Rockwell Automation
Allen-Bradley

1395 Connection Guide
Grounding and Power Connections

Installation

Objectives
The following data will guide you in planning the installation of the Bulletin 1395. Since most start-up difficulties are the result of incorrect wiring, every precaution must be taken to assure that the wiring is done as instructed.

IMPORTANT: The end user is responsible for completing the installation, wiring and grounding of the 1395 drive and for complying with all National and Local Electrical Codes.

WARNING: The following information is merely a guide for proper installation. The National Electrical Code and any other governing regional or local code will overrule this information. The Allen-Bradley Company **cannot assume** responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Environment
The drive must be mounted in a clean, dry, location. Contamination from oils, corrosive vapors and abrasive debris must be kept out of the enclosure. Temperatures around the drive must be kept between 0°C and 55°C (32°F and 131°F). Humidity must remain between 5% to 95% non-condensing. The drive can be applied at elevations of 3300 feet (1,000 meters) without derating. The drive current rating must be derated by 3% for each additional 1,000 feet (300 meters). Above 10,000 feet (3,000 meters), consult the local Allen-Bradley Sales Office.

Mounting
The 1395 drive is of the open type construction and is designed to be installed in a suitable enclosure. The selection of enclosure type is the responsibility of the user. The heat sink is electrically isolated and is used as a mounting surface.

WARNING: Shock hazard exists at motor armature terminals if gravity drop out contactor does not open. The drive **must** be mounted in the vertical position. Failure to observe this mounting practice can result in personal injury or death.

CAUTION: The installation of the drive must be planned such that all cutting, drilling, tapping and welding can be accomplished with the drive removed from the enclosure. The drive is of the open type construction and any metal debris must be kept from falling into the drive. Metal debris or other foreign matter may become lodged in the drive circuitry resulting in component damage.

Cooling Airflow
In order to maintain proper cooling, the drive must be mounted in a vertical position (fuses in the upper right hand corner).

The drive design produces up to a 10°C or 18°F air temperature rise when the drive is operated at full capacity. Precautions should be taken not to exceed the maximum inlet ambient air temperature of 55°C (131°F). If the drive is in an enclosed cabinet, air circulation fans or a closed circuit heat exchanger may be required.

NEMA Type 12 Enclosures
When the drive is mounted in a NEMA Type 12 nonventilated sheet metal enclosure, the enclosure must be sized properly to allow adequate convection cooling. The drive will dissipate a heat loss that is proportional to the amount of armature current being delivered.

The following table lists the approximate wattage dissipation of each drive based on its current rating.

Table A.
Drive Wattage Dissipation

Drive HP Rating		
230V AC	**460V AC**	**Watts Dissipated**
1-5	2 - 10	100
7.5 - 15	15 - 30	225
20	40	295
25 - 30	50 - 60	485
40 - 50	75 - 100	675
60 - 75	125 - 150	905
100	200	1265
125 - 200	250 - 400	2722
250 - 300	500 - 600	3456

The NEMA Type 12 enclosure should be sized such that 10 watts of power are dissipated for each 1 square foot of enclosure surface. This area should not include the enclosure bottom or surfaces of the enclosure mounted against a wall.

The heat loss for additional equipment that is mounted in the enclosure should be added to the heat loss of the drive.

Wiring Clearance

Although the minimum clearance should be maintained for proper cooling, this space may not always provide proper wiring clearance. The minimum allowable wire bending radius may necessitate that extra space be provided to accommodate power wiring. Consult the governing code for the proper wiring method.

Main Disconnect

IMPORTANT: The user is responsible for completing the installation of the drive system and to comply with all National and Local Electrical Codes. The following information is to be used as a reference only.

WARNING: Hazard of electric shock or equipment damage exist if drive is not installed correctly. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

A main disconnect and lockout device with cabinet interlocks must be provided by the user. This device must be wired in the isolation transformer or reactor primary circuit. The device must be sized to handle 115% of the primary current plus any additional loads that are connected to the control system. Proper branch circuit protection for the drive and additional devices must be provided according to NEC and local codes.

IMPORTANT: Refer to Tables P and Q for drive current ratings to aid in properly sizing wire.

Grounding Procedures

The purpose of grounding is to:

- Limit dangerous voltages on exposed parts to ground potential in the event of an electrical fault.
- To facilitate proper overcurrent device operation when ground fault conditions are incurred.
- To provide for electrical interference suppression.

The general grounding concept for the 1395 is explained below.

Safety Ground (PE)- is the safety ground required by code. The ground bus can be connected to adjacent building steel (girder, joist) or a floor ground loop, provided grounding points comply with NEC regulations. Multiple connections are permitted, but Do Not ground at the same point as the Signal Ground (TE). The minimum distance between Signal and Safety Ground is 10 feet (3 meters). The ground bus requires a maximum of 1 ohm resistance to ground.

