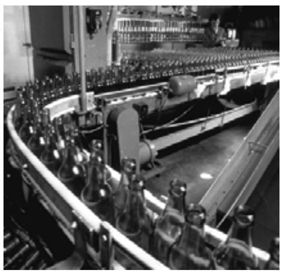
LISTEN.
THINK.
SOLVE.

Bulletin 1395 Digital DC Drive



USER MANUAL

Firmware Versions 5.xx to 10.10/9.30

Allen-Bradley • Rockwell Software

Rockwell Automation

Firmware Revision History

The following is a brief description of the MCB Firmware Revision History:

1.00: First Release.

2.30: Enhanced noise immunity.

3.01: Released Trending and VP and CP Autotune.

4.01: Enhanced EEprom fault reporting for SP-83 and SP30 SEEG device, VP indirects added, check for Ia with contactor open.

4.02: Consolidate 1396 and 1395 board assemblies.

4.03: Enhanced Feedback calculation on first pulse, CP phase loss updated for HKVA, software change for BH processor.

5.01: Released Tach recovery algorithm, EH E-step micro-processor, changed checksum routine VP and CP, added noise filter caps for CP-101-106.

- Added P688 Tach Switch Tolerance. **Note:** P688 used on 5.01 FW only. P731 and P732 used on all other FW.
- Added P689 Tach Switch Ki
- Added P690 Tach Switch Kp
- Added P691 Tach Switch Select
- Rev 18 = Enhanced 24VDV Fault Reporting
- Rev 19 = Enhanced CP-06 Phase Loss Reporting

6.01 and 7.01: Both released and recalled.

8.02: Rev 4 = Further Enhanced 24VDV Fault Reporting.
Rev 5 = Further Enhanced CP-06 Phase Loss Reporting.

8.03: VP:

1. Motor Thermal Overload — Modified algorithm for self ventilated motor options to work above 150% of base motor speed, P629 = 3 or 4.
2. Process Trim — Enhanced process trim regulator for enable/disable from logic command when using process trim velocity limiter function. The Process Trim Select (P628 = 0) had to be used instead of Logic Command bit to disable Process Trim.
3. Velocity Regulator — Modified integrator in the PI regulator for current limit switching. Example: switch from motoring to regen or vice versa.
4. CEMF regulator — Modify IR compensation so that 1PU CEMF is now equal to 100% at FULL LOAD. Previously, 1PU was the motor nameplate voltage at no load.
   Old: CEMF = Terminal Volts - IR
   New: CEMF = (Terminal Volts - IR)/(1 - R)
5. Field Flux Auto Tune Enhanced
   a. Allow CEMF regulator to trim flux reference to near zero (formerly limited to 10% minimum) during autotune.

b. Increase wait time for each flux table measurement from 5 seconds to 15 seconds.
c. Change test for up to speed (during field flux autotune) to use a constant 5% instead of being tied to the speed tolerance parameter, to reduce the occurrence of “Motor not up to speed” faults.

SP:

1. Slave percent 2 (P670) — Enhanced EEprom Save and Recall function for this parameter.
2. CEMF feedback (P120) — Change conversion formula and units display from volts to percent (4096 = 100%) to accommodate CEMF regulator change (see #4 under VP).

CP:

1. Auto tune test — Modified autotune to work with a wider range of motors (inductance related).
2. Change diode to enhance CP-15 24V PS Loss reporting.
3. Change diodes to enhance CP-06 Phase Loss reporting.

8.10:

Rev. 1 = Released. **Note:** 8.03 to 8.10 only updated the micro’s. Functionality did not change.
Rev. 2 = N/A (change diode tape/loose insertion).
Rev. 3 = Change diode to enhance Vel and Armature Voltage readout stability on the terminal.

9.20:

Rev. 1 = New features added:

1. Added P744 — Bridge Switch Delay (for electro-magnet applications).
2. Increased P617 — Rated AC Voltage Maximum to 690 VAC.
3. Increased P610 — Rated Motor Voltage Maximum to 850 VDC.
4. Enhanced df/dt functions to accommodate motor/generator switchover.
5. Enhanced Encoder Feedback processing.

10.10:

Rev. 1 = Enhanced Autotune feature to work with higher inductance motors.

- Added P745 — K disc Fraction for increased resolution.
- Added P746 — Arm Volt Offset to calibrate Arm Volts Zero +/-20 volts.
- Changed P734 — K disc default from 1024 to 288 and minimum value from 33 to 4.
- Changed P735 — KP Armature Loop default from 710 to 2330.
- Changed P736 — KI Armature Loop default from 90 to 386.
- Changed P741 and P742 Current Loop BW minimum from 100 to 40.

9.30:

Rev. 1 = Renumbered 10.10 firmware to 9.30 to accommodate ITS and DriveTools32™. No functional changes.

Chapter 1

Introduction, Inspection and Storage, and Publication References

Manual Objectives

The purpose of this manual is to provide the user with the necessary information to install, program, start up and maintain the1395 DC Drive. This manual should be read in its entirety before operating, servicing or initializing the 1395 Drive. This manual must be consulted first, as it will reference other 1395 manuals for troubleshooting or option initialization. This manual covers three different series of 1395 Drive and is organized with each topic broken down by horsepower range.

Who Should Use This Manual

This manual is intended for qualified service personnel responsible for setting up and servicing the 1395 DC Drive. You must have previous experience with and a basic understanding of electrical terminology, programming procedures, required equipment and safety precautions, as typical applications will consist of a properly rated DC motor, with or without feedback based on performance requirements, a line impedance device (line reactor or isolation transformer) and the 1395. A programming terminal is required to set up the drive and for enhanced monitoring and diagnostics.

WARNING: Only personnel familiar with the 1395 Drive and the associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the Drive. Failure to comply may result in personal injury and/or equipment damage.

CAUTION: An incorrectly applied or installed Drive can result in component damage or a reduction in product life. Wiring or application errors such as undersizing the motor, incorrect or inadequate AC supply or excessive ambient temperatures may result in damage to the Drive or motor.

CAUTION: This Drive contains ESD (Electrostatic Discharge sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference Allen-Bradley Publication 8000-4.5.2, *Guarding against Electrostatic Damage* or any other applicable ESD protection handbook.

Chapter Objective

Chapter 1 in addition to detailing drive features and specifications, also supplies the information needed to unpack, properly inspect and if necessary, store the 1395 Drive. A complete explanation of the catalog numbering system is also included at the back of this chapter.

Standard Drive Features

The 1395 is a microprocessor Digital DC Drive available in;

- Four quadrant, armature regenerative, two quadrant field:
  - 1 – 300 HP @ 230VAC in standard 1395 enclosures
  - 400 – 700 HP @ 230VAC in Bulletin 2100 CENTERLINE motor control centers (MCCs)
  - 2 – 600 HP @ 460VAC in standard 1395 enclosures
  - 700 to 1750 HP @ 460VAC in MCCs
  - 750 to 2250 HP @ 575VAC in MCCs
  - 750 to 2500 HP @ 660VAC in MCCs
- Non–regenerative:
  - 1 – 30 HP and 125 to 300 HP @ 230VAC in standard 1395 enclosures; 400 to 700 HP @ 230VAC in MCCs.
  - 2 to 60 HP and 250 to 600 HP @ 460VAC in standard 1395 enclosures; 700 to 1750 HP @ 460 VAC in MCCs.
  - 750 to 2250HP @ 575VAC in MCCs
  - 750 to 2500HP @ 660VAC in MCCs

NOTE: For information on high horsepower 1395 drives packaged in MCCs, refer to publication 2361–5.01. This publication contains:
  - hardware descriptions of 1395 drives rated at or above 700 HP @ 460VAC, 750HP @ 575/660VAC.

- Fused AC input
- DC Contactor
- Field regulation over a 6 to 1 speed range.
- Programmable Functions:
  - Independent Acceleration/Deceleration adjustment
  - Preset Speeds, Jog Speeds
  - Current Limit, Tapered Current Limit
- Protective Features:
  - Instantaneous Overcurrent, Motor Overload
  - Feedback Loss, Field Loss, Field Economy
- Open Chassis Construction
- UL Listed/CSA Approved
- Basic Input/Outputs

Options

- Discrete Adapter Board Provides:
  - 4 Digital Inputs, 120VAC
  - 2 Digital Outputs, Contact type 125VAC
  - 4 Analog Inputs, 4 Analog Outputs, +/– 10VDC
- Discrete Adapter Board Provides:
  - 4 Digital Inputs, 24VDC
  - 2 Digital Outputs, Contact type 24VDC
  - 4 Analog Inputs, 4 Analog Outputs +/– 10VDC
- Digital Reference Adapter Board Provides:
  - 1 Digital Reference Input
  - 10 Discrete Inputs, 5 Discrete Outputs, 24VDC
  - 2 Analog Inputs +/–10VDC, 2 Analog Outputs +/–10VDC

- Node Adapter Board

  Provides an interface between external (push buttons, pots) devices and the Bulletin 1395.

  The board allows the Bulletin 1395 to be controlled using an Allen-Bradley PLC® Programmable Controller from the PLC3® or PLC5® family.
- Multi-Communications Adapter Board

  Contains the hardware necessary to connect the 1395 to Allen-Bradley's RIO or Data Highway Plus® communication links.
- ControlNet Adapter Board contains the hardware necessary to connect the 1395 to a ControlNet Network.
- Normally Closed DB contact on the main motor contactor.
- Auxiliary Contact on the motor contactor for special interlocks (1 – N.O., 1 – N.C.).

Accessories

- Line Reactors
- Dynamic Braking

Receiving

It is the responsibility of the user to thoroughly inspect the equipment before accepting the shipment from the freight company. Check the item(s) received against the purchase order. If any items are obviously damaged, it is the responsibility of the user not to accept delivery until the freight agent has noted the damage on the freight bill. Should any concealed damage be found during unpacking, it is again the responsibility of the user to notify the freight agent. The shipping container must be left intact and the freight agent should be requested to make a visual inspection of the equipment.

Unpacking

Remove all packing material, wedges, or braces from within and around the drive. Remove all packing material from the cooling fans (when equipped) and the heat sink.

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

Inspection

After unpacking, check the item(s) nameplate catalog number against the purchase order. An explanation of the catalog numbering system for the 1395 drive is included as an aid for nameplate interpretation. Refer to the following pages for complete nomenclature.

Storing

The drive should remain in its shipping container prior to installation. If the equipment is not to be used for a period of time, it must be stored according to the following instructions in order to maintain warranty coverage:

- Store in a clean, dry location.
- Store within an ambient temp. range of 0° to 65°C (32° to 149°F).
- Store within a humidity range of 5% to 95%, non-condensing.
- Do not store equipment in a corrosive atmosphere.
- Do not store equipment in a construction area.

Specifications

Type Drive:	Full Wave Regen, 12 SCR w/Full Wave 1 ∅ Field Regulator
Electrical:	
Input Voltages –	150 – 460VAC +/– 10%, 3 phase 115VAC Control Power, +/– 10%, 1 phase
Input Power –	1.5 kVA to 660 kVA
Input Frequency –	50/60Hz +/– 3 Hz.
Max Rate of Change of Input Frequency –	3.5 Hz/Sec.
Output Voltage –	240VDC (230VAC Input) 400VDC (380 – 415 AC Input) 500VDC (460VAC Input)
Output Horsepower (Continuous) –	1 to 300 HP, 240VDC 1.5 to 500 HP, 400VDC 2 to 600 HP, 500VDC
Output Current–	3.6 to 980A
Field Voltage–	120 – 150VDC, 230VAC 200 – 250VDC, 380VAC 220 – 270VDC, 415VAC 240 – 300VDC, 460VAC Field Voltage Source is selectable between internal or external supply.
Field Current–	1 – 30HP, 230V; 2 – 60HP, 460V Drive: 150mA – 10 Amperes Continuous 40 – 100HP, 230V; 75 – 200HP, 460V Drive: 650mA – 20 Amperes (continuous) 125 – 300HP, 230V; 250 – 600HP, 460V Drive: 650mA – 40 Amperes (continuous)
Field Control–	A 6:1 speed range with an encoder or DC tach feedback
Field Economy–	Programmable enable, time delay, power on standby
Armature Firing–	Phase sequence insensitive, Regenerative/ Non–regenerative
Output Waveform–	6 pulse, full wave, NEMA Code C
Controller Current Output –	150% for one minute, 200% for 10 seconds, 260% for 5 seconds
Armature Control –	Tapered current limit, di/dt limit, Instantaneous overcurrent, Programmable motor overload
Speed Regulation:	
Encoder –	0.01% of set speed (over a 10:1 speed range); 0.001% of top speed (over a 100:1 speed range).
DC Tachometer –	0.5% of top speed with 5PY tachometer; 0.1% of top speed with BC42 tachometer.
Armature Voltage –	2% of top speed

Feedback Devices:

DC Tachometer –	5 PY, BC42 or equal
Encoder –	Incremental, dual channel; 12 volts, 500mA, isolated with differential transmitter, 102.5 kHz max. Quadrature : 90° ± 27° @ 25°C, Duty Cycle: 50% ± 10% Source/ Sink capable, A–B 845H or equal.

External Inputs:

Enable/Contingency Coast Stop –	24VDC/115VAC, hard–wired to DC contactor
System Reset –	24VDC/115VAC, Isolated
Motor Thermostat –	24VDC/115VAC, Isolated
Communication Port –	RS–422 for programming terminal

External Outputs:

Drive Ready/Faulted–	N.O. relay contact, open when drive faulted or de–energized, closed when ready. Contact rating – 1 ADC @ 24 VDC or 0.5A @ 120VAC

Environmental

Ambient Operating Temperature	0° to 55°C (32° – 130° F)
Relative Humidity	5% to 95%, non–condensing
Altitude	3,300 feet (1,000 meters)

Standard Features

Accel/Decel	0.1 to 6554 seconds, independently programmable.
Preset Speeds	5 adjustments, programmable
Jog Speeds	2 adjustments, programmable
“S” Ramp	Programmable
Motor Operated Pot (MOP)	10 adjustments, programmable

Options

Discrete Adapter Board;

Digital Inputs (4) –	24VDC or 120VAC, 10 mA. NOTE: A separate board and part number is used for each voltage rating.
Digital Outputs (2) –	Dry relay contacts rated at 0.6 amps at 125VAC or 2.0 amps at 30VDC.
Analog Inputs (4) –	0 to +/– 10 VDC, differential input impedance – 20K ohms.
Analog Outputs (4) –	–10 to + 10VDC, 1mA minimum output impedance – 200 ohms.
Power Supply (For external use) –	+10VDC, 4mA maximum, –10VDC, 4mA maximum.

Digital Reference Board;

Digital Reference Input (1) –	Current source and sink input for high common mode noise immunity. Nominal 5VDC or 12VDC interface (internal hardware configurable), + 10mA nominal current source/sink requirements.
Digital Inputs (10) –	24VDC Nominal; 18VDC minimum, 28VDC maximum; 10 mA nominal.
Discrete Outputs (5) –	-25%, +16.6%, 24VDC nominal; Current sourcing type driver; Diode clamped for inductive load; 18VDC minimum, 28VDC maximum; 1.5VDC saturation, 100mA maximum load.
Analog Inputs (2) –	0 to +/– 10 VDC, differential input impedance– differential > 1m ohm; 20K ohms (single ended to analog common).
Analog Outputs (2) –	–10 to +10VDC, 2.5mA maximum output impedance – 200 ohms.
Power Supply – (for external use)	+10VDC, 4mA maximum, –10VDC, 4mA maximum.
Node Adapter Board;	This board allows the Bulletin 1395 to be controlled using an Allen-Bradley PLC controller from either the PLC3 or PLC5 family. The +5V Node Adapter board power is generated internally in the Drive.

Multi-Communications Adapter Board;

Power Supply –	Board power provided by Drive discrete input, 24VDC or 115VAC, jumper selectable.
Communications Channels (2) –	Each channel can be configured as either Allen-Bradley Remote I/O (RIO) or Allen-Bradley Data Highway + (DH+) interfaces. Compatible with PLC3, PLC250, PLC5/15, PLC5/25, PLC5/40, PLC5/60 and Controlview.
Function Blocks (4)	These programmable function blocks can be used to manipulate data.
Discrete Input (1)	One programmable discrete input is available (24VDC or 115VAC).

ControlNet Adapter Board;

Rev Requirement –	Requires Main Control Board Revision 8.10 or greater.
Communication Channel –	One ControlNet channel with a redundant connector to allow for backup connection in case one fiber optic cable fails.
Port –	One Network Access Port

Catalog Number Explanation

230 Volt AC Input (1–100HP)

1395 – A61 – C1 – P10 – X1

First Position	Second Position	Third Position	Fourth Position
Bulletin No.	**Horsepower**	**Contactor Type**	**Options***

First Position – Bulletin No.

1395

Second Position – Horsepower

Non–Regenerative

Letter	HP
A61N	1HP
A62N	1.5 HP
A63N	2HP
A64N	3HP
A65N	5HP
A66N	7.5HP
A67N	10HP
A68N	15HP
A69N	20HP
A70N	25HP
A71N	30HP

Regenerative

Letter	HP
A61	1HP
A62	1.5 HP
A63	2HP
A64	3HP
A65	5HP
A66	7.5HP
A67	10HP
A68	15HP
A69	20HP
A70	25HP
A71	30HP
A72	40HP
A73	50HP
A74	60HP
A75	75HP
A76	100HP

Third Position – Contactor Type

Letter	HP
Standard	
C1	1 – 15HP
C2	20 – 30HP
C3	40 – 50HP
C4	60 – 75HP
C5	100HP
Dynamic Braking	
D1	1 – 15HP
D2	20 – 30HP
D3	40 – 50HP
D4	60 – 75HP
D5	100HP

Fourth Position – Options*

Letter	Description
P10	Discrete Adapter 115 VAC (Port A)
P11	Discrete Adapter 24VDC (Port A)
P12	Digital Reference Adapter (Port A)
P50	Node Adapter (Port B)
P51	Multi–Communication Adapter (Port B)
P54EN	ControlNet Adapter Board (Port A or B)
PZ	No Adapter

Other Options
X1 – Auxiliary Contact (1–N.O – 1–N.C.)
(standard on 100 HP)

* Multiple options are separated by dashes
* Limited to one adapter in port A and one adapter in Port B.

Publication References

This update provides you with a list of user manuals for 1395 and 2361 drives and their current status. If a firmware version or date is not shown with a publication, it indicates that the publication is the current version, which will be updated until the firmware version changes.

Bulletin 1395 HKVA Drives (Early Design)

230 Volt AC Input (400 – 600 HP (1350 – 2250 AMP))

For 1395 drives in this horsepower range, refer to publication 1395-5.70 for catalog number explanation.

460 Volt AC Input (700 – 1250 HP) (1350 – 2250 AMP)

For 1395 drives in this horsepower range, refer to publication 1395-5.70 for catalog number explanation.

660 Volt AC Input (900 – 2000 HP) (1350 – 2250 AMP)

For 1395 drives in this horsepower range, refer to publication 1395-5.70 for catalog number explanation.

Bulletin 2361 HKVA Motor Control Center (MCC) Drives (Later Design)

460 Volt AC Input (700 – 1750 HP) (1250 AMP)

For 1395 drives in this horsepower range, refer to publication 2361-5.01 for catalog number explanation.

575 Volt AC Input (750 – 2250 HP) (1650 AMP)

For 1395 drives in this horsepower range, refer to publication 2361-5.01 for catalog number explanation.

660 Volt AC Input (750 – 2500 HP) (3000 AMP)

For 1395 drives in this horsepower range, refer to publication 2361-5.01 for catalog number explanation.

Important: These drives are commonly referred to as “HIGH KVA (HKVA)” in this and other publications.

List of User Manuals for 1395 and 2361 Drives

PUB NO.	PUB DATE	DESCRIPTION	F/W VER	STATUS
1395 – 5.6	Feb. 1989	User Manual, Current Rated Drives	Ver. 2.3	OBSOLETE FIRMWARE
1395 – 5.11	Aug. 1989	User Manual, Current Rated Drives	Ver. 3.XX	OBSOLETE FIRMWARE
1395 – 5.11 DU1	Oct. 1991	User Manual Supplement, HP Rated Drives	Ver 4.XX	OBSOLETE FIRMWARE
1395 – 5.40	Oct. 2002	User Manual, HP Rated Drives	Ver 5.X –10.10/9.30	CURRENT
1395 – 5.70	Nov. 1995	User Manual, HP Rated Drives 800 – 1250 HP (2250 A), Series A.	Ver 5.X – 8.X	OBSOLETE FIRMWARE
2361–5.01	Jul. 1998	User Manual, 1250, 1650, 3000A, Series C		CURRENT
1395 – 5.1	Sep. 1988	Discrete Adapter Manual	Ver. 2.XX	OBSOLETE FIRMWARE
1395 – 5.7	Apr. 1989	Discrete Adapter Manual	Ver. 2.3	OBSOLETE FIRMWARE
1395 – 5.12	Aug. 1989	Discrete Adapter Manual	Ver. 3.XX	OBSOLETE (Use Current)
1395 – 5.12	Apr. 1993	Discrete Adapter Manual	Ver. 4.XX	OBSOLETE (Use Current)
1395 – 5.12	May 1994	Discrete Adapter Manual	Ver. 4.XX	OBSOLETE (Use Current)
1395 – 5.12	Feb. 1995	Discrete Adapter Manual	Ver. 4.10	CURRENT
1395 – 5.2	Jul. 1989	Node Adapter I&O Manual	Ver. 2.3	OBSOLETE FIRMWARE
1395 – 5.9	Aug. 1989	Node Adapter I&O Manual	Ver. 3.XX	OBSOLETE (Use Current)
1395 – 5.9	May 1994	Node Adapter I&O Manual	Ver. 3.XX	OBSOLETE (Use Current)
1395 – 5.9	Feb. 1995	Node Adapter I&O Manual	Ver. 3.XX	OBSOLETE (Use Current)
1395 – 5.9	Oct. 1995	Node Adapter I&O Manual	Ver. 3.01	CURRENT
1395 – 5.23	Apr. 1995	Encoder Drive Module	N/A	CURRENT
1395 – 5.33	March, 1992	Multi Comm Hardware & Software Manual	Ver. 1.XX	OBSOLETE (Use Current)
1395 – 5.33	March, 1995	Multi Comm Hardware & Software Manual	Ver. 1.XX	OBSOLETE (Use Current)
1395 – 5.33	Apr. 1996	Multi Comm Hardware & Software Manual	Ver. 1.06	CURRENT
1395 – 5.22	Jan. 1991	Digital Reference Adapter Board	Ver. 1.XX	OBSOLETE (Use Current)
1395 – 5.55	Apr. 1996	Digital Ref Adapter Hardware & Software Reference Manual	Ver. 1.02	CURRENT
1395 – 5.45	Jul. 1997	Troubleshooting Manual	Ver. 1.X – 8.X	CURRENT
1300 – 5.4	Aug. 1989	1300 – EHT		CURRENT
1300 – 5.5	Aug. 1989	1300 – DMT		CURRENT
1395 – 5.37	Sep. 1998	ControlNet Adapter Manual	Ver. 1.5	CURRENT
1395 – 6.0	Mar. 2002	Renewal Parts	All	CURRENT

RENEWAL PARTS: A current renewal parts publication is packaged with each unit at the time of shipment. Contact your Rockwell Automation sales/support office if additional renewal parts information is needed.

IMPORTANT: Drives with Motor Control Center (MCC) Construction have a different User manual configuration. Contact your local Rockwell Automation sales/support office for more information.

NOTE: Publication Date information is as of date of this manual. Manuals may be updated and have newer Publication Dates than what is shown above.

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Chapter 2

Hardware Description

1 – 30 HP; 230VAC
2 – 60 HP; 460VAC
(3.6 – 110 A)
Series B

Introduction

Chapter 2 contains both a general description of the major hardware components of the1395 Series B drive, and background information to support the procedures detailed in other chapters of this manual. You should use this chapter in conjunction with the installation Chapter when installing 1 – 30HP, 230VAC and 2 – 60HP, 460VAC Series B Drive.

Terminology

A brief description of new terms and concepts covered in Chapter 2 is presented here:

Adapter Board – Circuit board containing hardware and software required to interface external devices such as Allen-Bradley PLC or Discrete I/O devices to the 1395 drive.

Interface – Hardware and associated software required to transfer information and/or control signals from one device to another.

Microbus – Hardware and associated software designed by Allen-Bradley for the exchange of digital information at the microprocessor level. The microbus is used for the transfer of information between adapter boards and the main control board.

Port – Hardware located on the main control board which allows for connection of an adapter board to the microbus. There are two ports on the main control board.

Programming Terminal – Device used for programming and monitoring operation on the 1395 drive. The programming terminal is provided in two packages: digital handheld terminal and door mounted terminal.

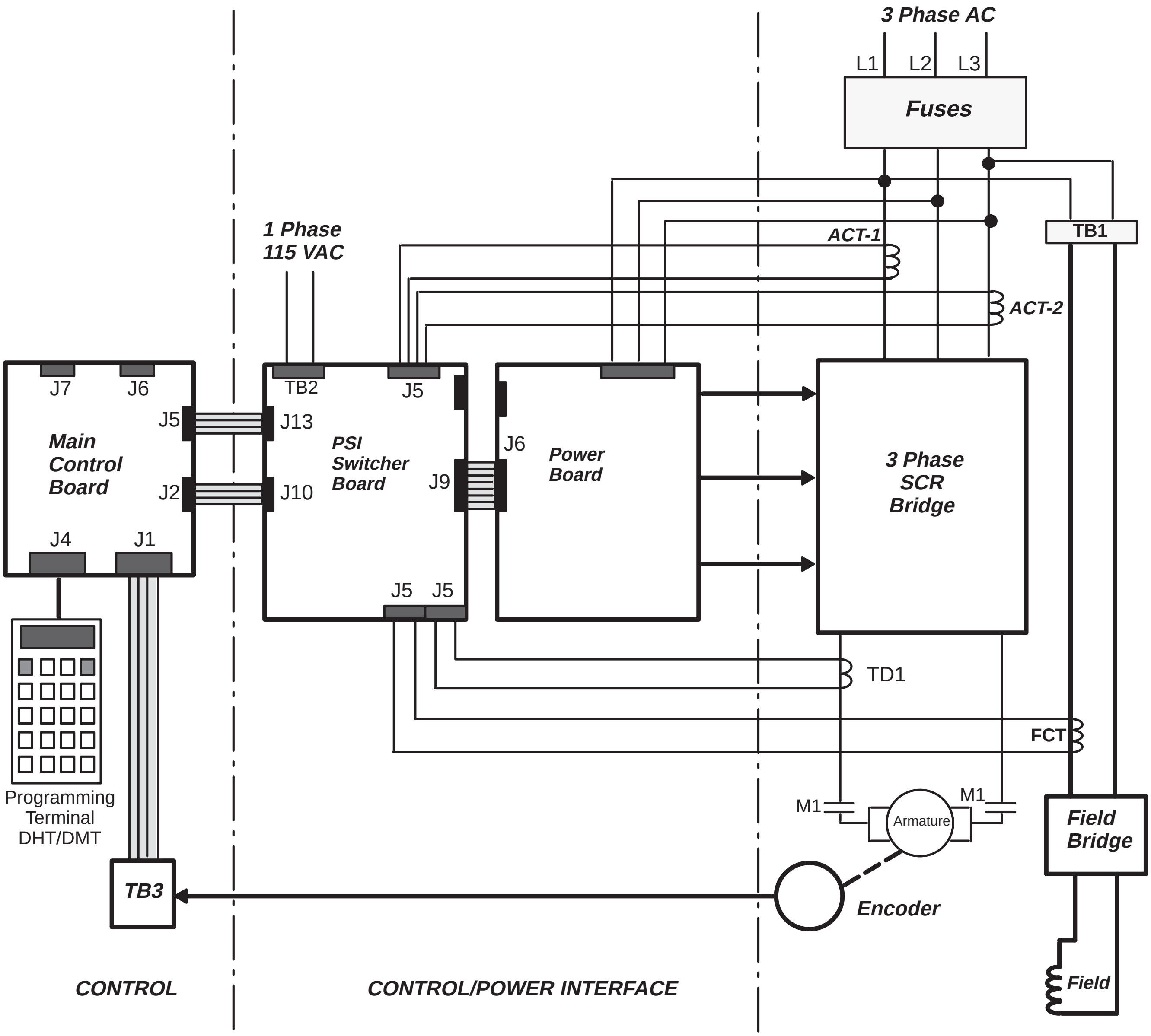
Hardware Overview

Figure 2.1 provides an overview of the hardware components associated with the 1 – 30 HP, 230VAC and 2 – 60 HP, 460VAC drives.

This chapter describes in general all of the major hardware components. Figures provided in this chapter are drawn based on hardware functionality. Some components may be repeated in several different diagrams.

Important: Refer to Chapter 1, “Publication References” for manuals describing larger horsepower and current ratings at other line voltages.

Figure 2.1
Hardware Overview



Armature Bridge Components

A general description of the components in the armature bridge (Figures 2.2 and 2.3) and their operation is detailed here:

AC Line Reactor – When connecting the drive directly to the main distribution system an AC line reactor must be used to protect the power bridge from rapid rate of current changes (di/dt).

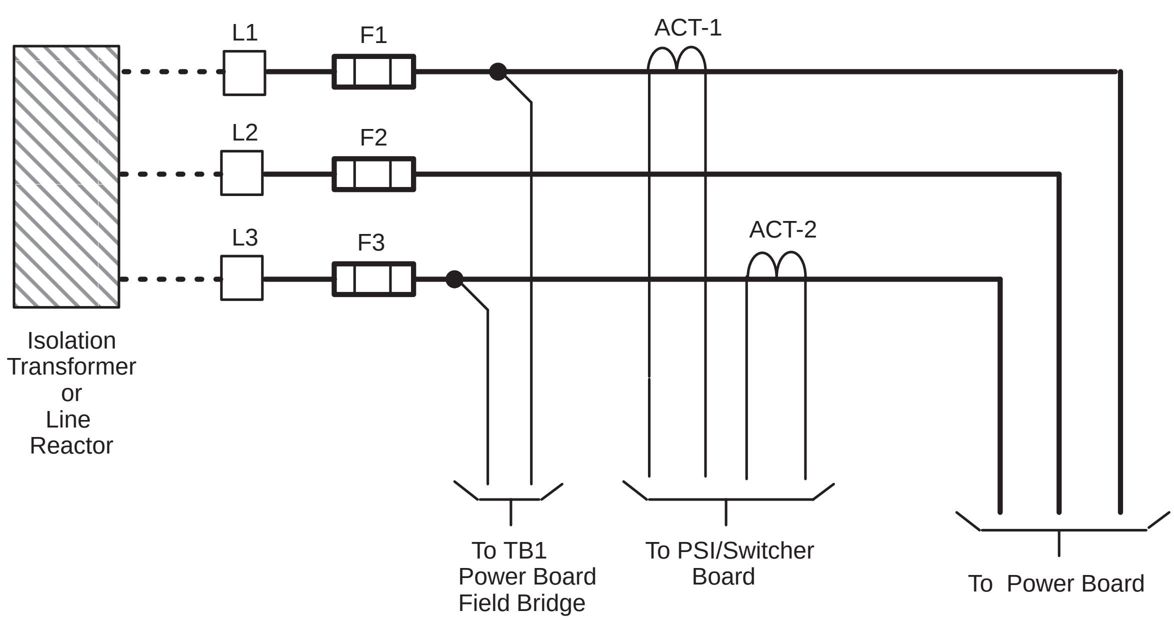
When an isolation transformer matched to the unit rating is used, an AC line reactor is not required.

Fast acting semiconductor fuses F1, F2 and F3 are standard on all drives.

Synchronization – The three-phase input to the drive is fed directly to the Power Board. The Power Board scales down the voltage and develops the synchronization information to be used by the Main Control Board.

AC Current Feedback – Current Transformers ACT-1 and ACT-2 (Figure 2.2) are used to provide current feedback information to the PSI/Switcher Board. The PSI/Switcher Board rectifies the feedback and scales a DC voltage representing the current feedback. This signal is then sent to the Main Control Board.

Figure 2.2
Armature Bridge Components (INPUT)



Surge Suppression – Surge suppressor MOV1 to MOV4 on the Power Board protects the armature power bridge from line voltage spikes and line surges.

Line Reactor – A reactor mounted outside the drive is used to protect the power bridge SCRs from rapid rate of current changes (di/dt).

SCR Packaging – SCR packaging in the 1395 in bridge ratings 3.6 – 110A (1 – 60 HP) consists of 2 SCRs per module. The regenerative construction has 6 SCR blocks PM1 through PM6. The non regenerative construction has 3 SCR blocks PM1, PM3 and PM5. Refer to Figure 2.3.

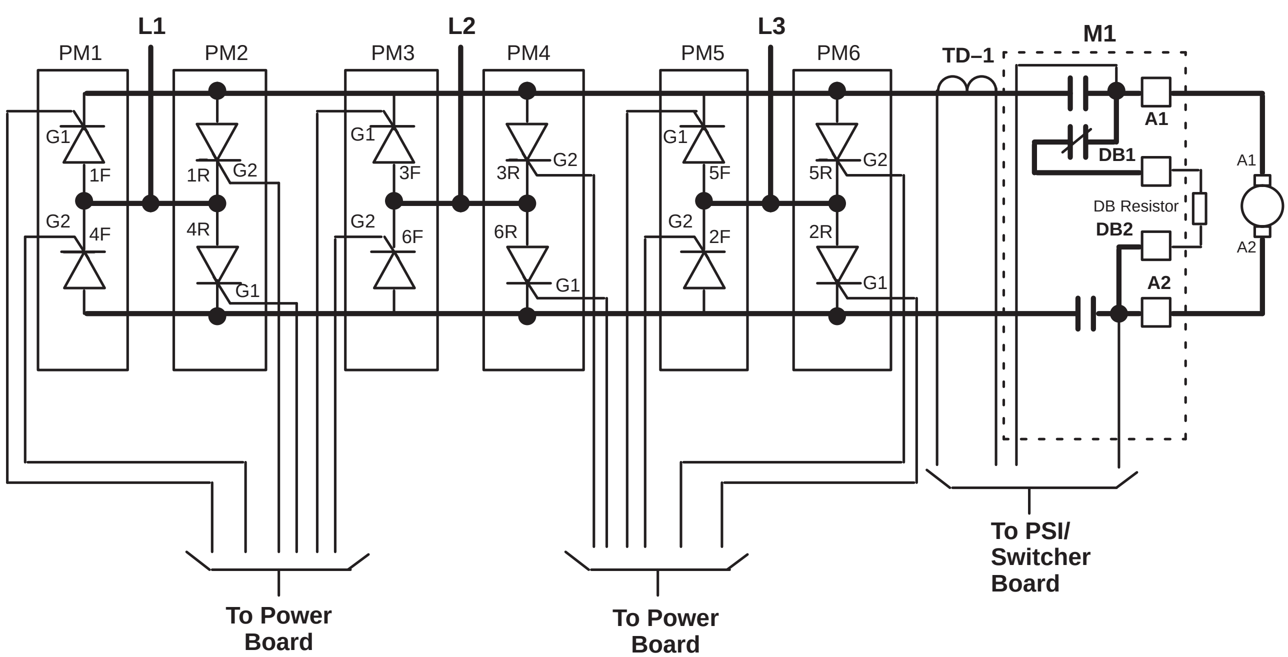
Pulse Transformers – Pulse Transformers on the Power Board provide the gate firing pulses and voltage isolation for the armature SCRs.

Voltage Transient Protection – RC networks contained on the Power Board are used to protect the SCRs against voltage transients (dv/dt).

DC Bus Snubbers – DC Bus Snubbers are used on 3.6 – 19 A units only.

DC Current Sensing – DC overcurrent sensing is provided using DC transducer TD1.

Figure 2.3
Armature Bridge Components (OUTPUTS)



DC Contactor – Output of the armature bridge is connected to the DC motor through the main DC contactor M1 (Fig. 2.3). Coil voltage to M1 is controlled by contacts from the pilot relay K3 (on PSI/Switcher board) and external 115VAC control input entering at TB2-2 and 3.

Bridge Output Connections – Bridge output connections labeled A1 and A2 (Fig. 2.3) correspond to the NEMA standards for connection to the A1 and A2 leads of the DC motor. If dynamic braking is used, the dynamic braking resistor bank is connected to terminals DB1 and DB2.

Field Bridge Components

A general description of the components in the field bridge (Fig. 2.4) and their operation is covered here:

Supply Voltage – Two of the three supply voltage phases are routed to the input of the field supply power bridge (TB1-1 and TB1-2).

Field Current Feedback – Current at transformer FCT provides field current feedback information to the PSI/Switcher board. The PSI/Switcher board rectifies the single phase feedback and scales the DC voltage using a burden resistor selected by the position of Jumper J1 on this board. The DC voltage representing field current feedback is sent to the main control board.

Surge Suppression – Surge suppressor MOV5 protects the field power bridge from high voltage line spikes and line surges on the incoming AC line. MOV6 protects the motor field windings from line spikes on the output of the field bridge.

Inductor – Inductor L1 protects the field power bridge SCRs from rapid rate of current changes (di/dt).

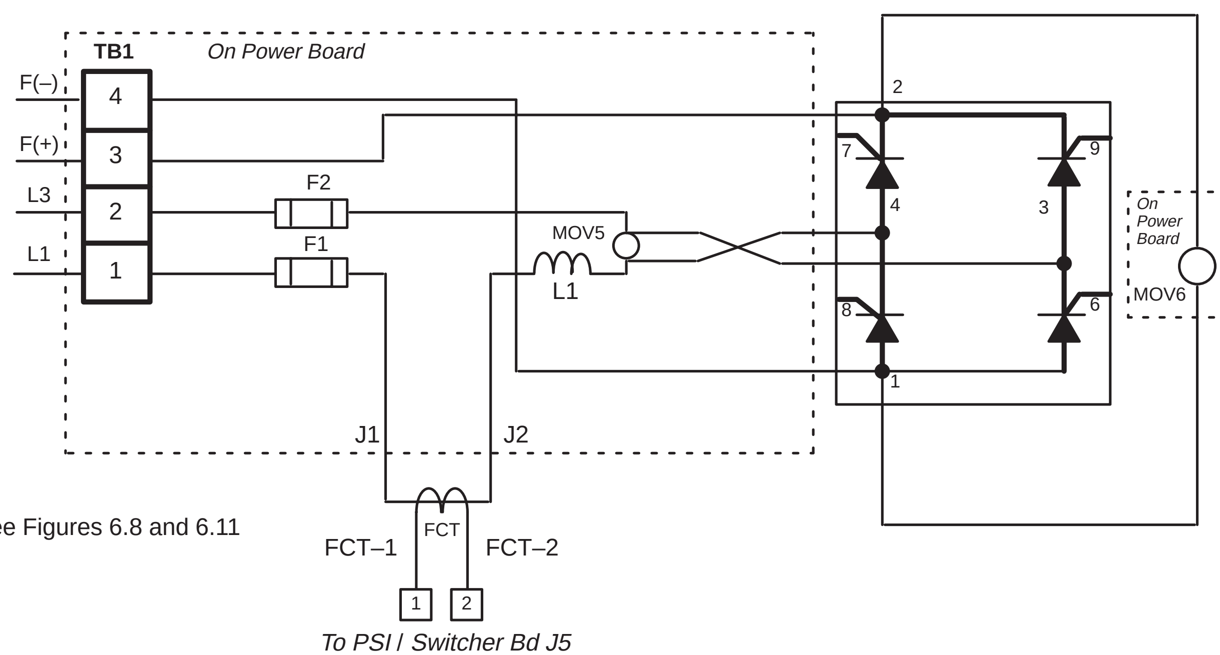
SCR Modules – Field bridge SCRs are contained in one single phase full wave module (PM7).

Field Pulse Transformer – The Field Pulse Transformers on the Power Board provide the gate firing pulses for the field SCRs.

Voltage Transient Protection – RC networks contained on the power board are used to protect the SCRs against voltage transients (dv/dt).

Bridge Output Connections – The output of the field bridge is connected to the Power Board. Connections of the motor field is at TB1-3 and TB1-4 on the Power Board.

Figure 2.4
Field Bridge Components



See Figures 6.8 and 6.11

Power Board

The operation of the Power Board components (Figures 2.5 and 2.6) is detailed here:

Gate Firing Pulses – The function of the Power Board is to provide the gate firing pulses for the armature and field bridges.

Transient Voltage Protection – The Power Board provides protection against line voltage spikes and transients (dv/dt) for the armature and field SCRs.

Bus Bar – The Power Board acts as an interface board between the SCRs and the Bus Bar. All armature SCR connections terminate at the bus bar mounted on the power board.

Feedback Circuitry – All voltage related feedback circuitry is contained on the Power Board. All signals are attenuated to logic level voltage.

Field Connections – All user motor field connections are located on TB1on the bottom left edge of the Power Board (Fig. 2.6).

Figure 2.5 shows the location of the power board in the drive, while Figure 2.6 illustrates the power board layout outlining the relevant components for user interface.

Figure 2.5
Power Board Location

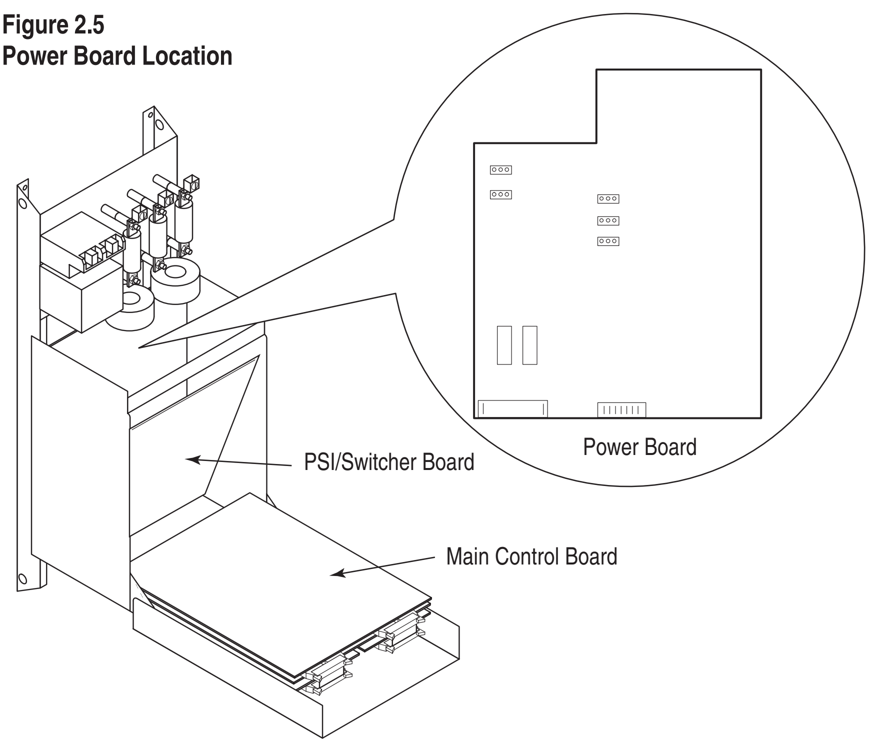
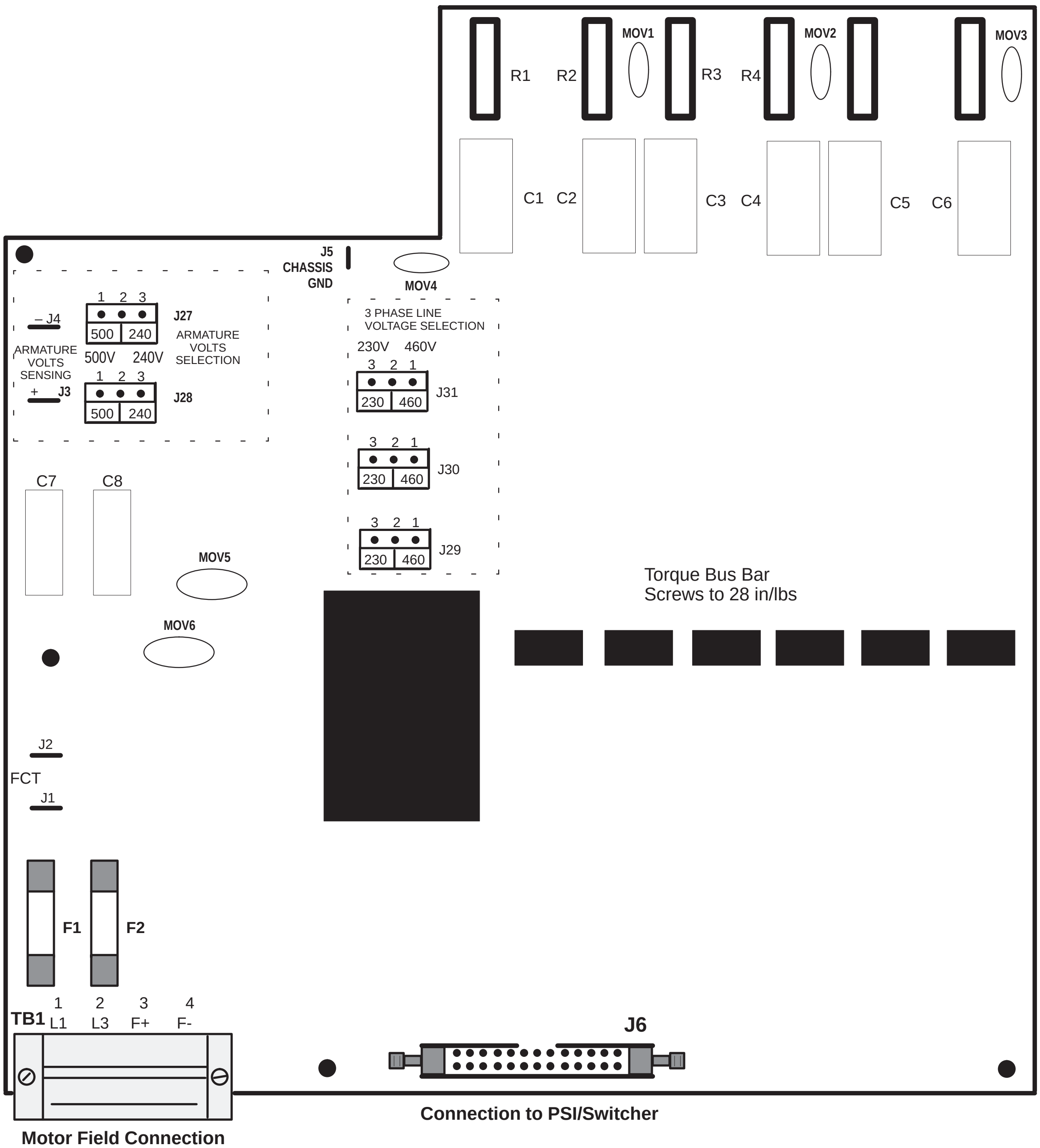


Figure 2.6
Switch and Hardware Location on Power Board

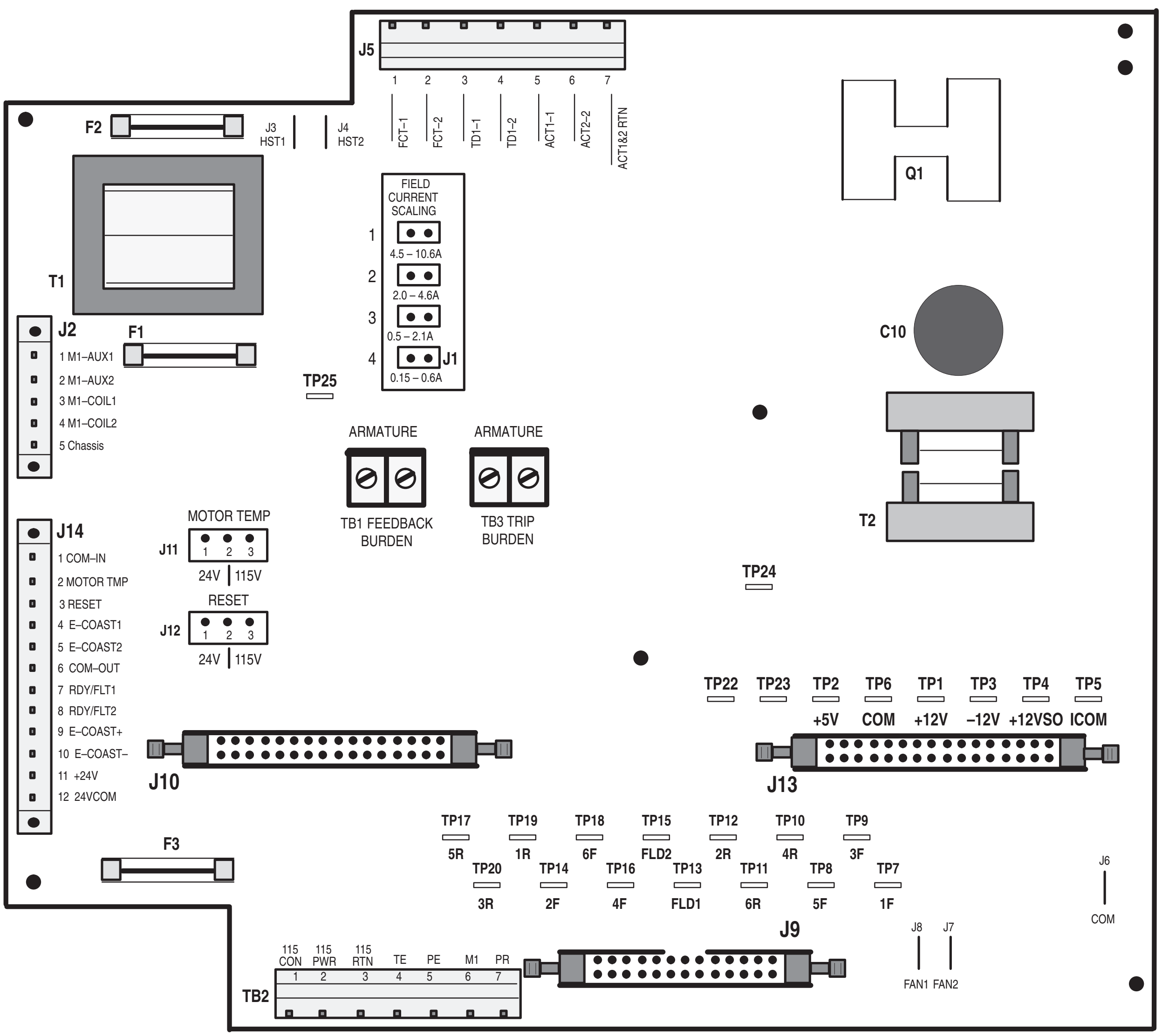


PSI/Switcher Board

The primary function of the board (Figure 2.7) is to provide interface between the Main Control Board, and the Power Board. The PSI/Switcher board also provides the following:

- Distribution of DC logic power to the Main Control Board.
- Three-Phase line synchronization signals to the Main Control Board.
- Contactor and other logic control interface with the Main Control Board.
- Rectification and Regulation of the external 115VAC power supply to produce 5VDC and +/–12VDC control voltage.
- All current related feedback scaling circuitry.
- Customer basic interface for 115VAC.
- Field Current Range jumpers.
- Jumper selection for 24VDC or 115VAC for reset, motor thermal and ECOAST.

Figure 2.7
PSI/Switcher Board Hardware Location



Customer Interface 115 VAC Control

Table 2.A
PSI/Switcher Board Jumper Settings

Jumper	Function	Position 1–2	Position 2–3
J11	MotorTemp	24VDC	120VAC
J12	Reset	24VDC	120VAC

Table 2.B
Field Current Range Jumper Selections (see Table 8.J)

J1 Jumper Position	1–30HP 240VDC; 2–60HP 500VDC Field Current Range
1	4.5 – 10.6A
2	2.0 – 4.6A
3	0.5 – 2.1A
4	0.15 – .6A

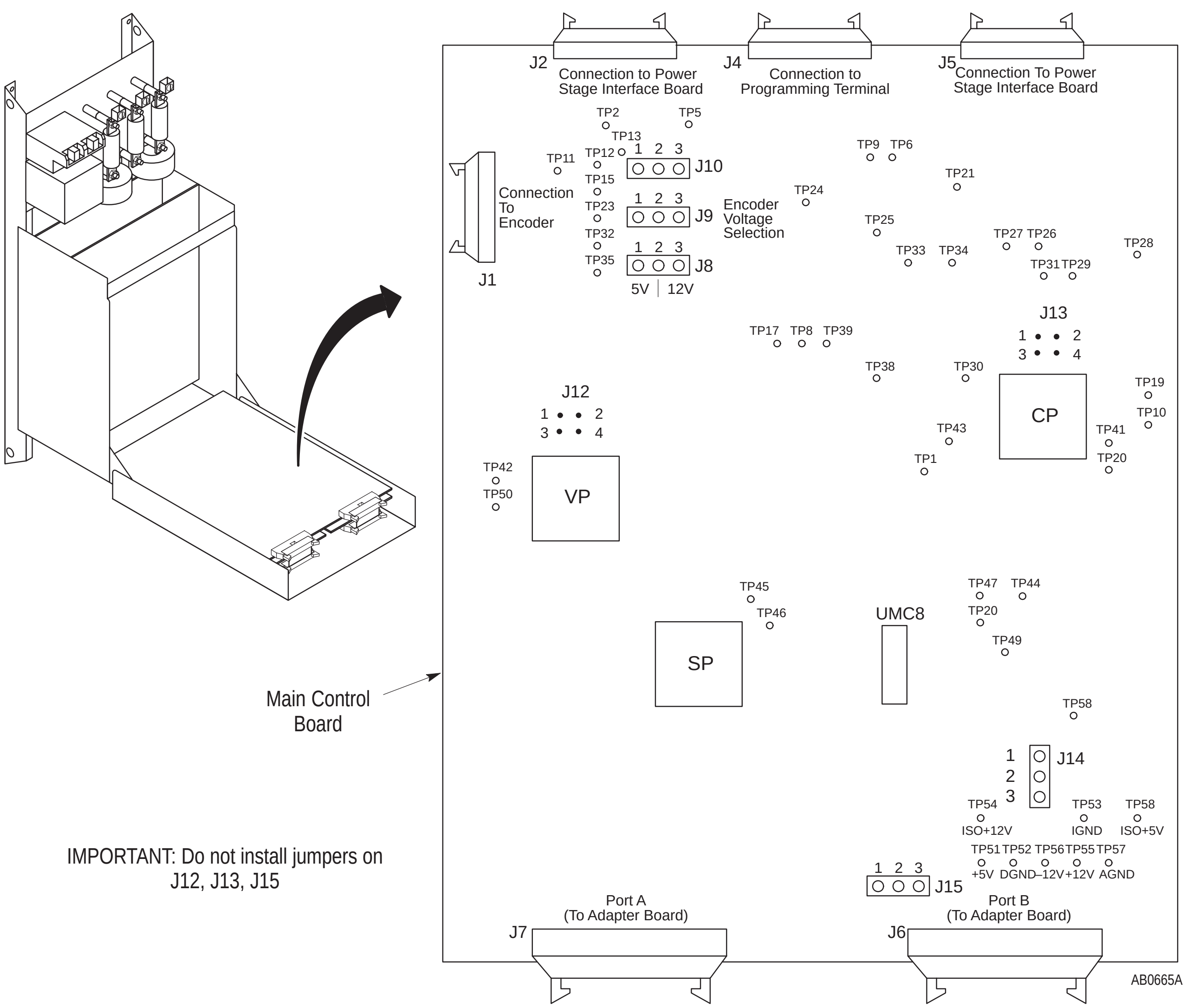
Note: See Table 8.J for additional high horsepower settings

Main Control Board

The Main Control Board (Figure 2.8) performs all control functions of the 1395 drive. Hardware located on the board is used to support operation of the microprocessor firmware. The primary functions performed include:

- Microbus interface.
- Control Firmware
- Analog signal interface
- Develop gate firing signals sent to the PSI/Switcher Board

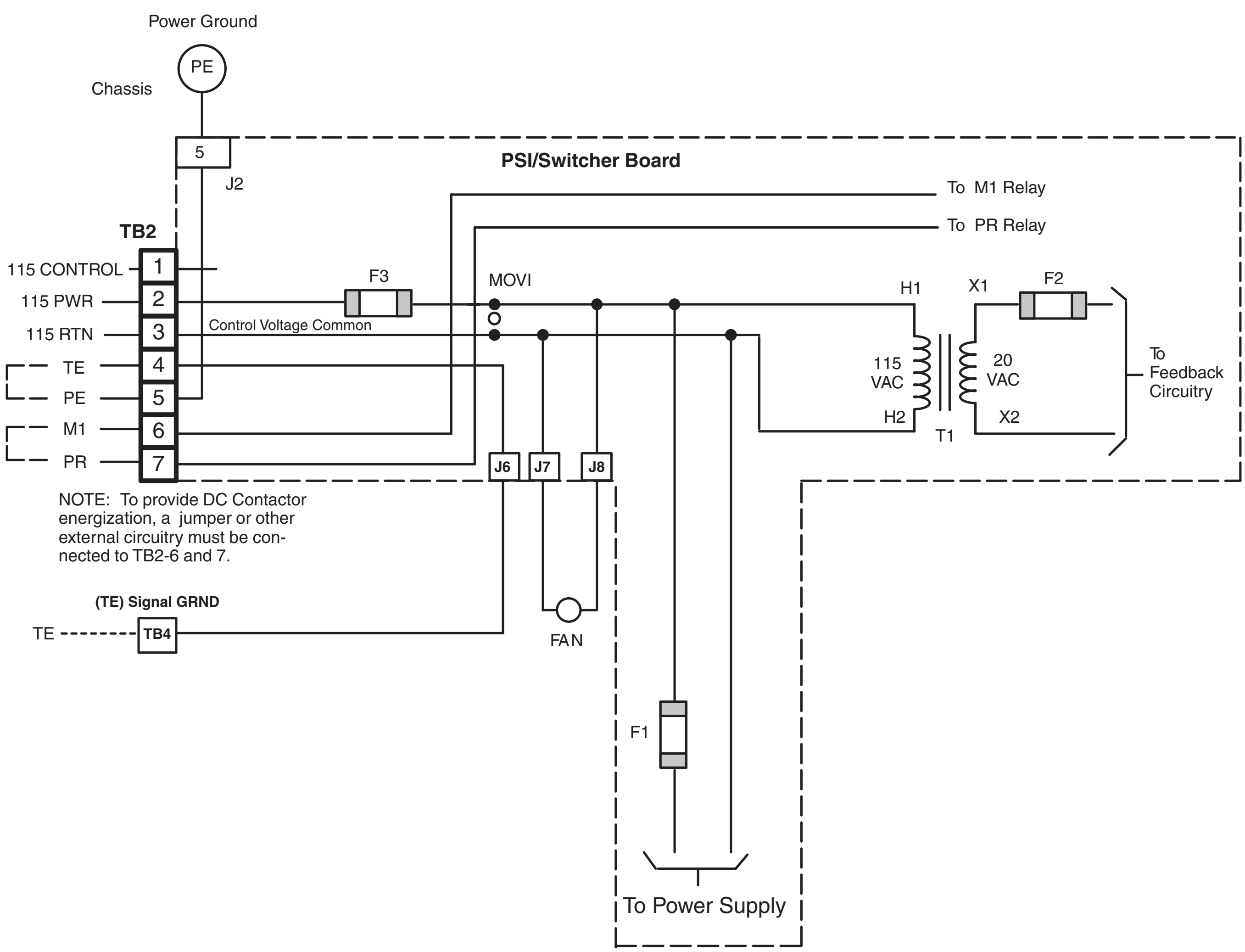
Figure 2.8
Main Control Board Hardware Location



Power Distribution

115VAC Control Voltage – Figure 2.9 illustrates the distribution of 115VAC control voltage within the Bulletin 1395. Single phase 115VAC control voltage, provided from an external source by the user enters the drive at TB2-2 and 3. Fuse F3 provides protection against short circuits on the 115VAC input to the drive.

Figure 2.9
115 VAC Control Voltage Distribution



DC Control Voltage Distribution – The Unit Power Supply located on the PSI/Switcher converts 115VAC to +5VDC and to +/–12VDC control voltages.

Relay Logic (1 – 30 HP 230VAC) (2 – 60 HP 460VAC)

Main Contactor (M1) Control – Figure 2.10 illustrates the hardware associated with the control of the coil voltage applied to the Main DC contactor M1. The coil voltage originates at an external 115 VAC source at TB2-1. The source voltage may be interrupted before being input to the drive at TB2-1 by the use of externally controlled contacts. These external contacts may include an external master coast stop, PLC controlled contacts, permissive contacts, etc. Main contactor M1 coil voltage is controlled within the 1395 through the PSI/Switcher Board.

Pilot Relay (PR) Control – K1 and K2 contacts in series with the 115VAC Coast Stop input to the drive control coil voltage to the Pilot Relay K3.

ECOAST Stop – The "ECOAST Stop" as defined and illustrated, is a contingency circuit designed to remove power from the motor in event of a malfunction in the solid state interface drive software which conforms to NEMA for electromechanical E Stop of a micro controlled drive.

When an ECOAST Stop is initiated, the DC loop contactor is de-energized and the motor will coast to a stop unless the drive is equipped with optional dynamic braking circuitry.

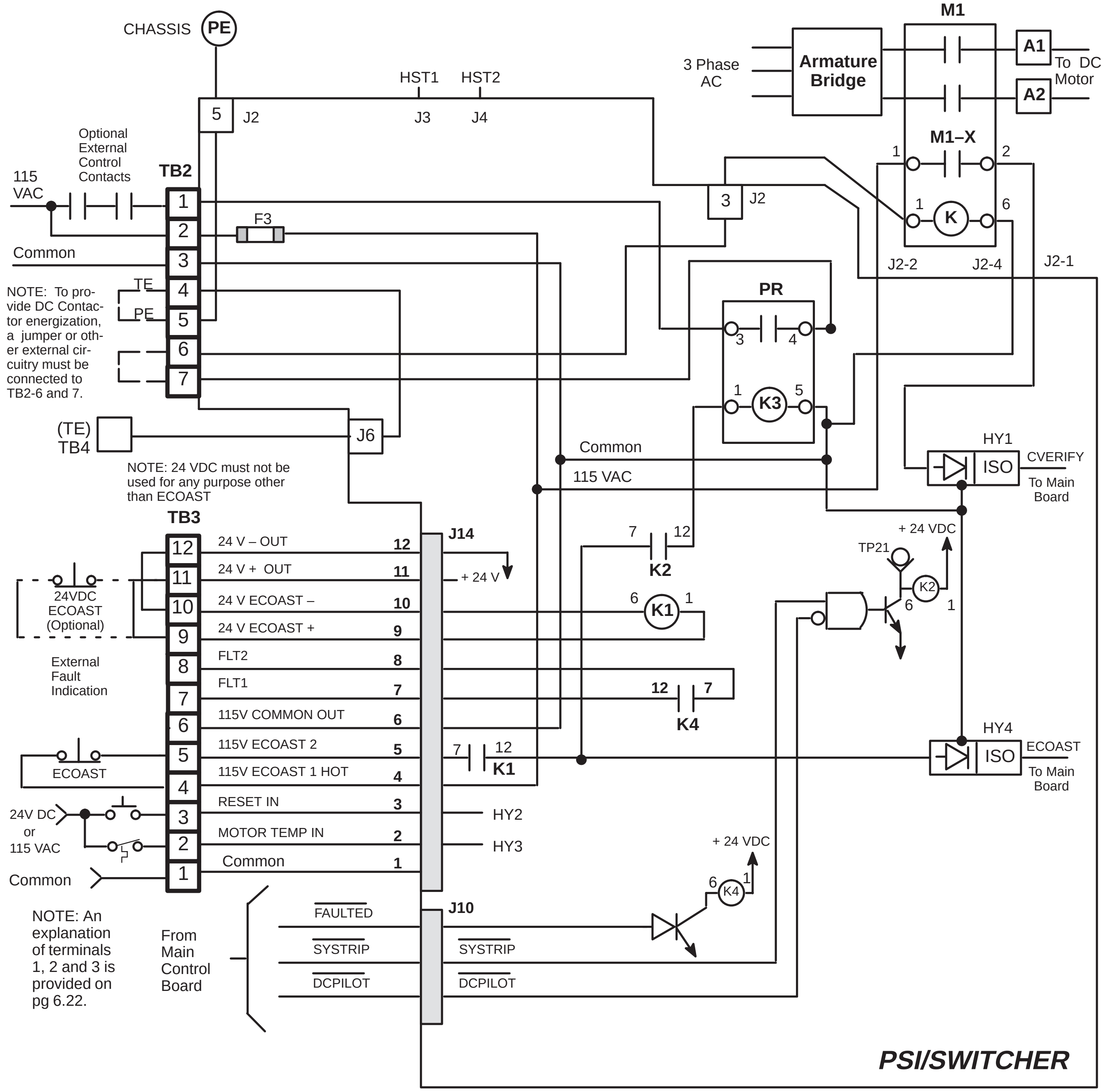
Relay K1 on the Power Stage Interface is the 24V ECOAST Stop relay and is controlled by +24VDC. As shown in Figure 2.10, +24VDC from the PSI/Switcher Board is connected to TB3-12 and 11. At this point, an external (dry) 24 VDC ECOAST stop contact could be used to control the application of 24VDC to K1 through TB3-9. TB3-12 and 10 should always be jumpered together to provide a return path for 24VDC. If an external 24VDC ECOAST Stop contact is not used, then TB3-9 and 11 must be jumpered.

In addition to the 24VDC ECOAST Stop, there is an 115VAC ECOAST Stop circuit which is also provided as standard in the 1395. 115VAC enters the PSI/Switcher Board at TB2. Between TB3-4 and 5, an external (dry) ECOAST Stop contact may be connected. If an external 115 VAC ECOAST stop circuit is not used, TB3-4 and 5 must be jumpered. 115VAC is returned to the Power Stage Interface from TB3-5 and sent to contacts of K2. The 115VAC ECOAST Stop Signal is also sent to an isolation circuit which converts the 115VAC to a +5VDC control Signal ECOAST which is sent to the Main Control Board.

Main Control Relay – K2 on the PSI/Switcher is the main control relay which controls turn on voltage to the coil of the pilot relay K3. K2 is controlled by logic signals from the Main Control board entering the PSI/Switcher through ribbon connector J10. The two signals which control K2 are the SYSTRIP and the DCPILOT signals. In order for K2 to energize PR, there must be no system fault and there must be a DC pilot relay turn on command. If both these conditions are met, K2 is energized, and the Pilot Relay is in turn energized.

The control voltage being applied to K2 may be monitored on the Power Stage Interface at TP21. If K3 is being commanded to energize, the voltage at TP21 will be 0VDC. If K3 is to be de-energized, the voltage at TP21 will be +24VDC.

Figure 2.10
Relay Logic



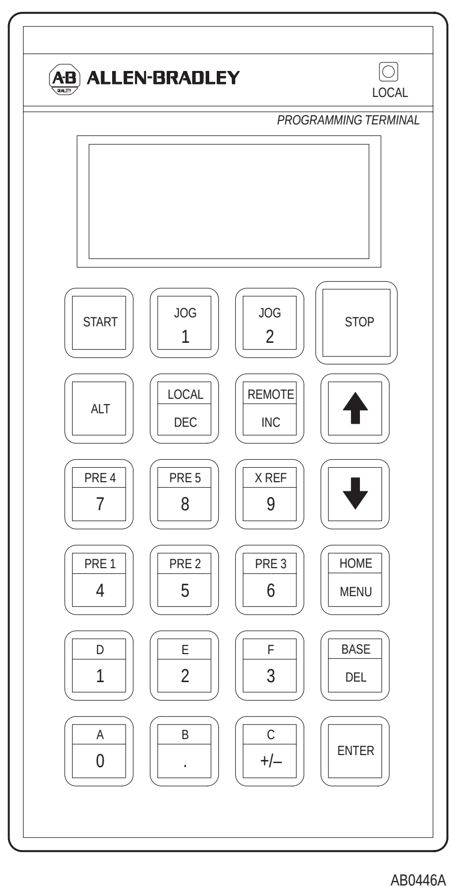
Options

Programming Terminal Interface – The Programming Terminal (shown in Figure 2.11) is used to access information in the firmware of the 1395. Keypads on both the handheld programming terminal and the door mounted terminal can be used to perform the following functions:

- Monitor real time parameter values
- Change parameter values
- Start/Stop the drive (depending on Model of Programming Terminal)
- Program drive configuration
- Save parameter values to EEPROM
- Monitor fault information
- Clear faults, system reset
- Autotune

Interface between the 1395 Main Control Board and the handheld Programming Terminal is accomplished using a 9 pin type connector physically mounted on the end of TB3. The cable coming from the D-shell connector is connected to J4 on the Main Control Board. For a detailed description of the Programming Terminal, refer to the Programming Terminal Installation and Operation Manual.

