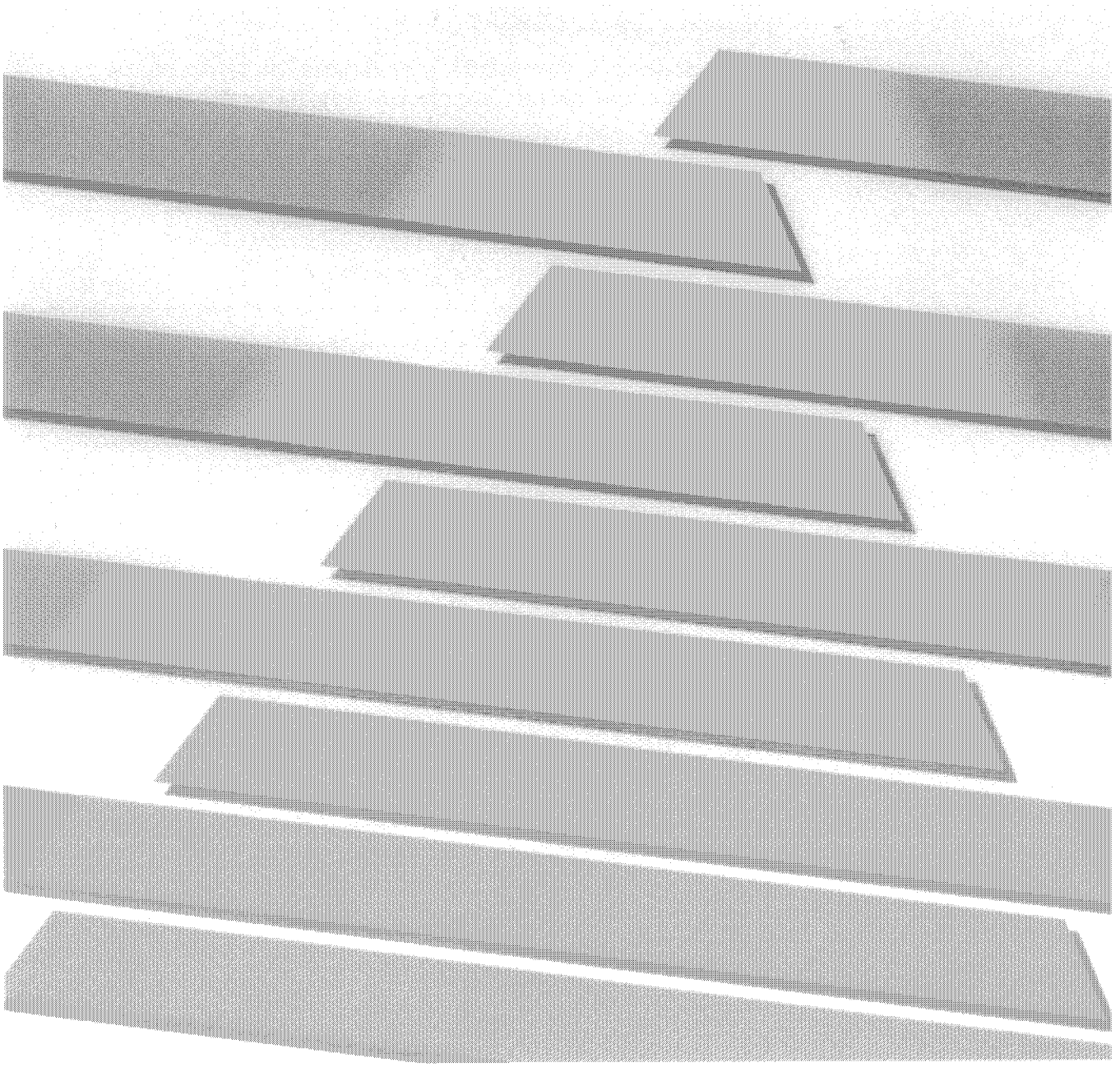
ALLEN-BRADLEY

Bulletin 1334
3-10 HP Series B
15-50 HP Series A
Adjustable Frequency AC Drives

Instruction Manual



Important User Information

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

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

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

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

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

Both of these Reader Alerts:

- Identify possible trouble spots.
- Tell what causes the trouble.
- Give the result of improper actions.
- Tell the reader how to avoid trouble.

Additionally:

SHOCK HAZARD labels may be located on or inside the Drive to alert people of hazards if service procedures are not followed properly.

Repair or Repair/Exchange Procedure

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

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

Return any equipment to be repaired to the Area Sales/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 Sales/Support Centers is available from your local Allen-Bradley Distributor or Sales Office.

Manual Objective

This Instruction Manual defines the installation, startup, operation and troubleshooting procedures for the Allen-Bradley Bulletin 1334 3 through 10 HP Series B and 15 through 50 HP Series A Adjustable Frequency AC Drive and is intended for use by personnel familiar with the functions of solid state Drive equipment.

CAUTION

This assembly may contain ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed when testing, servicing or repairing this assembly. If you are not familiar with static control procedures, before servicing, reference U.S. Department of Defense, DOD-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electronic Parts, Assemblies and Equipment or any other applicable ESD Protection Handbook.

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Chapter

1

Bulletin 1334 Pre-Installation Care

1.0 Pre-Installation & Operation

Before installing and operating your Bulletin 1334, carefully read this manual and observe all precautions. The catalog number of your Drive as explained in **Chapter 2** lists the Drive rating, type of enclosure, nominal line voltage, phase and frequency, as well as any additional options that were specified. Specifications for all Bulletin 1334 Drives including standard controls, adjustment range, diagnostics, and environmental qualifications are listed in **Chapter 3**. 380 & 415V Bulletin 1334 specifications and adjustments are detailed in **Chapter 7**.

1.1 Receiving

Once you have received your Bulletin 1334 Drive, careful inspection for shipping damage should be made. Damage to the shipping carton is usually a good indication that it has received rough handling. Any and all damage should be immediately reported to the freight carrier and your nearest Allen-Bradley Area Sales/Support Center.

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

1.2 Storage

If the Drive will not immediately be installed, it should be stored in a clean, dry area where the ambient temperature is not less than -25°C nor more than +65°C. The Drive must not be stored in a corrosive environment or subject to conditions in excess of the storage environment parameters stated in the **Specification Table**, Chapter 3.

1.3 Handling

Depending upon the rating and options ordered, in its shipping carton your Bulletin 1334 can weigh anywhere from 67 to over 500 lbs. Proper safety precautions and practices should be observed whenever the Drive is being moved from one location to another.

1.4 Shipping

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

1.5 ESD Precautions

CAUTION

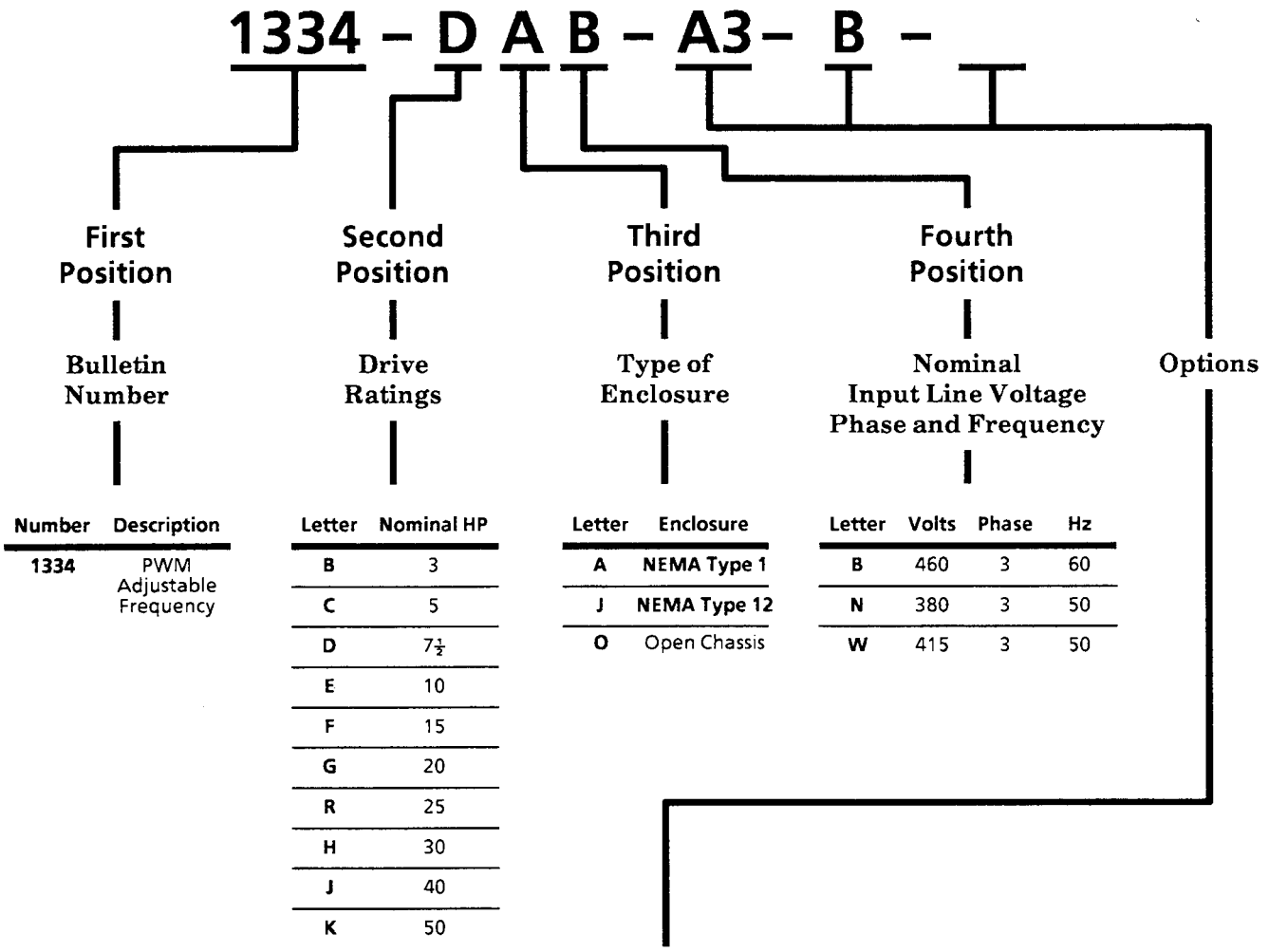
This assembly may contain ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed when testing, servicing or repairing this assembly. If you are not familiar with static control procedures, before servicing, reference U.S. Department of Defense, DOD-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electronic Parts, Assemblies and Equipment or any other applicable ESD Protection Handbook.

ESD (Electrostatic Discharge) generated by static electricity can damage the CMOS devices on various Drive boards. To guard against this type of damage when circuit boards are removed or installed, it is recommended that the following minimum precautions be observed.

- *Wear a wrist type grounding strap that is grounded to the Drive chassis.*
- *DO NOT remove the new circuit board from its conductive wrapper unless a ground strap is worn.*
- *When removing any circuit board from the Drive, immediately place it in conductive packing material.*

2.0 Catalog Number Explanation

The following is an explanation of the catalog numbering system for Bulletin 1334 Adjustable Frequency AC Drives. The catalog number for your Drive can be found both on the packing carton and the Drive nameplate.



Number	Description
1334	PWM Adjustable Frequency

Letter	Nominal HP
B	3
C	5
D	7½
E	10
F	15
G	20
R	25
H	30
J	40
K	50

Letter	Enclosure
A	NEMA Type 1
J	NEMA Type 12
O	Open Chassis

Letter	Volts	Phase	Hz
B	460	3	60
N	380	3	50
W	415	3	50

For Multiple Options, code letters are strung together as necessary separated by a dash.

IMPORTANT

For 380 or 415V AC operation a Function Expander Card (Option L) or Euro Card is required to provide proper volts-per-hertz for 50 Hz motors (the Euro Card is provided as standard for all 380 or 415V AC, 50 Hz Drives).

Bulletin 1334 Specifications

3.0 Specification Table

The following table lists all specifications for Bulletin 1334 Adjustable Frequency AC Drives. All Bulletin 1334 Drives are 460V, sine-weighted, PWM type voltage source inverters that have the capability of operating at 415V AC or 380V AC — 380 & 415V Bulletin 1334 specifications and adjustments are detailed in **Chapter 7. Unless otherwise specified, all descriptions of operation and performance throughout this manual will reference the 460V AC, 60 Hz unit.**

IMPORTANT

The Bulletin 1334 produces a sine-weighted, PWM output voltage at a variable output frequency for application to a standard 3 phase, NEMA Design B induction motor. For applications other than standard NEMA Design B motors, consult your nearest Allen-Bradley Area Sales/Support Center.

Model and Ratings 3-10 HP

Model Number	1334-B_B	1334-C_B	1334-D_B	1334-E_B
① Nominal HP	3	5	7½	10
Input Voltage	460	460	460	460
Output Voltage	0-460	0-460	0-460	0-460
Input Frequency	60	60	60	60
Output Frequency	0-200	0-200	0-200	0-200
Input Amps	4.25	6.5	9.7	13.0
Output Amps	5.0	7.5	11.3	15.0
Input kVA	3.0	5.0	7.7	10.3
Output kVA	4.0	6.0	9.0	12.0

Model and Ratings 15-25 HP

Model Number	1334-F_B	1334-G_B	1334-R_B
① Nominal HP	15	20	25
Input Voltage	460	460	460
Output Voltage	0-460	0-460	0-460
Input Frequency	60	60	60
Output Frequency	0-200	0-200	0-200
Input Amps	18.75	25.0	33.0
Output Amps	21.3	27.6	35.0
Input kVA	15.0	20.0	26.5
Output kVA	17.0	22.0	28.0

IMPORTANT: ① The HP rating shown is for Drives supplied from a 460V AC, 60 Hz power line and is nominal. The limiting factor in the application and use of the Bulletin 1334 Drive is the Output Amp Rating of the Drive.

3.0
Specification Table
(continued)

	Model Number	1334-H_B	1334-J_B	1334-K_B
Model and Ratings 30-50 HP	① Nominal HP	**30**	**40**	**50**
	Input Voltage	460	460	460
	Output Voltage	0-460	0-460	0-460
	Input Frequency	60	60	60
	Output Frequency	0-200	0-200	0-200
	Input Amps	39.0	51.0	62.0
	Output Amps	41.4	54.0	67.8
	Input kVA	31.0	41.0	49.4
	Output kVA	33.0	43.0	54.0

Power Supply	Allowable Variation	Input Voltage — 460V, 3Ø, ±10% Input Frequency — 60 Hz, ±2%
Control Specifications	Output Waveform Control Scheme	Sine Weighted PWM Control
	Output Switching Device	Transistor Power Switching Module
	Output Frequency Regulation	±0.6Hz at 0-40°C Ambient (Analog Input Mode)
	Voltage – Operator Controls	90V AC (12V DC for Local Reversing)
	Overload Capability	150% (Nominal) of Rated Drive Output Current for 60 Seconds
	Starting Torque	150% (Nominal) for 60 Seconds
Standard Controls and Adjustments	② Volts-per-Hertz Selection	3.8V/Hz or 7.6V/Hz (Standard)
	DC Boost	0-34 Volts
	START/STOP	Push Buttons Mounted on Drive Enclosure Door
	Speed Adjustment	Single Turn Potentiometer (1kΩ, 2W) Mounted on Drive Enclosure Door
	Minimum Speed Pot Setting	0-40Hz
	Maximum Speed Pot Setting	40-200Hz
	③ ACCEL/DECEL Rate Adjustment	ACCEL/DECEL Time of 0.4-50 Sec at 0-60Hz Independently Selectable Rates From 1.2 to 152.4 Hz/ Sec
	Stop Mode	Ramp-to-Stop or Coast-to-Stop

IMPORTANT: ① The HP rating shown is for Drives supplied from a 460V AC, 60 Hz power line and is nominal. The limiting factor in the application and use of the Bulletin 1334 Drive is the Output Amp Rating of the Drive.

② For 380 or 415V AC operation, refer to **Chapter 7.**

③ When an analog speed command is applied to the Drive, total ACCEL/DECEL time will be 0.5 to 1.6 seconds longer due to an RC type exponential tapering into the new speed. Rates specified are accurate when a speed command from a Digital Thumbwheel Card (option G, G2) or a BCD Interface Card (option G4) is used.

3.0
Specification Table
(continued)

Protection Circuits and Devices	Input Protection	Fused for 200,000 Amps Symmetrical Interrupting Capacity
	Power Loss Ride-Thru	Nominal .05 Seconds
	Input Transient Protection	Up to 5,000 Volts Peak at 150Ω Line Impedance
	Momentary Overload Protection	Allows Drive to "Ride-Thru" Nominal 150% Overloads for up to 1 Minute by Limiting Output Current
	① Input Under Voltage	414 Volts Nominal
	Output Phase-to-Phase Short Circuit	Monitors Excessive Current in Each Transistor (200% Nominal of Rated Drive Output Current)
	Drive Over Temperature	N.C. Thermal Switch on Heatsink
	Output Ground Short Circuit	Protects Drive Against Output Phase-to-Ground Faults
Diagnostics	Power ON Light	LED Indication When AC Line Power Is Applied to the Drive
	Momentary Overload Protection	LED Indication When a Momentary Drive Overload Occurs or a Momentary Drive Overload has Caused the Drive to Shut Down
	Input Under Voltage	LED Indication if Input Line Drops Below 10% of Rated Drive Input Voltage
	Bus Over Voltage	LED Indication if Bus Rises Above 760V DC
	A, B or C Phase Protect	Individual LED Indication if Drive Transistor Current in Any Phase Exceeds 200% (Nominal) of Rated Drive Output Current
	Brake Over Temperature	If Optional Dynamic Brake is Installed, LED Indication of Excessive Brake Resistor Temperature
	Drive Over Temperature	LED Indication if the Heat Sink Temperature of the Drive Reaches the Maximum Guideline Temperature of the Components
	Bus Charged	Neon Light Indication When Bus Voltage Is Greater Than 42V DC
	Output Ground	LED Indication if the Drive Output Circuitry Has Shorted to Ground (15-50 HP Series A Units Only)
Operating Environment	Ambient Operating Temperature	All Ratings **Open** : 0-40°C Without Derating **Enclosed** : 0-40°C Without Derating
	Relative Humidity	5 to 95% Noncondensing
	Vibration (Normal Mounting Position)	.006 Displacement, 1G Peak
	Shock (Normal Mounting Position)	15G Peak for 11mS Duration (±1.0mS)
	Elevation	All Ratings – 3,300 ft. Without Derating
	Noise Immunity	Showering Arc Transients from 350 to 2,000 Volts
Storage Environment	Ambient Storage Temperature	-25°C to 65°C Enclosed and Open Chassis
	Relative Humidity	5 to 95% Noncondensing

IMPORTANT: ① For 380 or 415V AC operation, refer to **Chapter 7**.

3.0
Specification Table
(continued)

Enclosure	Open Chassis	Available for All Ratings		
	NEMA Type 1	Available for 30-50 HP Ratings Only		
	① NEMA Type 12	Available for All Ratings		
Efficiency	Minimum Efficiency & Input Power Factor at 60 Hz, Full-Load	UNIT	DRIVE EFFICIENCY	② DRIVE POWER FACTOR
		3 HP	93%	.90 kW/kVA
		5 HP	93%	.90 kW/kVA
		7½ HP	94%	.90 kW/kVA
		10 HP	95%	.92 kW/kVA
		15 HP	96%	.91 kW/kVA
		20 HP	96%	.92 kW/kVA
		25 HP	95%	.91 kW/kVA
		30 HP	95%	.92 kW/kVA
		40 HP	96%	.92 kW/kVA
		50 HP	96%	.92 kW/kVA

IMPORTANT: ① The Bulletin 1334 NEMA Type 12 enclosure is suitable for use in NEMA Type 12 applications unless the Door Mounted Digital Thumbwheel Switch (option G) is installed. If this option is installed, the enclosure is only suitable for NEMA Type 1 applications.

② Drive displacement angle power factor is 0.95 to 0.97 constant. Listed values are displacement plus distortion power factor (kW/kVA).

Bulletin 1334 Installation Procedures

4.0 General Environmental Requirements

The Bulletin 1334 should be installed in an area where the following installation and environmental guidelines can be met.

- *Cabinet mounting is upright, leaving room for door clearance and a minimum clearance of (6) inches on all sides for proper ventilation.*
- *The Drive is easily accessible for maintenance and troubleshooting.*
- *The rated altitude does not exceed 3,300 ft. (1,006 meters).*
- *Vibration will be kept to a minimum as outlined in the* **Specification Table**, Chapter 3.
- *The ambient atmosphere is free of corrosive gases.*
- *The relative humidity is kept to within 95% for all Drive ratings.*

For NEMA Types 1 & 12 Drives

- *The rated ambient temperature should not exceed 40°C.*

For Open Chassis Drives

- *The rated heatsink ambient temperature should not exceed 40°C.*
- *The rated chassis component ambient temperature should not exceed 50°C.*

If the ambient temperature and/or altitude of the Drive installation site exceeds these values, contact your nearest Allen-Bradley Area Sales/Support Center for derating information.

4.1 Nonventilated Sheet Metal Enclosures

There are two ways in which an open chassis Drive can be installed in a NEMA Type 1 or 12 enclosure.

1. With both the Drive chassis and heatsink inside the enclosure.
2. With the Drive chassis inside the enclosure and the heatsink extended out the back of the enclosure.

In either case, each Drive chassis must have a customer supplied fan installed that will supply at least 100CFM to circulate air up through the Drive chassis. For 40 & 50 HP Drives which already have an integrally mounted fan, an additional 100 CFM fan must be mounted directly above the chassis to draw air up through the Drive chassis.

- Allow a minimum clearance of at least (6) inches between each Drive chassis when mounting them in a common enclosure.
- Determine the total watt dissipation of all Drives and other heat generating components to be mounted inside the enclosure such as transformers, etc. Total watt dissipation for Bulletin 1334 Drives with both the Drive chassis and heatsink inside the enclosure is shown in **table 4.1.1**.
- Follow the manufacturer's guidelines and any additonal codes and standards applicable to your application.

4.1.1 Enclosure Sizing – Drive Chassis and Heatsink Inside the Enclosure

Although the Drive chassis (excluding the heatsink) is rated for a maximum ambient air temperature of 50°C, the Drive heatsink itself is rated for a maximum ambient air temperature of 40°C. When mounting an open chassis type Drive with the heatsink inside the enclosure, use **table 4.1.1** in combination with the enclosure manufacturer's guidelines for sizing the enclosure. Follow the guidelines listed in **section 4.1** to help ensure that the temperature within the enclosure does not exceed 40°C.

HP	VOLTS	FULL LOAD OUTPUT AMPS	WATTS DISSIPATED	BTUs/HR DISSIPATED
3	460	5.0	215	734
5	460	7.5	320	1,093
7½	460	11.3	440	1,502
10	460	15.0	490	1,673
15	460	21.3	560	1,911
20	460	27.6	740	2,526
25	460	35.0	1,205	4,113
30	460	41.4	1,440	4,915
40	460	54.0	1,520	5,188
50	460	67.8	1,850	6,315

table 4.1.1 – Watt & BTU Dissipation Data for Open Chassis Drives with Heatsink Inside the Enclosure

4.1.2 Enclosure Sizing – Drive Chassis Inside the Enclosure – Heatsink Outside the Enclosure

Even when the Drive is mounted with the heatsink outside the enclosure, there is still heat dissipated within the enclosure by the Drive chassis. **Table 4.1.2** lists the heat dissipation of only the Drive chassis with the Drive heatsink mounted outside the enclosure in a 40°C ambient. Use **table 4.1.2** in combination with the enclosure manufacturer's guidelines for sizing the enclosure. Follow the guidelines listed in **section 4.1** to help ensure that the temperature within the enclosure does not exceed 50°C when the Drive chassis is mounted inside the enclosure while the Drive heatsink is mounted outside the enclosure.

HP	VOLTS	FULL LOAD OUTPUT AMPS	WATTS DISSIPATED	BTUs/HR DISSIPATED
3	460	5.0	65	222
5	460	7.5	96	328
7½	460	11.3	140	478
10	460	15.0	150	512
15	460	21.3	160	546
20	460	27.6	240	819
25	460	35.0	355	1,212
30	460	41.4	440	1,502
40	460	54.0	470	1,605
50	460	67.8	550	1,878

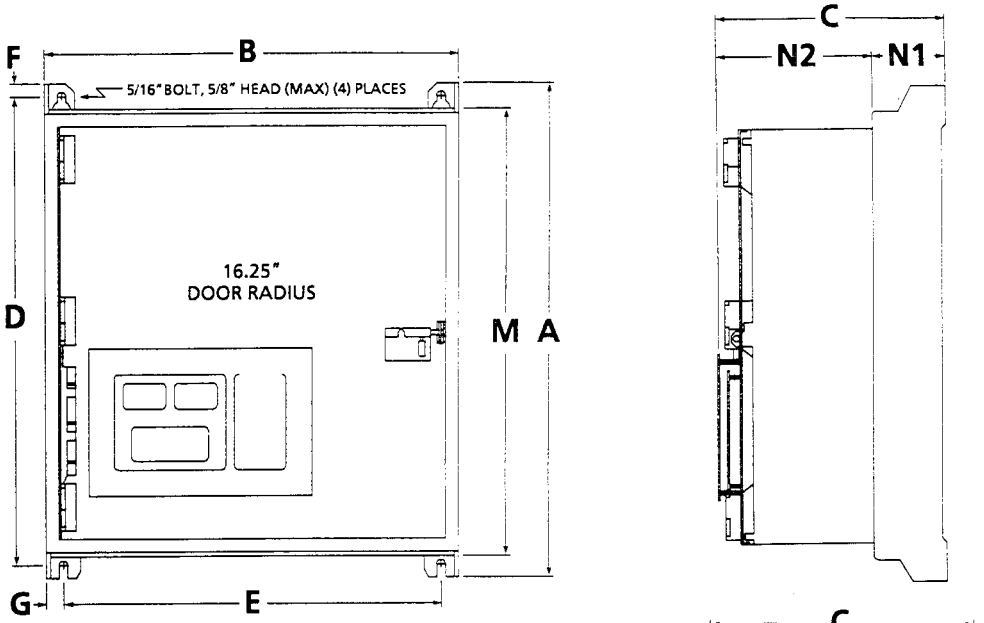
table 4.1.2 – Watt & BTU Dissipation Data for Open Chassis Drives with Heatsink Outside the Enclosure

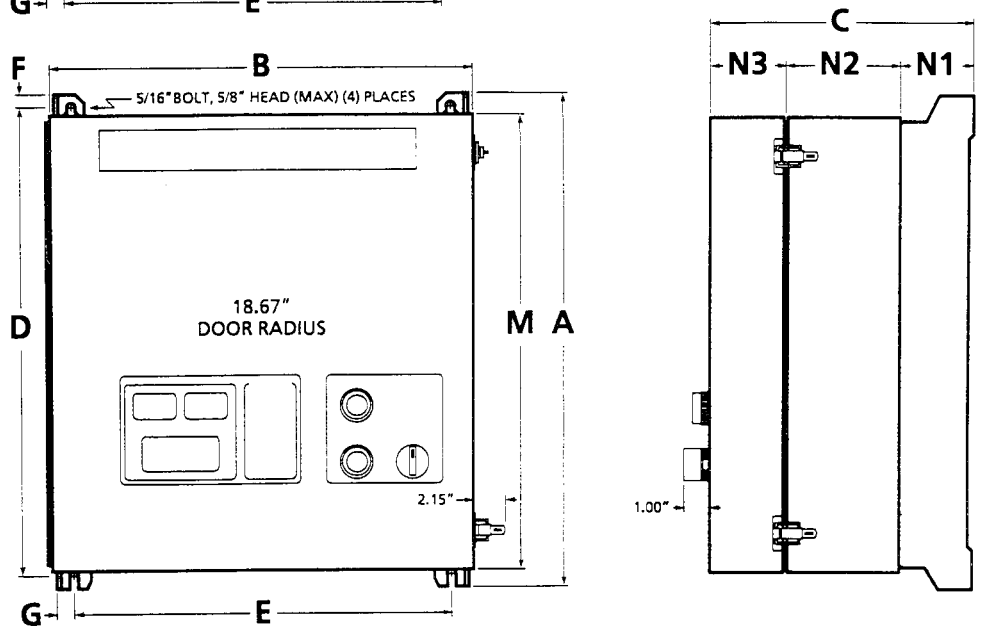
4.2 Dimensions and Weights

3-10 HP Series B Open Chassis & NEMA Type 12

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

	A	B	C	D	E	F	G	M	N1	N2	N3
OPEN CHASSIS	20.00 (508.0)	17.50 (444.5)	11.44 (290.6)	19.00 (482.6)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	18.00 (457.2)	3.50 (88.9)	7.94 (201.7)	
NEMA TYPE 12	20.00 (508.0)	18.38 (466.9)	13.12 (333.2)	19.00 (482.6)	16.00 (406.4)	0.50 (12.7)	1.19 (30.2)	18.88 (479.6)	3.50 (88.9)	6.12 (155.5)	3.50 (88.9)





NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

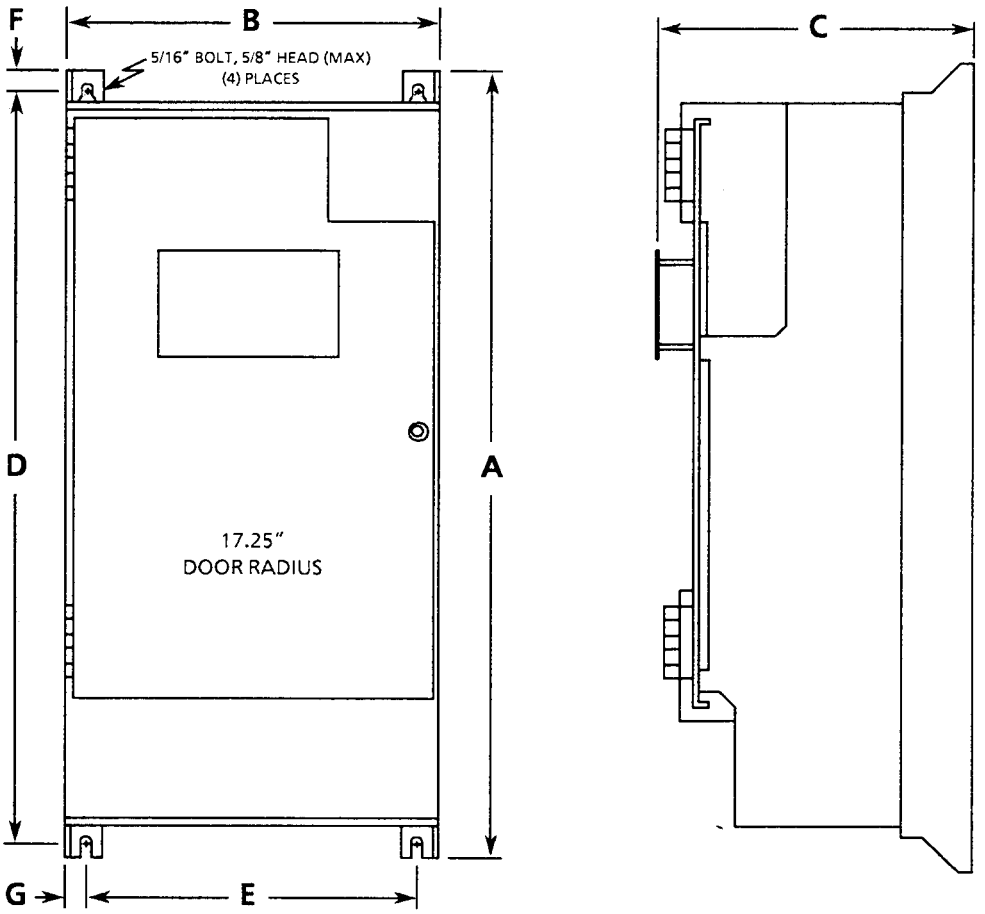
MOUNTING WEIGHT		SHIPPING WEIGHT	
OPEN CHASSIS	**NEMA TYPE 12**	**OPEN CHASSIS**	**NEMA TYPE 12**
53.00 (24.0)	75.00 (34.0)	67.00 (30.4)	89.00 (40.4)

4.2 Dimensions and Weights (continued)

15-25 HP Series A Open Chassis

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

A	B	C 15 & 20 HP	C 25 HP	D	E	F	G
38.00 (965.2)	17.50 (444.5)	13.38 (339.9)	13.88 (352.6)	37.00 (939.8)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)



NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

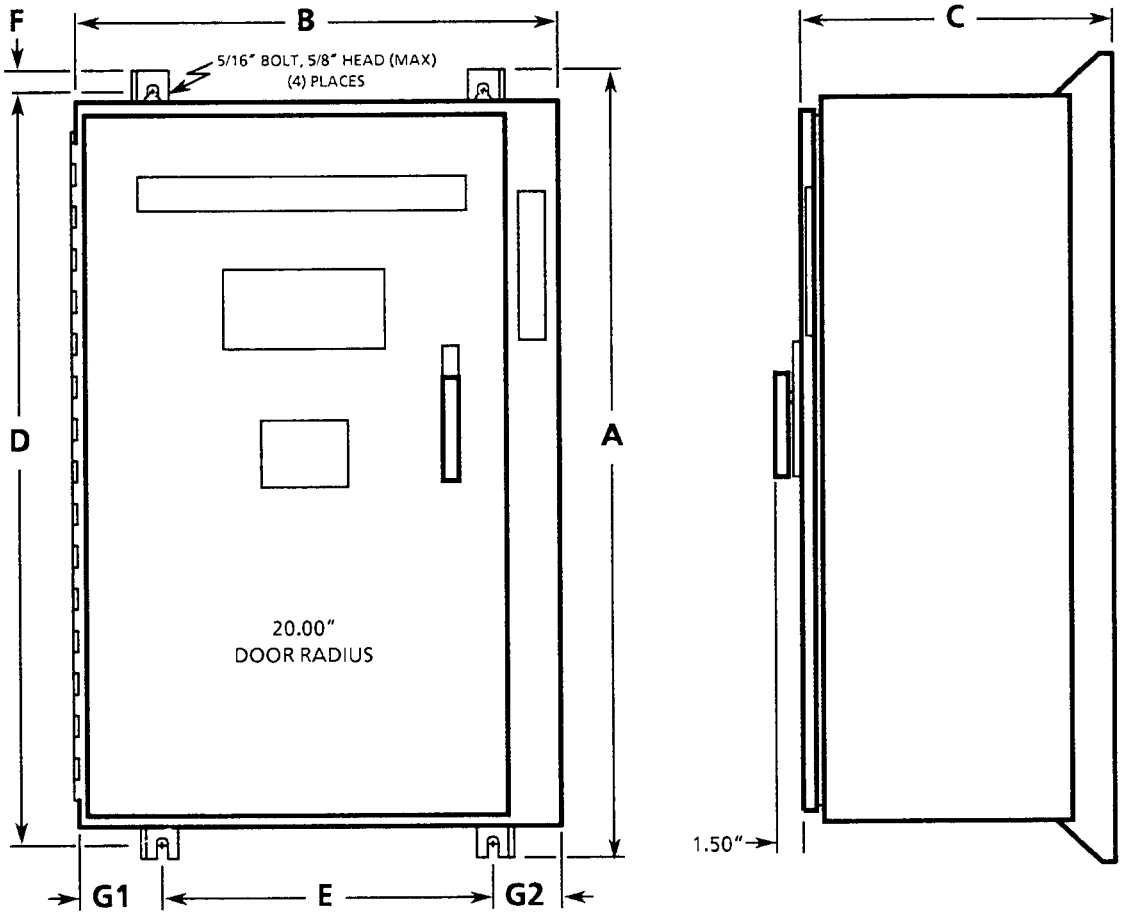
MOUNTING WEIGHT			SHIPPING WEIGHT		
15 HP	20 HP	25 HP	15 HP	20 HP	25 HP
143 (64.9)	146 (66.2)	177 (80.3)	165 (74.8)	168 (76.2)	199 (90.3)

4.2 Dimensions and Weights (continued)

15-25 HP Series A NEMA Type 12

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

A	B	C 15 & 20 HP	C 25 HP	D	E	F	G1	G2
38.00 (965.2)	22.50 (571.5)	15.00 (381.0)	15.50 (393.7)	37.00 (939.8)	16.00 (406.4)	0.50 (12.7)	2.25 (57.2)	4.25 (108.0)



NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

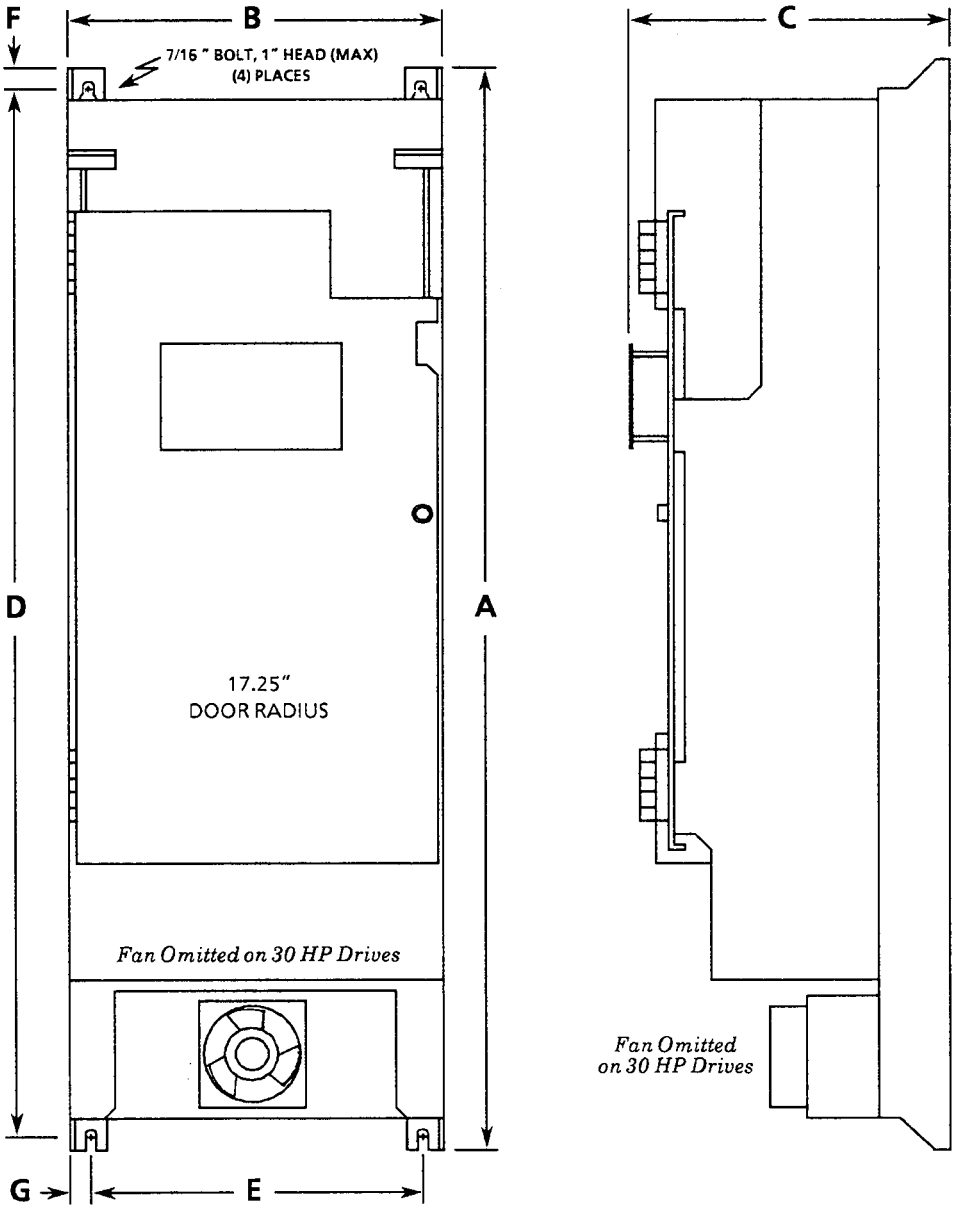
MOUNTING WEIGHT			SHIPPING WEIGHT		
15 HP	20 HP	25 HP	15 HP	20 HP	25 HP
230 (104.3)	233 (105.7)	265 (120.2)	252 (114.3)	255 (115.7)	315 (142.9)

4.2 Dimensions and Weights (continued)

30-50 HP Series A Open Chassis

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

A 30 HP	A 40 & 50 HP	B	C	D 30 HP	D 40 & 50 HP	E	F	G
44.00 (1,117.6)	50.00 (1,270.0)	17.50 (444.5)	13.88 (352.6)	43.00 (1,092.2)	49.00 (1,244.6)	15.50 (393.7)	0.50 (12.7)	1.00 (25.4)



NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

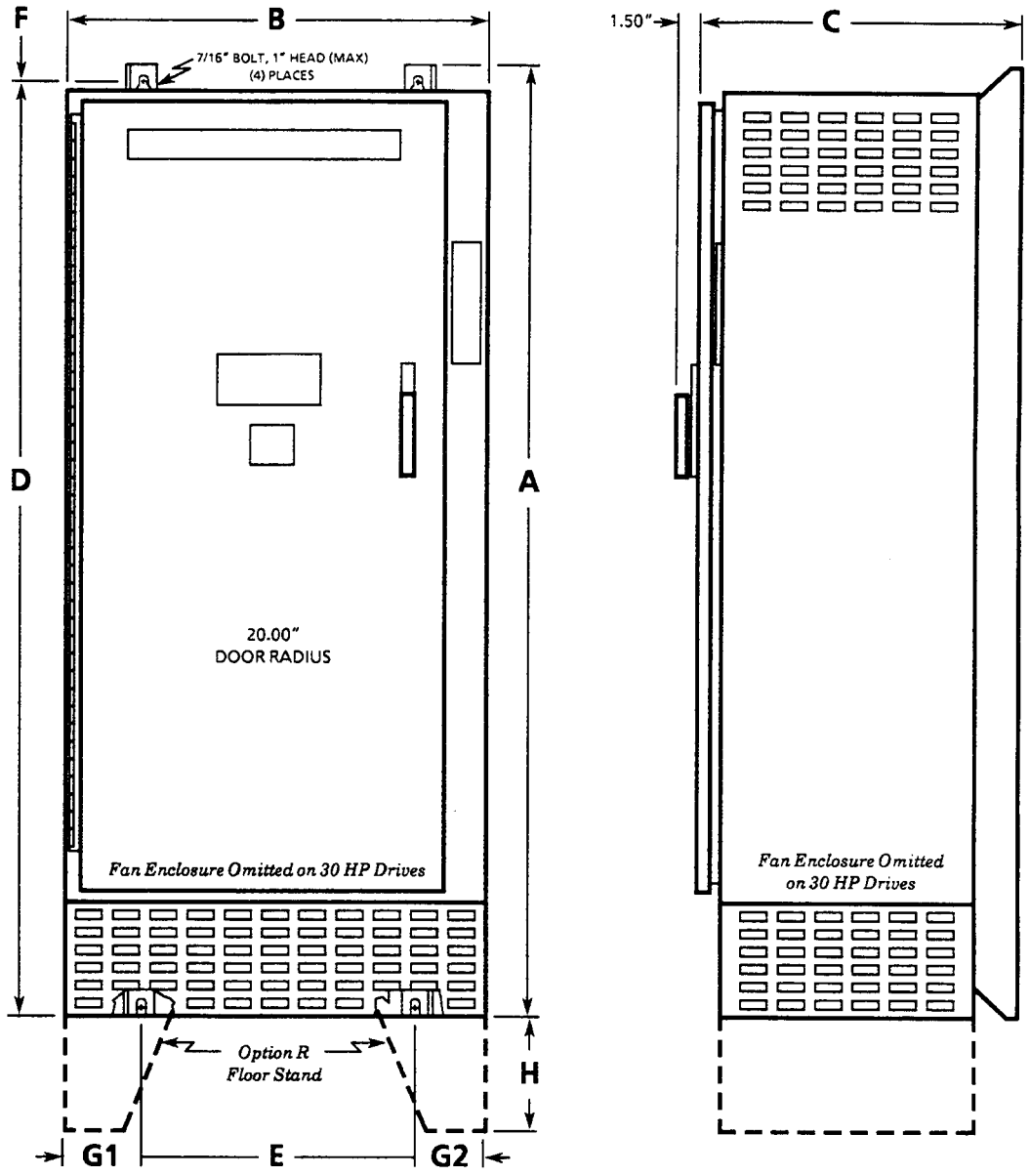
MOUNTING WEIGHT			SHIPPING WEIGHT		
30 HP	40 HP	50 HP	30 HP	40 HP	50 HP
172 (78.0)	208 (94.3)	210 (95.3)	222 (100.7)	258 (117.0)	260 (117.9)

4.2 Dimensions and Weights (continued)

30-50 HP Series A NEMA Type 1

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

A 30 HP *W/O Floor Stand*	A 40 & 50 HP *W/O Floor Stand*	B	C	D 30 HP	D 40 & 50 HP	E	F	G1	G2	H
44.00 (1,117.6)	50.00 (1,270.0)	22.50 (571.5)	15.50 (393.7)	43.00 (1,092.2)	49.00 (1,244.6)	15.50 (393.7)	0.50 (12.7)	2.50 (63.5)	4.50 (114.3)	6.00 (152.4)



NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

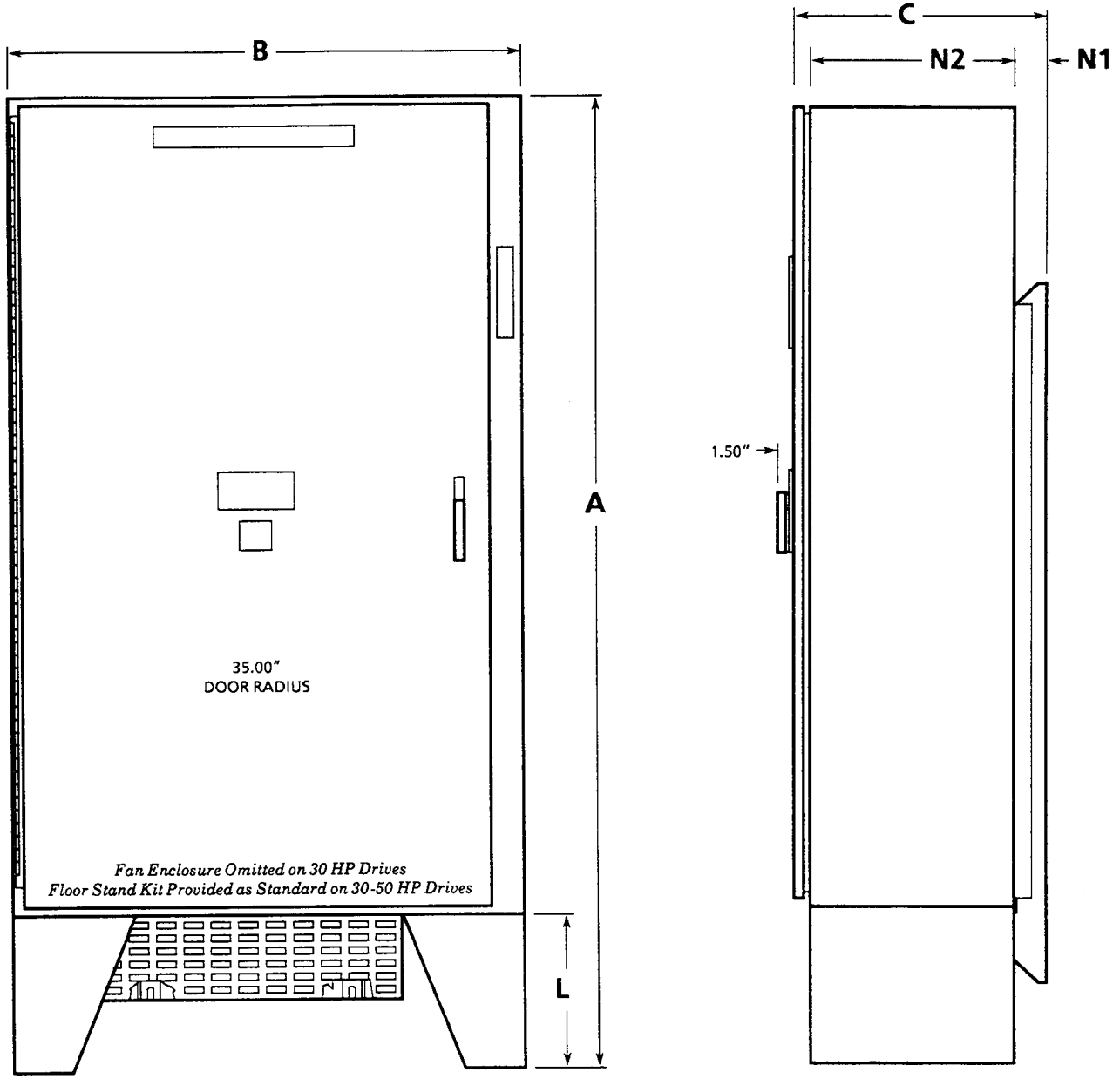
MOUNTING WEIGHT			SHIPPING WEIGHT		
30 HP	40 HP	50 HP	30 HP	40 HP	50 HP
262 (118.8)	298 (135.2)	300 (136.1)	312 (141.5)	348 (157.9)	350 (158.8)

4.2 Dimensions and Weights (continued)

30-50 HP Series A NEMA Type 12

NOMINAL DIMENSIONS
IN INCHES AND (MILLIMETERS)

A *With Floor Stand*	B	C	L	N1	N2
72.00 (1,828.8)	37.38 (949.5)	16.38 (416.1)	12.00 (304.8)	3.50 (88.9)	12.00 (304.8)



NOMINAL WEIGHTS
IN POUNDS AND (KILOGRAMS)

MOUNTING WEIGHT			SHIPPING WEIGHT		
30 HP	40 HP	50 HP	30 HP	40 HP	50 HP
374 (169.6)	385 (174.6)	387 (175.5)	499 (226.3)	510 (231.3)	512 (232.2)

4.3 General Wiring Practices

Depending on the Drive model number ordered, the Bulletin 1334 Adjustable Frequency Drive is designed to operate from either:

- A 3Ø, 60 Hz, 460V AC Input Source
- A 3Ø, 50 Hz, 380V AC Input Source
- A 3Ø, 50 Hz, 415V AC Input Source

Unless otherwise specified, the following information references the 460V AC, 60Hz unit. Refer to **Chapter 7** for 380 & 415V information.

The Drive maximum output voltage is approximately equal to the applied input voltage. Since the Drive maximum continuous current rating does not change with input voltage, the Drive output kVA rating decreases directly with input voltage.

For input AC supply voltages other than those listed in the specifications, an input transformer must be used and connected as indicated on the transformer.

The National Electrical Code (NEC) and local regulations govern the installation and wiring of the Bulletin 1334 Drive. Input power wiring, output power wiring, control wiring, and conduit must be sized and installed in accordance with these codes, the Drive nameplate data, and any Allen-Bradley information supplied with your Drive.

IMPORTANT

1) The National Electrical Code (NEC) requires that branch circuit protection of the AC line input power to the Drive be provided by circuit breaker or fusible disconnect switch. The standard Bulletin 1334 Drive does not provide this requirement.
2) The National Electrical Code requires that motor overload protection be provided in the motor branch circuit. The standard Bulletin 1334 Drive does not provide this requirement.

   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.

   Inverse time protection against motor overload can be obtained by means of the Bulletin 1334 Motor Overload Relay, Option T through T9.

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

4.3.1 Contingency STOP

WARNING

The START/STOP control circuitry in the Bulletin 1334 Drive includes solid state components that can malfunction. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hard wired contingency stop circuit may be required. Refer to codes and standards applicable to your particular system for specific requirements and additional information. A device that removes AC input power when a contingency stop is initiated can be used. When AC input power is removed however, 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.

After an emergency stop has been initiated, allow at least (5) seconds to elapse before reapplying AC input power to the Drive. The allowable number of contingency start/stops are (5) cycles of (3) starts per minute at (20) second intervals. Wait (5) minutes before attempting the next (5) cycles.

4.3.2 Recommended Control Signal Wiring, Power Wiring & Conduit Entry Area

CAUTION

When drilling into the Drive enclosure, be sure to protect Drive components from metal chips that could cause damage to the Drive once power is applied.