Power Feeder - Each power feeder from the substation transformer to the drive must be provided with properly sized ground cables. Simply utilizing the conduit or cable armor as a ground is not adequate. The conduit or cable armor and ground wires should be bonded to substation ground at both ends. Each transformer enclosure and/or frame must be bonded to ground at a minimum of two locations.

Motor Connection- Each DC motor frame must be bonded to grounded building steel within 20 feet (6 meters) of its location and tied to the drives PE via ground wires within the power cables and/or conduit. Bond the conduit or cable armor to ground at both ends. The ground wire size and installation must be per NEC Article 250.

Signal Ground (TE)- must be connected to an earth ground by a continuous separate lead (insulated #6 AWG or larger).

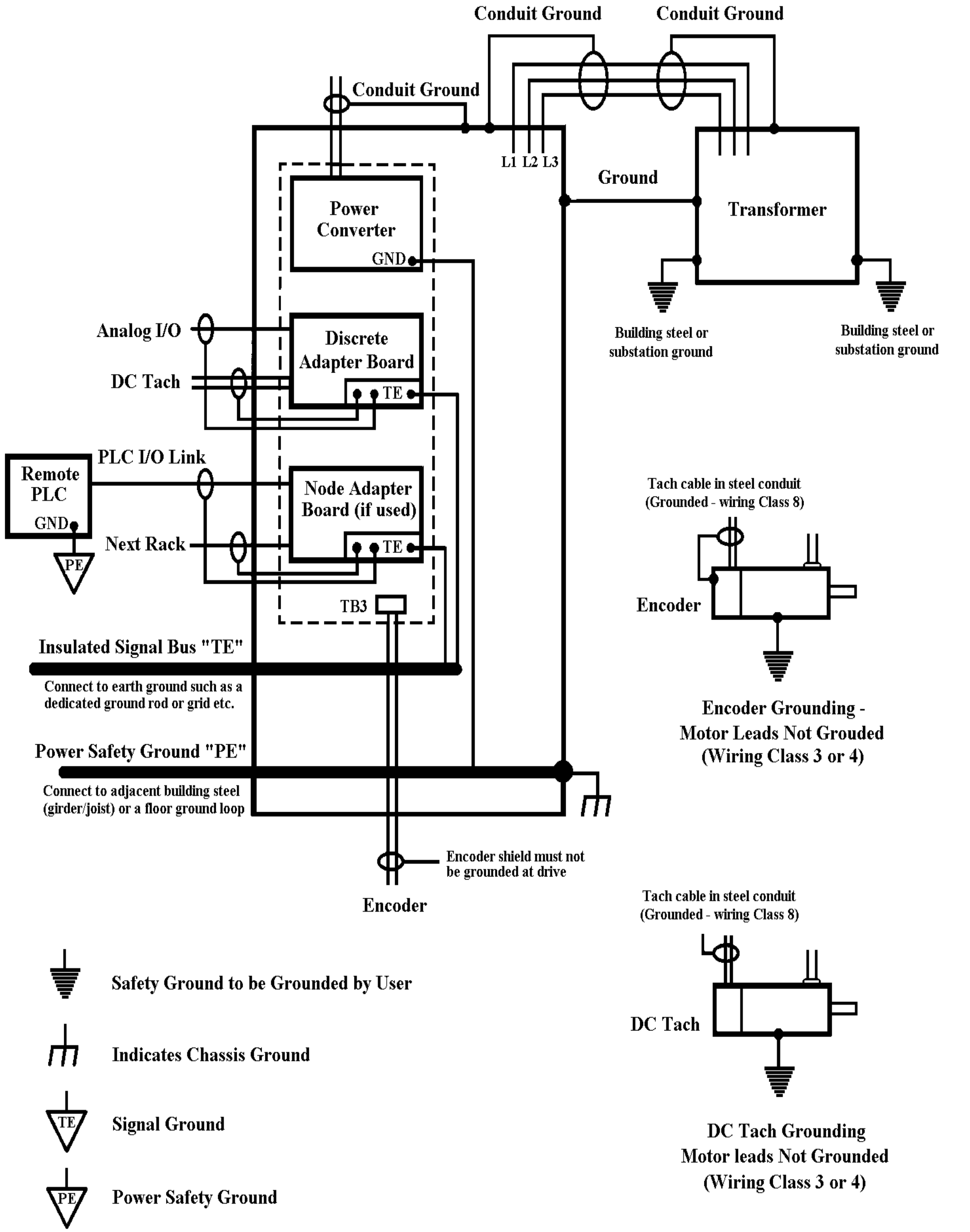
The PLC I/O Communication Link must be run in grounded steel conduit. The conduit should be bonded to ground at both ends. Ground the cable shield at the drive end only.

Encoder Connections- if required, must be routed in grounded steel conduit. The conduit must be grounded at both ends. Ground the cable shield at the motor only.

Tachometer Connections- if required, must be routed in grounded steel conduit. The conduit must be grounded at both ends. Ground the cable shield at the drive end Only.