Figure 2.11
Programming Terminal

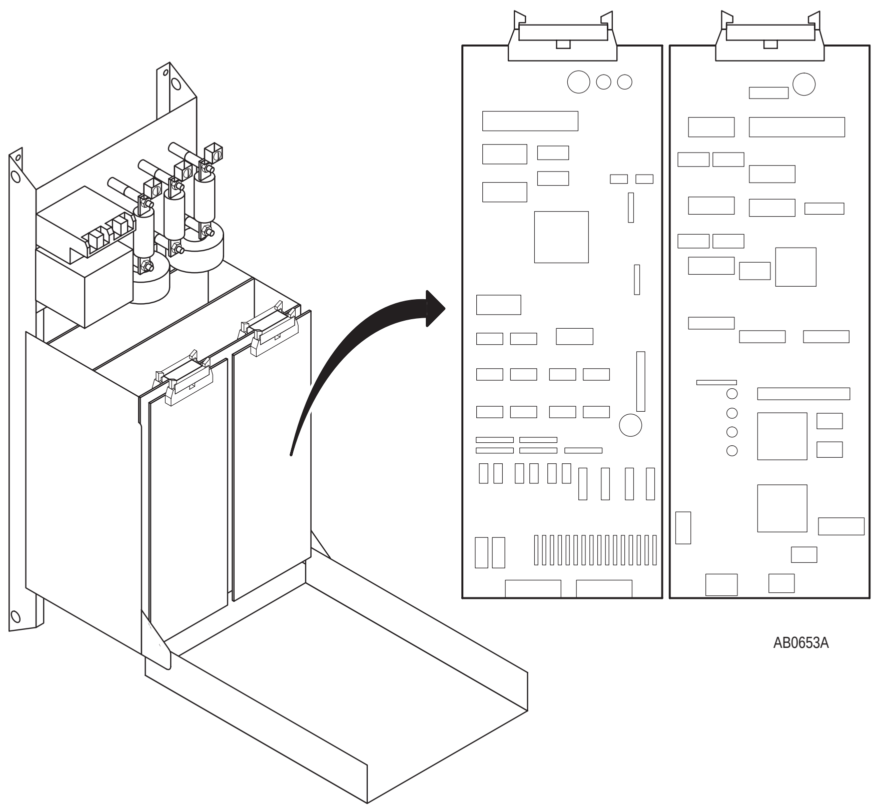


Note: The Programming Terminal can be hand-held or door-mounted when used with the mounting kit.

Adapter Boards – External control devices such as a PLC, discrete operators devices, etc., are interfaced with the Main Control Board through one of the two microbus ports, labeled Port A (J7) and Port B (J6) on the Main Control Board. The microbus is a 60 line bus designed specifically for the transfer of data between microprocessors. The microbus is used on the Main Control Board to transfer data between devices on the board. Additionally, hardware on the Main Control Board allows data transfer between the microprocessor on the Main Control Board and external devices through the two microbus Ports.

Information coming from external devices must be changed first to the format required by the microbus before being input to the microbus Port. The processing of data is accomplished through the use of the following adapter boards:

Figure 2.12
Construction and Location of Adapter Boards



Discrete Adapter Board

The Discrete Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. All user connections to the board are made at Terminal Block TB-3 located at the bottom of the 1395 Drive.

Digital Inputs – The Discrete Adapter Board contains four discrete inputs and is available in 120VAC or 24VDC versions. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.
The inputs are preconfigured for the following signals: STOP, JOG, START, CLEAR FAULT.

Digital Outputs – Two discrete outputs are provided through control of two on-board relays. The contact rating is 0.6A at 125VAC and 0.2A at 30VDC. These outputs allow the 1395 to signal various operating states of the Drive.
The outputs are preconfigured for the following signals: DRIVE RUNNING and AT ZERO SPEED.

Analog Inputs – Four preprogrammed 12-bit analog to digital inputs. These inputs allow a +/– 10VDC analog signal to be converted to a +/– 2048 digital signal, thus providing 4.88 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the converted signal can be extended to +/–32767.
The analog inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY, TRIM REFERENCE.

Analog Outputs – Four preprogrammed 11 bit digital to analog outputs. These outputs allow a +/– 1024 drive signal to be converted to a +/–10VDC analog output, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767.
The analog outputs are preconfigured for the following signals: VELOCITY FEEDBACK, FIELD CURRENT FEEDBACK, ARMATURE CURRENT FEEDBACK and ARMATURE VOLTAGE FEEDBACK.

All inputs and outputs have the flexibility to be reconfigured by the user for other signals. For a detailed description of the Discrete Adapter, refer to the Discrete Adapter manual.

Digital Reference Adapter Board

The Digital Reference Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. This interface supplies the Adapter Board with all logic voltages and communication capabilities. The Digital Reference Adapter has the following inputs and outputs:

Digital Reference Input – One digital frequency reference input which produces a digital velocity reference command for the Drive. The Adapter Board is set up by default for the encoder input signal to be single channel dual edge (ie. both the rising edge and falling edge are used by the counting logic).

Digital Inputs – Ten programmable discrete inputs for 24VDC signals. They can be connected to any Sink parameter such as the Logic command word. All ten inputs are LED indicated for high input level visibility. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.

The inputs are preconfigured for the following signals: RUN REFERENCE SELECT A,B,C, RAMP DISABLE, JOG 2, JOG1, NORMAL STOP, START, CLOSE CONTACTOR, CLEAR FAULT.

Digital Outputs – Five programmable solid state outputs are provided. These 24VDC outputs can be connected to any source parameter, such as the logic status word. All five outputs have LEDs indicating the bits of the state of the output (on or off).

These outputs are preconfigured for the following signals: ZERO SPEED, DRIVE RUNNING, READY, AT CURRENT LIMIT, AT SET SPEED.

Analog Inputs – Two programmable analog inputs allow a +/– 10 Volt signal through a 12 bit A to D converter, thus providing 4.88 millivolts per bit resolution.

The inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY.

Analog Outputs – Two programmable analog outputs allow a signal to be converted to a +/– 10VDC analog output through a 11 bit digital to analog converter, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767. The digital drive signal can be any of the 1395 run time sink parameters.

All user connections to the board are made at terminal block TB3 located at the bottom of the 1395 Drive.

The outputs are preconfigured for the following signals, VELOCITY FEEDBACK, ARMATURE CURRENT FEEDBACK.

All inputs and outputs have the flexibility to be reconfigured by the user for other signals. For a detailed description of the Digital Reference Adapter, refer to the Digital Reference Adapter manual.

Node Adapter Board

The Node Adapter Board provides an interface between PLC family devices and the Main Control Board of the 1395. The board allows the 1395 to be controlled using an Allen-Bradley PLC Controller from either the PLC3 or PLC5 family.

The Node Adapter Board is not preconfigured. Refer to the Node Adapter manual for hardware integration information.

Multi-Communication Board

The Multi-Communication Adapter Board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over serial communications links.

The Multi-Communication Adapter is not preconfigured. Refer to the Multi-Communication Board Software/Hardware Reference Manual for hardware and integration information.

ControlNet Adapter Board

The CNA board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over ControlNet. This adapter has the following features:

- One ControlNet channel, with a redundant connector to allow for backup connection in case one cable fails.
- Compatible with all Allen-Bradley PLCs and other products that support Programmable Controller Communication Commands.
- Compatible with Allen-Bradley 1395 Drives equipped with Version 8.10 or greater software.

Chapter 3

Hardware Description

40 – 100 HP; 230VAC
75 – 200 HP; 460VAC
(111 – 345 A)
Series A

Introduction

Chapter 3 contains both a general description of the major hardware components of the Series A 1395 drive and background information to support the procedures detailed in other chapters of this manual. You should use this chapter in conjunction with the Installation chapter when installing 40 – 100HP, 230VAC and 75 – 200HP, 460VAC Series A Drives.

Terminology

A brief description of new terms and concepts covered in Chapter 3 is presented here:

Adapter Board – Circuit board containing hardware and software required to interface external devices such as Allen-Bradley PLC or Discrete I/O devices to the 1395 drive.

Interface – Hardware and associated software required to transfer information and/or control signals from one device to another.

Microbus – Hardware and associated software designed by Allen-Bradley for the exchange of digital information at the microprocessor level. The microbus is used for the transfer of information between adapter boards and the main control board.

Port – Hardware located on the main control board which allows for connection of one adapter board to the microbus. There are two ports on the main control board.

Programming Terminal – Device used for programming and monitoring operation on the 1395 drive. The programming terminal is provided in two packages: digital handheld terminal and door-mounted terminal.

Hardware Overview

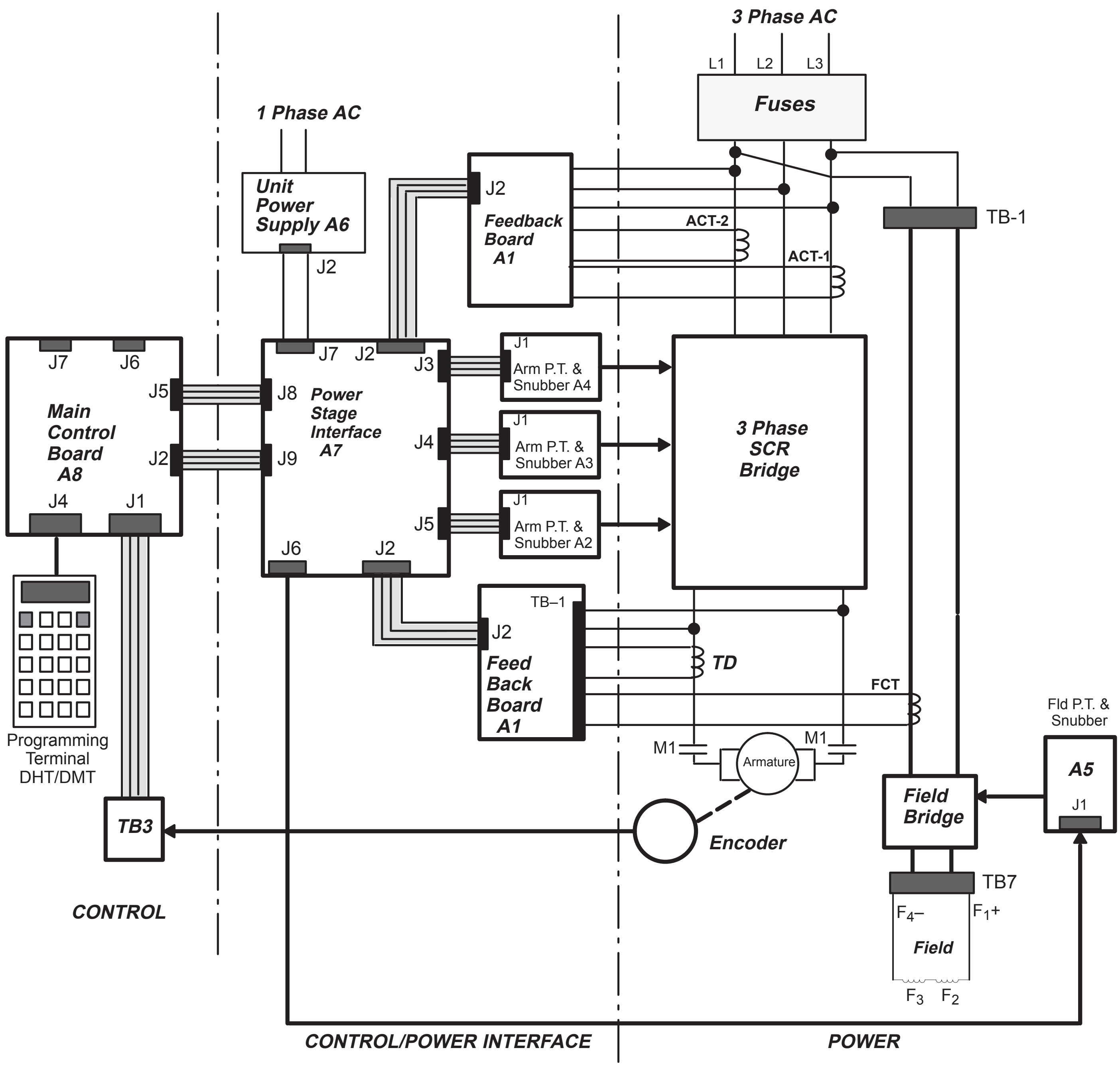
Figure 3.1 provides an overview of the hardware components associated with the Series A 1395 drive. Hardware can be broken into one of three categories:

- Control boards
- Control/Power interface hardware.
- Power hardware

This chapter describes in general all of the major hardware components. Figures provided in this chapter are drawn based on hardware functionality. Some components may be repeated in several different diagrams.

Important: Refer to Chapter 1, “Publication References” for manuals describing larger horsepower and current ratings at other line voltages.

Figure 3.1
Hardware Overview



Armature Bridge Components

A general description of the components in the armature bridge (Figures 3.2 and 3.3) and their operation is detailed here:

AC Line Reactor – When connecting the drive directly to the main distribution system an AC line reactor must be used to guard against system disturbance.

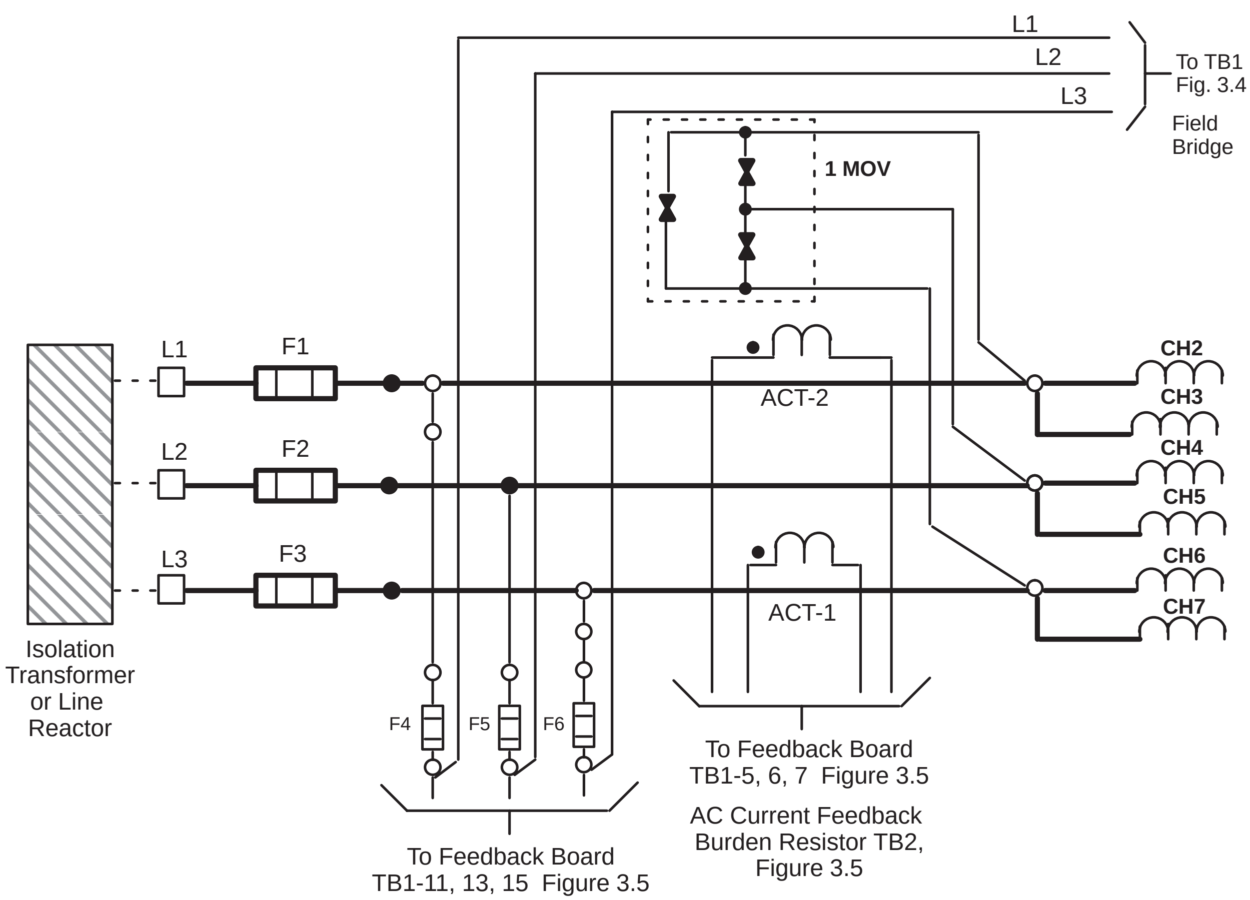
When an isolation transformer matched to the unit rating is used, an AC line reactor is not required.

Fast acting semiconductor fuses F1, F2 and F3 are standard on all drives.

Synchronization – The three-phase input to the drive is tapped and fused using fuses F4, F5 and F6 (Fig. 3.2) and enters the feedback board. The feedback board scales down the voltage before being sent to the power stage interface where it is used to develop the synchronizing information to be used by the Main Control Board.

AC Current Feedback – Current Transformers ACT-1 and ACT-2 (Figure 3.2) are used to provide current feedback information to the feedback board. The feedback board rectifies the three-phase feedback and scales the DC voltage before being sent to the power stage interface. The DC voltage representing the current feedback is passed directly through the power stage interface and sent to the main control board.

Figure 3.2
Armature Bridge Components (INPUT)



Surge Suppression – Surge suppressor 1 MOV (Fig. 3.2) protects the armature power bridge from high voltage line spikes and line surges.

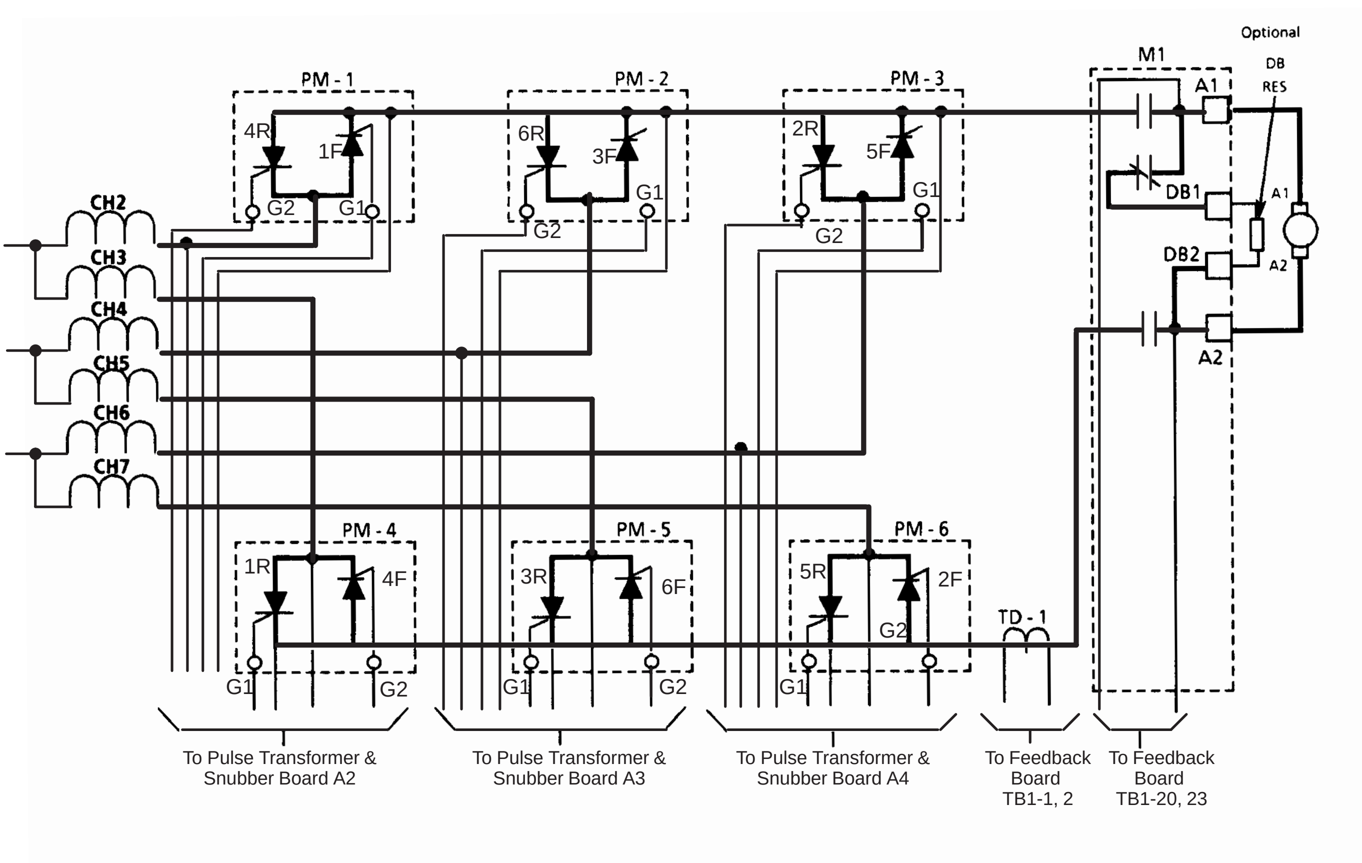
Line Chokes – Line Chokes CH2 through CH7 are used to protect the power bridge SCRs in each of the six legs of the power bridge from rapid rate of current changes (di/dt).

SCR Packaging – SCR packaging in the 1395 in bridge ratings 111 – 345 consists of 2 SCRs per module.

Pulse Transformer/Snubber Boards – All three boards are identical and are mounted directly to the armature bridge bus bars. R-C networks contained on the board are used to protect the SCRs against voltage transients (dv/dt).

DC Current Sensing – DC overcurrent sensing is provided using DC transducer TD1 (Fig. 3.3).

Figure 3.3
Armature Bridge Components (OUTPUT)



DC Contactor – Output of the armature bridge is connected to the DC motor through the main DC contactor M1 (Fig. 3.3). Coil voltage to M1 is controlled by contacts from the pilot relay PR and external 115VAC control input entering at TB2-3.

Bridge Output Connections – Bridge output connections labeled A1 and A2 (Fig. 3.3) correspond to the NEMA standards for connection to the A1 and A2 leads of the DC motor. If dynamic braking is used, the dynamic braking resistor bank is connected to terminals DB1 and DB2.

Field Bridge Components

A general description of the components in the field bridge (Fig. 3.4) and their operation is covered here:

Supply Voltage – In addition to being used for synchronization, the three-phase voltage from fuses F4, F5 and F6 is sent to TB1 where two of the three phases are routed to the input of the field supply power bridge (labeled Field L1 and Field L3 on Figure 3.4).

Field Current Feedback – Current transformer FCT provides field current feedback information to the feedback board at TB8 and 9. The feedback board rectifies the single phase feedback and scales the DC voltage using a burden resistor selected by the position of Jumper J1 on the feedback board before being sent to the power stage interface. The DC voltage representing field current feedback is passed directly through the power stage interface and sent to the main control board.

Surge Suppression – Surge suppressor 3MOV protects the field power bridge from high voltage line spikes and line surges on the incoming AC line. 2MOV protects the motor field windings from line spikes on the output of the field bridge.

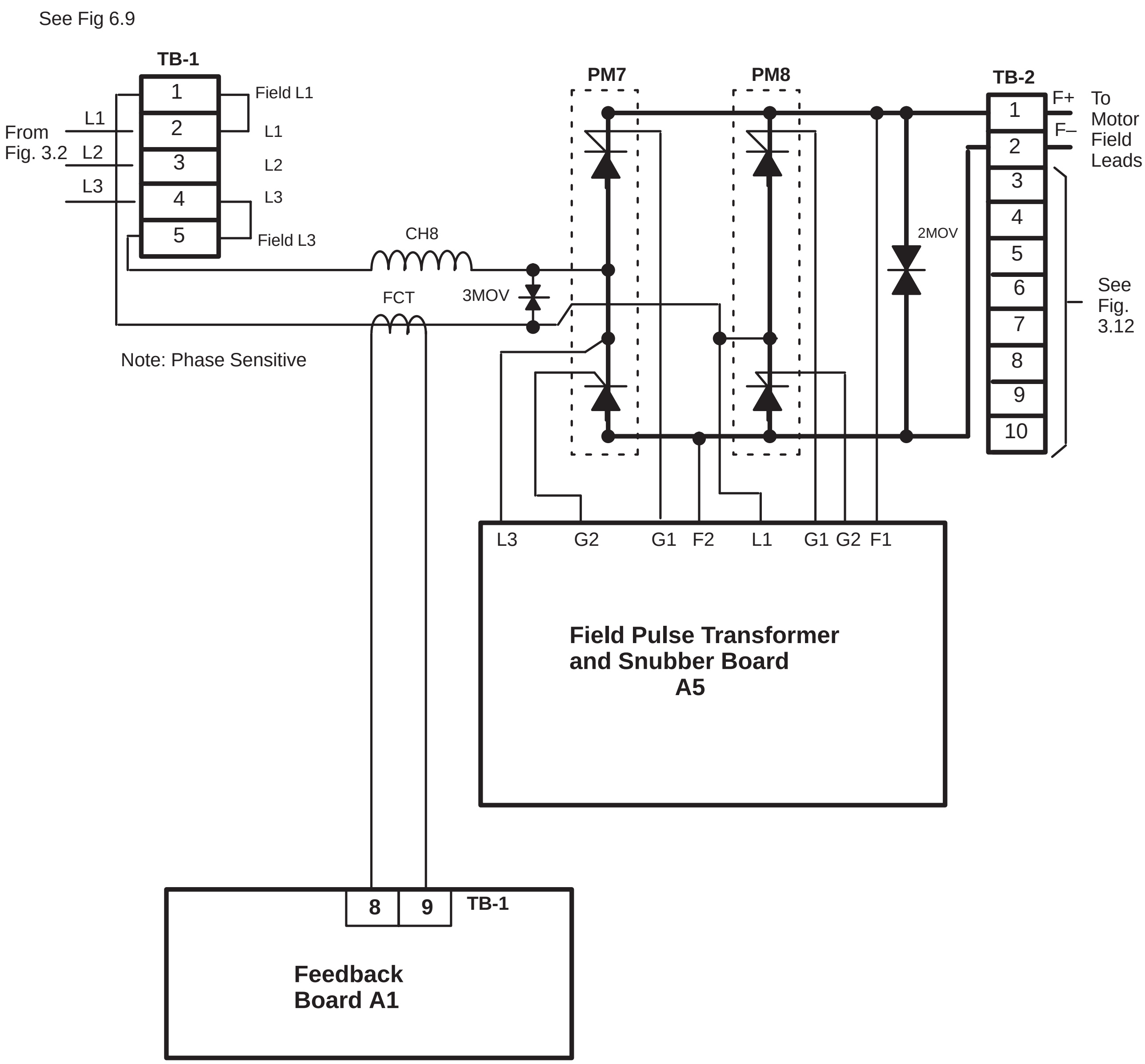
Line Choke – Line Choke CH8 protects the field power bridge SCRs from rapid rate of current changes.

SCR Modules – Field bridge SCRs are contained in modules made up of two SCRs per package (PM7 and PM8).

Field Pulse Transformer and Snubber Board – The Field Pulse Transformer Board provides the gate firing pulses and switching voltage transient (dv/dt) protection for the field SCRs.

Bridge Output Connections – The output of the field bridge is connected to TB2-1 and 2 which in turn is connected to the field leads of the motor. The terminal labeled F+ on TB2 is connected to the F1 lead of the motor and terminal F- to the F2 lead.

Figure 3.4
Field Bridge Components



Control Boards

Feedback Board – Figure 3.5 illustrates the major hardware points on the board. The primary function of the board is to provide scaling and transfer of feedback signals coming from power bridge devices being sent to the Power Stage Interface and eventually to the Main Control Board.

Figure 3.5
Feedback Board (A1) Overview

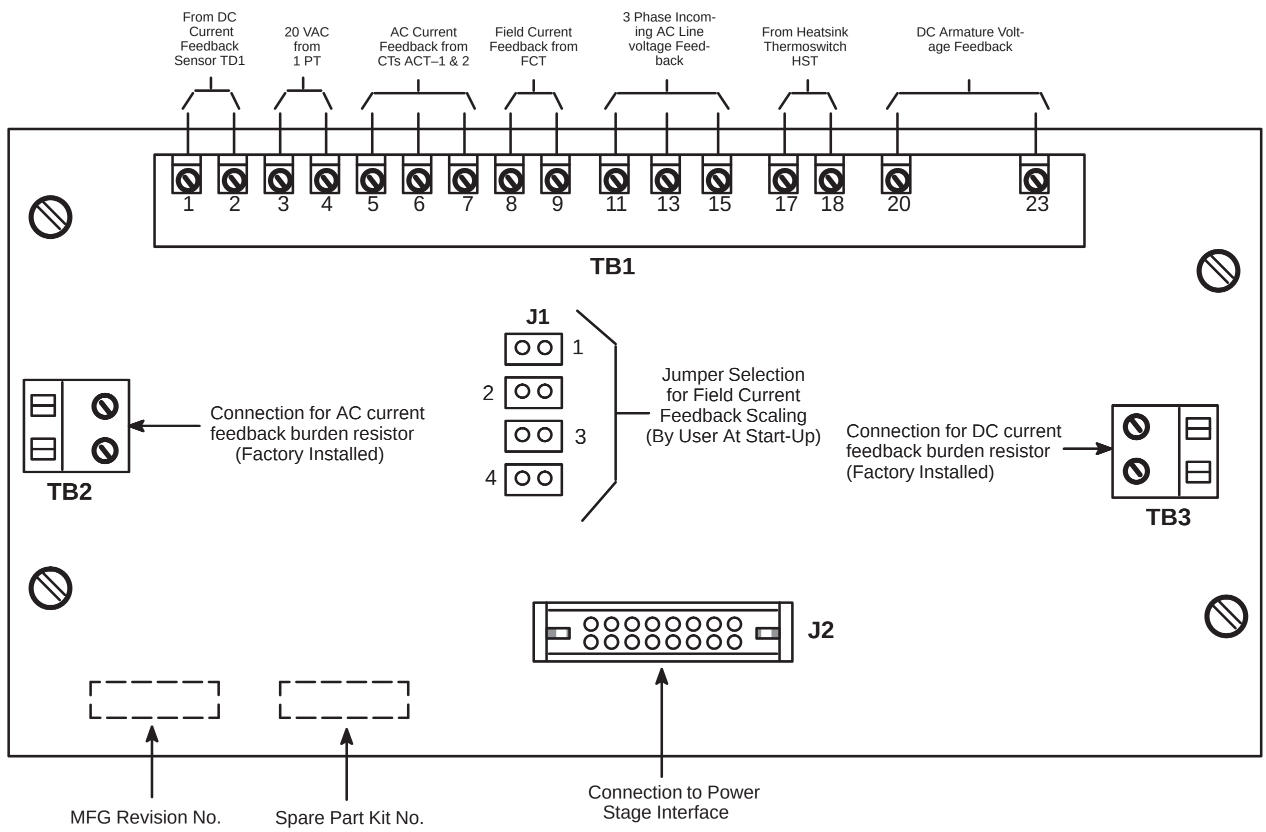
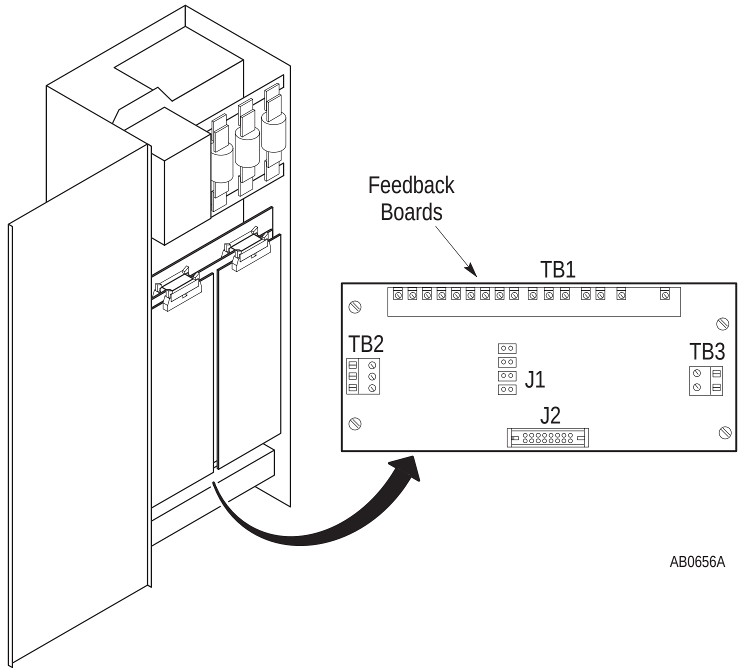


Table 3.A
Feedback Board Jumpers (see Table 8.J)

J1 Jumper Position	40 – 100 HP 240 VDC 75 – 200 HP 500 VDC Field Current Range
1	9.1 – 21.2 ADC
2	4.1 – 9.2 ADC
3	1.1 – 4.2 ADC
4	0.65 – 1.2 ADC

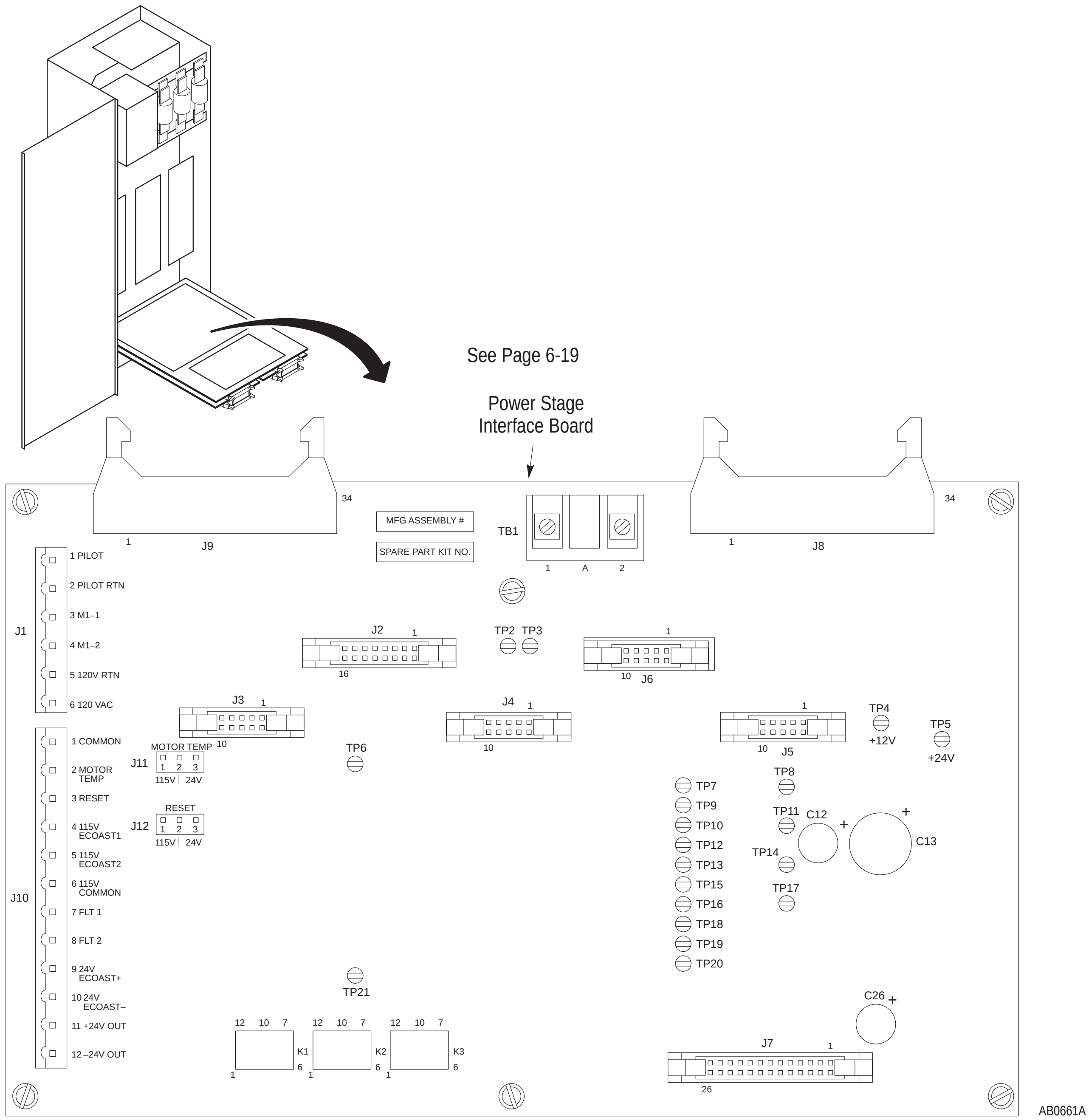
Figure 3.6
Feedback Board Hardware Location



Power Stage Interface (A7) – The primary function of the board is to provide interface between the Main Control Board, and the Power Bridge boards such as the Pulse Transformer and Snubber boards, and the Power Bridge boards such as the Pulse Transformer and Snubber boards and the Feedback Board. The primary functions performed include:

- Distribution of DC Control power to Main Control Board.
- Provide 3 phase line synchronization signals to Main Control Board.
- Produce all Armature and Field bridge SCR gate signals from control signals provided from the Main Control Board.
- Contactor and other logic control with interface to Main Control Board for these functions.

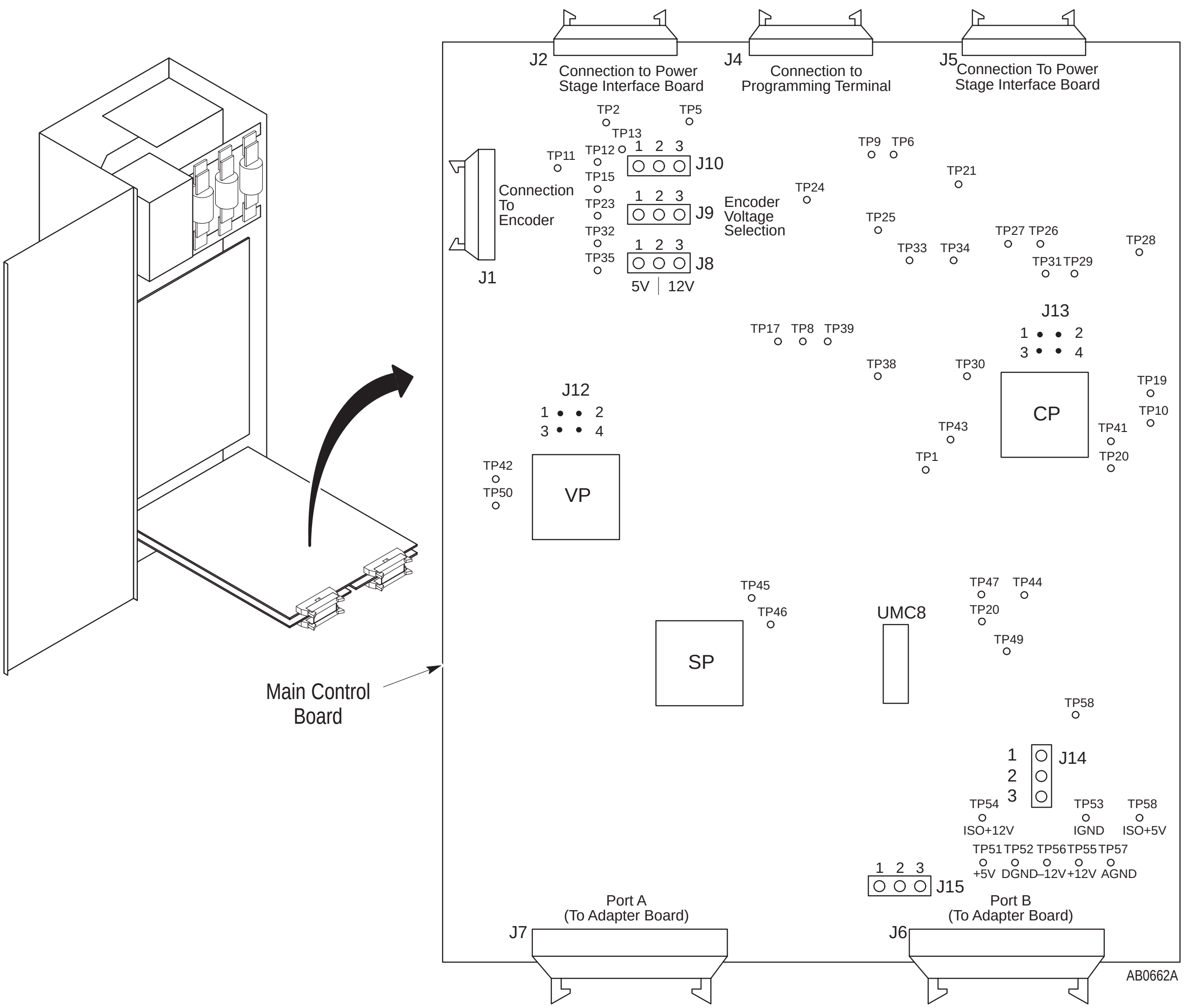
Figure 3.7
Power Stage Interface Hardware Location



Main Control Board (A8) – The Main Control Board (Figure 3.8) performs all control functions of the 1395 drive. Hardware located on the board is used to support operation of the microprocessor program. The primary functions performed include:

- Microbus interface.
- Control Firmware
- Analog signal interface
- Develop gate signals sent to the Power Stage Interface

Figure 3.8
Main Control Board Hardware Location

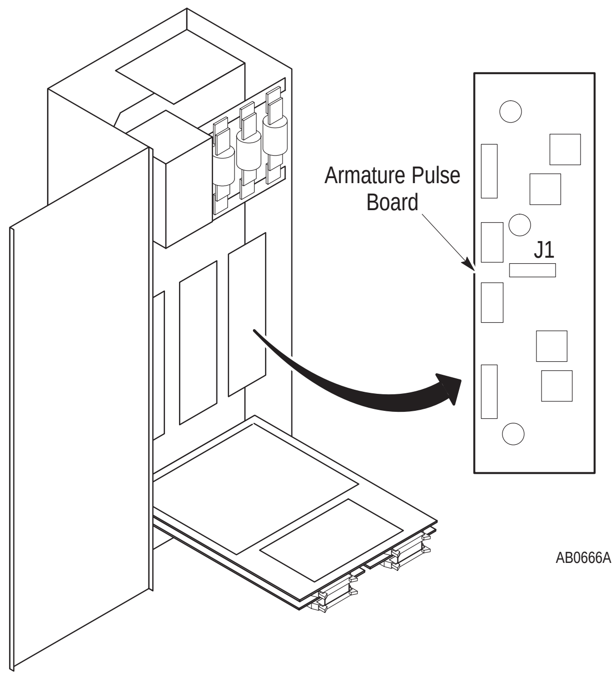


Armature Pulse Transformer and Snubber Board (A2, A3, A4) – The primary functions of the Armature Pulse Transformer and Snubber Board (Figure 3.9) include:

- Isolate power bridge circuitry from control circuitry.
- Provide dv/dt protection across SCRs.

There are 3 Armature Pulse Transformer and Snubber Boards. Each board is associated with a single phase of the incoming AC line. The board is physically mounted on the armature power bridge busbar, with screw terminals used to mount the board also used as the connections to the incoming AC line and DC bus.

Figure 3.9
Armature Pulse Transformer and Snubber Board Hardware Location

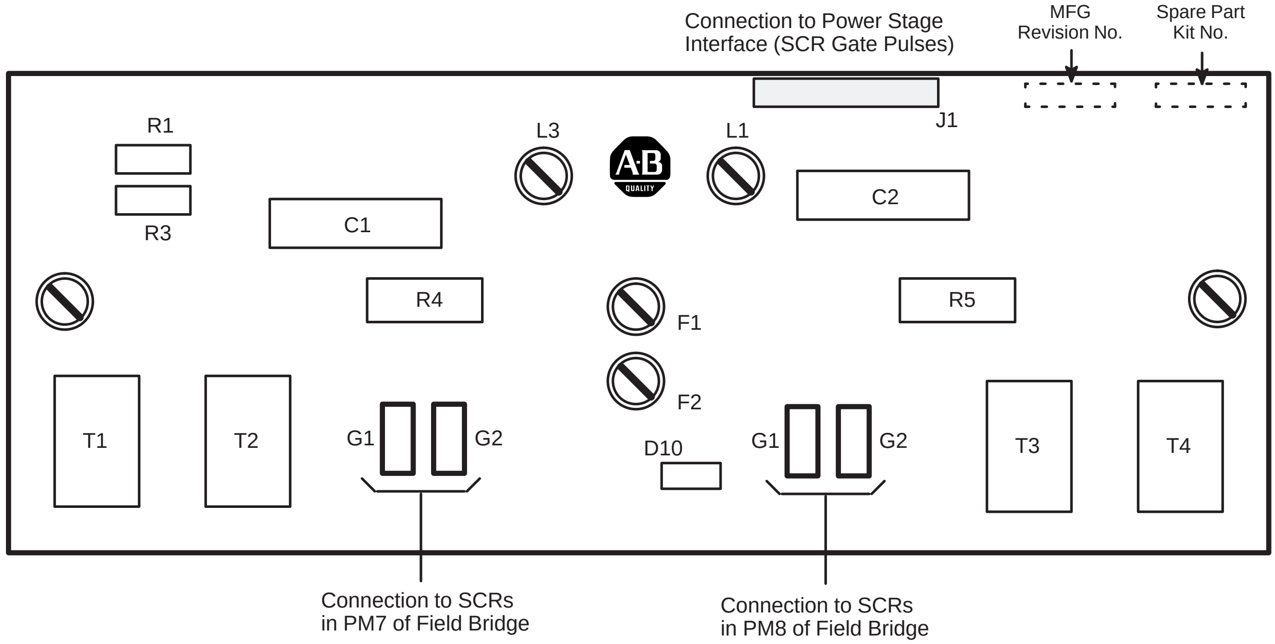


Field Pulse Transformer and Snubber Board (A5) – The primary functions of the Field Pulse Transformer and Snubber Board (Figure 3.10) include:

- Isolate power bridge circuitry from control circuitry
- Provide dv/dt protection across SCRs.

The board is physically mounted on the field power bridge buswork, with the screw terminals used to mount the board also being used as the connections to the incoming AC line and DC bus.

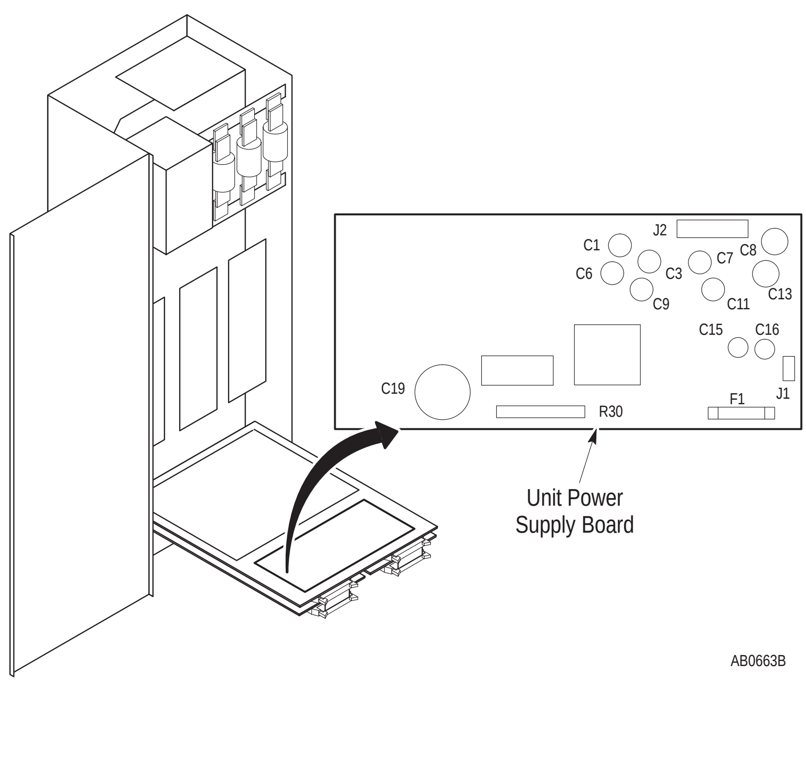
Figure 3.10
Field Pulse Transformer and Snubber Board Hardware Location



Peripheral Devices

Unit Power Supply (A6) – The Unit Power Supply 115VAC input comes from the user external 115VAC power supply. The AC voltage is rectified and regulated to produce +5VDC and + 12VDC control voltages which are distributed to the 1395 control boards through the Power Stage Interface. Figure 3.11 shows the location of components on the Unit Power Supply.

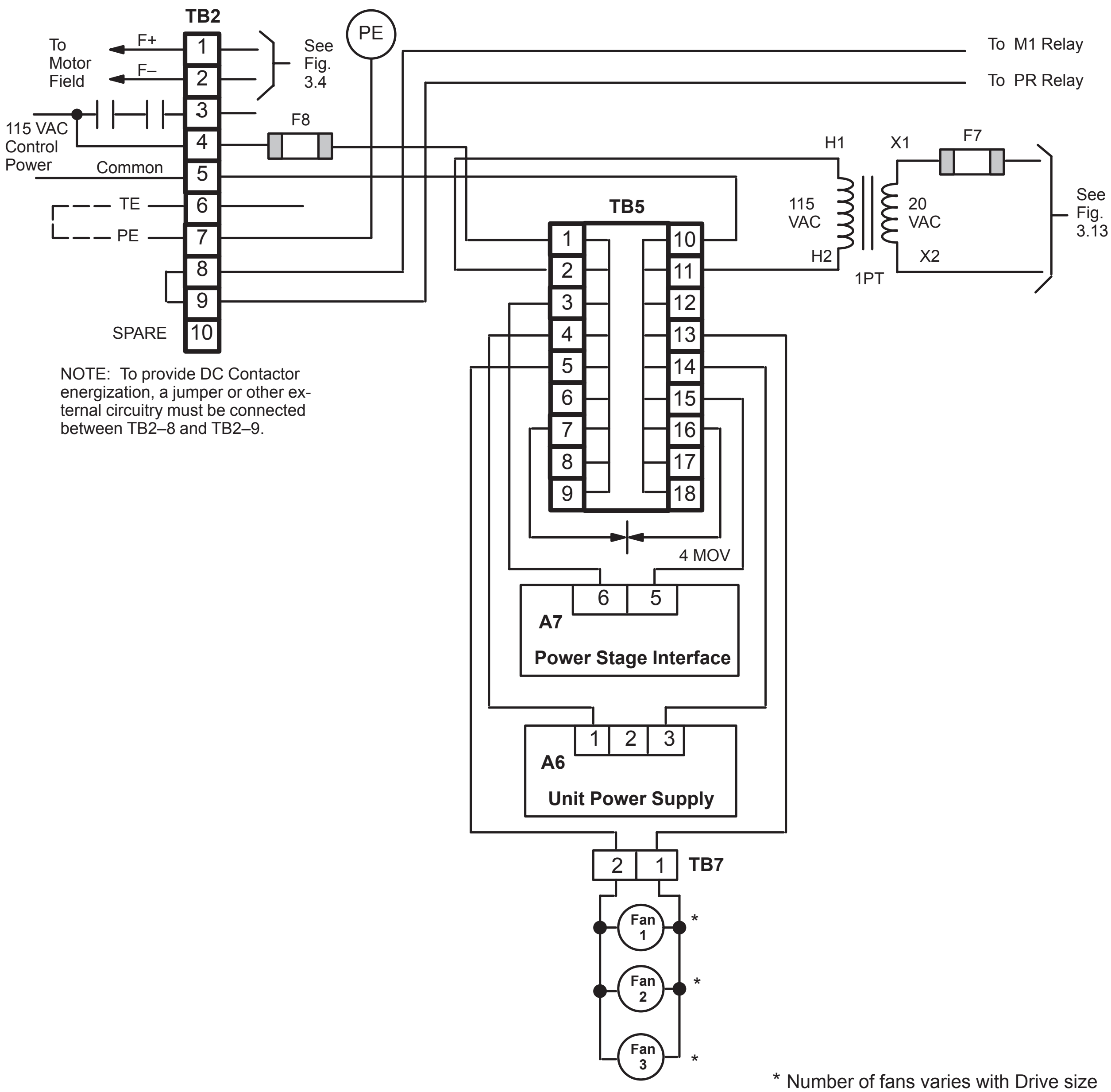
Figure 3.11
Unit Power Supply Hardware Location



Power Distribution

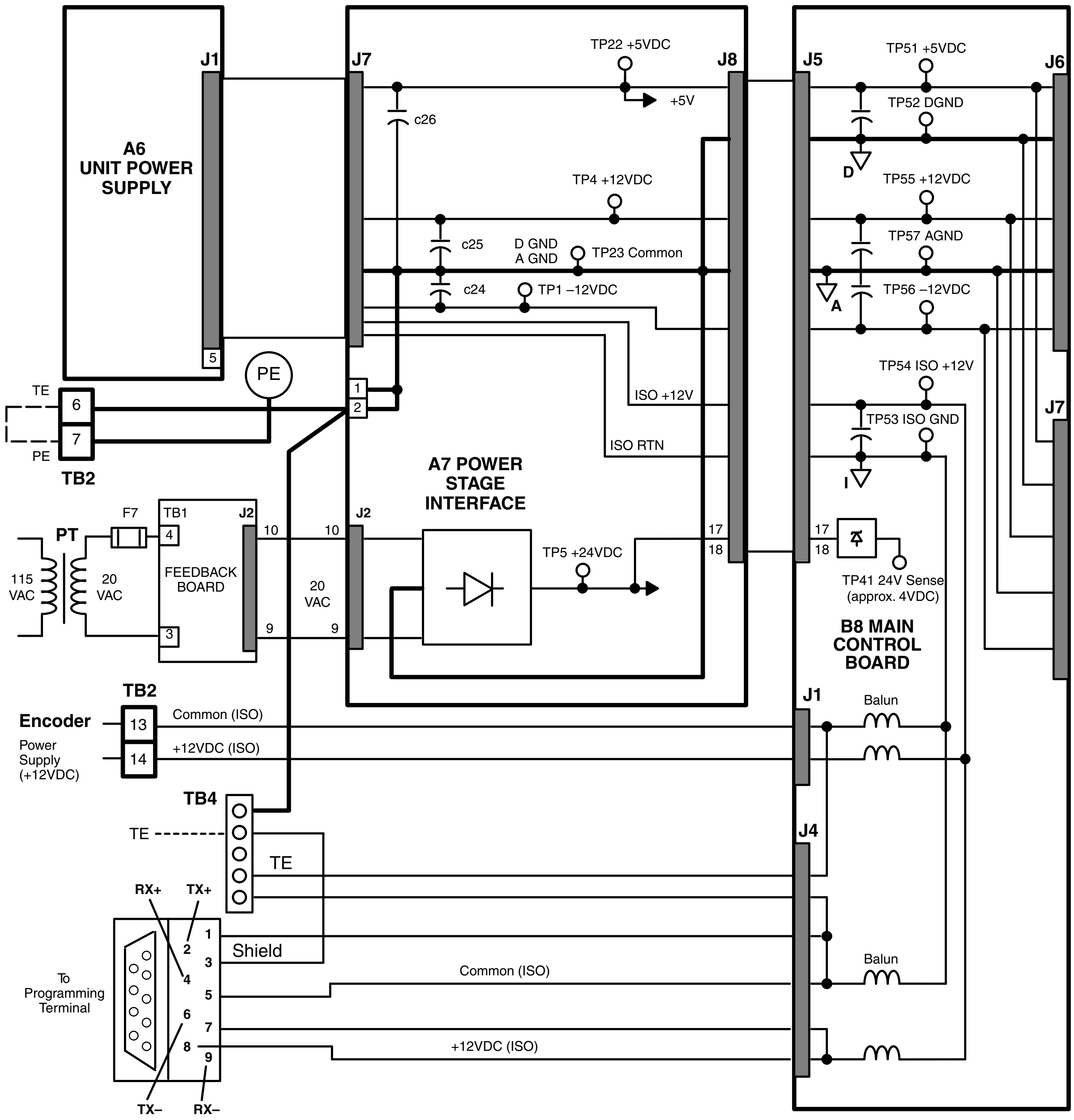
115VAC Control Voltage – Figure 3.12 illustrates the distribution of 115VAC control voltage within the Bulletin 1395. Single phase 115VAC control voltage, provided from an external source by the user enters the drive at TB2-4 and 5. Fuse F8 provides protection against short circuits on the 115VAC input to the drive. TB5 (an internal terminal block) distributes control voltage to components within the 1395.

Figure 3.12
115 VAC Control Voltage Distribution



DC Control Voltage Distribution – The Unit Power Supply converts 115VAC (supplied as shown in Figure 3.13) to +5VDC and the +/–12VDC control voltages. In addition to the voltages supplied by the Unit Power Supply, the Power Stage Interface converts the 20VAC coming from the control transformer 1 PT to 24VDC which is used for relay logic, including the ECoast, Pilot Relay, and Fault/No Fault Logic. It also provides the supply voltage to the SCR Pulse Transformer and Snubber boards to produce SCR gate signals for the armature and field.

Figure 3.13
DC Power Distribution and Control Common



Relay Logic

Main Contactor (M1) Control – Figure 3.14 illustrates the hardware associated with the control of the coil voltage applied to the Main DC contactor M1. The coil voltage originates at an external 115VAC source. The source voltage may be interrupted before being input to the drive at TB2-3 by the use of externally controlled contacts. These external contacts may include an external master coast stop, PLC controlled contacts, permissive contacts, etc. Main contactor M1 coil voltage is controlled within the 1395 through the Power Stage Interface when M1 is energized. This signal is rectified and optically isolated to produce a 5V logic signal CVERIFY which is sent to the Main Control Board.

Pilot Relay (PR) Control – K2 and K3 contacts in series with the 115VAC Coast Stop input to the drive control coil voltage to the Pilot Relay.

ECOAST Stop – The “ECOAST Stop” as defined and illustrated, is a contingency circuit designed to stop the motor in event of a malfunction in the solid state interface drive software.

When an ECOAST Stop is initiated, the DC loop contactor is de-energized and the motor will coast to a stop unless the drive is equipped with optional dynamic braking circuitry.

The optional dynamic braking circuitry is designed to develop 150% – 200% of rated motor torque for braking when an ECOAST Stop is initiated. Braking torque decreases with speed. This option is not recommended for repetitive operation.

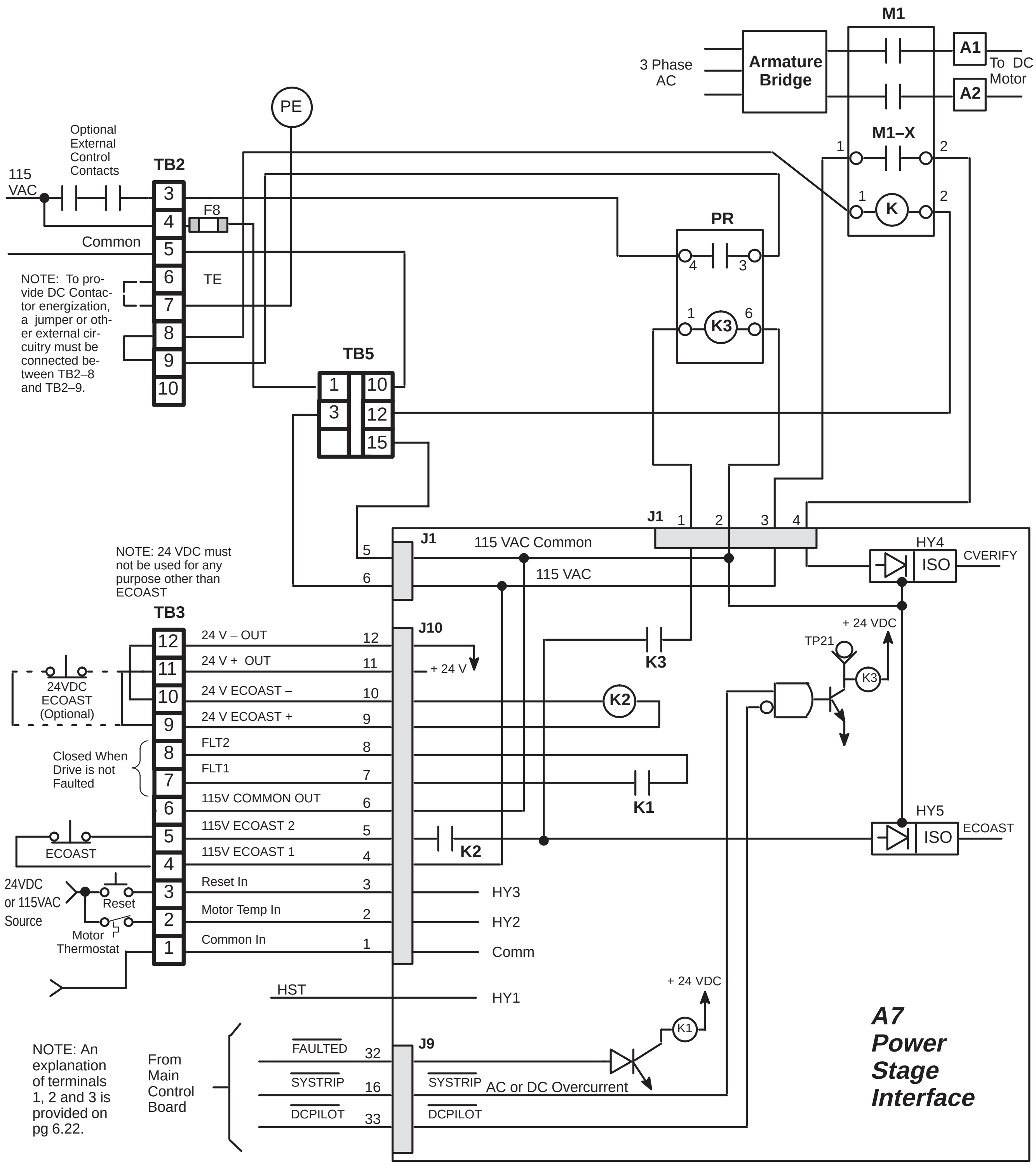
Relay K2 on the Power Stage Interface is the ECOAST Stop relay and is controlled by +24VDC. As shown in Figure 3.14, +24VDC from the Power Stage Interface is connected to TB3-12 and 11. At this point, an external (dry) 24 VDC ECOAST stop contact could be used to control the application of 24VDC to K2 through TB3-9. TB3-12 and 10 should always be jumpered together to provide a return path for 24VDC. If an external 24VDC ECOAST Stop contact is not used, then TB3-9 and 11 must be jumpered.

In addition to the 24 VDC ECOAST Stop, there is an 115 VAC ECOAST Stop circuit which is also provided as standard in the 1395. 115VAC enters the power stage interface from TB5 and is distributed to TB3-4. Between TB3-4 and 5, an external (dry) ECOAST Stop contact may be connected. If an external 115 VAC ECOAST stop circuit is not used, TB3-4 and 5 must be jumpered. 115VAC is returned to the Power Stage Interface from TB3-5 and sent to contacts of K2. From here it proceeds to the contacts of K3 on the Power Stage Interface. The 115VAC ECOAST Stop Signal is also sent to an isolation circuit which converts the 115VAC to a +5VDC control Signal ECOAST which is sent to the Main Control Board.

Main Control Relay – K3 on the Power Stage Interface is the main control relay which controls turn on voltage to the coil of the pilot relay PR. K3 is controlled by logic signals from the Main Control board entering the Power Stage Interface through ribbon connector J9. The two signals which control K3 are the SYSTRIP and the DCPILOT signals. In order for K3 to energize PR, there must be no system fault and there must be a DC pilot relay turn on command. If both these conditions are met, K3 is energized, and PR is in turn energized. The control voltage being applied to K3 may be monitored on the Power Stage Interface at TP21.

If K3 is being commanded to energize, the voltage at TP21 will be 0VDC. If K3 is to be de-energized, the voltage at TP21 will be +24VDC.

Figure 3.14
Relay Logic



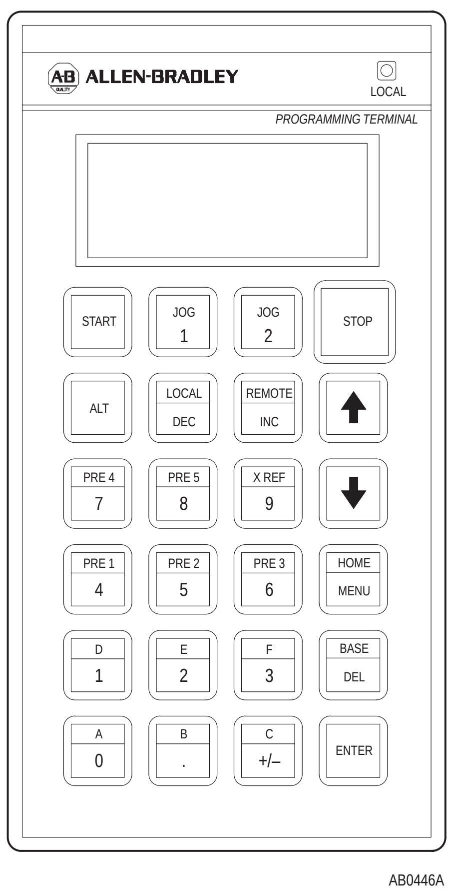
Options

Programming Terminal Interface – The handheld Programming Terminal is used to access information in the firmware of the 1395. Keypads on both the handheld programming terminal and the door-mounted terminal (shown in Figure 3.15) can be used to perform the following functions:

- Monitor real time parameter values
- Change parameter values
- Start/Stop the drive (depending on Model of Programming Terminal)
- Sets drive configuration
- Backup parameter values to EEPROM
- Monitor fault information

Interface between the 1395 Main Control Board and the handheld Programming Terminal is accomplished using a 9 pin type connector physically mounted on the end of TB3. The cable coming from the D-shell connector is connected to J4 on the Main Control Board. For a detailed description of the Programming Terminal, refer to the Programming Terminal Installation and Operation Manual.

Figure 3.15
Programming Terminal

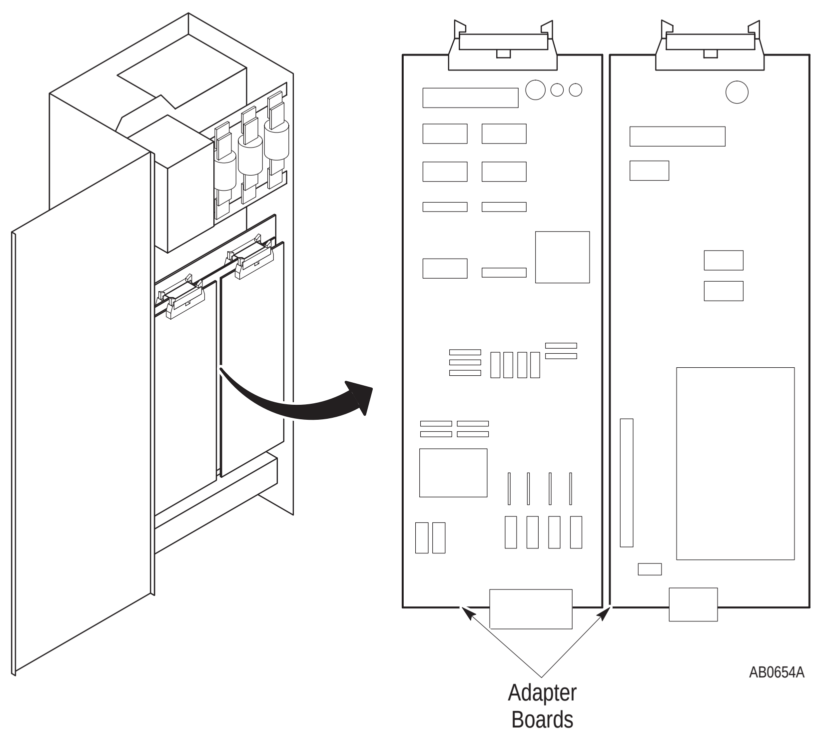


Note: The Programming Terminal can be hand-held or door-mounted when used with the mounting kit.

Adapter Boards – External control devices such as a PLC, discrete operators devices, etc., are interfaced with the Main Control Board through one of the two microbus ports, labeled PORT A (J7) and PORT B (J6) on the Main Control Board. The microbus is a 60 line bus designed specifically for the transfer of data between microprocessors. The microbus is used on the Main Control Board to transfer data between devices on the board. Additionally, hardware on the Main Control Board allows data transfer between the microprocessor on the Main Control Board and external devices through the two microbus Ports.

Information coming from external devices must be changed first to the format required by the microbus before being input to the microbus Port. The processing of data is accomplished through the use of the following adapter boards:

Figure 3.16
Construction and Location of Adapter Boards



Discrete Adapter Board

The Discrete Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. All user connections to the board are made at Terminal Block TB-3 located at the bottom of the 1395 Drive.

Digital Inputs – The Discrete Adapter Board contains four discrete inputs for either 120VAC signals or 24VDC signals. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.
The inputs are preconfigured for the following signals: STOP, JOG, START, CLEAR FAULT.

Digital Outputs – Two discrete outputs are provided through control of two on-board relays. The contact rating is 0.6A at 125VAC and 0.2A at 30VDC. These outputs allow the 1395 to signal various operating states of the Drive.
The outputs are preconfigured for the following signals: DRIVE RUNNING, AT ZERO SPEED.

Analog Inputs – Four preprogrammed 12-bit analog to digital inputs. These inputs allow a +/– 10VDC analog signal to be converted to a +/– 2048 digital signal, thus providing 4.88 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the converted signal can be extended to +/–32767.
The analog inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY, TRIM REFERENCE.

Analog Outputs – Four preprogrammed 11 bit digital to analog outputs. These outputs allow a +/– 1024 drive signal to be converted to a +/–10VDC analog analog output, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767.
The analog outputs are preconfigured for the following signals: VELOCITY FEEDBACK, FIELD CURRENT FEEDBACK, ARMATURE CURRENT FEEDBACK and ARMATURE VOLTAGE FEEDBACK.

