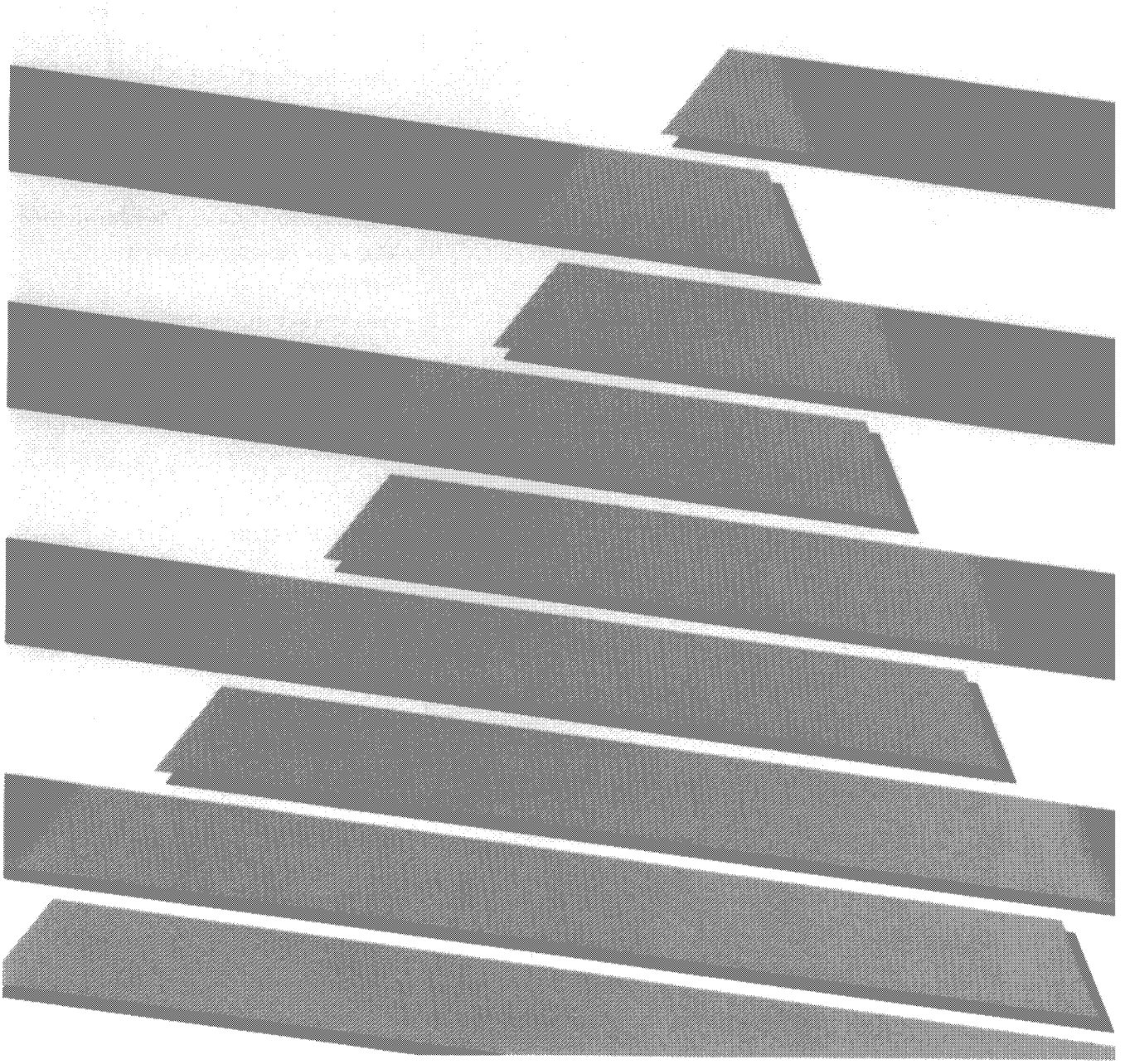
ALLEN-BRADLEY

Bulletin 1335
Variable Torque AC Drive
(12 through 96 Amp)

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 1335 12 through 96 Amp Variable Torque 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 1335 Pre-Installation Care

1.0 Pre-Installation & Operation

Before installing and operating your Bulletin 1335, 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 1335 Drives including standard controls, adjustment range, diagnostics, and environmental qualifications are listed in **Chapter 3**. 380 & 415V Bulletin 1335 specifications and adjustments are detailed in **Chapter 7**.

1.1 Receiving

Once you have received your Bulletin 1335 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 should 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 1335 can weigh anywhere from 94 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

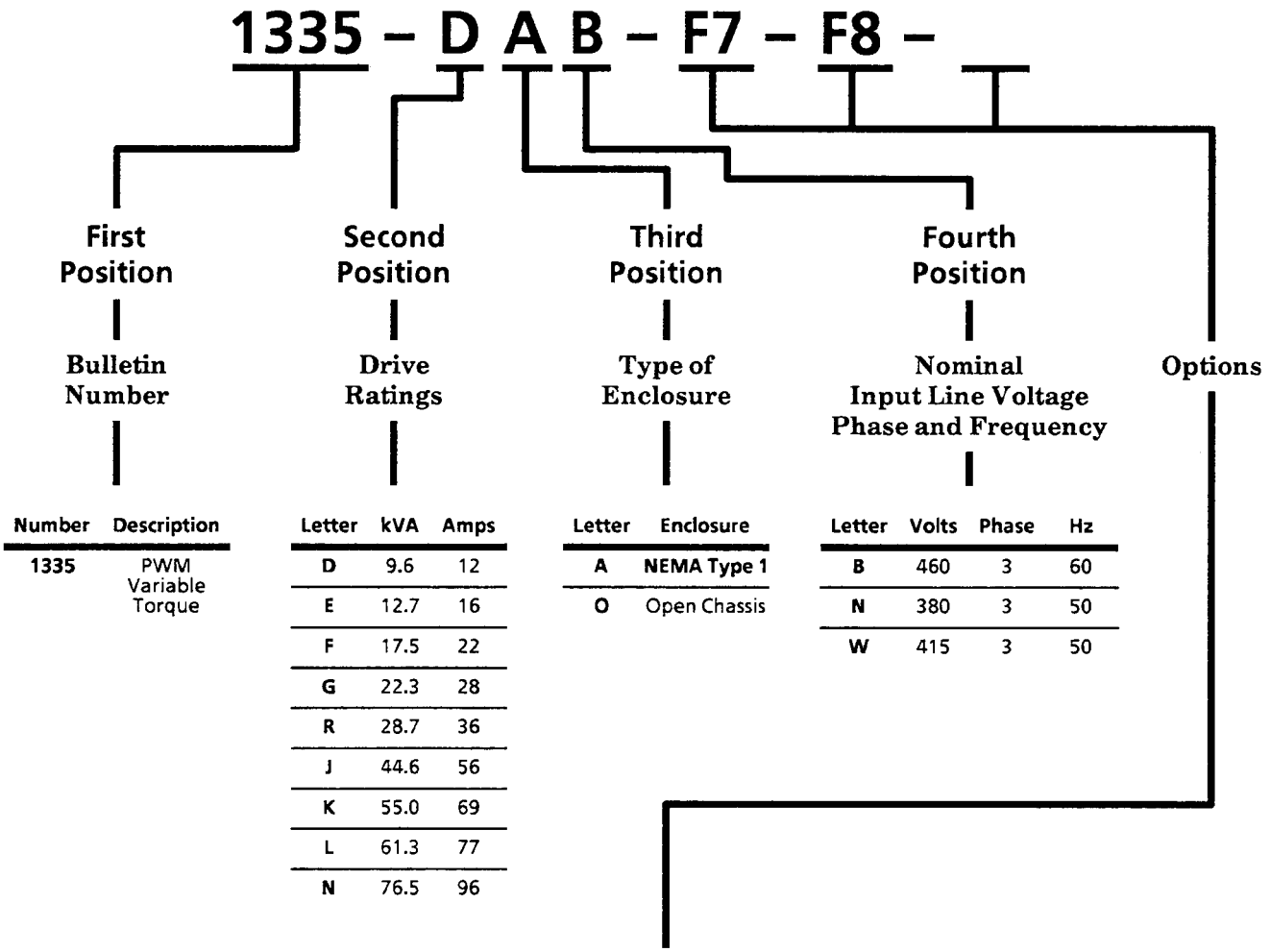
This assembly may contain ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed when testing, servicing or repairing this assembly. 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 1335 Variable Torque AC Drives. The catalog number for your Drive can be found both on the packing carton and the Drive nameplate.



Number	Description
1335	PWM Variable Torque

Letter	kVA	Amps
D	9.6	12
E	12.7	16
F	17.5	22
G	22.3	28
R	28.7	36
J	44.6	56
K	55.0	69
L	61.3	77
N	76.5	96

Letter	Enclosure
A	NEMA Type 1
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 1335 460V Specifications

3.0 Specification Table

The following table lists all specifications for Bulletin 1335 Variable Torque AC Drives. All Bulletin 1335 Drives are U.L. listed. All Bulletin 1335 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 1335 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 1335 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 Number	1335-D_B	1335-E_B
Model and Ratings 12 & 16 Amp	Output Amps	**12.0**	**16.0**
	Output Voltage	0-460	0-460
	Output kVA	9.6	12.7
	Input Amps	10.5	14.0
	Input Voltage	**460**	**460**
	Input kVA	8.4	11.2
	Output Frequency	0-200	0-200
	Input Frequency	60	60

	Model Number	1335-F_B	1335-G_B	1335-R_B
Model and Ratings 22, 28 & 36 Amp	Output Amps	**22.0**	**28.0**	**36.0**
	Output Voltage	0-460	0-460	0-460
	Output kVA	17.5	22.3	28.7
	Input Amps	19.3	25.3	33.6
	Input Voltage	**460**	**460**	**460**
	Input kVA	15.4	20.2	26.8
	Output Frequency	0-200	0-200	0-200
	Input Frequency	60	60	60

3.0
Specification Table
(continued)

Model and Ratings 56 & 69 Amp	Model Number	1335-J_B	1335-K_B
	Output Amps	**56.0**	**69.0**
	Output Voltage	0-460	0-460
	Output kVA	44.6	55.0
	Input Amps	52.4	63.5
	Input Voltage	**460**	**460**
	Input kVA	41.7	50.6
	Output Frequency	0-200	0-200
	Input Frequency	60	60

Model and Ratings 77 & 96 Amp	Model Number	1335-L_B	1335-N_B
	Output Amps	**77.0**	**96.0**
	Output Voltage	0-460	0-460
	Output kVA	61.3	76.5
	Input Amps	70.8	88.2
	Input Voltage	**460**	**460**
	Input kVA	56.4	70.3
	Output Frequency	0-200	0-200
	Input Frequency	60	60

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	Standard 90V AC Drive Supply (Customer 120V AC External Supply Allowed)
	Overload Capability	110% (Nominal) of Rated Drive Output Current for 60 Seconds

3.0
Specification Table
(continued)

Standard Controls and Adjustments	① Volts-per-Hertz Selection	3.8V/Hz or 7.6V/Hz (Standard)
	DC Boost	0-34 Volts
	Minimum Speed Pot Setting	0-40Hz
	Maximum Speed Pot Setting	40-200Hz
	② 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	Coast-to-Stop
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
	Overload	Allows Drive to "Ride-Thru" Nominal 110% 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 (180% 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 180% (Nominal) of Rated Drive Output Current
	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 (22 through 96 Amp Units Only)

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

② 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 BCD Interface Card (option G4) is used.

3.0
Specification Table
(continued)

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
Enclosure	Open Chassis	Available for All Ratings
	NEMA Type 1	Available for All Ratings

		UNIT	DRIVE EFFICIENCY	① DRIVE POWER FACTOR
Efficiency	Minimum Efficiency & Input Power Factor at 60 Hz, Full-Load	12 Amp	94%	.90 kW/kVA
		16 Amp	95%	.92 kW/kVA
		22 Amp	96%	.91 kW/kVA
		28 Amp	96%	.92 kW/kVA
		36 Amp	95%	.91 kW/kVA
		56 Amp	96%	.92 kW/kVA
		69 Amp	96%	.92 kW/kVA
		77 Amp	94%	.93 kW/kVA
		96 Amp	94%	.94 kW/kVA

① Drive displacement angle power factor is 0.95 to 0.97 constant. Listed values are displacement plus distortion power factor (kW/kVA).

Chapter

4

Bulletin 1335 Installation Procedures

4.0 General Environmental Requirements

The Bulletin 1335 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 Type 1 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 — *A NEMA Type 12 rating may not be maintained if this method is used for Drives with an option mounting panel.*

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 56 through 96 Amp 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 1335 Drives with both the Drive chassis and heatsink inside the enclosure is shown in **table 4.1.1**.

Do not include the bottom surface area of the enclosure.

Do not include the back surface area of the enclosure if the enclosure is closer than (6) inches to a wall or other surface.

Do not use more than one-half of the top surface area. Dust and debris accumulating on the top surface over time reduces the ability of the top surface to dissipate heat.

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.

FULL LOAD OUTPUT AMPS	VOLTS	WATTS DISSIPATED	BTUs/HR DISSIPATED
12	460	440	1,502
16	460	490	1,673
22	460	560	1,911
28	460	740	2,526
36	460	1,205	4,113
56	460	1,520	5,188
69	460	1,850	6,315
77	460	3,150	10,752
96	460	4,010	13,687

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.

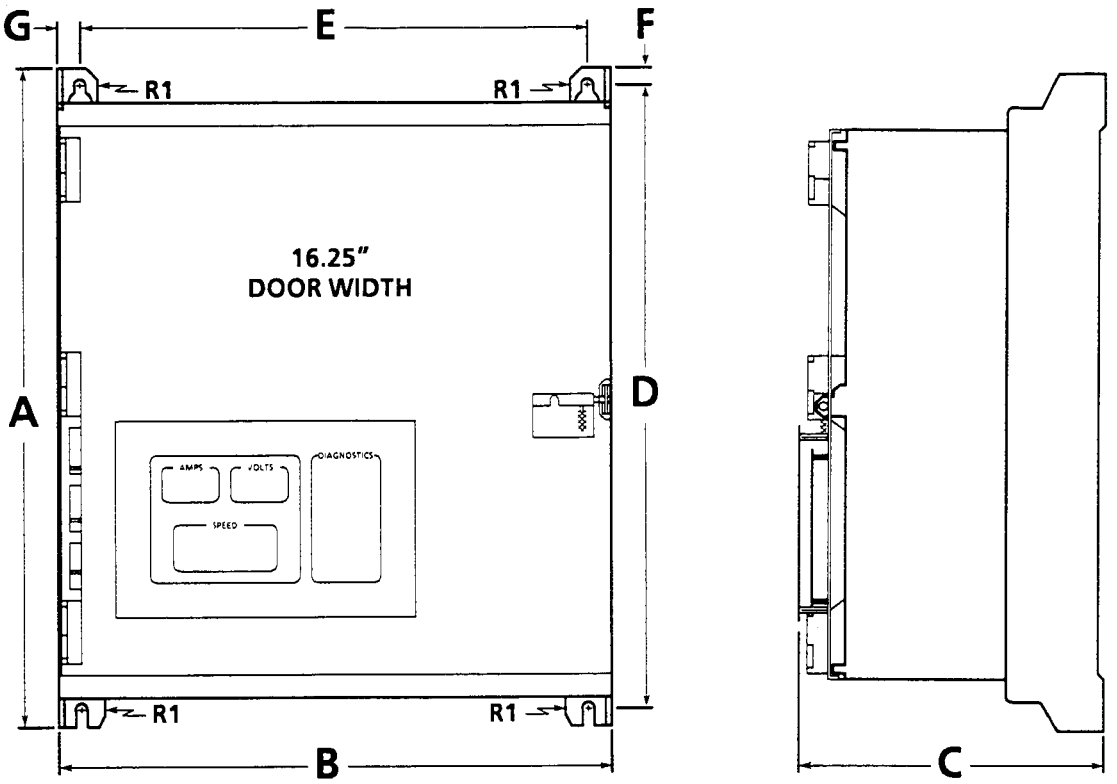
FULL LOAD OUTPUT AMPS	VOLTS	WATTS DISSIPATED	BTUs/HR DISSIPATED
12	460	140	478
16	460	150	512
22	460	160	546
28	460	240	819
36	460	355	1,212
56	460	470	1,605
69	460	550	1,878
77	460	1,650	5,634
96	460	2,160	7,375

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

4.2
Dimensions & Weights

12 & 16 Amp Open Chassis
(WITHOUT OPTION MOUNTING PANEL)

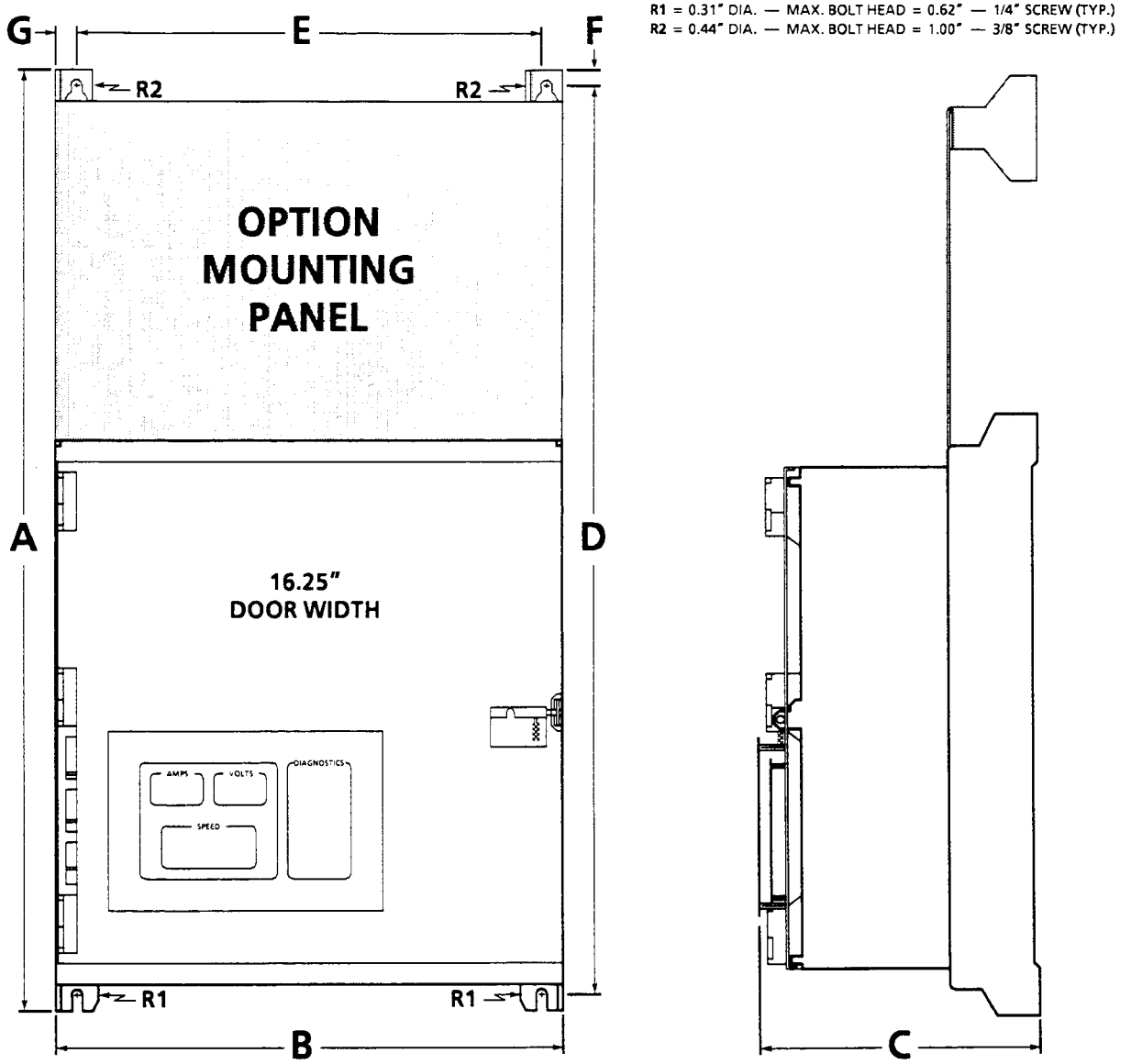
DOB & EOB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)



MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)							WEIGHTS IN POUNDS AND (KILOGRAMS)	
								WITHOUT OPTION MOUNTING PANEL OR OPTIONS	
	A	B	C	D	E	F	G	SHIPPING	MOUNTING
DOB EOB	20.00 (508.0)	17.50 (444.5)	11.56 (293.6)	19.00 (482.6)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	80.00 (36.3)	60.00 (27.2)

4.2
Dimensions & Weights
(continued)

12 & 16 Amp Open Chassis
(WITH OPTION MOUNTING PANEL)



MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)							WEIGHTS IN POUNDS AND (KILOGRAMS)	
								WITH OPTION MOUNTING PANEL AND OPTIONS	
	A	B	C	D	E	F	G	SHIPPING	MOUNTING
DOB EOB	31.12 (790.4)	17.50 (444.5)	11.56 (293.6)	30.12 (765.0)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	94.00 (42.6)	74.00 (33.6)

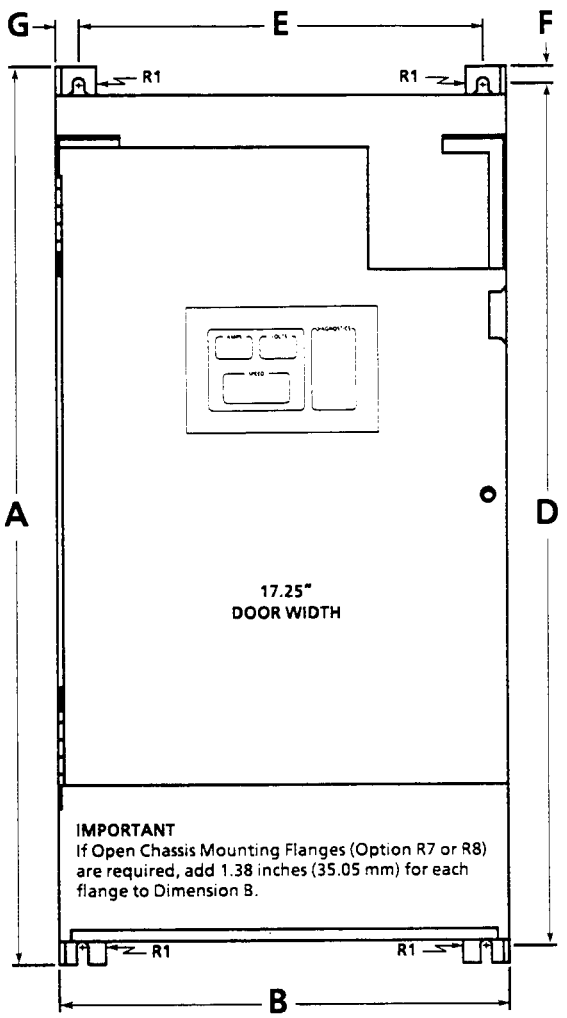
4.2
Dimensions & Weights
(continued)

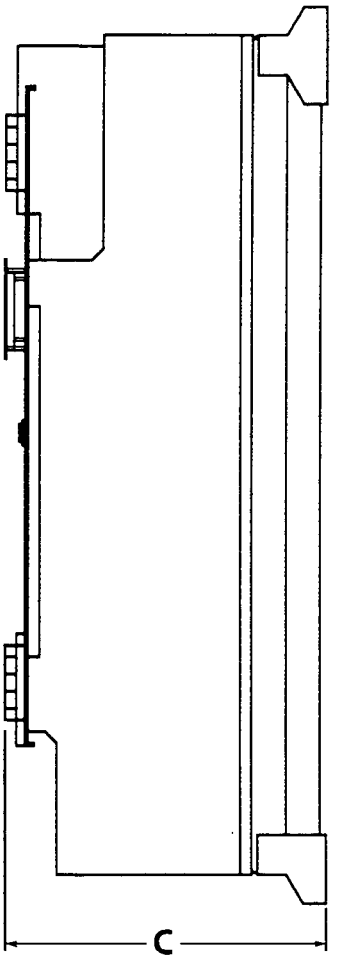
22-96 Amp Open Chassis
(WITHOUT OPTION MOUNTING PANEL)

ROB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)

FOB & GOB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)

JOB, KOB, LOB & NOB MOUNTING BOLTS
R1 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)





MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)							WEIGHTS IN POUNDS AND (KILOGRAMS) WITHOUT OPTION MOUNTING PANEL OR OPTIONS	
	A	B	C	D	E	F	G	SHIPPING	MOUNTING
FOB	38.00 (965.2)	17.50 (444.5)	13.06 (331.7)	37.00 (939.8)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	165.00 (74.8)	143.00 (64.9)
GOB								168.00 (76.2)	146.00 (66.2)
ROB	38.00 (965.2)	17.50 (444.5)	13.56 (344.4)	37.00 (939.8)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	199.00 (90.2)	177.00 (80.3)
JOB	50.00 (1,270.0)	17.50 (444.5)	13.88 (352.6)	49.00 (1,244.6)	16.00 (406.4)	0.50 (12.7)	0.75 (19.1)	333.00 (151.0)	208.00 (94.3)
KOB								335.00 (151.9)	210.00 (95.2)
LOB								340.00 (154.2)	215.00 (97.5)
NOB								345.00 (156.5)	220.00 (99.8)

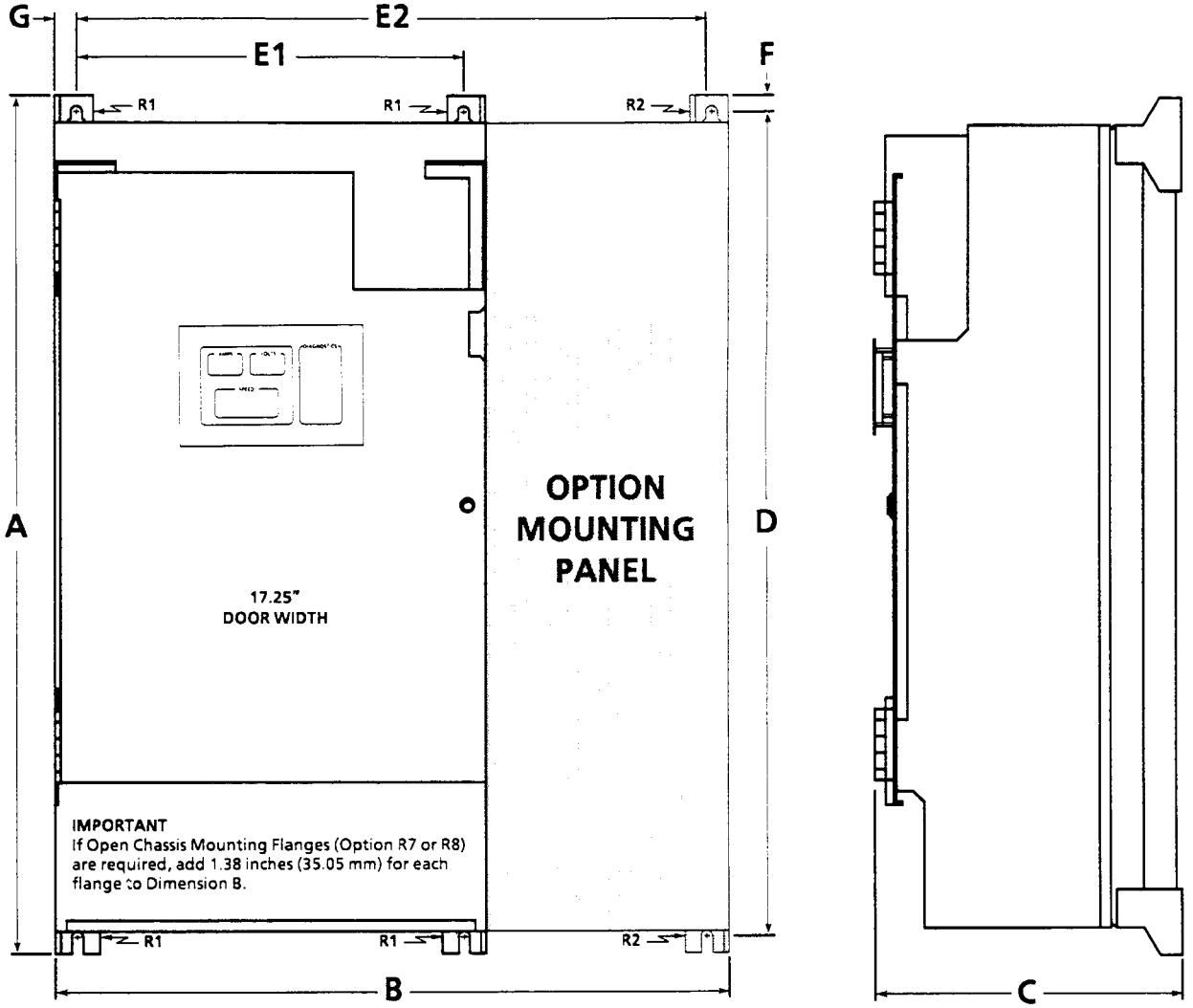
4.2
Dimensions & Weights
(continued)

22-96 Amp Open Chassis
(WITH OPTION MOUNTING PANEL)

FOB & GOB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)

ROB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)

JOB, KOB, LOB & NOB MOUNTING BOLTS
R1 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)

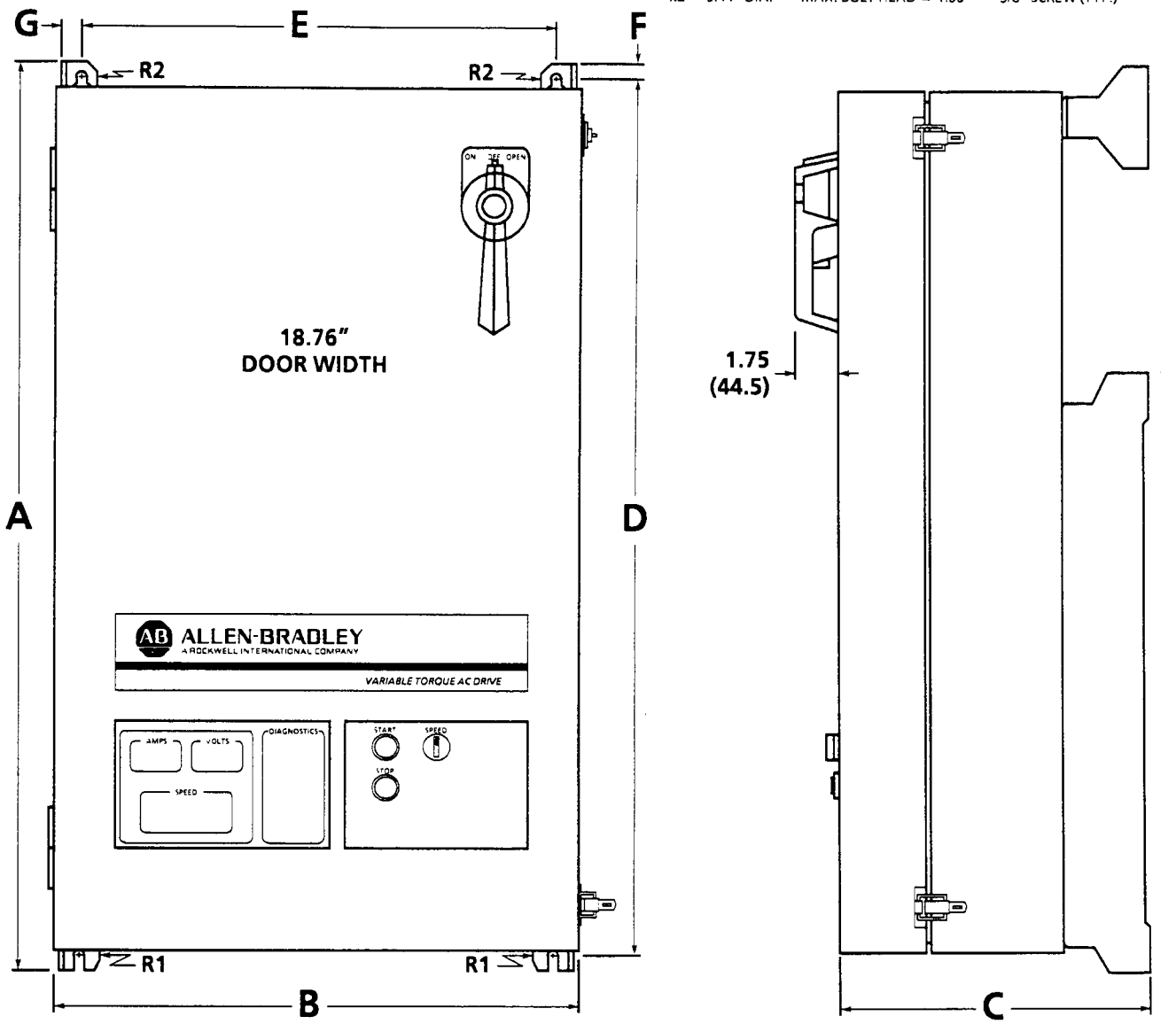


MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)								WEIGHTS IN POUNDS AND (KILOGRAMS) WITH OPTION MOUNTING PANEL AND OPTIONS	
	A	B	C	D	E1	E2	F	G	SHIPPING	MOUNTING
FOB	38.00 (965.2)	27.62 (701.5)	13.06 (331.7)	37.00 (939.8)	16.00 (406.4)	26.12 (663.4)	0.50 (12.7)	0.75 (19.1)	177.00 (80.3)	153.00 (69.4)
GOB									188.00 (85.3)	166.00 (75.3)
ROB	38.00 (965.2)	27.62 (701.5)	13.56 (344.4)	37.00 (939.8)	16.00 (406.4)	26.12 (663.4)	0.50 (12.7)	0.75 (19.1)	225.00 (102.1)	203.00 (92.1)
JOB	50.00 (1,270.0)	31.12 (790.4)	13.88 (352.6)	49.00 (1,244.6)	16.00 (406.4)	29.38 (746.3)	0.50 (12.7)	0.75 (19.1)	365.00 (165.5)	240.00 (108.9)
KOB									367.00 (166.6)	242.00 (109.8)
LOB									370.00 (167.8)	245.00 (111.1)
NOB									375.00 (170.1)	250.00 (113.4)

4.2
Dimensions & Weights
(continued)

12 & 16 Amp NEMA Type 1

DAB & EAB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)



MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)							WEIGHTS IN POUNDS AND (KILOGRAMS)			
								WITHOUT OPTIONS		WITH OPTIONS	
	A	B	C	D	E	F	G	SHIPPING	MOUNTING	SHIPPING	MOUNTING
DAB EAB	31.12 (790.4)	18.38 (466.9)	13.00 (330.2)	30.12 (765.0)	16.00 (406.4)	0.50 (12.7)	1.19 (30.2)	120.00 (54.4)	100.00 (45.4)	135.00 (61.2)	115.00 (52.2)

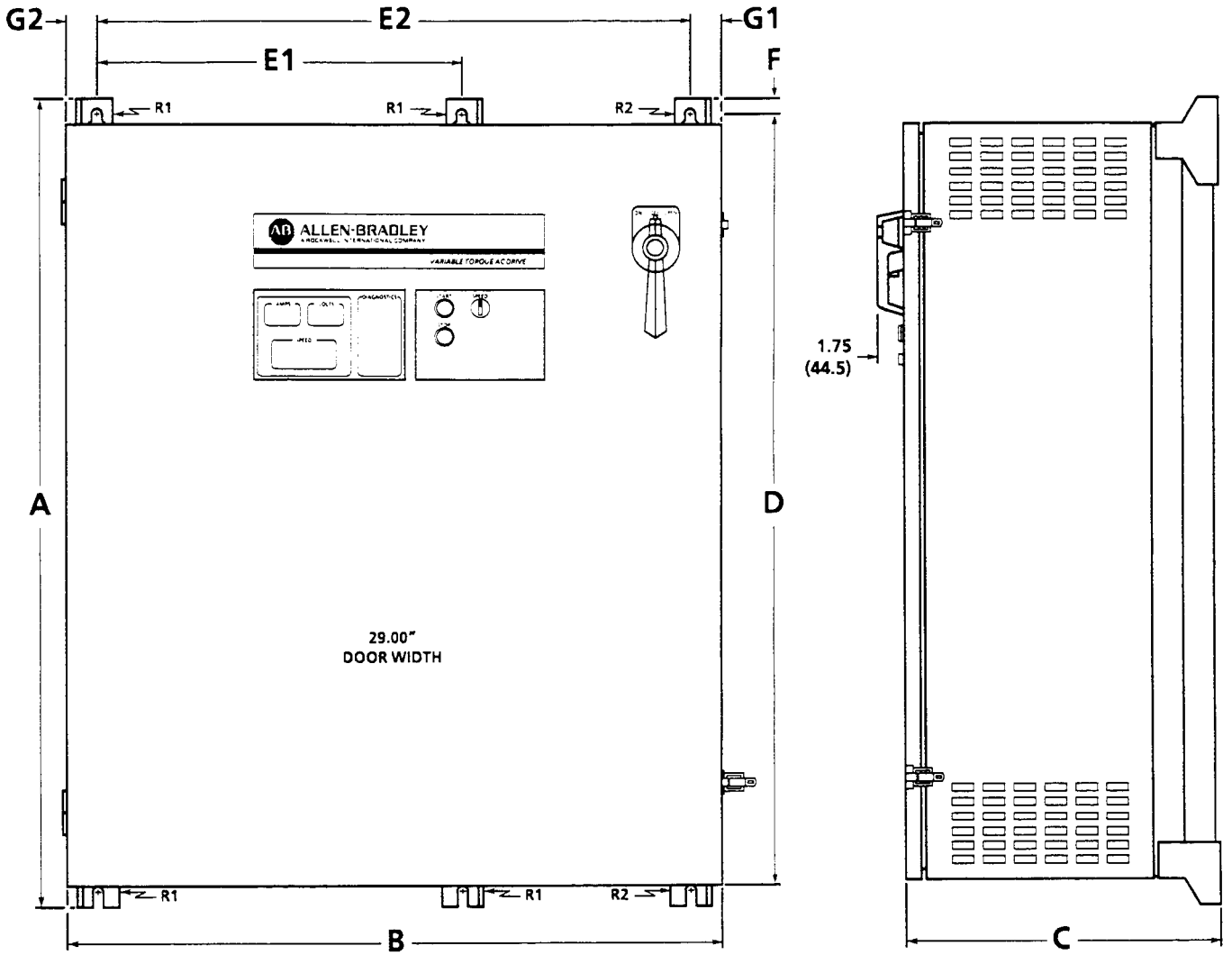
4.2
Dimensions & Weights
(continued)

22-96 Amp NEMA Type 1

RAB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)

FAB & GAB MOUNTING BOLTS
R1 = 0.31" DIA. — MAX. BOLT HEAD = 0.62" — 1/4" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)

JAB, KAB, LAB & NAB MOUNTING BOLTS
R1 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)
R2 = 0.44" DIA. — MAX. BOLT HEAD = 1.00" — 3/8" SCREW (TYP.)