Refer to the auxiliary device instruction manual for special grounding recommendations.

Figure 5
1395 Grounding Practices



As previously explained, two different types of grounds are used in the 1395 drive. They are defined as follows:

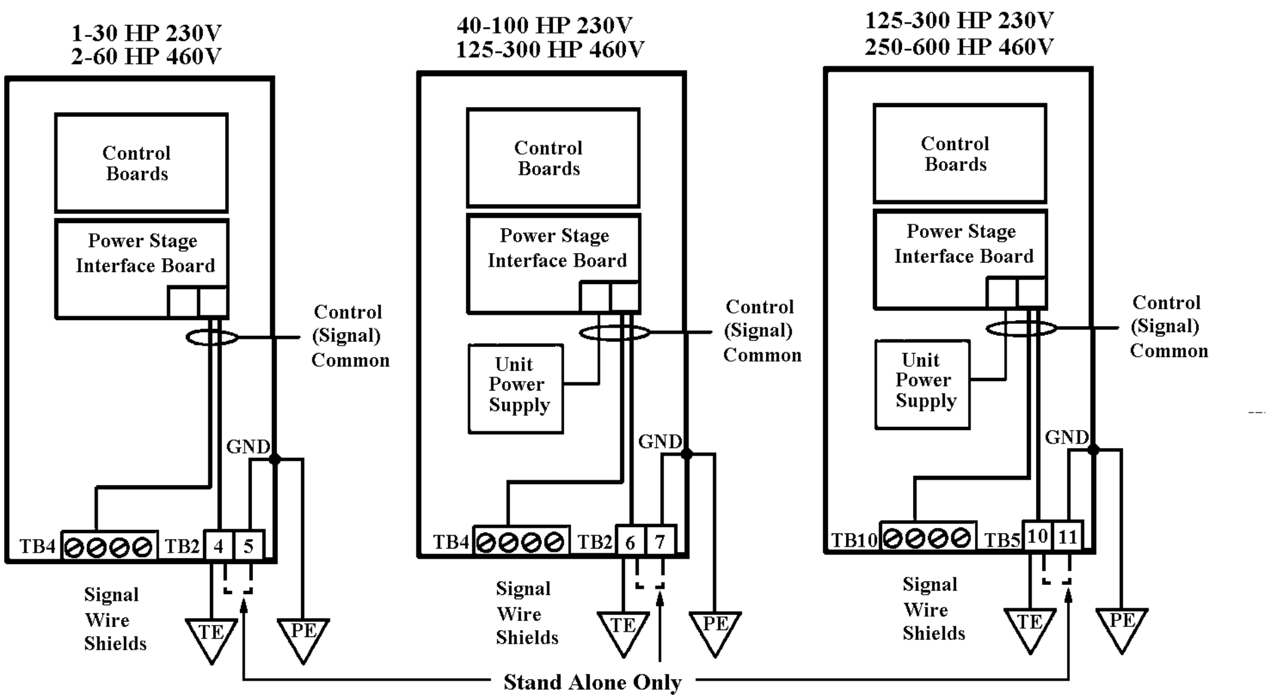
Safety Ground (PE)- A Safety Ground is normally required by the electrical code and is defined externally as PE ground. Main PE is located at the contactor stud.

TB-X connections are for jumpering TE to PE for stand alone only. The safety ground identified as PE ground is designated as follows:

• TB2-5	1-30HP 230VAC	2-60 HP 460VAC
• TB2-7	40-100 HP 230VAC	75-200 HP 460VAC
• TB5-11	125-300 HP 230VAC	250-600 HP 460VAC

Depending on the specific application, PE ground as defined above may be connected to a system ground bus when several drives are configured as part of a system and mounted in the same cabinet. In other applications, this terminal may be connected directly to a PE ground point consisting of adjacent building steel (girder, joist, floor ground loop, etc.), provided grounding points comply with NEC regulations. Figures 6 and 7 illustrate connection of PE for stand alone and system applications. PE should be connected in a "Star" fashion, and not daisy chained.

Figure 6
Stand Alone Drive Grounding



Signal Ground (TE)- The Signal Ground point is used for all control signals internal to the drive. Depending on the application, TE may be connected to a system TE bus or connected to PE ground. Figure 6 and 7 illustrate the possible connections for TE. If the drive is configured as a **stand alone unit**, the TE and PE grounds may be run individually to the drive, or a jumper can be placed as shown in Table C and one ground lead run as indicated in Table D.