All inputs and outputs have the flexibility to be reconfigured by the user for other signals. For a detailed description of the discrete adapter refer to the Discrete Adapter Manual.

Digital Reference Adapter Board

The Digital Reference Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. This interface supplies the Adapter Board with all logic voltages and communication capabilities. The Digital Reference Adapter has the following inputs and outputs:

Digital Reference Input – One digital reference input which produces a digital reference command for the Drive. The Adapter Board is set up by default for the encoder input signal to be single channel dual edge (ie. both the rising edge and falling edge are used by the counting logic).

Digital Inputs – Ten programmable discrete inputs for 24VDC signals. They can be connected to any Sink parameter such as the Logic command word. All ten inputs are LED indicated for high input level visibility. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.

The inputs are preconfigured for the following signals: RUN REFERENCE SELECT A,B,C, RAMP DISABLE, JOG2, JOG1, NORMAL STOP, START, CLOSE CONTACTOR, CLEAR FAULT.

Digital Outputs – Five programmable solid state outputs are provided. These 24VDC outputs, can be connected to any source parameter such as the logic status word. All five outputs have LEDs indicating when the signal is on.

These outputs are preconfigured for the following signals: ZERO SPEED, DRIVE RUNNING, READY, AT CURRENT LIMIT, AT SET SPEED.

Analog Inputs – Two programmable analog inputs allow a +/– 10 Volt signal through a 12 bit A to D converter, thus providing 4.88 millivolts per bit resolution.

The inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY.

Analog Outputs – Two programmable analog outputs allow a signal to be converted to a +/– 10VDC analog output through a 11 bit digital to analog converter, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767. The digital Drive signal can be any of the 1395 run time parameters.

All user connections to the board are made at terminal block TB3 located at the bottom of the 1395 Drive.

The outputs are preconfigured for the following signals, VELOCITY FEEDBACK, ARMATURE CURRENT FEEDBACK.

All inputs and outputs have the flexibility to be reconfigured by the user for other signals.

For a detailed description of the Digital Reference Adapter, refer to the Digital Reference Adapter Manual.

Node Adapter Board

The Node Adapter Board provides an interface between external devices and the Main Control Board of the 1395. The board allows the 1395 to be controlled using an Allen-Bradley PLC Controller from either the PLC3 or PLC5 family.

The Node Adapter Board is not preconfigured. Refer to the Node Adapter Manual for hardware and integration information.

Multi-Communication Board

The Multi-Communication Adapter Board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over serial communications links.

The Multi-Communication Adapter is not preconfigured. Refer to the Multi-Communication Board Software/Hardware Reference Manual, for hardware and integration information.

ControlNet Adapter Board

The CNA board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over ControlNet. This adapter has the following features:

- One ControlNet channel, with a redundant connector to allow for backup connection in case one cable fails.
- Compatible with all Allen-Bradley PLCs and other products that support Programmable Controller Communication Commands.
- Compatible with Allen-Bradley 1395 Drives equipped with Version 8.10 or greater software.

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Chapter 4

Hardware Description

125 – 300 HP; 230VAC
250 – 600 HP; 460VAC
Medium KVA (MKVA)

Introduction

Chapter 4 contains both a general description of the major hardware components of the Series B drive, and background information to support the procedures detailed in other chapters of this manual. You should use this chapter in conjunction with the Installation chapter when installing 125 – 300HP, 230VAC and 250 – 600HP, 460VAC Series B Drives.

Terminology

A brief description of new terms and concepts covered in Chapter 4 is presented here:

Adapter Board – Circuit board containing hardware and software required to interface external devices such as Allen-Bradley PLC or Discrete I/O devices to the 1395 Series B drive.

Interface – Hardware and associated software required to transfer information and/or control signals from one device to another.

Microbus – Hardware and associated software designed by Allen-Bradley for the exchange of digital information at the microprocessor level. The microbus is used for transfer of information between adapter boards and the main control board.

Port – Hardware located on the main control board which allows for connection of one adapter board to the microbus. There are two ports on the main control board.

Programming Terminal – Device used for programming and monitoring operation on the 1395 drive. The programming terminal is provided in two packages: digital handheld terminal and door-mounted terminal.

Important: Refer to Chapter 1, "Publication References" for manuals describing larger horsepower and current ratings at other line voltages.

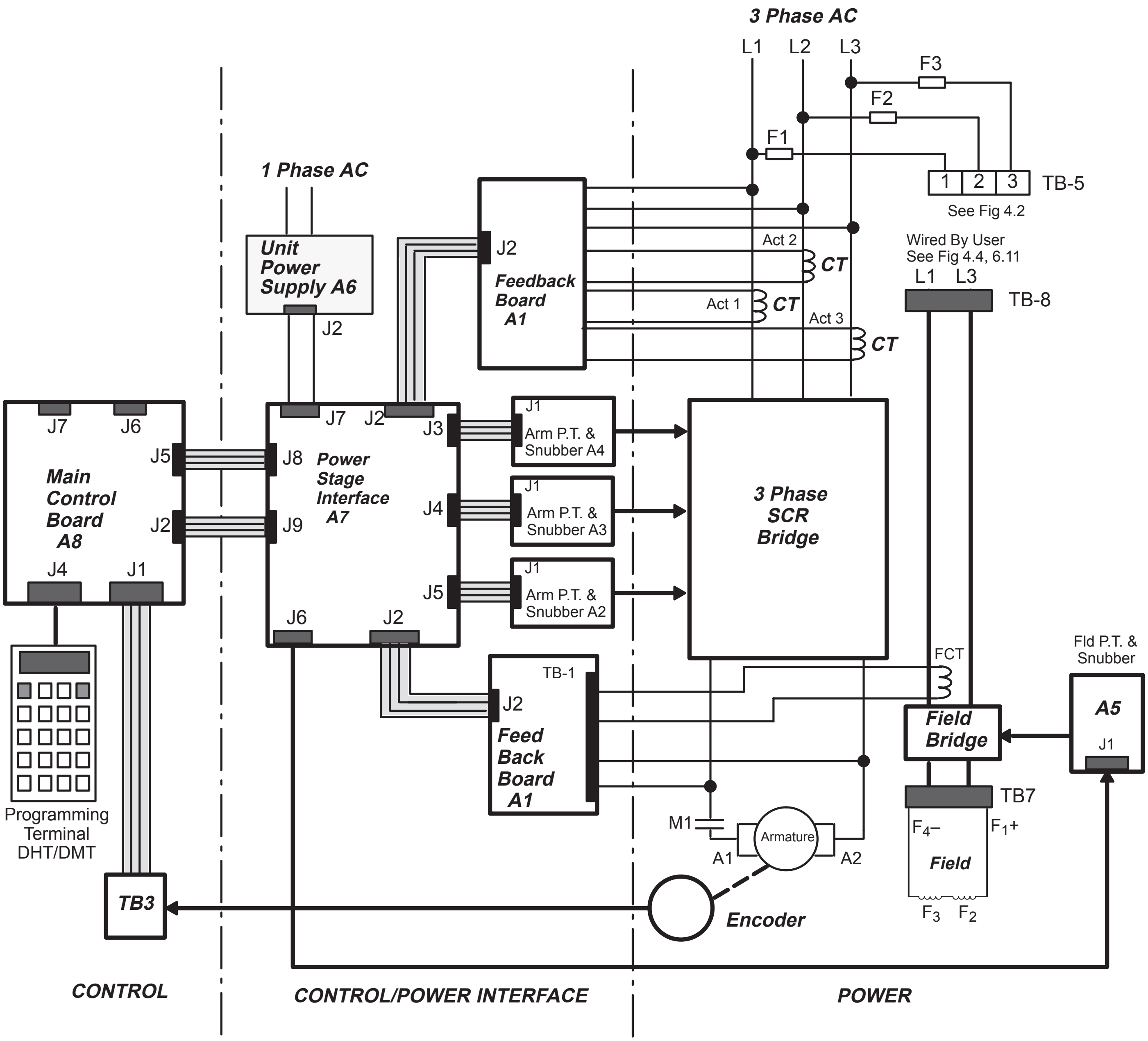
Hardware Overview

Figure 4.1 provides an overview of the hardware components associated with the 1395 drive. Hardware can be divided into one of three categories:

- Control Boards
- Control/Power Interface hardware
- Power Hardware

This chapter describes in general all of the major hardware components for a 125 – 600HP (346 – 980A) drives.

Figure 4.1
Hardware Overview



Armature Bridge Components

A general description of the components in the armature bridge (Figures 4.2 and 4.3) and their operation is detailed here:

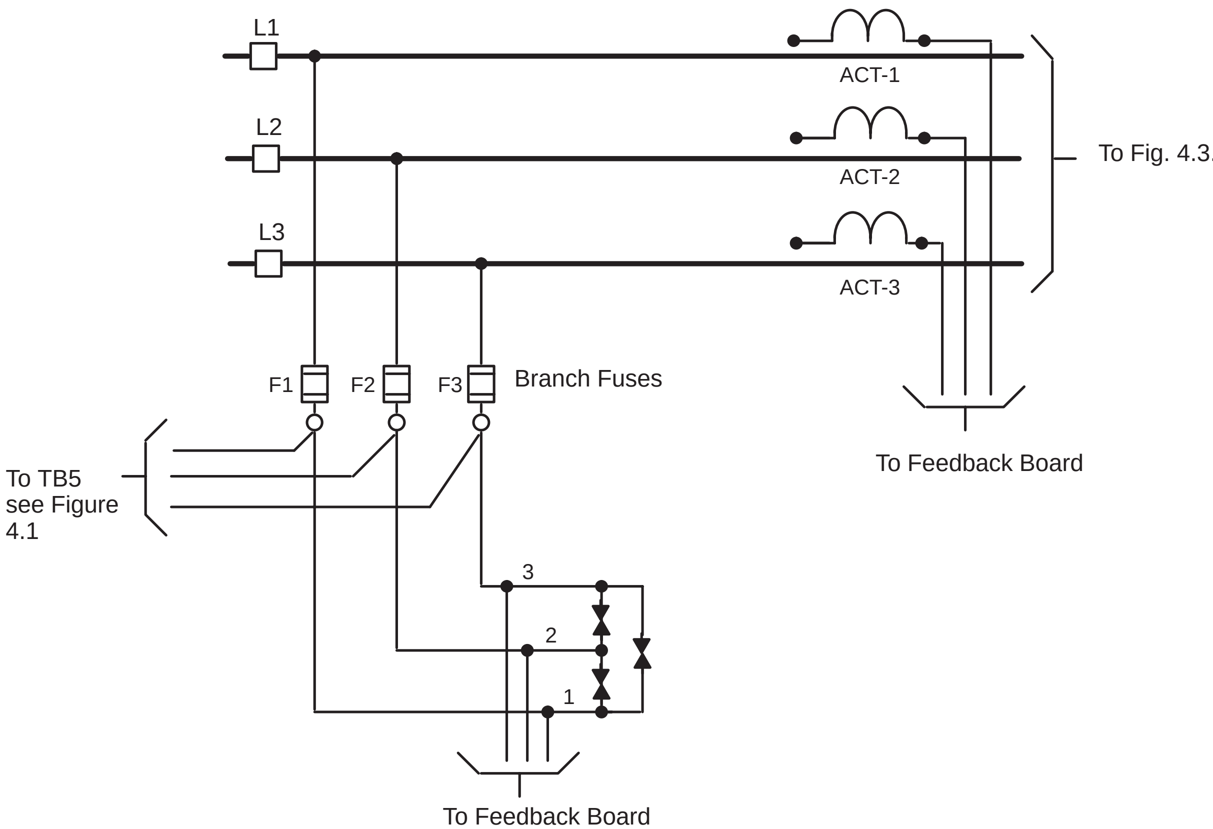
Incoming Device – Either a line choke or an isolation transformer is required.

Fuses – Fast acting semiconductor fuses are standard on all ratings.

Synchronization – The three-phase input to the drive is tapped and fused using fuses F1, F2 and F3 (Fig. 4.2) and enters the Feedback Board at AI TB1-11, 13, and 15. The feedback board scales down the voltage to a range from 3.4 to 7.0VAC depending on the three-phase incoming line voltage. The scaled voltage is sent to the Power Stage Interface where it is used to develop the synchronizing information to be used by the Main Control Board.

AC Current Feedback – Current Transformers ACT-1, ACT-2 and ACT-3 are used to provide current feedback information to the Feedback Board at AITB1 – 5, 6 and 7. The Feedback Board rectifies the three-phase feedback and scales the DC voltage before being sent to the Power Stage Interface. The DC voltage representing current feedback is passed directly through the Power Stage Interface and sent to the Main Control Board.

Figure 4.2
Armature Bridge Components (Input)

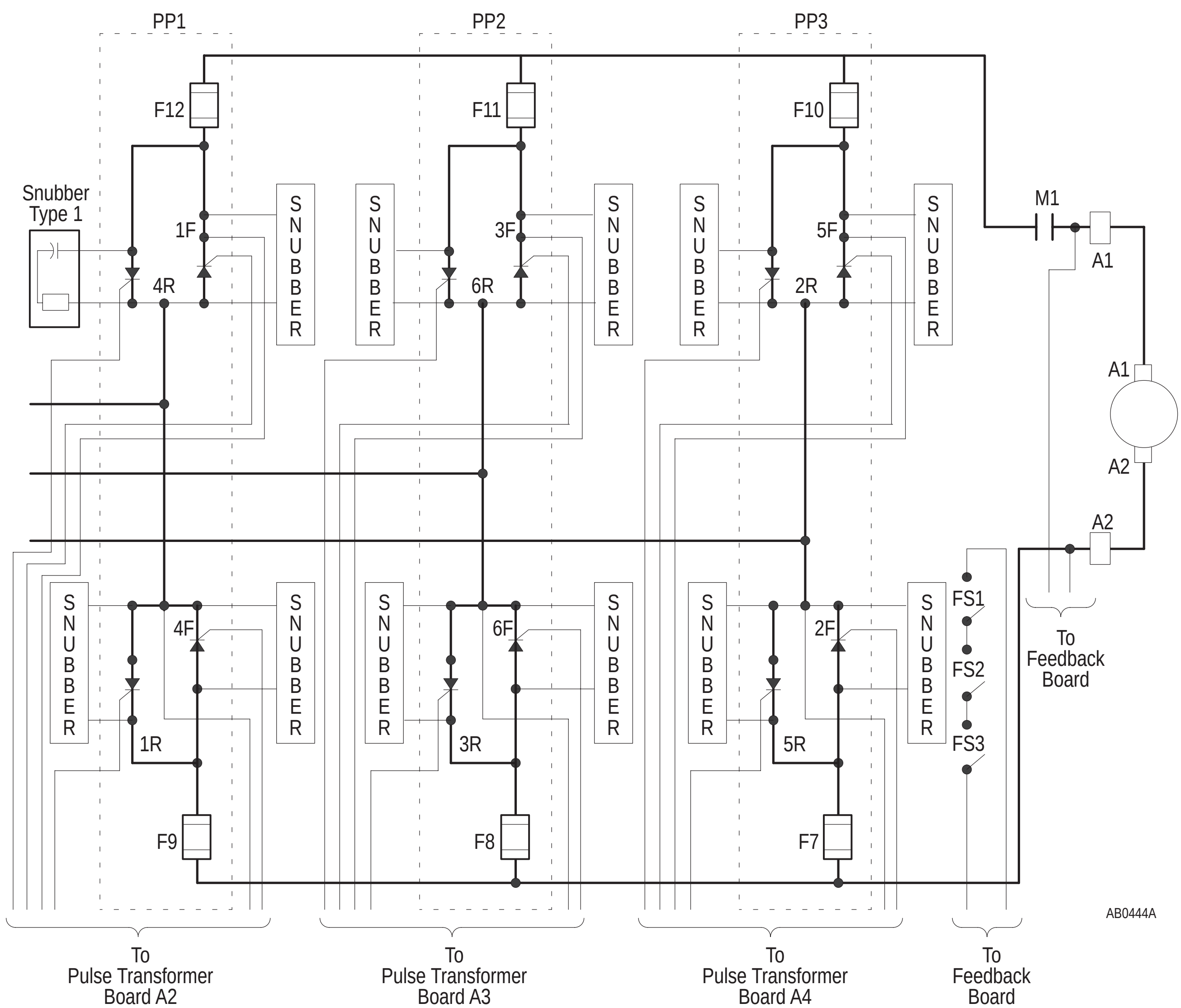


Surge Suppression – Surge Suppressor 1 MOV (Fig. 4.2) protects the armature power bridge from high voltage line spikes and line surges.

SCR Packaging – In 346 – 980A bridges (125 – 600HP) SCRs are packaged as individual hockey-puck type SCRs. Two SCRs connected in antiparallel in one of six legs of the bridge is referred to as an SCR cell. There are 6 SCR cells per bridge for armature regenerative construction. The non-regenerative version has 6 SCRs only. There are no reversing SCRs (1R through 6R).

SCR Cell Snubbers – Each SCR cell is protected from rapid rate of voltage change (dv/dt) using a resistor and capacitor network (referred to as a Cell Snubber) connected in parallel with the SCR cell.

Figure 4.3
Armature Regenerative Bridge Components (Output)



SCR Cell Fuses – Each SCR cell is protected from high currents by a cell fuse, located in each leg.

DC Contactor – Output of the armature bridge is connected to the DC motor through the main DC contactor M1. Coil voltage to M1 is controlled by contacts from the pilot relay PR (an external 115VAC control input entering at TB5).

Bridge Output Connections – Bridge output connections labeled A1 and A2 (Fig. 4.3) correspond to the NEMA standards for connection to the A1 and A2 leads of the DC motor.

Field Bridge Components

A general description of the components in the field bridge (Figure 4.4) and their operation is covered here.

Supply Voltage – The bridge requires two phases fused from an external source. This is connected to TB8-1 and 3 as detailed in Chap. 6, Installation.

Field Current Feedback – Current Transformer FCT provides field current feedback information to the Feedback board at TB1-8 and 9. The Feedback board rectifies the single phase feedback and scales the DC voltage using a burden resistor selected by the position of Jumper J1 on the Feedback Board before being sent to the Power Stage Interface. The DC voltage representing field current feedback is passed directly through the Power Stage Interface and sent to the Main Control Board.

Surge Suppression – Surge suppressor 3MOV protects the field power bridge from line voltage spikes and line surges on the incoming AC line. 2MOV protects the motor field windings from line spikes on the output of the field bridge.

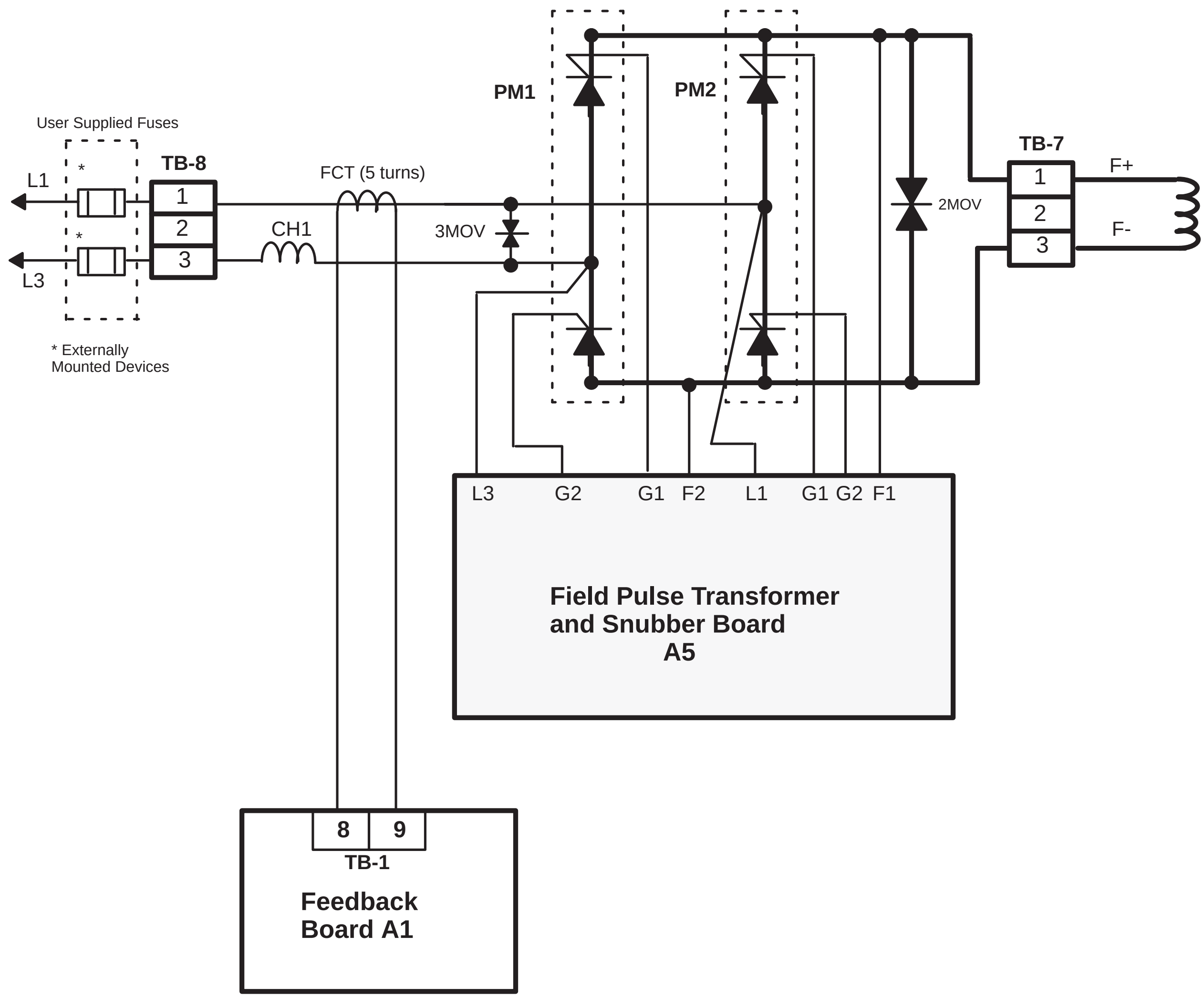
Line Choke – Line Choke CH1 protects the field power bridge SCRs from rapid rate of current changes (di/dt).

SCR Modules – Field bridge SCRs are contained in modules made up of two (2) SCRs per package (PM1 and PM2).

SCR Snubbers – Each forward and reverse armature SCR combination is protected from rapid rate of voltage changes (dv/dt) using a series combination of a resistor and capacitor (Snubber) connected in parallel with the two SCRs. The field SCRs do not have parallel snubbers, but have them on the input and output of the field bridge. All snubbers are contained on the Pulse Transformer and Snubber boards, and therefore are not shown on the bridge schematics.

Bridge Output Connections – The output of the field bridge is connected to TB7-1 and 3 which in turn is connected to the field leads of the motor. The terminal labeled F+ on TB2 is connected to the F1 lead of the motor and terminal F– to the F2 lead.

Figure 4.4
Field Bridge Components



Control Boards

Feedback Board – The primary function of the board is to provide scaling and transfer of feedback signals coming from power bridge devices being sent to the Power Stage Interface and eventually to the Main Control Board.

Figure 4.5
Feedback Board (A1) Overview

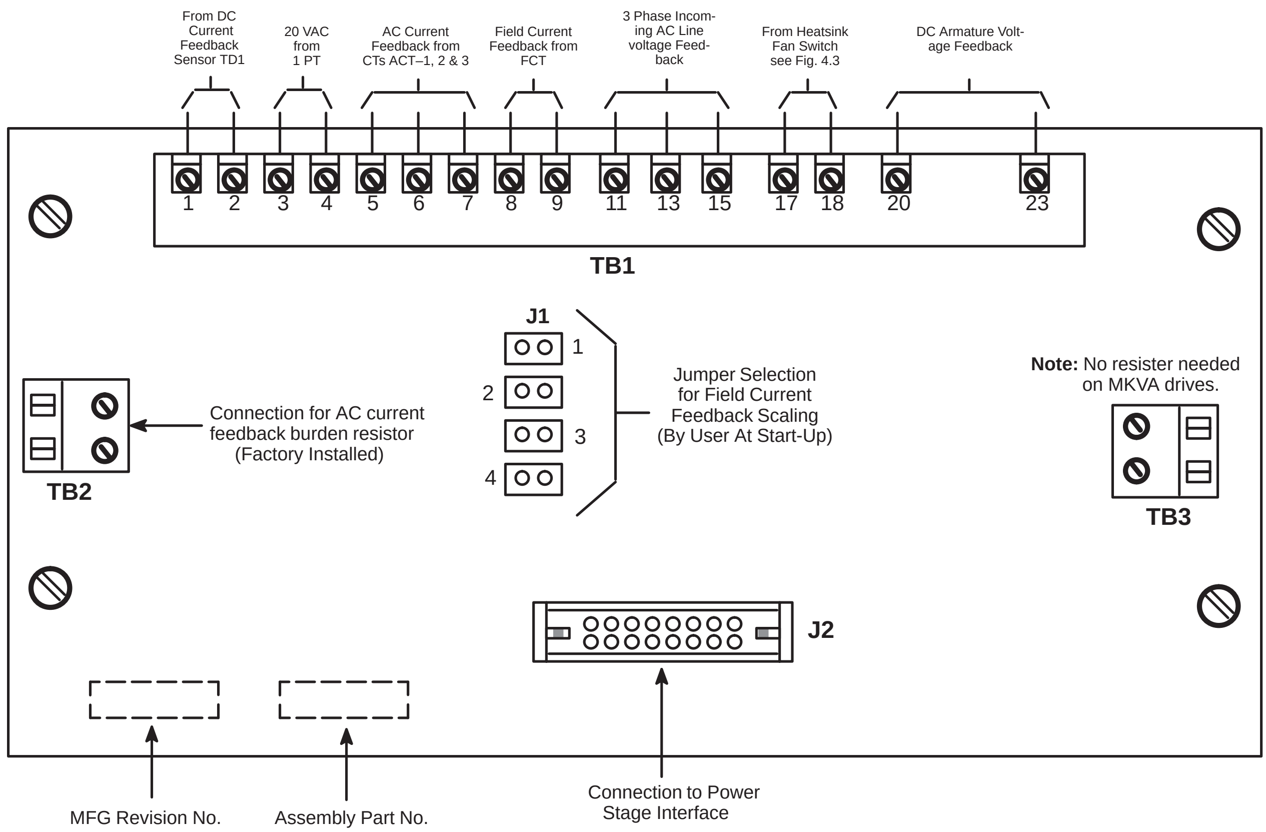


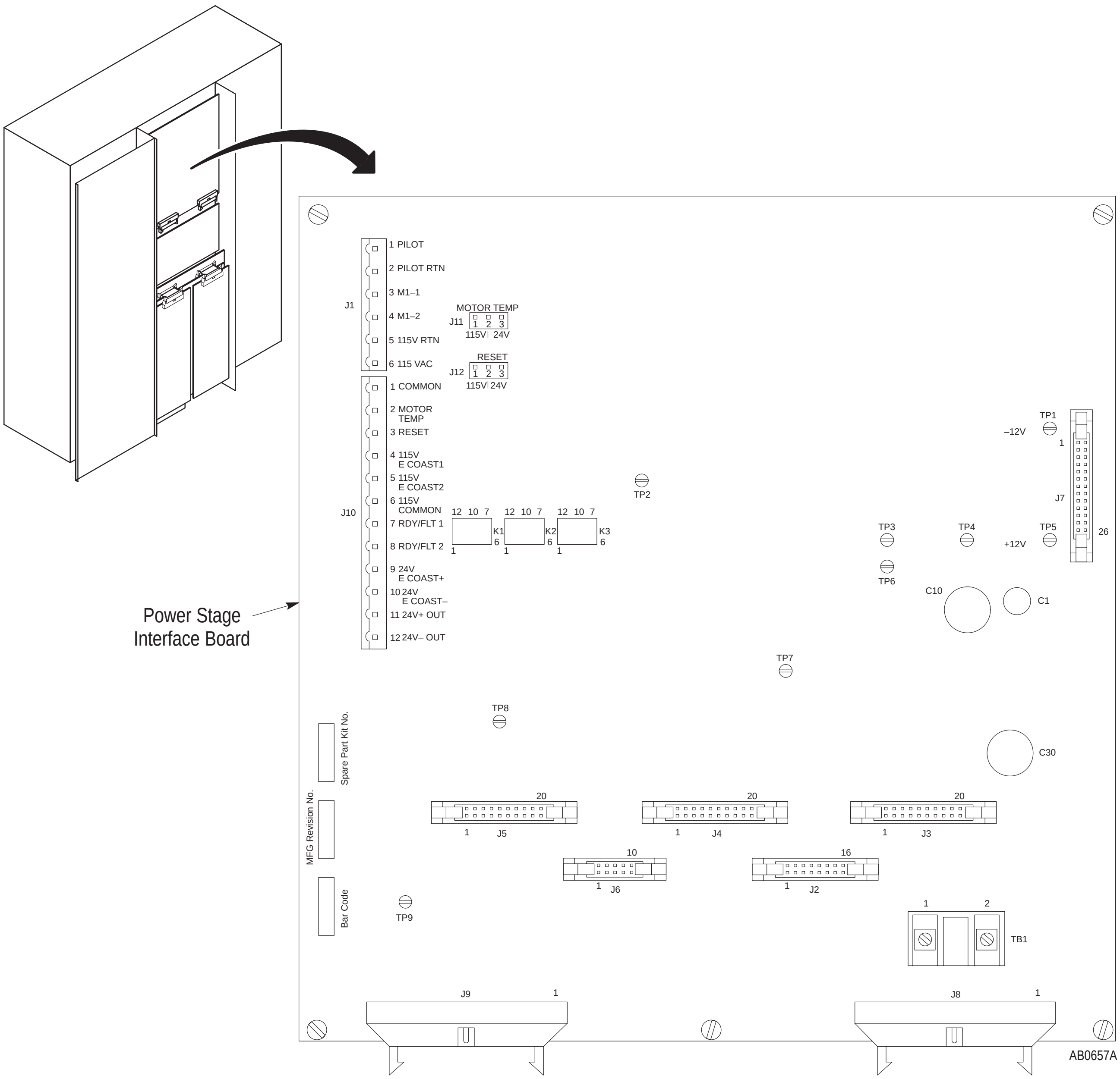
Table 4.A
Feedback Board Jumpers (see Table 8.J)

J1 Jumper Position	125 – 300HP 240VDC 250 – 600HP 500VDC Field Current Range
1	18.3– 42.4 ADC
2	8.6 – 18.4 ADC
3	2.3 – 8.7 ADC
4	1.0 – 2.4 ADC

Power Stage Interface (A7) – The primary function of the Power Stage Interface board (Fig. 4.6) is to provide interface between the Main Control Board, and the Power Bridge boards such as the Pulse Transformer and Snubber boards and the Feedback Board. The primary functions performed include:

- Distribution of DC Control power to Main Control Board.
- Provide 3 phase line synchronization signals to Main Control Board.
- Produce all Armature and Field Bridge SCR gate signals from control signals provided from the Main Control Board.
- Contactor and other logic control with interface to Main Control Board for these functions.

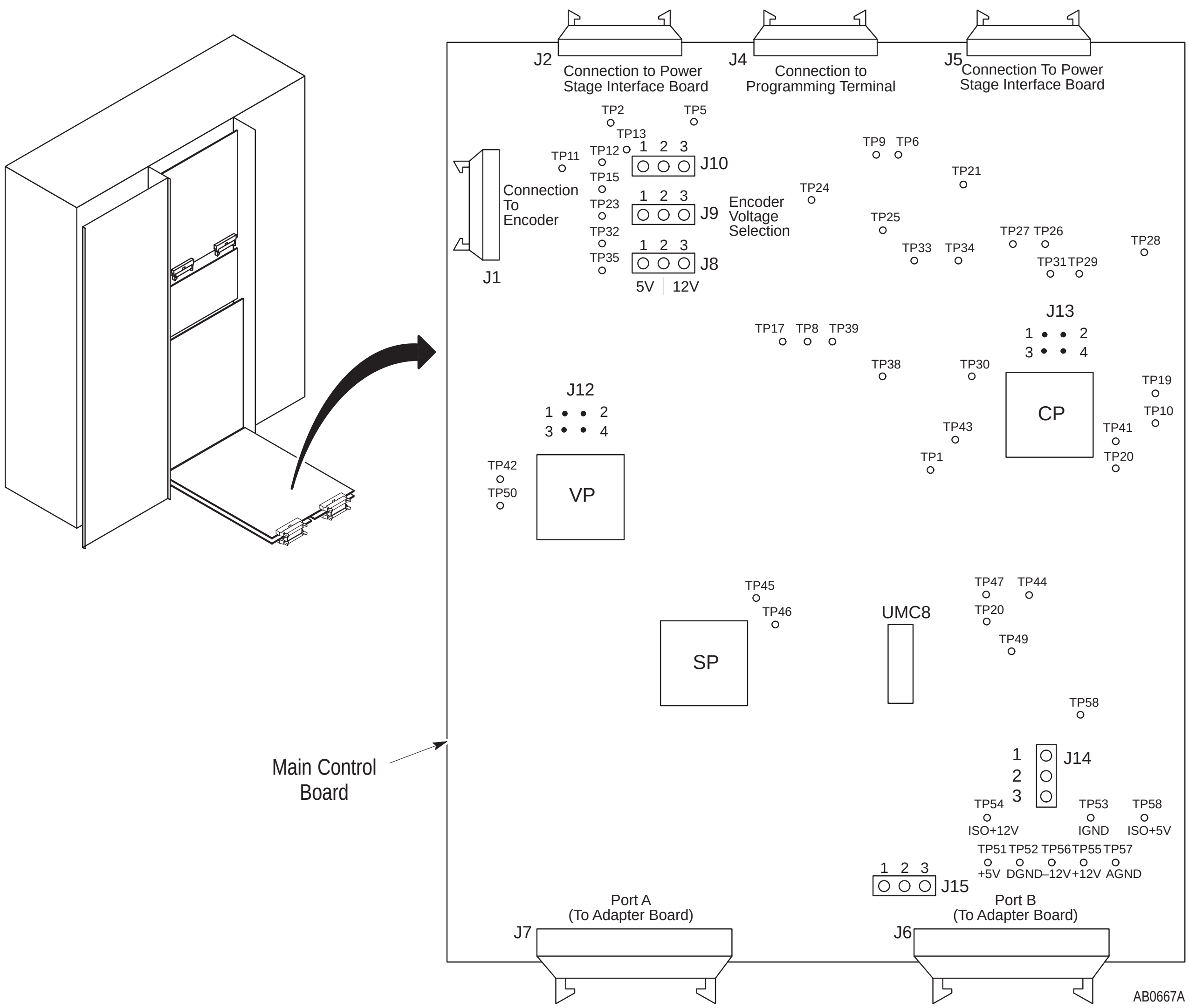
Figure 4.6
Power Stage Interface Hardware Location



Main Control Board – Figure 4.7 illustrates the major hardware points on the board. The board performs all control functions of the Bulletin 1395 drive. Hardware located on the board is used to support operation of the microprocessor program. The primary functions performed include:

- Microbus interface
- Control firmware
- Analog signal interface
- Develop gate control signals sent to the Power Stage Interface.

Figure 4.7
Main Control Board Hardware Location

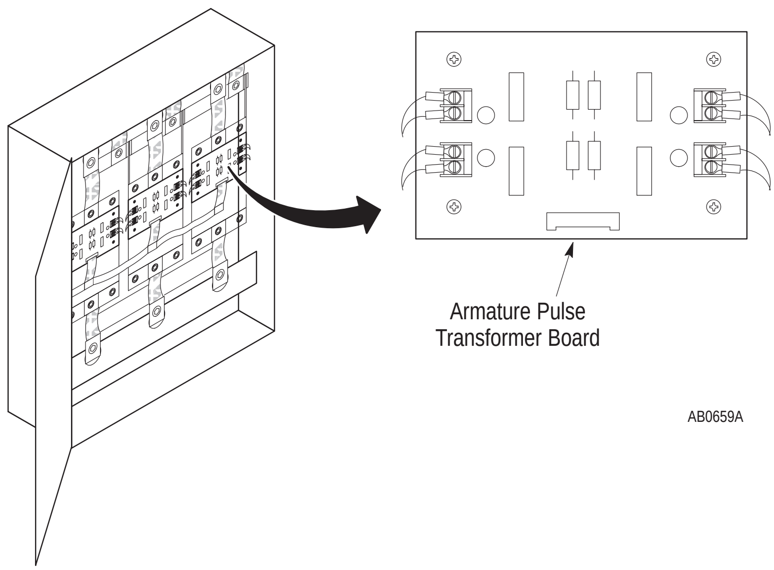


Armature Pulse Transformer Boards (A2, A3, A4) – Figure 4.8 illustrates the major hardware points on the board. The primary functions performed include:

- Isolate power bridge circuitry from control circuitry
- Provides Gate Pulses to the SCRs

There are three Armature Pulse Transformer Boards. Each board is associated with a single phase of the incoming AC line. The board is physically mounted on the armature power bridge buswork, with the screw terminals used to mount the board also used as the connections to the incoming AC line and the DC bus.

Figure 4.8
Armature Pulse Transformer Board Hardware Location

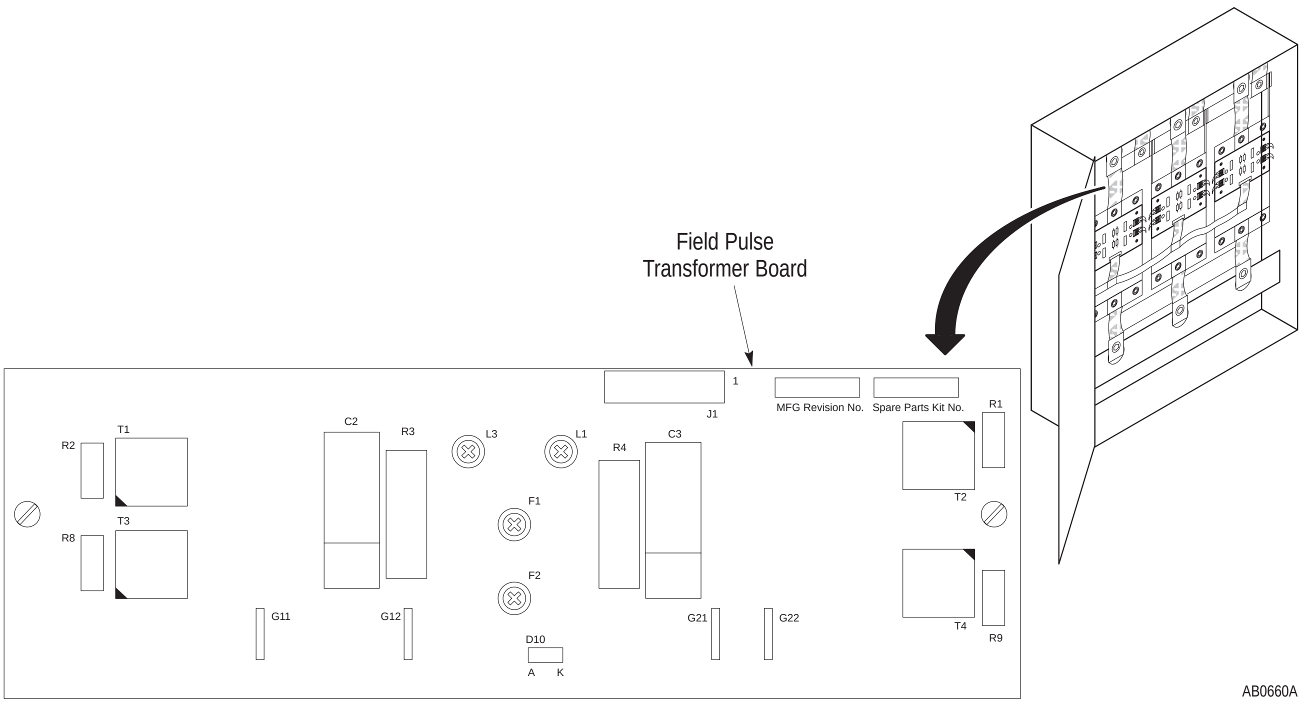


Field Pulse Transformer Boards (A5) – Figure 4.9 illustrates the major hardware points on the board. The primary functions performed include:

- Isolate power bridge circuitry from control circuitry
- Provide dv/dt protection for SCRs

The board is physically mounted on the field power bridge buswork, with the screw terminals used to mount the board also being used as the connections to the incoming AC line and the DC bus.

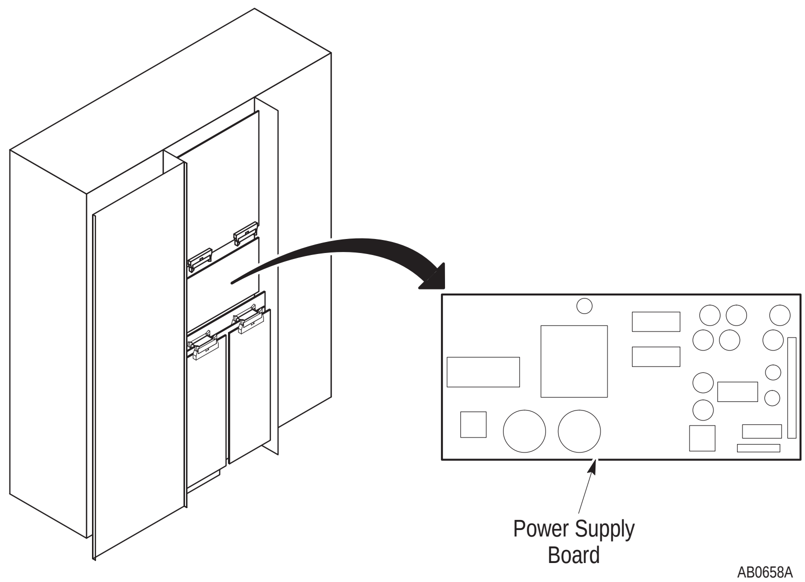
Figure 4.9
Field Pulse Transformer Board Hardware Location



Peripheral Devices

Unit Power Supply (A6) – The Unit Power Supply 115VAC input comes from the user external 115VAC power supply. The AC voltage is rectified and regulated to produce +5VDC and +/– 12VDC control voltages which are distributed to the 1395 control boards through the Power Stage Interface. Figure 4.10 shows the location of the Unit Power Supply.

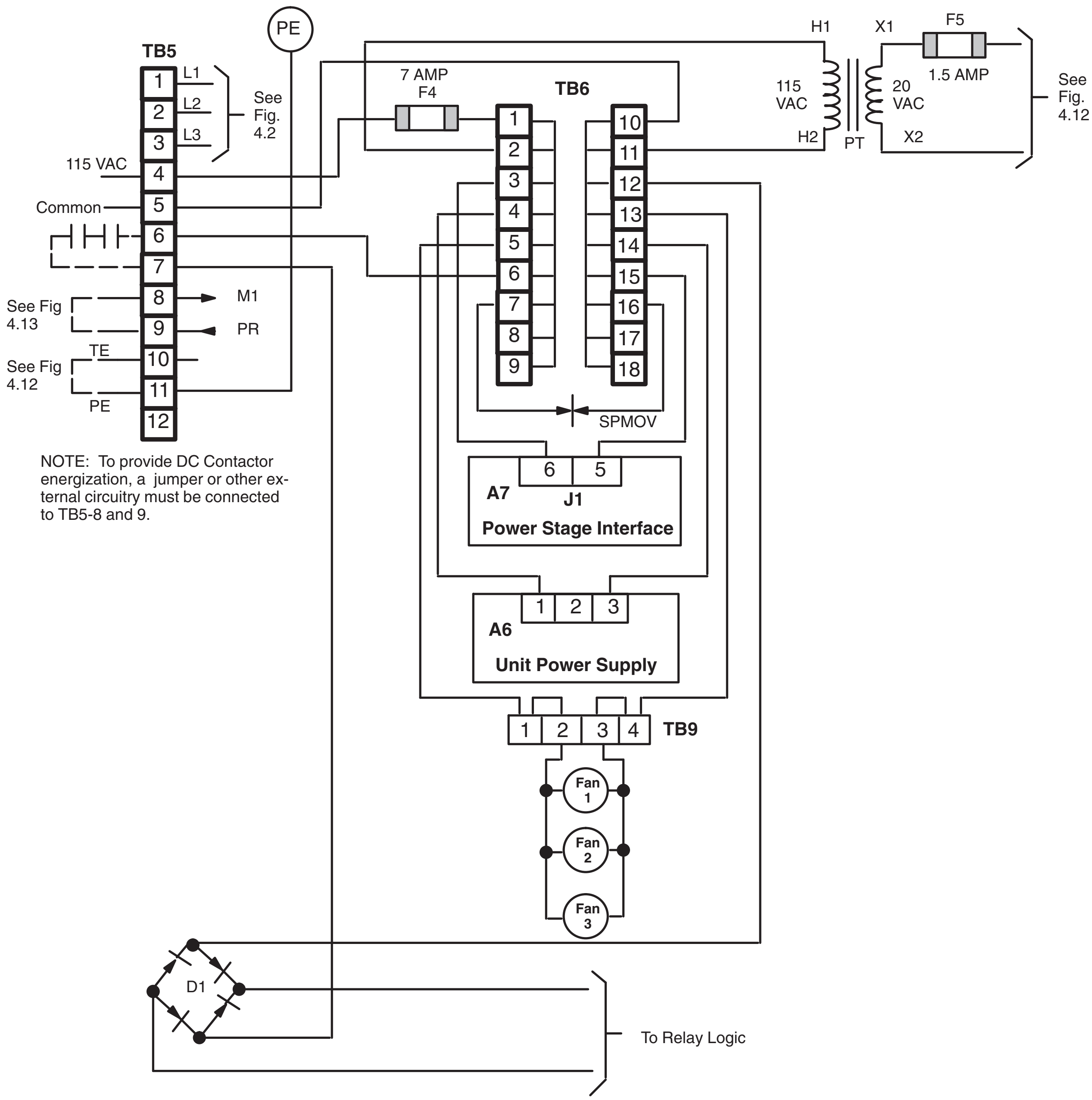
Figure 4.10
Location of Unit Power Supply



Power Distribution

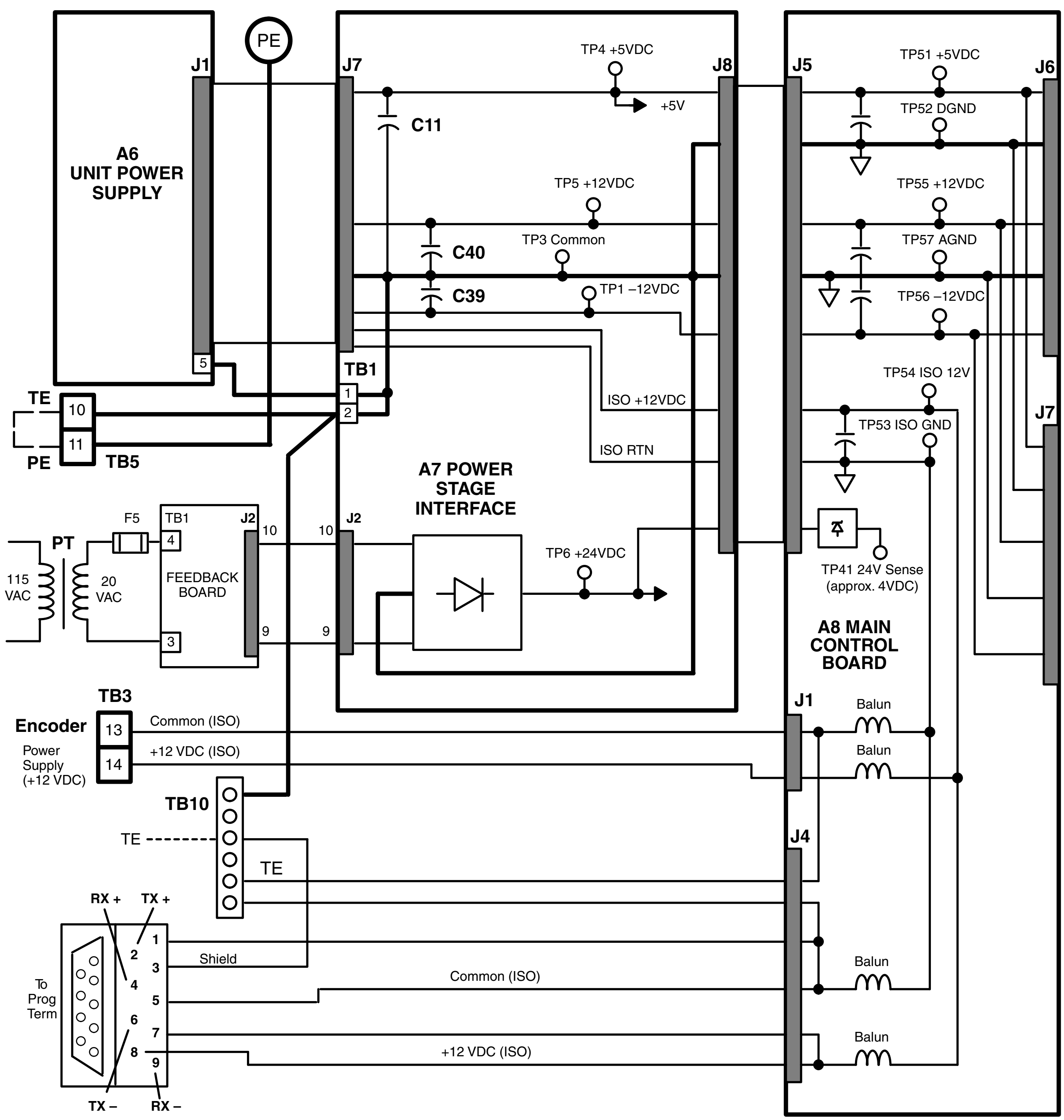
115VAC Control Voltage - Figure 4.11 illustrates the distribution of 115VAC control voltage within the Bulletin 1395. Single phase 115VAC control voltage, provided from an external source by the user enters the drive at TB5-4 and 5. Fuse F4 provides protection against short circuits on the 115VAC input to the drive terminal block TB6 (an internal terminal block).

Figure 4.11
115VAC Control Voltage Distribution



DC Control Voltage Distribution – The Unit Power Supply converts 115VAC (supplied as shown in Figure 4.12) to +5VDC and +/– 12VDC control voltages. In addition to the voltages supplied by the Unit Power Supply, the Power Stage Interface converts the 20VAC coming from the control transformer PT to 24VDC which is used for relay logic and provides the supply voltage to the SCR Pulse Transformer and Snubber boards to produce SCR gate signals for the armature and field.

Figure 4.12
DC Power Distribution and Control Common



Relay Logic

Main Contactor (M1) Control – Figure 4.13 illustrates the hardware associated with the control of the coil voltage applied to the Main DC contactor M1. The coil voltage originates at an external 115VAC source. The source voltage may be interrupted before being input to the Drive at TB5-6 by the use of externally controlled contacts. These external contacts may include an external master coast stop contact, PLC controlled contacts, permissive contacts, etc. These contacts are illustrated as“external control contacts”. Main contactor M1 coil voltage is controlled within the 1395 through the pilot relay (PR) contacts. Auxilliary contacts on M1 send 115VAC to the Power Stage Interface when M1 is energized. This signal is rectified and optically isolated to produce a 5V logic signal CVERIFY which is sent to the Main Control Board.

Pilot Relay (PR) Control – K2 and K3 contacts in series with the 115VAC Coast Stop input to the drive control coil voltage to the Pilot Relay.

ECOAST Stop – The “ECOAST STOP” as defined and illustrated, is a contingency circuit designed to stop the motor in the event of a malfunction in the solid state interface drive software.

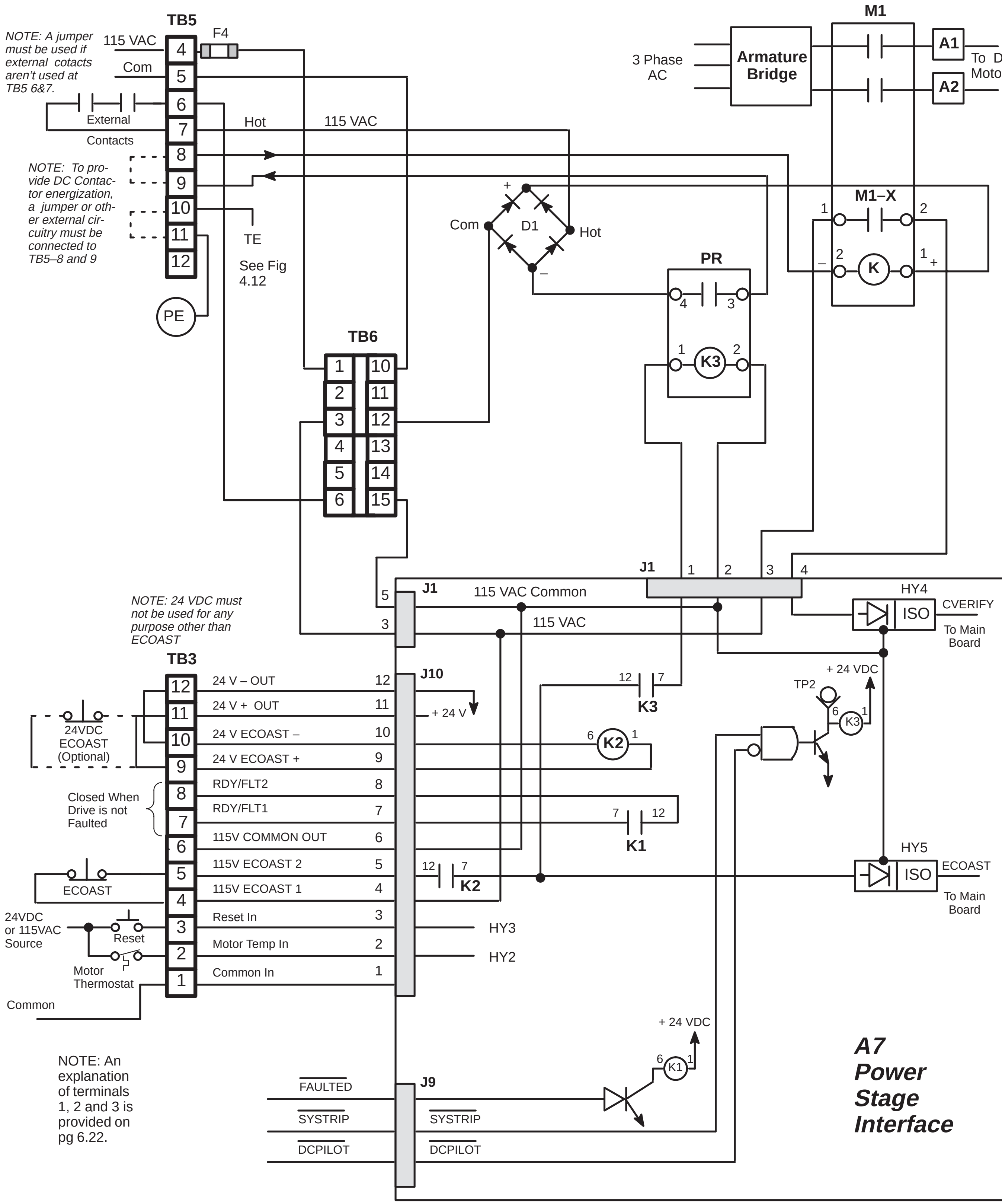
When an ECOAST Stop is initiated, the DC loop contactor is de-energized and the motor will coast to a stop.

Relay K2 on the Power Stage Interface is the ECOAST stop relay and is controlled by +24VDC. As shown in Figure 4.13, +24VDC from the Power Stage Interface is connected to TB3-12 and 11. At this point, an external 24VDC ECOAST stop contact could be used to control the application of 24VDC to K2 through TB3-9. TB3-12 and 10 should always be jumpered together to provide a return path for 24VDC. If an external 24 VDC ECOAST stop contact is not used, then TB3-9 and 11 must be jumpered.

In addition to the 24VDC ECOAST stop, there is a 115VAC ECOAST stop circuit which is provided as standard in the 1395. 115VAC enters the Power Stage Interface from TB6 and is distributed to TB3-4. Between TB3-4 and 5, an external ECOAST stop contact may be connected. If an external 115VAC ECOAST stop circuit is not used, TB3-4 and 5 must be jumpered. 115VAC is returned to the Power Stage Interface from TB3-5 and sent to the contacts K2. From here it proceeds to the contacts of K3 on the Power Stage Interface. The 115VAC ECOAST stop signal is also sent to an isolation circuit which converts the 115VAC to a +5VDC control signal ECOAST which is sent to the Main Control Board.

Main Control Relay – K3 on the Power Stage Interface is the main control relay which controls turn on voltage to the coil of the pilot relay PR. K3 is controlled by logic signals from the Main Control board entering the Power Stage Interface through ribbon connector J9. The two signals which control K3 are the SYSTRIP and the DCPILOT signals. In order for K3 to cause PR to be energized, there must be no system fault and there must be a DC pilot relay turn on command. If both these conditions are met, K3 is energized, and PR is in turn energized. The control voltage being applied to K3 may be monitored on the Power Stage Interface at TP2. If K3 is being commanded to energize, the voltage at TP2 will be 0VDC. If K3 is to be de-energized, the voltage at TP2 will be +24VDC.

Figure 4.13
Relay Logic



NOTE: An explanation of terminals 1, 2 and 3 is provided on pg 6.22.

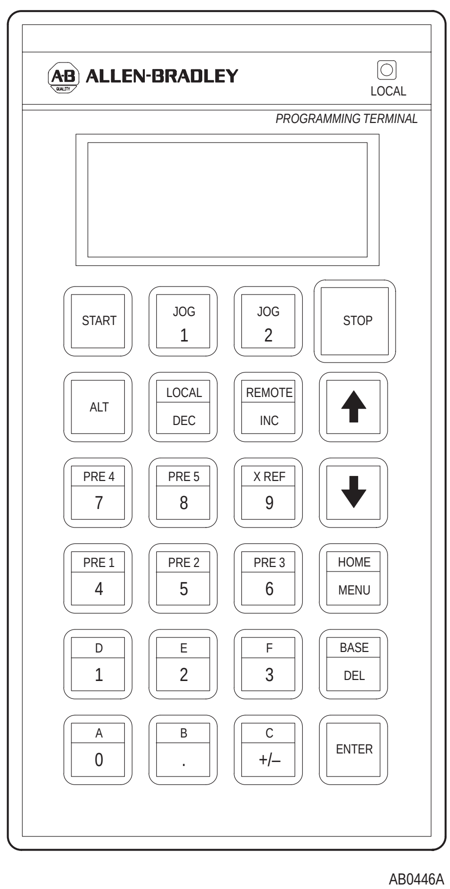
Options

Programming Terminal Interface – Both versions of the handheld Programming Terminal are used to access information in the firmware of the 1395. Keypads on both the handheld programming terminal and the door-mounted terminal (shown in Figure 4.14) can be used to perform the following functions:

- Monitor real time parameter values
- Change parameter values
- Start/Stop the drive (depending on Model of Programming Terminal)
- Sets drive configuration
- Backup parameter values to EEPROM
- Monitor fault information

Interface between the 1395 Main Control Board and the handheld Programming Terminal is accomplished using a 9 pin type connector physically mounted on the end of TB3. The cable coming from the D shell connector is connected to J4 on the Main Control Board. For a detailed description of the Programming Terminal, refer to the Programming Terminal Installation and Operation Manual.

Figure 4.14
Programming Terminal

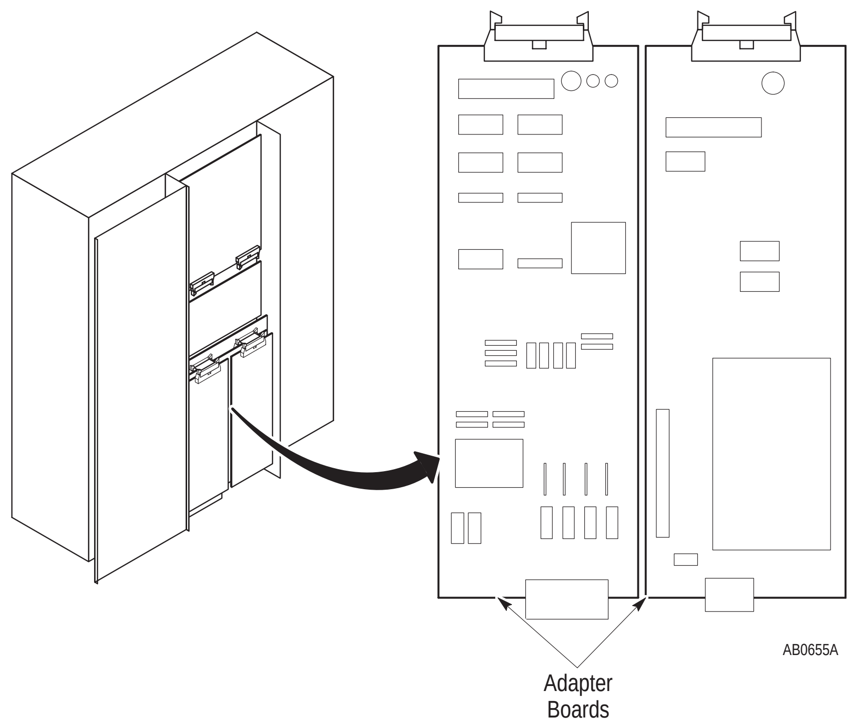


Note: The Programming Terminal can be hand-held or door-mounted when used with the mounting kit.

Adapter Boards – External control devices such as a PLC, discrete operators devices, etc., are interfaced with the Main Control Board through one of the two Microbus ports, labeled PORT A (J7) and PORT B (J6) on the Main Control Board. The Microbus is a 60 line bus designed specifically for the transfer of data between microprocessors. The Microbus is used on the Main Control Board to transfer data between devices on the board. Additionally, hardware on the Main Control Board allows data transfer between the microprocessor on the Main Control Board and external devices through the two Microbus Ports.

Information coming from external devices must be changed first to the format required by the Microbus before being input to the Microbus Port. The processing of data is accomplished through the use of the following adapter boards:

Figure 4.15
Construction and Location of Adapter Boards



Discrete Adapter Board

The Discrete Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. All user connections to the board are made at Terminal Block TB-3 located at the bottom of the 1395 Drive (Fig. 4.15).

Digital Inputs – The Discrete Adapter Board contains four discrete inputs for either 120VAC signals or 24VDC signals. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.

The inputs are preconfigured for the following signals: STOP, JOG, START, CLEAR FAULTS.

Digital Outputs – Two discrete outputs are provided through control of two on-board relays. The contact rating is 0.6A at 125VAC and 0.2A at 30VDC. These outputs allow the 1395 to signal various operating states of the Drive. The outputs are preconfigured for the following signals: DRIVE RUNNING, AT ZERO SPEED

Analog Inputs – Four preprogrammed 11-bit analog to digital inputs. These inputs allow a +/– 10VDC analog signal to be converted to a +/– 2048 digital signal, thus providing 4.88 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the converted signal can be extended to +/–32767. The analog inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY, TRIM REFERENCE.

Analog Outputs – Four preprogrammed 11 bit digital to analog outputs. These outputs allow a +/– 1024 drive signal to be converted to a +/– 10VDC analog analog output, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767.

The analog outputs are preconfigured for the following signals: VELOCITY FEEDBACK, FIELD CURRENT FEEDBACK, ARMATURE CURRENT FEEDBACK and ARMATURE VOLTAGE FEEDBACK.

All inputs and outputs have the flexibility to allow reconfiguration by the user for other signals.

For a more detailed description of the Discrete Adapter refer to the Discrete Adapter Manual.

Digital Reference Adapter Board

The Digital Reference Adapter Board connects directly to the Main Control Board using Port A of the Microbus interface. This interface supplies the Adapter Board with all logic voltages and communication capabilities. The Digital Reference Adapter has the following inputs and outputs:

Digital Reference Input – One digital reference input which produces a digital reference command for the Drive. The Adapter Board is set up by default for the encoder input signal to be single channel dual edge (ie. both the rising edge and falling edge are used by the counting logic).

Digital Inputs – Ten programmable discrete inputs for 24VDC signals. They can be connected to any Sink parameter such as the Logic command word. All ten inputs are LED indicated for high input level visibility. These optically coupled inputs provide a means for external control of the 1395 via pushbuttons, relays, switches, etc.

The inputs are preconfigured for the following signals: RUN REFERENCE SELECT A,B,C, RAMP DISABLE, JOG 2, JOG1, NORMAL STOP, START, CLOSE CONTACTOR, CLEAR FAULT.

Digital Outputs – Five programmable solid state outputs are provided. These 24VDC outputs, can be connected to any source parameter such as the logic status word. All five outputs are LED indicated for high input level visibility.

These outputs are preconfigured for the following signals: ZERO SPEED, DRIVE RUNNING, READY, AT CURRENT LIMIT, AT SET SPEED.

Analog Inputs – Two programmable analog inputs allow a +/– 10 volt signal through a 12 bit A to D converter, thus providing 4.88 millivolts per bit resolution.

The inputs are preconfigured for the following signals: VELOCITY REFERENCE, TACH VELOCITY.

Analog Outputs – Two programmable analog outputs allow a +/– 1024 Drive signal to be converted to a +/– 10VDC analog output through a 12 bit digital to analog converter, thus giving 9.76 millivolts per bit resolution. Through programming of associated Scale and Offset parameters the effective range of the Drive signal can be extended to +/– 32767. The digital Drive signal can be any of the 1395 run-time parameters.

The outputs are preconfigured for the following signals, VELOCITY FEEDBACK, ARMATURE CURRENT FEEDBACK.

All user connections to the board are made at Terminal Block TB3 located at the bottom of the 1395 Drive.

All inputs and outputs have the flexibility of being reconfigured by the user for other signals.

For a more detailed description of the Digital Reference Adapter, refer to the Digital Reference Adapter Manual.

Node Adapter Board

The Node Adapter Board provides an interface between external devices and the Main Control Board of the Bulletin 1395. The board allows the 1395 to be controlled using an Allen-Bradley PLC Controller from either the PLC3® or PLC5 ® family.

For a more detailed description of the Node Adapter, refer to the Node Adapter Manual.

Multi-Communication Board

The Multi-Communication Adapter Board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over serial communications links.

The Multi-Communication Adapter is not preconfigured. Refer to the Multi-Communication Board Software/Hardware Reference Manual, for hardware and integration information.

ControlNet Adapter Board

The CNA board provides a sophisticated interface to Allen-Bradley PLC controllers and other equipment capable of communicating over ControlNet. This adapter has the following features:

- One ControlNet channel, with a redundant connector to allow for backup connection in case one cable fails.
- Compatible with all Allen-Bradley PLCs and other products that support Programmable Controller Communication Commands.
- Compatible with Allen-Bradley 1395 Drives equipped with Version 8.10 or greater software.

Chapter 5

Functional Description

Introduction

Chapter 5 contains a general description of the functionality of the 1395 drive. This description is intended to provide sufficient background information to support other procedures in this manual and to enable the reader to:

- Configure the parameters of the drive.
- Interface the drive with peripheral devices such as an Allen-Bradley PLC, discrete operators I/O and the Programming Terminal.

This chapter is not intended to be an all encompassing technical description of the 1395 drive.

Terminology

Following is a brief description of new terms and concepts covered in Chapter 5.

Configuration The process of linking Sink to Source parameters.

Fast Parameter Fast parameters are all parameters whose values are updated every 4msec, and are used for the real time data input and output of the drive. Fast parameters are backed up in volatile memory only.

Interface Hardware and associated software required to transfer information and/or control signals from one device to another.

Microbus Hardware and associated software designed by Allen-Bradley for the exchange of digital information at the microprocessor level. The Microbus is used for the transfer of information between Adapter Boards and the Main Control Board.

Port Hardware located on the Main Control Board which allows for connection of one Adapter Board to the Microbus. There are two ports on the Main Control Board.

Parameter Memory location used to store drive data. Each parameter is given a number called the parameter number. The parameter value may be specified in decimal or hexadecimal. When specified in hexadecimal, the word “Hex” will appear after the parameter value.

Parameter Table Table of parameter entries for all Configuration and Setup parameters used in the drive.

Source Fast parameter used as a source of data.

Sink Fast parameter used to receive data input.

