays operating conditions of the Drive and indicates Fault signals. Fault signals illuminated on this panel are followed by a Drive shutdown sequence.

External Input / Output – This provides a means for the Drive to accept external commands instead of using the Local Control Panel.

5.3 Control Panel Switches and Adjustments

The Local Control Panel located on the front of the Drive enclosure contains adjustments and LED status indicators used in Drive set-up and operation. Figure 5–4 and the corresponding paragraphs give an explanation of the switches and adjustments.

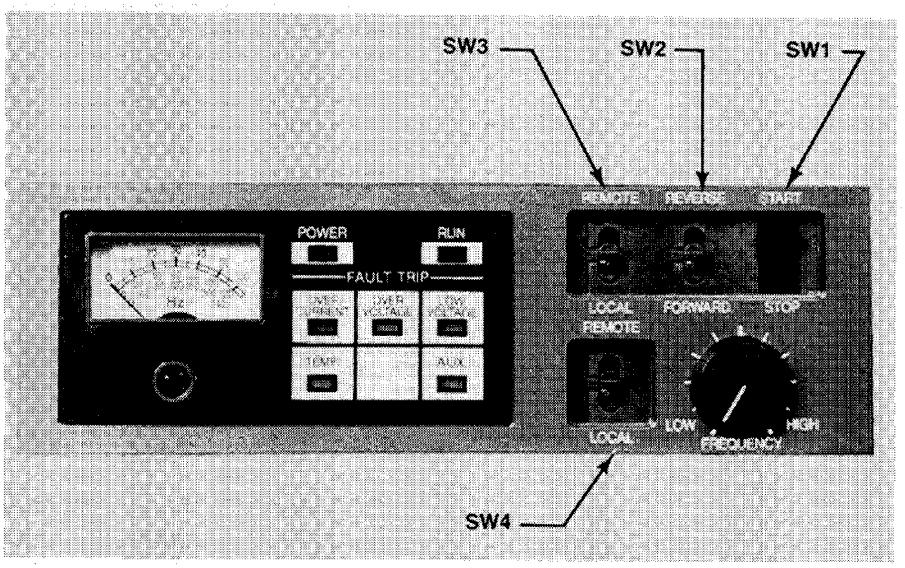


Figure 5–4. Control Panel Switches and Adjustments

- **SW1 (START / STOP)** – This switch Starts and Stops the Drive when SW3 is in the "LOCAL" mode. It also resets any of the protective Fault trips when put in the "STOP" position.

  Although the START switch stays in the START position, the Drive must be restarted after a Fault. After a Fault or an incoming AC line power outage condition, the Drive is restarted by depressing the switch to STOP and then to the START position.

- **SW2 (FWD / REV)** – This switch controls the direction of motor rotation when SW3 is in the "LOCAL" mode. If the position of SW2 is changed while the Drive is running, the Drive will decelerate to a slow running speed, switch direction, and then accelerate to set speed.

  If desired, the Local Forward/Reverse selector switch may be disabled. Refer to section 6.2 for connection details.

- **SW3 (LOCAL / REMOTE)** – This switch selects whether the START /STOP is controlled from the SW1 switch (local) or a switch connected to terminals 9, 10 and 11 (remote). It also switches the FORWARD / REVERSE control from the SW2 switch (local) to the switch connected to terminals 12 and 13 (remote). If the SW3 switch is in the remote position, both SW1 and SW2 will be deactivated, but SW1 must be kept in the STOP position for proper operation.

5.3 Control Panel Switches and Adjustments *(Continued)*

- **SW4 (LOCAL / REMOTE)** – This switch selects the speed reference input. In "LOCAL," the frequency adjustment potentiometer on the Local Control Panel is active. The "REMOTE" position allows speed control from a remote signal connected to the terminal block. The Drive is set up to handle either a 10kΩ potentiometer, a zero to positive 10V DC signal or a 4 to 20 mA DC signal.

- **FREQUENCY** – The frequency control is a frequency adjust reference potentiometer which adjusts Drive output frequency from minimum to maximum. (It is active when the SW4 switch is in "LOCAL").

5.4 LED Indicators

The Local Control Panel located on the front of the Drive enclosure contains the following LED status indicators used in monitoring Drive operation.

- **PWR** – The POWER LED is illuminated when input voltage is applied to the Drive.

- **RUN** – The RUN LED is illuminated when the Drive is in a running mode.

- **OC** – The OVERCURRENT LED is illuminated when an overcurrent trip occurs. An overcurrent trip will occur when the output section of the Drive is subjected to high current spikes such as an excessive motor overload, output short circuit, or inverter transistor failure.

- **OV** – The OVERVOLTAGE LED is illuminated when an overvoltage condition occurs on the DC bus of the Drive. This is caused by one of several factors.

  This condition could be due to decelerating the motor too rapidly on a high inertia load. This condition could also be caused by running the Drive in an overhauling load condition where the motor regenerates voltage to the DC bus.

- **LV** – The LOW VOLTAGE LED is illuminated when the incoming AC line to the Drive is below 90% of rated input voltage. A power outage will activate the LV circuit to shut off the Drive but will not light the LED due to the circuit being reset when power is removed.

- **TEMP** – The TEMP LED is illuminated when the heat sink temperature for the Drive exceeds the thermostat trip point. TEMP trips are normally due to excessive ambient temperature, or excessive dust or dirt on the Drive's heat sink.

- **AUX** – The AUX FAULT LED will illuminate if a open contact condition occurs between terminals 14 and 15. The N.C. contacts which are typically connected here are motor overload contacts and customer Fault interlocks (e.g. alarm, equipment malfunction, etc.). The AUX circuit provides a means of an external Fault interlock and indication when the Local Control Panel is the primary means of Drive control. When a contact opens, the circuit will cause the Drive to shut down. Terminals 14 and 15 are jumpered at the factory.

5.5 Fault Trips

When a Fault trip occurs, the Drive will stop running and allow the motor to coast to a stop. If other equipment is run in conjunction with the controller, the Fault relay contacts on the terminal block may be interfaced with the control of the other equipment to indicate a Drive Fault shutdown.

A Fault trip can be reset by one of two ways. 1) The Drive is given a STOP instruction either with SW1 or the remote STOP button (or switch). 2) Removing and re-applying input line voltage.

IMPORTANT: If a two wire remote START/STOP switch is connected to terminals 9 and 11, an **automatic restart** will occur after power is re-applied. If the load has a high inertia, the motor should be allowed to come to rest before a restart is attempted to prevent nuisance OV and OC trips due to motor regeneration.

5.6 Internal Switches and Jumpers

The following DIP switches are located on the upper front part of the Drive, under the enclosure cover. An " * " indicates switch positions when shipped from the factory. Figure 5–5 shows the location of the internal DIP switches.

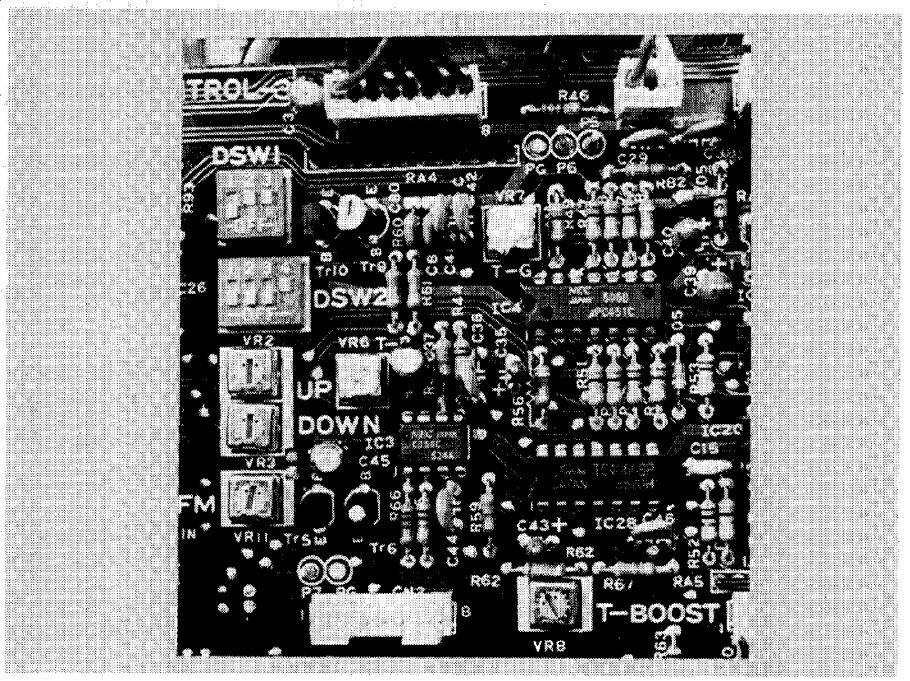


Figure 5–5. Internal DIP Switches and Potentiometers

- **DSW1 (Switch 1) Stop Mode Selection**
  ON – The motor will coast down to a stop when the STOP switch or pushbutton is depressed. This is similar to opening a motor starter.

  OFF * – The motor will be ramped down in speed and attempt to stop the load at a rate determined by the deceleration rate pot. The Drive will continue to supply power to the motor until the motor reaches a stop. The Drive will then shut down and open the RUN signal contact. Stopping time may be increased by operation of internal Drive protective functions. Refer to "Description of Operation" for Overvoltage Stall Protection (OVS) and Overcurrent Stall Protection (OCS).

5.6
Internal Switches and Jumpers
(Continued)

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

- **DSW1 (Switch 2) Overvoltage Stall Protection (OVS)**
  At deceleration time, in order to guard against regenerative overvoltage, the Overvoltage Stall Protection works automatically to let deceleration speed conform to the load inertia connected to the motor.

  ON * – The overvoltage stall protection circuit will stop Drive deceleration if the DC bus voltage exceeds the level listed in section 2.1. Deceleration will resume when the DC bus voltage drops back below the listed level. This will prevent the motor from regenerating too much energy back into the DC bus. In this way, the circuit will guard against, in most cases, overvoltage trips when the deceleration rate is too fast for the inertia of the system (refer to Figure 5–6).

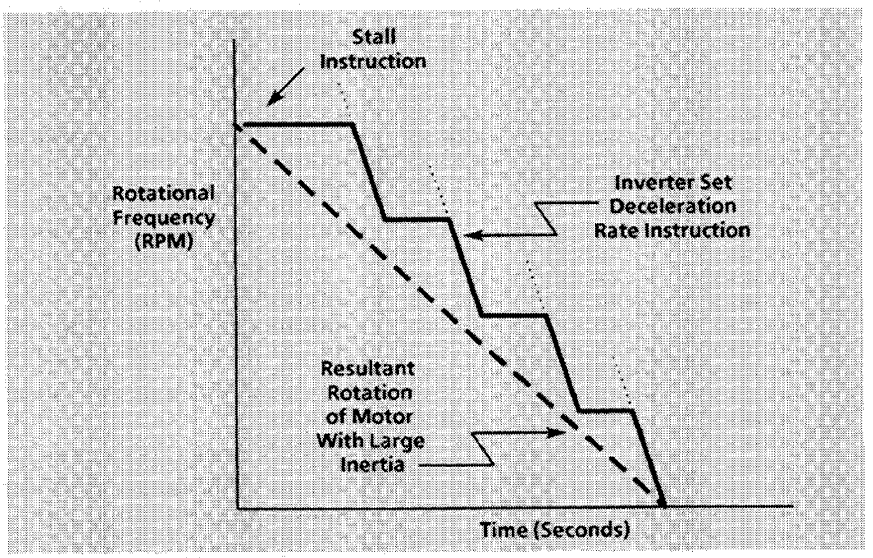


Figure 5–6. Deceleration Overvoltage Stall Protection

  OFF – The Drive can produce greater deceleration torque with this switch off. This torque will be limited only by the overvoltage trip circuit. The deceleration rate will have to be adjusted to a lower rate (longer time) if Overvoltage trips occur during deceleration.

- **DSW1 (Switch 3) Overcurrent Stall Protection (OCS)**
  In the case of a load with a large inertia, the rise in speed of the motor may be unable to follow the rise in frequency of the inverter. In this case overcurrent flows through the motor and the Drive trips out. The Overcurrent Stall Protection Circuit may be used to avoid these trips.

5.6 Internal Switches and Jumpers *(Continued)*

ON * – The overcurrent stall protection circuit will stop Drive acceleration if the motor current exceeds 140% of the rated output. When the current drops back below the 140% level, the acceleration will resume. In this way, the circuit will guard against, in most cases, overcurrent trips when the acceleration rate is too fast for the inertia of the system (refer to Figure 5–7).

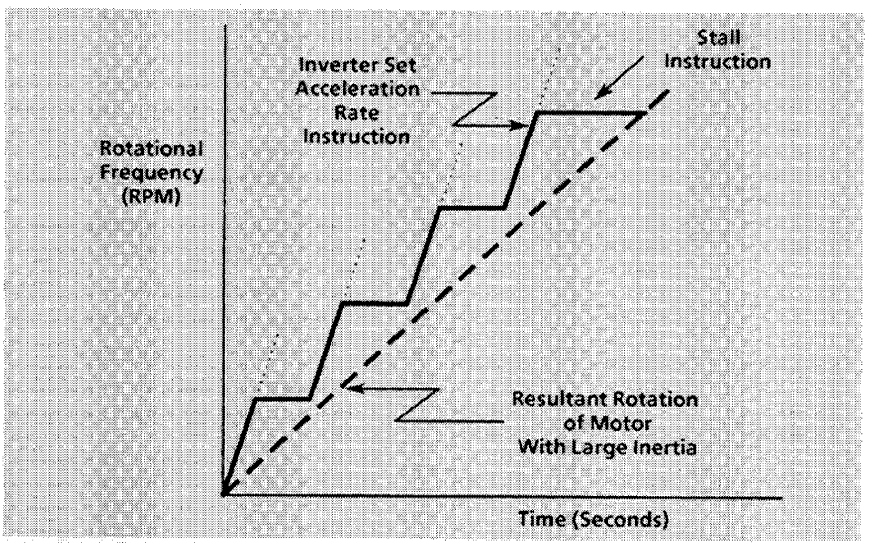


Figure 5–7. Acceleration Overcurrent Stall Protection

OFF – The Drive may produce greater acceleration torque, but this torque will be limited only by the overcurrent trip circuit. The acceleration rate will have to be adjusted to a lower rate if Overcurrent trips occur during acceleration. The Drive will not automatically limit the acceleration once 140% of the rated output is reached. Therefore, the Drive rating may be exceeded and an Overcurrent trip may occur.

- **DSW2 (Switches 1, 2 & 3) Frequency Selection**
  These switches are used in combination to select the appropriate maximum frequency of the Drive. Figure 5–8 indicates the various switch combinations and the accompanying V/Hz graph.

- **DSW2 (Switch 4) Voltage Boost Selection**
  OFF – In the "Off" mode, the voltage boost circuit is adjusted manually by potentiometer VR8.

  ON * – In the "On" mode, the voltage boost circuit responds automatically, based upon the motor load conditions.

- **DSW3 Voltage Setting** *(Not included on 230V, Series A Drives)*
  Switch DSW3 modifies the Volts per Hz output of the Drive and selects whether the maximum voltage output is reached with a 50 or 60 Hz output. Refer to Figure 5–9 for location of the DSW3.

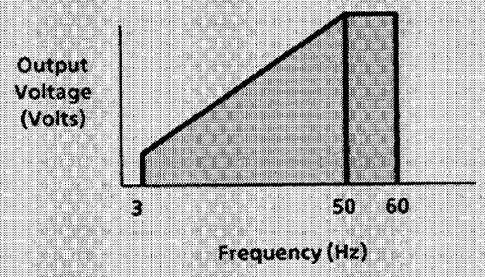
  50 (ON) – Maximum voltage is reached at 50 Hz.

  60 (OFF) * – Maximum voltage is reached at 60 Hz.

  Figure 5–8 shows the voltage output when the switch is in the 50 or 60 Hz position. The switch is typically set to match the motor nameplate frequency.