MODEL	DIMENSIONS IN INCHES AND (MILLIMETERS)									WEIGHTS IN POUNDS AND (KILOGRAMS)			
										WITHOUT OPTIONS		WITH OPTIONS	
	A	B	C	D	E1	E2	F	G1	G2	SHIPPING	MOUNTING	SHIPPING	MOUNTING
FAB	38.00 (965.2)	29.00 (736.6)	15.12 (384.0)	37.00 (939.8)	16.00 (406.4)	26.12 (663.4)	0.50 (12.7)	0.75 (19.1)	2.12 (53.8)	237.00 (107.5)	215.00 (97.5)	247.00 (112.0)	225.00 (102.1)
GAB										242.00 (109.8)	220.00 (99.8)	262.00 (118.8)	240.00 (108.9)
RAB	38.00 (965.2)	29.00 (736.6)	15.62 (396.7)	37.00 (939.8)	16.00 (406.4)	26.12 (663.4)	0.50 (12.7)	0.75 (19.1)	2.12 (53.8)	272.00 (123.4)	250.00 (113.4)	302.00 (137.0)	275.00 (124.7)
JAB	50.00 (1,270.0)	32.50 (825.50)	15.62 (396.7)	49.00 (1,244.6)	16.00 (406.4)	29.38 (746.3)	0.50 (12.7)	0.75 (19.1)	2.38 (60.5)	500.00 (226.8)	375.00 (170.1)	525.00 (238.1)	400.00 (181.4)
KAB										512.00 (232.2)	387.00 (175.5)	542.00 (245.8)	417.00 (189.2)
LAB										517.00 (234.5)	392.00 (177.8)	548.00 (248.6)	423.00 (191.9)
NAB										522.00 (236.8)	397.00 (180.1)	553.00 (250.8)	428.00 (194.1)

4.3 General Wiring Practices

Depending on the Drive model number ordered, the Bulletin 1335 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 1335 Drive. Input power wiring, output power wiring, control wiring, and conduit should 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 1335 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 1335 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 1335 Motor Overload Relay, Option T14 through T22.

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

4.3.1 Emergency STOP

CAUTION

The START/STOP control circuitry in the Bulletin 1335 Drive includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hard wired emergency 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 an emergency 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.

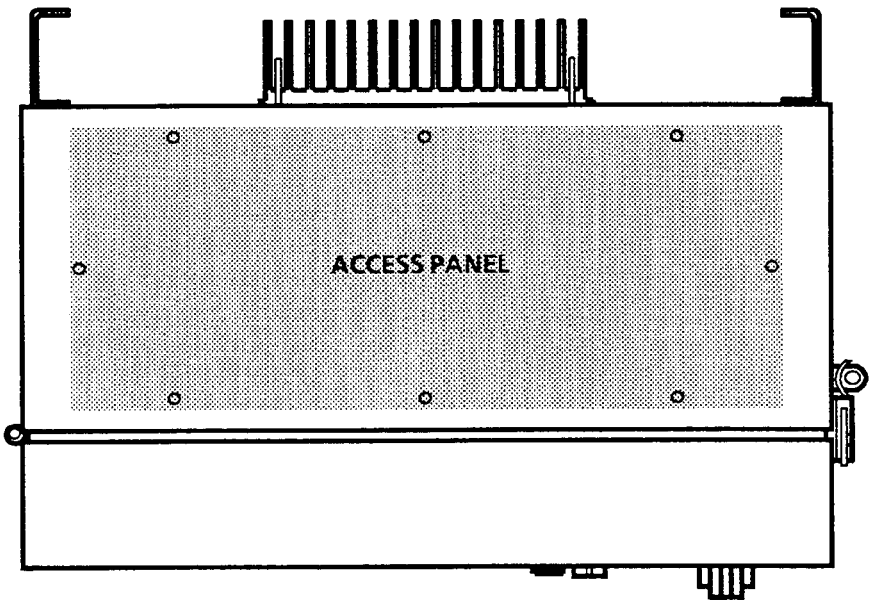
After an emergency stop has been initiated, allow at least (5) seconds to elapse before reapplying AC input power to the Drive. The allowable number of emergency start/stops are (5) cycles of (3) starts per minute at (20) second intervals. Wait (5) minutes before attempting the next (5) cycles.

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 1335 must be made through the access panel at the top of the Drive enclosure. Prior to drilling through the access panel, it is recommended that the panel be removed to protect the Drive components from falling metal chips.



(top view)

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.

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 1335 Drive. The standard Bulletin 1335 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 1335 Drives have two ground lugs labeled **GND** provided at the top of the Drive back panel. To guard against equipment damage or injury to personnel, 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, Drives Distributor, or Sales Office.

IMPORTANT

The Bulletin 1335 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, Drives Distributor, or Sales Office.

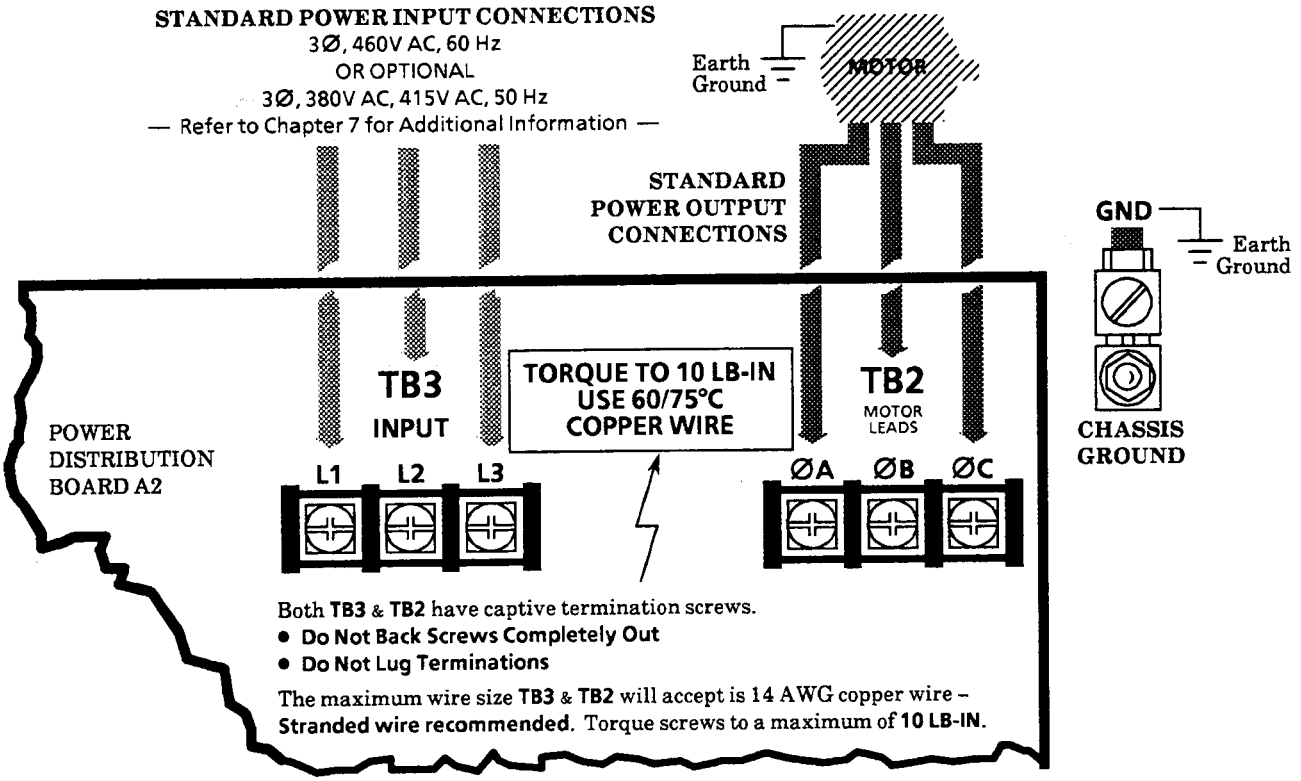


figure 4.3.3a – Bulletin 1335 12 & 16 Amp Power Input & Output Connections

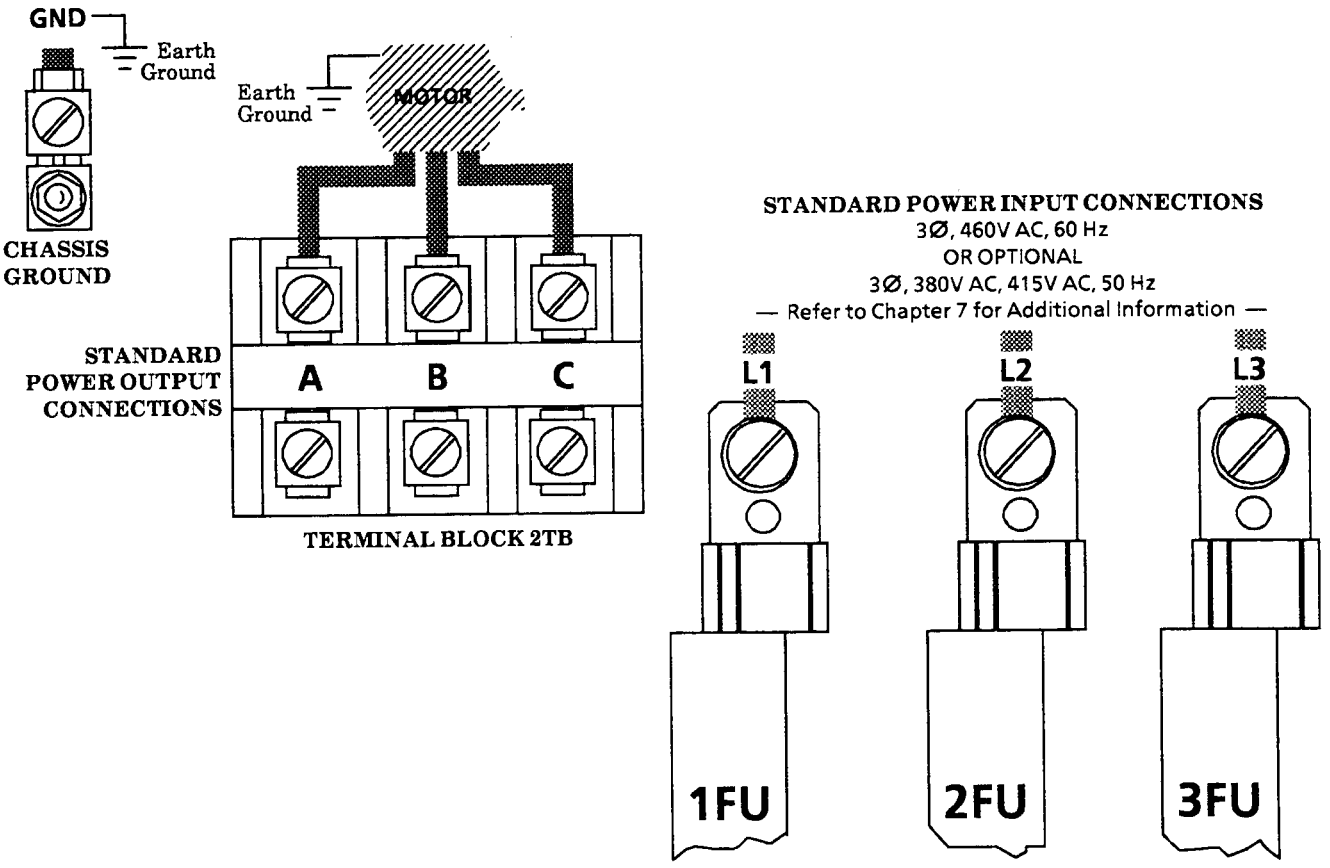


figure 4.3.3b – Bulletin 1335 22-96 Amp Power Input & Output Connections

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 1335 Drive. The standard Bulletin 1335 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 (12 & 16 Amp Drives) and 1TB (22-96 Amp 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.

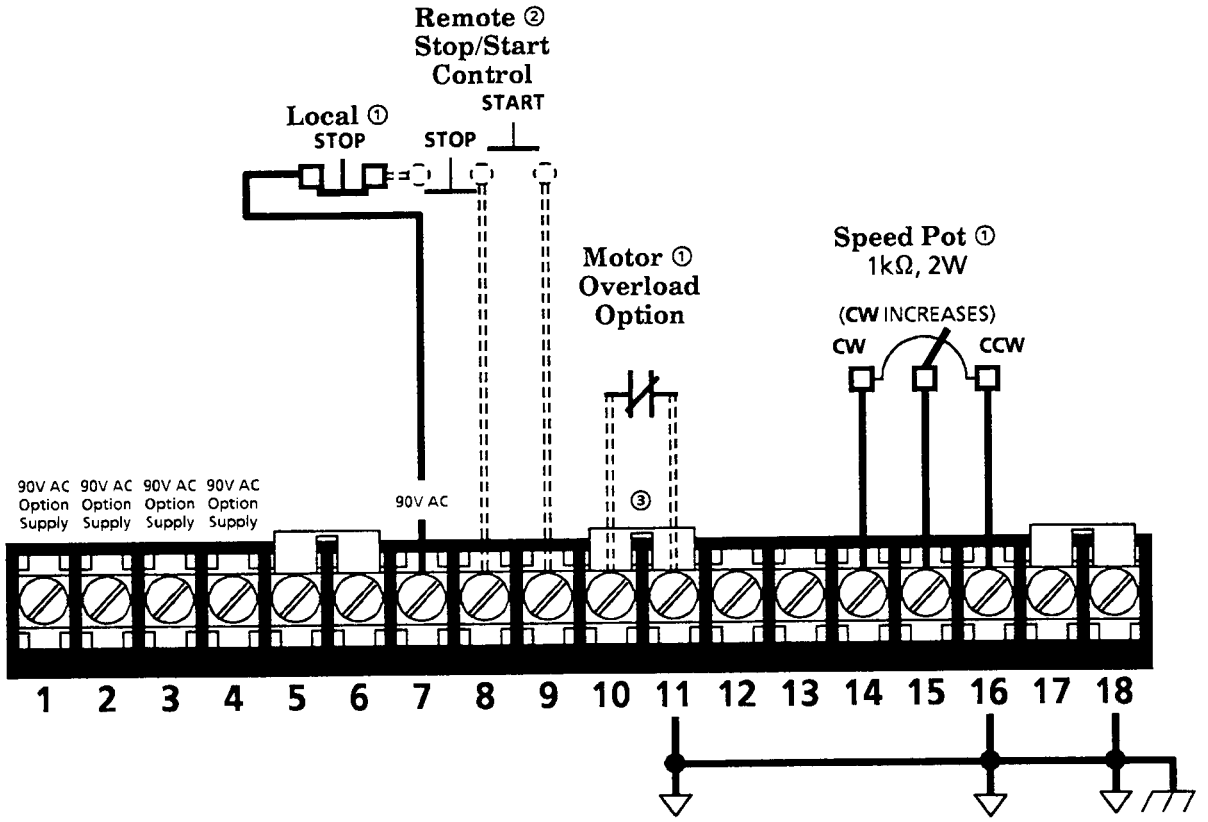
4.4.2 Terminal Block TB1 12 & 16 Amp Standard Interconnection Diagram

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 From Terminals 8 & 9 and Remove the START Pushbutton

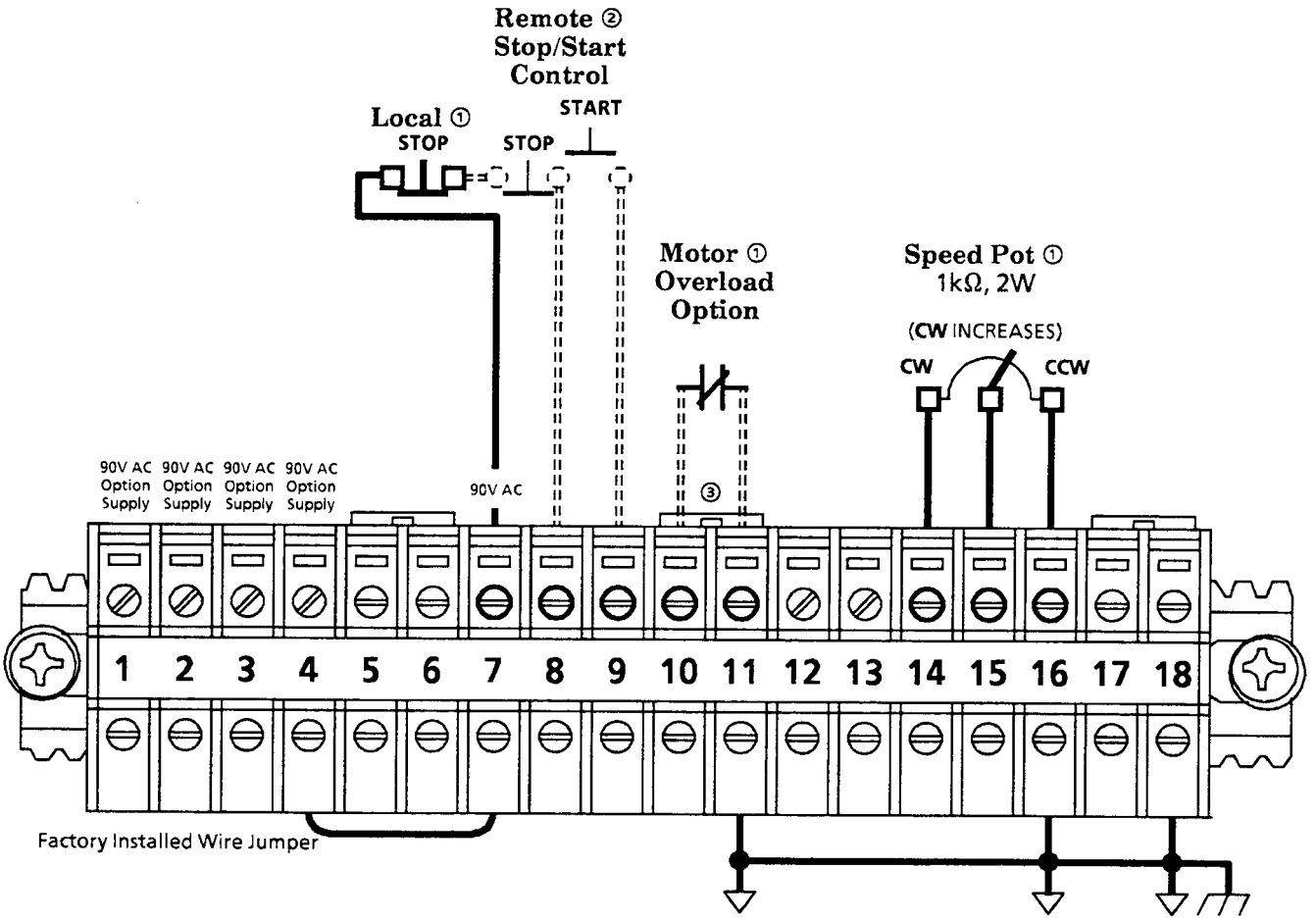
– Install a Closing Plug and Remove or Cover the START Legend

③ Remove Jumper When Connecting Option

⏚ Drive Common

⏚ Chassis Ground

4.4.3
Terminal Block 1TB
22-96 Amp 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

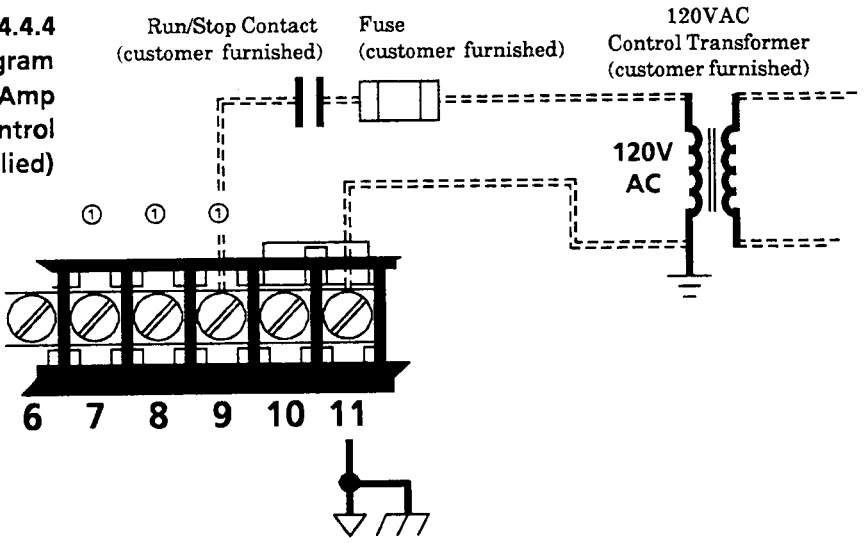
- Disconnect Existing START Pushbutton Wires From Terminals 8 & 9 and Remove the START Pushbutton
- Install a Closing Plug and Remove or Cover the START Legend

③ Remove Jumper When Connecting Option

⏚ Drive Common

⏚ Chassis Ground

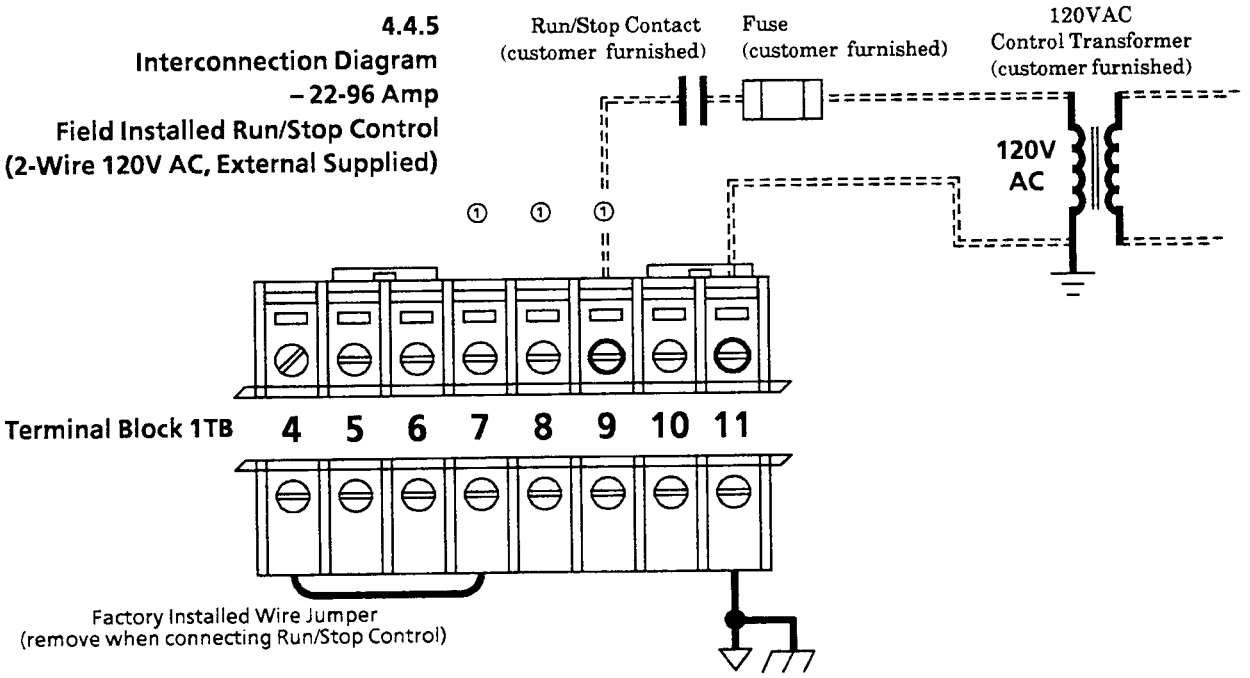
4.4.4 Interconnection Diagram – 12 & 16 Amp Field Installed Run/Stop Control (2-Wire 120V AC, External Supplied)



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 Closing Plugs and Remove or Cover Both the START & STOP Legends

⏚ Drive Common
⏚ Chassis Ground
⏚ Earth Ground

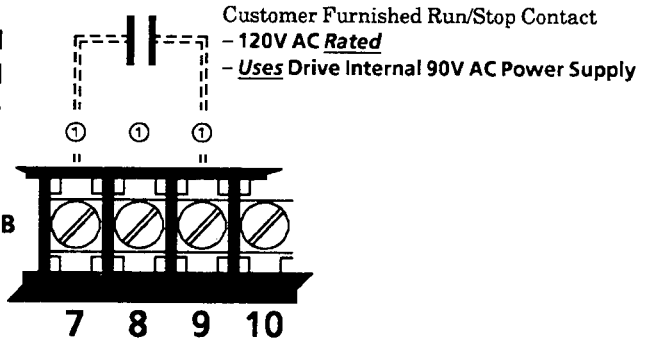
4.4.5 Interconnection Diagram – 22-96 Amp Field Installed Run/Stop Control (2-Wire 120V AC, External Supplied)



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 Closing Plugs and Remove or Cover Both the START & STOP Legends

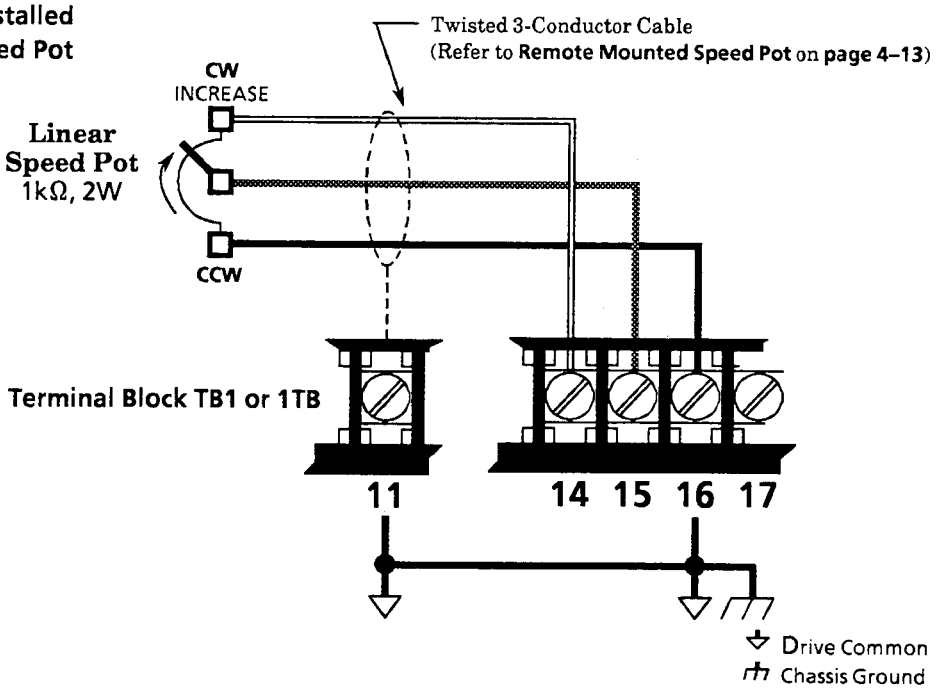
⏚ Drive Common
⏚ Chassis Ground
⏚ Earth Ground

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

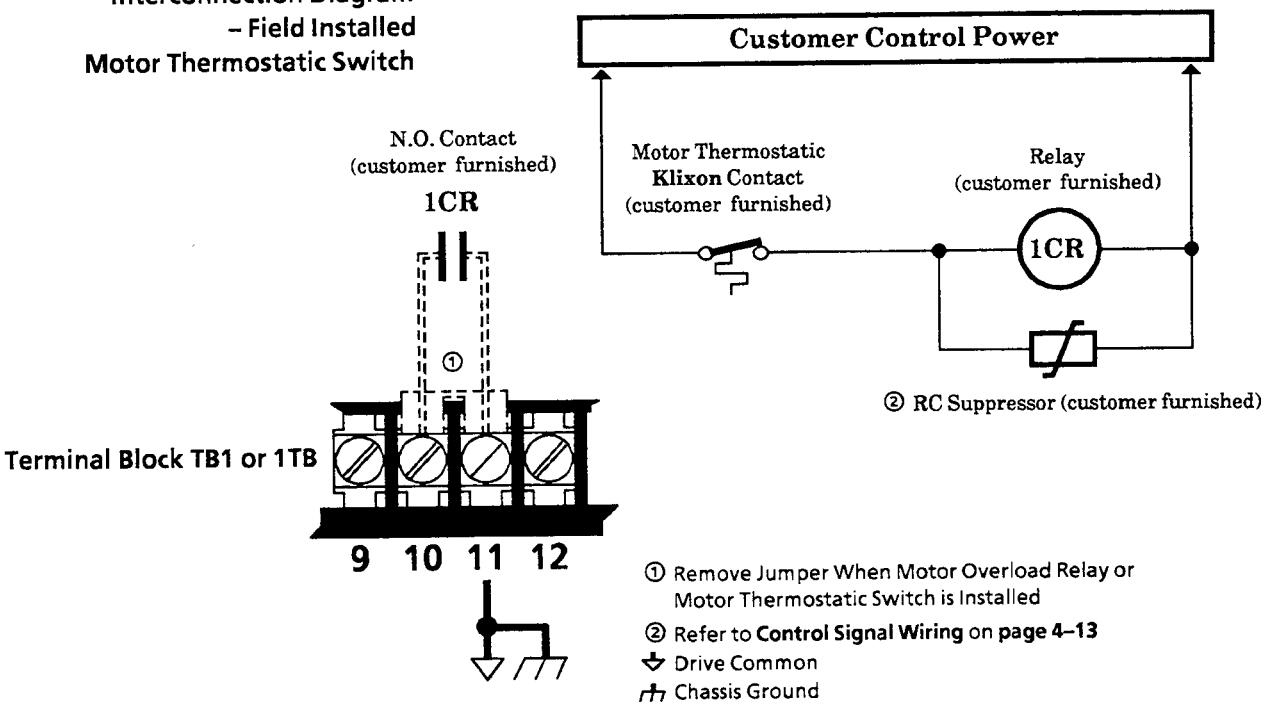


① When Using This Control Scheme, If Drive Has Factory Installed START/STOP Pushbuttons
– Disconnect Existing START/STOP Wires From Terms. 7, 8 & 9 and Remove Both the START & STOP Pushbuttons
– Install Closing Plugs and Remove or Cover Both the START & STOP Legends

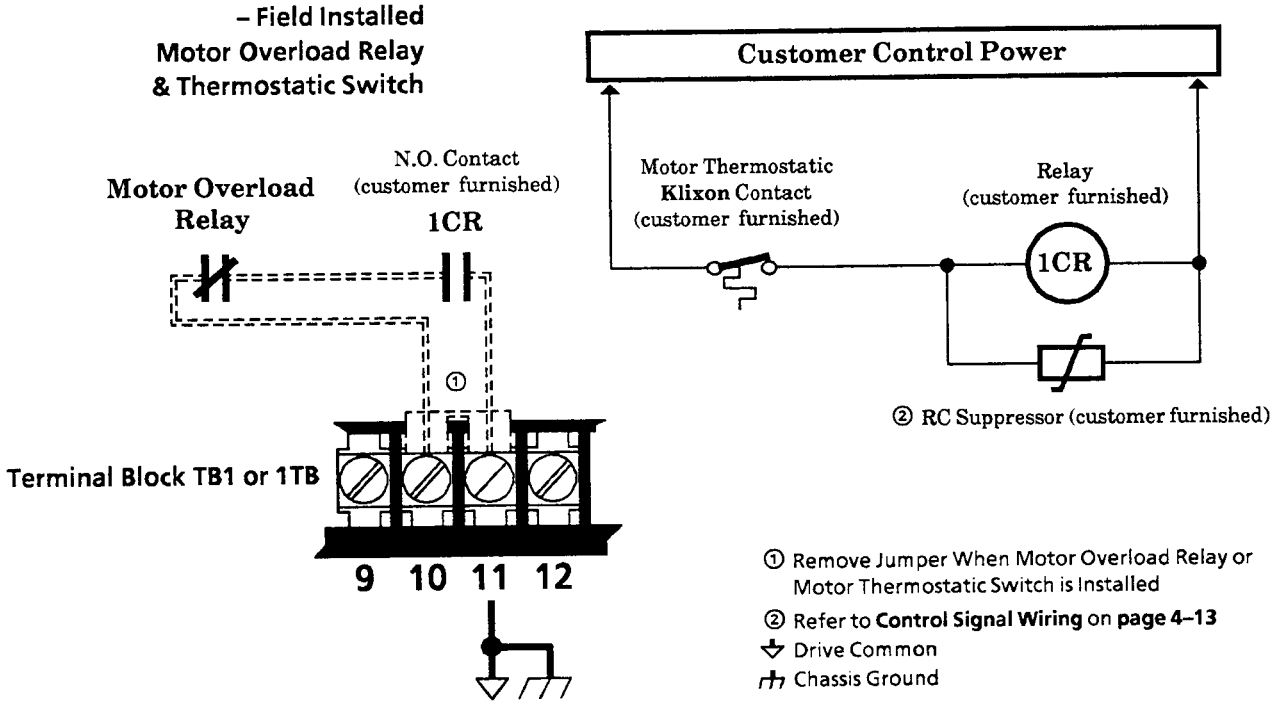
4.4.7 Interconnection Diagram – Field Installed Remote Mounted Speed Pot



4.4.8 Interconnection Diagram – Field Installed Motor Thermostatic Switch



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



Chapter

5

Bulletin 1335 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, C** or **D**. Refer to the **Diagnostic Display Panel** for your Drive in **Appendix E, F, G** or **H** 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 failure of 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 12 & 16 Amp Drives if neon light **DS1** on Power Distribution Board A2 is lit, hazardous voltages are present in the Drive cabinet.

For 22-96 Amp Drives if neon light **DS1** on Bus Indicator Board A41 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 and wait (60) Seconds To Ensure That DS1 Is Not Lit Before Servicing

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 1335 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 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.

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

That the **Speed Pot** or speed reference is set to **MINIMUM** (fully CCW).

That any **AUTO/OFF/MAN** or **AUTO/MAN** switches are set to **MAN**.

That the **DRIVE/OFF/BYPASS** switch if installed is set to **DRIVE**.

That the motor is uncoupled from its mechanical load.