Functional Overview

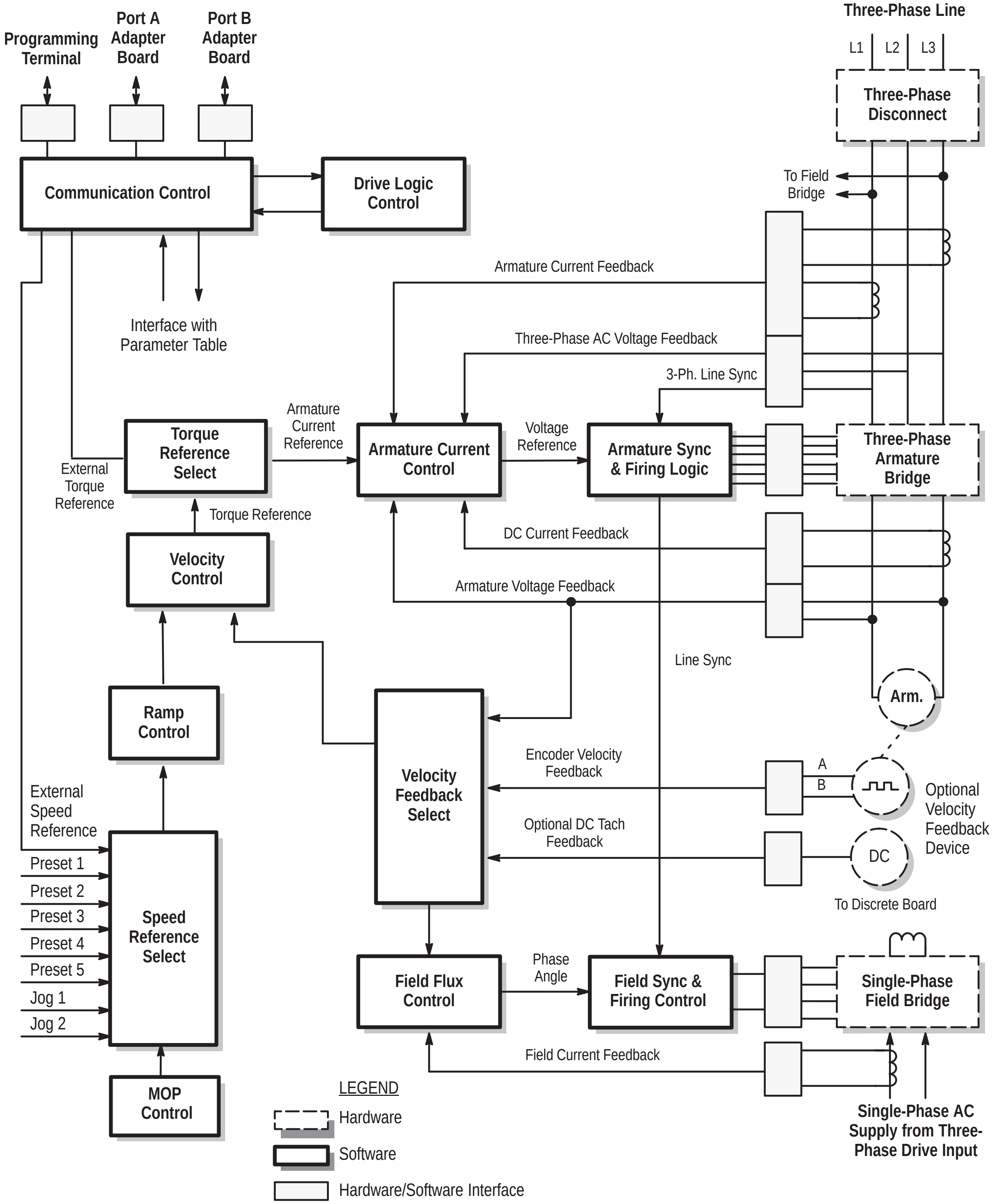
General

Figure 5.1 provides an overview of the major blocks associated with the control functions of the Bulletin 1395. All control functions in the 1395 are performed through the use of parameters which can be changed with a Programming Terminal.

Feedback information is derived from hardware devices as shown on the right side of Figure 5.1. Analog signals are converted to digital signals for use by the drive. Control signals may be provided to the drive from up to two optional Adapter Boards.

All setup and operation information used by the drive is stored in a system parameter table. Every parameter including Setup and Configuration parameters (Sources and Sinks) has an entry in the parameter table. For example, parameter 154 is named the “Vel Ref Whole” parameter and contains a number representing the velocity reference. The velocity reference can originate from an external control device such as a potentiometer connected to the Discrete Adapter Board or a signal coming from a PLC. Refer to Chapter 7 for parameter descriptions.

Figure 5.1
Functional Overview



Communication Control

The Communication Control block controls all of the data transfer. The Programming Terminal communicates with the drive through an RS-422 serial communication link. Internal communication in the drive is accomplished using a Microbus which is a specialized microprocessor bus designed by Allen-Bradley. In addition to internal communication, transfer of data between the drive and up to two Adapter Boards is provided through the Microbus. The hardware used for this interface is known as a Microbus Port. Two ports (labeled A and B) are available. Adapter Boards provide an interface between external control hardware such as discrete devices, PLC's, etc.

Drive Logic Control

This block controls the operating state of the drive in response to the logic command input. Selection of various reference parameters (i.e. speed reference) and control modes (i.e. droop) are performed in the drive Logic Control. In addition to controlling the state of the drive, the drive Logic Control monitors the present operating condition of the drive and provides this information as available feedback to external control devices. The drive Logic Control also monitors fault sensing.

Speed Reference Selection

There are five preset speeds stored in parameters in the drive. Additionally, an *External Speed Reference* and one of two Jog inputs may be selected as the velocity reference input to the drive. The Speed Reference Select block uses information provided from the drive Logic Control to determine which of the available references will be used as the input to the Velocity Control. The selected reference is sent to a ramp before being sent as the velocity reference input to the Velocity Control.

Velocity Feedback Select

The drive has been designed for normal operation using one of three possible means of velocity feedback. Hardware for interfacing the drive to a digital encoder is provided as standard in the drive. Armature voltage is constantly monitored by the drive and can be used for velocity feedback. If a DC tachometer is used for speed feedback, the drive must be equipped with a Discrete Adapter Board connected to Port A of the Microbus.

IMPORTANT: An external voltage divider for the DC Tach will be needed to obtain the correct voltage for the Discrete Adapter Board analog input circuit. Refer to Chapter 6 for details.

Feedback in the form of an analog signal from the DC tach is sent to the Discrete Board, converted to a digital signal and scaled for input to the Velocity Feedback Select block. The Velocity Feedback Select block uses information stored in a drive setup parameter to determine which of the feedback signals is to be sent to the Velocity Control.

Velocity Control

The Velocity Control compares the velocity reference to the velocity feedback to determine the velocity error.

Torque Reference Select

The 1395 can operate as either a speed regulated or a torque regulated drive, and therefore has the capability to accept either a velocity reference or a torque reference input. In addition, the Torque Reference Select block allows the drive to operate as a torque regulated drive and still have the velocity control operational. In this case, the drive can receive both a velocity reference and a torque reference at the same time. The Torque Reference Select block selects from either the output of the Velocity Control, or the External Torque Reference or both, depending on the mode of operation being commanded from the Drive Logic Control block. The reference which is selected is scaled based on the motor ratings to a current reference.

Armature Current Control

Armature current reference is compared to the *Armature Current Feedback* derived from the output of the current transformers (CT's). The Armature Current Control block produces a *Voltage Reference* which is applied to the Armature Sync and Firing Logic. In addition, the Armature Current Control monitors the *Three-Phase AC Voltage* and *Armature Voltage Feedback*.

Armature Sync and Firing Logic

The *Voltage Reference* output from the Armature Current Control is converted to a phase angle reference and then a time reference. The signal is then synchronized to the incoming three-phase line to produce the gate firing pulse for the SCRs located in the Armature Bridge. The Logic also provides synchronizing information to the Field Sync and Firing Logic.

Field Flux Control

The Field Current Control uses the *Field Flux Reference* from the Velocity Control to develop a field current reference. This reference is then compared to the *Field Current Feedback* derived from the current transformers in the incoming AC line to the Field Bridge. The error between the field current reference and feedback produces a field *Phase Angle* which is sent to the Field Sync and Firing Logic.

Field Sync and Firing Logic

The *Phase Angle* output from the Field Current Control is converted to a time reference which is synchronized to the *Line Sync* signal from the Armature Sync and Firing Logic to produce the gate firing pulses for the SCRs.

Configuration

Figure 5.2 shows an overview of the parameters associated with configuration of the drive. The 1395 has been designed to accept control input through the use of Adapter Boards. A portion of the drive control has been designed to act as a black box from the point of view of external devices. In order to perform the control functions required by the specific application, it is necessary to configure various control and reference information such as logic commands, speed reference and torque reference. Additionally, for the external control equipment to monitor the operating conditions in the drive (logic status, actual speed, actual armature current etc.), configuration provides a way for this information to be transferred to the external devices.

Sink Parameters

Several parameters associated with the control logic have been set aside specifically for the task of receiving input information from external control devices. These parameters are called “Sinks.” Figure 5.2 illustrates some of the Sink parameters used for input to the control logic. Refer to Table 5.A. for a listing of Sink parameters.

Figure 5.2
Source and Sink Parameters (Partial)

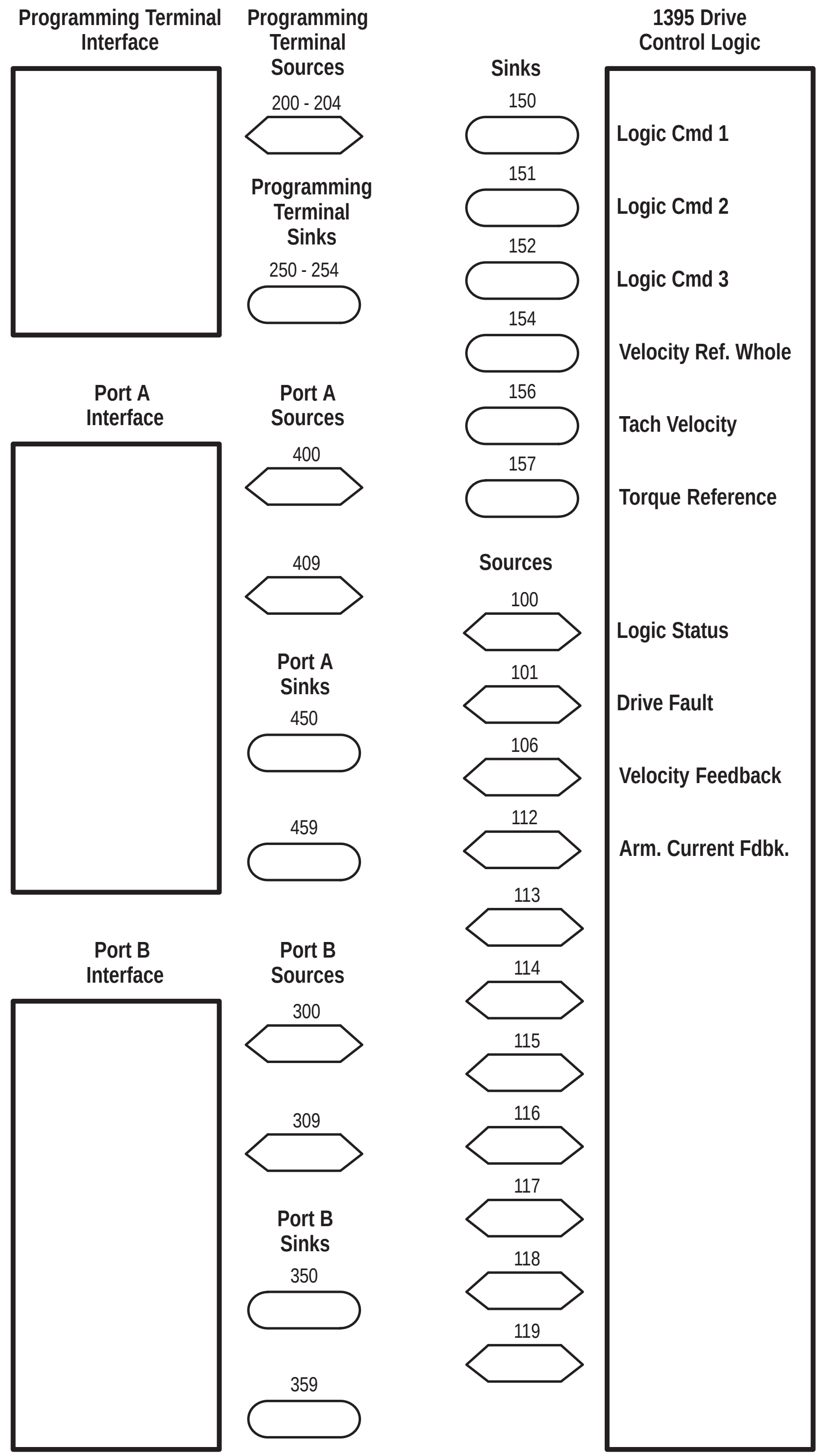


Table 5.A
Control Sink Parameters

Number	Name	Function
150	Logic Cmd 1	First 16 Bit Logic Command Word
151	Logic Cmd 2	Second 16 Bit Logic Command Word
152	Logic Cmd 3	Third 16 Bit Logic Command Word (Program Terminal)
153	Vel Ref Fraction	External Velocity Reference Fractional Part
154	Vel Ref Whole	External Velocity Reference Whole Part
156	Tach Velocity	Tachometer feedback signal coming from analog tach or other external velocity feedback device
157	Torque Reference	Torue Reference input. Used when drive operates as a torque regulator.
159	Flux Feed Fwd	External flux reference used as a feed forward term in field regulator.
160	CEMF Reference	Counter EMF Reference. Used when drive is operated as a torque regulator
161	Process Trim Ref	Process Trim Reference Input
162	Proc Trim Fdbk	Process Trim feedback derived from external sensing device
163	Vel Indirect 1	Indirect parameter, linked to slow Parameter 600
164	Vel Indirect 2	Indirect parameter, linked to slow Parameter 601
165	Vel Indirect 3	Indirect parameter, linked to slow Parameter 602
166	Vel Indirect 4	Indirect parameter, linked to slow Parameter 603

The function of each Sink parameter has been pre-defined and cannot be changed. For example, Parameter 151 (Logic Cmd 2) has been specifically set aside for the function of drive logic control. Because each Sink parameter has been defined for a specific use, each Sink parameter will have a specific data type and units of measure.

For example, Parameter 151 (Logic Cmd 2) is a 16 bit word where each bit has been defined for a specific function such as Start, Stop, Close Contactor, etc. A description of each parameter is provided in Chapter 7.

The specific external control devices which can be interfaced with the drive are defined by the type of Adapter Boards connected to Microbus Ports A and B on the Main Control Board. For example, the drive could be controlled by discrete hardware such as push buttons and pots. In this case, a Discrete Adapter Board would be required to interface the discrete control hardware to Port A. If interface with a PLC is desired, a Node Adapter Board is required in Port B.

Each Adapter Board also has Sink parameters associated with it as shown in Figure 5.2.

Source Parameters

Information input to a Sink parameter must originate from a Source parameter which transmits the information through the Microbus Ports. As shown in Figure 5.2, there are 10 Source parameters associated with each of the ports. The specific hardware devices associated with the Source parameters are determined by the Adapter Board which has been physically connected to the port. For example, if a Discrete Adapter Board has been connected to Port A, then Parameter 400 is defined as a 16 bit word, where 4 of the bits can be controlled directly by the 4 digital inputs to the board. If a Node Adapter Board has been connected to Port B, then Parameter 300 is defined as a 16 bit word, where all 16 bits are directly controlled by the program in the PLC. Refer to Chapter 6 for details on pre-configuration of the 1395 drive.

The control logic also provides Source parameters which may be used to send information to the Sink parameters associated with the Microbus Ports. Some of the Source parameters associated with the control logic have been shown in Figure 5.2. Table 5.B lists the Source parameters associated with the control logic.

There are additional sets of configuration links that cross the fast and slow parameter interface. These are called “indirect parameters”. The velocity processor has Parameters 600 through 603 that link to fast Parameters 163 through 166. The system processor has slow Parameters 840 through 844 that link to fast Parameters 10 through 14.

Indirect Parameters – These parameters allow data to be transferred between fast and slow parameters. There are a total of nine indirect parameters, four for the Velocity Processor and five for the System Processor.

The Velocity Processor parameters transfer a fast data value to a slow parameter value. When a configuration link is made with a Velocity Processor indirect parameter (Parameters 163 – 166), the real time data value is transferred to the parameter number specified in the corresponding Velocity select parameter (Parameters 600 to 603). Therefore, the real time data value is copied to a velocity processor setup parameter.

The System Processor indirect parameters transfer a slow data value to a fast source parameter. When a configuration link is made with a system Processor indirect parameter (Parameters 10 to 14), the data value programmed in the corresponding System select parameter (Parameter 840 to 844) is transferred to the indirect parameter. Therefore, a constant real time value is established which can be modified by entering a new value in the system select parameters.

Table 5.B
Control Logic Source Parameters

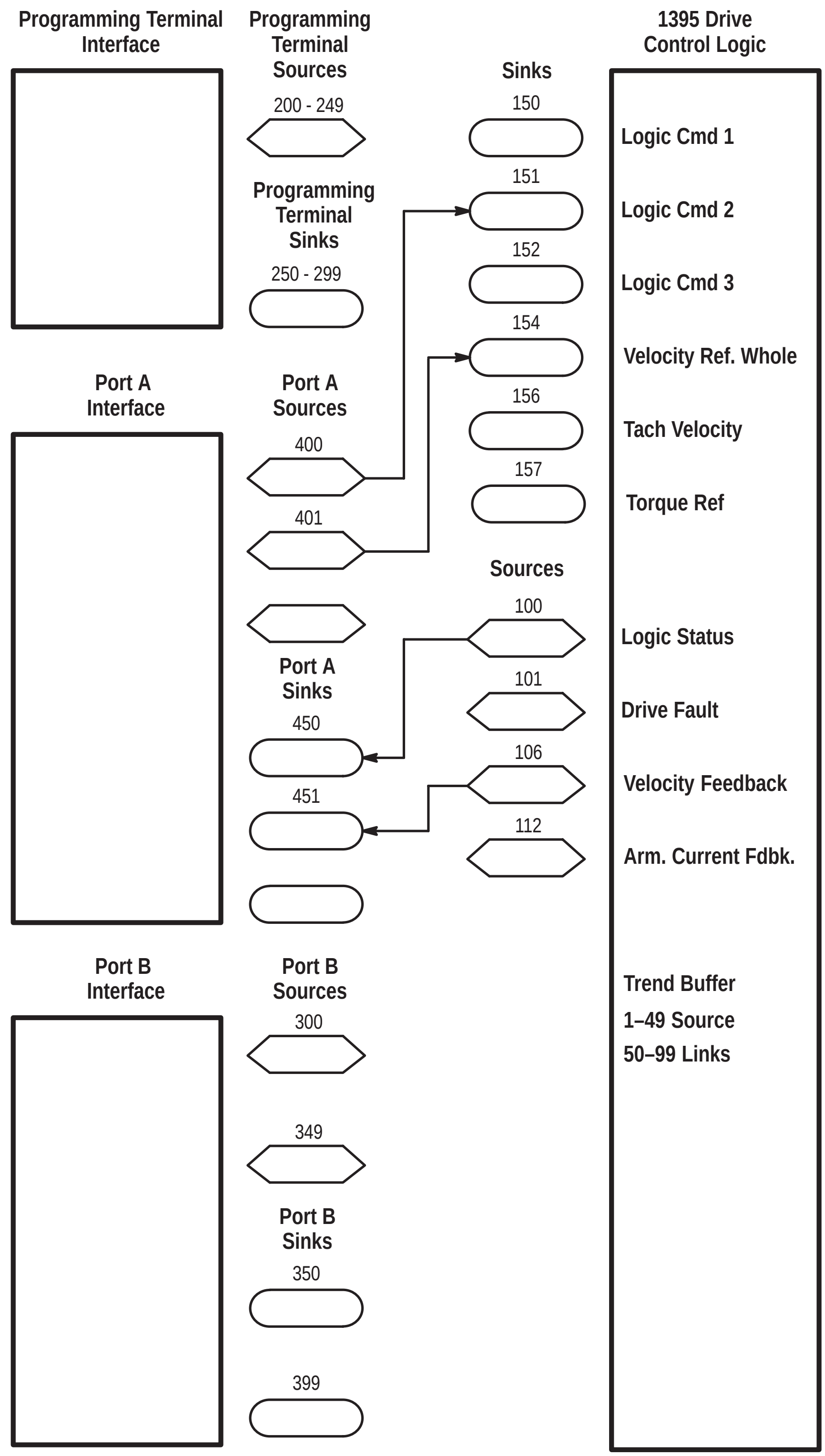
Number	Name	Function
100	Logic Status	16 bit word used to indicate the present operating condition of the drive.
101	Drive Fault	16 bit word used to indicate fault conditions in the drive.
102	Pre Ramp Vel Ref	Velocity reference output from the Velocity Reference Control
103	Ramp Vel Ref	Velocity reference output from the Ramp Control.
104	Final Vel Ref	Velocity Reference input to the Velocity PI Control which is the sum of the output from the Ramp Control, Process Trim and Droop functions.
105	Arm Voltage Fdbk	Actual armature voltage.
106	Velocity Fdbk	Final velocity feedback used as input to the Velocity PI Control.
107	Position Fdbk	Final position feedback used as input to the position control portion of the Velocity PI Control
108	Vel Feed Fwd	Error term used in proportional path of the velocity PI regulator
109	Position Error	Error between position reference and position feedback (P107)
110	Torque Command	Internal Torque Reference
111	Arm Current Ref	Torque command scaled by flux command.
112	Arm Current Fdbk	Actual armature current.
113	Arm Cur PI Out	Output of the Armature Current PI Control
114	Arm Cur Fire Ang	P113 converted to an angle reference modified by discontinuous current adaptation when operating in discontinuous current range.
115	Flux Command	Output of the field flux control.
116	AC Line Voltage	Actual three-phase input line voltage.
117	Fld Current Ref	Flux command scaled by the Field Flux Linearization Table.
118	Fld Current Fdbk	Actual field current.
119	Proc Trim Output	Output of velocity trim control.

Linking Source to Sink Parameters

In order for information from a Source parameter to be input to a Sink parameter, a link must be made between the two desired parameters. For example, to send the information from Parameter 400 (first Source parameter associated with Port A) to Parameter 151 (pre-defined as Logic Cmd 2, input), then Parameter 151 must be linked to Parameter 400. Linking of Parameter 151 to 400 is shown in Figure 5.3.

Linking of parameters is accomplished using the drive Setup Mode on the Programming Terminal. The drive will allow a total of 20 links to be made. There are two fixed links that cannot be altered or reconfigured, thereby allowing a maximum of 18 user configurable links. Linking of Sources to Sinks is referred to as "Configuring" the drive. For a complete description of how to use the Programming Terminal to configure the drive, refer to the Programming Terminal Instruction Manual. It should be noted that the 1395 drive is shipped from the factory pre-configured. The user has the capability of reconfiguring the drive as required.

Figure 5.3
Linking Sources to Sinks



The specific function and data requirements for each source parameter associated with the ports is defined by the Sink parameter from the control firmware to which it is linked. For example, in Figure 5.3, Parameter 400 is linked to Parameter 151 (Logic Cmd 2). Because Logic Cmd 2 has been pre-defined as a 16 bit control word, parameter 400 must be handled by the Adapter Board, and in turn by the external control devices, as the 16 bit control word Logic Cmd 2 (i.e. parameter 400 takes on the meaning of Logic Cmd 2).

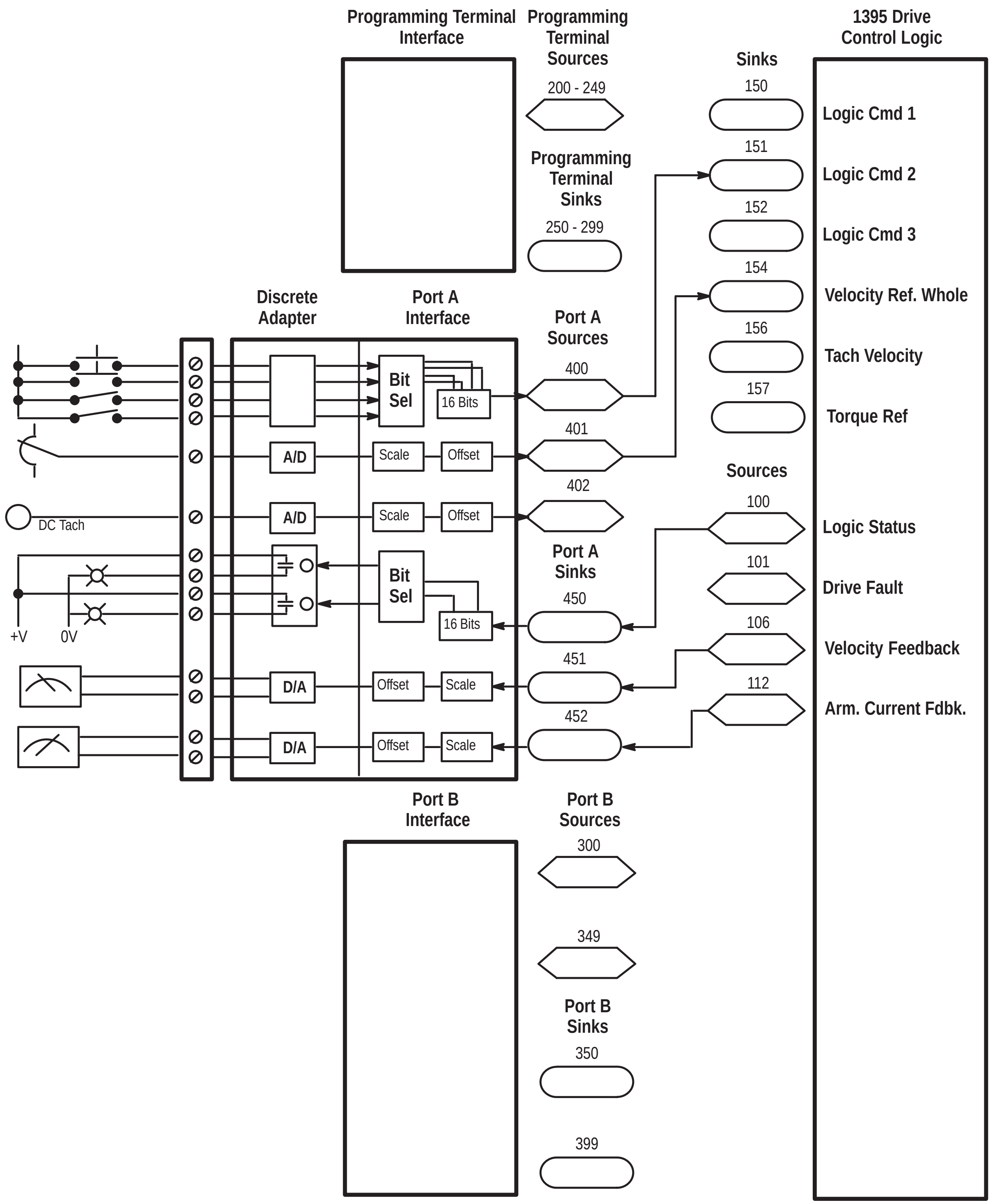
The same condition is true for Sink parameters associated with the Microbus Ports. For this reason, Sink and Source parameters associated with the ports have no meaning until they are linked to Source and Sink parameters from the control logic. Information may be flowing between the hardware connected to the Adapter Boards and the Source and Sink parameters associated with the corresponding Microbus Port, but until the Sink and Source parameters associated with the port are linked to control logic Source and Sink parameters, no transfer of data to the drive control will occur.

Example Configuration Using Discrete Adapter Board – Figure 5.4 shows a Discrete Adapter Board connected to Port A. The Discrete Adapter Board provides for up to four 24VDC/115VAC digital inputs, four analog inputs, two digital output contacts, and four analog outputs. Wiring to the actual discrete devices is provided through terminal TB3 in the drive package. Logic in the drive allows for scaling of input information for each analog input, before it is sent to the respective Source parameters. There are four Source parameters associated with the analog inputs, (Parameters 401 – 404 for PortA and Parameters 301 – 304 for Port B).

The four digital inputs to the drive are all sent to bits in a single 16 bit word which is to be used as a logic command input word. Parameters 400 for Port A and 300 for Port B are used for this purpose. Each of the four digital inputs to the Discrete Board can be configured to go to any of the 16 bits in the logic word for each port. The hardware of the Discrete Board, therefore, defines the possible usage for each of the Source and Sink parameters associated with the specific Port to which the Board has been connected.

In Figure 5.4 the Discrete Board has been connected to Port A, so only the Port A Source and Sink Parameters are defined by the hardware of the Discrete Board. Parameter 400, by definition of the Discrete Board must be linked in the Drive to to one of the logic command Sink parameters. In this example, Parameter 400 is linked to Parameter 151, Logic Command 2, so the four digital inputs to the Discrete Board will directly control four of the bits in Logic Command 2. Parameter 401, which is associated with the first analog input to the Discrete board is linked to Parameter 154, which means the analog signal entering the Discrete Board is defined as the External Velocity Reference input to the Control Logic.

Figure 5.4
Discrete Adapter Board Configuration Example



In this example, the speed feedback is being provided by a DC tachometer. The standard drive control is set up to use a digital Encoder for speed feedback, therefore, the standard hardware of the drive does not have an input for DC tach feedback. In this case, the DC tach feedback must be provided through the Discrete Board as an analog input as shown in Figure 5.4. The speed feedback derived from the tach appears at Parameter 402, and is linked to Parameter 156 which is the Tach Velocity input to the Control Logic and is used for external speed feedback.

In a similar manner, information from the Control Logic is linked to Sink parameters associated with Port A to provide digital and analog outputs from the Discrete Board as shown in Figure 5.4. Data flow between the Control Logic and other Adapter Boards may be traced in the same manner. For detailed information pertaining to the hardware and parameters associated with each Adapter Board, refer to the Installation and Maintenance Manual for that specific board.

Auto-tuning

The 1395 drive contains software that enables the drive to test and tune its current loop, velocity loop and field flux loop upon command. These features can be operated from the available program terminals or through a PLC program. Several of these tests require that the motor be capable of running at base speed. The choices available are detailed below.

– **Current Loop Test**. This feature checks the drive armature bridge for shorts or open circuits, verifies that armature voltage sensing is operating and measures the motor armature circuit.

– **Current Loop Tune**. This feature uses the information determined by the current loop test to tune the drive current loop.

– **Velocity Loop Motor Test** This feature calculates the motor inertia by running the motor under a controlled set of circumstances. The motor must be disconnected from the load to run this test.

– **Velocity Loop System Test**. This feature calculates the system inertia by running the motor under a controlled set of circumstances. The motor must be connected to the load to run this test.

– **Velocity Loop Tune**. This feature programs the drive velocity loop gains based on the information determined by the velocity loop motor and system tests.

– **Field Flux Tune**. This feature calibrates the drive field flux table to the actual motor field. The motor must be capable of running to complete this procedure. Due to the reduction of available torque, it may be necessary to disconnect the load to run this procedure.

Current Loop Tuning

As previously explained, the current loop tuning function performs two separate functions. First, it checks the armature bridge of the drive to assure that it is functional. Second, it tests and tunes the current loop gains of the drive. The current loop function can affect the following parameters:

Parameter No.	Description
734	K Discontinuous
735	KP Armature Loop
736	KI Armature Loop
741	Desired Current Loop Bandwidth
742	Maximum Current Loop Bandwidth

In addition, the parameters listed below are used by the current loop function during the test and tune procedure. These parameters must be set up correctly for the tuning function to work properly.

Parameter No.	Description
743	Current Loop Damping Factor
733	Armature Bridge Type

Current Test

The Autotune Current Test function requires the DC contactor to close and armature current to conduct through the DC motor for the diagnostic tests to work properly and Parameter 734 to be set correctly. Full field is applied during autotune, slight motor rotation is expected. The diagnostic tests first check for shorted SCRs by firing one SCR at a time with the DC contactor open. If current conducts through an SCR, then the software reports which SCR is shorted. However, the tests cannot identify multiple shorted SCRs.

Next, the diagnostic tests check for open components (open SCRs, open gate leads, disconnected motor, etc.) in the armature bridge after the DC contactor closes. Parameter 733 (Armature Bridge Type), has to be set properly before the Autotune Current Test is enabled. Otherwise, if the drive is non-regenerative and contains only six armature SCRs, the armature tests will erroneously report that the reverse armature bridge did not conduct (CP-120 REV SCRS DID NOT CONDUCT).

Finally, the average discontinuous current is measured and parameter 734 (K Discontinuous) is updated. If the maximum discontinuous current varies from pulse to pulse by too much (12.5 percent of full load), then the drive will fault. Parameter 734 is a function of the DC motor inductance connected to the drive. The diagnostic tests also verify that the armature voltage has the correct polarity while measuring the maximum discontinuous current or else the tests will report a fault.

Current Tune

The Autotune Current Tune calculates the maximum current loop bandwidth and current loop gains. The KP and KI Armature Loop gains (Parameters 735 and 736) are based on the maximum discontinuous current (Parameter 734), desired Current Loop Bandwidth (Parameter 741) and Damping Factor (Parameter 743). Parameter 734 is used by autotuning to calculate the current loop gains because Parameter 734 is inversely proportional to the armature inductance. Autotuning does not look at the actual current loop response to determine the gains or verify the actual bandwidth. Therefore, the desired bandwidth should be used as a measure of relative performance and not absolute performance. For example, if maximum performance is desired, then the desired bandwidth should be set equal to the maximum bandwidth.

The current processor limits the desired bandwidth that the user has entered to the maximum bandwidth calculated by the drive, which cannot be modified by the user. Whenever the user enters or reads the desired bandwidth, the current processor recalculates the maximum bandwidth (Parameter 742) and limits the desired bandwidth. Next, the current loop gains are calculated based on the damping factor, desired bandwidth, maximum discontinuous current and the AC line frequency which is measured by the current processor.

When Autotune Current Tune is executed, the present values for the desired bandwidth and damping factor specify the desired dynamic behavior of the current loop. If the user wants to tune the current loop with a different value of damping factor, the parameter has to be updated before the tune is executed. The current loop will be more responsive and reproduce the current reference more accurately if the bandwidth is increased. However, the current may exhibit more noise and overshoot as the current loop bandwidth is increased. Typically, the bandwidth should be set to about 90% of maximum to provide fast performance yet minimize the effects of noise and possible excessive overshoot. The damping factor influences the amount of overshoot the current loop will exhibit during a transient. The current will typically exhibit more overshoot and become oscillatory (underdamped) as the damping factor is reduced below one. For a damping factor above one, armature current should not exhibit much overshoot and have a slower rise time for a given current loop bandwidth.

Velocity Loop Tuning

The velocity loop tuning functions enable you to calibrate the drive to the motor and the system connected to the motor. The velocity loop function can effect the following parameters:

Parameter No.	Description
613	Motor inertia
659	KI Velocity Loop
660	KP Velocity Loop
700	Velocity Loop Desired Bandwidth
701	Velocity Loop Maximum Bandwidth
703	System Inertia

In addition, the parameters listed below are used by the velocity loop function during test and tune. These parameters must be set up properly for the tuning function to work properly.

Parameter No.	Description
698	Auto Tune I Lim
699	Auto Tune Speed
702	Velocity Loop Damping Factor

Velocity Loop Motor Test

The motor test calculates the motor inertia (Parameter 613) by running the drive through a defined velocity profile. When the profile is complete, torques and acceleration/deceleration times are used to calculate motor inertia. The armature current used during the test is set by Parameter 698. The default is 25% of rated Motor Current (Parameter 611).

If acceleration time is excessive during Velocity Loop Autotune, Parameter 698 may have to be increased.

The maximum velocity that the motor will run at, is determined by Parameter 699. The test is most accurate when Parameter 699 is set to base speed. However, acceptable results can be achieved at lower speeds. In all cases the motor must be disconnected from the load (system, process or machine) for this test to yield accurate results.

Velocity Loop System Test

The system test calculates the inertia of the system that is connected to the motor by running the drive/system through a defined velocity profile. When the profile is complete, torques and acceleration/deceleration times are used to calculate System Inertia (Parameter 703).

As with the motor test, the maximum velocity that the motor and system will run at is determined by Parameter 699. In order to obtain accurate results the motor must be connected to the load (system, process or machine).

Velocity Loop Tune

This function calibrates the velocity loop gains (Parameters 659 and 660), based on the results of the motor and system tests. These tests should be run prior to attempting to tune the velocity loop to assure that the drive has the latest information.

Field Flux Tuning

The Field Flux Tuning function calculates the field current values required to obtain specific field flux levels and calibrates the flux parameters accordingly. Field Flux Tuning is not performed if Armature Voltage Feedback is used as the feedback device type (Parameter 621).

It also calculates the rated field current and adjusts the Rated Field Current (Parameter 612) as required.

The field flux tuning function does not control the motor speed directly. This is done to allow the function to calibrate the drive regardless of the drive regulator type. For example, speed regulated, torque regulated or torque follower drives can all be calibrated with this feature.

In order to calibrate the field flux properly, the actual motor speed must match the value specified in Parameter 699. Also, best results are obtained if the motor is run at base speed. Gains must also be entered for KI Flux (Parameter 677) and KP Flux (Parameter 673). The defaults are recommended.

Trending

The 1395 has four internal trend buffers which can be programmed to monitor select fast parameters. These buffers are particularly useful during the commissioning of the drive. They can be used to monitor motor status, logic command or other important information.

Each trend has the following features:

- The parameter to be trended can be specified.
- The parameter number (operand X) whose value will be monitored for a trigger condition can be specified. The parameter number (operand Y), whose value will be compared against the monitored parameter to determine if a trigger should occur, can be specified.
- The operator used to determine what condition(s) will cause a trigger is established.
- The rate at which the chosen parameter is selected is changeable.
- The number of samples taken after the trigger has ocurred is changeable.
- Each trend can be setup as one shot or multiple occurrence. When setup as one shot, the trend has to be enabled after each trigger occurrence. When setup as multiple occurrence, the trend buffer will restart immediately after the trend data has been sent to the output buffer.
- Each trend can be deactivated so that it does not monitor for a trigger occurrence.
- Each trend output buffer can be linked to an external device. The rate at which the sampled data is transferred to the external device is also adjustable. This feature requires that the trends be set as “one-shot”.
- Trend buffers can be triggered from other trend buffers. This gives you the capability of recording up to 400 consecutive data samples for a given parameter.

- Once a trend buffer is activated, it continuously samples the selected parameter. When it is triggered, each buffer will take an additional number of samples as specified by the Post Sample Parameter. When finished sampling, the data is transferred to an output buffer where it can be displayed or sent to an external device.

An example of a typical trend buffer is shown below:

Parameter to be monitored:	Parameter 106 (Velocity feedback)
Trend Trigger operand X	Parameter106
Trend Trigger operand Y	Parameter 900 (signed trend constant). The value in 900 will be set to 100 RPM (Actual value is entered in Internal Units)
Trend Operator	Greater than (.GT)
Samples after trigger	80
Trend sample rate	Trend buffer sample rate, this will be set to 24 ms.
Continuous trigger	One shot, the trend will have to be reset after each trigger.
Trend Enable	Activate
Trend Output Rate	Output buffer data rate.

When setting up a trend buffer, the following equation is used for comparison of operand X and Y.
[operand X] [operator] [operand Y]

The example above would result in the following formula:
When [Parameter 106] is [greater than] [Parameter 900] the trend buffer will be triggered.

Using the setup above, parameter 106 would be monitored. When its value exceeded 100 RPM the trend buffer would be triggered and 80 more samples (at a rate of 1 every 24 ms) would be taken. Once the sampling is complete the data would be transferred to the output buffer and the trend would be deactivated.

Trend Setup Description – This procedure describes how to setup trend buffers using a 1395 Program Terminal. For information on setting up trend buffers from an Allen-Bradley PLC refer to the 1395 Node Adapter publication.

Table 5.C details all parameters associated with trending.

Table 5.C
Trending Parameters

Description	Trend #1 Parm. Num.	Trend #2 Parm. Num.	Trend #3 Parm. Num.	Trend #4 Parm. Num.
Trend Input Parameter	50	51	52	53
Trend Output Parameter	1	2	3	4
Signed Trend Constant	900	Constants are available to each buffer		
Signed Trend Constant	901	Constants are available to each buffer		
Signed Trend Constant	902	Constants are available to each buffer		
Signed Trend Constant	903	Constants are available to each buffer		
Bit Trend Constant	904	Constants are available to each buffer		
Bit Trend Constant	905	Constants are available to each buffer		
Bit Trend Constant	906	Constants are available to each buffer		
Bit Trend Constant	907	Constants are available to each buffer		
Unsigned Trend Constant	908	Constants are available to each buffer		
Unsigned Trend Constant	909	Constants are available to each buffer		
Trend X Operand X Parm.	910	920	930	940
Trend X Operand Y Parm.	911	921	931	941
Trend X Operator	912	922	932	942
Trend X sample rate	913	923	933	943
Trend X post samples	914	924	934	944
Trend X continuous trigger	915	925	935	945
Trend X enable	916	926	936	946
Trend X output rate	917	927	937	947

Chapter 9, Pages 9-8 and 9-9 contain a worksheet for each buffer. These worksheets will assist you in programming each buffer and can also act as installed documentation. Shown below is a sample of this worksheet.

TREND BUFFER #1

Trend Buffer #1 is linked to parameter:

The output of Trend Buffer #1 is linked to parameter:

Description	Parm. Num.	Parameter Range	Parm. Value
Trend 1 Operand Parameter X	910	1 through 947	
Trend 1 Operand Parameter Y	911	1 through 947	
Trend 1 Operator	912	GT, LT, EQ, AND, NAND OR, NOR	
Trend 1 Sample Rate	913	See Start-Up Checklist in Chapter 9	
Trend 1 Post Samples	914	See Start-Up Checklist in Chapter 9	
Trend 1 Multiple Trigger	915	See Start-Up Checklist in Chapter 9	
Trend 1 Enable	916	See Start-Up Checklist in Chapter 9	
Trend 1 Output Rate	917	See Start-Up Checklist in Chapter 9	

Programming a Trend Buffer

Determining What to Trend – The first step to programming a Trend Buffer is to determine which parameter you want to monitor or trend. The parameter you select to trend must be a fast parameter because you will establish a configuration link to that parameter. This link will be made between the parameter to be trended and the Trend Input Parameter (Parameters. 50 through 53).

NOTE: If you are not familiar with Drive configuration links refer to the Programming Terminal manual section detailing Drive Setup.

Setting up the Trend Trigger – In order for a trend to operate you must tell it what conditions (trigger) will cause it to store data. These conditions are setup by three parameters: Trend Operand X, Trend Operand Y, and Trend Operator. The following Equation is used to evaluate a trend trigger condition.:

If [Operand X] [Operator] [Operand Y] then trigger.

In other words, the value of parameter specified by Operand X is compared to the value of the parameter specified Operand Y. If the conditions specified by the Operator are satisfied, then the trend is triggered and begins storing data samples.

Operand X and Operand Y can be any parameter number from 1 to 947. If a constant value is required, the Trend constant parameters (Parmeters 900 through 909) can be used.

IMPORTANT: Attempting to compare a signed parameter with an unsigned parameter will result in unpredictable trend operation. All attempts should be made to keep both Operand X and Operand Y signed or unsigned.

1. Greater Than (.GT.) – Compares the data value for the parameter specified by Operand X to the data value for the parameter specified by Operand Y. If the comparison is positive, the trend is triggered
2. Less Than (.LT.) – Compares the data value for the parameter specified by Operand X to the data value for the parameter specified by Operand Y. If the comparison is positive, the trend is triggered
3. Equal (.EQ.) – Compares the data value for the parameter specified by Operand X to the data value for the parameter specified by Operand Y. If the comparison is equal, the trend is triggered
4. Not Equal (.NOT EQ.) – Compares the data value for the parameter specified by Operand X to the data value for the parameter specified by Operand Y. If the comparison isn’t equal, the trend is triggered.

5. AND (.AND.) – Compares the bits(s) of a 16 bit value for the parameter specified by Operand X to the bit(s) for the parameter specified by Operand Y. If ALL of the same bit(s) are set to “1” in both parameters, the trend is triggered Generally Operand Y is set up to use one of the Bit Trend Constant parameters (Parameters 904 through 907).
6. Negated AND (.NAND.) – Compares the bits(s) of a 16 bit value for the parameter specified by Operand X to the bit(s) for the parameter specified by Operand Y. If ALL of the same bit(s) are set to “0” in both parameters, the trend is triggered Generally Operand Y is set up to use one of the Bit Trend Constant parameters (Parameters 904 through 907).
7. Or (.OR.) – Compares the bits(s) of a 16 bit value for the parameter specified by Operand X to the bit(s) for the parameter specified by Operand Y. If ANY of the same bit(s) are set to “1” in both parameters, the trend is triggered Generally Operand Y is set up to use one of the Bit Trend Constant parameters (Parameters 904 through 907).
8. Negated OR (.OR.) – Compares the bits(s) of a 16 bit value for the parameter specified by Operand X to the bit(s) for the parameter specified by Operand Y. If ANY of the same bit(s) are set to “0” in both parameters, the trend is triggered Generally Operand Y is set up to use one of the Bit Trend Constant parameters (Parameters 904 through 907).

Adjusting the Data Sample Rate – The sample rate for data acquisition has a programmable range of 4ms through 30 seconds (In 4ms increments). The rate at which the data is sample and at which the trigger condition is evaluated is the same up to 40ms. This assures that possible trigger conditions will be monitored whenever the sample rate exceeds 40 ms. The sample rate can be changed while a trend is active.

Setting the Number of Post Samples – The number of data samples taken once a trigger condition has occurred is programmable. The range is 0 through 99, with one sample reserved for the instance the trigger condition becomes true.

Typically, when a trend buffer is set to trigger on a fault, the post sample parameter would be set to a lower number. 20 samples is a good number. This allows you to evaluate data before the trigger event on the trended parameters.

When a trend buffer is set up as a level detector, the post sample parameter is generally set to a higher value. 80 samples is a good number. This allows you to evaluate what happened after the trigger occurred.

Setting the Trend Buffer Type – Each trend buffer can be set up as a "one-shot" or "continuous trigger" buffer. When a buffer is set up as a "one-shot" it is turned off after all post samples have been taken. At this time, the trend enable parameter value is changed to OFF effectively disabling that trend buffer. The buffer will retain the data from the most recent trigger until it is manually activated or turned ON.

A "continuous trigger" trend buffer operates continuously, even if it is triggered multiple times. When a new trigger condition occurs, the previous data samples are overwritten.

Activating a Trend Buffer – Each trend buffer can be independently turned on or off. A deactivated trend buffer will not monitor the selected parameter or evaluate trigger conditions.

If a trend buffer is set to "one shot", the Drive will set the Trend Enable parameter to "OFF" when it has been triggered.

Setting the Trend Buffer Output Rate – Each trend actually consists of two separate buffers. One buffer is used during the monitoring and post sampling periods to store data samples. The second is used once a trend has finished sampling.

When a trigger condition occurs and all post samples have been taken, the data is transferred to an output buffer. At this time, it is available for display by a programming terminal or for an output to an external device.

When directed to an external device, the data sample output rate can be adjusted. The range is 4ms to 30 seconds per data sample (in 4ms increments). A programmable output rate allows you to connect a wide variety of devices (chart recorders or oscilliscopes for example) to an analog channel or an adapter board and view the sampled data, regardless of the speed of the device.

A positive spike followed immediately by a negative spike is also output, to indicate the start of the data samples. Data is continuously transmitted until the trend is restarted or if the Trend output configuration link is removed.

ATTENTION: Doing an EE recall or initialize function will cause termination of any executing trends, and of those trends contained in EEPROM. An EEPROM store function has no effect on Trend execution.

The trend buffers can be programmed to provide an expanded number of data samples beyond the standard 100 samples. This is accomplished by programming a second trend to trigger when the ENABLE parameter in the first trend is turned off. The maximum number of samples that can be taken is 400.

Trend Setup

Determining What to Trend:

1. While in the program terminal Drive setup configuration mode.
2. Link the Trend Input Parameter associated with the trend buffer to be setup to the Drive parameter you want to trend.
3. Link the Trend output parameter if trend data is to be output to an external device.

NOTE: Refer to the tables at the end of Chapter 9 for a listing of the parameter numbers for each trend buffer.

1. Select the PARAMETER choice from the program terminal main menu.
2. Select the parameter of Operand X for the trend buffer you are setting up (Refer to Table 5.C).
3. Enter the parameter number which contains the data for the Operand X comparison value.
4. Select the parameter of Operand Y for the Trend buffer you are setting up.
5. Enter the parameter number which contains the data for the Operand Y comparison value.
6. Select the parameter of the Operator for the trend buffer you are setting up.
7. Enter the Operator to be used for the Operand comparison.

Setting the Data Sample Rate:

1. Select the Sample Rate parameter for the trend buffer you are setting up.
2. Enter the desired sample rate.
   NOTE: The Drive will round the desired sample time to the nearest 4ms.

Setting the Post Samples Rate:

1. Select the Post Samples parameter for the trend buffer you are setting up.
2. Enter the number of data samples to be taken after a trigger condition occurs.

Setting the Trend Buffer Type:

1. Select the Trend Multiple Trigger parameter for the trend buffer you are setting up.
2. Setting this parameter “ON” enables multiple trigger operation, setting it “OFF” enables one shot operation.

Activating a Trend Buffer:

1. Select the Trend Enable parameter for the trend buffer you are setting up.
2. Set this parameter “ON” to activate the buffer or “OFF” to deactivate the buffer.

Setting the Output Data Rate:

1. Select the Trend Output Rate parameter for the trend buffer you are setting up.
2. Enter the desired sample rate.
   NOTE: The Drive will round the desired sample time to the nearest 4ms.

Trending To Aid Troubleshooting

To set up a Trend as an aid to troubleshooting, refer to Chapter 4 of the 1395 Troubleshooting manual for more information.

General Logic Description

A general block diagram (software overview) of the 1395 logic is shown in Figure 5.5. Each of the major functions has a circled reference number assigned to it, which corresponds to the general software functional description given in this section.

All diagrams used for the logic description in this manual use a function block representation of the actual software function being performed. Calibration and adjustment of the 1395 consists of changing the values of specific parameters.

Velocity Reference Control *(Circle 1)*

The 1395 is capable of selecting one of 8 possible speed reference values. The speed reference value which is selected is determined by the currently active Logic Command Word (Parameter 150, 151, 152). Bits 0, 1 and 2 of the logic command provide the binary data to select from 0 through 7 (which corresponds to the 8 speed reference options). Velocity Reference is a two parameter external velocity reference expressed in Drive Units (4096 = Base Speed). Parameter 154 supplies the whole number part, while Parameter 153 supplies the fractional part of the external reference. Also selectable are five different preset speeds, defined in Parameters 633 through 637. In addition, Logic Command, bits 0,1 and 2 can be used to select the output of a MOP as the speed reference. Selecting the MOP function output as a reference bypasses the Jog select function. The MOP output will enter directly into the speed limit block. Parameters 649 and 650, MOP max and MOP Min speeds, are used to limit the maximum and minimum MOP speeds that can be reached using the MOP INC and MOP DEC function.

Bits 9 and 10 of logic command select the Jog function as the speed reference. Two jog speeds are available; Parameter 638 represents Jog l and Parameter 639 represents Jog 2. These jog speeds can be defined as either forward or reverse speed references.

The selected speed reference then enters a speed limit block. The maximum and minimum limit of the speed reference are adjustable by changing the values of Forward Speed Limit (Parameter 608) and Reverse Speed Limit (Parameter 607). Forward Speed Limit sets the maximum speed reference for the forward direction, and Reverse Speed Limit sets the maximum speed reference for the reverse direction.

Pre–Ramp Velocity Reference (Parameter 102) indicates the value of the velocity reference that has been currently selected by the Velocity Reference Control. Parameter 102 is also the input to the Ramp Control. Two parameters control the accel and decel rates of the Ramp function. Accel Time, (Parameter 651), defines the time in seconds for the output of the Ramp to go from zero to base speed (linear beyond base speed). This rate applies to both forward and reverse speed references. Decel Time (Parameter 652), defines the time in seconds for the output of the Ramp to go from base speed to zero speed reference in both the forward and reverse directions. In addition to the Ramp function, an “S” filter function has been provided. Desired Contour (Parameter 653), specifies the rounding of the edges of the velocity profile or “S” filtering. These functions can be bypassed by setting bit 5 in Logic Command.

Ramp Velocity Reference (Parameter 103), is the output of the Ramp and Contour function blocks. The value of this parameter is conditionally offset by the Droop function (if used), to become the Final Velocity Reference (Parameter 104). The output of the Droop Control *(Circle 6)* is derived from Torque Command (Parameter 110), along with Droop Percent (Parameter 657) and Droop Gain (Parameter 658). Ramp Velocity Reference (Parameter 103), is the output of the Ramp and Contour function blocks. The value contained in this parameter is conditionally offset by the Droop and Process Trim functions (if used), to become the Final Velocity Reference, (Parameter 104). The output of the Droop Control (Circle 6) is derived from Torque Command (Parameter 110), along with Droop Percent, (Parameter 657) and Droop Gain, (Parameter 658). The Process Trim Control (Circle 4) allows either the speed reference or torque reference to be trimmed according to the process. It contains its own PI Control block, along with filters and limiting functions. A selection block in logic, controlled by Process Trim Select (Parameter 628), sends the output to be summed with the input to the velocity loop, or summed with External Torque Reference (Parameter 157), to be used as a torque reference.

Velocity Feedback Control *(Circle 4)*

The 1395 allows different methods of motor speed feedback. A digital encoder, analog DC tachometer or armature voltage may be selected as feedback methods. Feedback Device Type (Parameter 621), selects the source for motor velocity feedback. Velocity Filter Select (Parameter 631) provides the option of using a filter and designating what type it will be. The output of the Feedback Filter block provides the Velocity Feedback (Parameter 106). The “No Feedback” option is typically used for drives operating as torque regulators (torque mode select).

Velocity PI Control *(Circle 5)*

Compares the speed reference value from the Velocity Reference Control to the actual motor speed, from the Velocity Feedback Control. The Final Velocity Reference (Parameter 104), is modified by KF Velocity (Parameter 661). This parameter controls the amount of velocity reference that will be summed with velocity feedback. This is filtered and modified through a Proportional/Integral (PI) Control function. The proportional gain of the PI Control is determined by the value of KP Velocity Loop (Parameter 660). A value of 8 in Parameter 660 will provide a gain of 1. The integral gain of the PI Control is determined by the value of KI Velocity Loop (Parameter 659). The output of the velocity control firmware is a torque reference, which is limited before being applied to the torque selection block.

Process Trim *(Circle 7)*

Process Trim Reference (Parameter 161), and Process Trim Feedback (Parameter 162), are summed to provide the error signal into the filter block. Process Trim Filter Constant (Parameter 713), determines the gain of a single pole filter used in the process trim. The output of the filter is used as the input to the process trim P/I regulator. Process Trim KI Gain (Parameter 715) controls the integral gain, and Process Trim KP (Parameter 716), controls the proportional gain. The output of the PI Control is limited by adjustable high and low limits. Process Trim Low Limit (Parameter 717), specifies the low limit of the process trim trim output value. Process Trim High Limit (Parameter 718), specifies the high limit. Immediately prior to the the limit test, the output of the process trim regulator is scaled by a gain factor. Process Trim Trim Output Gain (Parameter 719), specifies the gain value to use. Process Trim Preload (Parameter 714), is used to preset the integral term prior to enabling of the process trim function. Logic Command bit 15, activates the process trim function. Process Trim Select, (Parameter 628), contains one of three selections for determining where the output of the process trim regulator will be applied. Possible selections include trim velocity reference, trim torque reference, or no use of the process trim output. If used to trim the velocity reference, the output is summed with the velocity reference, to produce Final Velocity Reference (Parameter 104). The sum will be limited by Parameter 721 Proc Trim Lo Sum and Parameter 722 Proc Trim Hi Sum. If used to trim the torque reference, the output is summed with External Torque Command (Parameter 157), to produce an input to the Torque Select block.

Torque Select *(Circle 8)*

Selects the reference input to the Current Control, based on the value of Torque Mode (Parameter 625). Torque Mode is a number coded parameter which allows operation under several different torque modes.

There are two possible reference inputs to choose from. The output of the Velocity PI Control, which has been converted to a torque reference, is used as an internal torque reference. If the drive is a stand alone drive, or considered the Master drive of a system, this reference could be used. The external Torque Reference, (Parameter 157), is used to supply an external torque reference for the drive. This could be used if the drive was a slave drive in a system. This parameter can also be modified by summing the Process Trim Output when the Process Trim Select (Parameter 628) selects the torque reference to trim. The external torque reference is also used when either the “Min” or “Max” torque modes are selected. These functions automatically make a selection between the external torque reference value and the output of the Velocity PI Control.

Torque Command, (Parameter 110), indicates the latest torque reference value. This value is converted to an armature current reference by dividing by the motor Field Flux Command, to be used in the Current PI Control. The value is also used as an input to the Droop Control.

Feedback Control *(Circle 14)*

Two current transformers (CT’s) sense armature current flow. The current feedback is scaled using Motor Armature Full Load Amps (Parameter 611) and Rated Armature Bridge Current (Parameter 615). Parameter 112 is the average armature current feedback value. The field current transducer (FCT) provides field current feedback to the control which is scaled by Rated Field Motor Current (Parameter 612) and Rated Field Bridge Current (Parameter 616). The average field current can be read by Parameter 118.

Tach Loss Recovery

When Tach Loss Recovery is selected, it allows the Drive to continue operation under armature voltage control in the event that the primary feedback device fails (the primary device can be an encoder or DC tach). The switchover occurs automatically and does not shut the Drive down.

This feature also provides an option for configuring a tach loss as a Warning Fault. This is done with Parameter 691 “Tach Switch Sel”. If Parameter 691 is set to one, the Tach Loss Recovery feature is activated and Tach Loss becomes a Warning fault. If Parameter 691 is set to zero, a tach loss causes a soft fault. The default value for Parameter 691 is zero (tach loss recovery disabled).

When enabled, the Tach Loss feature operates as follows:

Velocity feedback from an encoder or tach is compared against velocity feedback derived from armature voltage. When the magnitude (absolute value) of the difference between the two feedbacks exceeds the Tach Loss Window (Parameter #688), for a period of time in excess of 40 msec., an automatic switchover to Armature Volts Feedback will occur.
NOTE: This statement is true for version 5.01 Firmware. For Firmware versions greater than 5.01 refer to parameters 731 and 732 for Tach Loss/Switch over algorithm.

When a loss of feedback is detected in Tach Loss Recovery mode, the following action is automatically taken by the drive:

1. Change the velocity loop K_p and K_i gains to new values that will provide stable operation under armature voltage control. These gains are supplied by two parameters (Parameter 689 for Tach Loss K_i and Parameter 690 for Tach Loss K_p).
2. Freeze the field flux to the value present at the time of the Tach Loss.
3. Issue a Tach Loss warning via the Logic Status Word (Parameter 100 bit 1 = 0, bit 0 = 1) and the VP Fault Word (Parameter 101 bit 0 = 1).
4. Change the Feedback Device parameter to the Armature Voltage Feedback value (set Parameter 621 to 1).
5. The forward and reverse speed limits are set to the speed value at the time of the Tach Loss.

These changes remain in effect until a “Clear Faults” command is issued, or until the feedback device selection is changed back to its original value.

From this point on, the drive will continue running in Armature Voltage Feedback mode. If you were to make the original feedback device functional again, it would be possible to switch back to it using one of two methods:

1. Change the value of the feedback device parameter (Parameter 621) to the original feedback type. NOTE: If the drive is running while this change is made, the drive will check to make certain the feedback from the primary feedback device is within the tach loss window. If it is, the switch will be honored and the parameter values will be restored to their previous values. If not, the switchover will not be allowed.

2. Issue a “Clear Faults” command to the Drive. The fault will be cleared, and the Drive will be reset to it’s previous feedback device, gains and field flux level. Note that this command is only honored when the Drive is not running.

Current Reference Control *(Circle 9)*

The output of the Torque Reference Select block is applied to a limiting function block. Forward Bridge Current Limit (Parameter 663) and Reverse Bridge Current Limit (Parameter 664), specify the largest allowable positive and negative motor armature current that can be commanded. The limited current is then applied to a Torque Taper function block. Start Taper Speed (Parameter 665) defines the motor speed above which torque tapering will begin. End Taper Speed (Parameter 666) defines the speed above which the Minimum Taper Current (Parameter 667) will be used as the upper limit for armature current reference. The output of these function blocks is the Armature Current Reference (Parameter 111). This value is scaled using Parameters 611 and 615, and summed with Armature Current Feedback. The difference between the reference and feedback value is filtered and modified through a P/I Control Function. Armature Loop Proportional Gain (Parameter 735) determines the proportional gain of the current regulator. Armature Loop Integral Gain (Parameter 736) determines the integral gain. Parameter 734 is used to linearize the armature current loop for discontinuous current operation. The output of the Armature Current P/I Control block is converted to a time and sent to the armature SCR bridge.

Field Flux Control *(Circle 11 and 12)*

Provides information for field weakening, flux reference and field flux linearization. Several parameters are required to develop this information:

– Feedback Device Type (Parameter 621) provides the Flux Reference Selection block with feedback information.

– Flux Mode Select (Parameter 627) enables options in the flux control module.

– Field Flux Reference (Parameter 676) defines the highest flux reference that can be applied to the motor field.

– Field Economy Reference (Parameter 674) specifies the field flux flux reference to the motor. The flux value specified by this parameter will be in use when the motor has been stopped for the time specified in the Field Economy Delay (Parameter 675).

– Minimum Field Regulate Speed (Parameter 686), and velocity Fdbk, (Parameter 106), are required for Field Weakening. The drive will go into field weakening when actual speed is greater than base speed, unless defined otherwise by Minimum Field Regulate Speed (Parameter 686). This parameter specifies the minimum speed at which field weakening control and CEMF regulation begins.

The drive will go into field weakening when actual speed is greater than base speed. The CEMF regulation is always active when flux mode select (Parameter 627), field weakening (bit 1) is enabled. The output of these two blocks is applied to a Field Flux Linearization function, whose output becomes Field Current Reference (Parameter 117). This field current reference value is summed with the field current feedback value in the Field PI Control.

Field PI Control *(Circle 13)*

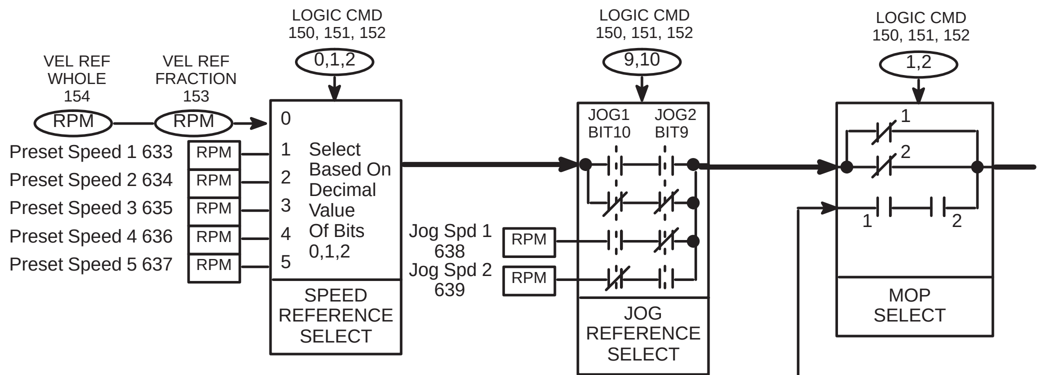
Field Current Feedback provided from the Feedback Control indicates the latest field current feedback value and is summed with Field Current Reference, and applied to the Field Pl Control. Parameter 737 determines the proportional gain and Parameter 738 determines the integral gain. The output of the Field PI Control is converted to a time and is sent to the field SCR bridge.

Figure 5.5
1395 Block Diagram

① **VELOCITY REFERENCE CONTROL**

SPEED REFERENCE SELECT

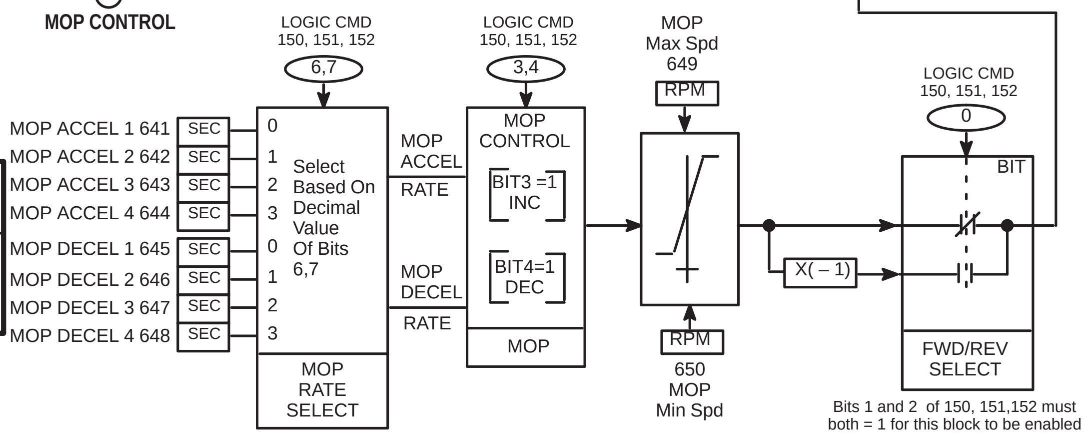
LOGIC CMD BITS 2	1	0	SPEED REF. PARAM
0	0	0	154
0	0	1	633
0	1	0	634
0	1	1	635
1	0	0	636
1	0	1	637
1	1	0	MOP FWD
1	1	1	MOP REV



② **MOP CONTROL**

MOP RATE SELECT

LOGIC CMD BITS 7	6	MOP RATE ACCEL	DECEL
0	0	641	645
0	1	642	646
1	0	643	647
1	1	644	648



S/W FAULT SELECT 623

BIT	FAULT
0	SCR OVERTEMP
1	MOTOR OVERTEMP
2	OVERLOAD TRIP
3	STALL
4	AC VOLT OUT OF TOL.
5	WAITING–SAFE ARM VOLTS
6	WAITING ZERO CUR.
7	BRIDGE OVERLOAD

MOTOR OVERLOAD SELECT 629

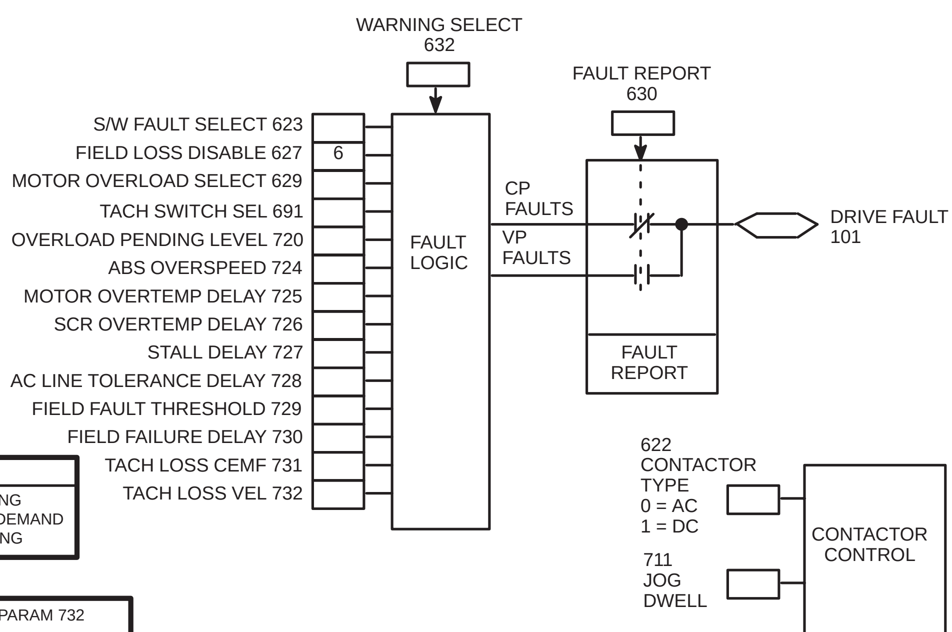
	FUNCTION
0	OVERLOAD DISABLED
1	150%/60SEC. COOLED MTR
2	200%/60SEC. COOLED MTR
3	150%/60 SEC.
4	200%/60 SEC.