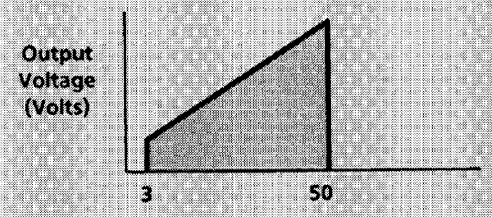
DSW2

SW1	SW2	SW3	Description
Off	Off	Off	Constant V/Hz, 3 to 50 Hz Maximum Frequency, 60 Hz



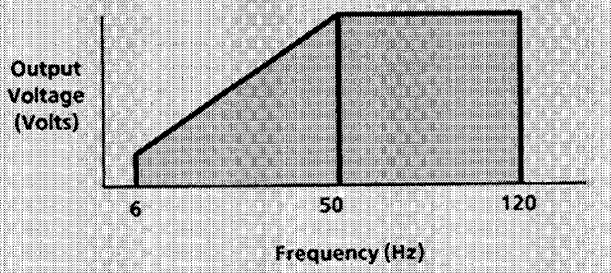
DSW2

SW1	SW2	SW3	Description
ON	Off	Off	Constant V/Hz, 3 to 50 Hz Maximum Frequency, 50 Hz



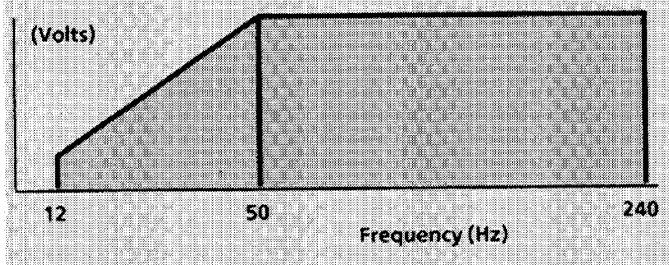
DSW2

SW1	SW2	SW3	Description
Off	ON	Off	Constant Volts, 50 to 120 Hz Maximum Frequency, 120 Hz



DSW2

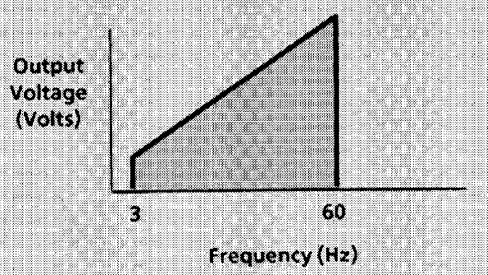
SW1	SW2	SW3	Description
Off	Off	ON	Constant Volts, 50 to 240 Hz Maximum Frequency, 240 Hz



DSW3 = 50 (ON)

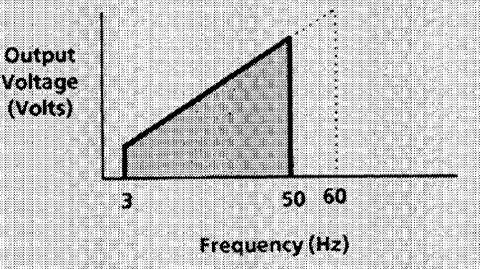
DSW2

SW1	SW2	SW3	Description
Off	Off	Off	Constant V/Hz, 3 to 60 Hz Maximum Frequency, 60 Hz



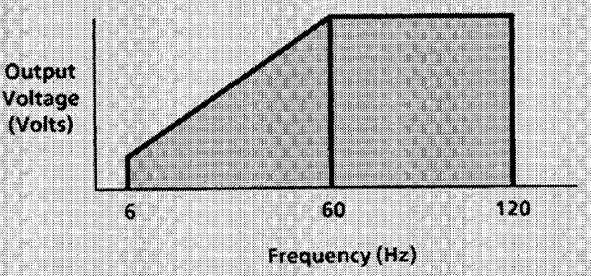
DSW2

SW1	SW2	SW3	Description
ON	Off	Off	Constant V/Hz, 3 to 50 Hz Maximum Frequency, 50 Hz



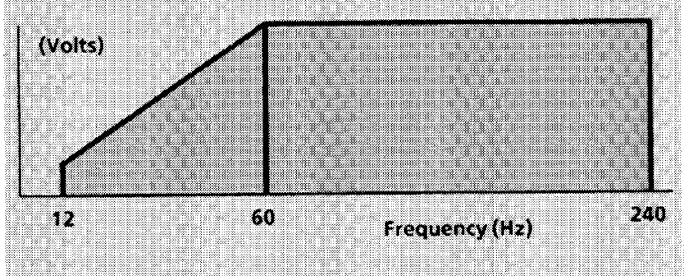
DSW2

SW1	SW2	SW3	Description
Off	ON	Off	Constant Volts, 60 to 120 Hz Maximum Frequency, 120 Hz



DSW2

SW1	SW2	SW3	Description
Off	Off	ON	Constant Volts, 60 to 240 Hz Maximum Frequency, 240 Hz



DSW3 = 60 (OFF)

Figure 5–8. DSW2, DSW3 Switch Settings

5.6 Internal Switches and Jumpers *(Continued)*

- **Automatic Restart Jumper (CN6)**
  When incoming line voltage falls below the rated input by 10%, internal protective functions operate to stop the Drive. But the Drive can be programmed to automatically re-start if the incoming line voltage stays above 30% of the rated input (below 30%, the restart circuit is inoperative). To do this, simply remove CN6. Figure 5–9 indicates the location of the automatic restart jumper.

WARNING: This operation may **only** be used as outlined in NFPA79, paragraph 6–14 (Exceptions 1, 2 & 3) for specialized applications. Equipment damage and /or personal injury may result if the Automatic Restart Jumper setting is used in an inappropriate application.

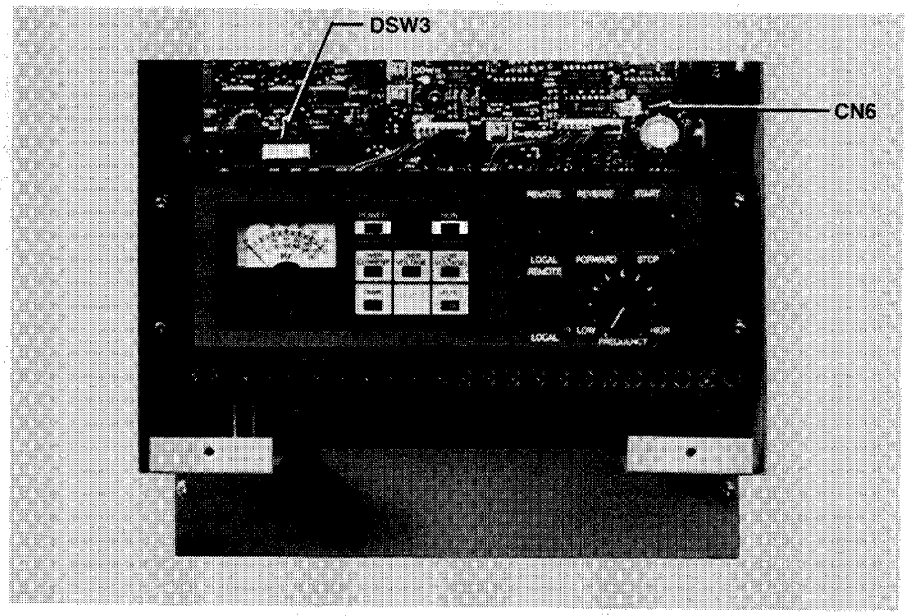


Figure 5–9. Component Locations

5.7 Internal Adjustments

The following potentiometers are located on the front of the Drive. They are under the enclosure cover, directly beneath DSW1 and DSW2 (refer to Figure 5–5).

- **VR2 – Acceleration Rate (UP)** – The acceleration ramp time can be adjusted by this potentiometer from approximately 1 to 50 seconds (5 to 150 seconds on 15 & 20 HP units). The ramp time is decreased when the potentiometer is turned clockwise (CW).

  Series A, 230V Drives are limited to an accel rate of 1 to 30 seconds.

- **VR3 – Deceleration Rate (DOWN)** – The deceleration ramp time can be adjusted by this potentiometer from approximately 1 to 50 seconds (5 to 150 seconds on 15 & 20 HP units). The ramp time is decreased when the potentiometer is turned clockwise (CW).

  Series A, 230V Drives are limited to a decel rate of 1 to 30 seconds.

5.7 Internal Adjustments *(Continued)*

- **VR11 – Meter Calibration (FM)** – This potentiometer is operative only if an external analog speed indicator is connected to terminals 7 & 8. This potentiometer will then allow for the calibration of the meter.

- **VR8 – Voltage Boost (T-BOOST)** – This potentiometer is operative only if DSW2, Switch 4 is in the OFF position. This potentiometer then adjusts the amount of voltage boost supplied to the motor. A 50% pot setting typically provides the Volts per Hz values listed in section 2.1.

CAUTION: All other potentiometers are considered to be factory adjustments. Altering these other adjustments may cause equipment damage and /or machinery process irregularities. If further adjustments are required, consult your nearest Allen-Bradley Sales Office.

5.8 Internal LED Indicators

The LED indicators described below are located within the Drive and can only be viewed with the Drive cover removed. See Figure 6–1 for LED locations.

- **Bus Discharge** – This LED will be illuminated whenever the DC bus is charged, indicating a high voltage within the Drive. The LED will extinguish when the DC bus voltage drops below 40 to 80V DC.

- **Overcurrent Stall (L1)** – *575 Volt Drives Only.* The Overcurrent Stall LED will illuminate when the output current reaches the stall protection level (approximately 140% of Drive rating) indicating that the Drive is in the Overcurrent Stall mode (if selected). Refer to section 5.6 for further information.

- **Overvoltage Stall (L2)** – *575 Volt Drives Only.* This LED will illuminate when the DC bus voltage reaches the stall protection level and indicates that the Drive is in the Overvoltage Stall mode (if selected). Refer to section 5.6 for further information.

5.9 Alternate Voltage Operation

This section provides the information necessary to operate Bulletin 1332 Drives designed for 230 or 460 Volt inputs at voltages of 208 or 380/415 Volts respectively, with only minor modifications.

208 Volt Operation of 230 Volt Drives (Series B Drives, *Only*)
Bulletin 1332 Drives designed for a 230V input may be operated on a 208V AC (±10%) incoming line. A control power supply tap must be changed to allow proper operation with the 208V AC input. Refer to the paragraphs that follow for details.

Fractional HP - 10 HP Drives
230 Volt Drives from fractional HP (ZAA) through 10 HP (EAA) contain a "pull-apart" connector for changing the control power. The connector is located in the lower left portion of the Drive and consists of two (2) female connectors labeled for 230 or 208 Volts and a mating male connector. The unit is modified for the appropriate incoming line voltage by moving the male connector to the appropriate female connector.

5.9 Alternate Voltage Operation *(Continued)*

15 and 20 HP Drives

15HP (FAA) and 20 HP (GAA) units have an added terminal block located next to the Power Terminal Block. Refer to Figure 5–10 for connection details. The dotted lines in the figure represent alternate jumper positions.

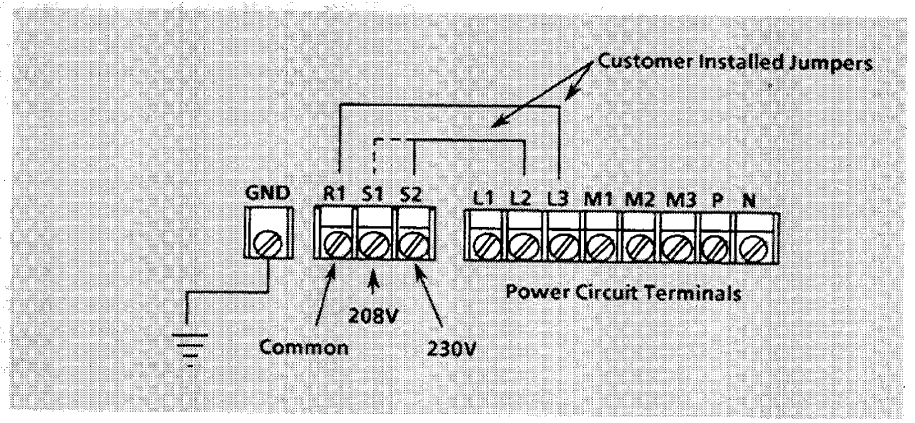


Figure 5–10. 15 & 20 HP Alternate Voltage Jumper Positions

380 or 415 Volt Operation of 460 Volt Drives

Bulletin 1332 Drives designed for a 460V AC input may be operated with a 380 or 415 Volt (±10%) incoming line. The control power supply must be modified to accommodate the different line voltage.

The Drive contains a "pull-apart" connector for changing the control power. The connector is located in the lower left portion of the Drive and consists of three (3) female connectors, each labeled for a specific voltage and a mating male connector. The unit is modified for the appropriate line voltage by moving the male connector to the appropriate female connector.

575 Volt Drives

These Drives are designed for 575 Volt operation **only.** Alternate input voltage operation is not available.

Chapter

6

Start–Up

6.0 Chapter Objectives

Chapter 6 provides the information necessary to start-up the Drive. Included is the recommended start-up procedure, operational checks and adjustments.

WARNING: Exercise extreme care when performing any task on the Drive control. Failure to do so may result in equipment damage or personal injury.

Become familiar with the equipment, installation and start-up procedures before attempting to interconnect the Drive equipment and perform this start-up. Many of the functional adjustments must be made to meet specific machine characteristics or operator preferences.

WARNING: Power must be applied to the Drive to perform many of the adjustments specified in the following paragraphs. Voltages on many components are at incoming line potential or bus voltage. To avoid injury to personnel and /or damage to equipment, make all adjustments taking necessary precautions to guard against accidental contact with Drive components.

REMOVE DRIVE POWER prior to making specified connections. If an event does not occur while performing this start-up, *do not proceed.* **REMOVE DRIVE POWER** by opening the branch circuit disconnect device and correct the malfunction *before* continuing.

6.1 Preliminary Checks and Adjustments

With power off and cover removed, verify that the incoming AC power and motor connections are in accordance with Appendix A. Also verify that all control logic interconnections are made in accordance with Chapter 3, *Installation.* Figure 6–1 indicates the locations of adjustments, switches and status LED's used in start–up and operation of the Bulletin 1332.

