CONTROL TECHNIQUES

Quantum III

Regenerative and Non-Regenerative Digital DC Drives 5 to 1,000 HP

User Guide

EMERSON
Industrial Automation

The drive stop and start inputs should not be relied upon alone to ensure the safety of personnel. If a safety hazard could arise from the unexpected starting of the drive, a further interlock mechanism should be provided to prevent the motor from running except when it is safe to do so.

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment, or from mismatching of the drive to the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User's Guide without notice.

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1.1 GENERAL DESCRIPTION

Quantum III is the new redesigned family of advanced, fully microprocessor-controlled DC variable speed drive units covering the output range 5 to 1000 HP both as single-ended converters, and in four-quadrant, fully regenerative models. The Quantum III marks a significant achievement in the field of DC drive technology by providing within a compact package all the accuracy and versatility inherent in microprocessor control while remaining competitive in price with conventional analog drives.

All models feature a fully controlled six-pulse SCR bridge, comprehensively protected against voltage transients and isolated from the control electronics. Full details of unit ratings and dimensions are included in sections 2, 4 and 5.

The microprocessor-based control system, employing the latest surface-mount technology, is programmed and adjusted by integral pushbuttons or by a serial interface, and displayed on two (2) seven-segment LED displays which form part of the powerful built in diagnostic facility.

Options include a second processor called MD29, to service special application software which expands the drive's standard capabilities.

Quantum III is extremely compact and simple in construction, taking full advantage of modern high-volume production techniques. Access is particularly good, for ease of installation and servicing.

Figure 1-1.
Quantum III
Fully Microprocessor-controlled
3-phase 6-pulse SCR Drive

1.2 EQUIPMENT IDENTIFICATION

It is important to identify the control completely and accurately whenever ordering spare parts or requesting assistance in service.

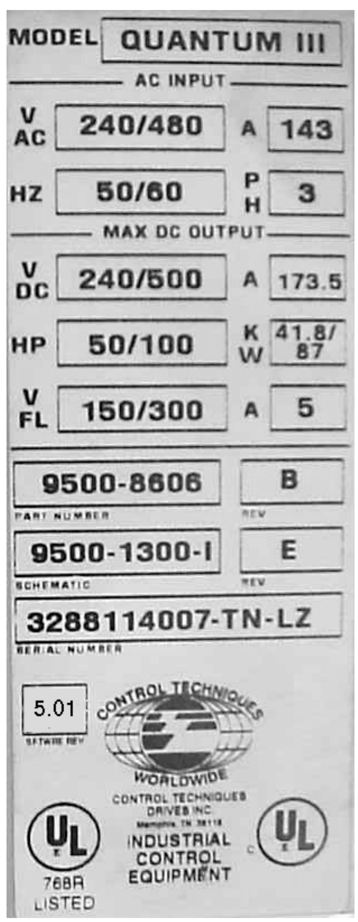
The control includes a product nameplate located on the side panel of the enclosure. The product nameplate should appear as the sample nameplate shown in Figure 1-2. Record the part number, revision level, and serial number for future reference on 8.11.

If the control is part of an engineered drive system, the system cabinet will also include a product nameplate. Record the part number, revision level, and serial number of the engineered system and include this information with the information on the individual controls whenever contacting the factory. See 8.11.

1.3 MODEL NUMBER/ RATING LABEL LOCATION

Figure 1-2
Size 1
9500-8x02 thru 8x06

Figure 1-3
Size 2
9500-8x07 thru 8x11



- Drive Model Name/Family → MODEL
- AC Line Voltage Input → V AC
- AC Line Frequency → HZ
- Max DC Armature Voltage Output → V DC
- Rated Horsepower → HP
- Field Voltage Output → V FL
- **Model Part Number** → PART NUMBER
- Schematic Set Number - Interconnect → SCHEMATIC
- **Serial Number** → SERIAL NUMBER
- **Software Program Revision** → SFTWRE REV
- Max AC Input Line Current - AC amps
- 3 Phase
- DC Output Amps @ Full Load-100%
- KW Output
- Maximum Field Output Amps-DC
- Model Revision Level
- Drawing Revision

Items in **bold** print are information required should one need to call for warranty replacement.

Figure 1-4
***Quantum III* Label**

1.3.1 Quantum III Models

Quantum III drives are available in Non-Regenerative (uni-directional) and Regenerative (bi-directional) models. These models span 5-1000HP using 3 basic chassis sizes as shown below.

Figure 1-5
Size 1
5-100HP @ 480 VAC
5-50HP @ 230 VAC
9500-8X02 thru 8X06

Figure 1-6
Size 2
150-400HP @ 480 VAC
75-200HP @ 230 VAC
9500-8X07 thru 8X11

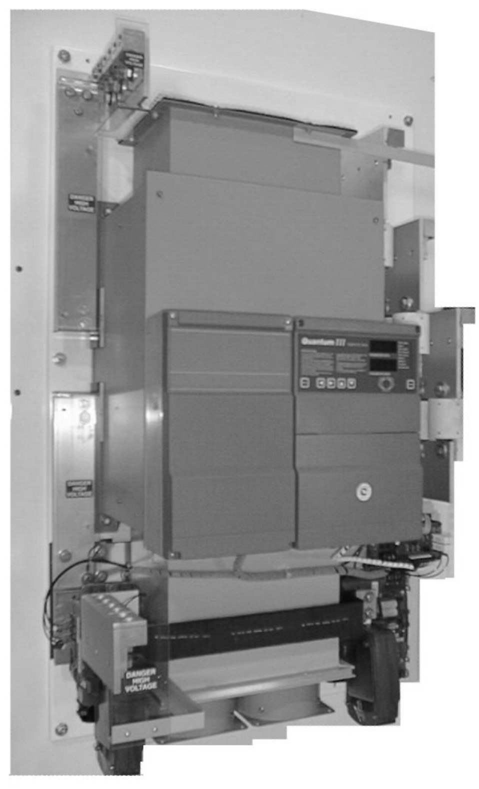


Figure 1-7
Size 3
500-1000HP @ 480 VAC
250-500HP @ 230 VAC
9500-8X15 thru 8X20

2.1 ELECTRICAL SPECIFICATIONS

2.1.1 Main AC Supply—3 Phase, 3 Wire, Jumper Selectable

50 Hz	60 Hz
208V -5% 208V +10%	208V -5% 208V +10%
240V -10% 240V +10%	240V -10% 240V +10%
380V -10% 380V +10%	380V -10% 380V +10%
415V -10% 415V +10%	415V -10% 415V +10%
480V -10% 480V +10%	480V -10% 480V +10%

Line Frequency
Variations: 45 to 62 Hz Auto Tracking

MAXIMUM RECOMMENDED MOTOR VOLTAGES:

Supply Voltage	Field Voltage	Arm. Voltage Single-Ended (Motor Only)	Arm. Voltage Four-Quadrant (Regenerative)
230	150	250	250
380	240	440	440
415	300	460	460
460	310	510	510
480	320	530	530

2.1.2 Speed Resolution

Reference	Feedback	Total
analog 0.025%	arm 0.83 V	0.83 V
analog 0.025%	tach 0.1%	0.125%
digital 0.0%	tach 0.1%	0.1%
analog 0.025%	encoder 0.01%	0.035%
digital 0.0%	encoder 0.0%	0.0%*
encoder 0.0%	encoder 0.0%	0.0%*

*Using Digital Lock in Menu 13

2.1.3 Response Times

Analog speed input TB1-3 has a voltage to frequency converter which requires 13 milliseconds to acquire sufficient pulses for an update.

GP-1 and GP-2 are updated six (6) times per cycle, 2.8 milliseconds @ 60 Hz. GP-3 and GP-4 are updated three (3) times per cycle, 5.6 milliseconds @ 60 Hz.

The Tachometer and Encoder feedback are both updated six (6) times per cycle, 2.8 milliseconds @60 Hz.

The current loop is updated twelve (12) times per cycle, 1.38 milliseconds @60 Hz.

2.2 ENVIRONMENT:

Operating ambient temperature range:

0°C to +55°C (32°F to +131°F) at chassis

Storage temperature range:

-40°C to +55°C (-40°F to +131°F)

Altitude Derating:

Rated altitude: 3300 ft
Derate linearly by 1% per 330 ft above 3300 ft Maximum relative humidity: 85% (non-condensing).

Overtemperature protection:

An overtemperature thermostat is installed on all fan cooled models, and is connected to the control circuit through a 2-pin connector located on the power board (PL18 on the MDA6 and PL2 on all other models), see 13.6. If the heatsink temperature exceeds 100°C, parameter 10.22 changes state to a logic 1 and shuts down the Quantum III, indicating an “Oh” overheat fault for all fan cooled controls. Parameter 10.33 should be set to “0” to enable this circuit. This change should be stored along with any other parameter changes.

The two smallest models are convection cooled and do not contain a Heat Sink sensor, therefore parameter #10.33 should be set to 1 to disable Oh fault detection.

2.3 POWER CIRCUIT:

Armature converter:

3 phase fully controlled six pulse SCR bridge. Available in both single ended (9500-8302 through -8320) six SCR and fully regenerative four quadrant (9500-8602 through -8620) inverse parallel twelve SCR bridge configurations.

Field supply:

Size		
1	8A current regulated, suitable for field weakening and field economy, on 5-100HP (9500-8X02 to 9500-8X06)	
2	10A on 125-400 HP (9500-8X07 to 9500-8X11)	Fixed voltage supply Rectified DC
3	20A on 500-1000 HP (9500-8315 to 9500-8320 and 9500-8612 to 9500-8620)	

Electrical isolation:

Low voltage control electronics to AC supply and ground. Impedance isolation of 1M ohm to electronics common. If desired, the control electronics may be grounded. However, this practice is not recommended because of the risk of erroneous signals being received by the drive if a ground fault occurs in the control wiring.

2.4 STATUS RELAY OUTPUTS

Please refer to the following TB1 terminals on the 9500-4025 board. These terminals are shown in Figure 9-1.

Terminals 13,14 - Run contact closes when drive is in Run or Jog.

Terminals 15,16 - NF (No Fault) - Relay picks up when drive is powered-up and no faults exist. Note that there will be a short time delay after power is first applied before this relay picks up. This is due to the drive self diagnostics routine which occurs after power is applied to the drive. No fault contacts shown in de-energized state. The relay will drop out when a drive fault occurs. This contact will also drop out momentarily during a drive reset. Can be selected as an N/O or N/C contact by JP2.

Terminals 17,18 - FR (System Fault) relay incorporates blower motor aux, motor thermal and other external interlocks--wired to TB1-1 through TB1-4. Can be selected as an N/O or N/C contact by JP3.

Terminals 19,20, 21 - PGM1 (Programmable Relay) defaulted to reverse. Form C contacts--wired to TB1-19,20,21.

Terminals 22,23 - PGM2 (Programmable Relay) defaulted to drive reset. Can be selected as an N/O or N/C contact by JP4. Wired to TB1-22 and 23.

Contact Rating - 5 amps at 115 VAC
5 amps at 5 VDC

2.5 CONTROL INPUTS AND OUTPUTS (REFER TO FIGURE 7-6)

Logic Inputs

Twelve (12) control logic inputs are provided, six(6) of which are user programmable. Logic inputs may be operated from open collector outputs or dry contacts and are individually selectable as an active high of +24 VDC or an active low of 0 VDC. They are defaulted as an active high and controlled by SW1A on the MDA-2 pcb.

Location MDA2	Description	Type
TB3-21	Run Permit	Dedicated
TB3-22	Reference On	Dedicated
TB3-23	Jog	Dedicated
TB3-24	Reverse	Programmable
TB3-25	Unassigned	Programmable
TB3-26	System Fault	Dedicated
TB3-27	Unassigned	Programmable
TB3-28	Unassigned	Programmable
TB3-29	Unassigned	Programmable
TB3-30	Unassigned	Programmable
TB4-31	Enable	Dedicated
TB4-32	Reset	Dedicated

Control Input Ratings

Maximum voltage -.5 VDC to +35 VDC

Switching Characteristics Maximum Low Voltage +2VDC
Minimum High Voltage +4VDC

Analog Inputs

Location MDA2	Description	Type
TB1-3	Speed reference ±10VDC 100K input impedance or 20mA, both have 12 bit resolution	Programmable
TB1-4,5,6,7	Analog inputs ±10VDC 100K input impedance, 10 bit resolution	Programmable

Location 9500-4030	Description	Type
TBS-1,3	HP shunt resistor-- all drives are defaulted to 5 HP at 480 VAC rating. This resistor selects proper rating. See Figure A-1 for values.	Dedicated
TBS-4,5	Motor thermal input	Dedicated
TBA-1,2,3	AC or DC Tach input on Tach interface board, P/N 9500-4030. Jumper selectable by JP4 and JP5.	Dedicated

Logic Outputs

Location MDA2	Description	Type
TB2-15 to 18	Open collector, 100mA, 24VDC	Programmable
TB2-37 to 39	Drive Ready, Form C Relay	Dedicated
TB2-34 to 36	Unassigned Form C Relay Defaulted to zero speed	Programmable

Logic Control Output Ratings

Maximum current sinking	100 mA
Contact rating	5 amp @ 5VDC
	5 amp @ 115VAC

Analog Outputs (4)

Location MDA2	Description	Type
TB2-11	Armature Current 0-6.6V Unipolar 6.6V = 150% I	Dedicated
TB2-12 to 14	Unassigned 0 ± 10V Bipolar	Programmable

Analog Outputs—5mA

Encoder Connections

Encoder must be dual channel, 100 KHz maximum, with quadrature.

Location	Description	Type
PL4-1	0	Reference
PL4-2	NC	“
PL4-3	A	“
PL4-4	$\overline{A}$	“
PL4-5	B	“
PL4-6	$\overline{B}$	“
PL4-7	NC	“
PL4-8	C	“
PL4-9	$\overline{C}$	“
PL4-10	0V	“
PL3/SK3 -1	0	Feedback
-2	Supply	“
-3	A	“
-4	$\overline{A}$	“
-5	B	“
-6	$\overline{B}$	“
-7	NC	“
-8	C	“
-9	$\overline{C}$	“
-10	0V (not SK3)	“

PL4 is a 10 pin header.
PL3 is a 10 pin header connected in parallel with SK3. SK3 is a 9 pin D type female connector for the feedback encoder.

Communications

Location	Description	Type
PL2-1	0V isolated	Serial Comm
PL2-2	$\overline{TX}$	“
PL2-3	$\overline{RX}$	“
PL2-4	NC	“
PL2-5	NC	“
PL2-6	TX	“
PL2-7	RX	“
PL2-8	NC	“
PL2-9	NC	“

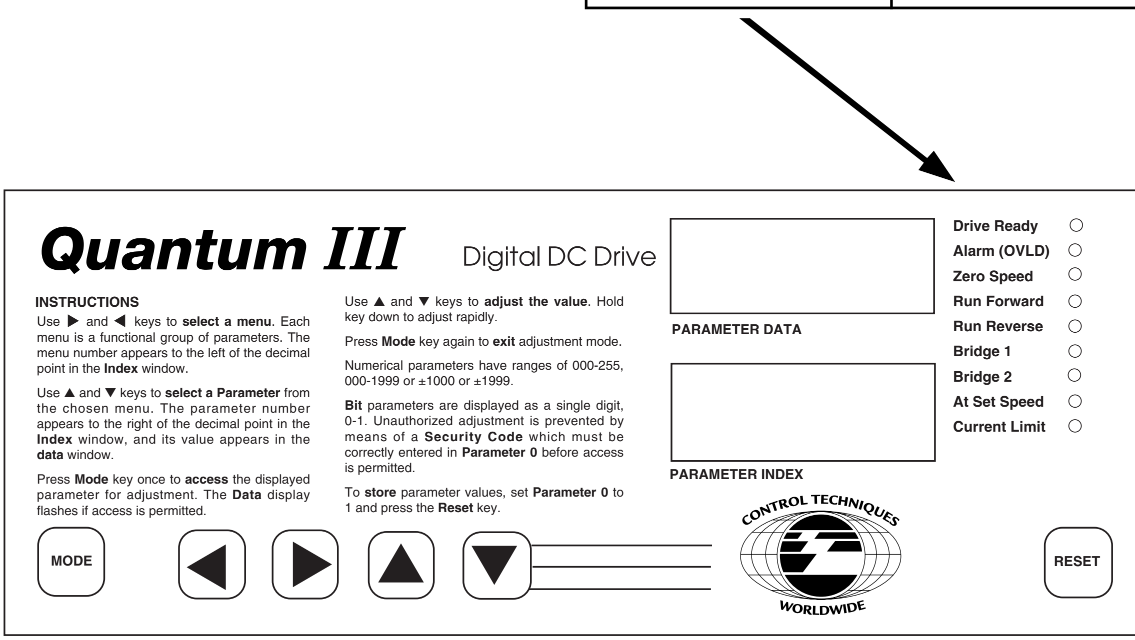
PL2 is a 9 pin D type male connector.

LED Status Indicators

Nine LEDs to the right of the parameter data and index panels present information, continuously updated, about the running condition of the drive and enable basic information to be seen at a glance.

The status LEDs (except for the Drive Ready LED) may be alternatively configured in software for special applications. (See description of parameters 11.21 and 11.22 in section 10.)

LED Illuminated	Information
Drive ready	The drive is turned on, not tripped.
Drive ready—flashing	The drive is tripped.
Alarm—flashing	The drive is in an overload trip condition, or is integrating in the I x T region.
Zero speed	Motor speed < zero speed threshold (programmable).
Run forward	Motor running forward.
Run reverse	Motor running in reverse.
Bridge 1	Output bridge 1 is enabled.
Bridge 2	Output bridge 2 is enabled (inactive in 1-quad drives).
At speed	Motor running at the speed demanded by the speed reference.
Current limit	Drive running and delivering maximum permitted current.



2.6 CONFIGURATION SOFTWARE

FREE Software

Control Techniques' commissioning software is free and can be downloaded from our web site: ***www.ctdrives.com/downloads***

MentorSoft, the Quantum III's configuration software is a Windows™ based package that allows the user to select drive operating modes and adjustment parameters for drive configuration. This program uses a window-style, menu driven program environment and can be set up for color or monochrome monitors. This program permits the user to configure a drive or series of drives in an office environment and save the resultant setup to disk. This file can be printed out for a permanent hard copy record and later "down-loaded" into the Quantum drive. A drive configuration can be "uploaded" at any time and saved to disk so that drive settings can be recorded and printed. MentorSoft permits the user to set-up identical duplicates or "cloned" replacement drives in seconds.

The major functions handled by the drive support software are:

- Drive Configuration
  - Scaling
  - Feature Selections
  - I/O Selections
- Register Monitoring
  - Setpoints and Feedback Quantities
  - I/O Status

This permits the following:

Drive Configuration in Office Environment:

For the convenience of not having to power up the drive or leave your office to pre-engineer a drive configuration for your application.

Drive Configuration to be Saved to Disk or Printer:

For a permanent record and documentation.

Resulting Configuration to be Downloaded in Test

Drive Configuration can be Uploaded and Saved:

After the drive application passes through test and all configuration touch-ups are completed, the final drive setup information can be uploaded and saved.

Drive Cloning for Identical Duplicate Spares:

In this manner, should a drive need to be replaced or a duplicate system be created, the original drive data file can be retrieved from disk and downloaded into the replacement clone.

Remote Control of Drive via Communication:

This becomes a convenient feature when starting up or performing machine maintenance. The Quantum III can be remotely controlled by severing hard-wired start/run inputs and analog references and controlling the drive remotely using MentorSoft communications.

Remote Drive Monitoring

This function is particularly useful during drive setup. MentorSoft permits you to monitor logic conditions as well as drive dynamic variables and simultaneously adjust internal parameters.

Also see Section 11.1

This section outlines procedures necessary to insure safe operation of any AC or DC drive. For further information, contact the Service Department at the address shown on the inside back cover of this manual.

3.1 GENERAL SAFETY PRECAUTIONS

WARNING

THIS CONTROL AND ASSOCIATED MOTOR CONTAINS HAZARDOUS VOLTAGES AND ROTATING MECHANICAL PARTS. EQUIPMENT DAMAGE OR PERSONAL INJURY CAN RESULT IF THE FOLLOWING GUIDELINES ARE NOT OBSERVED.

A. Only qualified personnel familiar with this type of equipment and the information supplied with it should be permitted to install, operate, troubleshoot or repair the apparatus. A qualified person must be previously trained in the following procedures:

- Energizing, de-energizing, grounding and tagging circuits and equipment in accordance with established safety practices.
- Using protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- Rendering first aid.

B. Installation of the equipment must be done in accordance with the National Electrical Code and any other state or local codes. Proper grounding, conductor sizing and short circuit protection must be installed for safe operation.

C. During normal operation, keep all covers in place and cabinet doors shut.

D. When performing visual inspections and maintenance, be sure the incoming AC power is turned off and locked out. The drive and motor will have hazardous voltages present until the AC power is turned off. The drive contactor does not remove hazardous voltages when it is opened.

E. When it is necessary to make measurements with the power turned on, do not touch any electrical connection points. Remove all jewelry from wrists and fingers. Make sure test equipment is in good, safe operating condition.

F. While servicing with the power on, stand on some type of insulation, being sure you are not grounded.

G. Follow the instructions given in this manual carefully and observe all warning and caution notices.

3.2 INSTALLATION SAFETY

When moving this control and associated motor into the installation position, do any required lifting only with adequate equipment and trained personnel. Drive units with or without cabinets are top heavy and will tip easily until securely anchored in place. Eyebolts or lifting hooks, when supplied, are intended for lifting the product only and must not be used to lift additional weight. Improper lifting can cause equipment damage or personal injury.

WARNING

HAZARDOUS VOLTAGES MAY BE PRESENT ON EXTERNAL SURFACES OF UNGROUNDED CONTROLS. THIS CAN RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE.

The drive is provided with a grounding lug to which a ground wire must be connected for personnel safety. Also any motor frame, transformer enclosure and operator station must be connected to earth ground. Consult the National Electrical Code and other local codes for specific equipment grounding requirements.

Protective guards must be installed around all exposed rotating parts.

CAUTION

Drilling or punching can create loose metal chips. This can result in shorts or grounds that can damage the equipment.

If it is necessary to drill or punch holes in the equipment enclosures for conduit entry, be sure that metal chips do not enter the circuits.

3.3 SHIELDED WIRING

Circuits shown on the drawings that require shielded cable are sensitive to pick-up from other electrical circuits. Examples include wiring from the tachometer and from the speed setting device. Erratic or improper operation of the equipment is likely if the following precautions are not observed:

A. Where shielded cable is required, use 2- or 3- conductor twisted and shielded cable with the shield either connected as shown in the drawings, or “floating”, if so specified. If the shield is to be connected, do so only at the specified terminal in the drive unit. Do not connect at a remote location.

B. Shielded cables outside the drive enclosure should be run in a separate steel conduit, and should not be mixed in with other circuits that are not wired with shielded cable.

C. Avoid running the shielded cable close to other non-shielded circuits. Avoid long parallel runs to other non-shielded circuits, and cross other cable bundles at right angles.

Do not connect any external circuits to the drive or its associated equipment other than those shown on the diagrams supplied. Connection of external devices to the tachometer or speed setting device can significantly affect drive performance.

CAUTION

Meggering circuits connected to the drive can cause damage to electronic components. Do not megger or hi-pot this equipment. Use a battery operated Volt-Ohm-Meter (VOM) to check for shorts, opens or miswiring.

Connection of unsuppressed inductive devices to the drive power feed or control circuits can cause mis-operation and possible component damage to the equipment.

Do not connect power factor correction capacitors with this equipment. Drive damage may result.

3.4 START-UP SAFETY

Detailed start-up procedures are described in the Drive Connection and Start-up sections of this manual. Before and during start-up, it is imperative that all of the following safety procedures be observed.

WARNING

AC POWER MUST BE DISCONNECTED FROM THE DRIVE CABINET TO ELIMINATE THE HAZARD OF SHOCK BEFORE IT IS SAFE TO TOUCH ANY OF THE INTERNAL PARTS OF THE DRIVE. CIRCUITS MAY BE AT LINE POTENTIAL WHETHER THE ENCLOSED DRIVE IS OPEN OR CLOSED.

CAUTION

Hazardous voltages are present on the motor until all power to the control is disconnected.

Turn off and lock-out all power to the control before touching any internal circuits on the motor.

A. The use of unauthorized parts in the repair of this equipment or tampering by unqualified personnel may result in dangerous conditions which can cause equipment damage or personal injury and will also void warranties. Follow all safety precautions contained in this manual and all safety warning labels on the product.

B. Loose rotating parts can cause personal injury or equipment damage.

Before starting the motor, remove all unused shaft keys and other loose parts on the motor or the rotating mechanical load. Be sure all covers and protective devices are in place. Refer to the instruction manual supplied with the motor for further information and precautions.

When using an oscilloscope to make measurements in the power circuits, use the connections shown in Figure 3-1. Failure to follow this procedure could result in the case (shell) of the oscilloscope being at line potential. Only qualified personnel should be allowed to use the oscilloscope and other test equipment.

Referring to Figure 3-1, set the oscilloscope to add channels A & B, and invert channel B. Before making measurements, connect both probes together and set the "zero" line. This connection allows the oscilloscope case to be connected to ground for safe operation.

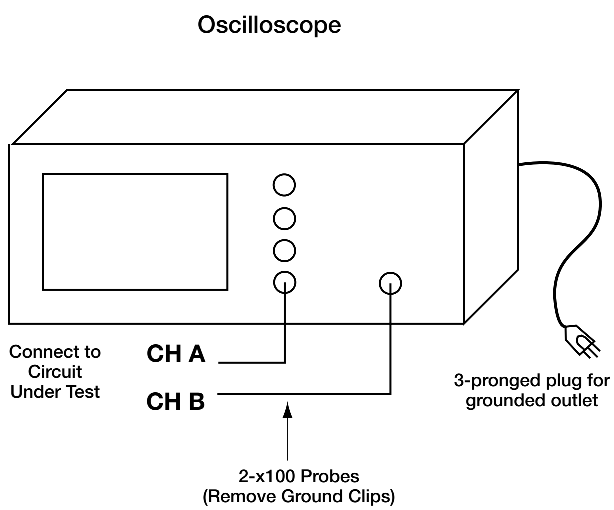


Figure 3-1.
Recommended
Oscilloscope Connections

NOTE
Using a 1:1 isolation transformer to power an oscilloscope will also reduce the possibilities of ground paths.

3.5 SAFETY WARNINGS

Only qualified electrical personnel familiar with the construction and operation of this type of equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual in its entirety before proceeding. Failure to observe these precautions may cause injury to personnel or damage to equipment.

The control and its associated motor and operator control devices must be installed and grounded in accordance with all local codes and the National Electrical Code (NEC). To reduce the potential for electric shock, disconnect all power sources before initiating any maintenance or repairs. Keep fingers and foreign objects away from ventilation and other openings. Keep air passages clear. Potentially lethal voltages exist within the control unit and connections. Use extreme caution during installation and start-up.

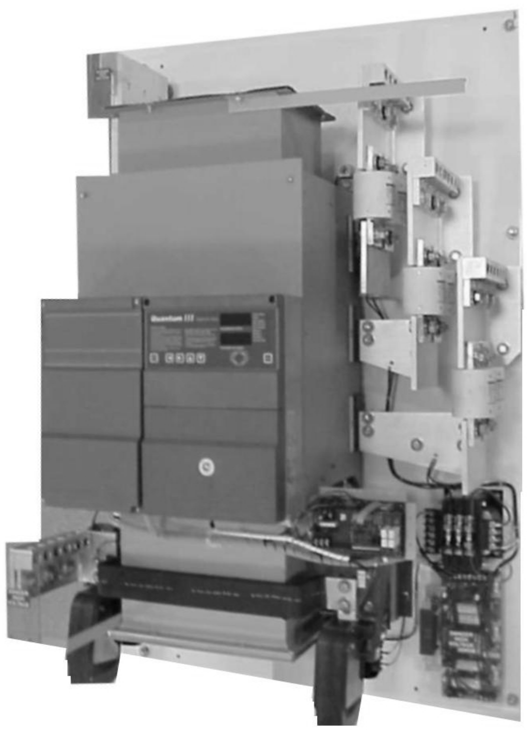
Special fastener sizes are used on some connections; use only the type hardware supplied with the control. Failure to observe this precaution can cause equipment damage.

3.6 INITIAL CHECKS

Before installing the control, check the unit for physical damage sustained during shipment. If damaged, file claim with shipper and return for repair following procedures outlined on the back cover of this manual. Remove all shipping restraints and padding. Check nameplate data for conformance with the AC power source and motor.

Size 1
5-100HP @ 480 VAC
5-50HP @ 230 VAC
9500-8X02 thru 8X06

Size 2
150-400HP @ 480 VA
75-200HP @ 230 VAC
9500-8X07 thru 8X11



Size 3
500-1000HP @ 480 VAC
250-500HP @ 230 VAC
9500-8X15 thru 8X20

RATING TABLE

	Drive Model No.	Typical DC Motor Rating at 240V/500V Arm		Drive Type	Heat Loss Max. Watts (2) (3)	(1) Maximum Continuous Current Rating @55C		Cooling		Approx. Weight	SIZE
		HP	KW			AC Input	DC Output	Method	Air Flow (CFM)	(lbs/kg)	
Non-Regenerative	9500-8302	10/20	9.1/19	1 Quadrant	123	31	38	Nat. Conv.	-	44/20	1
	9500-8303	15/30	13.2/27.5	1 Quadrant	179	45	55	Nat. Conv.	-		
	9500-8305	30/60	25.5/53.2	1 Quadrant	387	87	106	Built-in Fan	200	71/32	
	9500-8306	50/100	41.8/87	1 Quadrant	552	141	172	Built-in Fan	200		
	9500-8307	75/150	62/129	1 Quadrant	758	209	255	Built-in Fan	500	110/50	2
	9500-8308	100/200	83/172	1 Quadrant	968	277	338	Built-in Fan	500		
	9500-8309	125/250	102/213	1 Quadrant	1216	351	428	Built-in Fan	750		
	9500-8310	150/300	121/253	1 Quadrant	1400	417	508	Built-in Fan	750	155/70	
	9500-8311	200/400	158/329	1 Quadrant	1743	554	675	Built-in Fan	750		
	9500-8315	500	197/410	1 Quadrant	2084	672	820	Built-in Fan	760	397/180	3
	9500-8316	600	236/493	1 Quadrant	2436	808	985	Built-in Fan	760		
	9500-8317	700	276/575	1 Quadrant	2776	943	1150	Built-in Fan	760		
	9500-8318	800	300/625	1 Quadrant	2961	1025	1250	Built-in Fan	760	443/201	
	9500-8319	900	353/735	1 Quadrant	3647	1205	1470	Built-in Fan	760		
	9500-8320	1000	389/810	1 Quadrant	4000	1328	1620	Built-in Fan	760		
Regenerative	9500-8602	10/20	9.1/19	4 Quadrant	123	31	38	Nat. Conv.	-	55/25	1
	9500-8603	15/30	13.2/27.5	4 Quadrant	179	45	55	Nat. Conv.	-		
	9500-8605	30/60	25.5/53.2	4 Quadrant	387	87	106	Built-in Fan	200	75/34	
	9500-8606	50/100	41.8/87.4	4 Quadrant	552	141	172	Built-in Fan	200		
	9500-8607	75/150	62/129	4 Quadrant	758	209	255	Built-in Fan	500	120/54	2
	9500-8608	100/200	83/172	4 Quadrant	968	277	338	Built-in Fan	500		
	9500-8609	125/250	102/213	4 Quadrant	1216	351	428	Built-in Fan	750		
	9500-8610	150/300	121/253	4 Quadrant	1400	417	508	Built-in Fan	750	165/75	
	9500-8611	200/400	158/329	4 Quadrant	1743	554	675	Built-in Fan	750		
	9500-8615	500	197/410	4 Quadrant	2084	672	820	Built-in Fan	760	475/216	3
	9500-8616	600	236/493	4 Quadrant	2436	808	985	Built-in Fan	760		
	9500-8617	700	389/810	4 Quadrant	2776	943	1150	Built-in Fan	760		
	9500-8618	800	300/625	4 Quadrant	2961	1025	1250	Built-in Fan	760		
	9500-8619	900	353/735	4 Quadrant	3647	1205	1470	Built-in Fan	760	525/288	
	9500-8620	1000	389/810	4 Quadrant	4000	1328	1620	Built-in Fan	760		

NOTES:

(1) Refer to National Electric Code, Article 310, for cable size information.
(2) Total losses do not include field supply losses. Field losses = 1 x Field Current (in watts).
(3) All drives are rated at 99% efficiency based on 240V armature (worst case) and total losses (less field supply).
(4) These models do not include cooling fans, line fuses, armature fuse, or contactor.

- Size 1 Models -
  Suitable for use on a circuit capable of delivering not more than 10,000 RMS Symmetrical Amperes, 480V maximum.

- Size 2 Models -
  Suitable for use on a circuit capable of delivering not more than 18,000 RMS Symmetrical Amperes, 480V maximum.

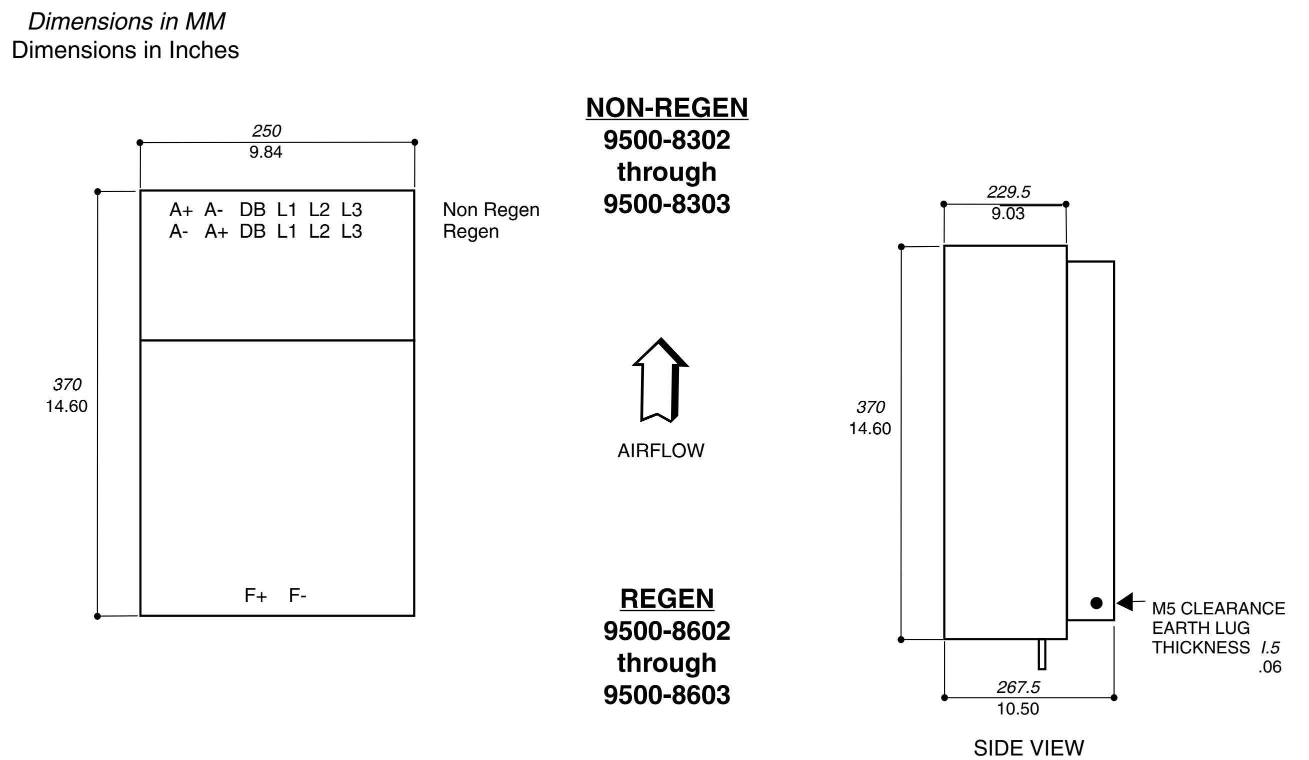


Figure 5-1.
Quantum III Dimensions

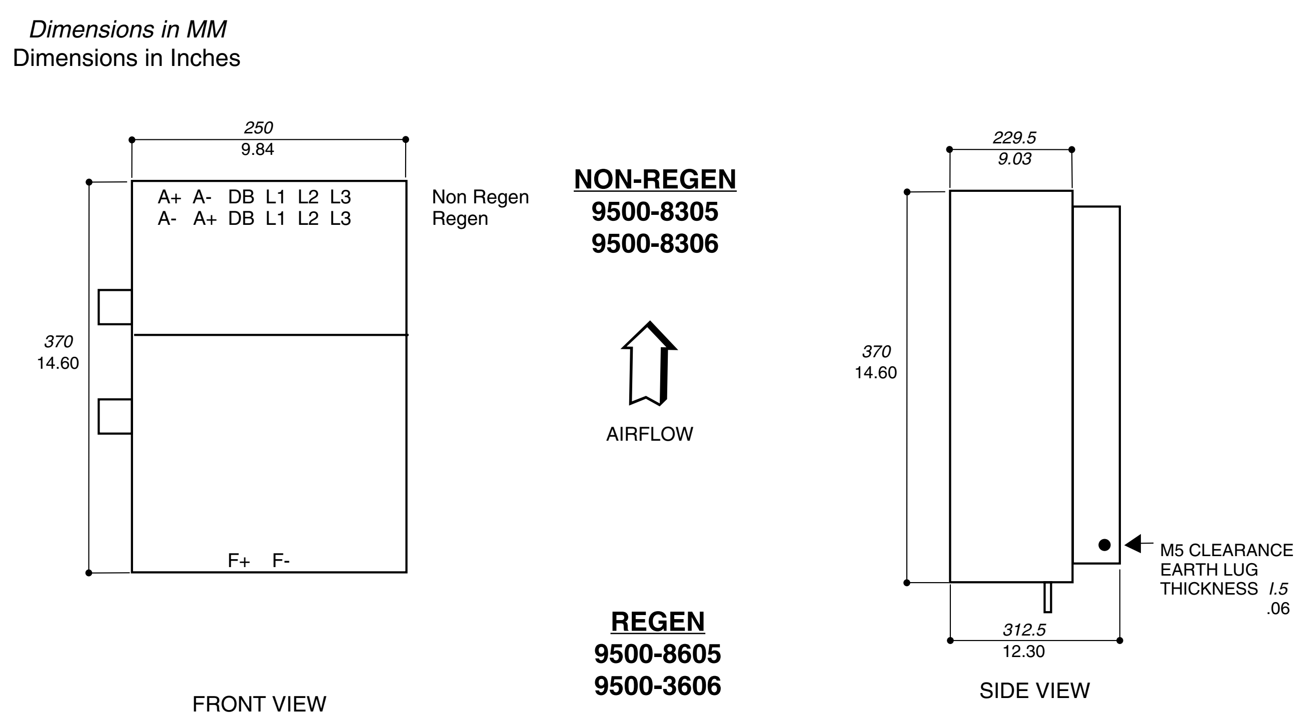
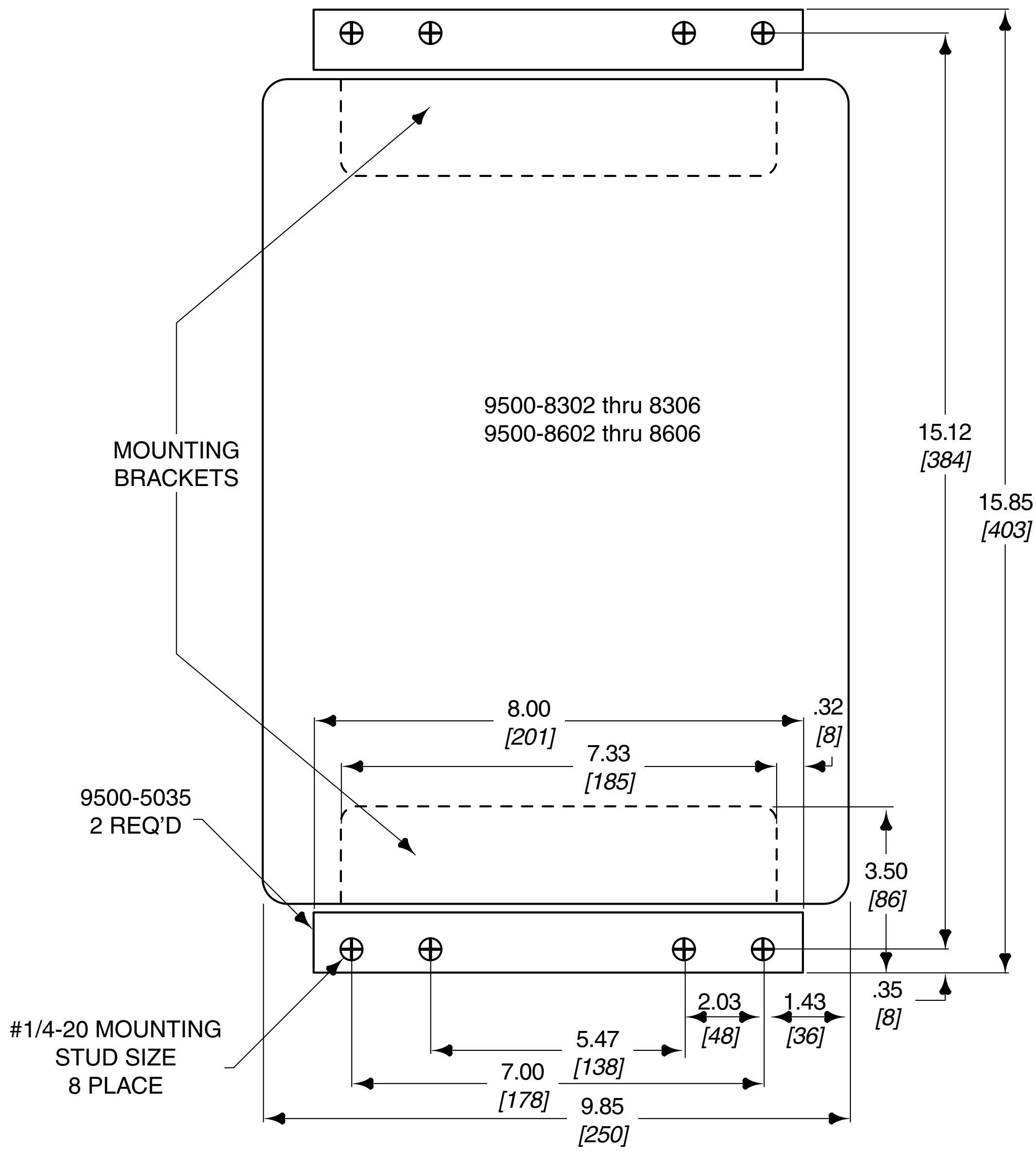


Figure 5-2.
Quantum III Dimensions



Dimensions in Inches
Dimensions in MM

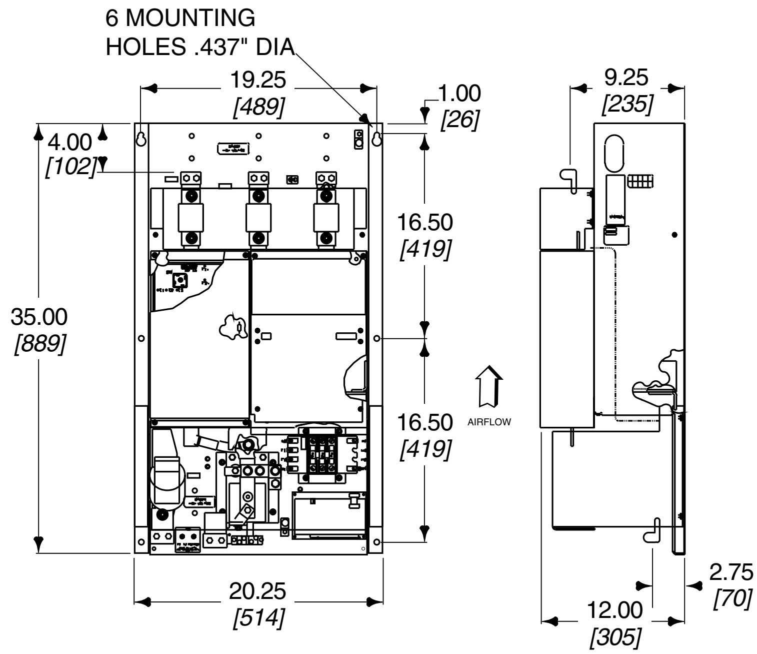
Figure 5-3.
Quantum III Panel Mounting Using Supplied Brackets

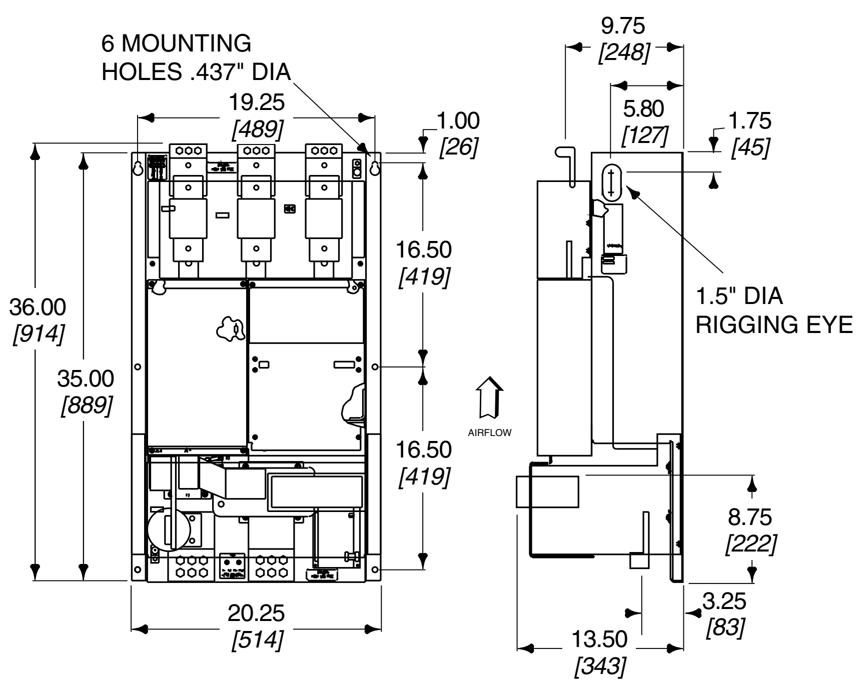
Dimensions in Inches
Dimensions in MM

QUANTUM III
125-250 HP

NON-REGENERATIVE
9500-8307
9500-8308
9500-8309

REGENERATIVE
9500-8607
9500-8608
9500-8609





QUANTUM III
300-400 HP

NON-REGENERATIVE
9500-8310
9500-8311

REGENERATIVE
9500-8610
9500-8611

Figure 5-4.
Quantum III Mounting

Dimensions in Inches
Dimensions in MM

NON-REGEN

9500-8315 thru 9500-8320

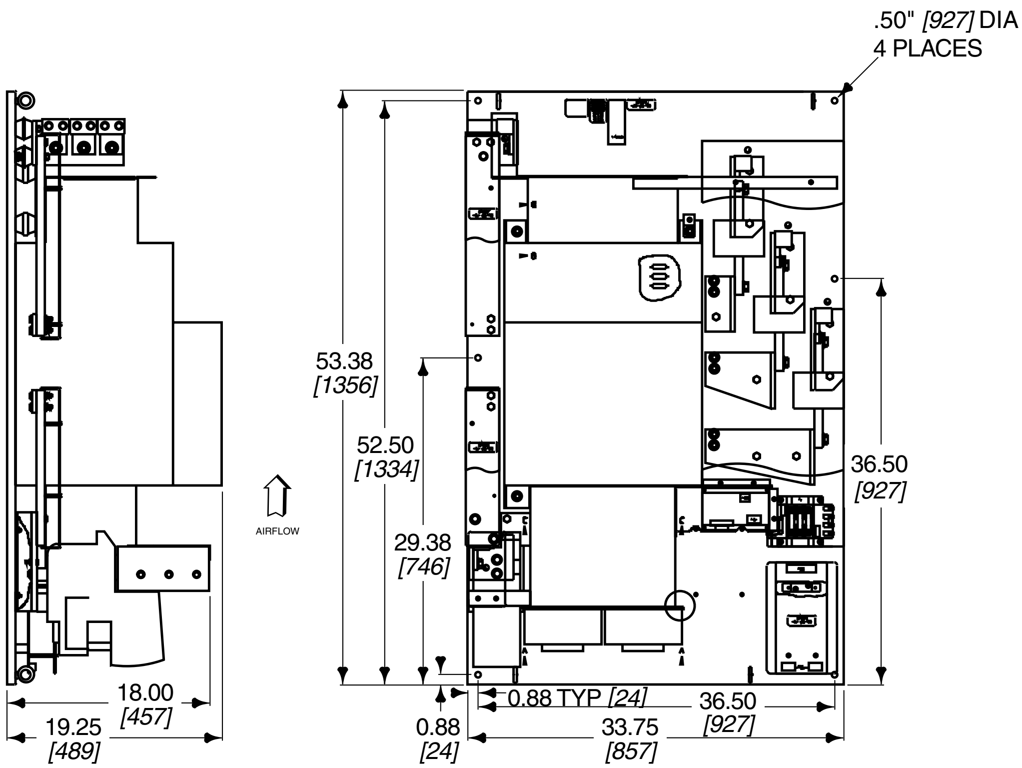
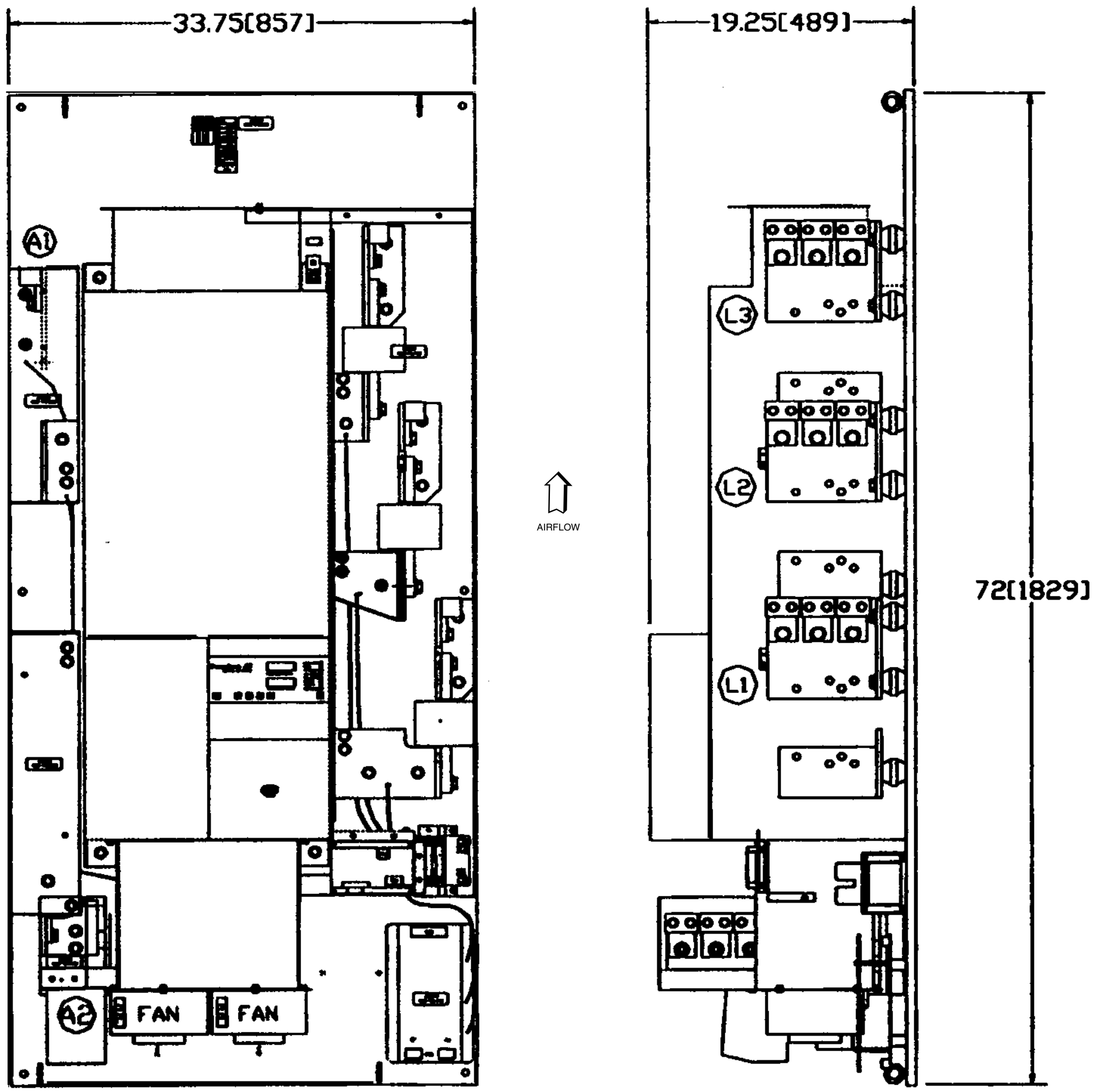


Figure 5-5.
500 HP - 1000 HP Non-Regenerative Quantum III Dimensions



Front View **Side View**

QUANTUM III 9500-8615 thru 9500-8620		
Drive Model	**Weight (lbs)**	**Weight (kg)**
9500-8615 thru 8618	475	216
9500-8619 & 8620	525	288

Figure 5-6.
500 HP - 1000 HP Regenerative Quantum III Dimensions

Figures 5-1 to 5-6 show the overall and mounting dimensions of the basic unit types, details of which are as follows.

6.1 9500 -8302, -03 9500 -8602, -03 — FIGURE 5-1

This unit type covers the following ratings at 480 VAC:

9500-8302, -03 (5, 7.5, 10, 20 & 30 HP)
9500-8602, -03 (5, 7.5, 10, 20 & 30 HP)

The above units are cooled by natural convection and have an isolated heat sink which should be grounded for safety.

The drive may be mounted by either of the following methods:

a) By means of the two mounting brackets supplied, as shown in Figure 5-3.
b) Through a panel cutout, the heat sink projecting into a separate cooling duct.

The naturally-ventilated drives may be mounted by the means described in 6.1a and b above.

6.2 9500-8305, -06 9500-8605, -06 — FIGS. 5-2 THROUGH 5-3

The 9500-8X05 through 06 type covers the following ratings at 480 VAC:

9500-8305, -06 (40, 50, 60, 75 & 100 HP)
9500-8605, -06 (40, 50, 60, 75 & 100 HP)

The fan-cooled drives are surface mounted by means of the fan housing. Mounting dimensions are shown in Figure 5-3.

6.3 9500-8307 THROUGH -8311 9500-8607 THROUGH -8611 — FIGURE 5-4

The 9500-8X07 through -11 type covers the following ratings at 480 VAC:

9500-8307, 08, 09, 10, 11
(150, 200, 250, 300 & 400 HP)
9500-8607, 08, 09, 10, 11
(150, 200, 250, 300 & 400 HP)

These two models are fan cooled. The heatsinks on these models are not isolated and are Hot to the power line.

6.4 9500-8315 THROUGH -8320 9500-8615 THROUGH -8620

This unit type covers the following ratings at 480 VAC:

9500-8X15 (500 HP)
9500-8X16 (600 HP)
9500-8X17 (700 HP)
9500-8X18 (800 HP)
9500-8X19 (900 HP)
9500-8X20 (1000 HP)

These fan ventilated drives are mounted on a panel and are suitable for surface mounting only. See Figures 5-5 and 5-6. The heatsinks on these models are not isolated and are Hot to the power line.

6.5 DETERMINING THE CONTROL LOCATION

The control is suitable for most well-ventilated factory areas where industrial equipment is installed. Locations subject to steam vapors, excessive moisture, oil vapors, flammable or combustible vapors, chemical fumes, corrosive gases or liquids, excessive dirt, dust or lint should be avoided unless an appropriate enclosure has been supplied or a clean air supply is provided to the enclosure. The location should be dry and the ambient temperature should not exceed 55°C for free-standing chassis mount controls, or 40°C for enclosed controls mounted inside an enclosure. If the mounting location is subject to vibration, the unit should be shock mounted.

If the enclosure is force ventilated, avoid, wherever possible, an environment having a high foreign matter content as this requires frequent filter changes or the installation of micron-filters. Should the control enclosure require cleaning on the inside, a low pressure vacuum cleaner is recommended. Do not use an air hose because of the possibility of oil vapor contaminating the control. Compressed high air pressure may damage the control.

6.6 INSTALLING CHASSIS MOUNT CONTROLS

The Quantum control is suitable for mounting in a user's enclosure where the internal temperature will not exceed 55°C. When mounting the control, insure that the ventilation areas at each end of the control are clear.

Mount the control vertically against the mounting surface. Minimum clearances must be maintained within the cabinet to allow adequate air circulation around and through the drive.

Install the control in the cabinet, using Figures 5-1 through 5-7 for dimensional reference.

CAUTION

Never operate the control for an extended time on its back. The drive is designed for vertical operation and convection cooling.