All power wiring, control wiring and conduit to the Bulletin 1334 must be made through the top of the Drive enclosure as shown in figures 4.3.2a, b and c on the following page. Connections to the Drive should be made as described in the following sections and in accordance with any additional interconnection diagrams packed with the Drive. Verify that shielded cable and/or steel conduit is used if indicated on any interconnection diagram.

figure 4.3.2a
Bulletin 1334 Series B
3-10 HP
(TOP VIEW)

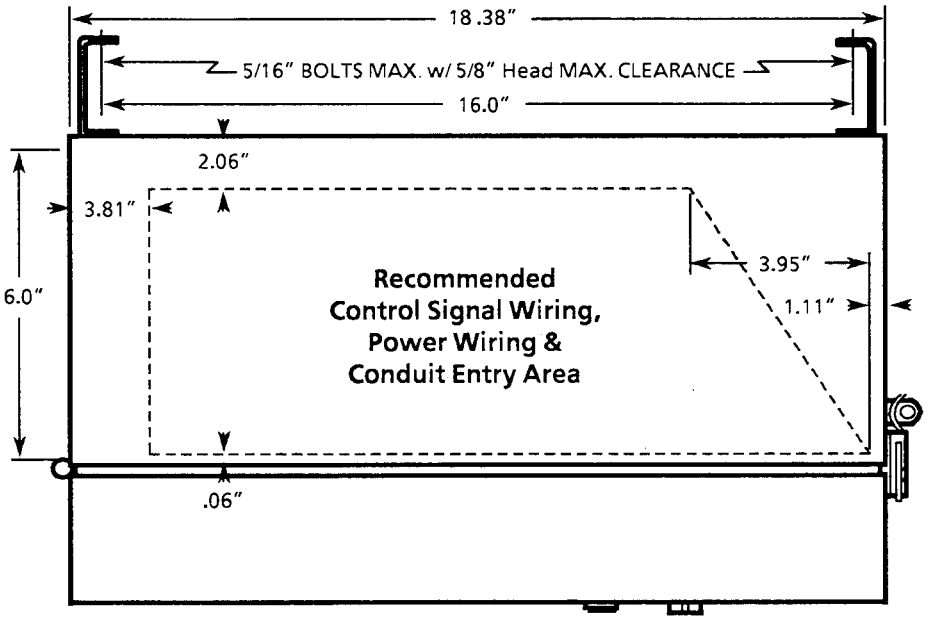


figure 4.3.2b
Bulletin 1334 Series A
15-25 HP
(TOP VIEW)

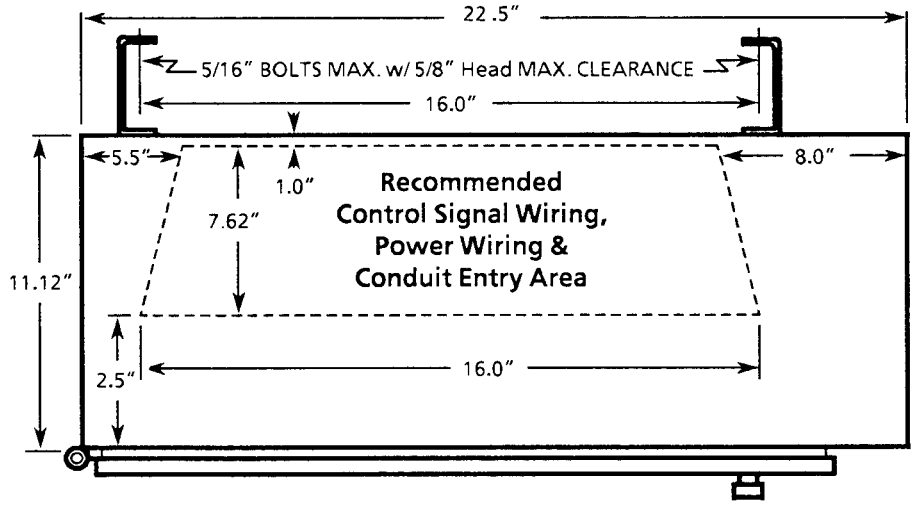
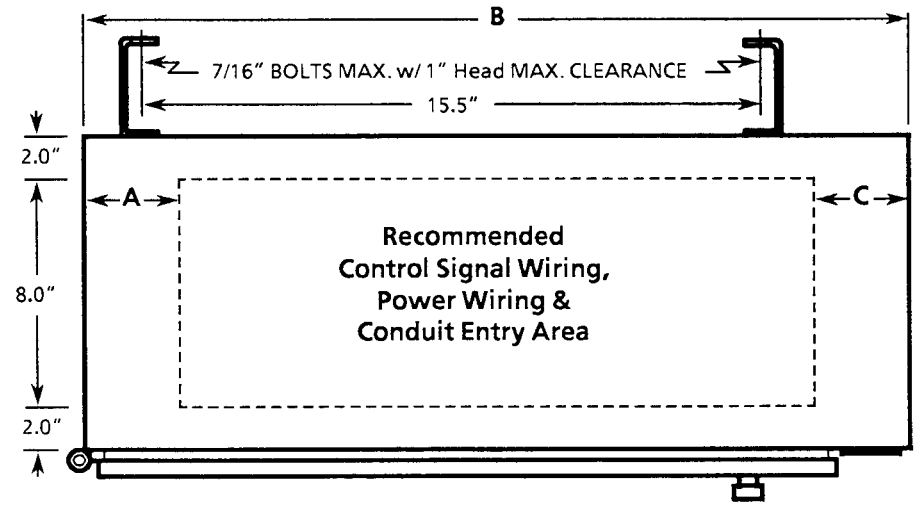


figure 4.3.2c
Bulletin 1334 Series A
30-50 HP
(TOP VIEW)

	A	B	C
NEMA Type 1	2.00"	22.50"	2.00"
NEMA Type 12	5.00"	37.38"	5.00"



4.3.3 Chassis Ground, Power Input & Output Connections

The input and output power connections to the Drive discussed in this section are for the standard Bulletin 1334 Drive. The standard Bulletin 1334 Drive does not include any of the available options. Additional Drive option information and connection drawings are supplied with the Drive as supplements to this manual.

WARNING

Bulletin 1334 Drives have two ground lugs labeled **GND** provided at the top of the Drive back panel. To guard against shock hazards or equipment damage, one of these lugs must be connected to earth ground as shown. Additionally, the motor frame must also be connected to earth ground.

CAUTION

Power factor correction capacitors connected to the Drive output cannot be used. The switching of power factor correction capacitors on the input AC line of the Drive may cause damage to the Drive.

If your application requires the use of power factor correction capacitors or output contactors, consult your nearest Allen-Bradley Area Sales/Support Center.

IMPORTANT

The Bulletin 1334 produces a sine-weighted, PWM output voltage at a variable output frequency for application to a standard 3 phase, NEMA Design B induction motor. For applications other than standard NEMA Design B motors, consult your nearest Allen-Bradley Area Sales/Support Center.

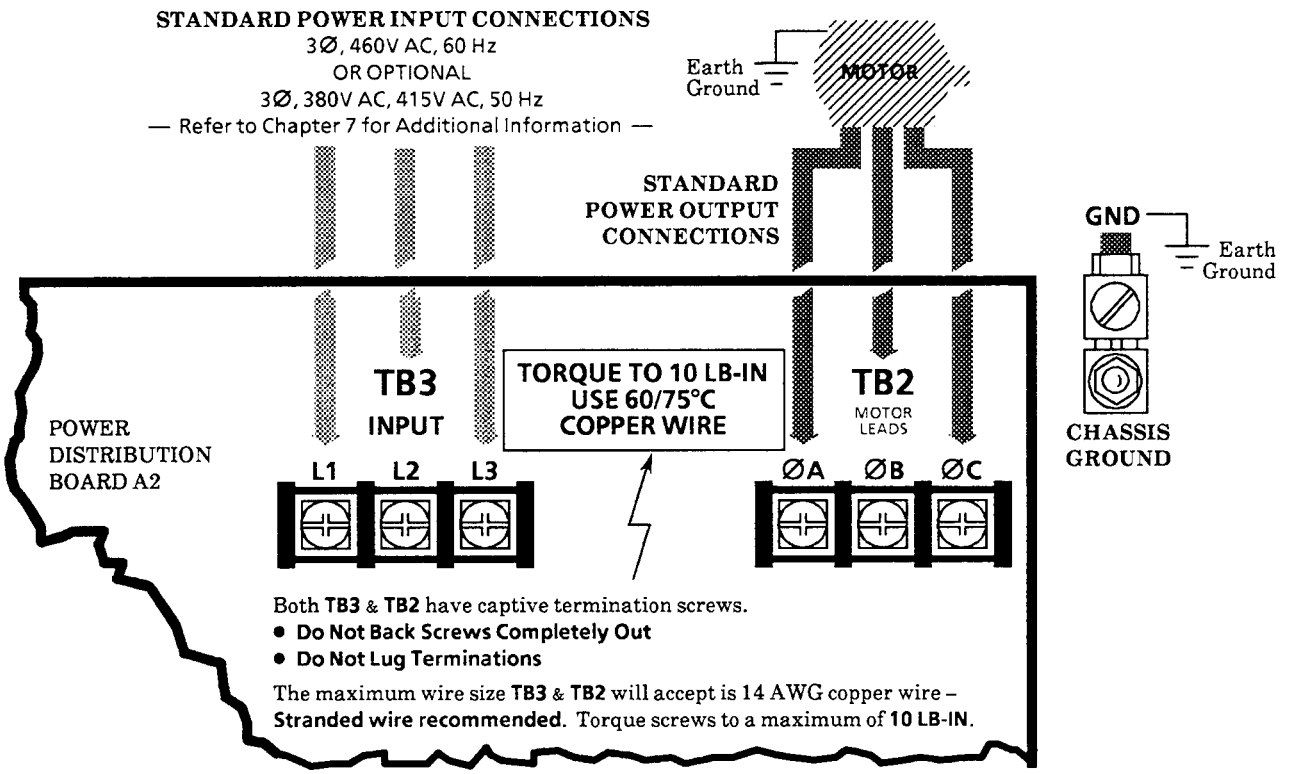


figure 4.3.3a – Bulletin 1334 Series B 3-10 HP Power Input & Output Connections

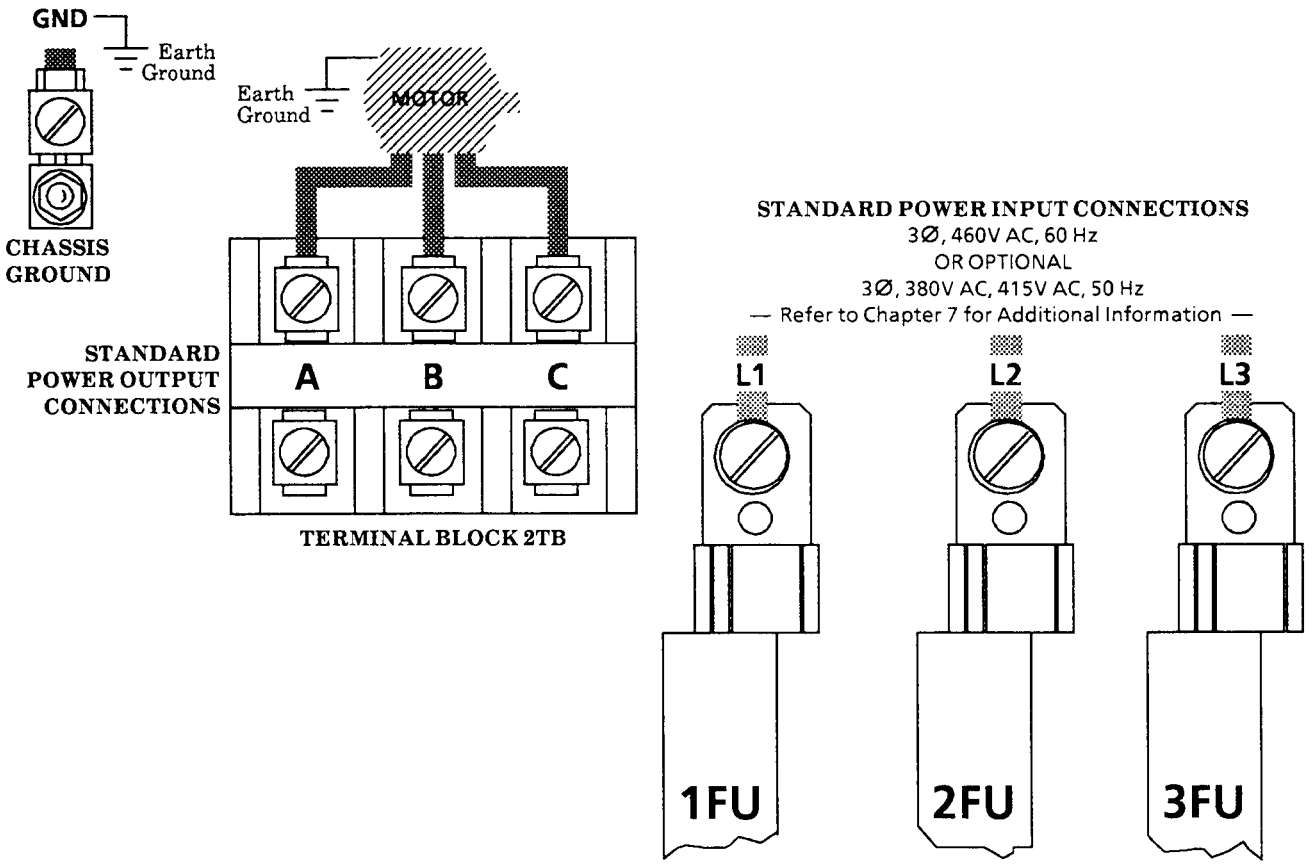


figure 4.3.3b – Bulletin 1334 Series A 15-50 HP Power Input & Output Connections

4.4 Control Wiring

The information on the following pages references control wiring, either factory supplied or field installed. All control wiring should be connected as shown in the following interconnection diagrams. The control and interconnection wiring to the Drive discussed in this section are for the standard Bulletin 1334 Drive. The standard Bulletin 1334 Drive does not include any of the available options. Additional Drive option information and connection drawings are supplied with the Drive as supplements to this manual.

4.4.1 Terminal Block TB1 or 1TB Interconnection Notes

Terminal Blocks TB1 (3-10 HP Series B Drives) and 1TB (15-50 HP Series A Drives) have identical control wiring interconnections except as noted in **sections 4.4.2 – 4.4.5**.

CAUTION

Motor Thermostatic Switch

Direct connection of a motor thermostatic switch to the Drive control circuit may damage the Drive. If a motor thermostatic switch is required to be connected to the Drive control circuit:

Use an interposing N.O. relay contact (customer furnished) to isolate the thermostatic switch from the Drive control circuit. Connect the relay contact between terminals 10 & 11 at Terminal Block TB1 or 1TB as shown in section 4.4.8.

If the Drive is equipped with a Motor Overload Relay, the interposing relay contact from the motor thermostatic switch should be wired in series with the normally closed contact of the Motor Overload Relay as shown in section 4.4.9.

Control Signal Wiring

1) *All* Control Signal Wiring must be run separate from power wiring in its own separate ferrous metal conduit.
2) **If Control Signal Wiring is Required**, any nearby relays, solenoids, or brake coils can produce electrical noise transients and cause erratic Drive behavior. An R-C suppressor device should be added across the coils of these devices. As an alternate, a 220Ω resistor in series with a 0.5μF, 600V capacitor can be used as a suppressor in 120V AC circuits.

Remote Mounted Speed Pot

1) Wiring must be twisted, three conductor wire, having (2) to (3) twists per inch.
2) Wiring must be run in separate ferrous metal conduit to minimize the possibility of electrical noise.
3) **If Shielded Wire is Required**, the shield must be connected to ground only at Terminal Block TB1 or 1TB, term. 11 – The other end must be left floating.

Field Installed START/STOP Control

1) **If Remotely Mounted**, wiring must be run in conduit separate from any speed reference or power wiring.
2) **When Using Remote (3) Wire STOP/START Pushbutton Control**, the local STOP pushbutton must be wired in series with the remote STOP pushbutton. Disconnect existing wires from terminals 8 & 9 and remove the START pushbutton. Install a closing plug and remove or cover the START legend. Refer to **sections 4.4.2 & 4.4.3**.
3) **When Using (2) Wire START/STOP Control Via a Relay Contact**, disconnect existing wires from terminals 7, 8 & 9 and remove both the START & STOP pushbuttons. Install closing plugs and remove or cover both the START and STOP legends. Refer to **sections 4.4.4, 4.4.5 & 4.4.6**.

WARNING

When using (2) wire START/STOP control via a maintained START or RUN contact, the Drive will automatically restart after loss of AC input power once power is restored. 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 device when servicing equipment.

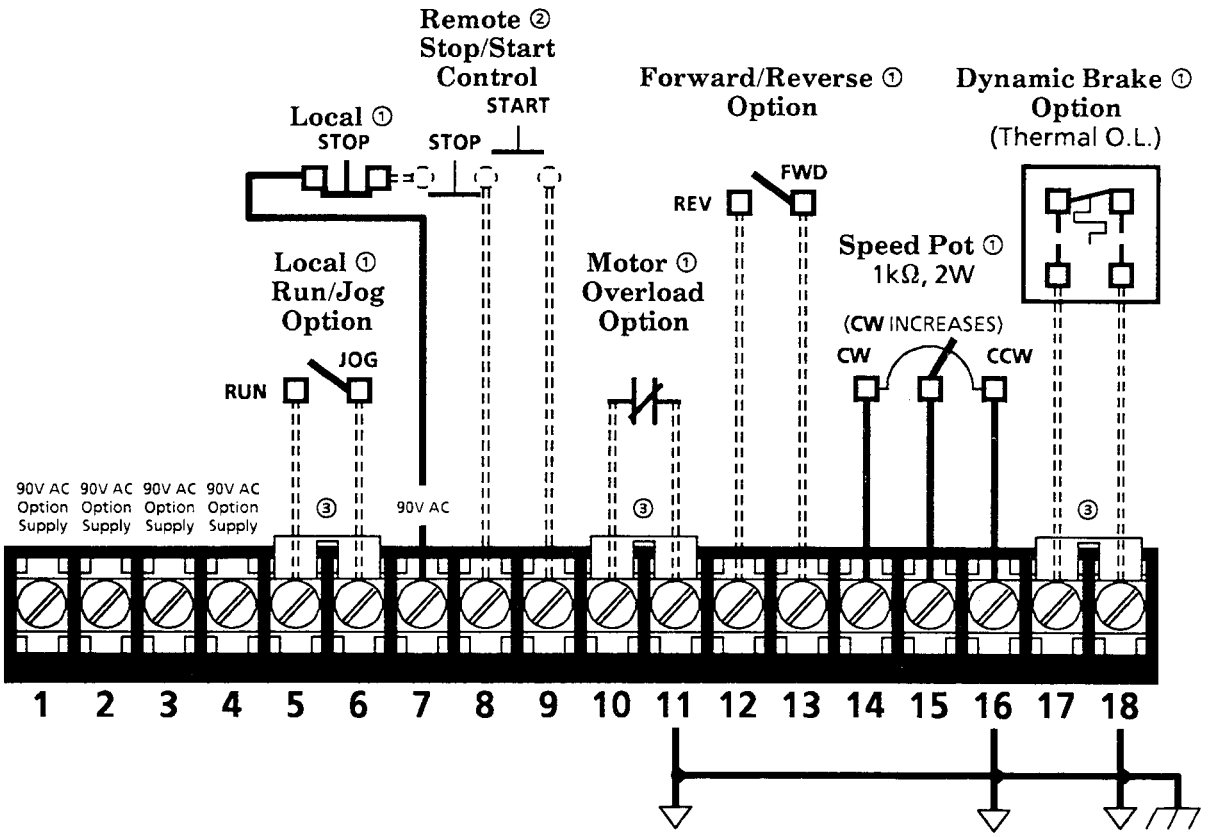
4.4.2 Terminal Block TB1 3-10 HP Series B Standard Interconnection Diagram

IMPORTANT

TERMINAL BLOCK TB1 INTERCONNECTIONS

The maximum wire size **TB1** will accept is 18 AWG – **Stranded wire recommended.** Terminal Block **TB1** has captive termination screws.

- **Do Not Back Screws Completely Out**
- **Do Not Lug Terminations**



① Components May be Supplied by User or Allen-Bradley

② When Using Remote (3) Wire STOP/START Control, the Local STOP Pushbutton Must Be Wired in Series with the Remote STOP Pushbutton

– Disconnect Existing START Pushbutton Wires FromTerminals 8 & 9 and Remove the START Pushbutton

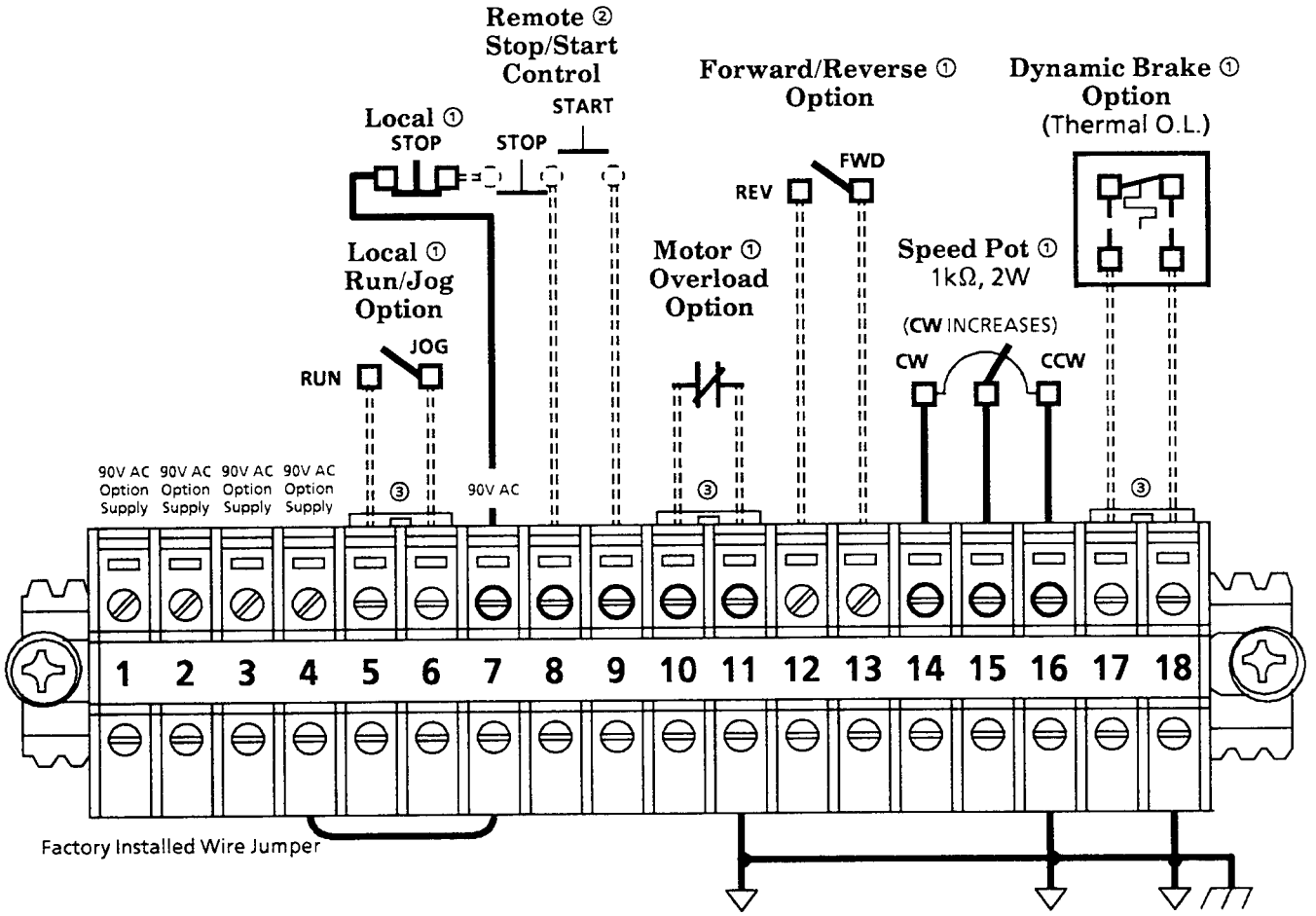
– Install a NEMA Type 12 Closing Plug and Remove or Cover the START Legend

③ Remove Jumper When Connecting Option

⏚ Drive Common

⏚ Chassis Ground

4.4.3
Terminal Block 1TB
15-50 HP Series A Standard
Interconnection Diagram



① Components May be Supplied by User or Allen-Bradley

② When Using Remote (3) Wire STOP/START Control, the Local STOP Pushbutton Must Be Wired in Series with the Remote STOP Pushbutton

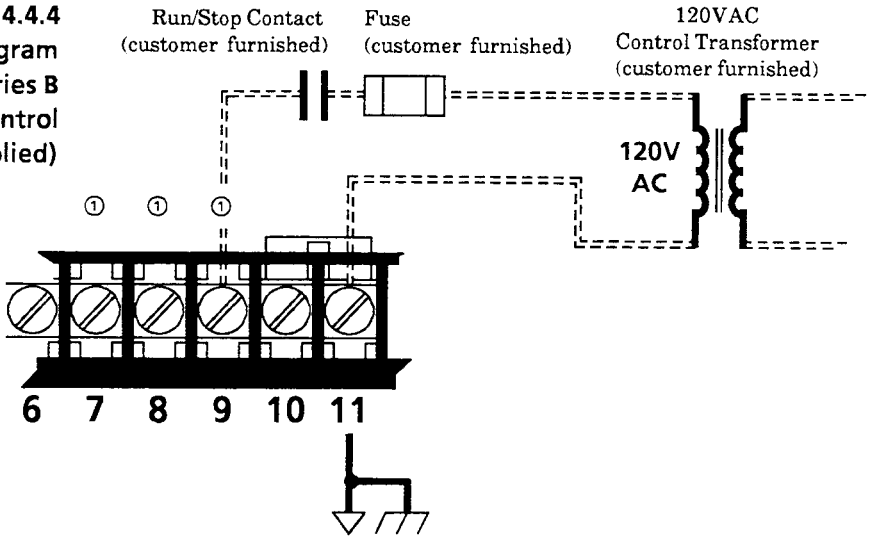
- Disconnect Existing START Pushbutton Wires FromTerminals 8 & 9 and Remove the START Pushbutton
- Install a NEMA Type 12 Closing Plug and Remove or Cover the START Legend

③ Remove Jumper When Connecting Option

⏚ Drive Common

⏚ Chassis Ground

4.4.4 Interconnection Diagram – 3-10 HP Series B Field Installed Run/Stop Control (2-Wire 120V AC, External Supplied)

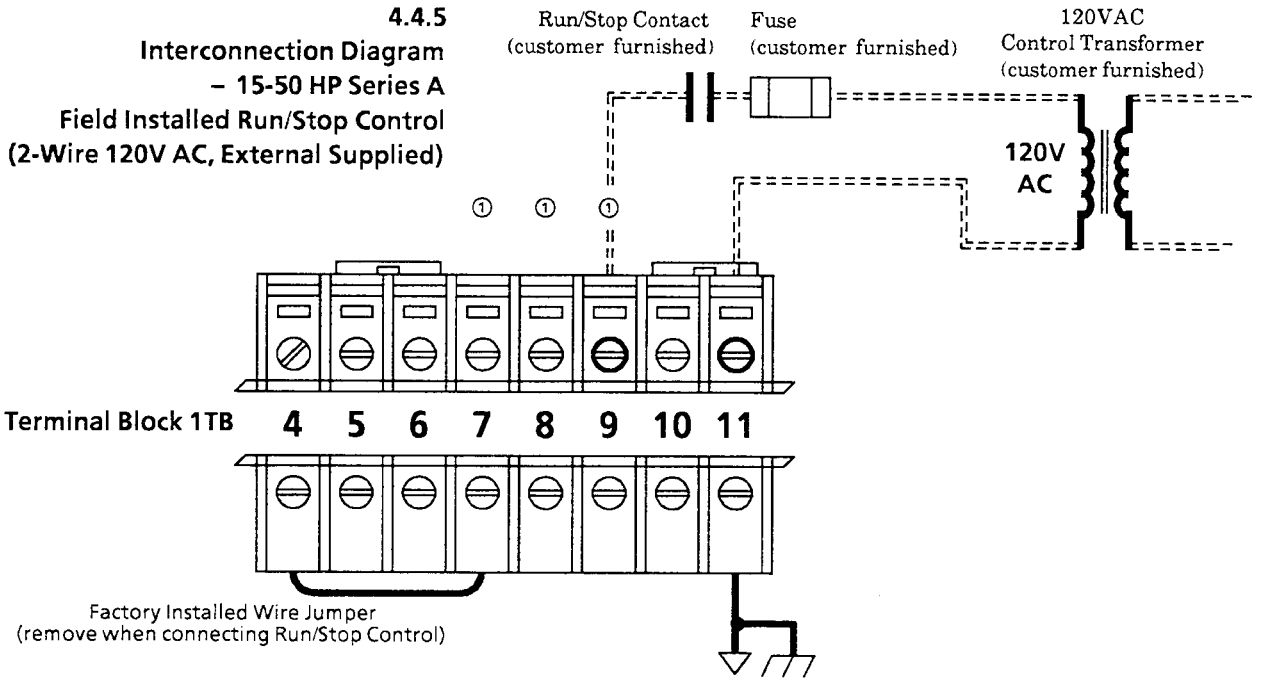


① When Using This Control Scheme, If Drive Has Factory Installed START/STOP Pushbuttons
- Disconnect Existing START/STOP Wires From Terms. 7, 8 & 9 and Remove Both the START & STOP Pushbuttons
- Install NEMA Type 12 Closing Plugs and Remove or Cover Both the START & STOP Legends

⏚ Drive Common

⏚ Chassis Ground

4.4.5 Interconnection Diagram – 15-50 HP Series A Field Installed Run/Stop Control (2-Wire 120V AC, External Supplied)

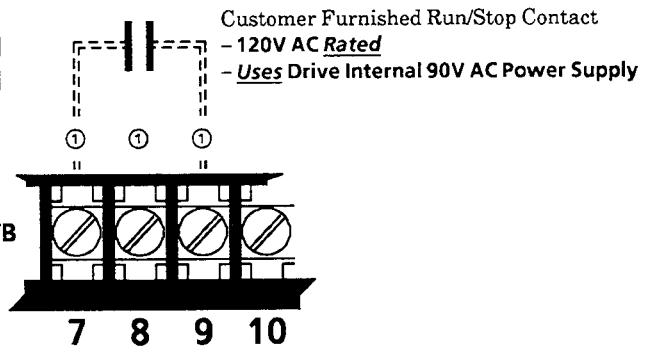


① When Using This Control Scheme, If Drive Has Factory Installed START/STOP Pushbuttons
- Disconnect Existing START/STOP Wires From Terms. 7, 8 & 9 and Remove Both the START & STOP Pushbuttons
- Install NEMA Type 12 Closing Plugs and Remove or Cover Both the START & STOP Legends

⏚ Drive Common

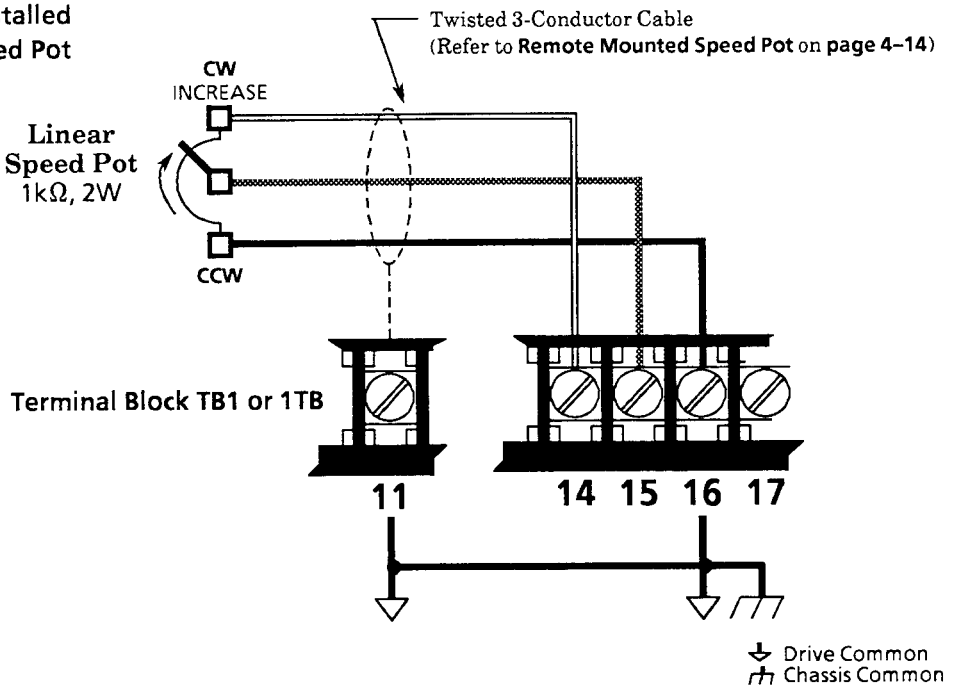
⏚ Chassis Ground

4.4.6 Interconnection Diagram – Field Installed Run/Stop Control (2-Wire 90V AC, Drive Supplied)

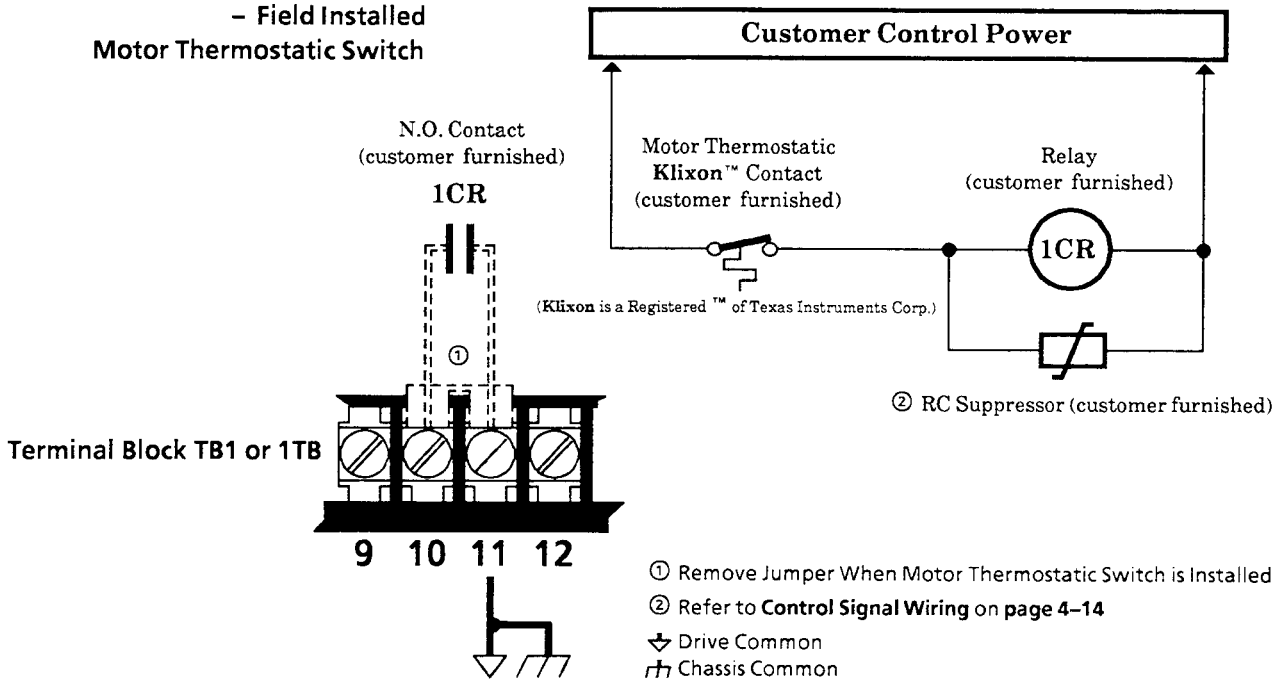


① When Using This Control Scheme, If Drive Has Factory Installed START/STOP Pushbuttons
– Disconnect Existing START/STOP Wires From Terms. 7, 8 & 9 and Remove Both the START & STOP Pushbuttons
– Install NEMA Type 12 Closing Plugs and Remove or Cover Both the START & STOP Legends

4.4.7 Interconnection Diagram – Field Installed Remote Mounted Speed Pot



4.4.8 Interconnection Diagram – Field Installed Motor Thermostatic Switch



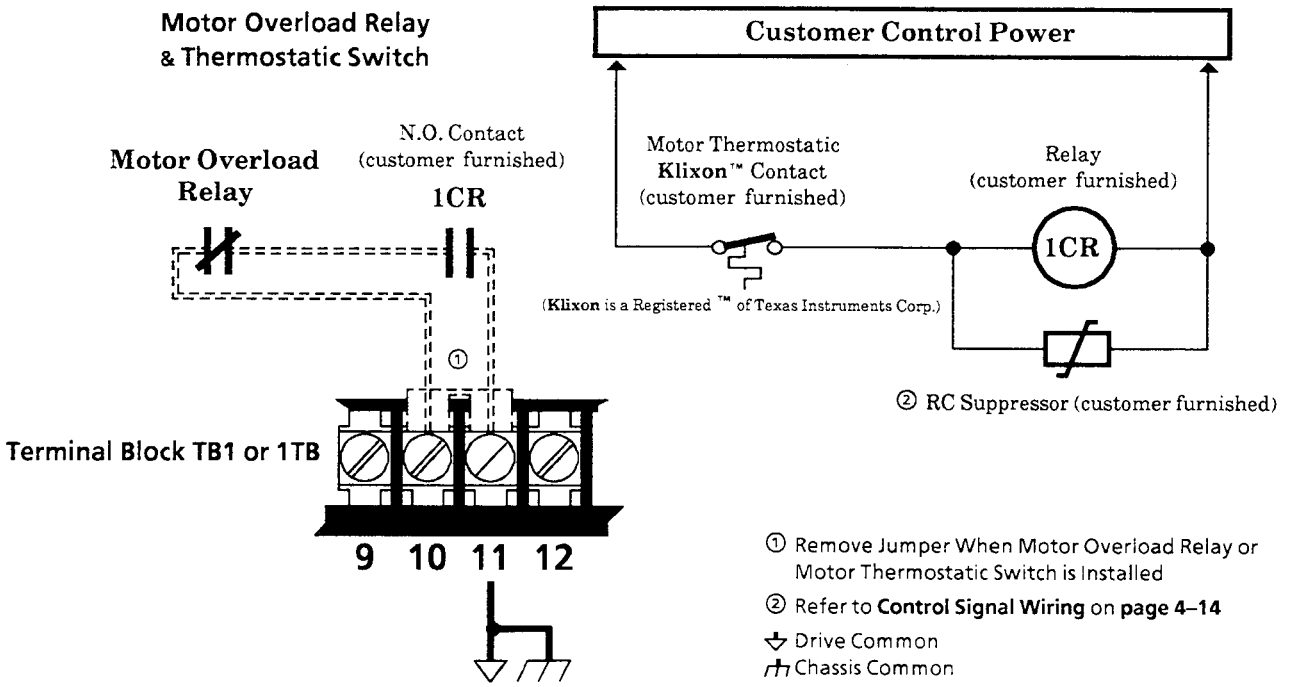
① Remove Jumper When Motor Thermostatic Switch is Installed

② Refer to **Control Signal Wiring** on **page 4–14**

⏚ Drive Common

⏚ Chassis Common

4.4.9 Interconnection Diagram – Field Installed Motor Overload Relay & Thermostatic Switch



① Remove Jumper When Motor Overload Relay or Motor Thermostatic Switch is Installed

② Refer to **Control Signal Wiring** on **page 4–14**

⏚ Drive Common

⏚ Chassis Common

Bulletin 1334 Startup & Adjustment Procedures

5.0 Prepower Check

Each Drive is functionally tested at the factory. It has been adjusted for the output voltage and frequency range indicated on the Drive nameplate. If new settings must be made to meet additional equipment requirements or operator preferences, refer to **section 5.3, Adjustment Procedures.**

Prior to operating the Drive, become familiar with the Drive by locating and identifying all major components for your Drive in **Appendix A, B,** or **C.** Refer to the **Diagnostic Display Panel** for your Drive in **Appendix D, E,** or **F** to become familiar with the fault indication features. Once the Drive has been installed and wired as outlined in **section 4.3, General Wiring Practices,** and **section 4.4, Control Wiring,** proceed as follows.

WARNING

Use specified incoming line fuses to guard against equipment damage and hazards due to ruptured electrolytic capacitors.

Hazardous voltage levels exist on some printed circuit boards and the Drive components.

If diagnostic LED(s) **PROT. A, PROT. B,** or **PROT. C** are lit, hazardous voltages can be present at the output terminals even though the STOP pushbutton has been depressed.

For 3-10 HP Drives if neon light **DS1** on Power Distribution Board A2 is lit, hazardous voltages are present in the Drive cabinet.

For 15-50 HP Drives if neon light **DS1** on Bus Indicator Board A5 is lit (or the Brake Board if installed), hazardous voltages are present in the Drive cabinet.

To guard against personal injury when boards or wires are being disconnected or reconnected or fuses are being replaced always:

Remove Power to the Drive at the Disconnect Device

- **For 3-10 HP Series B Drives, wait (60) seconds, and ensure that DS1 is not lit before servicing. Use a DVM to check for zero volts between pins 11 (+ BUS) & 15 (– BUS) at connector J202 on Power Distribution Board A2 as shown on page A-3.**
- **For 15-50 HP Series A Drives, wait (5) seconds, and ensure that DS1 is not lit before servicing. Use a DVM to check for zero volts between terminals 1 (+ BUS) & 5 (– BUS) at terminal block 4TB on the Drive backpanel as shown in Appendixes B and C.**

5.1 Initial Operation

Before applying input power to the Drive for the first time:

- Verify that all wiring to the Drive is correct and in compliance with the **Installation Procedures** as stated in **Chapter 4** and any additional or supplemental information provided with the Drive.
- With an ohmmeter set to its highest scale, check for grounds between the Drive output terminals and chassis ground (**GND**), as well as between the Drive input terminals and chassis ground (**GND**). Should any unintentional grounds be found, determine their cause and eliminate them prior to applying input power to the Drive.

5.1 Initial Operation (continued)

The Bulletin 1334 employs "power loss ride-thru" which prevents the Drive from shutting down on intermittent loss of input voltage for a nominal 50mS (3 cycles or less). Due to this, the total time between pressing the STOP pushbutton and shut down of the Drive will be a minimum of approximately 50mS. Additional time may elapse before the motor comes to a complete stop depending upon the stop mode selected by the **RTD S/OFF** jumper on the Modulator Logic Board. If the **RTD S/OFF** jumper is set to **OFF**, the output Power Switching Modules will be turned off after approximately 50mS in response to either a STOP command or the removal of input AC line power to the Drive.

If the **RTD S/OFF** jumper is set to **RTD S**, the 50mS delay will again occur when a STOP command is received, but the Drive will decelerate along the set decel ramp to a stop while maintaining excitation to the motor.

In the **RTD S** position when a rated stop occurs and the motor is at rest, a minimum DC Boost is still applied to the motor. This minimum value of excitation however, will not be enough to overheat the motor.

CAUTION : To Guard Against Equipment Damage, Before Pressing the START Pushbutton:

- Set the **Speed Pot** or speed reference to **MINIMUM** (fully CCW).
- Set the **FWD/REV Switch** (if present), to the proper position.
- Set any **AUTO/MAN** switches to **MAN**.
- Uncouple the motor from its mechanical load.

IMPORTANT

Drive Fault Trips

Before resetting any fault trip refer to the Bulletin 1334 Troubleshooting Appendix for your Drive — **D, E** or **F** — to isolate and correct the fault.

Determine the Correct Direction of Motor Rotation

Step 1 **With power removed to the Drive at the disconnect device, set operator switches.**

- If the BCD Interface or Isolated Signal Conditioner Card is installed, ensure that the card mounted **AUTO/MAN** switch is set to **MAN**.
- If the Drive is equipped with a **FWD/REV** switch, set the switch to **FWD** and ensure that the REV/NO REV jumper on the Modulator Logic Board is in the REV position.
- If the Drive is equipped with a **RUN/JOG** switch, set the switch to **JOG**.
- If the Drive is not equipped with a **RUN/JOG** switch, remove the **RUN/JOG** jumper between terminals 5 & 6 at Terminal Block TB1 or 1TB. This will permit the Drive to jog when the **START** pushbutton is depressed.

Step 2 **Apply power to the Drive at the disconnect device.**

Contactor **K1** or **1CON** should close. The amber **POWER ON** LED on the Diagnostic Display Panel should light.

For 3-10 HP Series B Drives, **DS1** the "bus charged" light on Power Distribution Board A2 should light.

5.1 Initial Operation (continued)

Step 3 Set the speed pot or speed reference to 10% speed. Check for correct motor rotation by pressing and releasing the **START** pushbutton (Drive will stop if the **START** pushbutton is not held in).

If the motor runs backwards, wait for the motor to coast-to-stop, **remove input power to the Drive at the disconnect device** and wait (60) seconds. To reverse direction, switch any two motor leads at:

TB2 for 3-10 HP Series B Drives.

2TB for 15-50 HP Series A Drives.

Check again for correct motor rotation by repeating **Steps 2** & **3**. The motor should now rotate in the correct direction.

Once Correct Rotation Has Been Established

Step 1 If the Drive is equipped with a **RUN/JOG** switch, release the **START** pushbutton and set the **RUN/JOG** switch to **RUN**.

Step 2 If the Drive is not equipped with a **RUN/JOG** switch, release the **START** pushbutton and remove power to the Drive at the disconnect device. Wait (60) seconds for 3-10 HP Series B Drives, (5) seconds for 15-50 HP Series A Drives, and reinstall the **RUN/JOG** jumper between terminals 5 & 6 at Terminal Block TB1 or 1TB.

Step 3 Set the **Speed Pot** to **MINIMUM** (fully CCW). Should a minimum speed other than 0 Hz be required, refer to section 5.3.1, **MIN Speed Pot R26** adjustment.

Step 4 If required, reapply power to the Drive at the disconnect device. Press the **START** pushbutton and slowly turn the speed pot CW. The motor should turn and not trip out when the **START** pushbutton is released. Should the Drive trip, refer to **Appendix D, E, or F, Bulletin 1334 Troubleshooting,** before resetting the Drive.

Step 5 If the Drive is equipped with a **FWD/REV** switch its operation must be checked while the motor is running.

Turn the Switch to **REV**. The motor should decelerate to zero speed, reverse direction, then accelerate to the same speed as before.

Slowly run the motor up to full speed and observe its operation. The motor should accelerate up to full speed without the occurrence of a fault trip. Should a maximum speed other than 60 Hz be required, refer to section 5.3.1, **MAX Speed Pot R25** adjustment.

Step 6 Press the **STOP** pushbutton. Restart the Drive and check the motor current at several different speed settings. Continuous currents for approximately (1) minute above the motor rated full load current may seriously damage the motor windings.

IMPORTANT

Clamp on type amp probes and current transformers are frequency sensitive. Inaccurate current readings at frequencies other than 60 Hz may be observed. It is recommended that a true RMS reading clamp on ammeter be used.

5.2 Bulletin 1334 Drive Data Log Sheets

The information below and on the following page should be filled in prior to making any Drive field changes. Any readjustment of Drive factory settings or option changes should be recorded here and on the following page.

Drive Nameplate Data

BULLETIN 1334
ADJUSTABLE FREQUENCY
MOTOR DRIVE

SERIAL NO . _____ Series _____
CATALOG NO . 1334– _____

	INPUT	OUTPUT
VOLTS		
AMPS		
PHASE		
KVA		
FREQ		

THE STANDARD UNIT DOES NOT PROVIDE MOTOR OVERLOAD PROTECTION IN ACCORDANCE WITH NEC.

Motor Nameplate Data

Mfg. : _____

Frame : _____ Type : _____

HP : _____

Volts : _____

Amps : _____

Hertz : _____

RPM : _____

Temp. Rise : _____

_____

_____

Modulator Logic Board **POTENTIOMETER SETTINGS**

MAX Speed Pot R25 – set for _____

MIN Speed Pot R26 – set for _____

Modulator Logic Board **SWITCH SETTINGS**

ACCEL SWITCH S1 – set for _____ Hz/Sec

DECEL SWITCH S2 – set for _____ Hz/Sec

DC BOOST SWITCH S3 – set for _____ Volts

Modulator Logic Board **JUMPER SETTINGS**

- ∩ **90/200 Frequency Range Jumper** – set for _____
- ∩ **H BST/L BST Jumper** – set for _____
- ∩ **RTD S/OFF Jumper** – set for _____
- ∩ **STD/THRD Jumper** – set for _____
- ∩ **IFB/XFB Jumper** – set for _____
- ∩ **REV/NO REV Jumper** – set for _____
- ∩ **VCO/EXT-C Jumper** – set for _____
- ∩ **V/Hz Jumper** – set for _____
- ∩ **NORM/DEC HOLD Jumper** – set for _____

3 thru 10 HP Series B Driver Board **JUMPER SETTINGS**

∩ **Overload Current Limit Threshold Adjustment**

Jumpers S100 & S101 set for ___ HP, position ___

Jumpers S200 & S201 set for ___ HP, position ___

Jumpers S300 & S301 set for ___ HP, position ___

15 & 20 HP Series A Driver Board **JUMPER SETTINGS**

∩ **Overload Current Limit Threshold Adjustment**

A3A Jumpers S1 & S2 set for ___ HP, position ___

A3B Jumpers S1 & S2 set for ___ HP, position ___

A3C Jumpers S1 & S2 set for ___ HP, position ___

Factory Installed Options

Customer Installed Options

5.3 Adjustment Procedures

Once initial operation has been verified and the Bulletin 1334 Drive Data Log Sheets filled in, the motor should be connected to the load and the Drive operated under load conditions. All Drive setup adjustments, with the exception of the overload current limit threshold level adjustment, are located on the Modulator Logic Board. The following adjustments must be made to conform to your specific load requirements and any options installed in your Drive.

MAX Speed Pot R25

MIN Speed Pot R26

ACCEL & DECEL Rate Adjustments

DC Boost Adjustment

Additional settings and adjustments may be required. Refer to the following information and any additional option instructions included with your Drive for final setup procedures.

5.3.1 Modulator Logic Board Potentiometer Settings

CAUTION

Potentiometers **R18** – Brake Adjust, **R19** – Over Voltage Trip Adjust, and **R124** – Voltage Sense Adjust, which have been factory set and sealed, *must not* be readjusted. Readjustment of these pots may cause damage to the motor and/or Drive.

MAX Speed Pot R25

Normally Set to 60 Hz at the Factory. Sets the Drive maximum speed when the Drive speed is controlled from the Manual Speed Pot, or the BCD Interface Card, Option G4.

MIN Speed Pot R26

Normally Set to 0 Hz at the Factory. Independent of **MAX Speed**. Sets the Drive minimum speed when the Drive speed is controlled from the Manual Speed Pot.

IMPORTANT

If the **Isolated Signal Conditioner Card** (option or N or N4) is installed, the **MIN** and **MAX** speed pots are inoperative when the AUTO mode has been selected on the Isolated Signal Conditioner Card.

If either the **Digital Thumbwheel Card** (options G or G2) or the **BCD Interface Card** (option G4) has been installed, the **MIN** speed pot on the card is inoperative when the AUTO mode has been selected.

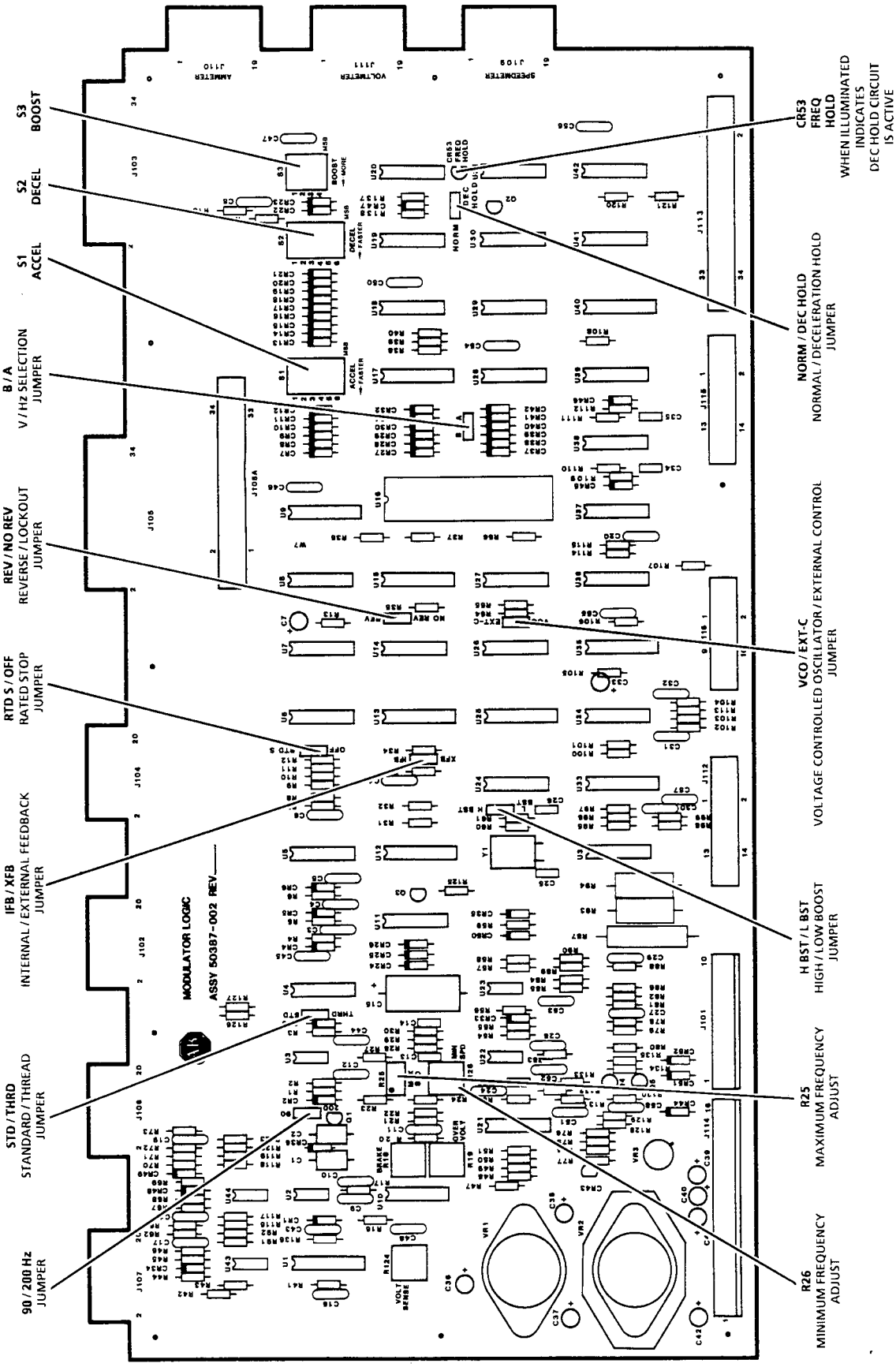


figure 5.3.1 – Modulator Board A1

5.3.2 Modulator Logic Board Jumper Settings

∩ 90/200 Frequency Range Jumper Selection

Normally set to **90** Hz at the Factory. Sets the Drive operating frequency range for either 0-90 Hz or 0-200 Hz.