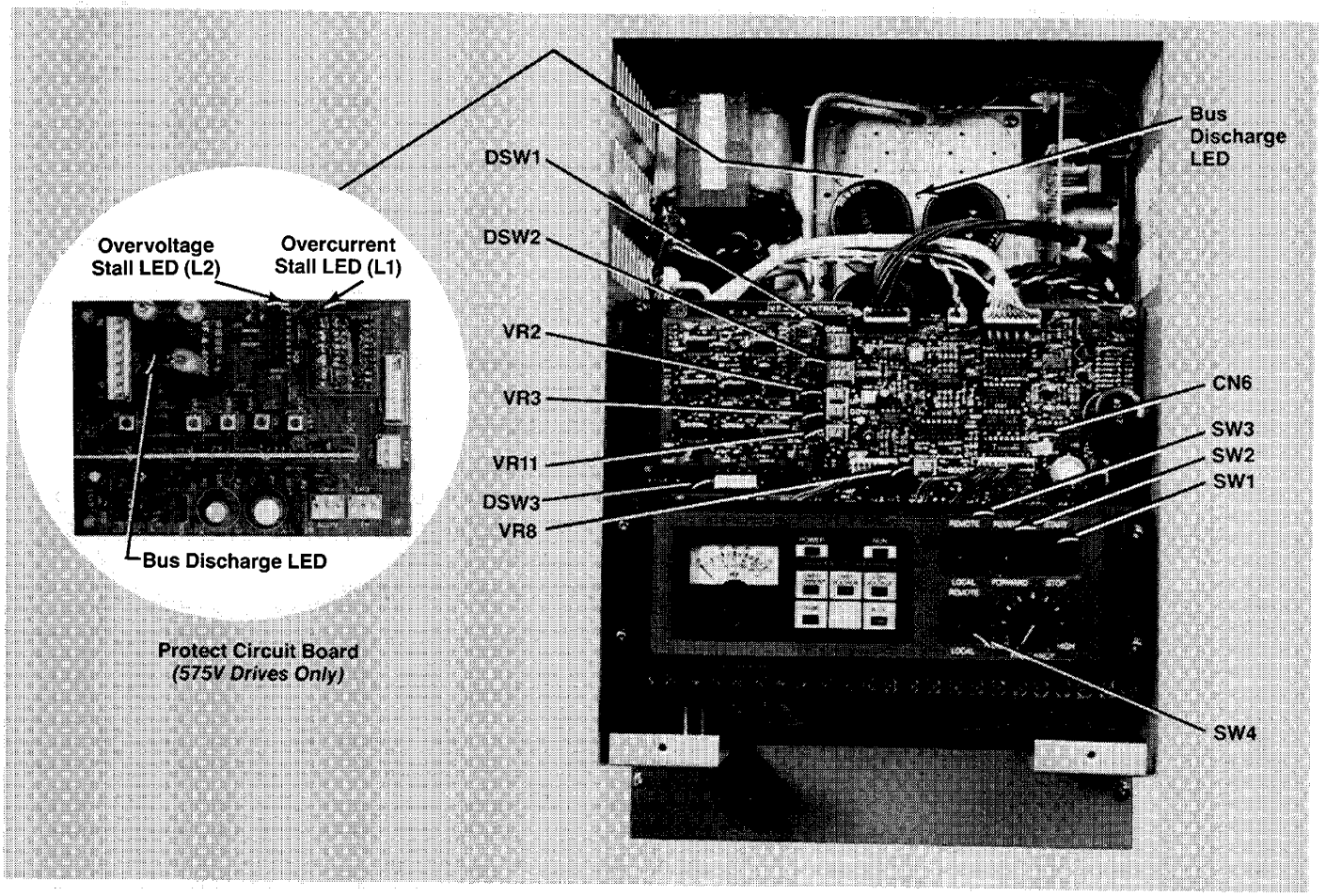


Figure 6–1. Adjustment, Switch and LED Locations

6.1 Preliminary Checks and Adjustments *(Continued)*

Initial Setting of Switches and Potentiometers

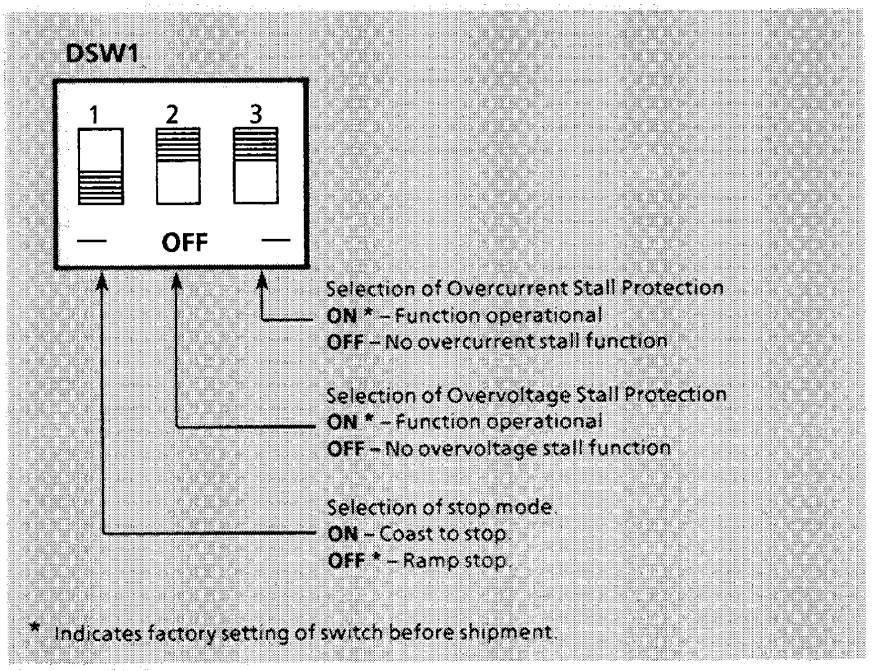
- **Local Control Panel**

FREQUENCY	This pot shall be initially set at zero (0% reference).
SW1	This switch shall be initially set in the STOP position (with SW3 in the LOCAL mode).
SW2	This switch shall be initially set in the FORWARD position.
SW3 & SW4	These switches shall be initially set in the LOCAL position.

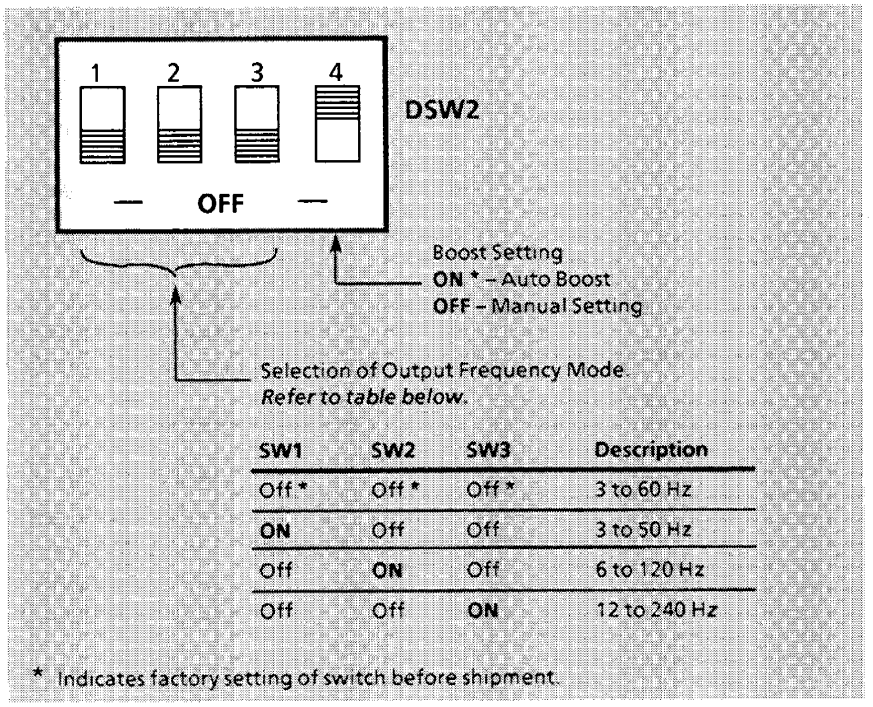
- **Internal Adjustments and Jumpers**
  With the enclosure cover removed, check and set the positions of the following internal switches, potentiometers and jumpers according to the desired parameters.

6.1 Preliminary Checks and Adjustments *(Continued)*

Stop Mode and Stall Function



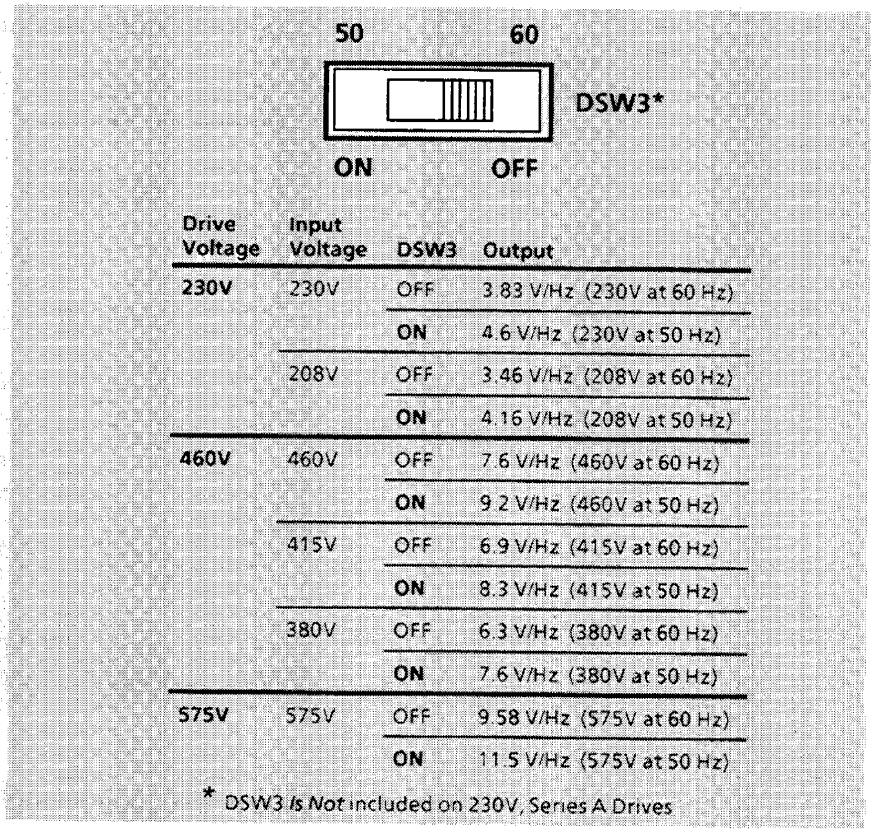
Output Frequency Mode and Boost



SW1	SW2	SW3	Description
Off *	Off *	Off *	3 to 60 Hz
ON	Off	Off	3 to 50 Hz
Off	ON	Off	6 to 120 Hz
Off	Off	ON	12 to 240 Hz

* Indicates factory setting of switch before shipment.

6.1 Preliminary Checks and Adjustments *(Continued)*



Drive Voltage	Input Voltage	DSW3	Output
230V	230V	OFF	3.83 V/Hz (230V at 60 Hz)
		ON	4.6 V/Hz (230V at 50 Hz)
	208V	OFF	3.46 V/Hz (208V at 60 Hz)
		ON	4.16 V/Hz (208V at 50 Hz)
460V	460V	OFF	7.6 V/Hz (460V at 60 Hz)
		ON	9.2 V/Hz (460V at 50 Hz)
	415V	OFF	6.9 V/Hz (415V at 60 Hz)
		ON	8.3 V/Hz (415V at 50 Hz)
	380V	OFF	6.3 V/Hz (380V at 60 Hz)
		ON	7.6 V/Hz (380V at 50 Hz)
575V	575V	OFF	9.58 V/Hz (575V at 60 Hz)
		ON	11.5 V/Hz (575V at 50 Hz)

* DSW3 *Is Not* included on 230V, Series A Drives

Figure 6–2. Maximum Voltage Output Setting

Verify the required motor Volts/Hz by dividing the nameplate voltage by the nameplate frequency. Select the Volts/Hz from the above table.

Automatic Restart Jumper

When incoming line voltage falls below 90% of Drive input rating, internal protective functions operate to stop the Drive. But the Drive can be programmed to automatically re-start if the incoming line voltage stays above 30% of the rated input (below 30%, the restart circuit is inoperative). To do this, simply remove CN6 (see Figure 6–1).

WARNING: This operation may **only** be used as outlined in NFPA79, paragraph 6–14 (Exceptions 1, 2 & 3) for specialized applications. Equipment damage and /or personal injury may result if the Automatic Restart Jumper setting is used in an inappropriate application.

Potentiometers

VR2 This pot shall be initially set at fully CCW (counterclockwise) – longest acceleration rate.

VR3 This pot shall be initially set at fully CCW (counterclockwise) – longest deceleration rate.

VR8 This pot shall be initially set at 50% which will produce values as listed in Figure 6–2.

6.1 Preliminary Checks and Adjustments *(Continued)*

- **Visual Indicators**
  With line voltage applied, verify that none of the front panel Fault indicators are illuminated *before* performing this Start-Up. If any of the indicators (i.e. Overcurrent, Overvoltage, Low Voltage, etc.) are illuminated and will not extinguish by resetting the Drive, **REMOVE DRIVE POWER.**

  Locate and correct the malfunction with the aid of the *Trouble-shooting Guide* in Appendix B, before proceeding with the Start-Up.

  IMPORTANT: Resetting the Drive involves switching SW1 to STOP and restarting the Drive by switching to START.

- **Remote Speed Reference Input**
  If a remote input is used, verify that the input is the proper polarity before operating the Drive. With Drive power off, apply the input signal and measure the polarity at the Drive input terminal blocks with a voltmeter. The proper polarity is shown in Figure 3–4.

WARNING: Before proceeding with any maintenance or troubleshooting activity, allow at least one minute after input power has been removed to allow for bus circuit discharge. A bus Discharge LED is incorporated on the Drive to provide visual indication of the presence of bus voltage. The bus voltage may be verified by using a voltmeter to measure the voltage between terminals "P" (+) and "N" (–) on the Power Terminal Block. Do not attempt any servicing until the LED has extinguished or the bus voltage has diminished to zero. Refer to Figure 6–1 for LED location.

Hazards of electrical shock exist if accidental contact is made with parts carrying bus voltage.

6.2 Direction of Rotation Check

1. **REMOVE DRIVE POWER.** Verify the following adjustment and switch positions: SW3 and SW4 in LOCAL, SW1 in STOP and FREQUENCY at 0% (zero).
2. Remove the load from the motor.
3. Apply Drive power and initiate a START.
4. Slowly increase FREQUENCY pot until rotation is observed.
5. Check the direction of motor rotation. If it is incorrect, follow the procedure below.
6. Initiate a STOP and **REMOVE DRIVE POWER.**

Procedure for incorrect Direction of Rotation

A. Initiate a STOP and **REMOVE DRIVE POWER.**

B. Interchange any two wires at terminals M1, M2 and M3 of the Power terminal block.

C. Return to Step 3 above.

6.2 Direction of Rotation Check *(Continued)*

Local Forward/Reverse Selector Switch Disable

If desired, the Local Forward/Reverse selector switch (SW2) may be disabled. If disabled, the Drive will operate the motor in the same direction of rotation regardless of the switch position. This feature is not available on 230V, Series A Drives.

1. **REMOVE DRIVE POWER.**
2. Remove Drive cover.
3. Remove the four (4) screws securing the Operator Panel to the chassis.
4. Position the Operator Panel so that the bottom of the panel is visible. Refer to Figure 6–3.
5. Locate the jumper between the Forward/Reverse switch (SW2) and the Local/Remote selector switch (SW3). Cut or remove the jumper to disable local forward/reverse operation.
6. Reassemble the Drive in reverse order.

IMPORTANT: The above modification does not disable the Remote Forward/Reverse capability of the Drive. Replacing the jumper previously removed will restore the Local Forward/Reverse capability.

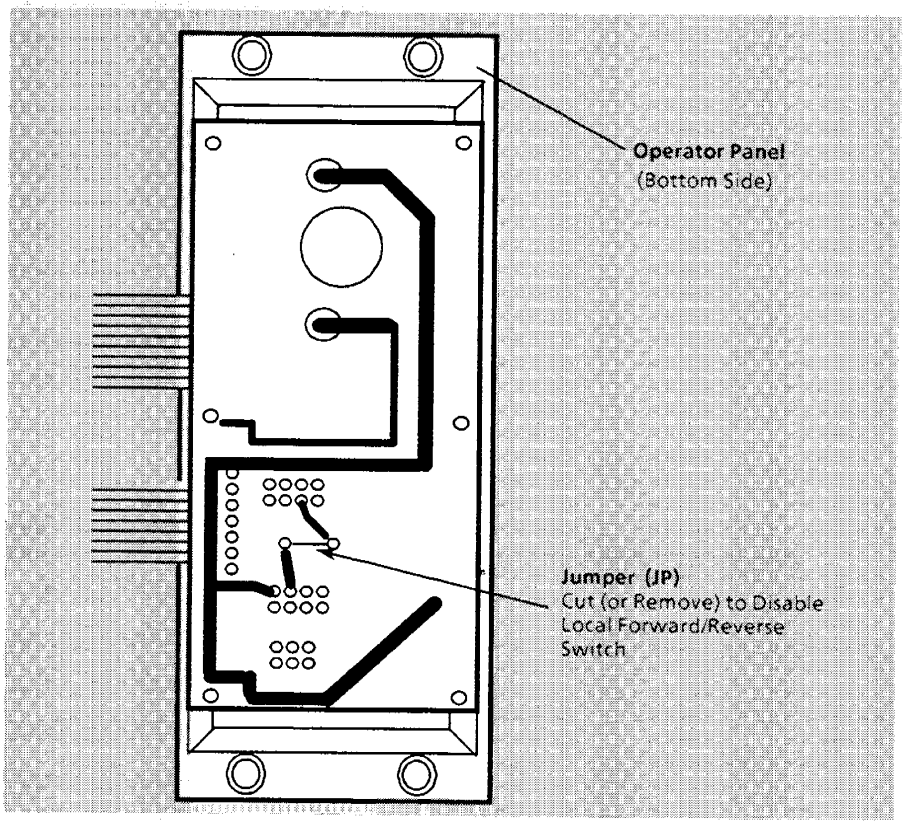


Figure 6–3. SW2 Disable Jumper Location

WARNING: To accomplish the following adjustments, the cover must be removed. Voltages on some components are at bus voltage or incoming line potential. An electrical shock hazard exists if accidental contact is made with these voltage carrying components during Start-Up procedures where power must be applied.

6.3 Acceleration and Deceleration Adjustment

IMPORTANT: High inertia loads on motors may cause the Stall Protection circuits to activate and override the Accel or Decel rate adjustment. Disconnect the load from the motor if the Accel or Decel rate pot has minimal effect.