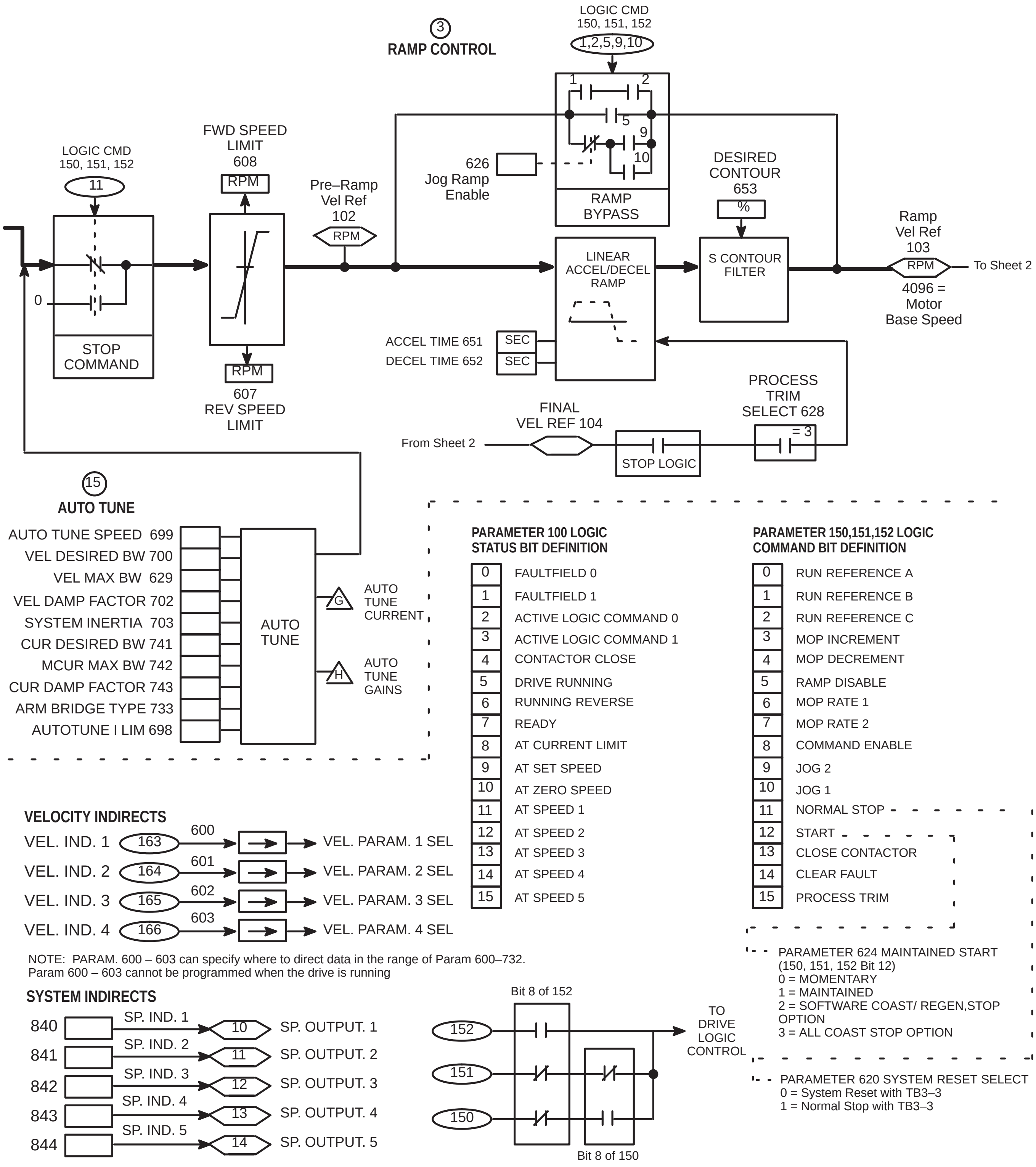
WARNING SELECT 632

BIT	WARNING
0	MOTOR OVERLOAD PENDING
1	EXCESSIVE ARMATURE VOLTS DEMAND
2	BRIDGE OVERLOAD PENDING

TACH SWITCH SEL 691

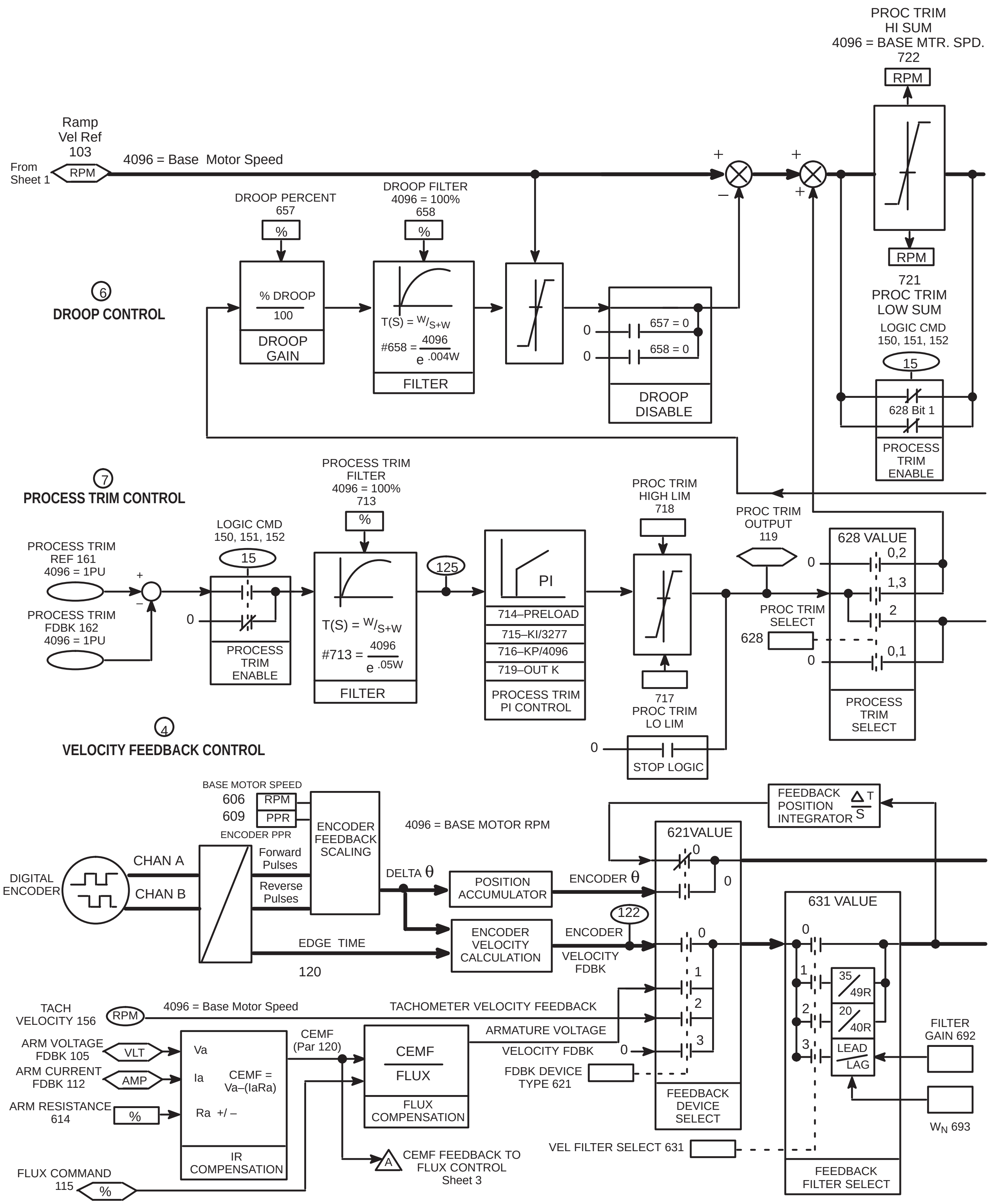
If CEMF > PARAM 731 and VEL FDBK < PARAM 732
and if 691 = 0, SOFT FAULT
else if 691 ≠ 0, WARNING FAULT

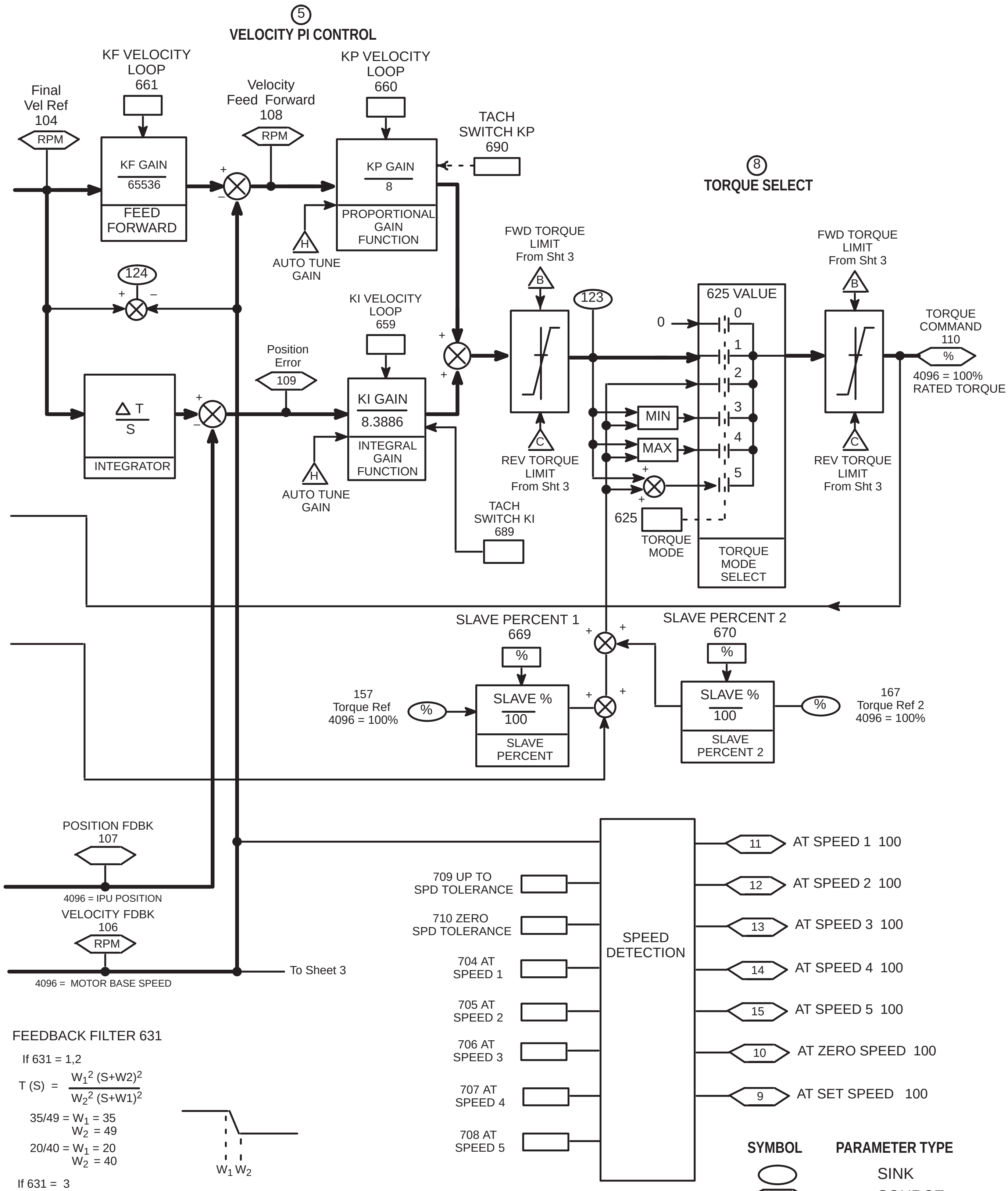




NOTE: PARAM. 840–844 can specify any constant in the range of ± 32,767

Figure 5.5 ***(Sheet 2 of 3)*** **1395 Block Diagram**





FEEDBACK FILTER 631

If 631 = 1,2

$$T(S) = \frac{W_1^2\ (S+W2)^2}{W_2^2\ (S+W1)^2}$$

35/49 = $W_1 = 35$
$W_2 = 49$

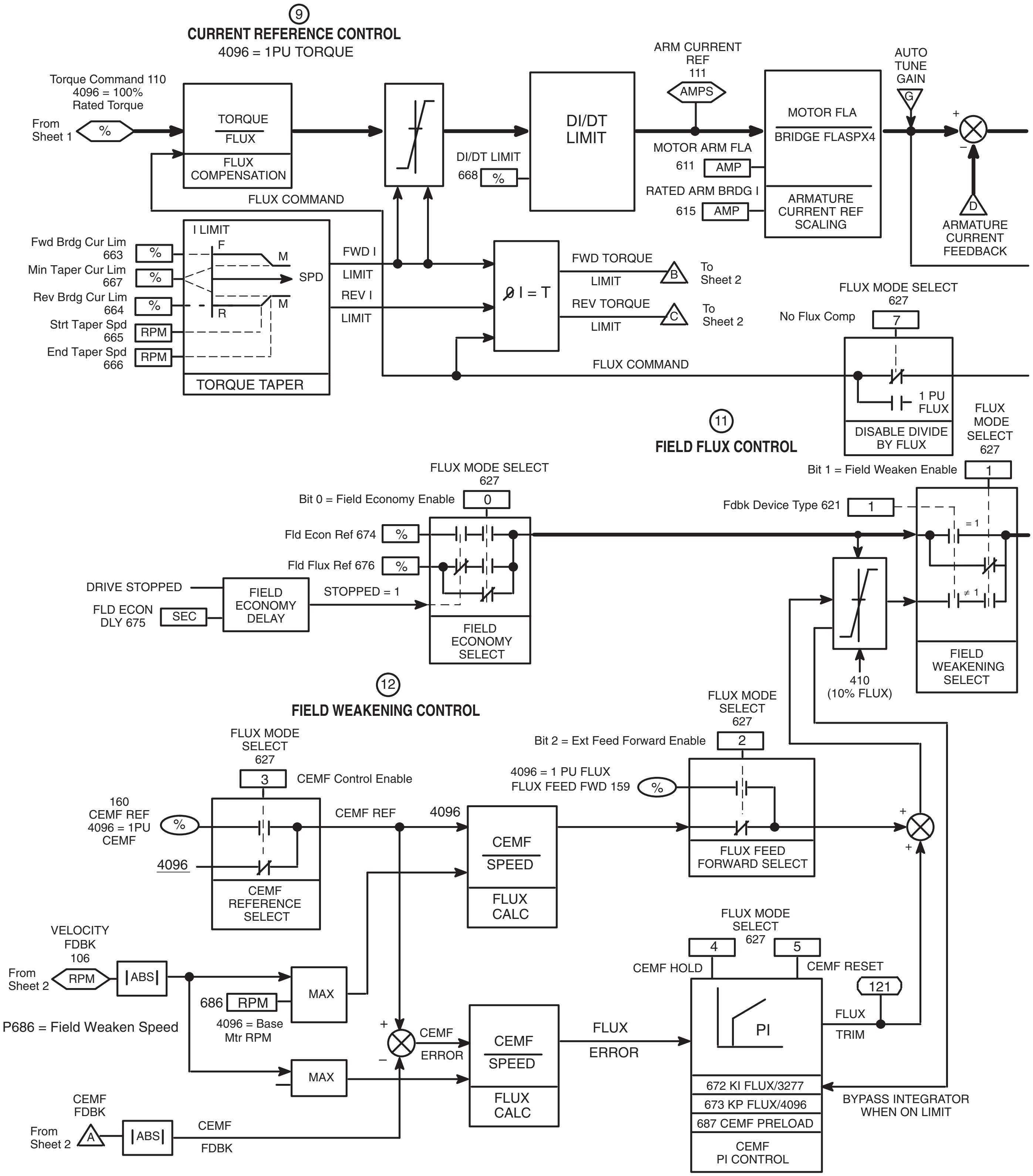
20/40 = $W_1 = 20$
$W_2 = 40$

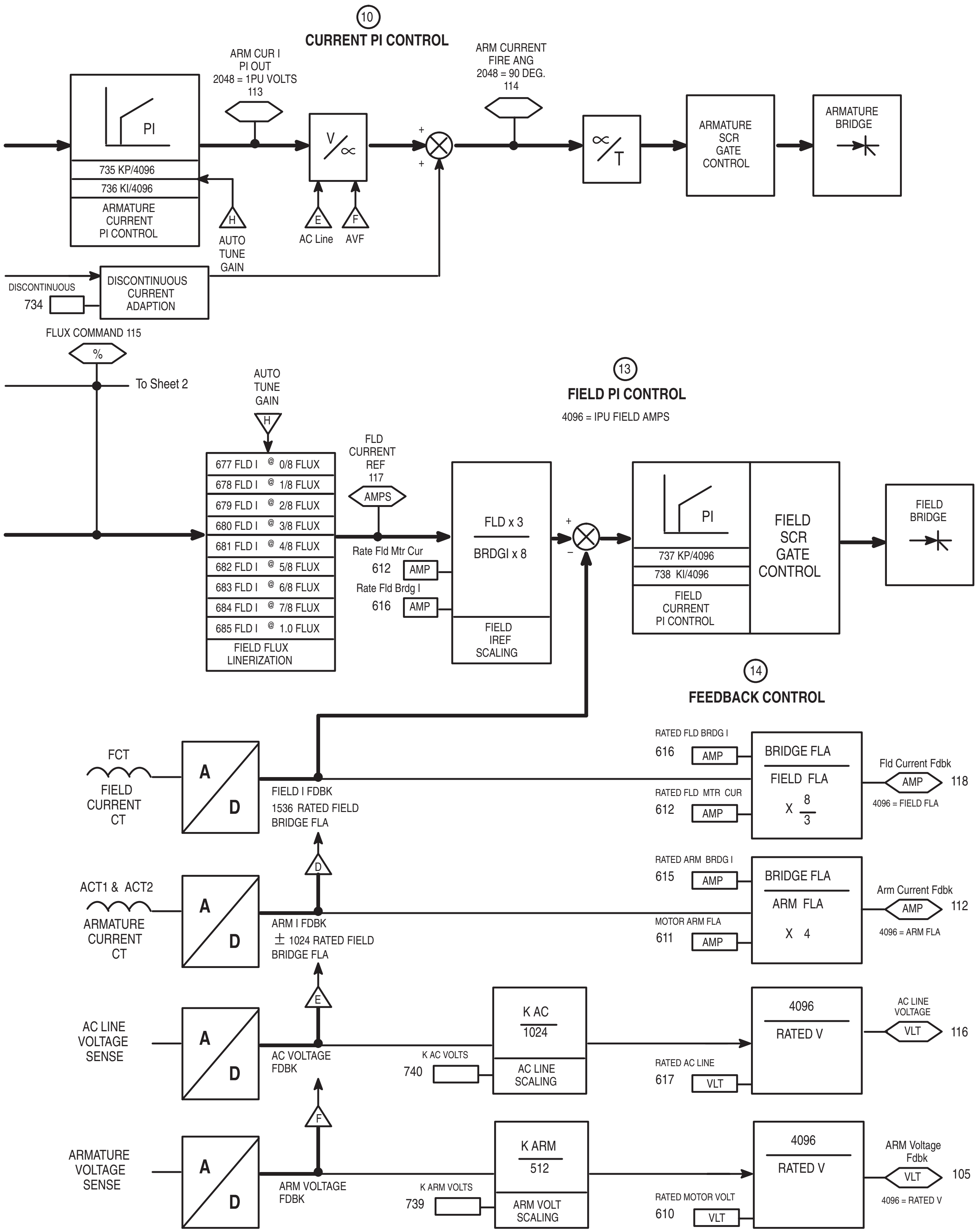
If 631 = 3

$$T(S) = \frac{(\text{GAIN}/256)\ (S + W_N)}{S + W_N}$$

SYMBOL	PARAMETER TYPE
(oval)	SINK
(hexagon)	SOURCE
(rectangle)	SET UP

Figure 5.5 ***(Sheet 3 of 3)*** **1395 Block Diagram**




10
CURRENT PI CONTROL
ARM CUR I
PI OUT
2048 = 1PU VOLTS
113
ARM CURRENT
FIRE ANG
2048 = 90 DEG.
114
PI
735 KP/4096
736 KI/4096
ARMATURE
CURRENT
PI CONTROL
V/∝
∝/T
ARMATURE
SCR
GATE
CONTROL
ARMATURE
BRIDGE
H
AUTO
TUNE
GAIN
E
AC Line
F
AVF
DISCONTINUOUS
734
DISCONTINUOUS
CURRENT
ADAPTION
FLUX COMMAND 115
%
To Sheet 2
AUTO
TUNE
GAIN
H
13
FIELD PI CONTROL
4096 = IPU FIELD AMPS
677 FLD I @ 0/8 FLUX
678 FLD I @ 1/8 FLUX
679 FLD I @ 2/8 FLUX
680 FLD I @ 3/8 FLUX
681 FLD I @ 4/8 FLUX
682 FLD I @ 5/8 FLUX
683 FLD I @ 6/8 FLUX
684 FLD I @ 7/8 FLUX
685 FLD I @ 1.0 FLUX
FIELD FLUX
LINERIZATION
FLD
CURRENT
REF
117
AMPS
Rate Fld Mtr Cur
612 AMP
Rate Fld Brdg I
616 AMP
FLD x 3
BRDGI x 8
FIELD
IREF
SCALING
PI
737 KP/4096
738 KI/4096
FIELD
CURRENT
PI CONTROL
FIELD
SCR
GATE
CONTROL
FIELD
BRIDGE
14
FEEDBACK CONTROL
FCT
FIELD
CURRENT
CT
A
D
FIELD I FDBK
1536 RATED FIELD
BRIDGE FLA
RATED FLD BRDG I
616 AMP
RATED FLD MTR CUR
612 AMP
BRIDGE FLA
FIELD FLA
X 8/3
Fld Current Fdbk
AMP 118
4096 = FIELD FLA
D
ACT1 & ACT2
ARMATURE
CURRENT
CT
ARM I FDBK
± 1024 RATED FIELD
BRIDGE FLA
RATED ARM BRDG I
615 AMP
MOTOR ARM FLA
611 AMP
BRIDGE FLA
ARM FLA
X 4
Arm Current Fdbk
AMP 112
4096 = ARM FLA
E
AC LINE
VOLTAGE
SENSE
AC VOLTAGE
FDBK
K AC VOLTS
740
K AC
1024
AC LINE
SCALING
4096
RATED V
RATED AC LINE
617 VLT
AC LINE
VOLTAGE
VLT 116
F
ARMATURE
VOLTAGE
SENSE
ARM VOLTAGE
FDBK
K ARM VOLTS
739
K ARM
512
ARM VOLT
SCALING
4096
RATED V
RATED MOTOR VOLT
610 VLT
ARM Voltage
Fdbk
VLT 105
4096 = RATED V

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Chapter 6

Installation

Chapter Objectives

The following data will guide you in planning the installation of Bulletin 1395 drives rated at 1–300HP @ 230VAC and 2–600HP @ 460VAC. For 1395 drives rated at or above 700HP @ 460 VAC, or 750HP @ 575VAC/660VAC, refer to publication 2361–5.01 for installation instructions. 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). NOTE: For drives mounted in Bulletin 2100 MCCs, the ambient temperature may not exceed 40°C. 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. Refer to the following figures for dimensions.

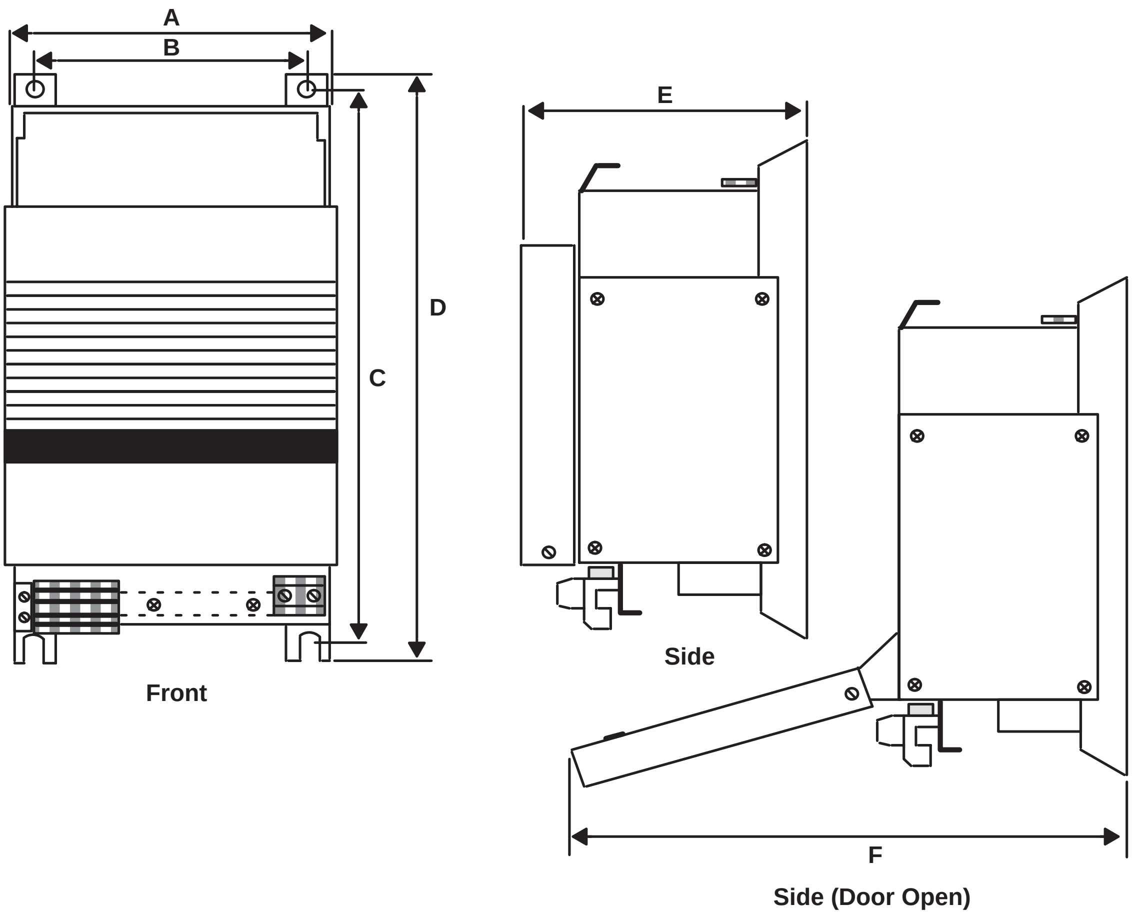
WARNING: Shock hazard exists at motor armature terminals if gravity drop out contactor does not open. The drive **must** be mounted in the vertical position. Failure to observe this mounting practice can result in personal injury or death.

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.

Figure 6.1
Nominal Dimensions Series B
1 – 30 HP 230V
2 – 60 HP 460V

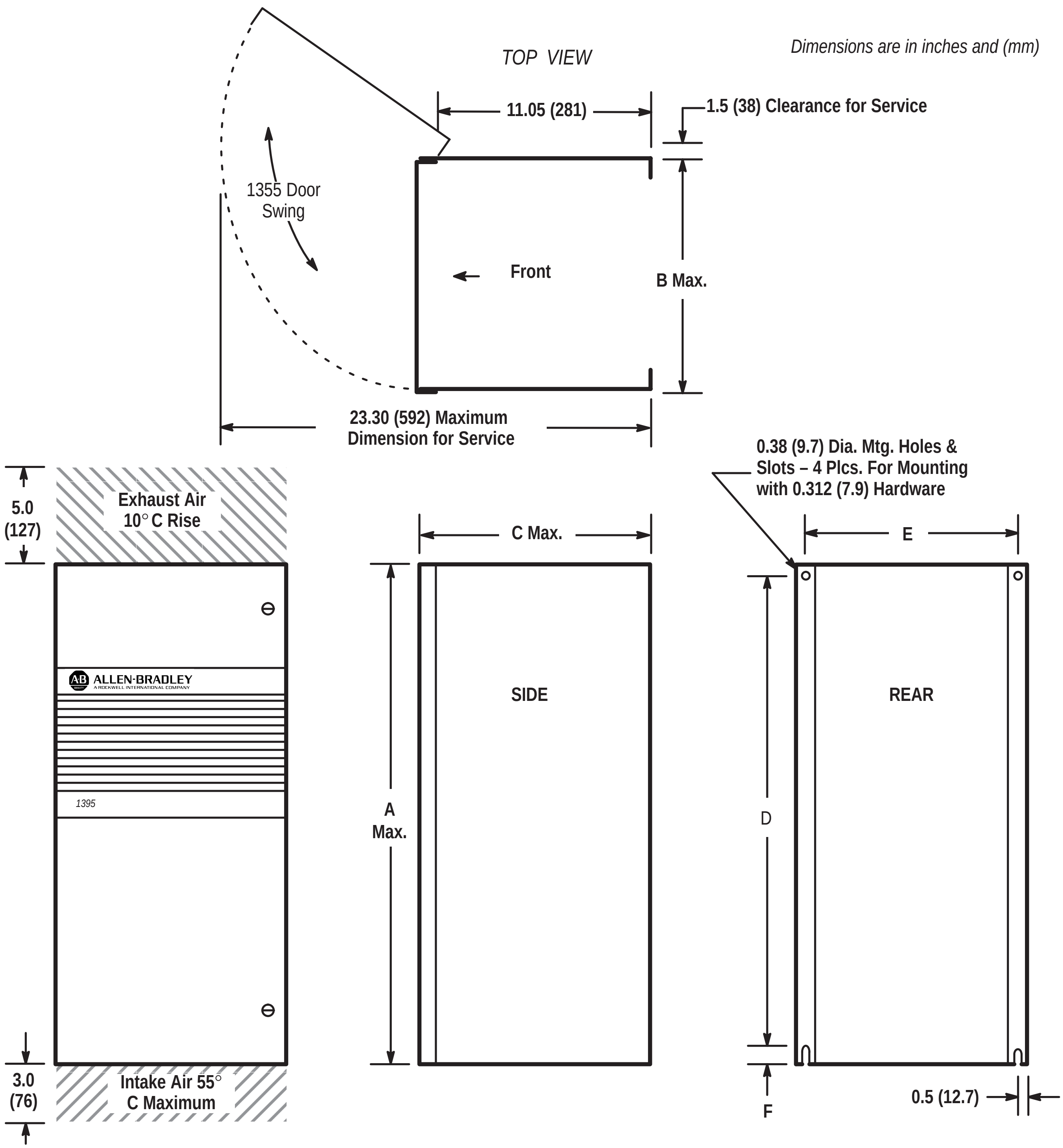
Dimensions

Note: Dimension drawings are for estimation only, do not use for construction. Contact factory for certified prints.



230V	460V	Weight. Lbs. (kg)	A Inches (mm)	B Inches (mm)	C Inches (mm)	D Inches (mm)	E Inches (mm)	F Inches (mm)
1 – 30 HP	2 – 60 HP	45 (20.4)	11.9 (302.2)	11.0 (279.4)	22.5 (571.5)	23.5 (596)	10.75 (273)	24.0 (609.6)

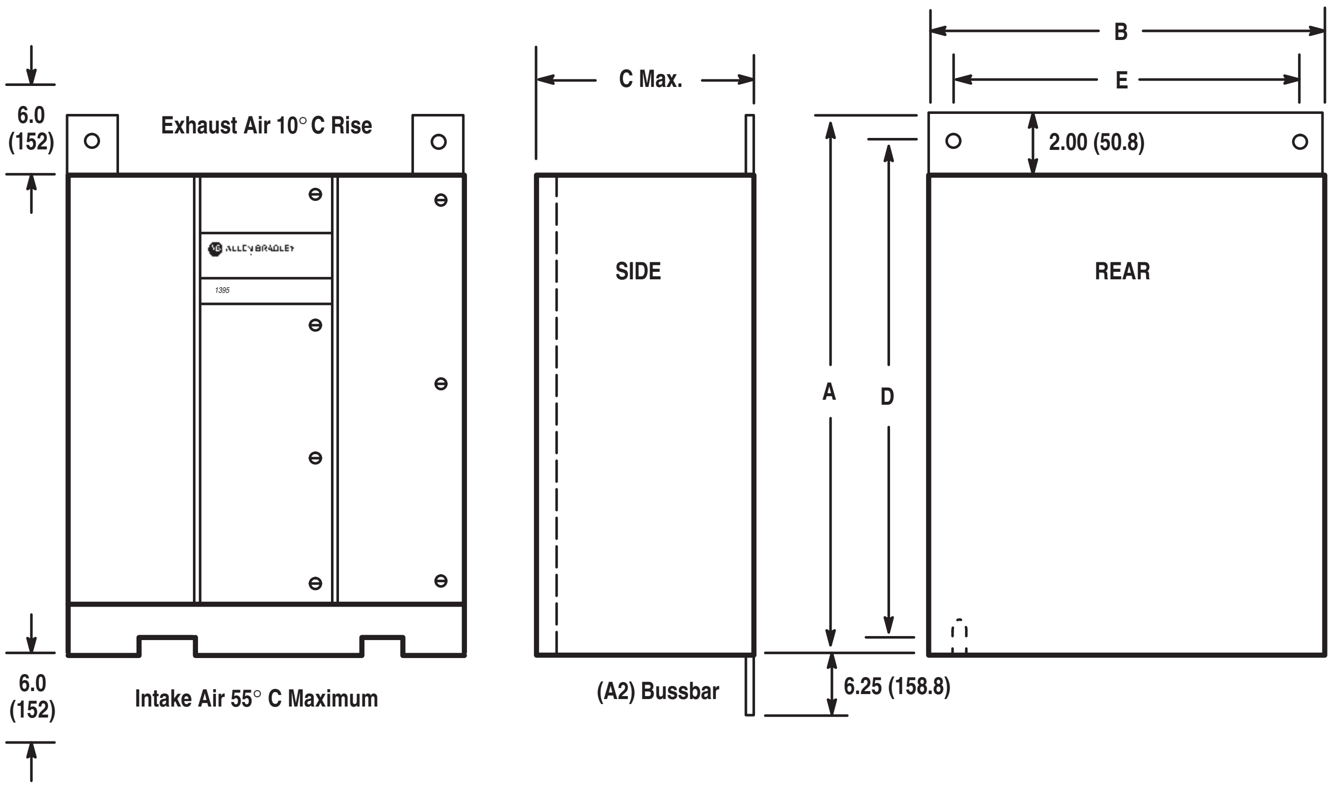
Figure 6.2
Nominal Dimensions Series A
40 – 100 HP 230V
75 – 200 HP 460V



230V Drive	460V Drive	Weight lb (kg)	A	B	C	D	E	F
40–50 HP	75–100 HP	110 (49.9)	29.00 (737)	12.25 (311)	12.10 (307)	27.50 (699)	11.00 (279)	1.00 (25)
60–100 HP	125–200 HP	165 (74.8)	34.00 (864)	15.50 (394)	12.70 (323)	33.00 (838)	14.25 (362)	0.50 (13)

Figure 6.3
Nominal Dimensions MKVA Series B
125 – 300 HP 230V
250 – 600 HP 460V

Dimensions are in inches and (mm)



230V Drive	460V Drive	Weight lbs. (kg)	A	B	C	D	E
125-300 HP	250-600 HP	515 (234)	46 (1168)	32.00 (813)	18.50 (470)	44.00 (1118)	28.00 (711)

Cooling Airflow

In order to maintain proper cooling, the drive must be mounted in a vertical position (fuses in the upper right hand corner). Refer to Figures 6.1 through 6.3 for the recommended minimum clearance of each drive.

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 6.A
Drive Wattage Dissipation

Drive HP Rating		
230VAC	460VAC	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.

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 6.R and 6.S for drive current ratings to aid in properly sizing wire.

Wire Size and Type

Wire sizes must be selected individually, observing all applicable safety and NEC regulations. The minimum permissible wire size does not necessarily result in the best operating economy. Due to the drive overload capacity, the conductors for the transformer primary and secondary must be sized (at a minimum) for 125% of the maximum rated motor current. The motor armature conductors must also be rated for 125% of the full load motor current. Motor field conductors should be run with no less than 14 gauge wire. The distance between the drive and motor may affect the size of the conductors used.

Shielded type wire is recommended in control circuits for protection against interference. A shielded wire is required for all signal wires. The recommended conductor size must be a minimum of 24 AWG. The best interference suppression is obtained with a wire having an individual shield for every pair. Table 6.B provides a listing and description of cable types and wiring recommendations. Figure 6.4 shows recommended cable shielding.

Figure 6.4
Cable Shielding Recommendations

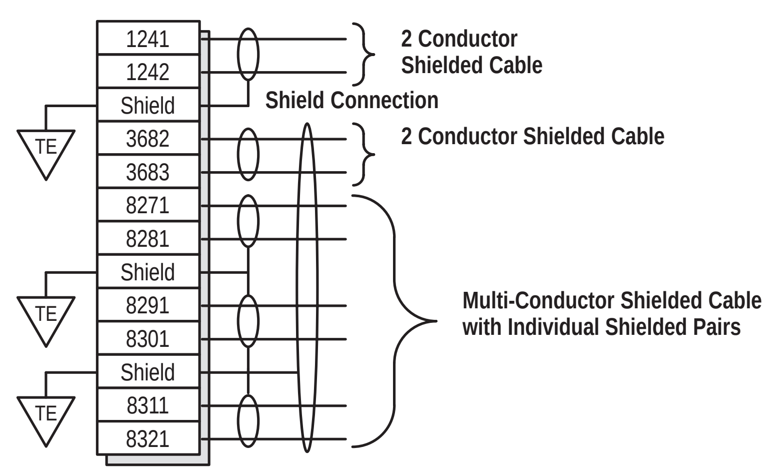


Table 6.B
Cable and Wiring Recommendations

Category	Wiring Class	Signal Definition	Signal Examples	Cable Type	Minimum Spacing in Inches between Classes – Steel Conduit/Tray: 1	2/3/4	5/6	7/8	9/10/11	Spacing Notes
Power	1	AC Power (600V or greater)	2.3kV 3/Ph AC Lines	per NEC & Local Codes	0	3/9	3/9	3/18	Note6	1/2/5
	2	AC Power (less than 600V)	460V 3/Ph AC Lines	per NEC & Local Codes	3/9	0	3/6	3/12	Note 6	1/2/5
	3	DC Power	DC Motor Armature	per NEC & Local Codes						
	4	DC Power	Reg.DC Motor Field	per NEC & Local Codes						
Control	5	115VAC/DC Logic	Relay Logic/PLC I/O Motor Thermostat	per NEC & Local Codes	3/9	3/6	0	3/9	Note 6	1/2/5
		115VAC Power	Power Supplies, Instruments							
	6	24VAC/DC Logic	PLC I/O	per NEC & Local Codes						
Signal **(Process)**	7	Analog Signals, DC Supplies	Reference/Feedback Signal, 5 to 24VDC	Shielded Cable – Belden 8735, 8737, 8404	3/ 18	3/ 12	3/9	0	1/3	2/3/4/5
		Digital (low speed)	TTL							
	8	Digital (high speed)	I/O, Encoder, Counte Pulse Tach	Shielded Cable – Belden 9728, 9730						
Signal **(Comm)**	9	Serial Communication	RS-232, 422 to Terminals/Printers	Shielded Cable – Belden RS-232 – 8735, 8737 RS-422 – 9729, 9730	Note 6			1/3	0	
	11	Serial Communication (greater than 20k baud)	PLC Remote I/O, PLC Data Highway	Twinaxial Cable – Belden 9463, A-B 1770-CD						

Example: Spacing relationship between 480VAC incoming power leads and 24VDC logic leads.

- 480VAC leads are Class 2 ; 24VDC leads are Class 6
- For separate steel conduits, the conduits must be 3 inches (76 mm) apart
- In a cable tray, the two groups of leads are to be 6 inches (152 mm) apart

Spacing Notes:

1. Both outgoing and return current carrying conductors are to be pulled in same conduit or laid adjacent in tray.
2. Cables of the following classes can be grouped together.
   A. Class 1; Equal to or above 601 volts.
   B. Classes 2,3, and 4 may have their respective circuits pulled in the same conduit or layered in the same tray.
   C. Classes 5 and 6 may have their respective circuits pulled in the same conduit or layered in the same tray.
   NOTE: Bundle may not exceed conditions of NEC 310.
   D. Classes7 and 8 may have their respective circuits pulled in the same conduit or layered in the same tray.
   NOTE: Encoder cables run in a bundle may experience some amount of EMI coupling. The circuit application may dictate separate spacing.
   E. Classes 9, 10 and 11 may have their respective circuits pulled in the same conduit or layered in the same tray.
   Communication cables run in a bundle may experience some amount of EMI coupling and corresponding communication faults. The application may dictate separate spacing.
3. All wires of class 7 through 11 MUST be shielded per the recommendations.
4. In cable trays, steel separators are advisable between the class groupings.
5. If conduit is used, it must be continuous and composed of magnetic steel.
6. Spacing of communication cables classes 2 through 6 is:

CONDUIT SPACING	through AIR
115 Volts – 1 inch	115 Volts – 2 inches
230 Volts – 1.5 inches	230 Volts – 4 inches
460/575 Volts – 3 inches	460/575 Volts – 8 inches
575 volts – proportional to 6” per 1000 volts.	575 volts proportional to 12” per 1000 volts

General Notes

1. Steel conduit is recommended for all wiring classes. (Classes 7-11).
2. Spacing shown between classes is the minimum required for parallel runs less than 400 feet. Greater spacing should be used where possible.
3. Shields for shielded cables must be connected at one end only. The other end should be cut back and insulated. Shields for cables from a cabinet to an external device must be connected at cabinet end. Shields for cables from one cabinet to another must be connected at the source end cabinet. Splicing of shielded cables, if absolutely necessary, should be done so that shields remain continuous and insulated from ground.
4. Power wire is selected by load. 16AWG is the minimum recommended size for control wiring.

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 shown in Figure 6.4 and explained below.

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 Zero Potential Bus (TE). The minimum distance between Ground and Zero Potential Bus 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.

Zero Potential Bus (TE) – Must be connected to an earth ground by a continuous separate lead (insulated #6 AWG or larger).

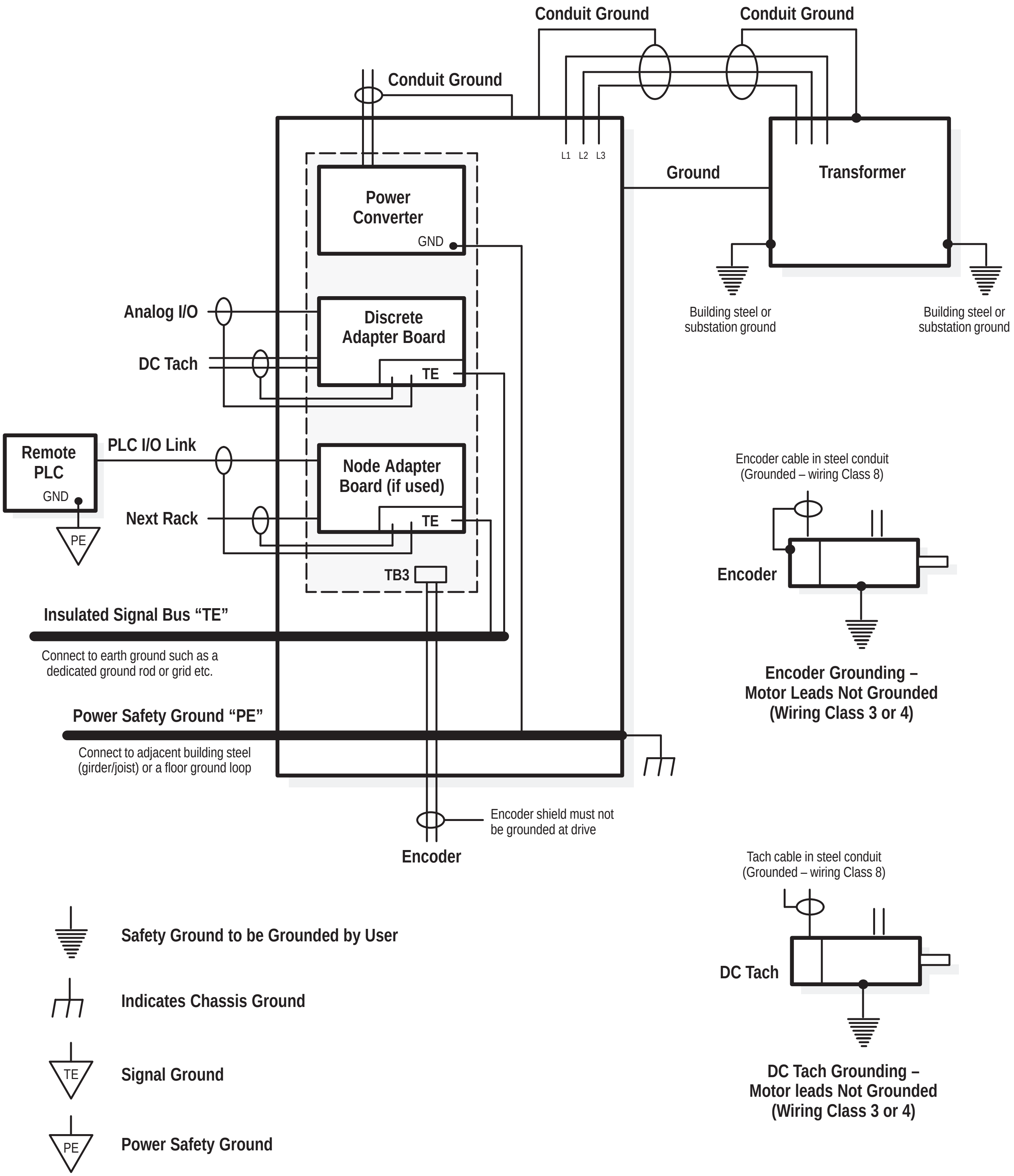
The PLC I/O Communication Link must be run in grounded steel conduit. The conduit should be bonded to ground at both ends. Connect the cable shield at the drive end only.

Encoder Connections – If required, must be routed in grounded steel conduit. The conduit must be grounded at both ends. Connect 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. Connect the cable shield at the drive end Only.

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

Figure 6.5
1395 Grounding Practices



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

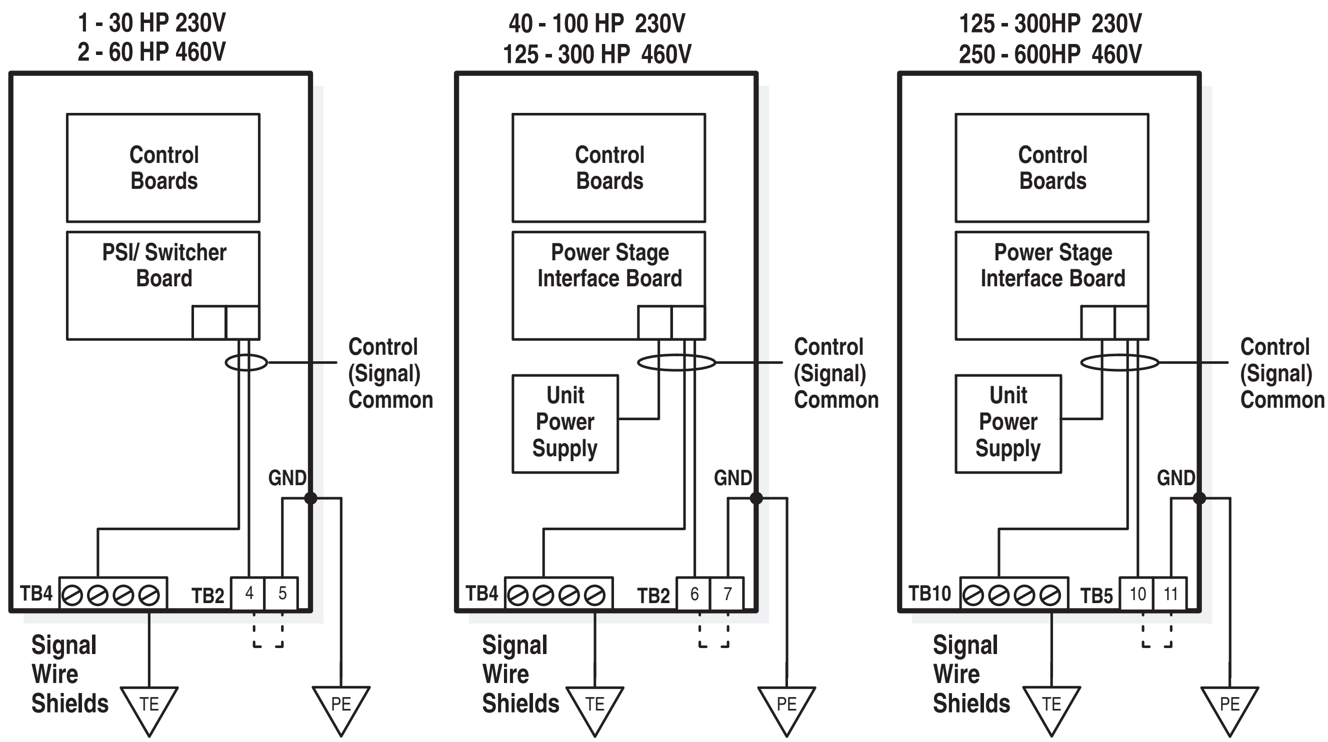
Ground (PE) - A Safety Ground is normally required by the electrical code and is defined externally as PE ground. Main PE is located at the ground stud next to the contactor. On MKVA: The PE ground stud is located on the back panel between L2 & L3 ACT's and bus bars.

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	1-30 HP 230VAC	2-60 HP 460VAC
· TB2 - 7	40-100 HP 230VAC	75-200 HP 460VAC
· TB5 - 1 1	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 grid, etc.), provided grounding points comply with NEC regulations. Figures 6.6 and 6.7 illustrate connection of PE for stand alone and system applications. PE should be connected in a "Star" fashion, and not daisy chained.

Figure 6.6
Stand Alone Drive Grounding



Zero Potential Bus (TE) - The Zero Potential Bus 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 6.6 and 6.7 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 6.C and one ground lead run as indicated in Table 6.D.

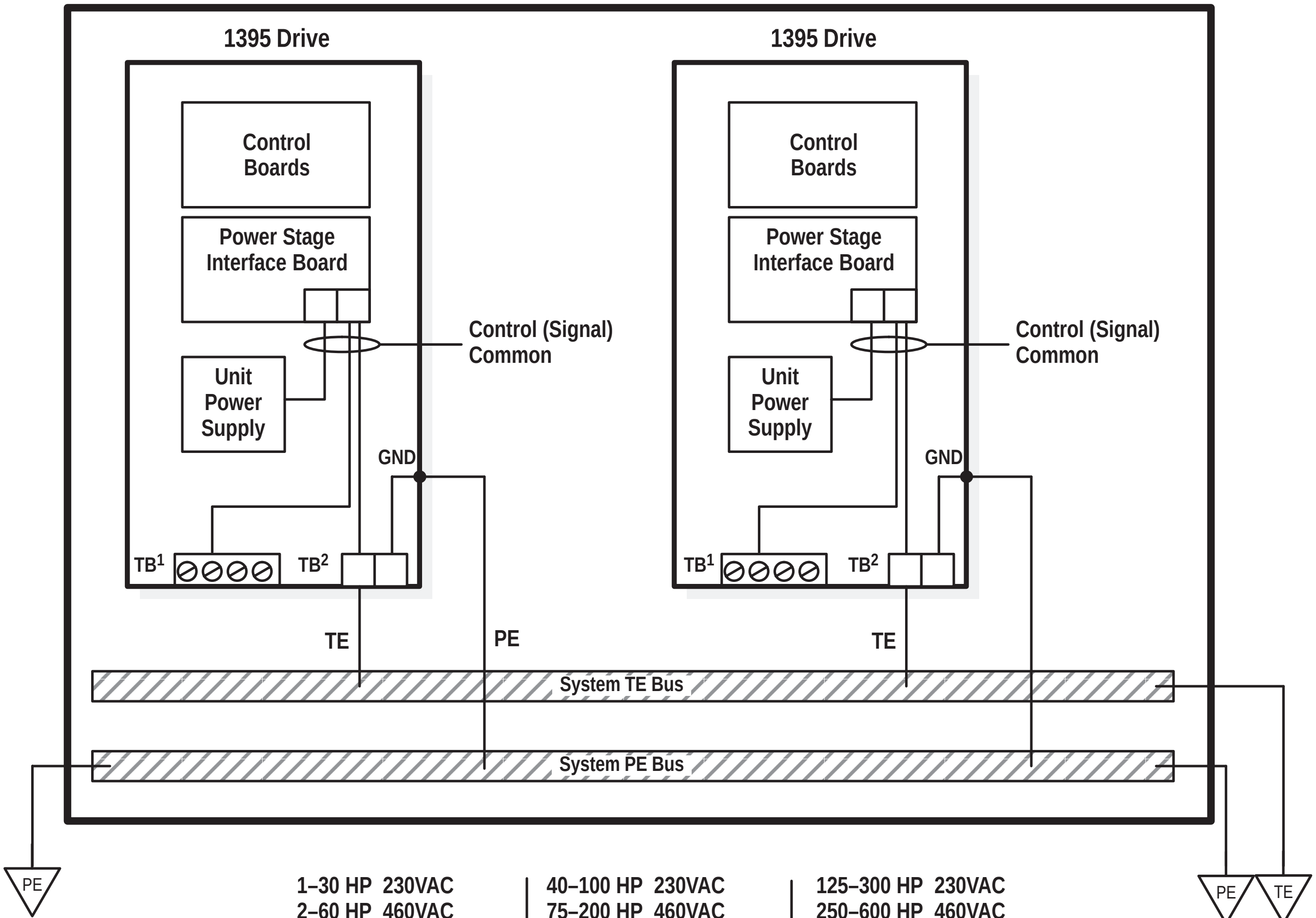
Table 6.C
Safety/Signal Ground

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

Table 6.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	TB5 – 11

Figure 6.7
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
TB1	TB 4	TB 4	TB 10
TB2	Terminals 4 & 5, TB2	Terminals 6 & 7, TB2	Terminals 10 & 11, TB5

On a multi drive system, assure that the TE bus 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 recommended that an Allen-Bradley DC Loop Contactor Lug Kit be ordered for proper wire terminations. Table 6.E provides a listing and description of the available lug kits.

Table 6.E
Allen-Bradley Armature 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	180	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 runs 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 6.F, verify that the motor field is compatible with the DC field voltage output of the drive.

Table 6.F
Standard Field Voltage Output

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

1. Connect the motor armature and field leads to produce proper direction of motor rotation. Table 6.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 6.G
Motor Connections for CCW Rotation

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

Refer to Figures 6.8 and 6.9 for power wiring with a standard field voltage. Note that 125-600 HP construction requires field voltage semiconductor fuses rated at 50A (use FWH-R Fuses).

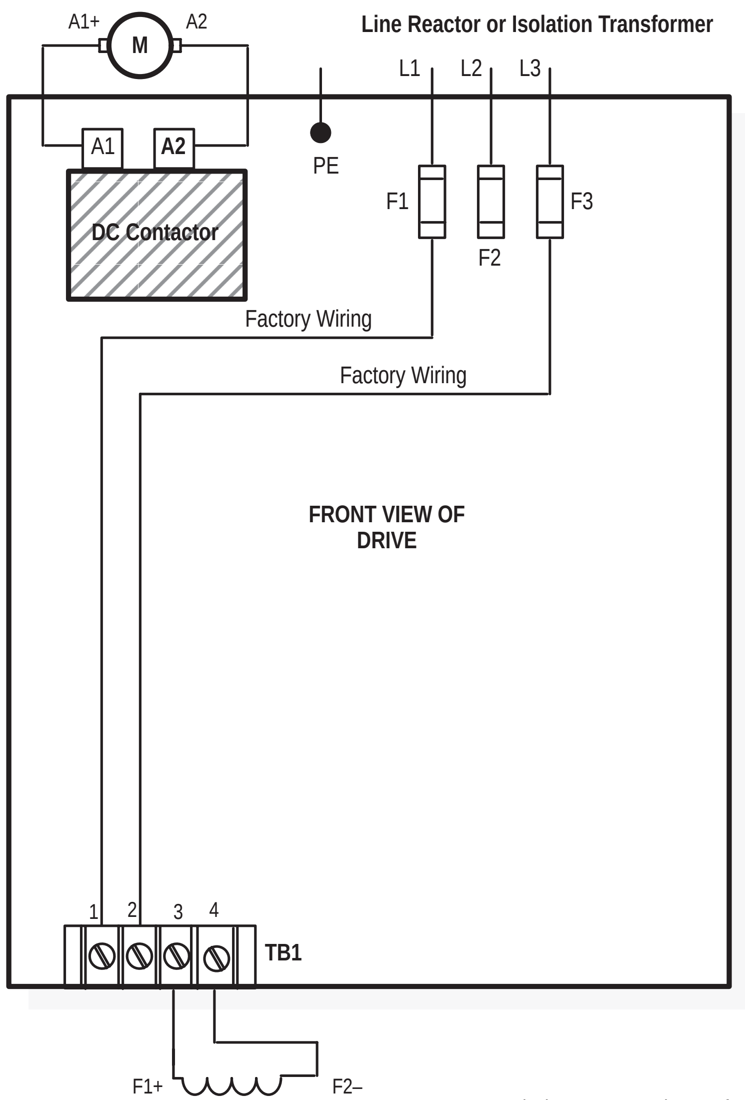
2. The 1395 is supplied with semi conductor fuses for line protection. An isolation transformer can also be used. In general, the 1395 is suitable for direct connection to a correct voltage AC line that has minimum impedance of 3%. If the line is lower impedance, a line reactor or isolation transformer must be added before the drive to increase line impedance. If the line impedance is too low, transient voltage spikes or interruptions can create excessive current spikes that will cause nuisance input fuse blowing, and may cause damage to the drive power structure. Refer to Figures 6.8, 6.9 and 6.10 for AC input wiring at the main fuses and to the IMPORTANT note when determining if a line reactor or isolation transformer is required for your installation.

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 6.R and 6.S for proper sizing of the AC power and branch 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 Figure 6.8 & 6.9.

Figure 6.8
Power Connections – Standard Field Voltage

1-30HP, 230VAC
2-60HP, 460VAC
Series B



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

IMPORTANT
If the AC input power system does not have a neutral or one phase referenced ground, an isolation transformer with the neutral of the secondary grounded is **highly recommended**. If the line-to-line voltages on any phase can exceed 125% of the nominal line-to-line voltage, an isolation transformer with the neutral of the secondary grounded, is **always required**.

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

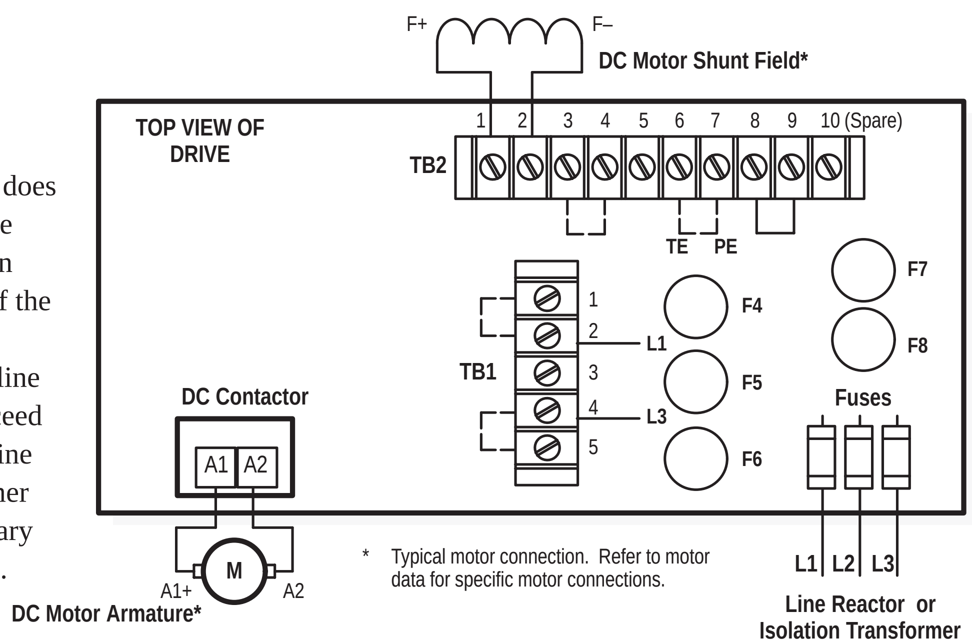
   a) The Field Control Transformer will have 230V primary, 460V secondary, single-phase 60 Hz.
   b) kVA = 2A x 460VAC x 1.5 = 1.38 kVA (1.5 kVA is closest)
   c) J1 – Field jumper selection is in location 3 as the motor field is 2A.
   d) Rated Field Motor Current (parameter 612) to be programmed “2” as stamped on the motor nameplate.
   e) Rated Field Bridge Current (parameter 616) to be programmed “2.1” as explained in Chapter 8.
   f) Refer to Figure 6.11 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 TB1-2 on the power board and remove these same wires at the other end at 1L1 and1L3 on the drive side of the main fuses. Wire the transformer as shown in Figure 6.11.

ATTENTION: The motor field supply is phase sensitive. To guard against possible drive/motor damage, ensure that the connections are properly made according to Figure 6.9.

Figure 6.9
Power Connections – Standard Field Voltage

40–100 HP, 230VAC
75–200 HP, 460VAC
Series A

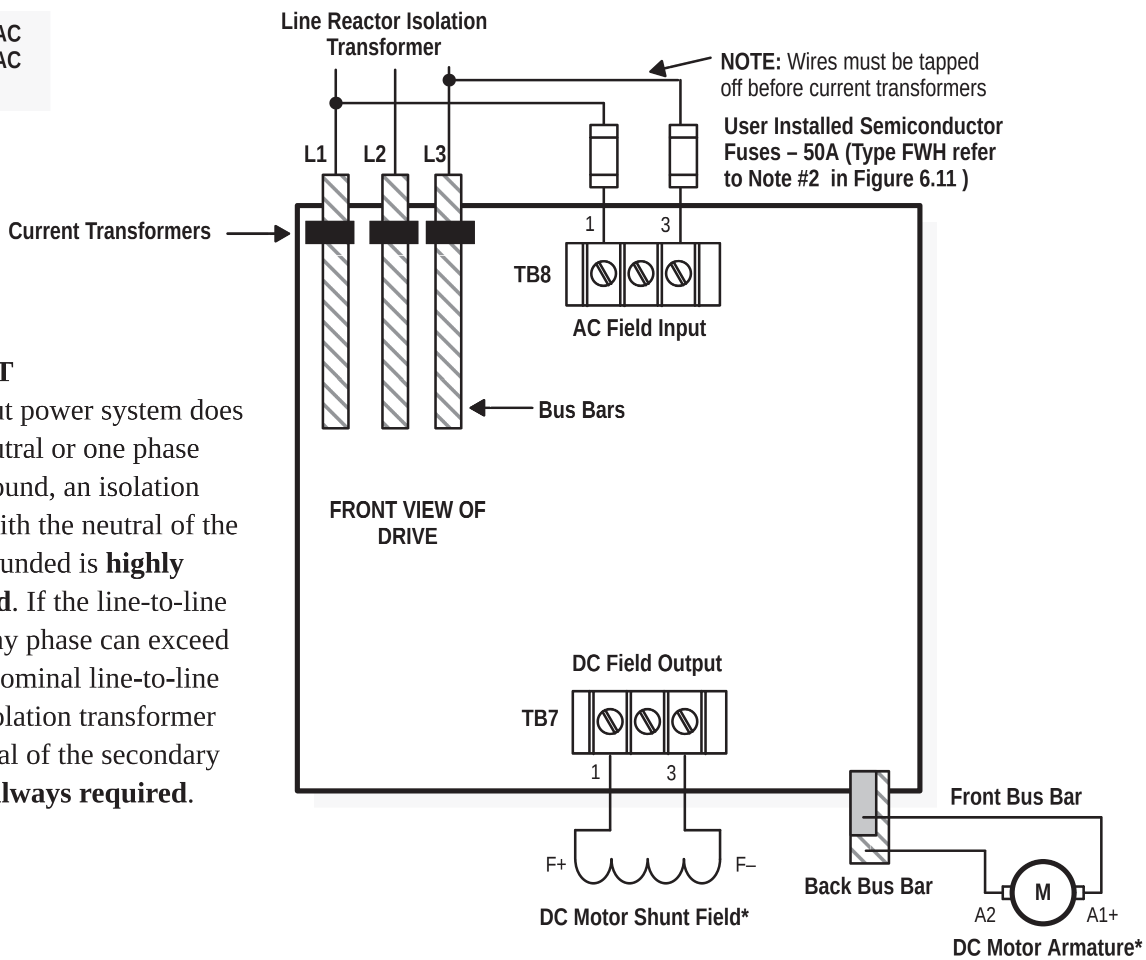
IMPORTANT
If the AC input power system does not have a neutral or one phase referenced ground, an isolation transformer with the neutral of the secondary grounded is **highly recommended**. If the line-to-line voltages on any phase can exceed 125% of the nominal line-to-line voltage, an isolation transformer with the neutral of the secondary grounded, is **always required**.



ATTENTION: The motor field supply is phase sensitive. To guard against possible drive/motor damage, ensure that the connections are properly made according to Figure 6.10.

125-300 HP, 230VAC
250-600 HP, 460VAC
MKVA Series B

Figure 6.10
Power Connections – Standard Field Voltage

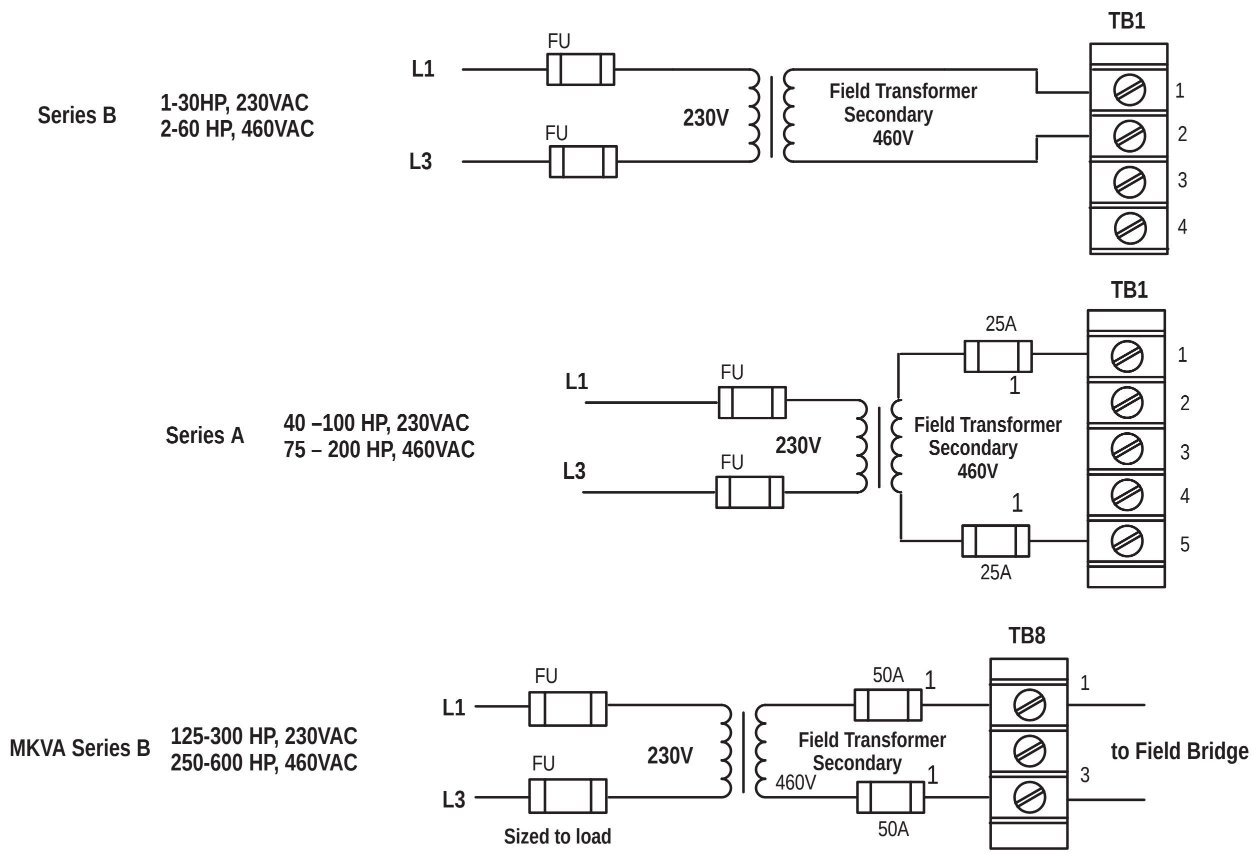


IMPORTANT
If the AC input power system does not have a neutral or one phase referenced ground, an isolation transformer with the neutral of the secondary grounded is **highly recommended**. If the line-to-line voltages on any phase can exceed 125% of the nominal line-to-line voltage, an isolation transformer with the neutral of the secondary grounded, is **always required**.

4. Typical external field transformer connections are shown in Figure 6.11 for a motor rated 240 volt armature, 240V field.

ATTENTION: The motor field supply is phase sensitive. To guard against possible drive/motor damage, ensure that the connections are properly made according to Figure 6.8, 6.9, 6.11 and 6.12.

Figure 6.11
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 FWH-25 or FWH-50 depending on Drive HP rating.

Circuit Board Jumper Connections

There are several jumpers located on different boards in the 1395 that are used to configure the drive for a specific application.

1. Verify that the motor field current jumper is in the proper location per Table 6.H. Obtain the motor full field current data from the motor nameplate. The position of the jumper is determined by both the drive current rating and DC shunt field current rating. Use the drive current rating to select the column in Table 6.H and the field current to select the field current jumper position.

Table 6.H
Field Current Jumper Setting

J1 Jumper on PSI /Switcher	Field Current Range 1-30 HP, 240VDC 2-60 HP, 500VDC
1	4.5 to 10.6A DC
2	2.0 to 4.6A DC
3	0.5 to 2.1A DC
4	0.15 to 0.6A DC

J1 Jumper on Fdbk Bd	Field Current Range 40-100 HP, 240VDC 75-200 HP, 500VDC	125-300 HP, 240VDC 250-600 HP, 500VDC
1	9.1 to 21.2A DC	18.3 to 42.4A DC
2	4.1 to 9.2A DC	8.6 to 18.4A DC
3	1.1 to 4.2A DC	2.3 to 8.7A DC
4	0.4 to 1.2A DC	1.0 to 2.4A DC

2. Verify that the voltage selection for the Reset and Motor Thermostat inputs is correct. Jumpers J11 and J12 on the Power Stage Interface Board determine whether the voltage used for the Reset and Motor Thermostat inputs is 24VDC or 115VAC. Both switches should be in the same position (See Table 6.I).