∩ STD/THRD Jumper

Normally set to **STD** (standard) at the Factory. For either Local or Remote Thread Speed operation, the jumper is set to the **THRD** (thread) position.

∩ IFB/XFB Jumper

Normally set to **IFB** at the Factory. Selects either **IFB** (internal feedback) or **XFB** (external feedback).

∩ RTD S/OFF

Normally set to **OFF** at the Factory. Selects either normal coast-to-stop (**OFF** position), or rated stop (**RTD S** position). In the **RTD S** position, the Drive will decel at whatever the decel rate switch **S2** is set for when the STOP pushbutton is depressed.

∩ REV/NO REV Jumper

Normally set to **NO REV** at the Factory. Used to enable or disable the Drive's ability to respond to a **REVERSE** command.

∩ V/Hz Jumper

Normally Set to **B** at the Factory. If option L, The Function Expander Card or the Euro Card is used, the volts-per-hertz jumper must be removed, otherwise it is set for **A** or **B**.

In the **A** position, the Drive will produce an output of 230V at 60 Hz and 460V at 120 Hz — 3.8 Volts-per-Hertz.

In the **B** position, the Drive will produce 460V at 60 Hz — 7.6 Volts-per-Hertz.

Once the output V/Hz has been established by setting the V/Hz jumper, it can still be affected by:

- *Setting the **H BST/L BST** Jumper and **Switch S3** – DC Boost*
- *Variations in Drive Input Line Voltage*
- *Operating the Drive at Frequencies Above the Frequency at Which Maximum Voltage Occurs*

Or any combination of the above.

∩ H BST/L BST Jumper Selection

Normally Set to **L BST** at the Factory. Sets the Drive DC boost range for either 0-20 volts (low boost – **L BST**) or 0-34 volts (high boost – **H BST**).

∩ VCO/EXT-C Jumper

Normally Set to **VCO** (voltage controlled oscillator) at the Factory. In the **VCO** position it connects the manual speed reference to the speed control circuit. The **EXT-C** position is used with option N or N4, the Isolated Signal Conditioner Card. It allows the option card to supply the frequency reference to the Drive.

5.3.2 Modulator Logic Board Jumper Settings (continued)

∩ NORM/DEC HOLD Jumper

Normally set to **DEC HOLD** (Deceleration Hold). Used to avoid overvoltage trips during deceleration of high inertia or regenerative loads.

In **DEC HOLD** the DC bus voltage is monitored by the Decel Hold circuit for a high voltage condition. If a high voltage condition is sensed — usually caused by decelerating a high inertia load too quickly — the deceleration of the Drive will be paused until the bus voltage decreases. Whenever the Decel Hold circuit is active, LED **CR53 FREQ HOLD** on the Modulator Logic Board will light.

In **NORM** the deceleration hold circuit is disabled. If a high Bus voltage occurs, the Drive will continue at the set deceleration rate. If the Bus voltage rises to the overvoltage trip level, the Drive will trip on an overvoltage fault. The **OVER VOLTS** fault LED will light at the diagnostic display but the **FREQ HOLD** will not be lit.

1. If the **MOPC**, or **PROT. A**, **B** or **C** LED comes on during deceleration, a reduction in the DC boost setting and/or a slower Decel rate may correct the problem.
2. If an **OVER VOLTS** fault trip occurs during deceleration and selecting **DEC HOLD** or a slower decel rate does not correct the problem, consult your nearest Allen-Bradley Sales/Support Center for additional information.
3. If the Dynamic Brake option is used with the Drive, it is recommended to use the **DEC HOLD** position.

5.3.3 Modulator Logic Board Switch Settings

S1 ACCEL and S2 DECEL Rate Adjustments

Both S1 and S2 are (6) position **ON/OFF** designated slide switches that select the ACCEL and DECEL rates within the range of 1.2 Hz/Sec to 152.4 Hz/Sec. ACCEL and DECEL rates are binary weighted as follows. Sliding a given switch from the ON to the ***OFF*** position produces a faster rate of change.

BIT WEIGHTS	
• POSITION **1** =	**2.4** Hz/Sec
• POSITION **2** =	**4.8** Hz/Sec
• POSITION **3** =	**9.6** Hz/Sec
• POSITION **4** =	**19.2** Hz/Sec
• POSITION **5** =	**38.4** Hz/Sec
• POSITION **6** =	**76.8** Hz/Sec

IMPORTANT

1) If an **M.O.P.C.** fault trip occurs during **ACCEL** and readjustment of the DC boost does not prevent the fault trip from reoccurring, a slower **ACCEL** rate may be required.
2) If the **M.O.P.C.** LED comes on or a phase protect trip occurs during **DECEL**, the **DEC HOLD** function and a reduction in the DC boost setting and/or a slower **DECEL** rate may correct the problem.
3) If an **OVER VOLTS** fault trip occurs during **DECEL** and a slower decel rate or the **DEC HOLD** function does not correct the problem, consult your nearest Allen-Bradley Area Sales/Support Center for additional information.

5.3.3
Modulator Logic Board
Switch Settings
(continued)

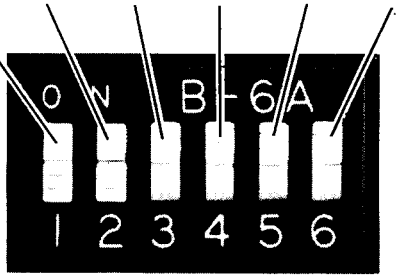
Setting The ACCEL and DECEL Rates

The rates shown below are accurate when a speed command from a Digital Thumbwheel Card (option G, G2) or a BCD Interface Card (option G4) is used. When an analog speed reference is used, total **ACCEL/DECEL** time will be 0.5 to 1.6 seconds longer than rates shown due to an RC type exponential tapering into the new speed.

CAUTION

Never set switches using a ball point pen or pencil. Switches contaminated with conductive debris may cause erratic Drive behavior.

1	2	3	4	5	6	Hz/Sec
ON	ON	ON	ON	ON	ON	1.2
OFF	ON	ON	ON	ON	ON	3.6
ON	OFF	ON	ON	ON	ON	6.0
OFF	OFF	ON	ON	ON	ON	8.4
ON	ON	OFF	ON	ON	ON	10.8
OFF	ON	OFF	ON	ON	ON	13.2
ON	OFF	OFF	ON	ON	ON	15.6
OFF	OFF	OFF	ON	ON	ON	18.0
ON	ON	ON	OFF	ON	ON	20.4
OFF	ON	ON	OFF	ON	ON	22.8
ON	OFF	ON	OFF	ON	ON	25.2
OFF	OFF	ON	OFF	ON	ON	27.6
ON	ON	OFF	OFF	ON	ON	30.0
OFF	ON	OFF	OFF	ON	ON	32.4
ON	OFF	OFF	OFF	ON	ON	34.8
OFF	OFF	OFF	OFF	ON	ON	37.2
ON	ON	ON	ON	OFF	ON	39.6
OFF	ON	ON	ON	OFF	ON	42.0
ON	OFF	ON	ON	OFF	ON	44.4
OFF	OFF	ON	ON	OFF	ON	46.8
ON	ON	OFF	ON	OFF	ON	49.2
OFF	ON	OFF	ON	OFF	ON	51.6
ON	OFF	OFF	ON	OFF	ON	54.0
OFF	OFF	OFF	ON	OFF	ON	56.4
ON	ON	ON	OFF	OFF	ON	58.5
OFF	ON	ON	OFF	OFF	ON	61.2
ON	OFF	ON	OFF	OFF	ON	63.6



1	2	3	4	5	6	Hz/Sec
OFF	OFF	ON	OFF	OFF	ON	66.0
ON	ON	OFF	OFF	OFF	ON	68.4
OFF	ON	OFF	OFF	OFF	ON	70.8
ON	OFF	OFF	OFF	OFF	ON	73.2
OFF	OFF	OFF	OFF	OFF	ON	75.6
ON	ON	ON	ON	ON	OFF	78.0
OFF	ON	ON	ON	ON	OFF	80.4
ON	OFF	ON	ON	ON	OFF	82.8
OFF	OFF	ON	ON	ON	OFF	85.2
ON	ON	OFF	ON	ON	OFF	87.6
OFF	ON	OFF	ON	ON	OFF	90.0
ON	OFF	OFF	ON	ON	OFF	92.4
OFF	OFF	OFF	ON	ON	OFF	94.8
ON	ON	ON	OFF	ON	OFF	97.2
OFF	ON	ON	OFF	ON	OFF	99.6
ON	OFF	ON	OFF	ON	OFF	102.0
OFF	OFF	ON	OFF	ON	OFF	104.4
ON	ON	OFF	OFF	ON	OFF	106.8
OFF	ON	OFF	OFF	ON	OFF	109.2
ON	OFF	OFF	OFF	ON	OFF	111.6
OFF	OFF	OFF	OFF	ON	OFF	114.0
ON	ON	ON	ON	OFF	OFF	116.4
OFF	ON	ON	ON	OFF	OFF	118.8
ON	OFF	ON	ON	OFF	OFF	121.2
OFF	OFF	ON	ON	OFF	OFF	123.6
ON	ON	OFF	ON	OFF	OFF	126.0
OFF	ON	OFF	ON	OFF	OFF	128.4
ON	OFF	OFF	ON	OFF	OFF	130.8
OFF	OFF	OFF	ON	OFF	OFF	133.2
ON	ON	ON	OFF	OFF	OFF	135.6
OFF	ON	ON	OFF	OFF	OFF	138.0
ON	OFF	ON	OFF	OFF	OFF	140.4
OFF	OFF	ON	OFF	OFF	OFF	142.8
ON	ON	OFF	OFF	OFF	OFF	145.2
OFF	ON	OFF	OFF	OFF	OFF	147.6
ON	OFF	OFF	OFF	OFF	OFF	150.0
OFF	OFF	OFF	OFF	OFF	OFF	152.4

5.3.3 Modulator Logic Board Switch Settings (continued)

S3 works in conjunction with the **H BST/L BST** jumper to set the Drive DC boost. Switch S3 consists of (4) rocker switches which allow up to (16) possible DC boost settings.

S3 DC Boost Adjustment

IMPORTANT

Two types of rocker switches are used on the Modulator Logic Board. The switch illustrated below adds more boost when the switch is rocked to ***OPEN***. The alternate switch is CLOSED when the number on the switch is depressed.

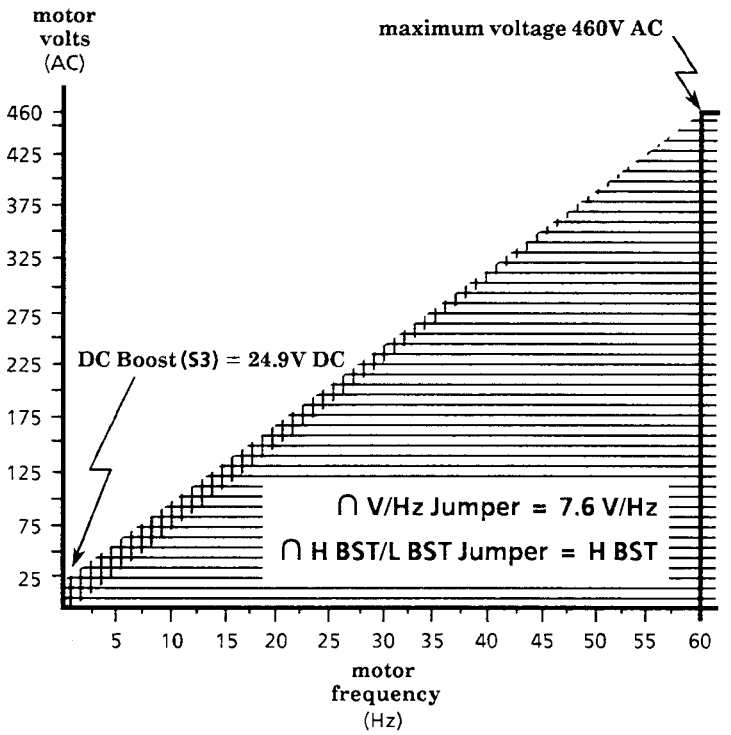
1	2	3	4	BOOST VOLTS L BST	BOOST VOLTS H BST
CLOSE	CLOSE	CLOSE	CLOSE	0	0
OPEN	CLOSE	CLOSE	CLOSE	1.33	2.27
CLOSE	***OPEN***	CLOSE	CLOSE	2.67	4.53
OPEN	***OPEN***	CLOSE	CLOSE	4.00	6.80
CLOSE	CLOSE	***OPEN***	CLOSE	5.33	9.07
OPEN	CLOSE	***OPEN***	CLOSE	6.67	11.33
CLOSE	***OPEN***	***OPEN***	CLOSE	8.00	13.60
OPEN	***OPEN***	***OPEN***	CLOSE	9.33	15.90
CLOSE	CLOSE	CLOSE	***OPEN***	10.70	18.10
OPEN	CLOSE	CLOSE	***OPEN***	12.00	20.40
CLOSE	***OPEN***	CLOSE	***OPEN***	13.30	22.70
OPEN	***OPEN***	CLOSE	***OPEN***	14.70	24.90
CLOSE	CLOSE	***OPEN***	***OPEN***	16.00	27.20
OPEN	CLOSE	***OPEN***	***OPEN***	17.30	29.50
CLOSE	***OPEN***	***OPEN***	***OPEN***	18.70	31.70
OPEN	***OPEN***	***OPEN***	***OPEN***	20.00	34.00

Adding DC Boost

Generally, less DC boost is required as developed motor HP and efficiency increases and starting torque demand decreases. Conversely, more DC boost is required as HP decreases, motor efficiency decreases, and starting load torque increases.

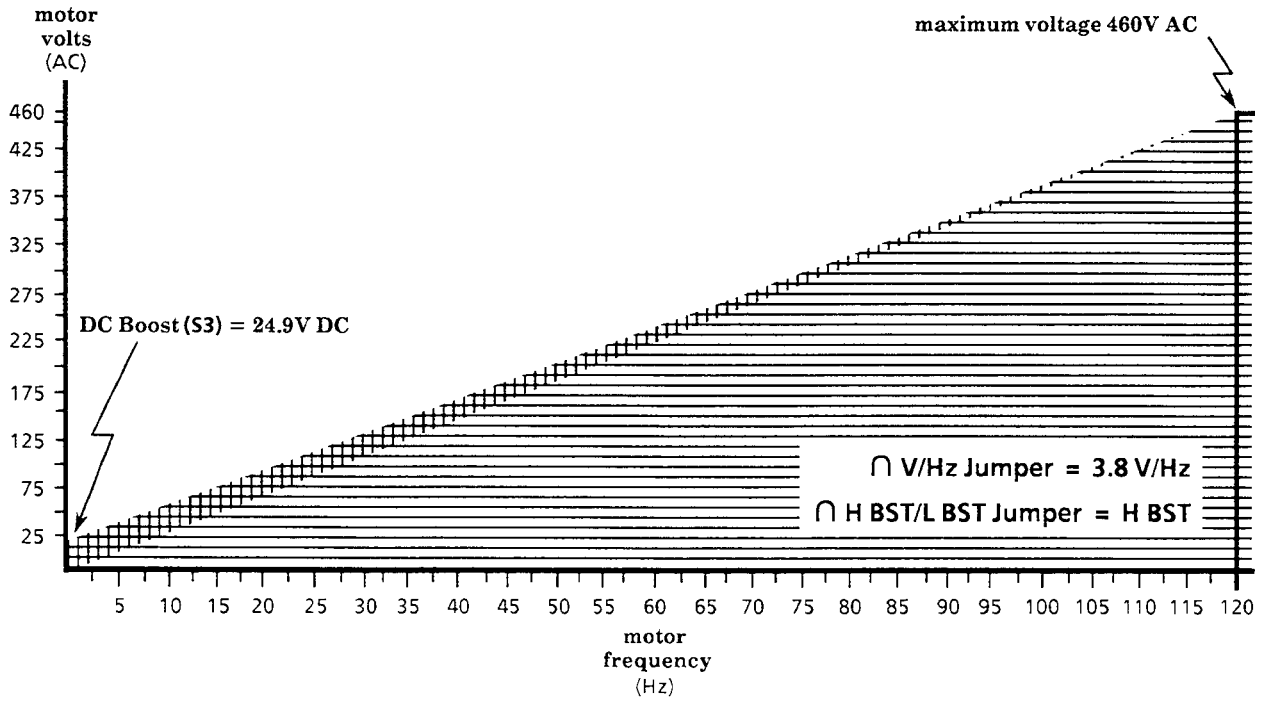
Too little boost will cause the motor to draw more in-phase current, while too much boost may increase the magnetizing current to the motor to the point of saturation. Generally, the best DC boost setting is the lowest value that will consistently start the load. Start with zero boost and increase the setting until capable of developing the required breakaway or starting torque.

5.3.3 Modulator Logic Board Switch Settings (continued)



Decelerating a large inertia load with excessive DC boost may cause the Drive to go into **M.O.P.C.** or experience a phase protect fault trip due to saturation of the motor.

Reducing the DC boost and/or using a slower DECEL rate will usually correct the problem. Reducing the DC boost however, may reduce the motor's ability to start the load. Should this occur, contact your nearest Allen-Bradley Area Sales/Support Center for application assistance.



5.3.4 Driver Board Jumper Settings

IMPORTANT

Driver Board Jumpers for 3-20 HP ratings have been preset at the factory at the HP rating specified on the Drive Nameplate. Field adjustment should not be necessary. Should the Driver Board require replacement, the jumpers should be set as described below and on the following pages prior to installation.

There are no adjustment settings for Bulletin 1334 25-50 HP Driver Boards, however 30-50 HP Driver Boards provide fuse status indication as described in **Appendix F**.

∩ 3-10 HP Series B M.O.P.C. Threshold Level Adjustment

There are two jumpers for each section of the Driver Board – **S100** & **S101** for **SECTION A**, **S200** & **S201** for **SECTION B**, **S300** & **S301** for **SECTION C**. These jumpers establish the threshold level at which the **M.O.P.C.** function becomes active.

All jumpers must be set to the same position as shown in **figure 5.3.4a** to correspond to either a 3, 5, 7½ or 10 HP Drive.

The Driver Board shown, 50905-002, is used by both the 7½ & 10 HP Bulletin 1334. For 7½ HP Drives, all jumpers on this board should be set to the "**A**" position. For 10 HP Drives, all jumpers should be set to the "**B**" position.

The 3 & 5 HP Bulletin 1334 uses a similar Driver Board, 50905-001. For 3 HP Drives, all jumpers on this board should be set to the "**A**" position. For 5 HP Drives, all jumpers should be set to the "**B**" position.

∩ 15 & 20 HP M.O.P.C. Threshold Level Adjustment

There are two jumpers, **S1** & **S2**, for each of the three Driver Boards, **A3A**, **A3B**, & **A3C**. These jumpers establish the threshold level at which the **M.O.P.C.** function becomes active.

All jumpers must be set to the same position as shown in **figure 5.3.4b** on each board to correspond to either a 15 or 20 HP Drive.

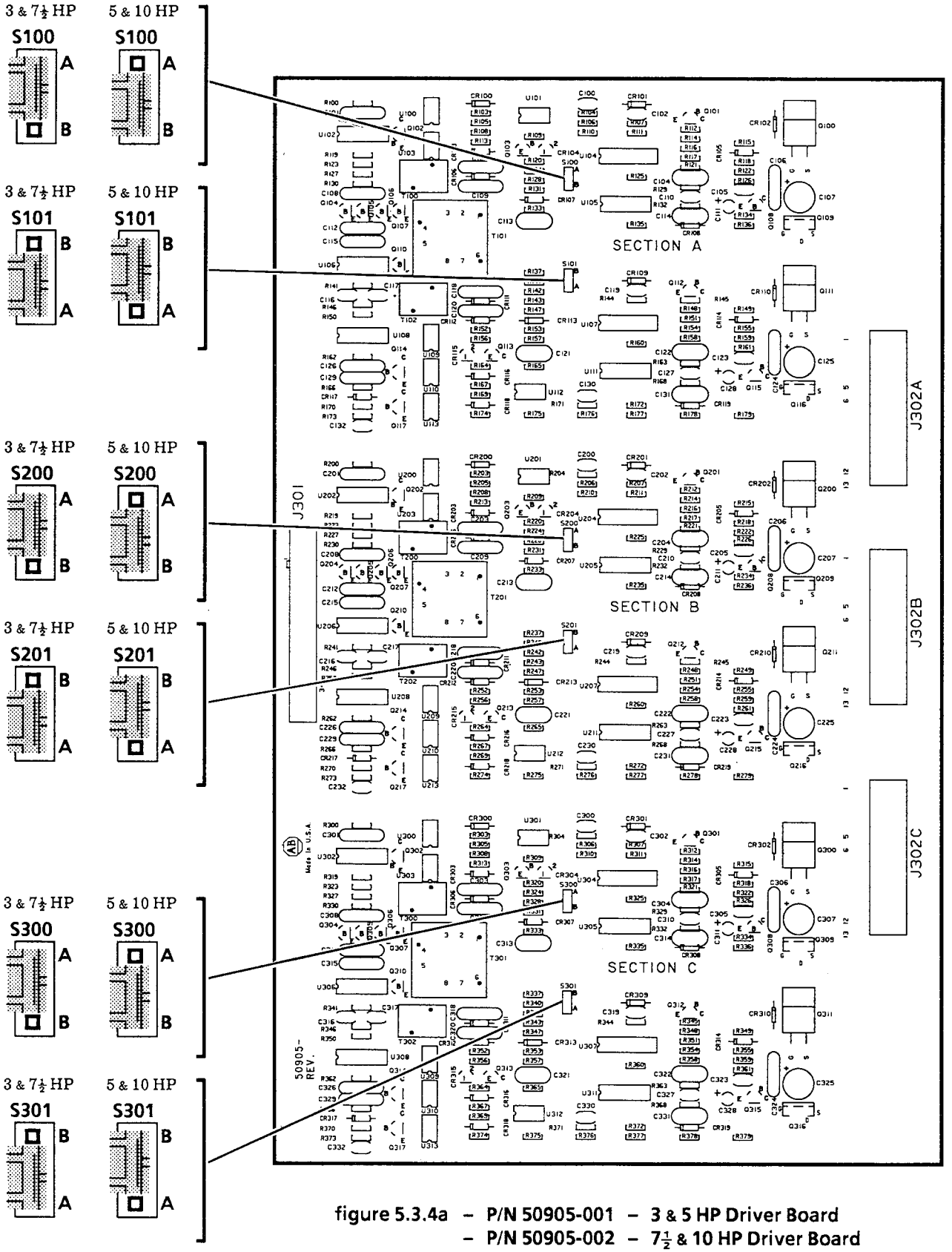


figure 5.3.4a – P/N 50905-001 – 3 & 5 HP Driver Board
– P/N 50905-002 – 7½ & 10 HP Driver Board

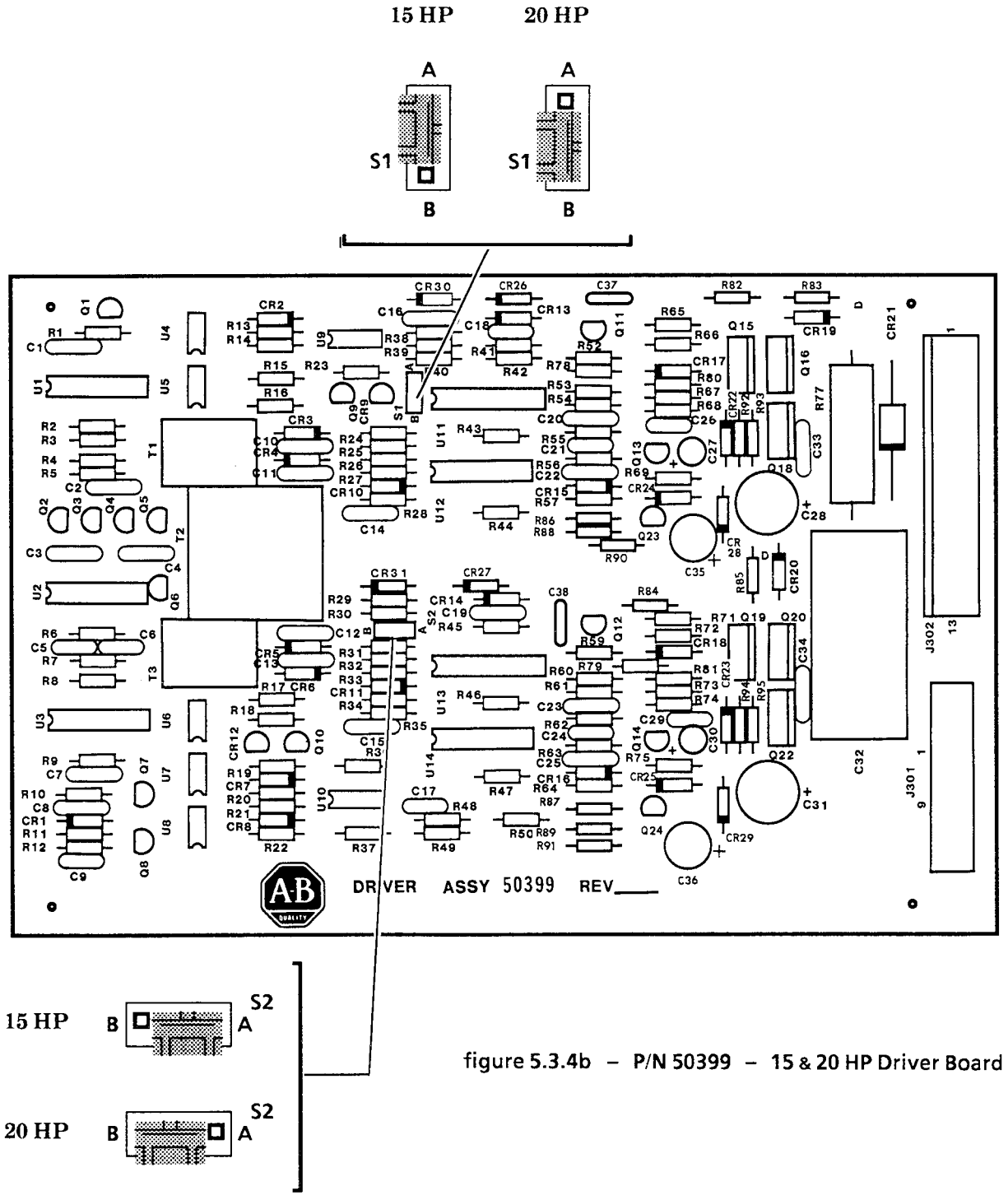


figure 5.3.4b – P/N 50399 – 15 & 20 HP Driver Board

6.0 Principles of Operation

The Bulletin 1334 Drive provides a three phase motor with variable frequency and voltage utilizing PWM (Pulse Width Modulated) technology. Varying the frequency of the applied power to the motor varies the speed of the motor. Maintaining a constant relationship between applied frequency and voltage within the base speed range of the motor results in *Constant Motor Torque* capability.

Typically the nameplate data on motors used in the U.S.A. specify base speed at a frequency of 60 Hz.

To achieve *Constant Horsepower* operation above base speed, the motor voltage remains constant while the frequency is increased. In the motoring mode of operation, the RMS output voltage of the Drive cannot be any greater than the RMS value of its applied AC input voltage. This results in constant horsepower operation of the motor out to a speed that is approximately 1.5 times the motor base speed.

In the constant horsepower range of operation, the motor horsepower remains reasonably constant. The motor output torque drops off inversely as the square of the difference in speed between the motor nameplate base speed, and the operating speed of the motor above base speed.

Figure 6.0a shows the relationship between the output voltage and frequency for a drive system that includes a motor having a base speed of 60 Hz. The output of the Drive is a sine weighted, pulse width modulated pattern.

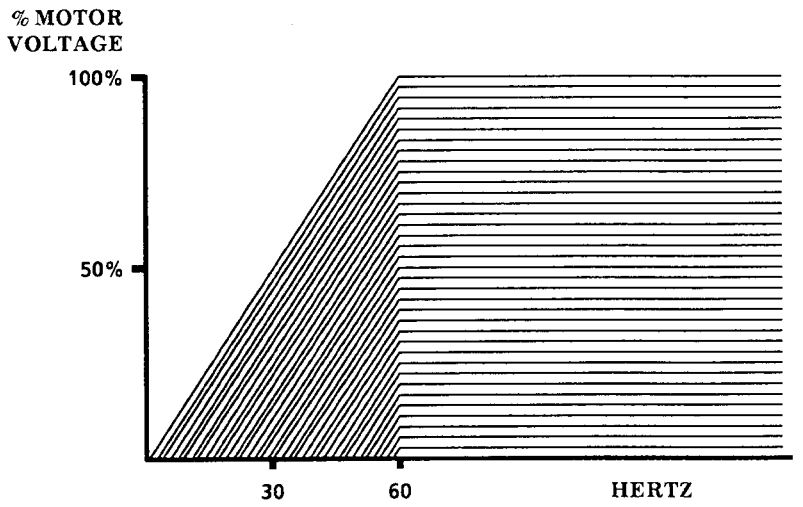


figure 6.0a – Voltage/Frequency Curve

Figure 6.0b illustrates this phase-to-phase output voltage waveform. To illustrate the approximate RMS value, an AC sine wave has been superimposed over the pulse width waveform.

6.0 Principles of Operation (continued)

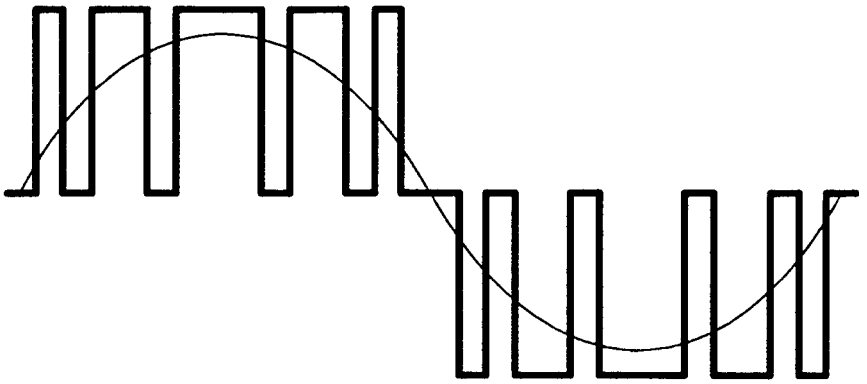


figure 6.0b – Output Voltage Waveform

The "ON" pulse width is decreased to obtain lower RMS voltages and increased for higher voltages. As the Drive output frequency is varied, the number of pulses per hertz changes such that the lower the output voltage, the greater the number of pulses per hertz.

The Bulletin 1334 Drive utilizes transistorized power switching modules that are sourced from a DC power bus in the inverter power section. The switching of these power modules is under the control of a special LSI chip located on the Modulator Logic Board. As the Drive output frequency is varied over its range, the LSI chip establishes the number of pulses per hertz and the duration of these pulses.

6.1 Main Circuit Overview

All Bulletin 1334 Drives can basically be divided into two sections, the **Power Section** and the **Logic and Control Section**.

The **Power Section** contains all of the high voltage and current power devices to convert AC input power to DC. It then inverts the DC to a variable frequency, PWM voltage for application to the AC motor.

The **Logic and Control Section** includes all of the low power signal generating and processing circuits, as well as the logic circuits that control the performance characteristics of the Drive. All customer control functions are interfaced to the Logic and Control Section of the Drive.

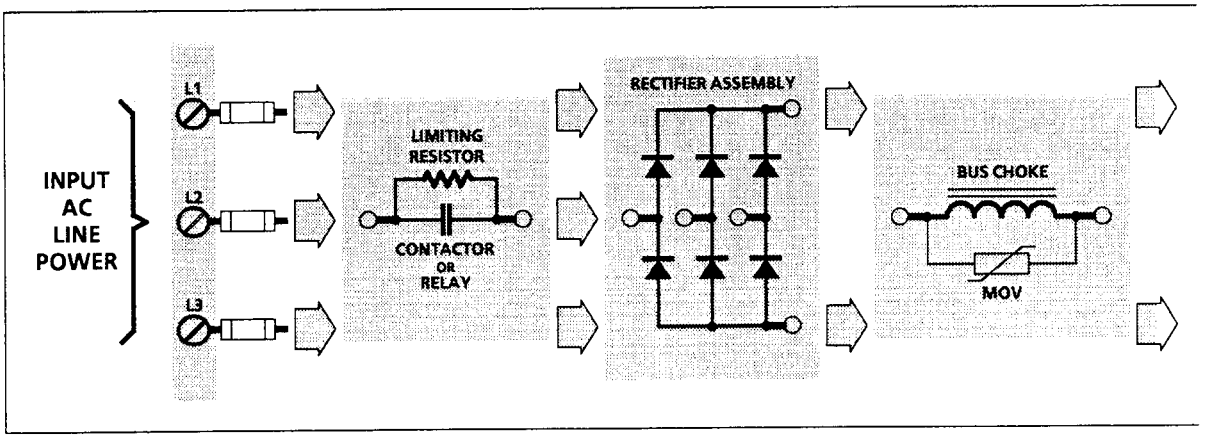


figure 6.2 – Bulletin 1334

6.2 The Power Section

As shown below in **figure 6.2**, the **Power Section** for Bulletin 1334 Drives includes the following circuits:

- **Incoming AC Line Power & Precharge Current Limiting Circuits**
- **Bridge Rectifier, DC Bus & Bus Discharge Circuits**
- **Output Inverting Circuits**

6.2.1 Incoming AC Line Power & Precharge Current Limiting Circuits

Input AC line power connections are made at a terminal block on the Drive that is directly connected to input line fuses. These input line fuses are coordinated with the Drive fault circuitry for protect against short circuits up to a maximum of 200,000 symmetrical amps.

Drive faults are electronically sensed. If a fault is detected, the Drive will shut down in an orderly fashion, and in most cases, without the loss of line fuses. The fault condition is simultaneously annunciated on a Diagnostic Display Board in the Drive.

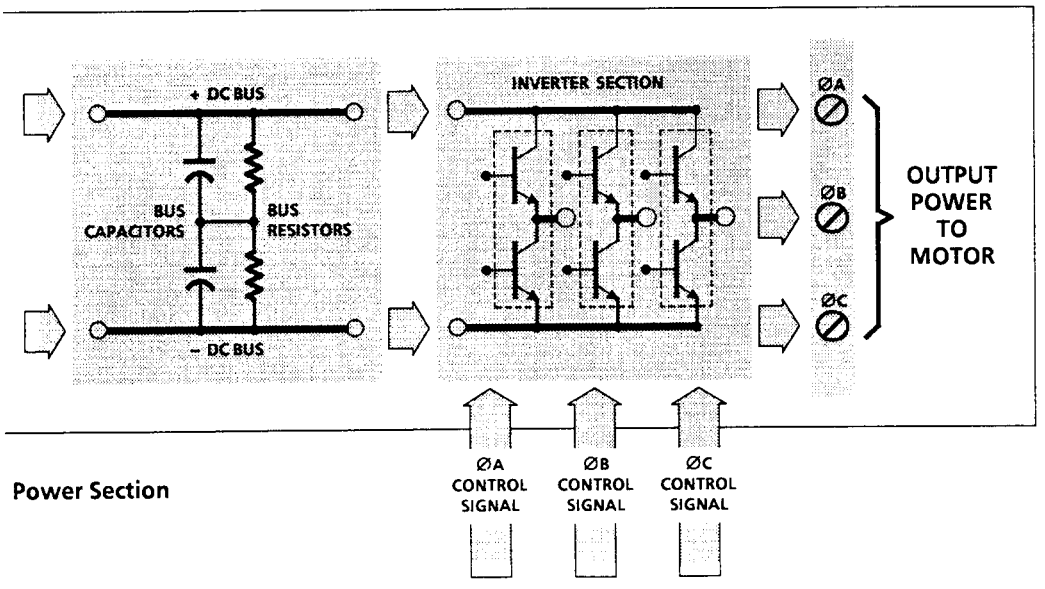
When input AC line power is first applied to the Drive, depending on the Drive rating, one or more resistors function to limit the inrush current of the DC bus capacitors. Once the capacitors have charged to approximately 90% of their final value, the Modulator Logic Board directs either a precharge relay or contactor to pickup and bypass these resistors.

6.2.2 Bridge Rectifier, DC Bus, & Bus Discharge Circuits

The diode bridge rectifier, along with one or more DC bus chokes (depending on the Drive rating), ensures that the Drive presents a high kW/kVA power factor to the incoming AC line. Depending on the Drive rating, metal oxide varistors or suppression devices provide additional protection against voltage transients to the DC bus. The bus chokes, along with the bus capacitors provides filtering that minimizes the RMS current required from the incoming AC line.

The DC bus sources DC voltage to the output power devices. Resistors connected across the bus capacitors ensures that bus voltage is equally distributed across the capacitors.

The working DC bus potential is nominally 1.414 times the RMS value of the incoming AC line voltage. For a 460V AC line, the DC bus potential would be 650V DC.



Power Section

6.2.2 Bridge Rectifier, DC Bus, & Bus Discharge Circuits (continued)

To avoid leaving high voltage on the DC bus and bus capacitors after power is removed, resistors drain off the bus capacitors to 42 volts within sixty seconds for Series B Drives. For Series A Drives, an addditonal board has been provided that allows the DC bus to fall below 42 volts within five seconds. For all Drives, a neon glow tube is illuminated whenever the DC bus potential is greater than 42V DC.

6.2.3 Output Inverting Circuits

The output inverting circuits invert the DC bus voltage to three phase AC voltage for the motor. Depending on the Drive rating, the main power components in these circuits are either three or six transistorized power switching modules.

Whether three or six switching modules are used, the modules are gated "ON" and "OFF" at the proper time by one or more driver boards. Each driver board, (or if only one master driver board is used, each section of the master driver board), controls the modules for a single phase – A, B or C. Each individual board, or section of the master driver board, is in turn under the direction of the LSI chip on the Modulator Logic Board. In this way, a variable frequency, pulse-width modulated output voltage is applied to the motor.

A typical three phase, sine weighted, PWM output wave form is illustrated in **figure 6.2.3a**. Proper 120° phase shift between output phases A, B and C remains constant over the entire output frequency range.

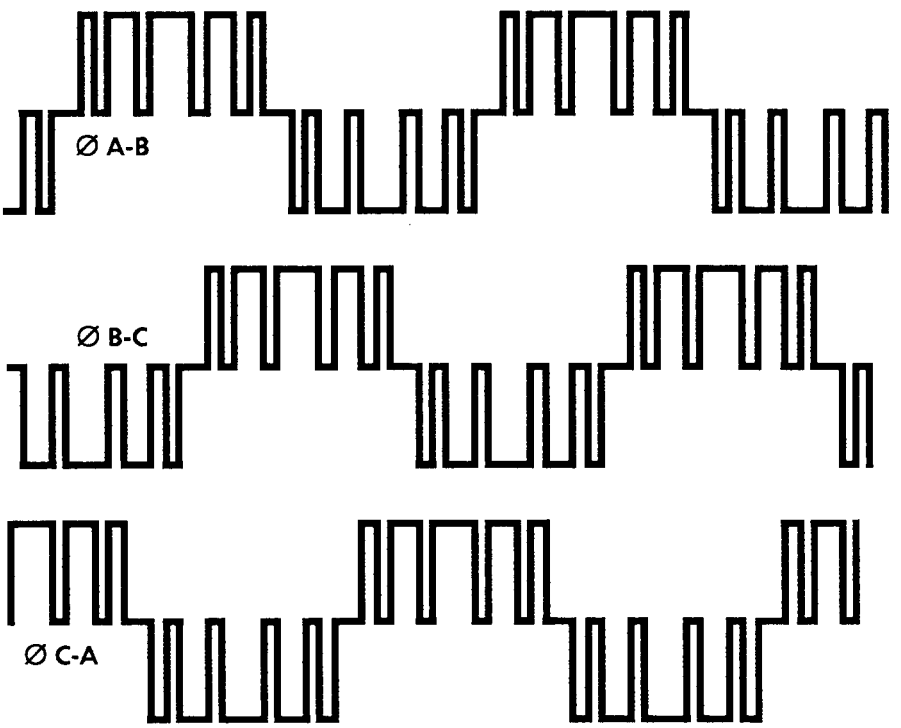


figure 6.2.3a – Three Phase, Sine Weighted, Output Voltage Waveforms

6.2.3 Output Inverting Circuits (continued)

Typical applied motor voltage and resulting current waveforms for one of the output phases at 60 Hz, full load, is shown in **figure 6.2.3b**. From this figure it can be seen that although the voltage is a series of pulses, the resultant current is nearly sinusoidal.

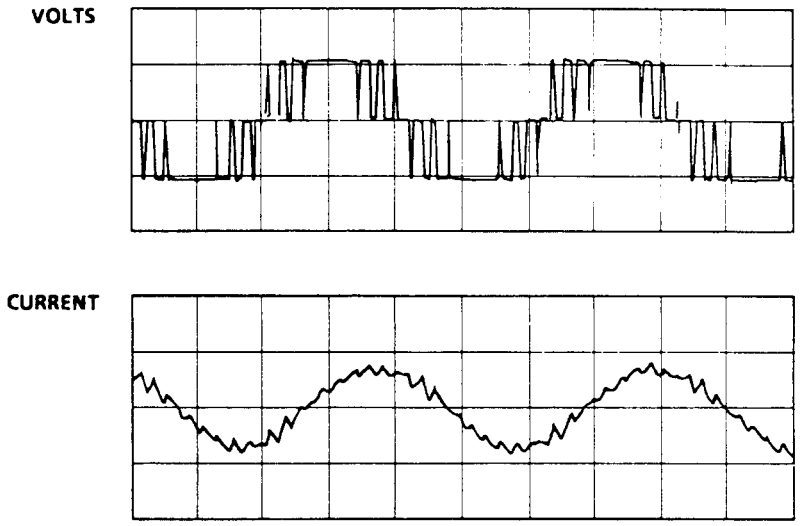


figure 6.2.3b – Applied Motor Voltage and Current Waveforms

6.3 The Logic and Control Section

The logic and control section of the Bulletin 1334 Drive accepts commands from operator elements and other external interfaces to control the output of the Drive. Most of the circuits operate at logic levels. All interfacing to the power section is electrically isolated so that the logic may be referenced to ground potential.

Five general tasks are accomplished by the logic and control section.

- **Controlling the Startup Sequence**
- **Generating Control Signals** for Output Power Switching Modules
- **Providing an Interface** for Control Signals and Auxiliary Functions
- **Providing an Orderly Rated Stop or Coast-to-Stop**
- **Monitoring of Fault and Protection Circuits**

Depending on the Drive rating, various printed circuit boards are used to accomplish these functions. All Drive ratings, however, use the Modulator Logic Board to direct the control of the other logic and control boards.

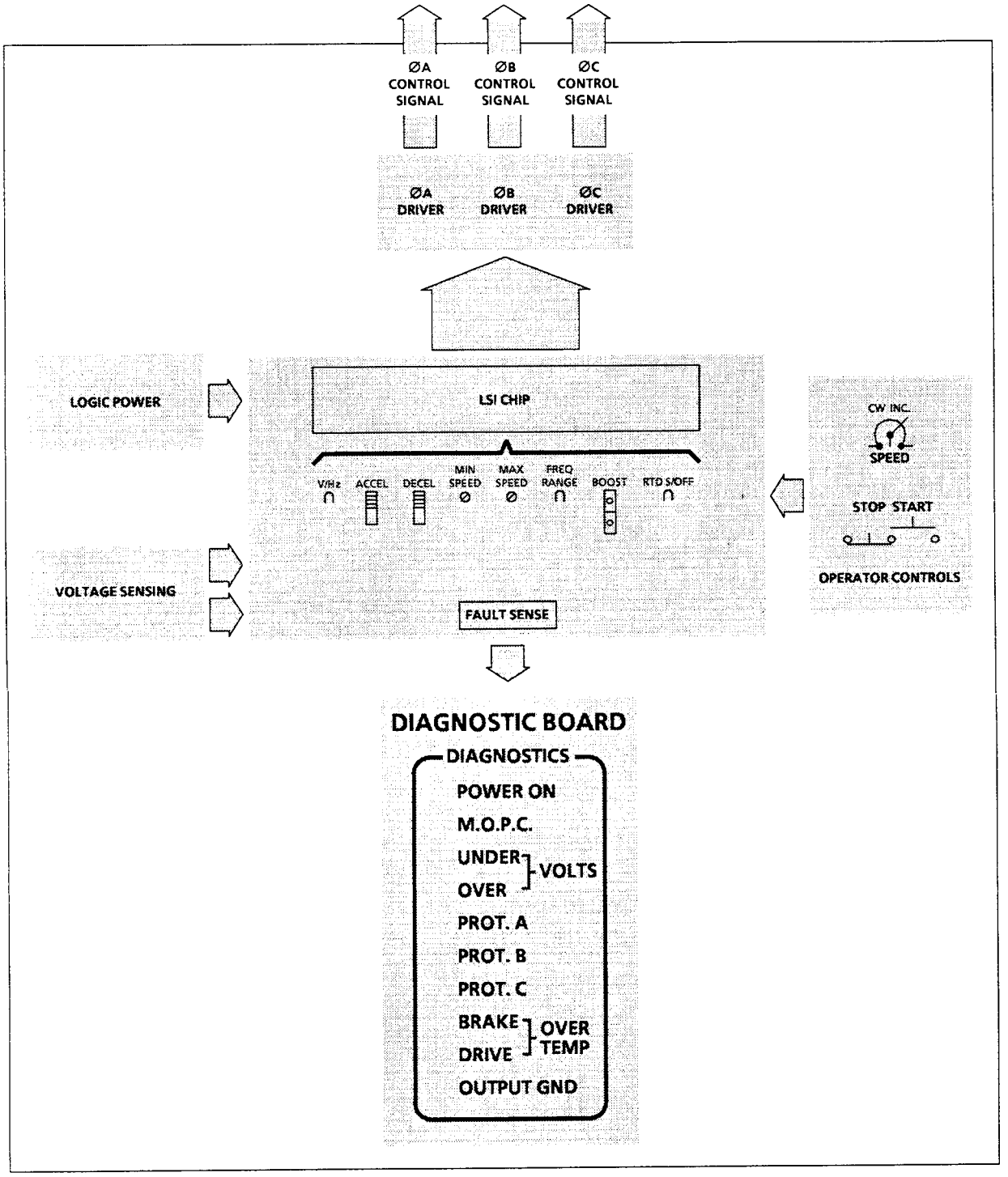


figure 6.3 – Bulletin 1334 Logic and Control Section

6.3.1 Controlling the Startup Sequence

Two functions must occur when AC power is applied to the Drive. One is Power-On-Reset of the logic circuit. The other is monitoring the precharge of the DC bus and energizing the precharge contactor once precharge is complete.

6.3.1 Controlling the Startup Sequence (continued)

Power-On-Reset (POR), is accomplished by the Modulator Logic Board. A time delay circuit generates the POR signal when power is first applied. This signal resets the fault trip circuit, as well as the LSI chip. It changes state to "normal" approximately 0.2 seconds after power is applied to the Drive.

The Modulator Logic Board also receives two signals from the voltage sensing section of the Drive. One signal is proportional to the line voltage, the other to the actual DC bus voltage. These signals are compared and when the DC bus reaches a level of approximately 90% of AC line level, precharge is considered complete. The precharge relay or contactor is then energized by the Modulator Logic Board and the Drive is now functionally operational.

6.3.2 Generating Control Signals

The control signals for the output power switching modules are all generated by the LSI chip located on the Modulator Logic Board. These signals are then fed to the appropriate section of the master Driver Board, or to the individual Driver Boards. Each section isolates the logic signals from the high voltage bus and buffers them to the proper driving level for its own switching module.

6.3.3 Providing an Interface

The LSI chip requires several inputs to generate switching signals. Many of these are programmable inputs located on the Modulator Logic Board and are available for customer adjustment. These adjustments include –

Volts per Hertz – In the motoring mode of operation, the RMS output voltage of the Drive cannot be any greater than the RMS value of its applied AC input voltage. The RMS output voltage must also vary directly with the RMS value of the input voltage. Two ranges are predetermined by jumper selection, 7.6 V/Hz or 3.8 V/Hz.

With an AC line input voltage of 460 volts and the jumper set at 7.6 V/Hz, the Drive will produce an output voltage of 460V at 60 Hz. With the same input line voltage applied but the jumper set at 3.8 V/Hz, the Drive will produce an output of 230V at 60 Hz and 460V at 120 Hz.

Accel Rate and Decel Rate – The accel and decel rates at which the Drive changes its output frequency in response to a step change in input speed command are independently selectable.

Two, six position ON/OFF slide switches, one for accel and one for decel, provide the means for a binary weighted rate selection. The standard range of adjustment is from 1.2 Hz/Sec (slow), to 152.4 Hz/Sec (very fast). Additional information and actual switch settings are detailed in Chapter 5, **Startup & Adjustment Procedures**.

Minimum and Maximum Speed Adjust – These two adjustment pots on the Modulator Logic Board normally establish the minimum and maximum output frequency of the Drive.

Minimum speed is normally adjustable over the range of 0-40 Hz. When the frequency range jumper is set to 90 Hz, **maximum speed** is normally adjustable from 40-120 Hz.

6.3.3 Providing an Interface (continued)

When the frequency range jumper is set to 200 Hz, **maximum speed** is normally adjustable from 40-200 Hz. However, certain options installed in the Drive will cause either the minimum or maximum speed pots to be ineffective.

The **minimum speed** pot is ineffective if any of the options listed below are installed.

1. The **Local Digital Thumbwheel Switch**, option G
2. The **Remote Digital Thumbwheel Switch**, option G2, when the AUTO mode is selected.
3. The **BCD Interface Card**, option G4, when the AUTO mode is selected.

If any one of these options are installed, the **maximum speed** pot then sets the maximum speed that can be commanded by either the Digital Thumbwheel Switch or the BCD Interface commands received by the Drive.

Both the **minimum** and **maximum speed** pots are ineffective if the Isolated Signal Conditioner Card is installed and set to the AUTO mode of operation. The OFFSET and GAIN adjustments on the option card now set the minimum and maximum Drive speed respectively. Only when the MANUAL mode of operation is selected will both the minimum and maximum speed pots be effective.

Frequency Range – Two preprogrammed ranges are jumper selectable, 0-90 Hz or 0-200 Hz. Selecting either range "*brackets*" the overall operating frequency within the range set by the minimum and maximum speed pots as explained above.

DC Boost and Boost Range – These two adjustments, one a switch setting, the other a jumper setting, establish the amount by which the V/Hz output of the Drive is increased in the lower output frequency range of operation. Boost is used to optimize the starting torque of the motor. The jumper selects either LOW or HIGH BOOST and the switch performs a binary selection of voltage values in the range of 0-20 volts or 0-34 volts.

Increasing the DC boost will increase the motors ability to develop torque at low speed by compensating for the IR drop of the motor. Too much boost however, will increase the magnetizing current drawn by the motor causing the motor to saturate. As this condition occurs, the peak currents drawn by the motor increase rapidly to the point where they can cause the Drive to trip out on either a PHASE PROTECT or M.O.P.C. trip.

Operator Speed Control – The standard Drive configuration with no options installed, receives its speed command from a 1kΩ pot that is connected across a DC source of 3.2 volts. The output of the potentiometer supplies a 0-3.2 volt speed command signal to the Modulator Logic Board. There it is conditioned by various circuits and applied to a VCO (Voltage Controlled Oscillator) that produces a frequency proportional to the speed command voltage. The VCO output frequency is 384 times the required Drive output frequency (384f). This 384f signal drives the LSI chip which uses it to generate the Drive output frequency.