1. **REMOVE DRIVE POWER.**
2. Set the FREQUENCY pot to 0%. Apply power and initiate a START.
3. Adjust the Acceleration Rate pot (VR2) for the desired acceleration rate. Rotate the FREQUENCY pot to 100% reference and observe the acceleration rate.
4. Repeat step 3 as necessary until the desired acceleration rate is achieved.
5. Once the motor is at the desired speed, adjust the Deceleration Rate pot (VR3) to the desired deceleration rate. Set the FREQUENCY pot fully counterclockwise (CCW) and observe the deceleration rate.
6. Repeat step 5 as necessary, until the desired deceleration rate is achieved.
7. Initiate a STOP and **REMOVE DRIVE POWER**.
8. Reconnect the load if necessary.

6.4 Auto Boost Adjustment

Normally, Auto Boost is preferred and will give optimum performance in the majority of applications. However, there may be a situation when the load change is large, the acceleration rate is too short and the "Auto Boost" switch setting is not suitable. In these situations, a manual setting of boost voltage is required. The following procedure indicates the proper method of manually adjusting the boost voltage.

CAUTION: An excessive adjustment of boost voltage may cause motor damage due to overheating. Exercise extreme care during adjustment. Increase the boost setting just to the point where adequate motor torque can be developed to accelerate the load.

Figure 6–4 indicates the effects of an increase or decrease in boost setting.

6.4 Auto Boost Adjustment *(Continued)*

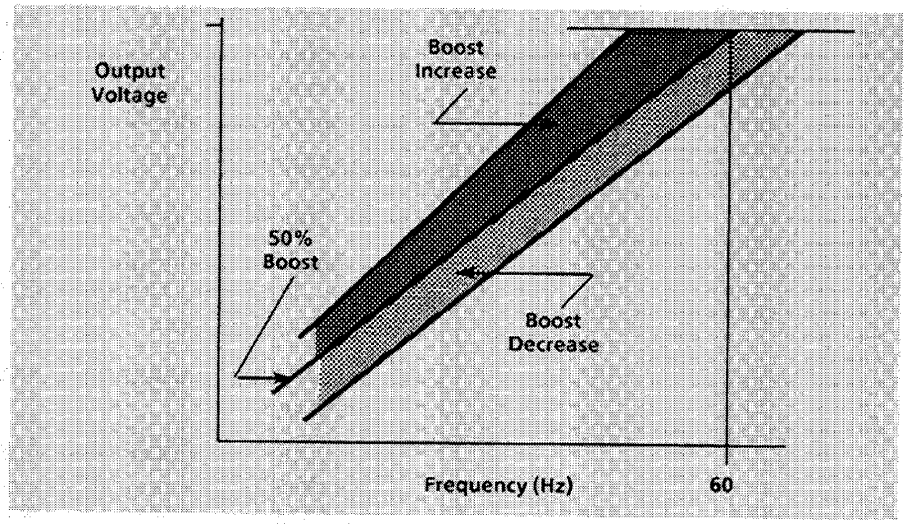


Figure 6–4. Boost Voltage Settings

1. **REMOVE DRIVE POWER** and turn OFF switch 4 of DSW2.
2. Turn the Boost adjustment pot VR8 clockwise (CW) to increase the boost voltage.
3. Apply power and initiate a START. Verify that the new setting is suitable to accelerate the required load. If the setting does not allow appropriate acceleration time, initiate a STOP and **REMOVE DRIVE POWER**.
4. Repeat step 2 for an appropriate boost setting, removing Drive power before any adjustment is done.
5. Initiate a STOP and **REMOVE DRIVE POWER**.

6.5 Remote Frequency Meter Calibration (Optional)

1. Apply Drive power and initiate a START in the FORWARD direction. Provide a 20% FREQUENCY reference.
2. Observe the meter needle deflection. If the needle does not deflect "upscale," **REMOVE DRIVE POWER** and interchange the wires at terminals (7) and (8).
3. Apply Drive power and initiate a START in the FORWARD direction. Turn the FREQUENCY reference pot clockwise (CW) to allow the motor to run at base speed.
4. With the motor running at base speed, turn the calibration pot on the Drive (VR11) until the needle corresponds with 100% on the meter scale.
5. Initiate a STOP. **REMOVE DRIVE POWER**.

Appendix

A

Power Interconnections

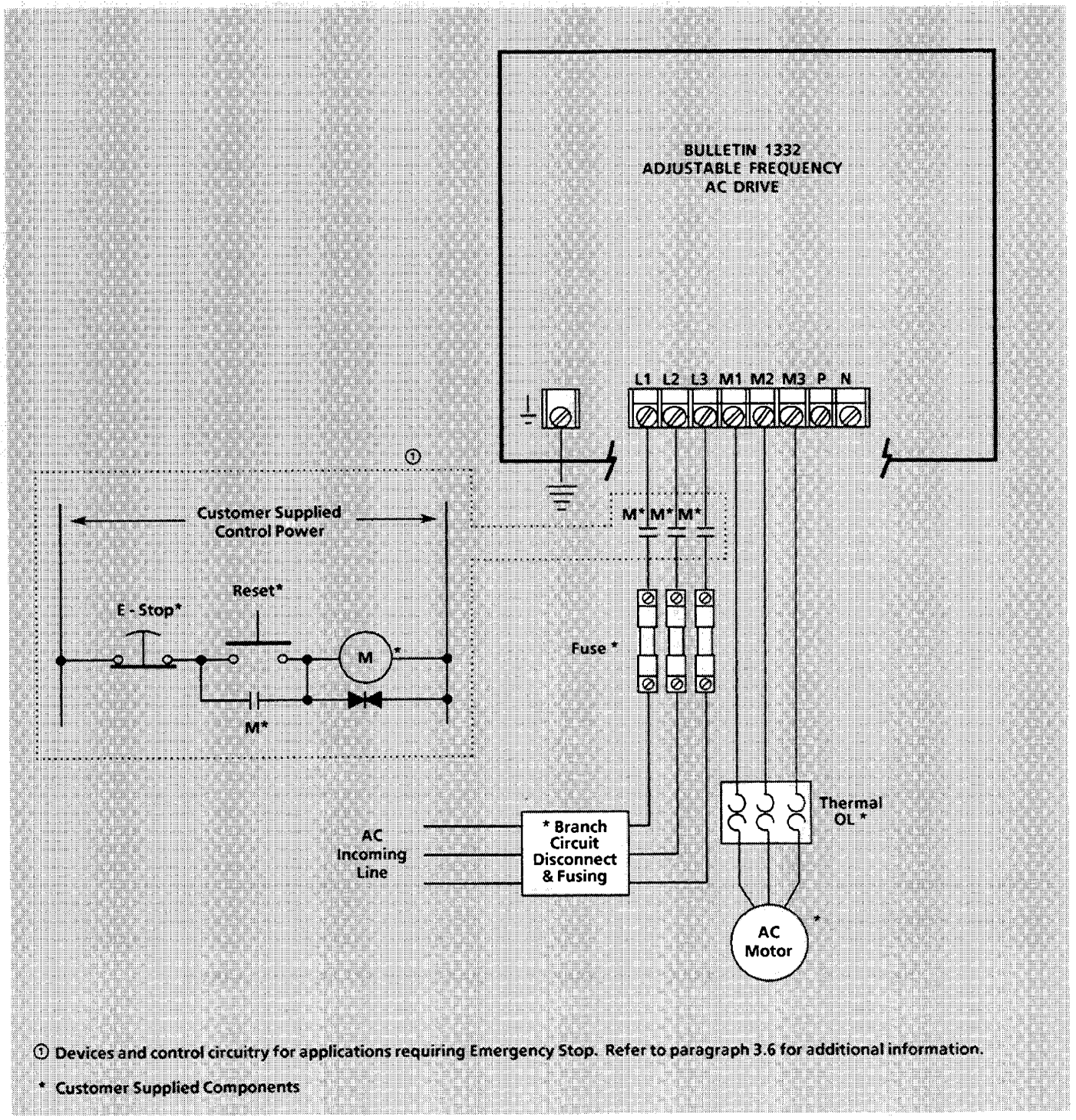


Figure A–1. Three-Phase Connections for 230, 460 and 575 Volt Drives

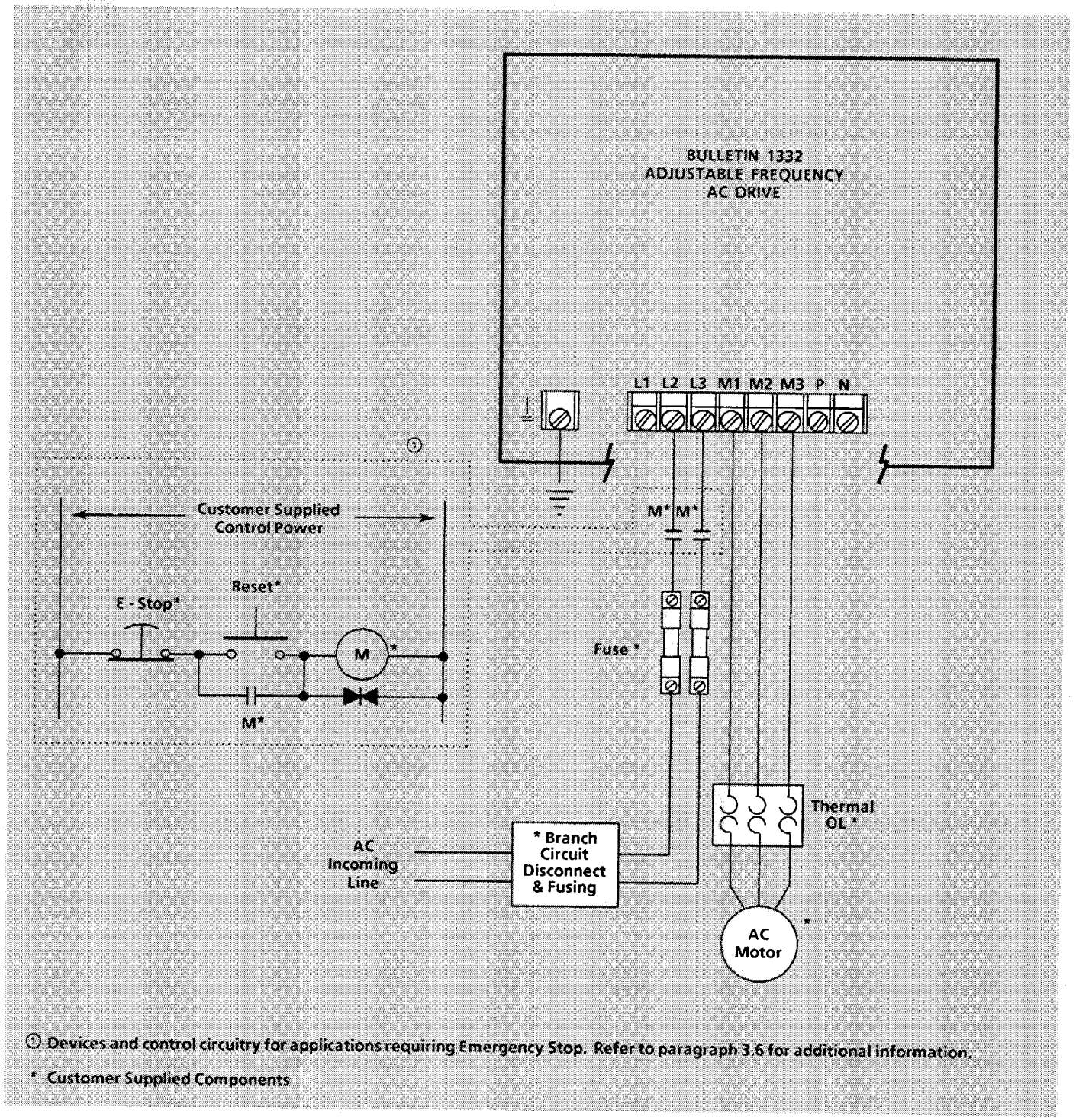


Figure A–2. Single-Phase Connections for Derated 230 or 575 Volt Drives Only

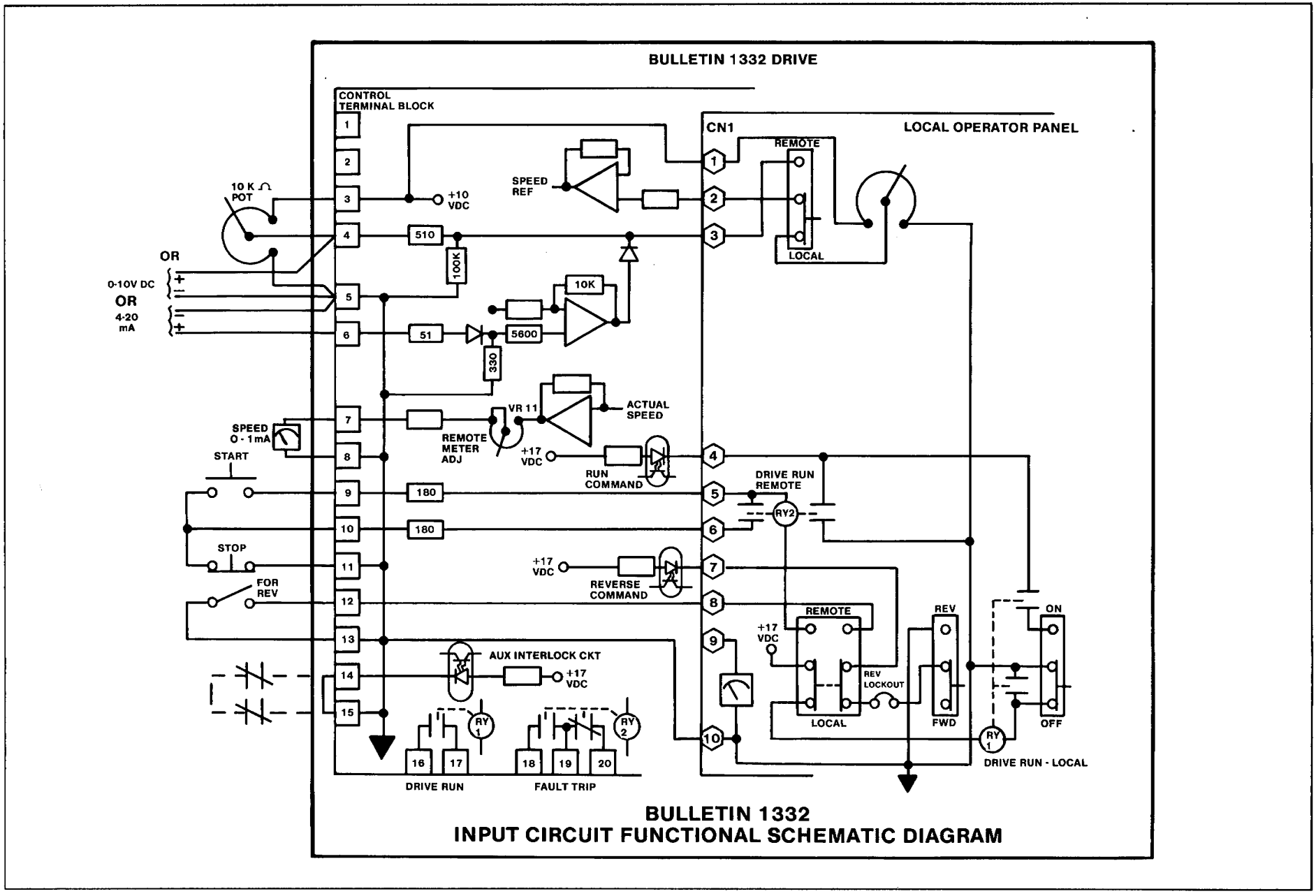


Figure A–3. Bulletin 1332 Input Circuit Functional Schematic Diagram

Appendix

B

Prechecks and Troubleshooting

Maintenance

The Drive is convection or fan 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. Air flow must never be restricted in any way.

Troubleshooting Prechecks

The following descriptions indicate the operation of protective circuitry in the Bulletin 1332. What is thought to be an operational problem with the Drive may, in reality be, normal operation of the Drive protective circuitry. Refer to the following descriptions before attempting to troubleshoot what may seem to be a Drive related malfunction.

Overcurrent Stall Protection

Function: If overcurrent, which is 140% of rated Drive current, flows during acceleration of the motor, the Overcurrent Stall Protection Circuit operates. This circuit stops the rise of frequency temporarily in order to avoid currents in excess of 140% and an OVERCURRENT trip. When load current falls below 140%, this circuit lets the frequency rise again, and continue acceleration to set frequency.