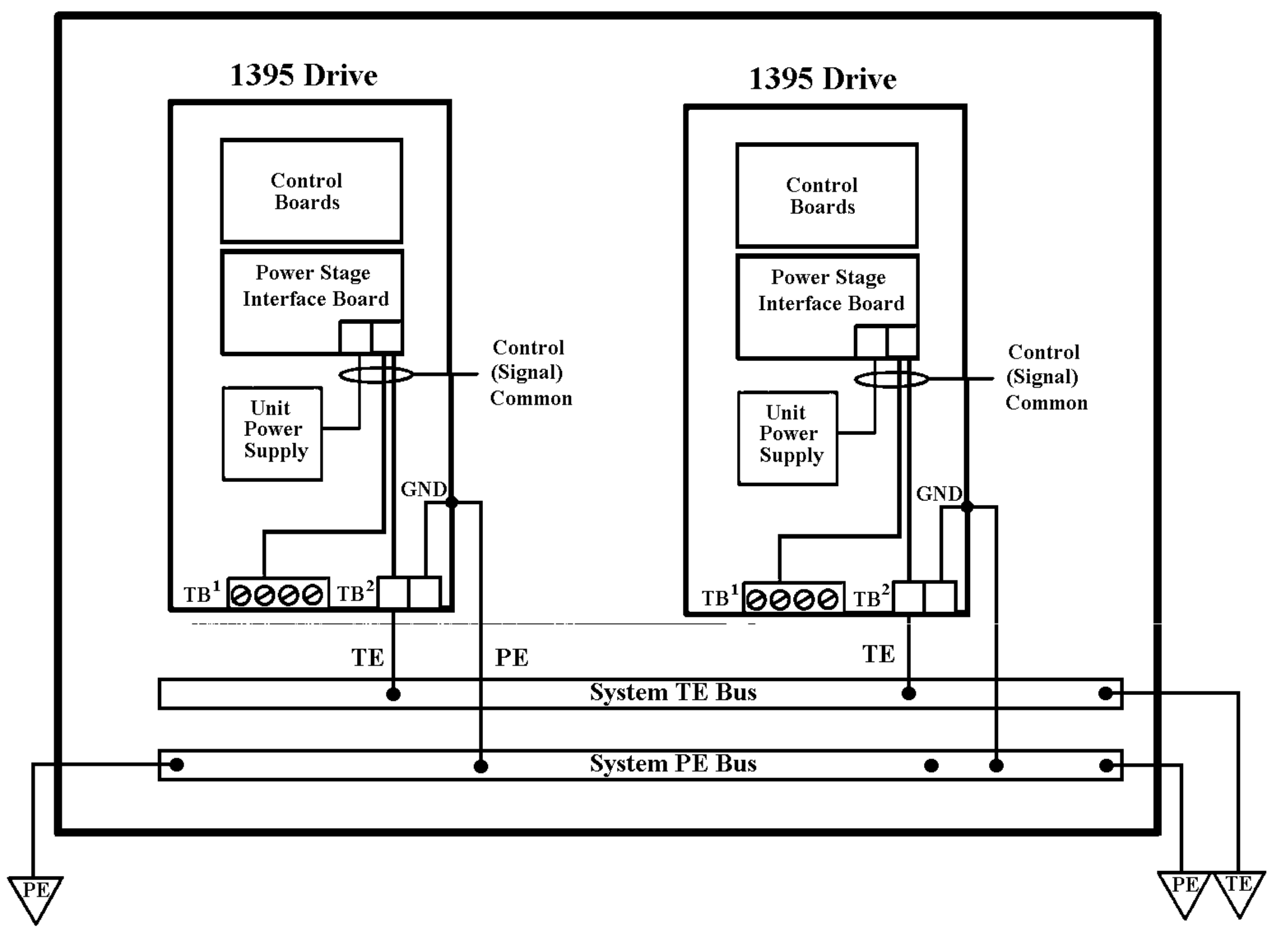
Table C.
Safety/Signal Ground

Rating	Wiring Connection
1 - 30HP 230VAC 2 - 60HP 460VAC	TB2 - 4 & 5
60 - 100HP 230VAC 75 - 200HP 460VAC	TB2 - 6 & 7
125 - 300HP 230VAC 250 - 600HP 460VAC	TB5 - 10 & 11

Table D.
Safety Ground Connections

Rating	Ground Terminal
1 - 30HP 230VAC 2 - 60 HP 460VAC	TB2 - 5
60 - 100HP 230VAC 75 - 200 HP 460VAC	TB2 - 7
125 - 300HP 230VAC 250 - 600 HP 460VAC	TB2 - 11

Figure 7
System Grounding Procedures



	1-30 HP 230VAC 2-60 HP 460VAC	40-100 HP 230VAC 75-200 HP 460VAC	125-300 HP 230VAC 250-600 HP 460VAC
TB[1]	TB 4	TB 4	TB 10
TB[2]	Terminals 4 & 5, TB2	Terminals 6 & 7, TB2	Terminals 10 & 11, TB5

On a multi drive system, assure that the Signal Ground (TE) of each drive is directly connected to the system TE bus. In addition, the Safety Ground (PE) of each drive must be directly connected to the system PE bus.

IMPORTANT: PE must be connected in a "star" fashion and not daisy chained.