WARNING

EQUIPMENT DAMAGE AND/OR PERSONAL INJURY MAY RESULT IF ANY JUMPER PROGRAMMING IS ATTEMPTED WHILE THE CONTROL IS OPERATIONAL. ALWAYS LOCK OUT POWER AT THE REMOTE DISCONNECT BEFORE CHANGING ANY JUMPER POSITIONS.

7.1 POWER WIRING

7.1.1 Incoming Power Requirements

Refer to Sections 7.2.1 through 7.2.3 for location of power connections.

A remote fused AC line disconnect or circuit breaker is required by the National Electric Code. This AC line disconnect or circuit breaker must be installed in the incoming AC power line ahead of the control.

Overload protection must be provided per NEC (National Electric Code) guidelines.

The control will operate from typical industrial 3-Phase AC power lines. The line should be monitored with an oscilloscope to insure that transients do not exceed limitations as listed below:

1. Repetitive line spikes of less than 10 microseconds must not exceed the following magnitude:

   240 Volt Programming: 400V Peak
   480 Volt Programming: 800V Peak

2. Non-repetitive transients must not exceed 25 watt seconds of energy. Transients of excessive magnitude or time duration can damage dv/dt suppression networks.
3. Line notches must not exceed 300 microseconds in duration. An abnormal line condition can reflect itself as an intermittent power unit fault. High amplitude spikes or excessive notch conditions in the applied power could result in a power unit failure.

The control is designed to accept three phase AC line voltage. See Section 4 Rating Table for drive input and output ratings and acceptable wire sizes. When using three phase power, connect the incoming lines to terminals L1, L2 and L3. These terminals are located as shown in Sections 7.2.1 through 7.2.3. Any incoming line can be connected to any of the L1, L2 and L3 terminals. The control is not sensitive to phase rotation.

WARNING

CONNECTING THE INPUT AC POWER LEADS TO ANY TERMINALS OTHER THAN L1, L2 OR L3 WILL CAUSE AN IMMEDIATE FAILURE OF THE CONTROL.

CAUTION

The voltage and frequency of the incoming line to the control must be as shown in Paragraph 2.1, depending on the jumper programming. If the incoming line voltage and/or frequency is out of this tolerance, the control may fail to operate properly.

WIRE SIZE AND LUG CONNECTION TABLE

Quantum Model	HP		AC Input	DC Output	AC Line Wire Size			Arm Wire Size		
	480vac	230vac	Amps	Amps	Max	Min	Lugs/Conn	Max	Min	Lugs/Conn
9500-8X02	20	10	31	38	6	14	1	6	14	1
9500-8X03	30	15	45	55	6	14	1	6	14	1
9500-8X05	60	30	87	106	250mcm	6	1	250mcm	6	1
9500-8X06	100	50	141	172	250mcm	6	1	250mcm	6	1
9500-8X07	150	75	209	255	350mcm	6	1	500mcm	4	1
9500-8X08	200	100	277	338	250mcm	6	2	250mcm	6	2
9500-8X09	250	125	351	428	250mcm	4	2	350mcm	4	2
9500-8X10	300	150	417	508	350mcm	4	2	600mcm	4	2
9500-8X11	400	200	554	675	350mcm	6	3	500mcm	4	3
9500-8X15	500	250	672	820	600mcm	2	6	600mcm	2	6
9500-8X16	600	300	808	985	600mcm	2	6	600mcm	2	6
9500-8X17	700	350	943	1150	600mcm	2	6	600mcm	2	6
9500-8X18	800	400	1025	1250	600mcm	2	6	600mcm	2	6
9500-8X19	900	450	1205	1470	600mcm	2	6	600mcm	2	6
9500-8X20	1000	500	1328	1620	600mcm	2	6	600mcm	2	6

7.1.2 Power Distribution Requirements

When applying DC Drives to power systems it is important to insure that the power distribution ampacity is sufficient but not too excessive. In general, if a power distribution KVA capacity exceeds 7 times that of the smallest drive KW rating, an isolation transformer or line reactor should be employed to achieve a suitable impedance between the drive and the power lines to insure reliable operation. AC power lines offering between 1% to 6% impedance provide the best operating conditions for variable speed drives.

Power Factor Corrected Lines

Drive installation should be avoided on lines that are corrected for power factor. When the power distribution system contains power factor correction capacitors, drives should be installed as far way as possible from these correction capacitors so that the length of wire offers some protective impedance. If this is not possible a 3% line reactor or an isolation transformer is recommended to insure reliable operation.

Note

For a complete list of recommended line reactors and isolation transformers to insure proper drive operation and protection, contact Control Techniques.

Size	Model	Line Voltage		Max. Supply KVA	
		240 HP	480 HP	@240 KVA	@480 KVA
1	9500-8X02	10	20	90	180
	9500-8X03	15	30	131	262
	9500-8X05	30	60	253	506
	9500-8X06	50	100	410	820
	9500-8X07	75	150	607	1215
	9500-8X08	100	200	805	1610
2	9500-8X09	125	250	1020	2040
	9500-8X10	150	300	1212	2424
	9500-8X11	200	400	1610	3220
	9500-8X15		500	1953	3906
	9500-8X16		600	2348	4697
3	9500-8X17		700	2741	5481
	9500-8X18		800	2979	5958
	9500-8X19		900	3502	7004
	9500-8X20		1000	3860	7719

The KVA values above provide the minimum impedance required for di/dt limiting. They do not provide any protection from cross talk between multiple drives on a common supply. Individual line reactors will provide this protection in most instances.

WARNING

EXCEEDING THE MAXIMUM RECOMMENDED SUPPLY AMPACITY LISTED IN THE TABLE ABOVE MAY CAUSE DAMAGE TO THE DRIVE. CONTROL TECHNIQUES WILL NOT BE LIABLE FOR ANY DAMAGE DUE TO EXCEEDING THE RECOMMENDED SUPPLY KVA AMPACITY.

7.2 OUTPUT POWER CONNECTIONS

Refer to Figures 7.2.1 through 7.2.3 for location of power connections.

Before connecting the DC motor to the control, observe all of the following precautions:

A. Verify the motor is the appropriate size to use with the drive.

CAUTION

All of the precautions listed in the following steps must always be observed to avoid equipment malfunctioning and damage.

1. Never connect the control to a motor with a current rating higher than the continuous rating of the drive. The motor current rating should not be less than 40% of the drive continuous rating, unless the drive is re-shunted..
2. Never connect the control to a motor with a field current rating greater than the drive field supply rating. When a field regulator is used the field current should not be forced below 0.25ADC, or 5% of the drive field current rating, whichever is greater.
3. When the control is in the regenerating mode (power flow is back into the line), the line voltage must commutate the SCRs. If the DC motor voltage is too high, or the line voltage is too low, commutation failures can occur. This may damage components and blow fuses. Armature voltage (as set by parameter #3.15) should never be set higher than 1.09 times the RMS incoming line voltage (500VDC for 460VAC supplies, or 240VDC for 230VAC supplies). If the armature voltage is reduced from the values listed above, the margin for proper commutation, if a line "dip" occurs, improves substantially.

B. Install the DC motor according to its instruction manual, being sure to maintain correct polarity between A1 and A2, S1 and S2, and F1, F2, F3, and F4.

NOTE

S1 and S2 should not be used with regenerative drives. S1 and S2 connections should be left unconnected and taped off.

C. Make sure the motor is properly aligned with the driven machinery to minimize unnecessary motor loading from shaft misalignment.

D. Install protective guards around all exposed rotating parts.

If the motor has a built-in thermal overload protection device, connect the thermal overload lead to the drive. Connect the motor thermal (P1, P2) as described in paragraph 7.2.

If, with the motor connected, the wrong rotational direction is observed, the rotational problem can be corrected in any of three (3) possible ways:

1. Exchanging the A+ and A- output leads to the motor.
2. Exchanging the shunt field F+ and F- leads on shunt wound motors only.
3. On regenerative drives only, changing the position of the Forward/Reverse switch (if used).

Note that exchanging the incoming power leads to terminals L1, L2, and L3 will not affect the direction of motor rotation.

7.2.1 Size 1 Power Connections

DB Resistor goes between the DB lug and the adjacent armature lug. The photo here is for a Regen model 9500-860X.

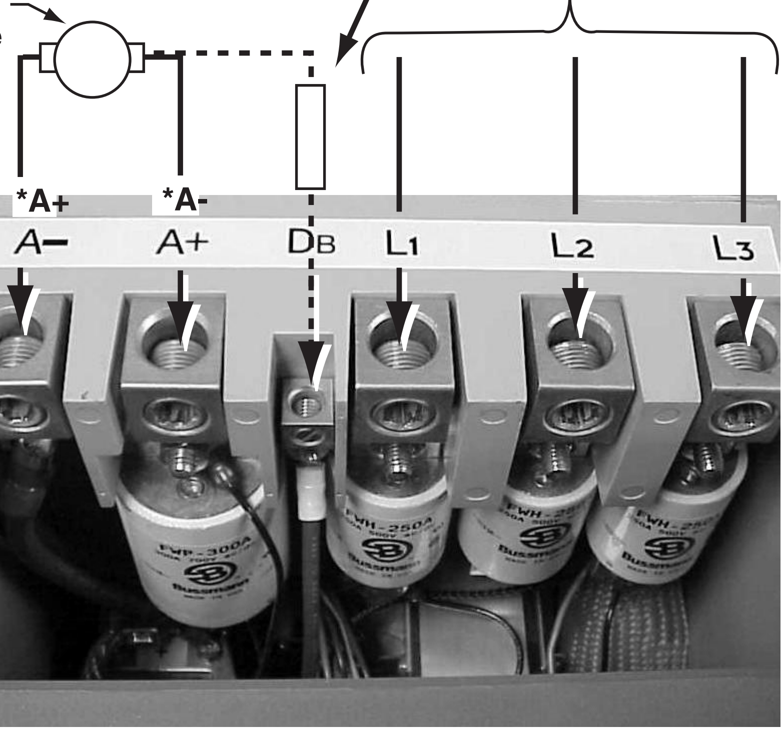
* For Non-Regen models 9500-830X, the adjacent lug would be labelled A-.

Optional DB (Dynamic Braking Resistor)

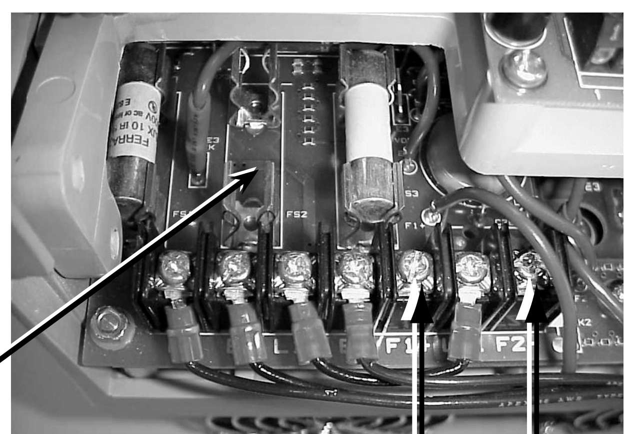
3 Phase AC Line Input

DC Motor Armature

View from top



View from bottom



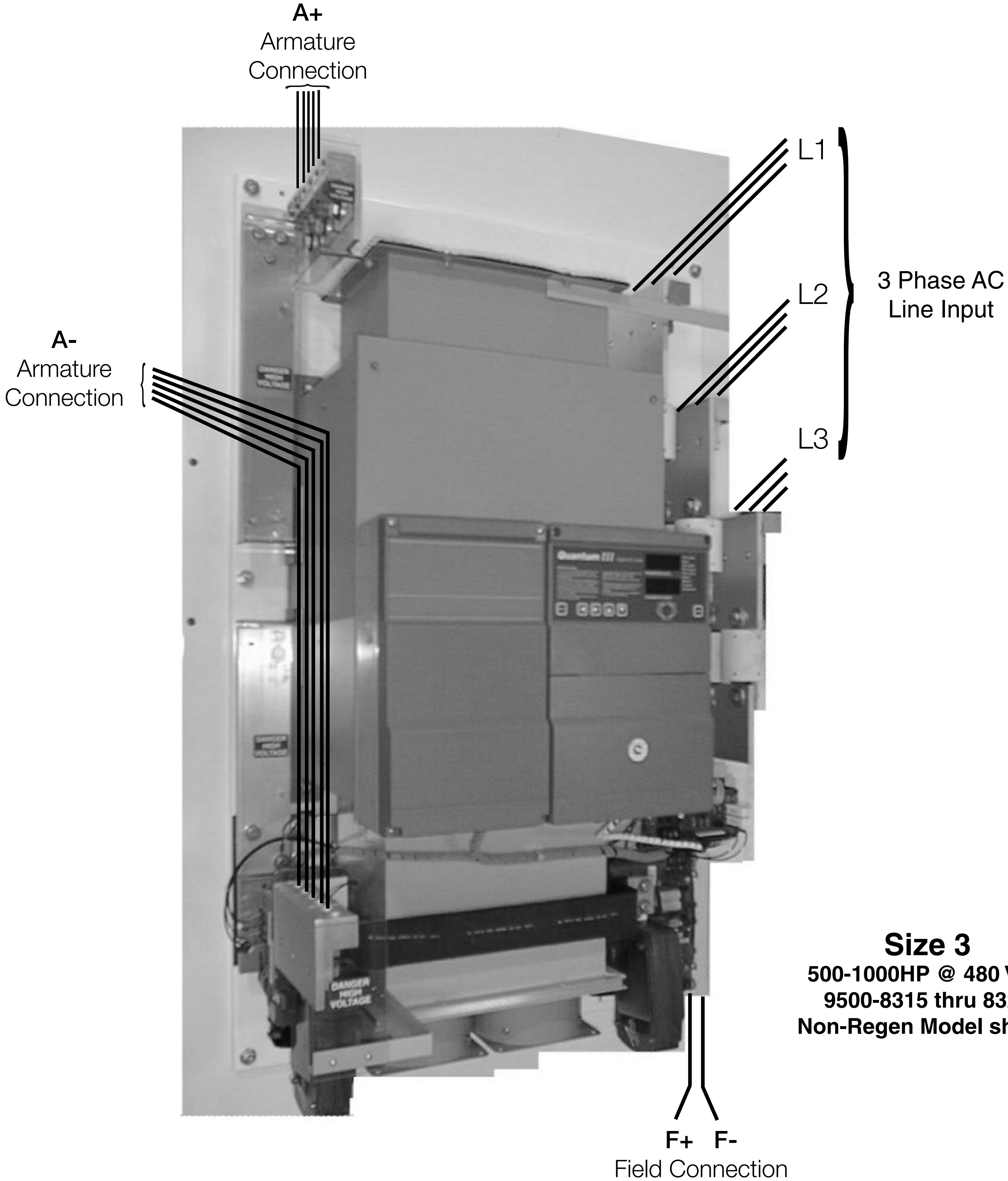
Note: Center fuse is not necessary.

Field Connections
F+ F-

7.2.2 Size 2 Power Connections

Size 2
150-400HP @ 480 VAC
75-200HP @ 230 VAC
9500-8X07 thru 8X11

7.2.3 Size 3 Power Connections



Size 3
500-1000HP @ 480 VAC
9500-8315 thru 8320
Non-Regen Model shown

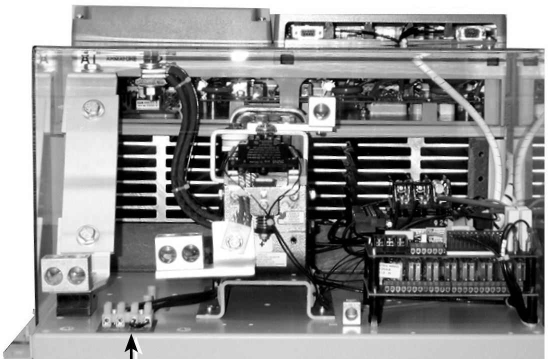
7.2.4 Field Connections for Quantum III Size 2 & Size 3

The Field Supply on Quantum III's Size 2 and 3 is a rectified DC voltage derived from the three phase AC power connected to L1, L2, L3. The approximate DC voltage supplied on F1 and F2 of the Quantum III is shown in the adjacent table.

One should ensure that parameter #10.29 is set to 0 to Enable Field Loss Detection and subsequent Drive Trips.

AC Power Line	Motor Field Voltage*
230	150
380	240
415	300
460	305
480	315

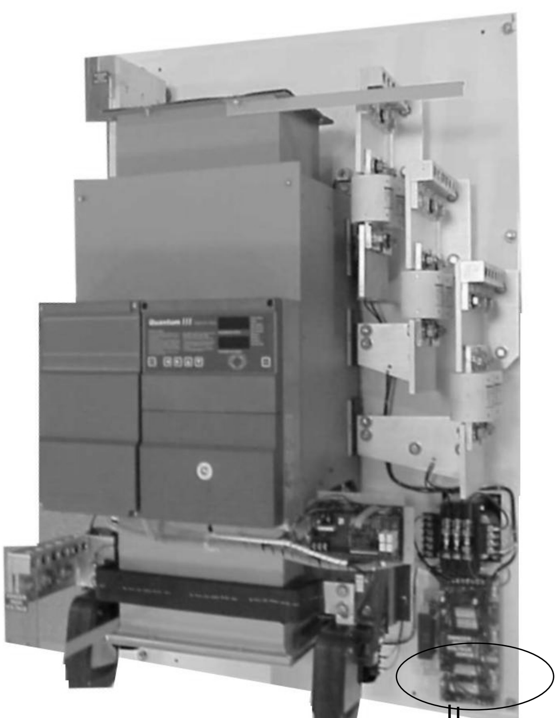
**Other custom voltages can be created. Contact technical support for more information.*



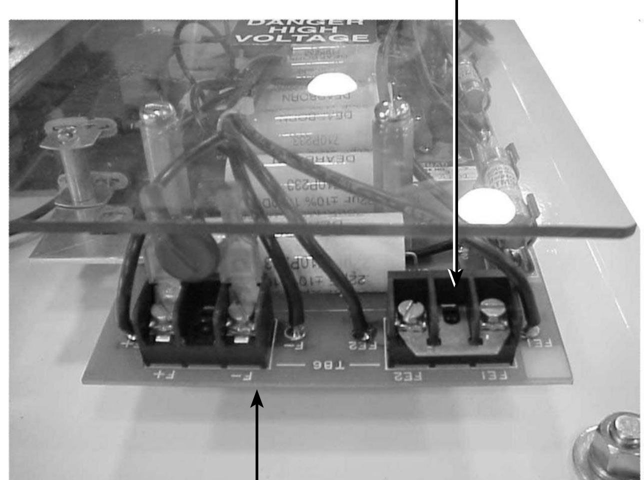
Field Connections
10A Max on Size 2 Quantum

For External Field
Economy Reduction.

Field Connections for Quantum III Size 3



F+ F-
Field Connection



Field Connections
20A Max on Size 3 Quantum

7.3 CONTROL LOGIC WIRING

Note the following in the interconnect diagrams, Figures A-1 through A-4 (9500-1300-I) in the rear of this manual. See Figures 7-6 for locations. Also refer to Section 9 for a complete description of logic interface circuits.

a. A 3-wire Start/Stop circuit is shown. A stop command in this configuration will cause the motor to coast to a stop. If the dynamic braking option is used, a stop command will cause the motor to stop by dynamic braking.

For applications requiring ramp stop, the only change required for a 3-wire configuration (as shown in Figure A-4) is to change the position of jumper JP3 on the 9500-4030 board from position 1-2 (coast stop) to position 2-3 (ramp stop). In this case, the E-stop/dynamic braking pushbutton (normally closed) should be connected between terminals #1 and #2 of TB1 on the 9500-4025 board.

b. A 2-wire Start/Stop is also shown. A jumper is connected between 5 and 6 and an N/O contact that closes to start the drive is wired to terminals 6 and 7. JP1 must be moved to the 1-2 position on the 9500-4025 board. For ramp stop, JP3 on the 9500-4030 board must be set in position 2-3 and the E-stop/dynamic braking pushbutton should be connected as described in step (a) above.

c. The Forward/Reverse wiring shown on the 9500-4025 board is for regenerative drives, only.

d. The motor thermal is connected between 3 and 4 of TB1 on the 9500-4025 board. The motor thermal can also be connected to TBS-4 and 5 on the 9500-4030 board. This will then show as a drive fault rather than a system fault and its status can be observed in parameter 10.21. Parameter 10.32 must be set to a 1 to enable this function. Terminals 2 and 3 on the 9500-4025 board are used for system interlocks. If these functions are not required, a closed connection must be provided.

e. The N/O Jog pushbutton is connected to terminals 8 and 9.

f. 120VAC at 6 VA is available on terminals 24 and 25 to power a drive run light.

g. An external drive reset function is available by connecting an N/O pushbutton to terminals 10 and 12.

h. A Form C NO/NC programmable relay rated 5 amps is available at TB3-34,35, and 36 on the MDA-2. It is defaulted to zero speed.

When proceeding with the signal wiring, the following safety precautions for the signal conduit and wire types must be followed.

A. SIGNAL CONDUIT REQUIREMENTS

- Use either a rigid steel or flexible armored steel cable.
- The signal conduit must cross non-signal conduit at an angle between 45° and 90°.
- Do not route the conduit through junction or terminal boxes that have non-signal wiring.

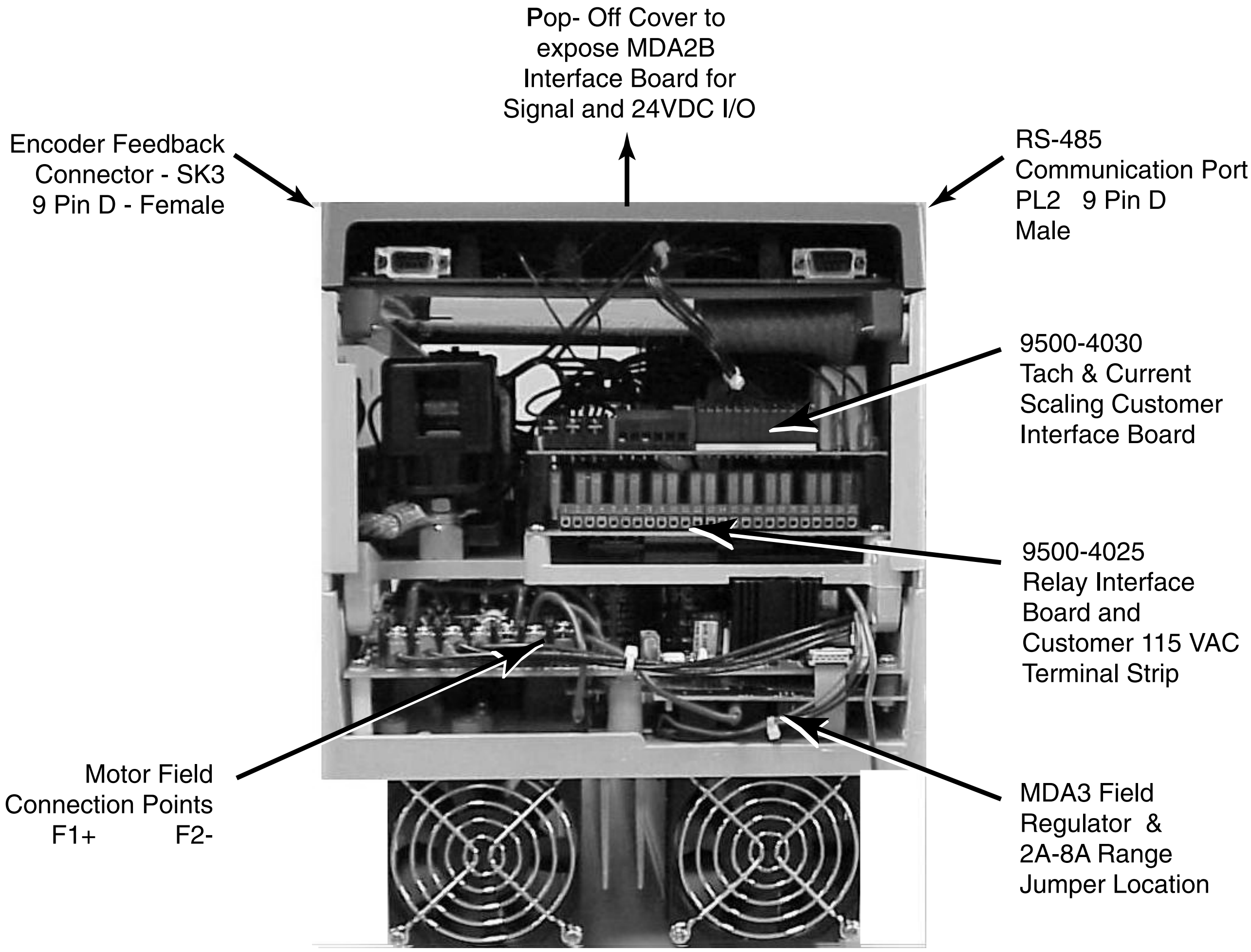
B. SIGNAL WIRE REQUIREMENTS

- Size and install all wiring in conformance with the NEC and all other applicable local codes.
- Use shielded wire for reference and other signal wire connections. Belden #83394 (2 conductor) and Belden #83395 (3 conductor) shielded wire (or equivalent) is recommended. The shields should be taped off at the remote end. At the drive control, the shields should be connected to circuit common.
- Route all wiring away from high current lines such as AC lines and armature wiring.
- Always run the signal wire in steel conduit. Never run the signal wire with non-signal wire.
- Route external wiring, rated at 600 volts or more, in separate steel conduit to eliminate electrical noise pickup.
- For distances less than 150 feet, use a minimum of #22AWG wire. For distances more than 150 feet and less than 1000 feet, use a minimum of #16AWG wire.

CAUTION

It is important to use wire rated at 600 volts or more because this wiring may make contact with uninsulated components. Failure to observe this precaution can result in equipment damage.

Quantum III Size 1 - Bottom End View

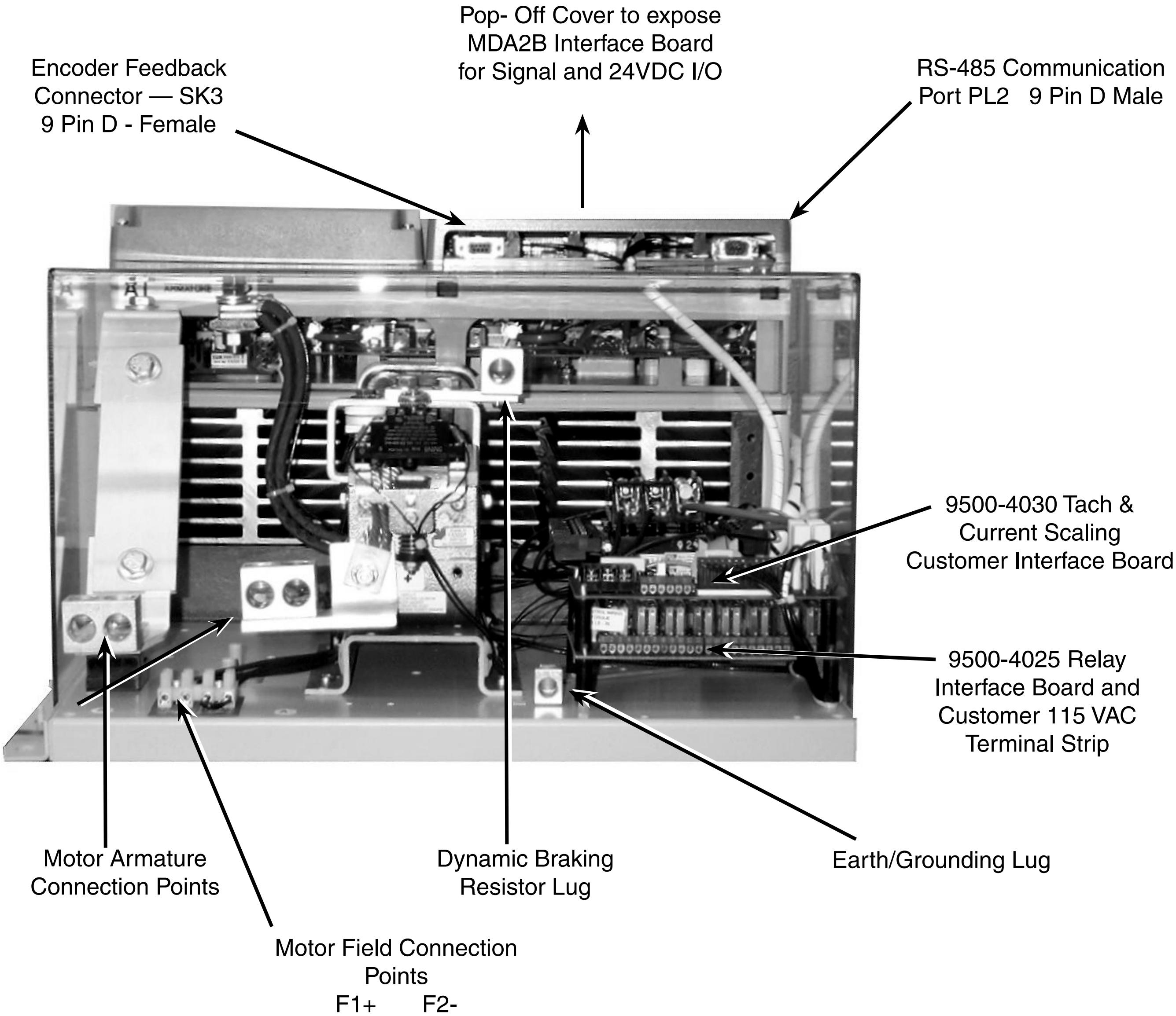


Note: Fans on 9500-8X05 and 9500-8X06 only

Size 1

Figure 7-1
Quantum III, Size 1 Bottom End View

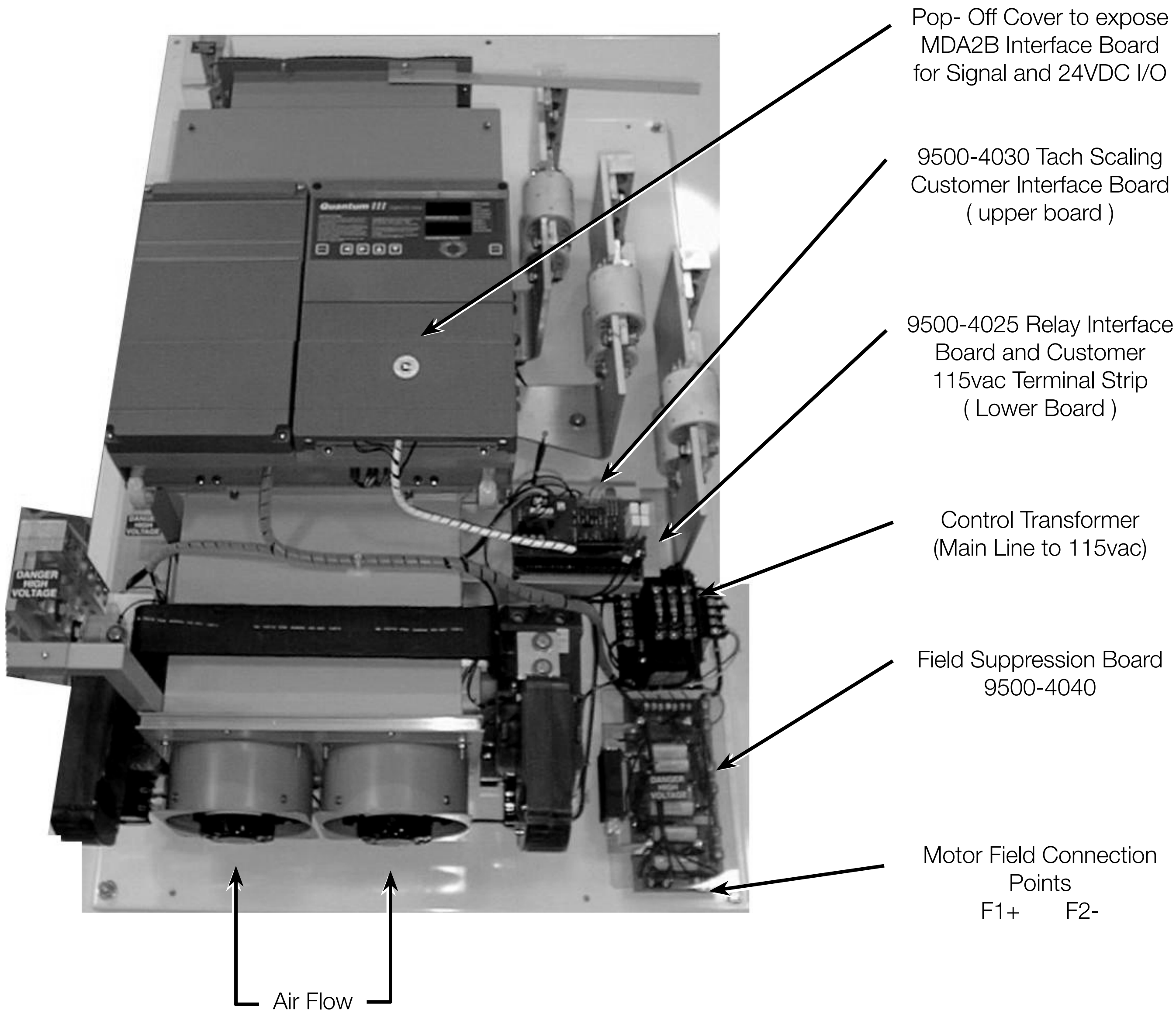
Quantum III Size 2 - Bottom End View



Size 2

Figure 7-2
Quantum III, Size 2 Bottom End View

Quantum III Size 3 - Bottom End View



Size 3

Figure 7-3
Quantum III, Size 3 Bottom End View

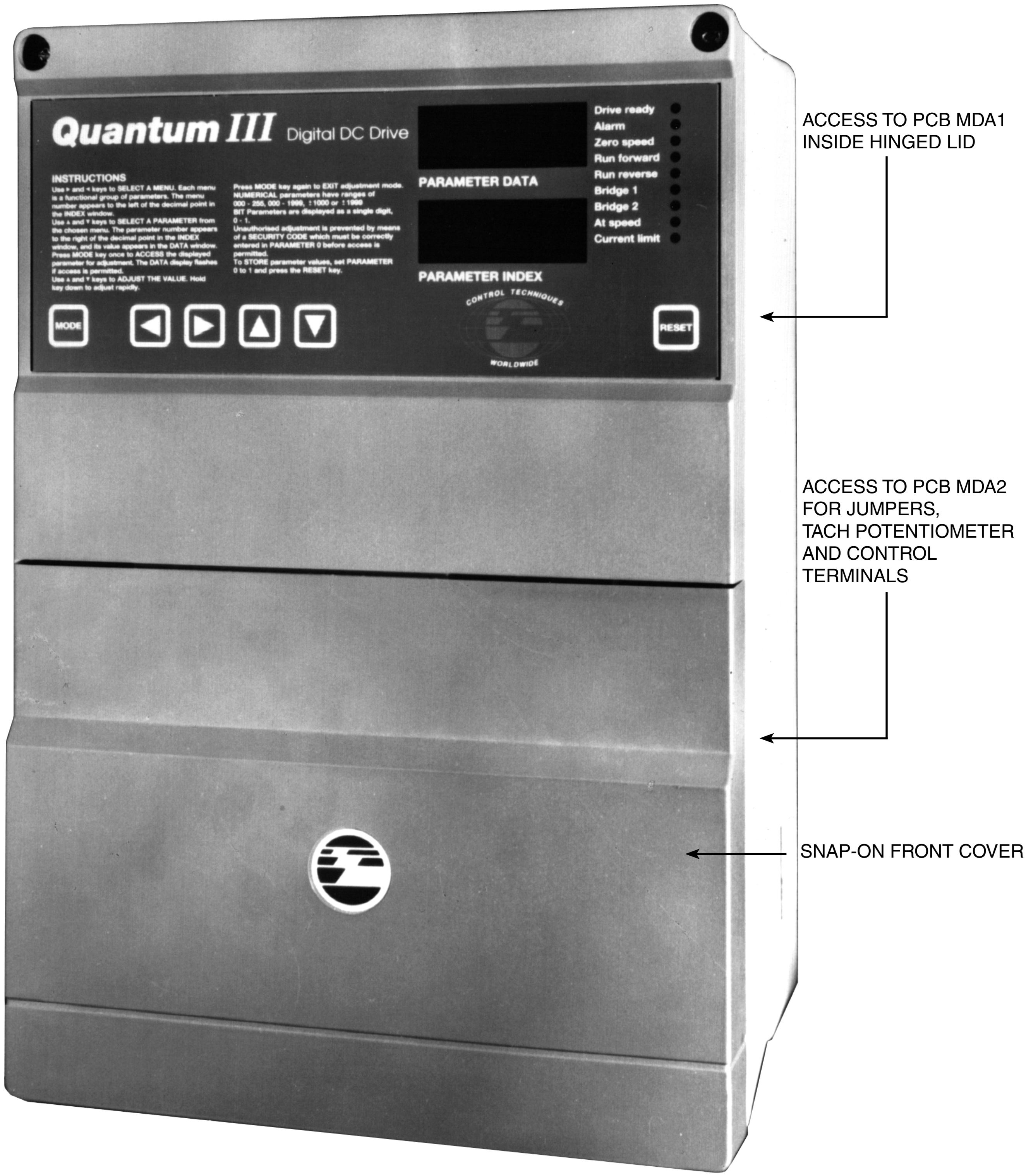


Figure 7-4.
Location of Main Components

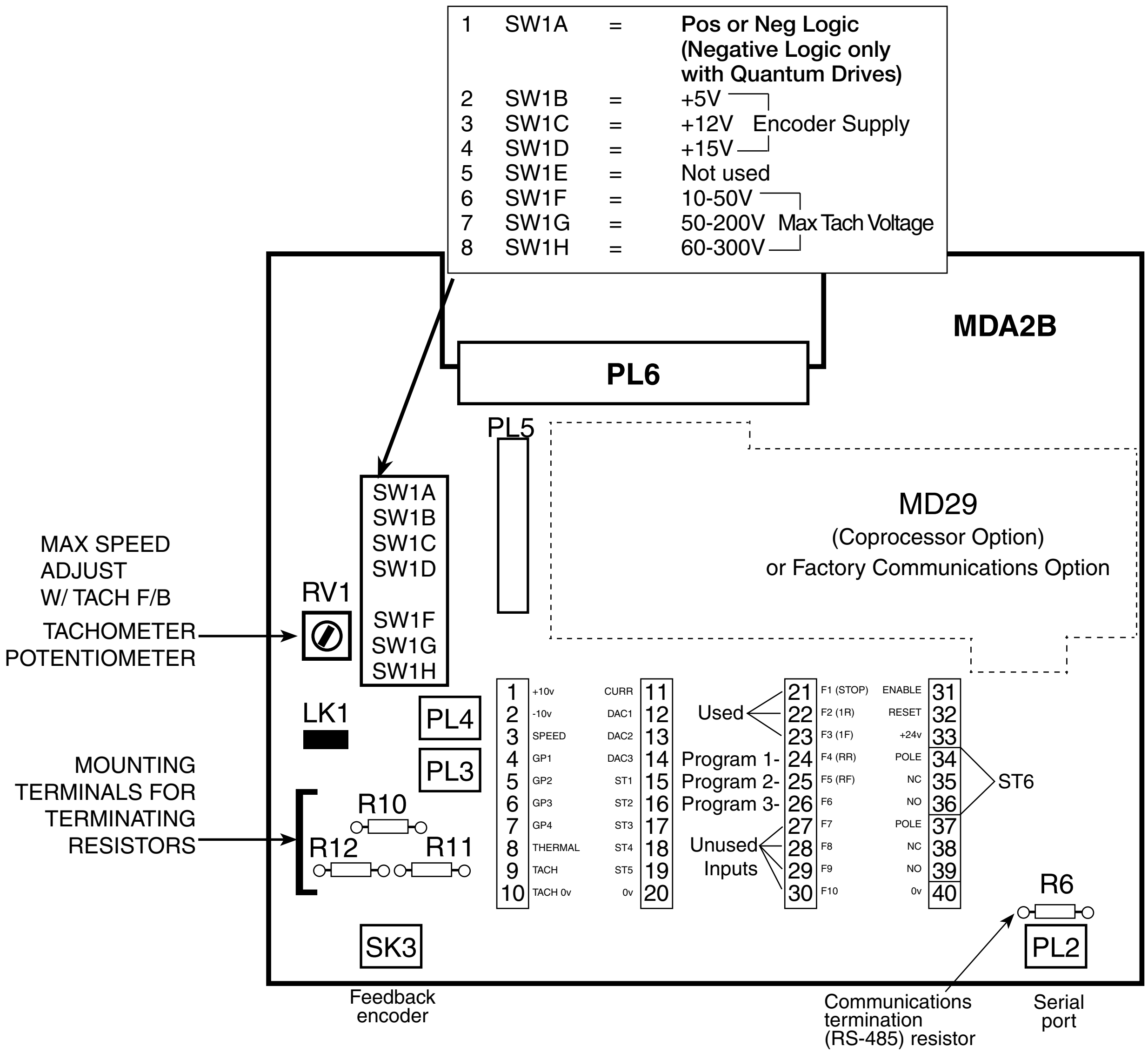


Figure 7-5.
Location of Principal Components on PCB MDA2, Rev. 2

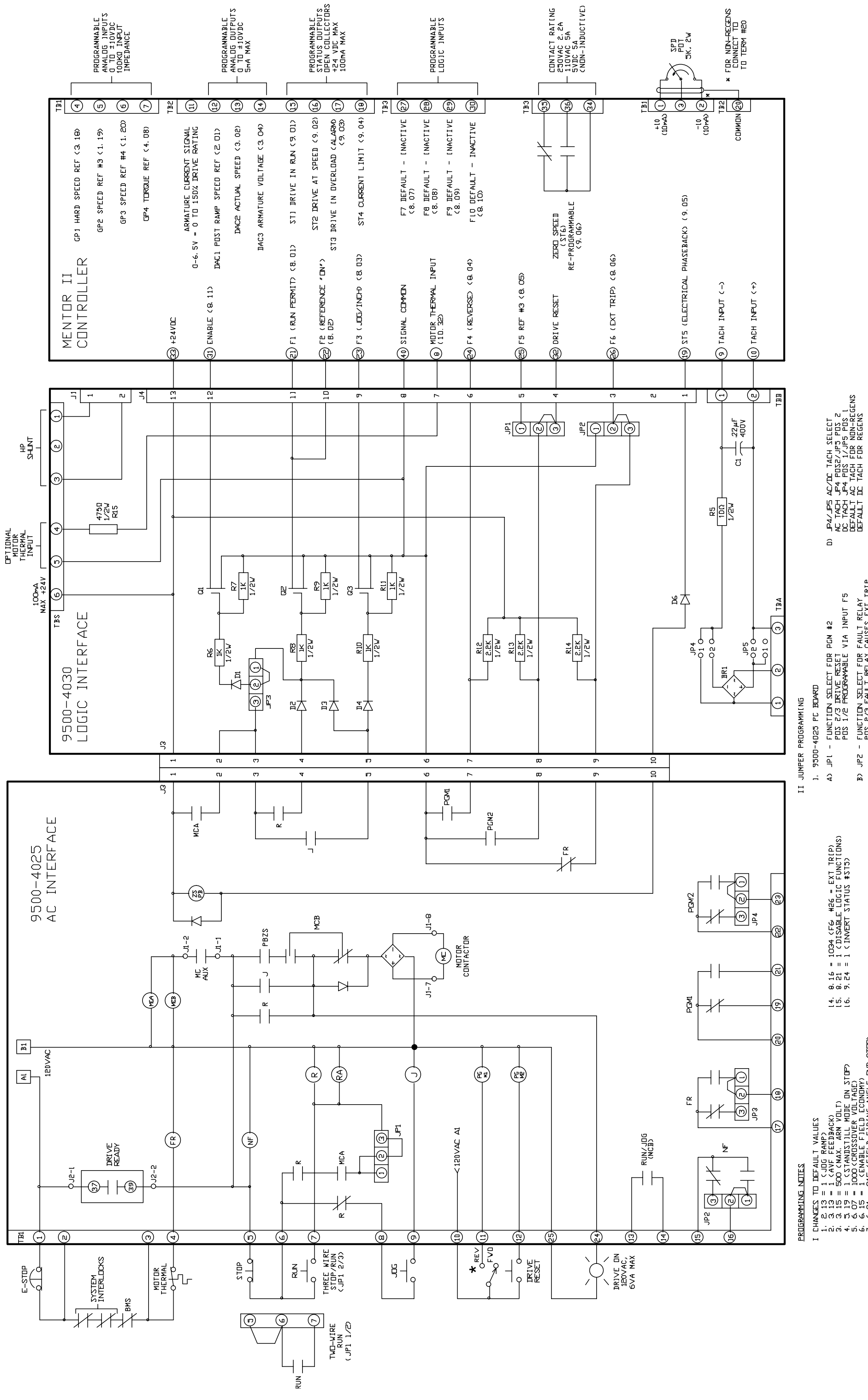


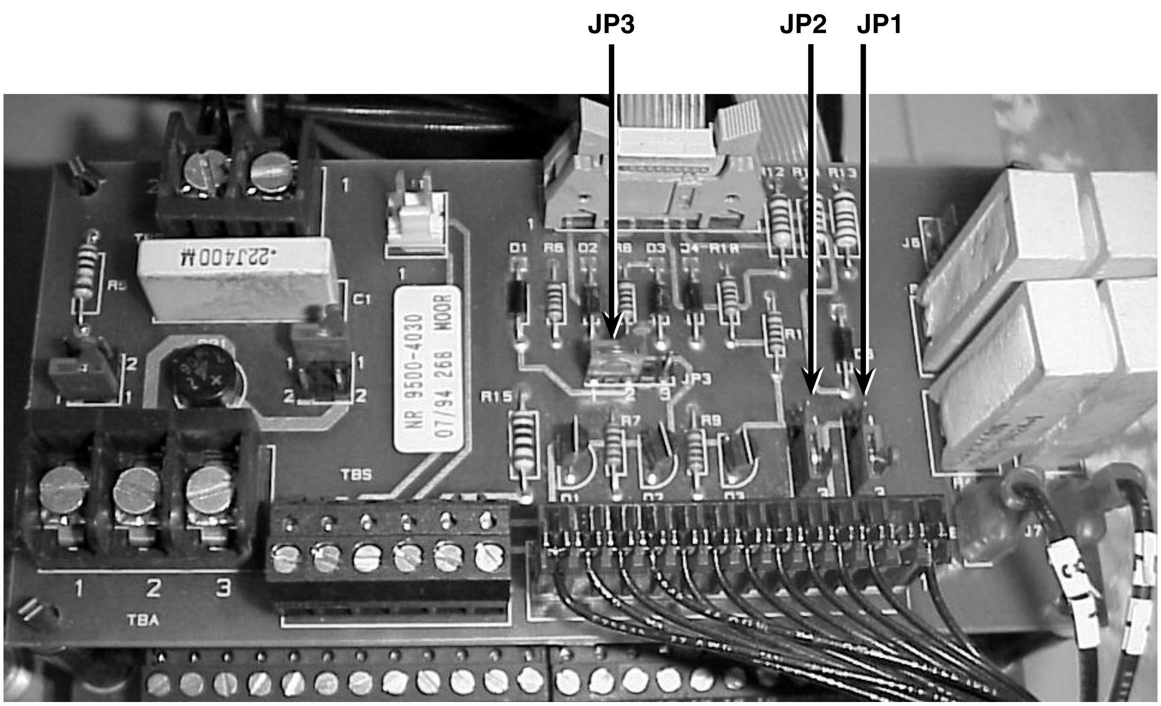
Figure 7-6.
Quantum III Interconnect Diagram
9500-1300-I, sheet 4

* Forward/Reverse selection not available on Non-Regen models

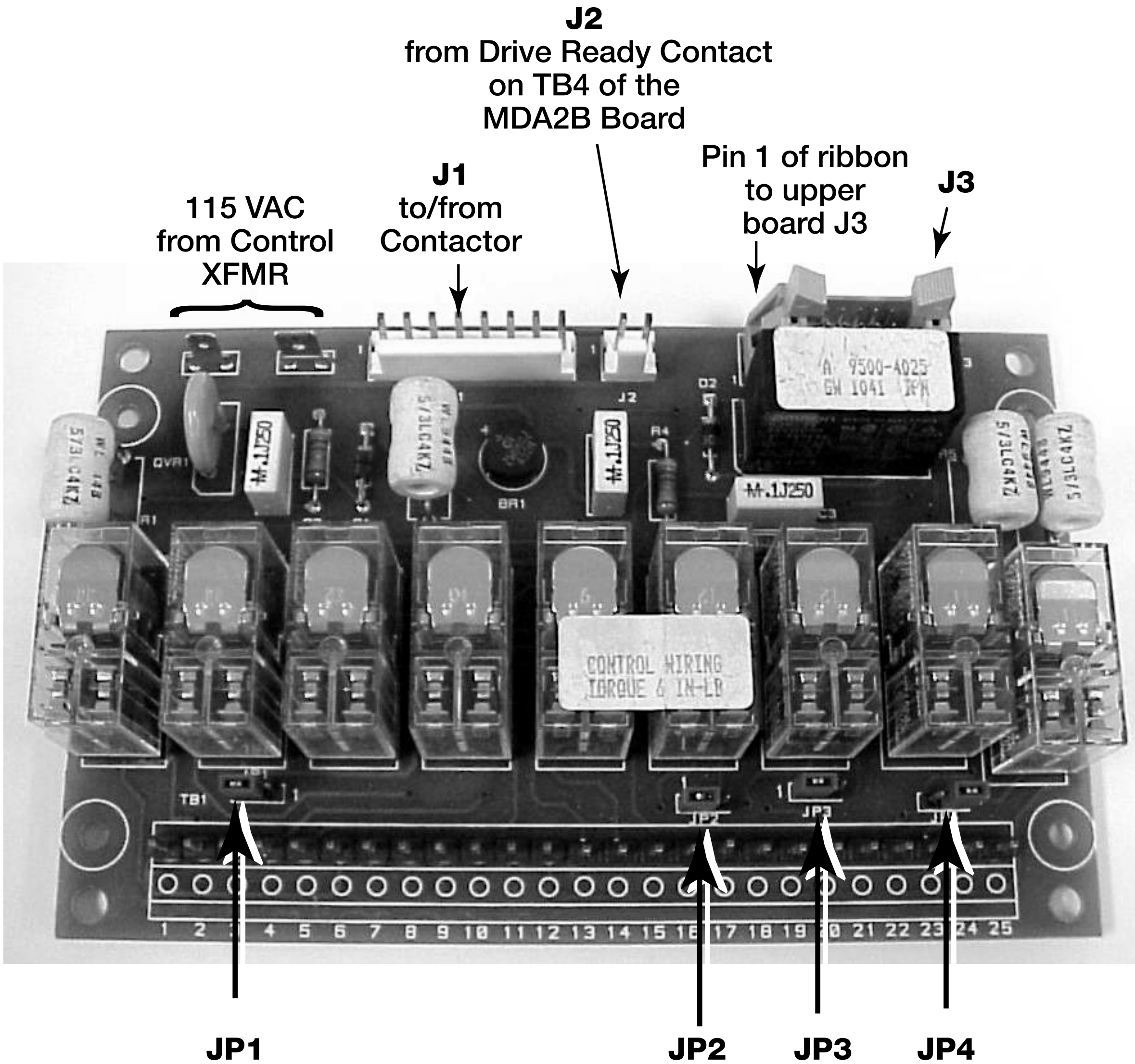
7.4.5 Other Jumper Selections on 9500-4030 Interface Board

JP1	Selection to determine the meaning of 115 VAC Programmable Input #2 (TB1 Pin 12)		
	Position	1-2	Select Digital Reference #3 (Parameter #1.19) as the Speed Reference i.e. for Thread or Drool Speed
	Position	**2-3**	**Remote Drive Reset**
JP2	Selection to determine the meaning of the FR (Fault Relay) Output (TB1 Pins 17 & 18)		
	Position	1-2	External Trip Inactive. FR Relay output contacts usable
	Position	**2-3**	**Loss of 115 VAC from TB1 Pin 4 will cause External Trip**
JP3	Selection to determine how the Drive is to stop		
	Position	**1-2**	**COAST STOP (Armature Contactor Opens upon STOP input)**
	Position	2-3	RAMP STOP (Reference is ramped to zero then Armature Contactor Opens)

Items in **bold** are factory settings.

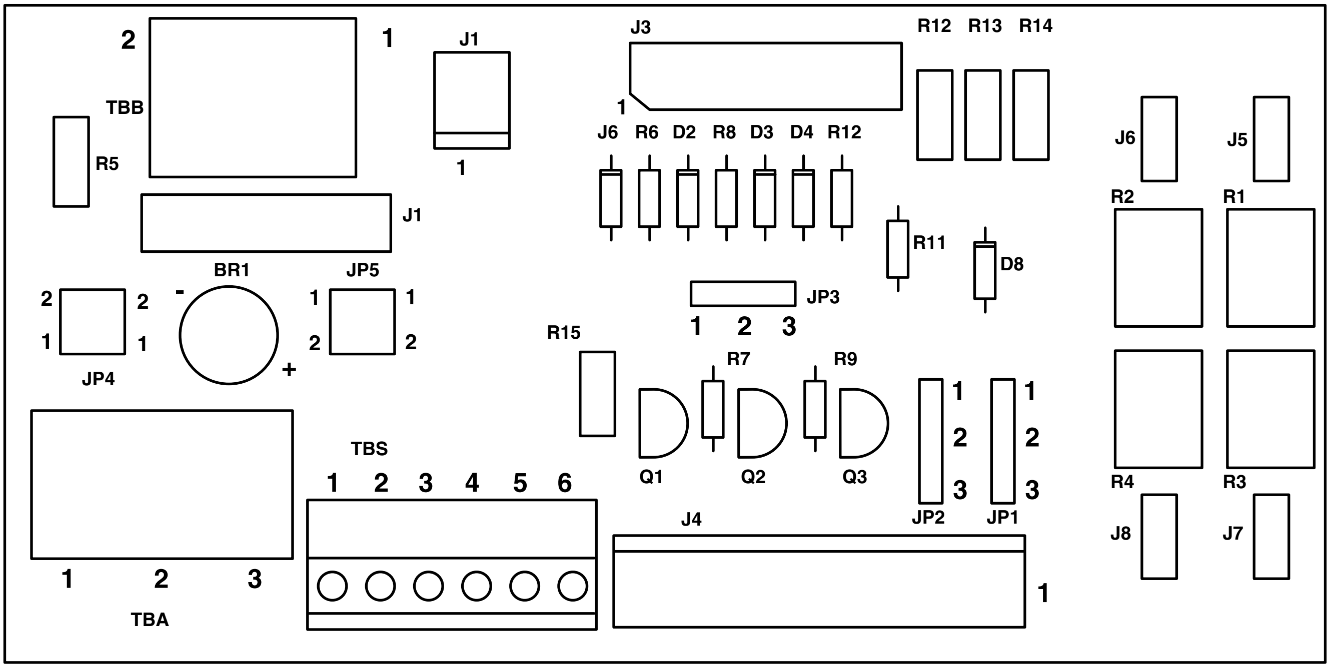


7.4.6 115 VAC Interface Board 9500-4025



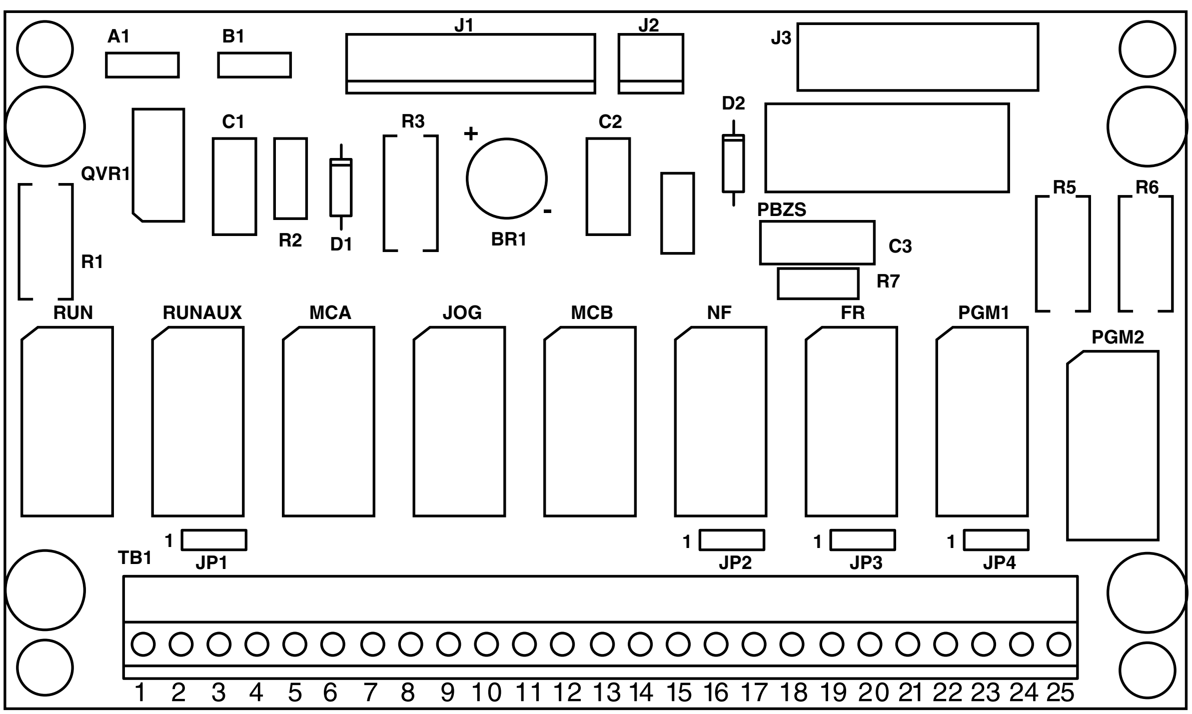
Jumper Number	Position 1-2	Alternate Position 2-3	Notes
JP1	2-Wire On/Off	**3-Wire Start/Stop**	For Run/Stop Logic
JP2	**NO No Fault Relay Output**	NC No Fault Relay Output	Drive has No Fault
JP3	**NO Fault Relay Output**	NC Fault Relay Output	External Trip In Effect
JP4	**NO PGM #2 Relay**	NC PGM #2 Relay	From Input #2

NO = Normally open
NC = Normally closed.
Items in **bold** are factory settings.