Remarks: If this function is not appropriate for the application, it can be eliminated by turning off DSW1, switch 3.

Overvoltage Stall Protection

Function: If DC bus voltage rises above a preset bus level by regenerative energy during deceleration of the motor, the Overvoltage Stall Protection Circuit stops frequency decrease temporarily in order to prevent an OVERVOLTAGE trip. When regenerative energy decreases and bus voltage falls below this level, this circuit lets frequency fall again and decelerate to set frequency. Refer to section 2.1 for voltage levels.

Remarks: If this function is not appropriate for the application, it can be eliminated by turning off DSW1, switch 2.

Overcurrent Protection

Function: If overcurrent exceeding 200% of rated current of the inverter flows, the protective circuit operates, stops operation of transistors and annunciates the condition. The "OVERCURRENT" LED illuminates.

Remarks:
1. Inertia of the load is excessively large, and acceleration time is extremely short.
2. The motor experienced an excessive overload condition while operating.
3. A short circuit exists in the output leads or motor windings.
4. A device in the Drive inverter section output has short circuited.

Troubleshooting Prechecks
(Continued)

Overvoltage Protection

Function: When bus voltage rises above a preset level by a high line or regenerative energy, the protective circuit operates, stops operation of transistors, and annunciates the condition. The "OVERVOLTAGE" LED illuminates. Refer to section 2.1 for actual voltage levels.

Remarks: Extremely short deceleration time is the main cause. Increase the deceleration time by adjusting the pot VR3. If this condition occurs while at rated speed, the condition might be considered an overhauling load. In this case and when deceleration time is critical, a dynamic brake is required.

Momentary Power Failure Protection

Function: When incoming line power failure exceeding 15ms occurs, the protective circuit operates to prevent mis-operation and stops operation of transistors. If momentary power failure is within 15ms, operation continues.

Undervoltage Protection

Function: When incoming line voltage falls below 90%, a protective circuit operates to prevent mis-operation, stop operation of transistors and annunciate the condition. The "LOW VOLTAGE" LED illuminates.

Remarks: When it is desired to restart automatically after incoming line voltage is re-applied, remove the jumper CN6 (see Figure 6–1).

Overtemperature Protection

Function: When temperature of the heat sink rises and the cooling effect to transistors is reduced, the protective circuit stops operation of transistors and annunciates the condition. The "TEMP" LED illuminates.

Remarks: Check specifications and ambient temperature around the Drive and the cooling fan operation (7.5 - 20 HP units).

Fault Trip

Function: It is possible that the Drive has stopped by means of an external interlock. The interlocks (e.g. thermal overload relay, external sequence circuit) are connected to terminals (14) and (15). The "AUX" LED will illuminate when an external Fault has occurred. Refer to section 3.6, *Fault Interlock Terminals* for connection information.

Troubleshooting Guide

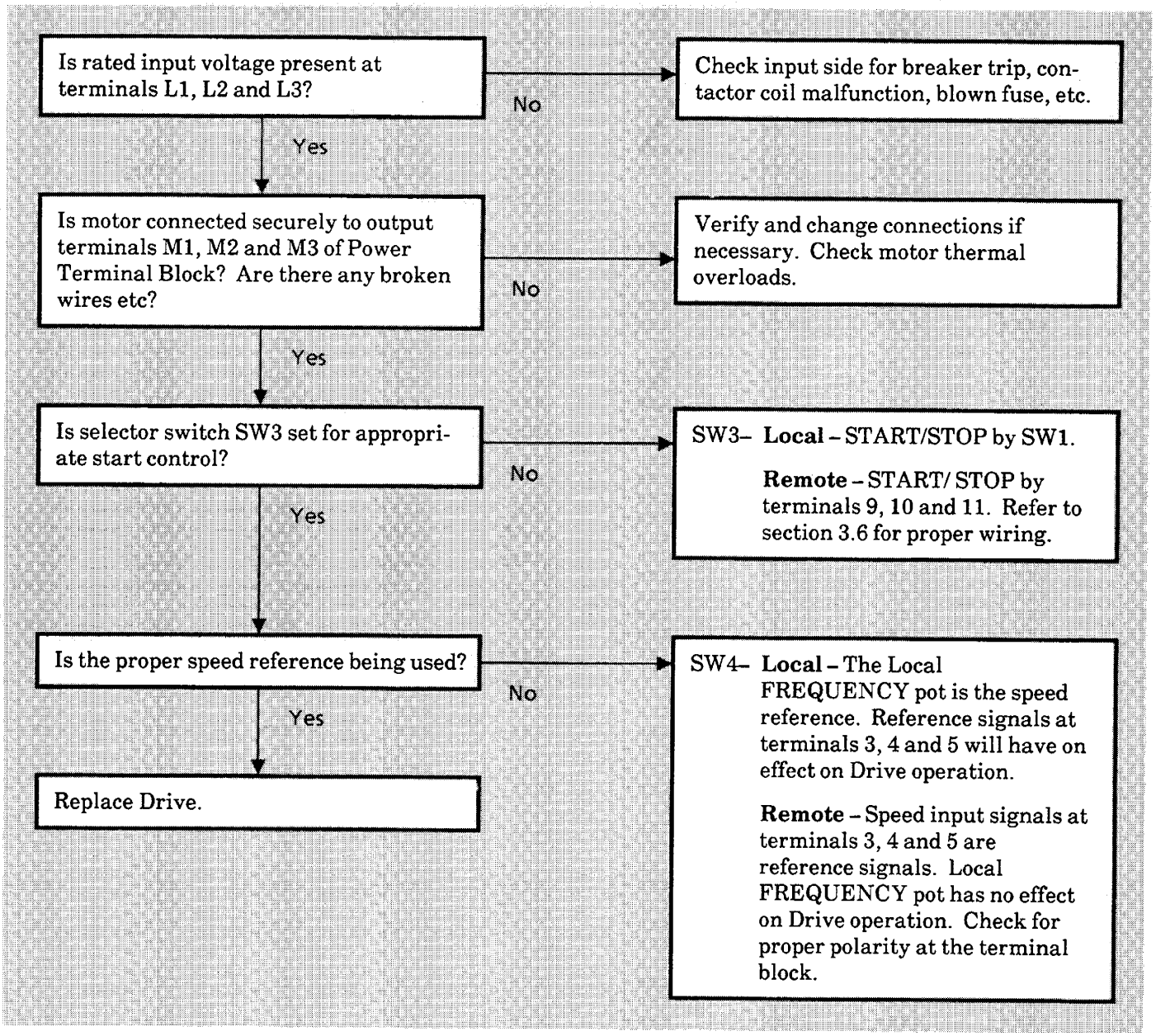
The following charts indicate several Drive malfunctions and the approved procedure for correcting these malfunctions.

WARNING: Voltages behind the enclosure cover are at bus voltage or incoming line potential. Hazards of electrical shock exist if accidental contact is made with voltage carrying components during troubleshooting procedures where power must be applied.

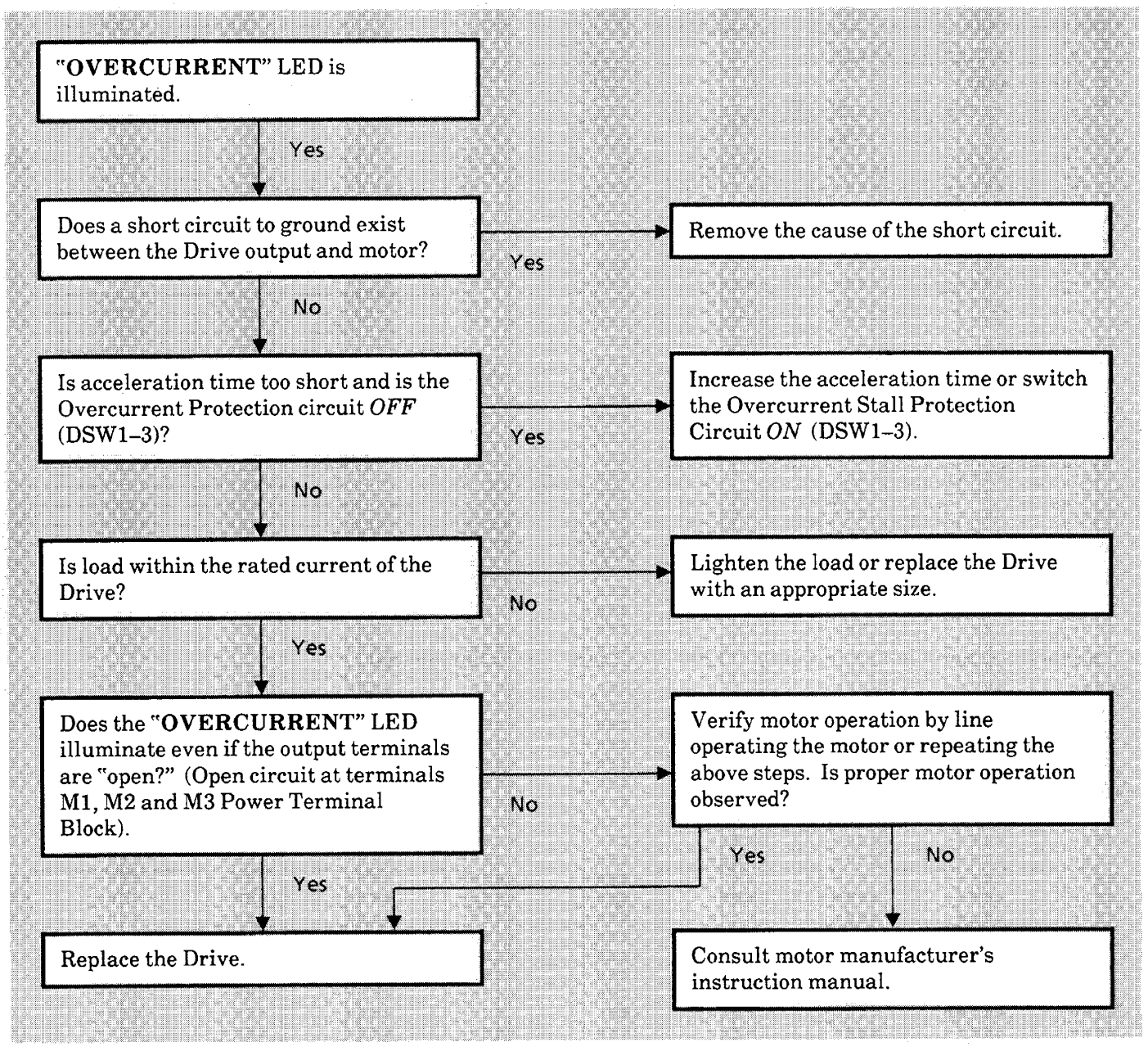
WARNING: Before proceeding with any maintenance or troubleshooting activity, allow at least one minute after input power has been removed to allow for bus circuit discharge. A bus Discharge LED is incorporated on the Drive to provide visual indication of the presence of bus voltage. The bus voltage may be verified by using a voltmeter to measure the voltage between terminals "P" (+) and "N" (–) on the Power Terminal Block. Do not attempt any servicing until the LED has extinguished or the bus voltage has diminished to **zero**. Refer to Figure 6–1 for LED location.

Hazards of electrical shock exist if accidental contact is made with parts carrying bus voltage.

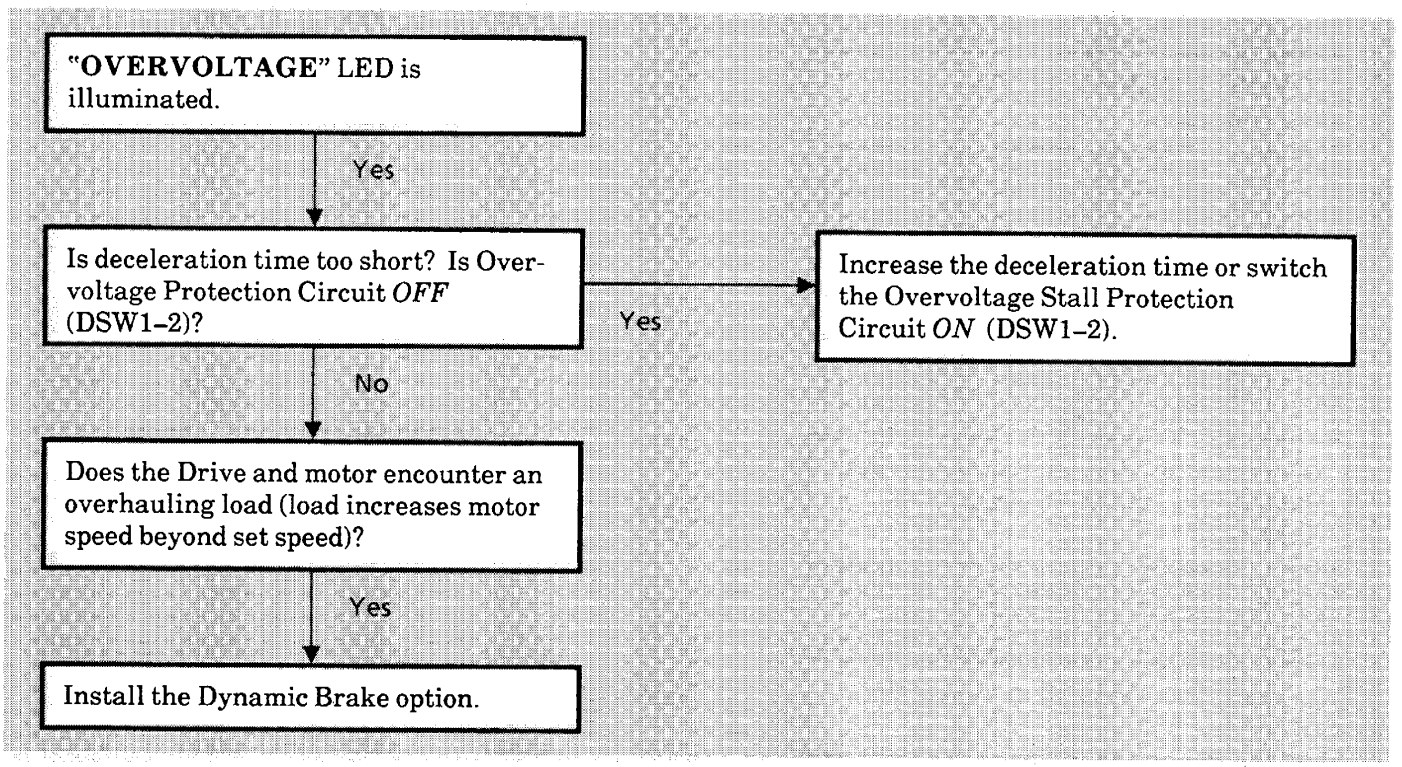
1. Motor Does Not Run – Fault LED's *Are Not* Illuminated



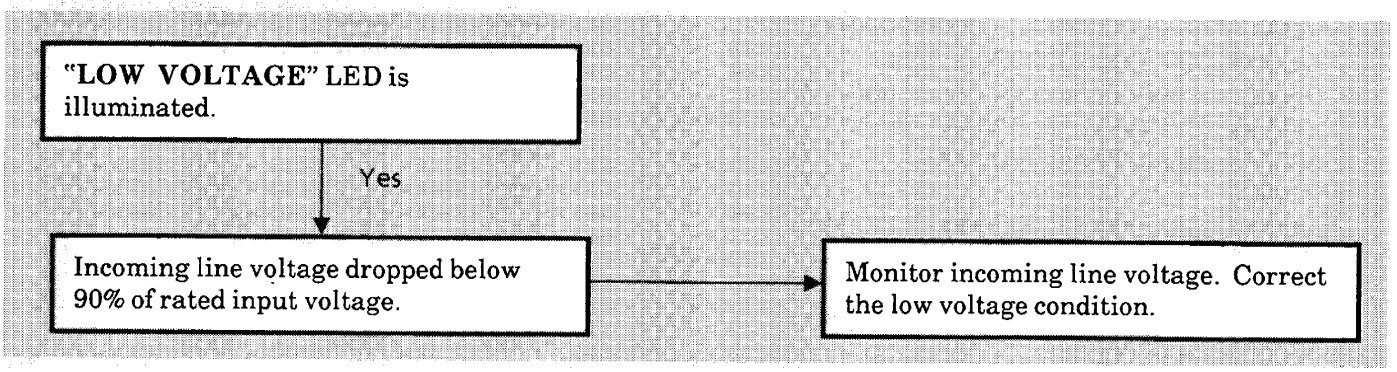
2A. Motor Does Not Run Continuously – "OVERCURRENT" LED *is* Illuminated