Power Wiring

It is the recommended that an Allen-Bradley DC Loop Contactor Lug Kit be ordered for proper wire terminations. Table E provides a listing and description of the available lug kits.

Table E
Allen-Bradley DC Loop Contactor Lug Kits

Rated Motor Arm. Current[1] A DC	DC Contactor Rating A DC	Armature Conductor Size[2] AWG	DB Conductor Size[3] AWG	Arm. Conductor Crimp Lug Hole Size	DB Conductor Crimp Lug Hole Size	Lug Kit Catalog Number
40	56	8	8	#10	#10	1370-LG40
52	56	6	8	#10	#10	1370-LG52
56	56	4	8	#10	#10	1370-LG56
68	110	4	8	1/4”	1/4”	1370-LG68
92	110	2	6	1/4”	1/4”	1370-LG92
104	110	1	6	1/4”	1/4”	1370-LG104
110	110	1/0	4	1/4”	1/4”	1370-LG110
120	180	1/0	4	5/16”	5/16”	1370-LG120
140	180	2/0	2	5/16”	5/16”	1370-LG140
160	160	3/0	2	5/16”	5/16”	1370-LG160
180	180	4/0	2	5/16”	5/16”	1370-LG180
204	280	250MCM	1	1/2”	3/8”	1370-LG204
228	280	300MCM	1/0	1/2”	3/8”	1370-LG228
248	280	350MCM	2/0	1/2”	3/8”	1370-LG248
268	280	400MCM	2/0	1/2”	3/8”	1370-LG268
280	280	500MCM	3/0	1/2”	3/8”	1370-LG280

1 The Rated Motor Armature Current is taken directly from the motor nameplate or motor data. The current listed in the table (column 1) is the maximum current allowed for the Armature Conductor Size (column 3) and the DC Contactor Rating (column 2).

2 The armature conductors are sized by multiplying the Rated Armature Current by 1 25 as provided for in NEC 430-22 (1987). The DC lug ratings are determined from NEC Table 310-16 (1987) for copper conductors, insulation temperature rated at 75° C (167° F) at an ambient temperature of 30° C (86° F). If conditions are other than shown in NEC Table 310-16 then refer to applicable codes.

3 The dynamic braking (DB) conductors are sized as in Note 2, but at half ampacity due to the short time duration of current flow in these conductors, and has been sized to satisfy NEMA Standard ICS 3-302.62 - Dynamic Braking. If the load inertia is larger than that of the motor, calculations must be made to determine correct conductor sizing and DB resistor wattage per NEMA Standard ICS 3-302.62. If the wire size of the DB conductor does not fit on the DB grid connection, install a terminal block near the DB resistors and use multiple wire nuns between the resistors and the terminal block.

Power Wiring Procedure

The following procedure provides the steps needed to properly perform the power wiring connections to the 1395 drive.

Using Table F, verify that the motor field is compatible with the DC field voltage output of the drive.

Table F.
Standard Field Voltage Output

AC Incoming Voltage to Drive	DC Supply Output Voltage to Field
230V AC	120-150V DC
380V AC	200-250V DC
415V AC	220-270V DC
460V AC	240-300V DC

1. Connect the motor armature and field leads to produce proper direction of motor rotation. Table G lists the connections required to produce counterclockwise rotation of the motor when viewed from the commutator end with a positive speed reference input to the drive.

Table G.
Motor Connections for CCW Rotation

Connection	Drive	Drive Terminal Connection	Motor Lead
Motor Field	**1 - 30 HP, 230V AC**	TB1-3	F1(+)
	2 - 60 HP, 460V AC	TB1-4	F2(-)
	40 - 100 HP, 230V AC	TB2-1	F1(+)
	75 - 200 HP, 460V AC	TB2-2	F2(-)
	125 - 300 HP, 230V AC	TB7-1	F1(+)
	250 - 600 HP, 460V AC	TB7-3	F2(-)
Motor Armature	**1 - 100 HP, 230V AC**	A1	A1(+)
	2 - 200 HP, 460V AC	A2	A2(-)
	125 - 300 HP, 230V AC	A1	A1(+)
	250 - 600 HP, 460V AC	A2	A2(-)

Refer to Figures 9 & 10 for power wiring with a standard field voltage. Note that 125-600 HP construction requires field voltage semiconductor fuses rated at 50A (use KTK-R Fuses).

ATTENTION: The motor field supply is phase sensitive. To guard against possible drive/motor damage, assure that the connections are properly made according to Figures 9 & 10.

2. The 1395 is supplied with semi conductor fuses for line protection. A line reactor must be used between the main distribution system and the drive. An isolation transformer can also be used. Refer to Figures 9 and 10 for AC input wiring at the main fuses. Connect incoming three-phase AC line power to the AC line fuses or to the bus bar on the 125 - 600 HP drive The fuses supplied are designed to provide protection against short circuits for the drive semiconductors and associated output wiring. They are not to be considered a substitute for the user supplied motor branch circuit protective devices that are required by the National Electrical Code. Refer to Tables P and Q for proper sizing of the AC power and branch fuses.