IMPORTANT

Drive Fault Trips

Before resetting any fault trip refer to the Bulletin 1335 Troubleshooting Appendix for your Drive — **E, F, G** or **H** — 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 Drive is equipped with an **AUTO/OFF/MAN** switch, set the switch to **MAN**.
- If the BCD Interface or Isolated Signal Conditioner Card is installed, ensure that the card mounted **AUTO/MAN** switch is set to **MAN**.

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 12 & 16 Amp Drives, **DS1** the "bus charged" light on Power Distribution Board A2 should light.

For 22-96 Amp Drives, **DS1** the "bus indicator" light on Bus Indicator Board A41 should light.

Step 3 **If the Drive is equipped with Manual Bypass Control, AC line phase must be established for correct motor rotation when in drive and bypass.**

Set the **DRIVE/OFF/BYPASS** switch or customer supplied control to **DRIVE**. Set the speed pot or speed reference to 10% speed. Check motor rotation by pressing the **START** pushbutton, then the **STOP** pushbutton as the motor just begins to rotate.

5.1 Initial Operation (continued)

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. Reverse direction by switching any two motor leads at **101TB** on the Option Mounting Panel.

Set the **DRIVE/OFF/BYPASS** switch or customer supplied control to **BYPASS**. Check motor rotation by pressing the **START** pushbutton, then the **STOP** pushbutton as the motor just begins to rotate.

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. Reverse direction by switching any two of the AC line input leads at the Drive disconnect device.

Step 4 **If the Drive is not equipped with Manual Bypass Control**, set the speed pot or speed reference to 10% speed. Check for correct motor rotation by pressing the **START** pushbutton, then the **STOP** pushbutton as the motor just begins to rotate.

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:

101TB if the Options Mounting Panel Is Installed

For 12 & 16 Amp Drives, TB2 if the Options Mounting Panel Is Not Installed

For 22-96 Amp Drives, 2TB if the Options Mounting Panel Is Not Installed

Once Correct Rotation Has Been Established

Step 1 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 2 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. Should the Drive trip, refer to **Appendix E, F, G or H, Bulletin 1335 Troubleshooting,** before resetting the Drive.

Step 3 Press the **STOP** pushbutton. Restart the Drive and check the motor current at several different speed settings. Currents above the motor rated full load current may seriously damage the motor windings if they are permitted to flow continuously for approximately (1) minute. If required, refer to **Appendix E, F, G or H, Bulletin 1335 Troubleshooting.**

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 1335 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 1335
ADJUSTABLE FREQUENCY
MOTOR DRIVE
56L6
LISTED INDUSTRIAL
CONTROL EQUIPMENT

SERIAL NO . _____
CATALOG NO . 1335- _____

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

12 & 16 Amp Driver Board JUMPER SETTINGS

- ∩ **Overload Current Limit Threshold Adjustment**
  - **Jumpers S100 & S101** set for ___ A, position ___
  - **Jumpers S200 & S201** set for ___ A, position ___
  - **Jumpers S300 & S301** set for ___ A, position ___

22 & 28 Amp Driver Board JUMPER SETTINGS

- ∩ **Overload Current Limit Threshold Adjustment**
  - **A3A Jumpers S1 & S2** set for ___ A, position ___
  - **A3B Jumpers S1 & S2** set for ___ A, position ___
  - **A3C Jumpers S1 & S2** set for ___ A, position ___

Factory Installed Options

Customer Installed Options

5.3 Adjustment Procedures

Once initial operation has been verified and the Bulletin 1335 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 **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 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.

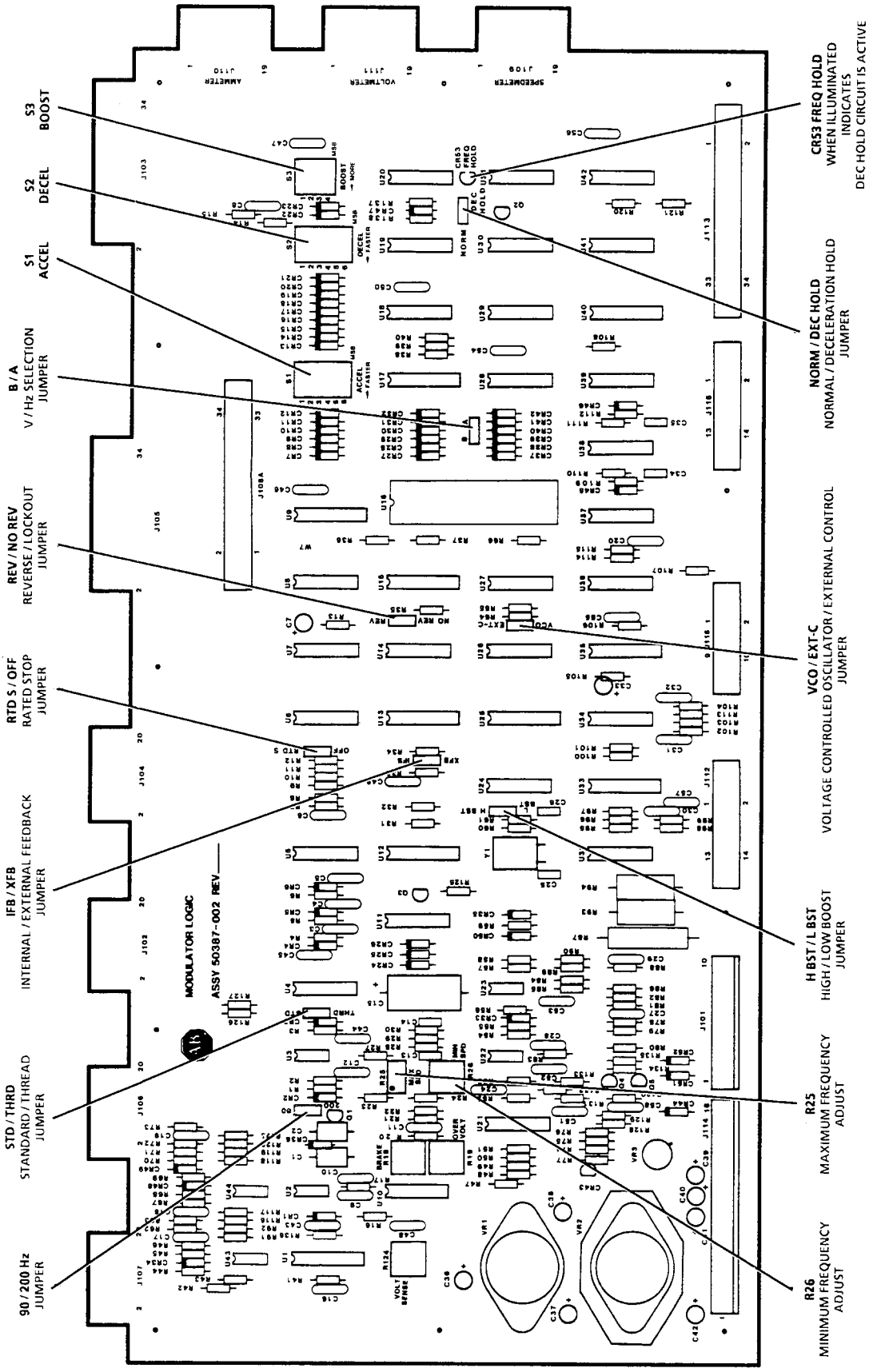


figure 5.3.1 – Modulator Board A1

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

Set to **STD** (standard) at the Factory. This jumper must always be set to the **STD** (standard) position to ensure correct Drive operation. Consult your nearest Allen-Bradley Sales/Support Office should the **THRD** position be required.

∩ IFB/XFB Jumper

Set to **IFB** at the Factory. This jumper must always be set to the **IFB** (internal feedback) position to ensure correct Drive frequency output. Consult your nearest Allen-Bradley Sales/Support Office should the **XFB** position be required.

∩ RTD S/OFF

Set to **OFF** at the Factory. This jumper must always be set to the **OFF** (coast-to-stop) position to ensure correct Drive operation. Consult your nearest Allen-Bradley Sales/Support Office should the **RTD S** position be required.

∩ REV/NO REV Jumper

Set to **NO REV** at the Factory. This jumper must always be set to the **NO REV** (no reverse) position to ensure correct Drive operation. Consult your nearest Allen-Bradley Sales/Support Office should the **REV** position be required.

∩ 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 **OVERLOAD**, 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, refer to **Appendix E, F, G** or **H, Bulletin 1335 Troubleshooting**, before resetting the Drive. Should the Drive trip again, consult your nearest Allen-Bradley Sales/Support Office for additional information.

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 **OVERLOAD** 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 **OVERLOAD** 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, Drives Distributor, or Sales Office for additional information.

5.3.3 Modulator Logic Board Switch Settings (continued)

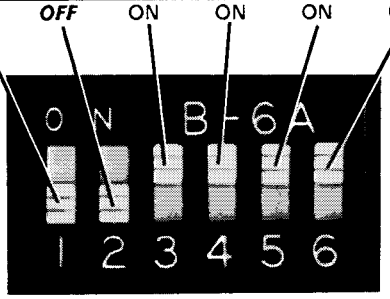
Setting The ACCEL and DECEL Rates

The rates shown below are accurate when a speed command from a 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



1	2	3	4	5	6	Hz/Sec
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

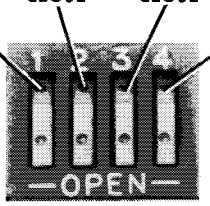
5.3.3 Modulator Logic Board Switch Settings (continued)

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.



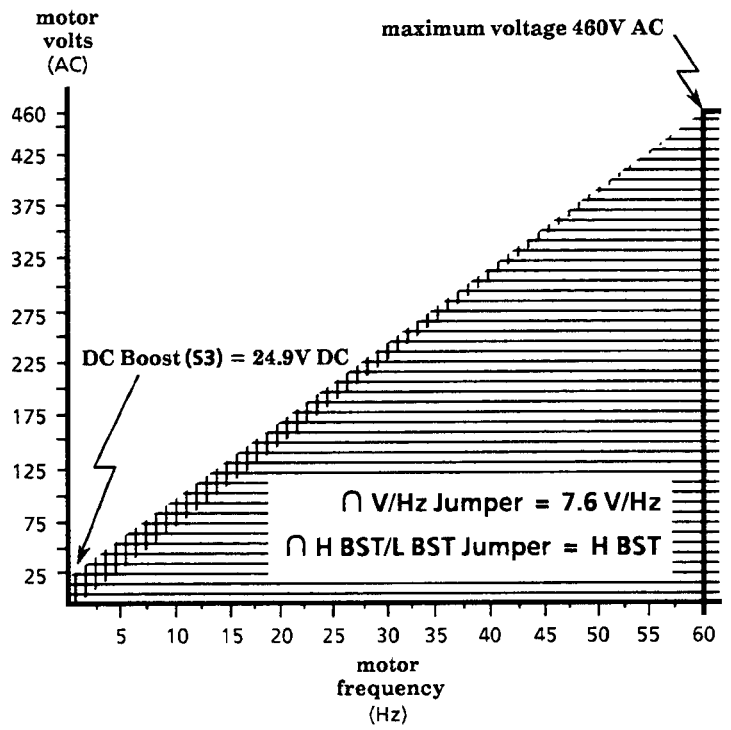
1	2	3	4	BOOST VOLTS L BST	BOOST VOLTS H BST
CLOSE	CLOSE	CLOSE	CLOSE	0	0
OPEN	CLOSE	CLOSE	CLOSE	1.33	2.27
CLOSE	***OPEN***	CLOSE	CLOSE	2.67	4.53
OPEN	***OPEN***	CLOSE	CLOSE	4.00	6.80
CLOSE	CLOSE	***OPEN***	CLOSE	5.33	9.07
OPEN	CLOSE	***OPEN***	CLOSE	6.67	11.33
CLOSE	***OPEN***	***OPEN***	CLOSE	8.00	13.60
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.

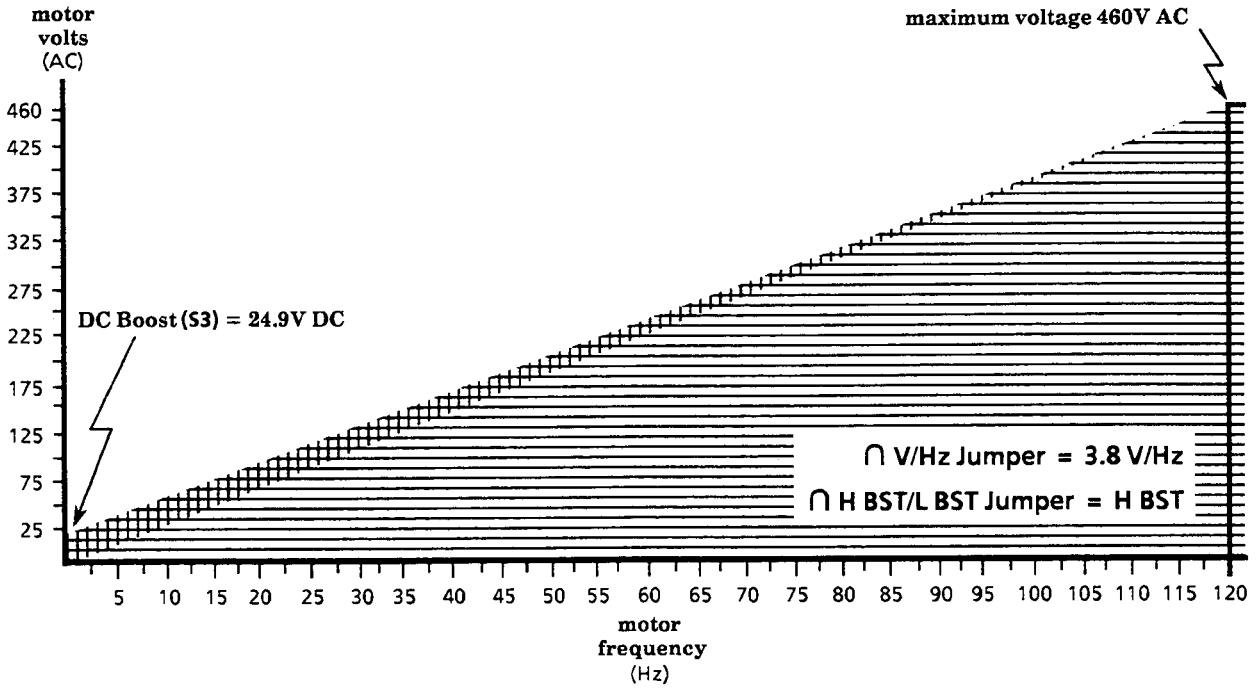
Too little boost will cause the motor to draw more in-phase current, while too much boost may increase the magnetizing current to the motor to the point of saturation. Generally, the best DC boost setting is the lowest value that will consistently start the load. Start with zero boost and increase the 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 **OVERLOAD** (current limit) 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, Drives Distributor, or Sales Office for application assistance.



5.3.4 Driver Board Jumper Settings

IMPORTANT

Driver Board Jumpers for 12-28 Amp ratings have been preset at the factory at the amp 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 1335 36-96 Amp Driver Boards, however 56-96 Amp Driver Board provide fuse status indication as described in **Appendix G** or **H**.

∩ 12 & 16 Amp Overload Current Limit 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 **OVERLOAD** (current limit) function becomes active.

All jumpers must be set to the same position as shown in **figure 5.3.4a** to correspond to either a 12 or 16 Amp Drive. For 12 Amp Drives, all jumpers on this board should be set to the "**A**" position. For 16 Amp Drives, all jumpers should be set to the "**B**" position.

∩ 22 & 28 Amp Overload Current Limit 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 **OVERLOAD** (current limit) 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 22 or 28 Amp Drive.

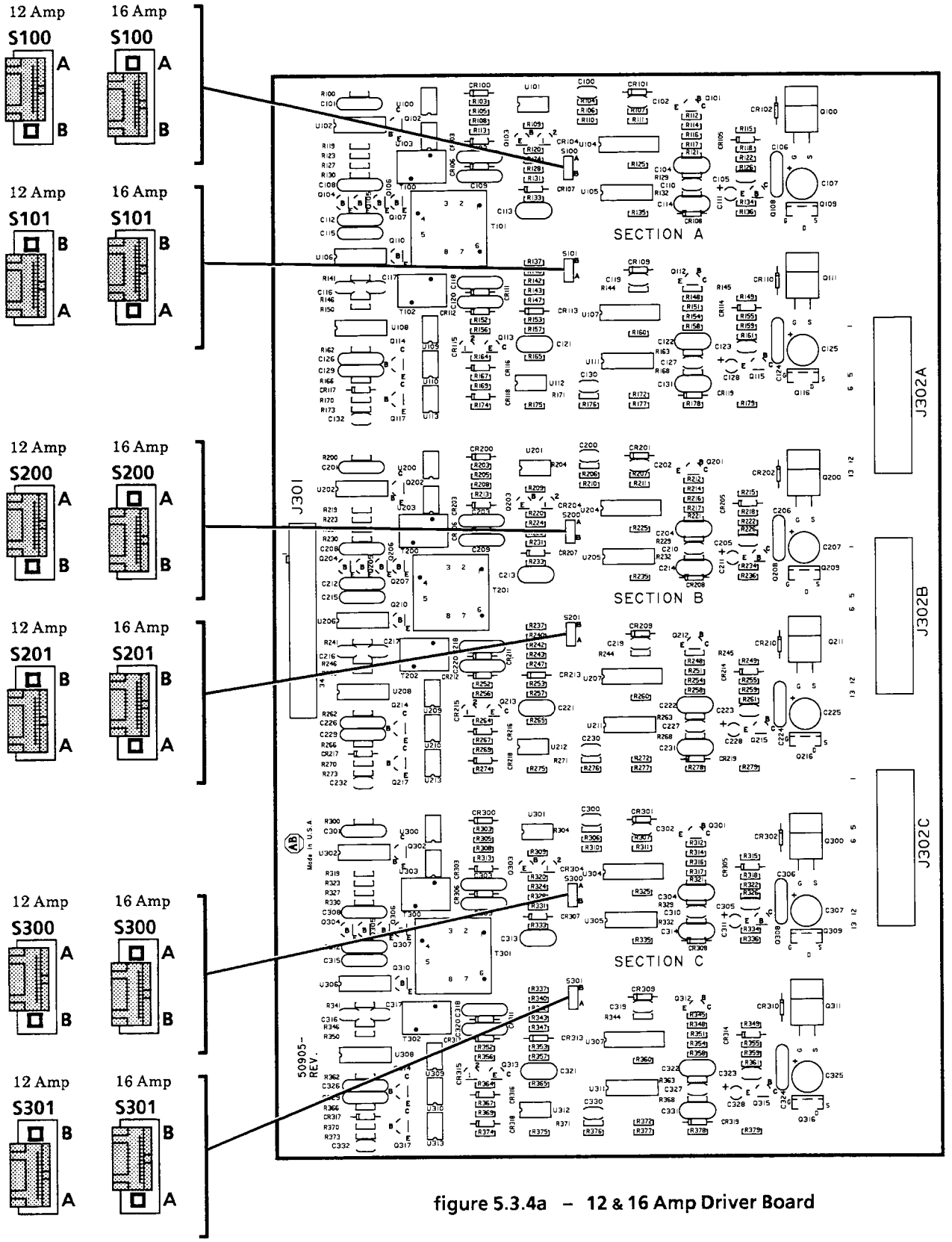


figure 5.3.4a – 12 & 16 Amp Driver Board

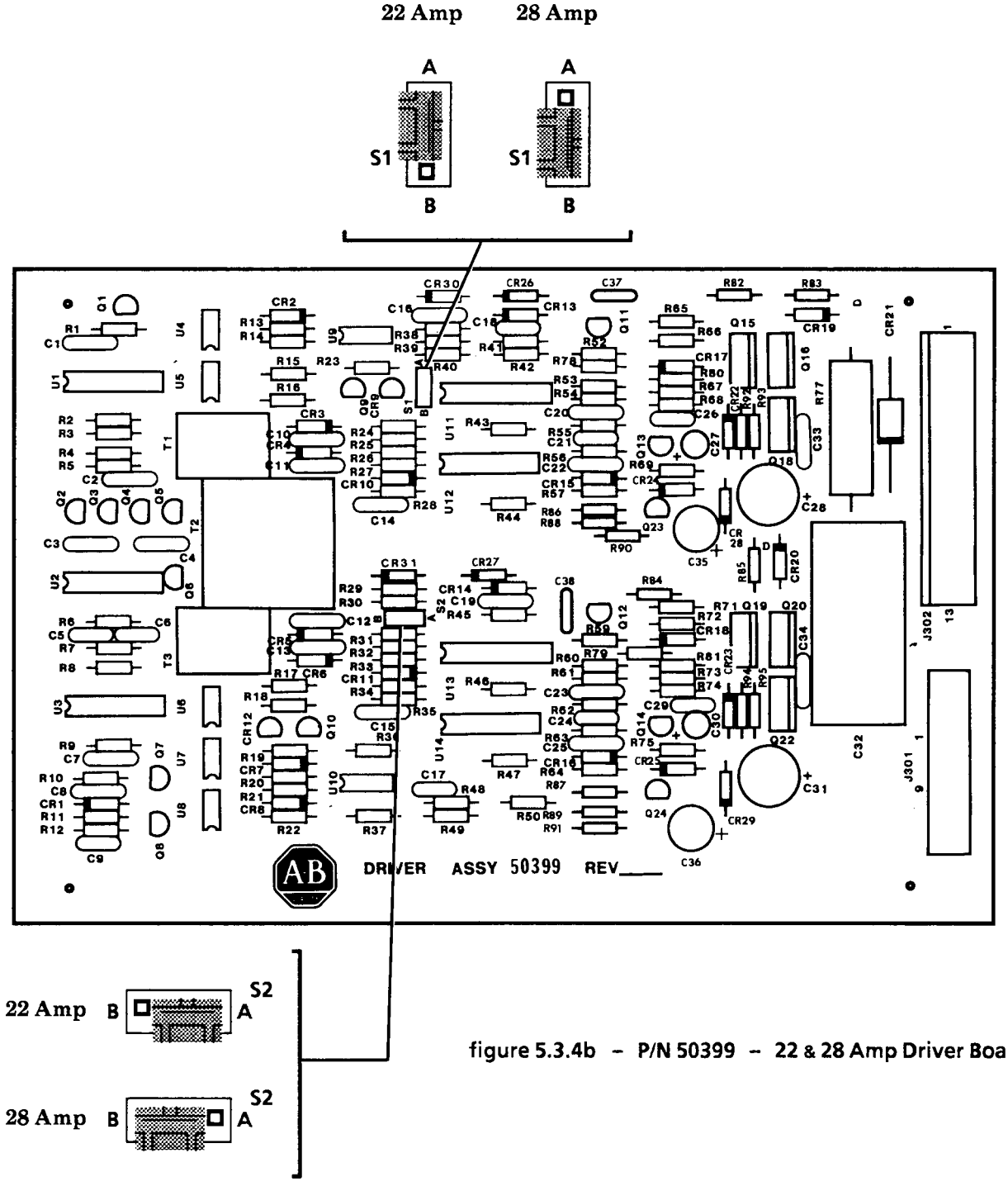


figure 5.3.4b – P/N 50399 – 22 & 28 Amp Driver Board

6.0 Operating Considerations

The Bulletin 1335 Variable Torque AC 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.

The Bulletin 1335 Drive is designed for use with variable torque, square law and cubed law loads. With square law loads, the torque varies directly with the change in speed while the horsepower varies as the square of the speed change. With cubed law loads, the torque varies as the square of the speed change while the horsepower varies as the cube of the speed change.

Typical examples of square law loads are:

- Some Positive Displacement Pumps
- Some Extruders and Some Mixers

Typical examples of cube law loads are:

- Some Centrifugal Pumps
- Fans and Blowers.

Regardless of whether your application is a square law or cube law load, sizing of the Bulletin 1335 Drive should be based upon the motor load current required at maximum operating speed. Caution is advised in going above motor base (nameplate) speed in these applications.

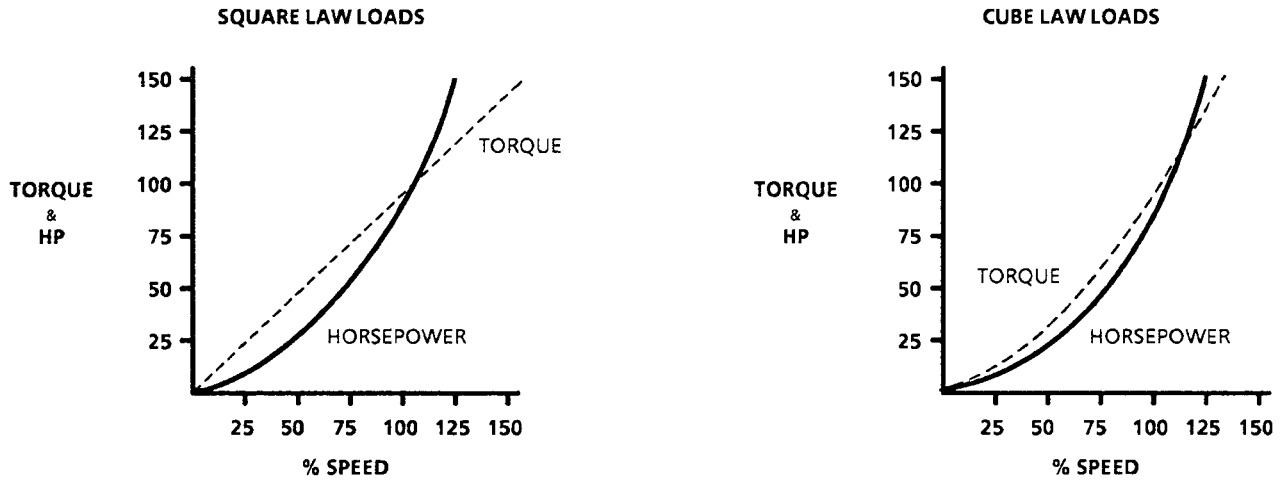


figure 6.0 – Square & Cube Law Load Curves

7.0
380V Specification Table

	Model Number	1335-D_N	1335-E_N	1335-F_N	1335-G_N	1335-R_N
Model and Ratings 12 & 16 Amp 22, 28 & 36 Amp	Output Amps	**12.0**	**16.0**	**22.0**	**28.0**	**36.0**
	Output Voltage	0-380	0-380	0-380	0-380	0-380
	Output KVA	7.9	10.5	14.5	18.4	23.7
	Input Amps	10.5	14.0	19.3	25.3	33.6
	Input Voltage	**380**	**380**	**380**	**380**	**380**
	Input kVA	6.9	9.2	12.7	16.7	22.1
	Output Frequency	0-200	0-200	0-200	0-200	0-200
	Input Frequency	50	50	50	50	50

	Model Number	1335-J_N	1335-K_N
Model and Ratings 56 & 69 Amp	Output Amps	**56.0**	**69.0**
	Output Voltage	0-380	0-380
	Output KVA	36.9	45.4
	Input Amps	52.4	63.5
	Input Voltage	**380**	**380**
	Input kVA	34.5	41.8
	Output Frequency	0-200	0-200
	Input Frequency	50	50

	Model Number	1335-L_N	1335-N_N
Model and Ratings 77 & 96 Amp	Output Amps	**77.0**	**96.0**
	Output Voltage	0-380	0-380
	Output KVA	50.7	63.2
	Input Amps	70.8	88.2
	Input Voltage	**380**	**380**
	Input kVA	46.6	58.0
	Output Frequency	0-200	0-200
	Input Frequency	50	50

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

7.1
415V Specification Table

	Model Number	1335-D_W	1335-E_W	1335-F_W	1335-G_W	1335-R_W
Model and Ratings 12 & 16 Amp 22, 28 & 36 Amp	Output Amps	**12.0**	**16.0**	**22.0**	**28.0**	**36.0**
	Output Voltage	0-415	0-415	0-415	0-415	0-415
	Output KVA	8.6	11.5	15.8	20.1	25.9
	Input Amps	10.5	14.0	19.3	25.3	33.6
	Input Voltage	**415**	**415**	**415**	**415**	**415**
	Input kVA	7.5	10.1	13.9	18.2	24.2
	Output Frequency	0-200	0-200	0-200	0-200	0-200
	Input Frequency	50	50	50	50	50

	Model Number	1335-J_W	1335-K_W
Model and Ratings 56 & 69 Amp	Output Amps	**56.0**	**69.0**
	Output Voltage	0-415	0-415
	Output KVA	40.3	49.6
	Input Amps	52.4	63.5
	Input Voltage	**415**	**415**
	Input kVA	37.7	45.6
	Output Frequency	0-200	0-200
	Input Frequency	50	50

	Model Number	1335-L_W	1335-N_W
Model and Ratings 77 & 96 Amp	Output Amps	**77.0**	**96.0**
	Output Voltage	0-415	0-415
	Output KVA	55.3	69.0
	Input Amps	70.8	88.2
	Input Voltage	**415**	**415**
	Input kVA	50.9	63.4
	Output Frequency	0-200	0-200
	Input Frequency	50	50

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

7.2 Adjustments

The Bulletin 1335 Variable Torque 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 power, control and fan transformers must be re-tapped to the correct voltage levels.
- If installed, Option M2, the Auxiliary Control Transformer must be re-tapped to the correct voltage level.
- 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, then determine the number and location of the transformers that require re-tapping from the information below. If option M2, the Auxiliary Control Transformer is installed, refer to the option information and connection drawings supplied with the Drive.

As shown in the **Drive Schematics** in **Appendixes I-L**, the transformers are normally set for 460V operation, but have 460/415/380V primary taps. All standard 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
1335-D __(12 Amp)	1T	Appendix A	Appendix I
1335-E __(16 Amp)	1T	Appendix A	Appendix I
1335-F __(22 Amp)	1T & 2T	Appendix B	Appendix J
1335-G __(28 Amp)	1T & 2T	Appendix B	Appendix J
1335-R __(36 Amp)	1T, & 2T	Appendix B	Appendix J
1335-J __(56 Amp)	1T, 2T, & 3T	Appendix C	Appendix K
1335-K __(69 Amp)	1T, 2T, & 3T	Appendix C	Appendix K
1335-L __(77 Amp)	1T, 2T, & 3T	Appendix D	Appendix L
1335-N __(96 Amp)	1T, 2T, & 3T	Appendix D	Appendix L

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 onto 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 1335 12 & 16 Amp Component Index

12 & 16 Amp 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	—	12 & 16 Amp	**1**
Driver Board	**A3**	50905-002	—	12 & 16 Amp	**1**
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	**0**
Fuse	**F1, F2, F3**	200935	15A, 600V (KTK 10)	12 Amp	**6**
		201925	20A, 600V (KTK 12)	16 Amp	**6**
Fuse	**F4, F5**	101775	0.6A, 500V (FNQ 6/10 or ATQ 6/10)	12 & 16 Amp	**2**
Bus Capacitor	**2C, 3C**	201906	1400µF, 450V DC	12 & 16 Amp	**1**
Control Transformer	**1T**	91854	—	12 & 16 Amp	**0**
MOV Assembly	**MOV 4**	40401	—	12 & 16 Amp	**0**
Inductor	**1L**	91864	2.9mH, 11.2A	12 Amp	**0**
		91865	2.2mH, 14.9A	16 Amp	**0**
Inductor	**2L**	91849	15mH, 1.3A	12 & 16 Amp	**0**
Power Switching Module	**1Q, 2Q, 3Q**	202099	—	12 & 16 Amp	**1**
Snubber Assembly	**1SN, 2SN, 3SN**	40410	—	12 & 16 Amp	**0**
Temperature Sensor	**1TAS**	201667	—	12 & 16 Amp	**0**
Rectifier Assembly	**1REC**	201525	—	12 & 16 Amp	**1**

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

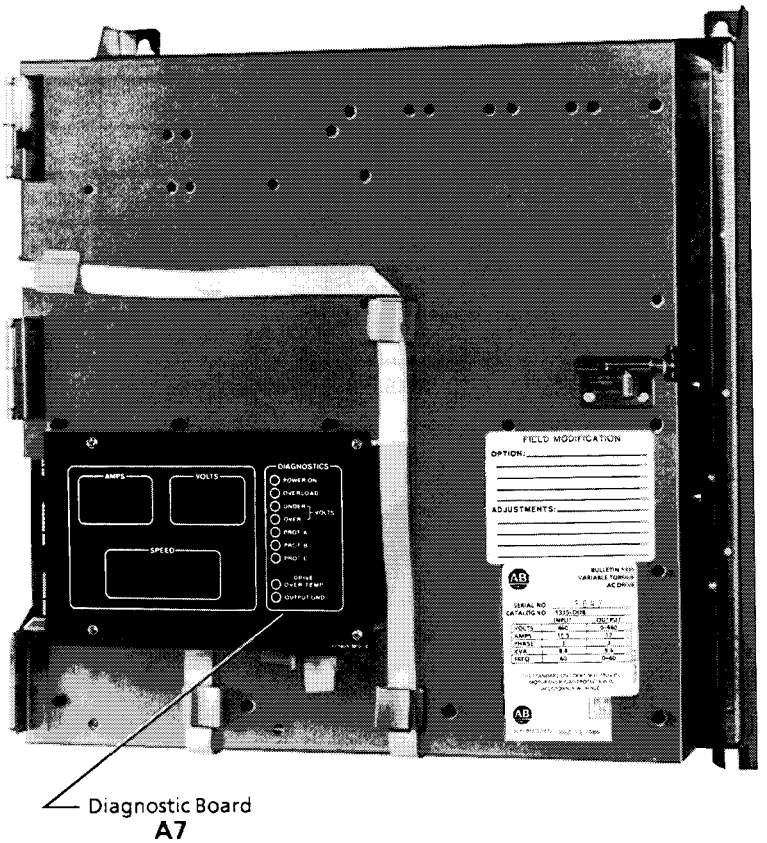
12 & 16 Amp Component Access & Location

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

12 & 16 Amp Component Access & Location

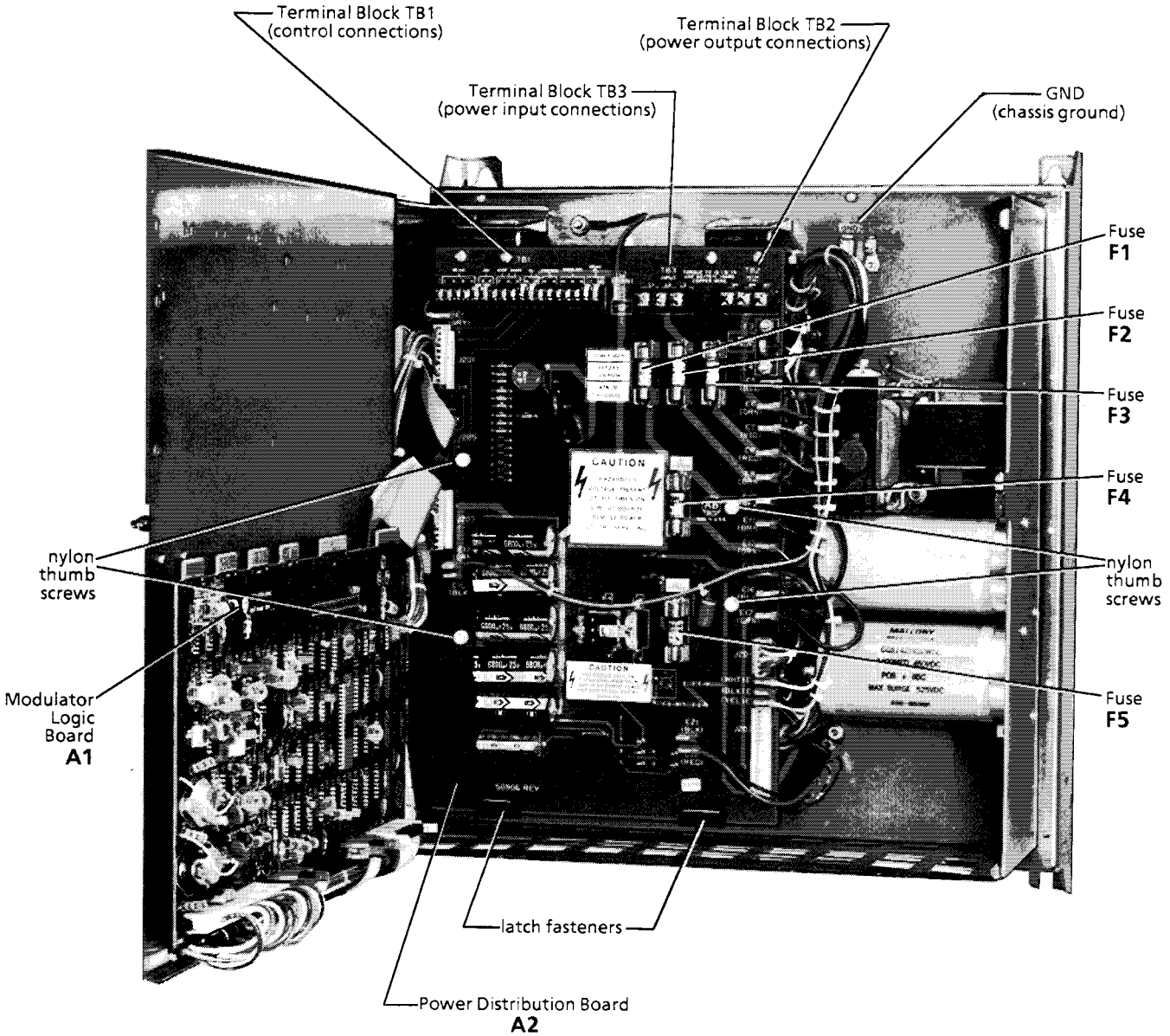
(Power Distribution Board A2)

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.