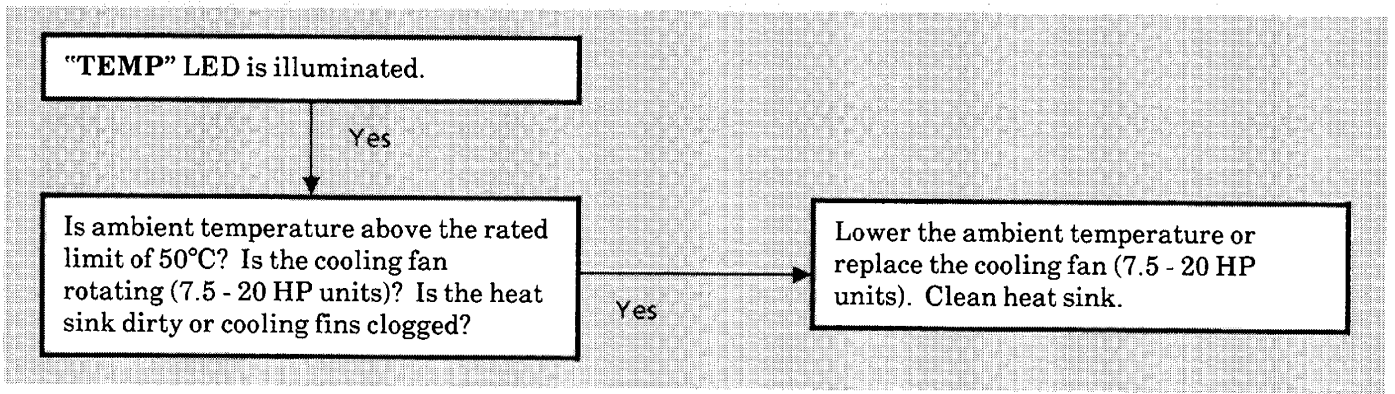
2B. Motor Does Not Run Continuously – "OVERVOLTAGE" LED *is* Illuminated



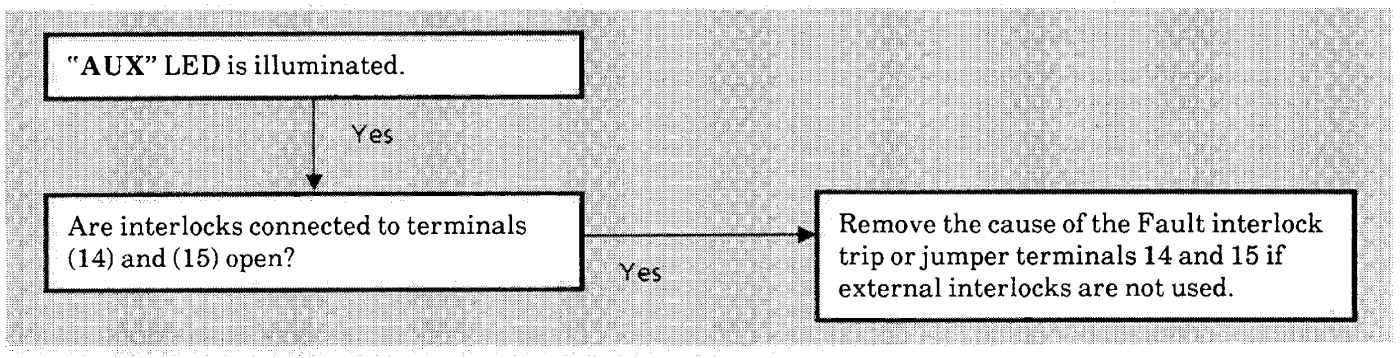
2C. Motor Does Not Run Continuously – "LOW VOLTAGE" LED *is* Illuminated



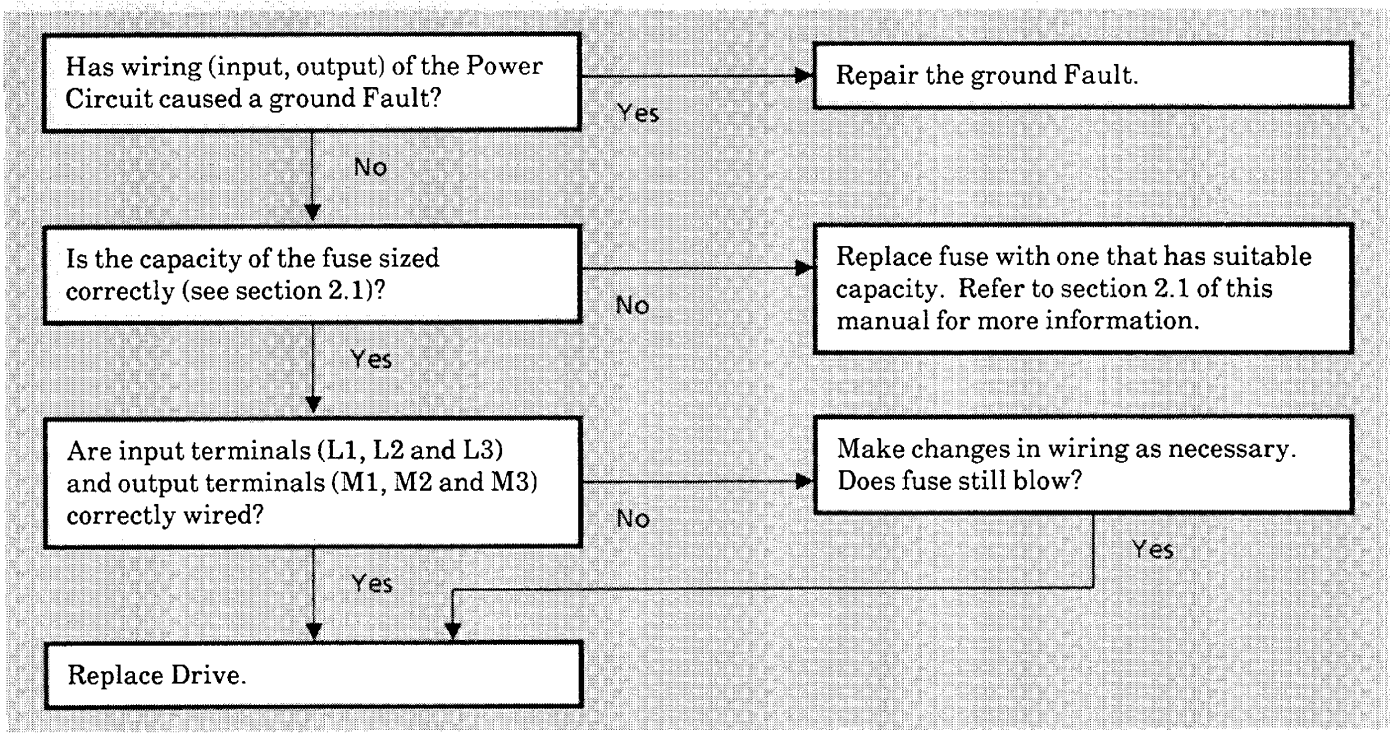
2D. Motor Does Not Run – "TEMP" LED *is* Illuminated



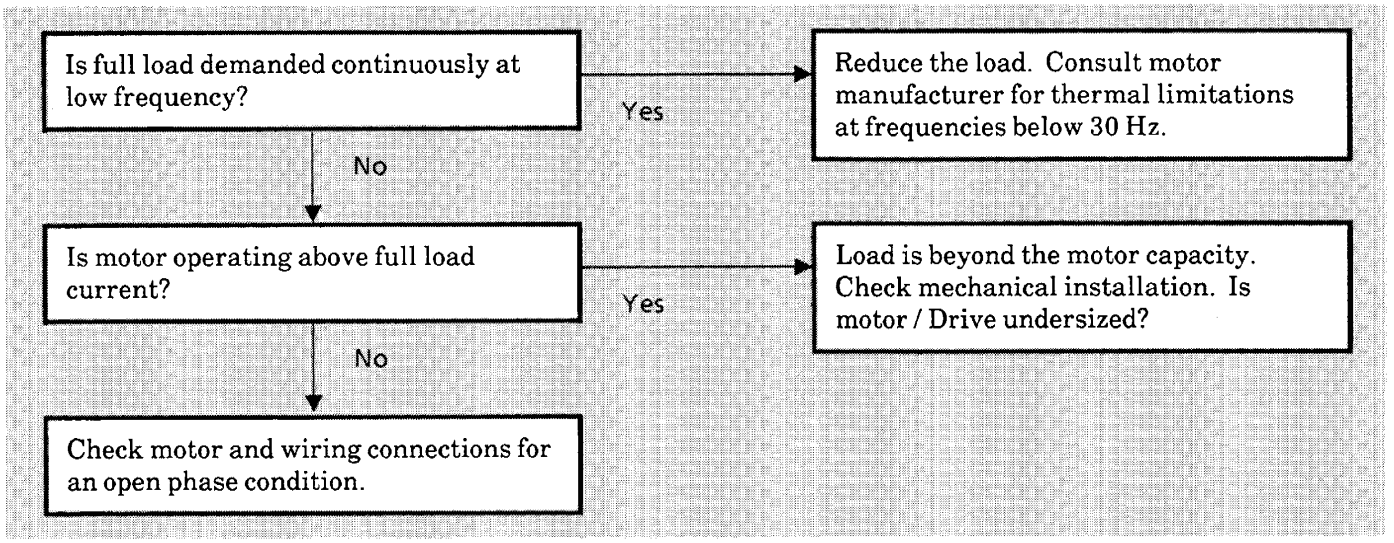
2E. Motor Does Not Run – "AUX" LED *is* Illuminated



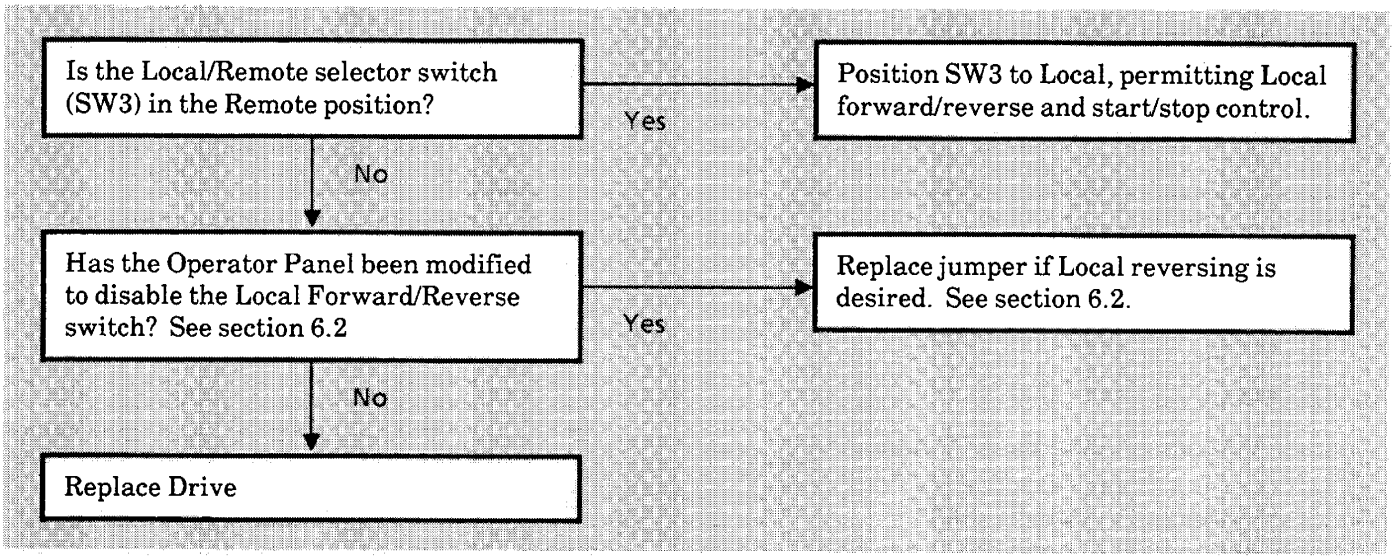
3. Fuse Blown



4. Motor Generates an Excessive Amount of Heat



5. Drive Will Not Reverse in Local Mode



Appendix

C

Remote Operator Station – MOD F

Description

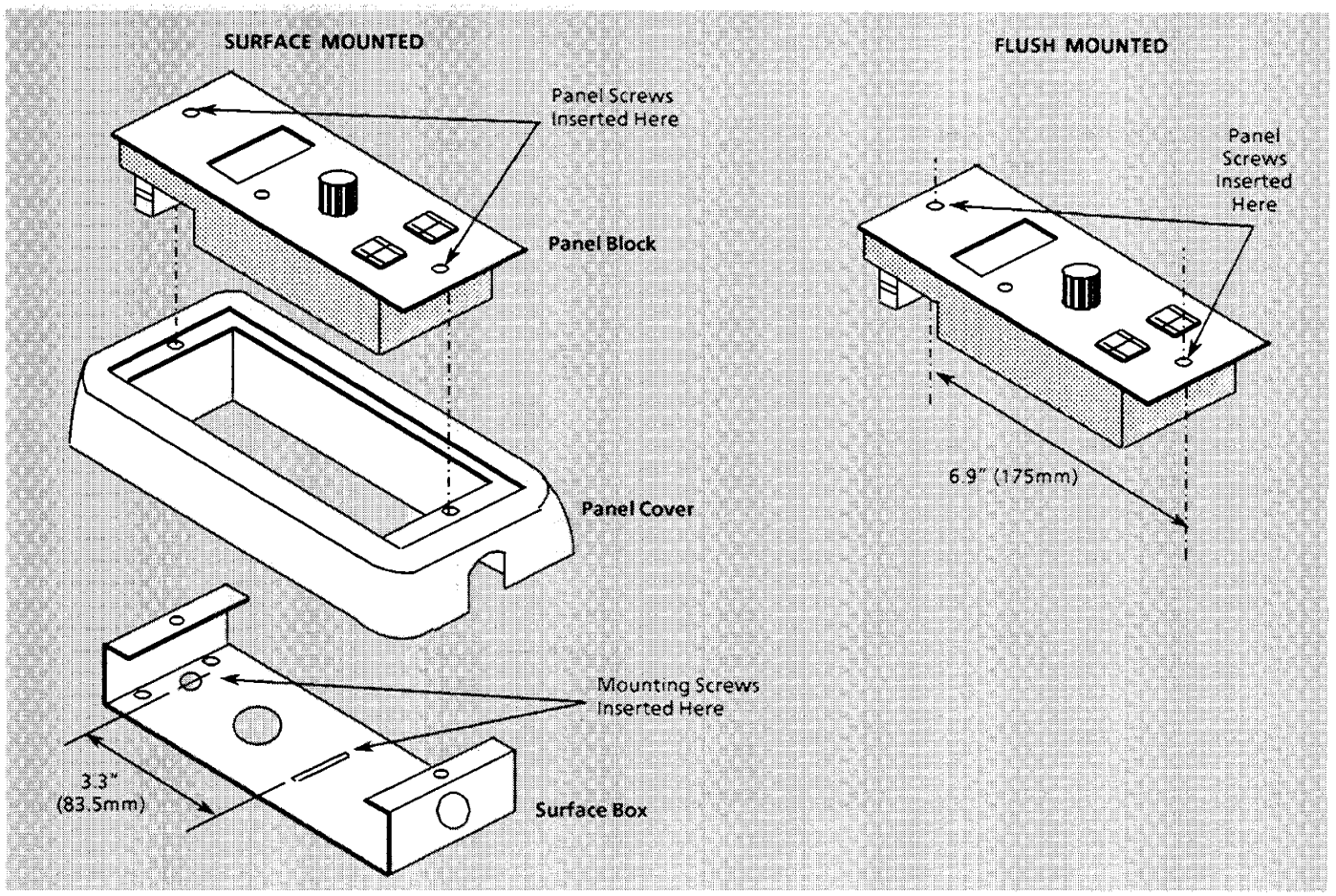
This control panel is used to remotely control the following functions: frequency, start/stop and forward/reverse. The panel can be flush or surface mounted and must be within 328 feet (100 meters) of the Drive controller.