Table 6.I
Power Stage Interface Board Jumper Settings

Series B Jumper	Position	Purpose 1-30 HP, 240VDC 2-60 HP, 500VDC
J11	1 – 2	24VDC Motor Thermal Input
	2 – 3	115VAC Motor Thermal Input
J12	1 – 2	24VDC Reset Input
	2 – 3	115VAC Reset Input

Series A Jumper	Position	Purpose 40-100 HP, 240VDC 75-200 HP, 500VDC
J11	1 – 2	115VAC Motor Thermal Input
	2 – 3	24VDC Motor Thermal Input
J12	1 – 2	115VAC Reset Input
	2 – 3	24VDC Reset Input

Series B MKVA Jumper	Position	Purpose 125-300 HP, 240VDC 250-600 HP, 500VDC
J11	1 – 2	115VAC Motor Thermal Input
	2 – 3	24VDC Motor Thermal Input
J12	1 – 2	115VAC Reset Input
	2 – 3	24VDC Reset Input

3. Verify Encoder supply voltage and output voltage return to the drive. If an encoder is used, the drive can provide +12VDC (500 mA) to power the encoder. If a 5VDC supply is required it must be externally sourced. Jumpers J8 through J10 on the Main Control Board must be set for the appropriate output voltage of the encoder which is fed back to the drive. Check the encoder documentation to determine which voltage is to be used. See Table 6.J for jumper settings.

Table 6.J
Main Control Board Jumper Settings (connected jumpers)

Jumper	+5VDC Position	+12VDC Position	Purpose
J8	1 – 2	2 – 3	Encoder Voltage Selection
J9	1 – 2	2 – 3	Encoder Voltage Selection
J10	1 – 2	2 – 3	Encoder Voltage Selection

NOTE: The encoder jumpers J8 – J10 are set for the voltage output of the encoder.

Jumper	Position	Purpose
J14	1 – 2	EE Write Enabled
	2 – 3	EE Write Disabled

ATTENTION: Jumpers J8 through J10 must all be in the same position. To guard against possible damage to the Main Control Board, ensure that jumpers are positioned correctly for your application.

Table 6.K
Main Control Board Jumper Settings (non-connected jumpers)

Jumper	+5VDC Position	+12VDC Position	Purpose
J12	No Connection	No Connection	Internal Use, Do Not Use
J13	No Connection	No Connection	Internal Use, Do Not Use
J15	No Connection	No Connection	Internal Use, Do Not Use

ATTENTION: No connections should be attempted on jumpers J12, J13, and J15. Making connection at these jumpers could cause damage to the Main Control Board.

Control Connections

A user installed 115VAC power supply is required to power the Power Stage Interface Board, power supply, DC contactor and fans. It is recommended that a control transformer be used to provide the 115VAC supply. Refer to Table 6.L for current requirements and Figure 6.13 or Figure 6.14 for connection information.

Table 6.L
115VAC Control Circuit Current Requirements

230V Drive 460V Drive	1-15 HP 2-30 HP	20-30 HP 40-60 HP	40-50 HP 75-100 HP	60-75 HP 125-150 HP	100 HP 200 HP
Total Sealed Current	1.230	2.083	2.283	2.910	3.100
Total Inrush Current	2.270	3.600	8.150	12.790	16.150

125 to 600 HP drives require a 0.750 kVA control transformer. The current required for the 115V discrete inputs and outputs must be added to the control circuit current requirement for proper sizing of the control transformer.

Input and output signals can be 24VDC, but will require a separate 24VDC power supply in addition to basic 115VAC control circuit requirement.

All control wiring to external devices except for contactor control is terminated in the drive at terminal block TB3. Signal definitions for terminals 1-20 have been predetermined and are independent of drive application. Figure 6.12 illustrates these terminals with their signal definitions.

TB3 is attached to a mounting rail at the bottom of the drive chassis. It provides a wiring connection for customer supplied control and signal devices, along with encoder interface and auxiliary peripheral devices.

Additional individual terminal blocks can be attached to the mounting rail to meet application requirements. These additional terminal blocks are supplied when using an adapter board, to allow for I/O to and from the drive.

Control Wiring Procedure

1. Wire Encoder to TB3. If an encoder is used, refer to the encoder instruction manual for proper wiring to the drive.

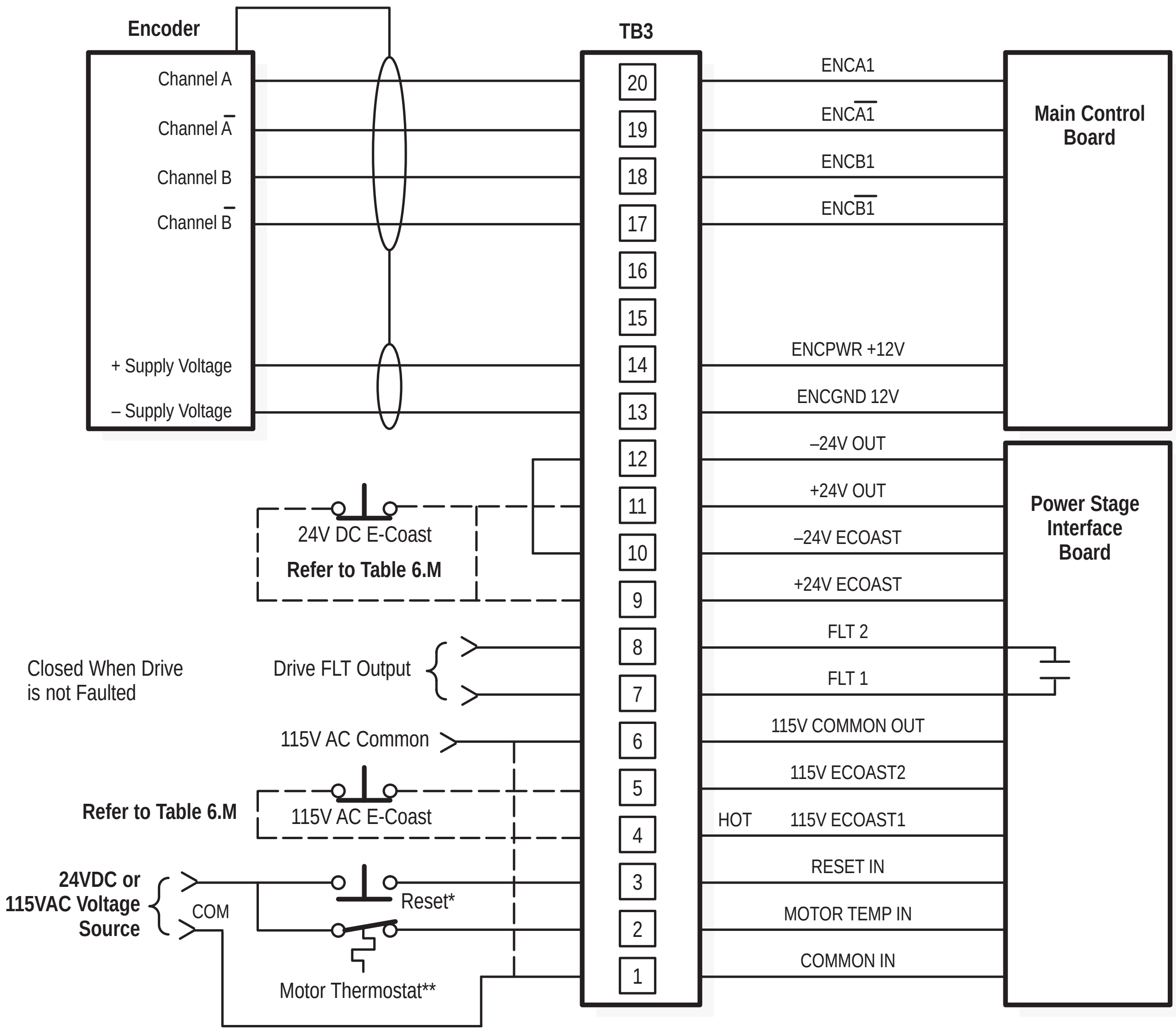
   a) Terminals 19 and 20 connect to differential encoder output A (NOT) and A.
   b) Terminals 17 and 18 connect to differential encoder output B (NOT) and B.
   c) Terminals 15 and 16 are reserved for future use and are not to be used.
   d) Terminal 14 provides + 12VDC (500 mA max.) power to the encoder. Some encoders limit the + 12VDC supply internally to + 5VDC for the output. Consult the encoder documentation to determine whether the encoder output signal level is + 12 or + 5VDC. Jumpers J8 - J10 on the Main Control Board must be properly positioned to correspond to the encoder output voltage.
   e) Terminal 13 provides connection to the encoder supply voltage common (ground).
   f) The encoder shield must be connected to the encoder case (ground).
   g) The encoder cable must be separate from armature and field leads, refer to Table 6.B.
   h) Maximum encoder cable length is 500 feet (150 meters). For other lengths contact your Allen-Bradley Sales Representative.

ATTENTION: The Start/Stop circuitry in this drive is composed of solid-state components. If hazards due to accidental contact with moving machine components or unintentional flow of liquid, gas or solids exist, a hardwired maintained Stop circuit must be used with this drive. For 115VAC control, this circuitry may be added at terminals 4 and 5 of TB3.

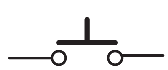
ATTENTION: If Dynamic Braking is used as an alternative stopping method, Do Not use a hard-wired Stop device that removes AC line power. This will de-energize the shunt field, causing a loss of the DB effect and the motor will coast to a stop. Hazards to personnel may exist if the machine is allowed to coast to a stop.

ATTENTION: The user has the ultimate responsibility to determine which stopping method is best suited to the application and will meet applicable standards for operator safety.

Figure 6.12
TB3 Terminal Descriptions



** If no thermostat is used 115VAC or 24VDC must still be applied to TB3 terminal 2.



* If parameter 620 = 0, then the Reset input requires a N.O. pushbutton as shown above. Closing the pushbutton causes System Reset to occur. This is the default value for the 1395.

* If parameter 620 = 1, then the Normal Stop input requires a N.C. pushbutton as shown above. Opening the pushbutton causes Normal Stop to occur.

NOTE: If N.C. is used, and 620 = 0, Drive will be in a continuous reset condition
If N.O is used, and 620 = 1, A Stop will be present in Logic Cmd 1 Par. 150.

2. Wire Emergency Coast Stop Circuit (ECOAST).

   The drive has the capability to accept an ECOAST input from either a 24VDC or 115VAC contact. The contact must be normally closed and will typically be a Stop pushbutton. Refer to the following paragraphs, Figure 6.13 and Table 6.M for connection information.

   If a 24VDC ECOAST is desired, the contacts of the ECOAST device must be wired between terminals 9 & 11 of TB3. Jumpers must then be connected between terminals 4 & 5 and 10 & 12 of TB3.

   If a 115VAC ECOAST is desired, the contacts of the ECOAST device must be wired between terminals 4 & 5 of TB3. Jumpers must then be connected between terminals 9 & 11 and 10 &12 of TB3.

Table 6.M
ECoast Connections

	ECoast Input	
TB-3 Terminals	**24VDC**	**115VAC**
4 and 5	Jumper	N.C. Contact Device
9 and 11	N.C. Contact Device	Jumper
10 and 12	Jumper	Jumper

ATTENTION: Applying improper input voltage could damage the Power Stage Interface Board. Jumpers J11 and J12 on the Power Stage Interface Board must be set for the proper input voltage before applying power to these inputs.

3. Wire the Motor Thermostat Circuit. Terminal TB3-2 is used to receive either a 24VDC or 115VAC input (derived from an external voltage source) when the motor thermostat contact is closed. The contacts of the motor thermostat must be N.C. The drive interprets a high voltage at TB3-2 as a normal expected condition. Refer to Figure 6.13 for further connection information.

4. Reset/Normal Stop.

   This input is programmable to provide either a System Reset function or a Normal Stop function. It accepts a 115VAC or 24VDC input voltage. System Reset Select (Parameter 620) determines which function this input provides.

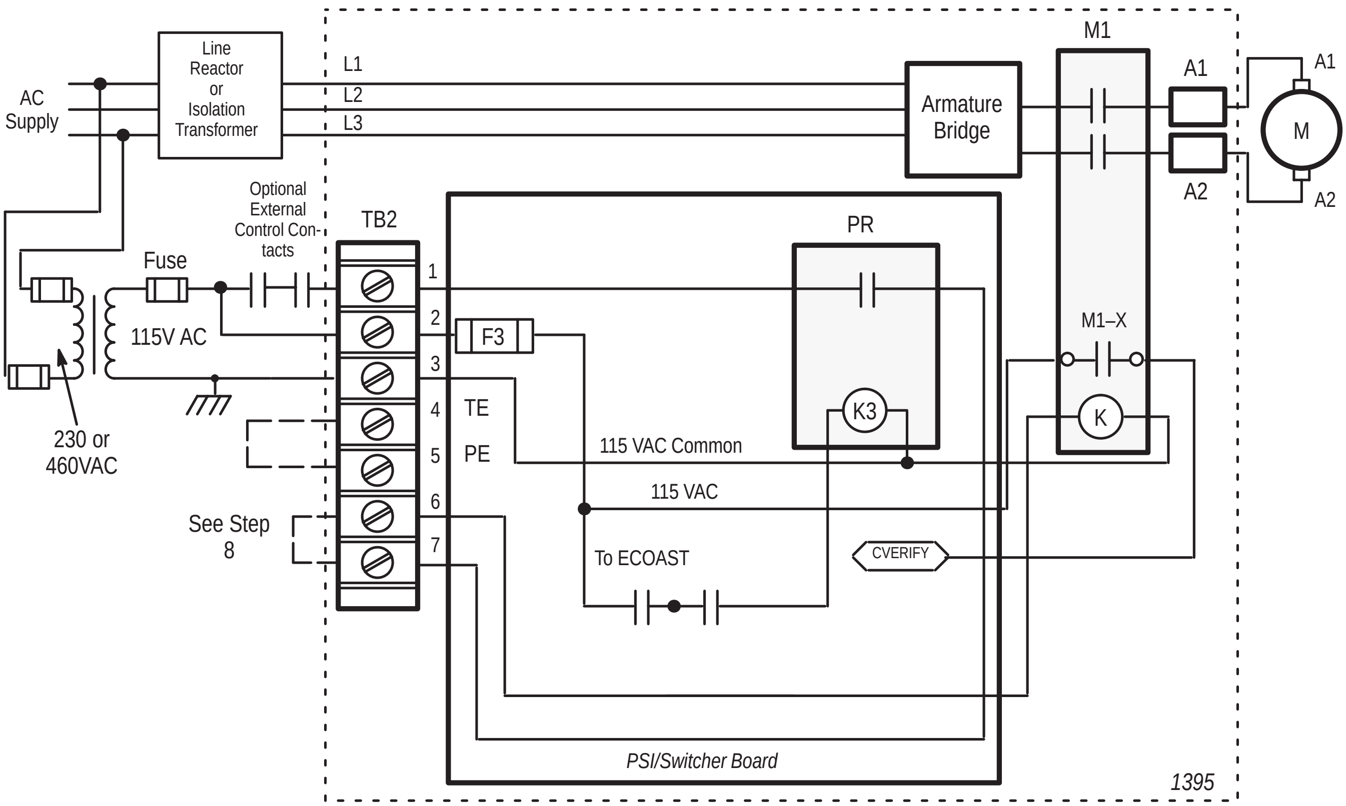
   The System Reset function requires a N.O. operator device which closes to cause a reset. A reset input causes the drive to perform a power-up sequence. **Any data not previously stored in EEPROM memory will be lost.**

   The Normal Stop function requires a N.C. operator device. When opened, the drive will stop (the type of stop is determined by Parameter 624). This may be used to provide an additional stop to the drive.

The voltage used must be the same as the voltage supplied for the motor thermostat input.

IMPORTANT: The 24VDC provided at TB3-11 and 12 must only be used for the 24VDC ECOAST circuit.

Figure 6.13
115VAC Input and Contactor Control Connections – 1 to 30 HP, 230VAC; 2–60HP, 460VAC



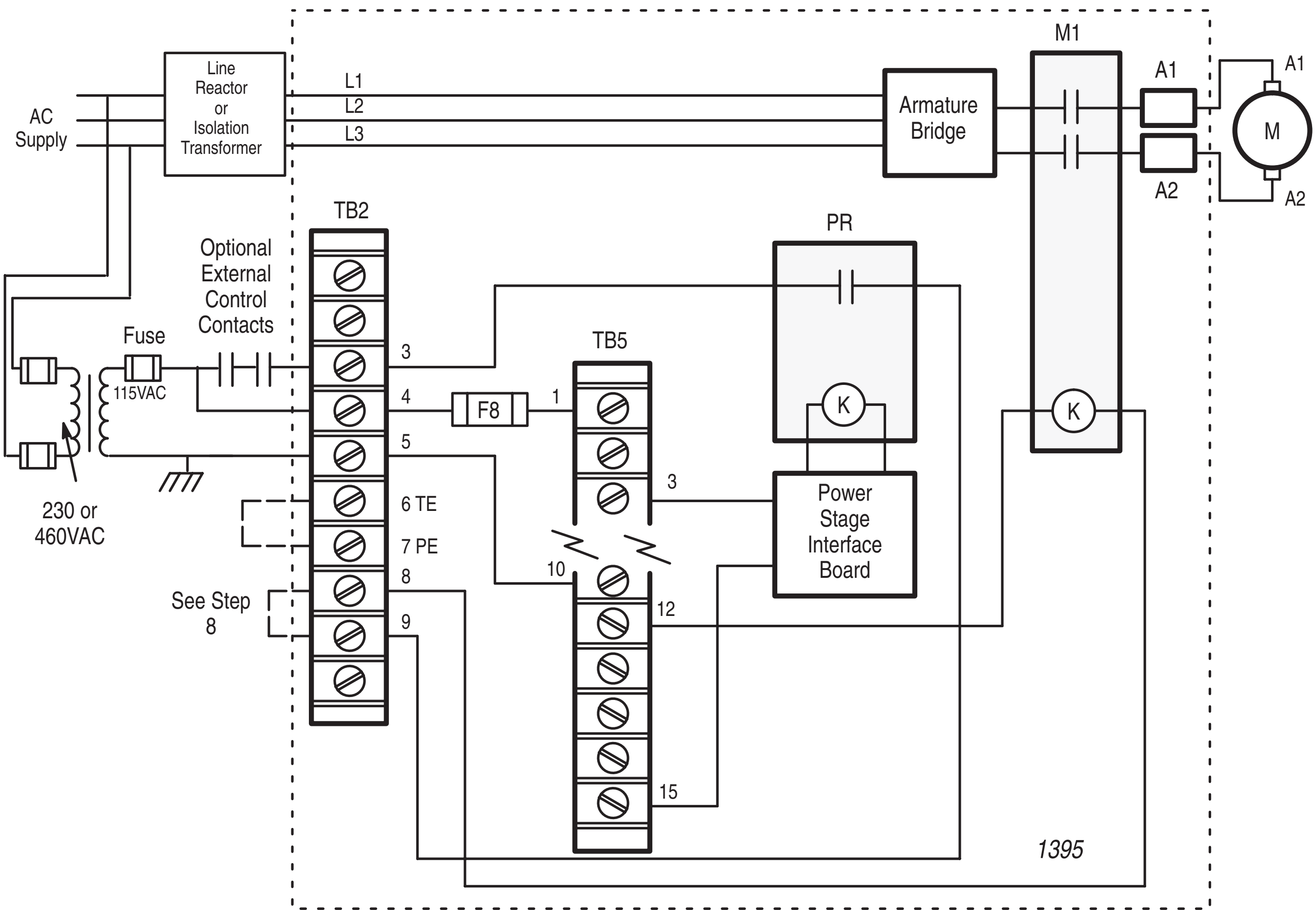
5. Wire External drive Ready Indicator. Terminals TB3-7 and 8 provide connection to the output contact of the Ready/Fault relay located on the Power Stage Interface Board. The contacts are rated for 1A at 24VDC or 0.6A at 115VAC.
6. Wire 115VAC Supply Voltage. It is recommended that the user ground the 115V secondary of the transformer. The drive *Does Not* derive its own control voltage. Therefore, 115VAC must be supplied to the drive from an external source. A control transformer having a primary of 230V or 460V, based on the drive rating, and a secondary of 115V is recommended. Primary and secondary must be fused to meet NEC code. Fuse type FRN and FRS are recommended.

   Terminal Connections and VA loads for the different ratings are outlined in Table 6.N.

Table 6.N
115VAC Connections

Drive Rating	115VAC Input Connection
1 – 30 HP 230VAC 2 – 60 HP 460VAC	TB2 – 2 and 3 (see Fig. 6.13)
40 – 100 HP 230VAC 75 – 200 HP 460VAC	TB2 – 4 and 5 (see Fig. 6.14)
125 – 300 HP 230VAC 250 – 600 HP 460VAC	TB5 – 4 and 5 (see Fig. 6.15)

Figure 6.14
115VAC Input and Contactor Control Connections –
40 – 100 HP on 230VAC Series A; 75 – 200 HP on 460VAC Series A



7. Wire External Contactor Control Contacts. Terminals TB2 or TB5 (depending on horsepower rating) provide connection to the external 115VAC control voltage used to energize the Main Contactor Ml as follows:

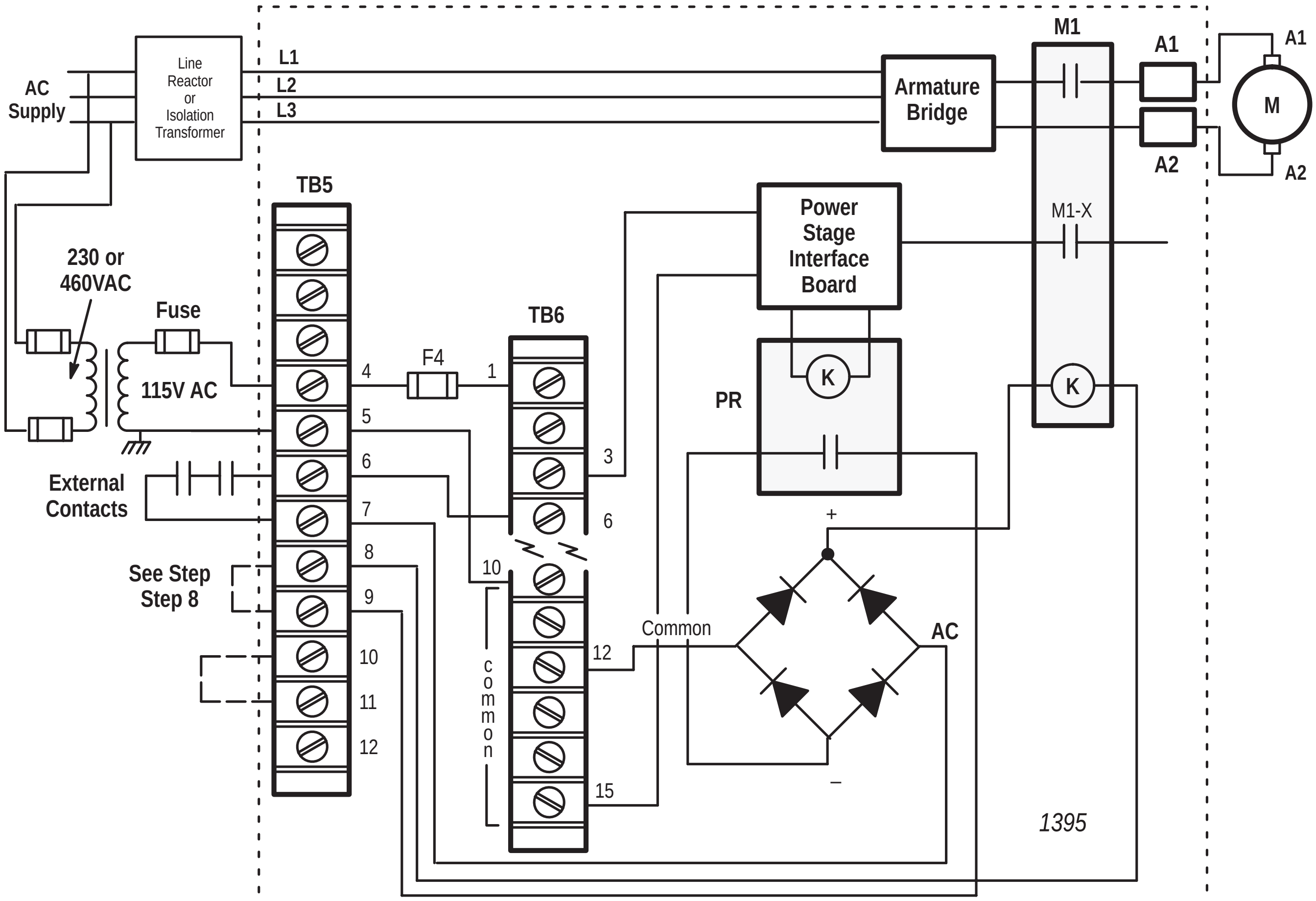
Terminal TB2–1	1–30HP 230VAC 2–60HP 460VAC
Terminal TB2–3	40–100HP 230VAC 75–200HP 460VAC

Terminal TB5–6&7	125–300HP 230VAC 250–600HP 460VAC

The 115VAC control voltage enters the drive and is controlled by the pilot relay (PR). If it is desired to control the Ml coil voltage using contacts external to the drive (in addition to the pilot relay), the external contacts must be wired in series with the 115VAC supply voltage before entering the drive at either TB2-1, TB2-3 or TB5-4 . In most applications, external contacts are not used, therefore, 115VAC is supplied directly to TB2 or TB5 as follows:

Terminal TB2-2	1–30HP 230VAC 2–60HP 460VAC
Terminal TB2-4	40–100HP 230VAC 75–200HP 460VAC
Terminal TB5-4	125–300HP 230VAC 250–600HP 460VAC

Figure 6.15
115VAC Input and Contactor Control Connections – 125 to 300 HP, 230 VAC; 250 to 600HP, 460 VAC



8. Terminals TB2 or TB5 (depending on horsepower rating) are used to allow the drive to be operated with external control of the contactor as follows:

Terminal TB2–6&7	1–30HP 230VAC 2–60HP 460VAC
Terminal TB2–8&9	40–100HP 230VAC 75–200HP 460VAC
Terminal TB5–8&9	125–300HP 230VAC 250–600HP 460VAC

IMPORTANT: If an external control of the contactor is not used, place a jumper across the terminals as outlined in Table 6.O.

Table 6.O
External Contactor Bypass Jumpers

Drive Rating	115VAC Input Connection
1 – 30 HP 230VAC 2 – 60 HP 460VAC	TB2 – 6 and 7
60 – 100 HP 230VAC 75 – 200 HP 460VAC	TB2 – 8 and 9
125 – 300 HP 230VAC 250 – 600 HP 460VAC	TB5 – 8 and 9

9. Connect Programming Terminal. Connect the 9 pin D-style connector of the Programming Terminal to the D-style connector (labeled DHT) mounted on the TB3 mounting rail. Refer to the Programming Terminal Installation and Operation Manual for further details.

Adapter Boards

Discrete Adapter Board

The Discrete Adapter Board is connected to Microbus Port A with wiring to external devices being accomplished at TB3, terminals 23 to 52.

The drive is shipped pre-configured, meaning that all of the inputs and outputs are linked to a predefined signal.

Figure 6.17 shows the 1395 standard configuration for the Discrete Adapter Board. The user has the flexibility to configure the drive for a particular application. Refer to the Discrete Adapter Manual for detailed information.

115VAC Connection – The 115VAC power source can be wired to be referenced or not referenced to common (zero volts) as shown in Fig. 6.16.

Figure 6.16
Typical 115VAC Digital Input Connections

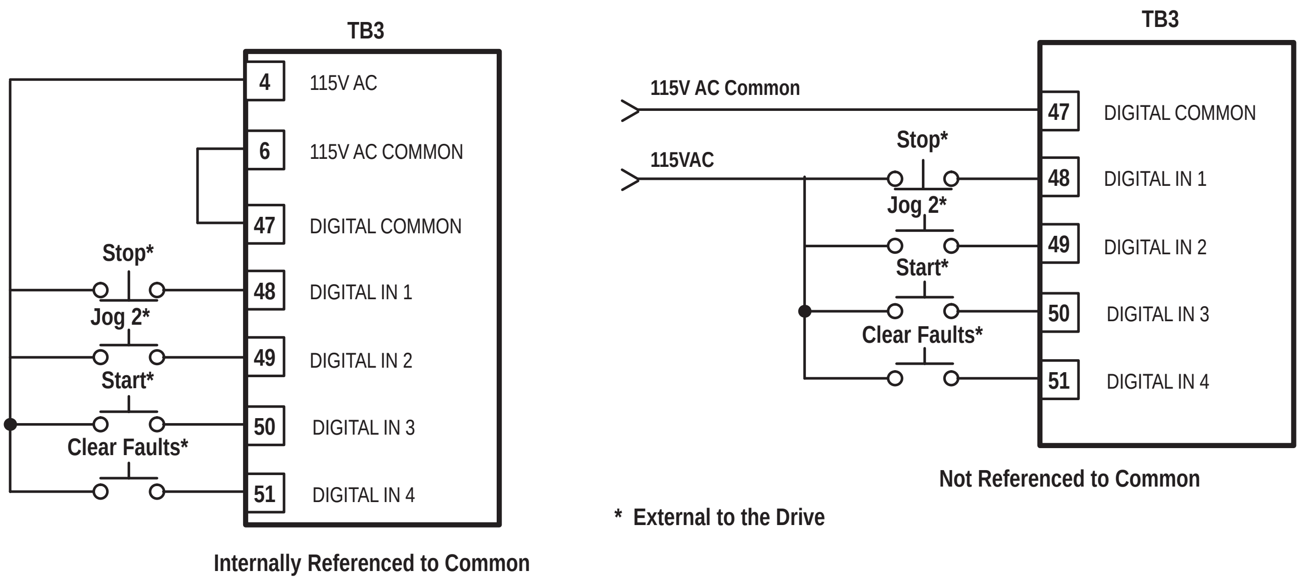
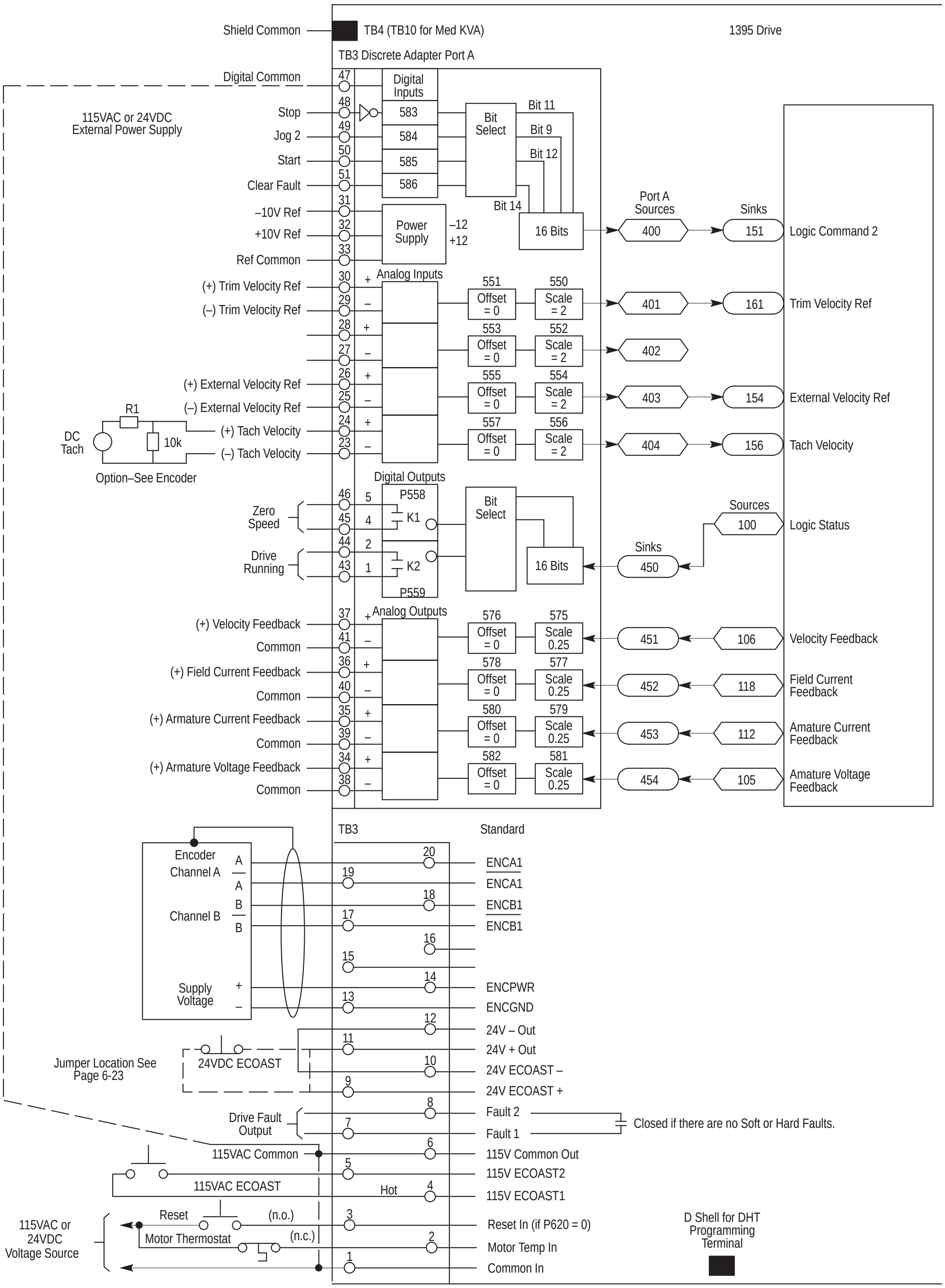


Figure 6.17
Example Discrete Adapter Board Configuration



24VDC Connection/Digital Input – Sizing of the power supply is based on the number of input and output selections. Figure 6.18 shows the typical connection of the digital input using the external power supply.

Analog Input – Velocity and Trim Reference. Connections for the velocity and trim reference inputs can be for uni- or bi-directional operation, using the internal drive ±10VDC power supply (see Fig.6.19).

Figure 6.18
Typical 24VDC Digital Input Connections using External Power Supply

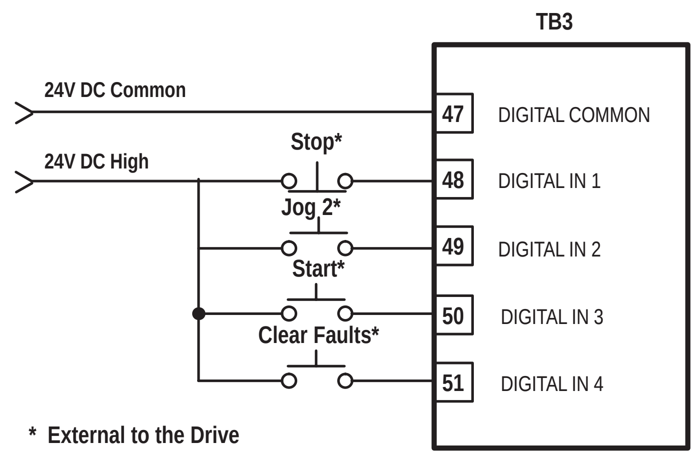
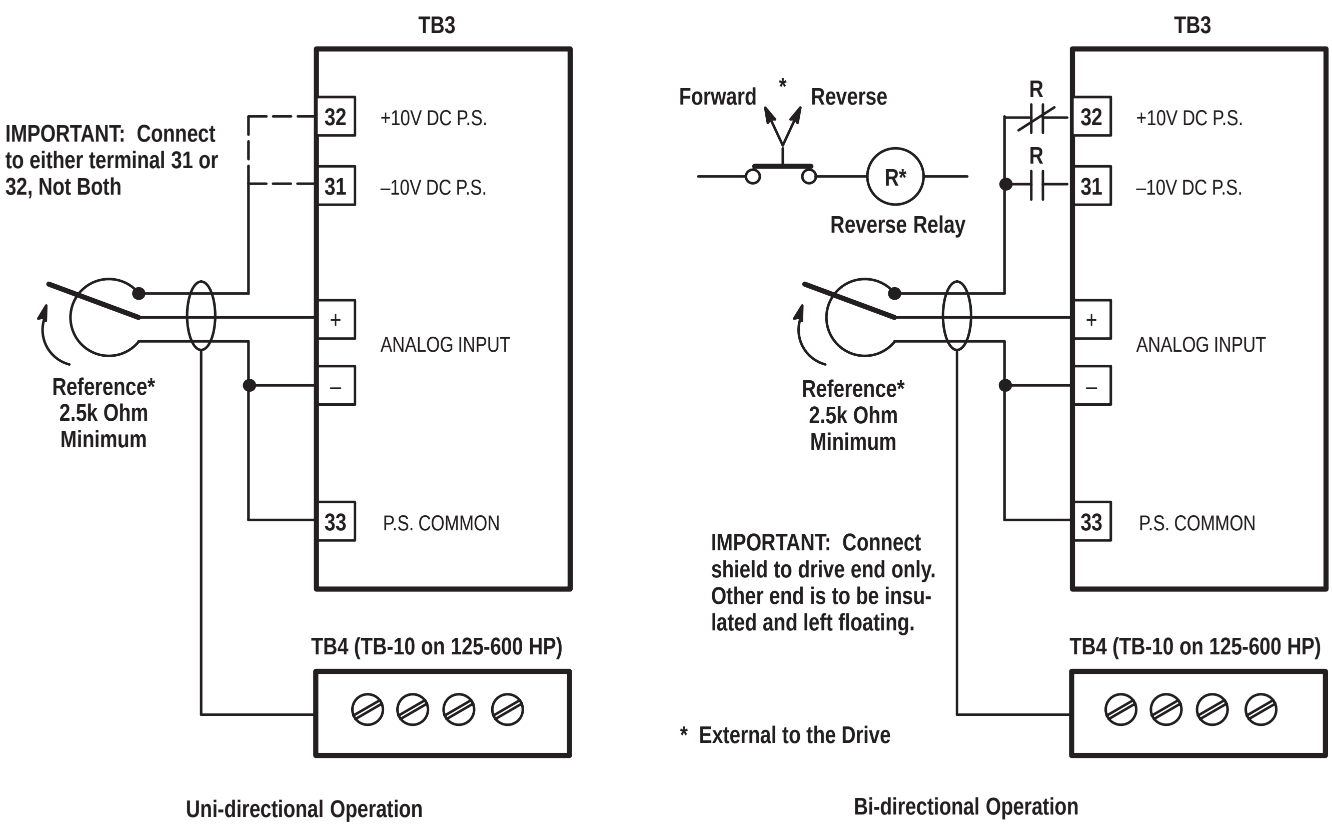


Figure 6.19
Typical Analog Input Connections



Tach Velocity – The analog tachometer device generates a DC voltage that is direction sensitive and proportional to speed. The tach output must be connected to an analog input channel on the Discrete Adapter Board or Digital Reference Board. Most industrial tachs have an output greater than the ±10V range of the analog inputs. The tach output must be scaled down, by an external voltage divider network, so that the entire speed range of the motor can be represented by a ± 9V feedback signal.

CAUTION: Connecting a tach which has an output range greater than ±10V directly to the analog input channel can severely damage the adapter board.

The tach signal then must be scaled in the adapter board to determine the proper relationship of output voltage/ motor velocity to base speed in Drive Units. This scaled configuration data must then be linked to Parameter 156 "Tach Velocity."

Many problems relate to the scaling of the tach signals. Below is a procedure for checking the scaling of the analog tach feedback for proper drive operation.

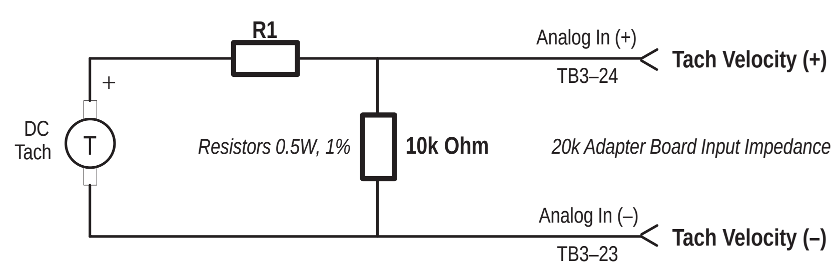
1. Determine the Volts/RPM rating of the tach (refer to tach name plate). Multiply this rating times the absolute maximum speed the motor will be commanded to accelerate to. This value should also be programmed in Parameter 607 "Rev Speed Lim" and 608 "Fwd Speed Lim" to assure that the velocity command will be properly clamped.

   Volts/RPM Rating x Max Speed = Max Volts Output

2. The Max Volts output must then be scaled to a level within the ±10V analog input channel range. This can be accomplished by using a voltage divider network external to the drive. The voltage divider will take the Max Volts output and scale it to a maximum 9V input. This allows for protection against 10% overshoot.

Figure 6.20 uses a l0k ohm resistor across the input channel. Rl represents the dropping resistor for the scaling network. To determine the value of Rl use the equation that follows (R1 should be rated for 0.5W, 1%).

Figure 6.20
Scaling Circuit



$$\frac{\text{(Max Volts Output) x 6666}}{\text{9V}} - 6666 = \text{R1}$$

3. The analog input channel on the adapter board must now be scaled to represent an accurate velocity feedback signal. First determine the analog input signal for base speed. Parameter numbers are given in ( ) where applicable.

$$\frac{\text{Base Motor Speed (606) x 9V}}{\text{Max Speed}} = \text{Base Speed Input}$$

4. The input voltage at base speed is then converted to Raw Adapter Units according to the following equation.

$$\frac{\text{Base Speed Input x 2048}}{10} = \text{Raw Adapter Units}$$

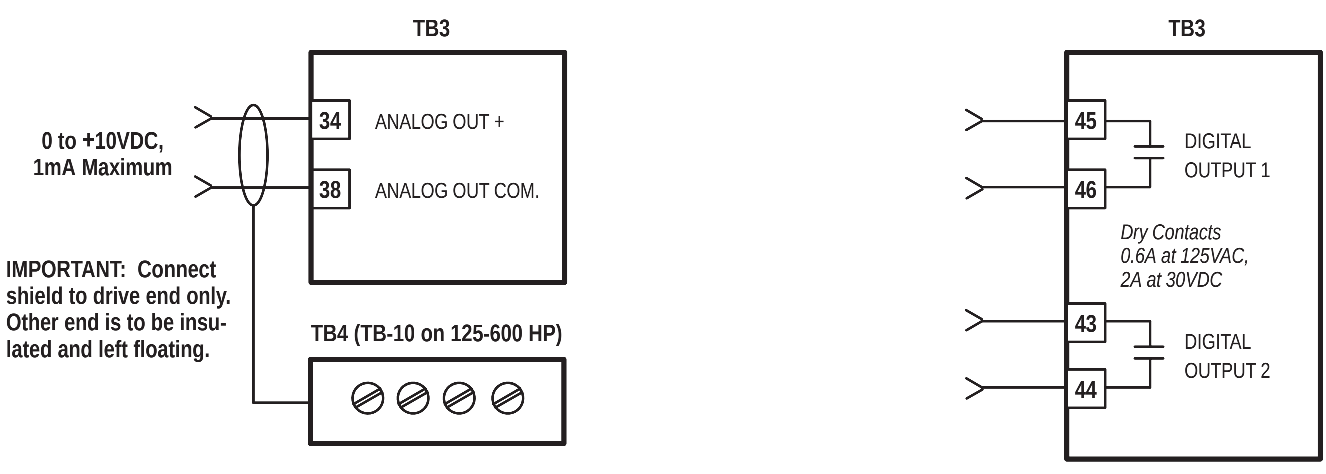
5. The Raw Adapter Units are then used to determine the correct scaling parameter value according to the equation below.

$$\frac{4096}{\text{Raw Adapter Units}} = \text{Scaling Parameter Value}$$

6. The Scaling Parameter Value should then be entered into the associated analog input scaling set-up parameter. This procedure will be correct to within 5%. Verify that the scaling is correct by measuring the actual motor velocity with a hand tachometer. Fine tune the scaling by adjusting the appropriate value to minimize any error.
7. Any drift at zero speed can be minimized by adjusting the offset parameter associated with the channel in use.

Analog Output – Figure 6.21 shows typical analog and digital output connections.

Figure 6.21
Typical Output Connections



Analog Output Connections

Digital Output Connections

Digital Reference Adapter Board

The Digital Reference Adapter Board is connected to Microbus Port A with wiring to external devices at terminals 23 to 62 of TB3.

The drive is shipped pre-configured, meaning that all of the inputs and outputs are linked to a predefined signal.

Figure 6.23 shows the 1395 standard configuration for the Digital Reference Adapter Board. The drive has the flexibility to be reconfigured for the application or as required.

24VDC Connection – A properly sized 24VDC power supply is required to power the 24 volt inputs.

Digital Reference Input – The Digital Reference Adapter Board contains one digital reference command for the drive. The board is set up by default for the encoder input signal to be single channel, dual edge (i.e. both the rising and falling edges are used by the counting logic). The hardware is configured for +5VDC signal inputs with jumpers J6 and J7 in the 1 – 2 position. For a +12VDC signal the jumpers must be placed in the 2 – 3 position.

ATTENTION: To guard against possible component damage, ensure that jumpers are positioned correctly.

Figure 6.22 shows the typical encoder connection used as a signal for the digital reference input. This encoder can be machine mounted or mounted on the motor of the lead section.

Figure 6.22
Encoder Connections

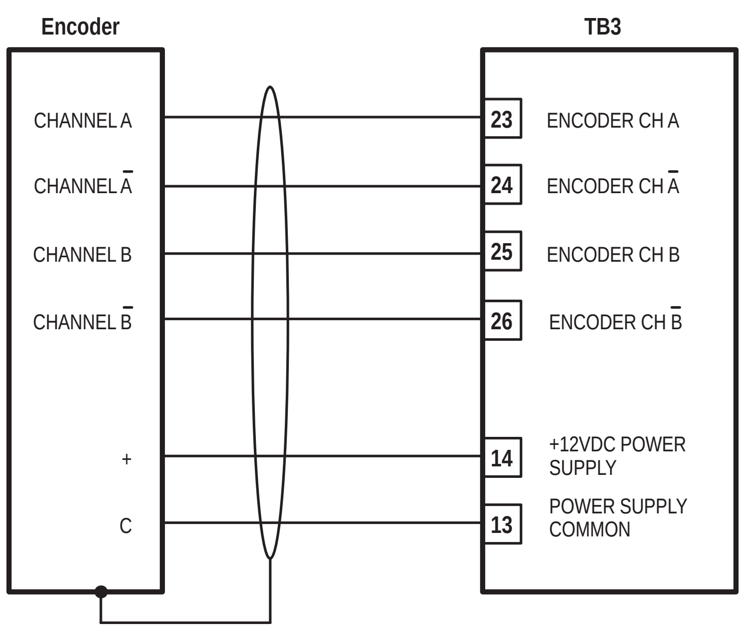


Figure 6.23
Example Digital Reference Adapter Board Configuration

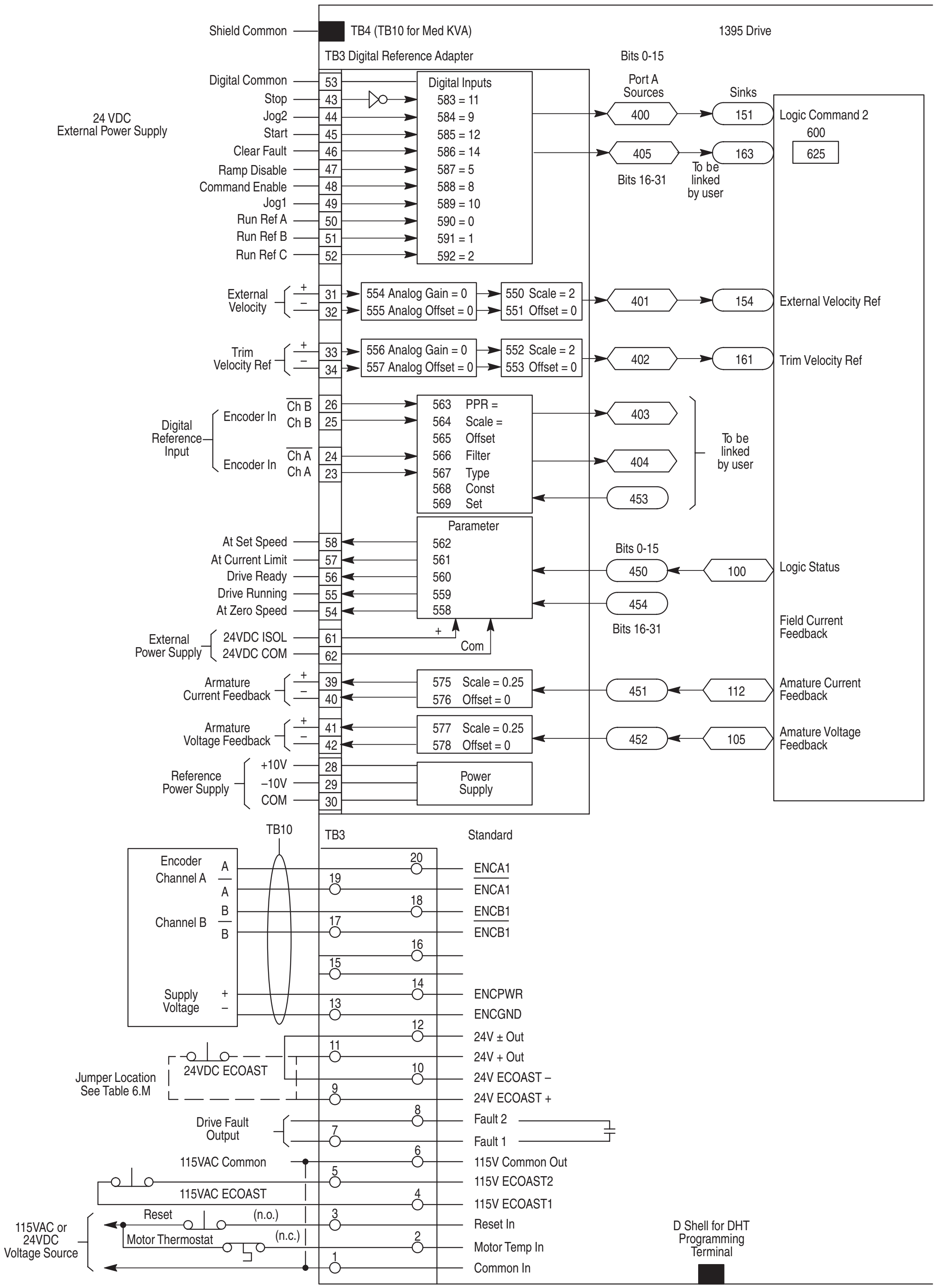
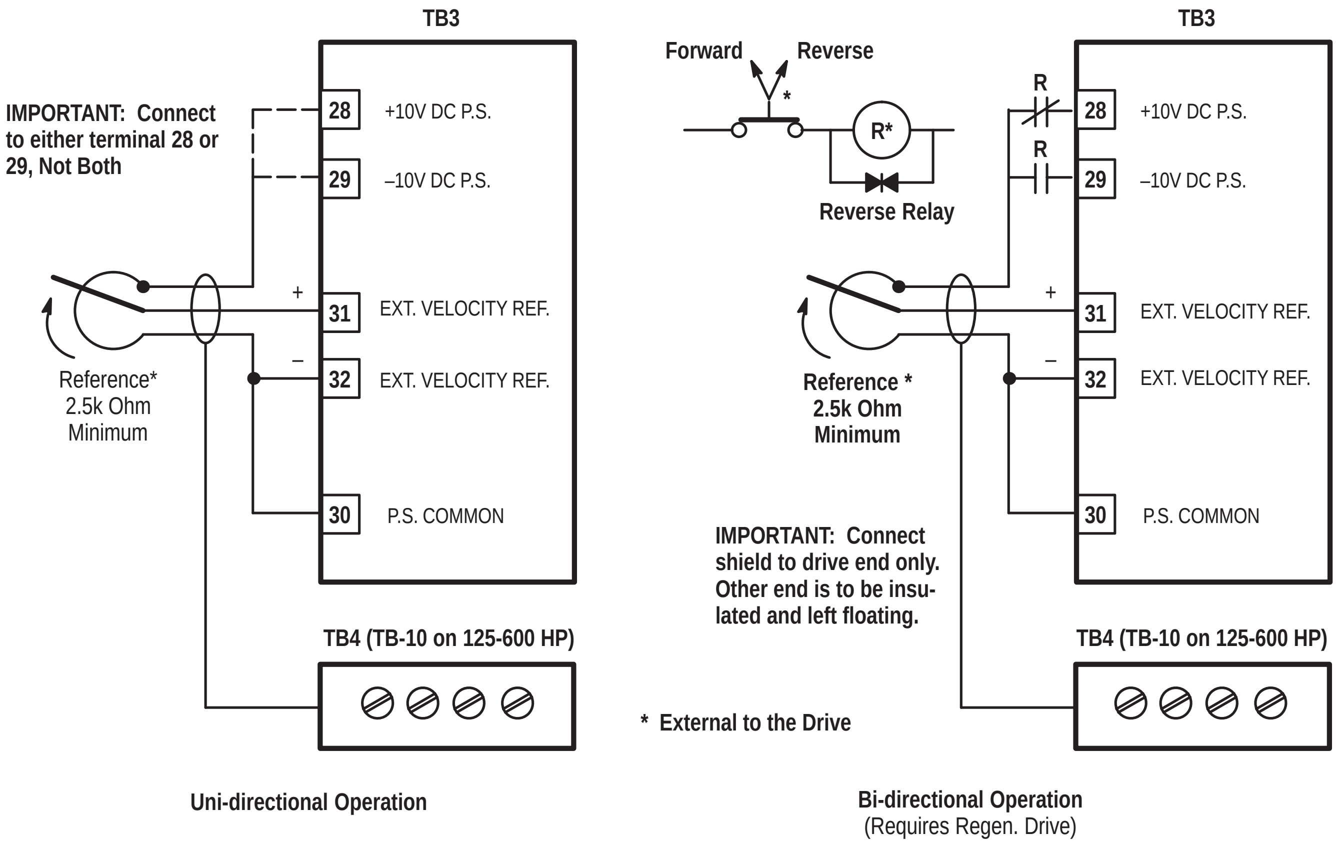


Figure 6.24
Typical Analog Input Connections



Analog Input – Velocity and Trim Reference

Connections for the velocity and trim reference inputs can be for uni- or bi-directional operation, using the internal drive ±10VDC power supply (see Figure 6.24).

Tach Velocity – The Digital Reference Adapter Board is not pre-configured for DC tachometer feedback. The user will have to reconfigure the drive by replacing the Trim Velocity Reference (parameter 161) with the Tach Velocity (parameter 156).

The analog tachometer device generates a DC voltage that is direction sensitive and proportional to speed. The tach output must be connected to an analog input channel on the Discrete Adapter Board. Most industrial tachs have an output greater than the ±10V range of the analog inputs. The tach output must be scaled down, by an external voltage divider network, so that the entire speed range of the motor can be represented by a ±9V feedback signal.

ATTENTION: Connecting a tach which has an output range greater than ±10V directly to the analog input channel can severely damage the adapter board.

The tach signal then must be scaled in the adapter board to determine the proper relationship of output voltage/ motor velocity to base speed in Drive Units. This scaled configuration data must then be linked to Parameter 156 "Tach Velocity."

Many problems relate to the scaling of the tach signals. Below is a procedure for checking the scaling of the analog tach feedback for proper drive operation.

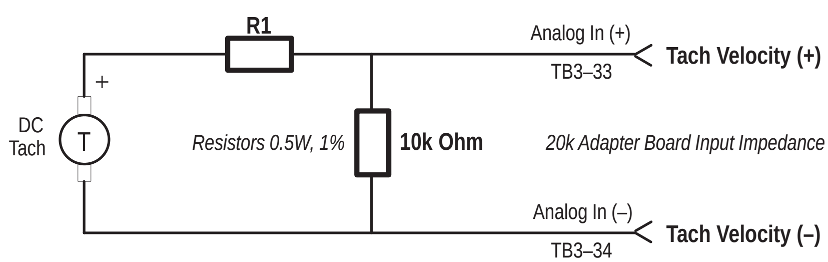
1. Determine the Volts/RPM rating of the tach (refer to tach name plate). Multiply this rating times the absolute maximum speed the motor will be commanded to accelerate to. This value should also be programmed in Parameter 607 "Rev Speed Lim" and 608 "Fwd Speed Lim" to assure that the velocity command will be properly clamped.

   Volts/RPM Rating x Max Speed = Max Volts Output

2. The Max Volts output must then be scaled to a level within the ±10V analog input channel range. This can be accomplished by using a voltage divider network external to the drive. The voltage divider will take the Max Volts output and scale it to a maximum 9V input. This allows for protection against 10% overshoot.

Figure 6.25 uses a l0k ohm resistor across the input channel. Rl represents the dropping resistor for the scaling network. To determine the value of Rl use the equation that follows:

Figure 6.25
Scaling Circuit



$$\frac{\text{(Max Volts Output) x 6666}}{\text{9V}} - 6666 = \text{R1}$$

3. The analog input channel on the adapter board must now be scaled to represent an accurate velocity feedback signal. First determine the analog input signal for base speed. Parameter numbers are given in ( ) where applicable.

$$\frac{\text{Base Motor Speed (606) x 9V}}{\text{Max Speed}} = \text{Base Speed Input}$$

4. The input voltage at base speed is then converted to Raw Adapter Units according to the following equation.

$$\frac{\text{Base Speed Input x 2048}}{10} = \text{Raw Adapter Units}$$

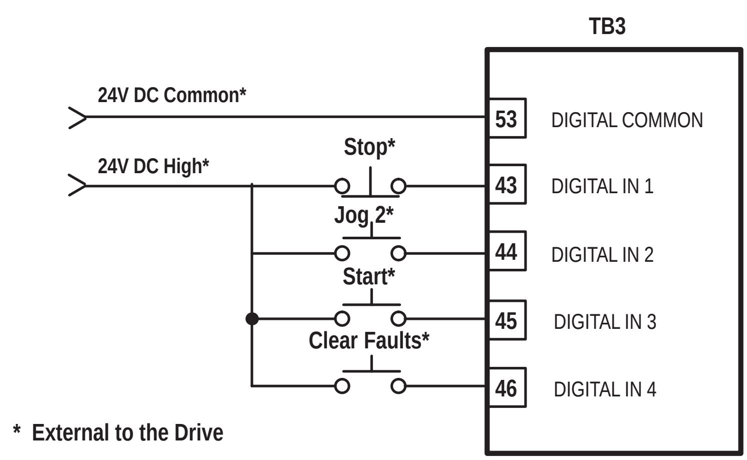
5. The Raw Adapter Units are then used to determine the correct scaling parameter value according to the equation below.

$$\frac{4096}{\text{Raw Adapter Units}} = \text{Scaling Parameter Value}$$

6. The Scaling Parameter Value should then be entered into the associated analog input scaling set-up parameter. This procedure will be correct to within 5%. Verify that the scaling is correct by measuring the actual motor velocity with a hand tachometer. Fine tune the scaling by adjusting the appropriate value to minimize any error.
7. Any drift at zero speed can be minimized by adjusting the offset parameter associated with the channel in use.

Digital Input – Figure 6.26 shows a typical digital input connection.

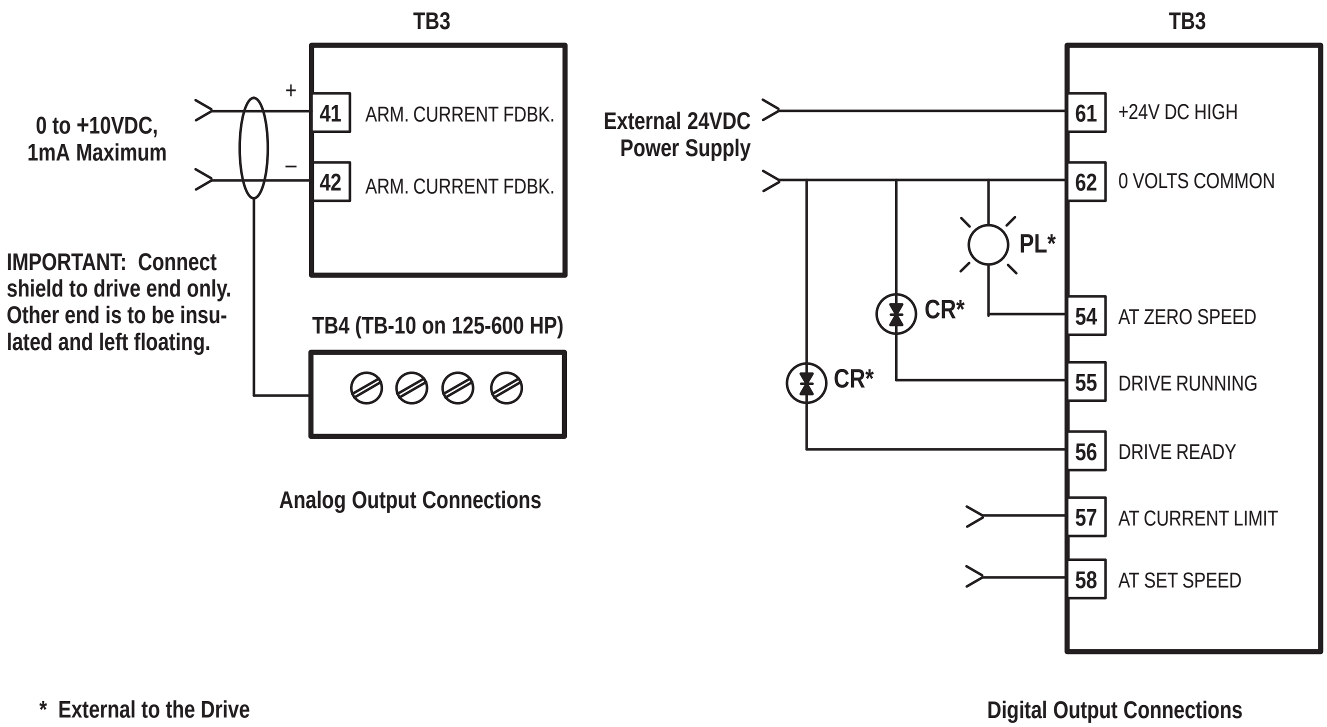
Figure 6.26
Typical 24VDC Digital Input Connections using External Power Supply



Analog/Digital Output

Figure 6.27 shows typical analog and digital output connections.

Figure 6.27
Typical Output Connections



Node Adapter Board

The Node Adapter Board is connected to Microbus Port B and is not preconfigured. Refer to the Node Adapter manual for configuration and installation information.

Multi-Communication Adapter Board

The Multi-Communication Board is not preconfigured. Refer to the Multi-Communication Adapter manual for configuration and installation information.

Table 6.P
Terminal Torque Values

Terminals L1 – L3	AC Input Amps	Wire Range	Torque In. – Lbs.
L1 – L3	2.9 – 45.7	4 – 14	45
–	46.5 – 89.8	2 – 8	50
TB1		14 Max.	5
TB2		22 – 12	5
TB3		22 – 10	6.2
TB4		22 – 12	6.2

Table 6.Q
Terminal Torque Values

Armature Amps	Wire Range of Lug	Torque In. - Lbs.
3.6 – 56	4 – 14	45
57 – 80	2 – 8	50
81 – 180	4/0 – 2	250
*141 – 345	250 MCM – 6	275
*2 wires per lug		

Armature Current Ratings

The following tables provide nameplate data information to help you size wires during installation.

Table 6.R
230VAC Input –Armature Current Ratings

	ARMATURE				FIELD			
	AC Input		DC Output		AC Input		DC Output	
Power Output	Volts	Max A	Volts	Max A	Volts	Max A	Volts	Max A
.75KW/1HP	230	3.85	240	4.7	230	10	150	10
1.2KW/1.5HP	230	5.4	240	6.6	230	10	150	10
1.5KW/2HP	230	7.0	240	8.5	230	10	150	10
2.2KW/3HP	230	10.0	240	12.2	230	10	150	10
3.7KW/5HP	230	16.4	240	20	230	10	150	10
5.6KW/7.5HP	230	23.7	240	29	230	10	150	10
7.5KW/10HP	230	31.0	240	38	230	10	150	10
11.2KW/15HP	230	45.0	240	55	230	10	150	10
15KW/20HP	230	65.3	240	80	230	10	150	10
18.7KW/25HP	230	80.0	240	98	230	10	150	10
22.4KW/30HP	230	89.8	240	110	230	10	150	10
29.9KW/40HP	230	135.3	240	140	230	20	150	10
37.3KW/50HP	230	168.0	240	180	230	20	150	20
44.8KW/60HP	230	188.0	240	210	230	20	150	20
56KW/75HP	230	233.3	240	260	230	20	150	20
74.6KW/100HP	230	302.7	240	345	230	20	150	20
93.3KW/125HP	230	416	240	472	230	40	150	20
112KW/150HP	230	497	240	564	230	40	150	40
149.2KW/200HP	230	591	240	670	230	40	150	40
186.5KW/250HP	230	810	240	918	230	40	150	40
223.8KW/300HP	230	864	240	980	230	40	150	40

Table 6.S
460VAC Input –Armature Current Ratings

	ARMATURE				FIELD			
	AC Input		DC Output		AC Input		DC Output	
Power Output	Volts	Max A	Volts	Max A	Volts	Max A	Volts	Max A
1.5KW/2HP	380/415/460	3.35	400/400/500	4.1	380/415/460	10	250/270/300	10
2.24KW/3HP	380/415/460	4.82	400/400/500	5.9	380/415/460	10	250/270/300	10
3.75KW5HP	380/415/460	7.84	400/400/500	9.6	380/415/460	10	250/270/300	10
5.6KW/7.5HP	380/415/460	11.35	400/400/500	13.9	380/415/460	10	250/270/300	10
7.5KW/10HP	380/415/460	14.95	400/400/500	18.3	380/415/460	10	250/270/300	10
11.2KW/15HP	380/415/460	22.9	400/400/500	28	380/415/460	10	250/270/300	10
15KW/20HP	380/415/460	29.4	400/400/500	36	380/415/460	10	250/270/300	10
18.7KW25HP	380/415/460	36.8	400/400/500	45	380/415/460	10	250/270/300	10
22.4KW/30HP	380/415/460	41.7	400/400/500	51	380/415/460	10	250/270/300	10
29.9KW/40HP	380/415/460	54.9	400/400/500	67.2	380/415/460	10	250/270/300	10
37.3KW/50HP	380/415/460	71.9	400/400/500	88	380/415/460	10	250/270/300	10
44.8KW/60HP	380/415/460	86.6	400/400/500	106	380/415/460	10	250/270/300	10
56KW/75HP	380/415/460	135.5	400/400/500	140	380/415/460	20	250/270/300	20
74.6KW/100HP	380/415/460	168.0	400/400/500	180	380/415/460	20	250/270/300	20
93.3KW/125HP	380/415/460	188.0	400/400/500	210	380/415/460	20	250/270/300	20
112KW/150HP	380/415/460	233.3	400/400/500	260	380/415/460	20	250/270/300	20
149.2KW/200HP	380/415/460	302.7	400/400/500	345	380/415/460	20	250/270/300	20
186.5KW/250HP	380/415/460	390	400/400/500	442	380/415/460	40	250/270/300	40
223.8KW/300HP	380/415/460	466	400/400/500	529	380/415/460	40	250/270/300	40
298.4KW/400HP	380/415/460	591	400/400/500	670	380/415/460	40	250/270/300	40
373KW/500HP	380/415/460	805	400/400/500	913	380/415/460	40	250/270/300	40
448KW/600HP	380/415/460	864	400/400/500	980	380/415/460	40	250/270/300	40

Chapter 7

Programming Parameters

Introduction

This chapter contains the information required to assist the user in programming the drive for a specific application after initial start-up. Drives are shipped programmed with default values and are preconfigured for the options installed.

The drive parameters can be divided into the following categories:

Basic – The basic parameters that must be programmed at the time of start–up.

Setup – The Setup parameters are default values that may require changing during start-up.

Speed Reference – The speed reference parameters are used as speed reference sources for the drive.

Input – The input parameters accept information from sources outside the drive.

Autotune – The autotune parameters are automatically set by the drive control during start-up. Occasionally, they may require modification by the user.

Status – The status parameters provide information about the drive and its operation.

Terminology

The definition of terms related to the parameter table include:

Configuration – The process of linking Sink to Source parameters.

Configuration Parameters – Parameters used to transfer data between the drive control and external devices. The Configuration Parameters are categorized into two types:

1. Source Parameters – Fast parameter used as a source of data.
2. Sink Parameters – Fast parameter used to receive data input.

Drive Units – The actual value of the parameter as it is stored within the Drive parameter table. The drive units may be converted to engineering units or to hexidecimal for display using the Programming Terminal, or may be displayed directly in drive units. All internal values in the drive are in terms of Per Unit numbering.

Engineering Units – A label given to parameter data which specifies what units are to be used to display the parameter value on the Programming Terminal. Examples of engineering units include: RPM, % etc.