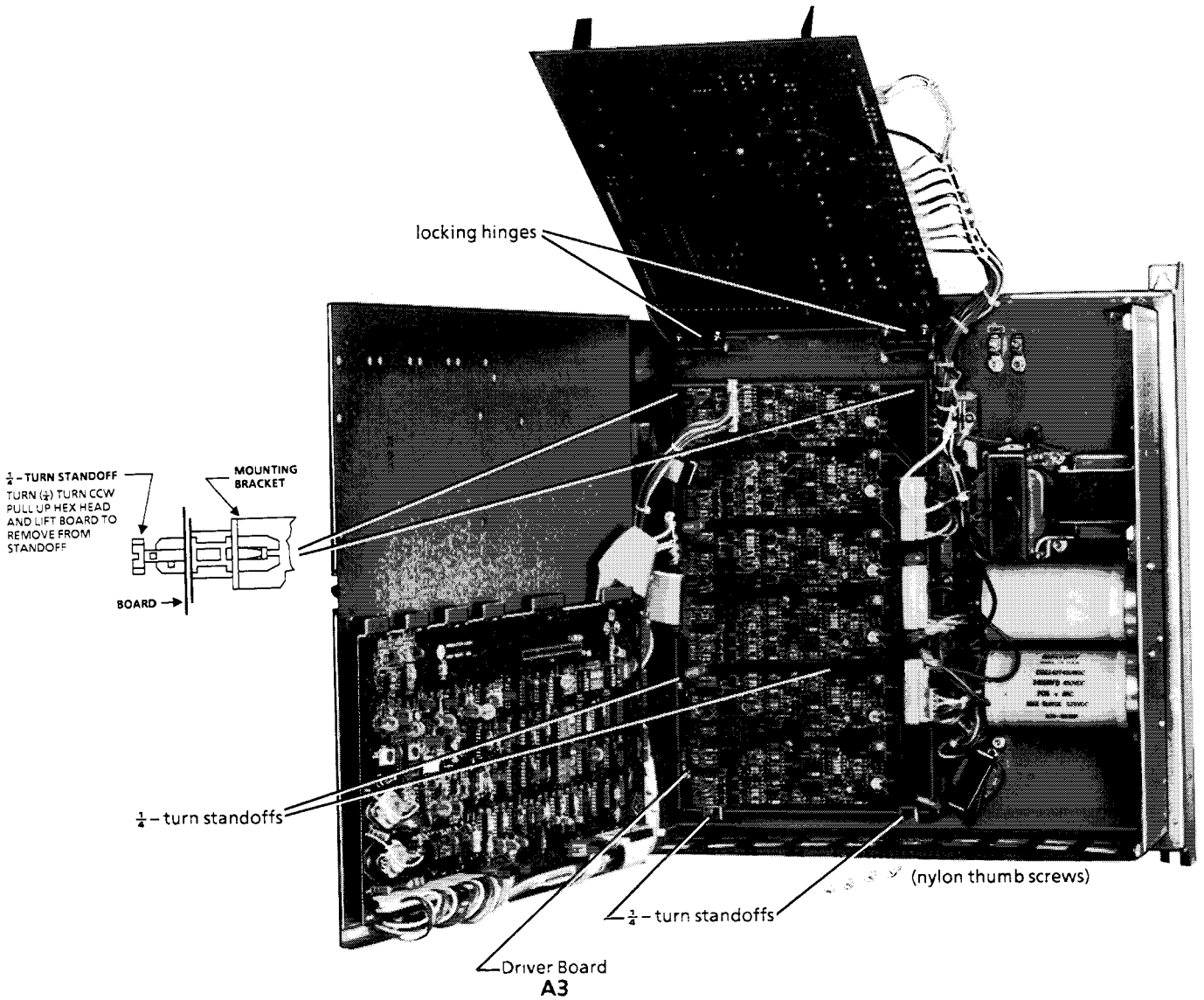
12 & 16 Amp Component Access & Location

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.



12 & 16 Amp Component Access & Location

Temperature Sensor 1TAS

Rectifier Assembly 1REC

Snubber Assemblies 1SN, 2SN & 3SN

Power Switching Modules 1Q, 2Q & 3Q

Resistors 2R & 3R

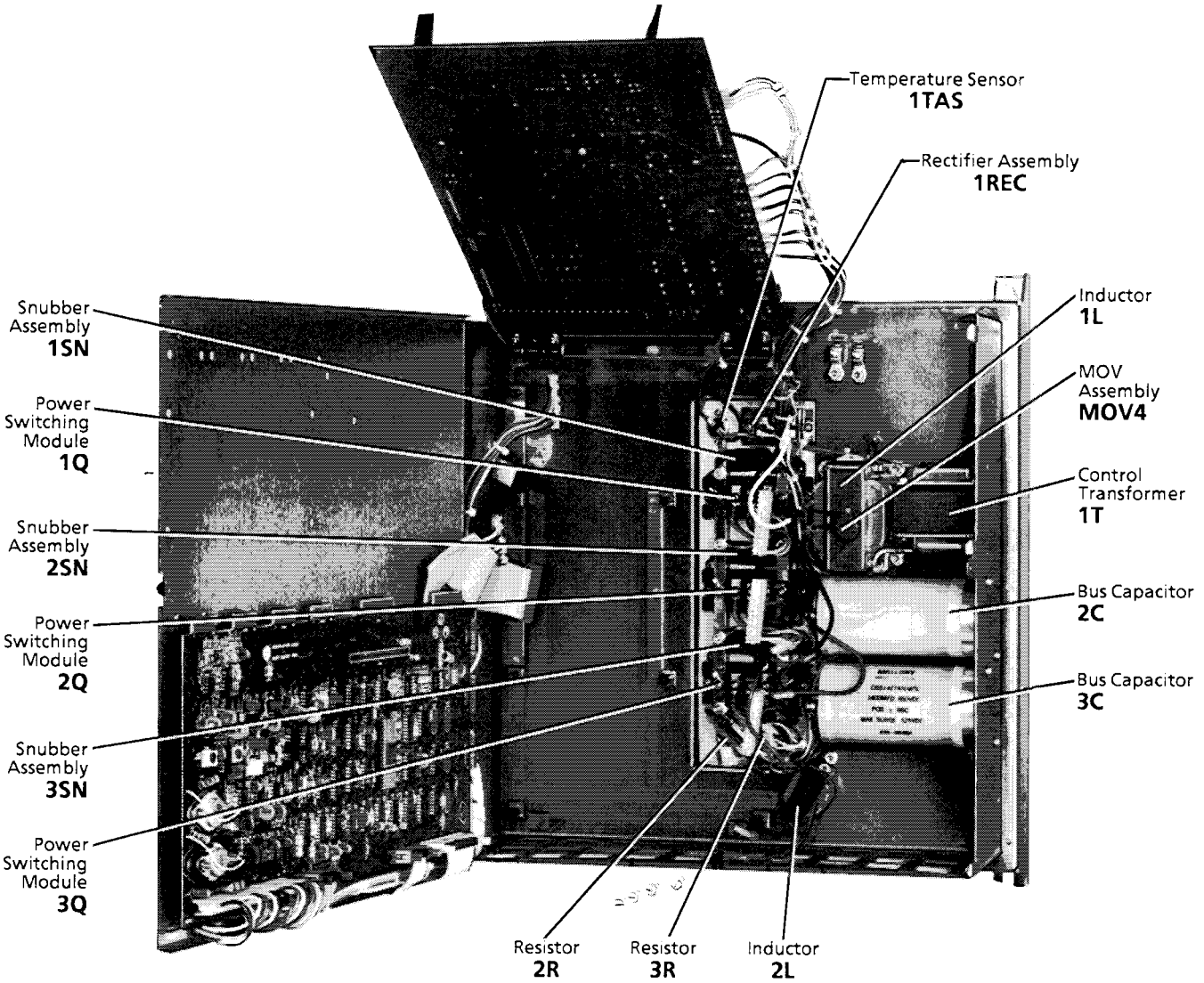
Inductors 1L & 2L

MOV4 Assembly

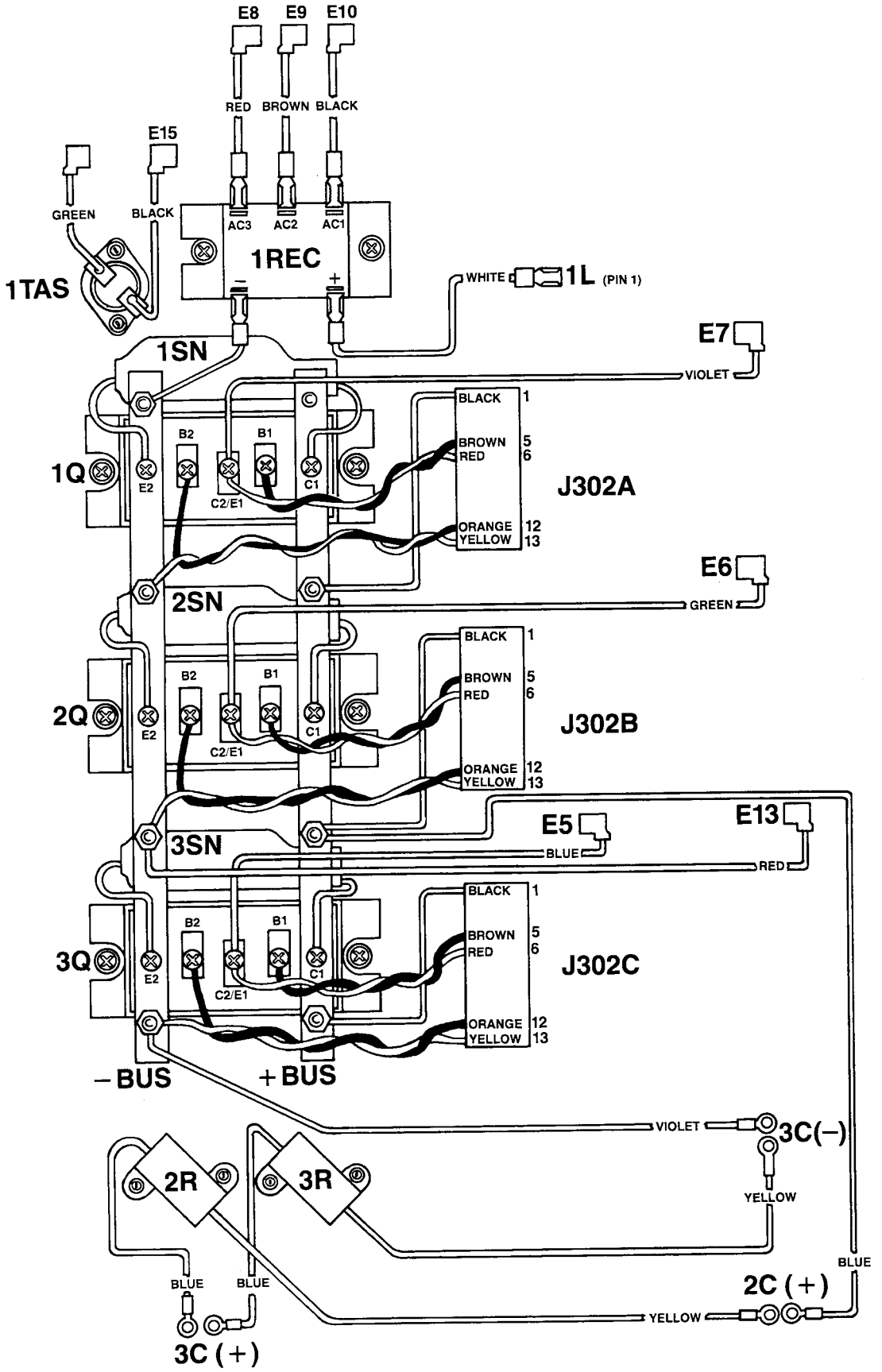
Transformer 1T

Bus Capacitors 2C & 3C

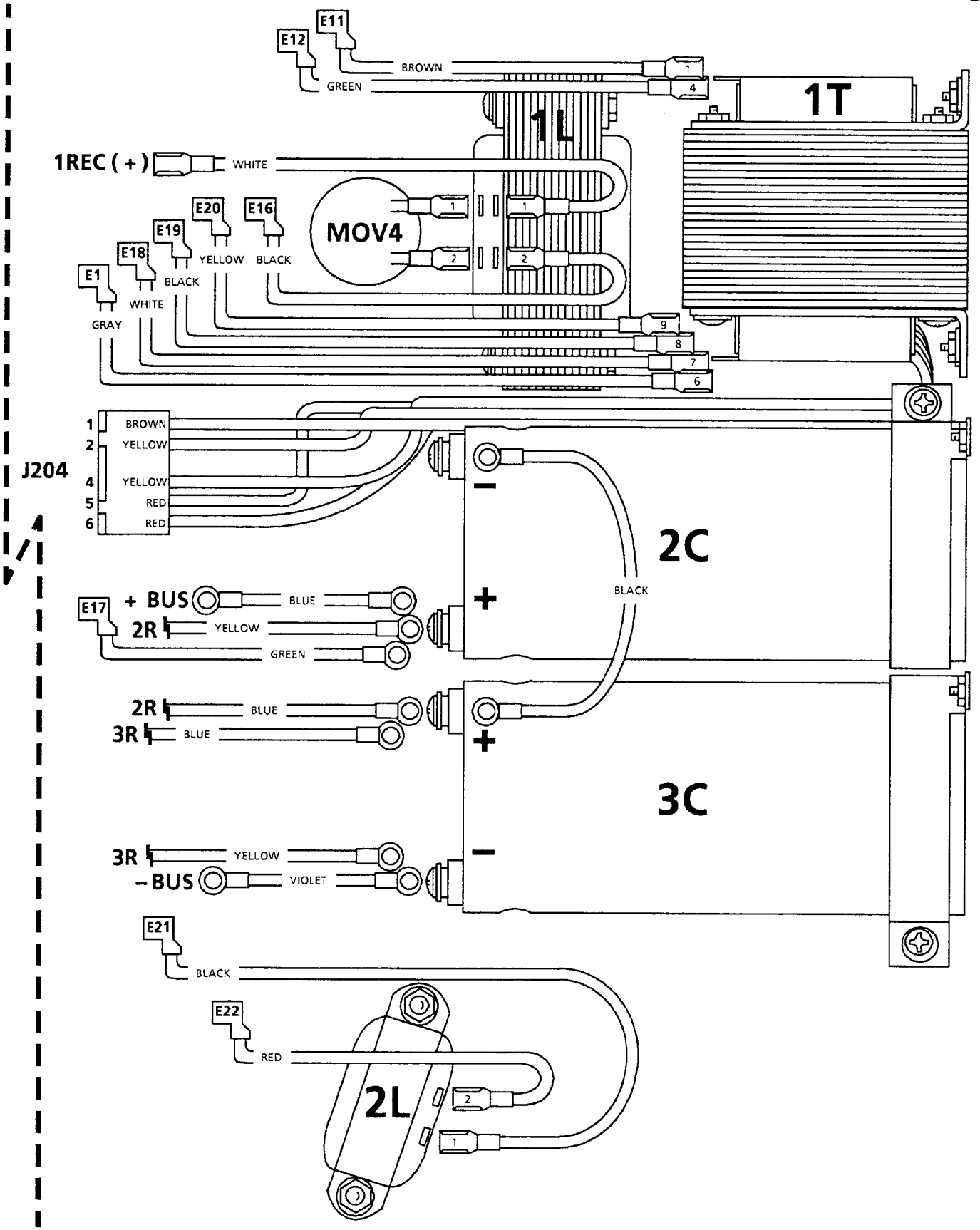
Wiring connections to the above components are shown on the following pages.



12 & 16 Amp Component Location & Wiring



12 & 16 Amp Component Location & Wiring



12 & 16 Amp 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 E**. 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 1335 22, 28 & 36 Amp Component Index

22, 28 & 36 Amp 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	—	22 & 28 Amp	**1**
		50399-001	—	36 Amp	**1**
Voltage Sensing Board	**A4**	50386	—	22, 28 & 36 Amp	**0**
Logic Power Supply Board	**A6**	50389	—	22, 28 & 36 Amp	**1**
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	**0**
Output Ground Sensor Board	**A8**	50385	—	22, 28 & 36 Amp	**1**
Contactor Interface Board	**A9**	50404-001	—	22, 28 & 36 Amp	**1**
Bus Indicator Board	**A41**	50913	—	22, 28 & 36 Amp	**0**
Fuse	**1FU, 2FU, 3FU**	201258	25A, 600V (JKS 25)	22 Amp	**6**
		200384	30A, 600V (JKS 30)	28 Amp	**6**
		201463	50A, 600V (JKS 50)	36 Amp	**6**
Fuse	**4FU, 5FU**	201590	1A, 500V (FNQ 1)	22, 28 & 36 Amp	**4**
Fuse	**4FU, 5FU**	248010	3A, 500V (FNQ 1)	22, 28 & 36 Amp	**4**
Bus Capacitor	**2C1, 2C2, 3C1, 3C2**	200364	2400µF, 450V DC	22, 28 & 36 Amp	**2**
Control Transformer	**1T**	91854	—	22, 28 & 36 Amp	**0**
Transformer	**2T**	91880	—	22, 28 & 36 Amp	**0**
Current Transformer	**1CT**	91824	—	22, 28 & 36 Amp	**0**

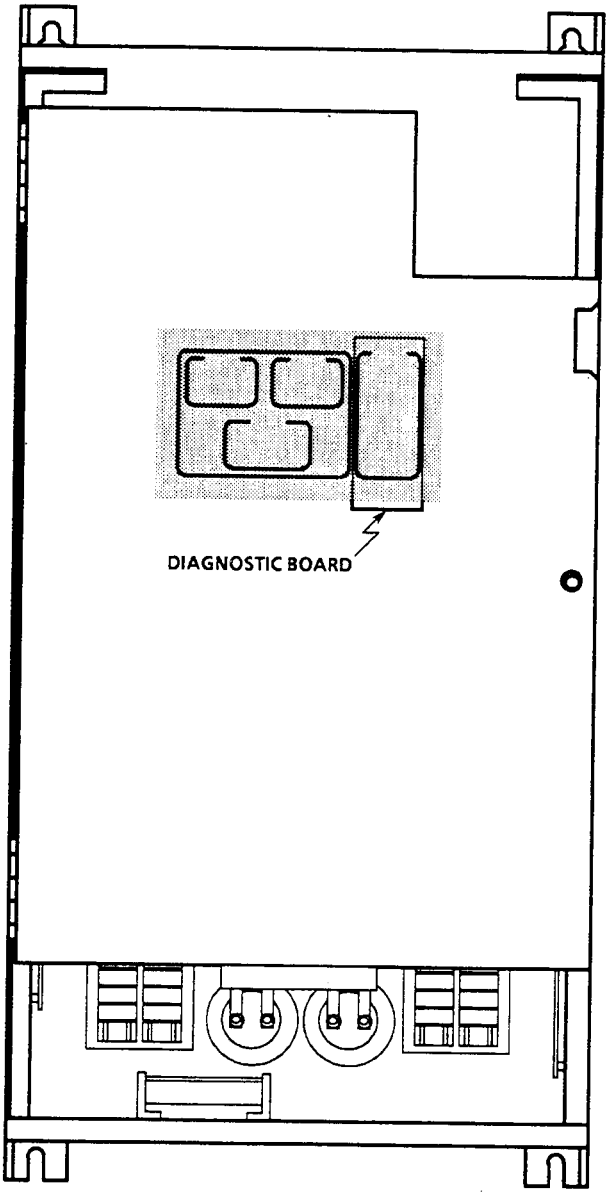
Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

22, 28 & 36 Amp Recommended Spare Parts
(continued)

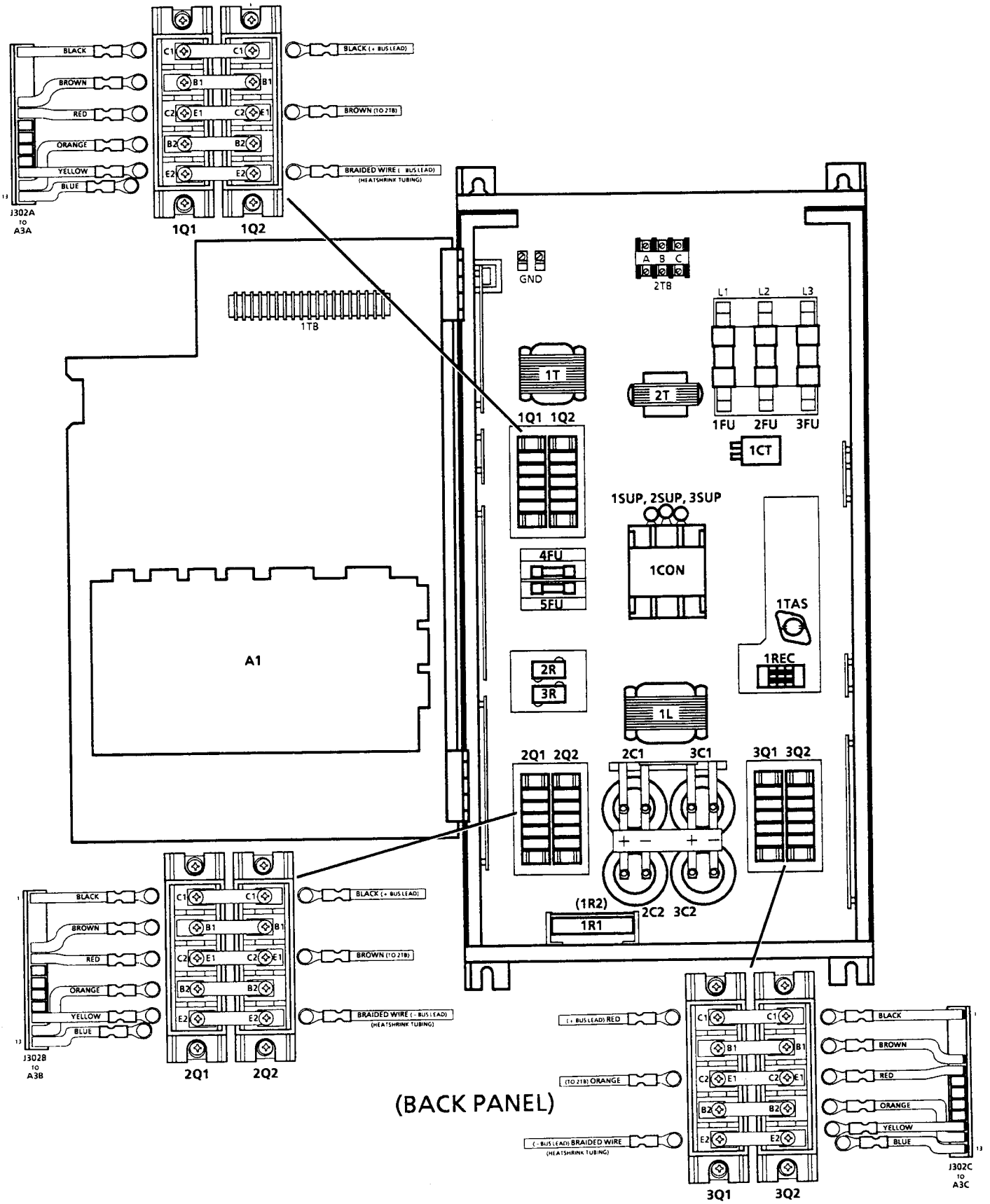
Description	Identification	Part №	Value	Used On	Recommended Stock
MOV Assembly	1 SUP, 2 SUP, 3 SUP	41475	—	22, 28 & 36 Amp	1
Inductor	1L	91866	—	22 Amp	0
		91867	—	28 Amp	0
		91871	—	36 Amp	0
Inductor	2L	91849	—	22, 28 & 36 Amp	0
Power Switching Module	1Q1, 2Q1, 3Q1 1Q2, 2Q2, 3Q2	202099	—	22, 28 & 36 Amp	2
Temperature Sensor	1TAS	201667	—	22, 28 & 36 Amp	0
Rectifier Assembly	1REC	201525	—	22 & 28 Amp	1
	1 REC, 2 REC, 3 REC	201445	—	36 Amp	2
Precharge Contactor	1 CON	201458	—	22, 28 & 36 Amp	0
Resistor Assembly	1R1, 1R2	41469	500Ω, 50W	22, 28 & 36 Amp	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.

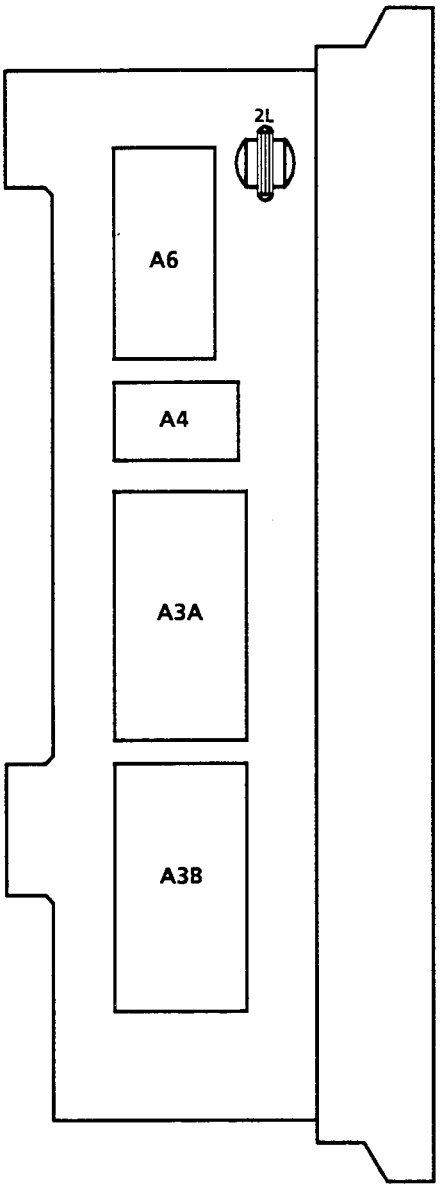
22, 28 & 36 Amp Drives



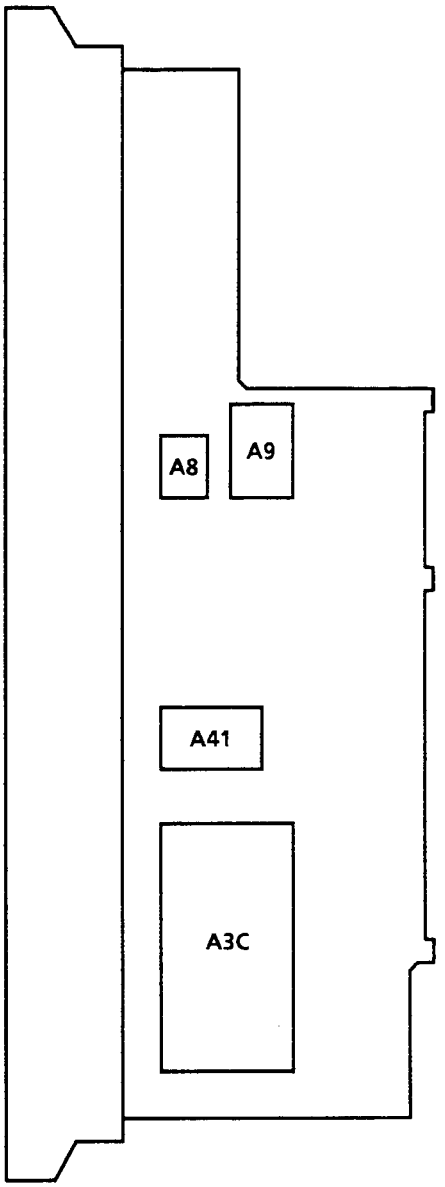
22 & 28 Amp Component Location



22 & 28 Amp Component Location

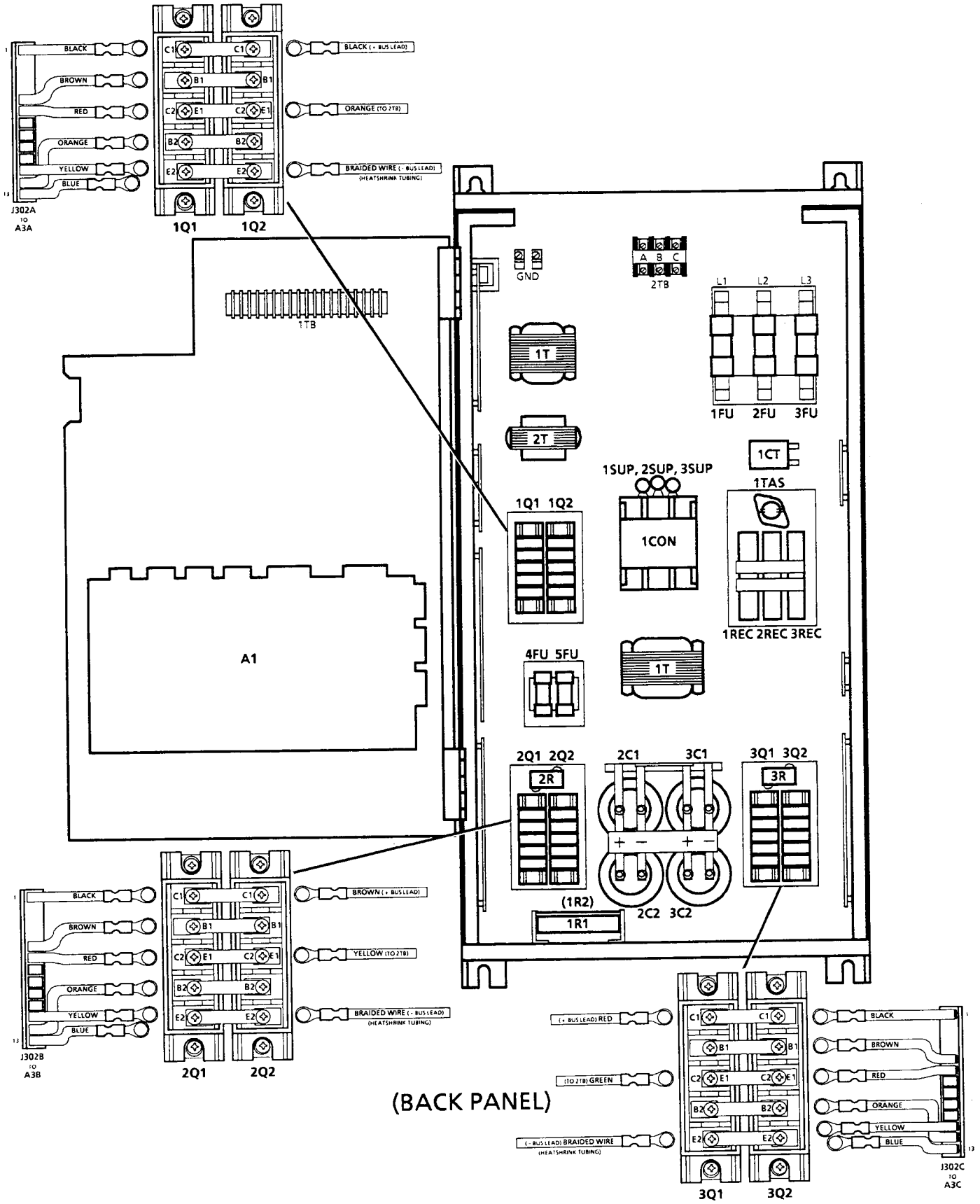


(LEFT HAND PANEL)

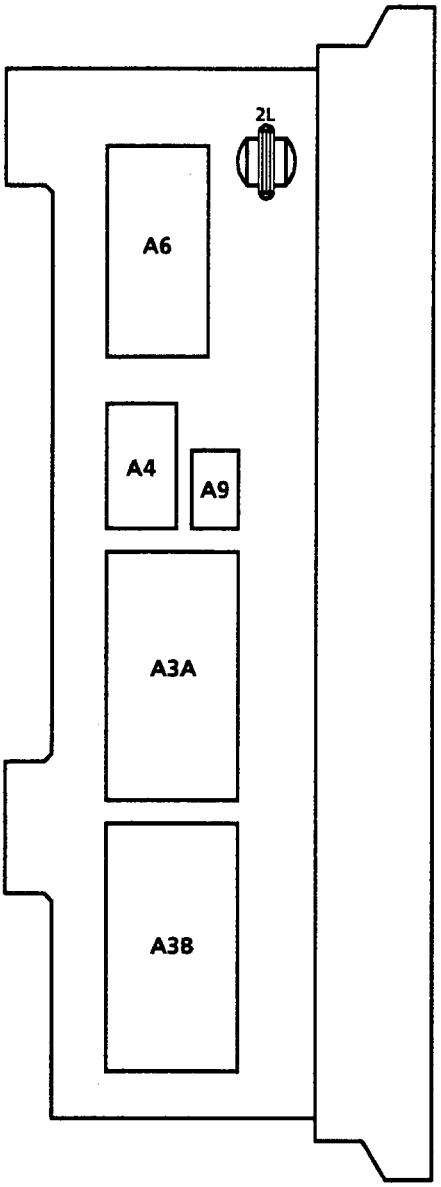


(RIGHT HAND PANEL)

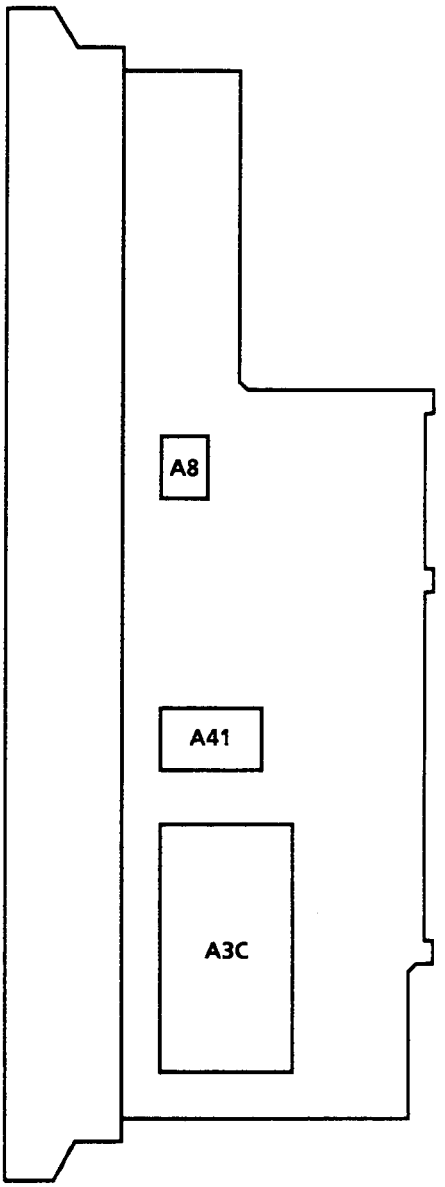
36 Amp Component Location



36 Amp Component Location



(LEFT HAND PANEL)



(RIGHT HAND PANEL)