Top Board—Logic Interface
9500-4030

See Figure A-8



Lower Board—AC Interface
9500-4025

See Figure A-8

Figure 7-7.
Logic Interface and AC Interface Boards

7.5 POST WIRING CHECKS

After connecting the motor to the control and grounding, the following readings across terminals A- and A+, F+ and F-, and GND should be verified. The reading connections for terminals A- and A+ must be made where the actual DC motor connection is made. Terminals F+ and F- are located on the fuse panel assembly. Perform these checks before connecting the AC power input.

In making the readings listed in the following table, use a volt-ohm-milliammeter such as a Simpson 260, Triplett 630, or equivalent.

WARNING

DO NOT USE A VACUUM TUBE VOLTMETER OR OTHER SIMILAR TYPE OF METER THAT REQUIRES AC POWER FOR OPERATION.

Using red as the positive lead, make the following checks:

CHECKS		RANGE OF ACCEPTABLE READINGS
RED +	BLACK -	
A+	A-	.02-4 ohms typical
F+	F-	20-300 ohms typical *
F+, F-, A+, A-	GND	Infinite

*Provided motor has a field winding.

If any of the above checks are not within the indicated range, verify all connections and recheck before proceeding.

WARNING

THE CUSTOMER IS RESPONSIBLE TO MEET ALL CODE REQUIREMENTS WITH RESPECT TO GROUNDING ALL EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN PERSONAL INJURY.

8.1 GENERAL START-UP PROCEDURES

The following paragraphs describe the start-up procedure for the control and the reading and setting of the operating parameters that is required for the application.

Read this section thoroughly to develop an understanding of the operation and logic incorporated into the control.

To insure maximum efficiency with a minimum amount of delay in production, factory start-up assistance by a factory engineer is also available. Contact Field Service as described in the inside back cover of this manual to make arrangements.

WARNING

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START AND ADJUST THIS EQUIPMENT. READ AND UNDERSTAND THIS ENTIRE SECTION BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN EQUIPMENT DAMAGE AND POSSIBLE PERSONAL INJURY.

When proceeding with the start-up, keep in mind the following:

1. The factory setting is for 480 VAC input. See paragraph 8.3.1 for jumper selection of other voltages.
2. Check all jumper programming described in paragraph 8.3.2.
3. The internal HP scaling resistor in Size 1 models (9500-8X02 through -8X06) is selected to limit the current output to 10 amps. See paragraph 8.7 for installation of external HP scaling resistors to program the control for proper horsepower.
4. Check all the wiring procedures described in Sec. 7.

Quantum III drives shipped from Control Techniques' factory are pre-set for 480VAC operation providing 500VDC on the armature and about 300VDC on the field. The units are set up for armature voltage feedback (AVF). Size 1 drives (9500-8X02 through -8X06) are set to produce current as described in paragraph 8.7. All other drives are set to produce 100% of their nameplate DC current rating of the lowest HP rating for each drive model. Current Limit is set at 150% and the Current Overload is set at 105% of this nameplate rating. For motors with an armature current less than the full load rating, these parameters must be reduced proportionally to protect the motor from excessive currents. See Paragraph 8.7 for details.

8.2 HARDWARE PRE-START CHECKS

8.2.1 General Checks

A. Read and thoroughly understand all of the safety information given in Section 3 of this manual.

B. Use a volt-ohmmeter having a sensitivity of 1000 or more ohms per volt on the DC scale (such as a Triplett Model 630 or a Simpson 260) as test equipment.

CAUTION

Do not use a megger to perform continuity checks in the drive equipment. Failure to observe this precaution could result in equipment damage.

8.2.2 Installation Checks

WARNING

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED TO THE DRIVE. DISCONNECT INCOMING POWER TO THE DRIVE BEFORE PROCEEDING. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS L1, L2 AND L3 THAT NO VOLTAGE EXISTS BEFORE TOUCHING ANY INTERNAL PARTS OF THE DRIVE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN PERSONAL INJURY.

A. Make sure the input disconnect is in the OFF position (power OFF). Install any safety locks if disconnect is remote.

B. Make sure the drive shutdown interlocks, such as safety switches installed around the driven machinery, are operational. When activated, these devices should shut down the drive.

C. Check that all the jumpers have been set correctly.

D. Verify the programming for the feedback used (AVF, tachometer, or encoder) is correct.

8.2.3 Motor Checks

A. Verify that motor nameplate data corresponds to the drive output ratings as shown in Section 4. Verify that motor full load armature current and motor field current do not exceed the drive ratings.

B. Check that the motor is installed according to the motor instruction manual.

C. If possible, uncouple the motor from the driven machinery.

D. Rotate the motor shaft by hand to check that the motor is free from any binding or mechanical load problem.

E. Check that no loose items, such as shaft keys, couplings, etc., are present.

F. Check that all connections are tight and properly insulated.

G. Check that any motor thermal switch or overload device is wired as needed.

WARNING

THE CUSTOMER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT THE MAXIMUM OPERATING SPEED OF THE DRIVE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN PERSONAL INJURY OR MACHINE DAMAGE.

8.2.4 Drive and Enclosure Checks

A. Open the drive front panel cover.

B. Look for physical damage, remaining installation debris, wire, strands, etc.

C. Remove all debris from the drive.

D. Check that there is adequate clearance around the drive for air flow.

E. Complete all the wiring procedures described in this manual.

F. Check that all control and power terminal connections are tight.

G. Check that all fuses are in place and properly seated in the fuse holders.

H. Check the continuity of all fuses. If any fuse reads open, replace the defective fuse.

I. Insure that the control has been properly programmed for the incoming line voltage. Using a voltmeter, check that the correct voltage is available on the incoming line side of the input disconnect.

8.2.5 Grounding Checks

WARNING

THE CUSTOMER IS RESPONSIBLE TO MEET ALL CODE REQUIREMENTS WITH RESPECT TO GROUNDING ALL EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN PERSONAL INJURY.

CAUTION

Do not check any points on the drive with an ohmmeter, megger or any similar device. Failure to observe this precaution could result in equipment damage.

A. Verify that the ground wire installed between the chassis ground terminal, the enclosure, and a suitable earth ground has been properly sized to meet NEC and local codes. Make sure that the connections are tight.

B. With the volt-ohmmeter, check for and eliminate any grounds between the drive input power leads and the drive chassis ground. Check for and eliminate any grounds between the drive output power leads and the drive chassis ground.

C. Verify that a properly sized ground wire is installed between the motor frame and a suitable earth ground and that the connections are tight.

D. With the volt-ohmmeter, check for and eliminate any grounds from the motor frame and the motor power leads.

E. Verify that a properly sized ground wire is installed between the transformer (if used) and a suitable earth ground and that the connections are tight.

F. Verify that a properly sized ground wire is installed between all operator's control stations (if used) and a suitable earth ground and that the connections are tight.

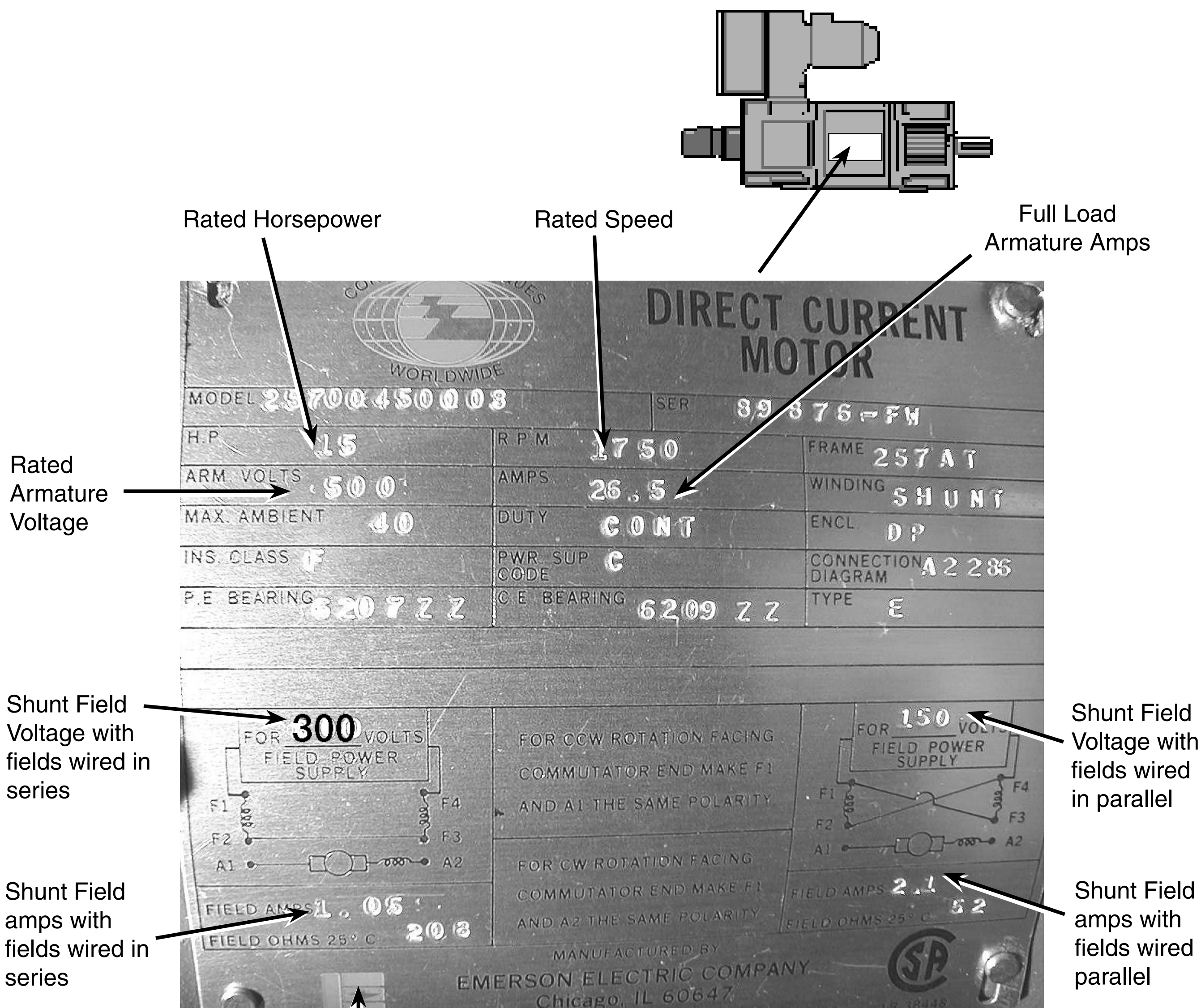
G. Verify that the above ground wires are run unbroken.

8.3 SETUP

8.3.1 Motor Nameplate

Shown below is a typical DC Shunt wound DC motor nameplate.

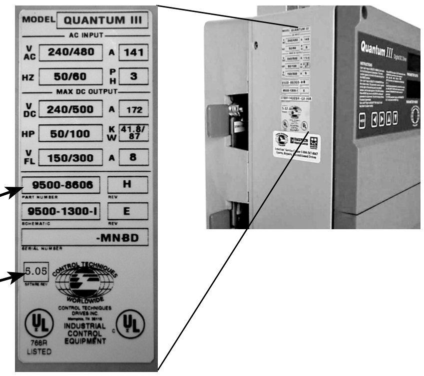
To setup your drive, your motor and application, complete the "Motor Application Data" form on the following page.



Typically for a 500v motor (armature) the shunt field windings should be wired for a series connection for 300 VDC supply

Note: This motor is not designed for extended speed range as it does not indicate 2 RPM values.

Quantum III
Motor Application Data



Drive Model Number

Quantum III Drives will begin with 9500-8________

Drive Software Version V______ or parameter #11.15

Motor Nameplate Data

Rated Armature Voltage__________vdc

Rated Armature Amps ___________Adc

Rated Speed__________RPM or _________/__________RPM (Rated / Weakened)

Field Voltage_________vdc

Field Amps ___________Adc or _________/__________ Adc (Rated / Weakened)

Field Ohms ____________

Does motor have one or two field windings ? ______ F1 & F2 or F1, F2, F3, F4

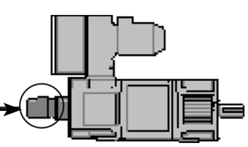
Does motor have a series field ? ________ S1, S2

Is there an External FXM5 Field Regulator being used ? _________

If so, is there a ribbon cable going into it ? _________

Motor Feedback

Does the motor have a speed feedback device on the end of it ?_______



If Yes, is it an AC or DC Tach ____ and what is the output of it _______v/1K rpm

If it is an Encoder, what is the Pulses/Rev _________PPR and voltage rating ____vdc

Application Information

What is the line voltage for the Drive ?_________vac

What kind of a machine is this being used on ? ______________ ie Extruder, Lathe

What is maximum motor speed required for this application ? _________RPM

Is reversing required ? ________

Is Speed controlled using a Speed Pot _________ or External Voltage _______ ?

How do intend to Start/Stop the drive? ___On/Off Switch -Contact or ___Start/Stop Buttons

Upon a Stop Command, do you want the motor to ___Coast or ___Decel Under Control?

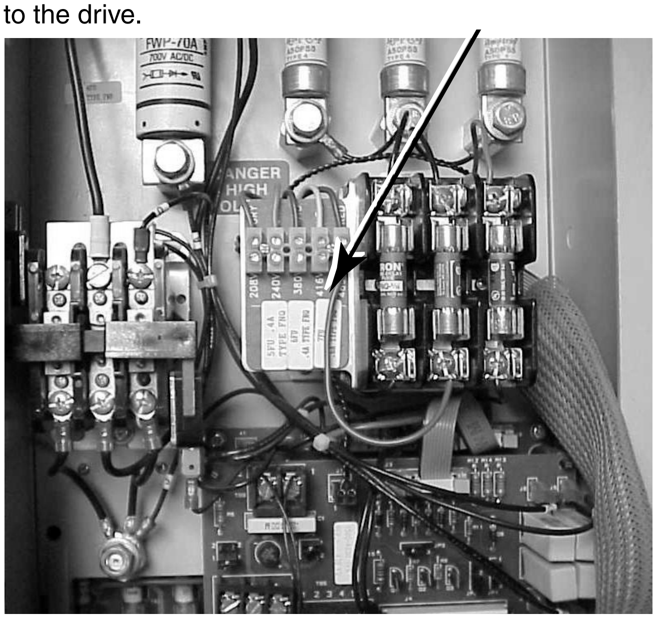
If you require assistance with setup, FAX Back to 716-774-8949 with your company name, your name and telephone number, and we'll help you get your drive started up. —Control Techniques Service Center

8.3.2 Setting the Power Transformer

The Quantum III's main control circuitry utilizes "switchmode" power supply technology that can accept line voltage anywhere between 208 VAC (-5%) to 480 VAC (+10%), 50/60Hz without jumpers or parameters to set.

LINE VOLTAGE	TOLERANCE	TAP SETTING	COMMENTS
480 VAC	+/-10%	**480 VAC**	← **Factory Setting**
415 VAC	+/-10%	415 VAC	
380 VAC	+/-10%	380 VAC	
240 VAC	+/-10%	240 VAC	
208 VAC	+10% -5%	208 VAC	

However, to provide 115 VAC for Interface Circuitry and correct voltage for the built-in Armature Contactor and fans (when required), a Control Transformer-T1 is used. The factory setting for this transformer tap is set on 480 VAC and must be changed to match other line voltages. Loosen the 480v screw and move the SINGLE RED wire to line voltage you will be applying to the drive.



8.4 ARMATURE VOLTAGE FEEDBACK

The factory settings for the Quantum III is expecting 480vac input for 500vdc motors. The feedback method is factory set for AVF (Armature Voltage Feedback) which does not require a tach or encoder. For your particular application, you must scale the Quantum's Max Armature Voltage (setting of parameter #3.15) to the voltage required to produce the desired motor RPM.

Max Arm Voltage Setting = #3.15 =
Motor Arm Voltage x Reduction Factor

$$\text{Reduction Factor} = \frac{\text{Intended Max RPM}}{\text{Rated Nameplate RPM}}$$

NOTE: 240VDC MOTORS

It is recommended that when operating 240vdc motors that your 3 phase Input AC Line voltage is also 240v. We do not recommend using a 480vac drive to power a 240vdc motor. Doing so results in high motor armature current peaks which can cause excessive motor heating and possible damage. In addition, the high voltage peaks delivered by the high AC line can potentially breakdown motor insulation which can result in both motor and drive damage. If your main power is 480vac, we would recommend the use of an Isolation Step Down Transformer from 480vac to 240vac.

8.4 Example: Our motor nameplate indicates that it will rotate 1750rpm with full field current (rated field) and 500v applied to the armature. Our machine has a 4:1 gearbox between the motor and the machine. The output shaft of the gearbox is to turn at 410RPM at full machine speed. How should the Quantum III be set to achieve this speed at maximum reference?

8.4 Solution: Since the machine requires 410RPM, the motor will need to rotate 4x this speed per the gear ratio or 1640RPM.

$$\textbf{Reduction} = \frac{\text{Intended Max RPM}}{\text{Rated Nameplate RPM}} = \frac{1640}{1750} = 0.937$$

Max Armature
Voltage Setting = Motor Arm Voltage x Reduction

Max Armature
Voltage Setting = 500 x 0.937 = 469v = #3.15

So for this example we would merely set #3.15= 469 or 470 to achieve approximately 1640RPM at maximum reference. We say approximately because AVF (armature voltage feedback), can only provide an approximate speed. One could actually measure the motor shaft speed using a “hand-held tachometer” or strobe light to calibrate #3.15 in order to achieve a more accurate speed setting.

Worksheet: Armature Voltage Scaling
Reduction = Application RPM / Rated Motor RPM = ________ = 0.________* (3 decimals)
Max. Arm Voltage setting = Motor Arm Voltage x Reduction Factor
Max. Arm Voltage setting = ________ x 0.________ = ________
Parameter #3.15 = ________ v (whole number)

*If reduction factor is >1, Field Weakening is indicated. Set #3.15 to equal your motor's rated armature voltage. Do not set #3.15 higher than the motor's nameplate voltage.

8.5 TACHOMETER FEEDBACK

WARNING

AC TACHOMETER FEEDBACK IS NOT FOR USE ON REGENERATIVE UNITS.

The controls are shipped set up for AC tach. Jumpers JP4 and JP5 on the 9500-4030 logic interface board must be re-programmed to the 1 position for DC tachometer feedback. See 8.5.3 for location.

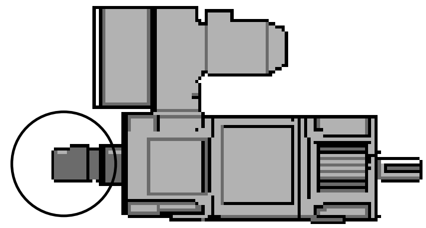
WARNING

EQUIPMENT DAMAGE AND/OR PERSONAL INJURY MAY RESULT IF ANY JUMPER PROGRAMMING IS ATTEMPTED WHILE THE CONTROL IS OPERATIONAL. ALWAYS LOCK OUT POWER AT THE REMOTE DISCONNECT BEFORE CHANGING ANY JUMPER POSITIONS.

8.5.1 AC or DC Tach Feedback

If the motor is equipped with a Speed Feedback device such as:

- AC Tach (not for use with regenerative models 9500-86xx
- DC Tach



Nameplate data/specifications for this device (if it is intended for use) must be obtained.

AC or DC Tach Voltage Constant -K_{tach}

The tachometer voltage constant or $K_{tach\_}$, is the value typically stamped on the tachometer nameplate and is usually expressed as volts/rpm.Some typical examples are listed below:

Ex. 1) 50.3 volts/1000RPM or
K_{tach} = 0.0503vdc/rpm

Ex. 2) 26VAC/1K rpm (or 26vac/1000rpm)
K_{tach} = 0.026vac/rpm

You will need to calculate the maximum generated tachometer voltage at your intended motor RPM which we can refer to as **Max Tach Voltage**.

Example 1:

Our motor uses a DC Tach whose nameplate indicates that it produces 50.6v/1000rpm. Our machine has a 4:1 gearbox between the motor and the machine. Our motor is a 1750RPM DC motor and the output shaft of the gearbox is to turn at 410RPM at full speed. What is the **Max Tach Voltage**?

Solution 1:

Since the machine requires 410RPM, the motor will need to rotate 4x this speed per the gear ratio or 1640RPM.

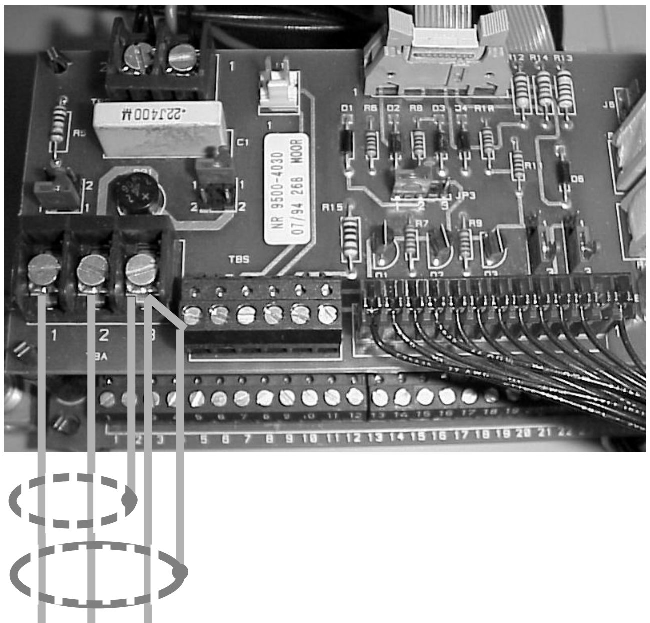
$$K_{tach} = \frac{\text{Tach Voltage at}}{\text{What RPM}} = \frac{50.6}{1000} = \mathbf{0.0506}$$

Max Tach Voltage =
K_{tach} x Max Intended Motor RPM

= 0.0506 x 1640

Max Tach Voltage = 82.984 or 83vdc

The **Max Tach Voltage** is that voltage which could be measured at the Tach terminals - TBA pins (on 9500-4030 Interface Board) at maximum machine speed. The previous formula/example would hold true for AC or DC tachometers.



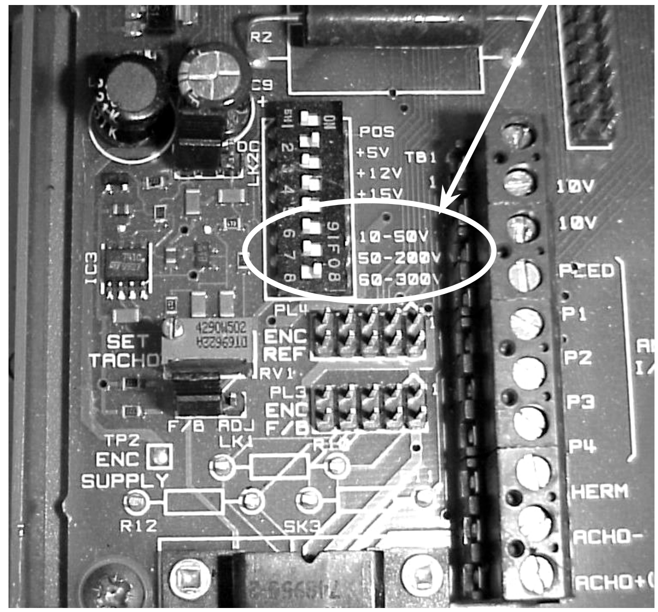
AC AC ← (if AC Tach used)

DC- DC+ ← (if DC Tach used)

Tachometer Connections

8.5.2 Setting the Max Tach Range

When using either AC or DC Tach Feedback, the Quantum III needs to be aware of the maximum Feedback Voltage that it will be reading. This is the value calculated previously. There are 3 switches that set the range of this Feedback Voltage namely switches 6, 7, and 8. See photo.



To allow enough headroom for any speed over-shoots an additional 10% is added to the Feedback Voltage value before the Tach Range Switch Setting is determined.

Tach Voltage Range =

Feedback Voltage x 1.1

Tach Voltage Range	Switch ON
10-49 volts	6
50 to 200v	7
150 to 300v	8

Example

From the previous example, since the Tach was a DC Tach, the **Feedback Voltage** was equal to the Max Tach Voltage or 89vdc. Therefore:

If using an AC tach multiply this entire result by 1.4

Tach Voltage Range =

Feedback Voltage x 1.1 89v x 1.1 = **98v**

This would indicate that Tach Range Switch 7 should be placed in the ON position based on the table above.

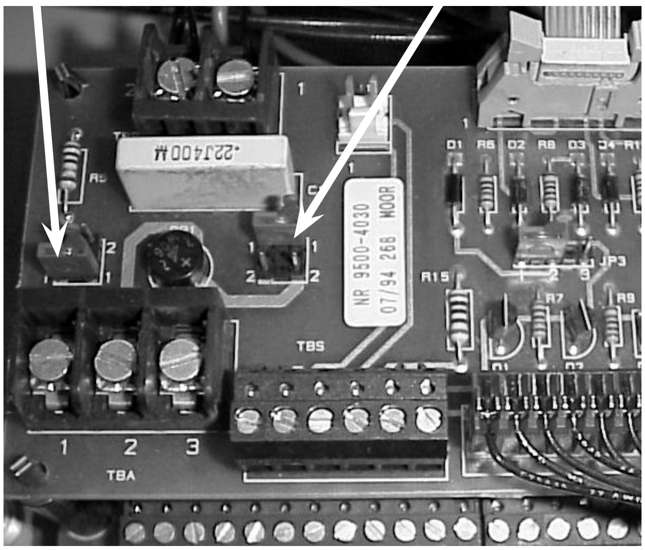
8.5.3 AC or DC Tach Feedback Setup

Shown below is the Interface Board and the jumpers that may need set for AC or DC Tach feedback. JP4 and JP5 are to be set in pairs. If tachometer feedback is not used these do not need to be considered.

AC Tachometers should not be used with Regenerative Models. AC Tach's supply speed information, but provide nothing about motor direction, which the regen drive may require.

TACHOMETER TYPE	JP4 POSITION	JP5 POSITION	FACTORY SETTING
AC	2	2	<— Not for Regen's
DC	1	1	

JP4 JP5



8.5.4 Tachometer Jumper and Calibration Items

MDA2B Control Board (lower left corner)

Under top cover

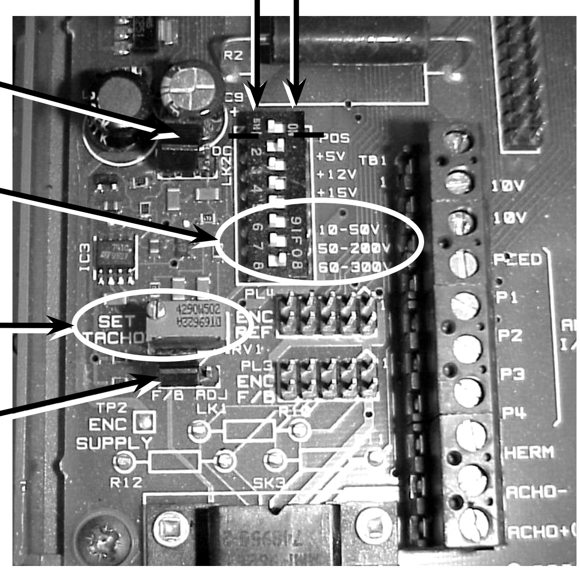
Optional Additional Filtering Put in LF (low-pass filter) position if using AC Tach or on noisy DC tachs

Tachometer Max Voltage Range Setting 6, 7 or 8 Set <u>only one</u> to ON

Tachometer Max Speed Adjustment

Optional Static Tach Calibration Jumper - must be in F/B (feedback position) during normal operation

OFF ON



8.5.4 Tach Scaling Worksheet

If your intended application RPM is greater than your motors rated (base) RPM, field weakening is indicated.

Worksheet: AC and DC Tach Scaling

Your K_{tach} = $\frac{\text{Tach Voltage}}{1000}$ = $\frac{\_\_\_\_\_\_\_\_}{1000}$ = 0.________

Max. Tach Voltage = Your Intended Motor RPM x K_{tach}

Max. Tach Voltage = ____________ x 0.________ = ________v

DC / **AC**

If a DC Tach, then

If an AC Tach, then

________ x 1.4 = ________

Your **Feedback Voltage =** __________ **vdc**

Perform the Next Three Steps

1
- If your Tach is a **DC Tach**, place jumper **LK2 on DC** position and ensure that JP4 and JP5 are in **position 1** (see 8.5.3).
- If your Tach is an **AC Tach**, place jumper **LK2 on LF** position and ensure that JP4 and JP5 are in **position 2** (see 8.5.3).

2 Your Tach Voltage Range equals Your **Feedback Voltage** (result from above) x 1.1.

Your Tach Voltage Range = __________ x 1.1 = __________

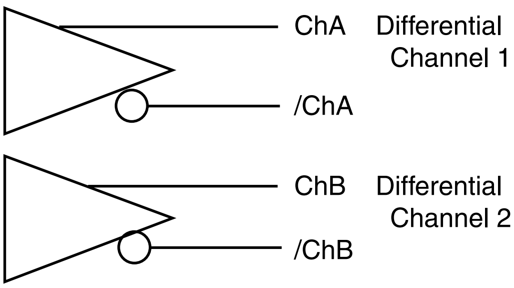
3 Set DIP Switch based on Your Tach Voltage Range

If less than 50	Set **6** to **ON**
If between 50 and 200	Set **7** to **ON**
If between 150 and 300	Set **8** to **ON**

NOTE: Only one switch should be ON, the other two switches must be OFF.

8.6 ENCODER/DIGITAL PULSE TACH REQUIREMENTS & CONNECTIONS

If a Pulse Tach is to be used as a Speed Feedback device, it must provide 2 complementary channels of information in quadrature. Encoder outputs must be a differential line driver type 88C30/8830 or similar. The encoder must provide:



Pin #Sk3	Function
1	0v Supply
2	+Supply
3	ChA
4	/ChA
5	ChB
6	/ChB
7	No conn
8*	ChC
9*	/ChC

} optional

If optional marker channel is used, the encoder must be 1024 ppr.
*If marker channel is not required, leave pins 8 and 9 open.

Encoders with Open collector channel outputs (or single ended outputs) are not directly usable.

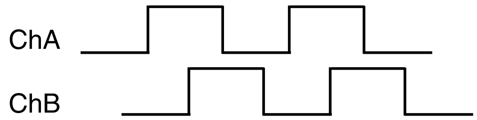
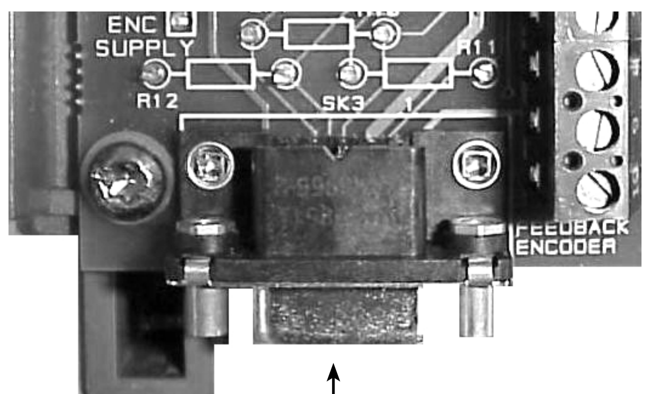


Illustration of 90° quadrature for direction sensing CHA leads CHB for CW rotation facing shaft end

A differential marker channel (ChC and /ChC) can be accommodated but is optional depending on the intended application.



Encoder Connector 9 Pin D Female Socket SK3

8.6.1 Encoder or Digital Pulse Tach Setup

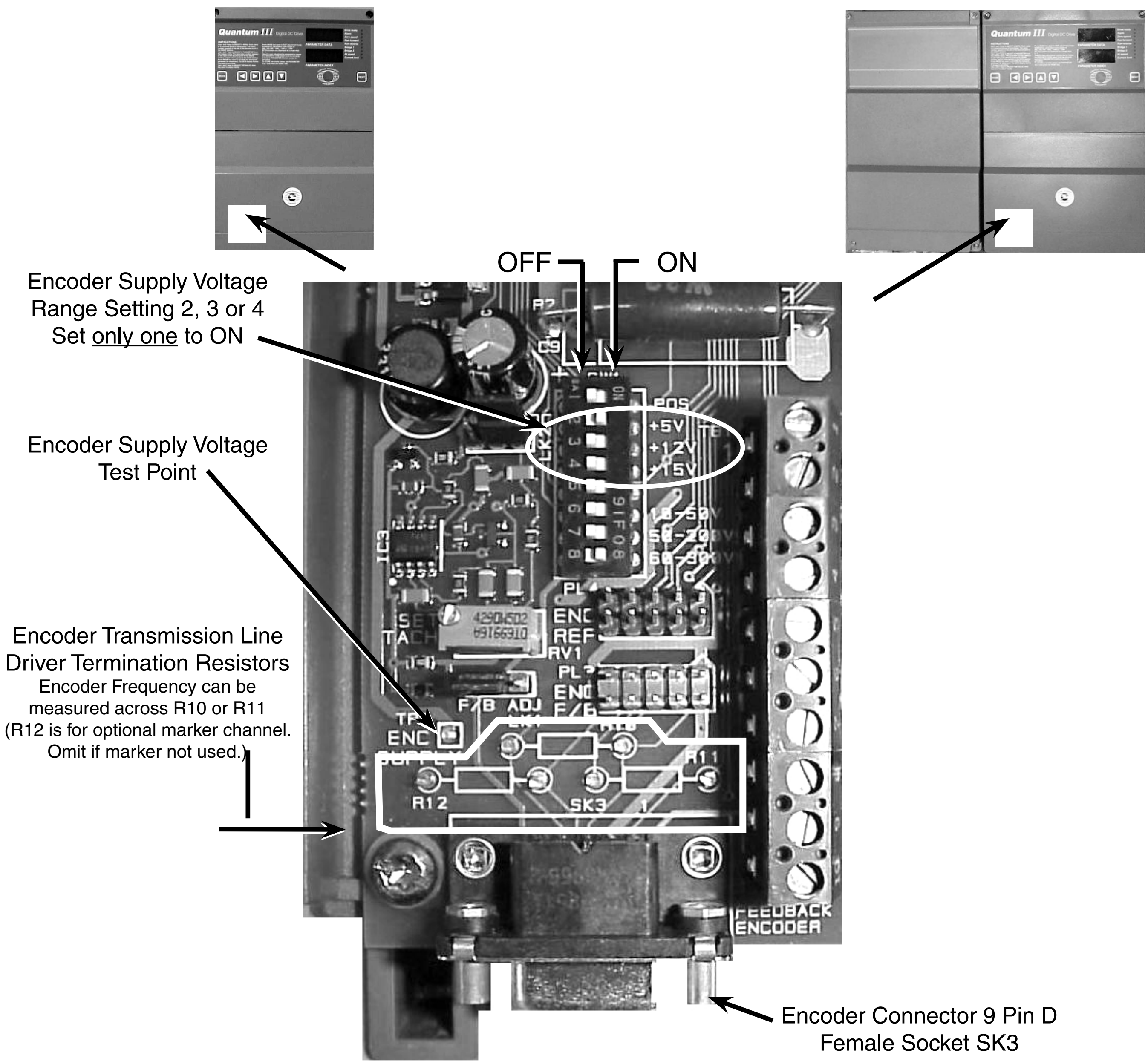
The MDA2B Control Board can supply 5 VDC, 12 VDC or 15 VDC (300mA max) for such encoders. Transmission line terminating resistors should be installed on the standoffs provided (see photo below). These terminating resistors help prevent line reflections and reduce noise pickup as it is important to have accurate speed feedback information. The ohmic value depends on the voltage swing of the differential drivers on the pulse tach. The following table summarizes settings and suggested terminating resistors for those supply ranges.

Switch Number*	Pulse Tach Supply	Terminating Resistor**
2	5vdc	330ohm
3	12vdc	750ohm
4	15vdc	1000ohm

Resistor values shown call for approximately 15-16mA drive capability from the encoder line driver. Different values can be calculated and used based on the manufacturer's recommended loading/termination resistor.

* Only one switch must be in the ON position and should only be switched with power off

** Resistors can be 1/4 or 1/2 watt



8.6.2 Encoder or Digital Pulse Tach Feedback

Example 1:

Our motor uses a Digital Pulse Tach whose nameplate indicates that it produces 1024PPR (or 1000 pulses/rev). Our machine has a 4:1 gearbox between the motor and the machine. Our motor is a 1750RPM DC motor and the output shaft of the gearbox is to turn at 410RPM at full speed. **What is the Max Tach Frequency and how do I set up the Quantum III for this situation ?**

Solution 1:

Since the machine requires 410RPM, the motor will need to rotate 4x this speed per the gear ratio or 1640RPM.

Max Tach Frequency =

PPR _ * Max Intended Motor RPM

$$= \frac{1024 \text{ pulses}}{1 \text{ rev}} \times \frac{1640 \text{ revs}}{1 \text{ MIN}} \times \frac{1 \text{ MIN}}{60 \text{sec}}$$

Max Tach Frequency =

$$27989.33 \frac{\text{pulses}}{\text{sec}} \text{ or } 27.989\text{KHz}$$

> The Max Tach Frequency is that frequency which could be measured at the encoder terminals at maximum machine speed with frequency meter to verify correct motor speed. See 8.9.6 for details.

The Max Tach Frequency must not exceed 100KHz.

8.6.3 Scaling the Quantum for Encoder

Setting the Quantum for this Encoder and this intended max motor RPM involves calculating a scaling value for parameter #3.14.

$$\#3.14 = \frac{1{,}000{,}000}{\text{PPR}} \times \frac{750}{\text{Intended Max RPM}}$$

$$\#3.14 = \frac{1{,}000{,}000}{1024} \times \frac{750}{1640}$$

#3.14 = 976.5625 x 750 then divide by 1640

#3.14 = 446.59 or rounded to **447**

Worksheet: Encoder Scaling

$$\frac{1{,}000{,}000}{\text{Your Encoder PPR}} = \frac{1{,}000{,}000}{\_\_\_\_\_\_} \times 750 = \frac{\_\_\_\_\_\_}{\text{Your Intended Max RPM}} = \_\_\_\_\_\_$$

Encoder Scaling #3.14 = ____________

If your intended application RPM is greater than your motors rated (base) RPM, field weakening is indicated.

8.7 CURRENT SET-UP PER MOTOR NAMEPLATE DATA

(For Size 2 or 3 Setup, go to page 8.7.4.)

8.7.1 Current Setup For Size 1 Quantum's Only

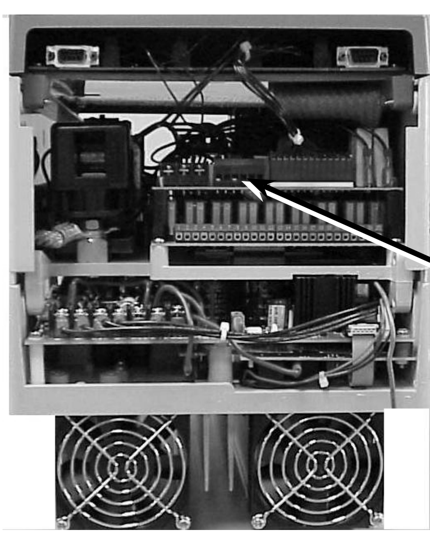
Models 9500-8x02 thru 9500-8x06

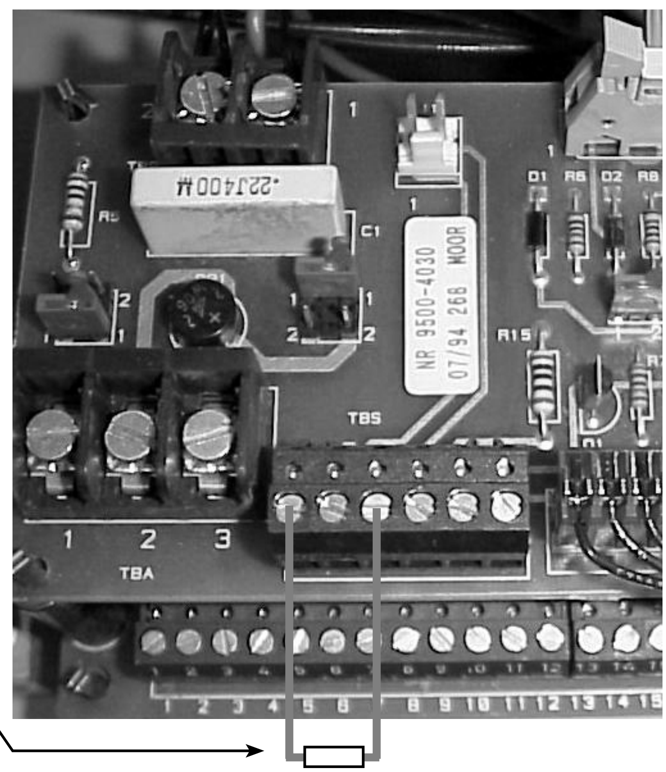
All Size 1 Quantum III models (9500-8x02 thru -8x06) have a built-in resistor that limits the output current to 10A (15A peak) as shipped from the factory. Each Quantum model can cover a range of standard motor Horsepowers (ie a 9500-8606 could be considered as a universal spare for any Quantum III size 1 drive)

To properly scale the Quantum to the selected motor, an external "HP Scaling Resistor" of the appropriate value can be selected from a small bag attached to the drive. The resistor value is selected by choosing an output current value from column B that is close to or slightly exceeds your motors nameplate Armature Current. It is to be inserted into terminals 1 and 3 of TBS on the 9500-4030 Interface Board as shown below.

After you have selected the proper scaling resistor for your Motors Nameplate Armature Amps and if it matches (within a few amps) the Quantum III's Max DC Output Amps becomes that which is indicated in column B of the HP Scaling chart per the resistor used. Set parameter #5.05 per column F on that same chart and the Current Limits will be set for 150% and the Overload for 100%.

If your Motor Nameplate Armature Amps is less than newly scaled Quantum III's Max DC Output Amps (which is shown in column B per the selected Scaling Resistor), you will need to reduce current limit(s) and the Overload threshold setting to properly scale the Quantum for less output for proper motor protection.





Horsepower Scaling Resistor

Location of resistor on 9500-4030 Current Scaling Interface Board

Trim leads to approximately one inch.

8.7.1 Horsepower Setup for Size 1 Models (Continued)

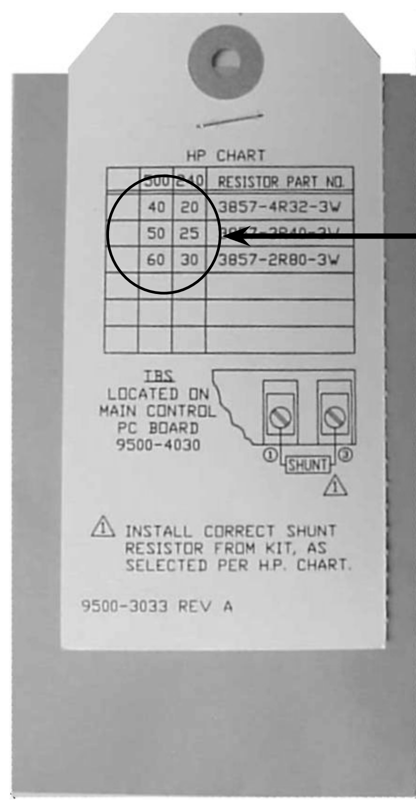
A	B	C	D		E		F
QUANTUM MODEL	DRIVE RATED OUTPUTS	MOTOR HORSEPOWER		SCALING RESISTOR			DRIVE AMMETER SCALER
Model Number	Amps	@240 VDC	@500 VDC	Value-	Part No.	Marking	Parameter #5.05
	DC			OHMS			
9500-8X02	10.2	2.5	5	n/a	n/a	n/a	15
	12.3	3	7.5	127	3857-127-3W	127	18
	20.4	5	10	26.1	3857-26R1-3W	26R1	31
	29.3	7.5	15	14	3857-14R0-3W	14R0	44
	38.2	10	20	9.53	3857-9R53-3W	9R53	57
9500-8X03	43.3	n/a	25	8.06	3857-8R06-3W	8R06	65
	55.4	15	30	5.9	3857-5R9-3W	5R9	83
9500-8x05	72	20	40	4.32	3857-4R32-3W	4R32	108
	88.6	25	50	3.4	3857-3R40-3W	3R40	133
	105	30	60	2.8	3857-2R80-3W	2R80	158
9500-8x06	125	n/a	75	2.32	3857-2R32-3W	2R32	188
	144	40	n/a	2	3857-2R00-3W	2R00	215
	172	50	100	1.65	3857-1R65-3W	1R65	288

Example:

If you are using a Quantum Model Number 9500-8x05, this is the chart from the scaling resistor bag that would be attached to the drive.

If your motor nameplate indicates 500v 40HP you would select, the topmost resistor 4R32 to be placed into TBS pins 1-3, (see 8.7).

In addition, you could calibrate the built-in Armature Ammeter by placing 108 in parameter #5.05. In doing so, parameter #5.02 will read out DC Armature Amps.



Your motors Armature Voltage & HP

8.7.2 Current Setup For Size 1, continued if necessary.

You should only need to perform the following if your Motor Nameplate Armature Amps is less than the Quantum III's Max DC Output Amps (based on column B and the selected Scaling Resistor). In this case, the Quantum can produce more current than your motor was designed for and must be scaled down. (Unless under special circumstances whereby the motor has a special duty rating, very intermittent duty or has some special means of cooling).

Current Limit (forward bridge) parameter #4.05
Factory setting = 1000 or 150%(only #4.05 needs set on non-regen models 9500-83xx)

Current Limit (reverse bridge)- parameter #4.06
Factory setting = 1000 or 150%(both #4.05 & #4.06 needs set on regen models 9500-86xx)

Overload Threshold - parameter #5.06
Factory setting = 667 representing 100%

Example: Suppose you were setting up to run a 75HP (500v) motor with a Quantum III regenerative model number 9500-8606 (rated at 100HP @ 500v).

What would be the new current related parameter settings to properly limit (reduce) the current to customary settings for your 75HP motor ?

Solution: First you would need to have the Quantum III's Max DC Output Rating and your motors Rated Full Load Amp nameplate data.

Your 75HP 500vdc Motor Rated Full Load Arm Amps = 135A

Quantum 9500-8306 Max DC Nameplate Output=172A

Looking at the HP Scaling Table column B, we can see that our motor needs more than 125A but less than 144A. So we would select the 144A row which calls for a 2ohm resistor from column E (marked 2R00) to be placed on TBS pins 1-3. This will bring the Drives rating down to 144 continuous amps.

To calculate the required ***reduction*** of Current Limit and Overload settings, one needs to only **multiply the Factory Setting** by the **Reduction Factor**.

The Reduction Factor is the ratio of :

$$\text{Reduction Factor} = \frac{\text{Motor Current Rating}}{\text{Drive Current Rating}}$$

For our example:

$$\text{Reduction Factor} = \frac{135}{144} = 0.9375$$

Reduction Factor should always be less than 1 and typically greater than 0.6. Only 93.75% of the Quantum's capability is needed for the motor.

8.7.3 CURRENT SET-UP PER MOTOR NAMEPLATE DATA - SIZE 1

New Value for I-Limit+ #4.05 = Factory Setting x Reduction Factor = 1000 x 0.9375 = 938

New Value for I-Limit - #4.06 = Factory Setting x Reduction Factor = 1000 x 0.9375 = 938

From Column F on the 144A row , we would set #5.05= 215 so that #5.02 would read out delivered motor **amps**

Worksheet: Current Setup for Size 1

Your Reduction Factor = $\frac{\text{Your Motor Current Rating}}{\text{Your Drive Current Rating}}$ = __________ = _________ = 0.__________
(Per Column B)
3 Decimals

I-Limit+ = Factory Setting x Reduction Factor = 1000 x__________ = ___________ = #4.05

I-Limit- = Factory Setting x Reduction Factor = 1000 x__________ = ___________ = #4.06

Current Readout Scaler from selected row of Column F = ______________ = #5.05

Overload Level = Factory Setting x Reduction Factor = 667 x __________ = ___________ #5.06

8.7.4 CURRENT SET-UP PER MOTOR NAMEPLATE DATA

(For Size 1 Setup, go to page 8.7.)

For Size 2 and Size 3 Quantum's Only

Models 9500-8x07 thru 9500-8x20

You should only need to perform the following if your Motor Nameplate Armature Amps is less than the Quantum III's Max DC Output Amps (based on column B). In this case, the Quantum can produce more current than your motor was designed for and must be scaled down. (Unless under special circumstances whereby the motor has a special duty rating, very intermittent duty or has some special means of cooling).

Current Limit (forward bridge) parameter #4.05
Factory setting = 1000 or 150%(only #4.05 needs set on non-regen models 9500-83xx)

Current Limit (reverse bridge)- parameter #4.06
Factory setting = 1000 or 150%(both #4.05 & #4.06 needs set on regen models 9500-86xx)

Overload Threshold - parameter #5.06
Factory setting = 667 representing 100%

Example: Suppose you were setting up to run a 125HP (500v) motor with a Quantum III non-regenerative model number 9500-8307 (Rated at 150 HP).

What would be the new current related parameter settings to properly limit (reduce) the current to customary settings for your 125HP motor ?

Solution: First you would need to have the Quantum III's Max DC Output Rating and your motors Rated Full Load Amp nameplate data.

Your 125HP 500vdc Motor Rated Full Load Arm Amps = 205A

Quantum 9500-8307 Max DC Nameplate Output=255A

To calculate the required ***reduction*** of Current Limit and Overload settings, one needs to only **multiply the Factory Setting** by the **Reduction Factor**.

The Reduction Factor is the ratio of :

$$\text{Reduction Factor} = \frac{\text{Motor Current Rating}}{\text{Drive Current Rating}}$$

For our example:

$$\text{Reduction Factor} = \frac{205}{255} = 0.804$$

Reduction Factor should always be less than 1 and typically greater than 0.6. Only 80.4% of the Quantum's capability is needed for the motor.

8.7.5 CURRENT SET-UP PER MOTOR NAMEPLATE DATA - SIZE 2 & 3

New Value for I-Limit+ #4.05 = Factory Setting x Reduction Factor = 1000 x 0.804 = 804

New Value for I-Limit - #4.06 = Factory Setting x Reduction Factor = 1000 x 0.804 = 804

From Column F on the 8X07 row, we would set #5.05= 382 so that #5.02 would read out delivered motor **amps**

New Value for Overload #5.06 = Factory Setting x Reduction Factor = 667 x 0.804 = 536

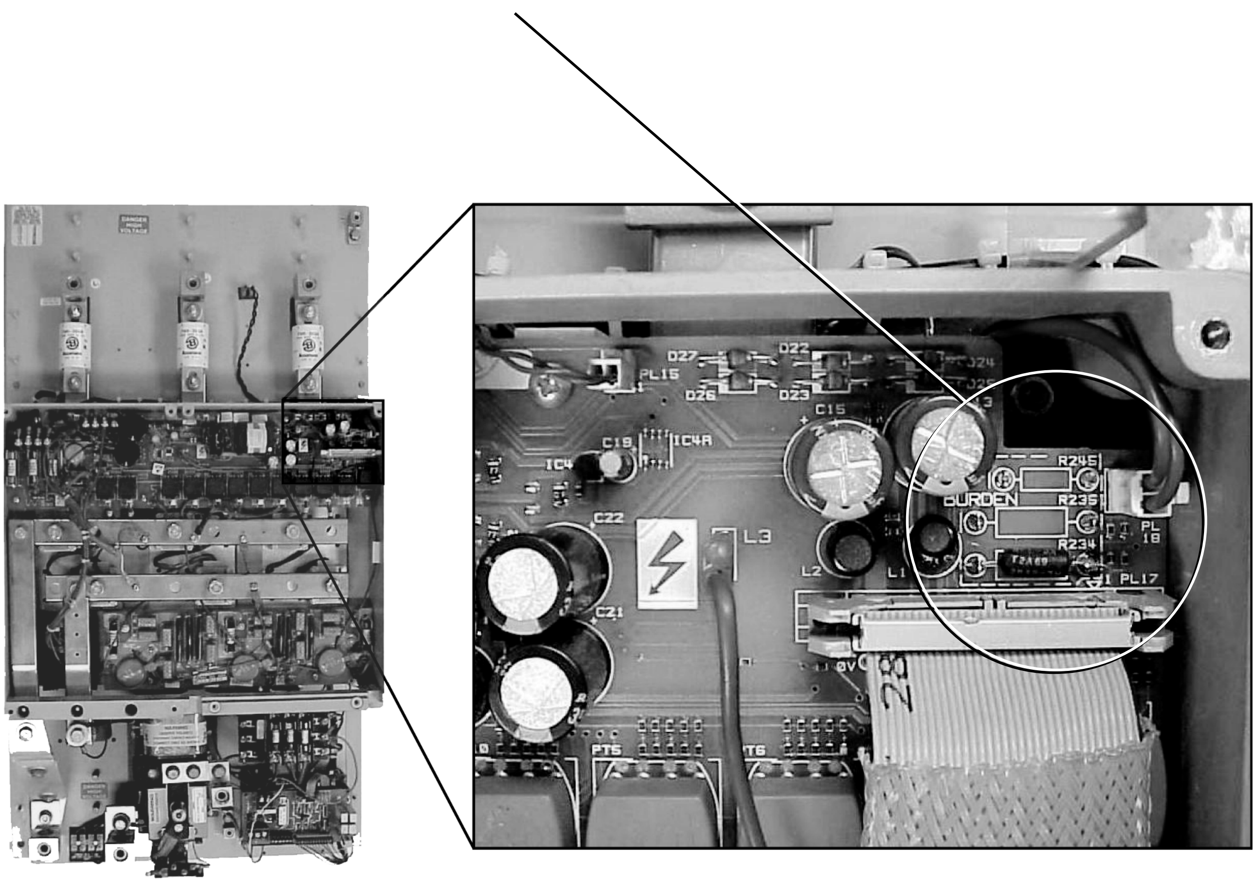
Worksheet: Current Setup for Size 2 and Size 3
Your Reduction Factor = Your Motor Current Rating / Your Drive Current Rating (Per Column B) = ________ = ________ = 0.________ (3 Decimals)
I-Limit+ = Factory Setting x Reduction Factor = 1000 x ________ = ________ = #4.05
I-Limit- = Factory Setting x Reduction Factor = 1000 x ________ = ________ = #4.06
Current Readout Scaler from selected row of Column F = ________ = #5.05
Overload Level = Factory Setting x Reduction Factor = 667 x ________ = ________ #5.06

8.7.6 CURRENT LIMIT SETUP FOR SIZE 2 and SIZE 3 MODELS continued)

Size 2 and Size 3

	A	Horsepower							B	F
Size	**Model**	**240v**	**500v**	**R234**	**R235**	**R236**	**Parallel Combo**	**150% amps**	**100% amps**	**#5.05**
2	9500-8X07	75	150	5.11	23.3		4.19 Ohms	382	**255**	382
	9500-8X08	100	200	3.18			3.18 Ohms	503	**335**	503
	9500-8X09	125	250	2.49			2.49 Ohms	643	**428**	643
	9500-8X10	150	300	2.15	64.9		2.08 Ohms	769	**513**	769
	9500-8X11	200	400	1.58			1.58 Ohms	1013	**675**	1013
3	9500-8X15		500	1.33	64.9		1.30 Ohms	1228	**818**	1228
	9500-8X16		600	1.58	3.4		1.08 Ohms	1483	**989**	1483
	9500-8X17		700	1.65	2.15		0.93 Ohms	1714	**1143**	1714
	9500-8X18		800	1.33	2.49	64.9	0.856 Ohms	1870	**1247**	1870
	9500-8X19		900	1.33	1.65	64.9	0.728 Ohms	2197	**1465**	220*
	9500-8X20		1000	1.33	1.33	64.9	0.658 Ohms	2431	**1620**	243*

* #5.02 will read out 1/10 Actual Delivered Amps.