6.3.4 Providing an Orderly Rated Stop or Coast-to-Stop

The RTD S/OFF jumper on the Modulator Logic Board allows the motor to either ramp-to-stop by following the decel rate down, or coast-to-stop in response to a Drive STOP command.

In the RTD S (rated stop) mode, the motor remains energized during the decel period. When at rest, it has a reduced value of DC boost applied to it. This low value of DC boost however will not cause the motor to overheat.

In the OFF (coast-to-stop) mode, 50mS after the Drive receives a STOP command, the Drive output Power Switching Modules are commanded OFF and the motor coasts to a stop with no excitation applied to it.

6.3.5 Monitoring of Fault and Protection Circuits

Drive circuitry continuously monitors its own operation as well as the incoming AC line. If a fault condition occurs, the Drive is designed to protect itself against the fault by tripping off and annunciating the fault condition by a series of LEDs located on a display panel on the front of the Drive.

IMPORTANT

Drive Fault Trips

Before resetting any fault trip refer to the Bulletin 1334 Troubleshooting Appendix for your Drive, D, E, or F, to isolate and correct the fault.

Fault trips are reset by first giving the Drive a STOP command, followed by a START command, or by removing power to the Drive for a minimum of (2) seconds.

The fault and monitoring circuits include:

Over Voltage – This circuit monitors the DC bus. If the bus voltage ever exceeds 760 volts, the circuit will shut down the Drive and turn on the "**OVER VOLTS**" LED.

Under Voltage – This circuit compares a signal from the incoming AC line with a regulated reference. If the line voltage is less than 414V for a 460V AC Drive, less than 373V for a 415V AC Drive, or less than 342V for a 380V AC Drive, the Drive will shut down and the "**UNDER VOLTS**" LED will come on.

Drive Over Temperature – The Drive has a thermal switch located on the Power Switching Module heat sink. If the heat sink temperature rises above the rated point due to overload or environmental conditions, the thermal switch will open, the Drive will shut down, and the "**DRIVE OVER TEMP.**" LED will come on.

Brake Over Temperature – When the Dynamic Brake option is used, a thermal over load switch located in the brake resistor assembly monitors the resistor temperature. Should the temperature ever exceed its preset limit, the thermal switch will open, the Drive will shut down, and the "**BRAKE OVER TEMP.**" LED will come on.

6.3.5 Monitoring of Fault and Protection Circuits (continued)

IMPORTANT : To reset a Brake Over Temperature Trip

1. *Remove input power to the Drive at the disconnect device.*
2. *Wait a few minutes to allow the O.L. heater and brake resistor to cool down.*
3. *Open the conduit box on the resistor cage assembly. Manually reset Thermal O.L. Relay 2TAS by depressing the plunger until a "click" is either heard or felt.*
4. *Reapply power to the Drive at the disconnect device.*
5. *Reset the Drive by giving it a STOP command followed by a START command.*

Phase A, B or C Fault Protection – Depending on the Drive rating, each section of the Driver Board, or each individual Driver Board, is designed to monitor the Power Switching Module or modules for the phase it is controlling. If a short circuit or output ground fault occurs, excessive fault current may flow in the transistors when they are turned on.

Each driver section or individual board can sense this and directly turn off the Power Switching Module(s) for that phase to help avoid failure. This condition is reported to the Modulator Logic Board, annunciated by a phase **A**, **B**, or **C** "**PROT.**" LED at the display panel, and the Drive is shut down.

Momentary Overload Protection Circuit (M.O.P.C.) – In addition to monitoring for fault currents, the Driver Board monitors the continuous current drawn by the motor. If the current exceeds a preset level of 150%, a signal is given to the Modulator Logic Board. The Modulator Logic Board responds by reducing the voltage and frequency to the motor and starting a timer.

Reducing the voltage and frequency will usually reduce the current drawn by the motor. This permits the Drive to operate the motor through a momentary overload without tripping off. Once the load is reduced below set point, the Drive will reaccelerate back to set speed at the selected ACCEL rate set by switch S1 on the Modulator Logic Board. If the overload continues, the Drive will continue to ramp down the voltage and frequency until a frequency is reached where the motor stalls out.

If this condition continues for approximately one minute after the timer starts, the Drive will shut off removing Drive output voltage to the motor. This condition will cause the M.O.P.C. LED to remain constantly lit after the Drive has tripped off. During momentary overload conditions, the M.O.P.C. LED will flicker on and off for the duration of the overload.

Output Ground – In the event of a ground fault at the output, the Drive will shut down on a phase protection trip. For 15-50 HP Series A Drives, the "**OUTPUT GND**" LED will also be lit.

6.4 General Application

Special considerations must be taken when applying a variable frequency drive to an existing motor. At slower speeds, cooling is not as effective due to reduced fan speed. Extended operation at full load torque at slow speeds may damage the motor due to overheating. The Bulletin 1334 is best suited for use with standard NEMA Design B induction motors. Consult your nearest Allen-Bradley Distributor or Sales Office before connecting any other type of motor to your Drive.

Due to harmonics in the Drive output waveform (inherent in all inverter type drives), the motor current will increase by approximately 5% when compared to the same load superimposed on a sinusoidal waveform.

Figure 6.4 shows a typical curve, plotting torque vs. speed. At slow speeds, if torque requirements continuously exceed levels shown (10 minutes or longer), a motor rated for the required speed and torque operation should be substituted.

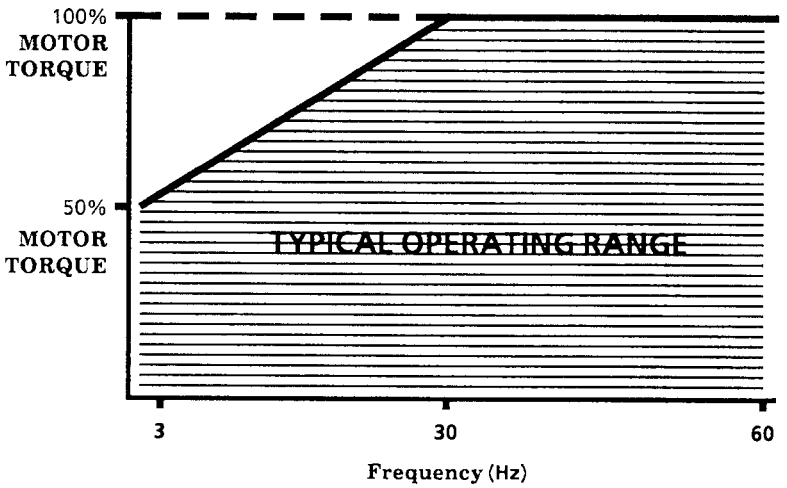


figure 6.4 – Torque vs. Frequency

CAUTION

Motors may overheat when operated at rated torque for long periods of time below $\frac{1}{2}$ 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.

Bulletin 1334 380/415V Specifications & Adjustments

7.0
380V Specification Table

	Model Number	1334-B_N	1334-C_N	1334-D_N	1334-E_N
Model and Ratings 3-10 HP	① Nominal HP	**3**	**5**	**7½**	**10**
	Input Voltage	380	380	380	380
	Output Voltage	0-380	0-380	0-380	0-380
	Input Frequency	50	50	50	50
	Output Frequency	0-200	0-200	0-200	0-200
	Input Amps	4.25	6.5	9.7	13.0
	Output Amps	5.0	7.5	11.3	15.0
	Input kVA	2.5	4.1	6.4	8.6
	Output kVA	3.3	4.9	7.4	9.9

	Model Number	1334-F_N	1334-G_N	1334-R_N
Model and Ratings 15-25 HP	① Nominal HP	**15**	**20**	**25**
	Input Voltage	380	380	380
	Output Voltage	0-380	0-380	0-380
	Input Frequency	50	50	50
	Output Frequency	0-200	0-200	0-200
	Input Amps	18.75	25.0	33.0
	Output Amps	21.3	27.6	35.0
	Input kVA	12.4	16.5	21.7
	Output kVA	14.0	18.2	23.0

	Model Number	1334-H_N	1334-J_N	1334-K_N
Model and Ratings 30-50 HP	① Nominal HP	**30**	**40**	**50**
	Input Voltage	380	380	380
	Output Voltage	0-380	0-380	0-380
	Input Frequency	50	50	50
	Output Frequency	0-200	0-200	0-200
	Input Amps	39.0	51.0	62.0
	Output Amps	41.4	54.0	67.8
	Input kVA	25.7	33.6	40.8
	Output kVA	27.2	35.5	44.6

Power Supply	Input Voltage — 380V, 3Ø, ±10% Input Frequency — 50 Hz, ±2%
Output Volts-per-Hertz	7.6V/Hz (380V at 50 Hz) with Eurocard or Function Expander Card Installed
DC Boost Adjustment	0-28 Volts
Input Under Voltage Protection	342 Volts Nominal

IMPORTANT: ① The HP rating shown is for Drives supplied from a 380V AC, 50 Hz power line and is nominal. The limiting factor in the application and use of the Bulletin 1334 Drive is the Output Amp Rating of the Drive.

7.1
415V Specification Table

	Model Number	1334-B_W	1334-C_W	1334-D_W	1334-E_W
Model and Ratings 3-10 HP	① Nominal HP	**3**	**5**	**7½**	**10**
	Input Voltage	415	415	415	415
	Output Voltage	0-415	0-415	0-415	0-415
	Input Frequency	50	50	50	50
	Output Frequency	0-200	0-200	0-200	0-200
	Input Amps	4.25	6.5	9.7	13.0
	Output Amps	5.0	7.5	11.3	15.0
	Input kVA	2.7	4.5	7.0	9.3
	Output kVA	3.6	5.4	8.1	10.8

	Model Number	1334-F_W	1334-G_W	1334-R_W
Model and Ratings 15-25 HP	① Nominal HP	**15**	**20**	**25**
	Input Voltage	415	415	415
	Output Voltage	0-415	0-415	0-415
	Input Frequency	50	50	50
	Output Frequency	0-200	0-200	0-200
	Input Amps	18.75	25.0	33.0
	Output Amps	21.3	27.6	35.0
	Input kVA	13.5	18.0	23.7
	Output kVA	15.3	19.8	25.2

	Model Number	1334-H_N	1334-J_N	1334-K_N
Model and Ratings 30-50 HP	① Nominal HP	**30**	**40**	**50**
	Input Voltage	415	415	415
	Output Voltage	0-415	0-415	0-415
	Input Frequency	50	50	50
	Output Frequency	0-200	0-200	0-200
	Input Amps	39.0	51.0	62.0
	Output Amps	41.4	54.0	67.8
	Input kVA	28.0	36.7	44.6
	Output kVA	29.8	38.8	48.7

Power Supply	Input Voltage — 415V, 3Ø, ±10% Input Frequency — 50 Hz, ±2%
Output Volts-per-Hertz	8.3V/Hz (415V at 50 Hz) with Eurocard or Function Expander Card Installed
DC Boost Adjustment	0-31 Volts
Input Under Voltage Protection	373 Volts Nominal

IMPORTANT: ① The HP rating shown is for Drives supplied from a 415V AC, 50 Hz power line and is nominal. The limiting factor in the application and use of the Bulletin 1334 Drive is the Output Amp Rating of the Drive.

7.2 Adjustments

The Bulletin 1334 Adjustable Frequency Drive has the capability of operating from AC input line voltages of 380 or 415V only when the following adjustments are made to the Drive.

- The Drive logic and power supply transformers must be re-tapped to the correct voltage levels.
- Either the Eurocard or the Function Expander Card must be installed to produce the correct volts-per-hertz output from the Drive.

Unless the Drive is ordered from the factory as a 380 or 415V unit, the following adjustments must be made.

7.2.1 Transformer Adjustments

Determine the model number of the Drive to be modified from the Drive nameplate. Determine the number and location of the transformers that require re-tapping from the information below.

As shown in the **Drive Schematics** in **Appendixes G-I**, power supply transformers are normally set for 460V operation, but have 460/415/380V primary taps. All transformer primaries are marked as follows.

TAP #	VOLTAGE
1	COMMON — For All Voltages
2	380V AC Input
3	415V AC Input
4	460V AC Input

MODEL	TRANSFORMER	LOCATION REFERENCE	SCHEMATIC REFERENCE
1334-B _ (3 HP)	1T	Appendix A	Appendix G
1334-C _ (5 HP)	1T	Appendix A	Appendix G
1334-D _ (7½ HP)	1T	Appendix A	Appendix G
1334-E _ (10 HP)	1T	Appendix A	Appendix G
1334-F _ (15 HP)	1T & 2T	Appendix B	Appendix H
1334-G _ (20 HP)	1T & 2T	Appendix B	Appendix H
1334-R _ (25 HP)	1T & 2T	Appendix B	Appendix H
1334-H _ (30 HP)	1T & 2T	Appendix C	Appendix I
1334-J _ (40 HP)	1T, 2T, & 3T	Appendix C	Appendix I
1334-K _ (50 HP)	1T, 2T, & 3T	Appendix C	Appendix I

7.2.2 Volts-per-Hertz Adjustment

For the Drive to produce the correct volts-per-hertz at either 380 or 415V, the V/Hz jumper located on the Modulator Logic Board must be unplugged and removed from the board (jumper location is shown in **figure 5.3.1, Chapter 5**). Once the jumper has been removed, either the Eurocard or Option L — the Function Expander Card — must then be installed in the Drive. Either card plugs unto Modulator Logic Board connector **J104**. If the Eurocard is used, additional volts-per-hertz adjustments are not required. If the Function Expander Card is used, follow the instructions provided with the kit to complete installation. Note all changes made to the Drive on both the **Drive Data Log Sheets, Section 5.2**, and on the Drive Nameplate in the Drive. Follow the installation and adjustment procedures as outlined in **Chapters 4 & 5**.

Bulletin 1334 3-10 HP Series B Component Index

3-10 HP Recommended Spare Parts

Description	Identification	Part №	Value	Used On	Recommended Stock
Modulator Logic Board	A1	50387-002	—	All Ratings	1
Power Distribution Board	A2	50906	—	3 – 10 HP	1
Driver Board	A3	50905-001	—	3 & 5 HP	1
		50905-002	—	7½ & 10 HP	1
Diagnostic Board	A7	50382	—	All Ratings	0
Fuse	F1, F2, F3	201669	10A, 600V (KTK 10)	3 HP	6
		201009	12A, 600V (KTK 12)	5 HP	6
		200935	15A, 600V (KTK 15)	7½ HP	6
		201925	20A, 600V (KTK 20)	10 HP	6
Fuse	F4, F5	101775	0.6A, 600V (FNQ 6/10 or ATQ 6/10)	3 – 10 HP	2
Bus Capacitor	2C, 3C	201676	650µF, 450V DC	3 & 5 HP	1
		201906	1400µF, 450V DC	7½ & 10 HP	1
Control Transformer	1T	91854	—	3 – 10 HP	0
MOV Assembly	MOV 4	40401	—	3 – 10 HP	0
Inductor	1L	91889	4.2mH, 7.5A	3 & 5 HP	0
		91864	2.9mH, 11.2A	7½ HP	0
		91865	2.2mH, 14.9A	10 HP	0
Inductor	2L	91849	15mH, 1.3A	3 – 10 HP	0
Power Switching Module	1Q, 2Q, 3Q	201050	—	3 & 5 HP	1
		201051	—	7½ & 10 HP	1
Snubber Asembly	1SN, 2SN, 3SN	40410	—	3 – 10 HP	0
Temperature Sensor	1TAS	201667	—	3 – 10 HP	0
Rectifier Assembly	1REC	201525	—	3 – 10 HP	1
Resistor	2R, 3R	40413-001	25kΩ, 25W, 3%	3 & 5 HP	0
		40413-002	16kΩ, 25W, 3%	7½ & 10 HP	0

Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

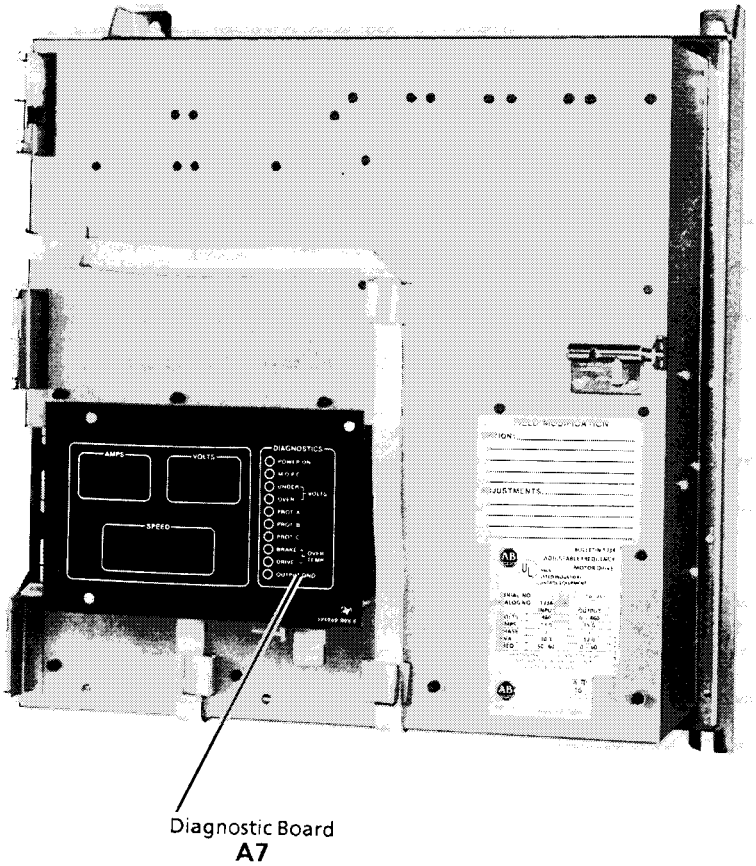
3-10 HP Component Access & Location

CAUTION

ESD Precautions

ESD (Electrostatic Discharge) generated by static electricity can damage the CMOS devices on various Drive boards. To guard against this type of damage, it is recommended that when circuit boards are removed or installed the following precautions be observed.

- *Wear a wrist type grounding strap that is grounded to the Drive chassis.*
- *DO NOT remove the new circuit board from its conductive wrapper unless a ground strap is worn.*
- *When removing any circuit board from the Drive, immediately place it in conductive packing material.*



Diagnostic Board
A7

3-10 HP Component Access & Location

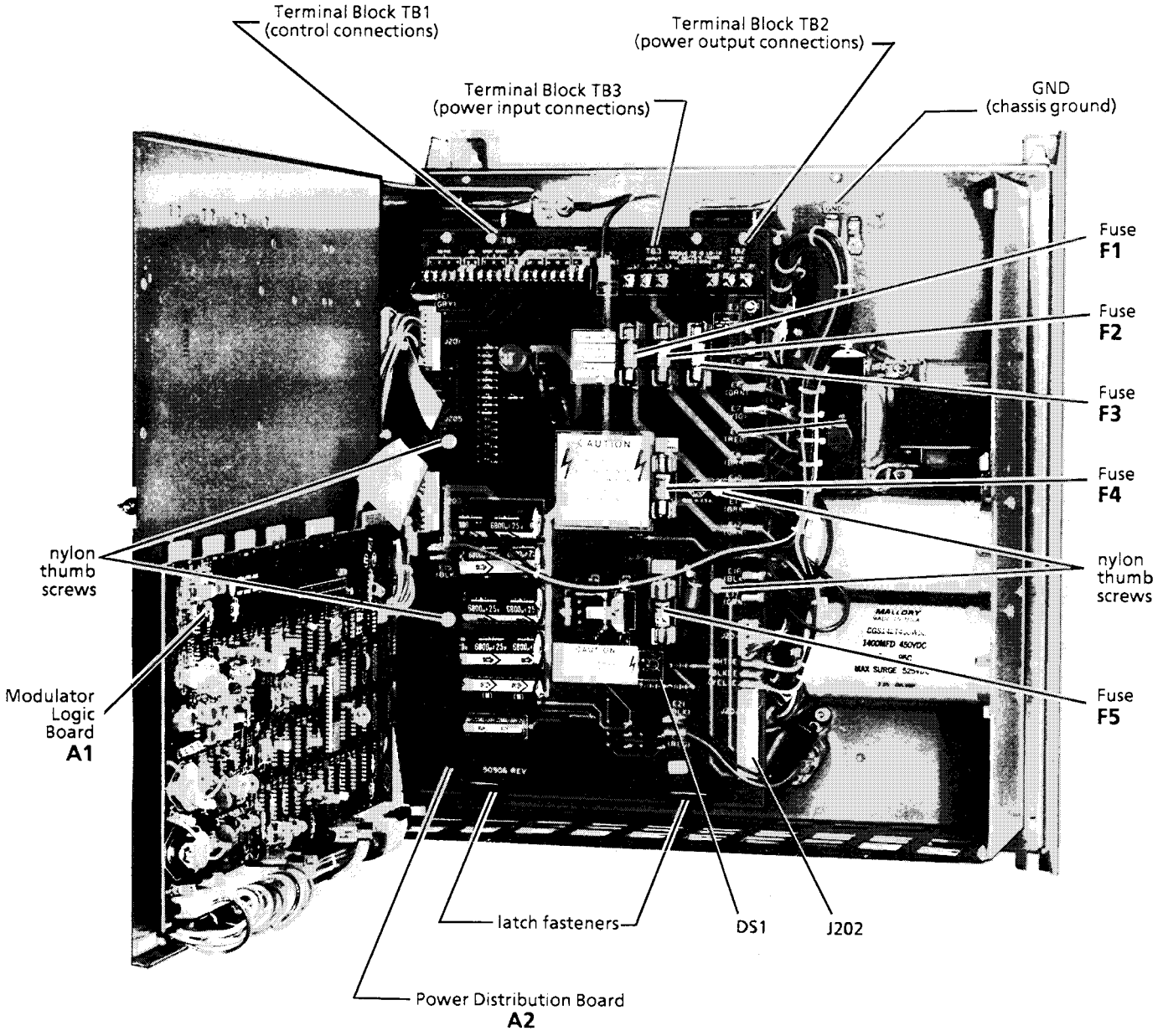
(Power Distribution Board A2)

Step 1 Disconnect molex connectors **J201**, **J203**, & **J204** and berg connector **J205** at Power Distribution Board A2.

Step 2 Disconnect push on connectors **E13**, **E16**, **E17**, **E21** & **E22** from Power Distribution Board A2.

Step 3 Remove the (4) nylon thumb screws from the board.

Step 4 Lift up the (2) latch fasteners at the bottom of the board. The Power Distribution Board will now be free to swing up.



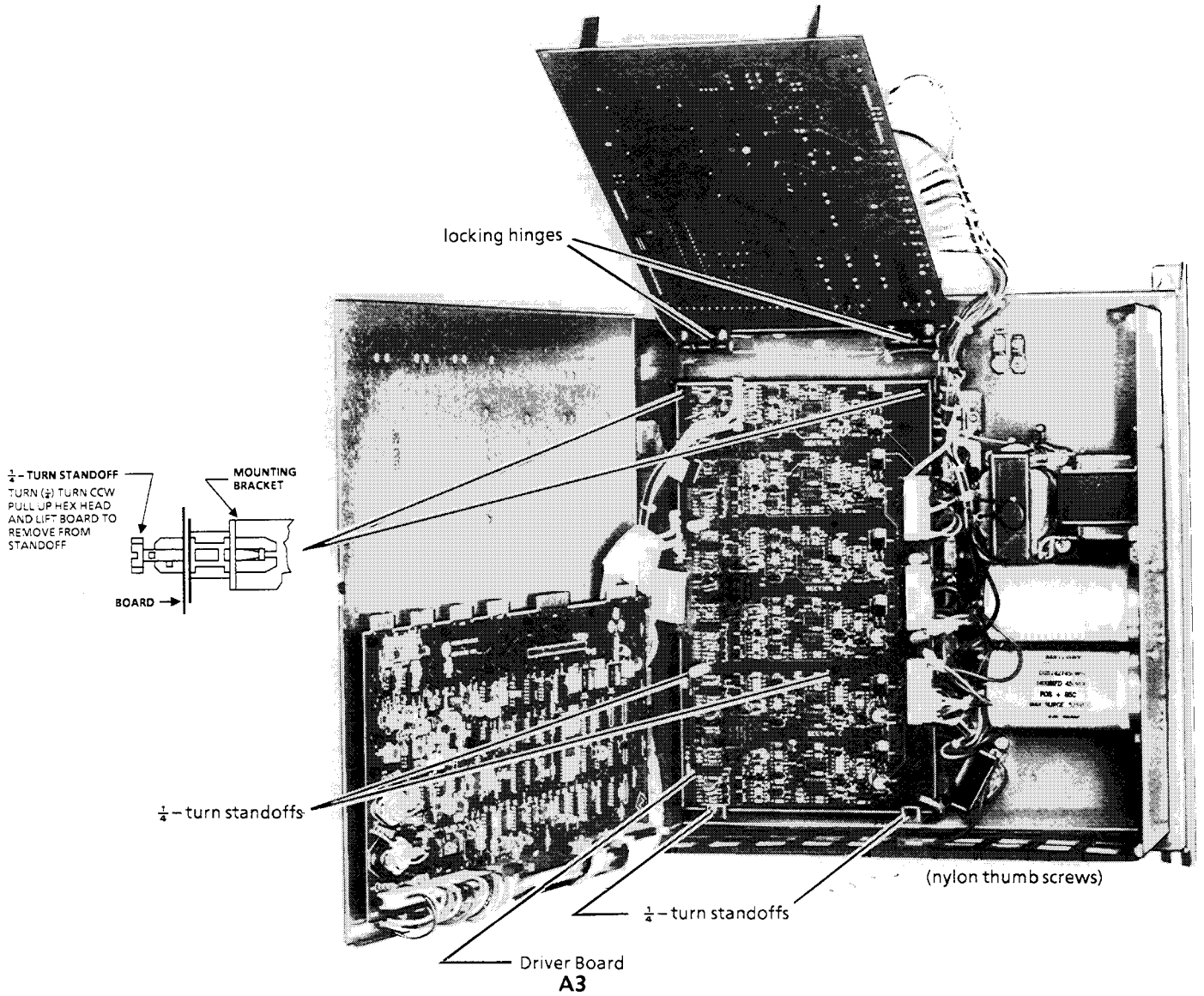
3-10 HP Component Access & Location

Step 5 To lock the Power Distribution Board in the raised position, tighten the phillips head screws (or wing nuts), on the board's (2) locking hinges. To lower the Power Distribution Board, back off the screws (or wing nuts) $\frac{1}{2}$ – turn.

(Driver Board A3)

Step 6 To remove Driver Board A3, disconnect molex connectors **J302A**, **J302B**, & **J302C** and berg connector **J301** at the board.

Step 7 Release the (6) $\frac{1}{4}$ – turn standoffs as shown. The Driver Board may now be lifted out.



3-10 HP Component Access & Location

Temperature Sensor 1TAS

Rectifier Assembly 1REC

Snubber Assemblies 1SN, 2SN & 3SN

Power Switching Modules 1Q, 2Q & 3Q

Resistors 2R & 3R

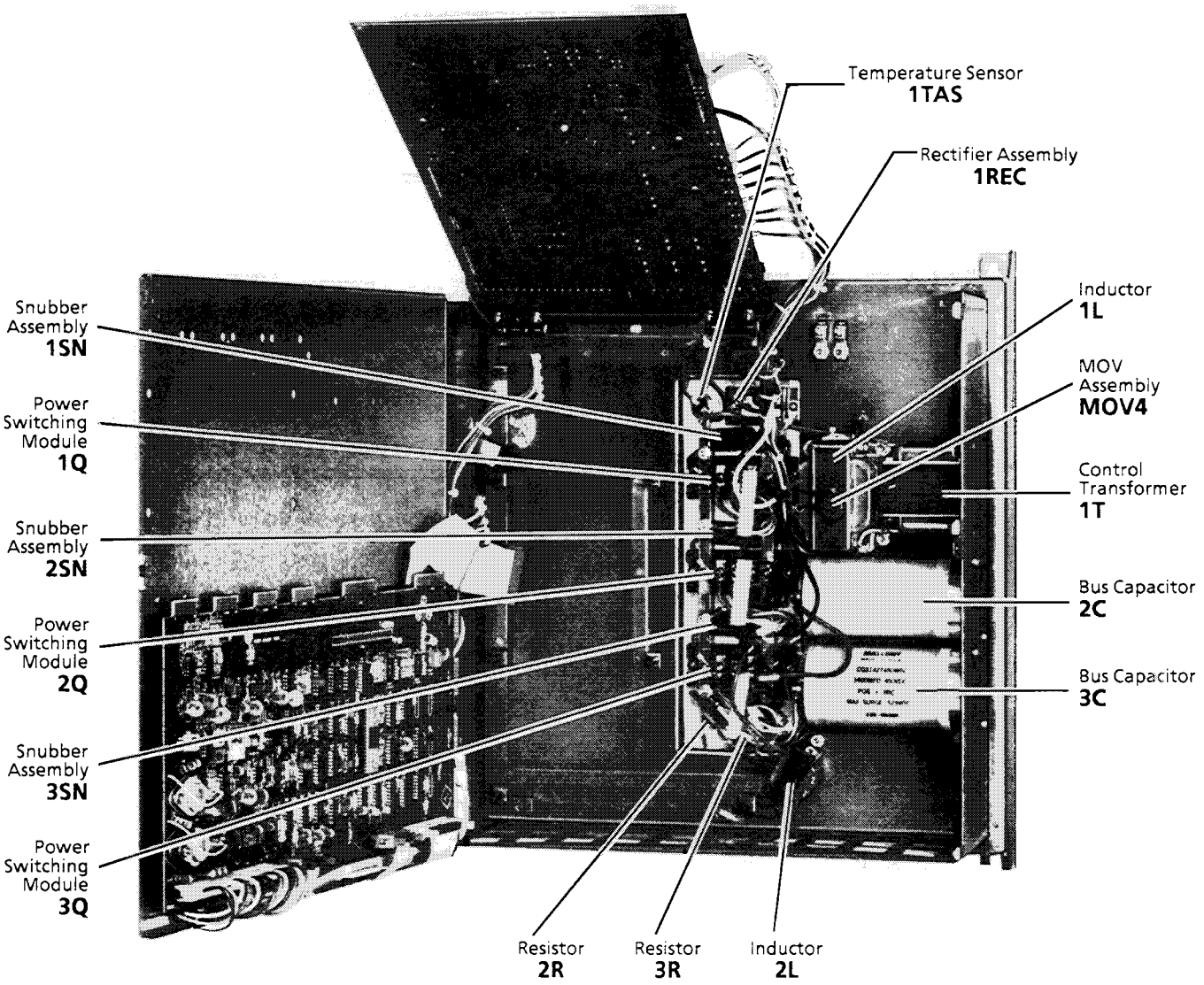
Inductors 1L & 2L

MOV4 Assembly

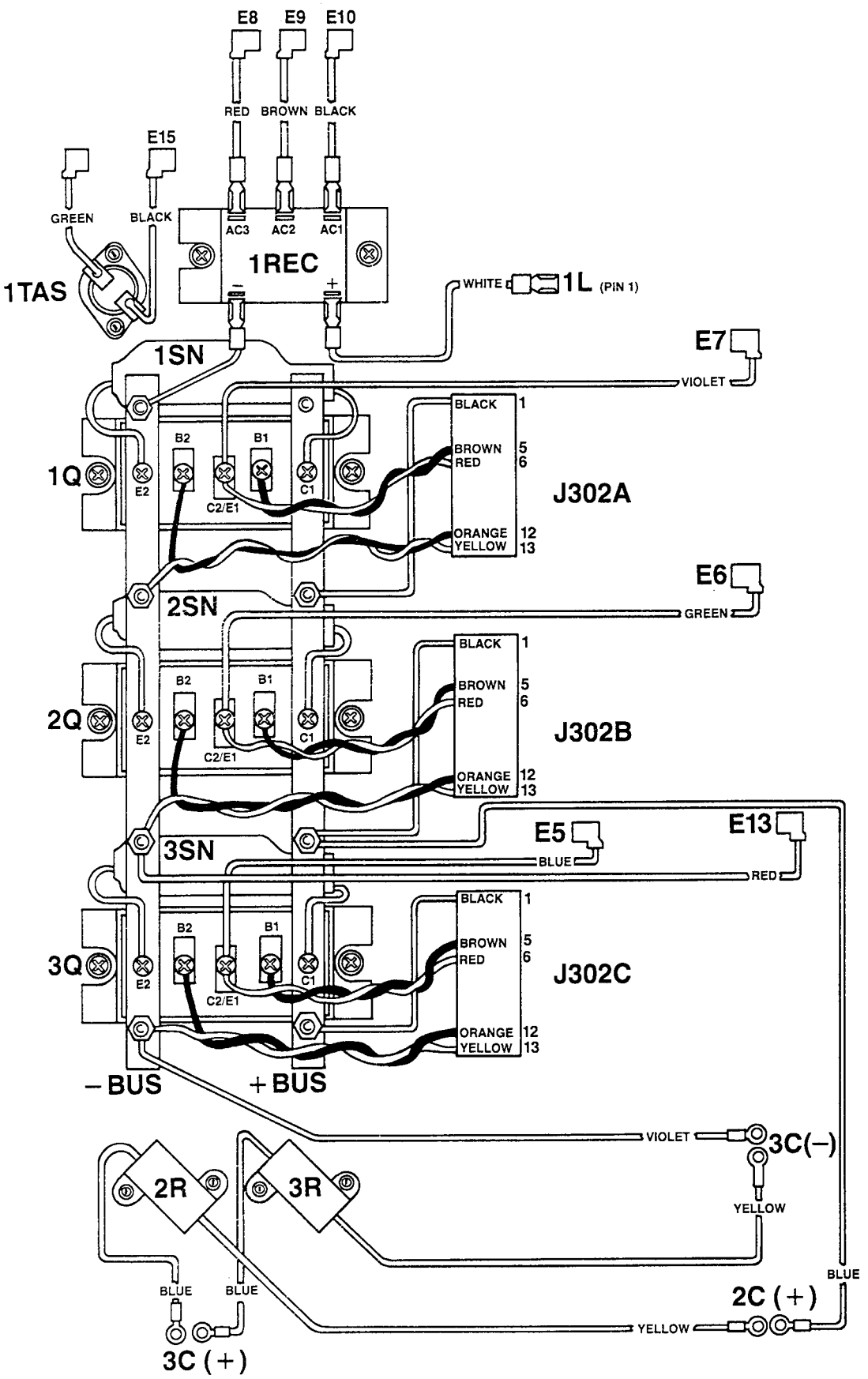
Transformer 1T

Bus Capacitors 2C & 3C

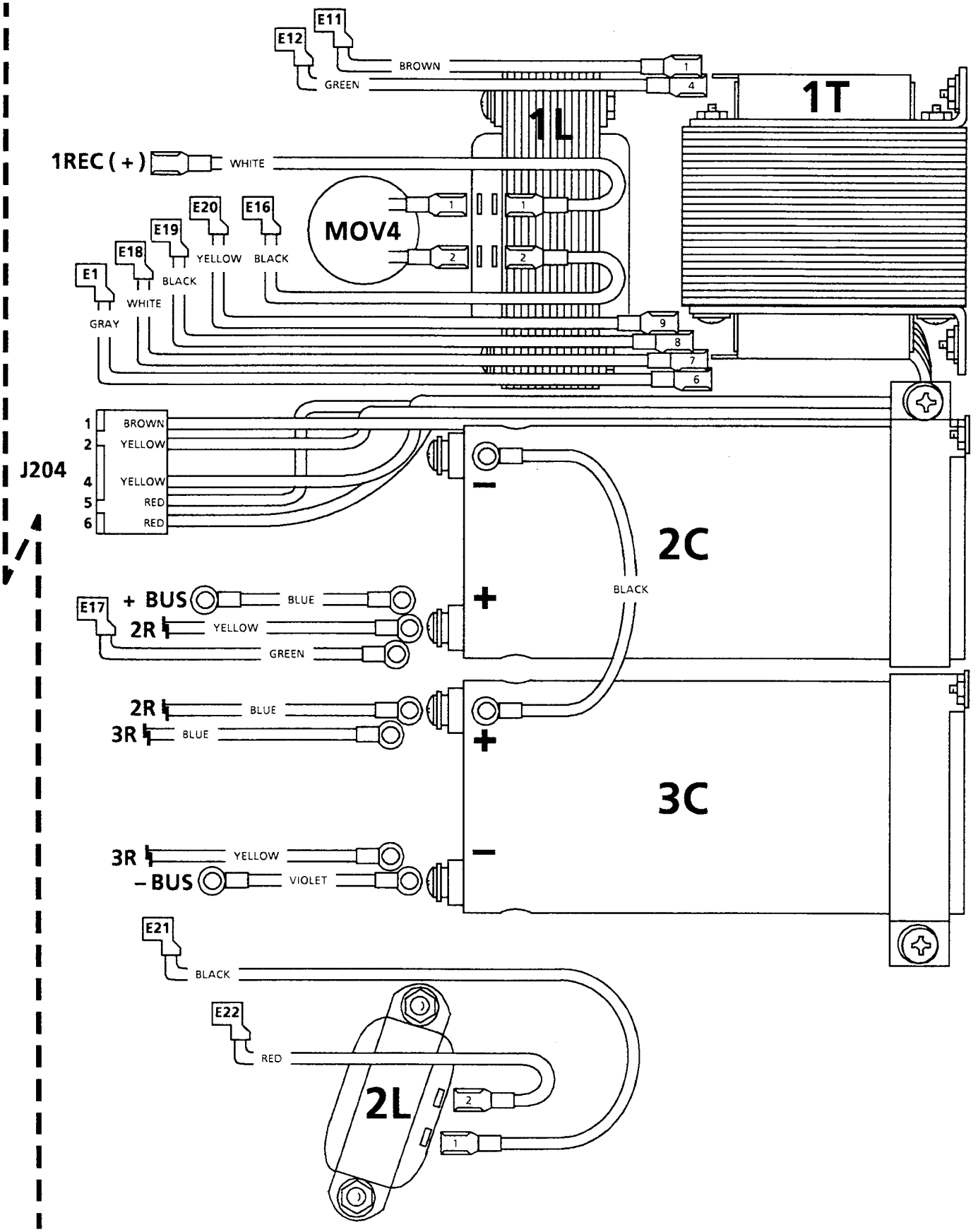
Wiring connections to the above components are shown on the following pages.



3-10 HP Component Location & Wiring



3-10 HP Component Location & Wiring



3-10 HP Component Wiring List

As shown on page **A-3**, wires going to interconnection points **E1**, **E2**, & **E5-22**, are marked and color coded on Power Distribution Board A2. These same points are referenced in the troubleshooting procedures for your Drive in **Appendix D**. These points may be accessed by slightly lifting up the insulated connectors.

COLOR	to	from
gray	Control Transformer **1T** (pin **6**)	Power Distribution Board **E1**
green	Chassis Ground	Power Distribution Board **E2**
blue	Power Switching Module **3Q** (**C2**/**E1**)	Power Distribution Board **E5**
green	Power Switching Module **2Q** (**C2**/**E1**)	Power Distribution Board **E6**
violet	Power Switching Module **1Q** (**C2**/**E1**)	Power Distribution Board **E7**
red	Rectifier Assembly **1 REC** (**AC3**)	Power Distribution Board **E8**
brown	Rectifier Assembly **1 REC** (**AC2**)	Power Distribution Board **E9**
black	Rectifier Assembly **1 REC** (**AC1**)	Power Distribution Board **E10**
brown	Control Transformer **1T** (pin **1**)	Power Distribution Board **E11**
green	Control Transformer **1T** (pin **4**)	Power Distribution Board **E12**
red	**– BUS**	Power Distribution Board **E13**
green	Temperature Sensor **1TAS**	Power Distribution Board **E14**
black	Temperature Sensor **1TAS**	Power Distribution Board **E15**
black	Inductor **1L** (pin **2**)	Power Distribution Board **E16**
green	Bus Capacitor **2C** (**+**)	Power Distribution Board **E17**
white	Control Transformer **1T** (pin **7**)	Power Distribution Board **E18**
black	Control Transformer **1T** (pin **8**)	Power Distribution Board **E19**
yellow	Control Transformer **1T** (pin **9**)	Power Distribution Board **E20**
black	Inductor **2L** (pin **1**)	Power Distribution Board **E21**
red	Inductor **2L** (pin **2**)	Power Distribution Board **E22**
gray	**– BUS**	Rectifier Assembly **1REC** (**–**)
white	Inductor **1L** (pin **1**)	Rectifier Assembly **1REC** (**+**)
blue	**+ BUS**	Bus Capacitor **2C** (**+**)
violet	**– BUS**	Bus Capacitor **3C** (**–**)
black	Bus Capacitor **2C** (**–**)	Bus Capacitor **3C** (**+**)
yellow	Bus Capacitor **2C** (**+**)	Resistor **2R**
blue	Bus Capacitor **3C** (**+**)	Resistor **2R**
yellow	Bus Capacitor **3C** (**–**)	Resistor **3R**
blue	Bus Capacitor **3C** (**+**)	Resistor **3R**

Bulletin 1334 15-25 HP Series A Component Index

15-25 HP Recommended Spare Parts

Description	Identification	Part №	Value	Used On	Recommended Stock
Modulator Logic Board	**A1**	*50387-002*	—	*All Ratings*	**1**
Driver Board	**A3A, A3B, A3C**	50399	—	15 & 20 HP	**1**
		50399-001	—	25 HP	**1**
Voltage Sensing Board	**A4**	50386	—	15 – 25 HP	**0**
Bus Discharge Board	**A5**	50390	—	15 – 25 HP	**1**
Logic Power Supply Board	**A6**	50389	—	15 – 25 HP	**1**
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	**0**
Output Ground Sensor Board	**A8**	50385	—	15 – 25 HP	**1**
Contactor Interface Board	**A9**	50404-001	—	15 – 25 HP	**1**
Fuse	**1FU, 2FU, 3FU**	201258	25A, 600V (JKS 25)	15 HP	**6**
		200384	30A, 600V (JKS 30)	20 HP	**6**
		201463	50A, 600V (JKS 50)	25 HP	**6**
Fuse	**4FU, 5FU**	201590	1A, 500V (FNQ 1)	15 – 25 HP	**4**
Fuse	**6FU**	248010	3A, 500V (KTK 3)	15 – 25 HP	**2**
Bus Capacitor	**2C1, 2C2, 3C1, 3C2**	200364	2400µF, 450V DC	15 – 25 HP	**2**
Control Transformer	**1T**	91854	—	15 – 25 HP	**0**
Transformer	**2T**	91880	—	15 – 25 HP	**0**
Current Transformer	**1CT**	91824	—	15 – 25 HP	**0**

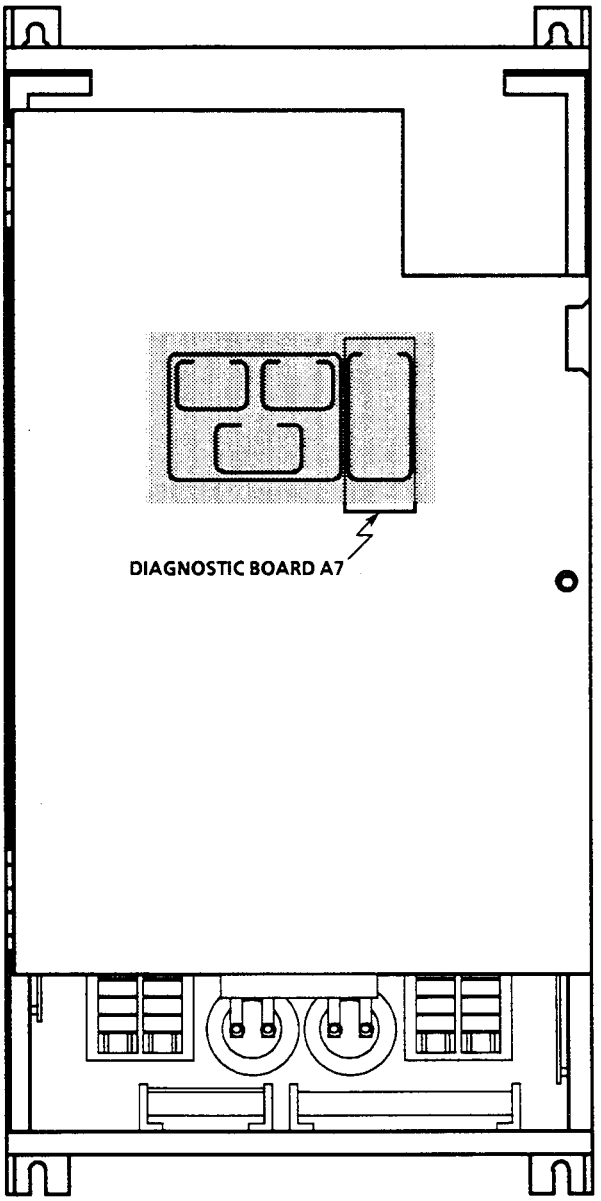
Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

15-25 HP Recommended Spare Parts
(continued)

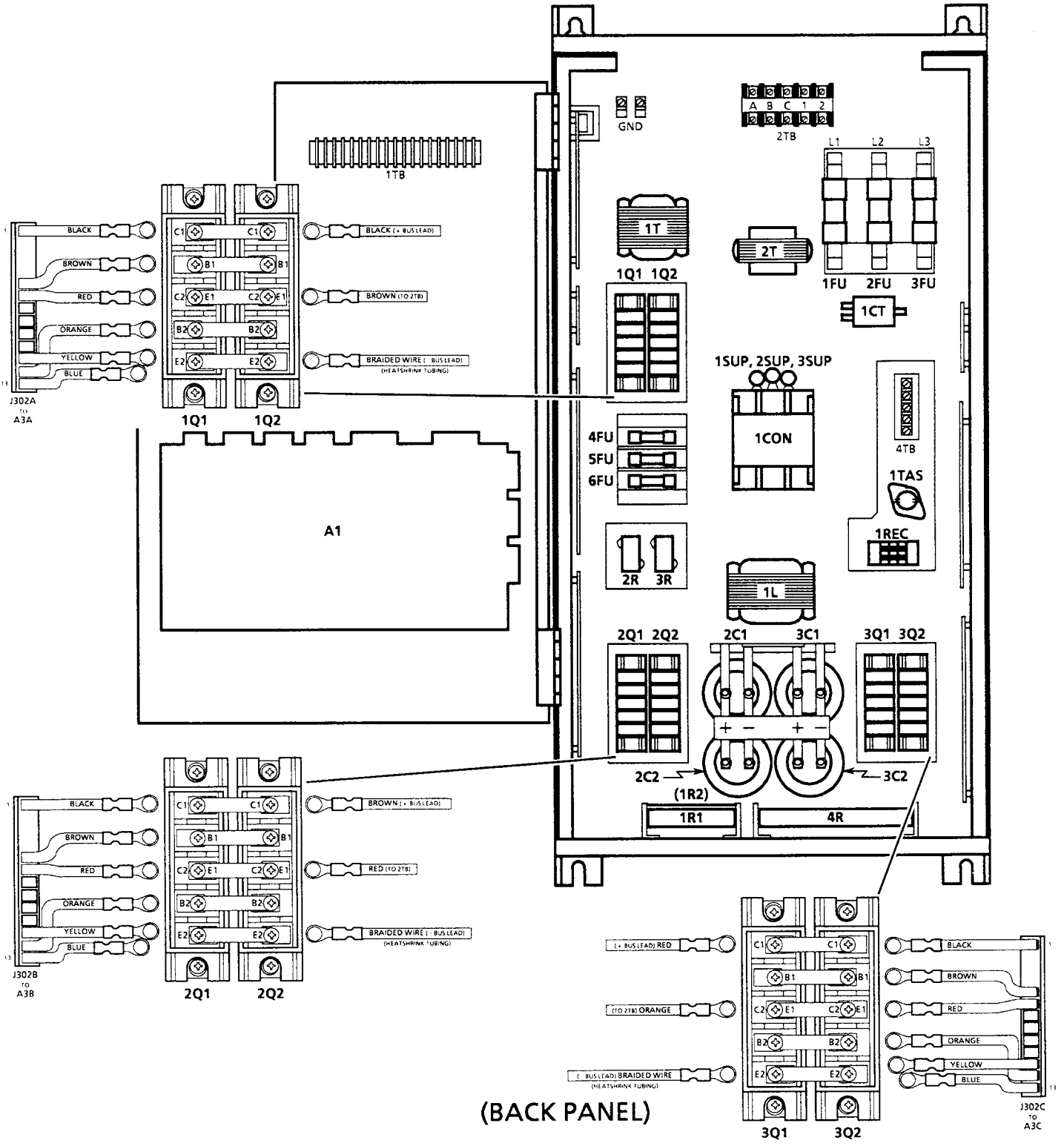
Description	Identification	Part №	Value	Used On	Recommended Stock
MOV Assembly	**1 SUP, 2 SUP, 3 SUP**	41475	—	15 – 25 HP	**1**
Inductor	**1L**	91866	—	15 HP	**0**
		91867	—	20 HP	**0**
		91871	—	25 HP	**0**
Inductor	**2L**	91849	—	15 – 25 HP	**0**
Power Switching Module	**1Q1, 2Q1, 3Q1 1Q2, 2Q2, 3Q2**	201051	—	15 – 25 HP	**2**
Temperature Sensor	**1TAS**	201000	—	15 & 20 HP	**0**
		201667	—	25 HP	**0**
Rectifier Assembly	**1REC**	201525	—	15 & 20 HP	**1**
	1 REC, 2 REC, 3 REC	201445	—	25 HP	**2**
Precharge Contactor	**1 CON**	201458	—	15 – 25 HP	**0**
Resistor	**2R, 3R**	202102	4.2kΩ, 50W, 3%	15 – 25 HP	**0**

Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

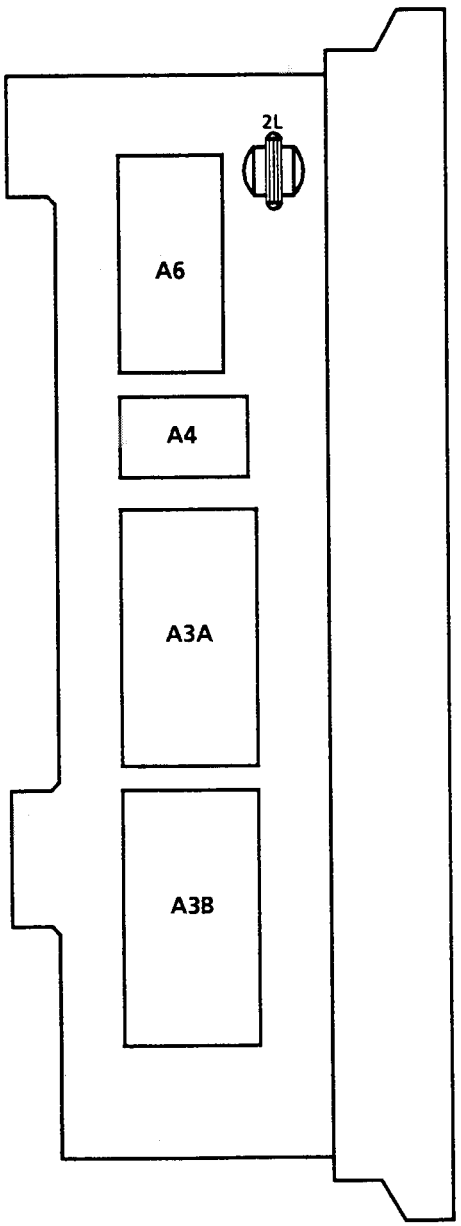
15-25 HP Drives



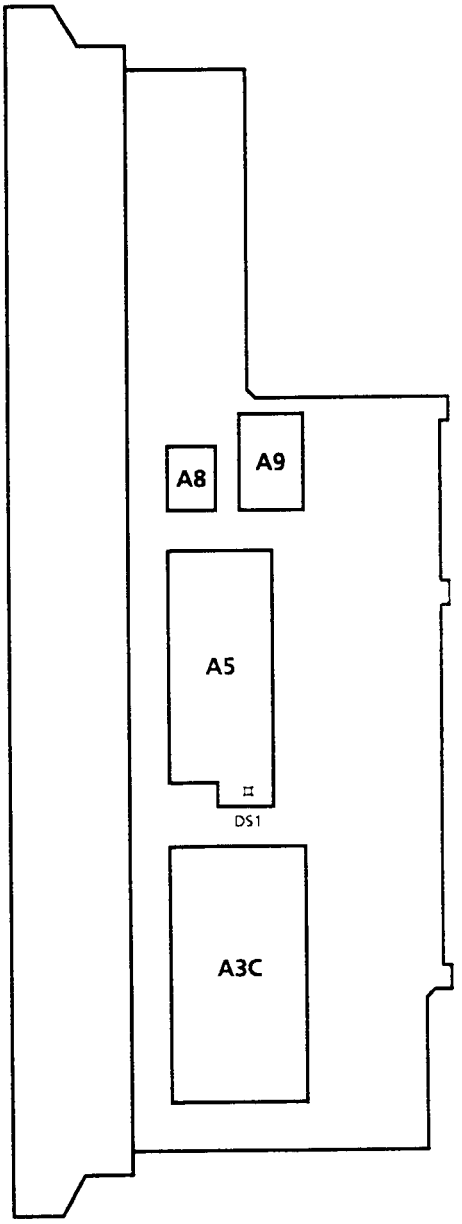
15 & 20 HP Component Location



15 & 20 HP Component Location

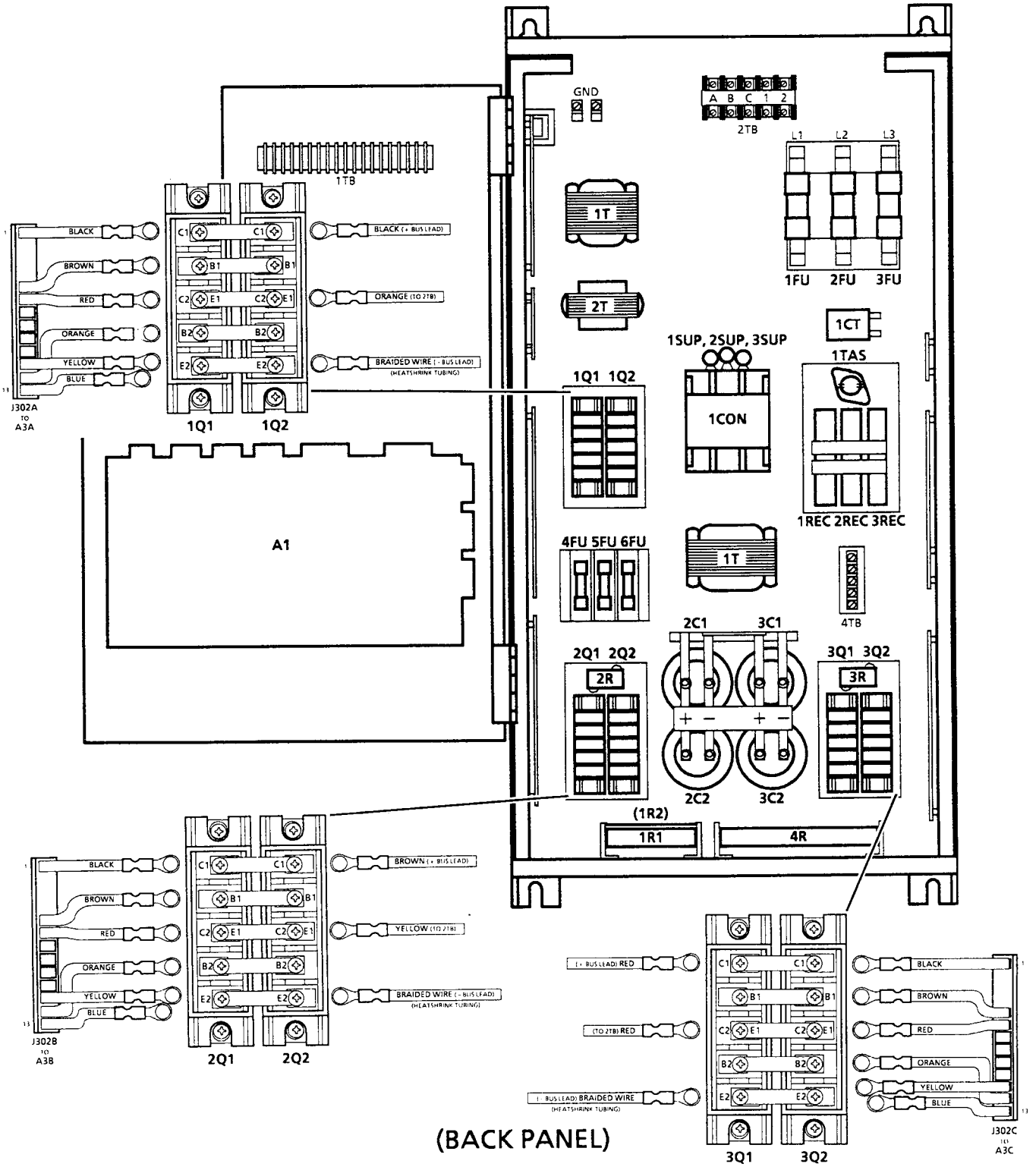


(LEFT HAND PANEL)

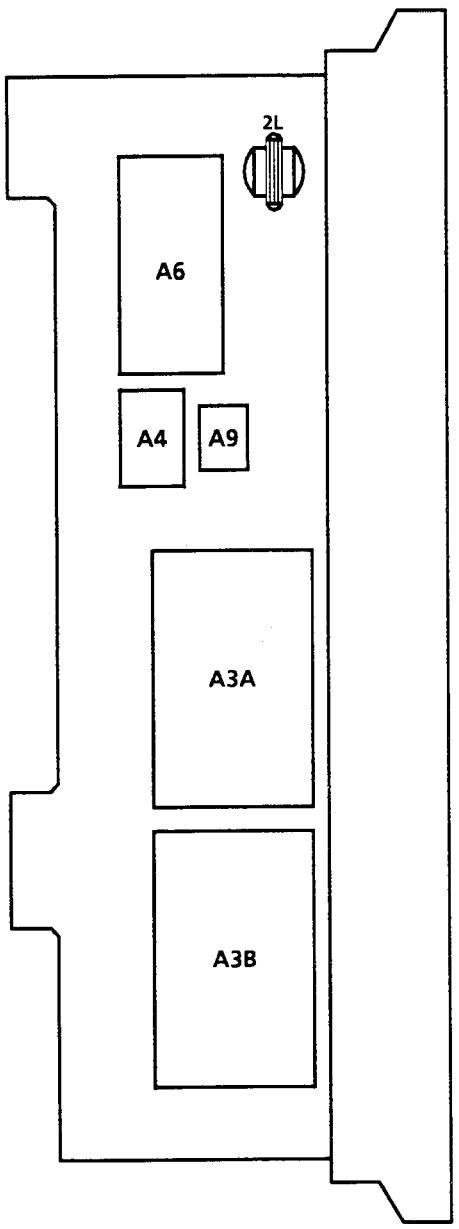


(RIGHT HAND PANEL)

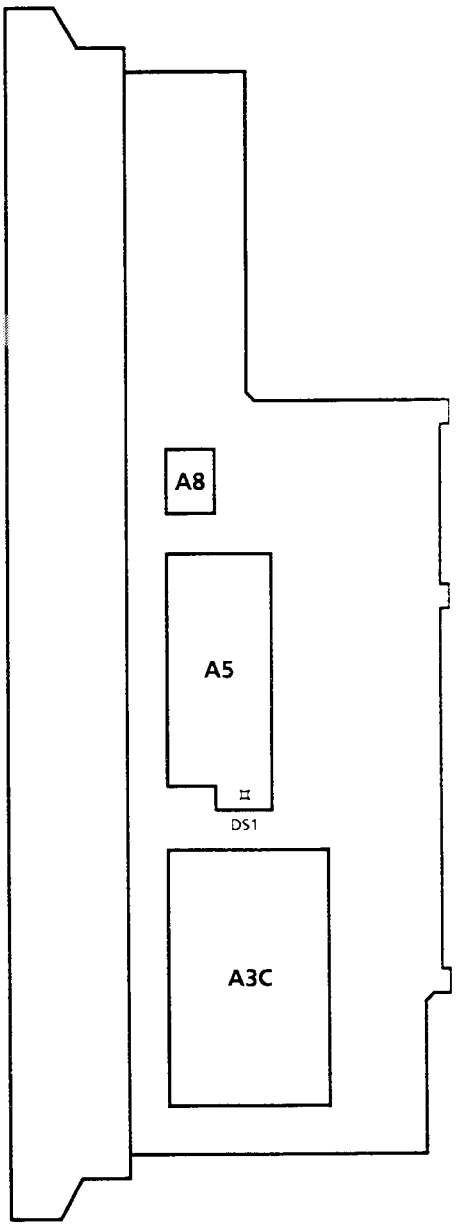
25 HP Component Location



25 HP Component Location



(LEFT HAND PANEL)



(RIGHT HAND PANEL)

Bulletin 1334 30-50 HP Series A Component Index

30-50 HP Recommended Spare Parts

Description	Identification	Part №	Value	Used On	Recommended Stock
Modulator Logic Board	**A1**	*50387-002*	—	*All Ratings*	**1**
Driver Board	**A3A, A3B, A3C**	50403	—	30 – 50 HP	**1**
Voltage Sensing Board	**A4**	50386	—	30 – 50 HP	**0**
Bus Discharge Board	**A5**	50405	—	30 – 50 HP	**1**
Logic Power Supply Board	**A6**	50389	—	30 – 50 HP	**1**
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	**0**
Output Ground Sensor Board	**A8**	50385	—	30 – 50 HP	**1**
Contactor Interface Board	**A9**	50404-001	—	30 – 50 HP	**1**
Driver Power Supply Board	**A10**	50406	—	30 – 50 HP	**1**
Fuse	**1FU, 2FU, 3FU**	201753	60A, 600V (JKS 60)	30 HP	**3**
		201749	100A, 600V (JKS 100)	40 & 50 HP	**3**
Fuse	**4FU**	201590	1A, 500V (FNQ 1)	30 – 50 HP	**1**
Fuse	**5FU**	201708	1.5A, 500V (FNQ 1.5)	30 – 50 HP	**1**
Fan Fuse	**7FU**	201478	.2A, 500V (FNQ .2)	40 & 50 HP	**0**
Bus Fuse	**8FU**	201575	70A, 600V (FWP 70)	30 HP	**1**
		201466	125A, 700V (FWP 125)	40 & 50 HP	**1**
Bus Capacitor	**2C1, 2C2 3C1, 3C2**	200364	2400µF, 450V DC	30 HP	**1**
	2C1, 2C2, 2C3 3C1, 3C2, 3C3			40 & 50 HP	**1**
Snubber Capacitor	**4C, 5C, 6C**	201455	10µF, 660V DC	30 – 50 HP	**0**
Control Transformer	**1T**	91854	—	30 – 50 HP	**0**
Transformer	**2T**	91880	—	30 – 50 HP	**0**
Fan Transformer	**3T**	91885	—	40 & 50 HP	**0**
Current Transformer	**1CT**	91824	—	30 – 50 HP	**0**

Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

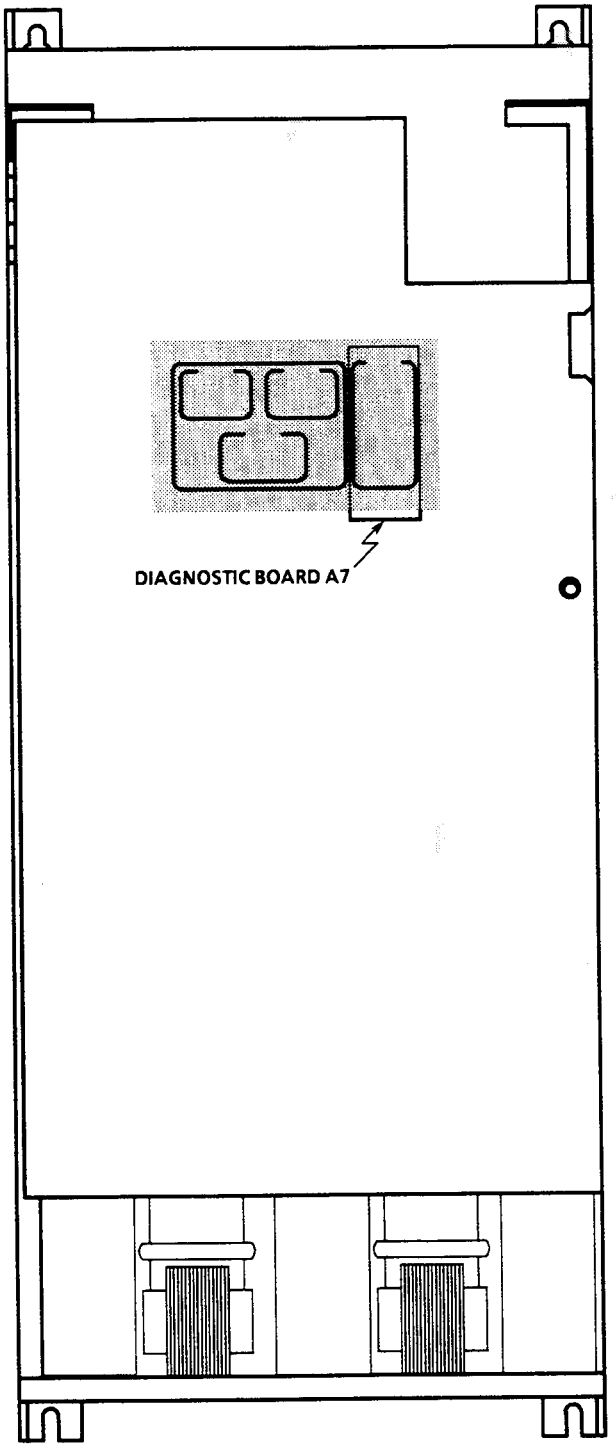
30-50 HP Recommended Spare Parts
(continued)

Description	Identification	Part №	Value	Used On	Recommended Stock
MOV Assembly	1 SUP, 2 SUP, 3 SUP	41475	—	30 HP	1
		41484	—	40 & 50 HP	1
Inductor	1L1, 1L2	91872	—	30 HP	0
		91886	—	40 HP	0
		91874	—	50 HP	0
Inductor	2L	91849	—	30 – 50 HP	0
Inductor	3L, 4L, 5L	91887	—	30 HP	0
		91879	—	40 & 50 HP	0
Power Switching Module	1Q1, 2Q1, 3Q1	201412	—	30 HP	1
	1Q1, 2Q1, 3Q1 1Q2, 2Q2, 3Q2	120784	—	40 & 50 HP	2
Temperature Sensor	1TAS	201000	—	30 – 50 HP	0
Rectifier Assembly	1 REC, 2 REC, 3 REC	201445	—	30 – 50 HP	2
Precharge Contactor	1 CON	201458	—	30 HP	0
		201459	—	40 & 50 HP	0
Fan	1FN	201508	—	40 & 50 HP	0
Snubber Diode	1D	201423	—	30 – 50 HP	0
Resistor	2R, 3R	201446	6kΩ, 50W, 3%	30 – 50 HP	0

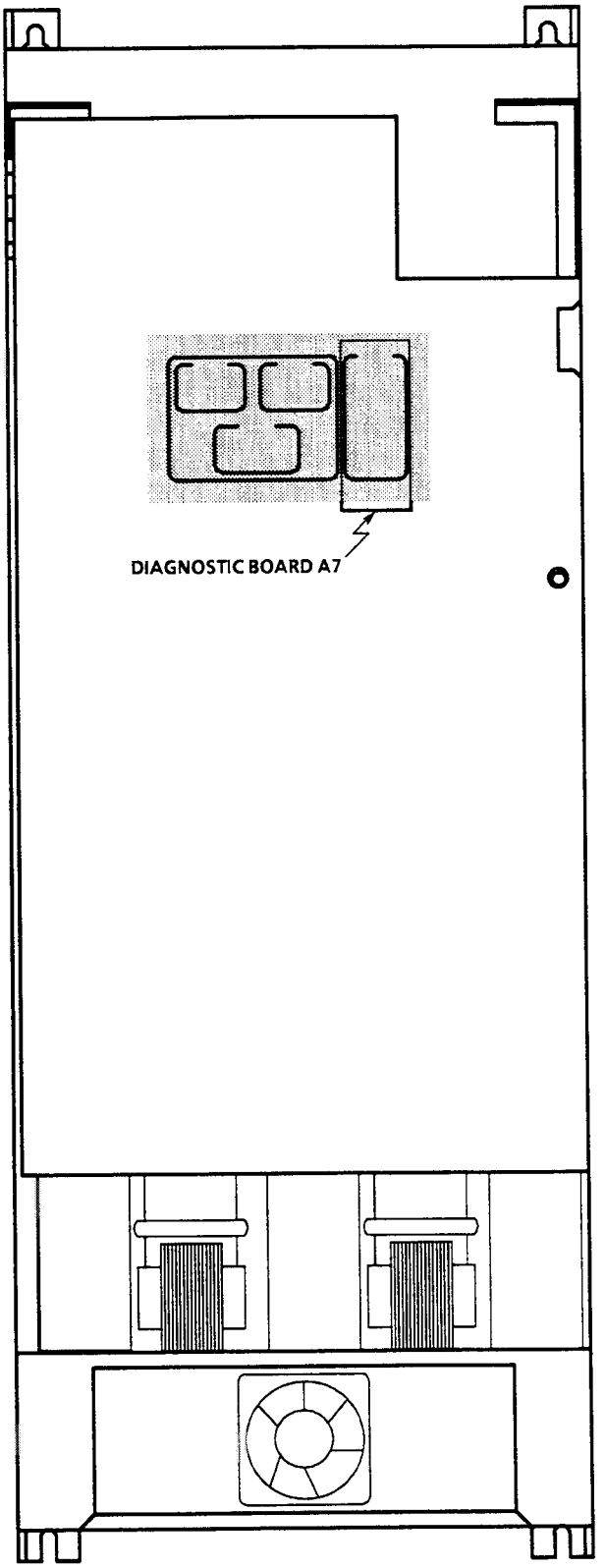
Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

CAUTION : To avoid damage to the Drive, **Power Switching Modules** connected in parallel must use the same part number. This may require changing both modules in a phase even though only one module needs to be replaced.

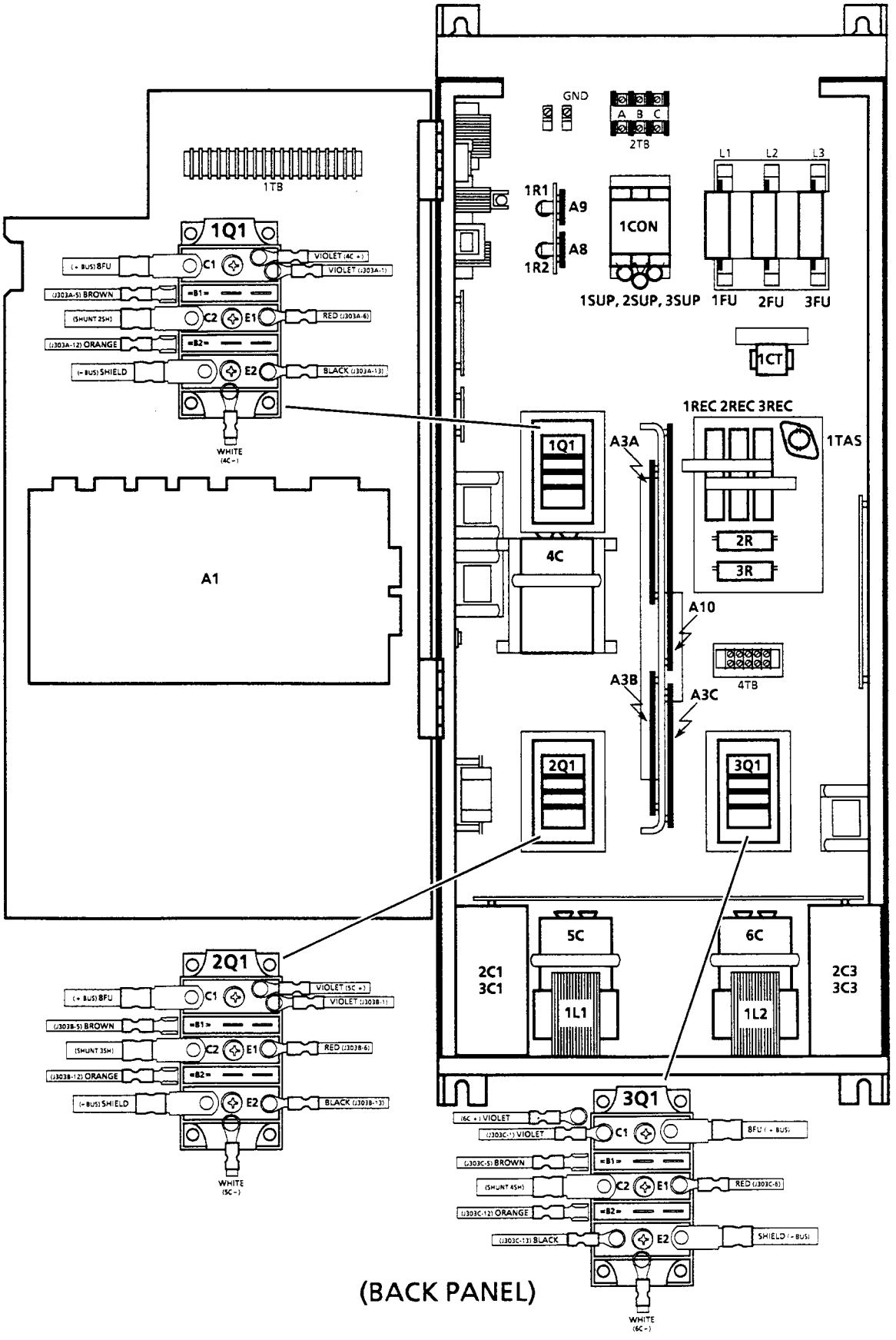
30 HP Drives



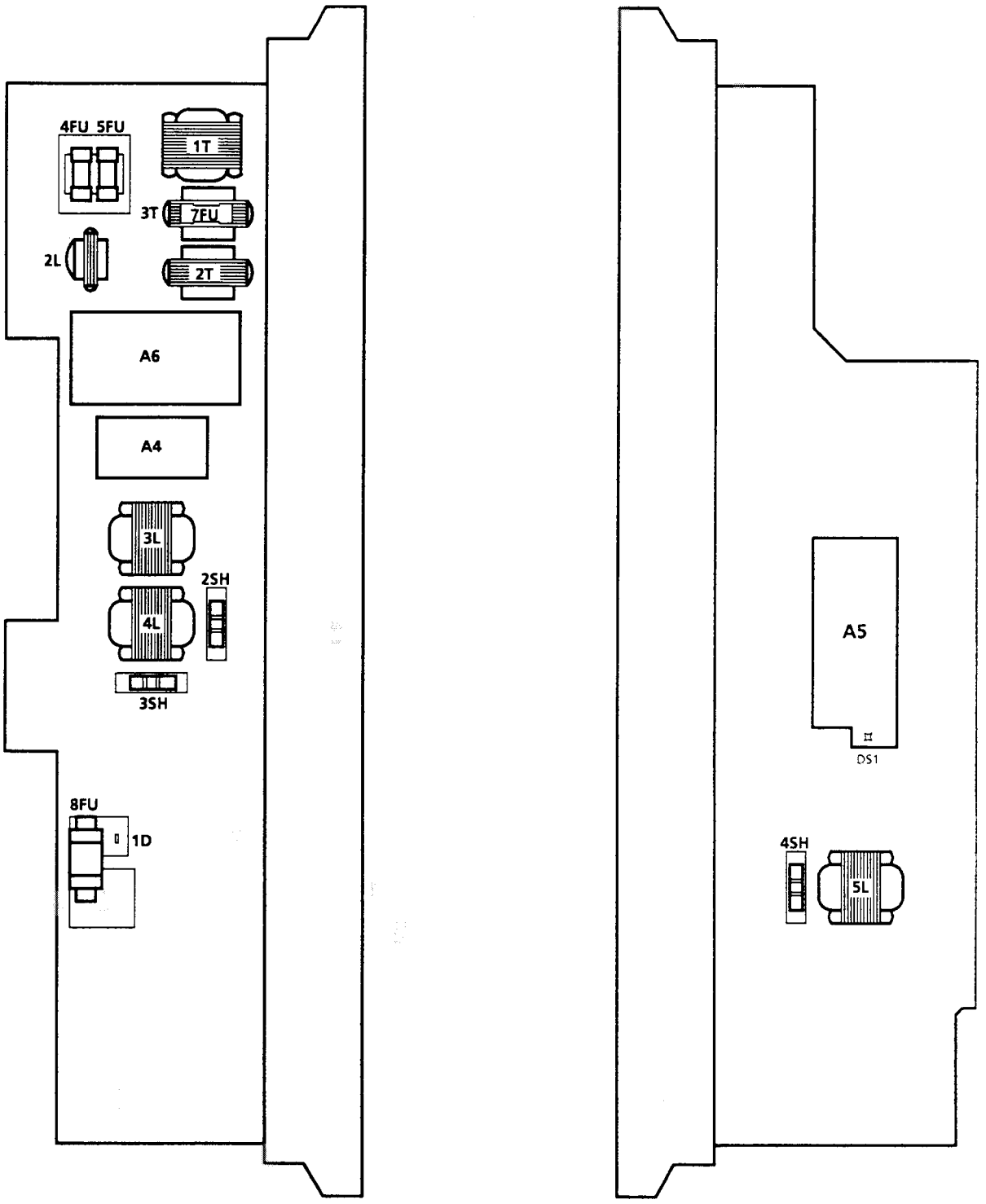
40 & 50 HP Drives



30 HP Component Location



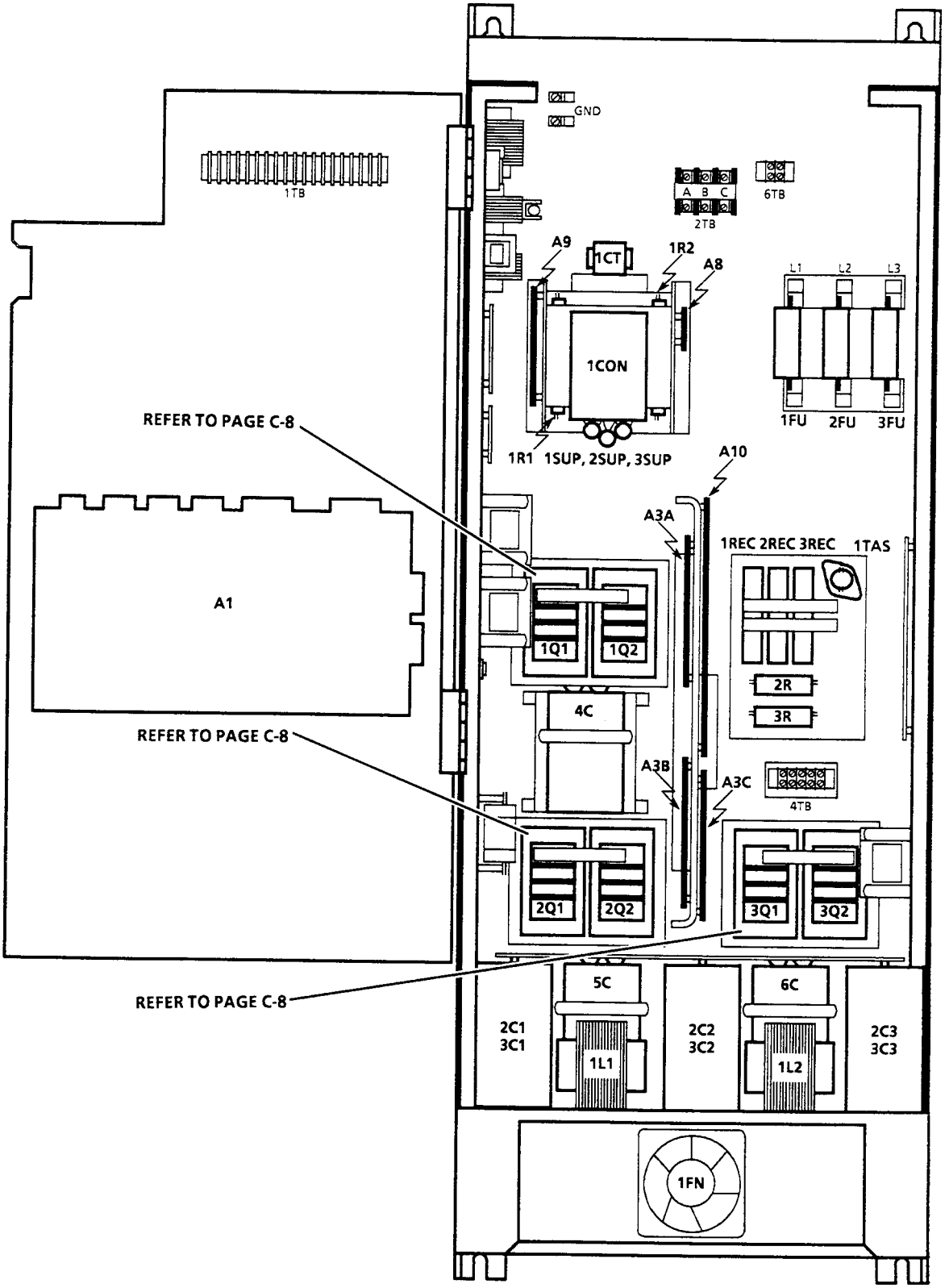
30 HP Component Location



(LEFT HAND PANEL)

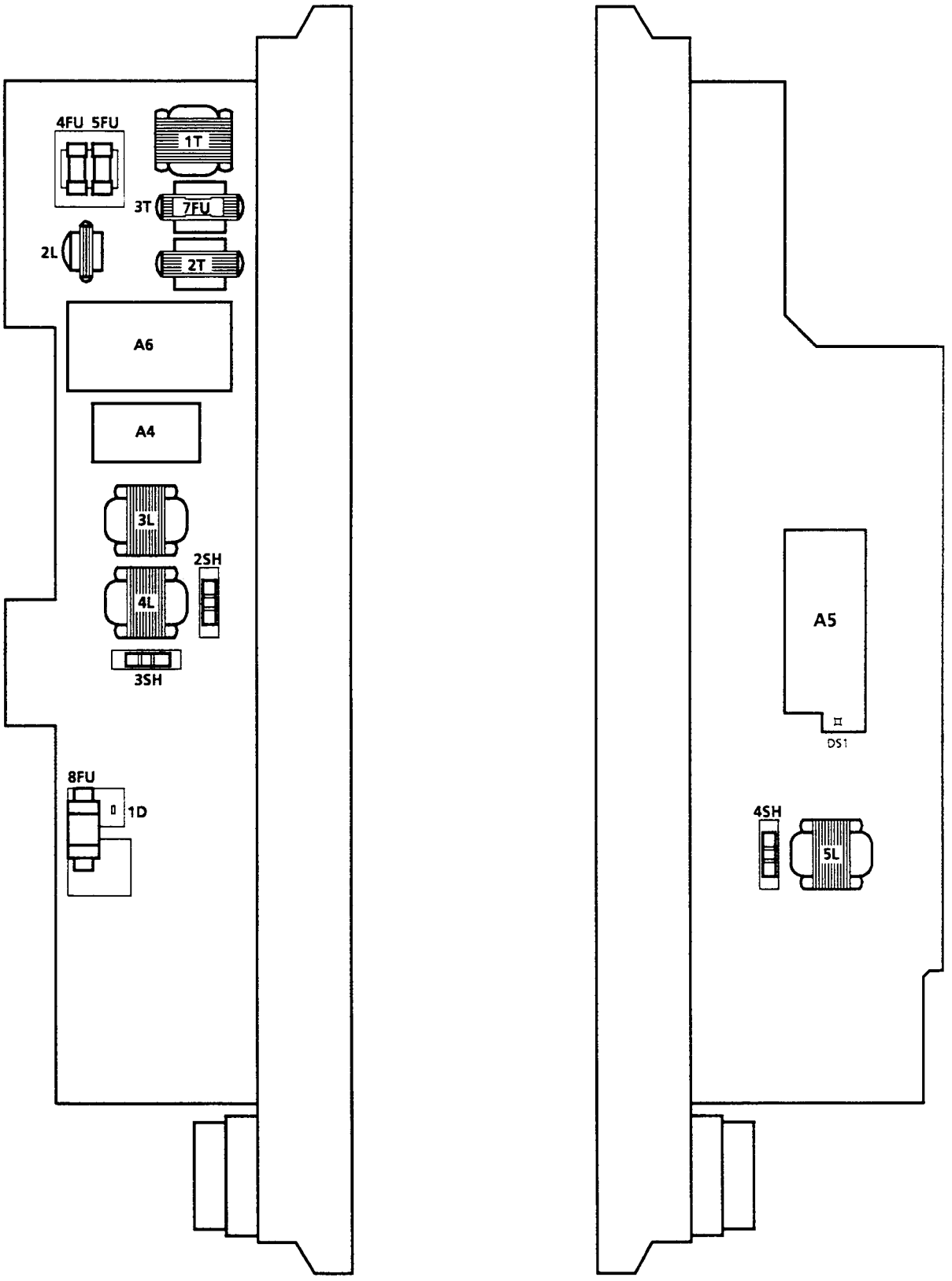
(RIGHT HAND PANEL)

40 & 50 HP Component Location



(BACK PANEL)

40 & 50 HP Component Location

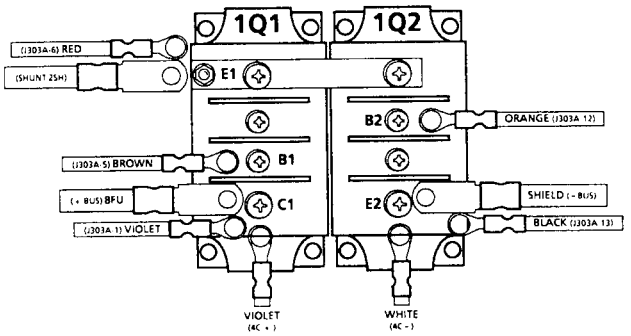


(LEFT HAND PANEL)

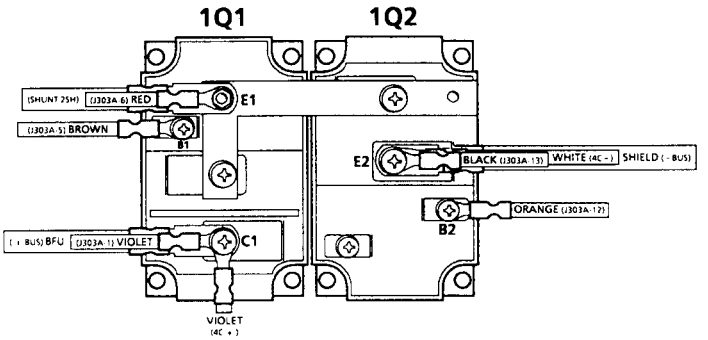
(RIGHT HAND PANEL)

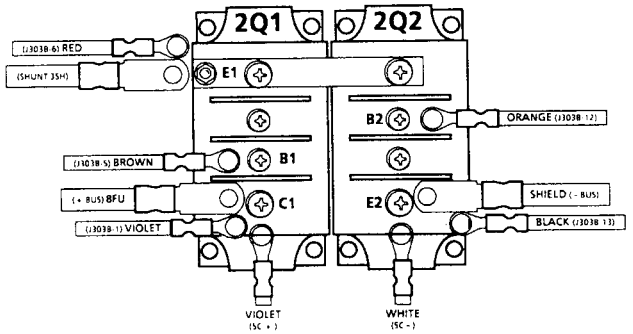
40 & 50 HP Power Switching Modules

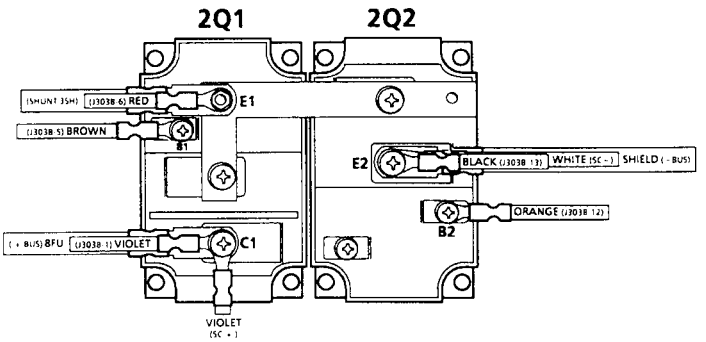
POWER SWITCHING MODULE ARRANGEMENT — P/N 201411

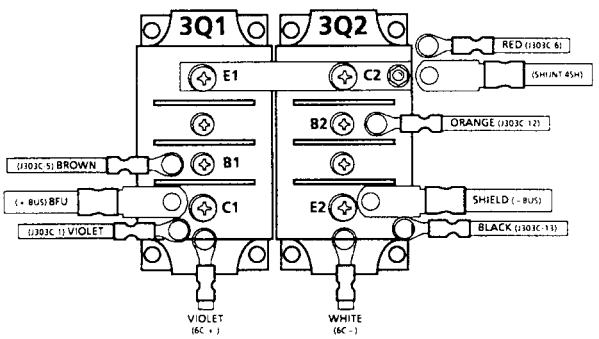


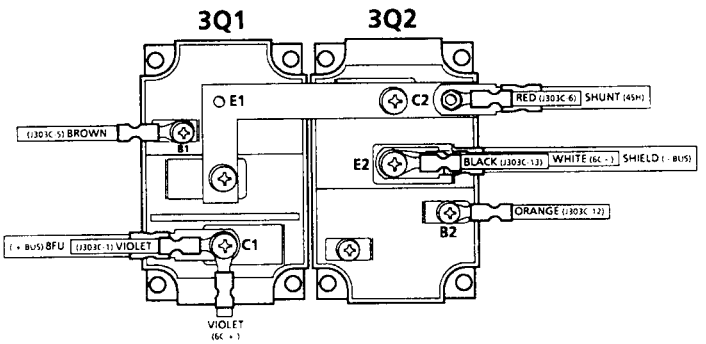
POWER SWITCHING MODULE ARRANGEMENT — P/N 120784











CAUTION : To avoid damage to the Drive, **Power Switching Modules** connected in parallel must use the same part number. This may require changing both modules in a phase even though only one module needs to be replaced.

Bulletin 1334 3-10 HP Series B Troubleshooting

3-10 HP Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Momentary Overload Protection Circuit – When constantly illuminated indicates an overload condition exceeded (60) seconds – Momentarily illuminated whenever circuit is activated.

Under Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to an input voltage that is less than 414 volts for a 460V Drive, 373 volts for a 415V Drive, or 342 volts for a 380V Drive.

Over Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to the bus voltage exceeding 760V DC.

"A" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 200%
- A Shorted **"A"** Phase Output Transistor
- Section **"A"** of the Driver Board is Malfunctioning

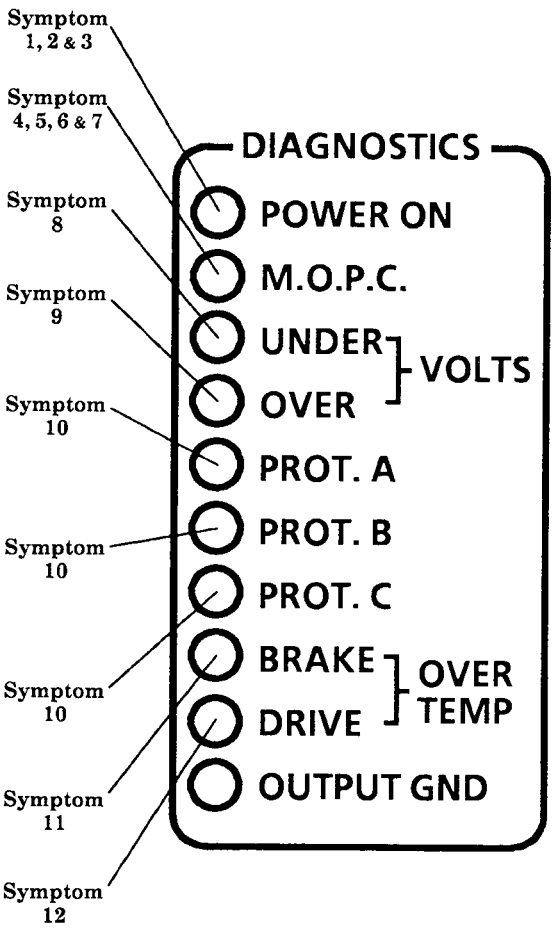
"B" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 200%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

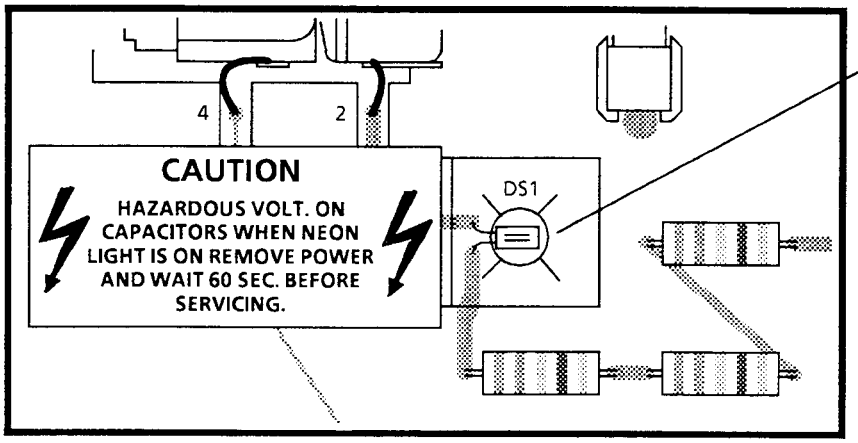
"C" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 200%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

Brake Resistor Over Temperature Protection Trip – When illuminated indicates excessive brake resistor temperature.

Drive Over Temperature Protection Trip – When illuminated indicates that the heatsink temperature of the Drive has exceeded the maximum safe operating limit.

Output Ground Fault Protection Trip Indication – *NOT UTILIZED ON 3, 5, 7½ & 10 HP DRIVES*





Symptom 13

DS1 – Located on Power Distribution Board A2 – When illuminated indicates that the bus potential is in excess of 42V DC.

3-10 HP Troubleshooting Procedures

IMPORTANT

Drive Fault Trips

Before resetting any fault trip, refer to the following troubleshooting procedures to isolate and correct the fault.

The **location of boards & Drive components** are illustrated in **Appendix A** on pages **A-2, A3, A4 & A-5.**

All Drive **interconnection wiring & interconnection points** are illustrated in **Appendix A** on pages **A-6 & A-7.**

All **voltage values & polarities** referenced in the following troubleshooting procedures are shown in the Drive Schematics in **Appendix G** or the Modulator Logic Board Interconnection Diagram in **Appendix J.**

WARNING

Hazardous voltage levels exist on some printed circuit boards and Drive components.

If diagnostic LED(s) **PROT. A, PROT. B,** or **PROT. C** are lit, hazardous voltages can be present at the output terminals even though the STOP pushbutton has been depressed.

If neon light **DS1** on Power Distribution Board A2 is lit, hazardous voltages are present in the Drive cabinet.

To guard against personal injury when boards or wires are being disconnected or reconnected, or fuses are being replaced, **always remove power to the Drive at the disconnect device, wait (60) seconds, and ensure that DS1 is not lit before servicing. Use a DVM to check for zero volts between pins 11 (+ BUS) & 15 (– BUS) at connector J202 on Power Distribution Board A2.**

CAUTION : To Guard Against Equipment Damage When Troubleshooting the Drive, Before Pressing the START Pushbutton Always:

- Set the **Speed Pot** or speed reference to **MINIMUM.**
- Set the **FWD/REV Switch** (if present), to the proper position.
- Uncouple the motor from its mechanical load.

IMPORTANT

ESD Precautions

ESD (Electrostatic Discharge) generated by static electricity can damage the CMOS devices on various Drive boards. To guard against this type of damage, it is recommended that when circuit boards are removed or installed the following precautions be observed.

- *Wear a wrist type grounding strap that is grounded to the Drive chassis.*
- *DO NOT remove the new circuit board from its conductive wrapper unless a ground strap is worn.*
- *When removing any circuit board from the Drive, immediately place it in conductive packing material.*

Symptom 1	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is not illuminated.	Check for possible loss of input line voltage by measuring line voltage between L1, L2 and L3. If voltage is present, measure voltage across Input line fuses **F1**, **F2** and **F3**. Measure voltage across input primary fuse **F4**. A voltage reading across any of these fuses indicates an open condition. Before replacing blown fuses complete **STEPS 1**, **2** & **3**. **STEP 1** – Remove input power to the Drive. Before proceeding, wait (60) seconds. **DS1**, the bus charged neon light on Power Distribution Board A2, should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged by measuring the voltage between connectors **E17** (+ BUS) and **E13** (– BUS) on Power Distribution Board A2. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale. **Connections Listed in Steps 2 & 3 are shown on pages A-6 & A-7** **STEP 2** – Check Rectifier Assembly **1REC**. Unplug connectors **E8, E9, E10** & **E13** at the Power Distribution Board. Unplug connector **1L-1** at Inductor **1L**. With an ohmmeter set on the x1 scale, check the resistance of **1REC** at the leads as follows. **OHMMETER** / **READING** + LEAD / – LEAD **1L-1** (1REC+) / **E10** (1REC-**AC1**) / **INFINITE** **1L-1** (1REC+) / **E9** (1REC-**AC2**) / **INFINITE** **1L-1** (1REC+) / **E8** (1REC-**AC3**) / **INFINITE** **E10** (1REC-**AC1**) / **E13** (1REC–) / **INFINITE** **E9** (1REC-**AC2**) / **E13** (1REC–) / **INFINITE** **E8** (1REC-**AC3**) / **E13** (1REC–) / **INFINITE** If any of the above readings are not as shown, replace Rectifier Assembly **1REC**. **IMPORTANT** : *When replacing Rectifier Assembly 1REC clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the assembly. Torque mounting screws to 17-26 in-lbs max.* **STEP 3** – With the ohmmeter set on the x100 scale, check Bus Capacitors **2C** & **3C** for a shorted condition as follows. Disconnect leads to Bus Capacitors **2C** & **3C** . Connect the (+) POSITIVE lead of the ohmmeter to the (+) POSITIVE terminal of the capacitor. Connect the (–) NEGATIVE lead of the ohmmeter to the (–) NEGATIVE terminal of the capacitor. The ohmmeter should immediately read low, then slowly increase to approximately 20kΩ. A sustained low reading indicates a shorted capacitor that requires replacement. After completing **STEPS 1**, **2** & **3**, replace blown fuses and reapply input power.

Symptom 2	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	Check for line out condition at fuse **F3** by measuring the AC line voltage from L3 to either L1 or L2. If voltage is present, measure voltage across **F3**. A voltage across **F3** indicates that it is open and must be replaced. Before replacing **F3**, perform **STEPS 1**, **2** & **3** in **Symptom 1**, then the following nine steps. **STEP 1** – Check precharge circuit fuse **F5** for an open condition. **STEP 2** With input power to the Drive removed at the disconnect device, check that all jumpers on Modulator Logic Board A1 are in their proper position, particularly the VCO/EXT-C jumper and the IFB/XFB jumper. **STEP 3** With input power to the Drive removed at the disconnect device, check installed options, particularly those with AUTO/MAN selection (both local and remote). Depending upon the options installed the maximum speed pot adjustment **R25** or the minimum speed pot adjustment **R26** may be ineffective. Refer to **section 5.3.1, Minimum and Maximum Speed Adjust**. • **If option N, N4, G2 or G4 is installed**, ensure that: The AUTO/MAN switch on the card is set to the MAN mode. A 1kΩ, 2W, linear taper speed pot has been properly connected to Terminal Block **TB1** between terminals **14**, **15** & **16**. • **If option G is installed**, ensure that the 1kΩ resistor included with the option kit has been installed at Terminal Block **TB1** between terminals **14** & **16**. • **If option K7 is installed**, check for continunity across the Brake Over Temperature circuit at Terminal Block **TB1** between terminals **17** & **18**. • **If option T, T1, T2 or T3 is installed**, check for continuity across the Motor Overload Relay contact circuit at Terminal Block **TB1** between terminals **10** & **11**. **(REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES)** **STEP 4** – Check for an open speed pot at Terminal Block **TB1**. Measure the voltage at Terminal Block **TB1** between terminals **14** & **16**. There should be 3.2V DC. If voltage is 12V DC, the speed pot may be open or there may be an open wire between the speed pot and terminals **14**, **15** & **16**. Check for an inoperative speed pot by turning the pot from 0 to 100%. The voltage between terminals **15** & **16** should vary from 0 to 3.2V DC. Replace or correct as required. **STEP 5** – Check the voltage between terminals **9** & **11** at Terminal Block **TB1**. • If standard START/STOP configuration is used, there should be 90V AC between terminals **9** & **11**. If not, the START/STOP circuit is open. Check the START/STOP circuit connections to **TB1**. • If field installed 2-wire, 90V AC, RUN/STOP control is used, there should be 90V AC between terminals **9** & **11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.6**. • If field installed 2-wire, 120V AC, RUN/STOP control is used, there should be 120V AC between terminals **9** & **11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.4**.

Symptom 2	DIAGNOSTIC PROCEDURE
(continued) Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	**STEP 6** – Measure the output voltages in the secondary circuits of Transformer **1T**. The following voltages should be present at the Power Distribution Board. molex connector **J204** between pins **4** & **1** ..... 14V AC molex connector **J204** between pins **2** & **1** ..... 14V AC molex connector **J204** between pins **5** & **6** ..... 15V AC between connector **E1** & molex connector **J204**, pin **1** ..... 90V AC between connectors **E20** & **E19** ..... 12V AC between connectors **E18** & **E19** ..... 12V AC If any one voltage is absent, remove input power and check all connections to **1T**. If all connections are correct, replace Transformer 1T. **STEP 7** – Measure all logic power supply output voltages at the Power Distribution Board. The following voltages should be present at molex connector **J203** with respect to Drive common, **J203**, pin **8**. If any one voltage is absent, replace Power Distribution Board A2. **J203**, pin **1** ..... –17V DC **J203**, pin **5** ..... + 17V DC **J203**, pin **6** ..... 14V AC **J203**, pin **7** ..... + 11 to + 13V DC (nominal) **J203**, pin **9** ..... + 11 to + 13V DC (nominal) **STEP 8** – Measure contactor **K1** supply voltage at Power Distribution Board A2. There should be + 9 to + 15V DC between pins **7** & **10** at molex connector **J203**. There should also be + 9 to + 15V DC between points **3** & **4** at the contactor. If 9 to 15 volts is measured and **K1** is not picked-up, the contactor may be inoperative. If inoperative, replace the Power Distribution Board. **STEP 9** – Check pin **10** at molex connector **J203** with respect to pin **8**, Drive common. If a TTL level "0" is not measured, replace Modulator Logic Board A1.

Symptom 3	DIAGNOSTIC PROCEDURE
Precharge cycle excessively long or not complete. Amber **POWER ON** LED may or may not be illuminated.	The DC bus precharge cycle should be completed within (5) seconds after input line power is applied to the Drive. Check precharge circuit fuse **F5** for an open condition first, then perform the following three steps. **STEP 1** – Check Rectifier Assembly **1REC** and Bus Capacitors **2C** & **3C** as specified in **STEPS 1, 2 & 3, symptom 1**. **STEP 2** – Check for an inoperative **K1** Contactor. Measure contactor coil supply voltage at Power Distribution Board A2. There should be +9 to +15V DC between pins **7** & **10** at molex connector **J203**. There should also be +9 to +15V DC between points **3** & **4** at the contactor. If 9 to 15 volts is measured and **K1** is not picked-up, the contactor may be inoperative. If inoperative, replace the Power Distribution Board. **STEP 3** – Check pin **10** at molex connector **J203** with respect to pin **8**, Drive common. If a TTL level "0" is not measured, replace Modulator Logic Board A1.

Symptom 4	DIAGNOSTIC PROCEDURE
Drive trips on momentary overloads causing phase protection indication. M.O.P.C. circuit not functioning properly. Red **M.O.P.C.** fault LED is not illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* With the motor rotor locked and boost set to zero, adjust the ACCEL RATE setting, switch **S1** on Modulator Logic Board A1, to 1.2 Hz/Sec. Set the operator speed pot or speed reference to zero. After completing the above, start the Drive and slowly increase the speed while monitoring the output motor current on any phase using a true RMS reading clamp on ammeter. The **M.O.P.C.** LED should light when the current reaches a nominal value of 150%. If the **M.O.P.C.** LED does not light, use an oscilloscope to check for a pulsed waveform at the following pins on connector **J113** of the Modulator Logic Board with respect to Drive common. **Pin 5** – ØA Driver Signal **Pin 16** – ØB Driver Signal **Pin 27** – ØC Driver Signal If pulse signals that go to a TTL level "0" are not present, replace Driver Board A3. If pulse signals are present on all (3) sections of the Driver Board, replace Modulator Logic Board A1. Return the boost and accel rate adjustments to their normal settings.