Bulletin 1335 56 & 69 Amp Component Index

56 & 69 Amp 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	—	56 & 69 Amp	**1**
Voltage Sensing Board	**A4**	50386	—	56 & 69 Amp	**0**
Logic Power Supply Board	**A6**	50389	—	56 & 69 Amp	**1**
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	**0**
Output Ground Sensor Board	**A8**	50385	—	56 & 69 Amp	**1**
Contactor Interface Board	**A9**	50404-001	—	56 & 69 Amp	**1**
Driver Power Supply Board	**A10**	50406	—	56 & 69 Amp	**1**
Bus Indicator Board	**A41**	50913	—	56 & 69 Amp	**0**
Fuse	**1FU, 2FU, 3FU**	112032	100A, 600V (JJS 100)	56 & 69 Amp	**3**
Fuse	**4FU**	201590	1A, 500V (FNQ 1)	56 & 69 Amp	**1**
Fuse	**5FU**	201708	1.5A, 500V (FNQ 1.5)	56 & 69 Amp	**1**
Fan Fuse	**7FU**	201478	.2A, 500V (FNQ .2)	56 & 69 Amp	**0**
Bus Fuse	**8FU**	201466	125A, 700V (FWP 125)	56 & 69 Amp	**1**
Bus Capacitor	**2C1, 2C2, 2C3 3C1, 3C2, 3C3**	200364	2400µF, 450V DC	56 & 69 Amp	**1**
Snubber Capacitor	**4C, 5C, 6C**	201455	10µF, 660V DC	56 & 69 Amp	**0**
Control Transformer	**1T**	91854	—	56 & 69 Amp	**0**
Transformer	**2T**	91880	—	56 & 69 Amp	**0**
Fan Transformer	**3T**	91885	—	56 & 69 Amp	**0**
Current Transformer	**1CT**	91824	—	56 & 69 Amp	**0**

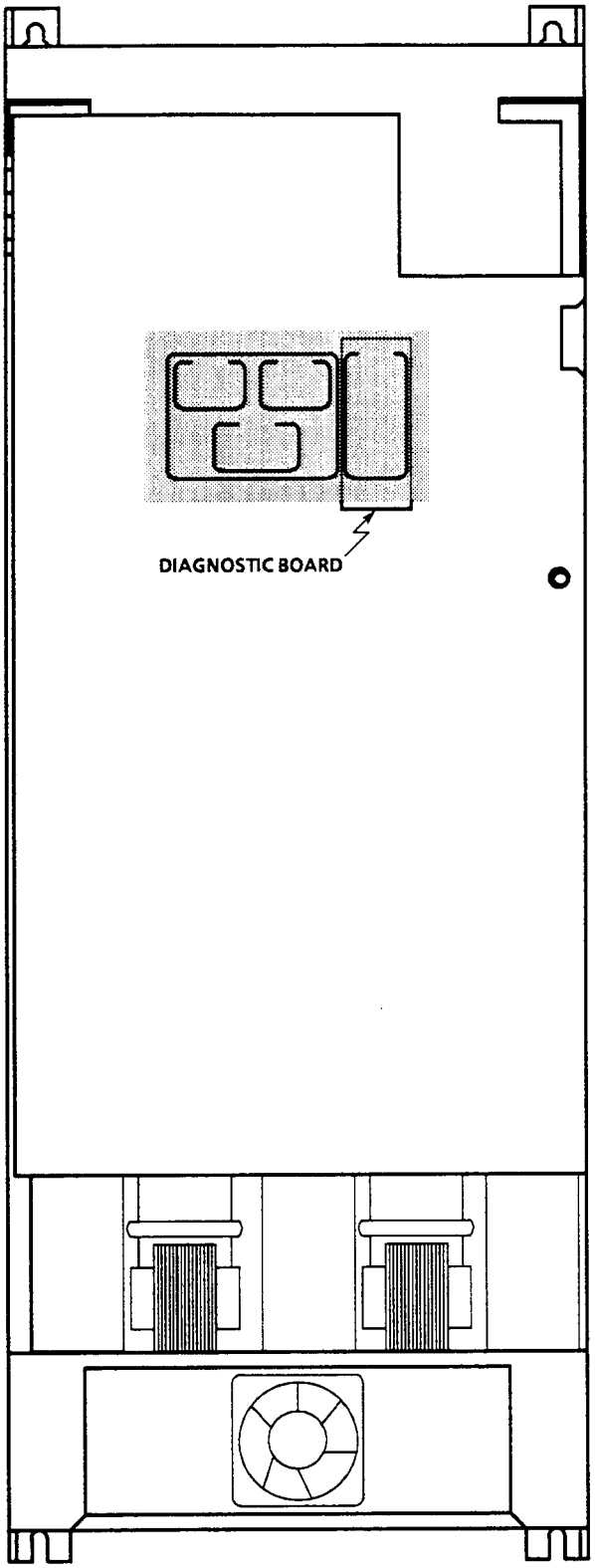
Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

56 & 69 Amp Recommended Spare Parts
(continued)

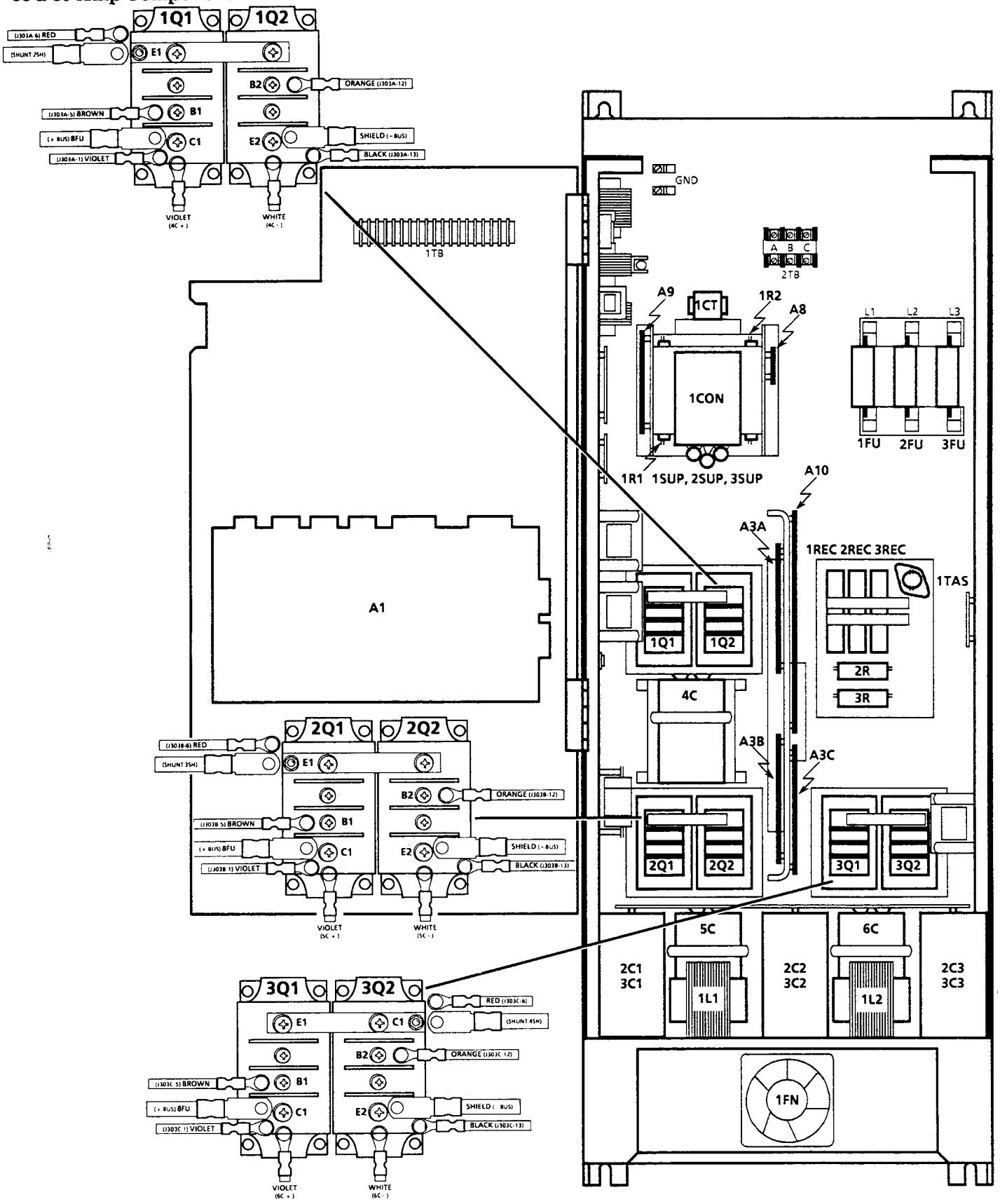
Description	Identification	Part №	Value	Used On	Recommended Stock
MOV Assembly	1 SUP, 2 SUP, 3 SUP	41484	—	56 & 69 Amp	1
Inductor	1L1, 1L2	91886	—	56 Amp	0
		91874	—	69 Amp	0
Inductor	2L	91849	—	56 & 69 Amp	0
Inductor	3L, 4L, 5L	91879	—	56 & 69 Amp	0
Power Switching Module	1Q1, 2Q1, 3Q1 1Q2, 2Q2, 3Q2	201411	—	56 & 69 Amp	2
Temperature Sensor	1TAS	201667	—	56 & 69 Amp	0
Rectifier Assembly	1 REC, 2 REC, 3 REC	201445	—	56 & 69 Amp	1
Precharge Contactor	1 CON	201459	—	56 & 69 Amp	0
Fan	1FN	201508	—	56 & 69 Amp	0
Snubber Diode	1D	201423	—	56 & 69 Amp	0
Resistor Assembly	1R1, 1R2	243426	25Ω, 50W	56 & 69 Amp	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.

56 & 69 Amp Component Location

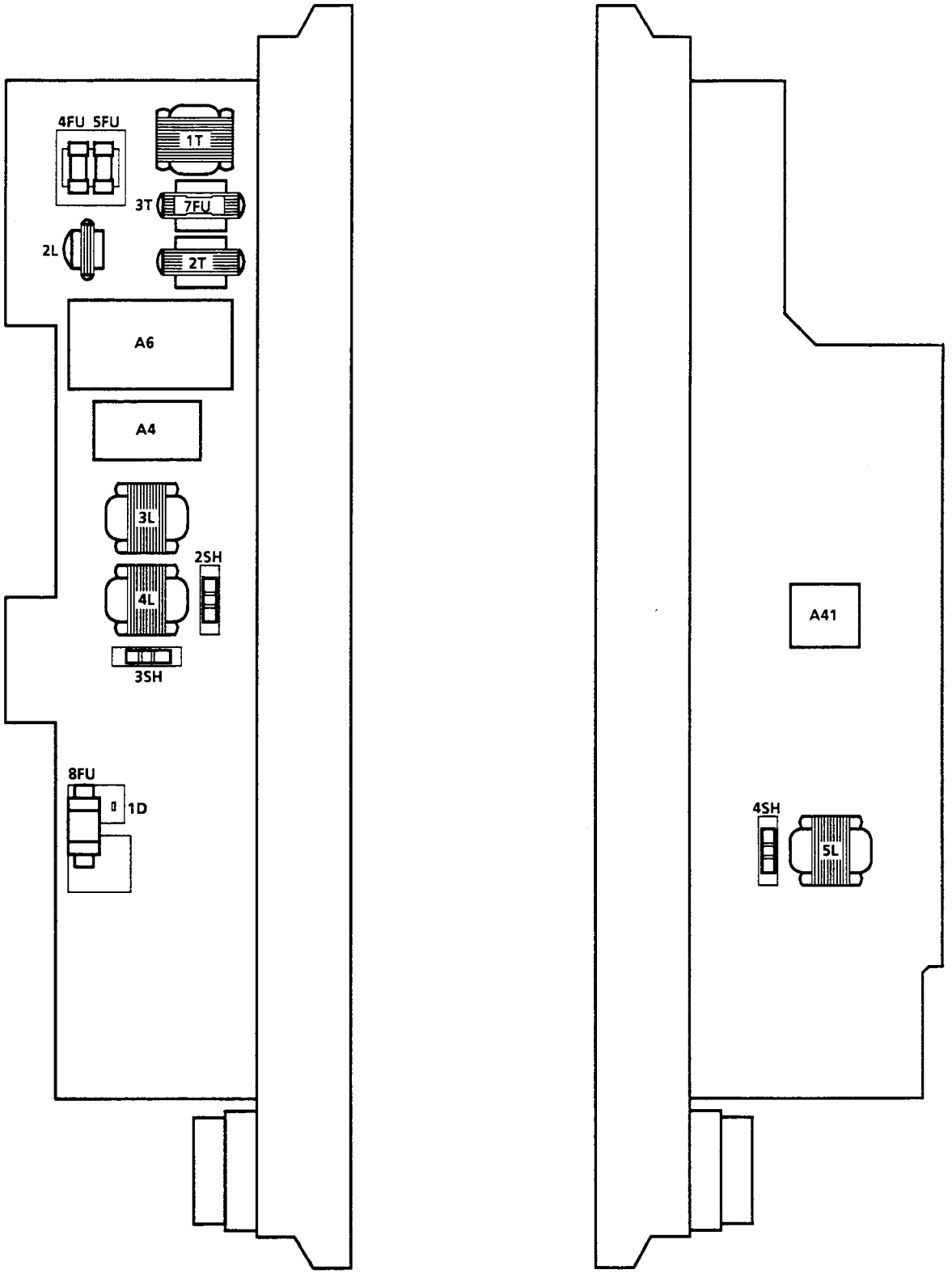


56 & 69 Amp Component Location



(BACK PANEL)

56 & 69 Amp Component Location



(LEFT HAND PANEL)

(RIGHT HAND PANEL)

Bulletin 1335 77 & 96 Amp Component Index

77 & 96 Amp 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	—	77 & 96 Amp	1
Voltage Sensing Board	**A4**	50386	—	77 & 96 Amp	0
Logic Power Supply Board	**A6**	50389	—	77 & 96 Amp	1
Diagnostic Board	**A7**	*50382*	—	*All Ratings*	0
Output Ground Sensor Board	**A8**	50385	—	77 & 96 Amp	1
Contactor Interface Board	**A9**	50404-003	—	77 & 96 Amp	1
Driver Power Supply Board	**A10**	50406	—	77 & 96 Amp	1
Bus Indicator Board	**A41**	50913	—	77 & 96 Amp	0
LEM Board	**A42**	50914-001	—	77 Amp	1
		50914-002	—	96 Amp	1
Fuse	**1FU, 2FU, 3FU**	202090	150A, 600V (JJS 150)	77 & 96 Amp	3
Fuse	**4FU**	201590	1A, 500V (FNQ 1)	77 & 96 Amp	1
Fuse	**5FU**	201708	1.5A, 500V (FNQ 1.5)	77 & 96 Amp	1
Fan Fuse	**7FU**	201927	.5A, 500V (FNQ .5)	77 & 96 Amp	0
Bus Fuse	**8FU**	202091	150A, 700V	77 & 96 Amp	1
Fuse	**9FU**	200816	10A, 250V (ABC10 or AGC10)	77 & 96 Amp	1
Bus Capacitor	**2C1, 2C2, 2C3 3C1, 3C2, 3C3**	200364	2400µF, 450V DC	77 & 96 Amp	1
Snubber Capacitor	**4C, 5C, 6C**	201455	10µF, 660V DC	77 & 96 Amp	0
Control Transformer	**1T**	91854	—	77 & 96 Amp	0
Transformer	**2T**	121521	—	77 & 96 Amp	0
Fan Transformer	**3T**	91885	—	77 & 96 Amp	0
Current Transformer	**1CT**	91824	—	77 & 96 Amp	0

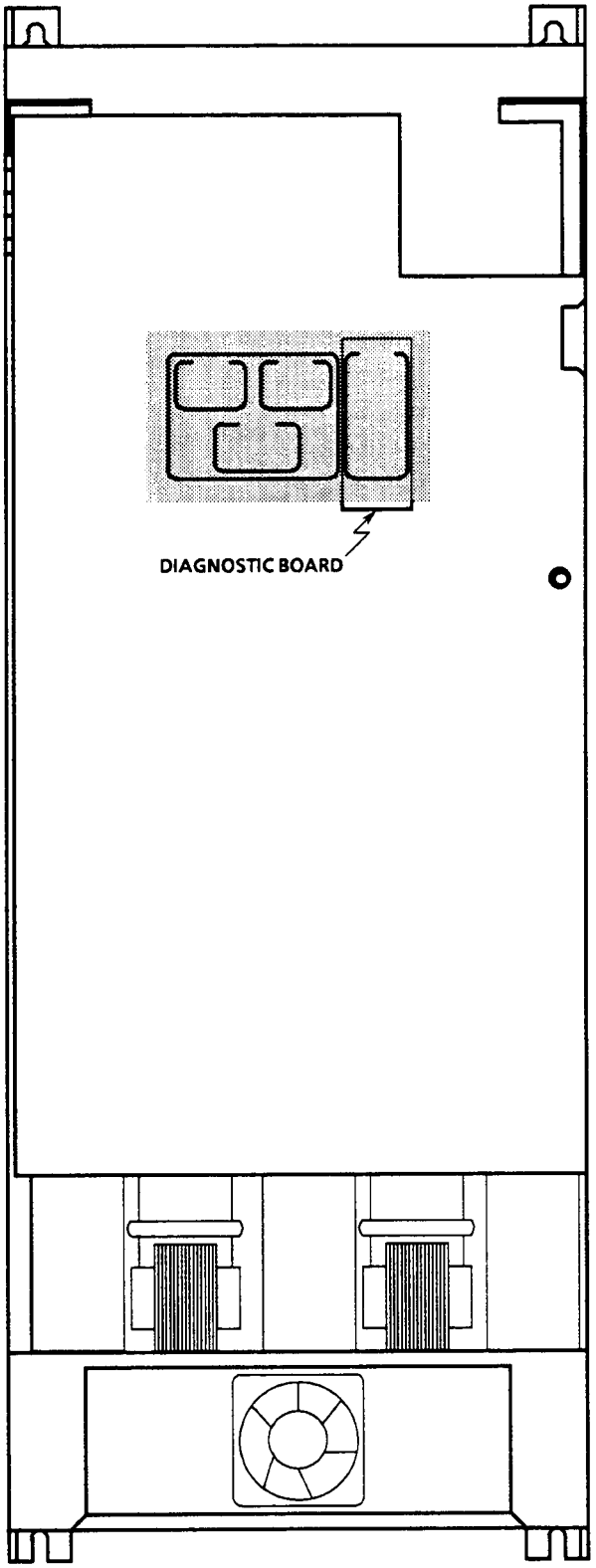
Recommended quantities for (1–4) Drives in one location. For more than (4) Drives, all parts should be stocked, additional quantities may be required.

77 & 96 Amp Recommended Spare Parts
(continued)

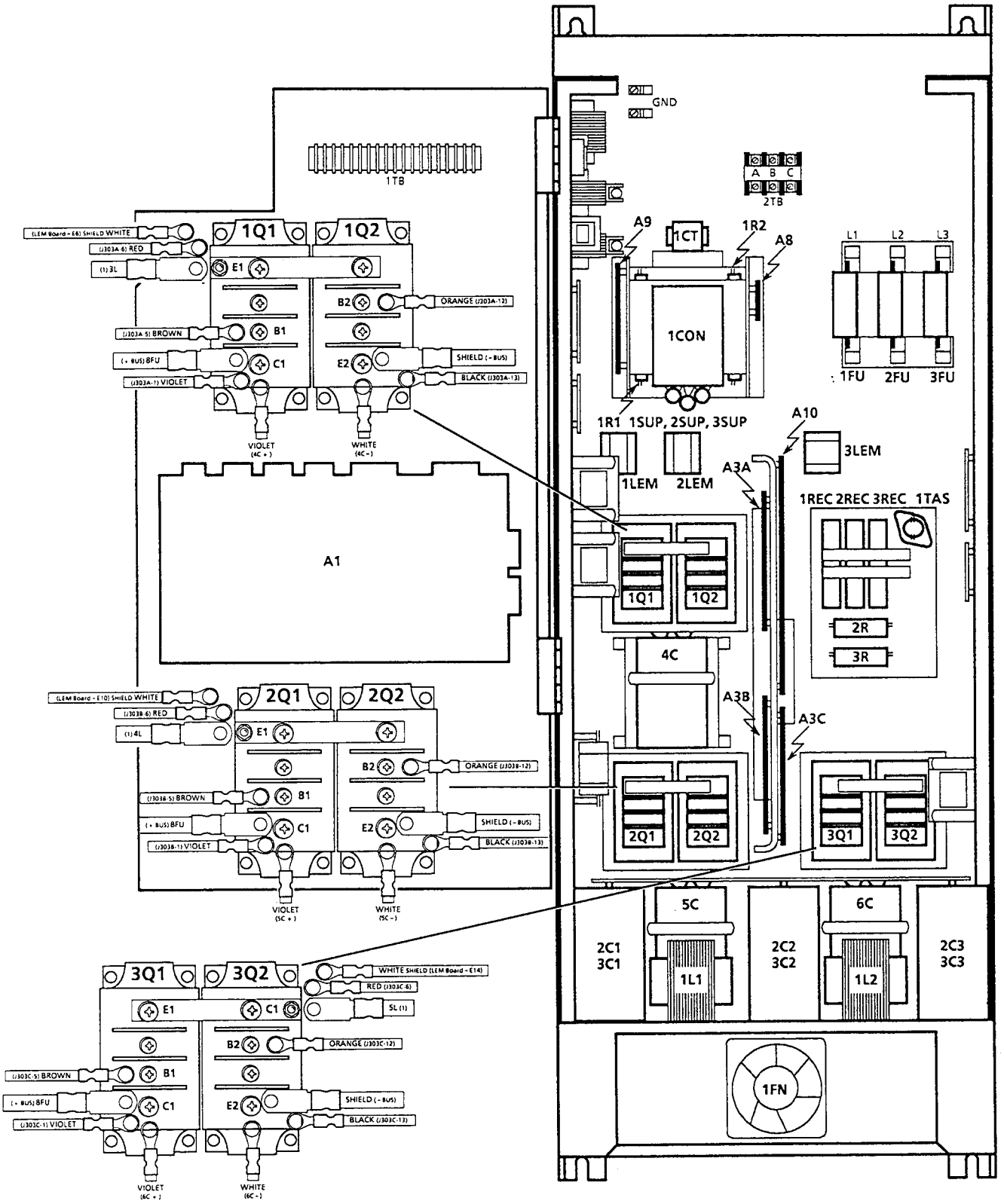
Description	Identification	Part №	Value	Used On	Recommended Stock
MOV Assembly	1 SUP, 2 SUP, 3 SUP	41484	—	77 & 96 Amp	1
Inductor	1L1, 1L2	91874	—	77 & 96 Amp	0
Inductor	2L	91849	—	77 & 96 Amp	0
Inductor	3L, 4L, 5L	91879	—	77 & 96 Amp	0
Power Switching Module	1Q1, 2Q1, 3Q1 1Q2, 2Q2, 3Q2	201411	—	77 & 96 Amp	2
Temperature Sensor	1TAS	201667	—	77 & 96 Amp	0
Rectifier Assembly	1 REC, 2 REC, 3 REC	201445	—	77 & 96 Amp	1
Precharge Contactor	1 CON	202127	—	77 & 96 Amp	0
Fan	1FN	201508	—	77 & 96 Amp	0
Snubber Diode	1D	201423	—	77 & 96 Amp	0
Resistor Assembly	1R1, 1R2	243426	25Ω, 50W	77 & 96 Amp	0
LEM Assembly	1 LEM, 2 LEM, 3 LEM	202097	—	77 & 96 Amp	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.

77 & 96 Amp Component Location

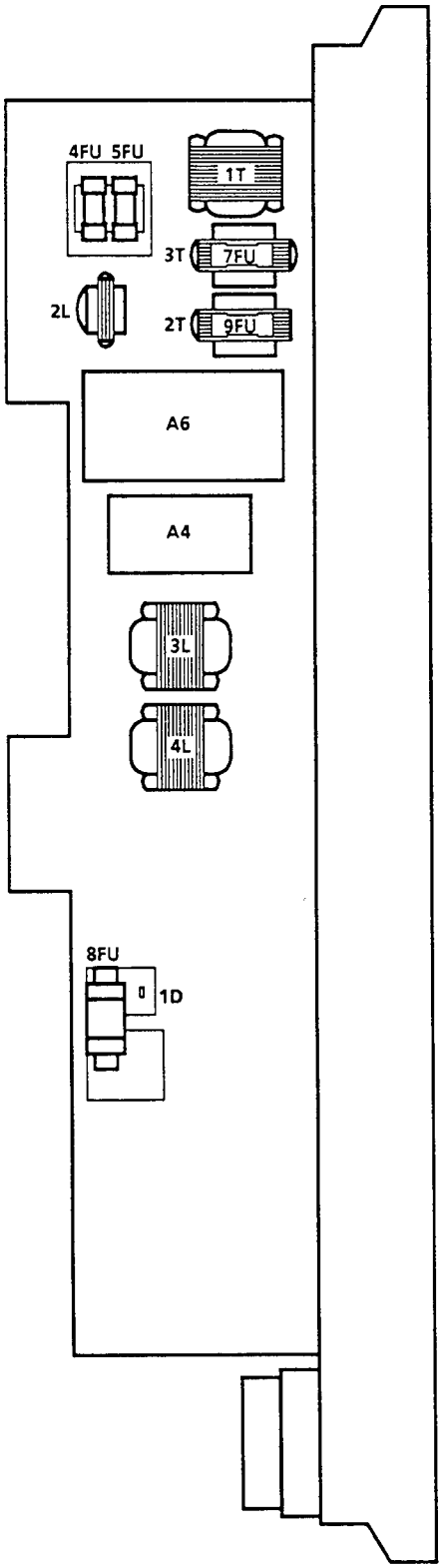


77 & 96 Amp Component Location

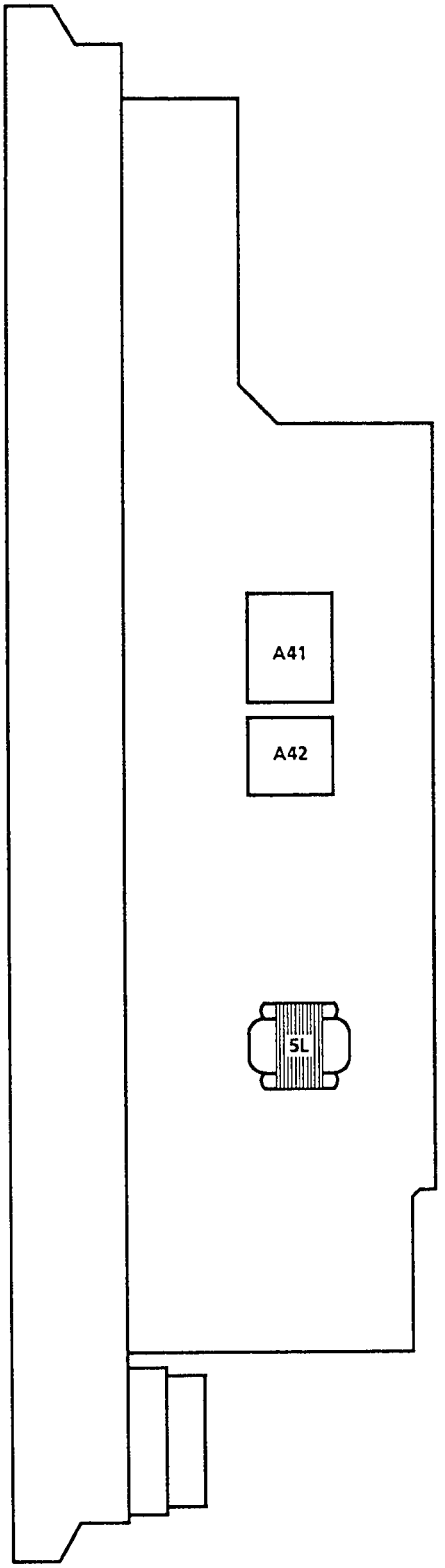


(BACK PANEL)

77 & 96 Amp Component Location



(LEFT HAND PANEL)



(RIGHT HAND PANEL)

Bulletin 1335 12 & 16 Amp Troubleshooting

12 & 16 Amp Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Overload Protection – When constantly illuminated indicates an over current 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.

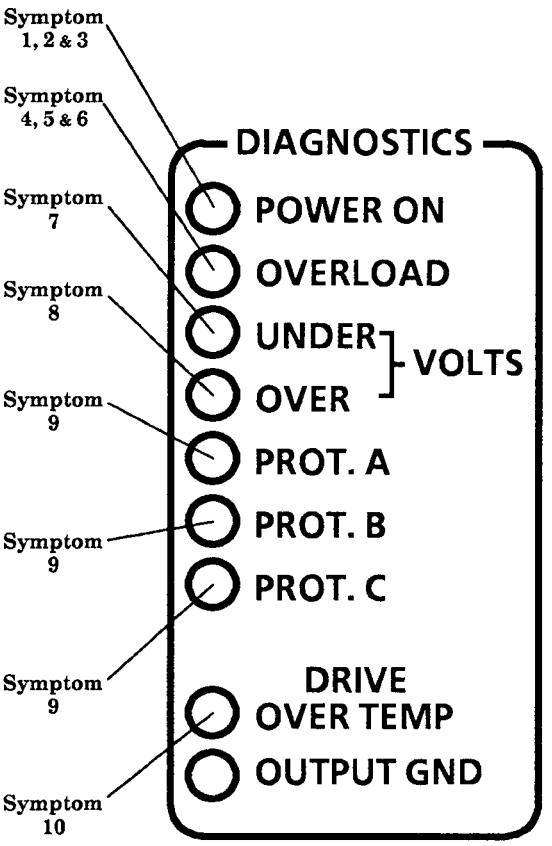
"A" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 180%
- A Shorted **"A"** Phase Output Transistor
- Section **"A"** of the Driver Board is Malfunctioning

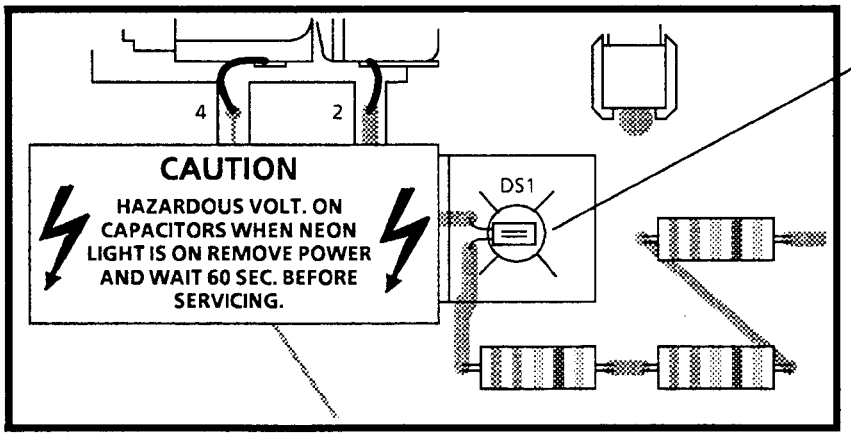
"B" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 180%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

"C" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 180%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

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 12 & 16 Amp DRIVES*





Symptom 11

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

12 & 16 Amp 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 I** or the Modulator Logic Board Interconnection Diagram in **Appendix M**.

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 the Power Distribution Board 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.**

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

That the **Speed Pot** or speed reference is set to **MINIMUM**.

That the **AUTO/OFF/MAN Switch** (if present), is in the proper position.

That the **DRIVE/OFF/BYPASS Switch** (if present), is in the proper position.

That the motor is uncoupled 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 any voltage is not present, check the AC line source for an open or missing phase. 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 + LEAD	OHMMETER – LEAD	READING
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 any voltage is not present, check the AC line source for an open or missing phase. 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 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 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 T14 or T15 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 starts momentarily then trips off or Drive trips off during normal operation. Red **OVERLOAD** 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 **OVERLOAD** LED indicates that the Drive has tripped off due to a nominal 110% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or start-up (breakaway), it is normal for the Overload LED to illuminate momentarily. This merely indicates that a momentary overload current of 110% has been sensed and that the Overload circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the Overload LED is constantly activated during startup (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 5	DIAGNOSTIC PROCEDURE
Motor does not return to full set speed after stalling. Red **OVERLOAD** 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, Drives Distributor, or Sales Office for application assistance. **IMPORTANT**: *If a 110% 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 Overload LED on the Diagnostic Display Panel.*

Symptom 6	DIAGNOSTIC PROCEDURE
Red **OVERLOAD** 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 7	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 8	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, Drives Distributor, or Sales Office.

Symptom 9	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 180% 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 180% 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.

Symptom 9	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.	• **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 180% 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, Drives Distributor, or Sales Office 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.** • **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.

Symptom 9	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 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 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, perform **STEP 5** on the following page.

Symptom 9	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 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, 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 **OVERLOAD** LED on the Modulator Logic Board should light when the current reaches a nominal value of 110%. If the **OVERLOAD** 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 10	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 11	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 1335 22, 28 & 36 Amp Troubleshooting

22, 28 & 36 Amp Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Overload Protection – When constantly illuminated indicates an over current 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 180%
- A Shorted **"A"** Phase Output Transistor
- Section **"A"** of the Driver Board is Malfunctioning

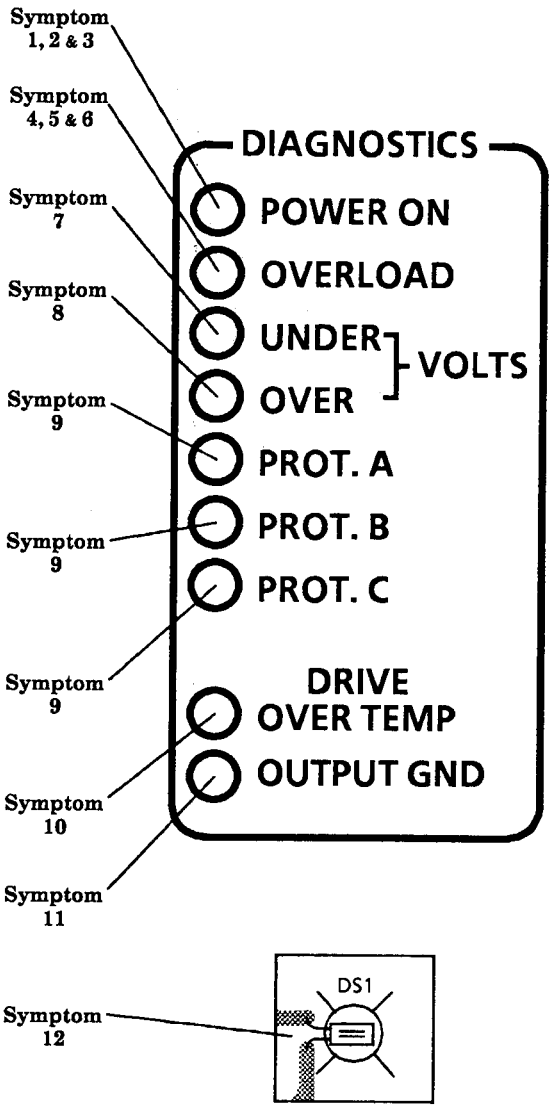
"B" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 180%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

"C" Phase Protection Trip – When illuminated indicates either:
- An Overload Condition Greater Than 180%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

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 Indicator Board A41 – When illuminated indicates that the bus potential is in excess of 42V DC.



22, 28 & 36 Amp 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** through **B-7**.

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

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 Indicator Board A41 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.**

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

That the **Speed Pot** or speed reference is set to **MINIMUM**.

That the **AUTO/OFF/MAN Switch** (if present), is in the proper position.

That the **DRIVE/OFF/BYPASS Switch** (if present), is in the proper position.

That the motor is uncoupled 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 any voltage is not present, check the AC line source for an open or missing phase. 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 (60) seconds. The Bus Indicator neon light on Bus Indicator Board A41 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 22 & 28 Amp 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 36 Amp 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 any voltage is not present, check the AC line source for an open or missing phase. 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 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 T16, T17 or T18 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 starts momentarily then trips off or Drive trips off during normal operation. Red **OVERLOAD** 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 **OVERLOAD** LED indicates that the Drive has tripped off due to a nominal 110% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or startup (breakaway), it is normal for the Overload LED to illuminate momentarily. This merely indicates that a momentary overload current of 110% has been sensed and that the Overload circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the Overload LED is constantly activated during startup (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 5	DIAGNOSTIC PROCEDURE
Motor does not return to full set speed after stalling. Red **OVERLOAD** 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, Drives Distributor, or Sales Office for application assistance. **IMPORTANT**: *If a 110 % 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 Overload LED on the Diagnostic Display Panel.*

Symptom 6	DIAGNOSTIC PROCEDURE
Red **OVERLOAD** 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 7	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 8	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, Drives Distributor, or Sales Office.

Symptom 9	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 180% 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 180% 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.

Symptom 9	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.	• **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 180% 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, Drives Distributor, or Sales Office 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.** • **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.