Figure 9
Power Connections - Standard Field Voltage

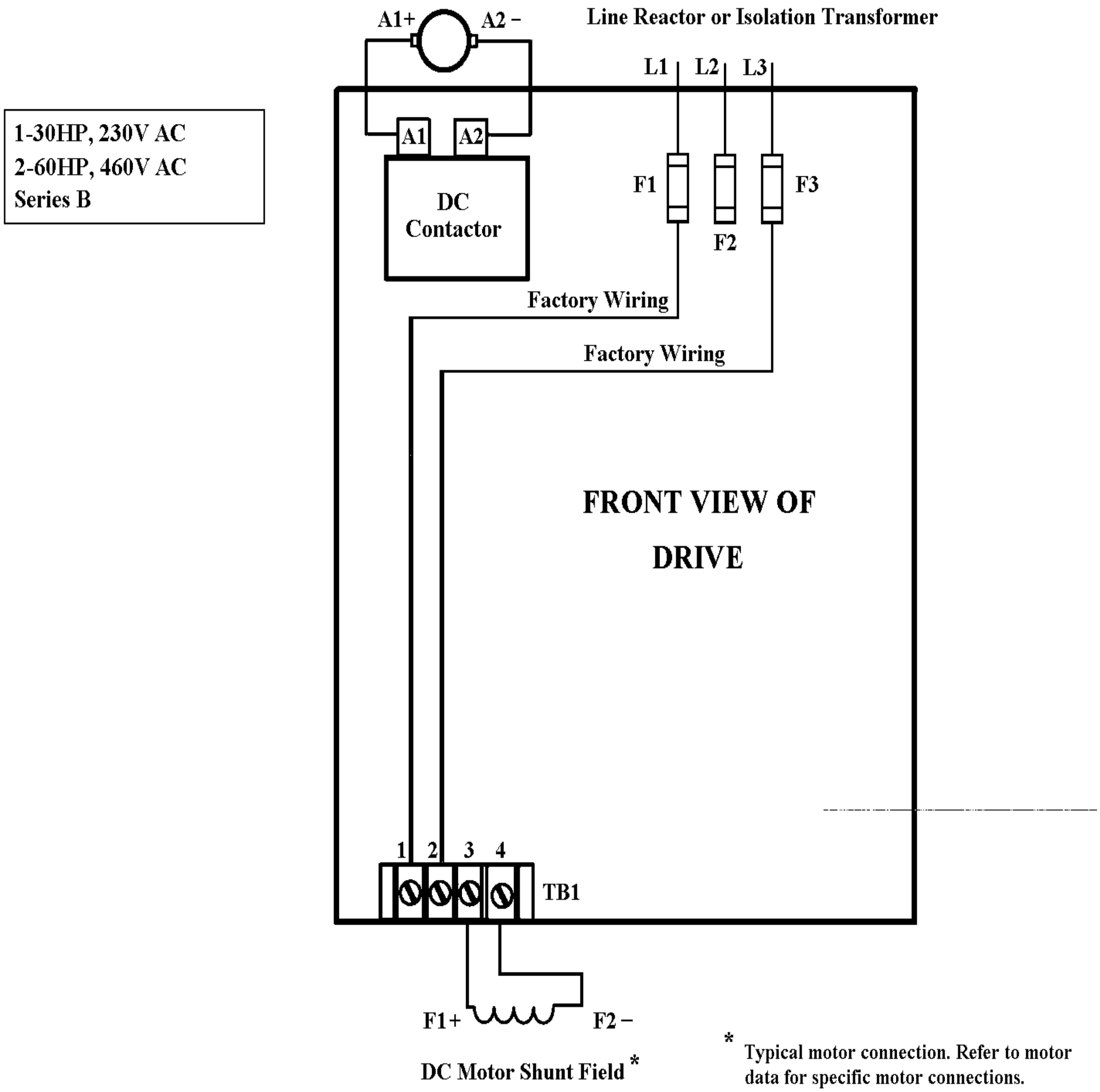
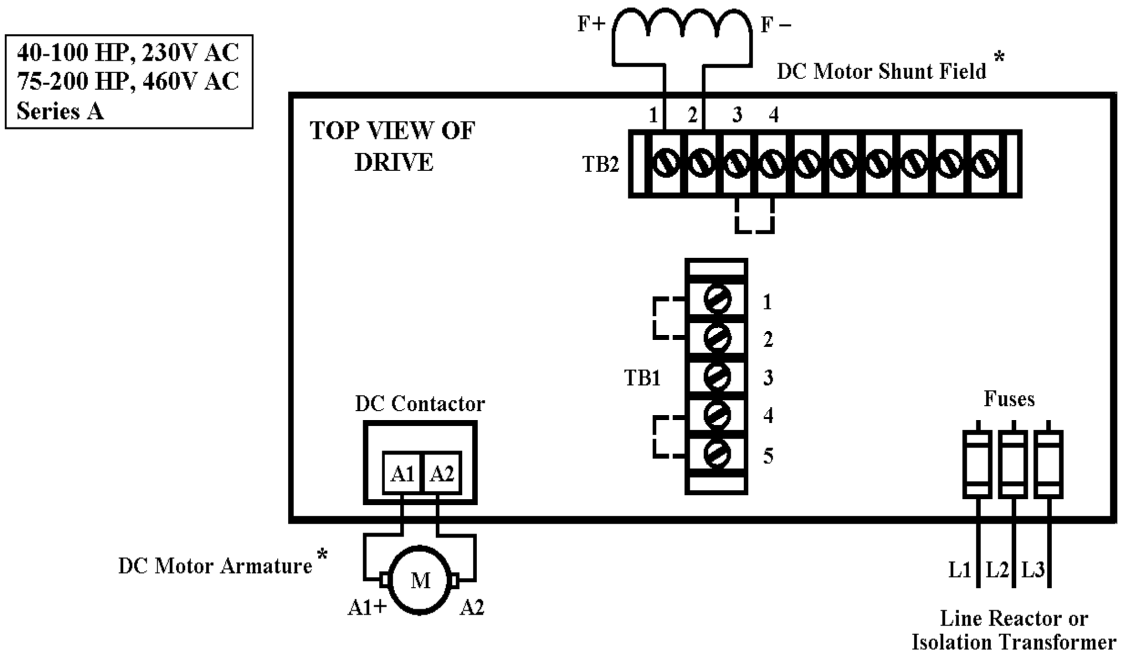
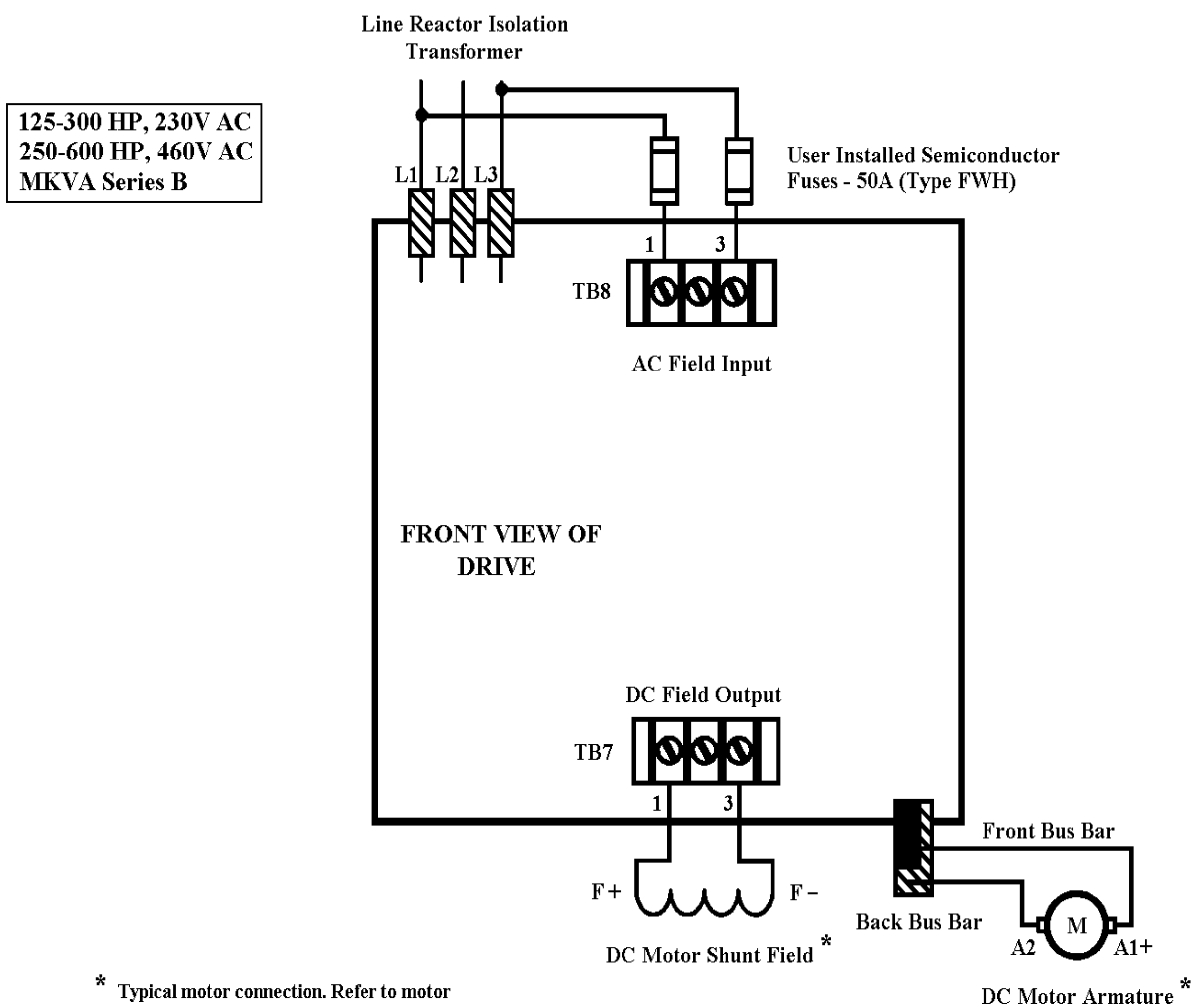


Figure 10
Power Connections - Standard Field Voltage





* Typical motor connection. Refer to motor data for specific motor connections.