8.8 FIELD CURRENT REGULATOR

Size 1 Quantum III models (9500-8X02 through -8X06) are supplied standard with 8 amp field current regulators (MDA-3). Size 2 & 3 Models (9500-8X07 through -8X20) can be supplied with an optional FXM5 20 amp field regulator. Both of these regulators are software controlled from menu 6 of the Quantum III. Jumper JP-1 on the MDA-3 and parameter 6.11 set the maximum current to be scaled for the desired field current. See Section 10 menu 6 for the range table of parameter 6.11.

Quantum III Size 2 & 3

These models have a fixed field voltage supply (see 7.2.4). Ignore Menu 6 parameters unless an FXM5 Field Regulator is employed

CAUTION

Be sure the field current is set to the motor nameplate rating. Motor damage may occur if current is incorrectly set.

Quantum III controls are shipped with the field disabled to prevent damage to the motor field. Parameter 06.13 must be set to 1 to enable field control after correct field settings have been entered.

8.8.2 Field Current Setup (Size 1)

Example : For Size 1 Quantum III

Suppose you were setting up to run a motor that had a Field that required 3.3A with a Size 1 Quantum III.

What changes would be needed to properly set up the drive for this motor?

Solution :

1) Set the MDA3 Field Range Jumper (2A/8A). Since the field current requires more than 2A, we must move the Field Range jumper to the 8A position.

2) Since the required field of 3.3A is greater than 3A we would need to set parameter #6.11 to deliver 3.5A. This calls for #6.11 to be set at 207 per the adjacent table.

3) But we don't want all 3.5A. We only want 3.3A. So we must reduce our request.

To calculate the required ***reduction*** of Field Current, one needs to only **multiply the factory setting** by the **Reduction Factor**.

The Reduction Factor is simply the ratio of:

Reduction Factor = $\frac{\text{Desired Field amps}}{\text{Max MDA3 amps}}$

For our example:

Reduction Factor = $\frac{3.3}{3.5}$ = 0.943

(We only need 94.3% of that range setting)

4) Parameter #6.08 sets the amount of the Max amps that #6.11 determines. The factory setting for #6.08 is 1000 (or 100%). So we would multiply the Reduction factor by the Factory Setting.

New Value for Full Field amps **#6.08** =
Factory Setting x Reduction Factor =
1000 x 0.943 = 943

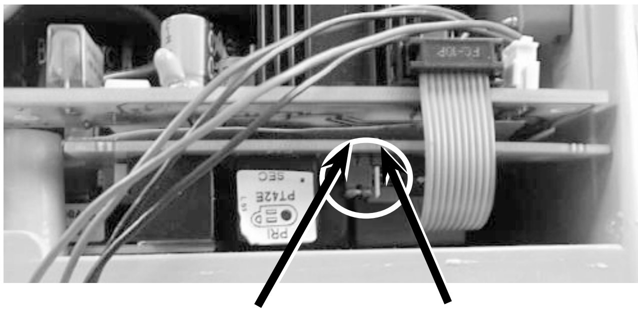
MDA3 Setup Table

MDA3 Max Amps	Field Range Jumper 2A/8A	Parameter #6.11 Setting
A	B	C
0.5	2	201
1	2	202
1.5	2	203
2	2	204
2.5	8	205
3	8	206
3.5	8	207
4	8	208
4.5	8	209
5	8	210
5.5	8	211
6	8	212
6.5	8	213
7	8	214
7.5	8	215
8	8	216

Parameter 6.21 limits the maximum firing angle to the field. To prevent the field from overheating if parameters are mis-set, it is defaulted to 815. If desired current cannot be achieved, increase its value accordingly.

8.8.2 FIELD CURRENT SETUP

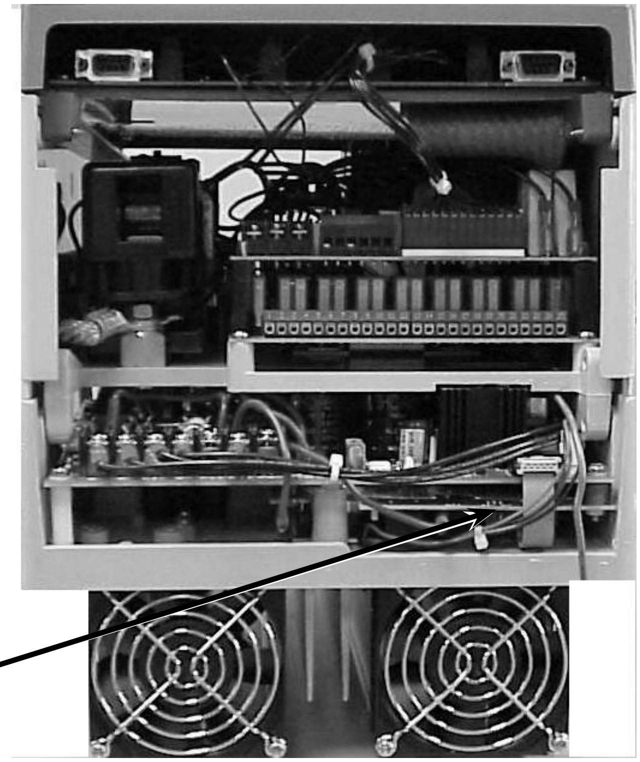
Maximum Field Range Output Select
On MDA3 Field Regulator Board
for Size 1 Quantums
Models 9500-8X02 thru 9500-8X06



2A
2 amp

8A
8amp

Bottom End View



MDA3 Field Regulator
& 2A-8A Range
Jumper Location

8.8.3 FIELD CURRENT WORKSHEET

Worksheet: Field Current
$\frac{\text{Your Field Amps}}{\text{Column A Value}}$ = ______________ = ________ x 1000 = ________ = #6.08

8.8.4 FIELD ECONOMY

Field economy reduces the current to the shunt field when the drive is not running. This will increase motor field life and reduce the possibility of field roast-outs due to loss of ventilation. Set parameter 6.15 to 1 to enable the field economy function.

The value of parameter 6.09 will determine the field economy current value. This is typically set to 500 or 50% of the full field current. Therefore, the setting of parameter 6.09 = 6.08 x 0.5. Parameter 6.12 sets the time before the drive goes to the economy current in seconds. It is defaulted to 30 seconds which is suitable for most applications.

8.8.5 FIELD WEAKENING

When field weakening is required, the maximum (base speed) current as defined by parameters 6.11, 6.08, and 6.21 is set as defined under paragraph 8.8, Field Current Regulator.

Parameter 6.07 is defaulted to 1000 to prevent field weakening. To enable field weakening, parameter 6.07, Back EMF Crossover Point, should be set 20 volts below the rated armature voltage of the motor. The field weakening will then occur over this span (from 480 to 500 VDC). For a 500 VDC motor, parameter 6.07 is set to 480. The field will weaken down to the minimum field current as set by parameter 6.10. This parameter is a percentage of the maximum set by range parameter 6.11 and is set as follows:

$$6.10 = \frac{\text{Minimum current desired x 1000}}{\text{MDA-3 max amps as set by 6.11}}$$

NOTE

Field weakening requires speed feedback for correct operation. AC tach, DC tach, or encoder feedback must be used. Field weakening is a more complex setup. If you need assistance, call Technical Support.

8.8.6 FIELD CONTROL UNIT FXM5

The FXM5 Unit enables all Quantum III drive models to operate a motor with the motor field under variable current control. It can be operated as a stand alone analog control or it can be controlled digitally (under ribbon cable control) by the parameters in Menu 06 (Field Control). Parameters in Menu 06 are provided as standard for use in conjunction with the optional controller. Refer to paragraph 10.7.6.

FXM5 Startup Data

Refer to the Instruction Manual (ES10-027) provided with the FXM5. The standard FXM5 Unit is suitable for motors with field current up to 20 amps, and is installed externally to the drive unit. It is suitable for installation by the user on site if desired.

Standard FXM5

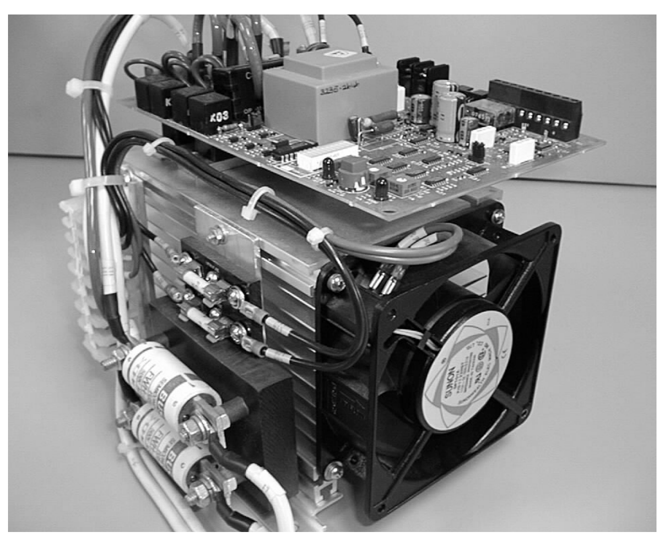
Installation

The FXM5 unit must be firmly attached to a vertical surface by the two (2) mounting brackets, See also, Figure 12-4. The unit must be located with the heat sink fins vertically aligned. This permits free circulation of cooling air. Access for cooling air to and from the heat sink must not be obstructed.

As supplied, the FXM5 has an integral cover retained by four (4) screws.

HiPower FXM5

The HiPower FXM5 is designed to accommodate motors with field current up to 90 amps.



8.9 INITIAL STARTUP GUIDE

Perform the PRE-POWER Checklist

Initial Checks before applying power:

- ☐ Verify that the AC Line Voltage that will be applied to the Drive is correct
- ☐ Verify that the Drive is set for that AC Line Voltage
- ☐ Verify the armature and field voltage rating of motor
  (If a buzzer Megger is used to “ring out” motor wiring or to check insulation the Drive must be completely disconnected from the motor.)
- ☐ Check for damage to equipment
- ☐ Check for loose or frayed wire ends.
- ☐ Check for metal clippings from cutting/drilling/taping around the drive
- ☐ Check to see that the motor turns freely and that there are not mechanical jams
- ☐ Check to see that cooling fans are free and clear of obstructions and materials that can be sucked in
- ☐ Ensure that rotation of the motor in either direction will not cause damage
- ☐ Ensure that nobody else is working on another part of the system that would be affected by powering up the Drive.
- ☐ Ensure that other equipment will not be damaged by powering up the Drive
- ☐ Disconnect the load from the motor shaft if possible
- ☐ Check to see that external Run contacts are open

8.9.1 Putting in Parameter Settings

CAUTION

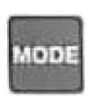
A mis-wired drive/motor or a drive with improper parameter setting can result in the motor accelerating very quickly in either direction upon a start command. This can cause fuses to blow and machine damage. The settings is this guide rely on accurate calculations, complete execution and correct parameter entry to help prevent such an occurrence. Only qualified technicians with motor and drives experience should attempt commissioning a motor/drive combination.

Apply AC power to the drive. The drive display should be lit and indicate 0 in the data display and 0.00 in the parameter index. There should be no fault codes or messages. (If there is a fault code, consult Fault Finding-Fault Codes in Section 13.)

Many of the parameter menus are “locked out” at this point. You must unlock security to gain access to necessary parameter areas.

Unlocking Security

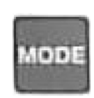
While the the parameter index is displaying 0.00 depress the M or Mode key. The data display should begin flashing. Depress and hold the UP/DOWN arrows to place a 200 into the data display. Depress the M key once again to stop changing memory location 0.00.



Then Depress

Until **#0.00 = 200**

Then Depress



You may enter data for your application into the various drive parameter locations. (Note that all these values are whole numbers without decimal points.)

STORE parameters thus far.

Set parameter **#0.00 = 1**

Then Depress

8.9.2 Setup for Running the Motor

Before running the motor for the first time, you must be sure the motor is free to rotate. It is usually best if the motor is uncoupled from the gearbox or load. If this is not possible, make sure the machine is clear of obstacles and especially other people working on or near the machine.

If You've Followed the Guide

The preceding pages of Section 8 should have helped you to set all the necessary jumpers selections and scaling switches. The setup should provide your motor with the correct field excitation. The setup guide will purposely guide you to be starting the drive up using Armature Voltage Feedback (AVF). (Ensure #3.12 = 0 and #3.13 = 1.) This method does not rely on external feedback being correct. Therefore it is inherently safer.

Run/Stop Setup

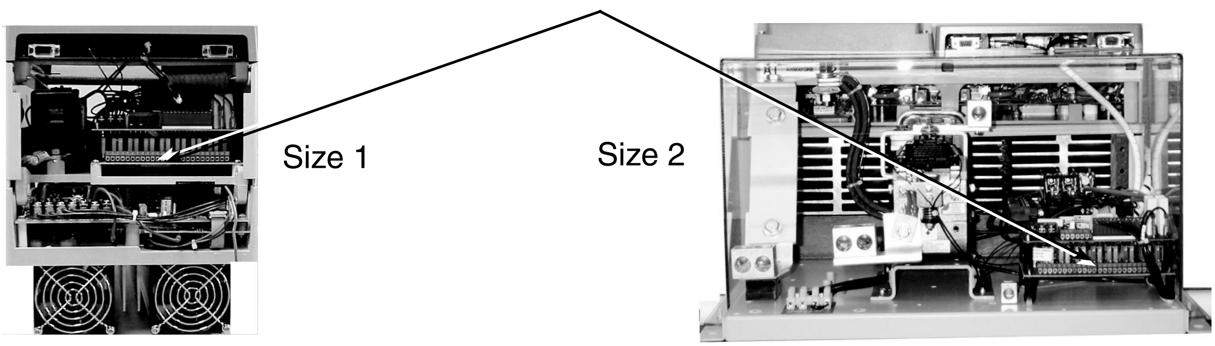
For initial running of the motor, we are going to only require a NO (normally open) RUN and a NC (normally closed) STOP pushbutton. A speed pot will not be required initially, as we will use a speed adjustment within the drive. This will eliminate speed pot wiring errors (as a mis-wired pot can cause the drive to go to maximum speed or can short out the power supply in the drive).

WARNING

DO NOT WIRE IN A SPEED POT OR ANY OTHER WIRES THAN THOSE SHOWN IN THE FOLLOWING DIAGRAM.

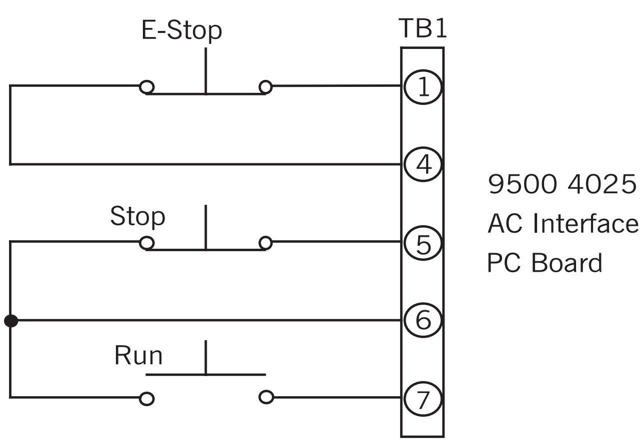
Run/Stop Setup

The RUN/STOP inputs are to be wired to the 9500-4025 115vac Interface Board.



3-Wire Run/Stop Pushbutton Method

Connect up the pushbutton switch arrangements to the 9500-4025 115vac Interface Board as shown here.



DO NOT ATTEMPT TO RUN MOTOR, YET!

8.9.3 Running the Motor

1. By adjusting parameter #1.04 you can run the motor up to full speed under digital reference control. The number in parameter #1.04 can be taken to + or - 1000. This 1000 represents 100.0% speed and the sign is the direction. If you are running a non-regen, the drive will be unable to follow a negative speed command. A regen drive however, will run the motor in reverse. You will not be able to adjust parameter #1.04 as it is protected by the Level 1 Security Code. To temporarily bypass security, place a 200 into parameter #0.00. After this, you should be able to adjust #1.04 as desired.

2. Take #1.04 up to about a value of 10. Observe parameter #1.02. It also should be 10. If it is not call Technical Support for assistance. Take parameter #1.04 back down to 0.

3. Test the E-STOP pushbutton/switch. The drive should indicate Et or External Trip and will require you to depress the RESET pushbutton on the display panel to clear this trip.

4. If power is applied and motor/machine is clear to run, depress the RUN pushbutton with the E-Stop pushbutton close at hand. The Armature Contactor should energize. The noise clap on the larger drive models is easily detected as the contactor energizes.

5. Slowly take #1.04 up in value with the E-Stop pushbutton close at hand. An uncoupled motor should begin rotating. If a motor coupled to a machine does not rotate, the machine load may be too great to be overcome by the reduced current setting. If this happens, the Current Limt LED on the status LED's will be lit. To obtain more current, you can increase the value in parameter #4.04. Keep this value as low as required to allow rotation until basic setup calibration is complete.

6. Run parameter #1.04 up to 1000 if everything appears OK. At maximum, parameter #3.04 can be observed to read the Armature Voltage being generated in volts.

7. Take #1.04 down to around 300 or 30%. Then depress the STOP pushbutton. The contactor should drop out and the motor should coast to a stop. You could re-energize the contactor and set the ACCEL time with parameter #2.04. The factory setting (default) is 50 or 5 seconds for this parameter. If you change this value, you could perform a STORE by placing a 1 into parameter #0.00, then depress RESET. Before doing the STORE make sure #1.04=0 or else that temporary setting would also be saved.

8. If you wish the drive to RAMP stop (not COAST), JP3 on the 9500-4030 HP & Tach Scaling Board must be moved to the 2-3 position. (Make jumper changes only with POWER OFF !). If the drive is set for RAMP stop, you could set parameter #2.05 for your desired deceleration time.

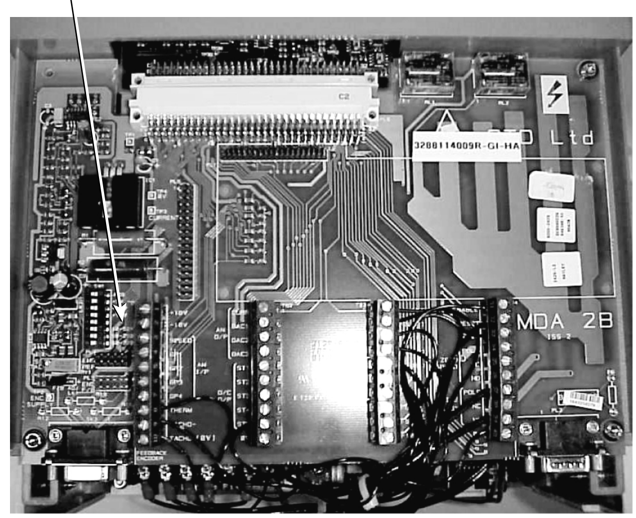
9. Shutting power off will re-enable parameter security and set all parameters back to their state prior to the last STORE event.

10. If Motor runs backwards, you could reverse the motor field wires to obtain your desired direction of rotation. Never remove Motor wires with drive Power ON.

8.9.4 Running with a Speed Pot

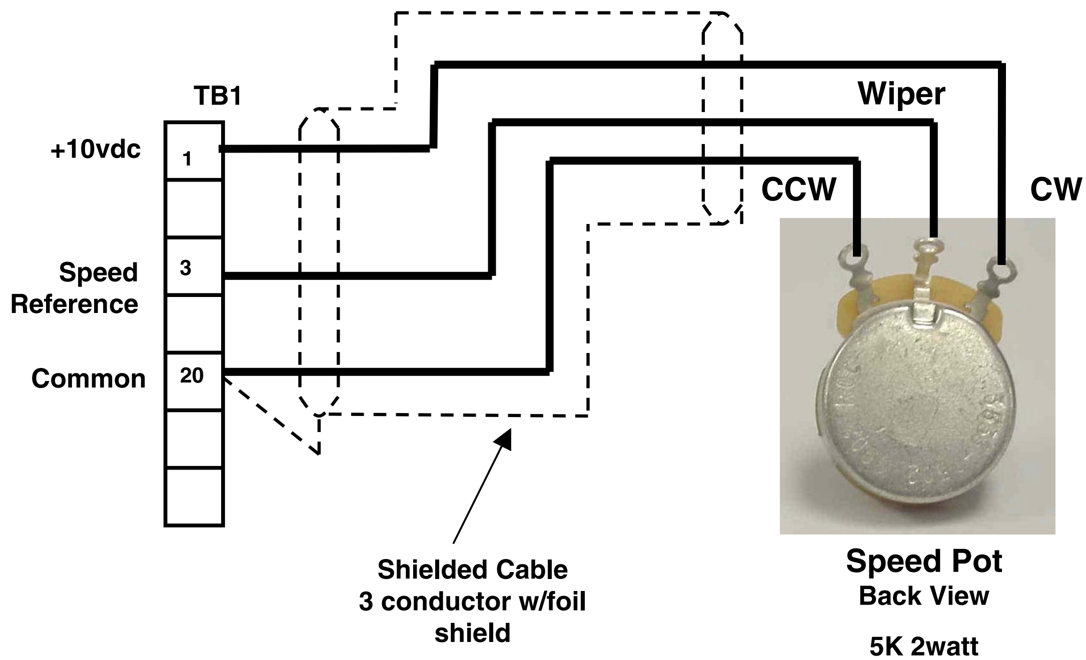
If you plan to run your motor ultimately with a speed pot, STOP the drive and remove power. Connect up your pot (in the range of 5K-50K in value) as indicated on the following page.

Pot Connection Diagram

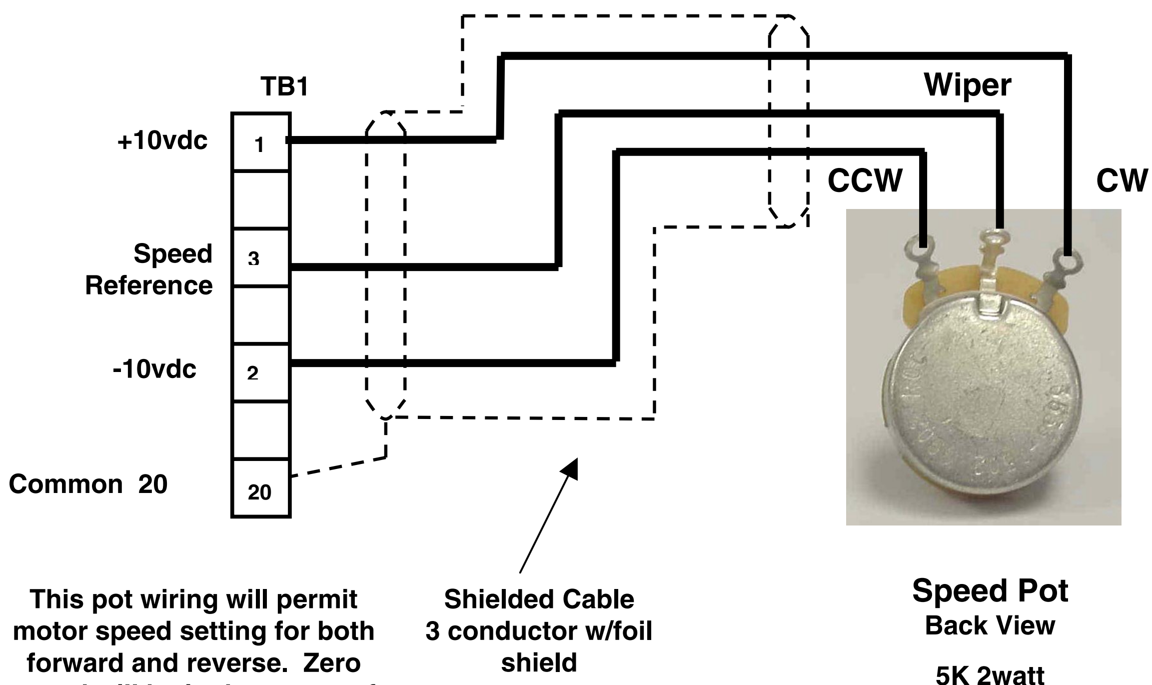


1. After your pot is connected, you can apply power to the drive once again. Always- before running the drive check your speed pot by simply monitoring parameter #1.01 and observing its' value. When your pot is at full minimum, #1.01 should be 0. If it is 1000 rotate your pot to full CW. If the pot reading goes to 0, exchange the wires on pins 1 and the pin corresponding to the clockwise end.

Standard Uni-Directional Speed Potentiometer Wiring
(For use with either Regen or Non-Regen Models)



Bi-Directional Speed Potentiometer Wiring (for regen models only- 9500-86XX)



This pot wiring will permit motor speed setting for both forward and reverse. Zero speed will be in the center of the dial .

Figure 8-1
Speed Pot Wiring

2. Once parameter #1.01 reads correctly, 0 to 1000 as the pot is turned up to full, you should re-check #1.02 to ensure that it too follows the same way. (If you have a reading in #1.02 with your Speed pot at minimum, re-check to make sure #1.04 is 0). You could then place the drive into run and now alter motor speed using your speed pot.

3. If operation looks okay, we could now run the Over-riding Current Limit #4.04 back up to 1000 and perform a STORE.

Note

If using a motor-mounted AC or DC Tach Feedback Device proceed with 8.9.5 below, or if using an Encoder or Pulse Tach proceed with directions under 8.9.6.

8.9.5 AC or DC Tach Feedback

Once you have determined the drive and motor run satisfactorily using Armature Voltage Feedback, it is now time to calibrate for your AC or DC Tach. By performing the next few steps you will be certain that:

- ▶ Your Tach Works, outputting the correct voltage
- ▶ Your Tach Polarity is Correct
- ▶ Your Tach Calibration is Correct so that your motor runs at the correct speed

4. With your tach connected, run the motor once again. This time, monitor parameter #3.02 (Speed Feedback). Adjust your speed reference either with your pot or parameter #1.04 until parameter #3.02 reads 980 or 98%.

5. Then go to parameter #3.26. Parameter #3.26 should display the same value as #3.02. If it does not, adjust the SET TACH trimpot until #3.26 matches #3.02. In addition, the polarity of the number in #3.26 must be the same as that which was observed in #3.02, otherwise the Tach wires are backwards and you will need to reverse them. (If the polarity of #3.26 was different than #3.02, the drive would have run away in speed if we were actually using the tach.)

6. If the polarity is ok and you've calibrated the tach per the previous instructions, you should run the drive up to full speed in Armature Voltage feedback to verify that #3.26 tracks all the way up. A tach that is faulty will have a fluctuating output at high speeds.

7. It would be a good idea to actually measure the tach feedback voltage at pins 9 & 10 of TB1 at this time. If it is steady and approximately the value you calculated then you are ready to switch over to Tach feedback.

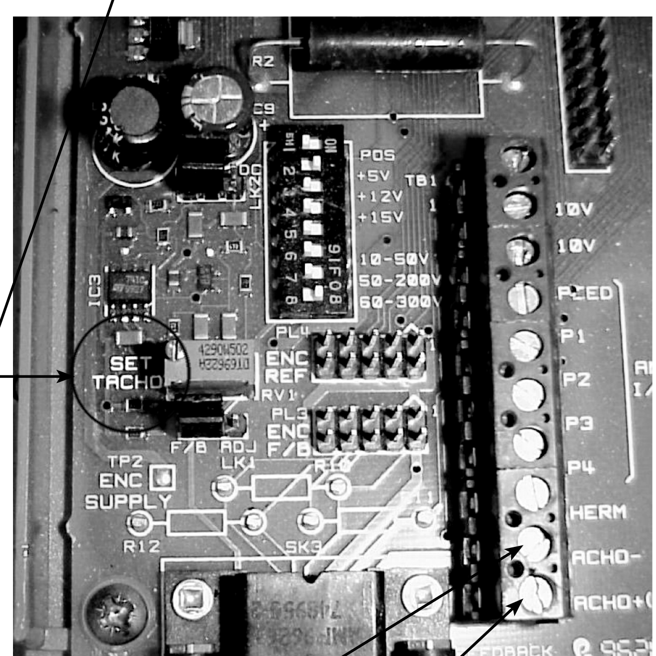
8. Take the speed down to zero and STOP the drive. You can now change parameter #3.13 to 0 . This will take the drive out of Armature Voltage feedback and set it up for Tach (speed) feedback. Current limit should be temporarily set to a low value (about 15% of the drive rating -by setting #4.04=100) so that the available output is reduced again for safety.

9. Re-start the drive with the speed pot at minimum and verify operation. Final calibration of speed can be now accomplished by measuring the Tach Feedback Voltage 9 & 10 of TB1 and adjusting the SET TACH trimpot for final calibration.

10. If operation looks ok, you could now run the Over-riding Current Limit #4.04 back up to 1000 and perform a STORE.

11. Speed stability may be able to be improved by adjusting values to be around #3.09=20-80 and #3.10=5-40. An unloaded non-regen drive (motor only) is difficult to tune without some machine load. Stability can be tested simply by quickly manipulating the speed pot back and forth while adjusting #3.09 and #3.10. If satisfied with your improvements perform a STORE.

Calibrate #3.26 using Set Tach Pot



TB1 **Pin 9** **Pin 10**

Do not reverse these wire connections if #3.26 polarity is incorrect. Reverse wires on 9500-4030 Board, Pin 1 and 3 of TBA to correct polarity.

8.9.6 Encoder or Pulse Tach Feedback

Note
These directions are only necessary if using a motor mounted encoder or pulse tach feedback device.

Once you have determined the drive and motor run satisfactorily using Armature Voltage Feedback, you should be ready to try switching over to Encoder Feedback assuming you have completed the worksheet on 8.6.3 and entered your calculated value into parameter #3.14.

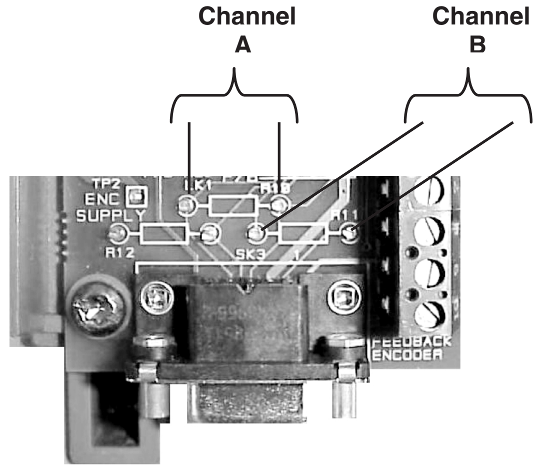
There is always the possibility that :

- There is an error in encoder wiring
- The encoder channel phasing is incorrect for your motor direction
- The encoder is faulty and will not provide proper speed feedback information

4. For this reason, current limit should be temporarily set to a low value (about 15% of the drive rating- by setting #4.04=100) so that the available output current is reduced for safety. In addition, we would strongly recommend that you verify that the encoder does indeed function by measuring the frequency of each channel as shown below while the motor is still operating with Armature Voltage Feedback (#3.12=0 and #3.13=1). It would be ideal to run the motor to Base Speed and verify the encoder output frequency. Both Channel A and B should read the same frequency.

$$\textbf{Frequency} = \frac{\text{Encoder PPR}}{60} \times \text{Motor Speed}$$

Example. For a 1750RPM motor with a 1024PPR Encoder, the frequency at this speed should read 29.886KHz or about 30Khz.



5. If the frequency measures okay on each channel, depress the STOP button. When the motor is stopped, you can now change over to Encoder feedback by setting #3.12=1. With you speed pot at zero, re-start the drive and slowly bring up the reference. Use caution as the drive may accelerated quickly if the phasing is incorrect. If the drive trips and displays Fbr (feedback reversed), exchange CHA with CHB and /CHA with /CHB and re-try.

6. If operation looks okay, you could now run the Over-riding Current Limit #4.04 back up to 1000 and perform a STORE.

7. Speed stability may be able to be improved by adjusting values to be around #3.09=20-80 and #3.10=5-40. An unloaded non-regen drive (motor only) is difficult to tune without some machine load. Stability can be tested simply by quickly manipulating the speed pot back and forth while adjusting #3.09 and #3.10. If satisfied with your improvements perform a STORE.

8.10 CURRENT LOOP SELF-TUNING

NOTE

The following procedure is optional and not required for most general applications. However, where optimum response is required, the inner most control loop (the current loop) must be properly set up to enable the outer control loop (such as the speed loop) to function correctly. The current loop dynamics is mainly a function of a particular motor's electrical characteristics.

For general purpose applications, the default values for current loop stability parameters are satisfactory. However, for optimal current loop tuning, the Quantum III has a self-tuning procedure built-in to the unit to facilitate tuning of this inner loop.

To perform this procedure, the motor rotor must be locked for PM (permanent magnet) motors or the field must be disconnected. This allows the drive to inject armature current and determine the motor armature electrical characteristics. The motor must not rotate during this procedure. Normally, when the field is removed, the shunt field motor will not rotate. Never remove field wires with power on.

Size 1 Quantum III units from (9500-8X02 through -8X06) contain an internal field regulator. Units with this regulator do not require the field wires to be removed for this purpose.

1. Apply power to the drive.
2. Set parameter 5.09 = 1. This enables the auto tune circuits and disables the field when a field regulator is used.
3. Enable drive run (the drive must first be disabled, then enabled). When the auto tune process is complete, it will reset 5.09 = 0 and disable the drive.
4. Store parameters to memory. Parameters affected are 5.12 through 5.15. See Also #5.27 in 10.7.5.
5. Fill out the Programming Chart on the following page for future reference in the event technical support or drive replacement is required.

8.11 JUMPER PROGRAMMING CHART

CUSTOMER JUMPER PROGRAMMING CHART (FILLED OUT BY CUSTOMER)					
JUMPER PROGRAMMING	**POSITION**	**FACTORY SETTING**		**POSITION AFTER STARTUP**	
		Off	**On**	**Off**	**On**
SW1-1	0V to +24V	■		■	□
SW1-2	+5 VDC		■	□	□
SW1-3	+12 VDC	■		□	□
SW1-4	+15 VDC	■		□	□
SW1-5	Not used				
SW1-6	10-50 V		■	□	□
SW1-7	50-200 V	■		□	□
SW1-8	60-300 V	■		□	□
LK1	F/B-ADS	F/B			
LK2	LF-DC	DC			

DRIVE MODEL NUMBER: 9500-____________________

DRIVE SERIAL NUMBER: ____________________

SOFTWARE REVISION (PARAMETER 11.15): ____________________

COMMUNICATION TERMINATING RESISTOR R6: _______ OHMS

MDA3 FIELD RANGE ①
JUMPER 2A □ 8A □

ENCODER TERMINATING RESISTORS:

R-10: ________OHMS
R-11: ________OHMS
R-12: ________OHMS

SCALING RESISTOR (HP SHUNT): ________OHMS ①

SYSTEM NUMBER (IF APPLICABLE): ____________________

① ONLY APPLICABLE ON SIZE 1 MODELS 9500-8X02 THRU 8X06.

The AC Logic Board, (9500-4025) and the Logic Interface Board (9500-4030) interface the 115VAC Start/Stop/Jog operators and the motor contactor to the control. The AC Interface Board (9500-4025) has the following relays with their associated functions (refer to Figure 7-6):

9.1 NF— NO FAULT

This relay provides a relay contact for external use. It is programmable via JP2 to provide either a normally open or closed contact. This relay is turned on when power is applied to the drive and no faults are present.

9.2 FR— FAULT RELAY

This relay provides a fault contact for external use. It is programmable via JP3 to provide either a normally open or closed contact. From Figure 9-1 it can be seen that the coil of this relay is in series with the E-Stop, the motor thermal and the additional system interlocks. All these interlocks are normally closed connections which open under a fault condition. A second contact off this relay is used to trigger an external trip fault in the control. Note that this contact changes state for only the time period in which the fault contact is open.

9.3 PGM#1— PROGRAMMABLE RELAY #1

This relay is free for customer use. Its default is the forward/reverse function applicable to regenerative drives only. Programmable logic input F4 inverts the polarity of the speed reference when PGM#1 is turned on via one of its contacts. A second contact (form C) is available at the terminal strip. The function of this relay may be changed to provide other functions, such as auto/manual, by changing the default function of the programmable logic input F4.

9.4 PGM#2— PROGRAMMABLE RELAY #2

This relay is also free for customer use. Its default function is drive reset. A relay contact is also available at the customer terminal strip which is selectable as either a normally open or closed contact. The function of this relay may be changed by moving jumper JP1 (on the 9500-4030 PC board) from position 2-3 to 1-2 and changing the programmable input F5 to the desired function.

9.5 RUN/STOP CONTACTOR LOGIC

The run/stop contactor control function is performed by relays R, RA, MCA, MCB, and ZS/PB. To describe the function and purpose of these relays, the basic sequence of operation will be given. To better understand this relay logic, a brief description of the required logic inputs to the control and their functions will be described. Note that the standard default parameters for run forward, run reverse, inch forward and inch reverse have been changed for use with the AC logic board. These parameter changes can be found in Section 10.

Terminal #31—Enable

When this input is pulled "low," the SCRs are enabled. When this input is released, the SCRs will be disabled 30 milliseconds later.

Terminal #21—Input F1/Run Permit

Terminal #22—Input F2/Reference ON

These two inputs are tied together. When these inputs are pulled "low," the Speed reference input to the accel/decel circuit is unclamped. If the Enable has been pulled low, the SCRs will be phased forward and the motor will accelerate to set speed.

When these inputs are released, the speed reference will be clamped. The motor will either decelerate to zero speed if the Enable input is held "low" (Ramp Stop Mode; JP3 on the 9500-4030 programmed for position 2-3) or the motor will go into a coast/dynamic braking mode if the Enable input is also released (Coast Stop Mode; JP3 programmed for position 1-2).

Terminal #23—Input F3/Jog (Inch)

When this input is pulled "low," the speed reference will be switched to the Jog reference (parameter 1.05).

Terminal #24—Input F4/Reverse

When this input is pulled "low," the polarity of either the speed reference or the jog reference (which ever is active) will be inverted.

Terminal #19—Status Output ST5/Electrical Phaseback

This is an open collector status output which turns on when the SCRs are phased forward (i.e. the control is actively supplying power to the motor). This output controls the relay ZS/PB (zero speed/ phaseback) which holds in the motor contactor when a stop command is given until the SCRs are fully phased back. This guarantees that the armature current has reached zero before allowing the motor contactor to open. If ramp stop has been selected, this will occur once the motor reaches zero speed.

9.6 RUN LOGIC

The Run/Stop sequence is as follows. The standard three wire configuration will be used. The two wire is exactly the same except the "seal in" circuit is not used and thus the drive will stop once the run input is opened. When the run button is depressed, the run relay will pick up. One of its contacts will then supply power to the motor contactor while a second contact will close between pins #3 and #4 of J3. Once the contactor picks up, an auxiliary contact off the contactor will close and turn on MCA and MCB. A contact of MCA then closes and connects pins #1 to #2. This now applies +24VDC to pins #2, #3, and #4 of J3. From Figure 7-6 one can see that Q1 and Q2 will turn on and pull "low" the Enable, the Run Permit, and the Reference On. This enables the SCRs and the speed reference. The drive is now active and will supply power to the motor. While all this is occurring, the run circuit is sealed-in through a run contact and a contact of MCA. This prevents the run circuit from sealing-in if the contactor did not stay picked-up. At this point, since the SCRs are now phased forward, the status output ST5 will pull low and pick up the ZS/PB relay. A contact off this relay, which is connected in series with a contact of MCB, closes around the run (or jog) relay contact which picked up the motor contactor. This arrangement allows the contactor to be held in when the run relay is dropped out for ramp stopping and for preventing the contactor from opening while it is conducting armature current. A second normally closed contact of MCB, connected around the diode in series with the motor contactor coil, opens to reduce the voltage supplied to this coil. This allows the coil to operate at reduced voltage providing cooler operation and a longer life. The MCB contact in series with the ZS/PB contact prevents the ZS/PB from sealing in the run (or jog) contact until the motor contactor has been turned on. The remaining contact of MCB is available at the terminal strip. This contact will close in run or jog and will open whenever the motor contactor opens.

When a stop command is given, the run relay will drop out and cause the run permit and the reference on to disable (when JP3 on the 9500-4030 board is programmed for ramp stop), or it will disable the run permit, reference on and the enable when programmed for coast stop. In the ramp stop mode, the motor will decelerate to zero speed and the SCRs will phaseback. At this point, the ZS/PB contact will open and the motor contactor will drop out. Since relay MCA (which is controlled by the auxiliary contact of the motor contactor) drops out, the contactor will then be locked out until another run command is given. In the coast stop mode, the same sequence occurs except the SCRs immediately phaseback, the contactor opens, and the motor either coasts to a stop or the dynamic braking is applied.

9.7 JOG LOGIC

The Jog logic is the same as the Run/Stop logic except that, with the two wire operation, the jog drops out when the jog contact is opened. In addition, Q3 will also be turned on, thus enabling programmable input F3, the Jog reference select.

9.8 ADDITIONAL CIRCUITRY ON THE 9500-4030 BOARD

There are three other circuits located on the 9500-4030 PC board. They are AC/DC tachometer select, HP (horsepower) shunt select, and an optional motor thermal input.

9.8.1 AC/DC Tachometer Select

This allows selection of either an AC or a DC tachometer for speed feedback. There are two jumpers on the 9500-4030 board, JP4 and JP5. To program for DC tachometer, both jumpers should be set for position #1. The tachometer should be connected to terminals #1 and #3 as shown in Figure 9-1. If an AC tachometer is used, JP4 and JP5 should be set for position #2 and the tachometer should be connected to terminals #1 and #2 (shield to #3) as shown in Figure 7-6. In both cases, the control should be programmed for tachometer feedback (parameters 3.12 and 3.13 both set to 0). Also, located on the MDA-2 board, SW1 (dip switch #1 positions F, G, and H) and potentiometer RV1 must be adjusted for proper feedback levels. Refer to section 8 of this manual.

9.8.2 HP Shunt Circuit

This circuit brings out to the terminal strip (#1 and #3 of TBS) the internal connections for the current scaling resistors in the control. The drive is defaulted to a current rating of 10.2 amps when no external resistor is connected to the terminal strip. Figure A-1 gives a table of resistor values for programming the drive for the various motor current/horsepower settings. The resistor values applicable to each drive model are provided with the unit. Note that this HP shunt connection is used only with Size 1 drive models up to and including 100HP (9500-8302 through -8306 and 9500-8602 through -8606).

9.8.3 Optional Motor Thermal Connection

Provided on TBS pins #4 and #5 of the 9500-4030 board are connections for a motor thermal (thermostat switch). The motor thermal may be connected to these two terminals or as shown in Figure 7-6 (in the 120VAC ladder circuit). The difference between these two selections is the way the fault is annunciated. If the motor thermal is connected in the 120VAC logic (TB1 Pin 3 and pin 4 of 9500-9025 relay board), a fault will cause the display to read “Et” (external trip), which is also the case with E-stop or any opening of the system interlocks. If the motor thermal is connected to terminals #4 and #5 on TBS, the display will show “th” (thermal trip) under a fault condition. To use this optional input, it must be enabled by setting parameter 10.32 to 0 and pressing reset. This parameter change should then be stored.

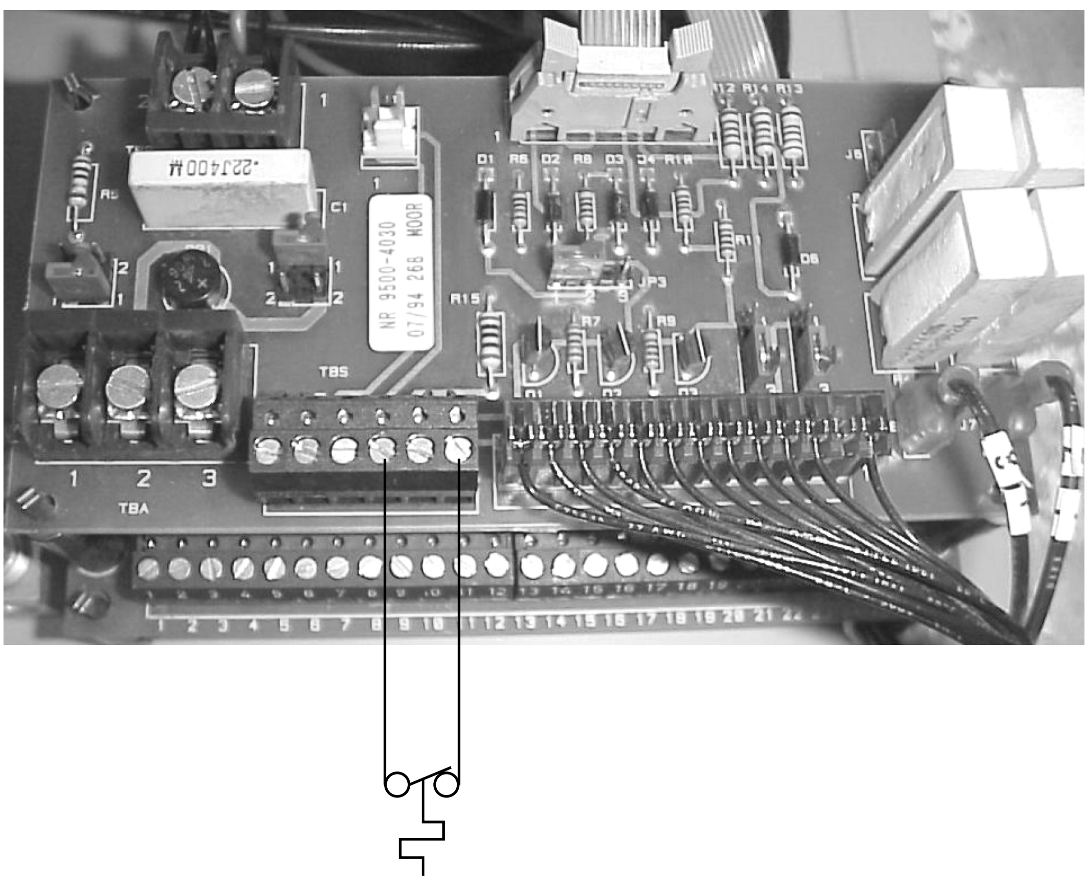


Fig. 9-1
Optional Motor Thermal Connection

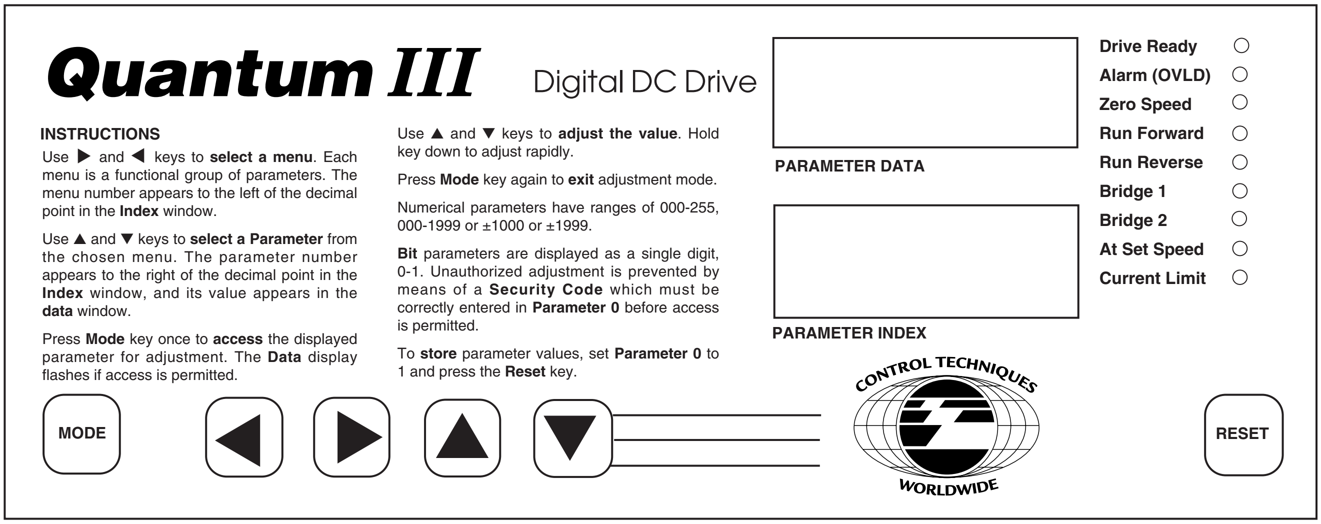


Figure 10-1.
Quantum III Decal

10.1 KEYPAD

The keypad serves two purposes:

1. You can configure the drive for specific applications and change its performance in many ways, such as adjusting the times of acceleration and deceleration and presetting levels of security access.

   Subject to safety considerations, adjustments may be made with the drive running or stopped. If running, the drive responds immediately to the new setting.

2. You can get full information about the settings and the operational status of the drive. Extensive diagnostic information is available in the event of a drive fault.

For parameter adjustment, the keypad has five keys. Use the ◀ or ▶keys to select a Menu (functional group of parameters). The menu number appears to the left of the decimal point in the Index window.

Use the ▲ or ▼ keys to select a parameter from the chosen menu. The parameter number appears to the right of the decimal point in the Index window, and the value of the chosen parameter appears in the Data window.

Press the MODE key once to access the displayed parameter value for adjustment. The value flashes if access is permitted.

NOTE

If access is not permitted, check the following:

1. The parameter is "read only."
2. The parameter is invisible and protected by a level of security (see paragraph 10.5).
3. The parameter is assigned to a programmable input.
4. The parameter is being driven by an application program with the serial interface.

Use the ▲ or ▼ keys to adjust the value. To adjust quickly, press and hold a key.

Press the MODE key again to exit from the adjustment mode.

SAVING PARAMETERS

To store (make permanently effective) the parameter value changes, set parameter 00 of any menu = 1 and press reset. If this sequence is not enacted, the changes will be lost when the power is removed from the drive.

10.2 DISPLAYS

1 Index

The lower four-digit display indicates menu number to the left of the (permanent) decimal point, and parameter number to the right.

2 Data

The upper four-digit display indicates the value of a selected parameter. The present value of each parameter, in turn, appears in the data display as parameter numbers are changed.

Numerical parameters have values in ranges of 000 to 255, 000 to +1999, or 000 to ±1000. Refer to the information starting with paragraph 10.3 for parameter unit values, e.g volts, rpm, etc.

Bit parameter values are displayed as 0 or 1, preceded by a b. The first digit for integer parameters (0 to 255) is a r .

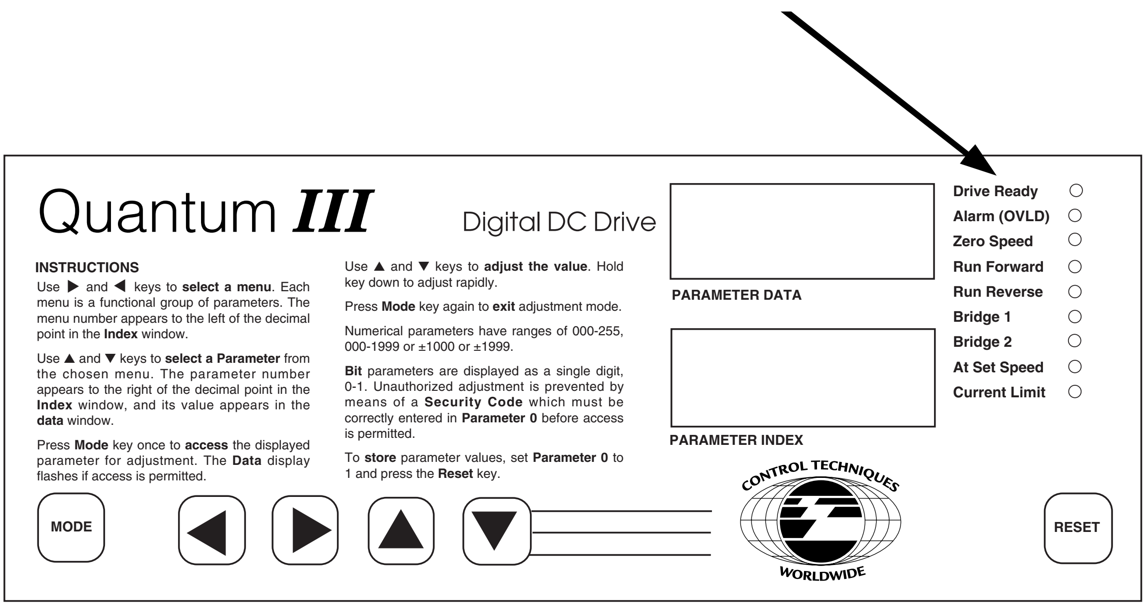
3 Trip Codes

If the drive faults, the index display shows "trip", and the data message will flash. The data display shows a mnemonic to indicate the reason for the fault. These are explained in Section 13, "Fault Finding."

4 Status Indicators

Nine LEDs to the right of the parameter data and index panels present information, continuously updated, about the running condition of the drive and enable basic information to be seen at a glance.

LED ILLUMINATED	INFORMATION
Drive ready	The drive is turned on, not tripped.
Drive ready — flashing	The drive is tripped.
Alarm — flashing	The drive is in an overload trip condition or is integrating in the I x t region.
Zero speed	Motor speed < zero speed threshold (programmable).
Run forward	Motor running forward.
Run reverse	Motor running in reverse.
Bridge 1	Output bridge 1 is enabled.
Bridge 2	Output bridge 2 is enabled. (inactive in 1-quad drives).
At speed	Motor running at the speed demanded by the speed reference.
Current limit	Drive running and delivering maximum permitted current.



10.3 DRIVE PARAMETERS

The list of menus is given in paragraph 10.6. Parameter names, ranges, default values and security are given in paragraph 10.6.2. A full description and explanation, when required, is found in paragraph 10.7. Block diagrams are shown for each menu in Figures 10-4 through 10-19.

Before attempting to adjust parameters, please refer to paragraph 10.1 for details on keypad entry and paragraph 10.5 for details on security.

10.4 TYPES OF PARAMETERS

Real Values:

A real value parameter has a numerical value and can be unipolar or bipolar. Its range can be from -1999 to +1999. Real values are comparable to potentiometers in analog drives, but are much more precise and not subject to drift. They are used to set variables such as speed, acceleration, or current limit.

Bit Values:

A bit value is one which can have a value of either 1 or 0 and is therefore reserved for drive status variables which are either true or false, enabled or disabled, etc. Bit values are used to represent such variables as quadrant enable, ramp enable, drive at speed, etc.

Each parameter falls into one of two further categories, as follows:

Read-only values:

Read-only values are ones which are set or measured by the drive itself, either during power-up reset or continuously during drive operation. As the name implies, these values may only be read, and allows one to MONITOR ONLY drive status and performance.

Read/Write Values:

Read/write values are those which are set by keypad entry, serial interface communication or background program execution to optimize the drive performance for a given application. Read/write values may also be monitored by means of the keypad and displays or via the serial interface to verify drive status and performance.

10.4.1 Visible and Invisible Parameters

The parameter set with which Quantum III drives are equipped is divided into two further groups for operational convenience.

Those which are ordinarily needed for setting the drive up at the installation and start-up stage can be called up whenever the drive is powered on. These are called the “visible” parameters.

The second group contains the “invisible” parameters, so called because at Level 1 security they do not appear in the Index display, even if called up. These are the parameters required for fine tuning a drive to operate, for example, in a process system, usually in conjunction with one or more other drives of the same or different type.

Visible and invisible parameters are distinguished in the text and in the control logic diagrams for Menus 1 to 16. Visible parameter numbers are in plain typeface, e.g. 01.01, and invisible parameters in italics, e.g. 01.01. They are also classified in paragraph 10.6.2.

Visible Parameters

Visible parameters, both RO and R/W, are always available to read when the drive is powered on. Visible R/W parameters are normally protected by one or more levels of security and cannot be changed until the correct codes have been entered. This is Level 1 security, unless and until a higher level code is set.

Invisible Parameters

Invisible parameters always require Level 2 security code, and will require Level 3 (if set). With the correct code(s), invisible RO parameters are accessible to read, and invisible R/W parameters are accessible to write.

10.4.2 Default Values

When power is removed and then reapplied to the drive, the parameters will revert to standard power-on default values—altered by any parameter changes that have been stored. See paragraph 10.4.7. The Quantum III defaults are listed in paragraph 10.6.2.

The parameters have been set to standard settings during manufacture of the basic world-wide drive. These values differ slightly from the power-on defaults listed in paragraph 10.6.2. It may be desirable to reset the Quantum III to these values. To re-establish factory defaults, select parameter 00 of any menu, press mode, and enter 255 for factory non-regenerative defaults or 233 for factory regenerative defaults, followed by reset.

NOTE

Drive must be in STOP condition before re-establishing defaults.

QUANTUM III FACTORY SETTINGS

After factory defaults are reset, the following must be changed to enable the drive to function as a Quantum III.

Changes to Default Values:

02.13=1 (Jog Ramp)
03.13=1 (AVF Feedback)
03.15=500 (Max Arm Volts)
05.06-667 (Overload Threshold
05.07=60 (Overload Heating)
05.08=150 (Overload Cooling)
05.19=1 (Standstill Mode on Stop)
06.07=1000 (Cross-over Voltage)
06.15=1 (Enable Field Economy)
06.21=815 (Field Firing Angle Endstop)
07.12=119 (Analog Input #2)
07.13=120 (Analog Input #3)
07.14=408
08.12=111 (F2: #22=Run Permit)
08.13=113 (F3: #23=Inch/Jog)
08.14=112 (F4: #24=Reverse)
08.15=115 (F5: #25=Ref #3)
08.16=1034 (F6: #26=Ext Trip)
08.21=1 (Disable Logic Functions)
09.24=1 (Invert Status #ST5)
10.33=1 Size 1 Models 9500-8X02 & 9500-8X03 only
11.01=304 Arm Volts DC
11.02=502 Arm Amps DC
11.03=303 Machine RPM
11.04=102 Speed Reference
11.05=706 AC Line Voltage
11.06=106 Max Reference Limit
11.07=105 Jog Speed
11.08=204 Accel Time
11.09=205 Decel Time
11.10=405 Current Limit

Then save, using procedure discussed in 8.3.3.