Symptom 9

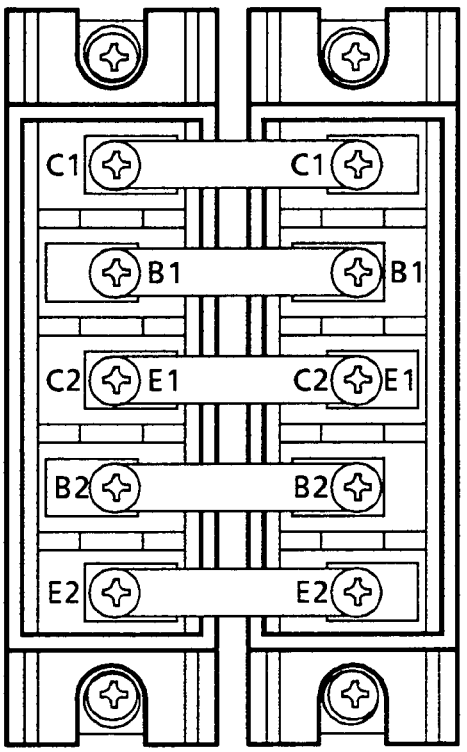
(continued)

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

STEP 1 – Remove input power to the Drive. Before proceeding, wait (60) seconds. **DS1**, the bus charged neon light on Bus Indicator Board **A41** 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 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 9	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 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, 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 **OVERLOAD** LED on the Modulator Logic Board should light when the current reaches a nominal value of 110%. If the **OVERLOAD** 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 10	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 11	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 12	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (60) seconds when input power is removed. Neon light **DS1** on Bus Indicator Board A41 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 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 at Voltage Sensing Board A4, connector **J402**, between pins **5** (+ BUS) and **1** (– BUS). 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 Bus Indicator Board A41.

Bulletin 1335 56 & 69 Amp Troubleshooting

56 & 69 Amp Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Overload Protection – When constantly illuminated indicates an over current 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 180%
- 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 180%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

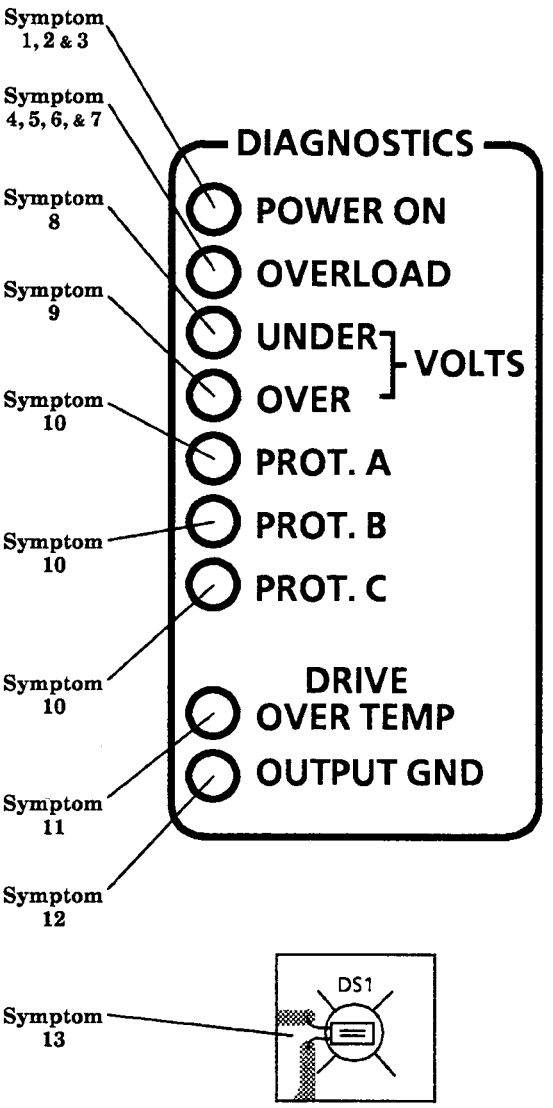
"C" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 180%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

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

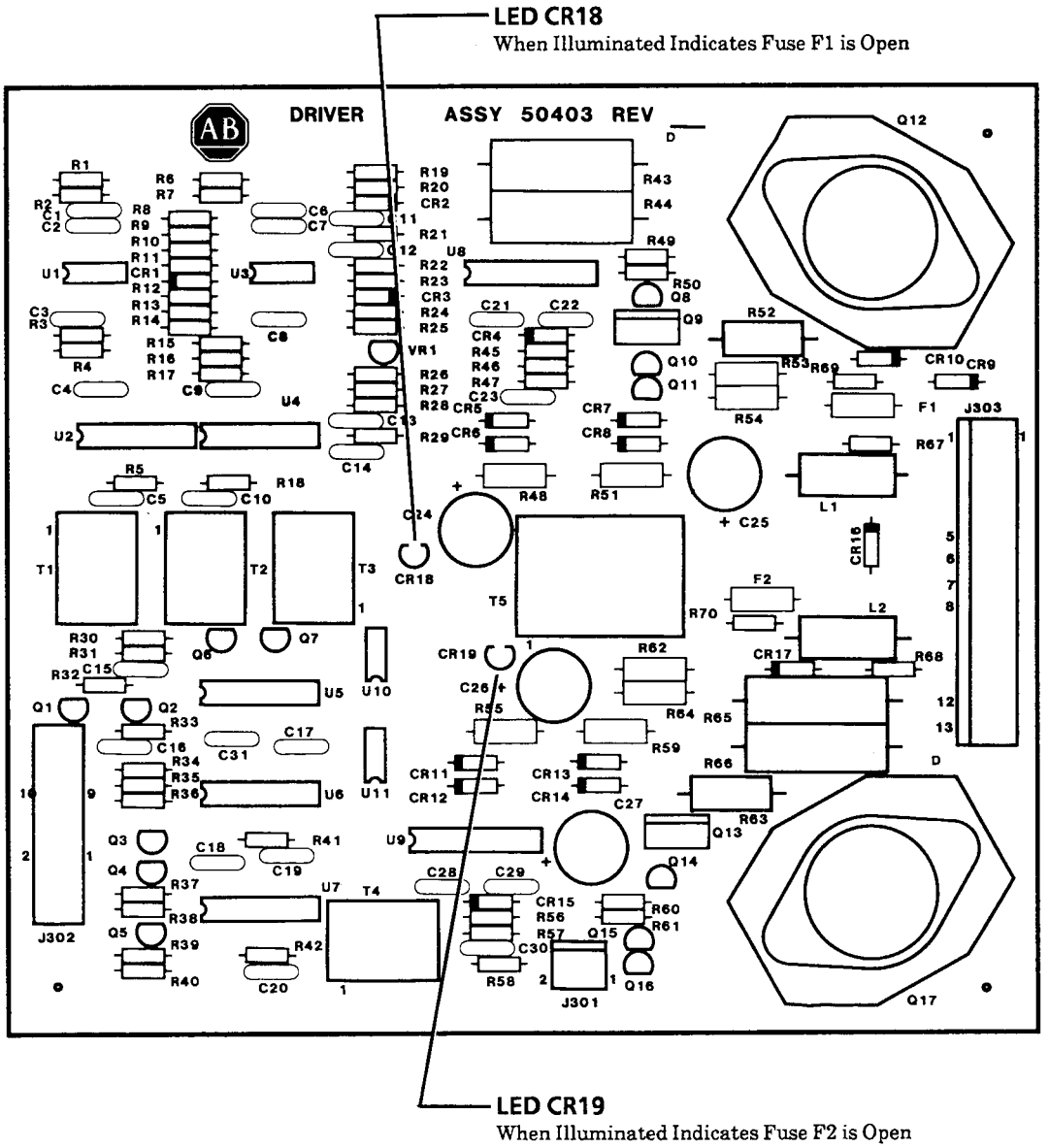
Output Ground Fault Protection Trip Indication – When illuminated indicates that the Drive circuitry has shorted to GROUND.

DS1 – Located on Bus Indicator Board A41 – When illuminated indicates that the bus potential is in excess of 42V DC.



56 & 69 Amp Driver Board LED Indication

There are no adjustment settings for Bulletin 1335 56 & 69 Amp 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 10** in the following troubleshooting procedures.



56 & 69 Amp 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** through **C-5**.

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

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 Indicator Board A41 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.**

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

That the **Speed Pot** or speed reference is set to **MINIMUM**.

That the **AUTO/OFF/MAN Switch** (if present), is in the proper position.

That the **DRIVE/OFF/BYPASS Switch** (if present), is in the proper position.

That the motor is uncoupled 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 any voltage is not present, check the AC line source for an open or missing phase. 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 (60) seconds. The Bus Indicator neon light on Bus Indicator Board A41 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.

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 any voltage is not present, check the AC line source for an open or missing phase. 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, 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 T19 or T20 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 **OVERLOAD** 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 **OVERLOAD** 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. Replace if required and check voltage again. If voltage is not present, replace Driver Power Supply Board A10. If voltage is present, perform the diagnostic procedure in **Symptom 5**.

Symptom 5	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **OVERLOAD** 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 **OVERLOAD** LED indicates that the Drive has tripped off due to a nominal 110% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or startup (breakaway), it is normal for the Overload LED to illuminate momentarily. This merely indicates that a momentary overload current of 110% has been sensed and that the Overload circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the Overload LED is constantly activated during startup (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 **OVERLOAD** 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, Drives Distributor, or Sales Office 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 Overload LED on the Diagnostic Display Panel.*

Symptom 7	DIAGNOSTIC PROCEDURE
Red **OVERLOAD** 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, Drives Distributor, or Sales Office.

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 180% 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 180% 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 180% 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, Drives Distributor, or Sales Office 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 (60) seconds. **DS1**, the bus charged neon light on Bus Indicator Board A41 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.

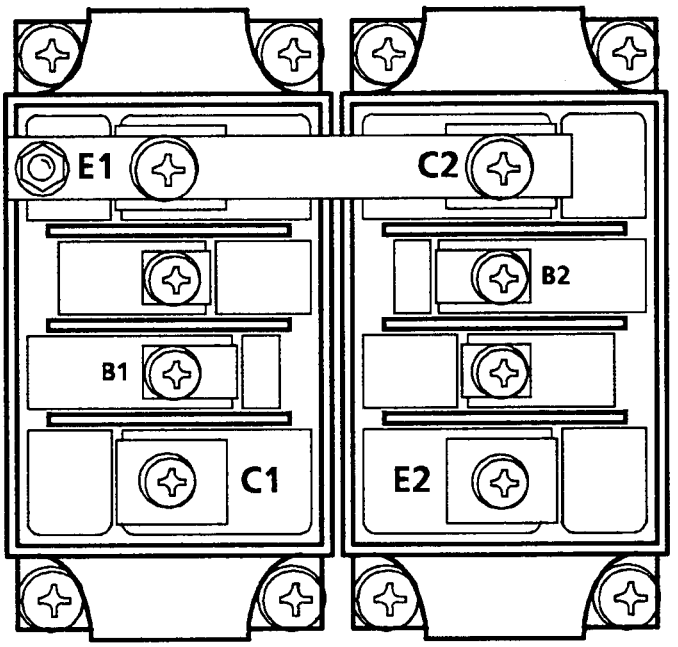
Symptom 10

(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

Connections Listed in Step 2 are shown in detail on page C-4



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)**.

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.

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 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, 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 **OVERLOAD** LED on the Modulator Logic Board should light when the current reaches a nominal value of 110%. If the **OVERLOAD** 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 11	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 12	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 13	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (60) seconds when input power is removed. Neon light **DS1** on Bus Indicator Board A41 is illuminated. Red **OVERLOAD** LED may or may not be illuminated.	After input power is removed the bus voltage should discharge to 42V DC in approximately (60) seconds if the discharge cycle is taking place. **STEP 1** - If the **OVERLOAD** LED is illuminated, 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. Replace if required and check voltage again. If voltage is still not present, replace Driver Power Supply Board A10. **STEP 2** - If the **OVERLOAD** LED is not illuminated, 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 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 by measuring the DC Bus voltage at Voltage Sensing Board A5, connector **J402**, between pins **5** (+ BUS) and **1** (– BUS). After approximately (60) seconds the voltage should be below 42V DC. If discharge cycle is still not taking place and/or either resistor opens again, replace Voltage Sensing Board A41.

Bulletin 1335 77 & 96 Amp Troubleshooting

77 & 96 Amp Diagnostic LED Display

Power ON – Indicates input power is connected when illuminated.

Overload Protection – When constantly illuminated indicates an over current 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 180%
- 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 180%
- A Shorted **"B"** Phase Output Transistor
- Section **"B"** of the Driver Board is Malfunctioning

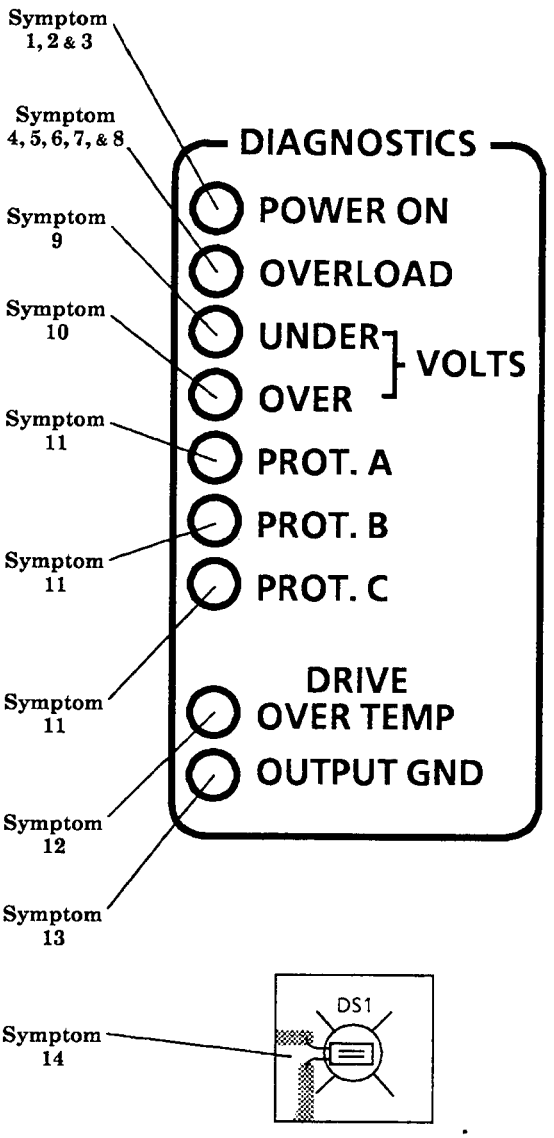
"C" Phase Protection Trip – When illuminated indicates either:

- An Overload Condition Greater Than 180%
- A Shorted **"C"** Phase Output Transistor
- Section **"C"** of the Driver Board is Malfunctioning

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

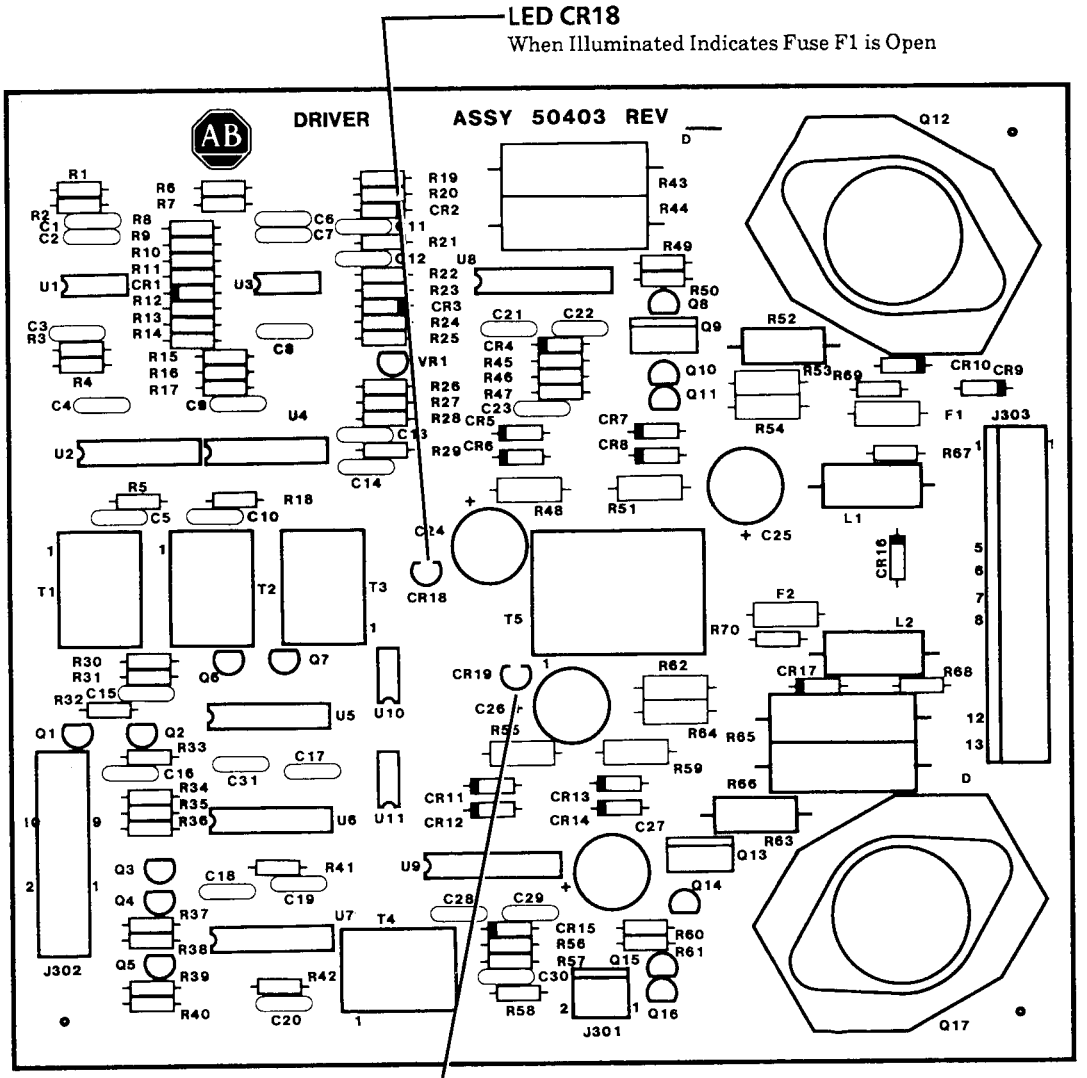
Output Ground Fault Protection Trip Indication – When illuminated indicates that the Drive circuitry has shorted to GROUND.

DS1 – Located on Bus Indicator Board A41 – When illuminated indicates that the bus potential is in excess of 42V DC.



77 & 96 Amp Driver Board LED Indication

There are no adjustment settings for Bulletin 1335 77 & 96 Amp 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.



77 & 96 Amp 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 D** on pages **D-3** through **D-5**.

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

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 Indicator Board A41 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.**

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

That the **Speed Pot** or speed reference is set to **MINIMUM**.

That the **AUTO/OFF/MAN Switch** (if present), is in the proper position.

That the **DRIVE/OFF/BYPASS Switch** (if present), is in the proper position.

That the motor is uncoupled 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 any voltage is not present, check the AC line source for an open or missing phase. 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 (60) seconds. The Bus Indicator neon light on Bus Indicator Board A41 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.

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 any voltage is not present, check the AC line source for an open or missing phase. 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, 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 T21 or T22 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 31V AC is absent, replace 2T. **STEP 9** – If **2T** checks out, Contactor Interface Board A9 may be inoperative. First check input protection fuse **9FU** for an open condition, then the Contactor Interface Board. 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. Current limiting circuit not functioning properly. Red **OVERLOAD** 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.* **STEP 1** – 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. Replace if required and check voltage again. If voltage is not present, replace Driver Power Supply Board A10. If voltage is present, complete **STEP 2**. **STEP 2** – Remove input power to the Drive and check connections between **J4201** on the LEM Board and pins **7** & **8** at connector **J303** on each Driver Board. Check connections between **E6**, **E10** & **E14** on the LEM Board and **E1** on Power Switching Module 1Q1, 2Q1 & 3Q1 respectively. If the problem still cannot be located, consult your nearest Allen-Bradley Area Sales/Support Center, Drives Distributor, or Sales Office for application assistance.

Symptom 5	DIAGNOSTIC PROCEDURE
Drive trips off during normal operation. Red **OVERLOAD** and **PROT. A** fault LEDs are 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.* When both the **OVERLOAD** and **PROT. A** LEDs are illuminated, there may be a loss of input power to the LEM Board. Check fuse **7FU** on fan transformer 3T for an open condition. Check connections between terminals **5** & **6** on transformer 3T and push-on connectors **E1** & **E2** on the LEM Board. 115V AC should be measured. If the problem still cannot be located, consult your nearest Allen-Bradley Area Sales/Support Center, Drives Distributor, or Sales Office for application assistance.

Symptom 6	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **OVERLOAD** 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 **OVERLOAD** LED indicates that the Drive has tripped off due to a nominal 110% overload condition which has exceeded the (60) second time period. **IMPORTANT** : *During acceleration or startup (breakaway), it is normal for the Overload LED to illuminate momentarily. This merely indicates that a momentary overload current of 110% has been sensed and that the Overload circuit has been activated. The LED will also flash momentarily when AC line power is first applied.* If the Overload LED is constantly activated during startup (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 **OVERLOAD** 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, Drives Distributor, or Sales Office 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 Overload LED on the Diagnostic Display Panel.*

Symptom 8	DIAGNOSTIC PROCEDURE
Red **OVERLOAD** 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** and Contactor Interface Board protection fuse **9FU** 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, Drives Distributor, or Sales Office.

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 180% 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 180% 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 180% 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, Drives Distributor, or Sales Office 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 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.	• **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 (60) seconds. **DS1**, the bus charged neon light on Bus Indicator Board A41 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.

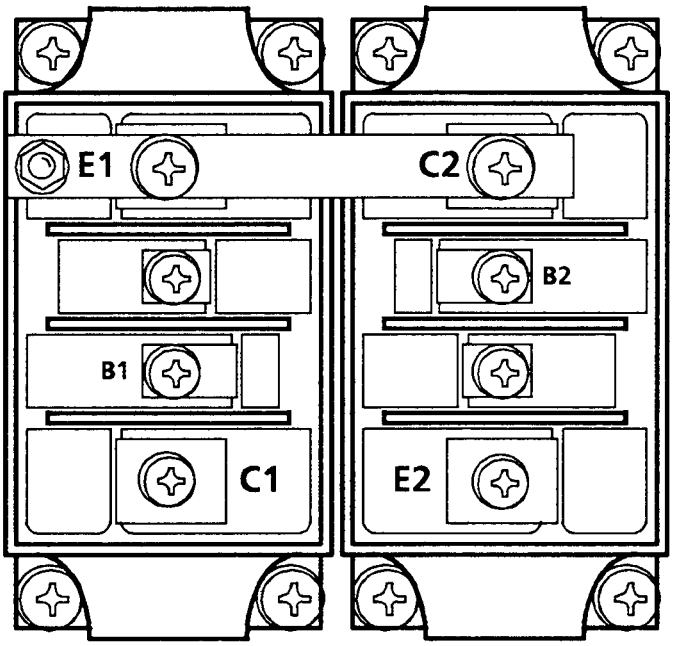
Symptom 11

(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

Connections Listed in Step 2 are shown in detail on page D-4



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**).

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.

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 **OVERLOAD** LED on the Modulator Logic Board should light when the current reaches a nominal value of 110%. If the **OVERLOAD** 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 **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.*

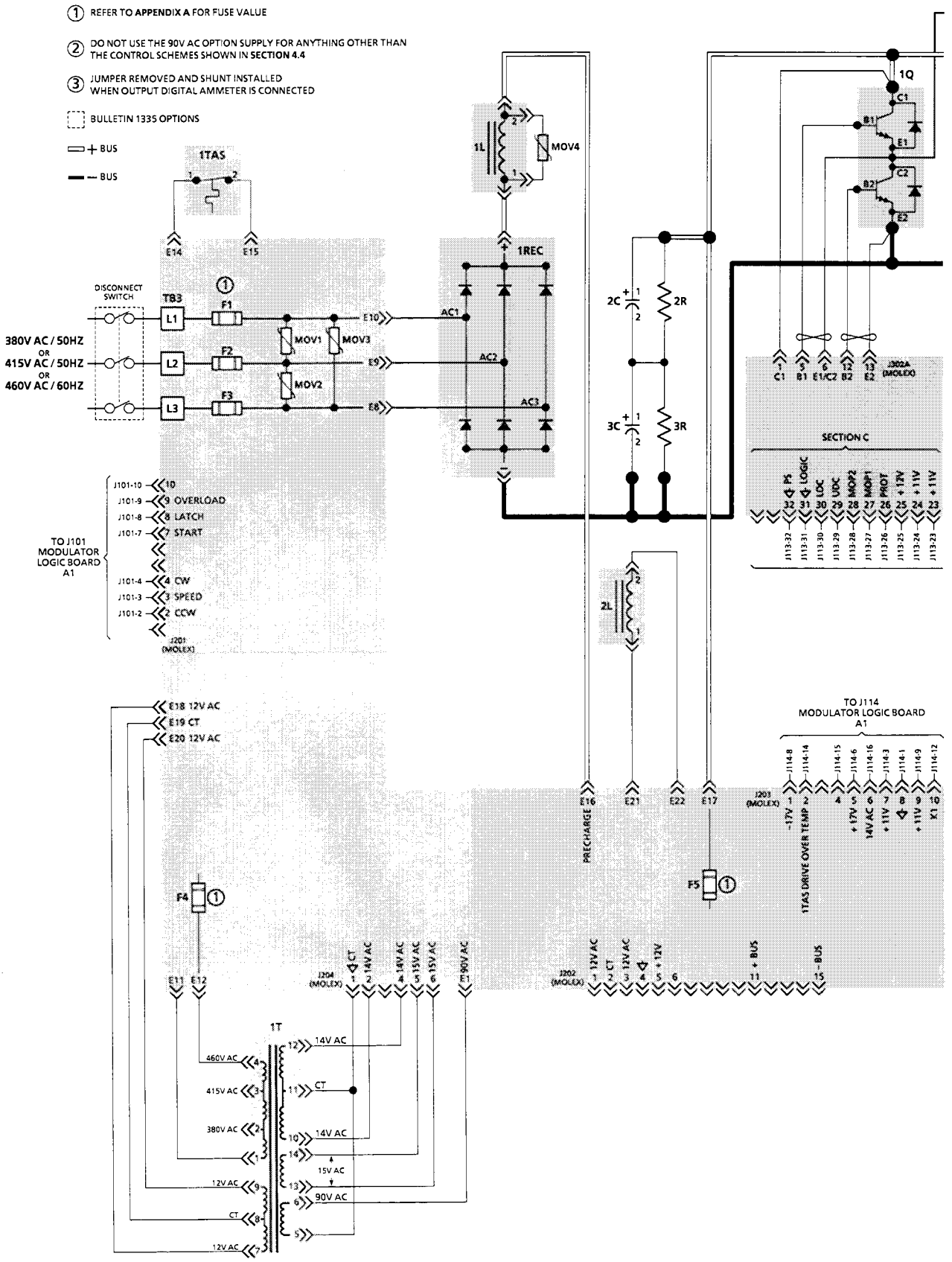
Symptom 13	DIAGNOSTIC PROCEDURE
Drive starts momentarily then trips off or Drive trips off during normal operation. Red **OUTPUT GND** fault LED is illuminated.	**IMPORTANT** : *If the Drive will not restart or reset after a fault trip, always check fuse 5FU for an open condition. Replace if necessary.* 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.

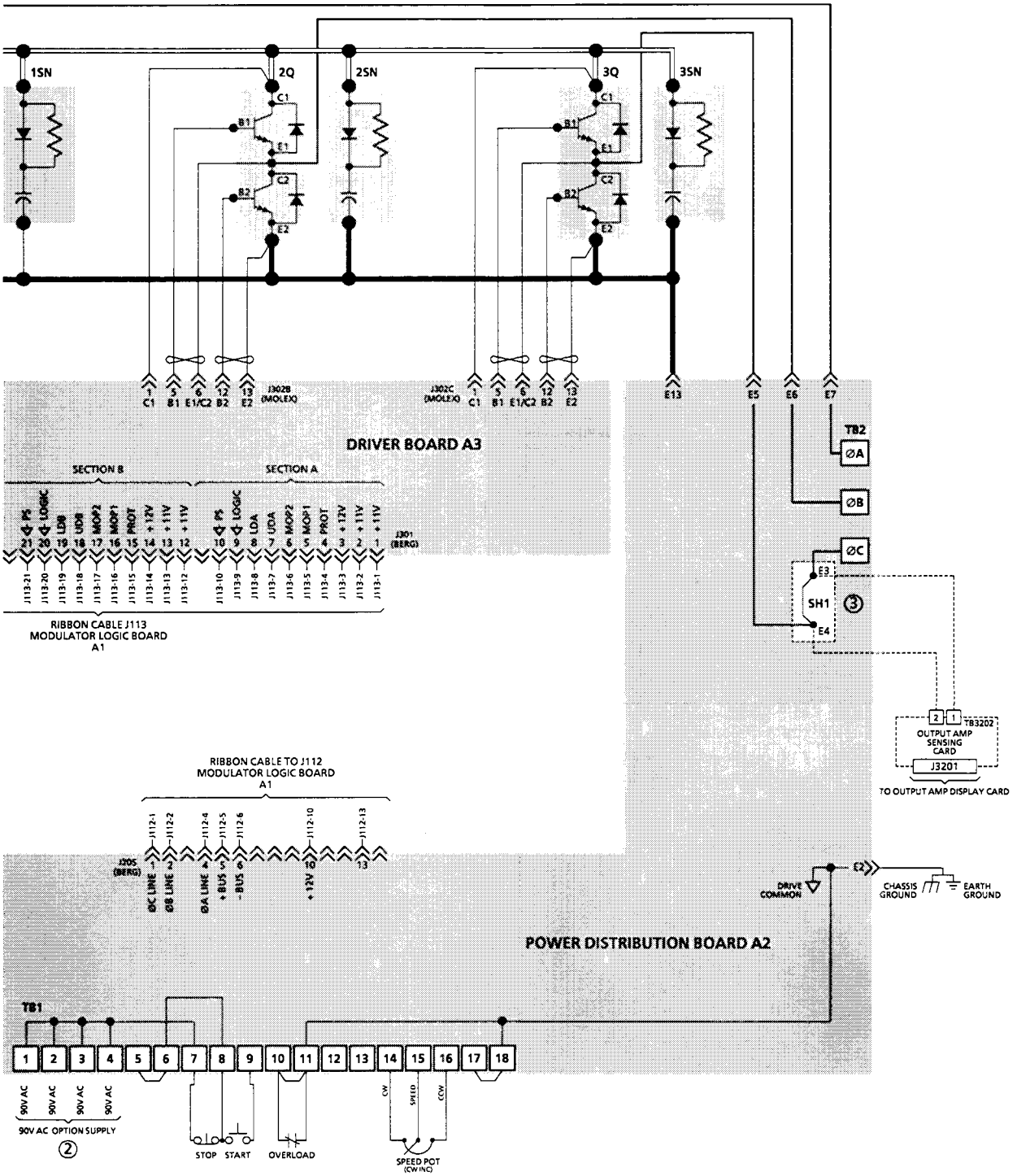
Symptom 14	DIAGNOSTIC PROCEDURE
Bus voltage does not discharge within (60) seconds when input power is removed. Neon light **DS1** on Bus Indicator Board A41 is illuminated. Red **OVERLOAD** LED may or may not be illuminated.	After input power is removed the bus voltage should discharge to 42V DC in approximately (60) seconds if the discharge cycle is taking place. **STEP 1** - If the **OVERLOAD** LED is illuminated, 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. Replace if required and check voltage again. If voltage is still not present, replace Driver Power Supply Board A10. **STEP 2** - If the **OVERLOAD** LED is not illuminated, 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 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 by measuring the DC Bus voltage at Voltage Sensing Board A5, connector **J402**, between pins **5** (+ BUS) and **1** (– BUS). After approximately (60) seconds the voltage should be below 42V DC. If discharge cycle is still not taking place and/or either resistor opens again, replace Voltage Sensing Board A41.