Specifications

Control Specifications	Frequency control by adjustment pot, (Start / Stop, Forward / Reverse)
Ambient Temperature & Humidity	– 10°C to + 50°C, 5 to 95% non-condensing
Environment	Indoor, no corrosive gas, non-hazardous
Vibration Resistance	Minimum 0.5G

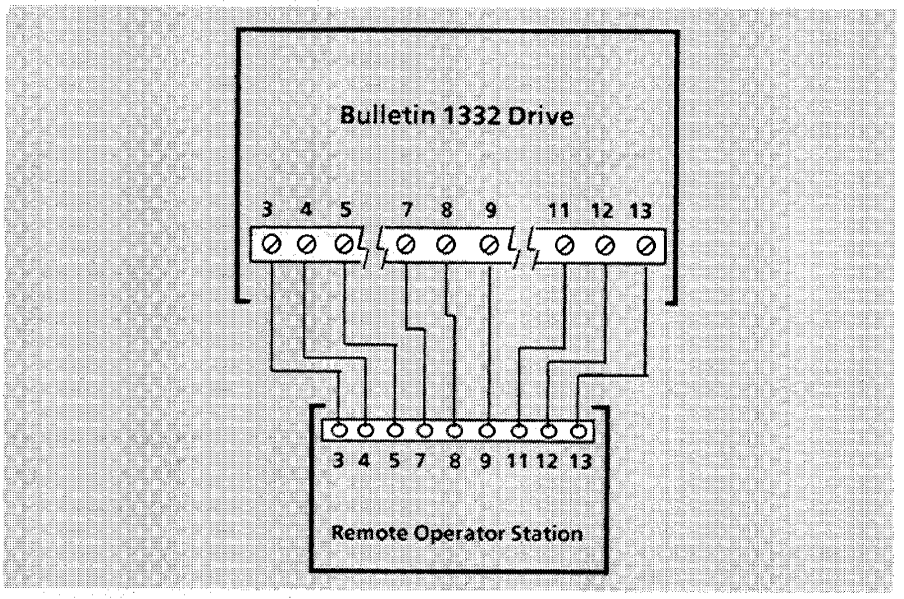
Installation

This remote control can be either flush or surface mounted. The Panel Cover and Surface Box are not used if an operator panel mounting is desired (see following figure).

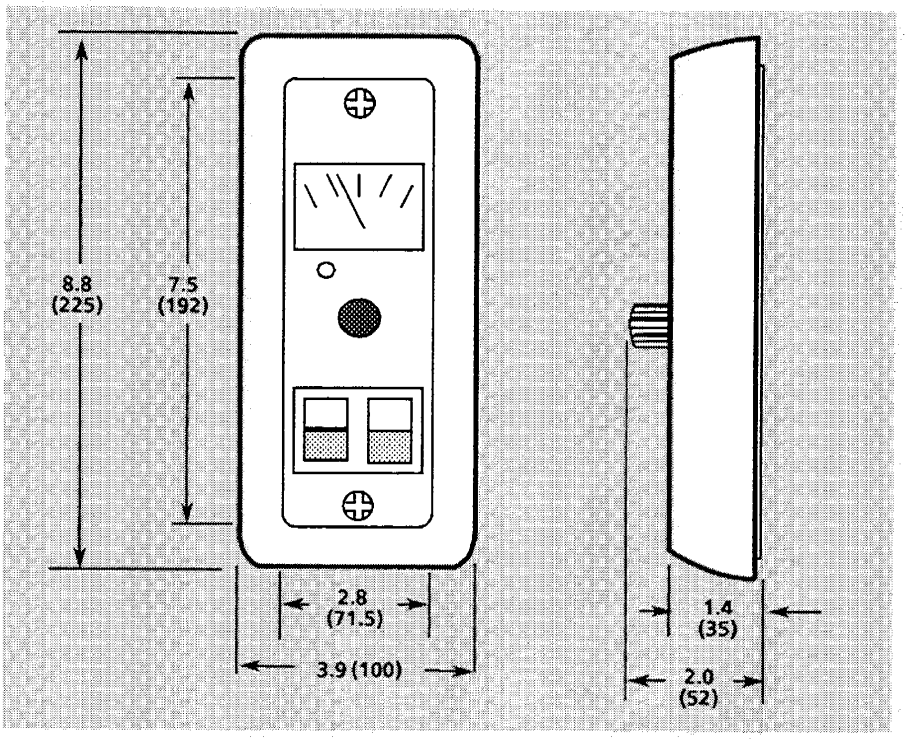


Wiring

The distance between the control station and the Drive controller must not exceed 328 feet (100 meters). It is recommended that shielded twisted pair cable be used for connections to terminals 3, 4, 5 and 7, 8. The shield conductor is to be grounded at the Drive enclosure only and the shield cut off and taped at the Remote Operator Station. All control wiring **must** be located at a minimum distance of 6 inches from any high voltage/ current carrying conductors.



Approximate Dimensions Inches (mm)



Appendix

D

Preset Speeds – MOD F2, F3, F4

Description

This option provides up to five (5) preset speeds, each independently adjustable over different speed ranges. Only one preset speed can be selected at any given time. Speeds are selected by one of four (4) customer contact closures. A ±15V DC power supply is included.

Specifications
Preset Speed Option – Mod F2 - F4

Input Power Source	Use ±15V DC Power Supply (Supplied)
Control Input 1 ①	4 Inputs (N.O., Isolated Contact Input) ②
Control Output 2 ①	5 Outputs (0 to 10V Input)
Ambient Temperature & Humidity	– 10°C to + 50°C, 5 to 95% non-condensing
Atmosphere	Indoor, no corrosive gas, non-hazardous
Vibration Resistance	Minimum 0.5G

① Refer to the table "Control Input and Control Output" for the input and output relationships

② Use low power rated (logic) type contacts

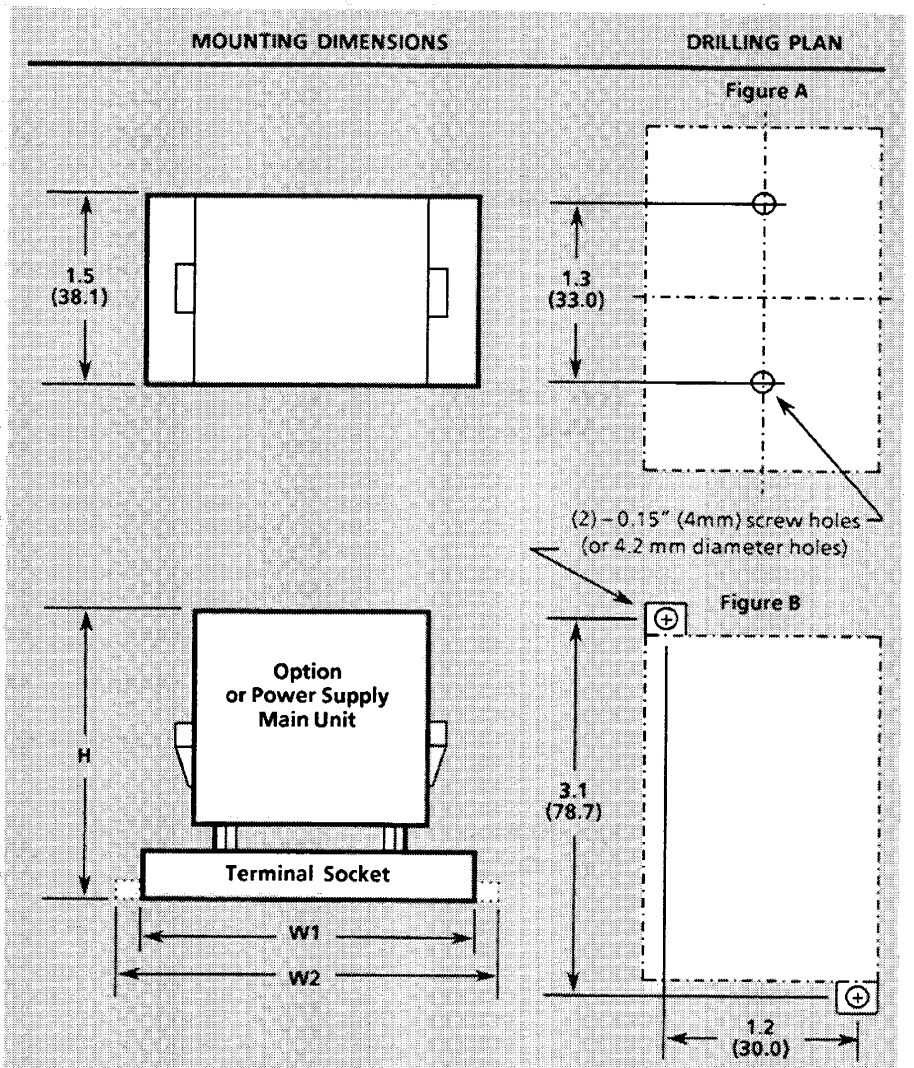
Specifications
± 15V DC Power Supply

Applicable Devices	Adjustable Minimum / Maximum Frequency & Preset Speeds Options
Input Voltage/Frequency	MOD F2 - 208 (Series B Drives *Only*)/230V AC, 60 Hz MOD F3 - 380/415/460V AC, 50/60 Hz MOD F4 - 575V AC, 50/60 Hz
Permissible Input Voltage Variation	±10%
Output Voltage	Terminals 3(–) to 4(+): 15V DC @ 6 mA Terminals 5(–) to 6(+): 15V DC @ 20 mA
Ambient Temperature & Humidity	– 10°C to + 50°C, 5 to 95% non-condensing
Vibration Resistance	Minimum 0.5G

Installation

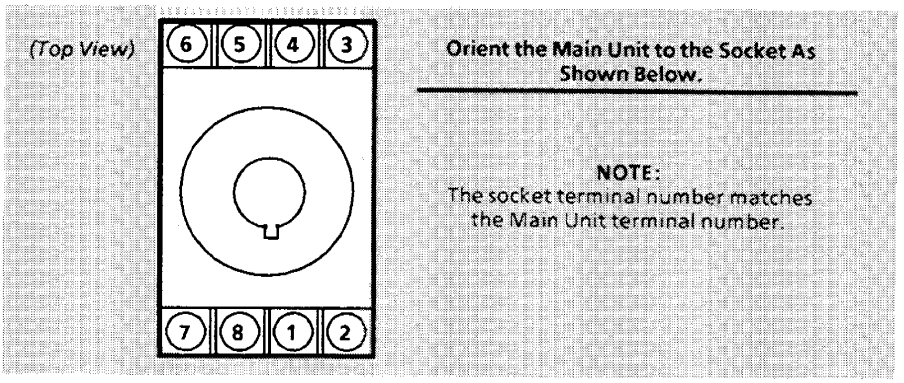
Install both the ±15V DC Power Supply and the Preset Speed Option on a flat surface in an area not subjected to corrosive gas or excessive temperatures (refer to specifications). Refer to the "Dimensions" and "Wiring" figures for further installation information.

Approximate Dimensions Inches (mm)



Mod	Unit	H	W1	W2	Drilling Plan
F2	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.0 (76.2)	2.8 (71.1)	–	Figure A
F3	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B
F4	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B

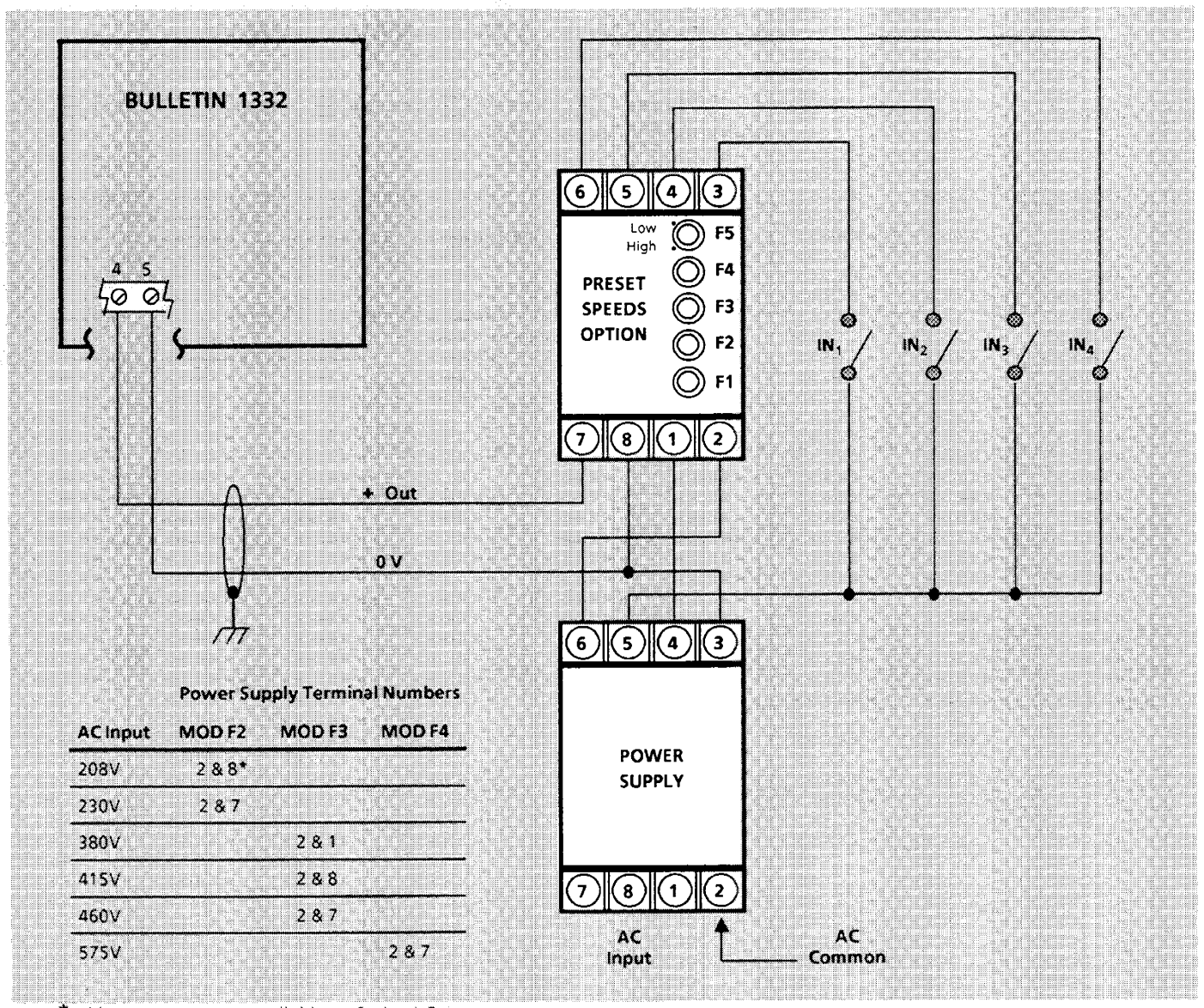
Socket Orientation



Wiring

WARNING: To avoid electrical shock hazard, REMOVE POWER before attempting to wire option.

The distance between the Preset Speed option and the Drive controller must not exceed 10 feet (3 meters). It is recommended that shielded twisted pair cable be used for connections from the Drive to terminals 7 and 8 of the option. The shield conductor is to be grounded at the Drive enclosure only, and the shield cut off and taped at the Preset Speed Option. It is recommended that wiring connected to terminals 1 – 6 be twisted wires and no longer that 33 feet (10 meters). All control wiring **must** be located at a minimum distance of 6 inches from any high voltage/ current carrying conductors.



Power Supply Terminal Numbers

AC Input	MOD F2	MOD F3	MOD F4
208V	2 & 8*		
230V	2 & 7		
380V		2 & 1	
415V		2 & 8	
460V		2 & 7	
575V			2 & 7

* 208V operation Not Available on Series A Drives.

Set-Up and Adjustment

IMPORTANT: The Start-Up procedure for the Drive must be completed prior to Set-Up and Adjustment of this option.

1. **REMOVE DRIVE POWER.** Verify that switch SW4 is in the REMOTE position to accept an external input.
2. Verify that the connection of the option to the Drive is correct. Refer to the "Wiring" section. Turn all pots on the option counterclockwise to the LOW position.
3. Apply Drive power and initiate a START.
4. With all inputs off and all switches off, adjust F1 for the appropriate range (see table below).
5. With all other switches off, close the IN_1 switch and adjust F2 for the desired frequency. Repeat this step for the remaining switches ($IN_2 - IN_4$) and pots (F3 – F5).
6. Initiate a STOP and **REMOVE DRIVE POWER.**

The following table indicates the relationship between the control input and control output voltages.