10.4.3 Organization

Parameters are organized into functionally-related sets, or menus, so that access to parameters related to a specific function is logical and quick. The menus are listed in paragraph 10.6.1.

10.4.4 Adjustment

Any menu and any visible parameter can be selected and will display its value to read without need for a Security Code. The procedure is the same if a parameter value is to be changed, except that entering a Security Code will normally have to be the first action.

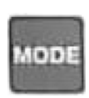
Any menu, and any invisible parameter can be selected and its value displayed to read and write when the correct security code has been entered.

Whenever the user returns to a menu (between power-on and power-off), the software immediately goes to the last parameter to have been selected in that menu. This is convenient when making a series of adjustments to a particular group of parameters.

10.4.5 Putting in Parameter Settings

Apply AC power to the drive. The drive display should be lit and indicate 0 in the data display and 0.00 in the parameter index. There should be no fault codes or messages. (If there is a fault code, consult Fault Finding-Fault Codes in Section 13.4. Many of the parameter menus are “locked out” at this point. You must unlock security to gain access to necessary parameter areas.

Unlocking Security. While the the parameter index is displaying 0.00 depress the M or Mode key. The data display should begin flashing. Depress and hold the UP/DOWN arrows to place a 200 into the data display. Depress the M key once again to stop changing memory location 0.00.



Then depress

Until **#0.00 = 200**
Then depress


You may enter data for your application into the various drive parameter locations. (Note that all these values are whole numbers without decimal points.)

Storing Settings. After you have entered in all required data, perform a **STORE**.

Set parameter **#0.00 = 1**
Then depress

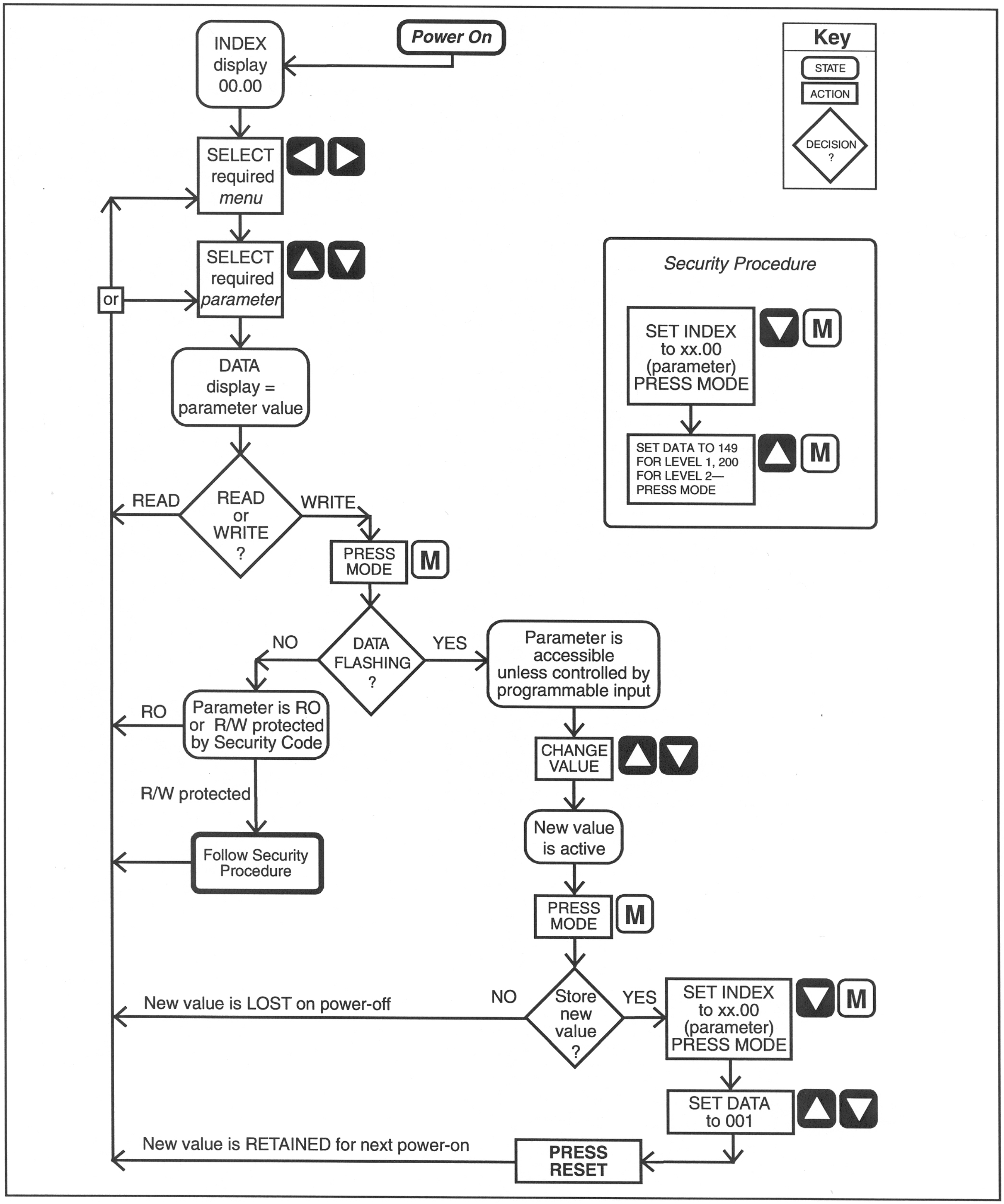



Figure 10-2.
Adjustment of Parameters and Level 1 Security

PROCEDURES FOR SELECTING AND CHANGING PARAMETERS		
OPERATION	**KEYS**	**DISPLAY WINDOW**
Select menu	◀ or ▶	Index, left of decimal point
Select parameter	▲ or ▼	Index, right of decimal point
Read only	—	Data
Read/Write Change value *only if display is flashing —refer to 10.5*	MODE, then ▲ or ▼	Data
Enter new value	MODE	Data

10.4.6 Access to Parameters

Initially, when the drive is first powered on, and if Level 3 security is not set, access to write is immediately available to a small group of the visible parameters. Refer to paragraph 10.5.1 and Figure 10-3.

If Level 3 security is set, all parameters are always protected.

10.4.7 Procedure

The procedure for selecting and changing a parameter is shown in Figure 10-2 and described on the following pages. It is also described on the keypad of the Quantum III.

For most parameters, the drive accepts and uses the value entered, and the motor will respond to the new value immediately. The exception is a change of Baud Rate (11.12), Serial Mode (11.13), Threshold 1 Destination (12.07) and Threshold 2 Destination (12.12) and all inputs. To enable the drive to act on the change in these cases, press RESET after writing the new value.

Any new value is not saved however, and will be lost at power-off.

The keypad is ready to select another menu or parameter.

10.4.8 SAVING VALUES

The following procedure saves the values of all parameters changed since the previous save. It will function in any of the 16 menus.

To Save the Value(s) Written

PROCEDURES FOR SAVING WRITTEN VALUES		
OPERATION	**KEYS**	**DISPLAY WINDOW**
Select parameter xx.00 of any menu	▼	Index, right of decimal point
Change value to 001	MODE, then ▲ or ▼ then MODE	Data Value = 001
Store	Reset	

Value(s) saved

- If the parameter data flashes, the user can change the value UNLESS the parameter has already been configured to be controlled by a programmable input.
- If the data does not flash, either the parameter is RO or, if R/W, it is protected by security. The procedure for gaining access to parameters protected by Level 1 security is given below.

  If the Level 1 security code does not afford access when applied, the parameter is protected by Level 3 security.

  Visible parameters are always accessible to the user to read only. Unless the Level 1 security code is entered, most R/W parameters are not accessible to write.

  A group of 24 parameters in Menus 1 to 6 plus parameters 11.01 to 11.10, are immediately accessible to write. These are listed in paragraph 10.5.1.

NOTE
These are not accessible if Level 3 security is set. See paragraph 10.5.5.

10.5 SECURITY

After selecting a parameter number and pressing MODE:

SECURITY PROCEDURES

10.5.1 Power On

A. The following visible parameters are immediately accessible, NOT protected by Level 1 or Level 2 security.

01.05	Inch reference
01.06	Maximum speed forward
01.09	Maximum speed reverse
01.11	Reference 'ON'
01.12	REVERSE selector
01.13	INCH selector
02.04	Forward acceleration 1
02.05	Forward deceleration 1
02.06	Reverse deceleration 1
02.07	Reverse acceleration 1
03.09	Speed loop P gain (proportional)
03.10	Speed loop I gain (integral)
03.11	Speed loop D gain (differential)
03.14	Feedback encoder scaling
03.15	Maximum armature voltage
03.16	Maximum speed (scaling rpm)
03.17	IR compensation
04.05	I limit Bridge 1
04.06	I limit Bridge 2
05.05	Maximum current (scaled)
06.06	IR compensation 2
06.07	Back-emf set point
06.08	Maximum field current 1
06.10	Minimum field current

and 11.01 to 11.10 — User Menu 00

B. Of the rest of the parameters —

- RO - (read only) parameters are accessible to be read.
- R/W - (read/write) parameters are read-only until a Level 1 security code is entered.

10.5.2 Level 1 Security to Access the Visible R/W Parameters (Figure 10-2)

- Select any menu
- ▲ or ▼ to set index to zero (xx.00)
- Press **mode** [M]
- ▲ or ▼ to write 149 in data (Level 1 security code) - PARTIAL ACCESS
- Press **mode** [M]

Visible R/W parameters are now accessible to write new values.

10.5.3 Level 2 Security to Access the Invisible R/W Parameters (Figure 10-2)

- Select any menu
- ▲ or ▼ to set index to zero (xx.00)
- Press **mode** [M]
- ▲ or ▼ to write 200 in data (Level 2 security code) - FULL ACCESS
- Press **mode** [M]

All R/W parameters are now accessible to write new values.

RO parameters can be read.

NOTE

Level 1 and Level 2 security entry is lost when power is removed from the drive. It must be reset after each power-up.

10.5.4 To Enable Free Access to ALL Parameters

A. To remove security—

- Power on
- ▲ or ▼ to set index to xx.00
- Press **mode** [M]
- ▲ or ▼ to write 200 in data (Level 2 security code)
- Press **mode** [M]
- ◀ or ▶ plus ▲ or ▼ to set index to 11.17
- Press **mode** [M]
- ▼ to write 0

If the parameters are now saved (paragraph 10.4.7), there is no protection for ANY parameter. Security has been disabled.

NOTE

All parameters are accessible even after power is removed and reapplied.

B. To reinstate security—

Repeat the procedure in paragraph 10.5.4 but make parameter 11.17=149, and save (paragraph 10.4.7).

10.5.5 Level 3 Security

An additional private security code, Level 3, is available to the user. The code is user-programmable from 1 to 255 **except** 149 (the Level 1 code). If applied, the effect prevents access to **all** parameters until the Level 3 code has been entered prior to entering the Level 1 or Level 2 code.

A. To assign a Level 3 security code number—

- Power up
- ▲ or ▼ to set index to xx.00
- Press **mode** [M]
- ▲ or ▼ to write 200 in data (Level 2 security code)
- Press **mode** [M]
- ◀ or ▶ plus ▲ or ▼ to set index to 11.17. Data display shows 149.
- Press **mode** [M]
- ▲ or ▼ to write any 3-digit number from 1 to 255 in data (excluding 149—the Level 1 security code)
- Press **mode** [M]
- Save (paragraph 10.4.7)

There is now no access to any parameter, not even to read only, until the assigned Level 3 code has been entered.

B. Level 3 Security Access—

- ◀ or ▶ plus ▲ or ▼ to set index to xx.00
- Press **mode** [M]
- ▲ or ▼ to write the assigned code number in data (Level 3 security code)
- Press **mode** [M]

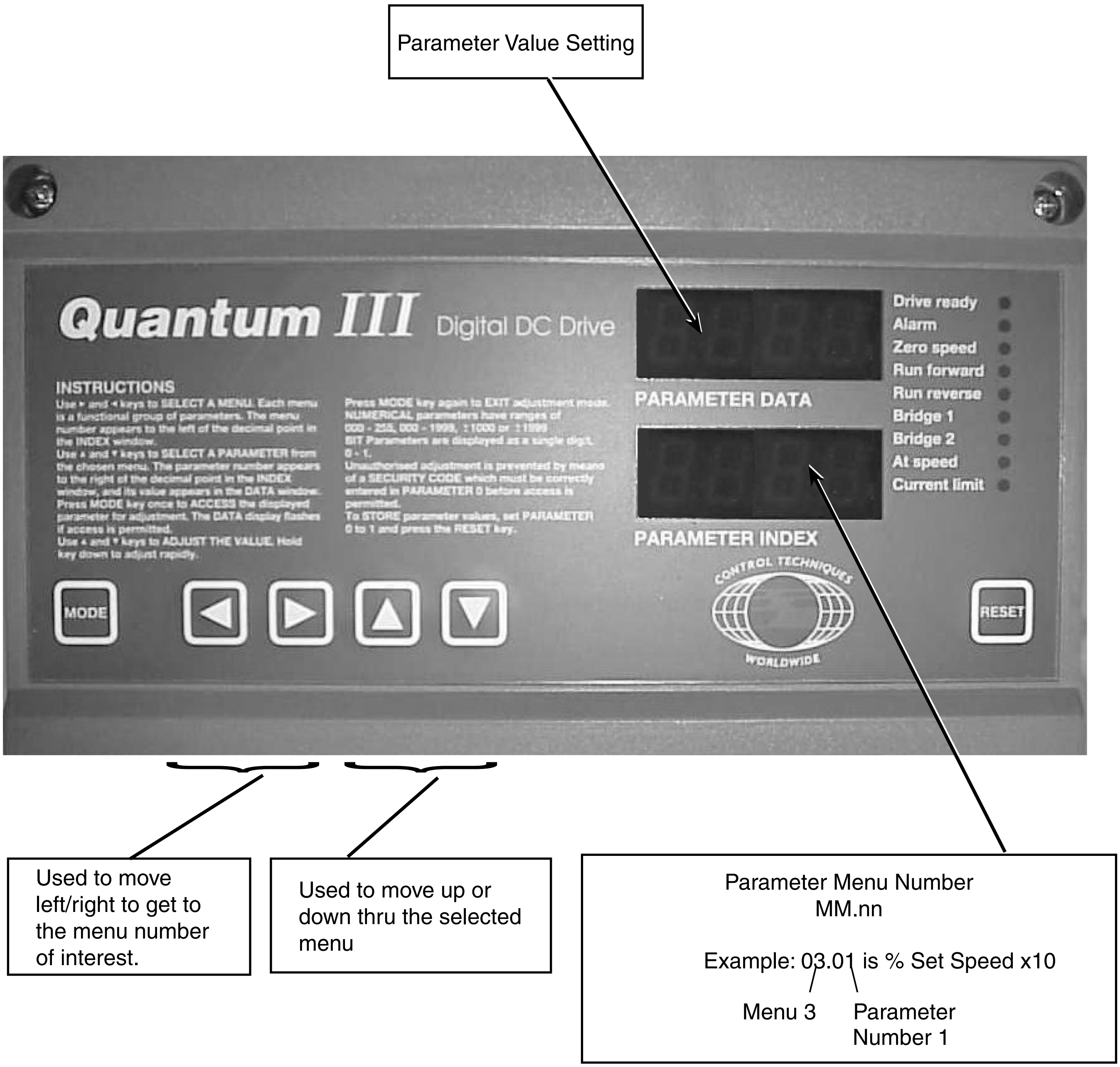
The user now has access through Level 1 and 2 Security, one of which has to be entered next.

CAUTION

When Level 3 security is set, you must maintain access to your 3-digit assigned code number. If you forget or lose this number, the factory must be consulted for a means of retrieving the number.

See Appendix F for more details on Security.

8.5.6 Basic Keypad/Display Operations



8.5.7 Changing a Parameter Value

Step 1

Move left/right to get to the menu number of interest.

Step 2

Move up or down thru a particular menu until that parameter number is indicated in the INDEX

Step 3

Depress the Mode key to allow you to MODIFY or change the selected parameter value shown in the DATA display - the current VALUE should flash*

* If DATA display does not flash either the parameter you are trying to change is secured by a security password or is for display only. See 10.3 Drive Parameters.

Step 4

Use the arrow keys to increase or decrease to the desired value.
<u>**Note**</u>: In general, adjustments take effect immediately.

Step 5

If done changing that parameter, depress the MODE key to leave the MODIFY mode. The DATA display should now stop flashing.

10.6 MENU INDEX

The menu index lists the 16 different menus available and a description of the function of the parameters associated with each menu. For detailed description of parameters, refer to paragraph 10.7.

10.6.1 Menus List

MENU	DESCRIPTION
00	User Menu—to give fast access to the most-used parameters
01	Speed Reference—selection of source and limits
02	Acceleration and Deceleration Ramps
03	Speed Feedback Selection and Speed Loop
04	Current — selection and limits
05	Current Loop
06	Field Control
07	Analog Inputs and Outputs
08	Logic Inputs
09	Status Outputs
10	Status Logic & Fault Information
11	Miscellaneous
12	Programmable Thresholds
13	Digital Lock
14	MD21 System Set-up
15	Applications Menu 1
16	Applications Menu 2

10.6.2 Parameters—Names, Range & Default Values

References in brackets (xx.xx) in the Default column indicate parameters which default to other parameters.

Parameters shown in **bold type** are those which are freely accessible only immediately after power-on.

NOTE

Parameters shown with an asterisk (*) and highlighted in gray must be reset to the default shown if **factory defaults** are enacted. Refer to paragraph 10.4.2.

Parameters at the end of each menu list in italic type are invisible. Refer to paragraphs 10.4 and 10.5.

MENU 00 USER LIBRARY — REFER TO MENU 11

Contains ten parameters (00.01 to 00.10). The user sets parameters 11.01 to 11.10 to any parameter numbers most often required or used. These can then be accessed directly through the corresponding numbers 00.01 to 00.10, avoiding the need to call up different menus. The parameters in this menu are accessible and are not protected by Level 1 or Level 2 security.

QUANTUM III SETTINGS

ACCESSED AT	PARAMETER DESCRIPTION	PARAMETER NUMBER
0.01	Armature Voltage	3.04
0.02	Armature Current	5.02
0.03	Motor RPM	3.03
0.04	Speed Reference	1.02
0.05	AC Line Voltage	7.06
0.06	Max Speed	1.06
0.07	Jog Speed	1.05
0.08	Forward Acceleration	2.04
0.09	Forward Deceleration	2.05
0.10	Current Limit	4.05

Menu 01 Speed Reference — Selection of source and limits

Number	Description	Range	Type	Default	Security	Comment
01.01	Pre-offset speed reference	±1000	RO		None	
01.02	Post-offset speed reference	±1000	RO		None	
01.03	Pre-ramp reference	±1000	RO		None	
01.04	Offset	±1000	R/W	+ 000	Level 1	
01.05	Inch reference	±1000	R/W	+ 050	None	
01.06	Maximum reference forward	0 to +1000	R/W	+1000	None	
01.07	Minimum reference forward	0 to +1000	R/W	+000	Level 1	
01.08	Minimum reference reverse	-1000 to 0	R/W	+000	Level 1	
01.09	Maximum reference reverse	(4Q)-1000 to 0	R/W	-1000	None	
		(1Q)-1000 to 0	R/W	000	None	
01.10	Bipolar reference selector	(4Q) 0 or 1	R/W	1	Level 1	
		(1Q)0 or 1	R/W	0	Level 1	
01.11	Reference 'ON'	0 or 1	R/W	0	None	
01.12	REVERSE selector	0 or 1	R/W	0	None	
01.13	INCH selector	0 or 1	R/W	0	None	
01.14	*Reference select 1*	0 or 1	R/W	0	Level 2	
01.15	*Reference select 2*	0 or 1	R/W	0	Level 2	
01.16	*Zero reference interlock*	0 or 1	R/W	0	Level 2	
01.17	*Reference 1*	±1000	R/W	(07.15)	Level 2	TB1-03
01.18	*Reference 2*	±1000	R/W	+300	Level 2	
01.19	*Reference 3*	±1000	R/W	(07.13)	Level 2	TB1-06
01.20	*Reference 4*	±1000	R/W	(07.14)	Level 2	TB1-07

MENU 02 ACCELERATION AND DECELERATION RAMPS

Number	Description	Range	Type	Default	Security	Comment
02.01	Post-ramp reference	±1000	RO		None	
02.02	Ramp enable	0 or 1	R/W	1	Level 1	
02.03	Ramp hold	0 or 1	R/W	0	Level 1	
02.04	Forward acceleration 1	0 to 1999	R/W	+ 050	None	Accel
02.05	Forward deceleration 1	0 to 1999	R/W	+ 050	None	Decel
02.06	Reverse deceleration 1	(4Q)0 to 1999	R/W	+ 050	None	
		(1Q)0 to 1999	R/W	000	None	
02.07	Reverse acceleration 1	(4Q)0 to 1999	R/W	+ 050	None	
		(1Q)0 to 1999	R/W	000	None	
02.08	*Forward acceleration 2*	0 to 1999	R/W	+100	Level 2	
02.09	*Forward deceleration 2*	0 to 1999	R/W	+100	Level 2	
02.10	*Reverse deceleration 2*	(4Q)0 to 1999	R/W	+100	Level 2	
		(1Q)0 to 1999	R/W	000	Level 2	
02.11	*Reverse acceleration 2*	(4Q)0 to 1999	R/W	+100	Level 2	
		(1Q)0 to 1999	R/W	000	Level 2	
02.12	*Inch ramp rate*	0 to 1999	R/W	+100	Level 2	Jog Acc/Dec
* *02.13*	*Enable inch ramp*	0 or 1	R/W	1	Level 2	
02.14	*Forward acceleration selector*	0 or 1	R/W	0	Level 2	
02.15	*Forward deceleration selector*	0 or 1	R/W	0	Level 2	
02.16	*Reverse deceleration selector*	0 or 1	R/W	0	Level 2	
02.17	*Reverse acceleration selector*	0 or 1	R/W	0	Level 2	
02.18	*Common ramp selector*	0 or 1	R/W	0	Level 2	
02.19	*Ramp Rate x 10*	0 or 1	R/W	0	Level 2	0 = Tenths 1 = Seconds

** Refer to paragraph 10.4.2.*

MENU 03 SPEED FEEDBACK SELECTION AND SPEED LOOP

	Number	Description	Range	Type	Default	Security	Comment
	03.01	Final speed demand	±1000	RO		None	
	03.02	Speed feedback	±1000	RO		None	
	03.03	Speed readout	±1999	RO		None	Scaled by 3.16
	03.04	Armature voltage Readout	±1000	RO		None	Volts
	03.05	IR compensation output	±1000	RO		None	
	03.06	Speed error	±1000	RO		None	
	03.07	Speed loop output	±1000	RO		None	
	03.08	Speed error integral	±1000	RO		None	
	03.09	Speed loop P gain	0 to 255	R/W	080	None	
	03.10	Speed loop I gain	0 to 255	R/W	040	None	
	03.11	Speed loop D gain	0 to 255	R/W	0	None	
	03.12	Digital feedback selector	0 or 1	R/W	0	Level 1	
*	03.13	AV analog feedback selector	0 or 1	R/W	1	Level 1	
	03.14	Feedback encoder scaling	0 to 1999	R/W	+ 419	None	
*	**03.15**	Maximum armature voltage	0 to 1000	R/W	+ 500	None	
	03.16	Speed readout scaler	0 to 1999	R/W	+1750	None	
	03.17	IR compensation	0 to 255	R/W	000	None	
	03.18	*Hard speed reference*	±1000	R/W	(07.11)	Level 2	
	03.19	*Hard speed reference selector*	0 or 1	R/W	0	Level 2	
	03.20	*IR droop selector*	0 or 1	R/W	0	Level 2	
	03.21	*Ramp output selector*	0 or 1	R/W	1	Level 2	
	03.22	*Speed offset fine*	0 to 255	R/W	128	Level 2	
	03.23	*Zero speed threshold*	0 to 255	R/W	16	Level 2	
	03.24	*D-term source*	1 to 3	R/W	1	Level 2	
	03.25	*Speed error filter*	0 to 255	R/W	128	Level 2	
	03.26	*Tachometer input*	±1000	RO		None	
	03.27	*RESERVED*	±1000	RO	0	None	
	03.28	*Speed Loop Prop Gain Multiplier*	0 or 1	R/W	0	None	1 = #3.09 x 4
	03.29	*Reduce PI Gains by 8*	0 or 1	R/W	0	None	

* Refer to paragraph 10.4.2.

MENU 04 CURRENT — SELECTION AND LIMITS

Number	Description	Range	Type	Default	Security	Comment
04.01	Current demand	±1000	RO		None	
04.02	Final current demand	±1000	RO		None	
04.03	Over-riding current limit	±1000	RO		None	
04.04	I limit #1 (also taper start point)	0 to 1000	R/W	+1000	Level 1	
04.05	I limit #1 Bridge 1	0 to 1000	R/W	+1000	None	
04.06	I limit Bridge 2	0 to 1000	R/W	+1000	None	
04.07	*I limit #2*	0 to 1000	R/W	+1000	Level 2	
04.08	*Torque reference*	±1000	R/W	+000	Level 2	
04.09	*Current offset*	±1000	R/W	+000	Level 2	
04.10	*I limit 2 selector*	0 or 1	R/W	0	Level 2	
04.11	*Current offset selector*	0 or 1	R/W	0	Level 2	
04.12	*Mode bit 0*	0 or 1	R/W	0	Level 2	
04.13	*Mode bit 1*	0 or 1	R/W	0	Level 2	
04.14	*Quadrant 1 enable*	0 or 1	R/W	1	Level 2	
04.15	*Quadrant 2 enable* Regen (4Q)	0 or 1	R/W	1	Level 2	
	Non Regen (1Q)	0 or 1	R/W	0	Level 2	
04.16	*Quadrant 3 enable* Regen (4Q)	0 or 1	R/W	1	Level 2	
	Non Regen (1Q)	0 or 1	R/W	0	Level 2	
04.17	*Quadrant 4 enable* Regen (4Q)	0 or 1	R/W	1	Level 2	
	Non Regen (1Q)	0 or 1	R/W	0	Level 2	
04.18	Enable Auto-I-limit-change	0 or 1	R/W	0	Level 2	
04.19	Current limit timer	0 to 255	R/W	000	Level 2	
04.20	Current taper 1 threshold	0 to 1000	R/W	+1000	Level 2	
04.21	Current taper 2 threshold	0 to 1000	R/W	+1000	Level 2	
04.22	Current taper 1 slope	0 to 255	R/W	000	Level 2	
04.23	Current taper 2 slope	0 to 255	R/W	000	Level 2	
04.24	Taper 1 threshold exceeded	0 or 1	RO		None	
04.25	Taper 2 threshold exceeded	0 or 1	RO		None	

MENU 05 CURRENT LOOP

Number	Description	Range	Type	Default	Security	Comment
05.01	Current feedback	±1000	RO		None	See 8.7
05.02	Current feedback (amps)	±1999	RO		None	
05.03	Firing angle	277 to 1023	RO		None	
05.04	Slew rate limit	0 to 255	R/W	040	Level 1	
05.05	Current readout scaler	0 to 1999	R/W	(rating)	None	See 8.7
05.06	Overload threshold	0 to 1000	R/W	+ 667	Level 1	See 8.7
05.07	Overload time (heating)	0 to 255	R/W	060	Level 1	
05.08	Overload time (cooling)	0 to 255	R/W	150	Level 1	
05.09	Enable start-up auto-tune	0 or 1	R/W	0	Level 1	
05.10	*Reduced endstop*	0 or 1	R/W	0	Level 2	
05.11	*Overload integrator*	0 to 1999	RO		None	
† *05.12*	*Discontinuous I gain*	0 to 255	R/W	16	Level 2	
† *05.13*	*Continuous P gain*	0 to 255	R/W	16	Level 2	
† *05.14*	*Continuous I gain*	0 to 255	R/W	16	Level 2	
† *05.15*	*Motor constant*	0 to 255	R/W	25	Level 2	
05.16	*Reserved*	0 to 255	R/W	0	Level 2	
05.17	*Inhibit firing*	0 or 1	R/W	0	Level 2	
05.18	*Standstill enable*	0 or 1	R/W	1	Level 2	
* *05.19*	*Standstill mode*	0 or 1	R/W	1	Level 2	
05.20	*Direct firing-angle control*	0 or 1	R/W	0	Level 2	
05.21	*Bridge lockout enable (4q12p)*	0 or 1	R/W	0	Level 2	
05.22	*Disable adaptive control*	0 or 1	R/W	0	Level 2	
05.23	*Enable (1q 12p)*	0 or 1	R/W	0	Level 2	
05.24	*Series 12P operation*	0 or 1	R/W	0	Level 2	
05.25	*Parallel 12P operation*	0 or 1	R/W	0	Level 2	
05.26	*Extra-safe bridge lockout*	0 or 1	R/W	0	Level 2	
05.27	*Continuous autotune*	0 or 1	R/W	0	Level 1	
05.28	*Reduce hysteresis on bridge changeover*	0 or 1	R/W	0	Level 1	
05.29	Burden resistor change bit	0 or 1	R/W	0	Level 1	

* Refer to paragraph 10.4.2.

† Adjusted during auto tune.

MENU 06 FIELD CONTROL

	Number	Description	Range	Type	Default	Security	Comment
	06.01	Back-emf	0 to 1000	RO		None	
	06.02	Field-current demand	0 to 1000	RO		None	
	06.03	Field-current feedback	0 to 1000	RO		None	
	06.04	Firing angle	261 to 1000	RO		None	
	06.05	IR compensation 2 output	±1000	RO		None	
	06.06	IR compensation 2	0 to 255	R/W	000	None	
*	**06.07**	Back emf set point	0 to 1000	R/W	+1000	None	
	06.08	Maximum field current	0 to 1000	R/W	+1000	None	Full Field
	06.09	Maximum field current1	0 to 1000	R/W	+500	None	Field economy
	06.10	Minimum field current	0 to 1000	R/W	+500	None	w/ field weakening
	06.11	Field feedback scaling1	0 to 255	R/W	204	Level 1	
	06.12	Field economy time-out	0 to 255	R/W	030	Level 1	
	06.13	Enable field control	0 or 1	R/W	0	Level 1	Enables field
	06.14	Maximum field 2 selector	0 or 1	R/W	0	Level 1	
*	06.15	Enable field economy time-out	0 or 1	R/W	1	Level 1	
	06.16	Field current loop gain selector	0 or 1	R/W	1	Level 1	
	06.17	Voltage loop integral gain	0 or 1	R/W	0	Level 1	
	06.18	*Enable speed gain adjustment*	0 or 1	R/W	0	Level 2	
	06.19	*Direct firing angle control*	0 or 1	R/W	0	Level 2	
	06.20	*Select alternative IR Comp. 1*	0 or 1	R/W	0	Level 2	
*	*06.21*	*Firing angle front endstop*	0 to 1000	R/W	+815	Level 2	
	06.22	*Full or half control*	0 or 1	R/W	0	Level 2	
		(FXM5 field control only)					
	06.23	*Reduce gain by 2*	0 or 1	R/W	0	Level 1	
	06.24	Reduce gain by 4	0 or 1	R/W	0	Level 1	

* Refer to paragraph 10.4.2.

1 Range values dependent on MDA-3 revision number

NOTE

This menu is for size 1 Quantums 9500-8X02 thru 9500-8X06 or for Quantums that use the FXM5 Field Controller with ribbon control cable.

MENU 07 ANALOG INPUTS AND OUTPUTS

Number	Description	Range	Type	Default	Security	Comment
07.01	General-purpose input 1	±1000	RO		None	TB1-04
07.02	General-purpose input 2	±1000	RO		None	TB1-05
07.03	General-purpose input 3	±1000	RO		None	TB1-06
07.04	General-purpose input 4	±1000	RO		None	TB1-07
07.05	Speed reference input	±1000	RO		None	TB1-03
07.06	RMS input voltage	0 to 1000	RO		None	AC line (VAC)
07.07	Heatsink temperature	0 to 100	RO		None	0 to 100C
07.08	DAC 1 source	0 to 1999	R/W	+ 201	Level 1	Ramped ref.
07.09	DAC 2 source	0 to 1999	R/W	+ 302	Level 1	Spd F/B
07.10	DAC 3 source	0 to 1999	R/W	+ 304	Level 1	Arm V
07.11	*GP1 destination*	0 to 1999	R/W	+318	Level 2	Hard ref.
* *07.12*	*GP2 destination*	0 to 1999	R/W	+408	Level 2	Torq ref.
* *07.13*	*GP3 destination*	0 to 1999	R/W	119	Level 2	Ref. 3
07.14	*GP4 destination*	0 to 1999	R/W	+120	Level 2	Ref. 4
07.15	*Speed destination*	0 to 1999	R/W	+117	Level 2	Ref. 1
07.16	*GP1 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.17	*GP2 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.18	*GP3 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.19	*GP4 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.20	*Speed reference scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.21	*DAC1 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.22	*DAC2 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.23	*DAC3 scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
07.24	*Reference-encoder scaling*	0 to 1999	R/W	+419	Level 2	
07.25	*Encoder reference selector*	0 or 1	R/W	0	Level 2	
07.26	*Current input selector*	0 or 1	R/W	0	Level 2	
07.27	*Current sense inverter*	0 or 1	R/W	0	Level 2	
07.28	*4mA offset selector*	0 or 1	R/W	1	Level 2	
07.29	*Invert sign GP3, GP4*	0 or 1	R/W	0	Level 1	

* Refer to paragraph 10.4.2.

MENU 08 PROGRAMMABLE LOGIC INPUTS

Number	Description	Range	Type	Default	Security	Comment
08.01	F1 input — run permit	0 or 1	RO		None	In use by Quantum
08.02	F2 input — inch reverse	0 or 1	RO		None	
08.03	F3 input — inch forward	0 or 1	RO		None	
08.04	F4 input — run reverse	0 or 1	RO		None	
08.05	F5 input — run forward	0 or 1	RO		None	
08.06	F6 input	0 or 1	RO		None	Ext. trip
08.07	F7 input	0 or 1	RO		None	Free for Customer use
08.08	F8 input	0 or 1	RO		None	
08.09	F9 input	0 or 1	RO		None	
08.10	F10 input	0 or 1	RO		None	
08.11	Enable input	0 or 1	RO		None	In use
* *08.12*	*F2 destination*	0 to 1999	R/W	+111	Level 2	Run
* *08.13*	*F3 destination*	0 to 1999	R/W	+113	Level 2	Jog
* *08.14*	*F4 destination*	0 to 1999	R/W	+112	Level 2	Fwd/Rev
* *08.15*	*F5 destination*	0 to 1999	R/W	+115	Level 2	Spd 1/Spd 3
* *08.16*	*F6 destination*	0 to 1999	R/W	+1034	Level 2	Ext. trip
08.17	*F7 destination*	0 to 1999	R/W	+000	Level 2	Free for Customer use
08.18	*F8 destination*	0 to 1999	R/W	+000	Level 2	
08.19	*F9 destination*	0 to 1999	R/W	+000	Level 2	
08.20	*F10 destination*	0 to 1999	R/W	+000	Level 2	
* *08.21*	*Disable normal logic functions*	0 or 1	R/W	1	Level 2	In use
08.22	*Invert F2 input*	0 or 1	R/W	0	Level 2	
08.23	*Invert F3 input*	0 or 1	R/W	0	Level 2	
08.24	*Invert F4 input*	0 or 1	R/W	0	Level 2	
08.25	*Invert F5 input*	0 or 1	R/W	0	Level 2	
08.26	*Invert F6 input*	0 or 1	R/W	0	Level 2	
08.27	*Invert F7 input*	0 or 1	R/W	0	Level 2	
08.28	*Invert F8 input*	0 or 1	R/W	0	Level 2	
08.29	*Invert F9 input*	0 or 1	R/W	0	Level 2	
08.30	*Invert F10 input*	0 or 1	R/W	0	Level 2	
08.31	*Enable inch reverse*	0 or 1	R/W	0	Level 2	
08.32	*Enable inch forward*	0 or 1	R/W	0	Level 2	
08.33	*Enable run reverse*	0 or 1	R/W	0	Level 2	
08.34	*Enable run forward*	0 or 1	R/W	0	Level 2	

* Refer to paragraph 10.4.2.

MENU 09 STATUS OUTPUTS - OPEN COLLECTOR AND RELAY OUTPUT

Number	Description	Range	Type	Default	Security	Comment
09.01	Status 1 output	0 or 1	RO		None	
09.02	Status 2 output	0 or 1	RO		None	
09.03	Status 3 output	0 or 1	RO		None	
09.04	Status 4 output	0 or 1	RO		None	
09.05	Status 5 output	0 or 1	RO		None	
09.06	Status 6 output (relay)	0 or 1	RO		None	
09.07	*Status 1 source 1*	0 to 1999	R/W	+111	Level 2	
09.08	*Invert status 1 source 1*	0 or 1	R/W	0	Level 2	
09.09	*Status 1 source 2*	0 to 1999	R/W	000	Level 2	
09.10	*Invert status 1 source 2*	0 or 1	R/W	0	Level 2	
09.11	*Invert status 1 output*	0 or 1	R/W	0	Level 2	
09.12	*Status 1 delay*	0 to 255 sec	R/W	0	Level 2	
09.13	*Status 2 source 1*	0 to 1999	R/W	+1007	Level 2	At Speed
09.14	*Invert status 2 source 2*	0 or 1	R/W	0	Level 2	
09.15	*Status 2 source 2*	0 to 1999	R/W	000	Level 2	
09.16	*Invert status 2 source 2*	0 or 1	R/W	0	Level 2	
09.17	*Invert status 2 output*	0 or 1	R/W	0	Level 2	
09.18	*Status 2 delay*	0 or 255 sec	R/W	0	Level 2	
09.19	*Status 3 source*	0 to 1999	R/W	+1013	Level 2	In overload
09.20	*Invert status 3 output*	0 or 1	R/W	0	Level 2	
09.21	*Status 4 source*	0 to 1999	R/W	+1003	Level 2	In current limit
09.22	*Invert status 4 output*	0 or 1	R/W	0	Level 2	
09.23	*Status 5 source*	0 to 1999	R/W	+1006	Level 2	Phased back
* *09.24*	*Invert status 5 output*	0 or 1	R/W	1	Level 2	
09.25	*Status 6 source (relay)*	0 to 1999	R/W	+1009	Level 2	At zero speed
09.26	*Invert status 6 output*	0 or 1	R/W	0	Level 2	

* *Refer to paragraph 10.4.2.*

MENU 10 DRIVE STATUS, FAULT INFORMATION, FAULT MONITORS

Number	Description	Range	Type	Default	Security	Comment
10.01	Forward velocity	0 or 1	RO		None	
10.02	Reverse velocity	0 or 1	RO		None	
10.03	Current limit	0 or 1	RO		None	In current limit
10.04	Bridge 1 enabled	0 or 1	RO		None	
10.05	Bridge 2 enabled	0 or 1	RO		None	
10.06	Electrical phase-back	0 or 1	RO		None	
10.07	At speed	0 or 1	RO		None	
10.08	Overspeed	0 or 1	RO		None	
10.09	Zero speed	0 or 1	RO		None	At zero speed
10.10	Armature voltage clamp active	0 or 1	RO		None	
10.11	Phase rotation	0 or 1	RO		None	
10.12	Drive normal	0 or 1	RO		None	Drive OK
10.13	Alarm I x t	0 or 1	RO		None	In overload
10.14	Field loss	0 or 1	RO		None	
10.15	Feedback loss	0 or 1	RO		None	
10.16	Phase loss	0 or 1	RO		None	
10.17	Instantaneous trip	0 or 1	RO		None	
10.18	Sustained overload	0 or 1	RO		None	
10.19	Processor 1 watchdog	0 or 1	RO		None	
10.20	Processor 2 watchdog	0 or 1	RO		None	
10.21	Motor overtemperature	0 or 1	RO		None	
10.22	Heatsink overtemperature	0 or 1	RO		None	
10.23	Speed loop saturated	0 or 1	RO		None	
10.24	Zero current limit	0 or 1	RO		None	
10.25	Last trip	0 to 255	RO		None	Fault history (10.25–10.28)
10.26	The trip before last trip (10.25)	0 to 255	RO		None	
10.27	The trip before 10.26	0 to 255	RO		None	
10.28	The trip before 10.27	0 to 255	RO		None	
10.29	*Disable field loss*	0 or 1	R/W	0	Level 2	
10.30	*Disable feedback loss*	0 or 1	R/W	0	Level 2	
10.31	*Disable phase loss*	0 or 1	R/W	0	Level 2	
10.32	*Disable motor overtemperature trip*	0 or 1	R/W	1	Level 2	

MENU 10 DRIVE STATUS, FAULT INFORMATION, FAULT MONITORS (CONT.)

Number	Description	Range	Type	Default	Security	Comment
10.33	*Disable heatsink overtemperature trip*	0 or 1	R/W	0 1 (For 9500-8X02,8X03)	Level 2	
10.34	*External trip*	0 or 1	R/W	0	Level 2	
10.35	*Processor 2 trip*	0 to 255	R/W	0	Level 2	
10.36	*Disable current loop loss trip*	0 or 1	R/W	0	Level 2	
10.37	*Disable armature open circuit trip*	0 or 1	R/W	0	Level 2	

MENU 11 MISCELLANEOUS

Number	Description	Range	Type	Default	Security	Comment
* **11.01**	Parameter 00.01	0 to 1999	R/W	Param. 3.04	None	Arm voltage
* **11.02**	Parameter 00.02	0 to 1999	R/W	Param. 5.02	None	Arm amps
* **11.03**	Parameter 00.03	0 to 1999	R/W	Param. 3.03	None	Speed readout
* **11.04**	Parameter 00.04	0 to 1999	R/W	Param. 1.02	None	Speed reference
* **11.05**	Parameter 00.05	0 to 1999	R/W	Param. 7.06	None	AC line voltage
* **11.06**	Parameter 00.06	0 to 1999	R/W	Param. 1.06	None	Speed limit
* **11.07**	Parameter 00.07	0 to 1999	R/W	Param. 1.05	None	Jog speed
* **11.08**	Parameter 00.08	0 to 1999	R/W	Param. 2.04	None	Accel time
* **11.09**	Parameter 00.09	0 to 1999	R/W	Param. 2.05	None	Decel time
* **11.10**	Parameter 00.10	0 to 1999	R/W	Param. 4.05	None	Bridge 1 I-limit
11.11	Serial address	0 to 99	R/W	001	Level 1	
11.12	Baud rate	0 to 1	R/W	0	Level 1	
11.13	Serial Mode	1 to 3	R/W	001	Level 1	
11.15	Processor 1 version	0 to 255	RO		None	
11.16	Processor 2 version	0 to 255	RO		None	
11.17	*Security code 3*	0 to 255	R/W	149	Level 2	Default 149
11.18	*Boot -up parameter*	0 to 1999	R/W	+000	Level 2	
11.19	*Serial programmable source*	0 to 1999	R/W	+000	Level 2	
11.20	*Serial scaling*	0 to 1999	R/W	+1000	Level 2	x1.000
11.21	*LEDs byte*	0 to 255	R/W		Level 2	
11.22	*Disable normal LED functions*	0 or 1	R/W	0	Level 2	
11.23	*Permissive for MDA6, Rev. 3*	0 or 1	R/W	0	Level 2	
11.24	*Enable AC line dip ride through*	0 or 1	R/W	0		

** Refer to paragraph 10.4.2.*

MENU 12 PROGRAMMABLE THRESHOLDS

Number	Description	Range	Type	Default	Security	Comment
12.01	Threshold 1 exceeded	0 or 1	RO		None	
12.02	Threshold 2 exceeded	0 or 1	RO		None	
12.03	Threshold 1 source	0 to 1999	R/W	+ 302	Level 1	Speed feedback
12.04	Threshold 1 level	0 to 1000	R/W	+ 000	Level 1	
12.05	Threshold 1 hysteresis	0 to 255	R/W	002	Level 1	
12.06	Invert threshold 1 output	0 or 1	R/W	0	Level 1	
12.07	Threshold 1 destination	0 to 1999	R/W	+ 000	Level 1	
12.08	Threshold 2 source	0 to 1999	R/W	+ 501	Level 1	Arm current
12.09	Threshold 2 level	0 to 1000	R/W	+ 000	Level 1	
12.10	Threshold 2 hysteresis	0 to 255	R/W	002	Level 1	
12.11	Invert threshold 2 output	0 or 1	R/W	0	Level 1	
12.12	Threshold 2 destination	0 to 1999	R/W	+ 000	Level 1	

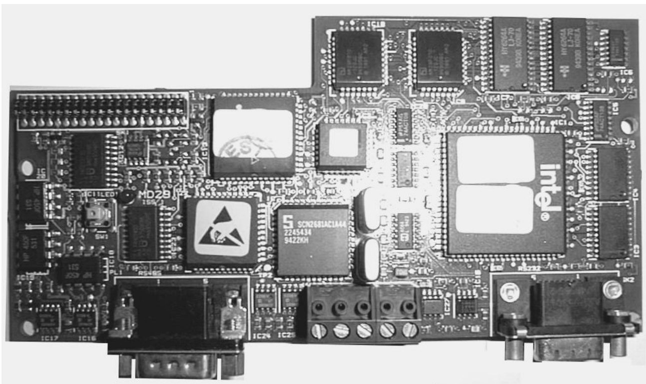
MENU 13 DIGITAL LOCK

Number	Description	Range	Type	Default	Security	Comment
13.01	Master counter value	0 to 1023	RO		None	
13.02	Slave counter value	0 to 1023	RO		None	
13.03	Master counter increment	±1000	RO		None	
13.04	Slave counter increment	±1000	RO		None	
13.05	Position error	0 to 255	RO		None	
13.06	Precision reference, lsb	0 to 255	R/W	000	Level 1	
13.07	Precision reference, msb	0 to 255	R/W	000	Level 1	
13.08	Position loop gain	0 to 255	R/W	025	Level 1	
13.09	Position loop correction limit	0 to 1000	R/W	+ 010	Level 1	
13.10	Enable digital lock	0 or 1	R/W	0	Level 1	
13.11	Rigid lock selector	0 or 1	R/W	1	Level 1	
13.12	Precision reference selector	0 or 1	R/W	0	Level 1	
13.13	Precision reference latch	0 to 1	R/W	1	Level 1	
13.14	Precision speed reference (16 bit) for serial comms	0 to 65535	R/W	0	Level 1	

MENU 14 OPTIONAL MD29 SET-UP PARAMETERS

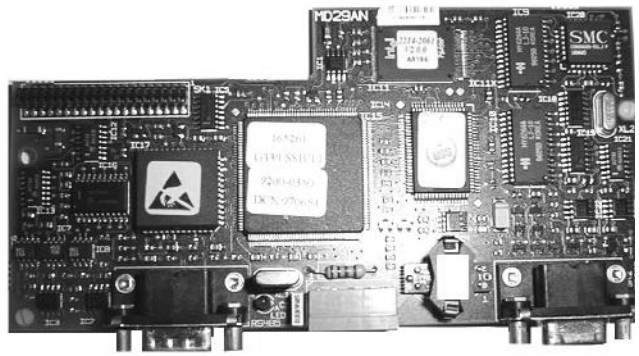
Listed below are a group of parameters governing the operation of the MD-29 and MD-29AN Co-Processors. Specific details about these parameters can be found in the MD29 Manual.

MD29



General Purpose RS-485 Port — CT-Remote Dedicated — RS-232 Port Programming

MD29AN (CT-Net Version)



General Purpose RS-485 Port — CTNet LAN — RS-232 Port Programming

Number	Description	Range	Type	Default	Security	Comment
14.01	ANSI Serial Address			1		
14.02	RS485 Mode			1		
14.03	RS485 Baud Rate			48		For modes 1, 5-9
14.04	Clock task time-base-mSec			0		
14.05	CTNet Node ID (MD29AN only)			0		
14.06	Auto-Run on Power-up Enable			1		
14.07	Global Run-time Trip Enable			1		
14.08	CT Remote I/O Trip Link Enable-RS-485			0		For CT Remote I/O Module
14.09	Enable Watchdog Trip			0		
14.10	Enable Trip on Parameter Write Overrange			1		Recommend Enable
14.11	Disable Toolkit Communications			0		For DPL Toolkit Comms
14.12	Internal Advanced Position Controller Enable			0		Not Menu 13
14.13	I/O Link Synchronization			0		For CT Remote I/O Module
14.14	Encoder Timebase Select			0		
14.16	Flash Memory Store Request			0		
14.17	Drive —> Drive Communications RS232			0		

Note: These parameters take effect only after an MD29 or Drive Reset or thru DPL code with the REINIT command.

For additional details on these parameters, consult the MD29 Manual (Part # 0400-0027) or within the help sections of the DPL toolkit.

MENU 15 OPTIONAL APPLICATIONS MENU 1

Number	Description	Range	Type	Default	Security	Comment
15.01	RO variable 1	±1999	RO		None	
15.02	RO variable 2	±1999	RO		None	
15.03	RO variable 3	±1999	RO		None	
15.04	RO variable 4	±1999	RO		None	
15.05	RO variable 5	±1999	RO		None	
15.06	Real R/W variable 1	±1999	R/W	+ 000	Level 1	
15.07	Real R/W variable 2	±1999	R/W	+ 000	Level 1	
15.08	Real R/W variable 3	±1999	R/W	+ 000	Level 1	
15.09	Real R/W variable 4	±1999	R/W	+ 000	Level 1	
15.10	Real R/W variable 5	±1999	R/W	+ 000	Level 1	
15.11	Integer R/W variable 1	0 to 255	R/W	000	Level 1	
15.12	Integer R/W variable 2	0 to 255	R/W	000	Level 1	
15.13	Integer R/W variable 3	0 to 255	R/W	000	Level 1	
15.14	Integer R/W variable 4	0 to 255	R/W	000	Level 1	
15.15	Integer R/W variable 5	0 to 255	R/W	000	Level 1	
15.16	Integer R/W variable 6	0 to 255	R/W	000	Level 1	
15.17	Integer R/W variable 7	0 to 255	R/W	000	Level 1	
15.18	Integer R/W variable 8	0 to 255	R/W	000	Level 1	
15.19	Integer R/W variable 9	0 to 255	R/W	000	Level 1	
15.20	Integer R/W variable 10	0 to 255	R/W	000	Level 1	
15.21	Bit variable 1	0 or 1	R/W	0	Level 1	
15.22	Bit variable 2	0 or 1	R/W	0	Level 1	
15.23	Bit variable 3	0 or 1	R/W	0	Level 1	
15.24	Bit variable 4	0 or 1	R/W	0	Level 1	
15.25	Bit variable 5	0 or 1	R/W	0	Level 1	
15.26	Bit variable 6	0 or 1	R/W	0	Level 1	
15.27	Bit variable 7	0 or 1	R/W	0	Level 1	
15.28	Bit variable 8	0 or 1	R/W	0	Level 1	
15.29	Bit variable 9	0 or 1	R/W	0	Level 1	
15.30	Bit variable 10	0 or 1	R/W	0	Level 1	
15.31	Bit variable 11	0 or 1	R/W	0	Level 1	
15.32	Bit variable 12	0 or 1	R/W	0	Level 1	
15.33	Bit variable 13	0 or 1	R/W	0	Level 1	
15.34	Bit variable 14	0 or 1	R/W	0	Level 1	

MENU 15 OPTIONAL APPLICATIONS MENU 1 (CONT.)

Number	Description	Range	Type	Default	Security	Comment
15.35	Bit variable 15	0 or 1	R/W	0	Level 1	
15.36	Bit variable 16	0 or 1	R/W	0	Level 1	
15.60	Ratio 1 wide integer = 15.16 & 15.17	0 to 255	R/W	000	Level 1	
15.61	Ratio 2 wide integer = 15.16 & 15.17	0 to 255	R/W	000	Level 1	
15.62	Serial mode 4 input data		RO		Level 1	
15.63	Serial mode 4 output data		RO		Level 1	

MENU 16 OPTIONAL APPLICATIONS MENU 2

Number	Description	Range	Type	Default	Security	Comment
16.01	RO variable 1	±1999	RO		None	
16.02	RO variable 2	±1999	RO		None	
16.03	RO variable 3	±1999	RO		None	
16.04	RO variable 4	±1999	RO		None	
16.05	RO variable 5	±1999	RO		None	
16.06	Real R/W variable 1	±1999	R/W	+ 000	Level 1	
16.07	Real R/W variable 2	±1999	R/W	+ 000	Level 1	
16.08	Real R/W variable 3	±1999	R/W	+ 000	Level 1	
16.09	Real R/W variable 4	±1999	R/W	+ 000	Level 1	
16.10	Real R/W variable 5	±1999	R/W	+ 000	Level 1	
16.11	Integer R/W variable 1	0 to 255	R/W	000	Level 1	
16.12	Integer R/W variable 2	0 to 255	R/W	000	Level 1	
16.13	Integer R/W variable 3	0 to 255	R/W	000	Level 1	
16.14	Integer R/W variable 4	0 to 255	R/W	000	Level 1	
16.15	Integer R/W variable 5	0 to 255	R/W	000	Level 1	
16.16	Integer R/W variable 6	0 to 255	R/W	000	Level 1	
16.17	Integer R/W variable 7	0 to 255	R/W	000	Level 1	
16.18	Integer R/W variable 8	0 to 255	R/W	000	Level 1	
16.19	Integer R/W variable 9	0 to 255	R/W	000	Level 1	
16.20	Integer R/W variable 10	0 to 255	R/W	000	Level 1	
16.21	Bit variable 1	0 or 1	R/W	0	Level 1	
16.22	Bit variable 2	0 or 1	R/W	0	Level 1	
16.23	Bit variable 3	0 or 1	R/W	0	Level 1	
16.24	Bit variable 4	0 or 1	R/W	0	Level 1	
16.25	Bit variable 5	0 or 1	R/W	0	Level 1	
16.26	Bit variable 6	0 or 1	R/W	0	Level 1	
16.27	Bit variable 7	0 or 1	R/W	0	Level 1	
16.28	Bit variable 8	0 or 1	R/W	0	Level 1	
16.29	Bit variable 9	0 or 1	R/W	0	Level 1	
16.30	Bit variable 10	0 or 1	R/W	0	Level 1	
16.31	Bit variable 11	0 or 1	R/W	0	Level 1	
16.32	Bit variable 12	0 or 1	R/W	0	Level 1	
16.33	Bit variable 13	0 or 1	R/W	0	Level 1	
16.34	Bit variable 14	0 or 1	R/W	0	Level 1	
16.35	Bit variable 15	0 or 1	R/W	0	Level 1	
16.36	Bit variable 16	0 or 1	R/W	0	Level 1	

10.7 DESCRIPTION OF PARAMETERS

Please refer to the parameter logic diagram, Figure 10-3, and the individual menu diagrams, Figures 10-4 through 10-18.

A drive, as supplied from the factory, has a standard setting for every parameter; this is its "default" value. The system of control is shown in its default condition in Figure 10-3 before any control or configuration changes have been applied.

In the default state and without altering any parameter, the drive operates a motor under speed and torque control. Minimum essential inputs are—

- a **speed reference** (demand) at terminal TB1-3;
- a **speed feedback**—refer to parameters 03.12 and 03.13 to select type;
- a "**drive enable**" signal at terminal TB4-31;
- a "**run permit**" signal at terminal TB3-21;
- a "**drive run**" signal at terminal TB3-25.

The final output of the logic is to define the firing angle, upon which depends the output voltage to the armature. External inputs (extreme left), parameter values, and selectors contribute to the final value of the firing angle parameter.

The most significant value in normal operation is the speed reference. The figure shows that the external speed demand finally controls the firing angle, but that it may be modified several times and in different ways by other factors.

The first selectable setting enables the speed reference input signal to be configured as a bipolar signal if required (#1.10). This is followed by a selector option which controls the dynamics of the speed reference signal, and enables the operator rapidly to communicate "run", "inch/jog", "forward", "reverse", and "stop" signals.

Control of reversal of direction should follow, and after that a selector which provides a "stop" signal by imposing a "zero speed" demand. Up to this stage there are also three read-only (RO) parameters, 01.01, 01.02, and 01.03, enabling the input signal state at each point to be displayed.

At this point in the control logic, the external speed demand is compared with the chosen "actual" speed parameter to produce the speed error parameter. The source of the actual speed feedback can be selected from one of two external sources, encoder or tachometer, or from the internally-computed armature voltage parameter 03.04.

The proportional, integral, and derivative (PID) gains are then applied, followed by the four current-limiting parameters. Note that the default values of the PID parameters are values which are likely to be good for average loads, but that the default current limits are set at maximum. The rate of change of the amplified speed error is finally limited if necessary by the slew rate parameter. By this stage, the speed demand has become a current demand, and is now summed algebraically with current feedback to generate the reference that controls the SCR bridge firing angle. From the ramp to the firing angle there are four interposed RO parameters for interrogation and to assist with precise modeling of the control system.