I

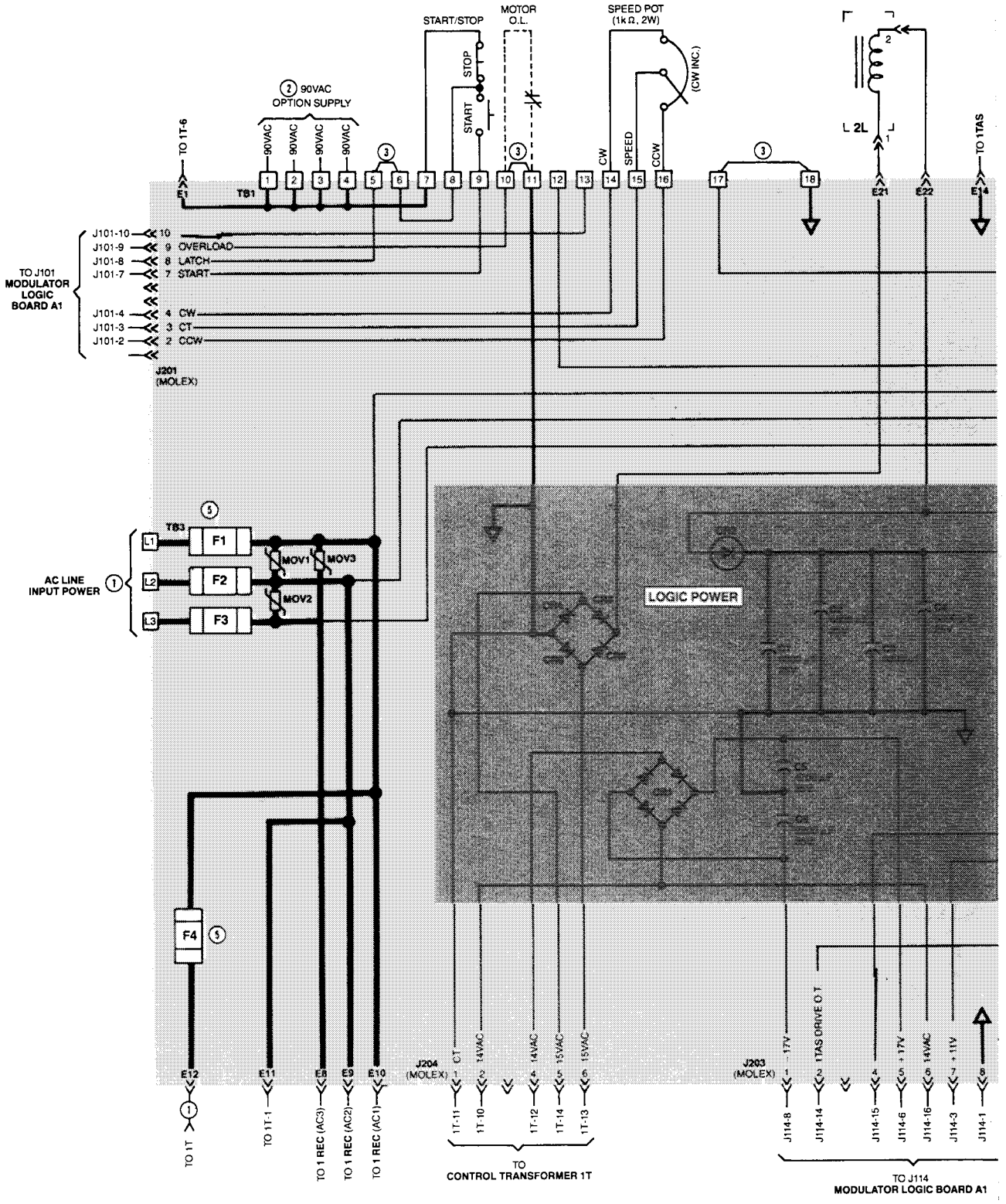
Bulletin 1335 12 & 16 Amp Drive Schematics

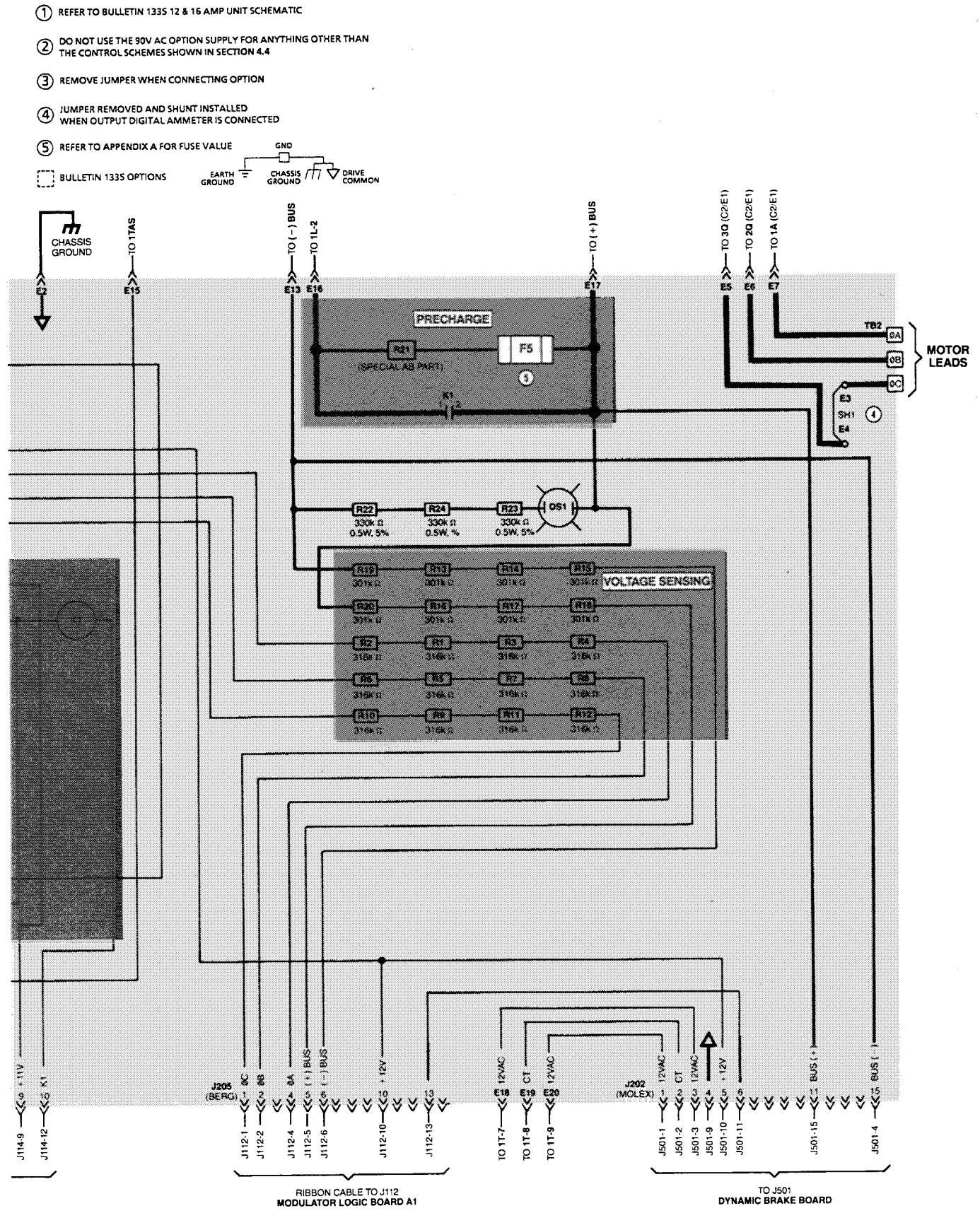
12 & 16 Amp Unit Schematic




1SN
2Q
2SN
3Q
3SN
C1
B1
E1
C2
B2
E2
J302B (MOLEX)
J302C (MOLEX)
E13
E5
E6
E7
TB2
ØA
ØB
ØC
E3
SH1
E4
DRIVER BOARD A3
SECTION B
SECTION A
RIBBON CABLE J113
MODULATOR LOGIC BOARD
A1
TB3202
OUTPUT AMP SENSING CARD
J3201
TO OUTPUT AMP DISPLAY CARD
RIBBON CABLE TO J112
MODULATOR LOGIC BOARD
A1
DRIVE COMMON
CHASSIS GROUND
EARTH GROUND
POWER DISTRIBUTION BOARD A2
TB1
90V AC
90V AC OPTION SUPPLY
STOP
START
OVERLOAD
CW
SPEED
CCW
SPEED POT (CW INC)

12 & 16 Amp Power Distribution Board Schematic



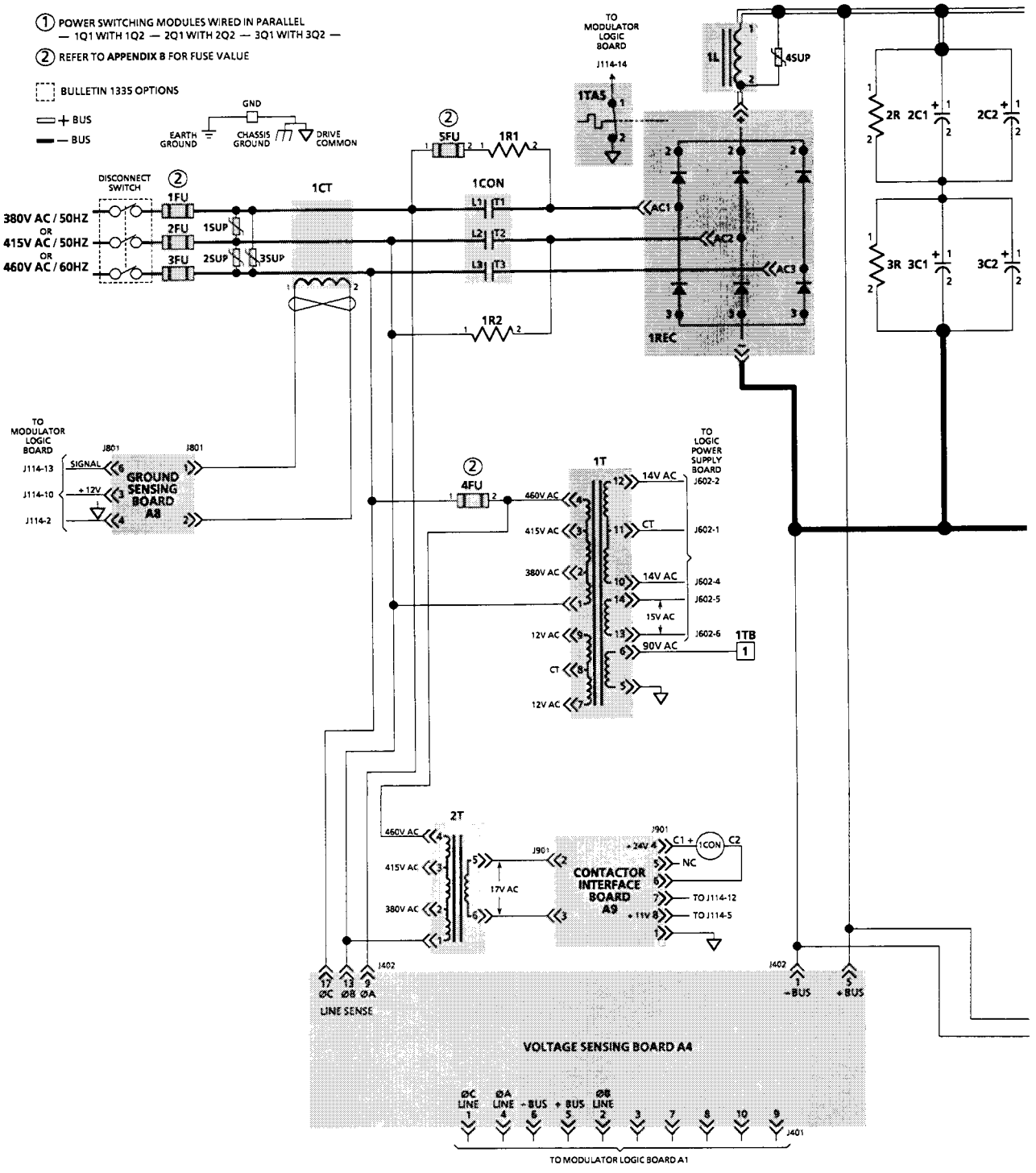

1 REFER TO BULLETIN 1335 12 & 16 AMP UNIT SCHEMATIC
2 DO NOT USE THE 90V AC OPTION SUPPLY FOR ANYTHING OTHER THAN THE CONTROL SCHEMES SHOWN IN SECTION 4.4
3 REMOVE JUMPER WHEN CONNECTING OPTION
4 JUMPER REMOVED AND SHUNT INSTALLED WHEN OUTPUT DIGITAL AMMETER IS CONNECTED
5 REFER TO APPENDIX A FOR FUSE VALUE
BULLETIN 1335 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
TB2
9A
9B
9C
MOTOR LEADS
E3
SH1
E4
R22 330k Ω 0.5W, 5%
R24 330k Ω 0.5W, %
R23 330k Ω 0.5W, 5%
DS1
VOLTAGE SENSING
R13 301k Ω
R14 301k Ω
R15
R16 301k Ω
R17 301k Ω
R18 301k Ω
R2 316k Ω
R1 316k Ω
R3 316k Ω
R4 316k Ω
R5 316k Ω
R7 316k Ω
R8 316k Ω
R10 316k Ω
R9 316k Ω
R11 316k Ω
R12 316k Ω
J114-9 + 11V
J114-12 K1
J205 (BERG)
J112-1 9C
J112-2 9B
J112-4 9A
J112-5 (+) BUS
J112-6 (-) BUS
J112-10 + 12V
J112-13
E18 12VAC
E19 CT
E20 12VAC
TO 1T-7
TO 1T-8
TO 1T-9
J202 (MOLEX)
J501-1 12VAC
J501-2 CT
J501-3 12VAC
J501-9
J501-10 + 12V
J501-11
J501-15 BUS (+)
J501-4 BUS (-)
RIBBON CABLE TO J112
MODULATOR LOGIC BOARD A1
TO J501
DYNAMIC BRAKE BOARD

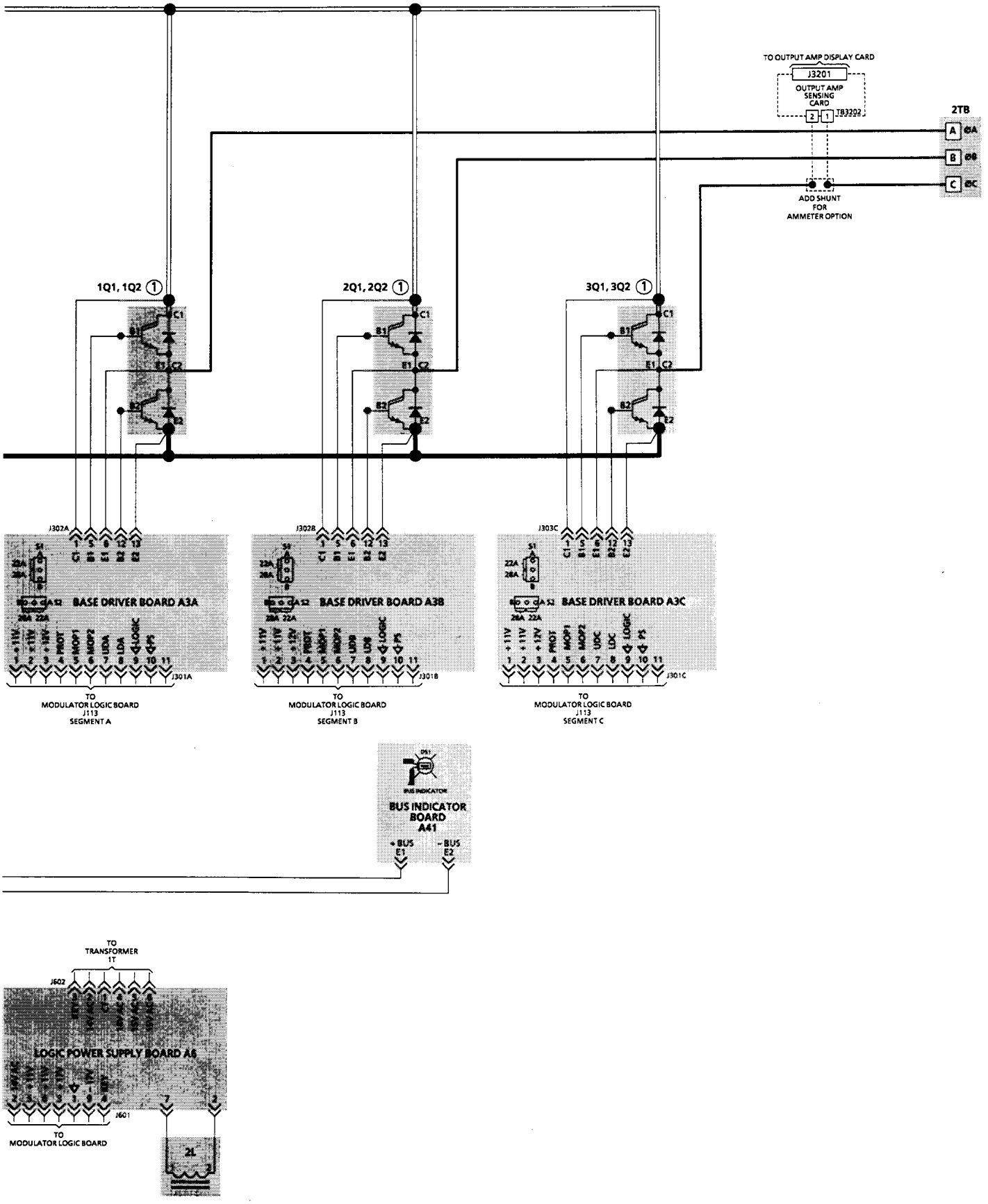
Appendix

J

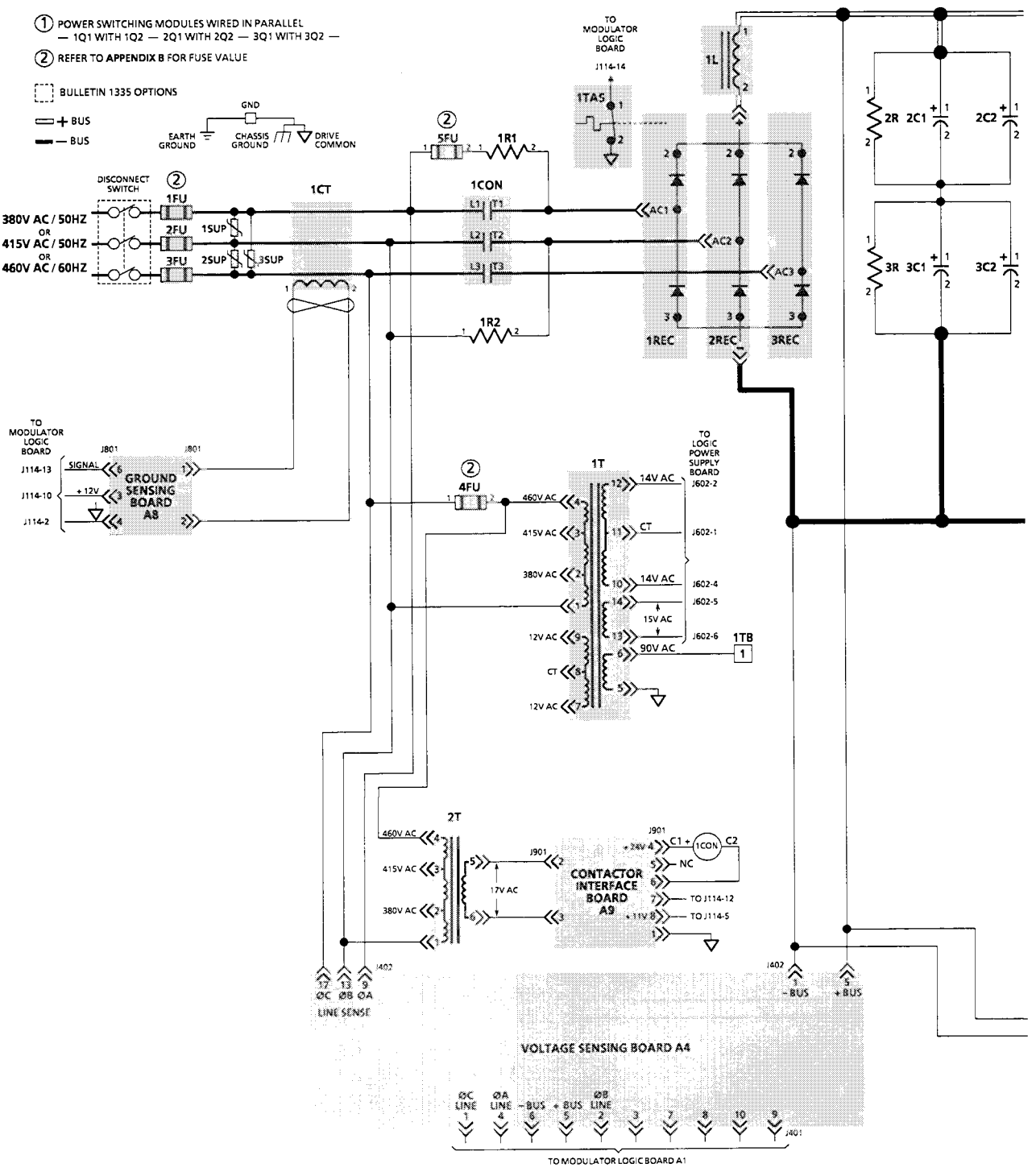
Bulletin 1335 22, 28 & 36 Amp Unit Schematics

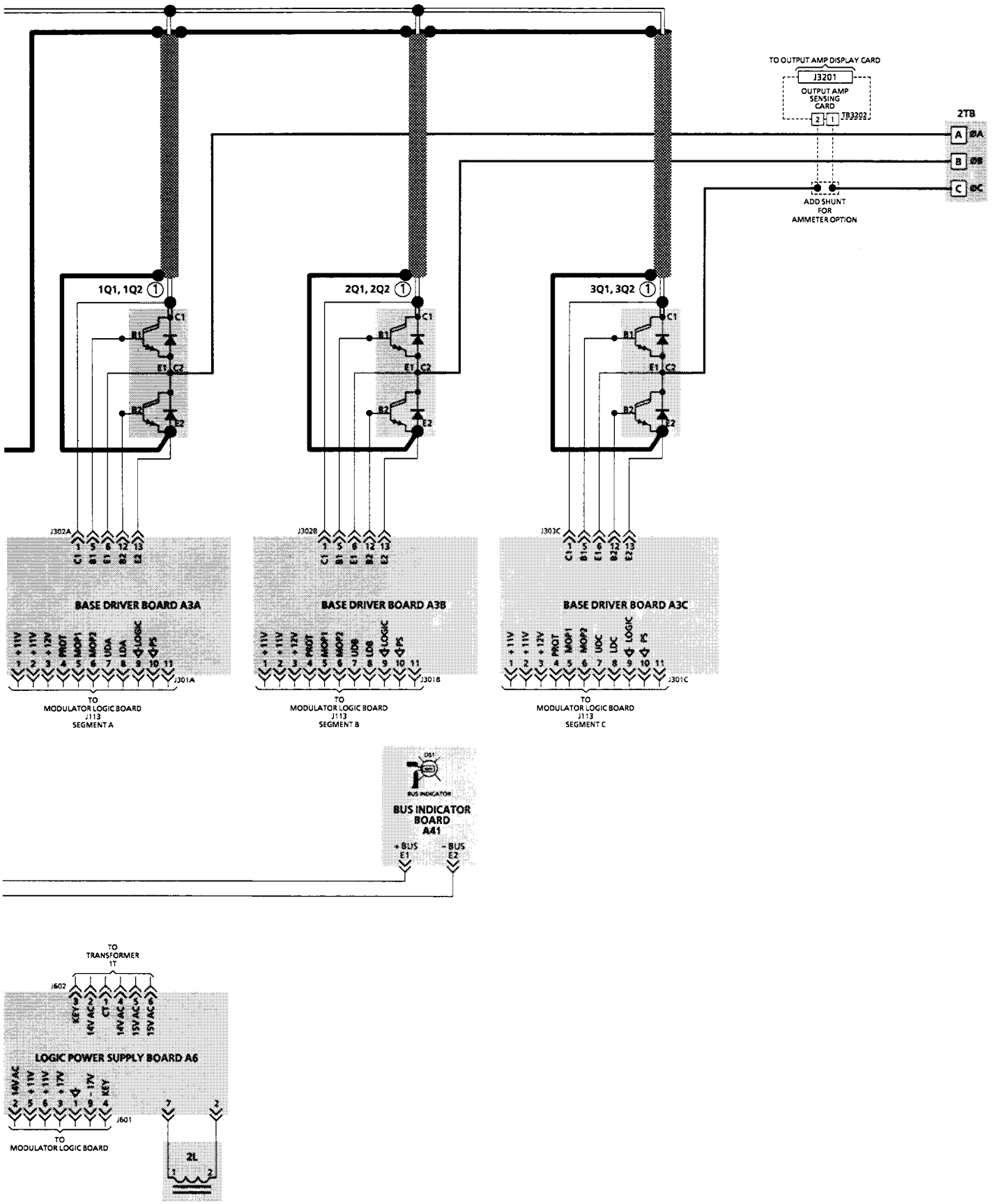
22 & 28 Amp Unit Schematic




TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
2TB
ADD SHUNT FOR AMMETER OPTION
1Q1, 1Q2
2Q1, 2Q2
3Q1, 3Q2
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
BUS INDICATOR BOARD A41
TO TRANSFORMER 1T
LOGIC POWER SUPPLY BOARD A6
TO MODULATOR LOGIC BOARD

36 Amp Unit Schematic



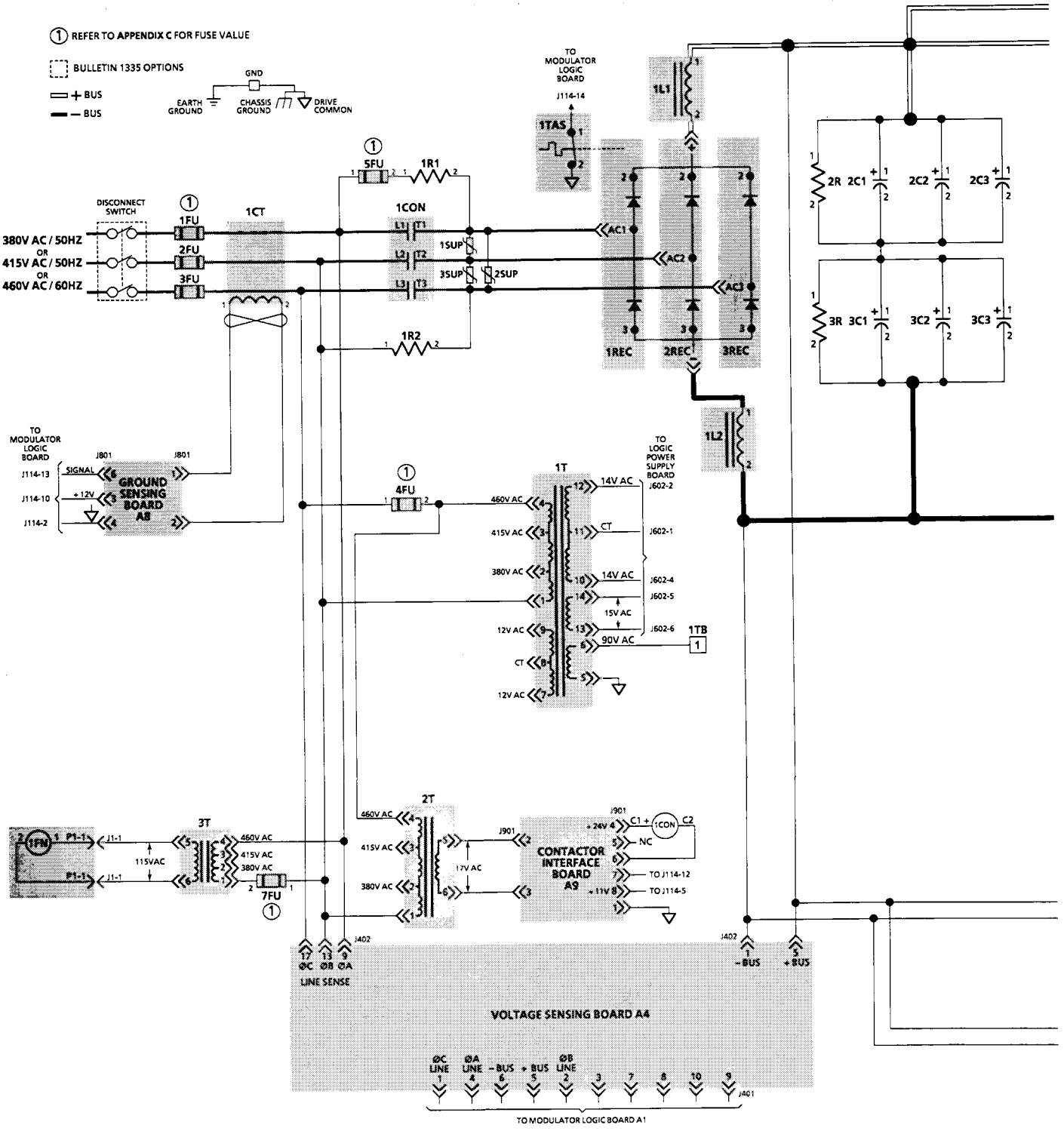

TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
2TB
ØA
ØB
ØC
ADD SHUNT FOR AMMETER OPTION
1Q1, 1Q2
2Q1, 2Q2
3Q1, 3Q2
C1
B1
E1
C2
B2
E2
J302A
J302B
J303C
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
+11V
+11V
+12V
PROT
MOP1
MOP2
UDA
LDA
UDB
LDB
LOGIC
PS
J301A
J301B
J301C
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
DS1
BUS INDICATOR
BUS INDICATOR BOARD A41
+BUS
-BUS
E1
E2
TO TRANSFORMER 1T
J602
KEY
16V AC
CT
14V AC
15V AC
15V AC
LOGIC POWER SUPPLY BOARD A6
16V AC
+11V
+11V
+12V
-12V
KEY
J601
TO MODULATOR LOGIC BOARD
2L

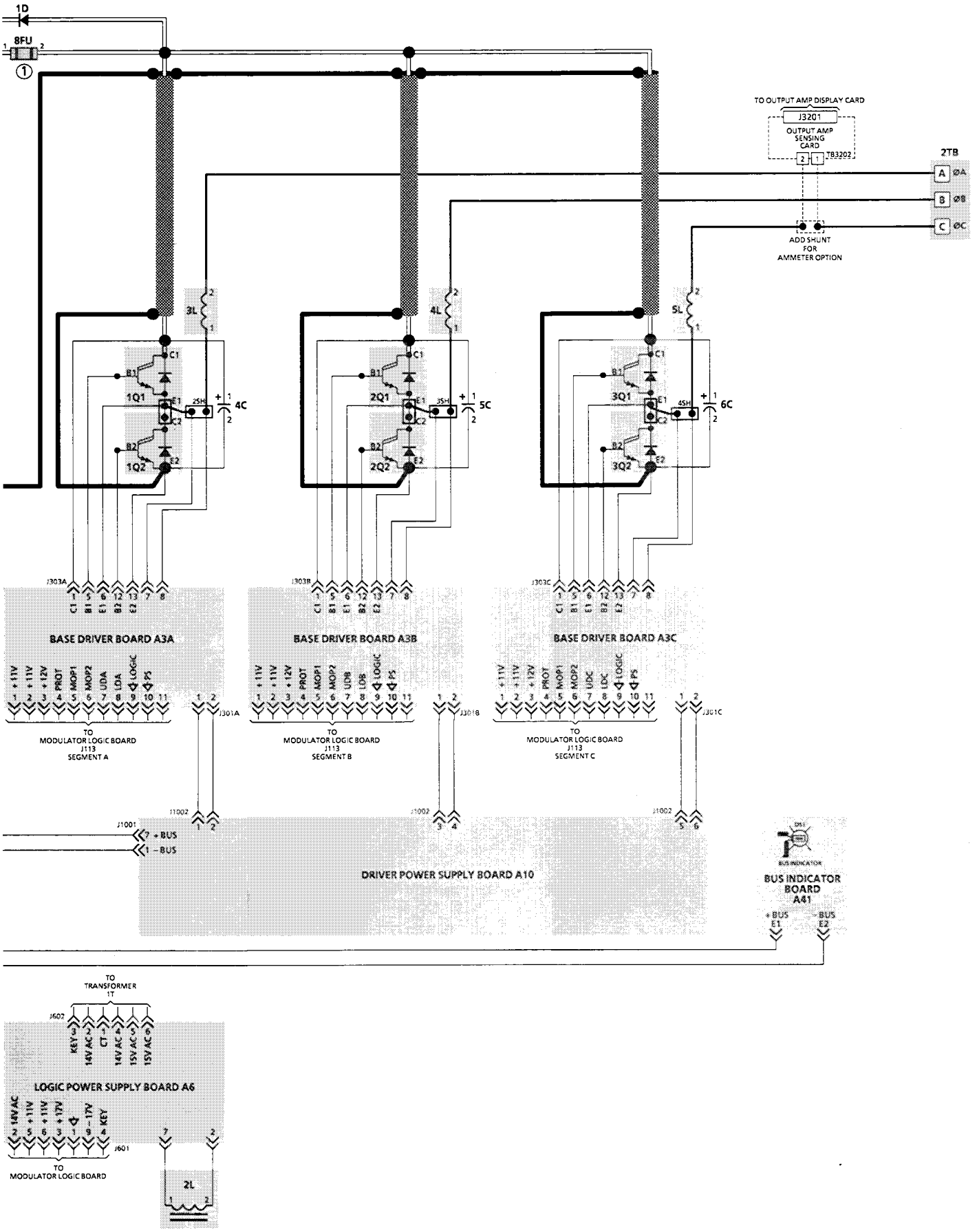
Appendix

K

Bulletin 1335 56 & 69 Amp Unit Schematic

56 & 69 Amp Unit Schematic



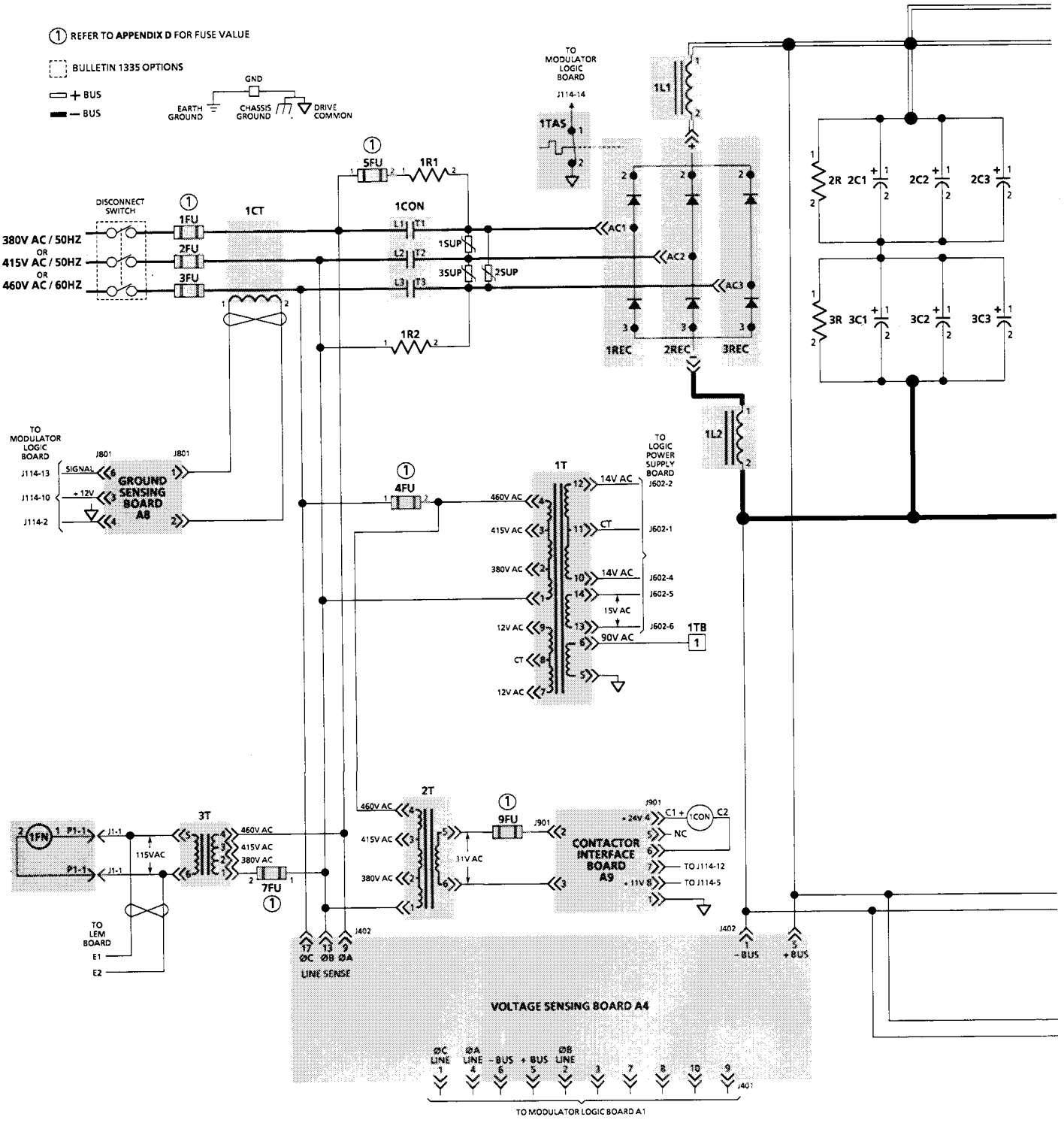

1D
8FU
1
2
TO OUTPUT AMP DISPLAY CARD
J3201
OUTPUT AMP SENSING CARD
TB3202
2TB
A ØA
B ØB
C ØC
ADD SHUNT FOR AMMETER OPTION
3L
4L
5L
1Q1
1Q2
2Q1
2Q2
3Q1
3Q2
4C
5C
6C
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
J1001
+ BUS
– BUS
DRIVER POWER SUPPLY BOARD A10
BUS INDICATOR BOARD A41
TO TRANSFORMER 1T
LOGIC POWER SUPPLY BOARD A6
TO MODULATOR LOGIC BOARD
2L