Control Input				Control Output *(output voltage between terminals 7 and 8)*
IN_1	IN_2	IN_3	IN_4	1 2 3 4 5 6 7 8 9 10V
Off	Off	Off	Off	F1 Adjustment Range
ON	Off	Off	Off	F2 Adjustment Range
*	ON	Off	Off	F3 Adjustment Range
*	*	ON	Off	F4 Adjustment Range
*	*	*	ON	F5 Adjustment Range
				SPEED
				0% 100%

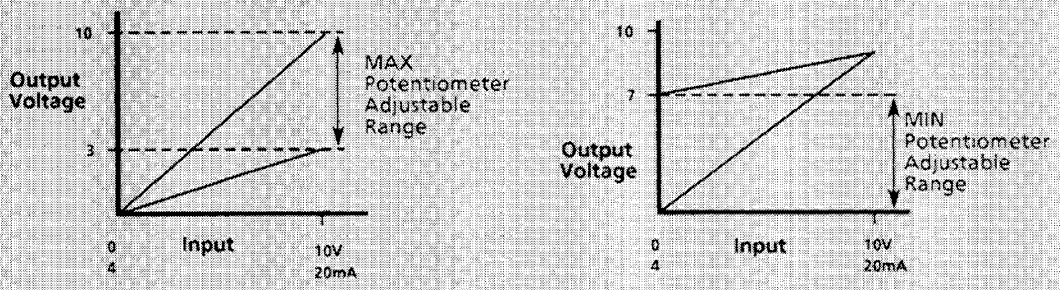
* Denotes that switch can be in the Off *or* On position

Adj. Min./Max. Frequency – MOD N - N6

Description

One option is available for use with a 0-10V input and one option is available for use with a 4-20mA input. When used with the specified input, this option provides an adjustable range for minimum frequency of 5% to 70% and Maximum frequency of 30% to 100%. A 15V DC power supply is included with this option.

Specifications

Input Power Source	Use ± 15V DC Power Source
Control Input	MOD N, N3, N5 - 0 to 10V DC, Input Impedance 100k Ohm MOD N2, N4, N6 - 4 to 20 mA DC, Input Impedance 380 Ohm
Control Output	Adjustable range of upper limit setting: Maximum 30% to 100% output voltage Adjustable range of lower limit setting: 0% to minimum 70% output voltage IMPORTANT: Zero voltage equals the minimum Drive frequency (3 Hz) 
Ambient Temperature & Humidity	– 10°C to + 50°C, 5 to 95% non-condensing
Atmosphere	Indoor, No Corrosive Gas, Non-hazardous
Vibration Resistance	Minimum 0.5G

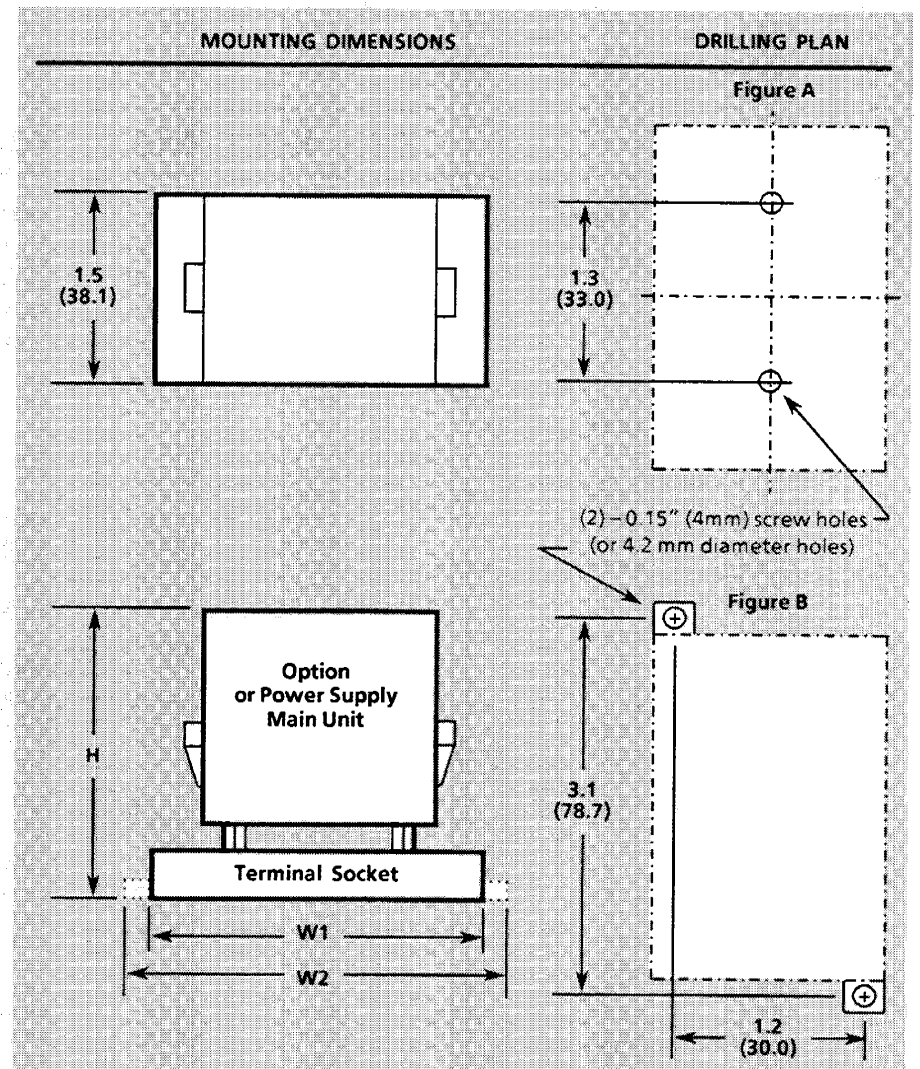
Specifications ± 15V DC Power Supply

Applicable Devices	Adjustable Minimum / Maximum Frequency & Preset Speeds Options
Input Voltage/Frequency	MOD N, N2 - 208 (Series B Drives *Only*)/230V AC, 60 Hz MOD N3, N4 - 380/415/460V AC, 50/60 Hz MOD N5, N6 - 575V AC, 50/60 Hz
Permissible Input Voltage Variation	± 10%
Output Voltage	Terminals 3(–) to 4(+): 15V DC @ 6 mA Terminals 5(–) to 6(+): 15V DC @ 20 mA
Ambient Temperature & Humidity	– 10°C to + 50°C, 5 to 95% non-condensing
Vibration Resistance	Minimum 0.5G

Installation

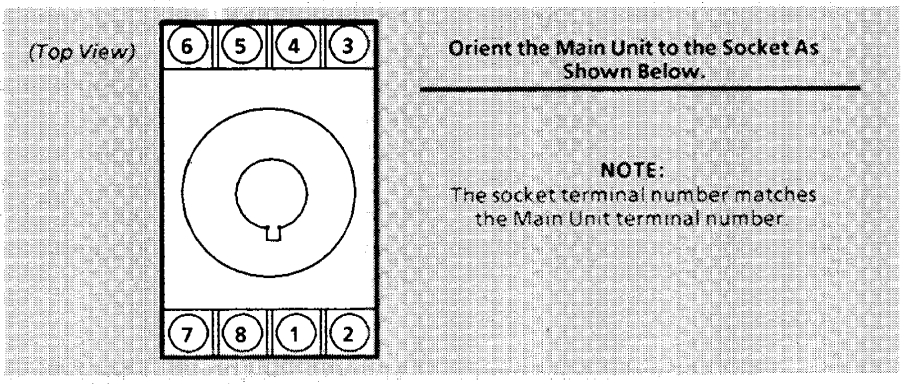
Install both the ± 15V DC Power Supply and the Adjustable Min. / Max. Frequency Option on a flat surface in an area not subjected to corrosive gasses or excessive temperatures (refer to specifications). Refer to the "Dimensions" and "Wiring" figures for further installation information.

Approximate Dimensions
Inches (mm)



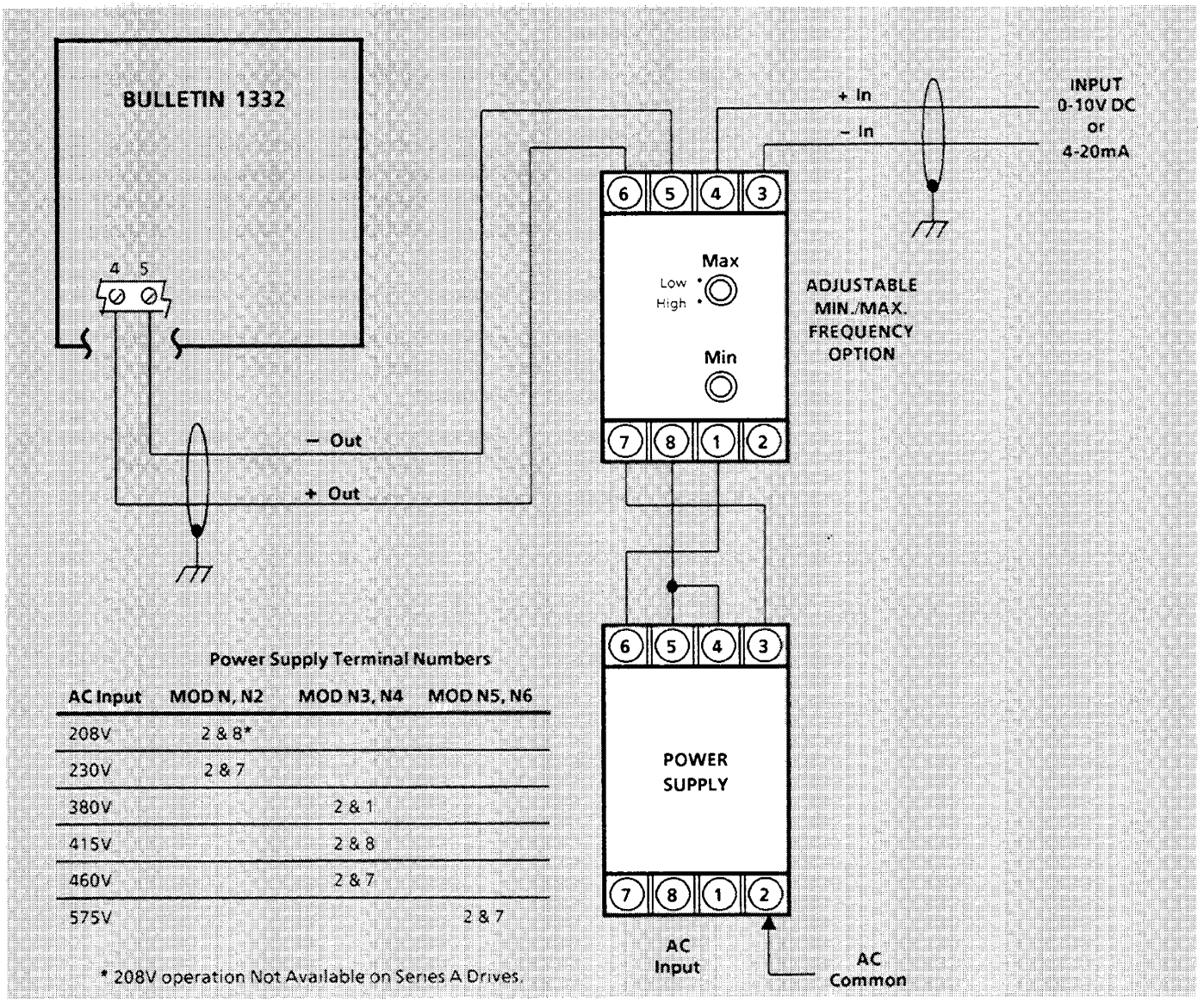
Mod	Unit	H	W1	W2	Drilling Plan
N	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.0 (76.2)	2.8 (71.1)	–	Figure A
N2	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.0 (76.2)	2.8 (71.1)	–	Figure A
N3	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B
N4	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B
N5	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B
N6	Main Unit	3.0 (76.2)	2.8 (71.1)	–	Figure A
	Power Supply	3.2 (81.3)	3.0 (76.2)	3.5 (88.9)	Figure B

Socket Orientation



Wiring

WARNING: To avoid electrical shock hazard, REMOVE POWER before attempting to wire option.



Power Supply Terminal Numbers

AC Input	MOD N, N2	MOD N3, N4	MOD N5, N6
208V	2 & 8*		
230V	2 & 7		
380V		2 & 1	
415V		2 & 8	
460V		2 & 7	
575V			2 & 7

* 208V operation Not Available on Series A Drives.

Wiring *(Continued)*

The distance between the Adjustable Min. / Max Frequency option and the Drive must not exceed 10 feet (3 meters). It is recommended that shielded twisted pair cable be used for connections to terminals 5 and 6. The shield conductor is to be grounded at the Drive enclosure only, and the shield cut off and taped at the Option case. It is recommended that wiring connected to terminals 3 and 4 either shielded cable or twisted wires and no longer that 33 feet (10 meters). All control wiring **must** be located at a minimum distance of 6 inches from any high voltage/ current carrying conductors.

Set-Up and Adjustment

IMPORTANT: The Start-Up procedure for the Drive must be completed prior to Set-Up and Adjustment of this option.

1. **REMOVE DRIVE POWER**. Verify that switch SW4 is in the REMOTE position to accept an external input.
2. Turn the MAX pot clockwise to the HIGH position and MIN pot counterclockwise (CCW) to the LOW position.
3. Verify the connections of the option to the Drive. Refer to the "Wiring" section.
4. Apply Drive power and initiate a START. Apply 0V or 4 mA to the option as applicable.
5. Turn the MIN pot slowly clockwise (CW) until the local or remote frequency meter shows the minimum desired frequency. Verify frequency setting by the scale deflection of the meter indicator as it takes a certain amount of time for the Drive to follow the speed command.
6. Apply 10V or 20mA to the option as applicable.
7. Turn the MAX pot slowly counterclockwise (CCW) until the maximum desired frequency is achieved. Verify frequency setting by the scale deflection of the meter.
8. Set-up of this option is a dynamic adjustment procedure. Repeat steps 3 and 6 as necessary until optimum performance is achieved.
9. Initiate a STOP and **REMOVE DRIVE POWER**.

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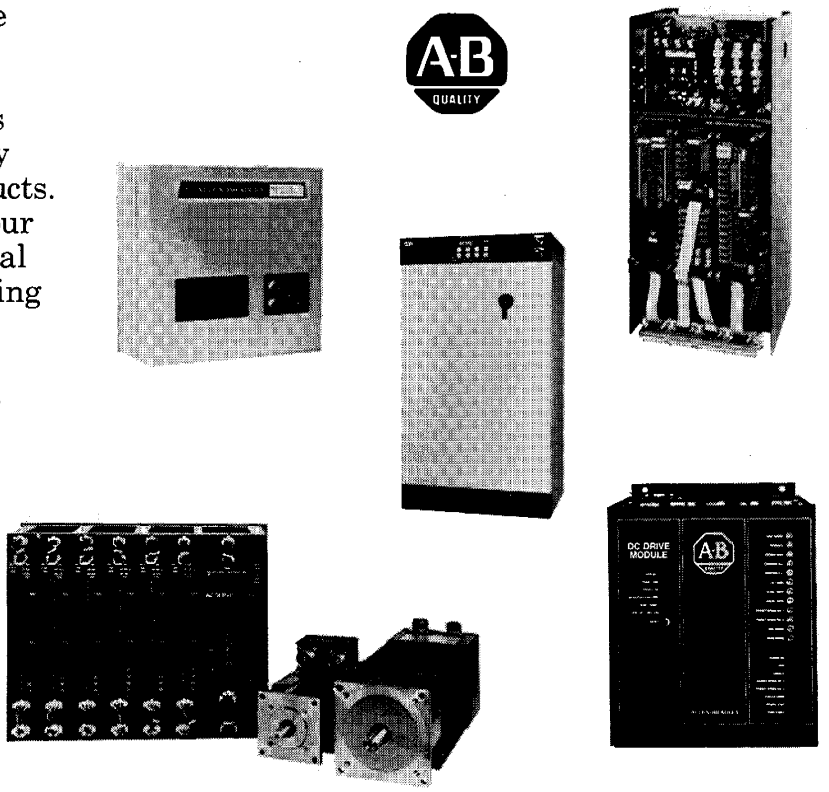

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