Symptom 5	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **M.O.P.C.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* An illuminated **M.O.P.C.** LED indicates that the Drive has tripped off due to a nominal 150% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or start-up (breakaway), it is normal for the M.O.P.C. LED to illuminate momentarily. This merely indicates that a momentary overload current of 150% has been sensed and that the M.O.P.C. circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the M.O.P.C. LED is constantly activated during start-up (breakaway), or if there is excessive LED activity at low frequency operation, less DC boost must be used. Refer to the **DC Boost Adjustment, section 5.3.3 and V/Hz Jumper Setting in section 5.3.2.** If Option L, the Function Expander Card is installed, **REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES.**

Symptom 6	DIAGNOSTIC PROCEDURE
Motor does not return to full set speed after stalling. Red **M.O.P.C.** fault LED is illuminated.	The load torque is exceeding the torque capability of the Drive. Check for problems with the mechanical load. If the mechanical load checks out, try increasing the DC boost as outlined in **section 5.3.3**. If this does not correct the condition, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance. **IMPORTANT**: *If a 150% continuous overload current demand exists, the motor will ramp down to a stalled condition and remain there until the overload condition no longer exists. If however the overload condition is sustained for (60) seconds, the Drive will trip and illuminate the M.O.P.C. LED on the Diagnostic Display Panel.*

Symptom 7	DIAGNOSTIC PROCEDURE
Red **M.O.P.C.** Fault LED is illuminated during DECEL or at (0) Hz.	Boost voltage set too high. Decrease the boost voltage by setting the DC boost switch lower and/or set the Decel switch to provide a slower ramp (Refer to **DC Boost Adjustment, ACCEL/DECEL Rate Adjustments, section 5.3.3**).

Symptom 8	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **UNDER VOLTS** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* An illuminated **UNDER VOLTS** LED indicates that Drive has tripped off due to an input line voltage that is less than: • **414V AC at the 460V AC Tap on Transformer 1T** • **373V AC at the 415V AC Tap on Transformer 1T** (50 Hz Input Power) • **342V AC at the 380V AC Tap on Transformer 1T** (50 Hz Input Power) STEP 1 – Check input primary fuse **F4** for an open condition. STEP 2 – Check the input voltage to Transformer **1T** by measuring the voltage between connectors **E11** & **E12** on Power Distribution Board A2. If proper voltage is present, replace Modulator Logic Board A1.

Symptom 9	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation or deceleration. Red **OVER VOLTS** fault LED is illuminated.	An illuminated **OVER VOLTS** LED indicates that the Drive has tripped off due to a bus voltage greater than 760V DC. Three conditions can cause an over voltage trip. • **Excessively High Input Voltage** • **DC Boost Set too High** • **Deceleration Rate too High for the Motor/Load Inertia** STEP 1 – Check the input line voltage across each phase at L1, L2, and L3. The voltage should not be greater than 506V AC. STEP 2 – If trip occurred during deceleration, check the position of the **NORM/DEC HOLD** jumper on the Modulator Logic Board. The jumper should be set to the **DEC HOLD** position. Monitor LED **CR53 FREQ HOLD** on the Modulator Logic Board. During deceleration, with the **NORM/DEC HOLD** jumper in the **DEC HOLD** position, the LED should light before an overvoltage trip occurs. If the LED lights, decrease the **DECEL RATE**, the **DC BOOST**, or both. Refer to the **Modulator Logic Board Switch Settings** in **section 5.3.3**. If the LED does not light, replace the Modulator Logic Board. STEP 3 – If the Drive trips out on over voltage during deceleration and a slower decel ramp is not acceptable, consult your nearest Allen-Bradley Area Sales/Support Center.

Symptom 10	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* An illuminated **A**, **B** or **C** phase protection LED indicates: • **An output overcurrent condition greater than 200% due to either:** 1) An output phase-to-phase short (Drive output, motor windings, or wiring to the motor). 2) An output overcurrent condition greater than 200% due to an output phase-to-ground short. In either case, remove input power to the Drive at the disconnect device. Disconnect the motor leads from the Drive at Terminal Block **TB2**. Reapply power to the Drive and give the Drive a START command. If the Drive can be operated without a phase protect trip occurring, the problem is in either the wiring to the motor or the motor itself. **A ground fault** can be found using an ohmmeter between the wiring to the motor and ground. Find the cause and correct it before reconnecting the motor leads to the Drive and reapplying power. **A shorted motor winding** is harder to detect because of the low resistance of the motor windings. Substitute a known, good motor for the suspected bad motor. Connect the substitute motor to the Drive output terminals and try running the Drive. If successful operation of the Drive and substitute motor is achieved, then the problem most likely is the motor originally connected to the Drive. • **Deceleration of an inertia type motor load at too high a value of DC boost or too fast a DECEL rate.** Under the right conditions, the motor can appear as a short circuit to the Drive. With excessive DC boost applied the motor can saturate, resulting in a peak current in excess of 200% causing a phase protect trip. Decrease the **DC BOOST**, the **DECEL RATE** or both. Refer to **section 5.3.3, DC Boost Adjustment, ACCEL/DECEL Rate Adjustment** for additional information. • **Excessive DC boost causing a phase protection trip during acceleration.** Excessive DC boost can cause a phase protection trip to occur during acceleration of the Drive and motor due to saturation of the motor windings. If reducing the DC boost setting eliminates the phase protection trip but does not produce sufficient torque to enable the motor to accelerate the load, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance. **Reset the Drive by giving it a STOP command followed by a START command. If proper operation cannot be obtained without the reoccurrence of a phase protect trip and you have eliminated the preceding possibilities, the problem is most likely caused by one of the following.**

Symptom 10	DIAGNOSTIC PROCEDURE
(continued) Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	• **A shorted output transistor in one of the Power Switching Modules.** **Phase "A"** ... 1Q **Phase "B"** ... 2Q **Phase "C"** ... 3Q Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board.** **Phase "A"** ... Section A of the Driver Board **Phase "B"** ... Section B of the Driver Board **Phase "C"** ... Section C of the Driver Board Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board causing an output power Switching Module to be ON when it shouldn't be.** **Phase "A"** ... Section A of the Driver Board **Phase "B"** ... Section B of the Driver Board **Phase "C"** ... Section C of the Driver Board Perform the following four steps to isolate and correct the problem. • **A malfunctioning Modulator Logic Board causing an abnormal Drive output voltage waveform.** Perform the following four steps to isolate and correct the problem. STEP 1 – Remove input power to the Drive. Before proceeding, wait (60) seconds. **DS1**, the bus charged neon light on Power Distribution Board A2, should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged by measuring the voltage between connectors **E17** (+BUS) and **E13** (– BUS) on Power Distribution Board A2. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale.

Symptom 10	DIAGNOSTIC PROCEDURE

(continued)

Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.

Connections Listed in Step 2 are shown on pages A-6 & A-7

STEP 2 – Check for a shorted output transistor module for the indicated phase as follows.

Unplug connectors **E5, E6, E7** & **E13** at the Power Distribution Board.

Unplug the molex connector for the indicated phase at the Driver Board **(J302A, B** or **C)**.

With an ohmmeter set on the x1 scale, measure the resistance between the collector and emitter of both upper and lower power switching transistors at molex connector **J302A, B** or **C** as follows.

OHMMETER		READING
+ LEAD	– LEAD	
J302, pin **1** (C1)	**J302**, pin **6** (E1)	**INFINITE**
J302, pin **6** (C2)	**J302**, pin **13** (E2)	**INFINITE**

With an ohmmeter set on the x1 scale, measure the resistance between the collector and base of both upper and lower power switching transistors at molex connector **J302A, B** or **C** as follows.

OHMMETER		READING
+ LEAD	– LEAD	
J302, pin **1** (C1)	**J302**, pin **5** (B1)	**INFINITE**
J302, pin **6** (C2)	**J302**, pin **12** (B2)	**INFINITE**

- If a collector to base short is found in either the upper or lower power switching transistor, replace the module.
- If either transistor has a collector to base short, replace the module and the Driver Board.

IMPORTANT: *When replacing power switching modules clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of each module. Torque mounting screws to 17-26 in-lbs max.*

STEP 3 – Before reconnecting the motor, reapply input power to the Drive and ensure that the Drive operates properly in the manual operating mode. Depending upon the options installed, switch to **MANUAL** control if required. No diagnostic LEDs should be illuminated. If satisfactory operation is achieved, reconnect the motor and check operation again. If satisfactory operation is not achieved, replace the Modulator Logic Board.

STEP 4 – Once proper operation is achieved in the manual mode, depending on the options installed check operation in the auto or normal operating mode. If the Drive is not functioning properly in the normal mode, check all Modulator Board jumper settings and input signals to the option cards. If satisfactory operation is not achieved, replace the Modulator Logic Board.

(REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES)

Symptom 11	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **BRAKE OVER TEMP.** fault LED is illuminated. (Used only when equipped with the Dynamic Brake Option).	**IMPORTANT** : *If Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* An illuminated **BRAKE OVER TEMPERATURE** LED indicates an excessive brake resistor assembly temperature. This condition is normally caused by either excessive braking or a deceleration rate too high for the motor/load inertia. When the Dynamic Brake Option is used, it is recommended that the **NORM/DEC HOLD** jumper be set to the **DEC HOLD** position. If neither of the above is true, check for: • **Open Precharge Fuse F5 and/or Shorted Brake Transistor 4Q** • **Malfunctioning Brake Resistor Thermal O.L.** (2TAS on Brake Resistor Assembly) • **Poorly Ventilated Resistor Enclosure** Check and repair as required. **IMPORTANT** : **To reset a Brake Over Temperature Trip**: 1. *Remove input power to the Drive at the disconnect device.* 2. *Wait a few minutes to allow the O.L. heater and brake resistor to cool down.* 3. *Open the conduit box on the resistor cage assembly. Manually reset Thermal O.L. Relay 2TAS by depressing the plunger until a reset "click" is either heard or felt.* 4. *Reapply power to the Drive at the disconnect device.* 5. *Reset the Drive by giving it a STOP command followed by a START command.*

Symptom 12	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **DRIVE OVER TEMP.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse F5 for an open condition. Replace if necessary.* An illuminated **DRIVE OVER TEMPERATURE** LED indicates that the Drive has tripped off due to an over temperature condition. Allow Drive to cool down for approximately (15) minutes before restarting. After restarting, if over temperature condition occurs again, check for the following conditions. • **Ambient Temperature that Exceeds the Drive Rating**. Measure the ambient temperature surrounding the Drive per the **Specification Table, Chapter 3.** • **Heat Flow Obstruction within the Heat Sink Assembly**. Visually inspect for unobstructed spacing between fins. Clean if necessary. • **Thermal Overloading Caused by Duty Cycle Demands Exceeding 100% of Current Over an Extended Period of Time**. Using an AC clamp on ammeter, measure the motor current over an extended period of time. **IMPORTANT** : *Clamp on type amp probes and current transformers are frequency sensitive. Inaccurate current readings at frequencies other than 60 Hz may be observed. It is recommended that a true RMS reading clamp on ammeter be used.* • **Malfunctioning Temperature Sensor 1TAS**. If all of the above conditions have been checked and the problem still remains, replace Temperature Sensor **1TAS**. **IMPORTANT** : *When replacing Temperature Sensor 1TAS clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the sensor. Torque mounting screws to 2.6-3.0 in-lbs max.*

Symptom 13	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (60) seconds when input power is removed. Neon light **DS1** on Power Distribution Board A2 is illuminated.	After input power is removed the bus voltage should discharge to 42V DC in approximately (60) seconds. If the discharge cycle is not taking place, check to see if resistor **2R** or **3R** has opened. If neither resistor is open, check for open wiring between the resistors and Bus Capacitors **2C** & **3C**. If all wiring is correct, replace Power Distribution Board A2. If either resistor is open, replace and reapply input power. **IMPORTANT** : *When replacing resistor 2R or 3R, clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the resistor. Torque mounting screws to 2.6-3.0 in-lbs Max.* Check for proper bus discharge cycle. Measure the DC voltage between connectors **E17** (+ BUS) and **E13** (– BUS) on Power Distribution Board A2. After approximately (60) seconds the voltage should be below 42 volts. If discharge cycle is still not taking place and/or either resistor opens again, replace Power Distribution Board A2.

Bulletin 1334 15-25 HP Series A Troubleshooting

15-25 HP Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Momentary Overload Protection Circuit – When constantly illuminated indicates an overload condition exceeded (60) seconds – Momentarily illuminated whenever circuit is activated.

Under Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to an input voltage that is less than 414 volts for a 460V Drive, 373 volts for a 415V Drive, or 342 volts for a 380V Drive.

Over Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to the bus voltage exceeding 760V DC.

"A" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"A"** Phase Output Transistor
- Section **"A"** of the Driver Board is Malfunctioning

"B" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

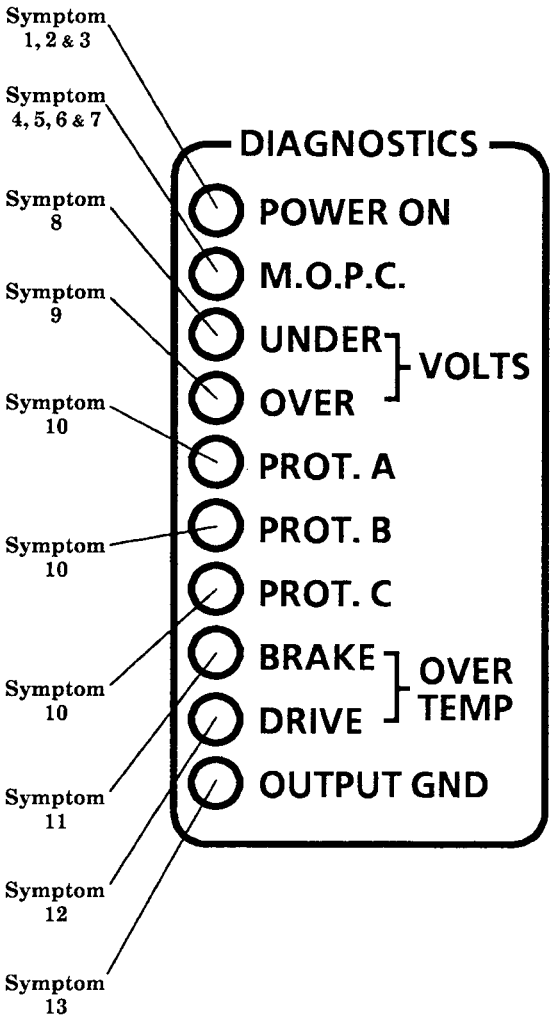
"C" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

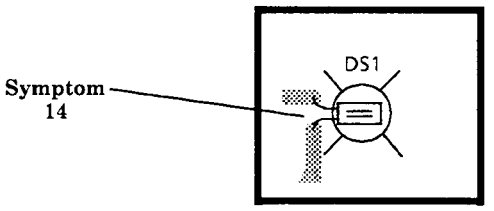
Brake Resistor Over Temperature Protection Trip – When illuminated indicates excessive brake resistor temperature.

Drive Over Temperature Protection Trip – When illuminated indicates that the heatsink temperature of the Drive has exceeded the maximum safe operating limit.

Output Ground Fault Protection Trip Indication – When illuminated indicates that the Drive circuitry has shorted to GROUND.



DS1 – Located on Bus Discharge Board A5 (or Dynamic Brake Board when installed) – When illuminated indicates that the bus potential is in excess of 42V DC.



15-25 HP Troubleshooting Procedures

IMPORTANT

Drive Fault Trips

Before resetting any fault trip, refer to the following troubleshooting procedures to isolate and correct the fault.

The **location of boards & Drive components** are illustrated in **Appendix B** on pages **B-3** & **B-4**.

All **voltage values & polarities** referenced in the following troubleshooting procedures are shown in the Drive Schematics in **Appendix H** or the Modulator Logic Board Interconnection Diagram in **Appendix J**.

WARNING

Hazardous voltage levels exist on some printed circuit boards and Drive components.

If diagnostic LED(s) **PROT. A**, **PROT. B**, or **PROT. C** are lit, hazardous voltages can be present at the output terminals even though the STOP pushbutton has been depressed.

If neon light **DS1** on Bus Discharge Board A5 (or the Brake Board if installed) is lit, hazardous voltages are present in the Drive cabinet.

To guard against personal injury when boards or wires are being disconnected or reconnected, or fuses are being replaced, **always remove power to the Drive at the disconnect device, wait (5) seconds, and ensure that DS1 is not lit before servicing. Use a DVM to check for zero volts between terminals 1 (+ BUS) & 5 (– BUS) at terminal block 4TB on the Drive backpanel.**

CAUTION : To Guard Against Equipment Damage When Troubleshooting the Drive, *Before* Pressing the START Pushbutton Always:

- Set the **Speed Pot** or speed reference to **MINIMUM**.
- Set the **FWD/REV Switch** (if present), to the proper position.
- Uncouple the motor from its mechanical load.

IMPORTANT

ESD Precautions

ESD (Electrostatic Discharge) generated by static electricity can damage the CMOS devices on various Drive boards. To guard against this type of damage, it is recommended that when circuit boards are removed or installed the following precautions be observed.

- *Wear a wrist type grounding strap that is grounded to the Drive chassis.*
- *DO NOT remove the new circuit board from its conductive wrapper unless a ground strap is worn.*
- *When removing any circuit board from the Drive, immediately place it in conductive packing material.*

Symptom 1	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is not illuminated.	Check for possible loss of input line voltage by measuring line voltage between L1, L2 and L3. If voltage is present, measure voltage across input line fuses **1FU**, **2FU**, and **3FU**. Measure voltage across input primary fuse **4FU** at transformer 1T. A voltage reading across any of these fuses indicates an open condition. Before replacing blown fuses complete **STEPS 1 – 4**. **STEP 1** – Remove input power to the Drive. Before proceeding, wait (5) seconds. The Bus Indicator neon light on Bus Discharge Board A5 (or Brake Board if installed), should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale. **STEP 2** – For 15 & 20 HP Drives, with an ohmmeter set on the x1 scale, check Rectifier Assembly **1 REC** as follows:

OHMMETER		READING
+ LEAD	– LEAD	
GREEN (1 REC +)	**ORANGE** (1 REC - AC1)	Infinite
GREEN (1 REC +)	**GRAY** (1 REC - AC2)	Infinite
GREEN (1 REC +)	**YELLOW** (1 REC - AC3)	Infinite
ORANGE (1 REC - AC1)	**WHITE** (1 REC –)	Infinite
GRAY (1 REC - AC2)	**WHITE** (1 REC –)	Infinite
YELLOW (1 REC - AC3)	**WHITE** (1 REC –)	Infinite

If any of the above readings are not as shown, replace Rectifier Assembly **1REC**.

STEP 3 – For 25 HP Drives, with an ohmmeter set on the x1 scale, check Rectifier Assembly **1 REC, 2 REC, 3 REC** as follows:

OHMMETER		READING
+ LEAD	– LEAD	
BLACK (1 REC +)	**ORANGE** (1 REC - AC1)	Infinite
BLACK (1 REC +)	**YELLOW** (2 REC - AC2)	Infinite
BLACK (1 REC +)	**GREEN** (3 REC - AC3)	Infinite
ORANGE (1 REC - AC1)	**WHITE** (1 REC –)	Infinite
YELLOW (2 REC - AC2)	**WHITE** (1 REC –)	Infinite
GREEN (3 REC - AC3)	**WHITE** (1 REC –)	Infinite

If any of the above readings are not as shown, replace Rectifier Assembly **1 REC, 2 REC, 3 REC**.

Symptom 1	DIAGNOSTIC PROCEDURE
(continued) Drive does not start. Amber **POWER ON** LED is not illuminated.	**IMPORTANT** : *When replacing the Rectifier Assembly clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the assembly. Torque mounting screws to 17-26 in-lbs max.* **STEP 4** – With the ohmmeter set on the x100 scale, check Bus Capacitors **2C1**, **3C1**, **2C2**, & **3C2** for a shorted condition as follows. Remove the capacitor support block and (+) POSITIVE bus bars. Connect the (+) POSITIVE lead of the ohmmeter to the (+) POSITIVE terminal of the capacitor. Connect the (–) NEGATIVE lead of the ohmmeter to the (–) NEGATIVE capacitor bus bar. The ohmmeter should immediately read low, then slowly increase to approximately 20kΩ. A sustained low reading indicates a shorted capacitor that requires replacement. After completing **STEPS 1** – **4**, replace blown fuses and reapply input power.

Symptom 2	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	Check for line out condition at fuse **3FU** by measuring the AC line voltage from L3 to either L1 or L2. If voltage is present, measure voltage across **3FU**. A voltage across **3FU** indicates that it is open and must be replaced. Before replacing **3FU**, perform **STEPS 1 – 4** in **Symptom 1**, then the following eleven steps. **STEP 1** – Check precharge circuit fuse **5FU** for an open condition. **STEP 2** With input power to the Drive removed at the disconnect device, check that all jumpers on Modulator Logic Board A1 are in their proper position, particularly the VCO/EXT-C jumper and the IFB/XFB jumper. **STEP 3** With input power to the Drive removed at the disconnect device, check installed options, particularly those with AUTO/MAN or AUTO/OFF/MANUAL selection (both local and remote). Depending upon the options installed the maximum speed pot adjustment **R25** or the minimum speed pot adjustment **R26** may be ineffective. Refer to **section 5.3.1, Minimum and Maximum Speed Adjust**. • **If option N, N4, G2 or G4 is installed**, ensure that: The AUTO/MAN switch on the card is set to the MAN mode. A 1kΩ, 2W, linear taper speed pot has been properly connected to Terminal Block **1TB** between terminals **14, 15** & **16**. • **If option G is installed**, ensure that the 1kΩ resistor included with the option kit has been installed at Terminal Block **TB1** between terminals **14** & **16**. • **If option K8 or K9 is installed**, check for continunity across the Brake Over Temperature circuit at Terminal Block **TB1** between terminals **17** & **18**. • **If option T4, T5 or T6 is installed**, check for continuity across the Motor Overload Relay contact circuit, terminals **10** & **11** at Terminal Block **1TB**. **(REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES)** **STEP 4** – Check for an open speed pot at Terminal Block **1TB**. Measure the voltage at Terminal Block **1TB** between terminals **14** & **16**. There should be 3.2V DC. If voltage is 12V DC, the speed pot may be open or there may be an open wire between the speed pot and terminals **14, 15** & **16**. Check for an inoperative speed pot by turning the pot from 0 to 100%. The voltage between terminals **15** & **16** should vary from 0 to 3.2V DC. Replace or correct as required. **STEP 5** – Check the voltage between terminals **9** & **11** at Terminal Block **1TB**. • If standard START/STOP configuration is used, there should be 90V AC between terminals **9** & **11**. If not, the START/STOP circuit is open. Check the START/STOP circuit connections to **1TB**. • If field installed 2-wire, 90V AC, RUN/STOP control is used, there should be 90V AC between terminals **9** & **11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.6**. • If field installed 2-wire, 120V AC, RUN/STOP control is used, there should be 120V AC between terminals **9** & **11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.5**.

Symptom 2	DIAGNOSTIC PROCEDURE
(continued) Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	**STEP 6** – Measure the output voltages in the secondary circuits of Transformer **1T**. The following voltages should be present at Power Supply Board A6. molex connector **J602** between pins **4** & **1** ..... 14V AC molex connector **J602** between pins **2** & **1** ..... 14V AC molex connector **J602** between pins **5** & **6** ..... 15V AC The following voltage should be present at terminal block **1TB**. between terminals **1** & **11** ..... 90V AC If any one voltage is absent, remove input power and check all connections to **1T**. If all connections are correct, replace Transformer 1T. **STEP 7** – Go to Logic Power Supply Board A6 and measure all output voltages. The following voltages should be present at molex connector **J601** with respect to Drive common, **J601** Pin **1**. If any one voltage is absent, replace A6. **J601**, pin **2** ..... 14V AC **J601**, pin **3** ..... +17V DC **J601**, pin **5** ..... +9 to +15V DC (nominal) **J601**, pin **6** ..... +9 to +15V DC (nominal) **J601**, pin **9** ..... –17V DC **STEP 8** – Measure the output voltage across the secondary circuit of Transformer **2T**, pins **5** & **6**. If 17V AC is absent, replace **2T**. **STEP 9** – If **2T** checks out, Contactor Interface Board A9 may be inoperative The following voltages should be present with respect to Drive common, **J901** Pin **1**. **J901**, pin **4** ..... +24V DC **J901**, pin **6** ..... 0V DC (nominal) **J901**, pin **7** ..... 0V DC (nominal) **J901**, pin **8** ..... +11V DC **STEP 10** – If Transformer **2T** and Contactor Interface Board A9 check out, measure the control voltage at contactor **1CON**. There should be +24V DC between points **C1** & **C2** at the contactor. If +24V DC is measured and **1CON** is not picked-up, the contactor may be inoperative. Replace if required. If the problem cannot be found after completing **STEPS 1** – **10**, replace Modulator Logic Board A1.

Symptom 3	DIAGNOSTIC PROCEDURE
Precharge cycle excessively long or not complete. Amber **POWER ON** LED may or may not be illuminated.	The DC bus precharge cycle should be completed within (5) seconds after input line power is applied to the Drive. Check precharge circuit fuse **5FU** for an open condition first, then perform the following three steps. **STEP 1** – Check Rectifier Assemblies and Bus Capacitors as specified in **STEPS 1 – 4**, **symptom 1**. **STEP 2** – Check Precharge Contactor Interface Board A9 The following voltages should be present at connector **J901** on the Contactor Interface Board. Replace if required. Transformer **2T** secondary voltage — 17V AC between pins **2** & **3** Contactor **1CON** control voltage — + 24V DC between pins **4** & **6** + 11V DC between pins **7** & **8** If the problem cannot be found after completing **STEPS 1** & **2**, replace Modulator Logic Board A1.

Symptom 4	DIAGNOSTIC PROCEDURE
Drive trips on momentary overloads causing phase protection indication. M.O.P.C. circuit not functioning properly. Red **M.O.P.C.** fault LED is not illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* With the motor rotor locked and boost set to zero, adjust the ACCEL RATE setting, switch **S1** on Modulator Logic Board A1, to 1.2 Hz/Sec. Set the operator speed pot or speed reference to zero. After completing the above, start the Drive and slowly increase the speed while monitoring the output motor current on any phase using a true RMS reading clamp on ammeter. The **M.O.P.C.** LED should light when the current reaches a nominal value of 150%. If the **M.O.P.C.** LED does not light, use an oscilloscope to check for a pulsed waveform at the following pins on connector **J113** of the Modulator Logic Board with respect to Drive common. **Pin 5** – ØA Driver Signal **Pin 16** – ØB Driver Signal **Pin 27** – ØC Driver Signal If pulse signals that go to a TTL level "0" are not present, replace the Driver Board in question. If pulse signals are present on all (3) Driver Boards, replace Modulator Logic Board A1. Return the boost and accel rate adjustments to their normal settings.

Symptom 5	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **M.O.P.C.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **M.O.P.C.** LED indicates that the Drive has tripped off due to a nominal 150% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or start-up (breakaway), it is normal for the M.O.P.C. LED to illuminate momentarily. This merely indicates that a momentary overload current of 150 % has been sensed and that the M.O.P.C. circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the M.O.P.C. LED is constantly activated during start-up (breakaway), or if there is excessive LED activity at low frequency operation, less DC boost must be used. Refer to the **DC Boost Adjustment, section 5.3.3 and V/Hz Jumper Setting in section 5.3.2.** If Option L, the Function Expander Card is installed, **REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES.**

Symptom 6	DIAGNOSTIC PROCEDURE
Motor does not return to full set speed after stalling. Red **M.O.P.C.** fault LED is illuminated.	The load torque is exceeding the torque capability of the Drive. Check for problems with the mechanical load. If the mechanical load checks out, try increasing the DC boost as outlined in **section 5.3.3**. If this does not correct the condition, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance. **IMPORTANT**: *If a 150 % continuous overload current demand exists, the motor will ramp down to a stalled condition and remain there until the overload condition no longer exists. If however the overload condition is sustained for (60) seconds, the Drive will trip and illuminate the M.O.P.C. LED on the Diagnostic Display Panel.*

Symptom 7	DIAGNOSTIC PROCEDURE
Red **M.O.P.C.** fault LED is illuminated during DECEL or at (0) Hz.	Boost voltage set too high. Decrease the boost voltage by setting the DC boost switch lower and/or set the Decel switch to provide a slower ramp (Refer to **DC Boost Adjustment, ACCEL/DECEL Rate Adjustments, section 5.3.3**).

Symptom 8	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **UNDER VOLTS** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **UNDER VOLTS** LED indicates that Drive has tripped off due to an input line voltage that is less than 414V AC at the 460V AC Tap on Transformer **1T** • **414V AC at the 460V AC Tap on Transformer 1T** • **373V AC at the 415V AC Tap on Transformer 1T** (50 Hz Input Power) • **342V AC at the 380V AC Tap on Transformer 1T** (50 Hz Input Power) **STEP 1** – Check input primary fuse **4FU** for an open condition. **STEP 2** – Measure the input voltage to Transformer **1T**. If proper voltage is present, replace Modulator Logic Board A1.

Symptom 9	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation or deceleration. Red **OVER VOLTS** fault LED is illuminated.	An illuminated **OVER VOLTS** LED indicates that the Drive has tripped off due to a bus voltage greater than 760V DC. Three conditions can cause an over voltage trip. • **Excessively High Input Voltage** • **DC Boost Set too High** • **Deceleration Rate too High for the Motor/Load Inertia** **STEP 1** – Check the input line voltage across each phase at L1, L2, and L3. The voltage should not be greater than 506V AC. **STEP 2** – If trip occurred during deceleration, check the position of the **NORM/DEC HOLD** jumper on the Modulator Logic Board. The jumper should be set to the **DEC HOLD** position. Monitor LED **CR53 FREQ HOLD** on the Modulator Logic Board. During deceleration, with the **NORM/DEC HOLD** jumper in the **DEC HOLD** position, the LED should light before an overvoltage trip occurs. If the LED lights, decrease the **DECEL RATE**, the **DC BOOST**, or both. Refer to the **Modulator Logic Board Switch Settings** in **section 5.3.3**. If the LED does not light, replace the Modulator Logic Board. **STEP 3** – If the Drive trips out on over voltage during deceleration and a slower decel ramp is not acceptable, consult your nearest Allen-Bradley Area Sales/Support Center.

Symptom 10	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **A**, **B** or **C** phase protection LED indicates: • **An output overcurrent condition greater than 200% due to either:** 1) An output phase-to-phase short (Drive output, motor windings, or wiring to the motor). 2) An output overcurrent condition greater than 200% due to an output phase-to-ground short. In either case, remove input power to the Drive at the disconnect device. Disconnect the motor leads from the Drive at Terminal Block **2TB**. Reapply power to the Drive and give the Drive a START command. If the Drive can be operated without a phase protect trip occurring, the problem is in either the wiring to the motor or the motor itself. **A ground fault** can be found using an ohmmeter between the wiring to the motor and ground. Find the cause and correct it before reconnecting the motor leads to the Drive and reapplying power. **A shorted motor winding** is harder to detect because of the low resistance of the motor windings. Substitute a known, good motor for the suspected bad motor. Connect the substitute motor to the Drive output terminals and try running the Drive. If successful operation of the Drive and substitute motor is achieved, then the problem most likely is the motor originally connected to the Drive. • **Deceleration of an inertia type motor load at too high a value of DC boost or too fast a DECEL rate.** Under the right conditions, the motor can appear as a short circuit to the Drive. With excessive DC boost applied, the motor can saturate, resulting in a peak current in excess of 200% causing a phase protect trip. Decrease the **DC BOOST**, the **DECEL RATE** or both. Refer to **section 5.3.3, DC Boost Adjustment, ACCEL/DECEL Rate Adjustment** for additional information. • **Excessive DC boost causing a phase protection trip during acceleration.** Excessive DC boost can cause a phase protection trip to occur during acceleration of the Drive and motor due to saturation of the motor windings. If reducing the DC boost setting eliminates the phase protection trip but does not produce sufficient torque to enable the motor to accelerate the load, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance. **Reset the Drive by giving it a STOP command followed by a START command. If proper operation cannot be obtained without the reoccurrence of a phase protect trip and you have eliminated the preceding possibilities, the problem is most likely caused by one of the following.**

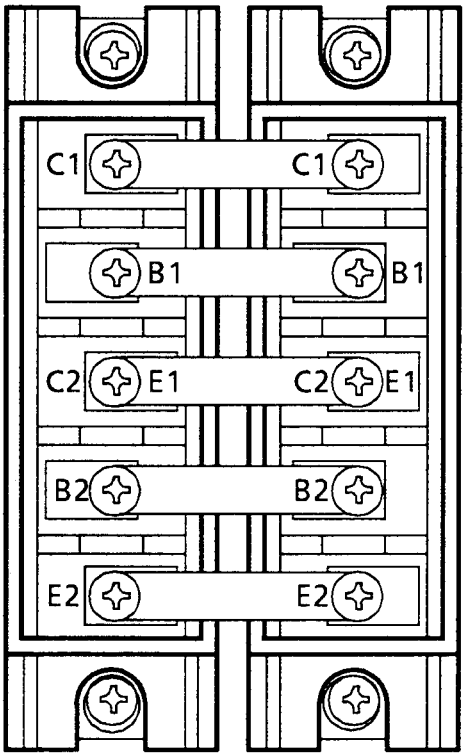
Symptom 10	DIAGNOSTIC PROCEDURE
(continued) Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	• **A shorted output transistor in one of the Power Switching Modules.** **Phase "A"** ... 1Q1, 1Q2 **Phase "B"** ... 2Q1, 2Q2 **Phase "C"** ... 3Q1, 3Q2 Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board.** **Phase "A"** ... A3A **Phase "B"** ... A3B **Phase "C"** ... A3C Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board causing an output power Switching Module to be ON when it shouldn't be.** **Phase "A"** ... A3A **Phase "B"** ... A3B **Phase "C"** ... A3C Perform the following four steps to isolate and correct the problem. • **A malfunctioning Modulator Logic Board causing an abnormal Drive output voltage waveform.** Perform the following four steps to isolate and correct the problem. STEP 1 – Remove input power to the Drive. Before proceeding, wait (5) seconds. **DS1**, the bus charged neon light on Bus Discharge Board **A5** (or Brake Board if installed), should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged by measuring the voltage at connector **J402** between pins **5** (**+** BUS) and **1** (**–** BUS) on Voltage Sensing Board **A4**. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale.

Symptom 10	DIAGNOSTIC PROCEDURE

(continued)

Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.

Connections Listed in Step 2 are shown in detail on pages B-4 & B-6



STEP 2 – Check for a shorted output transistor module for the indicated phase as follows.

Disconnect the (+) BUS lead at **C1** for the indicated phase at the Power Switching Module.

Disconnect the (–) BUS lead at **E2** at the Power Switching Module.

Unplug the molex connector for the indicated phase at the Driver Board (**J302A**, **B** or **C**).

Disconnect one end of the jumper bar that is connected between terminals **E1,C2** on the two Power Switching Modules and the output phase lead to terminal **2TB**. This will enable you to check all four transistors independently.

With an ohmmeter set on the x1 scale, measure the resistance between the collector and emitter of both upper and lower power switching transistors for each module as follows.

OHMMETER		READING
+ LEAD	– LEAD	
C1	**E1**	**INFINITE**
C2	**E2**	**INFINITE**

With an ohmmeter set on the x1 scale, measure the resistance between the collector and base of both upper and lower power switching transistors for each module as follows.

OHMMETER		READING
+ LEAD	– LEAD	
C1	**B1**	**INFINITE**
C2	**B2**	**INFINITE**

- If a collector to emitter short is found in either the upper or lower power switching transistor, replace the module.
- If either transistor has a collector to base short, replace the module and the Driver Board.

IMPORTANT: *When replacing power switching modules clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of each module. Torque mounting screws to 17-26 in-lbs max.*

Symptom 10	DIAGNOSTIC PROCEDURE
(continued) Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A, PROT. B,** or **PROT. C** fault LED is illuminated.	**STEP 3** – Before reconnecting the motor, reapply input power to the Drive and ensure that the Drive operates properly in the manual operating mode. Depending upon the options installed, switch to **MANUAL** control if required. No diagnostic LEDs should be illuminated. If satisfactory operation is achieved, reconnect the motor and check operation again. If satisfactory operation is not achieved, replace the Modulator Logic Board. **STEP 4** – Once proper operation is achieved in the manual mode, depending on the options installed, check operation in the auto or normal operating mode. If the Drive is not functioning properly in the normal mode, check all Modulator Board jumper settings and input signals to the option cards. If satisfactory operation is not achieved, replace the Modulator Logic Board. **(REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES)**

Symptom 11	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **BRAKE OVER TEMP.** fault LED is illuminated. (Used only when equipped with the Dynamic Brake Option).	**IMPORTANT** : *If Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **BRAKE OVER TEMPERATURE** LED indicates an excessive brake resistor assembly temperature. This condition is normally caused by either excessive braking or a deceleration rate too high for the motor/load inertia. When the Dynamic Brake Option is used, it is recommended that the **NORM/DEC HOLD** jumper be set to the **DEC HOLD** position. If neither of the above is true, check for: • **Open Precharge Fuse 5FU and/or Shorted Brake Transistor 4Q** • **Malfunctioning Brake Resistor Thermal O.L.** (2TAS on Brake Resistor Assembly) • **Poorly Ventilated Resistor Enclosure** Check and repair as required. **IMPORTANT : To reset a Brake Over Temperature Trip:** 1. *Remove input power to the Drive at the disconnect device.* 2. *Wait a few minutes to allow the O.L. heater and brake resistor to cool down.* 3. *Open the conduit box on the resistor cage assembly. Manually reset Thermal O.L. Relay 2TAS by depressing the plunger until a reset "click" is either heard or felt.* 4. *Reapply power to the Drive at the disconnect device.* 5. *Reset the Drive by giving it a STOP command followed by a START command.*

Symptom 12	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **DRIVE OVER TEMP.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **DRIVE OVER TEMPERATURE** LED indicates that the Drive has tripped off due to an over temperature condition. Allow Drive to cool down for approximately (15) minutes before restarting. After restarting, if over temperature condition occurs again, check for the following conditions. • **Ambient Temperature that Exceeds the Drive Rating**. Measure the ambient temperature surrounding the Drive per the **Specification Table, Chapter 3.** • **Heat Flow Obstruction within the Heat Sink Assembly**. Visually inspect for unobstructed spacing between fins. Clean if necessary. • **Thermal Overloading Caused by Duty Cycle Demands Exceeding 100% of Current Over an Extended Period of Time**. Using an AC clamp on ammeter, measure the motor current over an extended period of time. **IMPORTANT** : *Clamp on type amp probes and current transformers are frequency sensitive. Inaccurate current readings at frequencies other than 60 Hz may be observed. It is recommended that a true RMS reading clamp on ammeter be used.* • **Malfunctioning Temperature Sensor 1TAS**. If all of the above conditions have been checked and the problem still remains, replace Temperature Sensor **1TAS**. **IMPORTANT** : *When replacing Temperature Sensor 1TAS clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the sensor. Torque mounting screws to 2.6-3.0 in-lbs max.*

Symptom 13	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **OUTPUT GND** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **OUTPUT GROUND** LED indicates that the Drive circuitry has shorted to ground or there is a malfunctioning Output Ground Sensor Board A8. Remove input power to the Drive and disconnect the motor from the Drive. Reapply input power and start the Drive. If the Drive does not trip, check the motor for a grounded phase condition. Replace or repair the motor if required. If the Drive trips with the motor disconnected, check wire insulation and terminal connections on the Drive chassis for shorts to ground. If the problem still cannot be located, replace Output Ground Sensor Board A8.

Symptom 14	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (5) seconds when input power is removed. Neon light **DS1** on Bus Discharge Board A5 (or Brake Board if installed) is illuminated.	After input power is removed the bus voltage should discharge to 42V DC in approximately (5) seconds. If the discharge cycle is not taking place, check to see if fuse **6FU** or resistor **4R** has opened. **STEP 1** - If neither the fuse nor the resistor is open, measure the AC voltage at Bus Discharge Board A5, connector **J502**, between pins **1** & **4**. The voltage should be approximately 12V AC. If voltage is present, replace Bus Discharge Board A5 If voltage is not present, check fuse **4FU**. If **4FU** is good, replace Control Transformer **1T**. **STEP 2** - If either **6FU** or **4R** is open, replace and reapply input power. Check for proper bus discharge cycle by measuring the DC Bus voltage at Bus Discharge Board A5, connector **J503**, between pins **1** (+ BUS) and **11** or **12** (– BUS). After approximately (5) seconds the voltage should be below 42V DC. If discharge cycle is still not taking place and/or either the fuse or resistor opens again, replace Bus Dischgarge Board A5.

Bulletin 1334 30-50 HP Series A Troubleshooting

30-50 HP Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Momentary Overload Protection Circuit – When constantly illuminated indicates an overload condition exceeded (60) seconds – Momentarily illuminated whenever circuit is activated.

Under Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to an input voltage that is less than 414 volts for a 460V Drive, 373 volts for a 415V Drive, or 342 volts for a 380V Drive.

Over Voltage Protection – When illuminated indicates that the Drive has tripped **OFF** due to the bus voltage exceeding 760V DC.

"A" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"A"** Phase Output Transistor
- Section **"A"** of the Driver Board is Malfunctioning

"B" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

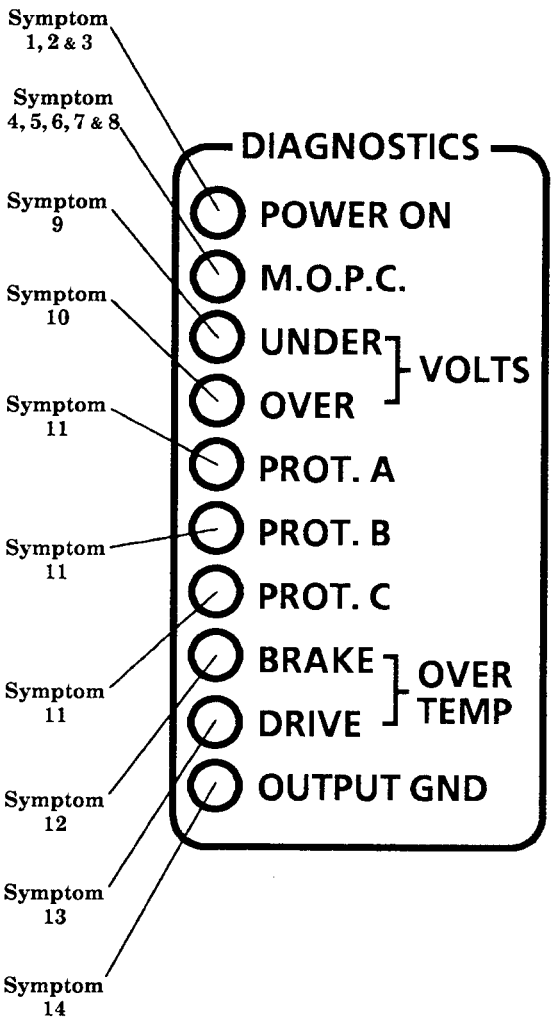
"C" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 200%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

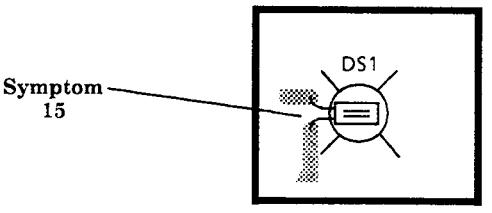
Brake Resistor Over Temperature Protection Trip – When illuminated indicates excessive brake resistor temperature.

Drive Over Temperature Protection Trip – When illuminated indicates that the heatsink temperature of the Drive has exceeded the maximum safe operating limit.

Output Ground Fault Protection Trip Indication – When illuminated indicates that the Drive circuitry has shorted to GROUND.

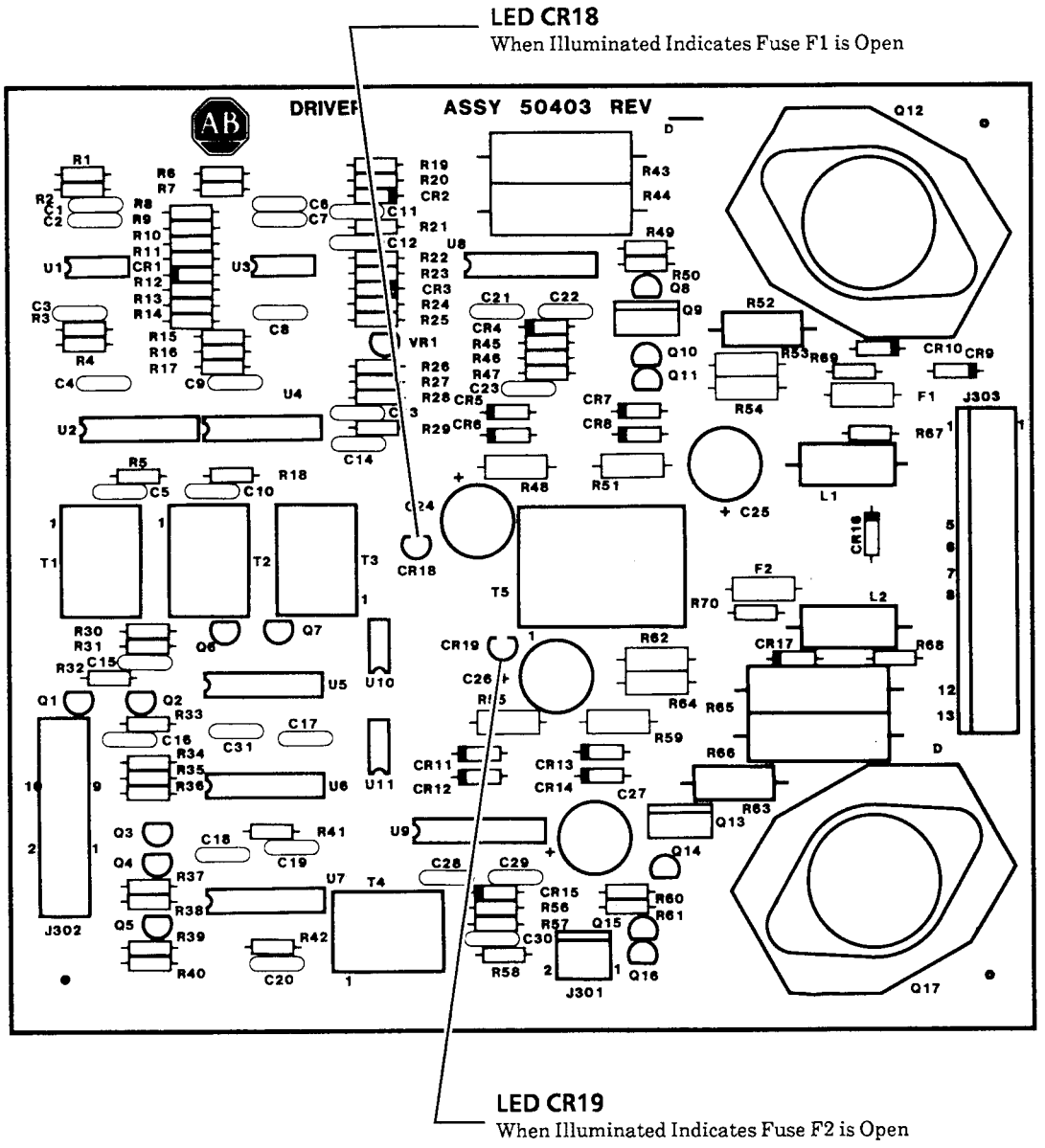


DS1 – Located on Bus Discharge Board A5 (or Dynamic Brake Board when installed) – When illuminated indicates that the bus potential is in excess of 42V DC.



30-50 HP Driver Board LED Indication

There are no adjustment settings for Bulletin 1334 30-50 HP Driver Boards. Each Driver Board does however provide fuse status indication. Two LEDs, CR18 and CR19, indicate the status of fuses F1 and F2 on each Driver Board respectively. An illuminated LED means that its associated fuse has opened as described in **Symptom** 11 in the following troubleshooting procedures.



30 thru 50 HP Troubleshooting Procedures

IMPORTANT

Drive Fault Trips

Before resetting any fault trip, refer to the following troubleshooting procedures to isolate and correct the fault.

The **location of boards & Drive components** are illustrated in **Appendix C** on pages **C-3** & **C-4**.

All **voltage values & polarities** referenced in the following troubleshooting procedures are shown in the Drive Schematics in **Appendix I** or the Modulator Logic Board Interconnection Diagram in **Appendix J**.

WARNING

Hazardous voltage levels exist on some printed circuit boards and Drive components.

If diagnostic LED(s) **PROT. A**, **PROT. B**, or **PROT. C** are lit, hazardous voltages can be present at the output terminals even though the STOP pushbutton has been depressed.

If neon light **DS1** on Bus Discharge Board A5 (or the Brake Board if installed) is lit, hazardous voltages are present in the Drive cabinet.

To guard against personal injury when boards or wires are being disconnected or reconnected, or fuses are being replaced, **always remove power to the Drive at the disconnect device, wait (5) seconds, and ensure that DS1 is not lit before servicing. Use a DVM to check for zero volts between terminals 1 (+ BUS) & 5 (– BUS) at terminal block 4TB on the Drive backpanel.**

CAUTION : To Guard Against Equipment Damage When Troubleshooting the Drive, *Before* Pressing the START Pushbutton Always:

Set the **Speed Pot** or speed reference to **MINIMUM**.

Set the **FWD/REV Switch** (if present), to the proper position.

Uncouple the motor from its mechanical load.

IMPORTANT

ESD Precautions

ESD (Electrostatic Discharge) generated by static electricity can damage the CMOS devices on various Drive boards. To guard against this type of damage, it is recommended that when circuit boards are removed or installed the following precautions be observed.

- *Wear a wrist type grounding strap that is grounded to the Drive chassis.*
- *DO NOT remove the new circuit board from its conductive wrapper unless a ground strap is worn.*
- *When removing any circuit board from the Drive, immediately place it in conductive packing material.*

Symptom 1	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is not illuminated.	Check for possible loss of input line voltage by measuring line voltage between L1, L2 and L3. If voltage is present, measure voltage across input line fuses **1FU**, **2FU**, and **3FU**. Measure voltage across input primary fuse **4FU** at transformer 1T. A voltage reading across any of these fuses indicates an open condition. Before replacing blown fuses complete **STEPS 1**, **2** and **3**. **STEP 1** – Remove input power to the Drive. Before proceeding, wait (5) seconds. The Bus Indicator neon light on Bus Discharge Board A5 (or Brake Board if installed), should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale. **STEP 2** – With an ohmmeter set on the x1 scale, check Rectifier Assembly **1 REC, 2 REC, 3 REC** as follows: **OHMMETER** / **READING** + LEAD / – LEAD **BLACK** (1 REC +) / **ORANGE** (1 REC - AC1) / Infinite **BLACK** (1 REC +) / **YELLOW** (2 REC - AC2) / Infinite **BLACK** (1 REC +) / **GREEN** (3 REC - AC3) / Infinite **ORANGE** (1 REC - AC1) / **BLACK** (1 REC –) / Infinite **YELLOW** (2 REC - AC2) / **BLACK** (1 REC –) / Infinite **GREEN** (3 REC - AC3) / **BLACK** (1 REC –) / Infinite If any of the above readings are not as shown, replace Rectifier Assembly **1 REC, 2 REC, 3 REC**. **IMPORTANT** : *When replacing the Rectifier Assembly clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the assembly. Torque mounting screws to 17-26 in-lbs max.* **STEP 3** – With the ohmmeter set on the x100 scale, check Bus Capacitors for a shorted condition as follows. (**2C1-2**, **3C1-2** for 30 HP Drives – **2C1-3**, **3C1-3** for 40 & 50 HP Drives) Remove the capacitor support block and (+) POSITIVE bus bars. Connect the (+) POSITIVE lead of the ohmmeter to the (+) POSITIVE terminal of the capacitor. Connect the (–) NEGATIVE lead of the ohmmeter to the (–) NEGATIVE capacitor bus bar. The ohmmeter should immediately read low, then slowly increase to approximately 20kΩ. A sustained low reading indicates a shorted capacitor that requires replacement. After completing **STEPS 1**, **2** & **3**, replace blown fuses and reapply input power.

Symptom 2	DIAGNOSTIC PROCEDURE
Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	Check for line out condition at fuse **3FU** by measuring the AC line voltage from L3 to either L1 or L2. If voltage is present, measure voltage across **3FU**. A voltage across **3FU** indicates that it is open and must be replaced. Before replacing **3FU**, perform **STEPS 1, 2 & 3** in **Symptom 1**, then the following eleven steps. **STEP 1** – Check precharge circuit fuse **5FU** for an open condition. **STEP 2** With input power to the Drive removed at the disconnect device, check that all jumpers on Modulator Logic Board A1 are in their proper position, particularly the VCO/EXT-C jumper and the IFB/XFB jumper. **STEP 3** With input power to the Drive removed at the disconnect device, check installed options, particularly those with AUTO/MAN or AUTO/OFF/MANUAL selection (both local and remote). Depending upon the options installed the maximum speed pot adjustment **R25**, or the minimum speed pot adjustment **R26**, may be ineffective. Refer to **section 5.3.1, Minimum and Maximum Speed Adjust**. • **If option N, N4, G2 or G4 is installed**, ensure that: The AUTO/MAN switch on the card is set to the MAN mode. A 1kΩ, 2W, linear taper speed pot has been properly connected to Terminal Block **1TB** between terminals **14, 15 & 16**. • **If option G is installed**, ensure that the 1kΩ resistor included with the option kit has been installed at Terminal Block **TB1** between terminals **14 & 16**. • **If option K9 is installed**, check for continunity across the Brake Over Temperature circuit at Terminal Block **TB1** between terminals **17 & 18**. • **If option T7, T8 or T9 is installed**, check for continuity across the Motor Overload Relay contact circuit, terminals **10 & 11** at Terminal Block **1TB**. **STEP 4** – Check for an open speed pot at Terminal Block **1TB**. Measure the voltage at Terminal Block **1TB** between terminals **14 & 16**. There should be 3.2V DC. If voltage is 12V DC, the speed pot may be open or there may be an open wire between the speed pot and terminals **14, 15 & 16**. Check for an inoperative speed pot by turning the pot from 0 to 100%. The voltage between terminals **15 & 16** should vary from 0 to 3.2V DC. Replace or correct as required. **STEP 5** – Check the voltage between terminals **9 & 11** at Terminal Block **1TB**. • If standard START/STOP configuration is used, there should be 90V AC between terminals **9 & 11**. If not, the START/STOP circuit is open. Check the START/STOP circuit connections to **1TB**. **– For a Standard Drive Without Factory Installed Options –** • If field installed 2-wire, 90V AC, RUN/STOP control is used, there should be 90V AC between terminals **9 & 11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.6**. • If field installed 2-wire, 120V AC, RUN/STOP control is used, there should be 120V AC between terminals **9 & 11**. If not, the RUN/STOP circuit is open. Ensure that the circuit has been installed as specified in **section 4.4.5**.