In addition, the most significant factors of drive condition are available from status bits (refer to Menu 10, paragraph 10.7.10).

The purpose and application of the different menus and of each individual parameter is explained in Paragraphs 10.7.0 through 10.7.16.

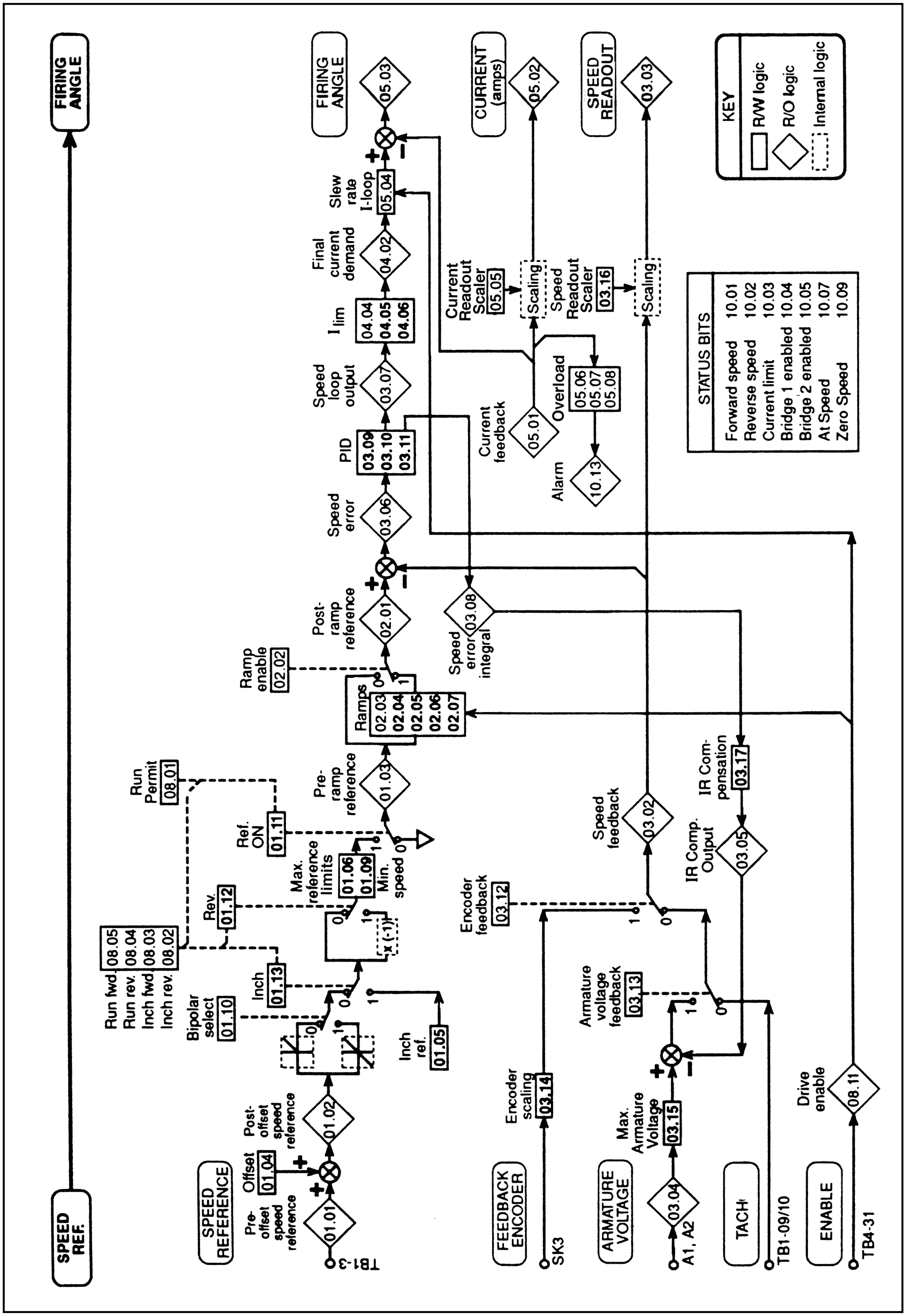


Figure 10-3.
Parameter Logic Overview

NOTE

In the following descriptions, parameters shown with an asterisk (*) must be reset to the default shown if **factory defaults** are enacted. They are not affected when power on defaults are selected. Refer to paragraph 10.4.2.

10.7.0 MENU 00—User Menu

This menu allows any 10 parameters from any menu to be combined in menu 00. They can be monitored, written to, and are not protected by security. These parameters are defined in menu 11.

The following parameters have been programmed to this menu at the factory. They may be changed at any time:

ACCESSED AT	PARAMETER DESCRIPTION	PARAMETER NUMBER
0.01	Armature Voltage	3.04
0.02	Armature Current	5.02
0.03	Motor RPM	3.03
0.04	Speed Reference	1.02
0.05	AC Line Voltage	7.06
0.06	Max Speed	1.06
0.07	Jog Speed	1.05
0.08	Forward Acceleration	2.04
0.09	Forward Deceleration	2.05
0.10	Current Limit	4.05

10.7.1 MENU 01—Speed Reference

There are four speed reference inputs—parameters 01.17, 01.18, 01.19, and 01.20. Each of the four can be set from +1000 forward to -1000 reverse with 1000 representing full speed. Parameter 01.17 is defaulted to TB1-3 through a 12-bit A/D. This is the normal analog speed reference input. The other three inputs can be set digitally through the keypad or serial communication, or they will accept analog inputs that are scaled and converted through 10-bit A/D converters. Refer to menu 8, analog inputs. Parameters 01.14 and 01.15 control the selection of the four references as the source speed reference. The selected reference can then be modified by adding offset (01.04), selecting bipolar operation (01.10), and setting minimum and maximum limits for both forward and reverse operation (01.06 through 01.09).

Reversing for regenerative drives is achieved by switching parameter 01.12. Inch or jog speed is activated by 01.13 and set by 01.05. The speed reference at source 01.01 is the input to the zero reference interlock 01.16, which (when selected, 01.16=1) inhibits the drive starting until the speed reference is close to zero. This, in effect, simulates a speed potentiometer with a zero speed interlock.

The availability of four selective speed references offers great flexibility when interfacing with other drives or process equipment.

See Figure 10-4 for details of menu 01.

01.01 RO Pre-offset speed reference
Range ±1000
Monitors the value of the speed reference continuously. Parameter 01.01 is also used to initiate the zero speed reference interlock, 01.16. This is the value applied at TB1-3--the speed reference input.

01.02 RO Post-offset speed reference
Range ±1000
Monitors the value of the speed reference after the offset, 01.04, has been added.

01.03 RO Pre-ramp reference
Range ±1000
The final speed reference before any ramp rates are applied (refer to Menu 02).

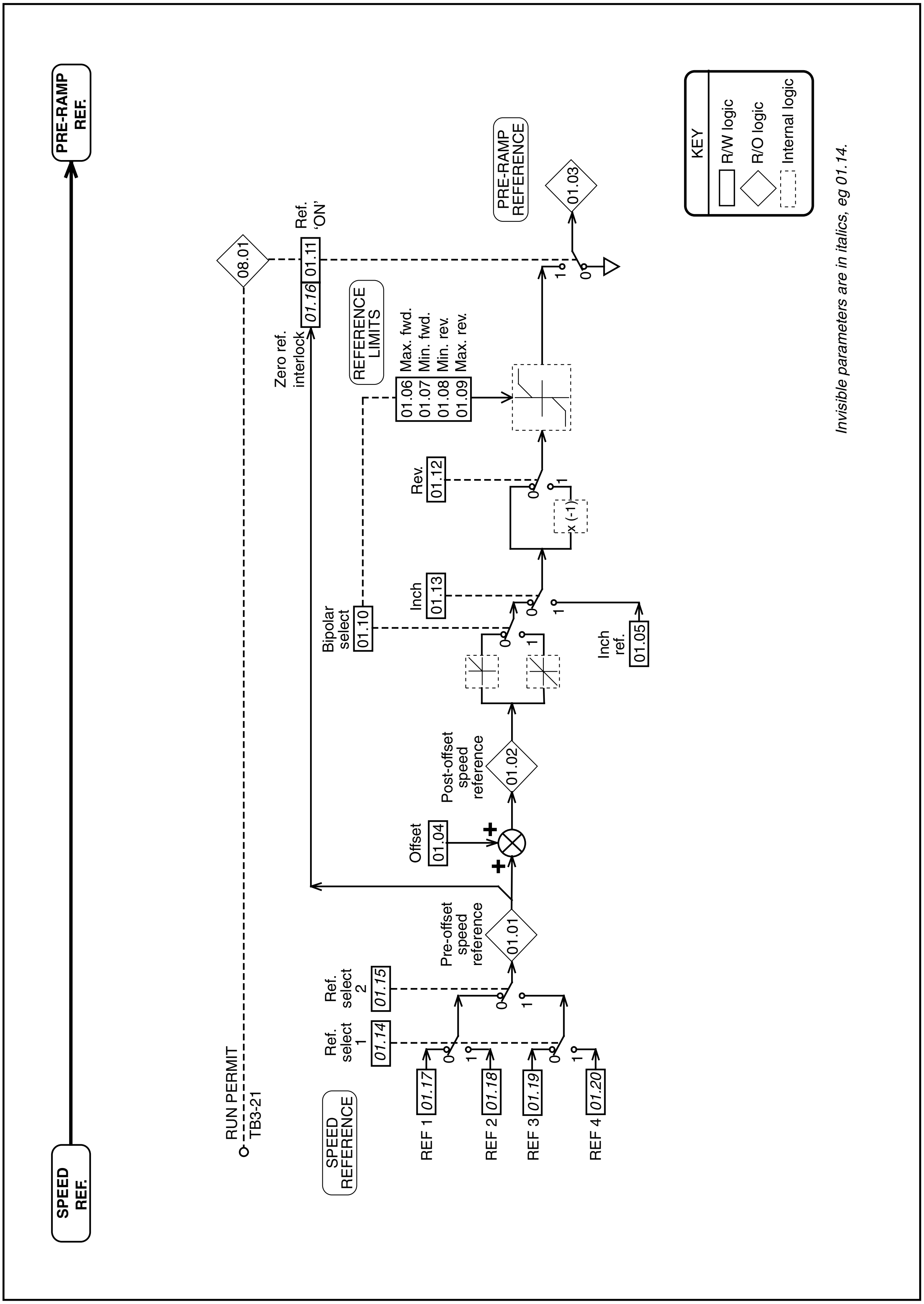


Figure 10-4.
Menu 01—Speed Reference Selection & Limits

01.04 R/W Offset
Range ±1000
The analog reference offset is a programmable speed demand term added to the speed reference value 01.01. It is a speed trim input, for example, from a dancer arm in tension control, or can be used to set a 'creep' or minimum speed.
Default + 000

01.05 R/W Inch/Jog reference
Range ±1000
Becomes the source of speed reference when selected by 01.13 (controlled in default by terminals TB3-22 and TB3-23). It provides the means to set a speed demand different from (and usually less than) the ordinary speed reference. Must be less than the limit set by 01.06 and 01.09. Used for internal jog speed reference.
Default + 050

01.06 R/W Max. Speed Forward Limit
Range 0 to +1000
Sets the upper limit of speed in the forward direction of rotation.
Default +1000

01.07 R/W Min. Speed Forward
Range 0 to +1000
Sets the lower limit of speed in the forward direction of rotation. This parameter is disabled if bipolar operation is selected (01.10=1) to prevent oscillation between the forward and reverse minimum speeds when the input speed reference is zero.
Default +000

01.08 R/W Min. Speed Reverse
Range -1000 to 0
Sets the lower limit of speed in the reverse direction of rotation. This parameter is disabled if bipolar operation is selected (01.10=1) to prevent oscillation between the forward and reverse minimum speeds when the input speed reference is zero.
Default -000

01.09 R/W Max. Speed Reverse
Range -1000 to 0
Sets the upper limit of speed in the reverse direction of rotation.
Default -1000 (4Q) Regen Models
000 (1Q) Non-Regen Models

01.10 R/W Bipolar selector
In its normal state (= 1) allows the drive to respond to a bipolar analog speed reference (01.02) in which case the direction of rotation is determined by the bipolar signal. Positive polarity causes forward rotation; negative polarity, reverse. Reversal of direction is then possible by 01.12 (in a four-quadrant drive). When 01.10 = 0 the drive responds in a unipolar mode, negative-polarity signals being treated as a zero speed demand.
Default — 4Q 1, bipolar mode Regen Models
Default — 1Q 0, unipolar mode Non-Regen Models

01.11 R/W Reference 'ON'
Applies the speed reference to 01.03, pre-ramp reference. Defaults to zero if terminal TB3-21 (Run permit) is de-activated. Cannot be set to 1 unless terminal TB3-21 is activated. Is also subject to the status of the normal logic functions — refer to Menu 08. Controlled in default by terminals TB3-22, TB3-23, TB3-24, TB3-25
Default 0, no speed reference

01.12 R/W Run/Jog Reverse selector
Reverse select inverts the polarity of the run speed reference signal and the inch/jog signal. It has the effect (in a four-quadrant drive) of reversing the sense of the speed signal without regard to the nominal direction of motor rotation. Default value 01.12 = 0, inversion not applied. Controlled in default by terminals TB3-22, TB3-23, TB3-24, and TB3-25.
Default 0, reverse not selected

01.13 R/W Inch/Jog selector
Inch/Jog select replaces all other speed demand references with the inch/jog reference 01.05. Default value 01.13=0, normal speed reference applied. Controlled in default by terminals TB3-22, TB3-23.
Default 0, inch not selected

***01.14** R/W Reference selector 1*
Selects references 1 and 3 or references 2 and 4. The two reference selectors 01.14 and 01.15 in combination enable any one of the four speed references 01.17 to 01.20 to be selected.
Default 0

***01.15** R/W Reference selector 2*

Selects references 1 and 2 or references 3 and 4. The two reference selectors 01.14 and 01.15 in combination enable any one of the four internal speed references 01.17 to 01.20 to be selected.

Default 0

***01.16** R/W Zero reference interlock*

Inhibits the starting of the drive until the analog speed reference, external or internal, is near to zero—(=0.1% of full speed). This capability is convenient in applications where, for safety or process reasons, the operator determines speed by observations of the process—for example, extrusion, or traction drives. This function simulates a potentiometer with a zero speed interlock—except the drive will run after the pot has been returned to zero, then given a ± reference.

Default 0, inhibit not applied

Not applicable to Quantum III, see Application Notes Section at the end of this manual.

CAUTION

As soon as the reference becomes zero the drive will become enabled. A preferred method of accomplishing this function is described in the rear of this manual in the application note section.

***01.17** R/W Ref #1*

Defaulted to TB1-3, the external speed potentiometer input, by parameter 07.15. Encoder reference can be selected by parameter 7.25=1.

***01.18** R/W Ref #2*

Default to internal speed reference.

Default +300 = 30% Speed

***01.19** R/W Ref #3*

Defaulted to TB1-5, analog input GP3, by parameter 07.12.

***01.20** R/W Ref #4*

Defaulted to TB1-6, analog input GP4, by parameter 07.13.

10.7.2 MENU 02—Ramps

Refer to Figure 10-5.

The options available for setting ramps are:

1. No ramps at all, bypassing the ramp functions.
2. A selection of forward and reverse ramps for normal run conditions and an optional separate ramp for inching.

The arrangement for selecting running ramps gives the maximum flexibility. There are two possible ramp values available for each mode of operation, e.g., forward accelerations 1 and 2, forward decelerations 1 and 2, and so on. A common ramp selector enables switching between the two groups (all the 1s or all the 2s). Also, it is possible to change ramps 1 and 2 of any quadrant within the common selection. Ramp selectors may be controlled by any of the logic programmable inputs.

To activate the inch ramp, a "select" signal is required from 01.13 in addition to the "enable" function 02.13. The time of all the selected ramps can be increased by a factor of 10 by parameter 02.19.

The ramp operation can be interrupted by the ramp hold parameter, which holds the ramp output at its present value when set to 1. Ramp disable overrides this feature.

The value of the speed reference signal after the ramp is monitored by the post-ramp reference.

02.01 RO Post-ramp Reference
Range ±1000rpm
Monitors the value of the speed reference after it has bypassed or been modified by the ramps selected.

02.02 R/W Ramp Enable
Activates ramp functions. If set to disable, makes the post-ramp speed reference 02.01 equal to the pre-ramp speed reference 01.03, effectively bypassing all ramp functions.
Default 1, enabled

02.03 R/W Ramp Hold
Holds the ramp output at its present value when set to 1. By using a programmable input to control this parameter, the speed of the drive may be controlled from 'increase' and 'decrease' pushbuttons instead of a potentiometer or other continuously-variable reference source, thus simulating a "MOP" function.
Default 0
See Appendix C

02.04 02.05 02.06 02.07 R/W
GROUP 1 Fwd. Accel & Decel., Rev. Decel & Accel
Range 0 to 1999 tenths of seconds
Defines the time taken to accelerate from zero speed to maximum speed, or to decelerate from maximum speed to zero speed as appropriate (01.03=1000). Each parameter is individually settable.
Default +050 = 5 sec

***02.08 02.09 02.10 02.11** R/W*
GROUP 2 Fwd. Accel & Decel., Rev. Decel & Accel
Range 0 to 1999 tenths of seconds
Defines the time taken to accelerate from zero speed to maximum speed, or to decelerate from maximum speed to zero speed as appropriate (01.03=1000). Each parameter is individually settable.
Default +100 = 10 sec

***02.12** R/W Inch/Jog Ramp Rate*
Range 0 to 1999 tenths of seconds
To select, 02.13=1. Defines the rate of acceleration and deceleration when the Inch/Jog reference is selected (01.13=1).
Default +100=10 sec

****02.13** R/W Enable Inch/Jog Ramp*
Selects a dedicated ramp rate (defined by 02.12) when inching or jogging. If not selected, the normal ramps 02.04 through to 02.11 are used for inching and jogging as well as running.
Default 1, enable = Quantum III factory setting
0 (factory default)

***02.14 02.15 02.16 02.17** R/W*
Fwd. Accel & Decel., Rev. Decel & Accel—Select from Group 1 or 2
These selectors enable ramps to be chosen from either of the two groups at will. This permits individual acceleration and/or deceleration rates to be changed on receipt of an appropriate command.
Default 0, Ramp 1

***02.18** R/W Common Ramp Select*
Enables selection between all ramps of Group 1 (if *02.14* to *02.17* = 0), or all of Group 2.
Default 0, Group 1

***02.19** R/W Ramp Scaling*
When set to 1, all ramps are multiplied by 10, so that 2.04, 2.05, 2.06 and 2.07 are set in seconds. If 2.19=0 these settings are in tenths of seconds.
Default 0

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*Refer to paragraph 10.4.2.

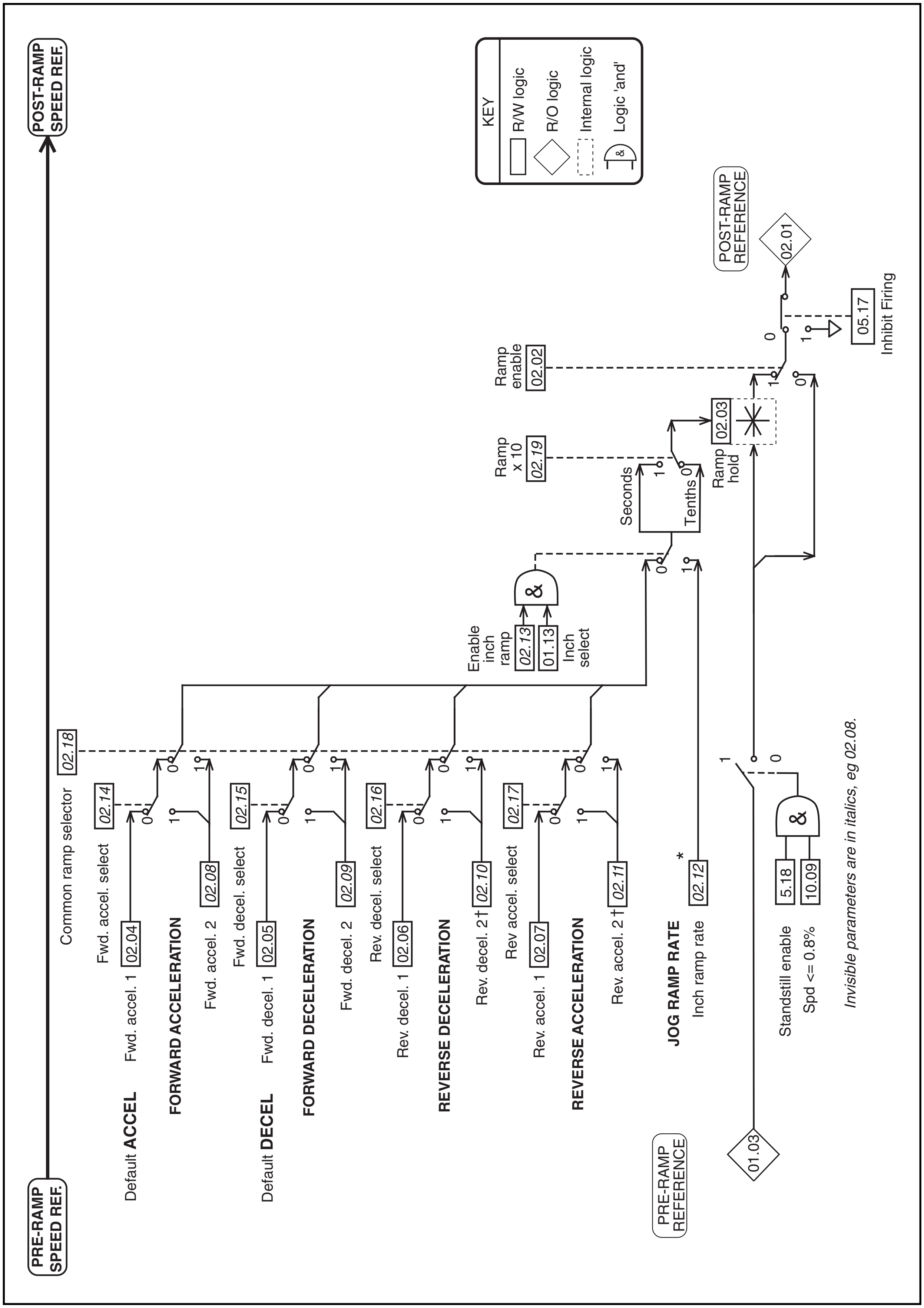

Figure 10-5.
Menu 02—Ramp Selection

* See appendix E

10.7.3 MENU 03 — Feedback Selection and Speed Loop

Refer to Figure 10-6.

The primary inputs are the post-ramp reference 02.01 and the hard speed reference (03.18). Final speed demand (03.01) can be either of these inputs or a summation of both. The selected input can be modified by the addition of an offset, which may be zero. The result of this summation is the final speed demand (03.01) which is added algebraically to the speed feedback to become the speed error (03.06). The speed error is finally proportioned by the PID function to become the speed loop output (03.07).

Speed feedback is derived from one of three possible sources— encoder, tachometer, or armature voltage. Whichever source is selected becomes the speed feedback (03.02). The selection is controlled by 03.12 and 03.13. The value is used for the closed-loop speed control of the motor. Scaling of the encoder signal is set by 03.14, and of the armature voltage feedback is controlled by the setting of maximum armature voltage 03.15. A potentiometer is provided for scaling the tachometer feedback signal. The speed feedback 03.02 is summed with the final speed demand 03.01 at the speed loop summation point. If the armature voltage is selected, it is first summed with the IR compensation (03.05) which is derived from the integral function of the speed error and the IR compensation factor. It is then either added to or subtracted from the scaled armature voltage feedback according to whether IR compensation or IR droop is selected.

The armature voltage feedback is passed to a comparator to provide a voltage clamp, used internally to prevent armature overvoltage. This clamp is used only if the armature voltage has NOT been selected as the feedback. Parameter 03.15 becomes the clamp level.

The speed feedback value is used for two further purposes — to supply a speed indication in rpm, and to indicate zero speed.

03.01 RO Final Speed Demand
Range ±1000
Monitors the value of the speed reference after it has bypassed or been modified by the ramps and/or by the hard speed reference (03.18) and speed offset fine (03.22). It is the speed reference which is sent to the speed loop summation point.

03.02 RO Speed Feedback
Range ±1000
Monitors the value of the speed feedback, derived from one of the following three sources — encoder, tachometer, or armature voltage. The selection of feedback is controlled by 03.12 and 03.13.

03.03 RO Displayed Speed Feedback
Range ±1999rpm
Scaled value of motor speed feedback for external information. Requires correct setting of 03.16, maximum speed scaler.

03.04 RO Armature Voltage
Range ±1000 (direct reading in Volts)
Monitors the value of armature volts.

03.05 RO IR Compensation Output
Range ±1000
The result of selected value of IR compensation (03.17) acting on the speed loop integral output.

03.06 RO Speed Error
Range ±1000
The result of the summation of the final speed demand and the speed feedback, after filtering.

03.07 RO Speed Loop Output
Range ±1000
Speed demand forward to become current demand (menu 04).

03.08 RO Speed Error Integral
Range ±1000
The integrated value of the speed error 03.06. Used as input to the IR compensation calculation when using armature voltage feedback (AVF).

03.09 R/W Speed Loop Proportional Gain
Range 0 to 255
The factor by which the speed error is multiplied to produce the correction term.

$$\text{Factor} = \frac{\text{value of 03.09}}{8}$$

Increasing this value increases both the system damping and the transient speed response, and if made too high for a given load the system will become unstable. The optimum setting is the highest value possible before instability starts to occur. Optimum speed loop performance is achieved by judicious combination of all three gains of the PID algorithm. (See also #3.28 for Gain x 4.
Default 080

03.10 R/W Speed Loop Integral Gain
Range 0 to 255
The factor by which the speed error is multiplied to produce the correction term.

$$\text{Factor} = \frac{6f \times (03.10)}{256}$$

where f = supply frequency

This term ensures zero speed error during steady state load conditions Increasing the value increases the rate of recovery after a disturbance. If the term is made too high, speed tends to oscillate instead of settling quickly. The optimum setting is the highest value possible before oscillation starts to occur. Optimum speed loop performance is achieved by judicious combination of all three gains of the PID algorithm. The integral term will be clamped if a torque mode is selected or if the drive goes into current limit.
Default 040

03.11 R/W Speed Loop Derivative Gain
Range 0 to 255
The factor by which the speed error is multiplied to produce the correction term. There are three possible sources of input to this term—either final speed demand 03.01, speed feedback 03.02, or speed error 03.06. The selector is 03.24. The derivative term is a function of the rate of change of value of the input.

If the input is the speed error 03.06, output is negative if speed error is increasing. This has a damping effect.

If the input is the final speed demand 03.01, output is positive when the final speed demand is increasing. This is called "velocity feed forward".

If the input is the speed feedback 03.02, output is negative if speed feedback is increasing. This has a damping effect, but dependent on the changing value of the speed feedback only, not the speed reference.
Default 0

03.12 R/W Digital feedback selector
Set to 1 to select encoder feedback. Set to 0 to select analog feedback.
Default 0, analog feedback selected

***03.13** R/W Armature Voltage / External Analog Feedback Selector
Determines the type of analog speed feedback when 03.12 is set to 0. Set to 1 to select armature voltage feedback. Default setting selects analog feedback from a tachometer or equivalent external source connected to terminal TB1-09.
Default 1, AVF selected = factory setting
0 (drive default)

03.14 R/W Encoder Feedback Scaling
Range 0 to 1999
The value should be set to correspond with the maximum speed of the motor and with the number of lines-per-revolution of the encoder. To calculate the scale factor —

$$\text{Scale factor} = \frac{750 \times 10^6}{N \times n}$$

where N = number of lines-per-revolution (encoder)
and n = max speed of motor in rpm.

The default value is determined on the basis of a 1024-line encoder, and a maximum speed of 1750rpm.
Default + 419

***03.15** R/W Maximum Armature Volts
Range 0 to 1000
Defines the maximum voltage permitted to be applied to the armature. When armature voltage is the selected feedback (03.12 = 0 and 03.13 = 1), the max. armature voltage value is used for scaling the armature voltage measurement so that speed feedback is full scale at maximum voltage. An automatic scale factor of 1.2 is applied to clamp the armature voltage feedback to 20% above maximum to allow for overshoot.

If the speed feedback is derived from an encoder or tachometer, the armature voltage is continuously monitored, and a clamp is applied when the voltage exceeds that set in 03.15. This can be used to prevent the voltage rising above a set level.

Default +500 = Quantum III factory setting

+600 (drive default)

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*Refer to paragraph 10.4.2.

03.16 R/W Speed Readout Scaler
Range 0 to 1999
Used only to scale the speed feedback so that the value displayed in 03.03 is actual speed in rpm. The value applied to 03.16 should be the max. speed in rpm (divided by ten if the maximum speed is >1999rpm); speed displayed in 03.03 is then rpm / 10. This does not affect motor speed.

If desired 3.03 could be scaled to readout machine speeds. Example: At 100% motor speed machine puts out 250 bottles/min. Place 250 into #3.16.

Default + 1750

03.17 R/W IR Compensation
Range 0 to 255

$$\text{Value of 03.05} = \frac{(03.08) \times (03.17)}{2048}$$

This value is used to calculate the compensation needed for the resistive voltage-drop of the armature to improve speed control with varying loads when the selected speed feedback is the armature voltage.

IR compensation is a positive feedback, and may give rise to instability if set too high. Furthermore, modern laminated-frame motors have typically a rising load-speed characteristic unsuited to armature voltage feedback with IR compensation. IR compensation is more suited to compound-wound motors with a flat (not rising) load-speed characteristic.

The integral of the speed error is used as the input to IR compensation rather than current feedback because it has the least amount of ripple of the variables; in speed control, the value of the speed error integral is the steady-state value of current demand.
Default 000

03.18 *R/W Hard Speed Reference*
Range ±1000
Speed reference fed into the speed loop without passing through the ramps.
Default *(07.11)*

03.19 *R/W Hard Speed Reference Selector*
If 03.19 is set to 1, and Ref “ON” (01.11) =1, the Hard Speed reference (3.18) is added at the speed loop summation point. To use hard reference only, 03.21 would be set = 0.
Default 0

03.20 *R/W IR Droop Selector*
If 03.20=1 when using armature voltage as the speed feedback, speed will decrease as load increases.
A typical application, for example, is a mechanical blanking press with a heavy flywheel. Applying IR droop prevents the drive from delivering a sudden increase of current at the moment of impact (sudden increase of torque demand). It is better that the drive deliver energy to the flywheel during the whole operating cycle rather than mostly at the moment of impact.
Default 0

03.21 *R/W Ramp Output Selector*
When 03.21=1, Ramp output is added at the speed loop summation point.
Default 1

03.22 *R/W Speed Offset Fine*

Range 0 to 255
Used as a fine trim on the speed reference signal to correct, or introduce, a small offset.
0 = maximum negative offset –8 units
255 = maximum positive offset +8 units
Default 128 = 0 Speed Units

03.23 *R/W Zero Speed Threshold*

Range 0 to 255
The threshold may be adjusted to any value up to 25.5% of maximum speed. Refer also to 10.09.
Default 16

03.24 *R/W Derivative Term Source*

Range 1,2, or 3
The derivative term of the PID in the speed loop may use one of three sources—

1=Speed error of 03.06
Damping changes in speed demand and feedback

2=Speed reference 03.01
Velocity feed forward

3=Speed feedback 03.02
Damping on feedback only (“feedback forcing”).

Default 1

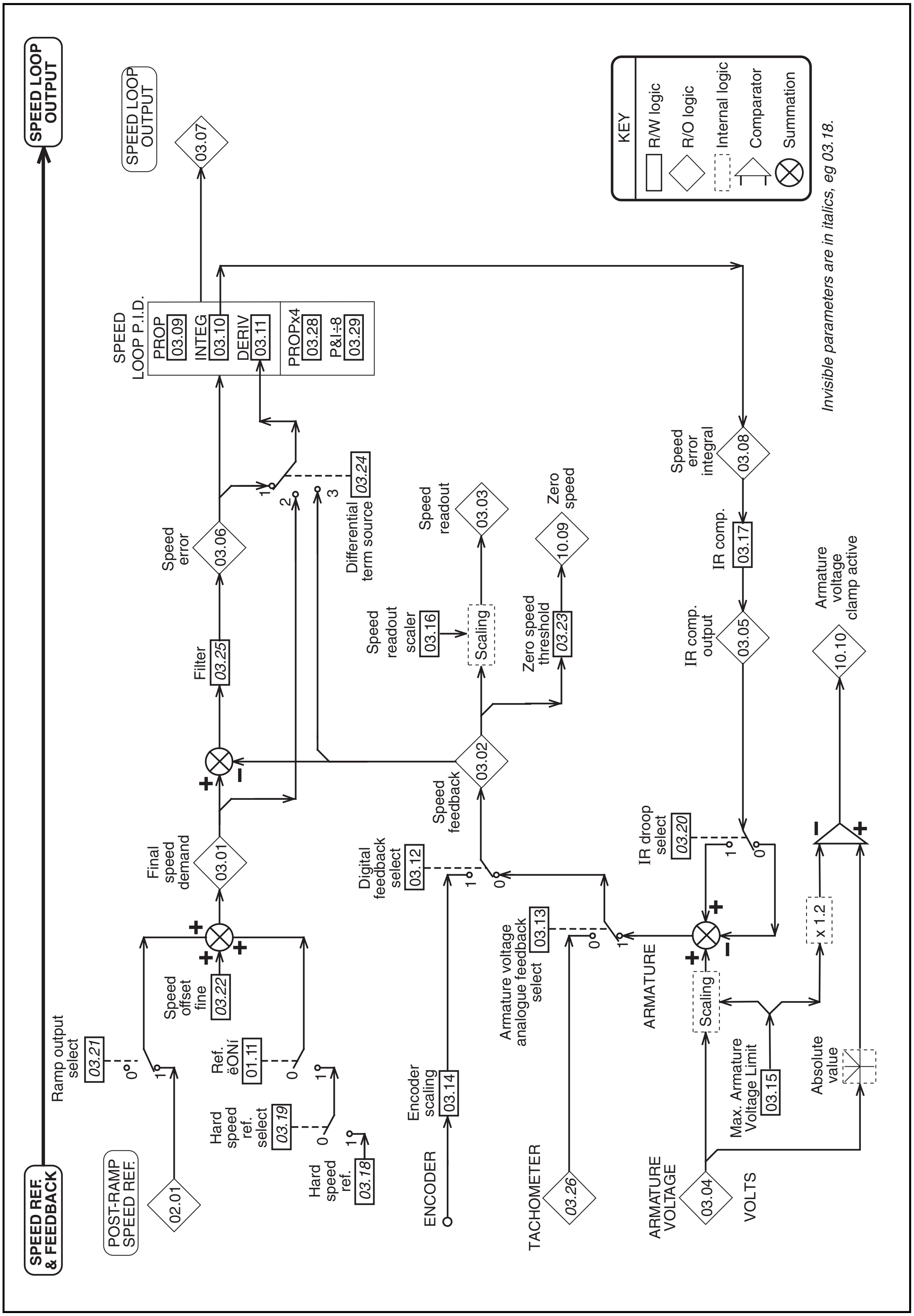

Figure 10-6.
Menu 03—Feedback Selection & Speed Loop

***03.25** R/W Speed Error Filter*

Range 0 to 255

$$\text{Filter time constant} = \frac{256}{6f \times (03.25)}$$

where, f = supply frequency

A low-pass filter to reduce the effect of interference on the speed error signal (03.04) —from a noisy tachometer, for example.

Default 128

***03.26** RO Tachometer Input*

Range ±1000

Monitors the tachometer input measurement. The tachometer potentiometer scales the feedback signal such that at full motor speed, 03.26 = 1000. Units displayed = 0.1% of full speed per increment.

***3.27** RO Speed Feedback Range*

Reserved.

3.28 R/W *Increase P Gain by 4*

Range 0 or 1

Setting this parameter at 1 will increase the speed loop proportional gain by a factor of 4. Proportional Gain x 4.

Default 0

03.29 R/W *Reduce P and I Gain by 8*

Range 0 or 1

Enables the user to increase the burden resistors by a factor of 1.6. Reduce P and I gain by 8 if set to 1.

Default 0

10.7.4 MENU 04 — Current Selection and Limits

Refer to Figure 10-10.

The main input is the speed loop output (03.07). The torque reference (04.08) can be selected for pure torque control of the motor, or it can be combined with the speed loop output by 04.12 and 04.13. These inputs become the current demand to which an offset or trim may be added (04.09). The result is then subject to an overriding limitation derived from several sources including speed. Current limit is set by 04.03 for single quadrant drives. For regenerative drives, the current limit in both bridges can be individually set by 04.05 and 04.06 and each of the four quadrants enabled or disabled by 04.14 through 04.17.

A feature in this menu is the ability to set a second current limit (04.07) automatically—refer to 04.10, 04.18 and 04.19—which enable current limit 2 to be applied after a chosen time delay. This is appropriate to applications where the initial load torque on start-up is high, but after some period becomes less. An example would be some mechanical mixing processes. Current can also be tapered as a function of speed. Refer to 04.20 through 04.25. *See "Application Note CTAN #163"

04.01 RO Current Demand

Range ±1000

The current demand signal is the controlling input to the current loop when the drive is being operated in speed-control mode. The signal is subject to limitation by 04.03, 04.05, and 04.06 before being passed to the current loop.

04.02 RO Final Current Demand

Range ±1000

Current demand final output, to the current loop (Menu 05) after limits have been applied.

04.03 RO Over-riding Current Limit

Range ±1000

This is the limiting value of current demand and is the result of the speed-dependent current taper calculation or I-limit 2 (if selected), whichever is less. Refer to parameters shown in Figure 10-10.

04.04 R/W Current-limit 1 (taper start point)

Range 0 to 1000 = 150% of drive rating

This parameter provides symmetrical current-limitation for bridges 1 and 2 and is the level from which the current taper functions operate—refer to 04.20 and 04.21. I-limit 1 can be used in applications where the motor kW rating is somewhat less than that of the drive, as an alternative to changing the fixed current-burden resistors.

Default +1000

04.05 R/W Current-limit Bridge 1

Range 0 to 1000

Determines the maximum limit of current demand when bridge 1, the 'positive' bridge, is conducting. It causes any demand for current in excess of the limit set point to be clamped.

Default +1000 = 150% of drive rating

04.06 R/W Current-limit Bridge 2

Range 0 to 1000

Determines the maximum limit of current demand when bridge 2, the 'negative' bridge, is conducting. It causes any demand for current in excess of the limit set point to be clamped.

Default +1000 = 150% of drive rating

04.07 *R/W Current-limit 2*

Range 0 to 1000

Available as an additional current limit. Applies to both bridges. The drive can be programmed, if desired, to select 04.05 automatically at a programmed time interval after a RUN signal. Refer to 04.10, 04.18 and 04.19.

Default +1000 = 150% of drive rating

04.08 *R/W Torque Reference*

Range ±1000

This value is an input to the current loop and can be selected for use in applications requiring direct control of current (motor torque).

Default +000

04.09 *R/W Current Offset*

Range ±1000

Current offset is used to apply a trim to the current demand 04.01.

Default +000

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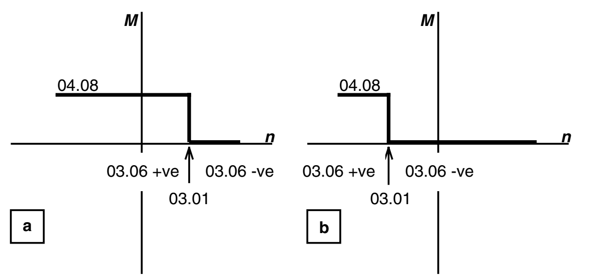
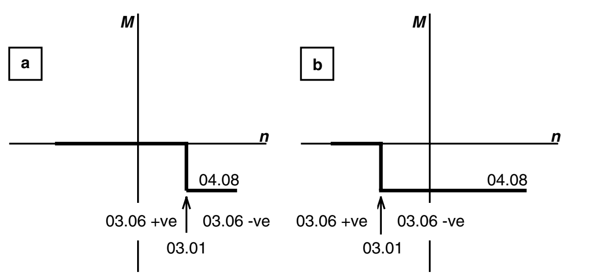
* Application Notes are available for downloading at www.ctdrives.com/downloads



a Q1 — Forward drive.
b Q2 — Reverse braking.
Positive torque, forward drive and reverse braking, is applied at the value of 03.01 when the speed error 03.06 is positive. When the speed error is negative, torque is zero.

Figure 10-7.
Torque Control With Speed Override.
Positive Torque Reference.



a Q4 — Forward braking.
b Q3 — Reverse drive.
Negative torque, forward braking and reverse drive, is applied at the value of 03.01 when the speed error 03.06 is negative. When the speed error is positive, torque is zero.

Figure 10-8.
Torque Control With Speed Override.
Negative Torque Reference.

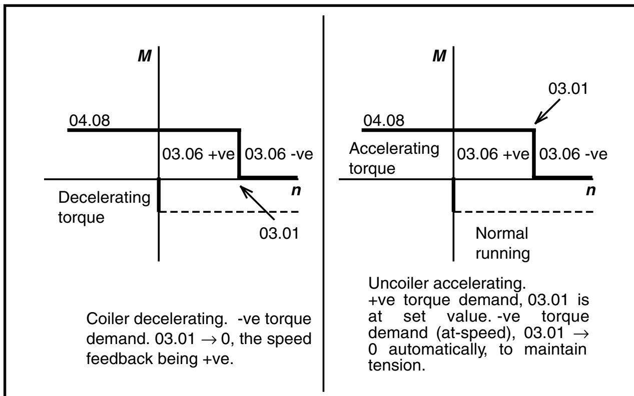


Figure 10-9.
Coiler Decelerating and Uncoiler Accelerating

04.10 *R/W Current -limit 2 Selector*
Set *04.10* = 1 to select I-limit 2, or can be programmed to change automatically—refer to *04.18* and *04.19*.
Default 0

04.11 *R/W Current Offset Selector*
Selects the value in *04.09* as a current offset.
Default 0

04.12 *R/W Mode bit 0*
Operates in conjunction with *04.13* to configure the drive for speed control or any of three modes of torque control. Refer to *04.13* .
Default 0, not selected

04.13 *R/W Mode bit 1*
Operates in conjunction with *04.12* to configure the drive for speed control or any of three modes of torque control, as follows—

04.12 = 0 and *04.13* = 0 Speed mode control (normal configuration)
04.12 = 1 and *04.13* = 0 Basic current- or torque-control mode.

In this mode, the torque reference *04.08* is the input to the current loop and is subject to the limitations of the over-riding current limit 04.03, the Bridge 1 and Bridge 2 limits 04.05 and 04.06, and to the current slew rate 05.04.

04.12 = 0 and *04.13* = 1 Torque-control mode with speed override. Refer to Figures 10-7 and 10-8.

In this mode, the output of the speed loop is clamped either to the value of the torque reference *04.08* , or to 0—depending on whether the speed error 03.06 is positive or negative, and on whether the torque reference is positive or negative, i.e., dependent on relative polarities.

In the two motoring quadrants, speed is limited to the value of the final speed demand 03.01, preventing uncontrolled increase of speed when load is removed. The drive should be adjusted to run at a slight over-speed when off load to insure adequate current demand at all speeds.

In the two regenerative quadrants, the current demand set by torque reference *04.08* is disabled when speed is less than that set by the final speed demand 03.01. This prevents the reducing load torque resulting in reversal of rotation. The 03.01 value should be 0.

A disadvantage of this mode is that it cannot provide torque at a particular speed both accelerating and decelerating. Parameter *04.08* behaves as a controllable current limit in this mode.

***04.13** R/W Mode bit 1* *(Continued)*

04.12 = 1 and *04.13* = 1	Coiler/uncoiler control mode. Refer to Figure 10-9.

This mode allows torque to be applied in either sense, for acceleration or deceleration, while preventing uncontrolled increase in speed or reversal if the load becomes 0. When the torque demand is in the sense opposite to that of speed feedback, this mode automatically selects zero speed reference.

For a coiler, the offset 01.04 should be set just slightly positive so that 03.01 is greater than the line speed reference. When a full reel (of a coiler) is decelerating, the torque demand may be negative. Since the speed feedback is positive, the speed reference is automatically made 0 so that the speed error becomes negative. Both torque demand and speed error being negative, decelerating torque is applied.

For an uncoiler, the offset 01.04 should be set just slightly negative so that there is a negative speed error at zero speed. (Negative speed error is needed to produce a negative torque to maintain tension at zero speed.) As the line speed reference increases, 03.01 becomes positive. A suitable scaling of the

input should be applied such at 03.01 is always greater than the speed feedback, thus maintaining a positive speed error 03.06. Since the speed feedback is positive, zero speed is automatically selected whenever the torque demand is negative—normal operation—but if the torque demand becomes positive, then the 03.01 value becomes the speed demand. Accelerating torque is allowed if the reel speed is not greater than 03.01.

For coiler/uncoiler applications, line speed reference corresponds to reel speed at *minimum* diameter.
Default 0, not selected

***04.14** R/W Quadrant 1 enable*

Quadrant 1 operation is defined as motoring in the forward direction, speed and torque both having positive values.
Default 1, enabled

***04.15** R/W Quadrant 2 enable*

Quadrant 2 operation is defined as regenerating (braking torque) in the reverse direction, speed being negative and torque positive.
Default 1, enabled for 4Q drive
Default 0, disabled for 1Q drive

***04.16** R/W Quadrant 3 enable*

Quadrant 3 operation is defined as motoring in the reverse direction, speed and torque negative.
Default 1, enabled for 4Q drive
Default 0, disabled for 1Q drive

***04.17** R/W Quadrant 4 enable*

Quadrant 4 operation is defined as regenerating (braking torque) in the forward direction, speed being positive and torque negative.
Default 1, enabled for 4Q drive
Default 0, disabled for 1Q drive

***04.18** R/W Enable automatic current-limit 2 change*

When this bit is enabled, the I-limit 2 selector is automatically changed to 1 after a time interval set by 04.19. The drive can be programmed to select 04.07 automatically at a programmed time interval (04.19) after a RUN signal.
Default 0, disabled

***04.19** R/W Current -limit timer*
Range 0 to 255
A time interval up to 255 seconds can be programmed. If 04.18=1, I-limit 2 is automatically selected when the set time elapses after a RUN command. This feature is appropriate to applications where the motor is short-time rated, such as mixing machinery, where the starting load is high and falls to a lower, constant value only after the machine has run for some time.
Default 000

***04.20** R/W Current taper 1 threshold*

Range 0 to 1000

Sets a threshold value of speed feedback, beyond which 04.24 changes to 1 to indicate that the threshold has been exceeded, and is the starting point for taper 1 (if implemented). Armature current reduces, as a function of speed, at a rate defined by 04.22. This parameter can also be used as a general purpose speed threshold.

If only one taper is used, it must be taper 1. If both are used, taper 1 must be the first.

Default +1000

***04.21** R/W Current taper 2 threshold*

Range 0 to 1000

Sets a threshold value of speed feedback, beyond which 04.25 changes to 1 to indicate that the threshold has been exceeded, and is the starting point for taper 2 (if implemented). Armature current reduces, as a function of speed, at a rate defined by 04.23. This parameter can also be used as a general purpose speed threshold.

Default +1000

***04.22** R/W Current taper 1 slope*

Range 0 to 255

Sets the rate of change of armature I-limit with respect to speed in either direction of rotation, above the threshold set by 04.20.

Scaling factor (refer to Figure 10-11):

$$04.22 = 128 \times \frac{\Delta I_1}{\Delta n_1}$$

Default 000

***04.23 R**/W Current taper 2 slope*

Range 0 to 255

Sets the rate of change of armature I-limit with respect to speed in either direction of rotation, above the threshold set by 04.21.

Scaling factor (refer to Figure 10-11):

$$04.23 = 128 \times \frac{\Delta I_2}{\Delta n_2}$$

Default 000

***04.24 RO** Taper threshold 1 exceeded*

Set to 1 when the threshold set point of 04.20 is exceeded.

***04.25 RO** Taper threshold 2 exceeded*

Set to 1 when the threshold set point of 04.21 is exceeded.

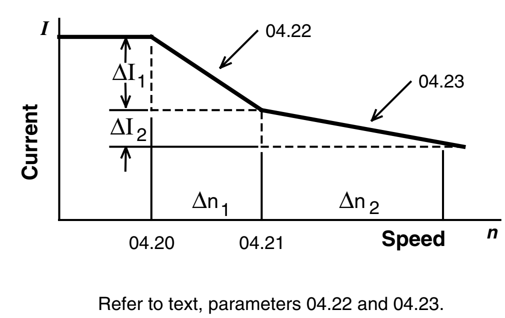


Figure 10-11.
Calculation of Current Taper Gradients 1 & 2.

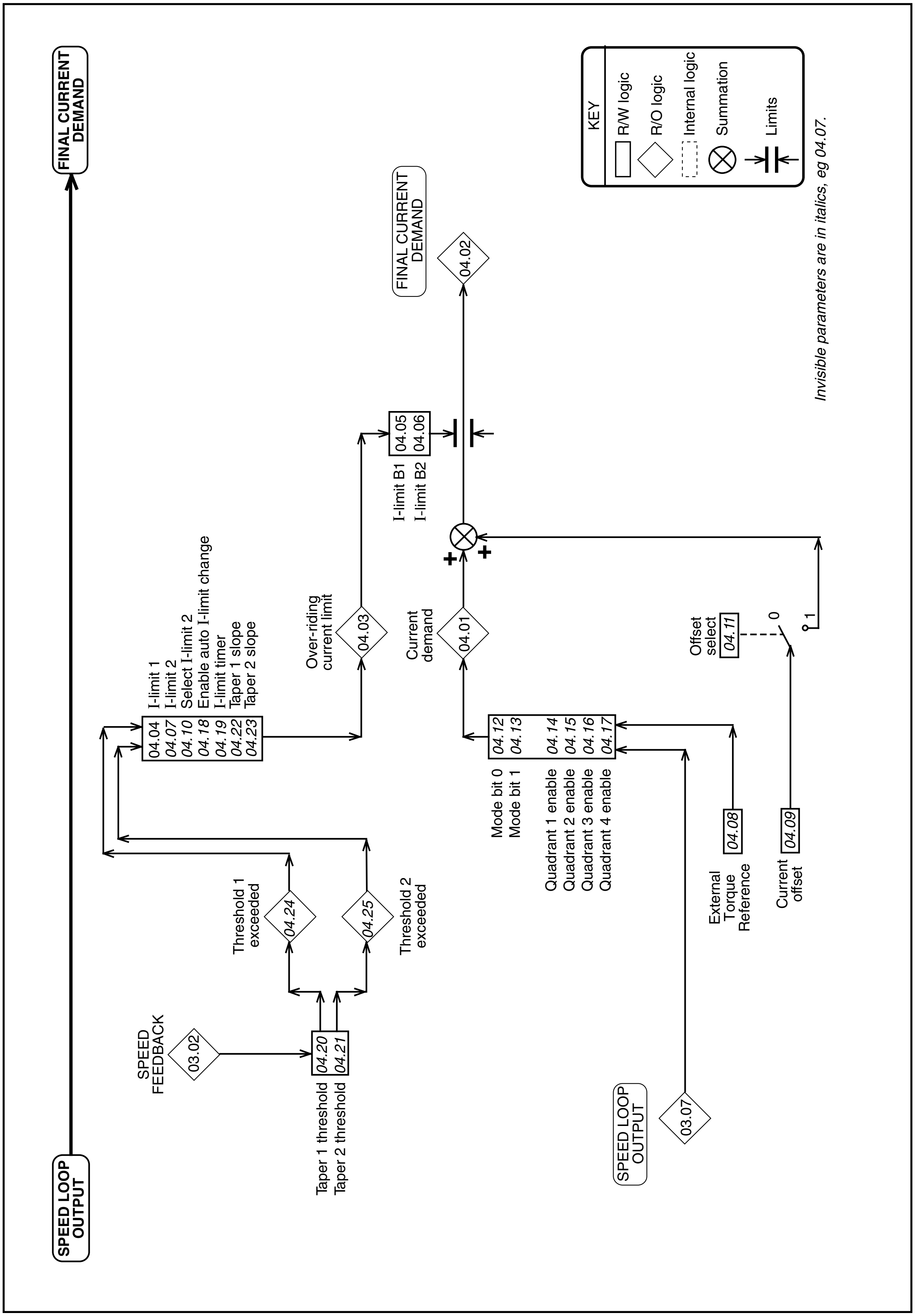


Figure 10-10.
Menu 04—Current Selection & Limits

10.7.5 MENU 05 — Current Loop

Refer to Figure 10-12.
This is the final stage in the processing of the speed and torque references and feedbacks to determine the final firing angle signal. The primary inputs are the final current demand, which is subject to the slew rate limit, and the current feedback which are summed algebraically and further modified by whatever settings may have been applied to the group of Current Loop parameters. Included in these parameters is the enable auto tune (05.09) which automatically sets the gains of the current loop parameters (05.12 through 05.15).

Current feedback, after scaling, delivers a readable signal to display actual current in amps. Current feedback also is an important function in the protection of the drive. The feedback signal is monitored in relation to the selected overload threshold, and modified according to preprogrammed values for overload time. The provision of two parameters for overload timing enables settings to be applied so as to take account of the fact that the cooling time of a motor can be longer than its heating time. The current and speed loops can be bypassed during start-up by (05.20), direct firing angle control.

The Overload Trip function can be disabled by setting #5.07 and #5.08 = 0

05.01 RO Current Feedback
Range ±1000
The current feedback signal is derived from internal current transformers. It is used for closed-loop control and indication of the armature current, and to initiate motor protection.

05.02 RO Current —Displayed Feedback Amps
Range ±1999
The current feedback signal, modified by the scaling factor, becomes available as an indication in amps. Refer also to 05.05. This does not affect motor current.

05.03 RO Firing Angle
Range 277 to 1023
This is the output of the current loop algorithm, and the input reference to the ASIC, which generates the firing pulses. 05.03 = 1023 indicates fully 'phased forward'.

05.04 R/W Slew Rate Limit
Range 0 to 255
This parameter limits the maximum rate of change of current demand. Older types of motors, especially if of non-laminated construction, may have a tendency to flash over if the rate of change of current is too high for the inherent lag of the interpole windings.
Defined as —

$$S = I_{max} \times 6f \times \frac{05.04}{256}$$

$$= 1.4\,(I_{max}) \times 5.04 \text{ @ } 60\text{Hz.}$$

Where, S = slew rate in amps s^{-1}
f = frequency of the power supply in Hz
I_{max} = max. current (A)

Default 40

05.05 R/W Current Readout Scaler
Range 0 to 1999
The maximum output current, in amps, is scaled by this parameter. This does not have any effect on the motor protection. The setting for 05.05 is calculated as follows— See paragraph 8.7 current limit set-up.

$05.05 = \frac{I_{max}}{10}$ if $I_{max} > 1999A$

$05.05 = I_{max}$ if $200A < I_{max} < 1999A$

Note: See Table for #5.05 Settings in Section 8.7.

Default Drive current rating

05.06 R/W Overload Threshold
Range 0 to 1000
Sets the threshold of armature current feedback beyond which the current-time overload protection begins to integrate. See Fig. 10-13.
Default + 667 = 100% of drive rating (Quantum III factory settings)
700 (drive default)

05.07 R/W Overload Integrating Time (heating)
Range 0 to 255
Integrating time for 05.06. For use in conjunction with 05.08, such that 05.07 < 05.08. See Fig 10-13.