3. If the DC motor field is not compatible with the field DC output of the drive, an external field control transformer must be used. Refer to the following example for transformer selection information.

EXAMPLE: 10 HP, 240 Volt Armature, 17.2A, 240 Volt Field, @ 2.0A

a) The Field Control Transformer - will have 230V primary, 460V secondary, single phase 60 Hz.

b) kVA = 2A x 460V AC x 1.5 = 1.38 kVA (1.5 kVA is closest)

c) J1 - Field jumper selection is in location 3 as the motor field is 2A.

d) Rated Field Motor Current (parameter - 612) to be programmed “2” as stamped on the motor nameplate.

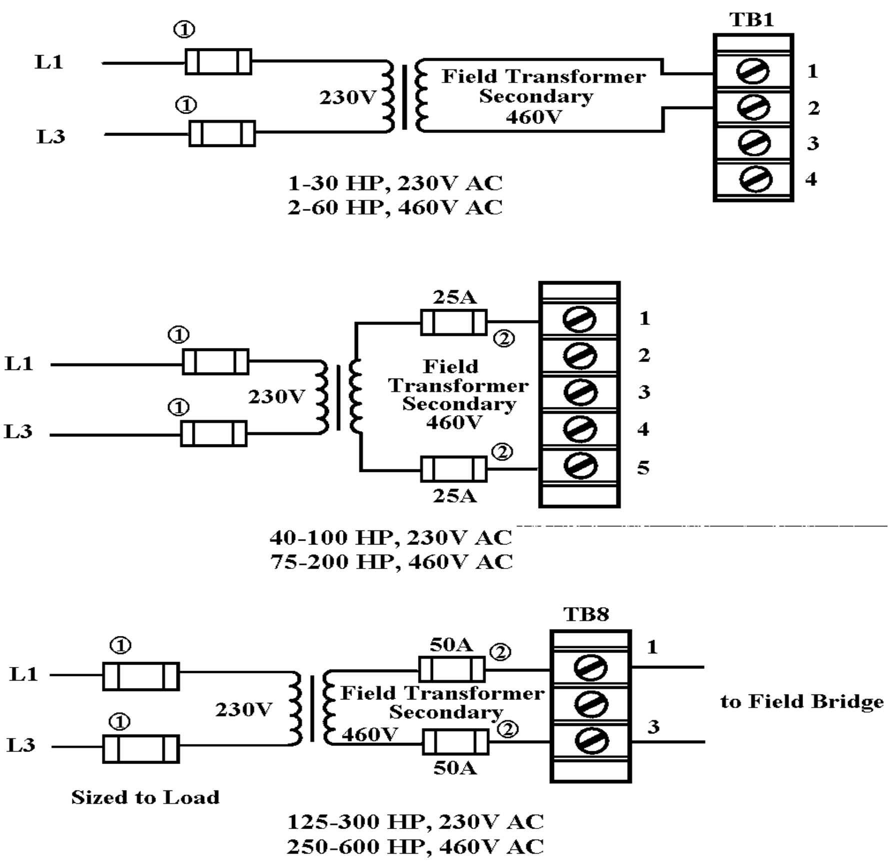
e) Rated Field Bridge Current (parameter 616) to be programmed “2.1”. See Table H (**1395 Connection Guide: Circuit Boards, Jumper Connections and Control Connections**), Jumper Selection 3 Max Field Current Rating.

f) Refer to Figure 11 and both NEC code and local codes for fusing requirements.

g) On 1-30 HP 230 volt and 2-60 HP 460 volt, remove factory installed wires at TB1-1 and TB2-2 on the power board and remove these same wires at TB1-1 and TB1-2 on the power board and remove these same wires at the other end at 1L1 and 1L3 on the drive side of the main fuses. Wire the transformer as shown in figure 11.

4. Typical external field transformer connections are shown in Figure 11 for a motor rated 240 volt armature, 240V field.

Figure 11
External Field Transformer Connections



1. The primary of the external field transformer requires branch circuit protection, to be fused with FRN or FRS style fuses. Refer to NEC Code (and local codes) for sizing.

2. As noted, the secondary of the external field transformer must be fused with semi conductor type fuses; type KTK-R. For correct value, refer to Figure 11.