Symptom 2	DIAGNOSTIC PROCEDURE
(continued) Drive does not start. Amber **POWER ON** LED is illuminated. No red fault LEDs are illuminated.	**STEP 6** – Measure the output voltages in the secondary circuits of Transformer 1T. The following voltages should be present at Power Supply Board A6. molex connector **J602** between pins **4** & **1** ..... 14V AC molex connector **J602** between pins **2** & **1** ..... 14V AC molex connector **J602** between pins **5** & **6** ..... 15V AC The following voltage should be present at terminal block **1TB**. between terminals **1** & **11** ..... 90V AC If any one voltage is absent, remove input power and check all connections to **1T**. If all connections are correct, replace Transformer **1T**. **STEP 7** – Go to Logic Power Supply Board A6 and measure all output voltages. The following voltages should be present at molex connector **J601** with respect to Drive common, **J601** Pin **1**. If any one voltage is absent, replace A6. **J601**, pin **2** ..... 14V AC **J601**, pin **3** ..... + 17V DC **J601**, pin **5** ..... + 9 to + 15V DC (nominal) **J601**, pin **6** ..... + 9 to + 15V DC (nominal) **J601**, pin **9** ..... –17V DC **STEP 8** – Measure the output voltage across the secondary circuit of Transformer **2T**, pins **5** & **6**. If 17V AC is absent, replace 2T. **STEP 9** – If **2T** checks out, Contactor Interface Board A9 may be inoperative The following voltages should be present with respect to Drive common, **J901** Pin **1**. **J901**, pin **4** ..... + 24V DC **J901**, pin **6** ..... 0V DC (nominal) **J901**, pin **7** ..... 0V DC (nominal) **J901**, pin **8** ..... + 11V DC **STEP 10** – If Transformer **2T** and Contactor Interface Board A9 check out, measure the control voltage at contactor **1CON**. There should be + 24V DC between points **C1** & **C2** at the contactor. If + 24V DC is measured and **1CON** is not picked-up, the contactor may be inoperative. Replace if required. If the problem cannot be found after completing **STEPS 1** – **10**, replace Modulator Logic Board A1.

Symptom 3	DIAGNOSTIC PROCEDURE
Precharge cycle excessively long or not complete. Amber **POWER ON** LED may or may not be illuminated.	The DC bus precharge cycle should be completed within (5) seconds after input line power is applied to the Drive. Check precharge circuit fuse **5FU** for an open condition first, then perform the following three steps. **STEP 1** – Check Rectifier Assemblies and Bus Capacitors as specified in **STEPS 1**, **2** & **3**, **symptom 1**. **STEP 2** – Check Precharge Contactor Interface Board A9 The following voltages should be present at connector **J901** on the Contactor Interface Board. Replace if required. Transformer **2T** secondary voltage — 17V AC between pins **2** & **3** Contactor **1CON** control voltage — + 24V DC between pins **4** & **6** + 11V DC between pins **7** & **8** If the problem cannot be found after completing **STEPS 1** & **2**, replace Modulator Logic Board A1.

Symptom 4	DIAGNOSTIC PROCEDURE
Drive trips just after input line power is applied before START command is given. Red **M.O.P.C.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **M.O.P.C.** LED indicates that there may be a loss of input power to the Driver Boards. Check the power supply at all three Driver Boards. Approximately 16V AC should be measured between pins **1** & **2** at each **J301** connector. If not, check fuse F1 on Driver Power Supply Board A10. If the fuse is open, replaceDriver Power Supply Board A10. If voltage is present, perform the diagnostic procedure in **Symptom 5**.

Symptom 5	DIAGNOSTIC PROCEDURE
Drive trips on momentary overloads causing phase protection indication. M.O.P.C. circuit not functioning properly. Red **M.O.P.C.** fault LED is not illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* With the motor rotor locked and boost set to zero, adjust the ACCEL RATE setting, switch **S1** on Modulator Logic Board A1, to 1.2 Hz/Sec. Set the operator speed pot or speed reference to zero. After completing the above, start the Drive and slowly increase the speed while monitoring the output motor current on any phase using a true RMS reading clamp on ammeter. The **M.O.P.C.** LED should light when the current reaches a nominal value of 150%. If the **M.O.P.C.** LED does not light, use an oscilloscope to check for a pulsed waveform at the following pins on connector **J113** of the Modulator Logic Board with respect to Drive common. **Pin 5** – ØA Driver Signal **Pin 16** – ØB Driver Signal **Pin 27** – ØC Driver Signal If pulse signals that go to a TTL level "0" are not present, replace the Driver Board in question. If pulse signals are present on all (3) Driver Boards, replace Modulator Logic Board A1. Return the boost and accel rate adjustments to their normal settings.

Symptom 6	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **M.O.P.C.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **M.O.P.C.** LED indicates that the Drive has tripped off due to a nominal 150% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or start-up (breakaway), it is normal for the M.O.P.C. LED to illuminate momentarily. This merely indicates that a momentary overload current of 150% has been sensed and that the M.O.P.C. circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the M.O.P.C. LED is constantly activated during start-up (breakaway), or if there is excessive LED activity at low frequency operation, less DC boost must be used. Refer to the **DC Boost Adjustment, section 5.3.3 and V/Hz Jumper Setting in section 5.3.2.** If Option L, the Function Expander Card is installed, **REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES.**

Symptom 7	DIAGNOSTIC PROCEDURE
Motor does not return to full set speed after stalling. Red **M.O.P.C.** fault LED is illuminated.	The load torque is exceeding the torque capability of the Drive. Check for problems with the mechanical load. If the mechanical load checks out, try increasing the DC boost as outlined in **section 5.3.3**. If this does not correct the condition, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance. **IMPORTANT**: *If a continuous overload current demand exists, the motor will ramp down to a stalled condition and remain there until the overload condition no longer exists. If however the overload condition is sustained for (60) seconds, the Drive will trip and illuminate the M.O.P.C. LED on the Diagnostic Display Panel.*

Symptom 8	DIAGNOSTIC PROCEDURE
Red **M.O.P.C.** fault LED is illuminated during DECEL or at (0) Hz.	Boost voltage set too high. Decrease the boost voltage by setting the DC boost switch lower and/or set the Decel switch to provide a slower ramp (Refer to **DC Boost Adjustment, ACCEL/DECEL Rate Adjustments, section 5.3.3).**

Symptom 9	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **UNDER VOLTS** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **UNDER VOLTS** LED indicates that Drive has tripped off due to an input line voltage that is less than 414V AC at the 460V AC Tap on Transformer **1T** • **414V AC at the 460V AC Tap on Transformer 1T** • **373V AC at the 415V AC Tap on Transformer 1T** (50 Hz Input Power) • **342V AC at the 380V AC Tap on Transformer 1T** (50 Hz Input Power) STEP 1 – Check input primary fuse **4FU** for an open condition. STEP 2 – Measure the input voltage to Transformer **1T**. If proper voltage is present, replace Modulator Logic Board A1.

Symptom 10	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation or deceleration. Red **OVER VOLTS** fault LED is illuminated.	An illuminated **OVER VOLTS** LED indicates that the Drive has tripped off due to a bus voltage greater than 760V DC. Three conditions can cause an over voltage trip. • **Excessively High Input Voltage** • **DC Boost Set too High** • **Deceleration Rate too High for the Motor/Load Inertia** STEP 1 – Check the input line voltage across each phase at L1, L2, and L3. The voltage should not be greater than 506V AC. STEP 2 – If trip occurred during deceleration, check the position of the **NORM/DEC HOLD** jumper on the Modulator Logic Board. The jumper should be set to the **DEC HOLD** position. Monitor LED **CR53 FREQ HOLD** on the Modulator Logic Board. During deceleration, with the **NORM/DEC HOLD** jumper in the **DEC HOLD** position, the LED should light before an overvoltage trip occurs. If the LED lights, decrease the **DECEL RATE**, the **DC BOOST**, or both. Refer to the **Modulator Logic Board Switch Settings** in **section 5.3.3**. If the LED does not light, replace the Modulator Logic Board. STEP 3 – If the Drive trips out on over voltage during deceleration and a slower decel ramp is not acceptable, consult your nearest Allen-Bradley Area Sales/Support Center.

Symptom 11	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **A**, **B** or **C** phase protection LED indicates: • **An output overcurrent condition greater than 200% due to either:** 1) An output phase-to-phase short (Drive output, motor windings, or wiring to the motor). 2) An output overcurrent condition greater than 200% due to an output phase-to-ground short. In either case, remove input power to the Drive at the disconnect device. Disconnect the motor leads from the Drive at Terminal Block **2TB**. Reapply power to the Drive and give the Drive a START command. If the Drive can be operated without a phase protect trip occurring, the problem is in either the wiring to the motor or the motor itself. **A ground fault** can be found using an ohmmeter between the wiring to the motor and ground. Find the cause and correct it before reconnecting the motor leads to the Drive and reapplying power. **A shorted motor winding** is harder to detect because of the low resistance of the motor windings. Substitute a known, good motor for the suspected bad motor. Connect the substitute motor to the Drive output terminals and try running the Drive. If successful operation of the Drive and substitute motor is achieved, then the problem most likely is the motor originally connected to the Drive. • **Deceleration of an inertia type motor load at too high a value of DC boost or too fast a DECEL rate.** Under the right conditions, the motor can appear as a short circuit to the Drive. With excessive DC boost applied, the motor can saturate, resulting in a peak current in excess of 200% causing a phase protect trip. Decrease the **DC BOOST**, the **DECEL RATE** or both. Refer to **section 5.3.3, DC Boost Adjustment, ACCEL/DECEL Rate Adjustment** for additional information. • **Excessive DC boost causing a phase protection trip during acceleration.** Excessive DC boost can cause a phase protection trip to occur during acceleration of the Drive and motor due to saturation of the motor windings. If reducing the DC boost setting eliminates the phase protection trip but does not produce sufficient torque to enable the motor to accelerate the load, consult your nearest Allen-Bradley Area Sales/Support Center for application assistance.

Symptom 11	DIAGNOSTIC PROCEDURE
(continued) Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.	**Reset the Drive by giving it a STOP command followed by a START command. If proper operation cannot be obtained without the reoccurrence of a phase protect trip and you have eliminated the preceding possibilities, the problem is most likely caused by one of the following.** • **A shorted output transistor in one of the Power Switching Modules.** **Phase "A"** ... 1Q1, 1Q2 **Phase "B"** ... 2Q1, 2Q2 **Phase "C"** ... 3Q1, 3Q2 Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board.** **Phase "A"** ... A3A **Phase "B"** ... A3B **Phase "C"** ... A3C Perform the following four steps to isolate and correct the problem. • **A malfunctioning Driver Board causing an output power Switching Module to be ON when it shouldn't be.** **Phase "A"** ... A3A **Phase "B"** ... A3B **Phase "C"** ... A3C Perform the following four steps to isolate and correct the problem. • **A malfunctioning Modulator Logic Board causing an abnormal Drive output voltage waveform.** Perform the following four steps to isolate and correct the problem. STEP 1 – Remove input power to the Drive. Before proceeding, wait (5) seconds. **DS1**, the bus charged neon light on Bus Discharge Board A5 (or Brake Board if Installed), should not be lit. Use a DC voltmeter to verify that the DC bus is fully discharged by measuring the voltage at connector J402 between pins **5** (**+** BUS) and **1** (– BUS) on Voltage Sensing Board A4. Start with the voltmeter on its highest scale (x 1000) and range downward to the lowest voltmeter scale. **Connections Listed in Step 2 are shown in detail on pages C4-C6** STEP 2 – Check for a shorted output transistor module for the indicated phase as follows. Disconnect all leads to **C1** at the Power Switching Module. Disconnect all leads to **E2** at the Power Switching Module. Unplug the molex connector for the indicated phase at the Driver Board (**J303A**, **B**, or **C**).

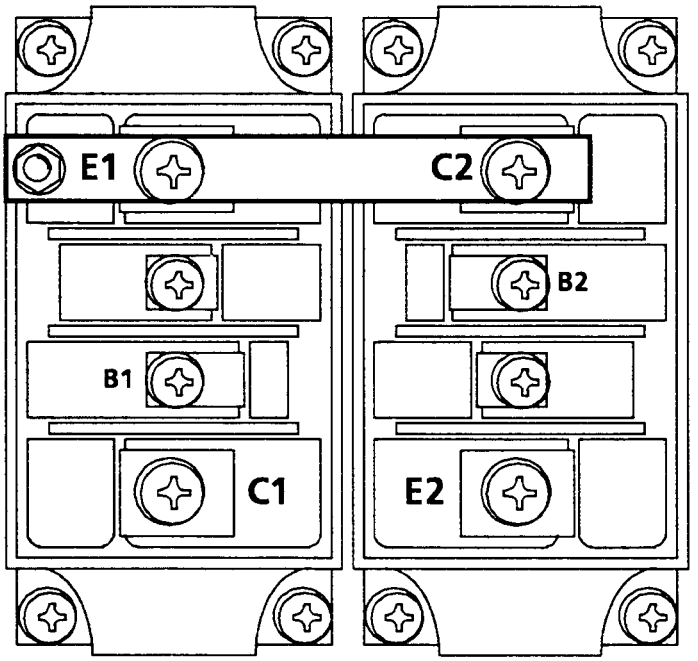
Symptom 11

(continued)

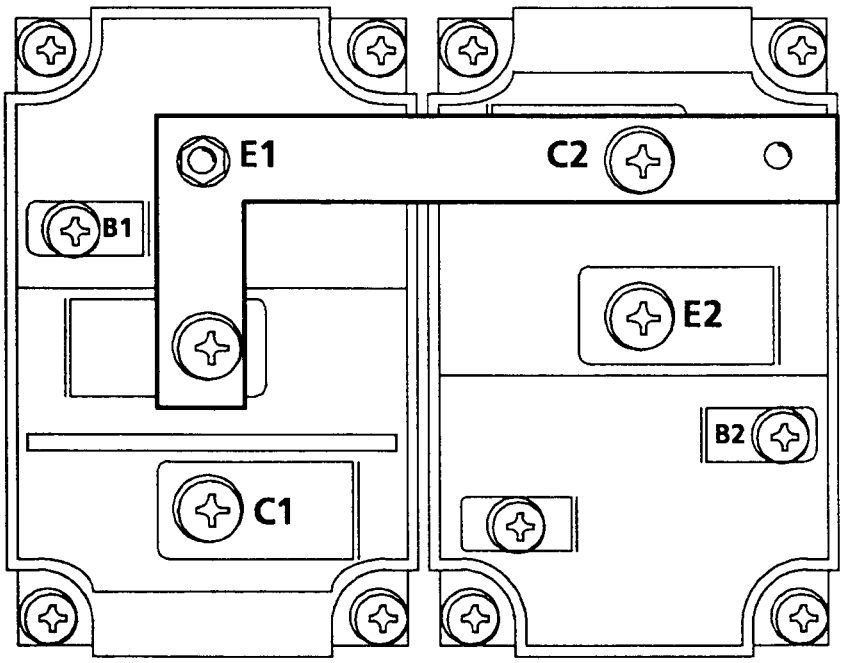
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.

DIAGNOSTIC PROCEDURE

For 40 & 50 HP Drives, disconnect one end of the jumper bar that is connected between terminals **E1,C2** on the two Power Switching Modules. This will enable you to check each transistor independently.



POWER SWITCHING MODULE ARRANGEMENT — P/N 201411



POWER SWITCHING MODULE ARRANGEMENT — P/N 120784

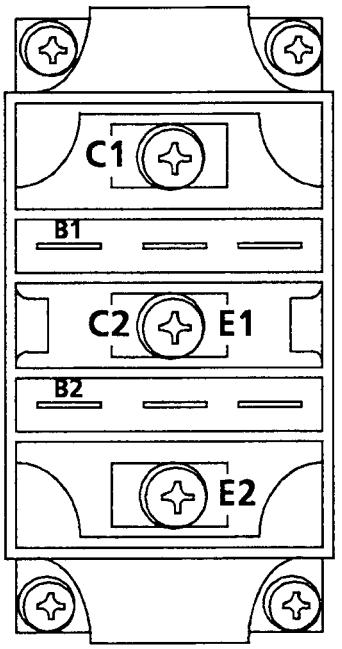
CAUTION : *To avoid damage to the Drive, modules connected in parallel must use the same part number. This may require changing both modules in a phase even though only one module needs to be replaced.*

Symptom 11	DIAGNOSTIC PROCEDURE

(continued)

Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A**, **PROT. B**, or **PROT. C** fault LED is illuminated.

For 30 HP Drives, check both upper and lower transistors.



With an ohmmeter set on the x1 scale, measure the resistance between the collector and emitter of each module as follows.

OHMMETER		READING
+ LEAD	− LEAD	
C1	E1	INFINITE
C2	E2	INFINITE

With an ohmmeter set on the x1 scale, measure the resistance between the collector and base of each module as follows.

OHMMETER		READING
+ LEAD	− LEAD	
C1	B1	INFINITE
C2	B2	INFINITE

If a short is found, replace the module and check the following.

IMPORTANT: *When replacing power switching modules clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of each module. Torque mounting screws to 17-26 in-lbs max.*

- DC Bus Fuse **8FU** for an open condition.
- Fuse F1 on Driver Power Supply Board A10. If fuse F1 is open, replace the board.
- Fuses F1 & F2 on the Driver Board for the indicated phase. If either fuse is open or it was noted that with input power applied either LED on the Driver Board was illuminated, replace the Driver Board. An illuminated LED indicates an open fuse which usually indicates failed components on the Driver Board.

Symptom 11	DIAGNOSTIC PROCEDURE
(continued) Drive starts momentarily then trips off or Drive trips off during normal operation. Red **PROT. A, PROT. B,** or **PROT. C** fault LED is illuminated.	**STEP 3** – Before reconnecting the motor, reapply input power to the Drive and ensure that the Drive operates properly in the manual operating mode. Depending upon the options installed, switch to **MANUAL** control if required. No diagnostic LEDs should be illuminated. If satisfactory operation is achieved, reconnect the motor and check operation again. If satisfactory operation is not achieved, perform **STEP 5** below. **STEP 4** – Once proper operation is achieved in the manual mode, depending on the options installed, check operation in the auto or normal operating mode. If Drive is not functioning properly in the normal mode, check all Modulator Board jumper settings and input signals to the option cards. If satisfactory operation is not achieved, perform **STEP 5** below. **(REFER TO THE OPTION KIT INSTRUCTIONS FOR CORRECT SETUP PROCEDURES)** **STEP 5** – Check for proper operation of the current sensing circuits on the Modulator Logic Board and the Driver Board for the indicated phase. With the motor rotor locked and boost set to zero, adjust the ACCEL RATE setting, switch **S1** on Modulator Logic Board A1, to 1.2 Hz/Sec. Set the operator speed pot or speed reference to zero. After completing the above, start the Drive and slowly increase the speed while monitoring the output motor current on any phase using a true RMS reading clamp on ammeter. The **M.O.P.C.** LED on the Modulator Logic Board should light when the current reaches a nominal value of 110%. If the **M.O.P.C.** LED does not light, use an oscilloscope to check for a pulsed waveform at the following pins on connector **J113** of the Modulator Logic Board with respect to Drive common. **Pin 5** – ØA Driver Signal **Pin 16** – ØB Driver Signal **Pin 27** – ØC Driver Signal If pulse signals that go to a TTL level "0" are not present, replace Driver Board A3. If pulse signals are present on all (3) sections of the Driver Board, replace Modulator Logic Board A1. Return the boost and accel rate adjustments to their normal settings.

Symptom 12	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **BRAKE OVER TEMP.** fault LED is illuminated. (Used only when equipped with the Dynamic Brake Option).	**IMPORTANT** : *If Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **BRAKE OVER TEMPERATURE** LED indicates an excessive brake resistor assembly temperature. This condition is normally caused by either excessive braking or a deceleration rate too high for the motor/load inertia. When the Dynamic Brake Option is used, it is recommended that the **NORM/DEC HOLD** jumper be set to the **DEC HOLD** position. If neither of the above is true, check for: • **Open Precharge Fuse 5FU and/or Shorted Brake Transistor 4Q** • **Malfunctioning Brake Resistor Thermal O.L.** (2TAS on Brake Resistor Assembly) • **Poorly Ventilated Resistor Enclosure** Check and repair as required. **IMPORTANT : To reset a Brake Over Temperature Trip:** 1. *Remove input power to the Drive at the disconnect device.* 2. *Wait a few minutes to allow the O.L. heater and brake resistor to cool down.* 3. *Open the conduit box on the resistor cage assembly. Manually reset Thermal O.L. Relay 2TAS by depressing the plunger until a reset "click" is either heard or felt.* 4. *Reapply power to the Drive at the disconnect device.* 5. *Reset the Drive by giving it a STOP command followed by a START command.*

Symptom 13	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **DRIVE OVER TEMP.** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **DRIVE OVER TEMPERATURE** LED indicates that the Drive has tripped off due to an over temperature condition. Allow the Drive to cool down for approximately (15) minutes before restarting. After restarting, if an over temperature condition occurs again, check for the following conditions. • **Ambient Temperature that Exceeds the Drive Rating**. Measure the ambient temperature surrounding the Drive per the **Specification Table, Chapter 3**. • **Heat Flow Obstruction within the Heat Sink Assembly**. Visually inspect for unobstructed spacing between fins. Clean if necessary. • **Drive Fan Obstruction, Open Fan Fuse 7FU or Malfunctioning Fan**. Check and replace as required. • **Open Winding or Connection to Transformer 3T**. Check for 115V AC between terminals 5 & 6 on transformer **3T**. Replace if required. • **Thermal Overloading Caused by Duty Cycle Demands Exceeding 100% of Current Over an Extended Period of Time**. Using an AC clamp on ammeter, measure the motor current over an extended period of time. **IMPORTANT** : *Clamp on type amp probes and current transformers are frequency sensitive. Inaccurate current readings at frequencies other than 60 Hz may be observed. It is recommended that a true RMS reading clamp on ammeter be used.* • **Malfunctioning Temperature Sensor 1TAS**. If all of the above conditions have been checked and the problem still remains, replace Temperature Sensor **1TAS**. **IMPORTANT** : *When replacing Temperature Sensor 1TAS clean all surfaces. Apply a thin layer of thermal grease (Dow Corning 340) to the back of the sensor. Torque mounting screws to 2.6-3.0 in-lbs max.*

Symptom 14	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **OUTPUT GND** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* An illuminated **OUTPUT GROUND** LED indicates that the Drive circuitry has shorted to ground or there is a malfunctioning Output Ground Sensor Board A8. Remove input power to the Drive and disconnect the motor from the Drive. Reapply input power and start the Drive. If the Drive does not trip, check the motor for a grounded phase condition. Replace or repair the motor if required. If the Drive trips with the motor disconnected, check wire insulation and terminal connections on the Drive Chassis for shorts to ground. If the problem still cannot be located, replace Output Ground Sensor Board A8.

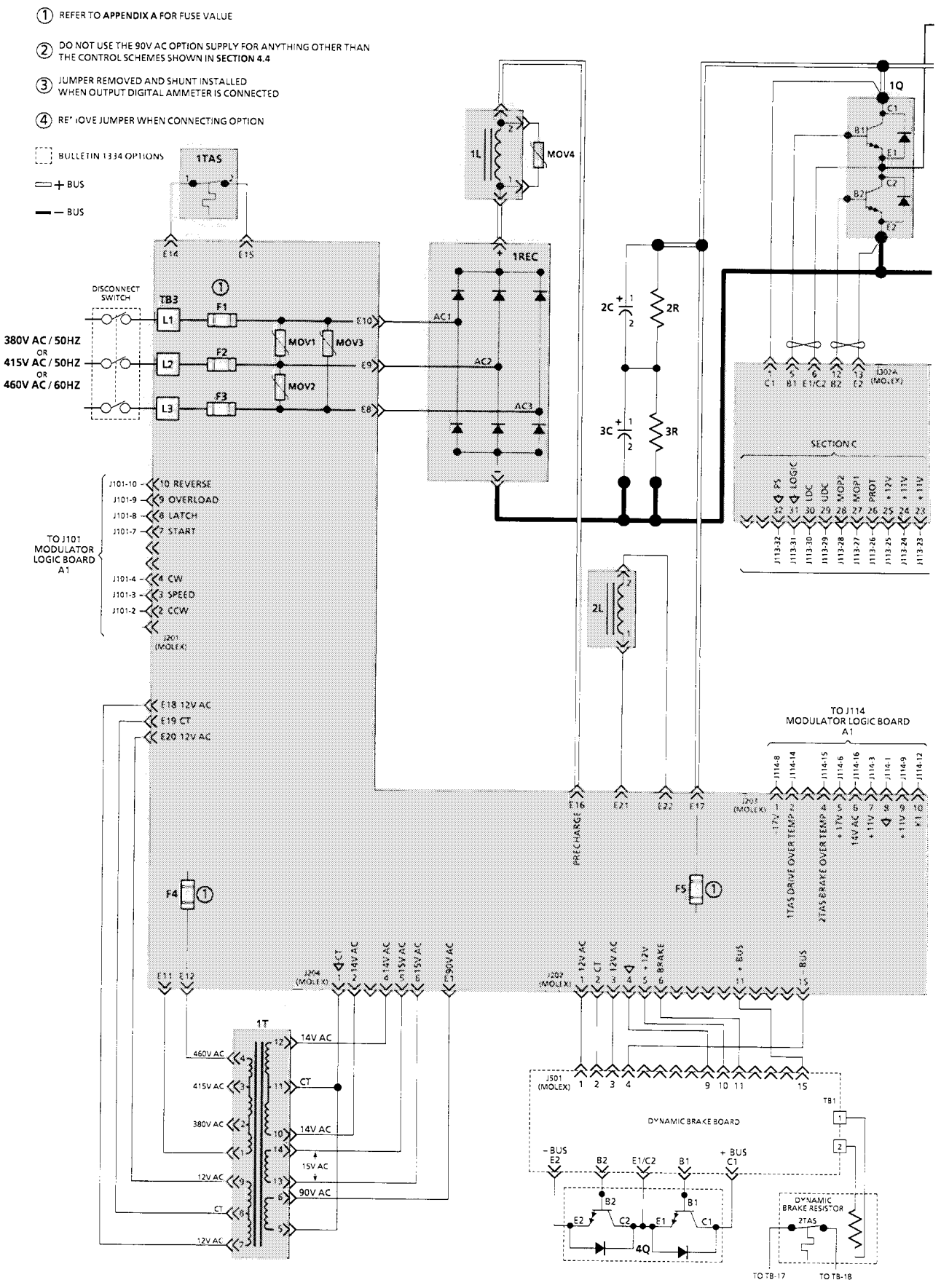
Symptom 15	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (5) seconds when input power is removed. Neon light **DS1** on Bus Discharge Board A5 (or Brake Board if installed) is illuminated.	After input power is removed the bus voltage should discharge to 42V DC in approximately (5) seconds if the discharge cycle is taking place. If the dischatrge cycle is not taking place, check to see if fuse **F1** or resistor **R13** on Bus Discharge Board A5 has opened. **STEP 1** - If neither the fuse nor the resistor is open, measure the AC voltage at Bus Discharge Board A5, connector **J502**, between pins **1** & **4**. The voltage should be approximately 12V AC. If voltage is present, replace Bus Discharge Board A5 **STEP 2** - If resistor **R13** is open, replace Bus Discharge Board A5 and reapply input power. If fuse **F1** is open, replace and reapply input power. Check for proper bus discharge cycle by measuring the DC Bus voltage at Bus Discharge Board A5, connector **J503**, between pins **1** (+ BUS) and **11** or **12** (– BUS). After approximately (5) seconds the voltage should be below 42V DC. If discharge cycle is still not taking place and/or either the fuse or resistor opens again, replace Bus Dischgarge Board A5.

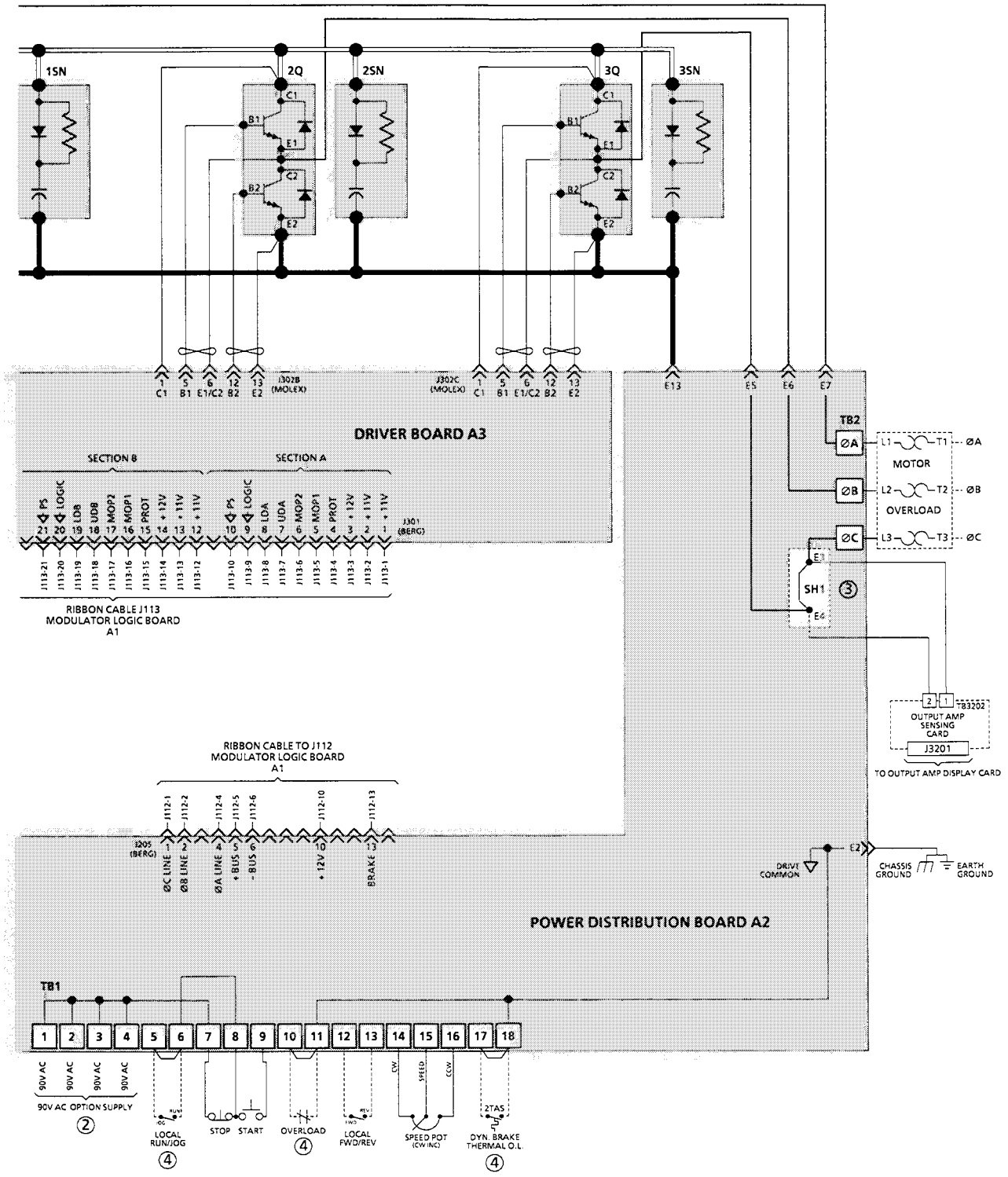
Appendix

G

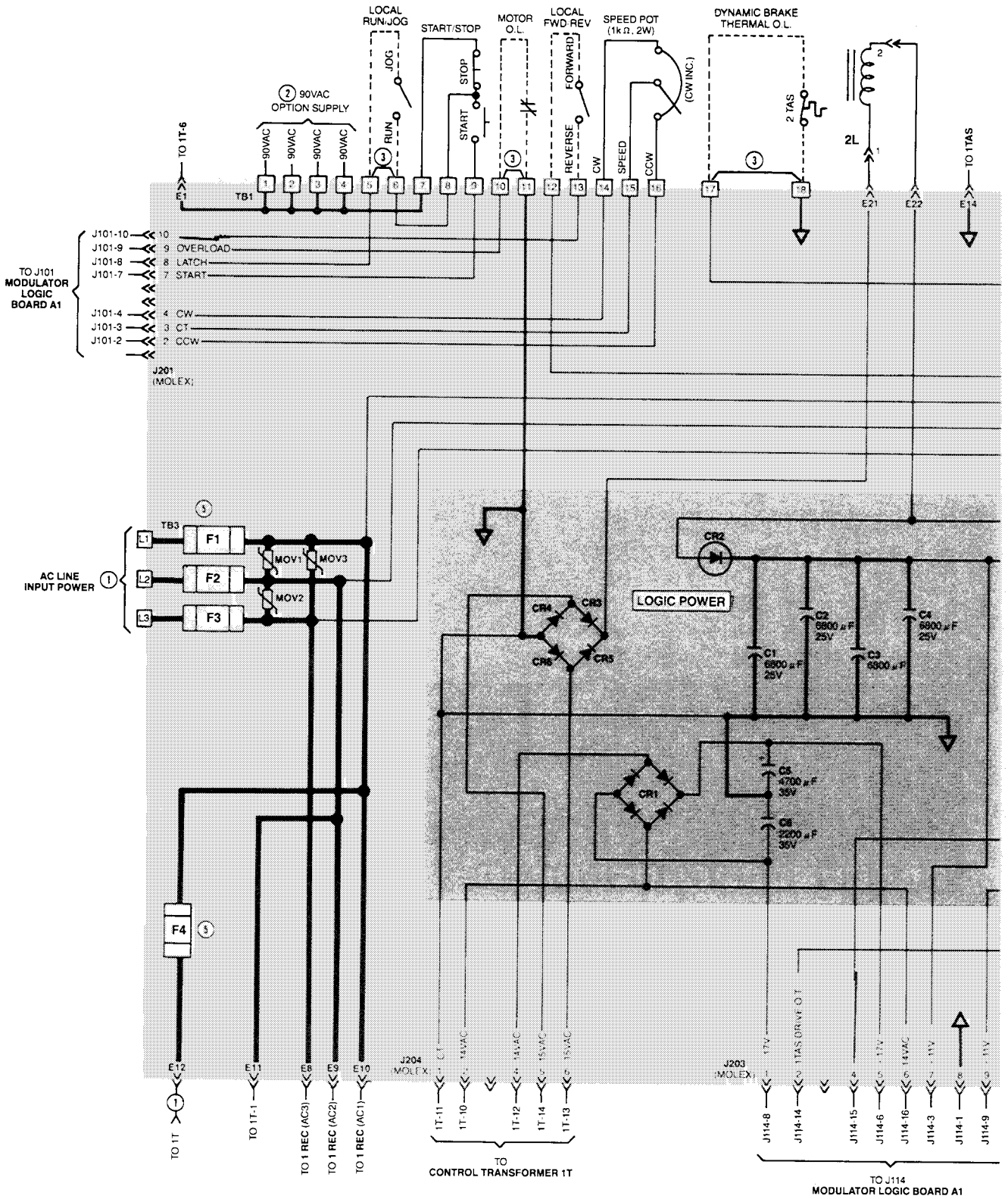
Bulletin 1334 3-10 HP Series B Drive Schematics

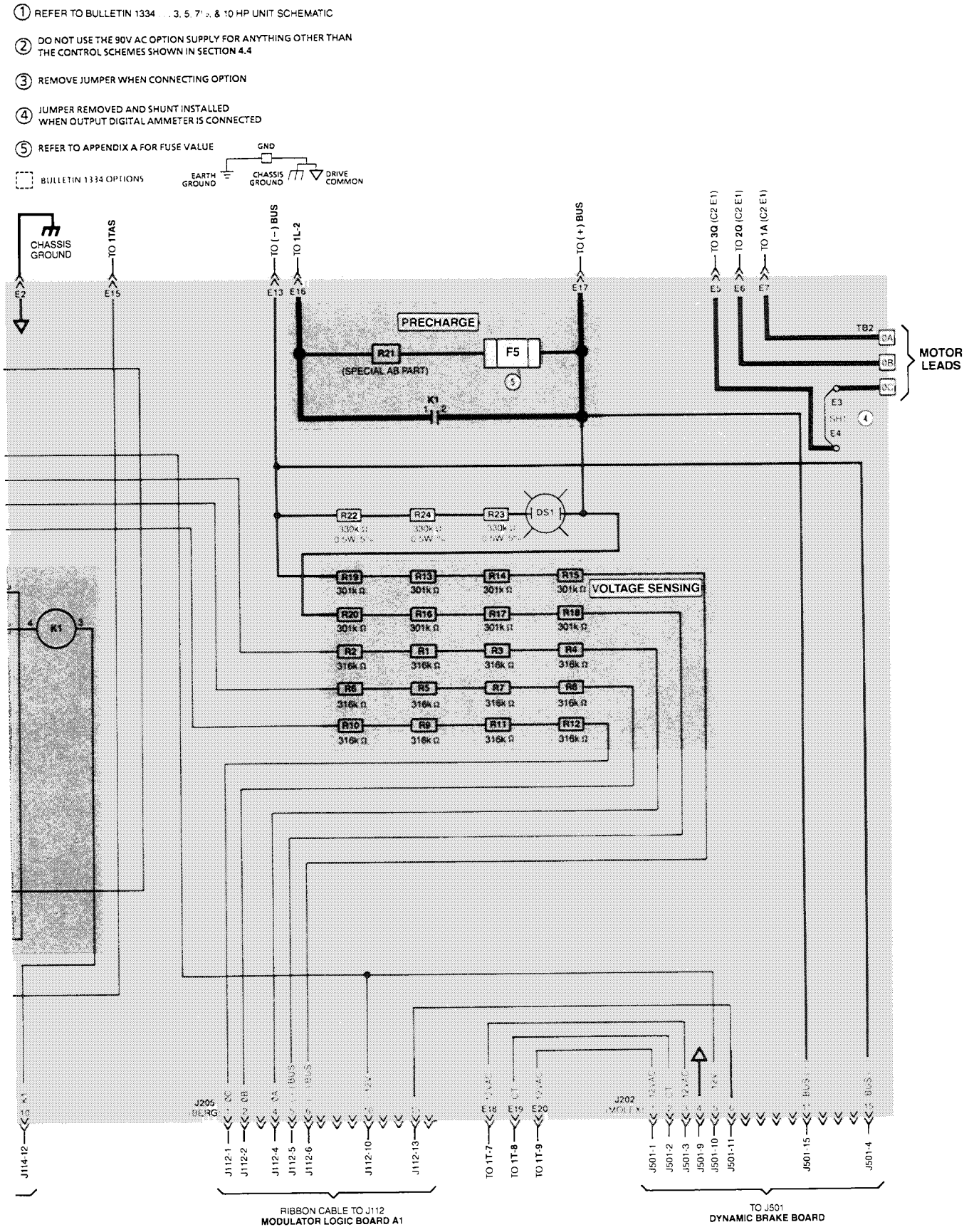
3-10 HP Series B Unit Schematic




1SN
2Q
2SN
3Q
3SN
C1
B1
E1
C2
B2
E2
J302B (MOLEX)
J302C (MOLEX)
DRIVER BOARD A3
SECTION B
SECTION A
PS
LOGIC
LDB
UDB
MOP2
MOP1
PROT
+ 12V
+ 11V
- 11V
LDA
UDA
J301 (BERG)
RIBBON CABLE J113
MODULATOR LOGIC BOARD
A1
TB2
ØA
ØB
ØC
MOTOR
OVERLOAD
L1
L2
L3
T1
T2
T3
SH1
OUTPUT AMP SENSING CARD
TB3202
J3201
TO OUTPUT AMP DISPLAY CARD
RIBBON CABLE TO J112
MODULATOR LOGIC BOARD
A1
J205 (BERG)
ØC LINE
ØB LINE
ØA LINE
+ BUS
- BUS
+ 12V
BRAKE
DRIVE COMMON
CHASSIS GROUND
EARTH GROUND
POWER DISTRIBUTION BOARD A2
TB1
90V AC
90V AC OPTION SUPPLY
LOCAL RUN/JOG
STOP
START
OVERLOAD
LOCAL FWD/REV
CW
SPEED
CCW
SPEED POT (CW INC)
2TAS
DYN. BRAKE THERMAL O.L.

3-10 HP Series B Power Distribution Board Schematic



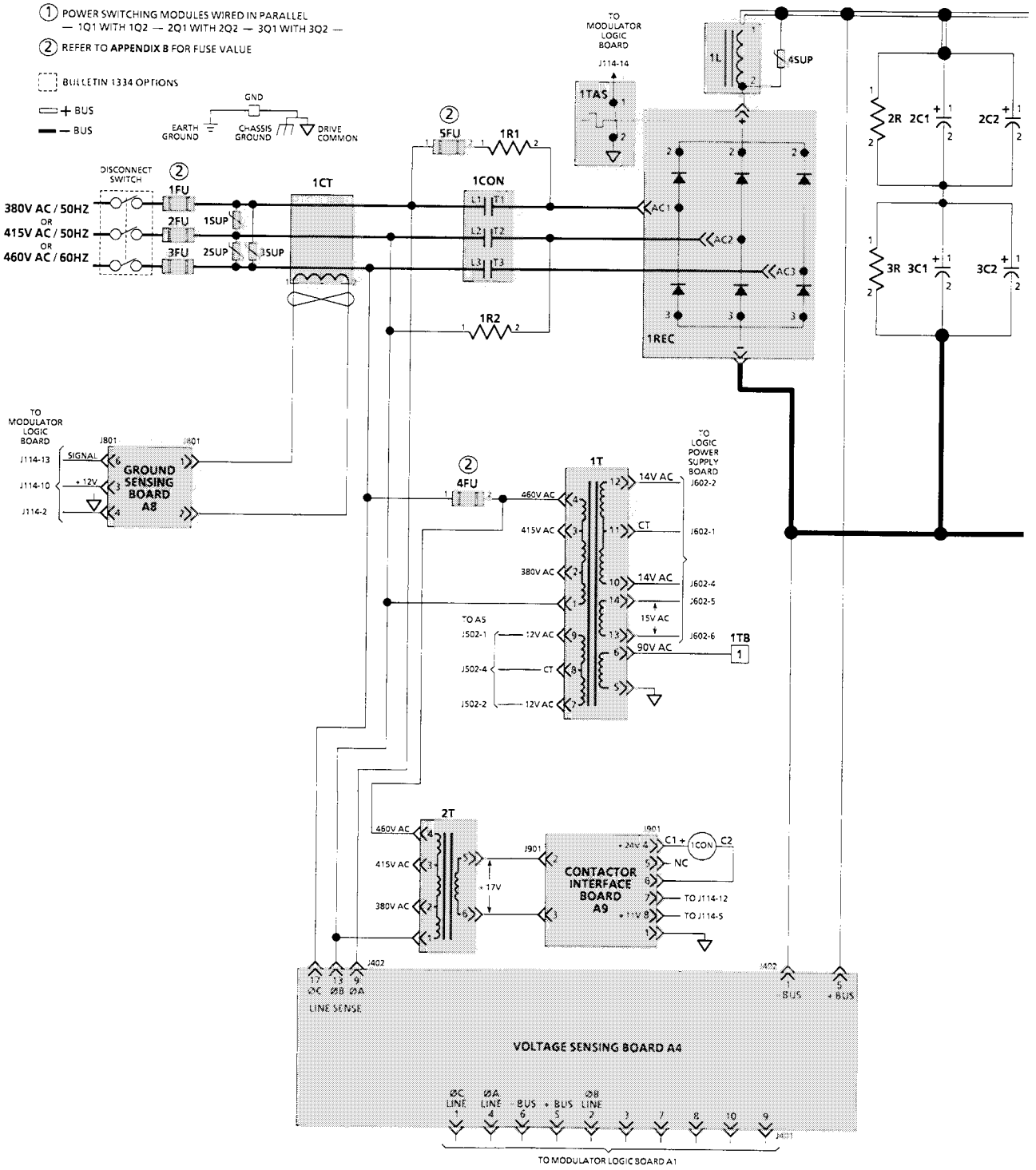

1 REFER TO BULLETIN 1334 . . 3, 5, 7½, & 10 HP UNIT SCHEMATIC
2 DO NOT USE THE 90V AC OPTION SUPPLY FOR ANYTHING OTHER THAN THE CONTROL SCHEMES SHOWN IN SECTION 4.4
3 REMOVE JUMPER WHEN CONNECTING OPTION
4 JUMPER REMOVED AND SHUNT INSTALLED WHEN OUTPUT DIGITAL AMMETER IS CONNECTED
5 REFER TO APPENDIX A FOR FUSE VALUE
BULLETIN 1334 OPTIONS
GND
EARTH GROUND
CHASSIS GROUND
DRIVE COMMON
CHASSIS GROUND
TO 1TAS
TO (–) BUS
TO 1L-2
TO (+) BUS
TO 3Q (C2 E1)
TO 2Q (C2 E1)
TO 1A (C2 E1)
E2
E15
E13
E16
E17
E5
E6
E7
PRECHARGE
R21
(SPECIAL AB PART)
F5
K1
T82
MOTOR LEADS
E3
E4
DS1
R22
R24
R23
R19
R13
R14
R15
VOLTAGE SENSING
R20
R16
R17
R18
R2
R1
R3
R4
R6
R5
R7
R8
R10
R9
R11
R12
316k Ω
301k Ω
J205
J202
J114-12
J112-1
J112-2
J112-4
J112-5
J112-6
J112-10
J112-13
TO 1T-7
TO 1T-8
TO 1T-9
J501-1
J501-2
J501-3
J501-9
J501-10
J501-11
J501-15
J501-4
RIBBON CABLE TO J112
MODULATOR LOGIC BOARD A1
TO J501
DYNAMIC BRAKE BOARD

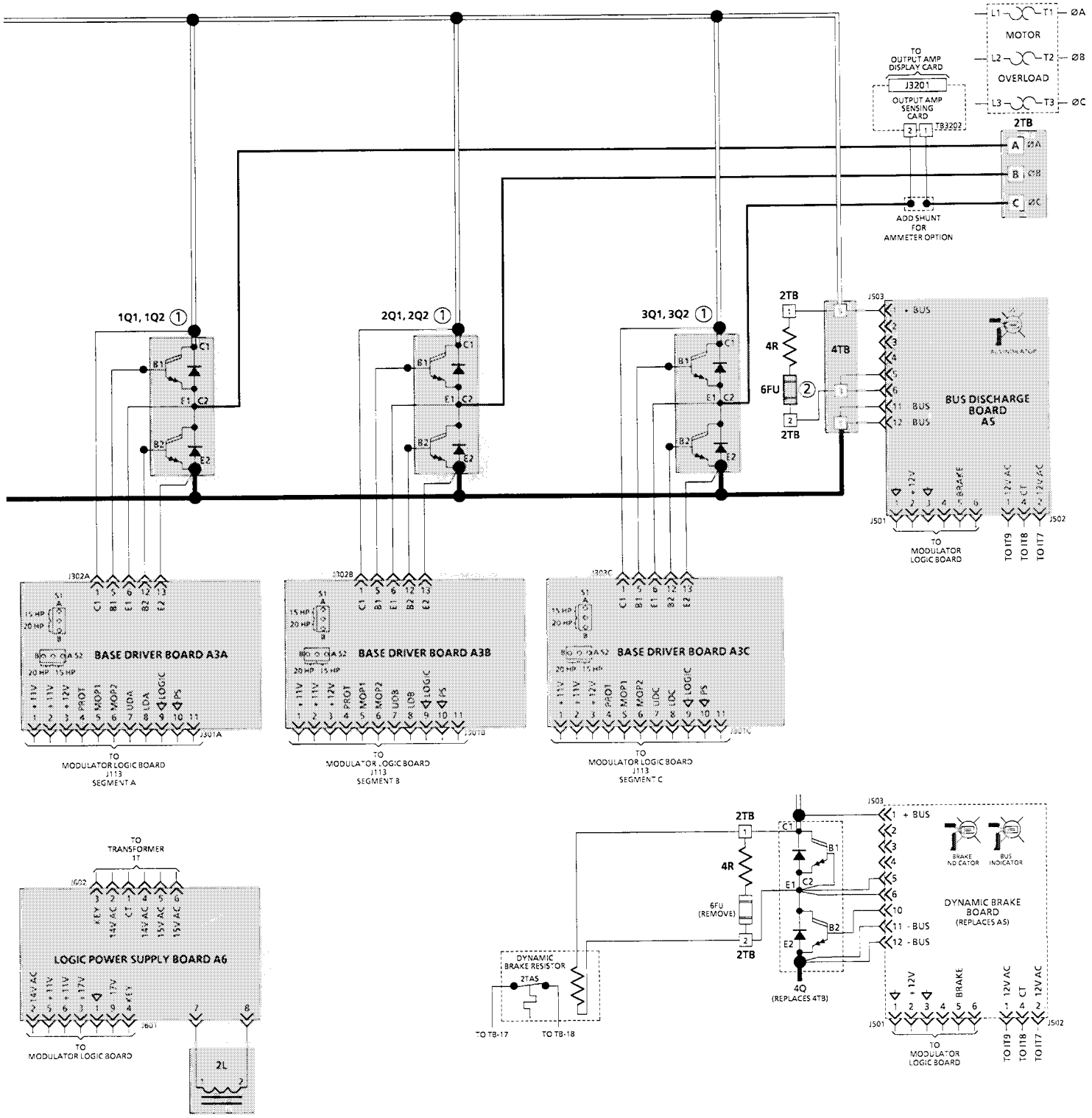
Appendix

H

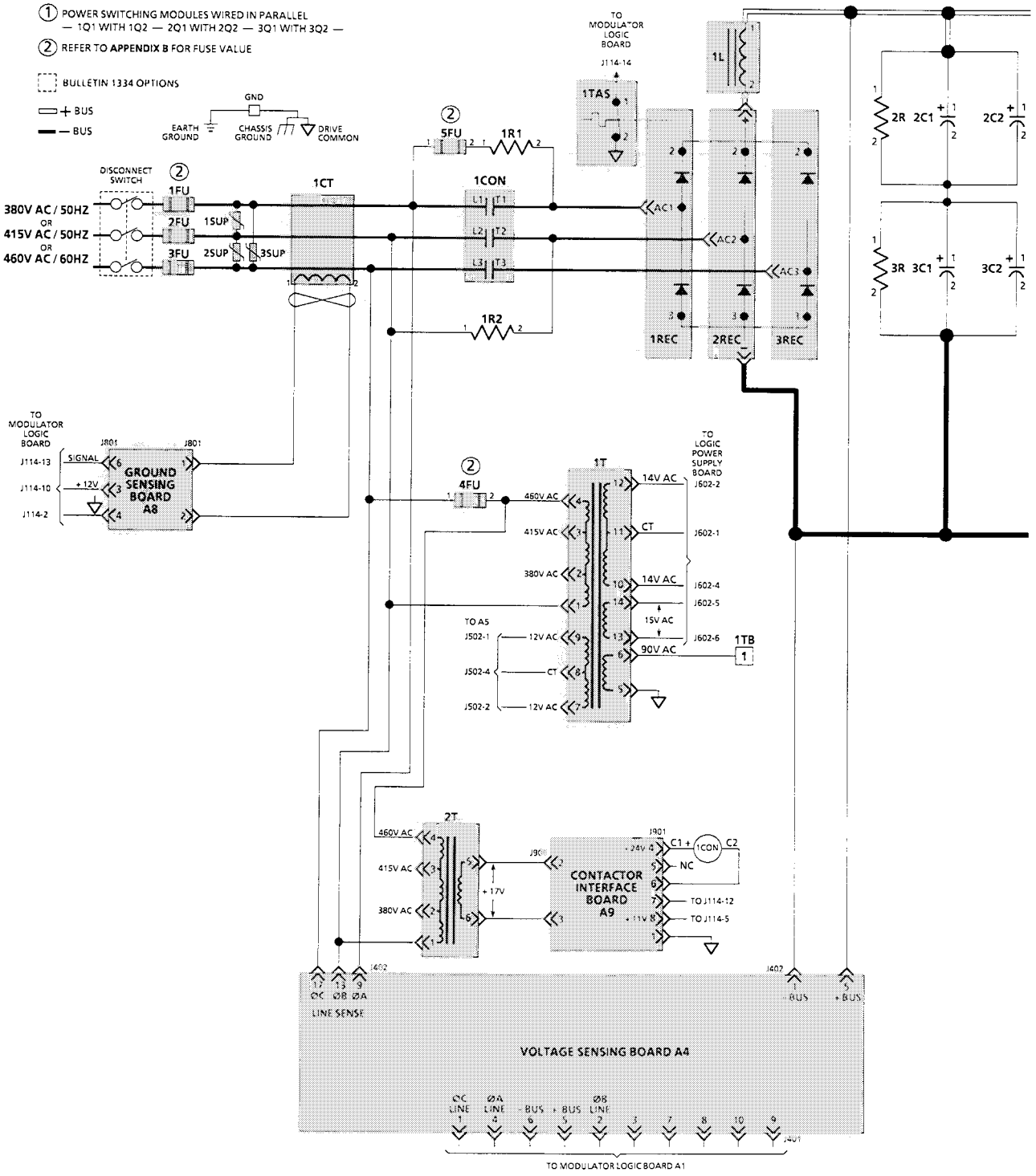
Bulletin 1334 15-25 HP Series A Drive Schematics