Time t to trip is —

$$t = (05.07) \times \frac{1000 - (05.06)}{(05.01) - (05.06)}$$

Refer also to Menu 10, parameter 10.18.
Default 060 (Quantum III factory settings)
030 (drive default)

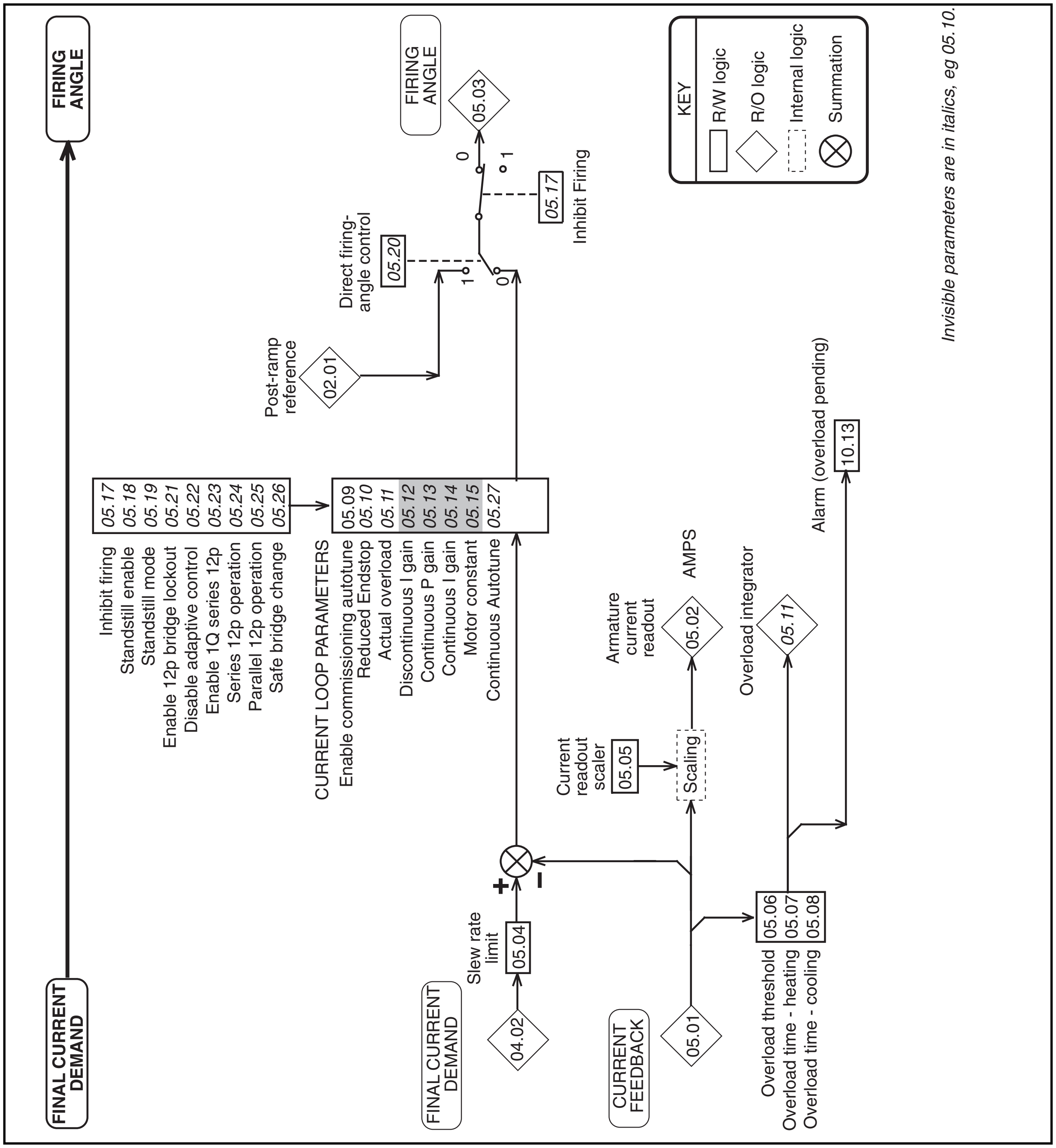


Figure 10-12.
Menu 05—Current Loop

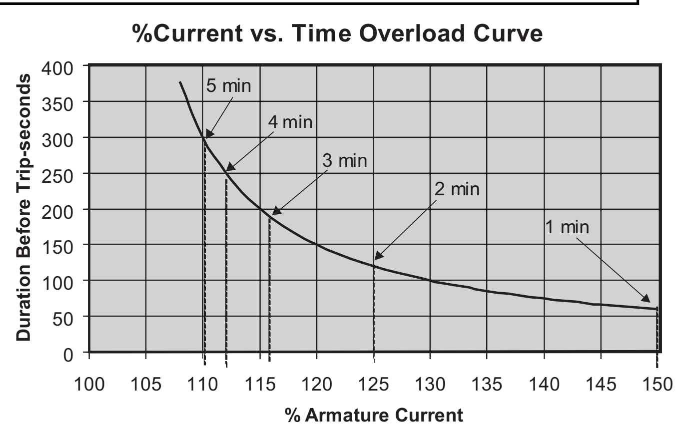


Figure 10-13
Current vs.
Time Overload Curve

05.08 R/W Overload Integrating Time (cooling)
Range 0 to 255
Integrating time for 05.06. For use in conjunction with 05.07, such that 05.08 > 05.07.

Time *t* to trip is —

$$t = (05.08) \times \frac{1000 - (05.06)}{(05.06) - (05.01)}$$

Refer also to Menu 10, parameter 10.18.
Default 150 (Quantum III factory setting)
50 (drive default)

05.09 R/W Enable Autotune
To autotune the current loop during start-up—

- Disconnect the field of the motor if a fixed field is being used. Models 9500-8X01 through 9500-8X06 are standard with field control. This will disconnect the field automatically. **Observe approved safety procedures!**
- Enable autotune — set 05.09 =1.
- Depress Start pushbutton to enable the drive.

When the autotune process is complete, the drive ready relay will open for 50ms after which the autotune parameter will be automatically set to disable (05.09 = 0). This process allows the autotune sequence to be started when a 'run permit' is present but returns the drive to a safe condition when the autotune is complete. It may be necessary to clamp the motor shaft if it tends to rotate during this procedure. Parameters 5.12–5.15 are affected. See also 5.27.
Default 0, disabled

05.10 *R/W Reduced Endstop*
The endstop allows the armature voltage to rise, during regeneration, to 1.16 x supply voltage. On very "soft" supplies the endstop may be too close to the crossover point. Setting 05.10=1 increases the safety margin but reduces the maximum regenerated armature voltage to 1.05 x supply voltage.
Default 0, disabled

05.11 *RO Actual overload*
Range 0 to 1999
Monitors the value of the integrating current-time overload. When the value reaches the trip point determined by 05.06, 05.07, and 05.08, an overload trip occurs. The overload trip operates when 05.11 reaches the value given by:

$$[1000-\{05.06\}] \times \frac{10}{16}$$

The rate at which 05.11 increases or decreases is controlled by the values of 05.07 and 05.08, respectively.

05.12 *R/W Discontinuous I-gain*
Range 0 to 255
Set by the Start-up Autotune parameter 05.09.
This parameter is set to correct any errors in the prediction of firing angle in the discontinuous current region. If 05.15 is set correctly, 05.12 has little effect; but if set too high, instability can occur.

$$\text{Gain applied} = \frac{\text{value of } \mathit{05.12}}{512}$$

Default 16 (ver. ≥ 4.10); 65 (ver. < 4.10)

05.13 *R/W Continuous P-gain*
Range 0 to 255
Set by the Start-up Autotune parameter 05.09.
This parameter enables the current loop to follow very closely a step-change in current. If set too high, there will be an overshoot. If set too low, the new current value will be achieved very slowly.

$$\text{Gain applied} = \frac{\text{value of } \mathit{05.13}}{512}$$

Default 16 (ver. ≥ 4.10); 33 (ver. < 4.10)

05.14 *R/W Continuous I-gain*
Range 0 to 255
Set by the Start-up Autotune parameter 05.09.
Its value will depend on the motor time-constant. Increasing the value of 05.14 improves the response of the current loop, but at the risk of instability.

$$\text{Gain applied} = \frac{\text{value of } \mathit{05.14}}{1024}$$

Default 16 (ver. ≥ 4.10); 33 (ver. < 4.10)

05.15 *R/W Motor Constant*
Range 0 to 255
This parameter is used to scale the current demand such that the control loop correctly predicts the firing angle in the discontinuous current region. It is set automatically by the Start-up Autotune parameter 05.09.
Default 25 (ver. ≥ 4.10); 50 (ver. < 4.10)

05.16 *R/W RESERVED*
Range 0 to 255
Default 0

05.17 *R/W Inhibit Firing*
If set to 1, disables SCR firing (both bridges), and resets acceleration and deceleration ramps.
Default 0, enabled

05.18 *R/W Enable Standstill Logic*
When enabled, causes the firing angle to be fully phased back when the drive has received a STOP command and when the speed falls below 0.8% of maximum speed. After a short time delay, the SCRs are inhibited also. This prevents "creep" and is used in applications in which there is no requirement to maintain motor torque at standstill. Refer also to *05.19*.
Default 1, enable

****05.19*** *R/W Standstill Mode*
05.19=0—standstill logic is enabled after STOP command or zero reference.

05.19=1—standstill logic enabled after STOP command only.

Setting 05.19=1 has the effect of not enabling the standstill logic when the stopping signal is given by the reference alone. This condition, therefore, allows creep speeds, shaft orientation, and other functions which occur close to zero speed, while preventing any "creep" after a STOP command.
Default 1
0 (factory default)

05.20 *R/W Enable Direct Firing Angle Control*
When enabled, the firing angle 05.03 is controlled by the value of the post-ramp reference 02.01. This mode is valuable for system diagnosis, particularly where instability is present. It allows the drive to operate without the influence of either the speed loop or the current loop, eliminating their effect upon the system.
Default 0, disabled

CAUTION

This function must be used cautiously. When the reference is 02.01, there is *no protection* against excessive acceleration, output voltage or current other than the instantaneous overcurrent trip. Also, be sure to reset 05.20=0 after completion of tests.

05.21 *R/W Enable Bridge 2 Lockout*
Requires to be set only for parallel 12-pulse 4Q system installations comprising two (2) drives which are to share load, to prevent one drive changing bridges while the other is still conducting.
Default 0, disabled

---

*Refer to paragraph 10.4.2.

05.22 *R/W Disable Adaptive Control*
Setting 05.22=1 disables adaptive control.
When adaptive control is enabled (default status), the current loop employs two different algorithms, one of which applies high gain in the discontinuous-current region. This is unsuitable for some applications, such as non-motor loads, for which adaptive control should be disabled.
Default 0, enabled

05.23 *R/W Enable Single-quadrant Series 12-pulse*
Enabling this function configures the drive to deliver normal and delayed firing pulses to a single 12-channel power board. Cannot be enabled if either of the Bridge 2 quadrants 04.16 and 04.17 are enabled.

In 6-pulse SCR drives, the current drawn from each phase of the supply is not continuous. Out of each 180° of the AC supply cycle, full load current is drawn for 120° and none for the remaining 60°. This imposes a degree of harmonic distortion on the supply.

Twelve-pulse SCR drives draw current for the full 360° of the AC supply cycle, and the current waveform approximates very closely to a sine wave, with much reduced distortion as a result.

A further advantage is the much smoother DC output from 12-pulse drives, which is a benefit in many applications.

Two 12-channel Power Boards are driven by pcb MDA1 for 4Q series 12 pulse.
Default 0, disabled

05.24 *R/W Series 12-pulse operation*
This parameter should be set for operation in either single- or four-quadrant 12-pulse mode. Parameter 05.23 (see above) is read by the software only at power-on and during a cyclic reset. (This is a reset when the drive is disabled.) If either of the Bridge 2 quadrants is enabled when 05.23 is read, the outputs are not diverted within the ASIC and 05.23 is set to 0.
Default 0, disabled

NOTE

Series 12-pulse mode is phase-sensitive. The rotation on the SCRs must be in the sequence L1, L2, L3 (10.11=1).

05.25 *R/W Parallel 12-pulse operation*
This parameter instructs the drive to operate in parallel 12-pulse mode and should be set for operation in either single- or four-quadrant mode. For 4-quadrant operation, parameter 05.21 (see above) must be set to 1. The F10 input of each drive must be connected to the ST5 output of the other. Also, the control 0V terminals of both drives must be connected.
Default 0, disabled

05.26 *R/W Extra-safe Bridge Lockout*
When enabled (=1), parameter 05.26 applies an additional safety margin to the bridge lockout logic. This may be required for highly inductive loads, such as a motor field winding.
Default 0, disabled

05.27 *RWB Continuous autotune (For firmware revisions ≥ 4.09.00)* When enabled, an additional autotune routine continually monitors current during conduction and adjusts the current loop gains according to the amount of current ripple measured for optimum performance.

This parameter could be left on continuously or it could be used for a short time 1-2 minutes under a loaded condition so that the AutoTune could perform it function. Parameters #5.12-#5.15 will be affected. If it is desired, #5.27 could be turned off after the tuned values have been determined by this Tuning function. The resulting values could then be saved by performing a STORE before powering down.
Default 0, disabled

05.28 *RWB Reduce Hysteresis or bridge changeover (For firmware revisions ≥ 4.09.00)* Used to reduce hysteresis or bridge changeover in applications when fine control of current is required under lightly loaded conditions. When set, reduces the hysteresis to 0.2% of drive maximum current.
Default 0

05.29 *R/W Burden Resistor Increase selection*
Range 0 or 1

This parameter when set allows the user to increase the HP scaling (burden) resistors by a factor of 1.6. The software scales the current feedback differently to compensate for the change in burden values.
When parameter #05.29 is set and the burdens have been changed, the minimum ripple of 0.6V on terminal 11 occurs at a feedback value of 38 in parameter #05.01 or 5.7% of drive rating.
Setting parameter #05.29 also changes the range of parameter #05.15 such that it does not have to be set close to its maximum value of 255 when continuous conduction occurs at such low currents.
Default 0

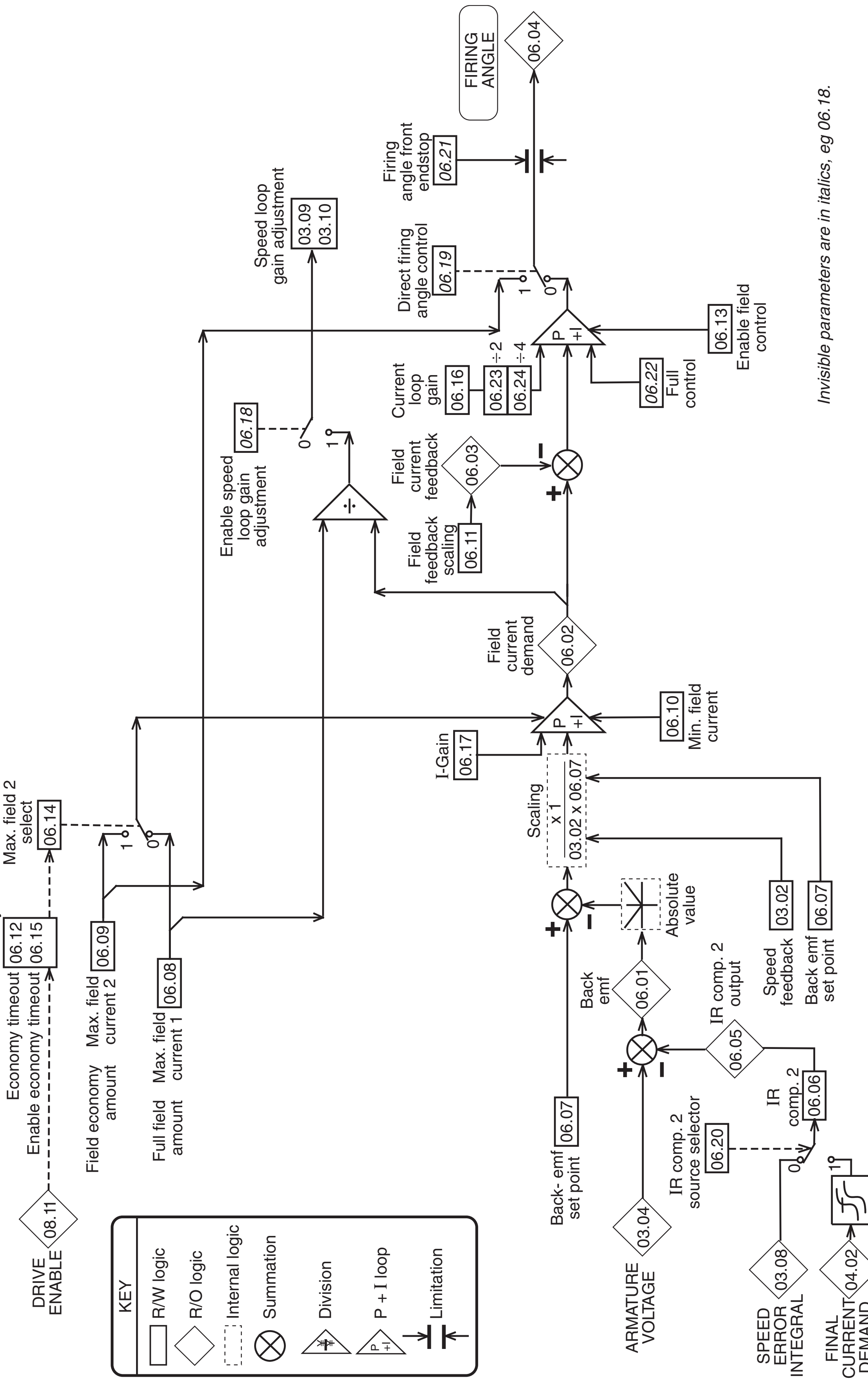


Figure 10-14. Menu 06—Field Control

10.7.6 MENU 06 — Field Control

Refer to Figure 10-14.

The Quantum III has an 8 amp field regulator standard on all Size 1 units from 9500-8X02 through 9500-8X06. For higher HP units (Size 2 and 3) or fields requiring up to 20 amps, the FXM5 Field Control should be used. **If a Size 2 or Size 3 Drive is being used WITHOUT an FXM5, this menu does not apply.**

Provision is made for programming two selectable values of maximum field current. The higher value (06.08) is used to set base speed current when used as a field current regulator. The lower value of maximum field current (6.09) can be configured by a programmable timer (06.12/06.15) so that, when the drive is not running, the field can be switched automatically into the field economy mode.

The resulting field current demand is summed algebraically with the field current feedback to produce a current error which is the input to the field current loop. The output of the field current loop is the firing angle, subject to the front endstop limit (06.21). The front endstop is defaulted to 815 to prevent field overcurrent and potential roast-out.

The field current can alternatively be controlled directly by either of the maximum field parameters 06.08 and 06.09 via a programmable input or by application software. There is a facility (06.19) for direct control of the firing angle, useful for diagnosis.

The principal inputs in spillover mode are, from the internal logic, the armature voltage and a set point for back-emf.

Field current demand is the output of the back-emf voltage loop, subject to programmed maximum (06.08 or 06.09) and minimum (06.10) field current values. The voltage loop compares the calculated back-emf value with a programmed set point which is used as factor in determining field current demand. The voltage loop output, and consequently the field current demand, is maximum when the calculated back-emf is less than the setpoint value. When the calculated value exceeds the set point value (at base speed) the voltage loop reduces the field current demand to regulate the calculated back-emf to the set point value.

Alternatively, the user may wish not to use the voltage loop, but to enter a current demand directly. The user can set two maximum field current parameter values. In this mode, the value of the back-emf set point should be set to maximum, such that the voltage loop always demands maximum field current. The current demand is then the selected maximum field current parameter.

06.01 RO Back EMF

Range 0 to 1000

The calculated motor back emf based on armature voltage minus IR compensation value 2, 06.05. Feedback to the emf loop in spillover mode.

06.02 RO Field Current Demand

Range 0 to 1000

The current demand from the emf loop, subject to the limits of 06.08, 06.09 and 06.10.

06.03 RO Field Current Feedback

Range 0 to 1000

Feedback to the field current loop.

06.04 RO Firing Angle

Range 261 to 1000

Scaling —

06.04 = 1000 corresponds to 'fully phased forward'

06.05 RO IR Compensation 2 Output

Range ±1000

The value resulting from the application of 06.06 to the speed error integral input.

06.06 R/W IR Compensation 2

Range 0 to 255

A programmable factor used for calculation of the armature IR-drop as correction to measured armature voltage, to enable the back emf to be computed.

$$06.05 = \frac{(03.08) \times (06.06)}{2048}$$

Default 000

***06.07** R/W Back EMF Set Point

Range 0 to 1000

The programmable value of the armature back emf in volts, at which the field begins to weaken. Defined as the voltage at which base speed is reached.

Default 1000 (Quantum factory default)

---

*Refer to paragraph 10.4.2.

06.08 R/W Maximum Field Current 1
Range 0 to 1000
Programmable value of the maximum current demand of the emf loop. If the field control is to be used in current mode, this parameter would become the current reference of the field control loop, and the back emf set point should normally be set to maximum to prevent spillover occurring; alternatively, if motor overvoltage protection by spillover is required, the back emf set point should be set to maximum armature voltage.
Default +1000 = 100% of 6.11 setting

06.09 R/W Maximum Field Current 2
Range 0 to 1000
Alternative to 06.07, for use as an economy setting. Refer to 06.12, 06.14 and 06.15.
Default + 500 = 50% of 6.11 setting

06.10 R/W Minimum Field Current
Range 0 to 1000
The minimum value of current demand, to prevent excessive field weakening, for example with overhauling loads.
Default + 500 = 50% of 6.11 setting

06.11 R/W Field Feedback Scaling
Range 0 to 255
The MDA3 card has a fixed scaling resistor. Parameter 06.11 permits the user to apply a scaling factor to the current feedback. Output is the value of 06.03.
Default +204 2 Amps Max. if range jumper in 2A position.

06.11 SETTING	MDA3 J1 POSITION	MDA3 MAX. AMPS
201	2A	0.5
202	2A	1
203	2A	1.5
204	2A	2
205	8A	2.5
206	8A	3
207	8A	3.5
208	8A	4
209	8A	4.5
210	8A	5
211	8A	5.5
212	8A	6
213	8A	6.5
214	8A	7
215	8A	7.5
216	8A	8

This table is applicable for Size 1 Quantum III's only.

For FXM5 Issue 1 and Drive Software ≥ 4.0.0
For FXM5 Issue 2 and Drive Software ≥ 4.2.0

MAXIMUM CURRENT (A)	PRIMARY TURNS N_p	LK1 POSITION		PARAM. 6.11
		20 N_p	15 N_p	
1	10		•	1
2	10	•		2
3	5		•	3
4	5	•		4
5	4	•		5
6	3	•		6
7	2	•		7
8	2	•		8
9	2	•		9
10	2	•		10
11	1		•	11
12	1		•	12
13	1		•	13
14	1		•	14
15	1		•	15
16	1	•		16
17	1	•		17
18	1	•		18
19	1	•		19
20	1	•		20

See FXM5 User Guide for more details.

The Quantum III can also be used with an external FXM5 field regulator capable of a maximum current of 20 amps. Refer to the FXM5 Instruction Manual for DC current transformer scaling and LK1 position.

NOTE
Software revision 4.2 or greater requires an FXM5 Revision 2 or greater. LK1 on the Quantum III power board must be cut when using the FXM5. See Fig. 12-4.

06.12 R/W Field Economy Timeout
Range 0 to 255
Permits the drive to be configured to select maximum field 2 (a reduced setting) automatically after the drive has been disabled for a period (in seconds) defined by the value chosen for this parameter. Provided so that the windings do not overheat if the drive is stopped and the motor ventilation is switched off, or to maintain a reduced level of field current to prevent condensation when the motor is not in use.

Default 030 Seconds

06.13 R/W Enable Field Control
Enables internal software control of the field current regulator. Must be set = 1 to permit Menu 6 parameters to function.
Default 0, disabled

06.14 R/W Maximum Field 2 Selector
Set to 1 to engage maximum field 2. Controlled automatically by field economy timeout function if 06.15 is set to 1. Maximum field 2 is selected after a time delay (refer to 06.12) when a drive disable signal is given.
Default 0, disabled

***06.15** R/W Enable Field Economy Timeout
When enabled (=1), parameter 06.14 is automatically controlled by the field economy timeout function when a drive enable signal is removed. When the timeout is disabled, parameter 06.14 becomes user R/W.
Default 1, enable (Quantum factory setting)
0, disabled (Drive default)

06.16 R/W Field Time-Constant Selector
set 06.16=1 for time constant > 0.3 sec.
set 06.16=0 for time constant < 0.3 sec.
(default)
Default 1, disabled

06.17 R/W Voltage Loop Integral Gain
Set 06.17 = 1 to double the integral gain if less overshoot is desired.
Default 0, disabled

***06.18** R/W Enable Speed Gain Adjustment*
This parameter adjusts the speed loop gains (menu 03) to compensate for the weakening of the field flux in field control mode so that the torque response remains substantially constant throughout the whole speed range. Defined as—

$$G = \frac{06.08}{06.02}$$

Where G = Speed loop gain adjustment factor
Default 0, disabled

***06.19** R/W Direct Firing Angle Control*
Enables 06.09 to control the firing angle directly, subject only to the front endstop. Permits operation without the voltage or the current loop, for the purpose of setup and troubleshooting.

Default 0, disabled

CAUTION

In this mode, there is no protection against excessive field voltage and current.

***06.20** R/W Alternative IR Comp. 2 Selector*
Determines the source of the IR Compensation 2. The source selection may be either the Speed Error Integral (03.08) or the Final Current Demand (04.02).
Default 0, 03.08 1=04.02 Current Demand

****06.21** R/W Firing Angle Front Endstop*
Range 0 to 1000
Restricts the advance of the firing angle in cases where 180° advance would result in overvoltage being applied to the field windings.
Default 815 (Quantum factory setting)
1000 (Drive default)

***06.22** R/W Full or Half Control Selector*
Provides the option of full or half control. Available only with the FXM5 Field Controller. Please refer to the FXM5 Manual for complete details.
Default 0, half control

Full control only for fast field weakening

***06.23** RWB Reduce Gain by Factor 2*
When enabled, reduces field loop current gain by a factor of 2. Can be used with 6.24 to reduce gains by a factor of 8.
Default 0

***06.24** RWB Reduce Gain by Factor 4*
When enabled, reduces field loop current gain by a factor of 4. Can be used with 6.23 to reduce gains by a factor of 8.
Default 0

10.7.7 MENU 07 — Analog Inputs & Outputs

Refer to Figure 10-15.

Scaling parameters have a multiplying range from 0.001 to 1.999 (a multiplier of 0 would give the parameter a zero value).

Source and Destination parameters define a parameter to be used as either input or output, thereby defining the function of the programmable input and output terminals.

Menu 07 contains three analog-input/output groupings. There are two separate groups of analog input. The first is a 12-bit analog input which is normally used as the speed reference input and assigned to TB1-3 (see Figure 10-3), but can alternatively be programmed to any real R/W destination.

High accuracy is achieved by voltage-to-frequency conversion. The terminal can be programmed as a voltage input or as a current loop input, with options 0-20mA, 20-0mA, 4-20mA, or 20-4mA. A reference encoder can also be selected as the speed reference input. This reference is scaled by 07.20 and sent to its destination by 07.15. The default is 01.17 which is the speed reference for the drive.

The second group provides a flexible means for scaling and assigning destinations to the four general purpose inputs GP1, GP2, GP3 and GP4, all of which are 10-bit resolution.

The third group consists of three analog outputs, via digital-to-analog (DAC) converters, featuring programmable-source parameters and scaling.

Finally, read only parameters are available for heatsink temperature (07.02) and RMS input voltage (07.06).

07.01 RO General Purpose Input 1
Range ±1000
Displays the value of the analog signal applied to terminal TB1-04. Can be used as a general-purpose input for monitoring, or for Processor 2 special applications. 10-bit bipolar

---

07.02 RO General Purpose Input 2
Range ±1000
Displays the value of the analog signal applied to terminal TB1-05. Can be used as a general-purpose input for monitoring, or for Processor 2 special applications. 10-bit bipolar

---

07.03 RO General Purpose Input 3
Range ±1000
Displays the value of the analog signal applied to terminal TB1-06. Can be used as a general-purpose input for monitoring, or for Processor 2 special applications. 10-bit bipolar

---

07.04 RO General Purpose Input 4
Range ±1000
Displays the value of the analog signal applied to terminal TB1-07. Can be used as a general-purpose input for monitoring, or for Processor 2 special applications. 10-bit bipolar

---

07.05 RO Speed Reference Input
Range ±1000
Displays the value of the analog speed demand at terminal TB1-03, or master encoder reference via PL4, and after scaling by *07.24*; dependent on reference mode being selected by *07.25*. 12-bit bipolar

---

07.06 RO RMS Input Voltage
Range 0 to 1000
Monitors the value of the voltage applied to line input terminals L1, L2, L3 (the SCR supply).

07.07 RO Heatsink Temperature
Range 0 to 100
Monitors the temperature of the SCR heatsink on those drives with installed thermistors. Readout is in degrees celsius. 100 = 100C

07.08 R/W DAC 1 Source
Range 0 to 1999
Selects the source of analog output 1 via terminal TB2-12. Default value 201 = 02.01, ramp output.
Default 201

07.09 R/W DAC 2 Source
Range 0 to 1999
Selects the source of analog output 2 via terminal TB2-13. Default value 302 = 03.02, speed feedback.
Default 302

07.10 R/W DAC 3 Source
Range 0 to 1999
Selects the source of analog output 3 via terminal TB2-14. Default value 304 = 03.04, armature voltage.
Default 304

NOTE
Concerning the following "invisible" parameters, **scaling parameters** have a multiplying range from 0.000 to 1.999. **Source and Destination parameters** define a parameter to be used as either input or output, thereby defining the function of the programmable input and output terminals.

***07.11** R/W GP 1 Destination*
Range 0 to 1999 (see appendix D)
Selects the destination of analog input 1 via terminal TB1-04. Default value 318=03.18, hard speed reference.
A changed value becomes effective only when the RESET pushbutton is pressed.
Default 318

****07.12** R/W GP 2 Destination*
Range 0 to 1999 (see appendix D)
Selects the destination of analog input 2 via terminal TB1-05. Default value 408=4.08, speed reference 3.
A changed value becomes effective only when the RESET pushbutton is pressed.
Default 119 (factory default)

****07.13** R/W GP 3 Destination*
Range 0 to 1999 (see appendix D)
Selects the destination of analog input 3 via terminal TB1-06. Default value 119=01.19, speed reference 4.
A changed value becomes effective only when the RESET pushbutton is pressed.
Default 120 (factory default)

***07.14** R/W GP 4 Destination*
Range 0 to 1999 (see appendix D)
Selects the destination of analog input 4 via terminal TB1-07. Default value 120=1.20, torque reference.

A changed value becomes effective only when the RESET pushbutton is pressed.
Default 408

***07.15** R/W Speed Reference Destination*
Range 0 to 1999
Selects the destination of speed reference 07.05. Default value 117=01.17, speed reference 1.

A changed value becomes effective only when the RESET pushbutton is pressed.
Default 117

***07.16** R/W GP 1 Scaling*
Range 0 to 1999
Sets the scaling for the signal from source GP1 via terminal TB1-04.

$$\text{Scaling factor} = \frac{07.16}{1000}$$

Default +1000 = x 1.000

***07.17** R/W GP 2 Scaling*
Range 0 to 1999
Sets the scaling for the signal from source GP2 via terminal TB1-05.

$$\text{Scaling factor} = \frac{07.17}{1000}$$

Default +1000 = x 1.000

***07.18** R/W GP 3 Scaling*
Range 0 to 1999
Sets the scaling for the signal from source GP3 via terminal TB1-06.

$$\text{Scaling factor} = \frac{07.18}{1000}$$

Default +1000 = x 1.000

***07.19** R/W GP 4 Scaling*
Range 0 to 1999
Sets the scaling for the signal from source GP4 via terminal TB1-07.

$$\text{Scaling factor} = \frac{07.19}{1000}$$

Default +1000 = x 1.000

***07.20** R/W Speed Reference Scaling*
Range 0 to 1999
The factor by which 07.05 is multiplied to produce the speed reference. Used to set maximum speed under defaults after feedback has been scaled.

$$\text{Scaling factor} = \frac{07.20}{1000}$$

Default +1000 = x 1.000

*Refer to paragraph 10.4.2.

***07.21** R/W DAC 1 Scaling*
Range 0 to 1999
Sets the scaling for the signal output to DAC1 TB2-12.

$$\text{Scaling factor} = \frac{07.21}{1000}$$

Default +1000 = x 1.000

***07.22** R/W DAC 2 Scaling*
Range 0 to 1999
Sets the scaling for the signal output to DAC2 TB2-13.

$$\text{Scaling factor} = \frac{07.22}{1000}$$

Default +1000 = x 1.000

***07.23** R/W DAC 3 Scaling*
Range 0 to 1999
Sets the scaling for the signal output to DAC3 TB2-14.

$$\text{Scaling factor} = \frac{07.23}{1000}$$

Default +1000 = x 1.000

***07.24** R/W Reference Encoder Scaling*
Range 0 to 1999
Sets the scaling for signals from the reference encoder connected to terminal socket PL4. The value should be set to correspond with the maximum speed of the motor and with the number of lines-per-revolution of the encoder. To calculate the scale factor—

$$\text{Scaling factor} = \frac{750 \times 10^6}{N \times n}$$

where N = number of lines-per-revolution (encoder)
n = max speed of motor in rpm.

Default value is determined on the basis of a 1024-line encoder, and a maximum speed of 1750 rpm.
Default +419

***07.25** R/W Reference Encoder Selector*
Selects either the analog signal at terminal TB1-03 or the encoder input via PL4 as the source of speed reference signal.
Default 0, analog reference selected

***07.26** R/W Voltage /Current loop selector*
Configures the speed input terminal (TB1-03) to accept either a voltage or a 20mA current input signal.
Default 0, voltage input selected

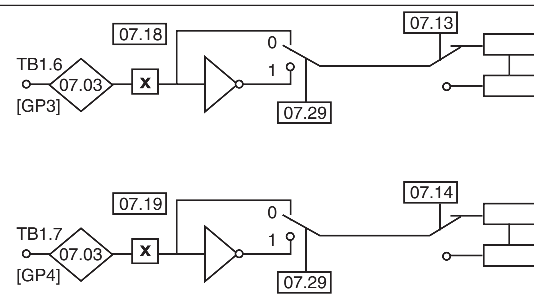
***07.27** R/W 20mA Current Loop Mode Selector 1*
In conjunction with 07.28, configures 20mA current loop input. Refer to table on 07.28.
Default 0

***07.28** R/W 20mA Current Loop Mode Selector 2—Offset Selector*
In conjunction with 07.27, configures 20mA current loop input. Refer to table. When a 4mA offset is used, the drive trips if it senses that the current is <3.5mA—indicating “loop open”.
Default 1

CURRENT LOOP INPUT SELECTION

INPUT	07.28	07.27
0-20mA	0	0
20-0mA	0	1
4-20mA	1	0
20-4mA	1	1

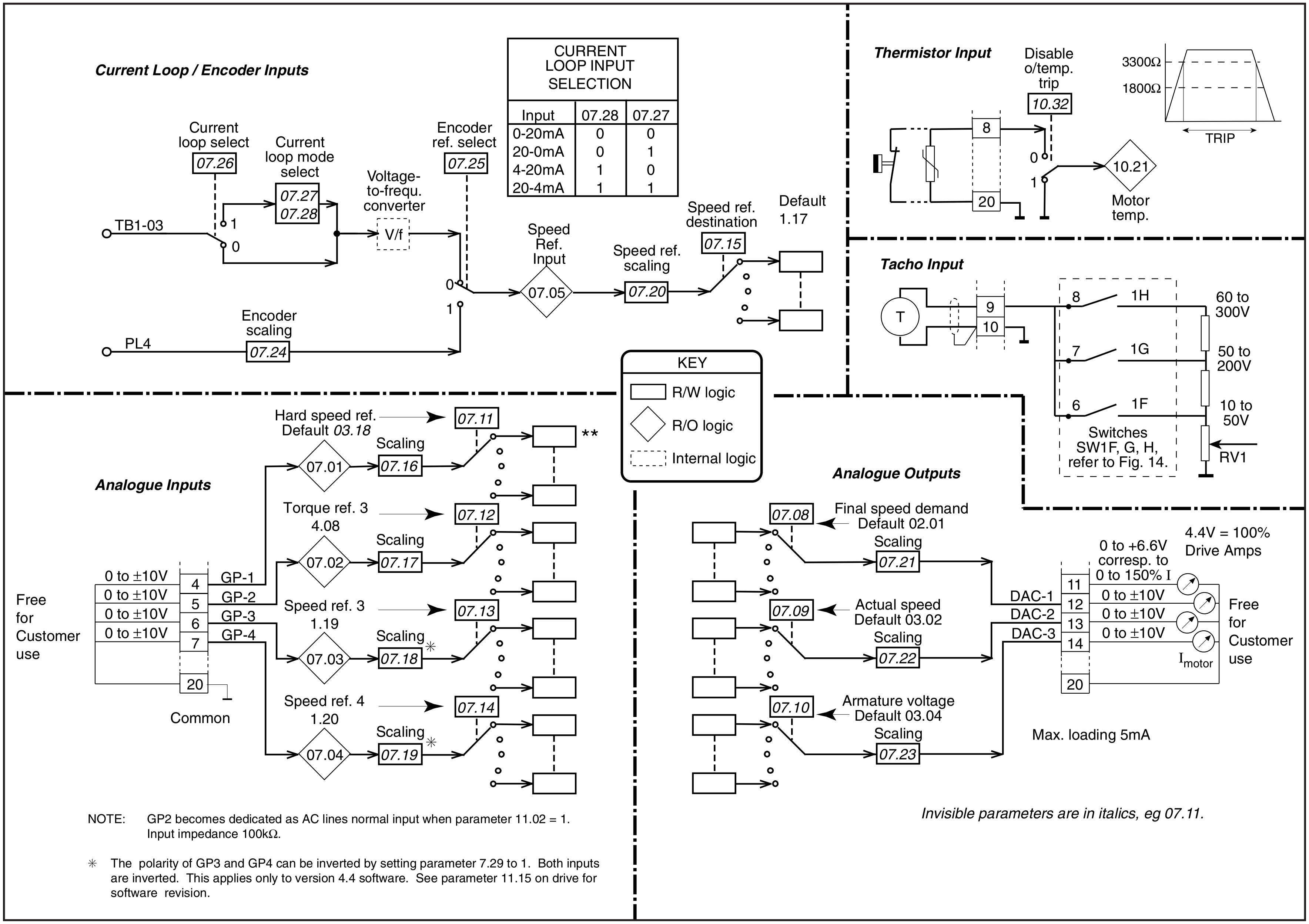
***07.29** Invert Sign GP3, GP4 (for firmware revisions* ≥ 4.05.0
The R/O parameters (07.03 & 07.04) are not affected by the setting of the parameter
However, the destinations programmed by the 07.13 and 07.14 will have an opposite sign to the analogue input if the destination parameter range allows this.
Default 0



Parameters not addressable by Analog Inputs

The five analog inputs of the Quantum III can direct their readings to a great many drive registers (via 7.11-7.15) but there are some exceptions. The destinations of their bi-polar data **cannot** be directed to: **Read Only Parameters, Bit Parameters, or Parameters having a range of 0 - 255.** In addition, the following Parameters **cannot** be used:

2.02 *to* 2.12; **3.15** and **3.16**; **5.05**; **6.21**; **7.08 *to* 7.23**; **9.07**, **9.09**, **9.13**, **9.15**, **9.19**, **9.21**, **9.23**, **9.25**; **11.01 *to* 11.10**, **11.18 *to* 11.20**; **12.03**, **12.07**, **12.08**, **12.12**; **13.14**; and **15.60 *to* 15.63**.



** See appendix D

Figure 10-15.
Menu 07—Analog Inputs & Outputs

10.7.8 MENU 08—Logic Inputs

Refer to Figure 10-16.

Scaling parameters have a multiplying range from 0.001 to 1.999 (a multiplier of 0 would give the parameter a zero value).

Source and Destination parameters define a parameter to be used as either input or output, thereby defining the function of the programmable input and output terminals.

Menu 8 contains three (3) separate input groups.

The first group is dedicated to normal drive sequencing and cannot be reassigned. It consists of:

LOCATION	PARAMETER	FUNCTION
TB3-21	08.01	Run Permit
TB3-22	08.02	Run Permit
TB3-23	08.03	Jog
TB3-31	08.11	Enable

The second group is not assigned and is freely user programmable. It consists of:

LOCATION	PARAMETER	FUNCTION
TB3-27	08.07	Unassigned
TB3-28	08.08	Unassigned
TB3-29	08.09	Unassigned
TB3-30	08.10	Unassigned

The third group is used for common drive functions and is driven by relay contacts from the 9500-4025 AC interface board. Their function may be reprogrammed to other functions via the jumpers on the 9500-4030 board.

LOCATION (9500-4025)	PARAMETER	ASSIGNED FUNCTION
TB1-11	08.04	Fwd/Rev
TB1-12	Dedicated	Drive Reset
TB3-1 on MDA2	08.06	External Trip

NOTE

Refer to Section 9 on control logic interface for a complete description of F1 through F6 input.

08.01 RO F1 Input — Run Permit
0 = stop drive
1 = start enabled
Monitors the drive start-permit control input from terminal TB3-21 and indicates status. This input performs an over-riding drive stop function in speed control mode as follows —

The input must be active to permit a drive start
If the input becomes inactive, 08.01 causes the pre-ramp reference 01.03 to be set to zero.
The drive will stop unless 02.03, ramp hold, is active.

08.02 RO F2 Input — Reference On
0 = input not active 1 = input active
Monitors the control input from terminal TB3-22 and indicates status. TB2-22 is tied to TB2-21.

08.03 RO F3 Input — Default Jog/ Inch Forward
0 = input not active 1 = input active
Monitors the control input from terminal TB3-23 and indicates status.

08.04 RO F4 Input — Default Reverse
0 = input not active 1 = input active
Monitors the control input from terminal TB3-24 and indicates status.

08.05 RO F5 Input — Default Reference #3
0 = input not active 1 = input active
Monitors the control input from terminal TB3-25 and indicates status.

08.06 RO F6 Input — External Trip
0 = input not active 1 = input active
Monitors the control input from terminal TB3-26 and indicates status.

08.07 RO F7 Input — User-Programmable— Unassigned
0 = input not active 1 = input active
Monitors the control input from terminal TB3-27 and indicates status.

08.08 RO F8 Input — User-Programmable—Unassigned
0 = input not active 1 = input active
Monitors the control input from terminal TB3-28 and indicates status.

08.09 RO F9 Input — User-Programmable—Unassigned
0 = input not active 1 = input active
Monitors the control input from terminal TB3-29 and indicates status.

08.10 RO F10 Input — User-Programmable—Unassigned
0 = input not active 1 = input active
Monitors the control input from terminal TB3-30 and indicates status.

08.11 RO Drive Enable Input—Dedicated
0 = disable 1 = enable
Monitors the drive enable input from terminal TB4-31 and indicates status. Input must be active for the drive to operate. When the drive is disabled by disconnecting the input, all firing pulses are switched off after a 30msec delay. If the drive is running when this occurs, the result is a coast-stop and ramps reset.

****08.12*** *R/W F2 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-22. Effective *only* after RESET.
Default 111 (Quantum factory setting)
+000 (drive default)

****08.13*** *R/W F3 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-23. Effective *only* after RESET.
Default 113 (Quantum factory setting)
+000 (drive default)

****08.14*** *R/W F4 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-24. Effective *only* after RESET.
Default 112 (Quantum factory setting)
+000 (drive default)

---

*Refer to paragraph 10.4.2.

****08.15*** *R/W F5 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-25. Effective *only* after RESET.
Default 115 (Quantum factory setting)
+000 (drive default)

****08.16*** *R/W F6 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-26. Effective *only* after RESET.
Default 1034 (Quantum factory setting)
+000 (drive default)

08.17 *R/W F7 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-27. Effective *only* after RESET.
Default +000

08.18 *R/W F8 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-28. Effective *only* after RESET.
Default +000

08.19 *R/W F9 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-29. Effective *only* after RESET.
Default +000

08.20 *R/W F10 Destination*
Range 0 to 1999
Defines the destination of external logic input at terminal TB3-30. Effective *only* after RESET.
Default +000

****08.21*** *R/W Disable Normal Logic Functions*
If set to enable (=0), this parameter configures logic inputs as follows—

F2	TB3-22	Inch Reverse
F3	TB3-23	Inch Forward
F4	TB3-24	Run Reverse
F5	TB3-25	Run Forward

If set to disable (=1), the logic inputs must be programmed by the user. Refer to 08.31 through 08.34.

If *08.21* = 0, F2/3/4/5 still perform their programmed functions.
Default 1 = disable normal logic functions
0 (factory default)

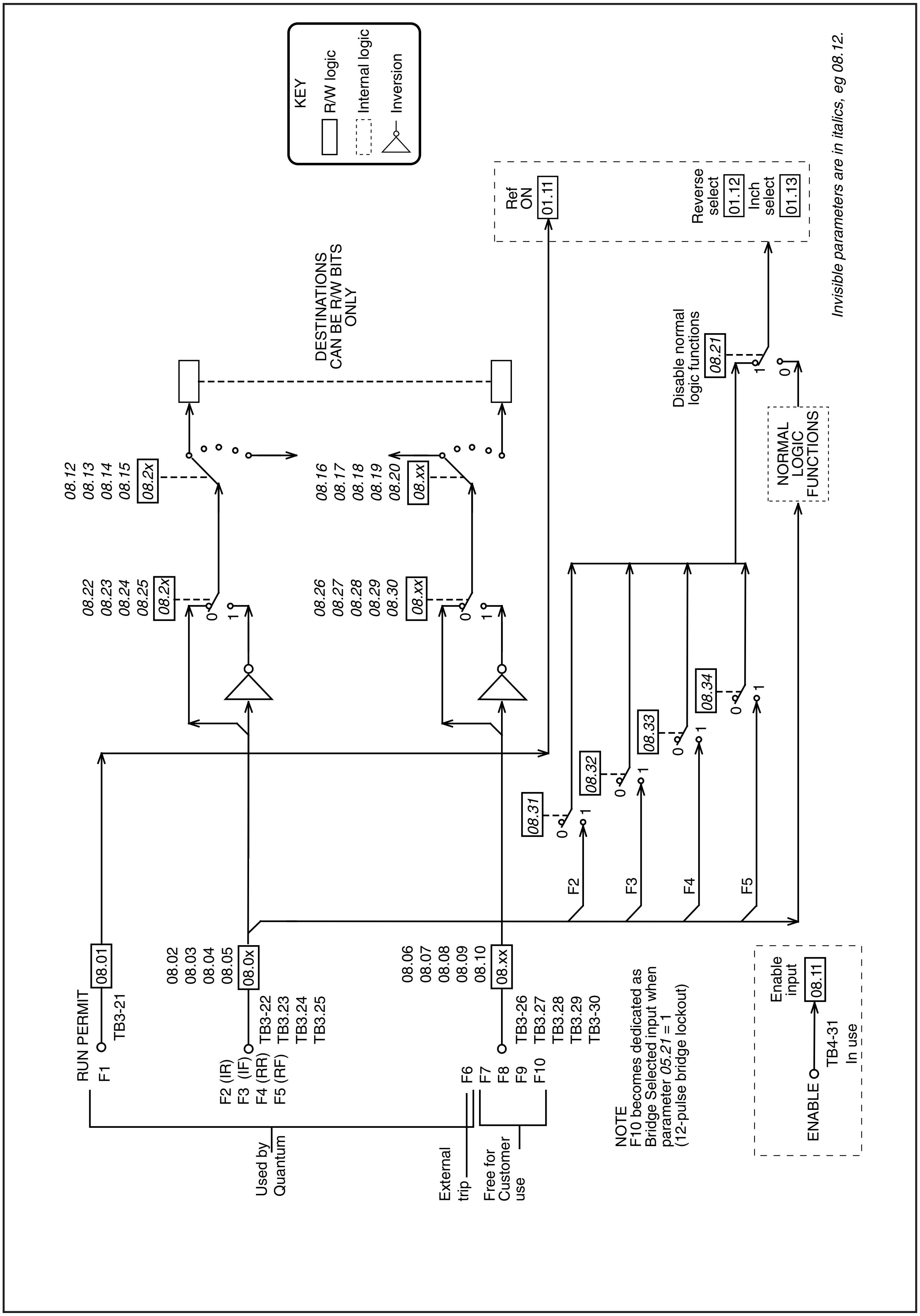


Figure 10-16.
Menu 08—Logic Inputs

***08.22** R/W Invert Logic Function of F2*
0 = non-invert 1 = invert
Default 0

***08.23** R/W Invert Logic Function of F3*
0 = non-invert 1 = invert
Default 0

***08.24** R/W Invert Logic Function of F4*
0 = non-invert 1 = invert
Default 0

***08.25** R/W Invert Logic Function of F5*
0 = non-invert 1 = invert
Default 0

***08.26** R/W Invert Logic Function of F6*
0 = non-invert 1 = invert
Default 0

***08.27** R/W Invert Logic Function of F7*
0 = non-invert 1 = invert
Default 0

***08.28** R/W Invert Logic Function of F8*
0 = non-invert 1 = invert
Default 0

***08.29** R/W Invert Logic Function of F9*
0 = non-invert 1 = invert
Default 0

***08.30** R/W Invert Logic Function of F10*
0 = non-invert 1 = invert
Default 0

****08.31** R/W Enable Inch Reverse*
0 = not enable 1 = Enable inch reverse
When 08.21 = 1, normal logic functions disabled, 8.31 can enable inch reverse.
Default 0

****08.32** R/W Enable Inch Forward*
0 = not enable 1 = Enable inch forward
When 08.21 = 1, normal logic functions disabled, 08.32 can enable inch forward.
Default 0

****08.33** R/W Enable Run Reverse*
0 = not enable 1 = Enable run reverse
When 08.21 = 1, normal logic functions disabled, 08.33 can enable run reverse.
Default 0

****08.34** R/W Enable Run Forward*
0 = not enable 1 = Enable run forward
When 08.21 = 1, normal logic functions disabled, 08.34 can enable run forward.
Default 0

**** Not applicable to Quantum III***

10.7.9 MENU 09—Status Outputs

Status outputs (refer to Figure 10-17) will switch five open collector transistors, each user programmable, and two relays. The drive ready is dedicated and cannot be changed. The other relay is defaulted to zero speed, but is user programmable to any other parameter. Menu 9 contains three status source groups and each is invertible.

The first group allows the status 1 inputs from source 1 and source 2 to be combined into logic gates (OR, NOR, AND, NAND) to form PC logic. The result can be subjected to a time delay that is, in effect, in 0-1 transactions but immediate without delay in 1-0 transactions. An output is available at TB2-15. The process is duplicated with status 2 inputs and the output is at TB2-16. (For more information and application examples on using logic gates and timers, see Application Notes CTAN-122, -140 and -141, which are available at www.ctdrives.com/downloads.)

The second group selects parameters from sources ST2, ST3, and ST4 for output at terminals TB2-17, -18, and -19.

The third group selects parameters from sources ST6 and drives the form C relay at terminals TB3-35, 36, and 37.

09.01 RO Status 1 Output
Range 0 to 1
Status 1 output ST1 to TB2-15.

09.02 RO Status 2 Output
Range 0 to 1
Status 2 output ST2 to TB2-16

09.03 RO Status 3 Output
Range 0 to 1
Status 3 output ST3 to TB2-17.

09.04 RO Status 4 Output
Range 0 to 1
Status 4 output ST4 to TB2-18.

09.05 RO Status 5 Output
Range 0 to 1
Status 5 output ST5 to TB2-19.

09.06 RO Status 6 Relay Output
Range 0 to 1
Output to form C relay at terminals TB4-34,35,36
1 = Relay on

09.07 *R/W Status 1 Source 1*
Range 0 to 1999
Selects the status source to be combined with 9.09 and displayed on TB2-15.
Default +111

09.08 *R/W Invert Status 1 Source 1*
Range 0 to 1
Selects inversion of input on 9.07.
Default 0 (non-invert)

09.09 *R/W Status 1 Source 2*
Range 0 to 1999
Selects the status source to be combined with 9.07 and displayed on TB2-15.
Default 000

09.10 *R/W Invert Status 1 Source 2*
Range 0 to 1
Selects inversion of input on 9.09.
Default 0 (non-invert)

09.11 *R/W Invert Status 1 Output*
Range 0 to 1
Selects inversion of combination of 9.07 and 9.09.
Default 0 (non-invert)

09.12 *R/W Status 1 Delay*
Range 0 to 255 (sec.)
Sets delay time for status 1 output.
Default 0

09.13 *R/W Status 2 Source 1*
Range 0 to 1999
Selects the status source to be combined with 9.15 and displayed on TB2-16.
Default 1007

09.14 *R/W Invert Status 2 Source 2*
Range 0 to 1
Selects inversion of input on 9.13.
Default 0 (non-invert)

09.15 *R/W Status 2 Source 2*
Range 0 to 1999
Selects the status source to be combined with 9.13 and displayed on TB2-16.
Default 000

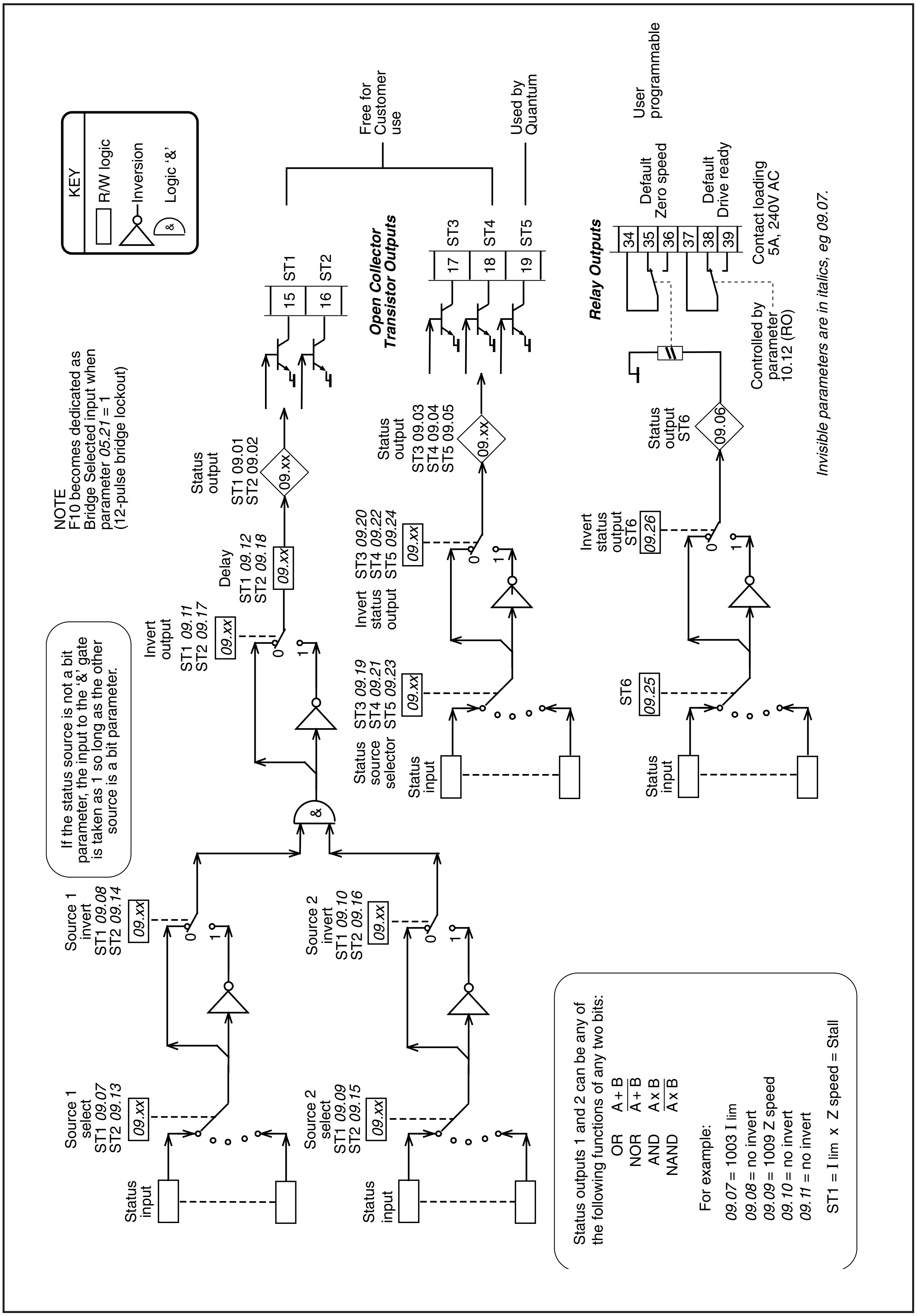


Figure 10-17.
Menu 09—Status Outputs

09.16 *R/W Invert Status 2 Source 2*
Range 0 to 1
Selects inversion of input on 9.15.
Default 0 (non-invert)

09.17 *R/W Invert Status 2 Output*
Range 0 to 1
Selects inversion of combination of 9.13 and 9.15.
Default 0 (non-invert)

09.18 *R/W Status 2 Delay*
Range 0 to 255 (sec.)
Sets delay time for status 2 output.
Default 0

09.19 *R/W Status 3 Source*
Range 0 to 1999
Selects the status source to be displayed on TB2-17.
Default 1013 Overload alarm
User programmable

09.20 *R/W Invert Status 3 Output*
Range 0 to 1
Default 0 (non-invert)

09.21 *R/W Status 4 Source*
Range 0 to 1999
Selects the status source to be displayed on TB3-18.
Default 1003 In current limit
User programmable

09.22 *R/W Invert Status 4 Output*
Range 0 to 1
Default 0 (non-invert)

09.23 *R/W Status 5 Source*
Range 0 to 1999
Selects the status source to be displayed on TB3-19.
Default 1006 Phase back
In use by Quantum

****09.24*** *R/W Invert Status 5 Output*
Range 0 to 1
Default 1 (invert)
0 (factory default)

09.25 *R/W Status 6 Source—Relay Output*
Range 0 to 1999
Selects the status to activate relay to TB4-34,35,36
Default 1009 (Zero Speed)
User programmable

09.26 *R/W Invert Status 6 Output*
Range 0 to 1
Default 0 (non-invert)

10.7.10 MENU 10 — Status Logic & Diagnostic Information

All real (not bit) RO parameters are frozen at the instant of tripping as an aid to diagnosis of the fault. They remain in this condition until the drive is reset. The last four faults are stored in 10.25 through 10.28 to form a fault history.