Fast Parameter – Fast parameters are all parameters whose values are updated every 4 milliseconds. Fast parameters are used for the real time data input and output of the drive. Fast parameters are NOT backed up in non-volatile memory.

Non-Volatile Memory – Data memory in the drive which retains the values of all data even when power is disconnected from the drive control. EEPROM (Electrically Erasable Programmable Read Only Memory) chips are used for the 1395 non-volatile memory to store some of the drive parameters.

Parameter Table – Table of parameter entries for all configuration and setup parameters used in the drive.

Parameter Entry – Information stored in the drive which contains the parameter number, parameter data and all other information related to the specific parameter.

Parameter – Memory location used to store drive data. Each parameter is given a number called the parameter number. The parameter value may be specified in decimal, or in hexadecimal. When specified in hexadecimal, the word “Hex” will appear after the parameter value.

Per Unit Numbering – Per Unit numbering is a numbering system which defines a specific numeric value as representing 100% of a particular quantity being measured. The number 4096 is used in many places in the drive to represent 1 Per Unit (100%) [pu].

For Example: The number 4096 in Parameter 106 (Velocity Fdbk) represents base motor speed. The number 4096 in Parameter105 (Arm Voltage Fdbk) represents rated motor armature voltage.

Real Time Data – Real Time data is defined as any data which is updated at a rate equal to or faster than that required by the control in order to regulate the drive within the desired bandwidth. All Fast Parameters are considered to be real time within the 1395 drive.

Set Up Parameter – Parameter which is used to store information required by the drive in order to perform the regulation functions of the drive. Setup parameters include parameters used for calibration, scaling and some selection functions required to setup the drive for operation. Data stored in Setup parameters may be backed up in non-volatile memory (EEPROM).

IMPORTANT: The user should become familiar with the programming terminal manual 1300-5.55 before attempting any change of parameters.
DO NOT INITIALIZE THE DRIVE UNDER EEPROM MODE. PRECONFIGURED DATA AND PARAMETERS WILL REVERT TO DEFAULT VALUES.

Parameter Table Structure

All data used by the 1395 control to perform the drive functions is stored in the Parameter Table. Each parameter entry in the parameter table contains the information illustrated in Figure 7.1.

Figure 7.1
Parameter Entry

Parameter Number
Hex
Units
Name
Init. Value
Min
Max
EE
Function/Classification

The parameter data may be obtained by the Programming Terminal or by external devices connected to either Port A or Port B using the appropriate Adapter Board. The various elements of the parameter data are defined as:

Parameter Number – The parameter number in decimal.

Hex – Parameter number in hexidecimal.

Units – Indicates the units displayed for the parameter value using the Programming Terminal and displaying the value using engineering units.

Name – Parameter name as it appears on the Programming Terminal.

Init. Value – Parameter value as it will appear after the Drive Initialize command has been sent from the Programming Terminal. The Init. values are the same as the default values listed in the Parameter Descriptions section of this chapter.

Min – Minimum allowable value for the parameter. If no min value is given, the parameter has not been assigned a minimum limit.

Max – Maximum allowable value for the parameter. If no max value is given, the parameter has not been assigned a maximum limit.

EE – Indicates whether the parameter can be backed up in EEPROM.

Function/Classification – Indicates the control function to which the parameter is associated, and its classification.

Data Types

The Actual Value portion of the parameter entry for each parameter in the parameter table is a 16 bit word. The data represented by this 16 bit word is one of the three following types:

Numerical Data – 16 bit binary integer which can represent signed integers from –32,768 to +32767 or unsigned integers from 0 to +65535.

16 Bit Field Select – 16 bit word where each bit is used to enable/disable a specific drive function.

1 Bit Field Select – A single bit used to enable/disable a specific drive function. For 1 bit field select type data, the entire 16 bit word is stored in the parameter entry, but only the first bit (bit 0) is used.

Parameter Table Storage

Whenever power is applied to the drive control, the entire parameter table is copied from EEPROM to RAM (Random Access Memory). All information stored in RAM is lost when power is disconnected. All Set-Up parameters in the drive required for the basic calibration and scaling of the control functions must be retained even when power is disconnected from the drive, so that the setup information does not need to be re-entered into the drive every time power is re-applied. EEPROM memory is used to store the values of the Setup Parameters when the drive is not powered up.

Whenever a parameter value is changed, either from the Programming Terminal, or through an external device connected to Port A or B, the new information is stored in the RAM of the drive. If this data will be stored in the EEPROM, the Drive must be commanded to copy the parameter data from the RAM to the EEPROM. This is done using a write to EEPROM command (available on the Programming Terminal through the EEPROM mode).

In addition to the parameter values, the configuration information (linking Source to Sink parameters) is also stored in the RAM of the drive. Whenever a change to the configuration is to be backed up in EEPROM, the EEPROM write command must be given.

For details on saving parameters refer to the Programming Terminal Operation Manual.

Table 7.A
Parameters

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
1	1H	Trend 1 Output						Fast Source
2	2H	Trend 2 Output						Fast Source
3	3H	Trend 3 Output						Fast Source
4	4H	Trend 4 Output						Fast Source
10	AH	SP Output 1						Fast Source from Parameter 840
11	BH	SP Output 2						Fast Source from Parameter 841
12	CH	SP Output 3						Fast Source from Parameter 842
13	DH	SP Output 4						Fast Source from Parameter 843
14	EH	SP Output 5						Fast Source from Parameter 844
50	032H	Trend 1 Input						Fast Sink
51	033H	Trend 2 Input						Fast Sink
52	034H	Trend 3 Input						Fast Sink
53	035H	Trend 4 Input						Fast Sink
100	64H	Logic Status						Logic Control
101	65H	Drive Fault						Fault Detection
102	66H	Pre Ramp Vel Ref	RPM					Ramp Control
103	67H	Ramp Vel Ref	RPM					Ramp Control
104	68H	Final Vel Ref	RPM					Velocity Ref Control
105	69H	Arm Voltage Fdbk	VLT					Feedback Control
106	6AH	Velocity Fdbk	RPM					Velocity Fdbk Control
107	6BH	Position Fdbk						Velocity Fdbk Control
108	6CH	Vel Feed Fwd	RPM					Velocity PI Control
109	6DH	Position Error						Velocity PI Control
110	6EH	Torque Command	%					Torque Select
111	6FH	Arm Current Ref	AMP					Current Ref Control
112	70H	Arm Current Fdbk	AMP					Feedback Control
113	71H	Arm Cur PI Out						Current PI Control
114	72H	Arm Cur Fire Ang						Current PI Control
115	73H	Flux Command	%					Field Flux Control
116	74H	AC Line Voltage	VLT					Feedback Control
117	75H	Fld Current Ref	AMP					Field Flux Control
118	76H	Fld Current Fdbk	AMP					Feedback Control
119	77H	Proc Trim Output						Process Trim Control
120	78H	CEMF Feedback	VLT					Software Test Point
121	79H	Flux Trim	%					Software Test Point
122	7AH	Encoder Velocity	RPM					Software Test Point

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
123	7BH	Velocity PI Output	%					Software Test Point
124	7CH	Velocity Error	RPM					Software Test Point
125	7DH	Process Trim PI Input						Software Test Point
150	96H	Logic Cmd 1						Logic Control/Input
151	97H	Logic Cmd 2						Logic Control/Input
152	98H	Logic Cmd 3						Logic Control/Input
153	99H	Vel Ref Fraction						Velocity Ref Control/Input
154	9AH	Vel Ref Whole	RPM					Velocity Ref Control/Input
156	9CH	Tach Velocity	RPM					Velocity Fdbk Control/Input
157	9DH	Torque Reference	%					Torque Select
159	9FH	Flux Feed Forward	%					Field Flux Control
160	A0H	CEMF Reference	%					Field Flux Control
161	A1H	Process Trim Ref						Process Trim Control/Input
162	A2H	Process Trim Fdbk						Process Trim Control/Input
163	A3H	Vel Indirect 1						Fast Sink, Pointer in 600
164	A4H	Vel Indirect 2						Fast Sink, Pointer in 601
165	A5H	Vel Indirect 3						Fast Sink, Pointer in 602
166	A6H	Vel Indirect 4						Fast Sink, Pointer in 603
167	A7H	Torque Reference 2	%					Torque Select
200	C8H	DHT In Par 1						Fast Source
201	C9H	DHT In Par 2						Fast Source
202	CAH	DHT In Par 3						Fast Source
203	CBH	DHT In Par 4						Fast Source
204	CCH	DHT In Par 5						Fast Source
250	FAH	DHT Out Par 1						Fast Sink
251	FBH	DHTOut Par 2						Fast Sink
252	FCH	DHT Out Par 3						Fast Sink
253	FDH	DHT Out Par 4						Fast Sink
254	FEH	DHT Out Par 5						Fast Sink
300	12CH	Pt B IN Par 1						Fast Source
301	12DH	Pt B IN Par 2						Fast Source
302	12EH	Pt B In Par 3						Fast Source
303	12FH	Pt B In Par 4						Fast Source
304	130H	Pt B In Par 5						Fast Source
305	131H	Pt B In Par 6						Fast Source
306	132H	Pt B In Par 7						Fast Source
307	133H	Pt B In Par 8						Fast Source

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
308	134H	Pt B IN Par 9						Fast Source
309	135H	Pt B In Par10						Fast Source
350	15EH	Pt B Out Par 1						Fast Sink
351	15FH	Pt B Out Par 2						Fast Sink
352	160H	Pt B Out Par 3						Fast Sink
353	161H	Pt B Out Par 4						Fast Sink
354	162H	Pt B Out Par 5						Fast Sink
355	163H	Pt B Out Par 6						Fast Sink
356	164H	Pt B Out Par 7						Fast Sink
357	165H	Pt B Out Par 8						Fast Sink
358	166H	Pt B Out Par 9						Fast Sink
359	167H	Pt B Out Par 10						Fast Sink
400	190H	Pt A IN Par 1						Fast Source
401	191H	Pt A In Par 2						Fast Source
402	192H	Pt A In Par 3						Fast Source
403	193H	Pt A In Par 4						Fast Source
404	194H	Pt A In Par 5						Fast Source
405	195H	Pt A In Par 6						Fast Source
406	196H	Pt A IN Par 7						Fast Source
407	197H	Pt A IN Par 8						Fast Source
408	198H	Pt A IN Par 9						Fast Source
409	199H	Pt A IN Par 10						Fast Source
450	1C2H	Pt A OUT Par 1						Fast Sink
451	1C3H	Pt A Out Par 2						Fast Sink
452	1C4H	Pt A Out Par 3						Fast Sink
453	1C5H	Pt A OUT Par 4						Fast Sink
454	1C6H	Pt A OUT Par 5						Fast Sink
455	1C7H	Pt A OUT Par 6						Fast Sink
456	1C8H	Pt A OUT Par 7						Fast Sink
457	1C9H	Pt A OUT Par 8						Fast Sink
458	1CAH	Pt A OUT Par 9						Fast Sink
459	1CBH	Pt A OUT Par 10						Fast Sink
500	1F4H	Pt B IN Cnfg 1					EE	Configuration
501	1F5H	Pt B IN Cnfg 2					EE	Configuration
502	1F6H	Pt B IN Cnfg 3					EE	Configuration
503	1F7H	Pt B IN Cnfg 4					EE	Configuration
504	1F8H	Pt B IN Cnfg 5					EE	Configuration
505	1F9H	Pt B IN Cnfg 6					EE	Configuration

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
506	1FAH	Pt B IN Confg 7					EE	Configuration
507	1FBH	Pt B IN Confg 8					EE	Configuration
508	1FCH	Pt B IN Confg 9					EE	Configuration
509	1FDH	Pt B IN Config 10					EE	Configuration
510	1FEH	Pt B IN Config 11					EE	Configuration
511	1FFH	Pt B IN Config 12					EE	Configuration
512	200H	Pt B IN Config 13					EE	Configuration
513	201H	Pt B IN Config 14					EE	Configuration
514	202H	Pt B IN Config 15					EE	Configuration
515	203H	Pt B IN Config 16					EE	Configuration
516	204H	Pt B IN Config 17					EE	Configuration
517	205H	Pt B IN Config 18					EE	Configuration
518	206H	Pt B IN Config 19					EE	Configuration
519	207H	Pt B IN Config 20					EE	Configuration
520	208H	Pt B IN Config 21					EE	Configuration
521	209H	Pt B IN Config 22					EE	Configuration
522	20AH	Pt B IN Config 23					EE	Configuration
523	20BH	Pt B IN Config 24					EE	Configuration
524	20CH	Pt B IN Config 25					EE	Configuration
525	20DH	Pt B OUT Config 1					EE	Configuration
526	20EH	Pt B OUT Config 2					EE	Configuration
527	20FH	Pt B OUT Config 3					EE	Configuration
528	210H	Pt B OUT Config 4					EE	Configuration
529	211H	Pt B OUT Config 5					EE	Configuration
530	212H	Pt B OUT Config 5					EE	Configuration
531	213H	Pt B OUT Config 7					EE	Configuration
532	214H	Pt B OUT Config 8					EE	Configuration
533	215H	Pt B OUT Config 9					EE	Configuration
534	216H	Pt B OUT Config 10					EE	Configuration
535	217H	Pt B OUT Config 11					EE	Configuration
536	218H	Pt B OUT Config 12					EE	Configuration
537	219H	Pt B OUT Config 13					EE	Configuration
538	21AH	Pt B OUT Config 14					EE	Configuration
539	21BH	Pt B OUT Config 15					EE	Configuration
540	21CH	Pt B OUT Config 16					EE	Configuration
541	21DH	Pt B OUT Config 17					EE	Configuration
542	21EH	Pt B OUT Config 18					EE	Configuration
543	21FH	Pt B OUT Config 19					EE	Configuration

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
544	220H	Pt B OUT Cnfg 20					EE	Configuration
545	221H	Pt B OUT Confg 21					EE	Configuration
546	222H	Pt B OUT Confg 22					EE	Configuration
547	223H	Pt B OUT Config 23					EE	Configuration
548	224H	Pt B OUT Config 24					EE	Configuration
549	225H	Pt B OUT Config 25					EE	Configuration
550	226H	Pt A IN Config 1					EE	Configuration
551	227H	Pt A IN Config 2					EE	Configuration
552	228H	Pt AIN Config 3					EE	Configuration
553	229H	Pt A IN Config 4					EE	Configuration
554	22AH	Pt A IN Config 5					EE	Configuration
555	22BH	Pt A IN Config 6					EE	Configuration
556	22CH	Pt A IN Config 7					EE	Configuration
557	22DH	Pt A IN Config 8					EE	Configuration
558	22EH	Pt A IN Config 9					EE	Configuration
559	22FH	Pt A IN Config 10					EE	Configuration
560	230H	Pt A IN Config 11					EE	Configuration
561	231H	Pt A IN Config 12					EE	Configuration
562	232H	Pt A IN Config 13					EE	Configuration
563	233H	Pt A IN Config 14					EE	Configuration
564	234H	Pt A IN Config 15					EE	Configuration
565	235H	Pt A IN Config 16					EE	Configuration
566	236H	Pt A IN Config 17					EE	Configuration
567	237H	Pt A IN Config 18					EE	Configuration
568	238H	Pt A IN Config 19					EE	Configuration
569	239H	Pt A IN Config 19					EE	Configuration
570	23AH	Pt A IN Config 21					EE	Configuration
571	23BH	Pt A IN Config 22					EE	Configuration
572	23CH	Pt A IN Config 23					EE	Configuration
573	23DH	Pt A IN Config 24					EE	Configuration
574	23EH	Pt A IN Config 25					EE	Configuration
575	23FH	Pt A OUT Config 1					EE	Configuration
576	240H	Pt A OUT Config 2					EE	Configuration
577	241H	Pt A OUT Config 3					EE	Configuration
578	242H	Pt A OUT Config 4					EE	Configuration
579	243H	Pt A OUT Config 5					EE	Configuration
580	244H	Pt A OUT Config 6					EE	Configuration
581	245H	Pt A OUT Config 7					EE	Configuration
582	246H	Pt A OUT Config 8					EE	Configuration

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
583	247H	Pt A OUT Confg 9					EE	Configuration
584	248H	Pt A OUT Confg 10					EE	Configuration
585	249H	Pt A OUT Config 11					EE	Configuration
586	24AH	Pt A OUT Config 12					EE	Configuration
587	24BH	Pt A OUT Config 13					EE	Configuration
588	24CH	Pt A OUT Config 14					EE	Configuration
589	24DH	Pt A OUT Config 15					EE	Configuration
590	24EH	Pt A OUT Config 16					EE	Configuration
591	24FH	Pt A OUT Config 17					EE	Configuration
592	250H	Pt A OUT Config 18					EE	Configuration
593	251H	Pt A OUT Config 19					EE	Configuration
594	252H	Pt A OUT Config 20					EE	Configuration
595	253H	Pt A OUT Config 21					EE	Configuration
596	254H	Pt A OUT Config 22					EE	Configuration
597	255H	Pt A OUT Config 23					EE	Configuration
598	256H	Pt A OUT Config 24					EE	Configuration
599	257H	Pt A OUT Config 25					EE	Configuration
600	258H	Vel Parameter Sel 1		600	600	732	EE	Pointer for Parameter 163
601	259H	Vel Parameter Sel 2		601	600	732	EE	Pointer for Parameter 164
602	25AH	Vel Parameter Sel 3		602	600	732	EE	Pointer for Parameter 165
603	25BH	Vel Parameter Sel 4		603	600	732	EE	Pointer for Parameter 166
606	25EH	Base Motor Speed	RPM	1750	1	6000	EE	Velocity Fdbk Cntrl
607	25FH	Rev Speed Limit	RPM	–B.S.	–6xB.S.	0	EE	Ramp Control
608	260H	Fwd Speed Limit	RPM	B.S.	0	+6 x B.S.	EE	Ramp Control
609	261H	Encoder PPR		1024	100	32767	EE	Vel Fdbk Cntrl
610	262H	Rated Motor Volt	VOLTS	240	75	850	EE	Feedback Control
611	263H	Motor Arm FLA	AMPS	0.2	0.1	3276.7	EE	Feedback Control
612	264H	Rate Fld Mtr Cur	AMPS	0.1	0.1	32767	EE	Feedback Control
613	265H	Motor Inertia	SECS	6.0	0.01	10	EE	
614	266H	Arm Resistance	%	5.0	0	100	EE	Velocity Fdbk Cntrl
615	267H	Rated Arm Brdg I	AMPS	20.0	0.1	3276.7	EE	Feedback Control
616	268H	Rated Fld Brdg I	AMPS	10.0	10.0	3276.7	EE	Feedback Control
617	269H	Rated AC Line	VOLTS	460.0	230.0	690	EE	Feedback Control
620	26CH	System Reset Select		0	0	1	EE	Logic Control
621	26DH	Fdbk Device Type		1	0	3	EE	Velocity Fdbk Cntrl
622	26EH	Contactor Device		1	0	1	EE	Logic Control
623	26FH	Fault Select		*			EE	Fault Detection
624	270H	Maintain Start		1	0	3	EE	Logic Control

* See Parameter Description

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
625	271H	Torque Mode		1	0	5	EE	Torque Select
626	272H	Jog Ramp Enable		0	0	1	EE	Ramp Cntrl/Set-Up
627	273H	Flux Mode Select		*			EE	Field Flux Control/Set-Up
628	274H	Proc Trim Select		0	0	2	EE	Process Trim Control/Set-Up
629	275H	MTR Overload Sel		1	0	4	EE	Fault Detection/Setup
630	276H	Fault Report		1	0	1	EE	Fault Detection/Set-Up
631	277H	Vel Filter Sel		0	0	2	EE	Velocity Ref Cntrl/Setup
632	278H	Warning Select	*				EE	Fault Detection/Setup
633	279H	Preset Speed 1	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
634	27AH	Preset Speed 2	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
635	27BH	Preset Speed 3	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
636	27CH	Preset Speed 4	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
637	27DH	Preset Speed 5	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
638	27EH	Jog Speed 1	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
639	27FH	Jog Speed 2	RPM	0	–6xB.S.	+6xB.S.	EE	Velocity Ref Cntrl/Spd Ref
641	281H	MOP Accel 1	SEC	0.1	0.1	6553.5	EE	MOP Control
642	282H	MOP Accel 2	SEC	0.1	0.1	6553.5	EE	MOP Control
643	283H	MOP Accel 3	SEC	0.1	0.1	6553.5	EE	MOP Control
644	284H	MOP Accel 4	SEC	0.1	0.1	6553.5	EE	MOP Control
645	285H	MOP Decel 1	SEC	0.1	0.1	6553.5	EE	MOP Control
646	286H	MOP Decel 2	SEC	0.1	0.1	6553.5	EE	MOP Control
647	287H	MOP Decel 3	SEC	0.1	0.1	6553.5	EE	MOP Control
648	288H	MOP Decel 4	SEC	0.1	0.1	6553.5	EE	MOP Control
649	289H	MOP Max Speed	RPM	1750	0	+6xB.S.	EE	MOP Control
650	28AH	MOP Min Speed	RPM	0	0	+6xB.S.	EE	MOP Control
651	28BH	Accel Time	SEC	10	0.1	6553.5	EE	Ramp Control
652	28CH	Decel Time	SEC	10	0.1	6553.5	EE	Ramp Control
653	28DH	Desired Contour	%	0	0	100	EE	Ramp Control
657	291H	Droop Percent	%	0	0	25.5	EE	Droop Control/Set-Up
658	292H	Droop Filter	%	0	0	100%	EE	Droop Control/Set-Up
659	293H	KI Velocity Loop		256	0	32767	EE	Velocity PI Control/Autotune
660	294H	KP Velocity Loop		64	0	1600	EE	Velocity PI Control/Autotune
661	295H	KF Velocity Loop		65535	0	65535	EE	Velocity PI Control/Autotune
663	297H	Fwd Brdg Cur Lim	%	50%	0.0244	260	EE	Current Ref Control
664	298H	Rev Brdg Cur Lim	%	50%	0.0244	260	EE	Current Ref Control
665	299H	Strt Taper Speed	RPM	B.S.	B.S./4096	+6xB.S.	EE	Current Ref Control/Set-Up
666	29AH	End Taper Speed	RPM	B.S.	B.S./4096	+6xB.S.	EE	Current Ref Control/Set-Up
667	29BH	Min Taper Current	%	100	0.0244	260	EE	Current Ref Control/Set-Up
668	29CH	DI/DT Limit	%	25.0%	0.0244	260	EE	Current Ref Control/Set-Up
669	29DH	Slave Percent	%	100	–200	200	EE	Torque Control/Set-Up

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
670	29EH	Slave Percent 2		0	–200	200	EE	Torque Control/Setup
672	2A0H	KI Flux		1638	0	32767	EE	Field Weak Control/Set-Up
673	2A1H	KP Flux		4096	0	32767	EE	Field Weak Control/Set-Up
674	2A2H	Fld Economy Ref	%	50	0	100	EE	Field Flux Control/Set-Up
675	2A3H	Fld Economy Ref	Sec	30	0	6553.5	EE	Field Flux Control/Set-Up
676	2A4H	Fld Flux Ref	%	100	0.0244	125	EE	Field Flux Control/Set-Up
677	2A5H	Fld I @ 0/8 Flux	%	0	0	100	EE	Field Flux Control/Autotune
678	2A6H	Fld I @ 1/8 Flux	%	6.6	0	100	EE	Field Flux Control/Autotune
679	2A7H	Fld I @ 2/8 Flux	%	14.3	0	100	EE	Field Flux Control/Autotune
680	2A8H	Fld I @ 3/8 Flux	%	23.1	0	100	EE	Field Flux Control/Autotune
681	2A9H	Fld I @ 4/8 Flux	%	33.3	0	100	EE	Field Flux Control/Autotune
682	2AAH	Fld I @ 5/8 Flux	%	45.5	0	100	EE	Field Flux Control/Autotune
683	2ABH	Fld I @ 6/8 Flux	%	60.0	0	100	EE	Field Flux Control/Autotune
684	2ACH	Fld I @ 7/8 Flux	%	77.7	0	100	EE	Field Flux Control/Autotune
685	2ADH	Fld I @ 1.0Flux	RPM	100	0	100	EE	Field Flux Control/Autotune
686	2AEH	Fld Weaken Spd.	RPM	B.S.	B.S./8	+6xB.S.	EE	Field Weak Control
687	2AFH	CEMF Reg. Preload	%	0	–799.9	799.9	EE	Field Flux Control
688	2B0H	Tach Switch Tol.	RPM	10%B.S	0	B.S	EE	Tach Loss Recovery/Set-Up
689	2B1H	Tach Switch Ki		50	0	65535	EE	Tach Loss Recovery/Set-Up
690	2B2H	Tach Switch Kp		10	0	65535	EE	Tach Loss Recovery/Set-Up
691	2B3H	Tach Switch Select		0	0	1	EE	Tach Loss Recovery/Set-Up
692	2B4H	Kn Filter		512	–32767	+32767	EE	Set-Up
693	2B5H	Wn Filter		300	1	500	EE	Set-Up
698	2BAH	Auto Tune I Lim	RPM	25	.0244	100	EE	Auto Tuning Setup/Autotune
699	2BBH	Auto Tune Speed	RPM	B.S.	– B.S.	B.S.	EE	Auto Tuning Setup/Autotune
700	2BCH	Vel Desired BW	Rad/Sec	5	0.1	150	EE	Auto Tuning Setup/Autotune
701	2BDH	Vel Max BW	Rad/Sec	50	50	150	EE	Auto Tuning Setup/Autotune
702	2BEH	Vel Damp Factor		1.0	1.0	3.0	EE	Auto Tuning Setup/Autotune
703	2BFH	System Inertia	Sec	2.0	2.0	655.0	EE	Auto Tuning Setup/Autotune
704	2C0H	At Speed 1	RPM	0	0	+6xB.S.	EE	Velocity Ref Cntrl/ Spd Ref
705	2C1H	At Speed 2	RPM	BS/8	BS/8	+6xB.S.	EE	Velocity Ref Cntrl/ Spd Ref
706	2C2H	At Speed 3	RPM	BS/4	BS/4	+6xB.S.	EE	Velocity Ref Cntrl/ Spd Ref
707	2C3H	At Speed 4	RPM	BS/2	BS/2	+6xB.S.	EE	Velocity Ref Cntrl/ Spd Ref
708	2C4H	At Speed 5	RPM	BS	BS	+6xB.S.	EE	Velocity Ref Cntrl/ Spd Ref
709	2C5H	Up To Speed Tol	RPM	BS/100	–6xB.S.	B.S./10	EE	Logic Control/Set-Up
710	2C6H	Zero Speed Tol	RPM	BS/100	0	+6xB.S.	EE	Logic Control/Set-Up
711	2C7H	Jog Dwell	SEC	0	0	6553.5	EE	Logic Control/Set-Up
713	2C9H	Proc Trim Fltr K		0	0	100	EE	Process Trim Control/Set-Up
714	2CAH	Proc Trim Preload		0	–32767	32767	EE	Process Trim Control/Set-Up
715	2CBH	Proc Trim KI		1638	0	32767	EE	Process Trim Control/Set-Up

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
716	2CCH	Proc Trim KP		4096	0	32767	EE	Process Trim Control/Set-Up
717	2CDH	Proc Tri Lo Lim		–4096	–32767	32767	EE	Process Trim Control/Set-Up
718	2CEH	Proc Trim Hi Lim		4096	–32767	32767	EE	Process Trim Control/Set-Up
719	2CFH	Proce Trim Out K		1.000	–16.0	+16.0	EE	Process Trim Control/Set-Up
720	2D0H	Ovld Pend Level	%	115	0.0244	260	EE	Fault Detection/Set-Up
721	2D1H	Proc Trim Lo Sum	RPM	–6xB.S.	–6xB.S.	0	EE	Process Trim Control/Setup
722	2D2H	Proc Trim Hi Sum	RPM	+6xB.S.	+6xB.S.	+6xB.S.	EE	Process Trim Control/Set-Up
724	2D4H	ABS Overspeed	RPM	175	0	B.S.	EE	Process Trim Control/Set-Up
725	2D5H	Ext Overtemp Dly	SEC	1.0	0.1	3276.7	EE	Fault Detection/Set-Up
726	2D6H	SCR Overtemp Dly	SEC	1.0	0.1	3276.7	EE	Fault Detection/Set-Up
727	2D7H	Stall Delay	SEC	10.0	0	100	EE	Fault Detection/Set-Up
728	2D8H	AC Line Tol Dly	SEC	0.1	0	1.0	EE	Fault Detection/Set-Up
729	2D9H	Field Fault Threshold	%	30	0	100	EE	Fault Detection/Set-Up
730	2DAH	Fld Failure Dly	SEC	1.0	0.1	5.0	EE	Fault Detection/Set-Up
731	2DBH	Tach Loss CEMF	%	10.01	0	50.0	EE	Fault Detection/Set-Up
732	2DCH	Tach Loss Vel	%	2.002	.2441	50.0	EE	Fault Detection/Set-Up
733	2DDH	Arm Bridge Type		1	0	1	EE	Auto Tuning Setup/Basic
734	2DEH	K Discontinuous		288	4	2048	EE	Current PI Control/Autotune
735	2DFH	KP Armature Loop		2330	0	32767	EE	Current PI Control/Autotune
736	2E0H	KI Armature Loop		386	0	32767	EE	Current PI Control/Autotune
737	2E1H	KP Field Loop		16384	0	32767	EE	Field PI Control/Set-Up
738	2E2H	KI Field Loop		168	0	32767	EE	Field PI Control/Set-Up
739	2E3H	K Arm Volts		12500	3000	25000	EE	Feedback Control/Basic
740	2E4H	K AC Volts		7225	2000	15000	EE	Feedback Control/Basic
741	2E5H	Cur Desired BW	Rad/Sec	500	40	1000	EE	AutoTuning Setup/Autotune
742	2E6H	Cur Max BW	Rad/Sec	500	40	1000	EE	AutoTuning Setup/Autotune
743	2E7H	Cur Damp Factor		1.0	0.8	3.0	EE	AutoTuning Setup/Autotune
744	2E8H	Bridge Switch Delay		2	0	75	EE	Basic
745	2E9H	K_Disc_fraction		0.0	0.0	0.9	EE	Current PI Control/Autotune
746	2EAH	Arm_Volt_Offset	Volts	0.0	–20.0	20.0	EE	Basic
780	30CH	Firmware Ver No.	X.XX	X.XX	0			
840	348H	SP Indirect 1		0	–32767	32767	EE	SP Control/Configuration
841	349H	SP Indirect 2		0	–32767	32767	EE	SP Control/Configuration
842	34AH	SP Indirect 3		0	–32767	32767	EE	SP Control/Configuration
843	34BH	SP Indirect 4		0	–32767	32767	EE	SP Control/Configuration
844	34CH	SP Indirect 5		0	–32767	32767	EE	SP Control/Configuration
900	384H	Trend Sign Val		0	–32767	32767	EE	Trend Function
901	385H	Trend Sign Val		0	–32767	32767	EE	Trend Function
902	386H	Trend Sign Val		0	–32767	32767	EE	Trend Function
903	387H	Trend Sign Val		0	–32767	32767	EE	Trend Function

Table 7.A Cont.

PARM	HEX	NAME	UNITS	INIT	MIN	MAX	EE	FUNCTION/CLASSIFICATION/PORT
904	388H	Trend Logic Value		0	0	See Descrip	EE	Trend Function
905	389H	Trend Logic Value		0	0	See Descrip	EE	Trend Function
906	38AH	Trend Logic Val		0	0	32767	EE	Trend Function
907	38BH	Trend Logic Val		0	0	32767	EE	Trend Function
908	38CH	Trend Unsign Val		0	0	+16.0	EE	Trend Function
909	38DH	Trend Unsign Val		0	0	260	EE	Trend Function
910	38EH	Tr1 Opnd Parm X		100	1	947	EE	Trend Function
911	38FH	Tr1 Opnd Parm Y		904	1	947	EE	Trend Function
912	390H	Tr1 Operator		.AND	.GT	.NOR	EE	Trend Function
913	391H	Tr1 Sample Rate	SEC	0.02	0.004	30	EE	Trend Function
914	392H	Tr1 Post Samples		30	0	99	EE	Trend Function
915	393H	Tr1 Cont Trigger		1	0	1	EE	Trend Function
916	394H	Tr1 Enable		0	0	1	EE	Trend Function
917	395H	Tr1 Output Rate	SEC	0.04	0.004	30	EE	Trend Function
920	398H	Tr2 Opnd Param X		100	1	947	EE	Trend Function
921	399H	Tr2 Opnd Param Y		904	1	947	EE	Trend Function
922	39AH	Tr2 Operator		.AND	.GT	.NOR	EE	Trend Function
923	39BH	Tr2 Sample Rate	SEC	0.02	0.004	30	EE	Trend Function
924	39CH	Tr2 Post Samples		30	0	99	EE	Trend Function
925	39DH	Tr2 Mult Trigger		1	0	1	EE	Trend Function
926	39EH	Tr2 Enable		0	0	1	EE	Trend Function
927	39FH	Tr2 Output Rate	SEC	0.04	0.004	30	EE	Trend Function
930	3A2H	Tr3 Opnd Param X		100	1	947	EE	Trend Function
931	3A3H	Tr3 Opnd Param Y		904	1	947	EE	Trend Function
932	3A4H	Tr3 Operator		.AND	.GT	.NOR	EE	Trend Function
933	3A5H	Tr3 Sample Rate	SEC	0.02	0.004	30	EE	Trend Function
934	3A6H	Tr3 Post Samples		30	0	99	EE	Trend Function
935	3A7H	Tr3 Mult Trigger		1	0	1	EE	Trend Function
936	3A8H	Tr3 Enable		0	0	1	EE	Trend Function
937	3A9H	Tr3 Output Rate	SEC	0.04	0.004	30	EE	Trend Function
940	3ACH	Tr4 Opnd Param X		100	1	947	EE	Trend Function
941	3ADH	Tr4 Opnd Param Y		904	1	947	EE	Trend Function
942	3AEH	Tr4 Operator		.AND	.GT	.NOR	EE	Trend Function
943	3AFH	Tr4 Sample Rate	SEC	0.02	0.004	30	EE	Trend Function
944	3B0H	Tr4 Post Samples		30	0	99	EE	Trend Function
945	3B1H	Tr4 MultTrigger		1	0	0	EE	Trend Function
946	3B2H	Tr4 Enable		0	0	1	EE	Trend Function
947	3B3H	Tr4 Output Rate	SEC	0.04	0.004	30	EE	Trend Function

NOTE: All parameter numbers not listed in this table are currently not in use.

Parameter Descriptions

This section provides a brief description of the parameters in the Bulletin 1395. The programming terminal for the 1395 is also used for other products. Parameters not used by the 1395 will appear as follows "NOT USED, NOT CHANGEABLE". Information is provided in the following format:

Parameter Number – Parameter Name [Parameter Name as it appears on the Programming Terminal].

Internal Units – Definition of per unit numbers used internally by the Bulletin 1395 Control.

Programming Terminal Units – Scaled engineering units which appear on the Programming Terminal.

Minimum – Minimum value in engineering units where possible.

Maximum – Maximum value in engineering units where possible.

Default – Initial default in engineering units where possible.

Description – Brief Description of the use and operation of the parameter.

Parameters (Numerical)

Parameter 10 – SP Output 1 [SP Output 1]

Internal Units :
Programming Terminal units :
Description : This is a fast source from Parameter 840

Parameter 11 – SP Output 2 [SP Output 2]

Internal Units :
Programming Terminal units :
Description : This is a fast source from Parameter 841

Parameter 12 – SP Output 3 [SP Output 3]

Internal Units :
Programming Terminal units :
Description : This is a fast source from Parameter 842

Parameter 13 – SP Output 4 [SP Output 4]

Internal Units :
Programming Terminal units :
Description : This is a fast source from Parameter 843

Parameter 14 – SP Output 5 [SP Output 5]

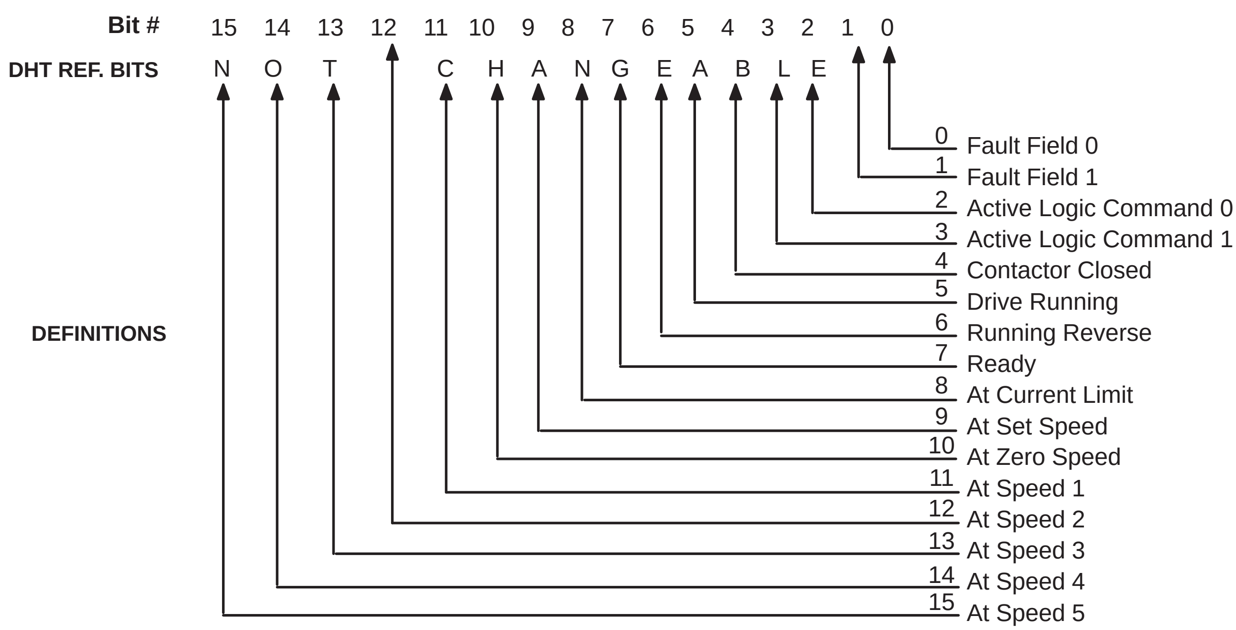
Internal Units :
Programming Terminal units :
Description : This is a fast source from Parameter 844

Parameter 100 – Logic Status [Logic Status]

Internal Units : None

Programming Terminal units : Bit Field

Description : This is a word of status data that indicates conditions within the Drive in boolean logic. Where a bit is set to 1, the corresponding condition in the drive is true, otherwise the condition is false. The bits in the Logic Status word are defined as:



Fault Field 0, 1 (Bits 0, 1) : This 2-bit field denotes the fault status of the Drive as follows:

Flt. Fld. 1	Flt. Fld. 0	DEFINITION
0	0	No Fault
0	1	Warning Fault
1	0	Soft Fault
1	1	Hard Fault

Active Logic Command 0,1 (Bits 2,3) : This 2-bit field denotes the logic command the Drive is acting upon as follows:

Logic CMD 1	Logic CMD. 0	DEFINITION
0	1	Parameter 150
1	0	Parameter 151
1	1	Parameter 152

Contactor closed (Bit 4) : A 1- bit field indicating the status of the contactor. 1 denotes contactor closed and 0 denotes open.

Drive running (Bit 5) : A 1-bit field, when set to 1, indicates the drive has acknowledged the start or jog inputs in the logic command and is regulating speed. 1 denotes Drive is running and zero not running.

Running reverse (Bit 6) : A 1-bit field, indicating the motor is moving at a non-zero velocity in the reverse direction. 1 denotes reverse rotation and 0 denotes zero or forward rotation.

Ready (Bit 7) : A 1-bit field, when set to 1, indicates the drive is ready to accept a start command, and regulate to the speed or torque selected. Set to 0 indicates not ready. Conditions required for ready are: no Stop input from any logic command, no hard or soft fault, ECOAST closed, less than 15% armature voltage. Contactor Type set correctly (Parameter 622). Parameter 620 set to 0, if TB3 is used for reset or not wired. The Ready will be set to 0 unless all of the previous conditions are true.

At current limit (Bit 8) : A 1-bit field that is set to 1 when the armature current request exceeds the forward or reverse bridge current limit value. It is set to 0 if the armature current request is within the forward and reverse bridge limits. The Armature Current Reference (Parameter 111) is compared to the forward bridge current limit (Parameter 663) and the Reverse Bridge Current Limit (Parameter 664) to accomplish this.

At set speed (Bit 9) : A 1-bit field that is set to 1 when the actual velocity of the motor is within a tolerance of the selected reference speed. Otherwise, set to 0. Internally in the drive, feedback velocity is compared to the Pre Ramp Velocity reference (Parameter 102), and if the difference is within the Up To Speed tolerance (Parameter 709), the at speed bit is set to 1.

At zero speed (Bit 10) : A 1-bit field that is set to 1 when the actual velocity of the motor is within a tolerance of zero speed. Otherwise, set to 0. Internally in the drive, if the Feedback Velocity (Parameter 106) is within the Zero Speed Tolerance band (Parameter 710), then At Zero Speed bit is set to 1.

At Speed 1 (Bit 11) : A 1-bit field that is set to 1 when the actual velocity of the motor is within a tolerance of the at speed 1 setpoint. Otherwise, set to 0. Internally in the drive, feedback velocity (Parameter 106) is compared to at speed 1 (Parameter 704), and if the absolute value of the difference is within the Up To Speed tolerance (Parameter 709), the At Speed 1 bit is set to 1.

At speed 2 (Bit 12) : A 1-bit field that is set to 1 when the actual velocity of the motor is within a tolerance of the at speed 2 setpoint. Otherwise, set to 0. Internally in the drive, feedback velocity (Parameter 106) is compared to at speed 2 (Parameter 705), and if the absolute value of the difference is within the up to speed tolerance (Parameter 709), the At Speed 2 bit is set to 1.

At speed 3 (Bit 13) : A 1-bit field that is set to 1 when the actual velocity of the motor is greater than the at speed 3 setpoint. Otherwise, set to 0. Internally in the drive, if the Feedback Velocity (Parameter 106) is greater than or equal to At Speed 3 (Parameter 706), the At Speed 3 bit is set to 1.

At speed 4 (Bit 14) : A 1-bit field that is set to 1 when the actual velocity of the motor is greater than the at speed 4 setpoint. Otherwise, set to 0. Internally in the drive, if the Feedback Velocity (Parameter 106) is greater than or equal to at speed 4 (Parameter 707), the At Speed 4 bit is set to 1.

At speed 5 (Bit 15) : A 1-bit field that is set to 1 when the actual velocity of the motor is greater than the At Speed 5 setpoint. Otherwise, set to 0. Internally in the drive, if the Feedback Velocity (Parameter 106) is greater than or equal to At Speed 5 (Parameter 708), the At Speed 5 bit is set to 1.

ATTENTION: Any of the source outputs of the Drive (Parameters 100-125) may not be reliable if the drive is hard or soft faulted. As a result, precautions should be taken when using these outputs for PLC's, analog outputs to meters, discrete outputs, etc. The ready/faulted output on TB3 is the most reliable indicator of drive fault status.

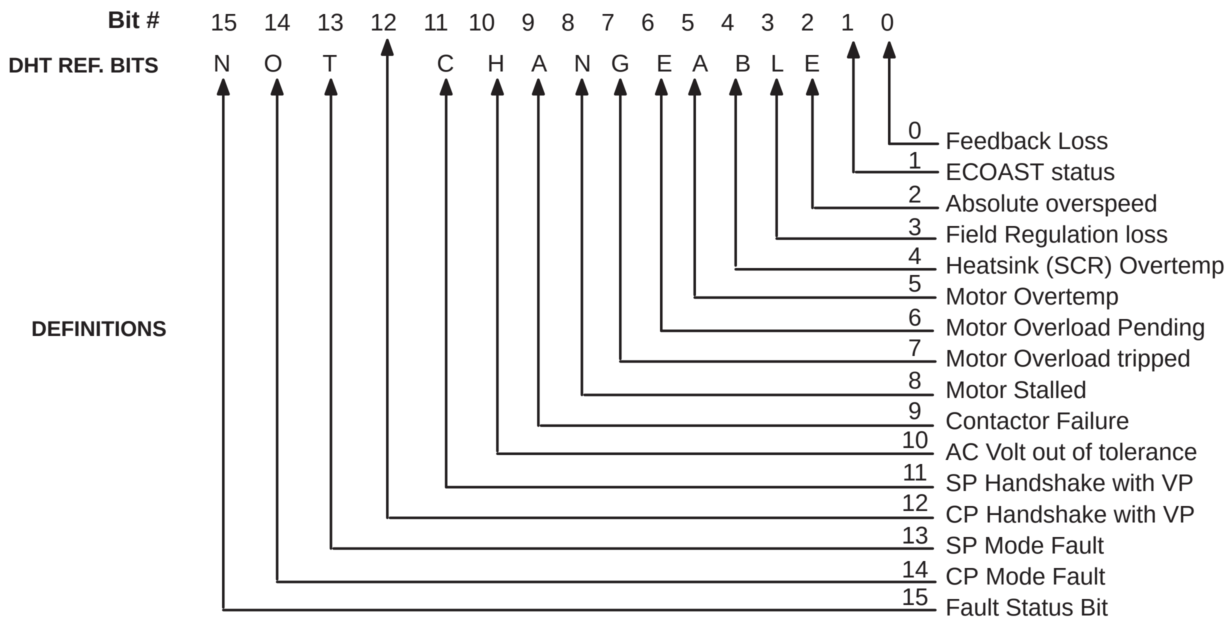
Parameter 101 – Drive Fault [Drive Fault]

Internal units : None

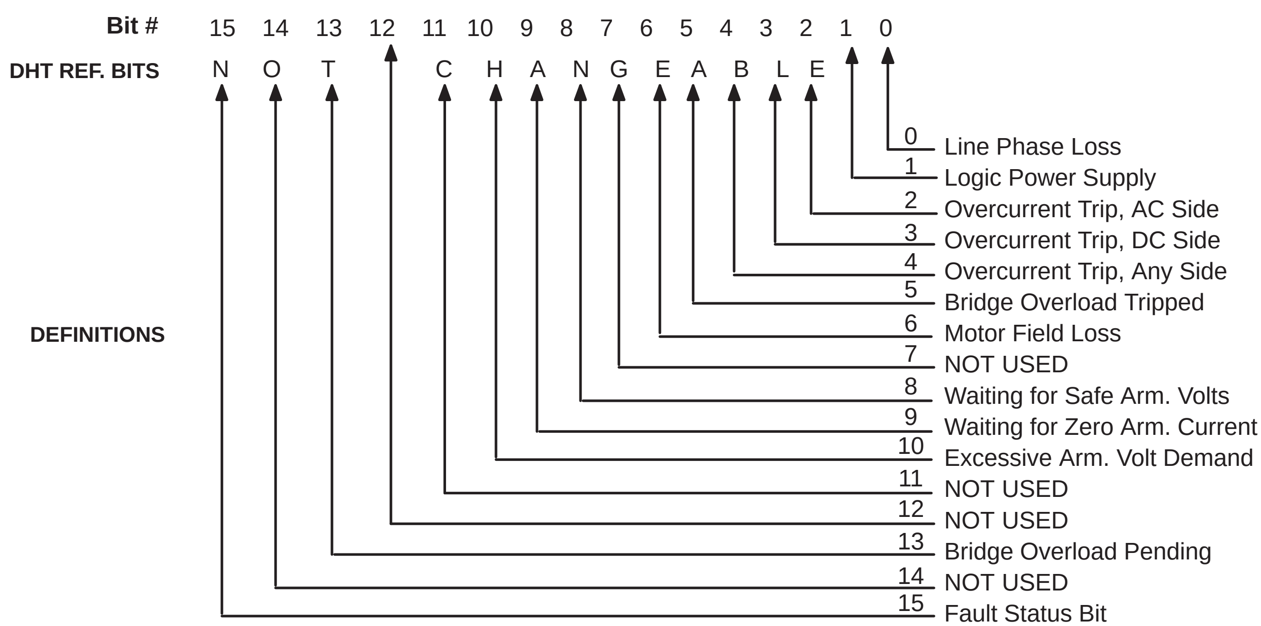
DHT units : Bit field

Description : A status word maintained by the Drive stating a fault is true (bit set to 1) or false (bit set to 0). Fault Report (param 630) determines if Velocity Control faults will be reported (630 = 1) or if Current Control faults will be reported (630 = 0). Bit 15 is a status bit that indicates which control faults are being reported. If bit 15 = 1, velocity control faults are being reported. If bit 15 = 0, current control faults are being reported. The bits in the drive fault word are defined as:

IF VELOCITY CONTROL FAULTS ARE SELECTED: (630 = 1)



IF CURRENT CONTROL FAULTS ARE SELECTED: (630 = 0)



For detailed descriptions of the bits in Parameter 101 refer to the 1395 Troubleshooting Manual.

Parameter 102 – Pre Ramp Velocity Reference [Pre Ramp Vel Ref]

Internal Units : 4096 = 1000h = 1 pu = base motor speed

Programming Terminal units : RPM

Description : This parameter indicates the value of the velocity reference that has been currently selected by the reference control. When a 32 bit velocity reference is used, this will be the most significant 16 bits or upper word. This data is input to the velocity reference ramp software.

Parameter 103 – Ramp Velocity Reference [Ramp Vel Ref]

Internal Units : 4096 = 1000h = 1 pu = base motor speed

Programming Terminal units : RPM

Description : This parameter indicates the value of the Ramp Velocity Reference after being processed by the Linear Accel/Decel Ramp and S Contour filter. The number contained in this variable is conditionally offset by the output of the Droop and Process Trim functions and then becomes the Final Velocity Reference (Parameter 104).

The value of Parameter 103 represents the most significant 16 bits or upper word when a 32 bit speed reference is in use.

Parameter 104 – Final Velocity Reference [Final Vel Ref]

Internal units : 4096 = 1000h = 1 pu = base motor speed

Programming Terminal units : RPM

Description: This parameter indicates the value of the Ramp Velocity Reference after being offset by the Droop Compensation and Process Trim output variables.

The value of Parameter 104 represents the most significant 16 bits or upper word when a 32 bit speed reference is in use.

Parameter 105 – Armature Voltage Feedback [Arm Voltage Fdbk]

Internal units : 4096 = 1000h = 1 PU = rated Motor voltage

Programming Terminal units : volts

Description: This parameter indicates the present value of the armature voltage feedback. It is scaled in internal units so that a value of 4096 represents rated motor voltage.

Parameter 106 – Velocity Feedback [Velocity Fdbk]

Internal Units : 4096 = 1000h = 1 PU = base motor speed

Programming Terminal units : RPM

Description : Velocity Feedback indicates the latest measured motor velocity. This information could originate from a digital encoder, analog tachometer, or armature voltage feedback, depending upon the selected feedback device (Parameter 621).

Parameter 107 – Position Feedback [Position Fdbk]

Internal Units : 4096 = 1000h = 1 PU = 1 pu position

Programming Terminal units : None

Description : Position Feedback indicates the latest measured angular motor position. This information could originate from a digital encoder, analog tachometer, or armature voltage feedback, depending upon the selected feedback device (Parameter 621). This signal will be scaled so that 31250 represents the change in motor position that will occur over 1 second when running at base motor speed. It is also true that the position change per motor revolution is equal to 1,875,000/ base motor speed in RPM

Parameter 108 – Velocity Feed Forward [Vel Feed Fwd]

Internal Units : 4096 = 1000h = 1 PU = base motor speed

Programming Terminal units : RPM

Description : Velocity Feed Forward indicates the difference between the Final Velocity Reference (Parameter 104) multiplied by the KF term and Velocity Feedback (Parameter 106). This value, when multiplied by the KP Velocity Loop gain divided by 8, becomes the proportional part of the Torque Command.

Parameter 109 – Position Error [Position Error]

Internal Units : 4096 = 1000h = 1 pu position

Programming Terminal units : None

Description : Position Error indicates the difference between the Position Reference and Position Feedback (Parameter 107). Position Reference is the integrated value of Parameter 104 (Final Vel Ref) and has the same units as Parameter 107 (Position Feedback). Position Error when multiplied by the KI Velocity Loop gain, becomes the integral part of the Torque Command (Parameter 110).

Parameter 110 – Torque Command [Torque Command]

Internal Units : 4096 = 1000h = 1 PU = 100% rated torque

Programming Terminal units : Percent rated torque

Description : Torque Command indicates the latest "torque reference" value. 100% rated torque is the motor torque produced at rated motor armature current and rated motor field current.

The source of the Torque Command is determined by the selection made in Torque Mode (Parameter 625).

Parameter 111 – Armature Current Reference [Arm Current Ref]

Internal Units : 4096 = 1000h = 1 PU = 100% rated arm. current

Programming Terminal units : Amps

Description : The parameter indicates the latest armature current reference value. This is the Torque Command after it has been divided by the Flux Command, range limited to the forward and reverse current limits, and then slew limited to the di/dt limit value (Parameter 668).

Parameter 112 – Armature Current Feedback [Arm Current Fdbk]

Internal Units : 4096 = 1000h = 1 PU = 100% rated arm. current

Programming Terminal units : Amps

Description : This parameter indicates the latest armature current feedback value.

Parameter 113 – Armature Current PI Output [Arm Current PI Out]

Internal Units : 2048 = 1 pu armature voltage

Programming Terminal units : None

Description : This parameter indicates the latest output of the armature current PI regulator.

Parameter 114 – Armature Current Firing Angle [Arm Cur Fire Ang]

Internal Units : 2048 = 90 degrees

Programming Terminal units : None

Description : This parameter indicates the latest armature current firing angle, angle of retard, alpha.

Parameter 115 – Flux Command [Flux Command]

Internal Units : 4096 = 1000h = 1 PU = 100% rated field flux

Programming Terminal units : Percent rated field flux

Description : This parameter indicates the latest field flux reference value as determined by the field control. When field weakening, this parameter may be less than the Field Flux Reference (Parameter 676) or the Field Economy Reference (Parameter 674).

100% rated field flux represents the motor field flux present when operating at base motor speed with the rated armature voltage present across the armature. For a constant motor speed, as field flux is reduced, the armature voltage should decrease proportionally. The field flux linearization table (Parameter 677 thru 685) ensures that the relationship between field flux and armature voltage remains linear.

Parameter 116 – AC Line Voltage [AC Line Voltage]

Internal Units : volts x 10

Programming Terminal units : Volts

Description : This parameter indicates the latest AC line voltage as measured by the drive.

Parameter 117 – Field Current Reference [Fld Current Ref]

Internal units : 4096 = 1000h = 1 pu = 100% rated motor field current

Programming Terminal units: Amps

Description : This parameter indicates the latest field current reference as calculated by the drive. This value is derived from the Flux Command by use of the flux linearization table (Parameter 677-685).

Parameter 118 – Field Current Feedback [Fld Current Fdbk]

Internal units : 4096 = 1000h = 1 pu = 100% rated motor field current
Programming Terminal units: Amps
Description : This parameter indicates the latest field current feedback value as measured by the drive.

Parameter 119 – Process Trim Output [Proc Trim Output]

Internal units : 4096 = 1000h = 1 pu
Programming Terminal units: None
Description : This parameter represents the scaled and limited output of the process trim function. The Process trim consists of a general purpose PI regulator that uses reference and feedback inputs (Parameters 161 and 162). The number contained in this parameter may also be used to offset the velocity or torque reference by making the appropriate selection in Process Trim Select (Parameter 628).

Parameter 120 – CEMF Feedback [CEMF FEEDBACK]

Internal units : 4096 = 100% rated motor voltage
Programming Terminal units: Volts
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the value of CEMF used as a feedback value for the CEMF PI regulator in the drive. It is calculated by subtracting the motor IR drop from the actual Armature Voltage Feedback. The Armature Resistance, Parameter 614, is used to calculate the motor IR Drop.

Parameter 121 – Flux Trim [FLUX TRIM]

Internal units : 4096 = 100% rated motor voltage
Programming Terminal units: %
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the value of Field Flux Trim from the output CEMF regulator in the Drive.

Parameter 122 – Encoder Velocity [ENCODER VELOCITY]

Internal units : 4096 = base motor speed
Programming Terminal units: RPM
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the measured velocity feedback from the encoder feedback

Parameter 123 – Velocity PI Output [VELOCITY PI OUT]

Internal units : 4096 = 100% rated motor torque
Programming Terminal units: %
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the value of the output of the Velocity PI Regulator. This value will match the value in Torque Command (Param #110) when in Speed Mode (param #625 = 1).

Parameter 124 – Velocity Error [VELOCITY ERROR]

Internal units : 4096 = base motor speed
Programming Terminal units: RPM
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the difference between the Final Velocity Reference (Param #104) and Velocity Feedback (param #106).

Parameter 125 – Process Trim PI Input [PTRIM PI INPUT]

Internal units : 4096 = 1 per unit
Programming Terminal units: None
Minimum Value: N/A
Maximum Value: N/A
Default Value: N/A
Function: Software Test Point
Description : This is the input to the Process Trim Regulator.

ATTENTION: Any of the source outputs of the Drive (Parameters 100-125) may not be reliable if the drive is hard or soft faulted. As a result, precautions should be taken when using these outputs for PLC's, analog outputs to meters, discrete outputs, etc. The ready/faulted output on TB3 is designed to indicate drive fault status.

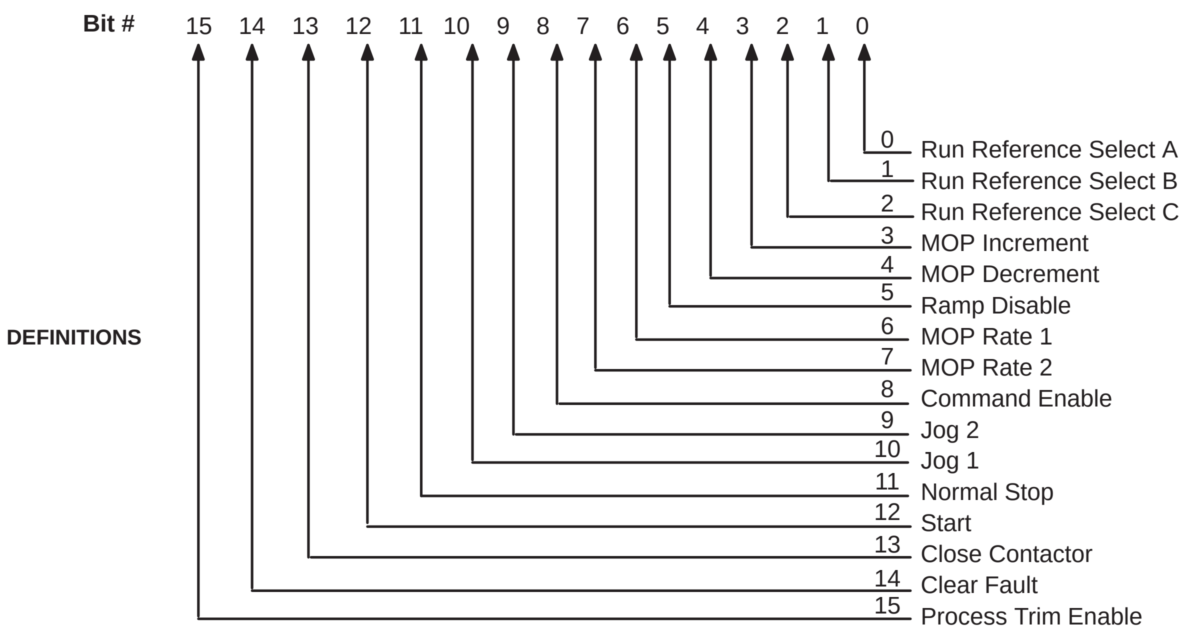
Parameter 150 – Logic Command 1 [Logic Cmd 1]

Internal units : None

Programming Terminal units: Bit Field

Description : This is a word of fast data used to control drive logic operation. The information is contained in binary (boolean) form. If a bit is set, the associated function is enabled, otherwise the function is disabled (inactive).

The functions contained in Logic Command 1 are similar to those in Logic Command 2 and 3. The software checks the state of this signal in Logic Command 3. It then checks to see if the Command Enable Signal is present in Logic CMD 1 before making the selection of Logic Command 1 or 2. In Logic Command 2, the command enable bit is ignored. Regardless of the selected Logic Command word (1, 2, or 3), a Stop request from any Logic Command word will be honored. The bits in the Logic Command words are defined as follows:



In addition to the basic bit definitions provided above, several bits are used together for the purpose of selection. Bits 0,1,2 are grouped to determine which speed reference is used for input to the velocity control. Bits 6 and 7 are used to determine which MOP Accel/Decel rates are in effect.   Bit usage is defined in tables 7.B and 7.C.

Run Reference Select (bits 0,1,2) : These three bits select the velocity reference for the motor. The Start input in the logic command will close the contactor and the drive will run the motor at the velocity selected by these run reference select bits. For each run reference select combination, there corresponds a speed reference parameter.

Table 7.B
Logic Command Word Bits 0,1,2

2	1	0	Definition	Selected Parameters
0	0	0	External Speed Reference	154
0	0	1	Preset Speed 1	633
0	1	0	Preset Speed 2	634
0	1	1	Preset Speed 3	635
1	0	0	Preset Speed 4	636
1	0	1	Preset Speed 5	637
1	1	0	MOP Forward Speed	MOP
1	1	1	MOP Reverse Speed	MOP

External speed reference indicates Parameters 153 and 154 will be the velocity reference.

Preset speeds 1 to 5 indicate Parameters 633 to 637 respectively, will be the selected velocity reference.

MOP forward speed selects the positive MOP command velocity. MOP reverse speed selects the negative MOP command velocity. For the MOP function, the start input will cause the MOP forward/reverse speed to be set to the MOP minimum speed (Parameter 650)

MOP increment (Bit 3): A 1 -bit field when set to 1, will cause the MOP to increase speed by the rate selected in the MOP rate bits (6,7) in the logic command. The MOP command velocity will continue to increase until this bit is cleared or a speed limit is reached. This limit can be the MOP Min Speed (Parameter 650) or the reverse speed limit (Parameter 607).

Ramp Disable (Bit 5) : A 1-bit field that will disable the ramp function in the Drive when set to 1. The ramp function limits the rate of change of velocity command, or acceleration/deceleration, to the rate set by the Accel Time and Decel Time parameters (Parameters 651 and 652). The ramp velocity reference (Parameter 103) becomes the same value as the Pre Ramp Velocity reference (Parameter 102) when the ramp disable is set to 1. Ramp disable will also cause the MOP ramp to be bypassed when performing a stop function with a MOP reference selected.

MOP rate 1, 2 (Bits 6,7): A 2-bit field, that will specify the accel and decel rates to be used by the MOP controller. There are four possible rates. Accel and Decel rates are separately adjustable by Parameters 641 to 648. The Table for this two bit field is shown in Table 7.C.

Table 7.C
Logic Command Word Bits 6, 7

Bit 7	Bit 6	Definition	Selected Parameters
0	0	MOP 1 accel, decel	641, 645
0	1	MOP 2 accel, decel	642, 646
0	0	MOP 3 accel, decel	643, 647
1	1	MOP 4 accel, decel	644, 648

Command Enable (Bit 8) : A 1-bit field used to select one of the three logic commands in the Drive. For details see table 7.D.

If the command enable bit is set to 1 in Logic Command 3, then Logic Command 3 is the active logic command accepted by the Drive. If the command enable bit in logic command 3 is set to 0, then the Logic Command 1 is checked. If the command enable in Logic Command 1 is set to 1, then Logic Command 1 is the active logic command accepted by the drive. If the command enable in Logic Command 1 is set to 0, the Logic Command 2 is the active logic command accepted by the Drive. The Logic Command 2 enable bit is ignored.

Table 7.D
Logic Command Word Bit 8

Bit 8	1	0
Logic Command 1	Drive Active From Logic Command 1*	Drive Active From Logic Command 2
Logic Command 2	BIT 8 IGNORED	BIT 8 IGNORED
Logic Command 3	Drive Active From Logic Command 3	Logic Command 1 Checked

* If Logic CMD 3 is 0

A Stop request from any Logic Command word will always be acknowledged, regardless of the state of the command enable bit.

Jog 2 (Bit 9) : A 1-bit field specifying the drive to select the Jog 2 Speed (Parameter 639). When set to 1, the contactor will close and velocity regulation will begin.

The drive will continue to run using the Jog 2 Speed reference until this bit is set to 0. At this time, velocity reference will be set to zero and the drive will regenerate to a stop. Once the motor has stopped, velocity regulation will stop. The contactor will remain closed for the time specified by Jog Dwell (Parameter 711). The ramp function can be selected while jogging by properly programming JOG RAMP ENABLE (Parameter 626).

Jog 1 (Bit 10) : A 1-bit field specifying the drive to select the Jog 1 Speed (Parameter 638). When set to 1, the contactor will close and velocity regulation will begin.

The drive will continue to run using the Jog 1 speed reference until this bit is set to 0. At this time, velocity reference will be set to zero and the drive regenerate to a stop. Once the motor has stopped, velocity regulation will stop. The contactor will remain closed for the time specified by Jog Dwell (Parameter 711). For jogging, the ramp function may be using the Jog Ramp Enable (Parameter 626).

Normal Stop (Bit 11) : A 1-bit field specifying the drive to decelerate the motor to zero velocity, and when at zero velocity, open the contactor. The normal stop bits in both Logic Command 1,2 and 3 are active, regardless of the state of the command enable bit in Logic Command 1 or 3. Normal Stop will override the Start function.

Important: Refer to Chapter 6 – Installation, for important information and warnings regarding stop mode interfaces with the 1395.

Start (Bit 12) : A 1-bit field specifying the drive to close the contactor and run the motor at the speed specified in the reference select A, B or C in the logic command (bits 0,1,2). This bit will be treated as a maintained signal if the Maintained Start (Parameter 624) is set to 1. For a maintained Start, the motor will stop should this bit be cleared. If maintained Start is not selected (Parameter 624 = 0), this bit will be latched by the Drive and a Stop input will be required to stop the motor.

Close Contactor (Bit 13) : A 1-bit field when set to 1, closes the motor contactor. When set to 0, opens the contactor. On the rise of this input, the contactor will be manually closed. The contactor will remain closed until this bit is set to 0, or a hard fault, soft fault or ECOAST request occurs.

Clear Fault (Bit 14) : A 1-bit field that will clear all warning and most soft faults present in the Drive when set to 1. When set to 0, the clear faults is inactive. Hard faults (except Communication Faults via PLC/RIO) require system reset or cycling of control power.

Process trim enable (Bit 15): A 1-bit field that will make the Process trim function active when set to 1. The Process Trim Reference and Feedback (Parameters 161,162) will be used to generate the Process Trim Output (Parameter 119). When this bit is set to 0, the Process Trim Output is set to zero and the Process Trim Reference and Feedback inputs are not used.

Parameter 151 – Logic Command 2 [Logic Cmd 2]

Internal units : None

Programming Terminal units: Bit Field

Description : This word controls Drive logic operation when the Command/Enable bit in Logic Command 1 and Logic Command 3 is low (0). The Stop request bit in Logic Command 2 is active, regardless of the Command/Enable selection status. All other functions present in Logic Command 2 are identical to Logic Command 1.

Parameter 152 – Logic Command 3 [Logic Cmd 3]

Internal units : None

Programming Terminal units: Bit Field

Description : This controls Drive logic operation when the Programming Terminal is in control of the Drive. All functions present in Logic Command 3 are identical to Logic Command 1. The Command/Enable bit in logic command 3 will select Drive control with logic command 3 (if set) regardless of the state of the Command/Enable bit in other logic words. The Stop bit in logic command word 3 is logically OR'D with the Stop bits in logic command word 1 and 2.

Parameter 153 – Velocity Reference Fraction [Vel Ref Fraction]

Internal units : 65535 = ffffh = base motor speed / 4096

Programming Terminal units: None

Description : This word supplies the fractional part of an external velocity reference when external velocity control has been selected in the Logic Command word. The data contained in this word represents the low order, fractional portion of a 32 bit velocity reference.

The motor base speed value is always equated to the following number representation:

Parameter 154	Parameter 153
+/– 4,096	0

Use of this parameter allows extended resolution when specifying an external velocity reference. Note that a value of 32768 (8000h) is equivalent to 1/2 of 1 unit of reference in Parameter 154. Similarly, 16384 (4000h) is equivalent to 1/4 of 1 unit of reference, and 65535 (ffffh) is equivalent to 65535/65536 or 1 unit of reference. In this way, Parameter 153 can be thought of as a means of specifying an additional fraction of one unit of velocity reference for Parameter 154. If fraction resolution is not needed, then Parameter 153 should not be linked and its value will be defaulted to zero.

Parameter 154 – Velocity Reference Whole [Vel Ref Whole]

Internal units : 4096 = 1000h = 1 pu = base motor speed

Programming Terminal units: RPM

Description : This word supplies the whole number part of an external velocity reference when external velocity control has been selected in the Logic Command word. The data contained in this word represents the high order, whole number portion of a 32 bit velocity reference.

Parameter 156 – Tach Velocity [Tach Velocity]

Internal units : 4096 = 1000h = 1 pu = base motor speed

Programming Terminal units: RPM

Description : This word supplies a motor velocity feedback signal when an analog tachometer is used. This input will typically be linked to an analog input parameter from the Discrete Adapter Board. The analog scaling for the adapter should be set up so that a value of 4096 in this parameter represents base motor speed.