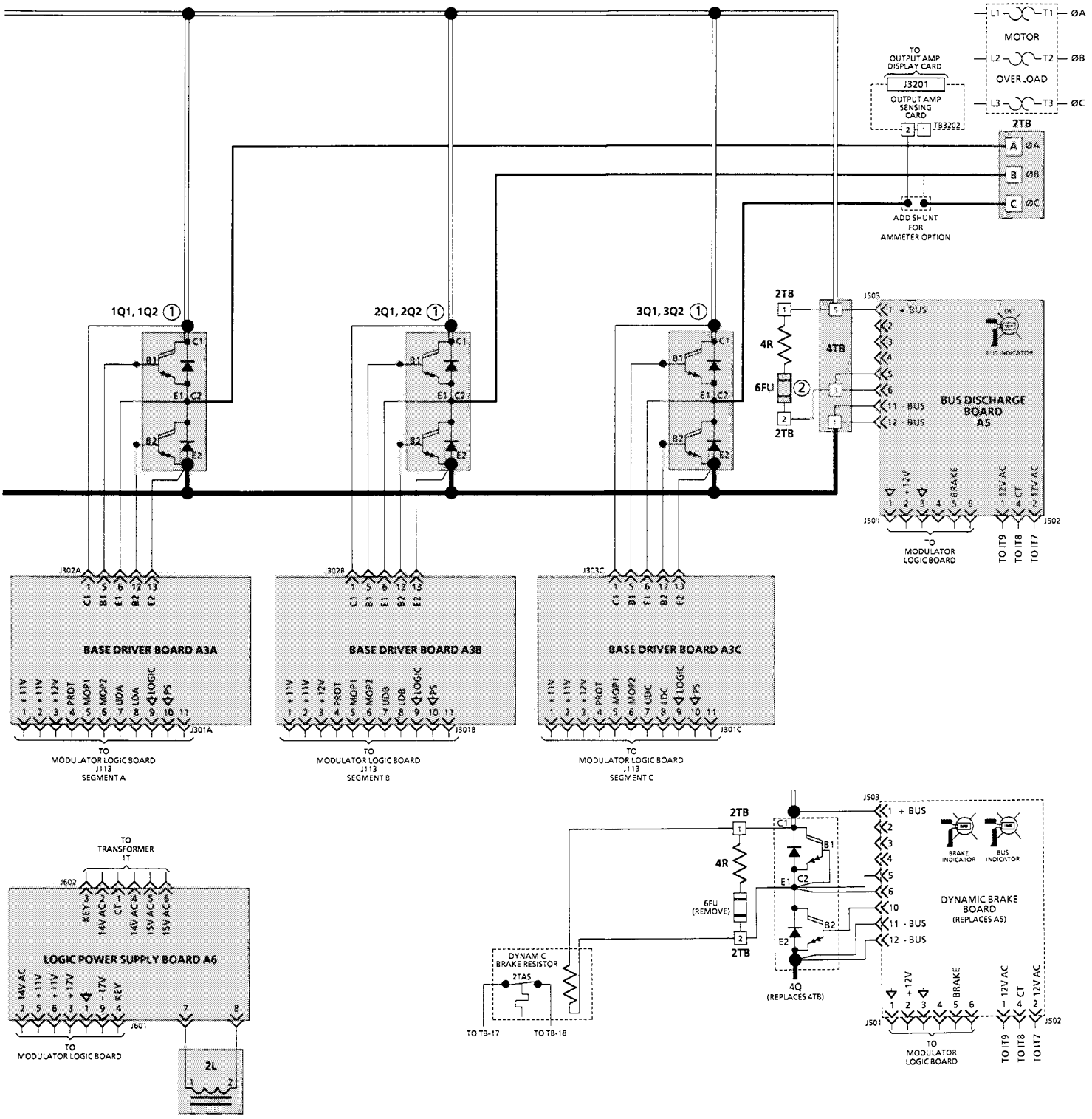
15 & 20 HP Unit Schematic




L1
T1
ØA
MOTOR
L2
T2
ØB
OVERLOAD
L3
T3
ØC
TO
OUTPUT AMP
DISPLAY CARD
J3201
OUTPUT AMP
SENSING
CARD
TB3202
2TB
A ØA
B ØB
C ØC
ADD SHUNT
FOR
AMMETER OPTION
1Q1, 1Q2
2Q1, 2Q2
3Q1, 3Q2
C1
B1
E1
C2
B2
E2
4R
6FU
2TB
4TB
J503
+ BUS
BUS
BUS DISCHARGE
BOARD
A5
BRAKE
J501
J502
TO
MODULATOR
LOGIC BOARD
TO 119
TO 118
TO 117
J302A
J302B
J302C
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
15 HP
20 HP
+ 11V
+ 12V
PROT
MOP1
MOP2
UDA
LDA
UDB
LDB
LOGIC
PS
J301A
J301B
J301C
TO
MODULATOR LOGIC BOARD
J113
SEGMENT A
SEGMENT B
SEGMENT C
TO
TRANSFORMER
1T
J602
KEY
14V AC
CT
15V AC
LOGIC POWER SUPPLY BOARD A6
J601
2L
DYNAMIC
BRAKE RESISTOR
2TAS
TO TB-17
TO TB-18
6FU
(REMOVE)
4Q
(REPLACES 4TB)
DYNAMIC BRAKE
BOARD
(REPLACES A5)
BRAKE
INDICATOR
BUS
INDICATOR
- BUS
- 12V
- 12V AC
CT

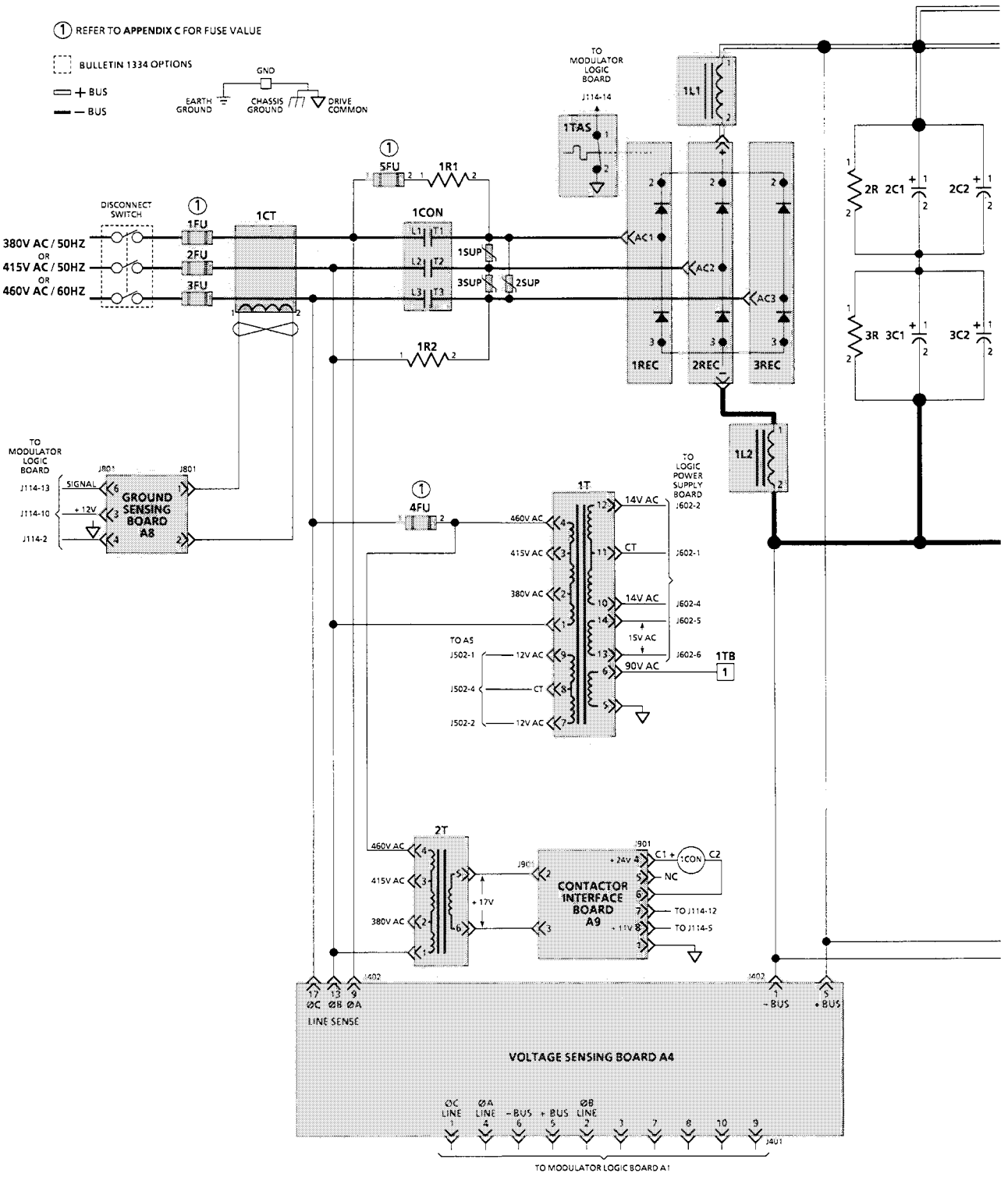
25 HP Unit Schematic

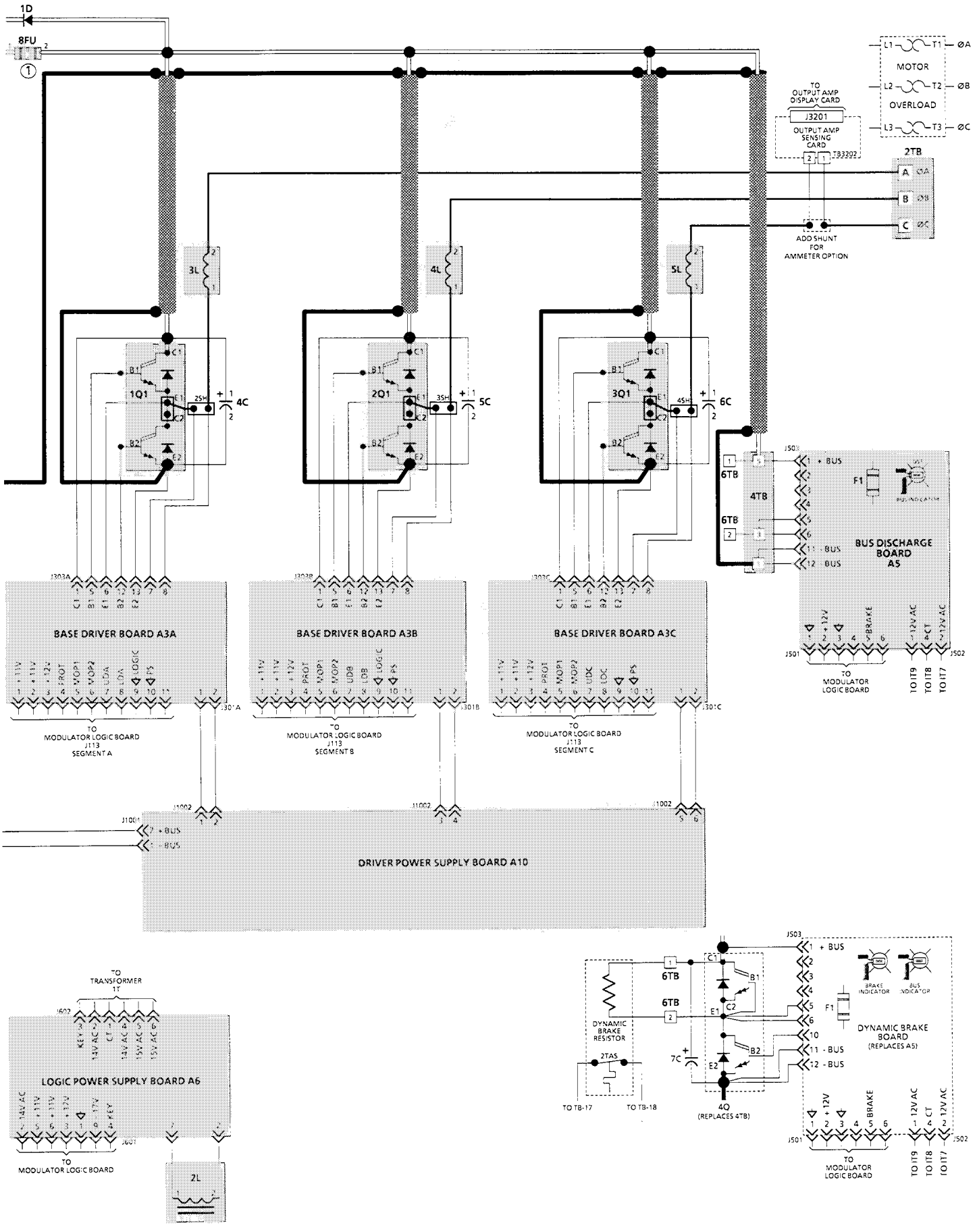



L1 T1 ØA
MOTOR
L2 T2 ØB
OVERLOAD
L3 T3 ØC
TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
2TB
A ØA
B ØB
C ØC
ADD SHUNT FOR AMMETER OPTION
1Q1, 1Q2 (1)
2Q1, 2Q2 (1)
3Q1, 3Q2 (1)
C1 B1 E1 C2 B2 E2
2TB
4R
6FU (2)
2TB
4TB
J503
1 + BUS
11 BUS
12 BUS
DS1
BUS INDICATOR
BUS DISCHARGE BOARD A5
J501
+ 12V
BRAKE
12V AC
CT
12V AC
J502
TO MODULATOR LOGIC BOARD
TO IT9
TO IT8
TO IT7
J302A
J302B
J303C
C1 B1 E1 B2 E2
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
+ 11V
+ 12V
PROT
MOP1
MOP2
UDA
LDA
UDB
LDB
UDC
LDC
LOGIC
PS
J301A
J301B
J301C
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
TO TRANSFORMER 1T
J602
KEY
14V AC
CT
14V AC
15V AC
15V AC
LOGIC POWER SUPPLY BOARD A6
14V AC
+ 11V
+ 17V
- 17V
KEY
J601
TO MODULATOR LOGIC BOARD
2L
DYNAMIC BRAKE RESISTOR
2TA5
TO TB-17
TO TB-18
6FU (REMOVE)
4Q (REPLACES 4TB)
BRAKE INDICATOR
DYNAMIC BRAKE BOARD (REPLACES A5)

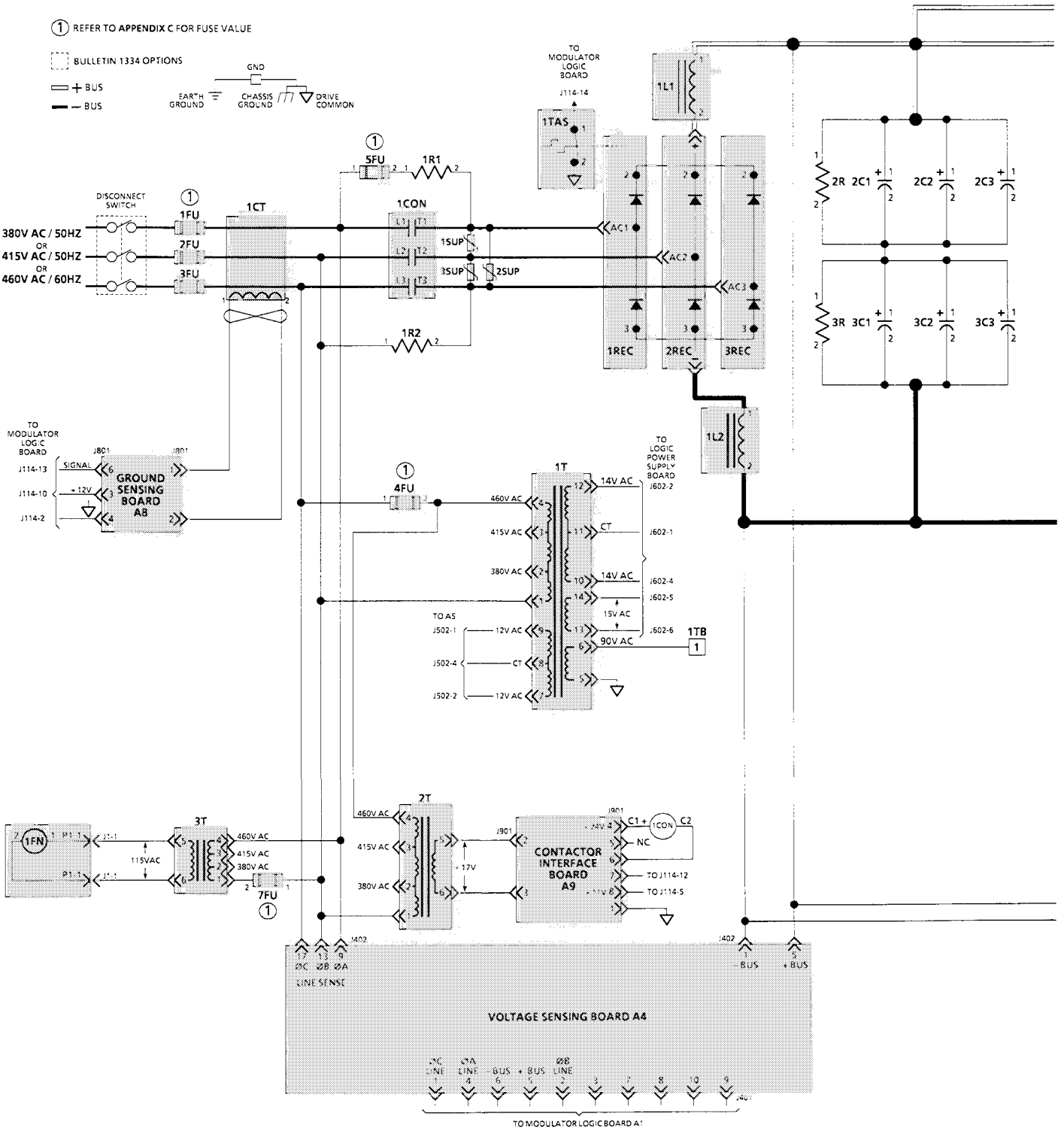
Bulletin 1334 30-50 HP Series A Drive Schematics

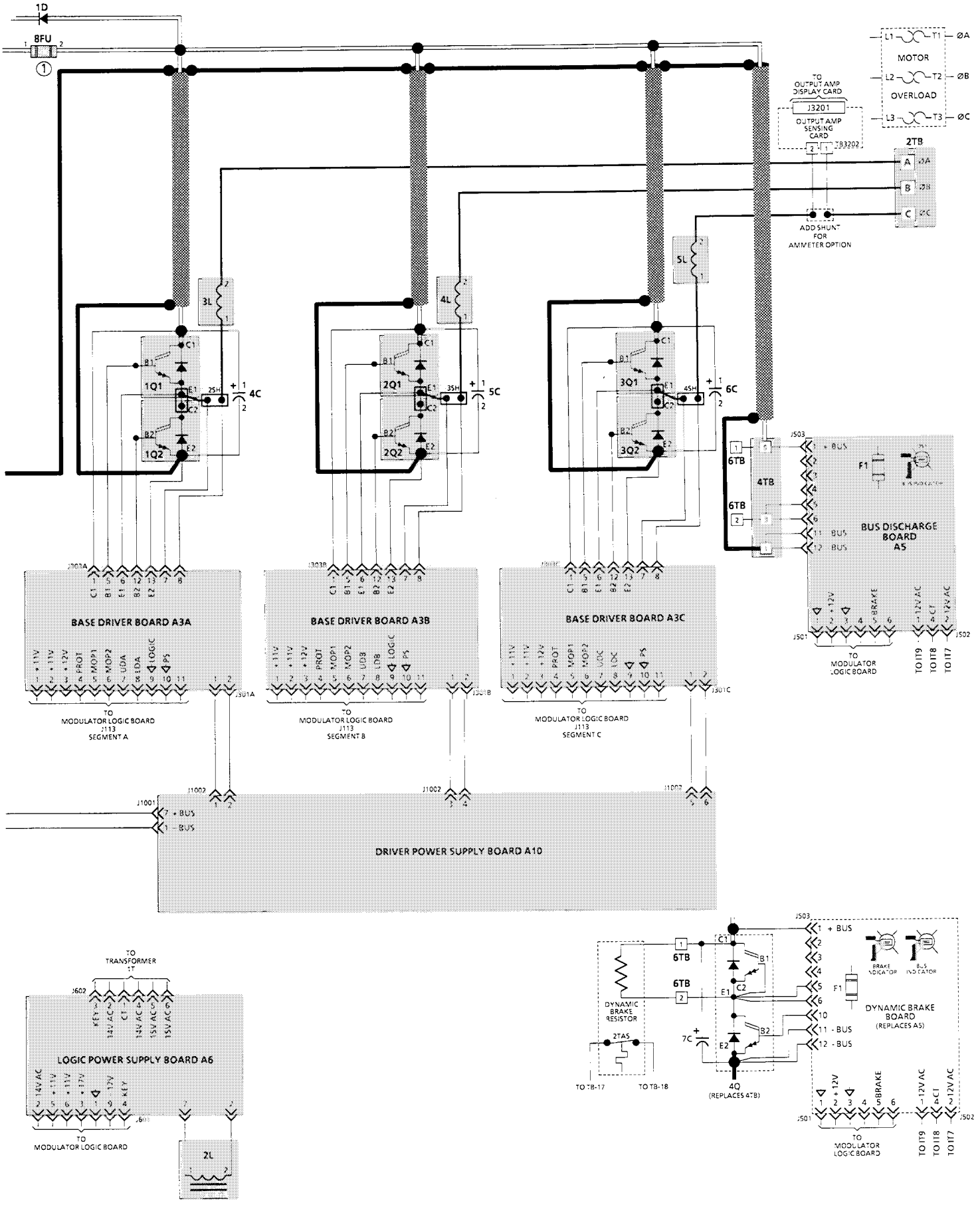
30 HP Unit Schematic




1D
8FU
MOTOR
OVERLOAD
TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
ADD SHUNT FOR AMMETER OPTION
2TB
3L
4L
5L
1Q1
2Q1
3Q1
4C
5C
6C
6TB
4TB
BUS DISCHARGE BOARD A5
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
DRIVER POWER SUPPLY BOARD A10
TO MODULATOR LOGIC BOARD
TO IT9
TO IT8
TO IT7
TO TRANSFORMER 1T
LOGIC POWER SUPPLY BOARD A6
2L
DYNAMIC BRAKE RESISTOR
2TAS
TO TB-17
TO TB-18
7C
4Q
(REPLACES 4TB)
DYNAMIC BRAKE BOARD
(REPLACES A5)
BRAKE INDICATOR
BUS INDICATOR

40 & 50 HP Unit Schematic



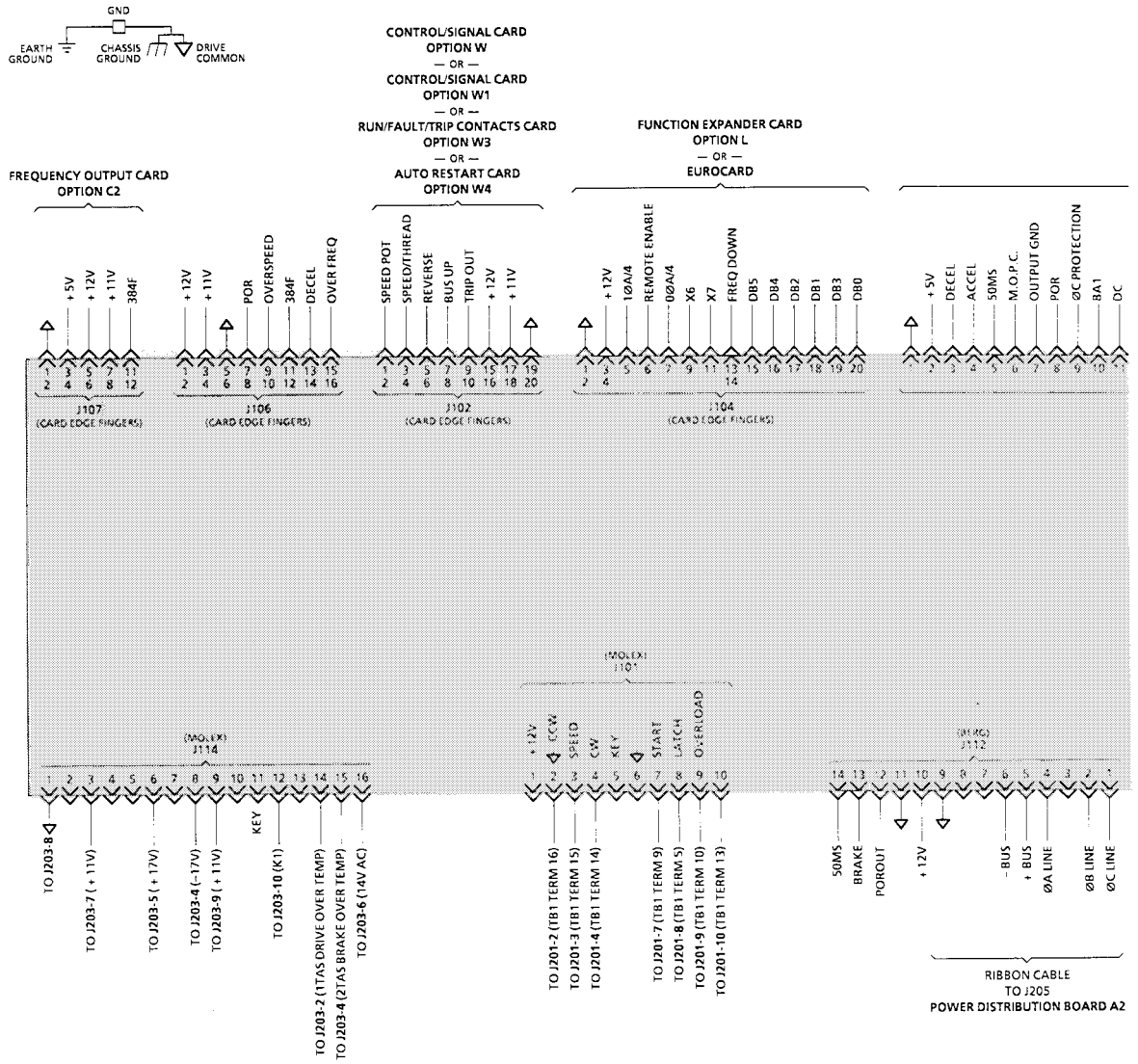

1D
8FU
MOTOR
OVERLOAD
L1
L2
L3
T1
T2
T3
ØA
ØB
ØC
TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
2TB
ADD SHUNT FOR AMMETER OPTION
3L
4L
5L
1Q1
1Q2
2Q1
2Q2
3Q1
3Q2
4C
5C
6C
6TB
4TB
BUS DISCHARGE BOARD A5
F1
BUS
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
TO MODULATOR LOGIC BOARD
DRIVER POWER SUPPLY BOARD A10
TO I19
TO I18
TO I17
TO TRANSFORMER 1T
LOGIC POWER SUPPLY BOARD A6
2L
DYNAMIC BRAKE RESISTOR
2TAS
7C
4Q (REPLACES 4TB)
DYNAMIC BRAKE BOARD (REPLACES A5)
BRAKE INDICATOR
BUS INDICATOR
TO TB-17
TO TB-18

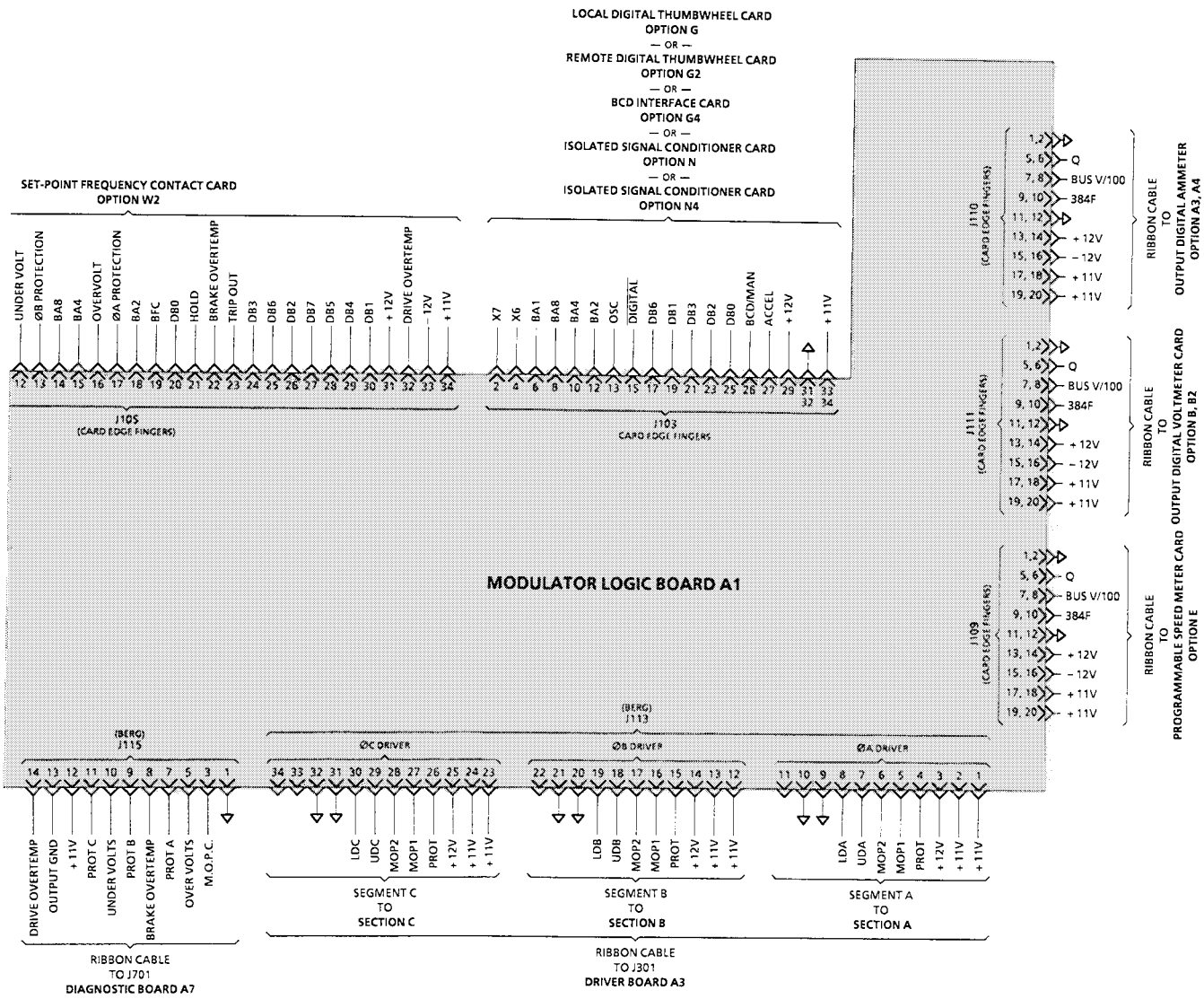
Appendix

J

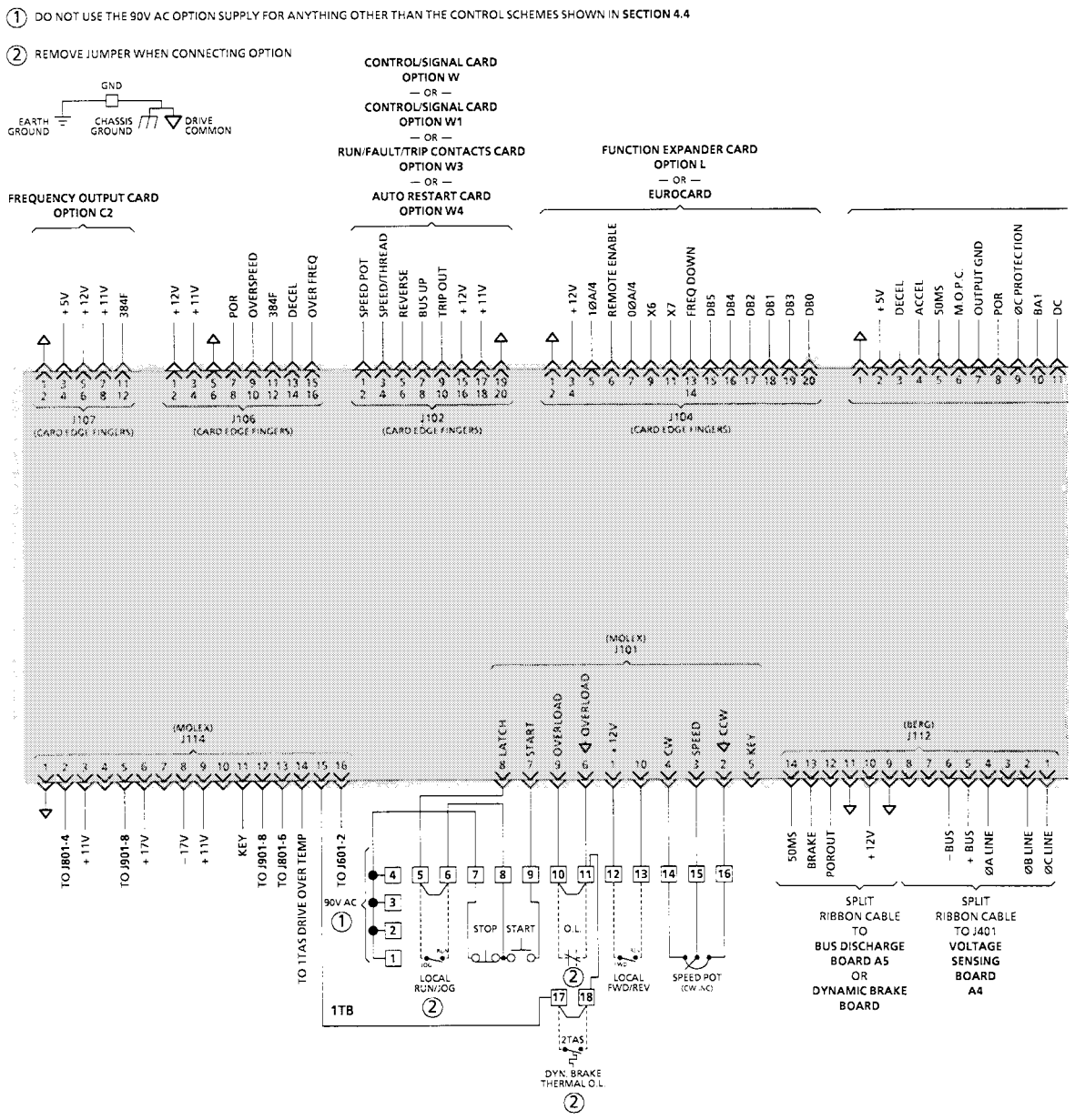
Bulletin 1334 Modulator Logic Board Interconnection Diagrams

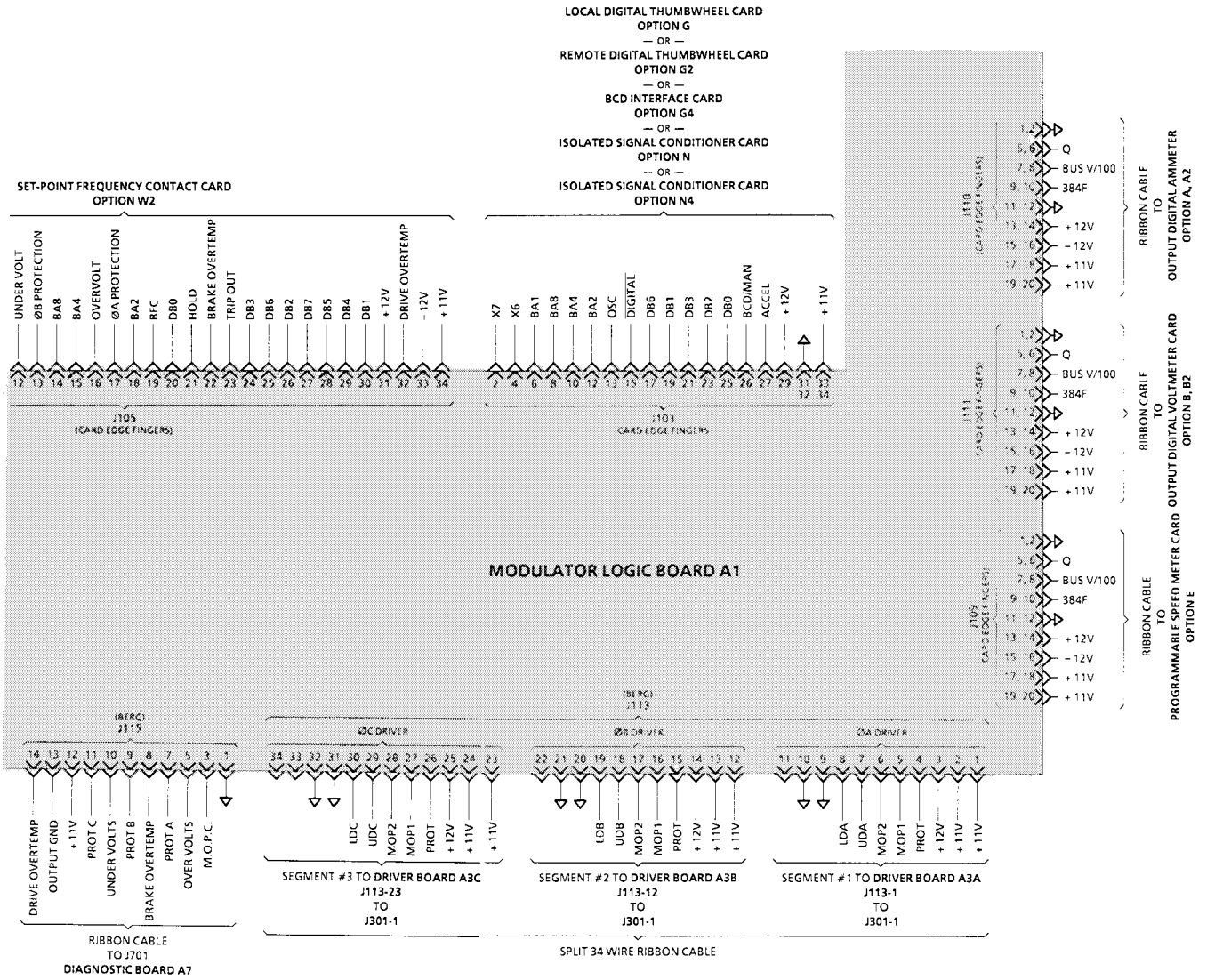
3-10 HP Series B Modulator Logic Board Interconnection Diagram



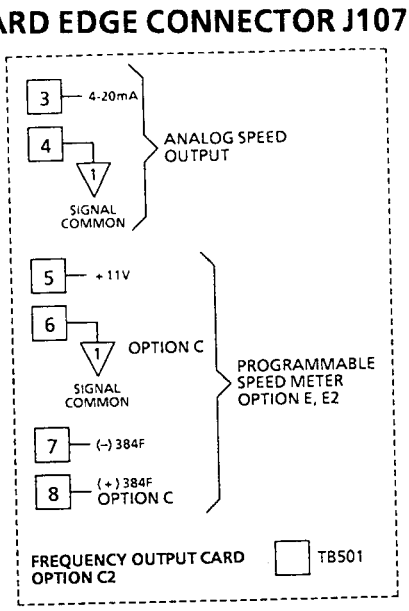

LOCAL DIGITAL THUMBWHEEL CARD
OPTION G
— OR —
REMOTE DIGITAL THUMBWHEEL CARD
OPTION G2
— OR —
BCD INTERFACE CARD
OPTION G4
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N4
SET-POINT FREQUENCY CONTACT CARD
OPTION W2
MODULATOR LOGIC BOARD A1
J105
(CARD EDGE FINGERS)
J103
CARD EDGE FINGERS
J110
(CARD EDGE FINGERS)
J111
(CARD EDGE FINGERS)
J109
(CARD EDGE FINGERS)
RIBBON CABLE TO OUTPUT DIGITAL AMMETER OPTION A3, A4
RIBBON CABLE TO OUTPUT DIGITAL VOLTMETER CARD OPTION B, B2
RIBBON CABLE TO PROGRAMMABLE SPEED METER CARD OPTION E
(BERG) J115
(BERG) J113
ØC DRIVER
ØB DRIVER
ØA DRIVER
SEGMENT C TO SECTION C
SEGMENT B TO SECTION B
SEGMENT A TO SECTION A
RIBBON CABLE TO J701 DIAGNOSTIC BOARD A7
RIBBON CABLE TO J301 DRIVER BOARD A3

15-50 HP Series A Modulator Logic Board Interconnection Diagram



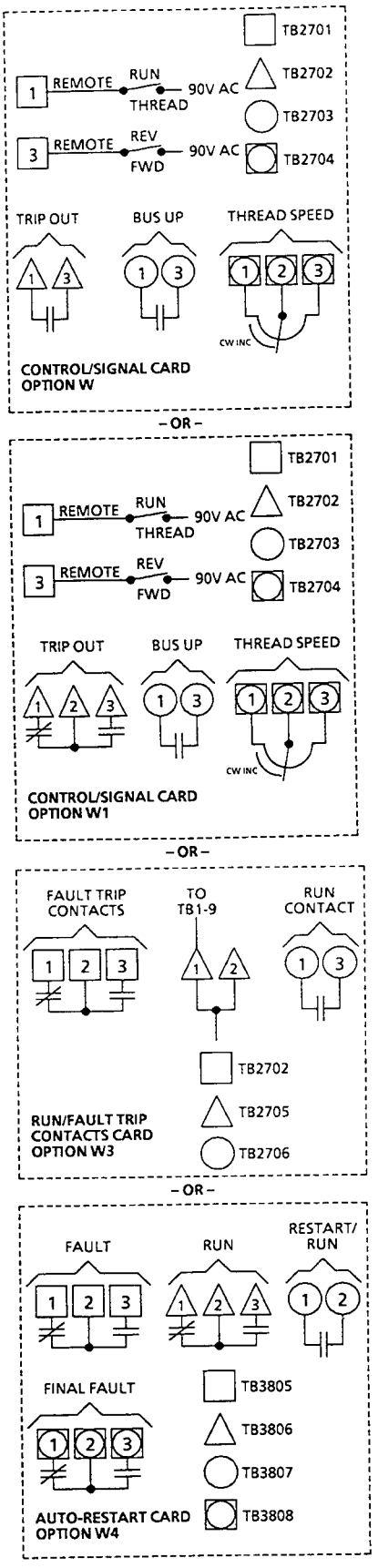

LOCAL DIGITAL THUMBWHEEL CARD
OPTION G
— OR —
REMOTE DIGITAL THUMBWHEEL CARD
OPTION G2
— OR —
BCD INTERFACE CARD
OPTION G4
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N4
SET-POINT FREQUENCY CONTACT CARD
OPTION W2
UNDER VOLT
ØB PROTECTION
BA8
BA4
OVERVOLT
ØA PROTECTION
BA2
BFC
DB0
HOLD
BRAKE OVERTEMP
TRIP OUT
DB3
DB6
DB2
DB7
DB5
DB4
DB1
+ 12V
DRIVE OVERTEMP
– 12V
+ 11V
X7
X6
BA1
BA8
BA4
BA2
OSC
DIGITAL
DB6
DB1
DB3
DB2
DB0
BCD/MAN
ACCEL
+ 12V
+ 11V
J105
(CARD EDGE FINGERS)
J103
CARD EDGE FINGERS
MODULATOR LOGIC BOARD A1
J110
J111
J109
Q
BUS V/100
384F
+ 12V
– 12V
+ 11V
+ 11V
RIBBON CABLE TO OUTPUT DIGITAL AMMETER OPTION A, A2
RIBBON CABLE TO OUTPUT DIGITAL VOLTMETER CARD OPTION B, B2
RIBBON CABLE TO PROGRAMMABLE SPEED METER CARD OPTION E
(BERG) J115
(BERG) J113
ØC DRIVER
ØB DRIVER
ØA DRIVER
DRIVE OVERTEMP
OUTPUT GND
+ 11V
PROT C
UNDER VOLTS
PROT B
BRAKE OVERTEMP
PROT A
OVER VOLTS
M.O.P.C.
LDC
UDC
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
LDB
UDB
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
LDA
UDA
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
SEGMENT #3 TO DRIVER BOARD A3C
J113-23
TO
J301-1
SEGMENT #2 TO DRIVER BOARD A3B
J113-12
TO
J301-1
SEGMENT #1 TO DRIVER BOARD A3A
J113-1
TO
J301-1
RIBBON CABLE
TO J701
DIAGNOSTIC BOARD A7
SPLIT 34 WIRE RIBBON CABLE

Bulletin 1334 Modulator Logic Board Plug-In Options

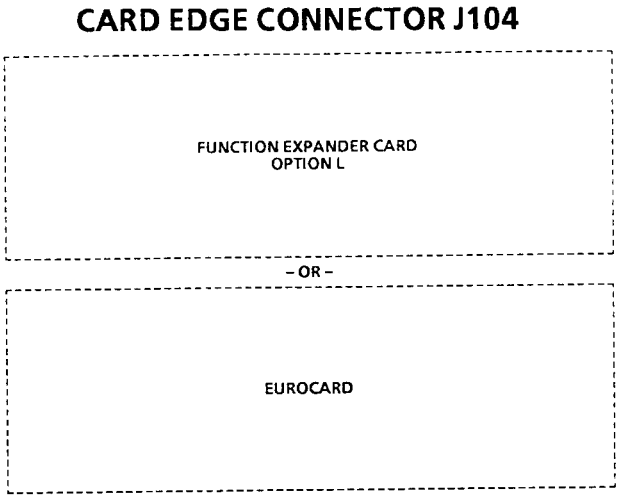


Bulletin 1334 Modulator Logic Board Plug-In Options

CARD EDGE CONNECTOR J102

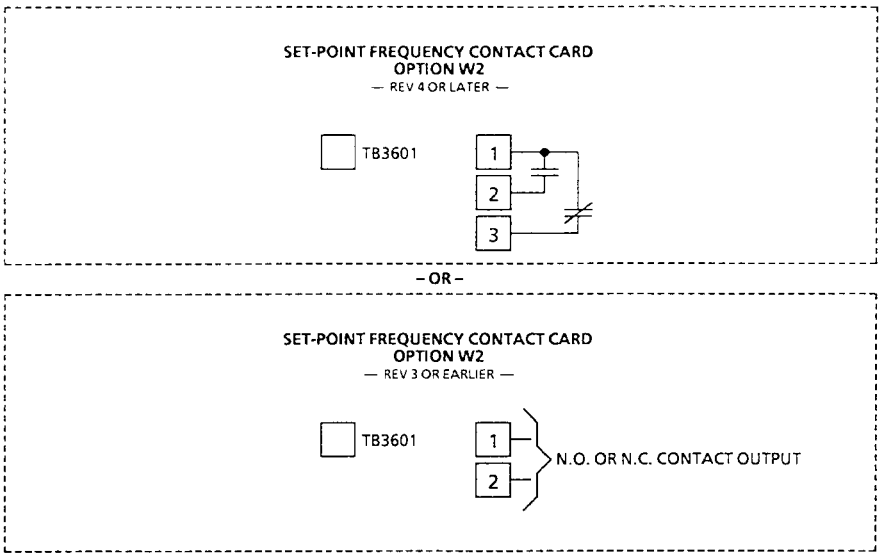


Bulletin 1334 Modulator Logic Board Plug-In Options

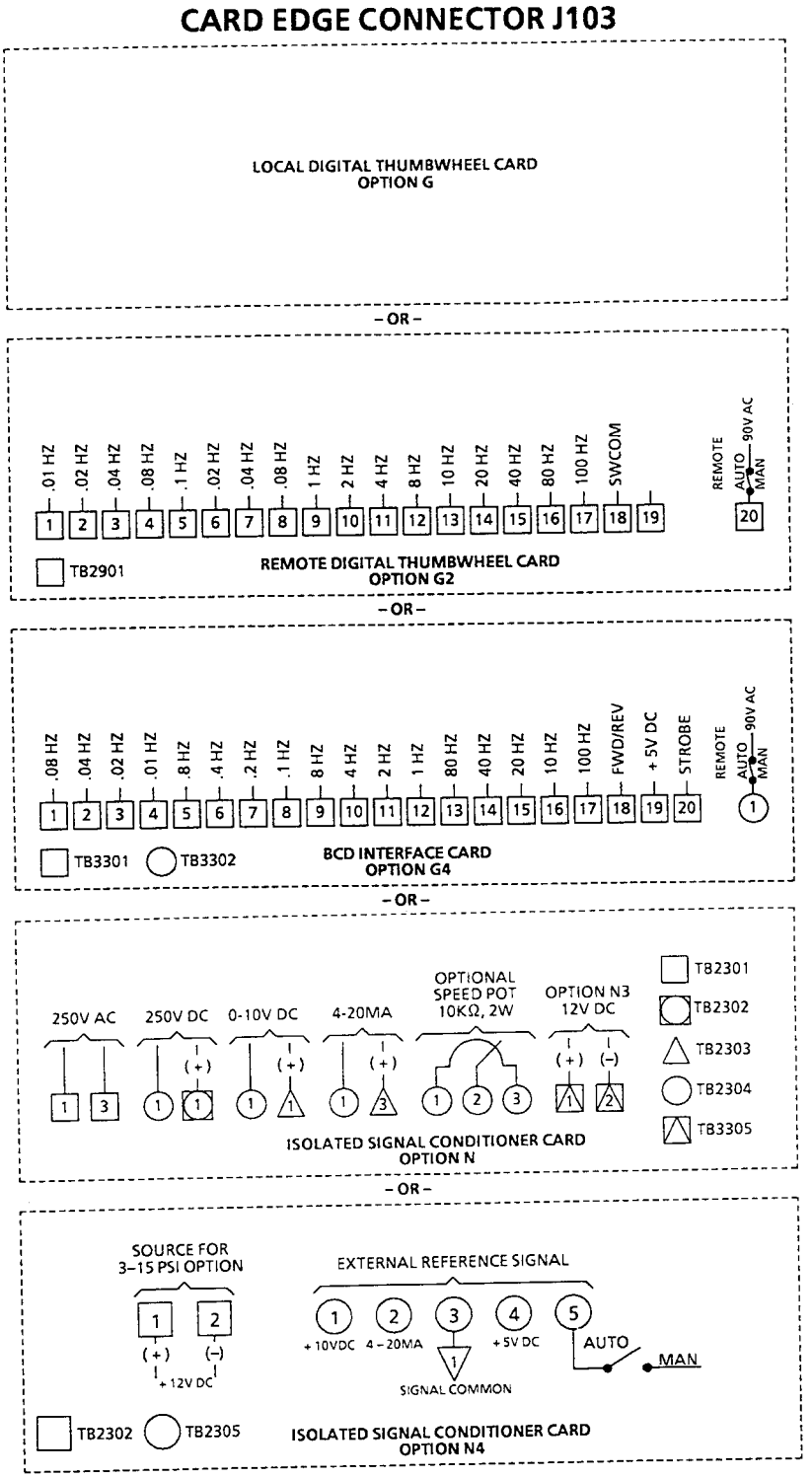


Bulletin 1334 Modulator Logic Board Plug-In Options

CARD EDGE CONNECTOR J105



Bulletin 1334 Modulator Logic Board Plug-In Options



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We would appreciate your comments on the usefulness and readability of this manual. Please take a few moments to complete the following questions. If desired, provide specific examples that would make this manual a more useful tool.

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EASE OF READING IS . . .	❑ GOOD	❑ ADEQUATE	❑ POOR
LEVEL OF INFORMATION IS . . .	❑ GOOD	❑ ADEQUATE	❑ POOR
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