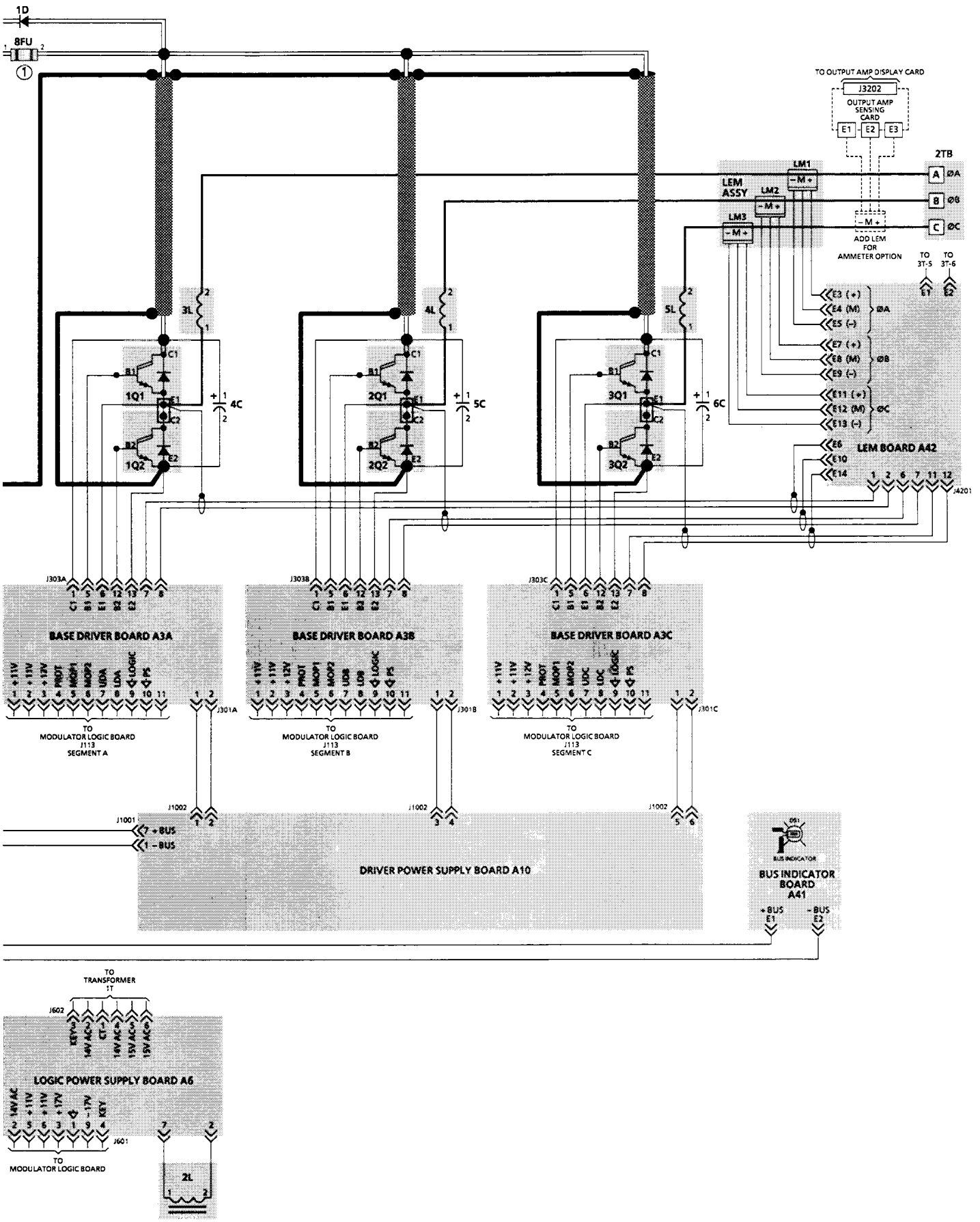
Appendix

L

Bulletin 1335 77 & 96 Amp Unit Schematic

77 & 96 Amp Unit Schematic



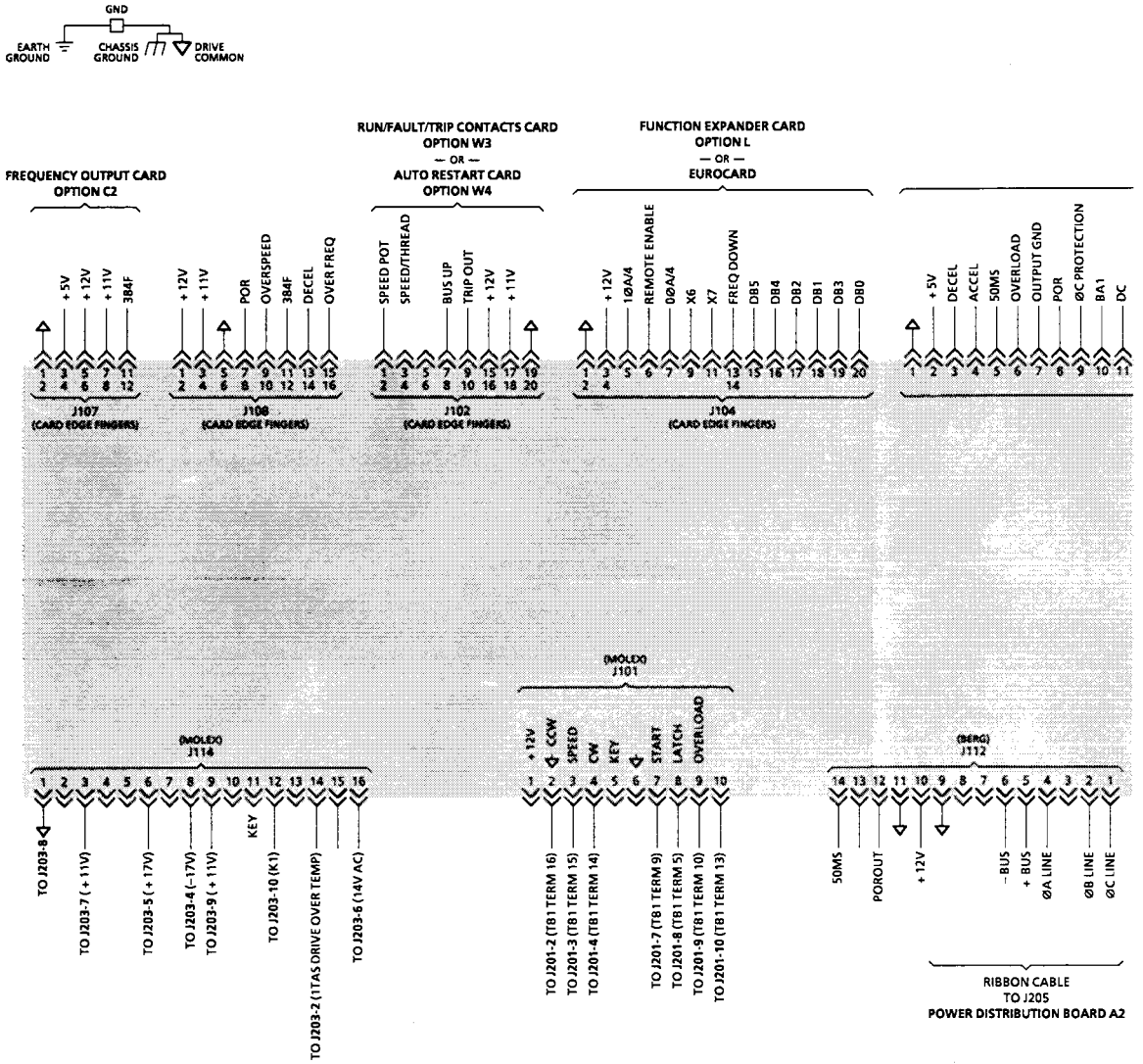

1D
8FU
TO OUTPUT AMP DISPLAY CARD
J3202
OUTPUT AMP SENSING CARD
E1 E2 E3
2TB
A ØA
B ØB
C ØC
LEM ASSY
LM1
LM2
LM3
- M +
ADD LEM FOR AMMETER OPTION
TO 3T-5
TO 3T-6
E1
E2
3L
4L
5L
1Q1
1Q2
2Q1
2Q2
3Q1
3Q2
4C
5C
6C
E3 (+)
E4 (M)
E5 (-)
E7 (+)
E8 (M)
E9 (-)
E11 (+)
E12 (M)
E13 (-)
E6
E10
E14
LEM BOARD A42
J4201
J303A
J303B
J303C
BASE DRIVER BOARD A3A
BASE DRIVER BOARD A3B
BASE DRIVER BOARD A3C
+11V
+11V
+12V
PROT
MOP1
MOP2
UDA
LDA
UDB
LDB
LOGIC
PS
TO MODULATOR LOGIC BOARD J113 SEGMENT A
TO MODULATOR LOGIC BOARD J113 SEGMENT B
TO MODULATOR LOGIC BOARD J113 SEGMENT C
J301A
J301B
J301C
J1002
J1001
+ BUS
- BUS
DRIVER POWER SUPPLY BOARD A10
BUS INDICATOR BOARD A41
+BUS E1
-BUS E2
TO TRANSFORMER 1T
J602
KEY
14V AC
CT
14V AC
15V AC
15V AC
LOGIC POWER SUPPLY BOARD A6
14V AC
+11V
+11V
+17V
-17V
KEY
J601
TO MODULATOR LOGIC BOARD
2L

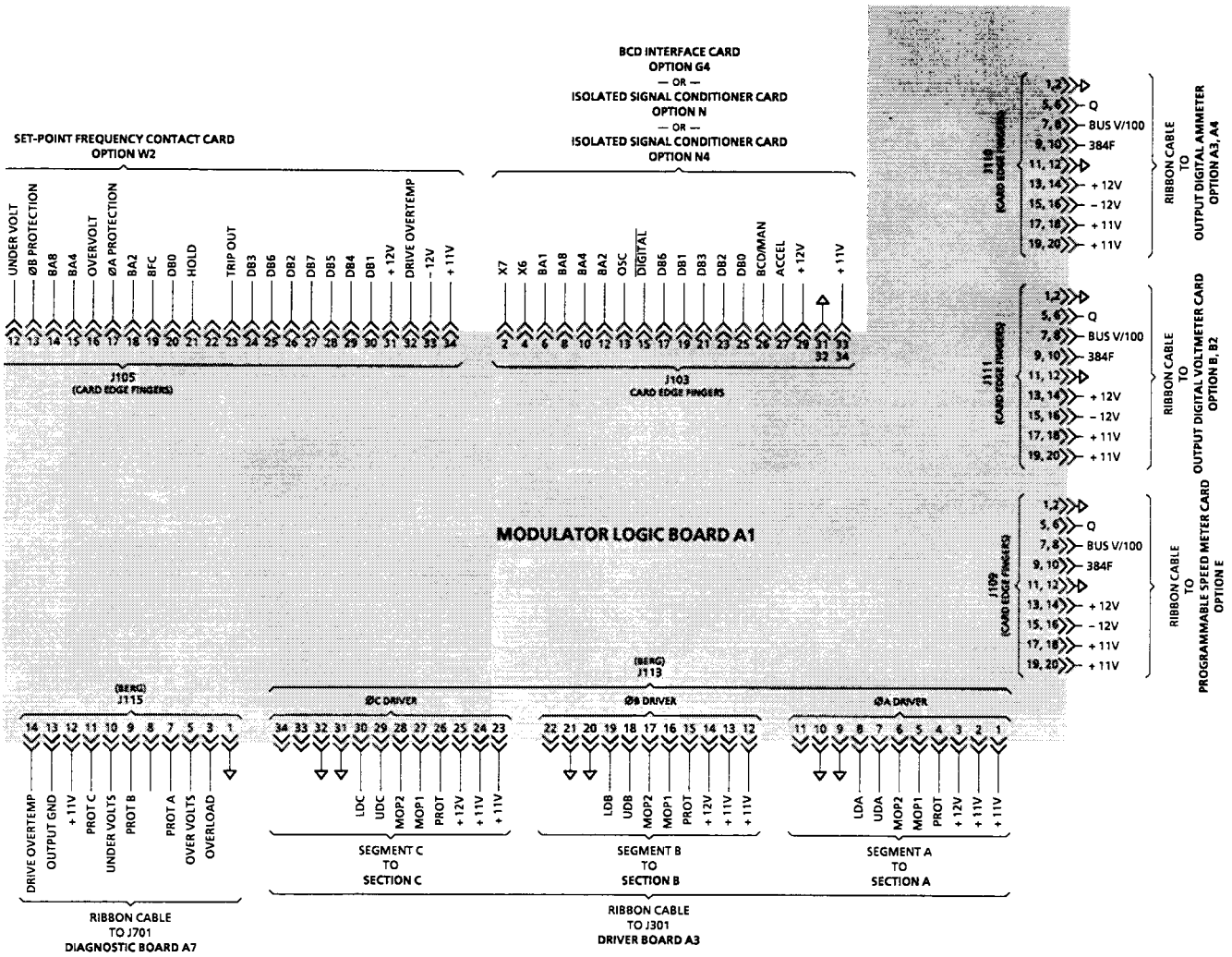
Appendix

M

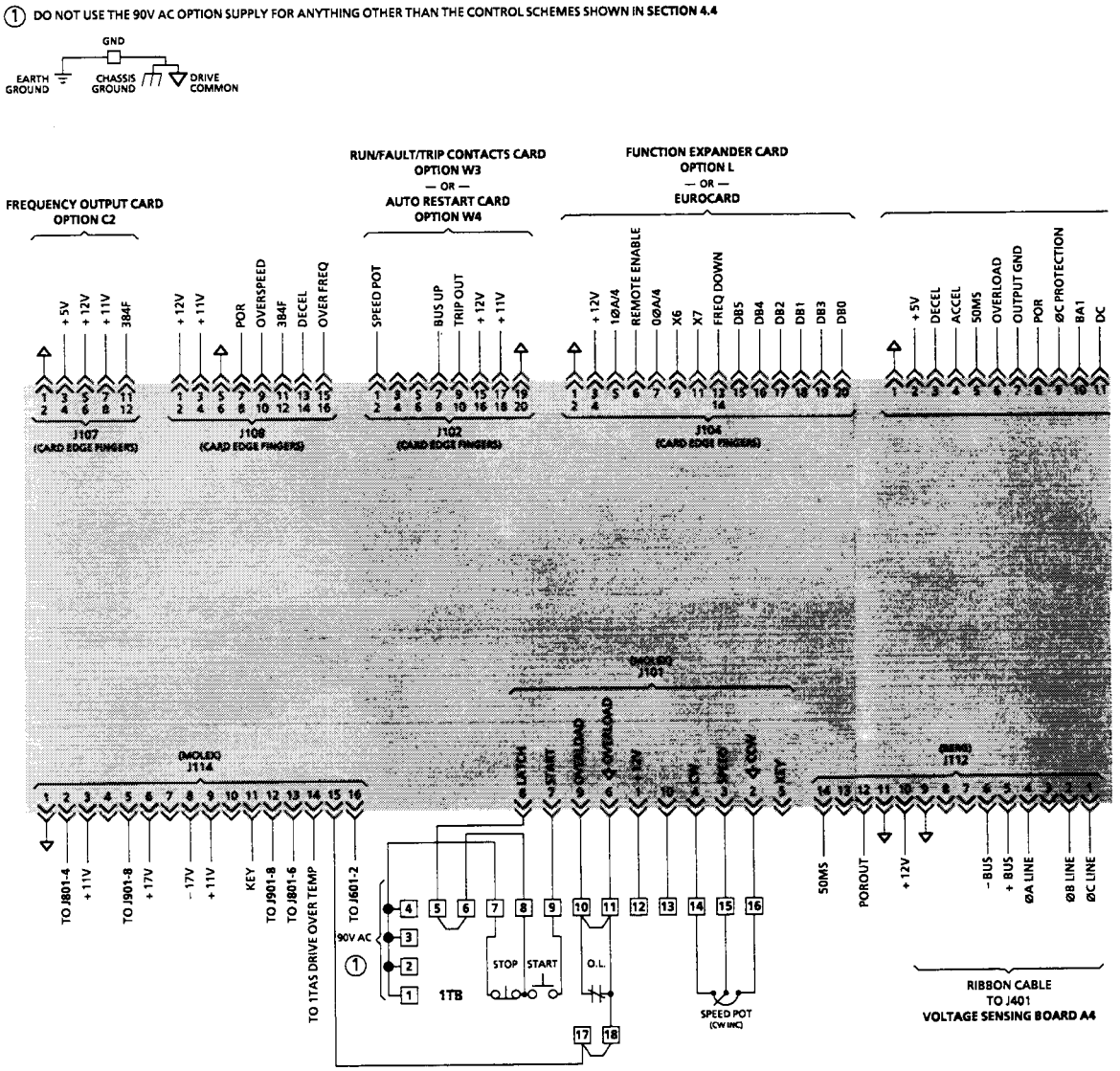
Bulletin 1335 Modulator Logic Board Interconnection Diagrams

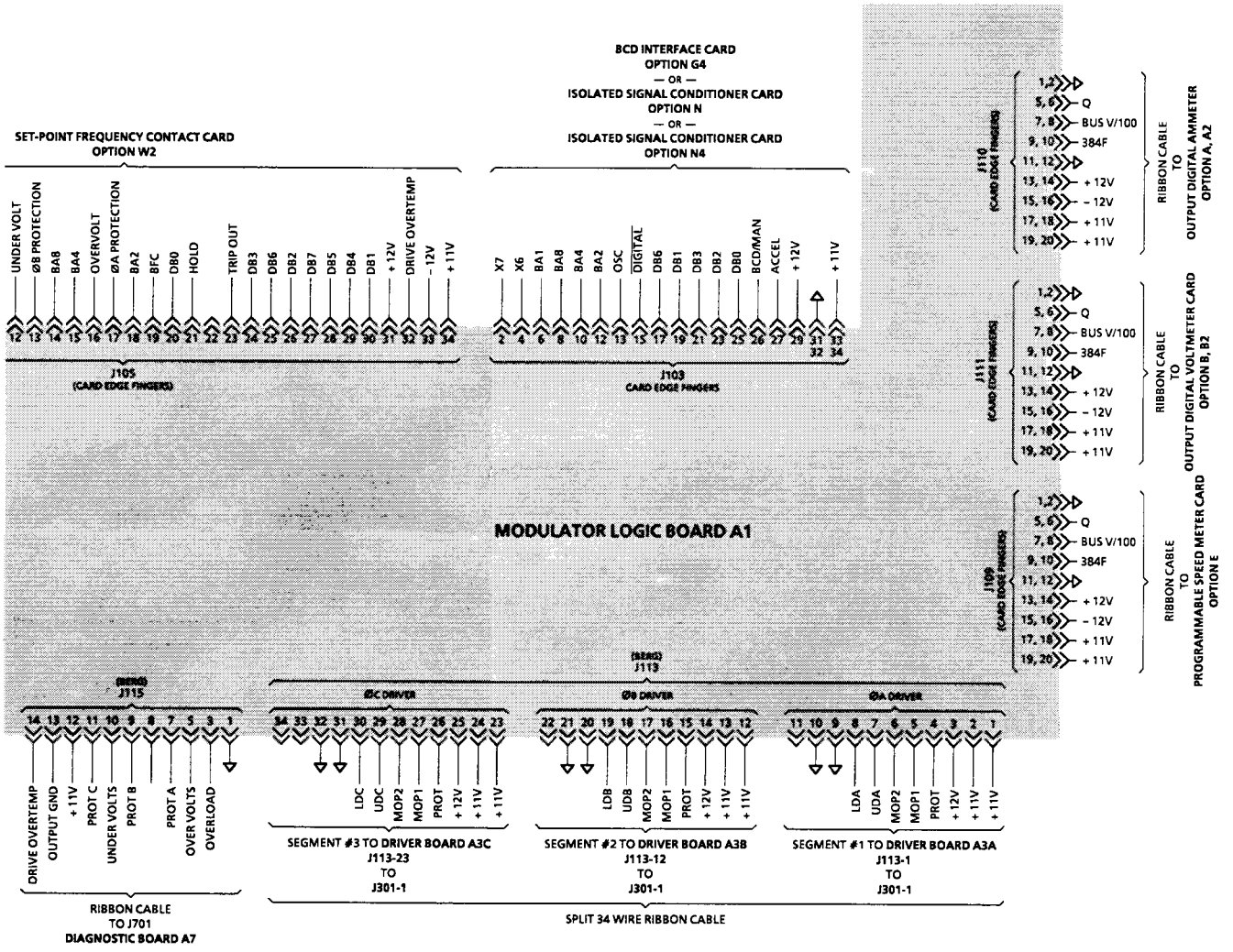
12 & 16 Amp Modulator Logic Board Interconnection Diagram



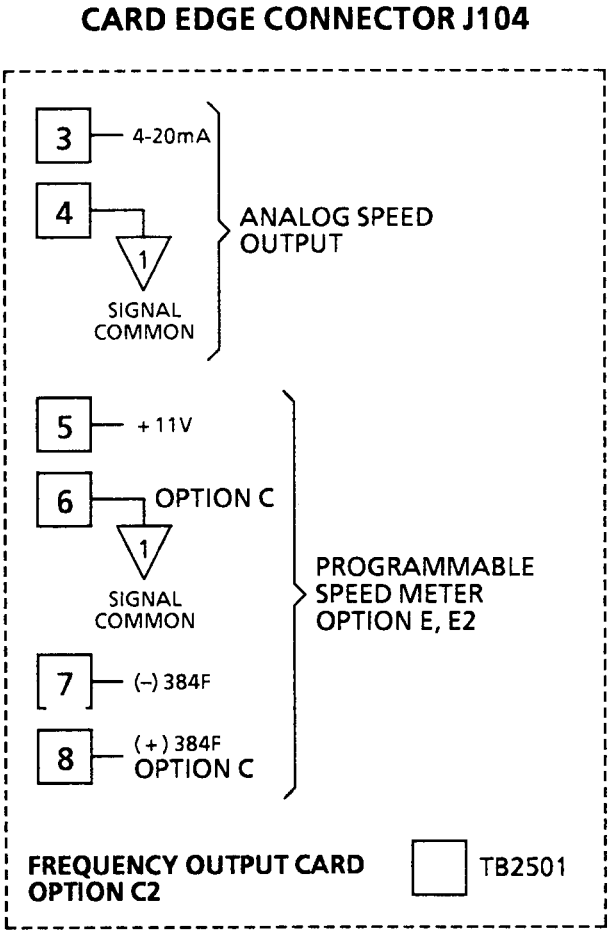

SET-POINT FREQUENCY CONTACT CARD
OPTION W2
UNDER VOLT
ØB PROTECTION
BA8
BA4
OVERVOLT
ØA PROTECTION
BA2
BFC
DB0
HOLD
TRIP OUT
DB3
DB6
DB2
DB7
DB5
DB4
DB1
+ 12V
DRIVE OVERTEMP
– 12V
+ 11V
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
J105
(CARD EDGE FINGERS)
BCD INTERFACE CARD
OPTION G4
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N4
X7
X6
BA1
BA8
BA4
BA2
OSC
DIGITAL
DB6
DB1
DB3
DB2
DB0
BCD/MAN
ACCEL
+ 12V
+ 11V
2 4 6 8 10 12 13 15 17 19 21 23 25 26 27 29 31 32 33 34
J103
CARD EDGE FINGERS
J110
(CARD EDGE FINGERS)
1,2
5,6 Q
7,8 BUS V/100
9,10 384F
11,12
13,14 + 12V
15,16 – 12V
17,18 + 11V
19,20 + 11V
RIBBON CABLE
TO
OUTPUT DIGITAL AMMETER
OPTION A3, A4
J111
(CARD EDGE FINGERS)
1,2
5,6 Q
7,8 BUS V/100
9,10 384F
11,12
13,14 + 12V
15,16 – 12V
17,18 + 11V
19,20 + 11V
RIBBON CABLE
TO
OUTPUT DIGITAL VOLTMETER CARD
OPTION B, B2
MODULATOR LOGIC BOARD A1
J109
(CARD EDGE FINGERS)
1,2
5,6 Q
7,8 BUS V/100
9,10 384F
11,12
13,14 + 12V
15,16 – 12V
17,18 + 11V
19,20 + 11V
RIBBON CABLE
TO
PROGRAMMABLE SPEED METER CARD
OPTION E
(BERG)
J115
14 13 12 11 10 9 8 7 5 3 1
DRIVE OVERTEMP
OUTPUT GND
+ 11V
PROT C
UNDER VOLTS
PROT B
PROT A
OVER VOLTS
OVERLOAD
RIBBON CABLE
TO J701
DIAGNOSTIC BOARD A7
(BERG)
J113
ØC DRIVER
34 33 32 31 30 29 28 27 26 25 24 23
LDC
UDC
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
SEGMENT C
TO
SECTION C
ØB DRIVER
22 21 20 19 18 17 16 15 14 13 12
LDB
UDB
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
SEGMENT B
TO
SECTION B
ØA DRIVER
11 10 9 8 7 6 5 4 3 2 1
LDA
UDA
MOP2
MOP1
PROT
+ 12V
+ 11V
+ 11V
SEGMENT A
TO
SECTION A
RIBBON CABLE
TO J301
DRIVER BOARD A3

22-96 Amp Modulator Logic Board Interconnection Diagram



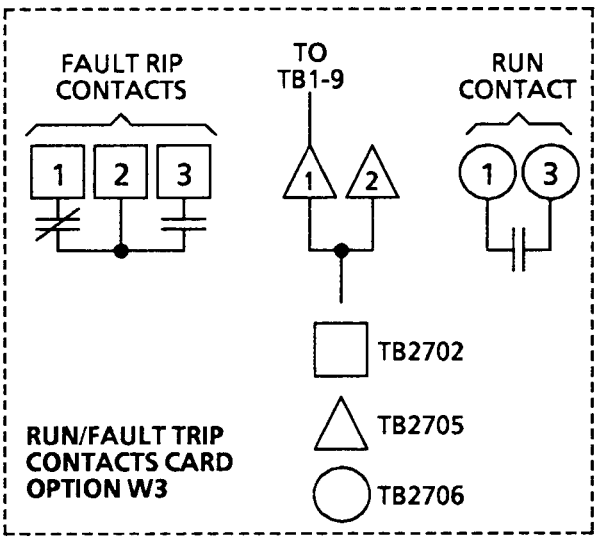

SET-POINT FREQUENCY CONTACT CARD
OPTION W2
BCD INTERFACE CARD
OPTION G4
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N
— OR —
ISOLATED SIGNAL CONDITIONER CARD
OPTION N4
UNDER VOLT
ØB PROTECTION
BA8
BA4
OVERVOLT
ØA PROTECTION
BA2
BFC
DB0
HOLD
TRIP OUT
DB3
DB6
DB2
DB7
DB5
DB4
DB1
+ 12V
DRIVE OVERTEMP
– 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
(CARD EDGE FINGERS)
J111
(CARD EDGE FINGERS)
J109
(CARD EDGE FINGERS)
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
J115
ØC DRIVER
ØB DRIVER
ØA DRIVER
J113
DRIVE OVERTEMP
OUTPUT GND
+ 11V
PROT C
UNDER VOLTS
PROT B
PROT A
OVER VOLTS
OVERLOAD
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 1335 Modulator Logic Board Plug-In Options



Bulletin 1335 Modulator Logic Board Plug-In Options

CARD EDGE CONNECTOR J102



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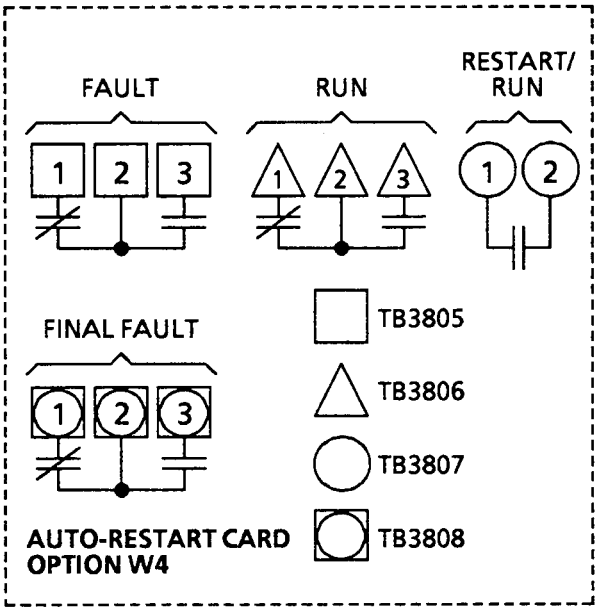
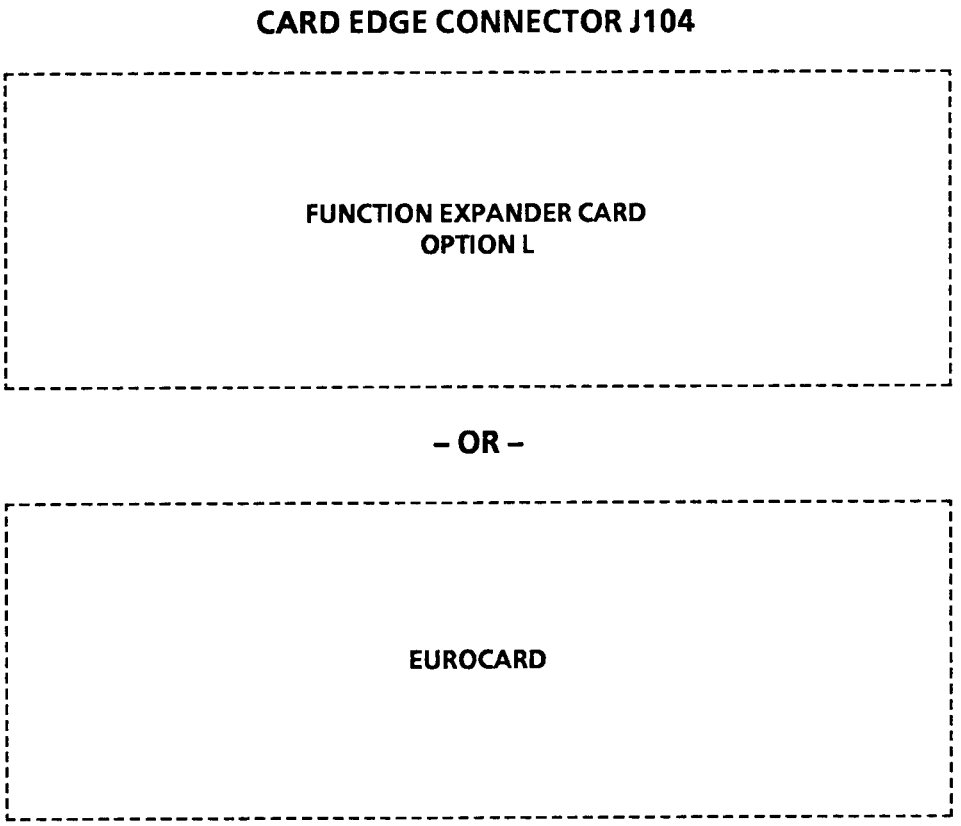


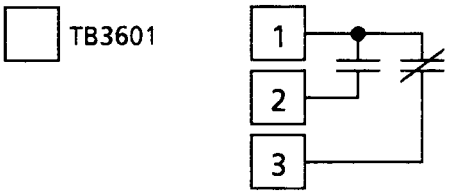
Bulletin 1335 Modulator Logic Board Plug-In Options



Bulletin 1335 Modulator Logic Board Plug-In Options

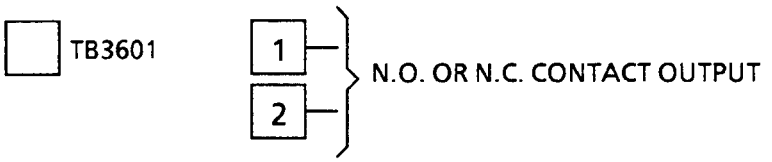
CARD EDGE CONNECTOR J105

SET-POINT FREQUENCY CONTACT CARD
OPTION W2
— REV 4 OR LATER —



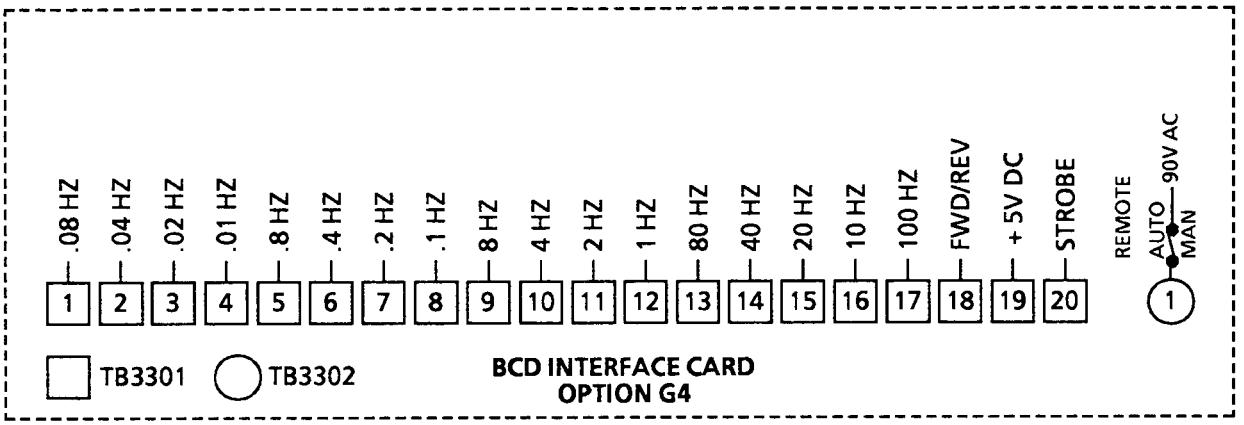
– OR –

SET-POINT FREQUENCY CONTACT CARD
OPTION W2
— REV 3 OR EARLIER —



Bulletin 1335 Modulator Logic Board Plug-In Options

CARD EDGE CONNECTOR J103



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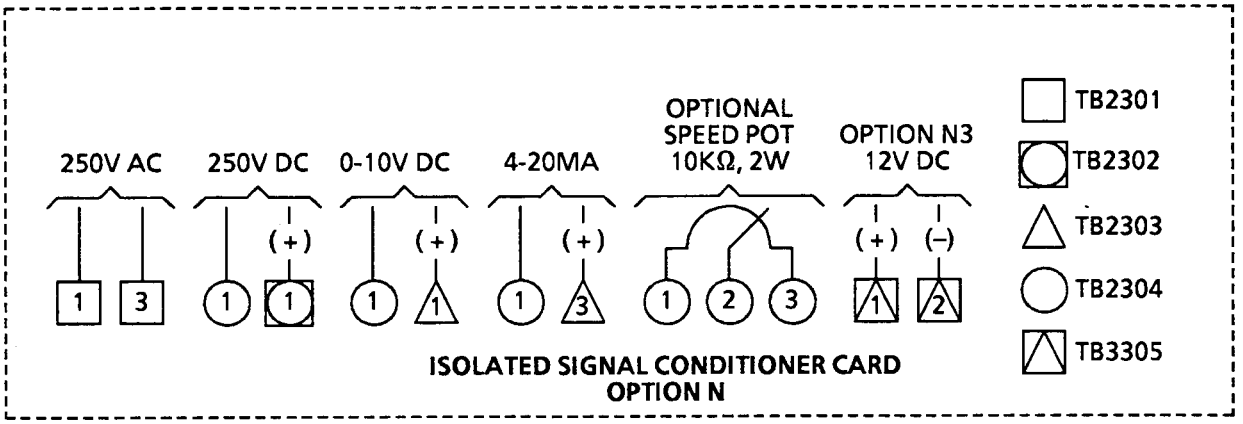

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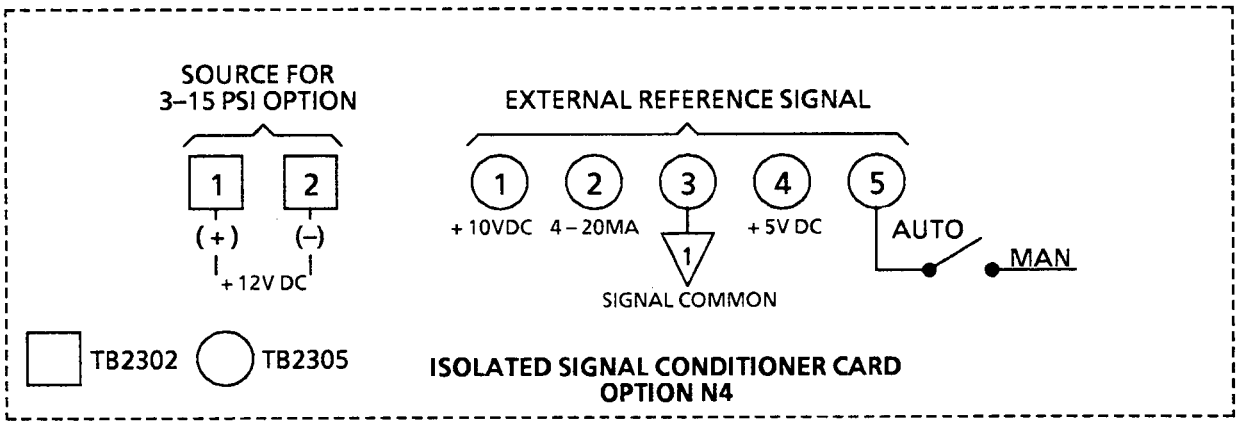

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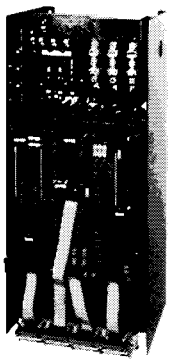

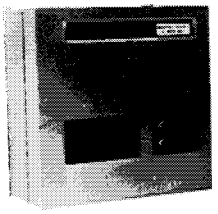

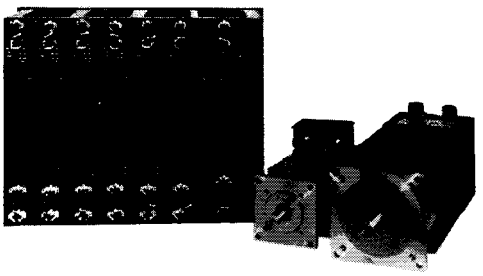

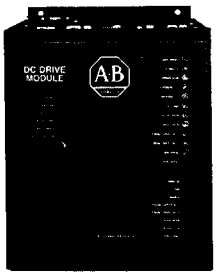

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Company _____

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EUROPE/MIDDLE EAST/ AFRICA HEADQUARTERS
Allen-Bradley Europe B.V.
Amsterdamseweg 15
1422 AC Uithoorn
The Netherlands
Tel: (31) 2975/43500
Telex: (844) 18042
Fax: (31) 2975/60222

ASIA/PACIFIC HEADQUARTERS
Allen-Bradley (Hong Kong) Limited
Room 1006, Block B, Sea View Estate
2-8 Watson Road
Hong Kong
Tel: (852) 887-4788
Telex: (780) 64347
Fax: (852) 510-9436

CANADA HEADQUARTERS
Allen-Bradley Canada Limited
135 Dundas Street
Cambridge, Ontario N1R 5X1
Canada
Tel: (1) 519 623-1810
Fax: (1) 519 623-8930

LATIN AMERICA HEADQUARTERS
Allen-Bradley
1201 South Second Street
Milwaukee, WI 53204 USA
Tel: (1) 414 382-2000
Telex: 43 11 016
Fax: (1) 414 382-2400

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