When Tach Velocity is used for velocity feedback, a value of "2" must be entered in Feedback Device Type (Parameter 621).

Parameter 157 – Torque Reference [Torque Reference]

Internal units : 4096 = 1000h = 1 pu = 100% rated motor torque

Programming Terminal units: Percent rated motor torque

Description : This word supplies an external motor torque reference to the Drive. The external torque reference can be selected by setting Torque Mode (Parameter 625) to a value of "2". The external torque reference can also be modified by summing the Process Trim output when the Process Trim Select (Parameter 628) contains a value of "2".

The external torque reference input is also used when either the "minimum" or "maximum" torque modes are selected (Parameter 625). These functions automatically make a selection between the external torque reference value and the output of the velocity speed regulator.

The external torque reference input should be scaled so that a value of 4096 represents 100% rated motor torque. This is the torque that the motor would produce when operating at rated armature current and rated field current.

Parameter 159 – Flux Feed Forward [Flux Feed Fwd]

Internal units : 4096 = 1000h = 1 pu = 100% motor field flux

Programming Terminal units: Percent of full motor field flux.

Description : This word supplies an external flux reference to the Drive. The drive will use this input when the External Feed Forward Enable Bit is set in Flux Mode Select (Parameter 627).

This input could be used to bypass the flux calculation in the flux control software. The flux calculation produces a flux command that is inversely proportional to speed when motor speeds are above the Minimum Field Regulate Speed.

Parameter 160 – CEMF Reference [CEMF Reference]

Internal units : 4096 = 1000h = 100% motor CEMF

Programming Terminal units: Percent of full motor CEMF.

Description : This word supplies an external CEMF reference to the flux control. This input would be used when it is desired to operate the field flux control in the CEMF mode of operation. The Drive will use this input when the CEMF Control Enable bit is set in Flux Mode Select (Parameter 627).

The flux control will use the CEMF reference input as both the variable in the flux calculation and also as the reference input to the CEMF regulator. The flux calculation produces a flux command that is inversely proportional to speed when motor speeds are above the Field Weakening Speed (Parameter 686).

Parameter 161 – Process Trim Reference [Process Trim Ref]

Internal units : 4096 = 1000h = 1pu

Programming Terminal units : None

Description : This is the reference input value for Velocity Trim. When the Process Trim function has been enabled by setting the Trim Enable bit in the Logic Command parameter, then this input will be used by the process trim PI regulator. Process trim will then update the Process Trim Output (Parameter 119) based on the value of this input.

Parameter 162 – Process Trim Feedback [Process Trim Fdbk]

Internal units : 4096 = 1000h = 1pu
Programming Terminal units : None
Description : This is the feedback value for Process Trim. When the Process Trim has been enabled by setting the Process Trim Enable bit in the Logic Command parameter, then this input will be used by the process trim PI regulator. Process Trim will then update the Process Trim Output parameter based on the value of this input.

Parameter 163 – Velocity Indirect 1 [Vel Indirect 1]

Internal units :
Programming Terminal units :
Description : This is the Fast Sink, with its pointer in Parameter 600, Velocity Parameter Select 1.

Parameter 164 – Velocity Indirect 2 [Vel Indirect 2]

Internal units :
Programming Terminal units :
Description : This is the Fast Sink, with its pointer in Parameter 601, Velocity Parameter Select 2.

Parameter 165 – Velocity Indirect 3 [Vel Indirect 3]

Internal units :
Programming Terminal units :
Description : This is the Fast Sink, with its pointer in Parameter 602, Velocity Parameter Select 3.

Parameter 166 – Velocity Indirect 4 [Vel Indirect 4]

Internal units :
Programming Terminal units :
Description : This is the Fast Sink, with its pointer in Parameter 603, Velocity Parameter Select 4.

Parameter 167 – Torque Reference 2 [TORQUE REF 2]

Internal units : 4096 = 100% Rated Motor Torque
Programming Terminal units : Percent Rated Motor Torque
Minimum Value: NA
Maximum Value: NA
Default Value: 0
Function: Torque Control

Description : This is a Parameter Sink that can be used to bring a second Torque Reference into the Drive. The data that is linked to this parameter is scaled using the Slave % 2 parameter and then summed with the Torque Reference value from Parameter #157.

Parameter 600 – Velocity Parameter 1 Select [Vel Param 1 Sel]

Internal units : RPM
Programming Terminal units: RPM
Minimum Value: 600
Maximum Value: 732
Default Value: 600

Description : This is the pointer for Parameter 163 Velocity Indirect 1

Parameter 601 – Velocity Parameter 2 Select [Vel Param 2 Sel]

Internal units : RPM
Programming Terminal units: RPM
Minimum Value: 600
Maximum Value: 732
Default Value: 601

Description : This is the pointer for Parameter 164 Velocity Indirect 2

Parameter 602 – Velocity Parameter 3 Select [Vel Param 3 Sel]

Internal units : RPM
Programming Terminal units: RPM
Minimum Value: 600
Maximum Value: 732
Default Value: 602

Description : This is the pointer for Parameter 165 Velocity Indirect 3

Parameter 603 – Velocity Parameter 4 Select [Vel Param 4 Sel]

Internal units : RPM
Programming Terminal units: RPM
Minimum Value: 600
Maximum Value: 732
Default Value: 603

Description : This is the pointer for Parameter 166 Velocity Indirect 4

Parameter 606 – Base Motor Speed [Base Motor Speed]

Internal units : RPM
Programming Terminal units: RPM
Minimum Value: 1
Maximum Value: 6000
Default Value: 1750

Description : Nameplate base motor speed in RPM.

Parameter 607 – Reverse Speed Limit [Rev Speed Limit]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: 0
Default Value: – base speed

Description : This parameter sets a limit on velocity reference in the negative direction and is dependent on the value entered for Base Motor Speed (Parameter 606). The full numerical range for Parameter 607 is 0 to – 6 x the value entered in Parameter 606. The reverse motor speed will not be allowed to exceed this value. This parameter is also used together with the absolute overspeed parameter to determine when an absolute overspeed fault will occur. Note that the value entered for this parameter must be negative.

Parameter 608 – Forward Speed Limit [Fwd Speed Limit]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: 0
Maximum Value: 6 x base speed
Default Value: base speed

Description : This parameter sets a limit on velocity reference in the positive direction and is dependent on the value entered for Base Motor Speed (Parameter 606). The full numerical range for Parameter 607 is 0 to +6 x the value entered in Parameter 606. The forward motor speed will not be allowed to exceed this value. This parameter is also used together with the Absolute Overspeed Parameter to determine when an Absolute Overspeed Fault will occur.

Parameter 609 – Encoder PPR [Encoder PPR]

Internal units : pulses per revolution
Programming Terminal units: PPR
Minimum Value: 100
Maximum Value: 32767
Default Value: 1024

Description : Pulse Per Revolution rating of feedback device when using an encoder mounted on the motor. The encoder is used to determine motor feedback velocity.

Parameter 610 – Rated Motor Voltage [Rated Motor Volt]

Internal units : volts x 10
Programming Terminal units: VOLTS
Minimum Value: 75
Maximum Value: 850
Default Value: 240
Function: Torque Control

Description : Nameplate rated motor voltage. This should be the measured armature voltage when the motor is running at base speed with rated field current.
Note: This parameter WILL NOT limit motor voltage to the value entered. Complete parameter set-up (Chapter 8) is required to prevent overvoltage conditions from occuring.

Parameter 611 – Motor Armature Full Load Amp [Motor Arm FLA]

Internal units : Amps x 10
Programming Terminal units: AMPS
Minimum Value: 0.1
Maximum Value: 32767
Default Value: 0.2

Description : Nameplate rated motor armature current

Parameter 612 – Rated Field Motor Current [Rate Fld Mtr Cur]

Internal units : Amps x 10
Programming Terminal units: AMPS
Minimum Value: 0.1
Maximum Value: 32767
Default Value: 0.1
Description : Nameplate rated motor field current.

Parameter 613 – Motor Inertia [Motor Inertia]

Internal units : seconds x 100
Programming Terminal units: Seconds
Minimum Value: 0.01
Maximum Value: 10.00
Default Value: 6.0
Description : This parameter represents the time, in seconds, taken for the uncoupled motor to accelerate from zero speed to base speed with rated motor armature and field current applied.

Parameter 614 – Armature Resistance [Arm Resistance]

Internal units : 4096 = 1000h = 1 per unit = 100% of rated armature voltage.

Programming Terminal units: Percent of rated armature voltage

Minimum Value: 0%

Maximum Value: 100.0%

Default Value: 5.0%

Description: This parameter represents the armature voltage drop (IR Compensation), expressed as a percent of rated armature volts, that would be measured with the armature locked and with rated motor armature and field current applied. Typical values do not exceed 5%.

Parameter 615 – Rated Armature Bridge Current [Rated Arm Brdg I]

Internal units : Amps x 10

Programming Terminal units: AMPS

Minimum Value: 0.1

Maximum Value: 32767

Default Value: 20.0

Description: The drive armature bridge current per Table 8.I in Chapter 8.

Parameter 616 – Rated Field Bridge Current [Rated Fld Brdg I]

Internal units : Amps x 10

Programming Terminal units: AMPS

Minimum Value: 0.1

Maximum Value: 32767

Default Value: 10.0

Description: The drive field bridge current rating. Used for Field Current Feedback scaling, Field Flux and Field Weakening Control. Refer to Table 8.J in Chapter 8.

Parameter 617 – Rated AC Line Voltage [Rated AC Line]

Internal units : Volts x 10

Programming Terminal units: VOLTS

Minimum Value: 150

Maximum Value: 690

Default Value: 460.0

Description: The AC line voltage connected to the drive.

Parameter 620 – System Reset Select [Sys Reset Select]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 0

Description: This parameter determines whether terminal TB3–3 provides the System Reset function or the Logic Command Stop function. The choices are:

0 = System Reset

1 = Normal Stop

The System Reset function requires a Normally Open operator device which closes to cause a reset. A reset then allows the 1395 to perform its power up sequence. Any data not previously stored in EEPROM will be lost.

The Logic Command Normal Stop function requires a Normally Closed operator device. When opened, the drive will stop. The stop method (ramp stop, coast stop, regen stop, etc.) will be determined by the setting of Parameter 624 (maintain start) and the logic command parameter that has control of the Drive.

Parameter 621 – Feedback Device Type [Fdbk Device Type]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 2
Default Value: 1

Description: Is the selected source for motor velocity feedback. Choices are:

0 = Encoder feedback.

1 = Armature voltage feedback. This limits the motor speed application to base speed or less.
Note: Setting this value to 1 will not limit the motor to base speed or less. This value must be used with parameters 607/608 to properly configure the top motor speed.

2 = Analog tachometer feedback. When choosing this function, an analog input should be linked to Parameter 156 (Tach Velocity).

3 = No feedback device in use. This will disable the speed regulator and tach loss fault detection. This is used in torque mode applications.

Parameter 622 – Contactor Type [ContactorType]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 1

Description: Parameter 622 selects the location of the contactor in the circuit. The choices are:

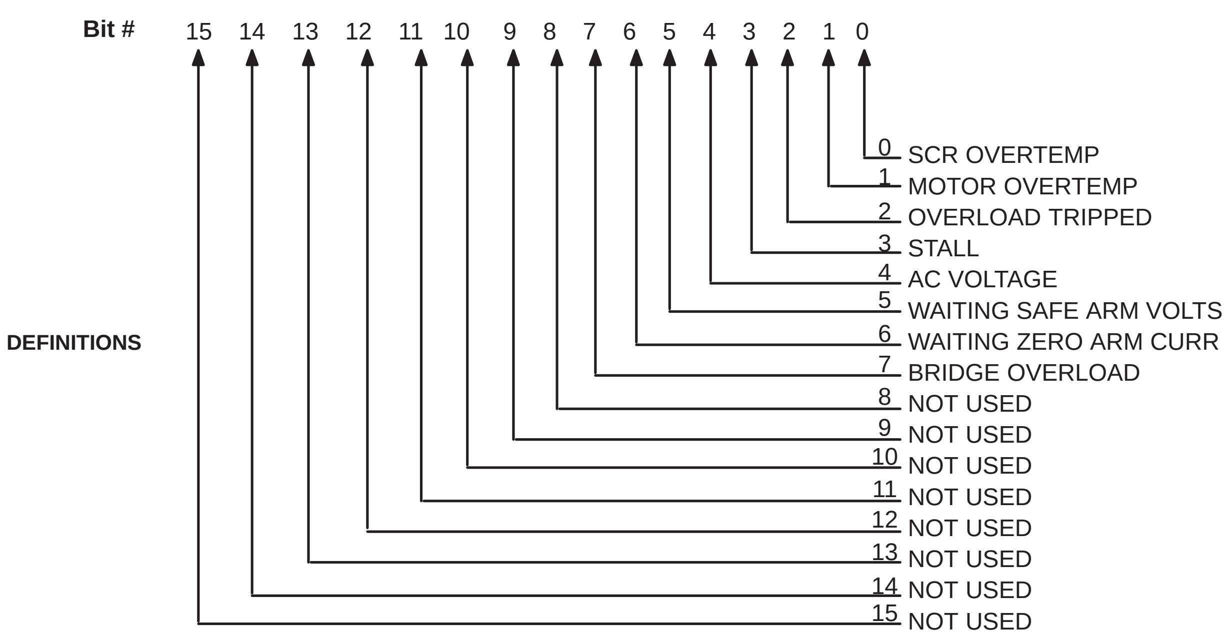
AC Contactor Mode, 0 = Contactor interrupts AC supply. Contactor will not automatically close/open with Drive Start/Stop operation.

DC Contactor Mode, 1 = Contactor interrupts DC armature circuit. Contactor will automatically close/open with Drive Start/Stop operation.

Parameter 623 – Fault Select [Fault Select]

Internal units : None
Programming Terminal units: Bit adjustable units
Minimum Value: All bits off
Maximum Value: All bits on
Default Value: All bits set to 1

Description: This word indicates the boolean selection of soft or warning configurable faults for the drive. If a bit is set to 1, the corresponding fault is treated as soft, otherwise it is considered a warning. Soft faults disable drive operation. Warning faults are only reported and the drive may continue to run (Refer to Chapter 2 in the Troubleshooting Manual for a detailed description of these faults). The bits in this word are selected as follows:



Parameter 624 – Maintained Start [Maintain Start]

Internal units : None
Programming Terminal units: 0/1 selection
Minimum Value: 0
Maximum Value: 3
Default Value: 2
Description: Parameter 624 selects the type of Start signal required in the logic command word. Choices are:
0 = Start signal treated as a momentary input. The drive will latch the start input. A Stop bit will be required to unlatch the start function and regen to a stop.
1 = Start signal treated as a maintained input. The motor will regen to a stop should the Start bit become 0, or the Stop bit become 1.
2 = Software Coast / Regen Stop option. The start signal will be treated as a maintained input. The Drive will Regen Stop when the start bit is removed. The Drive will Coast Stop when the Stop bit is set.
3= All Coast Stop option. The start signal will be treated as a maintained input. The Drive will Coast Stop (phase back SCR firing and open Main Contactor) under all Stop conditions:

- Remove Start bit
- Set Stop bit
- Remove Jog bit

ATTENTION: Refer to Ch 6 – Installation, for important information and warnings regarding stop mode interfaces with the 1395.

Parameter 625 – Torque Mode [Torque Mode]

Internal units : None
Programming Terminal units: 0/1 selection
Minimum Value: 0
Maximum Value: 5
Default Value: 1
Description: Parameter 625 selects the torque command source within the Drive. Choices are:
0 = Zero torque command under all conditions.
1 = Velocity regulator output
2 = External torque reference comes from Parameters 157 (Torque Reference). A stop condition will initiate a coast stop.
3 = Minimum select of 1 and 2. Selecting this function will automatically connect this algebraic minimum of either the velocity regulator output or the external torque reference to the torque mode. A stop condition will initiate a coast stop.
4 = Maximum select of 1 and 2. Selecting this function will automatically connect the algebraic maximum of either the velocity regulator output or the external torque reference to the torque mode. A stop condition will initiate a coast stop.
5 = Load Response (sum of 1 and 2). Selecting this function will automatically take the algebraic sum of the velocity regulator output and the external torque reference to the torque mode. A stop condition will initiate a coast stop.

Parameter 626 – Jog Ramp Enable [Jog Ramp Enable]

Internal units : None
Programming Terminal units: 0/1 selection
Minimum Value: 0
Maximum Value: 1
Default Value: 0
Description: Parameter 626 selects the use of velocity reference ramp while jogging. Choices are:

0 = No ramp when jogging (on both start and stop)
1 = Use ramp when jogging (on both start and stop)

Parameter 627 – Flux Mode Select [Flux Mode Select]

Internal units : None
Programming Terminal units: Bit adjustable field
Minimum Value: All Bits Off
Maximum Value: All Bits On
Default Value: Bit 0 On, all others off.
Description: This word is used to enable options for field weakening and field economy.
Bit 0 – Field Economy Enable. When Field Economy is selected, the field economy reference (param 674) specifies the field command (param 115) when the motor has been stopped for the time specified in the field economy delay (param 675).

Bit 1 – Field Weakening Enable. When field weaken enable is selected, the field flux command will be supplied by the field weakening control software. This also enables the CEMF regulator output as a trim for the field flux command.

Bit 2 – External Feed Forward Enable. When the External Flux Feed Forward option is selected, the flux feed forward value (Parameter 159) is used as the basis for determining the field flux command (Parameter 115). The field weaken enable bit must also be on for this option to be effective.

Bit 3 – Counter EMF Control Enable. When external CEMF Reference is selected, the field flux command (Parameter 115) is determined by the sum of the external CEMF reference value (Parameter 160) divided by the absolute value of velocity feedback (Parameter 106) and the Flux Trim (Parameter 121) which is the output of CEMF PI Control. The input to the CEMF PI Control is the flux error. This is the difference between the CEMF Reference (Parameter 160) and the CEMF Feedback, divided by the absolute value of Velocity Feedback (Parameter 106). The division by velocity is done in order to keep the application dependent gains of the CEMF PI Control constant and independent of motor shaft speed. The CEMF regulator with the gains nonzero (Parameter 672, 673) can offset the feed forward term. To disable CEMF regulation when using the external feed forward, set the KI, KP gain to zero. The Field Weaken Enable bit must also be on for this option to be effective.

Bit 4 – CEMF Hold: When set, this bit holds the integral term and output of the CEMF regulator to the last value before the bit was set. When clear, the CEMF regulator is not affected.

Bit 5 – CEMF Reset: When set, this bit will cause the integral term and out put of the CEMF regulator to be preset to the value found in CEMF Preload Parameter (#687). When clear, the CEMF regulator is not affected.

Bit 6 – Disable Field Loss Detection: When set, this bit will disable the check for field loss. This feature could be used in applications where external field supplies or permanent magnet motors are used. When clear, field loss detection is active. Caution should be used when disabling the Field Loss Detection feature. Damage to equipment or injury to personnel could occur during an un-detected field loss with non-permanent magnet type motors.

Bit 7 – No Flux Compensation: When set, the torque command will not be divided by Flux to Produce the Armature Current Command. As a result, the flux will be treated as 100%, even if the field is weakened. If bit 7 is set to 0, the torque command will be divided by flux to produce the armature current command.

Parameter 628 – Process Trim Select [Proc Trim Select]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 2
Default Value: 0
Description: This is a word of data containing one of three selections for applying the output of the process trim regulator. Selections are:

0 = Do not use process trim output
1 = Trim velocity reference
2 = Trim torque reference
3 = Trim Velocity with Ramp Stop

Parameter 629 – Motor Overload Select [Mtr Overload Sel]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 4
Default Value: 1
Description: This parameter specifies a selection of motor overload characteristics:

0 = Overload function disabled
1 = 60 seconds to trip @ 150% armature current for externally cooled motors.
2 = 60 seconds to trip @ 200% armature current for externally cooled motors.
3 = 60 seconds to trip @ 150% armature current for self cooled motors.
4 = 60 seconds to trip @ 200% armature current for self cooled motors.

Parameter 630 – Fault Report [Fault Report]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 1
Description: This parameter selects whether Velocity or Current Control fault status will be written to the FAULT WORD (Parameter 101).
0 = Select Current Processor Faults
1 = Select Velocity Processor Faults

Parameter 631 – Velocity Feedback Filter Select [Vel Filter Selct]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 2
Default Value: 0
Description: This parameter selects a 2 pole feedback filter or a lead/lag velocity feedback filter. When option 3 is selected, Parameters 692 "KN Filter" and Parameter 693 "Wn Filter" must be configured. One of four selections can be made as follows:
0 = No filter
1 = 35/49 radian filter
2 = 20/40 radian filter
3 = Lead/Lag velocity filter

Parameter 632 – Warning Select [WARNING SELECT]

Internal units : None
Programming Terminal units: Bit field
Minimum Value: All bits off
Maximum Value: All bits on
Default Value: 0
Description: This parameter can enable/disable certain warning fault detection. If set to a 1, that particular fault will not be reported in the fault word (Parameter 101), or in the fault queue. If set to 0, the fault will be detected and reported as usual. The following bits define the fault:
Bit 0 – Motor overload pending
Bit 1 – Excessive Armature volts demand
Bit 2 – Bridge overload pending

Parameter 633 – Preset Speed 1 [Preset Speed 1]

Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the drive when preset 1 has been selected in the logic command word.

Parameter 634 – Preset Speed 2 [Preset Speed 2]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the drive when preset 2 has been selected in the logic command word.

Parameter 635 – Preset Speed 3 [Preset Speed 3]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the drive when preset 3 has been selected in the logic command word.

Parameter 636 – Preset Speed 4 [Preset Speed 4]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the drive when preset 4 has been selected in the logic command word.

Parameter 637 – Preset Speed 5 [Preset Speed 5]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the Drive when preset 5 has been selected in the logic command word.

Parameter 638 – Jog 1 Speed [Jog 1 Speed]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the Drive when Jog 1 has been selected in the logic command word.

Parameter 639 – Jog 2 Speed [Jog 2 Speed]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0
Description: This will be the velocity reference used by the Drive when Jog 2 has been selected in the logic command word.

Parameter 641 – Mop Accel 1 [MOP Accel 1]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the acceleration rate of the MOP generated velocity reference when Mop rate 1 has been selected in the logic command word. The units are in seconds to accelerate from 0 to base speed.

Parameter 642 – Mop Accel 2 [MOP Accel 2]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the acceleration rate of the MOP generated velocity reference when Mop rate 2 has been selected in the logic command word. The units are in seconds to accelerate from 0 to base speed.

Parameter 643 – Mop Accel 3 [MOP Accel 3]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the acceleration rate of the MOP generated velocity reference when Mop rate 3 has been selected in the logic command word. The units are in seconds to accelerate from 0 to base speed.

Parameter 644 – Mop Accel 4 [MOP Accel 4]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the acceleration rate of the MOP generated velocity reference when Mop rate 4 has been selected in the logic command word. The units are in seconds to accelerate from 0 to base speed.

Parameter 645 – Mop Decel 1 [MOP Decel 1]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the deceleration rate of the MOP generated velocity reference when Mop rate 1 has been selected in the logic command word. The units are in seconds to decelerate from base speed to zero speed.

Parameter 646 – Mop Decel 2 [MOP Decel 2]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the deceleration rate of the MOP generated velocity reference when Mop rate 2 has been selected in the logic command word. The units are in seconds to decelerate from base speed to zero speed.

Parameter 647 – Mop Decel 3 [MOP Decel 3]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the deceleration rate of the MOP generated velocity reference when Mop rate 3 has been selected in the logic command word. The units are in seconds to decelerate from base speed to zero speed.

Parameter 648 – Mop Decel 4 [MOP Decel 4]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 0.1
Description: This parameter determines the deceleration rate of the MOP generated velocity reference when Mop rate 4 has been selected in the logic command word. The units are in seconds to decelerate from base speed to zero speed.

Parameter 649 – Mop Max Speed [MOP Max Speed]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: 0
Maximum Value: +6 x base speed
Default Value: base speed
Description: This parameter will limit the maximum MOP speed that can be reached. The MOP generated reference velocity will always be less than or equal to this number. The MOP reference speed will also be limited to values less than or equal to Forward Speed Limit (Parameter 608), or Reverse Speed Limit (Parameter 607) depending on the selected MOP direction.

Parameter 650 – Mop Min Speed [MOP Min Speed]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: 0
Maximum Value: +6 x base speed
Default Value: 0
Description: This parameter will determine the minimum MOP speed that can be reached using the MOP decrease in the logic command. This is also the speed setpoint used when a Start function is executed with the MOP velocity reference selected in the logic control word.

Parameter 651 – Accel Time [Accel Time]

Internal units : seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 10.0
Description: This parameter determines the acceleration rate of the velocity reference selected. Units are measured in seconds to accelerate from 0 to base speed. The acceleration ramp applies to speed changes away from zero speed in either the forward or reverse direction. The velocity ramp function can be bypassed by setting bit 5 to 1 in the logic command word.

Parameter 652 – Decel Time [Decel Time]

Internal units : seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 6553.5
Default Value: 10.0
Description: This parameter determines the deceleration rate of the velocity reference selected. Units are measured in seconds taken to decelerate from base speed to 0 speed. The deceleration ramp applies to speed changes toward zero speed in either the forward or reverse direction. The velocity ramp function can be bypassed by setting a bit 5 to 1 in the logic command word.

Parameter 653 – Desired Contour [Desired Contour]

Internal units : 4096 = 1000h = 100% contour effect
Programming Terminal units: Percent of full contour
Minimum Value: 0%
Maximum Value: 100.0%
Default Value: 0%
Description: This parameter specifies the rounding of the edges of the velocity profile or “S” filtering. This parameter affects the gain of a single pole filter that is cascaded with the velocity ramp function. Increasing the value of this parameter causes the edges of the velocity reference curve to be more rounded. 100% contour represents maximum velocity reference filtering. 0% contour will disable the velocity filter function.

Parameter 657 – Droop Percent [Droop Percent]

Internal units : % droop effect x 10
Programming Terminal units: Percent of base speed @ full load current.
Minimum Value: 0%
Maximum Value: 25.5%
Default Value: 0%
Description: This parameter specifies the percent of base speed that the velocity reference will be reduced when at full load current. For example; given a motor running at base speed and no load, for 5% droop, the speed becomes 95% of base speed at full load current. 0% Droop disables the Droop function.

Parameter 658 – Droop Filter (Gain) [Droop Filter]

Internal units : 4096 = 1000h = 100% droop filtering
Programming Terminal units: Percent of maximum Droop filtering
Minimum Value: 0%
Maximum Value: 100.0%
Default Value: 93%
Description: This parameter determines the gain of a single pole filter used in the droop. A filter is used to correct for stability problems caused by subtracting a function of velocity error from the velocity reference. 100% Droop filtering provides the maximum Droop filtering effect. 0% Droop filter value will disable the entire Droop function.

Parameter 659 – KI Velocity Loop [KI Velocity Loop]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 256
Description: This parameter controls the integral error gain of the velocity regulator. For example: If KI = 8, then 1 pu Velocity Error for 1 second will produce 1 pu Torque Reference.

Parameter 660 – KP Velocity Loop [KP Velocity Loop]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1600
Default Value: 64
Description: This parameter controls the proportional error gain of the velocity regulator. For example: If KP = 8, then 1 pu Velocity Error will produce 1 pu Torque Reference.

Parameter 661 – KF Velocity Loop [KF Velocity Loop]

Internal units : none
Programming Terminal units: none
Minimum Value: 0
Maximum Value: 65535
Default Value: 65535
Description: This parameter controls feed forward gain of the velocity regulator.
Setting the KF gain to a value less than one reduces velocity feedback overshoot in response to a step change in velocity reference. The velocity loop response to a step change in load is unaffected by the KF term.

Parameter 663 – Forward Bridge Current Limit [Fwd Brdg Cur Lim]

Internal units : 4096 = 1000h = 100% rated motor current
Programming Terminal units: Percent of rated motor current
Minimum Value: 0.024%
Maximum Value: 260%
Default Value: 50%
Description: This parameter specifies the largest allowable positive motor armature current that will be commanded. Attempts by the speed regulator to exceed this level will be limited to this value.

Parameter 664 – Reverse Bridge Current Limit [Rev Brdg Cur Lim]

Internal units : 4096 = 1000h = 100% rated motor current
Programming Terminal units: Percent of rated motor current
Minimum Value: 0.024%
Maximum Value: 260%
Default Value: 50%
Description: This parameter specifies the largest allowable negative motor armature current that will be commanded. Attempts by the speed regulator to exceed this level will be limited.

Parameter 665 – Start Taper Speed [Strt Taper Speed]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: Base Motor Speed/4096
Maximum Value: 6 x base speed
Default Value: base motor speed
Description: This parameter is associated with the torque taper function. Torque Tapering will begin when motor speed exceeds this speed.

Parameter 666 – End Taper Speed [End Taper Speed]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: Base Motor Speed/4096
Maximum Value: 6 x base speed
Default Value: base motor speed
Description: This parameter is associated with the Torque Taper function. Minimum Taper Current will be used as the upper limit for armature current reference when speed exceeds this speed.

Parameter 667 – Minimum Tapered Current [Min Taper Cur]

Internal units : 4096 = 1000h = 100% rated motor current
Programming Terminal units: percent of rated motor current
Minimum Value: 0.024%
Maximum Value: 260%
Default Value: 100%
Description: This is the armature current limit value that will be used for motor speeds above the End Taper Speed value. The final armature current reference value will be limited to a number less than or equal to this number.

Parameter 668 – DI/DT Limit [dI/dT Limit]

Internal units : 4096 = 1000h = 100% rated motor current
Programming Terminal units: percent of rated motor current
Minimum Value: 0.024%
Maximum Value: 260%
Default Value: 25.0%
Description: This parameter specifies the largest change in armature current reference that will be allowed per 4.0 msec sample. A value of 100% indicates that the armature current reference will be allowed to change by no more than rated motor current in a 4.0 msec period.

Parameter 669 – Slave Percent [SLAVE PERCENT]

Internal units : None
Programming Terminal units: %
Minimum Value: –200
Maximum Value: 200
Default Value: 100
Description: The torque reference (Parameter 157) will be multiplied by slave percent, when the torque mode in Parameter 625 = 2, 3, 4, 5.

Parameter 670 – Slave Percent 2 [SLAVE PERCENT 2]

Internal units : 4096 = 1000h = unity gain
Programming Terminal units: Percent gain
Minimum Value: –200%
Maximum Value: 200%
Default Value: 0%
Description: Torque Reference 2 will be scaled by the gain specified in this parameter. The scaled torque will then be summed with the scaled torque reference value from Parameter 157.

Parameter 672 – KI Flux [KI Flux]

Internal units : gain / 3277
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 1638
Description: This parameter controls the integral gain of the CEMF Regulator. For example; If KI flux is equal to 32767, then 1 pu CEMF error will produce 1 pu flux command in 1 second.
The CEMF Regulator is a classical PI regulator that is activated by setting an enable bit in Flux Mode Select (Parameter 627). It is used to trim the flux command based on the difference between CEMF Reference (Parameter 160) and CEMF Feedback. Trim is limited to a minimum value of 10% of flux command.

Parameter 673 – KP Flux [KP Flux]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 4096
Description: This parameter controls the proportional gain of the CEMF Regulator. For example; If KP flux is equal to 32767, then 1 PU CEMF error will produce 1 pu flux command.

Parameter 674 – Field Economy Reference [Fld Economy Ref]

Internal units : 4096 = 1000h = 100% full motor flux.
Programming Terminal units: percent of full motor field flux.
Minimum Value: 0%
Maximum Value: 100%
Default Value: 50%
Description: This parameter specifies the full flux reference value for the motor when field economy has been enabled in Flux Mode Select (Parameter 627). The flux specified by this parameter will be in use when the motor has been stopped for the time specified in Field Economy Delay (Parameter 675).

Parameter 675 – Field Economy Delay [Fld Economy Dly]

Internal units : seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0
Maximum Value: 6553.5
Default Value: 30.0
Description: This parameter specifies the time delay, in seconds, after the contactor opens before selection of field economy flux reference. This parameter is applicable only when field economy has been enabled by setting a bit in the Flux Mode Select (Parameter 627).

Parameter 676 – Field Flux Reference [Fld Flux Ref]

Internal units : 4096 = 1000h = 100% full motor flux.
Programming Terminal units: percent of full motor field flux.
Minimum Value: 0.024%
Maximum Value: 125%
Default Value: 100%
Description: This parameter specifies the full flux reference value for the motor. This value is the highest flux reference value that can be applied to the motor field. For a drive running below base speed (no field weakening), this is the flux value that will be in use.

Parameter 677 – Field Current at 0/8 Flux [Fld I @ 0/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: None
Minimum Value: 0%
Maximum Value: 100%
Default Value: 0%
Description: This is the first entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 0 armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current. This should always be at 0%.

Parameter 678 – Field Current at 1/8 Flux [Fld I @ 1/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: None
Minimum Value: 0%
Maximum Value: 100%
Default Value: 6.6%
Description: This is the second entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 12.5% armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 679– Field Current at 2/8 Flux [Fld I @ 2/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: None
Minimum Value: 0%
Maximum Value: 100%
Default Value: 14.3%
Description: This is the third entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 25% armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 680– Field Current at 3/8 Flux [Fld I @ 3/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 23.1%
Description: This is the fourth entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 37.5% rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 681– Field Current at 4/8 Flux [Fld I @ 4/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 33.1%
Description: This is the fifth entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 50% rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 682– Field Current at 5/8 Flux [Fld I @ 5/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 45.5%
Description: This is the sixth entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 62.5% rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 683 – Field Current at 6/8 Flux [Fld I @ 6/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 60%
Description: This is the seventh entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 75 % rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 684 – Field Current at 7/8 Flux [Fld I @ 7/8 FLUX]

Internal units : 4096 = 1000h = 100% rated field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 77.7%
Description: This is the eighth entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 87.5 % rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current.

Parameter 685 – Field Current at 1.0 Flux [Fld I @ 1/0 FLUX]

Internal units : 4096 = 1000h = 100% rated field current

Programming Terminal units: Percent rated field current

Minimum Value: 0%

Maximum Value: 100%

Default Value: 100%

Description: This is the eighth entry in a 9 element lookup table for converting flux reference commands to field current reference. The lookup conversion is used to linearize the field current reference with respect to flux. This value corresponds to the field current required to produce 100 % rated armature volts when the motor is running at base speed and is in terms of internal units where 4096 = 100% rated field current. This should always be 100%.

Parameter 686 – Field Weakened Speed [Fld Weaken Speed]

Internal units : 4096 = 1000h = base motor speed

Programming Terminal units: RPM

Minimum Value: base speed/8

Maximum Value: 6 x base speed

Default Value: base motor speed

Description: This parameter specifies the speed at which field weakening control and CEMF regulation begins. Field weakening and CEMF operation is enabled by setting bits in the Flux Mode Select (Parameter 627). A typical value used for the Field Weakened Speed, is base motor speed.

Parameter 687 – CEMF Reg Preload [CEMF Reg Preload]

Internal units : 4096 = 1000H = 1 pu Flux

Programming Terminal units: Percent of unity flux

Minimum Value: –799.9%

Maximum Value: 799.9%

Default Value: 0

Description: This parameter is associated with the CEMF reset function (bit 5) in Parameter 627. When the reset bit is set high, the integral term and output of the CEMF regulator will be set to the value in this parameter. This parameter is scaled so that 1 pu flux = 4096.

Only Available in Firmware Version 5.01

Parameter 688 – Tach Switch Tolerance [TACH SWITCH TOL]

Internal units : 4096 = base motor speed
Programming Terminal units: RPM
Minimum Value: 0
Maximum Value: base speed
Default Value: 10% base speed
Function: Tach Loss Recovery
Description: (5.01 firmware only) This parameter establishes the window for detection of tach loss when the Tach Loss Recovery feature is selected. When the active feedback device (encoder or tach) deviates from the Armature Voltage derived feedback for more than 40 msec, then a Tach Switchover will occur.
NOTE: This parameter is NOT used with 6.01 and later revision firmware. The combination of Parameter 731 and Parameter 732 took over this function.

Available in Version 5.01 and Later Firmware

Parameter 689 – Tach Switch Ki [TACH SWITCH KI]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 65535
Default Value: 50
Function: Tach Loss Recovery
Description: This parameter establishes the Ki gain that will be used in the Velocity Regulator, following an automatic Tach Switchover to Armature Voltage Feedback.

Available in Version 5.01 and Later Firmware

Parameter 690 – Tach Switch Kp [TACH SWITCH KP]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 65535
Default Value: 10
Function: Tach Loss Recovery
Description: This parameter establishes the Kp gain that will be used in the Velocity Regulator, following an automatic Tach Switchover to Armature Voltage Feedback.

Available in Version 5.01 and Later Firmware

Parameter 691 – Tach Switch Select [TACH SWITCH SEL]

Internal units : None

Programming Terminal units: None

Minimum Value: 0

Maximum Value: 1

Default Value: 0

Function: Tach Loss Recovery

Description: This parameter selects the automatic Tach Switchover to Armature Voltage Feedback feature. When set to a one, a malfunction of the selected velocity feedback device will cause a warning to be reported and the drive will continue to run using Armature Voltage feedback. When set to a zero (default value), a tach loss condition will cause a soft fault to occur and the drive will coast stop.

Parameter 692 – Kn Filter

Internal units :

Programming Terminal units:

Minimum Value: –32767

Maximum Value: +32767

Default Value: 512

Description: When using a lead/lag filter and Parameter 631 = 3, the gain of the filter can be selected. The transfer function G (s) = [(kn/256) s + ωn] / (s + ωn) describe the filter.

Parameter 693 – Wn Filter

Internal units :

Programming Terminal units:

Minimum Value: 1

Maximum Value: 500

Default Value: 300

Description: Filter Frequency Break Point (–3db). When using a lead/lag filter and Parameter 631 = 3, the natural frequency of the filter can be selected. The transfer function G(s) = [(kn/256) s +ωn] / (s + ωn) describe the filter.

Parameter 698 – Auto Tune Current Limit [Auto Tune I Lim]

Internal units : 4096 = 1000H = 100%

Programming Terminal units: %

Minimum Value: .0244%

Maximum Value: 100%

Default Value: 25%

Description: This parameter specifies the armature current that is applied to the motor during the Velocity motor test and Velocity system test.

Parameter 699 – Auto Tune Speed [Auto Tune Speed]

Internal units : 4096 = 1000H = 1 pu = Base motor speed
Programming Terminal units: RPM
Minimum Value: – Base Speed
Maximum Value: +Base Speed
Default Value: +Base Speed
Description: This parameter is the top speed of the motor during an auto tune velocity motor test, velocity system test, and field flux tune. For a field flux tune, the motor must be at the auto tune speed before performing the field flux tune.

Parameter 700 – Velocity Desired Bandwidth [Vel Desired BW]

Internal units : RAD x 10
Programming Terminal units: RAD/Sec
Minimum Value: 0.1
Maximum Value: 150
Default Value: 5
Description: This parameter specifies the velocity loop bandwidth requested by the user and determines (along with Parameter 702) the dynamic behavior of the velocity loop. The desired bandwidth is limited to the maximum achievable bandwidth which is calculated by the velocity processor (VP) during auto tune system test. The velocity loop becomes more responsive and reproduces the velocity reference more accurately as the bandwidth is increased. However, the velocity may exhibit more oscillation and overshoot as it is increased.

Parameter 701 – Velocity Maximum Bandwidth [Vel Max BW]

Internal units : RAD x 10
Programming Terminal units: RAD/Sec
Minimum Value: 0.1
Maximum Value: 150
Default Value: 50
Description: This parameter specifies the maximum achievable velocity loop bandwidth as calculated by the VP. The maximum bandwidth is a function of the velocity loop damping factor (Parameter 702) and the system inertia. The VP updates the parameter during auto tuning and whenever the user reads this parameter. The maximum velocity loop bandwidth is not changeable by the user.

Parameter 702 – Velocity Damping Factor [Vel Damp Factor]

Internal units : None
Programming Terminal units: None
Minimum Value: 0.5
Maximum Value: 3.0
Default Value: 1.0
Description: This parameter (along with Parameter 700) determines the dynamic behavior of the velocity loop. The damping factor influences the amount of overshoot the velocity loop will exhibit during a transient. The velocity will typically exhibit more overshoot and become oscillatory (underdamped) as the damping factor is reduced below 1. For a damping factor above 1, the velocity loop should not exhibit much overshoot and have a slower rise time for a given velocity loop bandwidth.

Parameter 703 – System Inertia [System Inertia]

Internal units : Secs x 100
Programming Terminal units: SECS
Minimum Value: 0.01
Maximum Value: 655.0
Default Value: 2.0
Description: This parameter represents the time, in seconds, for a motor coupled to a load, to accelerate from zero to base speed at rated armature and field current. This parameter is calculated by the auto tune velocity system.

Parameter 704 – At Speed 1 [At Speed 1]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: 0 rpm
Description: This parameter specifies a setpoint for determining when the motor has reached a given speed. When the motor feedback speed is within the Up to Speed Tolerance (Parameter 709) from the AT SPEED 1 setpoint, then the AT SPEED 1 output bit 11 in the Logic Status (Parameter 100) will be set to 1. Up to speed tolerance sets hysteresis for the At Speed 1 output.

Parameter 705 – At Speed 2 [At Speed 2]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: base speed/8 rpm
Description: This parameter specifies a setpoint for determining when the motor has reached a given speed. When the motor feedback speed is within the Up to Speed Tolerance (Parameter 709) from the AT SPEED 2 setpoint, then the AT SPEED 2 output bit 12 in the Logic Status parameter (Parameter 100) will become set. Up to speed tolerance sets hysteresis for the At Speed 2 output.

Parameter 706 – At Speed 3 [At Speed 3]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: base speed/4 rpm
Description: This parameter is used to specify the at speed 3 setpoint in the logic status (Parameter 100, bit 13). This 1 bit field is set to 1 when the actual velocity of the motor is greater than the at speed 3 setpoint. Otherwise, set to 0. Internally, if the Velocity Feedback (Parameter 106) is greater than or equal to At Speed 3 (Parameter 706), the At Speed 3 bit 13 is set to 1. Otherwise it is set to 0.

Parameter 707 – At Speed 4 [At Speed 4]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: base speed/2 rpm
Description: This parameter is used to specify the at speed 4 setpoint in the logic status (Parameter 100, bit 14). This 1 bit field is set to 1 when the actual velocity of the motor is greater than the at speed 4 setpoint. Otherwise, set to 0. Internally, if the Velocity Feedback (Parameter 106) is greater than or equal to At Speed 4 (Parameter 707), the At Speed 4 bit 14 is set to 1. Otherwise it is set to 0.

Parameter 708 – At Speed 5 [At Speed 5]

Internal units : 4096 = 1000h = 1 pu = base motor speed
Programming Terminal units: RPM
Minimum Value: – 6 x base speed
Maximum Value: +6 x base speed
Default Value: base speed rpm
Description: This parameter is used to specify the at speed 5 setpoint in the logic status (Parameter 100, bit 15). This 1 bit field is set to 1 when the actual velocity of the motor is greater than the at speed 5 setpoint. Otherwise, set to 0. Internally, if the Velocity Feedback (Parameter 106) is greater than or equal to At Speed 5 (Parameter 708), the At Speed 5 bit 15 is set to 1. Otherwise it is set to 0.

Parameter 709 – Up To Speed Tolerance [Up to Speed Tol]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: 0 rpm
Maximum Value: + base speed / 10
Default Value: base speed / 100
Description: This parameter establishes a band around the At Speed setpoints (Parameters 704 to 708) that will be used to determine when to update the At Speed bit, Parameter 100 bits 11 – 15 and the At Set Speed bit, Parameter 100 bit 9 in the Logic Status word. Refer to the descriptions for the At Speed setpoints for more information.

Parameter 710 – Zero Speed Tolerance [Zero Speed Tol]

Internal units : 4096 = 1000h = 1 PU = base motor speed
Programming Terminal units: RPM
Minimum Value: 0 rpm
Maximum Value: 6 x base speed
Default Value: base speed / 100
Description: This parameter establishes a band around zero speed that will be used to determine when to update the At Zero Speed bit, Parameter 100, bit 10 in the Logic Status word. This output is checked using the same method as At Speed 1 and 2 except the set point is fixed at zero speed.

Parameter 711 – Jog Dwell [Jog Dwell]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.0
Maximum Value: 6553.5
Default Value: 0
Description: This parameter specifies dwell time before the contactor opens after completing a jog function.

Parameter 713 – Process Trim Filter Constant [Proc Trim Fltr K]

Internal units : 4096 = 1000h = 100% process trim filtering
Programming Terminal units: percent of maximum process trim filtering.
Minimum Value: 0%
Maximum Value: 100%
Default Value: 0%
Description: This parameter determines the gain of a single pole filter used in the Process Trim. The input to the filter is the difference between the Process Trim Reference Parameter (161) and the Process Trim Feedback Parameter (162). The output of the filter is used as the input to the process trim PI regulator.
100% Process Trim Filtering provides the maximum filtering effect. When 0% is used for the Process Trim Filter constant, the filter will be disabled.

Parameter 714 – Process Trim Preload [Proc Trim Preload]

Internal units : 4096 = 1000h = 100% Process Trim Preload
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: 32767
Default Value: 0
Description: This parameter is used to preset the integral term of the Process Trim regulator.

Parameter 715 – Process Trim KI Gain [Proc Trim KI]

Internal units : gain/3277
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 1638
Description: This parameter controls the integral gain of the Process Trim regulator. If KI Process Trim equals 3277, the 1 pu Process Trim PI regulator output will equal 1 pu in 1 second, for 1 pu Process Trim error.

Parameter 716 – Process Trim KP [Proc Trim KP]

Internal units : gain/4096
Programming Terminal units: None
Minimum Value: –32767
Maximum Value: 32767
Default Value: 4096 = Unity Gain
Description: This parameter controls the Proportional gain of the Process Trim regulator. If KP Process Trim is equal to 4096, then 1 pu Process Trim PI regulator output will equal 1 pu for 1 pu Process Trim error.

Parameter 717 – Process Trim Low Limit [Proc Trim Lo Lim]

Internal units : 1000h = 4096 = 1 PU
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: 32767
Default Value: – 4096
Description: The output of the process trim regulator is limited by adjustable high and low limits. This parameter specifies the low limit of the Process Trim output value .

Parameter 718 – Process Trim High Limit [Proc Trim Hi Lim]

Internal units : 1000h = 4096 = 1 PU
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: 32767
Default Value: + 4096
Description: The output of the Process Trim regulator is limited by adjustable high and low limits. This parameter specifies the high limit of the Process Trim output value.

Parameter 719 – Process Trim Output Gain [Proc Trim Out K]

Internal units : 800h = 2048 = unity gain
Programming Terminal units: None
Minimum Value: – 16.00
Maximum Value: + 16.00
Default Value: 1.0 (unity gain)
Description: The output of the Process Trim regulator is scaled by a gain factor. This occurs immediately before the application upper and lower limit. This parameter specifies the gain value to use. Positive or negative gains may be used. A negative gain value will invert the Process Trim output.

Parameter 720 – Overload Pending Level [Ovld Pend Level]

Internal units : 4096 = 1000H = 100% rated motor current
Programming Terminal units: percent of rated motor current
Minimum Value: 0.024%
Maximum Value: 260%
Default Value: 115%
Description: This parameter determines the armature current level at which an overload pending fault will occur.

Parameter 721– Process Trim Low Sum [Proc Trim Low Sum]

Internal units : 4096 = 1000H = 1 PU = base motor speed

Programming Terminal units: RPM

Minimum Value: – 6 x BS RPM

Maximum Value: 0 RPM

Default Value: – 6 x Base Speed RPM

Description: This parameter is associated with the Speed trim option of the Process Trim Select Parameter (628 = 1). Parameter 721 will be in use when the speed trim option is enabled and the Process Trim Regulator has been enabled. The value in Parameter 721 will be used as the lower limit on the sum of the Ramp Velocity Reference (Parameter 103) and the output of Process Trim (Parameter 119). The limited sum will appear as the Final Velocity Reference (Parameter 104).

Parameter 722 – Process Trim High Sum [Proc Trim High Sum]

Internal units : 4096 = 1000H = 1 PU = base motor speed

Programming Terminal units: RPM

Minimum Value: 0 RPM

Maximum Value: + 6 x BS RPM

Default Value: +6 x BS RPM

Description: This parameter is the upper limit on the sum of the Ramp Velocity Reference (Parameter 103) and the output of Process Trim (Parameter 119). Parameter 722 will be in use when the speed trim option is enabled and the Process Trim Regulator has been enabled. The value in Parameter 722 will be used as the high limit on the sum of the Ramp Velocity Reference (Parameter 103) and the output of Process Trim (Parameter 119). The limited sum will appear as the Final Velocity Reference (Parameter104).

Parameter 724 – Absolute Overspeed [ABS Overspeed]

Internal units : 4096 = 1000h = 1 PU = base motor speed

Programming Terminal units: RPM

Minimum Value: 0

Maximum Value: + Base Speed

Default Value: Base Speed/100

Description: This parameter indicates the incremental speed above Forward Speed Limit (Parameter 608) or Reverse Speed Limit (Parameter 607) that is allowable before an absolute overspeed fault is indicated. Not active in AVF (1) or No Feedback Device (3). Active in Torque Mode if Encoder or DCTACH is selected.

Parameter 725 – External Overtemperature Delay [Ext Overtemp Dly]

Internal units : Seconds x 10

Programming Terminal units: Seconds

Minimum Value: 0.1

Maximum Value: 3276.7

Default Value: 1.0

Description: This parameter specifies the length of time that the motor overtemperature discrete input must be low before a motor overtemperature fault will be indicated.

Parameter 726– SCR Overtemperature Delay [SCR Overtemp Delay]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 3276.7
Default Value: 1.0
Description: This parameter specifies the length of time that the heatsink overtemperature discrete input must be low before an SCR overtemperature fault will be indicated.

Parameter 727– Stall Delay [Stall Delay]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0
Maximum Value: 100.0
Default Value: 10.0
Description: This parameter specifies the length of time that the drive must be in current limit and at zero speed before a stall fault will be indicated.

Parameter 728 – AC Line Tolerance Delay [AC Line Tol Delay]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0
Maximum Value: 1.0
Default Value: 0.1
Description: This parameter specifies the length of time that the supply voltage is allowed to deviate by more than +15% or –20% of the rated value (Parameter 617) before a voltage out of tolerance fault will be indicated.

Parameter 729– Field Fault Threshold [Fld Flt Thresh]

Internal units : 4096 = 1000h = 1 PU = 100% rated motor field current
Programming Terminal units: Percent rated field current
Minimum Value: 0%
Maximum Value: 100%
Default Value: 30%
Description: This parameter is used to set the threshold for activating the motor field loss fault in the CP fault word (Parameter 101, bit 6). Internally, if the field current reference (Parameter 117) is greater than the field current threshold (Parameter 729) and the field current feedback (Parameter 118) is less than 10% of threshold, a field loss fault occurs. A value of zero disables the field loss fault detection.

Parameter 730– Field Failure Delay [Fld Failure Dly]

Internal units : Seconds x 10
Programming Terminal units: Seconds
Minimum Value: 0.1
Maximum Value: 5.0
Default Value: 1.0
Description: This parameter indicates the length of time that the field current feedback value can deviate by more than 50% of field current reference before a field loss condition is indicated.

Parameter 731– Tach Loss CEMF [Tach Loss CEMF]

Internal Units: 4096 = 1000h = 100% of full CEMF
Programming Terminal Units: %
Minimum Value: 0 %
Maximum Value: 50%
Default Value: 10.01%
Description: To open window: increase P731 and decrease P732. This parameter sets the CEMF level, above which a Tach (or encoder) Loss Fault will occur. CEMF is obtained from the Armature Voltage Feedback level, less the calculated IR drop. Units for this parameter are in percent of full CEMF. The velocity feedback must also be less than the level set by Parameter 732 for a Tach Loss fault to be detected.

Parameter 732 – Tach Loss Velocity [Tach Loss Vel]

Internal Units: 4096 = 1000h = 100% base motor speed
Programming Terminal Units: %
Minimum Value: 0.244 %
Maximum Value: 50%
Default Value: 2.002%
Description: This parameter sets the velocity feedback level, below which a Tach (or encoder) Loss Fault will occur. Units for this parameter are in percent of base motor speed. The CEMF level must also be greater than the level set by Parameter 731 for a Tach Loss fault to be detected.

Parameter 733 – Armature Bridge Type [Arm Bridge Type]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 1
Description: Selects the type of armature bridge (regenerative or nonregenerative). The choices are:
0 = Nonregenerative Drive. The armature bridge has 6 SCRs.
1 = Regenerative Drive. The armature bridge consists of 12 SCRs.

Parameter 734 – K Discontinuous [K Discontinuous]
Internal units : 1024 = 400h = Full load current
Programming Terminal units: None
Minimum Value: 4
Maximum Value: 2048
Default Value: 288
Description: Represents the average value of current feedback at the cross over point between discontinuous and continuous armature current. Used to linearize the armature current loop and calculate the armature current loop gains.

Parameter 735 – KP Armature Loop [KP Armature Loop]
Internal units : 4096 = unity gain
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 2330
Description: The proportional gain for the PI regulator in the armature current loop.

Parameter 736 – KI Armature Loop [KI Armature Loop]
Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 386
Description: The integral gain for the PI regulator in the armature current loop.

Parameter 737– KP Field Loop [KP Field Loop]
Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 16384
Description: The proportional gain for the PI regulator in the field current loop.

Parameter 738 – KI Field Loop [KI Field Loop]
Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 32767
Default Value: 168
Description: The integral gain for the PI regulator in the field current loop.

Parameter 739 – K Armature Volts [K Arm Volts]

Internal units : 10 x armature volts@ maximum A/D input
Programming Terminal units: None
Minimum Value: 3000
Maximum Value: 25000
Default Value: 12500
Description: A parameter which scales the analog armature voltage (± 2.5 volt = ± 512 a/d value) into ten times the actual armature voltage. K ARM VOLT should be equal to ten times the armature voltage required to produce 5 volts on TP 27. The typical value depends on the feedback board installed in the Drive. The typical value for a 500 V feedback board is 12500 and the Typical value for a 240 V feedback board is 6400.

The Programming Terminal can be used to to determine the proper value for K ARM Volt. With the motor rotating at some nominal speed to produce armature voltage, enter the typical value for K ARM VOLT. Measure the armature voltage to the motor while the motor is rotating and compare it to the value on the Programming Terminal at Parameter 105. Increase K ARM VOLT if the armature voltage read from the Programming Terminal is low, or decrease it if the armature voltage reading is too high.

Parameter 740 – K AC Volts [K AC Volts]

Internal units : 10 x AC volts@ maximum A/D input
Programming Terminal units: None
Minimum Value: 2000
Maximum Value: 15000
Default Value: 7225
Description: A parameter which scales the analog line voltage feedback (5 volt = 1024 A/D value) into ten times the actual RMS AC voltage. K AC VOLTS should be equal to ten times the line voltage required to produce 5 volts on TP 4. The typical value depends on the feedback board installed in the Drive. The typical value for a 460 V feedback board is 7225 and the typical value for a 230V feedback board is 3800.

The Programming Terminal can be used to determine the proper value for K AC Volt. Enter the typical value for K ARM VOLT. Measure the line voltage to the Drive and compare it to the reading on the Programming Terminal at Parameter 116. Increase K AC VOLT if the armature voltage read from the Programming Terminal is low, or decrease it if the line voltage reading is too high.

Parameter 741– Desired Current Loop Bandwidth [Cur Desired BW]

Internal units : None

Programming Terminal units: RAD/Sec.

Minimum Value: 40

Maximum Value: 1000

Default Value: 500

Description: This parameter specifies the armature current loop bandwidth requested by the user and determines (along with Parameter 743) the dynamic behavior of the current loop.

The desired bandwidth is limited to the maximum achievable bandwidth which is calculated by the current processor (CP). The current loop becomes more responsive and reproduces the current reference more accurately as the bandwidth is increased. However, the current may exhibit more noise and overshoot as the current loop bandwidth is increased. Typically, the bandwidth should be set as high as possible so that the velocity loop performance is not limited by the current loop.

Parameter 742 – Maximum Current Loop Bandwidth [Cur Max BW]

Internal units : None

Programming Terminal units: RAD/Sec

Minimum Value: 40

Maximum Value: 1000

Default Value: 500

Description: This parameter specifies the maximum achievable armature current loop bandwidth as calculated by the CP. The maximum bandwidth as calculated by the CP. The maximum bandwidth is a function of the current loop damping factor (Parameter 743) and the AC line frequency. The CP updates this Parameter during autotuning and whenever the user reads this parameter. The maximum current loop bandwidth is not changeable by the user.

Parameter 743 – Current Damping Factor [Cur Damp Factor]

Internal units : None

Programming Terminal units: None

Minimum Value: 0.8

Maximum Value: 3.0

Default Value: 1.0

Description: This parameter (along with Parameter 741) determines the dynamic behavior of the armature current loop. The damping factor influences the amount of overshoot the current loop will exhibit during a transient. The current will typically exhibit more overshoot and become oscillatory (underdamped) as the damping factor is reduced below one. For a damping factor above one, armature current loop should not exhibit much overshoot and have a slower rise time for a given current loop bandwidth.

Added in Firmware Version 9.20

Parameter 744 - Bridge Switch Delay

Internal units : None
Minimum Value: 0
Maximum Value: 75
Default Value: 2

Description: This parameter allows the user to set up a programmable delay which would begin after the drive's Zero Current Detector tells the drive to switch between bridges. A load with higher than normal inductance could mean that an undesirable level of current still exists when the drive attempts to change bridges. This is true for both forward to reverse and for a reverse to forward bridge change. This delay would help to insure that the armature circuit current has additional time to reach zero before the bridge change occurs.

The units used for Parameter 744 will be a number "**n**" ranging from 0 to 75. Where " **n**" represents the number of "time increments" to delay the bridge change. The length of these time increments will vary for 60Hz or 50Hz systems.

For a 60 Hz system:
Time delay in seconds = $\mathbf{n}(2.78\text{x}10^{-3}) + 1.1\text{x}10^{-3}$ where 2.78 ms is the conduction time @ 60Hz.

For a 50 Hz system:
Time delay in seconds = $\mathbf{n}(3.30\text{x}10^{-3}) + 1.1\text{x}10^{-3}$ where 3.33 ms is the conduction time @ 50Hz.

The 1.1 ms in the above formula is the standard time delay used for normal armature inductance. As you can see in the above formula, the number programmed into Parameter 744 is the integer number of conduction periods added to the normal 1.1ms delay.

NOTE: For DC motor armature time constants in the range of 1 to 100 milliseconds, Parameter 744 should be set to zero. (2 is the default value)

In order to determine the desired time delay some additional application information is required and the following equation solved.
$t_d = 0.03(I_0)(L_a)/V_d$ Time delay in seconds
where:
I_0 = Rated armature bridge amps of the 1395
L_a = Inductance of the load in Henrys, when the load current is $0.03(I_0)$
$V_d = 1.169(V_{11})$ where:
V_{11} = the lowest average line to line voltage input to the 1395 at a particular installation.

Example: Assume a load with a 10 Henry inductance, a drive rated a 75 amps, and a 460VAC line that could dip to 90% of nominal.

$t_d = 0.03(75)(10)/1.169(414) = 0.0649$ would be the desired delay for this application. Using this value in the equation for calculating the time delay for Parameter 744@ 60Hz:

$0.04649 = \mathbf{n}(2.78\text{x}10^{-3}) + 1.1\text{x}10^{-3}$ and rearranging to solve for **n**:

$n = (0.04649 - 1.1 \times 10^{-3})/(2.78 \times 10^{-3}) = 16.33$. Rounding to the next highest integer, 17 would be the value programmed into Parameter 744. If additional safety margin is desired, the number 20 might be suitable for this application.

Added in Firmware Version 10.10

Parameter 745 – K Discontinuous Fraction [K Disc Fraction]

Internal units : 10240 = 2800h = Full Load Current
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 0.9
Default Value: 0
Description: Represents the fractional part of Parameter 734 – K Discontinuous and together represent the average value of current feedback at the cross over point between discontinuous and continuous armature current. This parameter provides additional resolution for parameter 734 – K Discontinuous. Both parameters are used to calculate the armature current loop gains. This parameter is only available with firmware version 10.10 or later.

Added in Firmware Version 10.10

Parameter 746 – Armature Voltage Offset Calibration [Arm Volt Offset]

Internal units: Volts x 10
Programming Terminal units: Volts
Minimum Value: –20.0
Maximum Value: +20.0
Default Value: 0
Description: This parameter is used for calibrating Parameter 105 – Armature Voltage feedback to zero. This parameter is only available with firmware version 10.10 or later.

Parameter 780 – 1395 Version Number [1395 Version No]

Internal units : None
Programming Terminal units: None
Description: This non-changeable parameter specifies the current firmware version number on the Main Control Board, comprising the VP, SP and CP.

Parameter 840 – SP Indirect 1 [SP Indirect 1]

Internal units : None
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: + 32767
Default Value: 0
Description: When programmed, appears as a constant Source Parameter value at Parameter 10, and can be linked to a Sink Parameter.
ATTENTION: For system indirect inputs, proper values, Min/ Max limits and polarities must be observed. Entering incorrect values, limits or polarities could cause the drive to operate in a runaway or erractic condition.

Parameter 841 – SP Indirect 2 [SP Indirect 2]

Internal units : None

Programming Terminal units: None

Minimum Value: – 32767

Maximum Value: + 32767

Default Value: 0

Description: When programmed, appears as a constant Source Parameter value at Parameter 11, and can be linked to a Sink Parameter.

ATTENTION: For system indirect inputs, proper values, Min/ Max limits and polarities must be observed. Entering incorrect values, limits or polarities could cause the drive to operate in a runaway or erractic condition.

Parameter 842 – SP Indirect 3 [SP Indirect 3]

Internal units : None

Programming Terminal units: None

Minimum Value: – 32767

Maximum Value: + 32767

Default Value: 0

Description: When programmed, appears as a constant Source Parameter value at Parameter 12 and can be linked to a Sink Parameter.

ATTENTION: For system indirect inputs, proper values, Min/ Max limits and polarities must be observed. Entering incorrect values, limits or polarities could cause the drive to operate in a runaway or erractic condition.

Parameter 843 – SP Indirect 4 [SP Indirect 4]

Internal units : None
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: + 32767
Default Value: 0
Description: When programmed, appears as a constant Source Parameter value at Parameter 13 and can be linked to a Sink Parameter.
ATTENTION: For system indirect inputs, proper values, Min/ Max limits and polarities must be observed. Entering incorrect values, limits or polarities could cause the drive to operate in a runaway or erractic condition.

Parameter 844 – SP Indirect 5 [SP Indirect 5]

Internal units : None
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: + 32767
Default Value: 0
Description: When programmed, appears as a constant Source Parameter value at Parameter 14 and can be linked to a Sink Parameter.
ATTENTION: For system indirect inputs, proper values, Min/ Max limits and polarities must be observed. Entering incorrect values, limits or polarities could cause the drive to operate in a runaway or erractic condition.

Parameter 900 – Trend Constant Signed Value [Trend Sign Val]

Internal units : None
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: + 32767
Default Value: 0
Description: This parameter specifies a signed constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 901 – Trend Constant Signed Value [Trend Sign Val]

Internal units : None
Programming Terminal units: None
Minimum Value: – 32767
Maximum Value: + 32767
Default Value: 0
Description: This parameter specifies a signed constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 902 – Trend Constant Signed Value [Trend Sign Val]

Internal units : None

Programming Terminal units: None

Minimum Value: – 32767

Maximum Value: + 32767

Default Value: 0

Description: This parameter specifies a signed constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 903 – Trend Constant Signed Value [Trend Sign Val]

Internal units : None

Programming Terminal units: None

Minimum Value: – 32767

Maximum Value: + 32767

Default Value: 0

Description: This parameter specifies a signed constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 904 – Trend Constant Logic Value [Trend Logic Val]

Internal units : None

Programming Terminal units: None

Minimum Value: 0000 0000 0000 0000

Maximum Value: 1111 1111 1111 1111

Default Value: 0000 0000 0000 0000

Description: This parameter specifies a bit(s) value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y. The default value is zero.

Parameter 905 – Trend Constant Logic Value [Trend Logic Val]

Internal units : None

Programming Terminal units: None

Minimum Value: 0000 0000 0000 0000

Maximum Value: 1111 1111 1111 1111

Default Value: 0000 0000 0000 0000

Description: This parameter specifies a bit(s) value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y. The default value is zero.

Parameter 906 – Trend Constant Logic Value [Trend Logic Val]

Internal units : None
Programming Terminal units: None
Minimum Value: 0000 0000 0000 0000
Maximum Value: 1111 1111 1111 1111
Default Value: 0000 0000 0000 0000
Description: This parameter specifies a bit(s) value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y. The default value is zero.

Parameter 907 – Trend Constant Logic Value [Trend Logic Val]

Internal units : None
Programming Terminal units: None
Minimum Value: 0000 0000 0000 0000
Maximum Value: 1111 1111 1111 1111
Default Value: 0000 0000 0000 0000
Description: This parameter specifies a bit(s) value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y. The default value is zero.

Parameter 908 – Trend Constant Unsigned Value [Trend Unsign Val]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 65535
Default Value: 0
Description: This parameter specifies an unsigned constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 909 – Trend Constant Unsigned Value [Trend Unsign Val]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 65535
Default Value: 0
Description: This parameter specifies an unsigned constant value used for trend trigger evaluation. This parameter number is entered when programming Trend Operand Parameter X or Y.

Parameter 910 – Trend 1 Operand Parameter X [Tr 1 Opnd X Param]

Internal units : None
Programming Terminal units: None
Minimum Value: 1
Maximum Value: 947
Default Value: 100
Description: This parameter specifies the first of two parameter numbers for the trend trigger evaluation. The data value for the entered parameter number is used in the trigger evaluation.

Parameter 911 – Trend 1 Operand Parameter Y [Tr 1 Opnd Y Param]

Internal units : None
Programming Terminal units: None
Minimum Value: 1
Maximum Value: 947
Default Value: 904
Description: This parameter specifies the second of two parameter numbers used for the trend trigger evaluation. The data value for the entered parameter number is used in the trigger evaluation.

Parameter 912 – Trend 1 Operator [Tr 1 Operator]

Internal units : None
Programming Terminal units: None
Minimum Value: 1
Maximum Value: 8
Default Value: 5
Description: This parameter specifies the operator used in Parameters 910 and 911 for the trend trigger evaluation. The available operators are:

1 – Greater Than	(.GT.)
2 – Less Than	(.LT.)
3 – Equals	(.EQ.)
4 – Not Equals	(.NE.)
5 – Logical AND	(.AND.)
6 – Logical NAND	(.NAND.)
7 – Logical OR	(.OR.)
8 – Logical NOR	(.NOR.)

Parameter 913 – Trend 1 Sampling Rate [Tr 1 Sample Rate]

Internal units : 1 = 0.001 secs.
Programming Terminal units: Secs
Minimum Value: 0.004
Maximum Value: 30.0
Default Value: 0.020
Description: This parameter specifies the interval at which the data for the fast source parameter, linked with the Trend fast sink parameter, is sampled. It is programmable in increments of 4ms. All values are rounded down to the nearest 4ms.

Parameter 914 – Trend 1 Samples After Trigger Condition is True [Tr 1 Post Samples]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 99
Default Value: 30
Description: This parameter specifies the number of data samples for the fast source Parameter to gather once the trigger evaluation becomes true.

Parameter 915 – Trend 1 Contiguous Trigger Switch [Tr 1 Cont Trigger]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 1
Description: This parameter specifies the type of trend. The choices are One Shot Trend, 0 = Once the trigger condition is true, and the number of samples after the trigger is taken (as programmed in 914) are gathered, the trend will halt.
Continuous Trend, 1 = Once the trigger condition is true, and the number of samples after the trigger is taken (as programmed in 914) are gathered, the trend will continue looking for the next occurrence when the trigger condition is true.

Parameter 916 – Trend 1 Enable Trend [Tr 1 Enable]

Internal units : None
Programming Terminal units: None
Minimum Value: 0
Maximum Value: 1
Default Value: 0
Description: This parameter is a switch that enables (activates) or disables (de-activates) the trend. The choices are:

Disable, 0 = Immediately terminates the trend (if it is activated).

Enable, 1 = Starts the trend provided a link has been established with the corresponding Trend 1 Input source fast parameter. Otherwise, the trend is automatically disabled.

Parameter 917 – Trend 1 Output Transmit Rate [Tr 1 Output Rate]

Internal units : 1 = 0.001 secs
Programming Terminal units: Secs
Minimum Value: 0.004
Maximum Value: 30.0
Default Value: 0.040
Description: This parameter specifies the rate at which ordered, sampled data (indicating the trend has triggered and taken post samples) is copied to the Trend Fast source parameter and subsequently transferred to the configured fast sink parameter number. It is programmable in 4 ms increments. All values are rounded down to the nearest 4ms.

Parameters 920 to 927 are identical to Parameters 910 to 917 for Trend Buffer 2.

Parameters 930 to 937 are identical to Parameters 910 to 917 for Trend Buffer 3.

Parameters 940 to 947 are identical to Parameters 910 to 917 for Trend Buffer 4.