10.01 RO Forward Velocity
0 = drive stationary or running in reverse
1 = drive running forward at >zero speed threshold
Forward direction defined as —

When tach feedback selected, terminal TB1-09 negative with respect to terminal TB1-10.

When armature voltage feedback selected, terminal A1 positive with respect to terminal A2.

When encoder feedback selected, A-channel leads B-channel.

10.02 RO Reverse Velocity
0 = drive stationary or running forward
1 = drive running in reverse at >zero speed threshold
Reverse direction defined as follows —

When tach feedback selected, terminal TB1-09 positive with respect to terminal TB1-10.

When armature voltage feedback selected, terminal A1 negative with respect to terminal A2.

When encoder feedback selected, A-channel lags B-channel.

NOTE

If 10.01 = 10.02 = 0, the motor is either stationary or running at <zero speed threshold. In this condition, 10.09 = 1 and the Zero Speed LED lights on the keypad (and RL2 is turned on, if programmed to show zero speed).

10.03 RO Current Limit
0 = drive not in current limit
1 = drive in current limit
Indicates that the sum of the current demand 04.01 and the offset 04.09 is being limited by the current limit over-ride 04.03 or by one of the bridge limits.

10.04 RO Bridge 1 Enabled
0 = disabled 1 = enabled
Indicates that SCR bridge 1 (the forward or positive bridge) is being fired. Does not necessarily indicate that the bridge is conducting, since conduction depends on firing angle and operating conditions.

10.05 RO Bridge 2 Enabled
0 = disabled 1 = enabled
Indicates that SCR bridge 2 (the reverse or negative bridge) is being fired. Does not necessarily indicate that the bridge is conducting, since conduction depends on firing angle and operating conditions.

10.06 RO Electrical Phase-Back
0 = firing pulses not phased back
1 = firing pulses phased back (at standstill)
Indicates that the firing pulses are being phased back by the action of the standstill function. Refer to 05.18 and 05.19.

10.07 RO At Speed
0 = drive not at speed 1 = drive at speed
Indicates that the drive has attained set speed, post-ramp reference 02.01 = pre-ramp reference 01.03, and that comparison of final speed demand 03.01 with speed feedback 03.02 results in a speed error of <1.5% of maximum speed. External signal also provided through open collector output ST2 to terminal TB2-16 if source parameter 09.13 is at default setting.

10.08 RO Overspeed
0 = motor not overspeeding
1 = motor over speed
Indicates that the speed feedback 03.02 > ±1000, that is, the speed is out of range, suggesting that the motor is being mechanically driven faster than the maximum speed of the drive. This function is a monitor only, and does not initiate a trip signal.

10.09 RO Zero Speed
0 = speed not zero 1 = zero speed
Set if speed feedback 03.02 < zero speed threshold 03.23. Refer to 10.01 and 10.02.

10.10 RO Armature Voltage Clamp Active
0 = clamp not active 1 = clamp active
Set when the armature voltage clamp is activated. Prevents the voltage from increasing further. Refer to 03.15.

10.11 RO Phase Rotation
0 = L1 L3 L2 1 = L1 L2 L3
Rotation is detected from L1, L2, L3.

NOTE that connection to E1 and E3 must also be correct — refer to the drawings shown in Figures A-1 through A-4 in Appendix A.

10.12 RO Drive Normal
1 = drive is powered-up and has not tripped.

10.13 RO Alarm
0 = no alarm condition present
1 = alarm condition present, impending sustained-overload trip
Indicates that the drive is in an overload condition and will eventually trip on sustained overload 10.18 if the overload condition is not removed. The time taken to trip is dependent on the settings of 05.06 and 05.07 and on the magnitude of overload.
Visual indication that the alarm has been actuated is given by the Alarm LED (flashing). External signal also provided through status logic output ST3 to terminal TB2-17—provided that source parameter 09.19 is its default value.

10.14 RO Field Loss
0 = field normal 1 = field failed
Indicates that no current is being drawn from the internal field supply (or the FXM5 optional external field control unit if installed).

10.15 RO Feedback Loss
0 = speed feedback present
1 = speed feedback absent or polarity reversed
Indicates no feedback signal, or reversed polarity. Applies to tachometer or encoder feedback, whichever is selected. Loss of feedback is not detected until the firing angle has advanced to the point where the value of 05.03 (firing angle) >767. This condition can be prevented from tripping the drive by disabling feedback loss detection 10.30.

10.16 RO Supply or Phase Loss
0 = normal 1 = supply/phase loss
Indicates loss of one or more input phases connected to L1, L2, L3. Can be disabled with 10.31.

10.17 RO Instantaneous Trip
0 = no overcurrent peak detected
1 = overcurrent peak detected
Indicates that a current peak >2 x (max. current according to the burden resistor installed) has occurred. Firing pulses are immediately suppressed, shutting the drive down.

10.18 RO Sustained Overload
0 = sustained overload not detected
1 = sustained overload detected
Indicates that current feedback 05.01 has exceeded the overload threshold 05.06 for a length of time determined by the overload time values 05.07 and 05.08 integrated with the magnitude of the overload (the conventional I x t function).

When the current exceeds the overload threshold, the excess integrates with time causing the value of the actual overload 05.11 to increase.

Conversely, if the current falls below the threshold during integration, the value of 05.11 falls towards zero. The rate of integration is set by 05.07 when the current is > threshold, and by 05.08 when the current is < threshold. The rate of integration is the trip time with full scale overload (05.01 = 1000). This function imitates the behavior of a thermal relay and simulates the thermal characteristic of a motor.

10.19 RO Processor 1 Watchdog
0 = normal 1 = trip
In normal operation of the drive, the watchdog timer is reset periodically by Processor 1 as a check that the processor and drive program are functioning normally. If a reset does not occur before the timer has timed out, the conclusion is either that the processor has failed or that the drive program has crashed. The result is immediate controlled shutdown of the drive, accompanied by a watchdog fault trip signal.

10.20 RO Processor 2 Watchdog
0 = normal 1 = trip

10.21 RO Motor Overtemperature
0 = normal 1 = trip
10.21 = 1 indicates trip detected at the motor thermistor input terminal.

trip level	3k
detector reset level	1.8k

10.22 RO Heatsink Overtemperature
0 = normal 1 = trip
10.22 = 1 indicates SCR heatsink overtemperature, >100°C (on drives installed with an SCR heatsink thermistor).

10.23 RO Speed Loop Saturated
0 = speed loop not saturated
1 = speed loop saturated
Indicates that the output of the speed loop algorithm, from which the current demand 04.01 is derived, is at a limit. This may be due to the application of a current limit or a zero-current clamp, and may occur if the motor is mechanically stalled.

10.24 RO Zero Current Demand
0 = current demand > 0
1 = current demand = 0
Indicates that the current demand signal is being limited to zero. This could occur, for example, as a result of a sudden loss of load, the drive being in torque control mode with speed over-ride. The speed could reach the set speed threshold as a consequence, causing the speed loop to reduce the current demand to zero.

HISTORICAL FAULT LOG

10.25 RO Last Trip
Range 0 to 255
Record of the last-trip code, forming the basis of a trip history. See Sec. 13.4 for trip code list.

10.26 RO The Trip Before the Last Trip (10.25)
Range 0 to 255
Record of the trip before that which is saved in 10.25.

10.27 RO The Trip Before 10.26
Range 0 to 255
Record of the trip before that which is saved in 10.26.

10.28 RO The Trip Before 10.27
Range 0 to 255
Record of the trip before that which is saved in 10.27.
The four parameters 10.25 to 10.28 provide a permanent memory of the last four trips. They are updated only by a new trip occurring.

10.29 *R/W Disable Field Loss Trip*
Prevents the drive from tripping when field loss is detected; for example, in applications where the internal field supply is not used (as with permanent magnet motors) or is switched off when the drive is not running.
Default 0, field loss trip enabled

10.30 *R/W Disable Feedback Loss Trip*
Prevents the drive from tripping when speed feedback loss is detected, for example, in certain load-sharing applications and in applications which do not involve motors, such as battery charging and other electrolytic processes.
Default 0, feedback loss enabled

10.31 *R/W Disable Supply or Phase Loss Trip*
Prevents the drive from tripping when supply or supply phase loss is detected, allowing the drive to ride through brief supply interruptions.
Default 0, supply/phase loss enabled

10.32 *R/W Disable Motor Overtemperature Trip*
Prevents the drive from tripping when motor temperature sensor input changes to high resistance, for example when motor overtemperature protection is used in the alarm mode, or to achieve a line normal stop.
Default 1, motor overtemperature trip disabled

10.33 *R/W Disable Heatsink Overtemperature Trip*
Prevents the drive from tripping when heatsink temperature sensor detects a temperature greater than 100°C, for example, when heatsink overtemperature protection is used in the alarm mode, or to achieve a system normal stop.
Default 0, heatsink overtemperature trip enabled
1, for models 9500-8X02,8X03

10.34 *R/W External Trip*
If 10.34 = 1, the drive trips. If an external trip is required, the user can program any logic input to control this bit (refer to Menu 08). Alternatively, it can be controlled by application software or through the serial interface.
Default 0

***10.35** R/W Processor 2 Trip*

Range 0 to 255
If the drive is normal, the data display for *10.35* is 0. The value of *10.35* is continuously monitored by the processor. The drive trips immediately if a non-zero value (other than 255) appears via the serial communications interface, or Processor 2 software.

If *10.35* = 255, this is the equivalent of a RESET.
Default 0

***10.36** R/W Disable Current Loop Loss Trip*
When 10.36 = 1, the trip which normally follows current loop loss is disabled.
Default 0

***10.37** R/W Disable Armature Open Circuit Trip*
(For firmware revisions ≥ 4.02.00)
When 10.37 = 1, the trip which normally follows armature open circuit is disabled. This is used for non-motor applications such as the drive being used as a front end bridge to an inverter.
Default 0

10.7.11 MENU 11— Miscellaneous

***User-Defined Menu**

Parameters 11.01 through to 11.10 define the parameters in the user-defined Menu 00. For example, if the user wishes parameter 00.01 to display speed in rpm (03.03), parameter 11.01 (corresponding to 00.01) should be set to 303. Other miscellaneous parameters are also defined.

The following parameters are programmed in the menu and can be changed at any time.

QUANTUM FACTORY SETTINGS

ACCESSED AT	PARAMETER DESCRIPTION	PARAMETER NUMBER
0.01	Armature Voltage	3.04
0.02	Armature Current	5.02
0.03	Motor RPM	3.03
0.04	Speed Reference	1.02
0.05	AC Line Voltage	7.06
0.06	Max Speed	1.06
0.07	Jog Speed	1.05
0.08	Forward Acceleration	2.04
0.09	Forward Deceleration	2.05
0.10	Current Limit	4.05

11.11 R/W Serial Address
Range 0 to 99
Defines the unique address of a drive when several are connected to common serial bus in a multidrop application. If set 100, the value is taken as 99.
Default 001

11.12 R/W Baud Rate
Range 0 to 1
Two Baud rates are available for the communications interface with the standard drives. Enter the 'setting' number appropriate to the required Baud rate as shown —

Baud	*Setting*
4800	0
9600	1

Default 0

---

*Refer to paragraph 10.4.2.

11.13 R/W Serial Mode
Range 1 to 4
Defines the mode of operation of the serial port. There are four modes. Enter the 'setting' number appropriate to the required mode as shown —

Mode	*Setting*
ANSI protocol	1
Output variable defined by 11.19	2
Input variable into parameter defined by 11.19	3
Wide integer (16-bit) driver	4

Mode 1 is for communication between the drive and another serial device (terminal, plc, computer).

Mode settings **2** and **3** are for rapid transfer of information between two drives, avoiding the need for analog signals to pass between them. For example, mode settings 2 and 3 could be used in a load-sharing application to output the current demand from one drive in Mode 2 and input a current demand to another in Mode 3.

In **Mode 4** the drive will output the wide integer 15.63 to the transmit lines, and put any received data into 15.62. This permits a digital reference to be transmitted down a line of drives, and offers the possibility of setting ratios at each stage. Data must be transferred from 15.62 to 15.63 by a BASIC program. If a Wide Integer is read from the serial comms interface, the data is sent as five ASCII characters with no sign. (The full range of parameters can be written by five ASCII characters if no sign is included.) Data is transferred by mode 4 at the rate of 3X mains frequency.
Default 001

11.15 RO Processor 1 Software Version
Range 0 to 255
Displays the revision number of the software installed in Processor 1. For example, version 4.10.0 is displayed as 410 (data window).

11.16 RO Processor 2 Software Version
Range 0 to 255
Reserved for processor 2 special application software (MD29 option PCB).

11.17 *R/W Level 3 Security Code*
Range 0 to 255
If this parameter is changed (to any value other than 0 or 149) and stored, the value set must be entered into parameter 0 to return the drive to its "as-delivered" state. Level 1 or 2 security must then be used in the normal way. If 11.17 is set = 0, all parameters are freely read-write, accessible without the need to enter a security code. To store, set parameter 00 = 1 and press RESET.
Default 149

11.18 *R/W Boot-up Parameter*
Range 0 to 1999
Used for setting the parameter displayed at the keypad at power-on. See Appendix B in the rear of this manual for additional info on this feature
Default +000

11.19 *R/W Serial Programmable Source*
Range 0 to 1999
Defines an output or input parameter when serial mode 2 or 3 is selected. Refer to 11.13.
Default +000

11.20 *R/W Serial Scaling*
Range 0 to 1999
Scales the input data in serial mode 3. Refer to 11.13.
Default +1000

11.21 *R/W LEDs Byte*
Range 0 to 255
Designations—

Bit 7	Alarm
Bit 6	Zero speed
Bit 5	Run forward
Bit 4	Run reverse
Bit 3	Bridge 1
Bit 2	Bridge 2
Bit 1	At speed
Bit 0	Current limit

The displayed value is the decimal equivalent of the bit-pattern.

11.22 *R/W Disable Normal LED Functions*
Disables the normal functions of the keypad LED indicators (with the exception of *Drive Ready*) and renders them programmable. By setting 11.22 = 1, normal LED functions (with the exception of *Drive Ready*) can be controlled via the serial interface or processor 2 special application software. The LEDs display the binary equivalent of the value in 11.21.
Default 0, enabled

11.23 *R/W Permissive for MDA210 Rev. 3*
If the High Voltage version of the MDA6 power board is to be used for a High Voltage (660vac) drive, this parameter must be set to a 1.
Default 0

11.24
Deals with line dip ride-through.
Leave Default as a 0. Consult your Drive Center or Technical Support for more information if necessary.
Default 0

10.7.12 MENU 12 — Comparators Programmable Thresholds

Refer to Figure 10-18.

This menu allows parameters to be selected and compared to a settable threshold level . Hysteresis can be added and the result inverted, if required, and sent to an internal destination or to the status menu 09. For more information and application examples on comparators, see Application Note CTAN-142, which can be downloaded from our web site, www.ctdrives.com/downloads.

Comparator 1

12.01 RO Threshold 1 Exceeded
0 = normal 1 = threshold exceeded

***12.03** R/W Threshold 1 Source
Range 0 to 1999
Default + 302

12.04 R/W Threshold 1 Level
Range 0 to 1000
Default + 000

12.05 R/W Threshold 1 Hysteresis
Range 0 to 255
Default 002

12.06 R/W Invert Threshold 1 Output
0 = default 1 = signal inverted

***12.07** R/W Threshold 1 Destination
Range 0 to 1999
Default + 000

Comparator 2

12.02 RO Threshold 2 Exceeded
0 = normal 1 = threshold exceeded

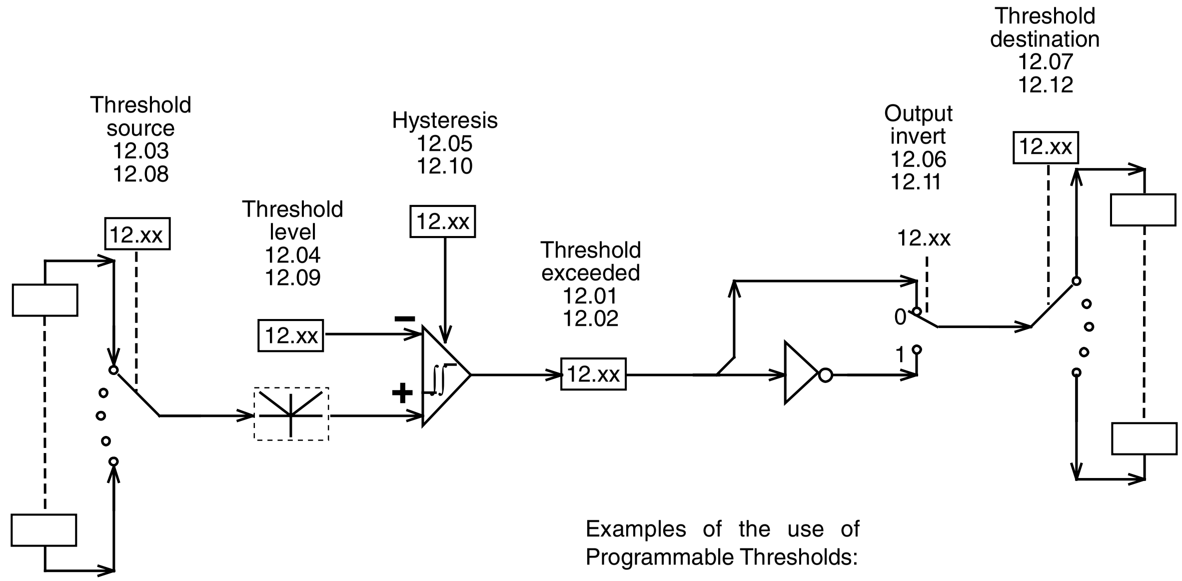
***12.08** R/W Threshold 2 Source
Range 0 to 1999
Default + 501

12.09 R/W Threshold 2 Level
Range 0 to 1000
Default + 000

12.10 R/W Threshold 2 Hysteresis
Range 0 to 255
Default 002

12.11 R/W Invert Threshold 2 Output
0 = default 1 = signal inverted

***12.12** R/W Threshold 2 Destination
Range 0 to 1999
Default + 000



Examples of the use of Programmable Thresholds:

1 To control parameter 02.18, the Common Ramp Selector, to change ramp rates at a certain speed.

2 Torque-proving (hoists and strip handling).

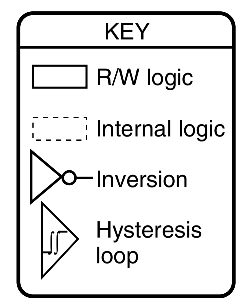


Figure 10-18.
Menu 12—Programmable Thresholds (Qty-2)

10.7.13 MENU 13 — Digital Lock

Refer to Figure 10-19.

When the Digital Lock feature of the Quantum III is required, a small change in the programmable logic inputs must be made. Since the drive in its standard configuration uses logic input F2 (terminal #22) for "Reference On," it imposes a conflict with the F2 input, "Inch Reverse" (parameter #8.02) of this menu. To eliminate this conflict, the following changes should be made:

1. Move the wire connection to terminal #22 (MDA1 board) to terminal #27.
2. Reprogram the logic input F2 (set parameter #8.12 to 000).
3. Program the logic input F7 destination to Reference On (set parameter #8.17 to 111).

To program these parameters, enter the security code (200) into any X.00 menu; then make the changes in Steps 2 and 3 above. When this is done, press drive reset; then perform a store sequence (menu X.00 to 1 and then reset). This completes the setup.

13.01 RO Master Encoder (Reference Encoder) Value
Range 0 to 1023

13.02 RO Slave Encoder (Feedback Encoder) Value
Range 0 to 1023

13.03 RO Master Counter Increment
Range ±1000

13.04 RO Slave Counter Increment
Range ±1000

13.05 RO Position Error
Range 0 to 255
Indicates the difference between the positions of the motor shaft and the slave shaft.

13.06 R/W Precision Reference
Range 0 to 255
See also **13.07,13.12**, and **13.13.**

13.07 R/W Precision Reference
Range 0 to 255
See also **13.06,13.12**, and **13.13.**
Parameters 13.06 and 13.07 are used, in conjunction with each other, to define a 16-bit velocity reference when parameter 13.12 = 0.

Parameter 13.06 is the least-significant component.

Parameter 13.07 is the most-significant component.

Each unit of 13.07 represents 256 increments of 13.06.

13.08 R/W Precision Loop Gain
Range 0 to 255
Determines the amount of velocity correction per unit of position error. The setting thus determines how quickly the loop responds to a disturbance, and thus affects the motor output shaft position.
This parameter must be adjusted in conjunction with the Speed Loop PID Gains 03.09, 03.10 and 03.11 to attain the best balance between stability and quick response.

13.09 R/W Position Loop Correction Limit
Range 0 to 1000
Limits the amount of the velocity-correction resulting from a position error.

13.10 R/W Position Loop Software Enable
0 = disabled 1 = enabled
Enables the Position Loop software.

13.11 R/W Rigid Lock Enable
0 = disabled 1 = enabled
When 13.11 = 1, the position error, relative to the time the position loop is closed, is always absolute. Therefore, if the slave output shaft is slowed down by an overload, position is regained by an automatic speed increase when the load reduces to or below maximum.
When 13.11 = 0 (default), the Position Loop is closed only when the "At Speed" condition is reached. This allows the accelerating ramps to be used without overspeeding the slave output shaft.

13.12 R/W Reference Source
1 = master encoder 0 = precision reference
Determines the source of the digital loop reference, as between the master encoder (13.01) or the precision references (13.06 and 13.07).

---

*Requires a reset to take effect after a change.

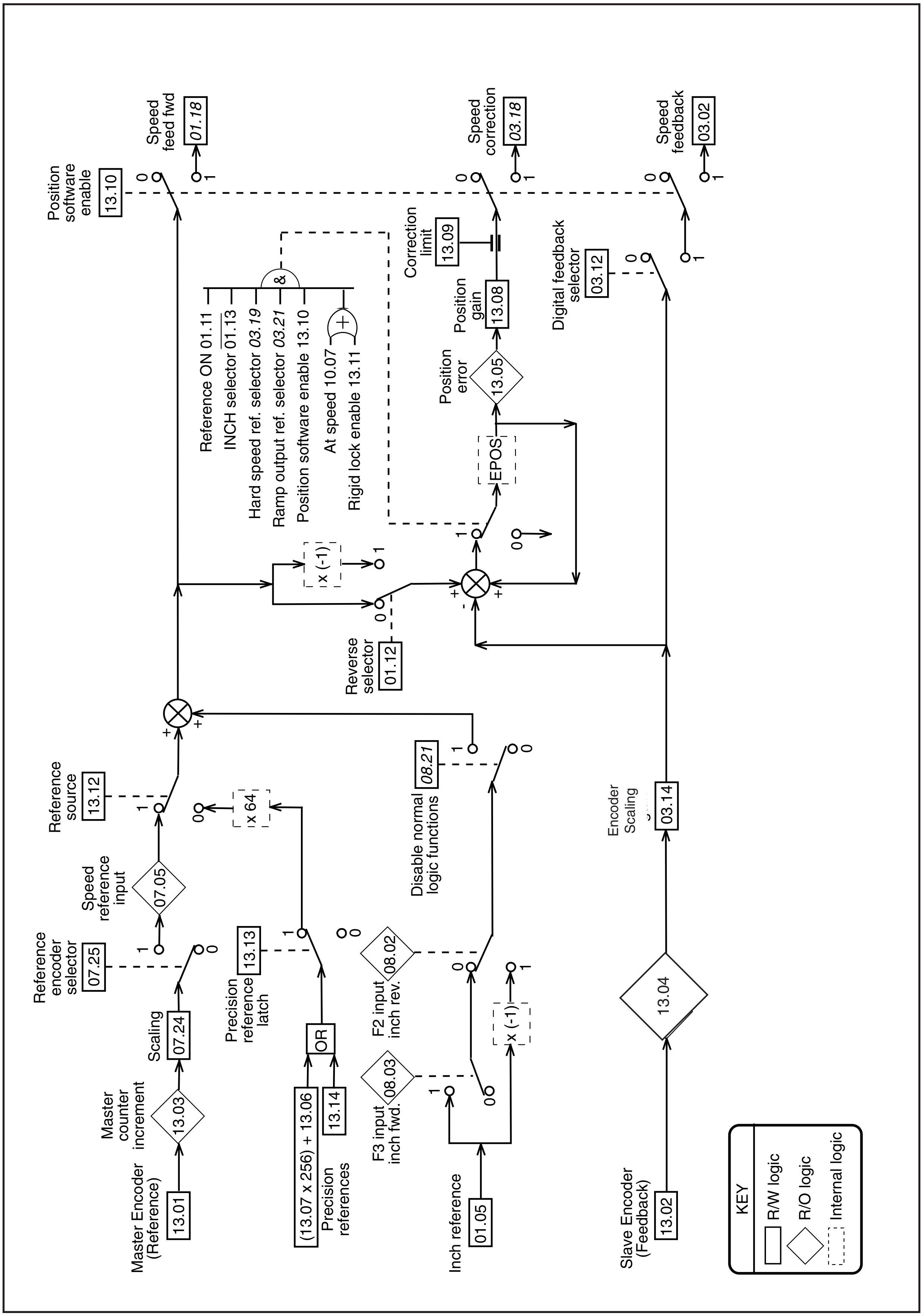


Figure 10-19.
Menu 13—Digital Lock

13.13 R/W Precision Reference Latch
0 = use last values 1 = use updated values
The two Precision Reference values, 13.06 and 13.07, cannot be changed simultaneously. To prevent the Position Loop reading inconsistent values during the change, parameter 13.13 = 0 (default) enables the Position Loop to continue to use the last values while the change is occurring. When a change of both 13.06 and 13.07 has been completed, setting 13.13 = 0 causes the updated values to be applied. 13.13 should then be reset to 0, ready for the next update.

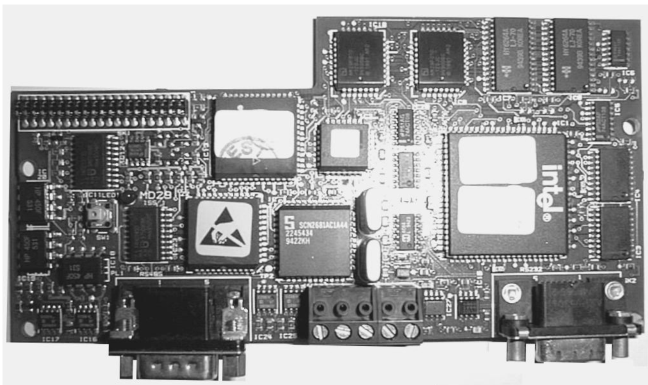
13.14 R/W Precision Speed Reference (16-bit)
Range 000 to 65,535
This parameter is a "wide integer" equivalent to the Precision Reference 13.06 and 13.07. It allows the precision reference to be written as a single statement, removing the need for the latch, parameter 13.13.

Parameter 13.14 is intended mainly for use through serial communications.

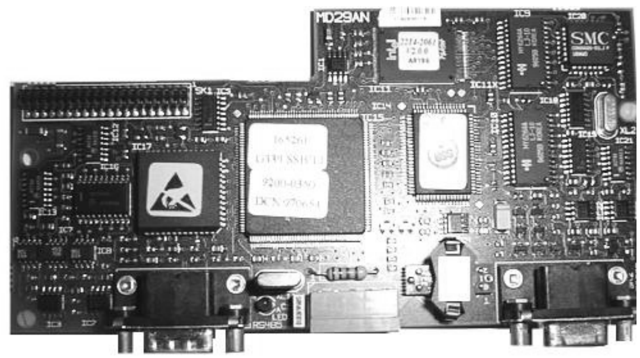
10.7.14 Menu 14 Optional MD29 Set-Up Parameters

Listed below are a group of parameters governing the operation of the MD-29 and MD-29AN Co-Processors. Specific details about these parameters can be found in the MD29 Manual.

MD29



MD29AN (CT-Net Version)



No.	Description	Range	Type	Default	Comment
14.01	ANSI Serial Address	0-99	R/W	1	
14.02	RS485 Mode	1-16	R/W	1	ANSI
14.03	RS485 Baud Rate	3-192	R/W	48	For modes 1, 5-9
14.04	Clock task time-base-mSec	1-100	R/W	0	10 = 10msec
14.05	CTNet Node ID (MD29AN only)	0-255	R/W	0	
14.06	Auto-Run on Power-up Enable	0 or 1	R/W	1	1 for final installation
14.07	Global Run-time Trip Enable	0 or 1	R/W	1	1 for final installation
14.08	CT Remote I/O Trip Link Enable-RS-485	0 or 1	R/W	0	For CT Remote I/O Module
14.09	Enable Watchdog Trip	0 or 1	R/W	0	
14.10	Enable Trip on Parameter Write Overrange	0 or 1		1	Recommend Enable
14.11	Disable Toolkit Communications	0 or 1		0	For SyPT Toolkit Comms
14.12	Internal Advanced Position Controller Enable	0 or 1		0	Not Menu 13
14.13	I/O Link Synchronization	0 or 1		0	For CT Remote I/O Module
14.14	Encoder Timebase Select	0 or 1		0	0 = 5msec 1= 2.5msec
14.16	Flash Memory Store Request	0 or 1		0	For Pxx% and Qxx%
14.17	Drive —> Drive Communications RS232	0 or 1		0	High Speed RS-232

Note: These parameters take effect only after an MD29 or Drive Reset or thru DPL code with the REINIT command.

For additional details on these parameters, consult the MD29 Manual (Part # 0400-0027) or within the help sections of the SyPT toolkit.

10.7.15 MENU 15 — Optional Application Menu 1

For parameter values, please refer to the following list.

Number	Description	Range	Type	Default	Security	Comment
15.01	RO variable 1	±1999	RO		None	
15.02	RO variable 2	±1999	RO		None	
15.03	RO variable 3	±1999	RO		None	
15.04	RO variable 4	±1999	RO		None	
15.05	RO variable 5	±1999	RO		None	
15.06	Real R/W variable 1	±1999	R/W	+ 000	Level 1	
15.07	Real R/W variable 2	±1999	R/W	+ 000	Level 1	
15.08	Real R/W variable 3	±1999	R/W	+ 000	Level 1	
15.09	Real R/W variable 4	±1999	R/W	+ 000	Level 1	
15.10	Real R/W variable 5	±1999	R/W	+ 000	Level 1	
15.11	Integer R/W variable 1	0 to 255	R/W	000	Level 1	
15.12	Integer R/W variable 2	0 to 255	R/W	000	Level 1	
15.13	Integer R/W variable 3	0 to 255	R/W	000	Level 1	
15.14	Integer R/W variable 4	0 to 255	R/W	000	Level 1	
15.15	Integer R/W variable 5	0 to 255	R/W	000	Level 1	
15.16	Integer R/W variable 6	0 to 255	R/W	000	Level 1	See 15.60 and 15.61
15.17	Integer R/W variable 7	0 to 255	R/W	000	Level 1	See 15.60 and 15.61
15.18	Integer R/W variable 8	0 to 255	R/W	000	Level 1	See 15.60 and 15.61
15.19	Integer R/W variable 9	0 to 255	R/W	000	Level 1	See 15.60 and 15.61
15.20	Integer R/W variable 10	0 to 255	R/W	000	Level 1	
15.21	Bit variable 1	0 or 1	R/W	0	Level 1	
15.22	Bit variable 2	0 or 1	R/W	0	Level 1	
15.23	Bit variable 3	0 or 1	R/W	0	Level 1	
15.24	Bit variable 4	0 or 1	R/W	0	Level 1	
15.25	Bit variable 5	0 or 1	R/W	0	Level 1	
15.26	Bit variable 6	0 or 1	R/W	0	Level 1	
15.27	Bit variable 7	0 or 1	R/W	0	Level 1	
15.28	Bit variable 8	0 or 1	R/W	0	Level 1	
15.29	Bit variable 9	0 or 1	R/W	0	Level 1	
15.30	Bit variable 10	0 or 1	R/W	0	Level 1	
15.31	Bit variable 11	0 or 1	R/W	0	Level 1	
15.32	Bit variable 12	0 or 1	R/W	0	Level 1	
15.33	Bit variable 13	0 or 1	R/W	0	Level 1	

Menu 15 — Optional Applications Menu 1 (Cont.)

Number	Description	Range	Type	Default	Security	Comment
15.34	Bit variable 14	0 or 1	R/W	0	Level 1	
15.35	Bit variable 15	0 or 1	R/W	0	Level 1	
15.36	Bit variable 16	0 or 1	R/W	0	Level 1	
15.60	Ratio 1 wide integer = 15.16 & 15.17	0 to 255	R/W	000	Level 1	Used w/ digital lock MD29 program
15.61	Ratio 2 wide integer = 15.18 & 15.19	0 to 255	R/W	000	Level 1	
15.62	Serial mode 4 input data		RO		Level 1	
15.63	Serial mode 4 output data		RO		Level 1	

15.60 Ratio 1
This parameter is the equivalent of parameters 15.16 and 15.17, such that Ratio 1 in the Digital Lock software can be written simultaneously, removing the need for the latch, 15.31.

15.61 Ratio 2
This parameter is the equivalent of parameters 15.18 and 15.19, such that Ratio 2 in the Digital Lock software can be written simultaneously, removing the need for the latch, 15.31.

15.62 Serial 'Mode 4' Input Data
When serial (interface) Mode 4 is selected, this parameter is loaded with a variable input from the serial (interface) port. Refer also to parameter 11.13.

15.63 Serial 'Mode 4' Output Data
When serial (interface) Mode 4 is selected, this parameter is transmitted to the next drive down the line.

10.7.16 MENU 16 — Optional Application Menu 2

For parameter values, please refer to the following list.

Number	Description	Range	Type	Default	Security	Comment
16.01	RO variable 1	±1999	RO		None	
16.02	RO variable 2	±1999	RO		None	
16.03	RO variable 3	±1999	RO		None	
16.04	RO variable 4	±1999	RO		None	
16.05	RO variable 5	±1999	RO		None	
16.06	Real R/W variable 1	±1999	R/W	+ 000	Level 1	
16.07	Real R/W variable 2	±1999	R/W	+ 000	Level 1	
16.08	Real R/W variable 3	±1999	R/W	+ 000	Level 1	
16.09	Real R/W variable 4	±1999	R/W	+ 000	Level 1	
16.10	Real R/W variable 5	±1999	R/W	+ 000	Level 1	
16.11	Integer R/W variable 1	0 to 255	R/W	000	Level 1	
16.12	Integer R/W variable 2	0 to 255	R/W	000	Level 1	
16.13	Integer R/W variable 3	0 to 255	R/W	000	Level 1	
16.14	Integer R/W variable 4	0 to 255	R/W	000	Level 1	
16.15	Integer R/W variable 5	0 to 255	R/W	000	Level 1	
16.16	Integer R/W variable 6	0 to 255	R/W	000	Level 1	
16.17	Integer R/W variable 7	0 to 255	R/W	000	Level 1	
16.18	Integer R/W variable 8	0 to 255	R/W	000	Level 1	
16.19	Integer R/W variable 9	0 to 255	R/W	000	Level 1	
16.20	Integer R/W variable 10	0 to 255	R/W	000	Level 1	
16.21	Bit variable 1	0 or 1	R/W	0	Level 1	
16.22	Bit variable 2	0 or 1	R/W	0	Level 1	
16.23	Bit variable 3	0 or 1	R/W	0	Level 1	
16.24	Bit variable 4	0 or 1	R/W	0	Level 1	
16.25	Bit variable 5	0 or 1	R/W	0	Level 1	
16.26	Bit variable 6	0 or 1	R/W	0	Level 1	
16.27	Bit variable 7	0 or 1	R/W	0	Level 1	
16.28	Bit variable 8	0 or 1	R/W	0	Level 1	
16.29	Bit variable 9	0 or 1	R/W	0	Level 1	
16.30	Bit variable 10	0 or 1	R/W	0	Level 1	
16.31	Bit variable 11	0 or 1	R/W	0	Level 1	
16.32	Bit variable 12	0 or 1	R/W	0	Level 1	
16.33	Bit variable 13	0 or 1	R/W	0	Level 1	
16.34	Bit variable 14	0 or 1	R/W	0	Level 1	
16.35	Bit variable 15	0 or 1	R/W	0	Level 1	
16.36	Bit variable 16	0 or 1	R/W	0	Level 1	

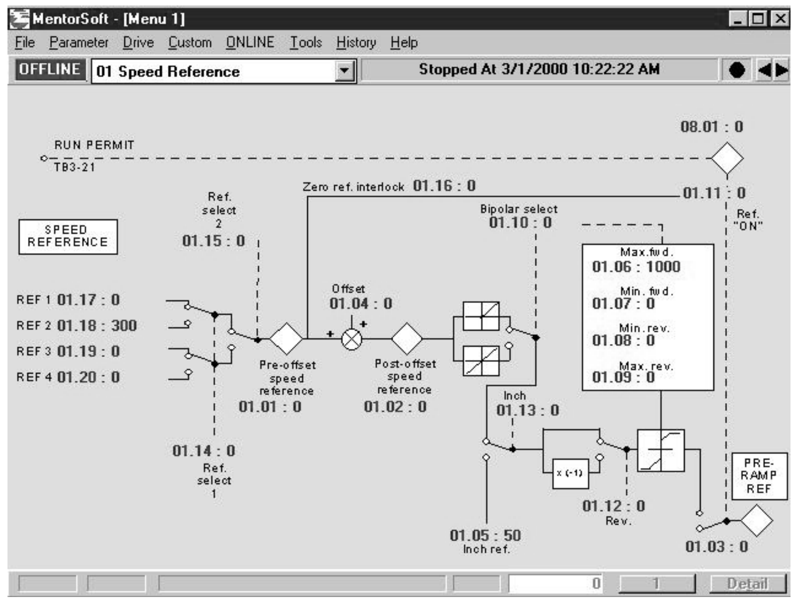
11.1 COMMUNICATIONS PACKAGES

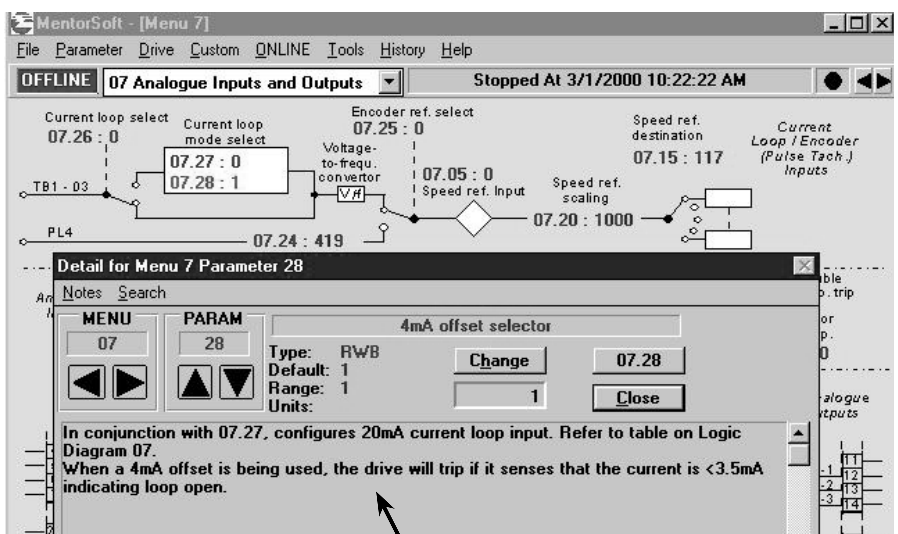
There are a number of communication packages that can be used with the Quantum III to facilitate setup, record parameter data, view internal activity on a soft-scope and permit real-time interaction using soft meter, dial, sliders and other graphical animations such as bar graphs etc.

11.1.1 MentorSoft

Permits one to observe/trace signal flow as they come into the drive and pass through the various internal software areas

- Permits one to change any parameter via the PC
- Permits one to upload and save drive data to a file
- Permits one to download and restore a drive data file
- Permits one to compare the drive setup with a previously stored file





Extensive Built-In Help

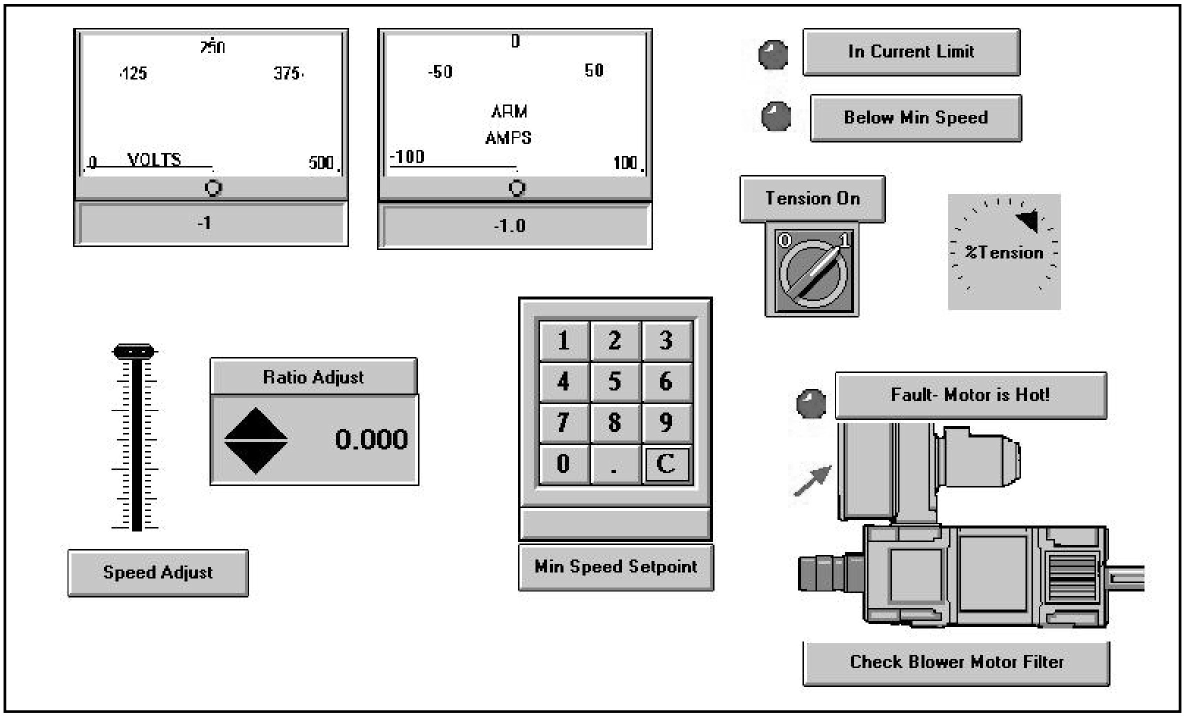
To obtain a copy of this program visit our website at:
www.ctdrives.com/downloads under software.
Also see Appendix C Application Notes

11.1.2 SystemWise

SystemWise is a SCADA-like software product that is excellent for setting up or tuning a drive. It permits you to observe internal drive data as a bar graph or analog style meter or as a scaled digital number expressed in your units. Conditions can be annunciated using soft LEDís and you can control internal parameters using software Dials, Sliders and Increase/Decrease buttons. Graphics and custom photographs can be incorporated to permit you to customize your screens to your machine situation.

FREE Software

For additional information check out our website at **www.ctdrive.com/downloads**



11.1.3 Factory Field Bus Communication Options

There are a number of popular communication options available for the Quantum III Drive listed in the table below.

Module	Description
MDIBS	**Interbus S** Communications Module-no coprocessor*
MD24	**Profibus DP** Communication Module -no coprocessor*
MD25	**DeviceNet** Communication Module-no coprocessor*
9500-9100	**Modbus Plus** Communication Module-no coprocessor*
MD29	**Modbus RTU**/Modbus ASCII Communications plus coprocessor
MD29AN	**CTNet** High-speed Token Ring LAN

* These Modules do not offer coprocessor DPL or SyPT programmability.

A communications interface is standard in all Quantum III drives. It is a machine-machine interface, enabling one or more drives to be used in systems controlled by a host such as a process logic controller (PLC), computer, or Operator Interface (keypad).

Quantum III drives can be directly controlled and their operating configuration can be altered. Their status can be interrogated by such a host and continuously monitored by data logging equipment. A host can interface with up to thirty-two (32) Quantum III drives, Fig. 11-1, and up to 99 if line buffers are used.

The communication port of the drive unit is the connector PL2 (Fig.11-2). The standard connection is the RS485. Protocol is ANSI x 3.28 - 2.5 - A4, as standard for industrial interfaces.

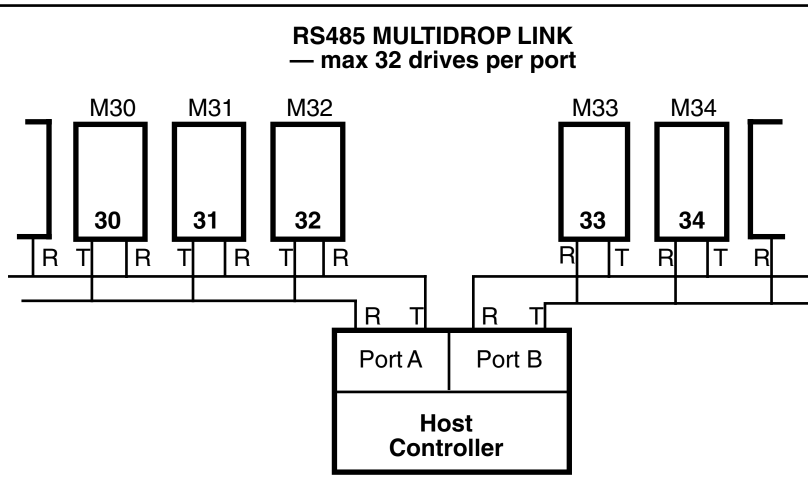
11.2 FUNDAMENTALS

Logic processors, such as computers, PLCs, and the communications systems of Control Techniques drives communicate by means of binary logic. Binary logic is 'two state', and is readily implemented by an electrical circuit which is either on or off. In Quantum III drives, the on-state is represented by a positive voltage, and the off-state by zero volts. The two voltages thus represent two distinct units of data, each being a binary digit ('bit') — either 0 or 1.

By fixing a time duration for each bit, a series of bits transmitted can be recognized by a receiver. If, also, a series or group always contains the same number of bits it becomes possible to construct a variety of different 'characters' that the receiver can recognize and decode. A group of four bits has sixteen (16) possible variants — 0000, 0001, 0010, and so on to 1111. Each of the sixteen variants represents one 'hexadecimal' character-unit — corresponding to the decimal numerals 0 to 9 followed by the six letters A to F — making 16 different and distinct characters.

The scope of the data that can be represented is much increased if two hexadecimal characters are combined to make a simple code. Since there are 16 hex characters, two in combination will produce 16 x 16 = 256 possible different characters. Using this as the basis of a code, it becomes possible to represent a large number of symbols, or units of data, by means of only two hex characters, each of four bits, making eight bits in all and known as a 'byte'.

Early in the development of computer technology it was recognized that a long stream of bits without, so to speak, any punctuation marks would be unmanageable and at risk of transmission errors passing unrecognized. The byte was adopted as a standard unit. To ensure that each byte is distinct, a start bit and a stop bit are added. The convention is that the start bit is a 0 and the stop bit a 1.



Serial address 11.11. Unique identity code for up to 32 drives per communications port at the host.

Figure 11-1.
Serial Address 11.11.

Each byte, therefore, occupies a finite time in transmission, but the interval between successive bytes is of no importance. Only the structure — the 'framing' or 'character format' — of the byte is significant. There is more than one convention for 'framing' the character. The format in Quantum III drives is ten bits as shown diagrammatically —

<table>
<tr><td></td><td colspan="7">'Low' ASCII character byte</td><td></td><td></td></tr>
<tr><td></td><td colspan="4">1st hex character</td><td colspan="3">2nd hex character</td><td></td><td></td></tr>
<tr><td>Start bit</td><td colspan="7">Seven data bits, variable</td><td>Parity bit</td><td>Stop bit</td></tr>
<tr><td>0</td><td>lsb</td><td></td><td></td><td></td><td></td><td></td><td>msb</td><td></td><td>1</td></tr>
</table>

The parity bit is used by the receiver of the message to check the integrity of the data byte.

The character set used in Quantum III drives is the 'low' American Standard Code for Information Interchange (ASCII), comprising 128 characters, decimally numbered 0 to 127. The 'Low' ASCII Set is shown complete at the end of this Section. In the low ASCII set, the first hex character extends only from 0 to 7, binary 000, 001 etc to 111. A 'start bit', 0, is added to the beginning of the message, and a 'parity bit' and a 'stop bit',1, are attached at the end.

The first 32 characters in the ASCII set (hex 00 to 1F) are used to represent special codes. These are the Control Codes, each of which has a particular meaning. For example, 'start of text' is STX, and, from a keyboard, is made by holding down the Control key and striking B once (Control-B). This is hex 02, and the actual transmission is the binary byte 0000 0010. The drive is programmed to know that this character signals that a command will follow. The control code at the end is EOT — 'end of transmission' — which tells all drives to look for a new message. If a host has a video screen, control characters appear on it in its format.

The components of all messages between the host and a Quantum III drive are formed of ASCII characters. The format of a message, i.e., the sequence in which the characters appear, is standardized for messages of each different kind, and is explained under Structure of Messages, in the next column.

11.3 PRELIMINARY ADJUSTMENTS TO THE DRIVE

Each drive requires a unique identity number, or serial address, set by parameter 11.11. The Baud rate 11.12 must be set to match the host. Data, drive status and the parameter set-up can be read from the drive in any mode, provided only that the drive is turned on, and that the serial address and Baud rate are correctly set.

Communication Setup Parameters

When using the communication port, it is important that the PC comm port setting and the drive comm port setting match.

Param. #	Function	Range	Default Setting
#11.11	Serial Address of Drive	0 to 99	1
#11.12	Baud Rate	0 or 1 0=4800 1=9600	0 or 4800 baud
#11.13	Port Mode	1 to 4	1 = ANSI

RS232 Connection

It is possible to communicate to the Quantum III directly from a Lap Top PC Compatible Computer using RS-232 communications, however it is not the recommended method. RS-232 communications is rather noise sensitive especially when used in industrial environments where drives are employed. Additionally, some PC's produce different voltage levels on their RS-232 outputs which can result in some PC's working ok and some not. At best, the cable length when using RS-232 would be as short as possible and never more than 10 feet.

Terminal designations for connector PL2 for RS485 communications interfaces is —

PIN #	Function
1	0V
2	$\overline{\text{TXD}}$
3	$\overline{\text{RXD}}$
4	—
5	—
6	TXD
7	RXD
8	—
9	—

COMPUTER INTERFACE CABLE

RS-232 to Quantum III

Computer DB-9 Female	Drive RS-485 Port Female
3	3
2	2
5	Jumper 1-6-7 shield

Cable should be no more than 10' in length.

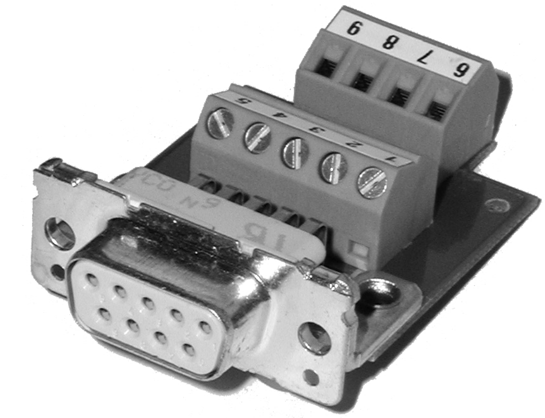
The serial port uses 7 data, 1 stop and even parity bits.

Preferred Method

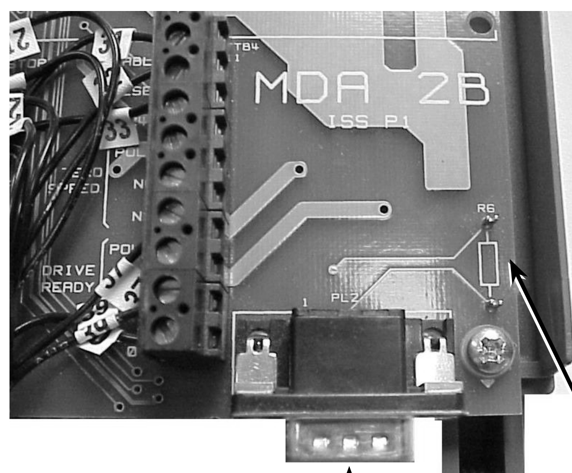
The recommended method of communication is using and RS-485 interface. From a PC, the use of an external RS-232 to RS-485 converter is recommended for temporary hookups. For a permanent communication situation such as when an Industrial PC is used as a SCADA (System Control And Data Acquisition) device, an RS-485 card placed within the PC would be the best option.

RS-485 Port Wiring

To facilitate wiring one could elect to apply a Terminal Strip board as shown below. Part Number DB9F-TERM. It permits one to connect up using screw terminals rather than soldering a 9pin D female connector.



RS-422/485 Communication Port



Transmission Line Terminating Resistor

9 Pin Male D Connector PL2

Location

11.4 RESOLUTION

Some parameters can be set to a higher resolution than that displayed or read by the serial interface. These are the real parameters with a range of ±1000.

If the user wishes to set variable to a higher resolution, six digits must be written in the data field. Quantum III then recognizes the request for higher resolution. For example, to set the speed demand to 47.65% of maximum speed, transmit —

+ 0 4 7 6 5

Refer to the following paragraphs for further explanation of the data field.

11.5 COMPONENTS OF MESSAGES

11.5.1 Control Characters

To conform to the standard structure of a message, the stages of a message are signalled by control characters. Each character has a specific meaning, a standard abbreviation, and is transmitted and received in ASCII code. If a message is initiated from a keyboard, the control characters are keyed by holding the Control key down while making a single-letter keystroke. Of the 32 control characters in the ASCII set, the seven in the table entitled “Control Characters in Quantum III Drives” are used in Quantum III serial communications.

11.5.2 Serial Address

Each drive is given an identity or address (parameter 11.11) so that only the drive that is concerned will respond. For security, the format is that each digit of the two-digit drive address is repeated, thus the address of drive number 23 is sent as four characters—

2 2 3 3

The serial address follows immediately after the first control character of the message.

11.5.3 Parameter Identification

For transmission by serial interface, parameters are identified by the four digits representing the menu and the parameter number, but without the decimal point, which is used in the text of this Manual for clarity. For example, to send ‘menu 04, parameter 26’, write 0 4 2 6.

11.5.4 Data Field

Data to be sent or requested occupies the next five characters after the parameter number. All of the operating parameters of the drive are **numerical** values, such as load, current, etc. The field for data is variable in length up to five characters maximum (but see reference to increased resolution in paragraph 11.4). No decimal point is used.

The state of **bit-parameters** is transmitted and received as real-value data, of value 0 or 1. Again, the format is flexible as long as no more than five characters are comprised, for example —

1

0 1

— and so on.

CONTROL CHARACTERS IN QUANTUM III DRIVES			
CHARACTER	**MEANING**	**ASCII CODE HEX**	**KEYED AS… CONTROL**
EOT	Reset, or ‘Now hear this’ or End of Transmission	04	D
ENQ	Enquiry, interrogating the drive	05	E
STX	Start of text	02	B
ETX	End of text	03	C
ACK	Acknowledge (message accepted)	06	F
BS	Backspace (go to previous parameter)	08	H
NAK	Negative acknowledge (message not understood)	15	U

CONTROL	ADDRESS				CONTROL	PARAM				DATA					CONTROL	BCC
EOT	1	1	4	4	STX	*	1	1	7	-		4	7	6	ETX	<
CONTROL -D					CONTROL -B										CONTROL -C	

* If this character happens to be a 0 as in this example, it can be written as a 0 or a space.

11.5.5 Block Checksum (BCC)

To permit the drive and the host to ensure that messages from one to the other have not become corrupted in transmission, all commands and data responses must be terminated by a block checksum character (BCC, paragraph 11.9).

11.6 STRUCTURE OF MESSAGES

11.6.1 Host to Drive

Messages from the host to the drive are of two kinds—

a request for information, or—
a command.

Both kinds must start with the control character EOT (Control-D) to initiate the drive to receive a new message. This is followed by the serial address of the drive receiving the message. The format of the data and the choice of control character to terminate the message is different for the two kinds.

For an **information request**, sending the parameter number followed by ENQ instructs the particular drive addressed to supply data relating to that parameter.

For a **command**, a control character after the serial address tells the drive that the message is to be an instruction concerning its operational parameters, and that the next part of the message will be a parameter number and the instruction data. The instruction data occupies five to nine characters, or ten for high resolution. An instruction message is terminated by control character ETX followed by a block checksum (BCC, paragraph 11.9).

11.6.2 Drive to Host

Messages from the drive to the host are of two kinds—

a reply to a data request, or—
acknowledgement of a message.

In **reply** to a data request, the start control character is STX, and is followed by the parameter number to confirm the request from the host, and then the five characters of data. The message is terminated by the control character ETX and a block checksum (BCC).

A message is **acknowledged** by the control character ACK if understood, or NAK if invalid, wrongly formatted or corrupt.

11.6.3 Multiple Drives

A message can be sent to two or more addresses simultaneously. If all drives are to respond to the same request or instruction, the message is transmitted to address 0 (zero).

11.7 SENDING DATA

Host command —

reset - address - start of text - menu and parameter - 1 to 5 data characters - end - BCC

For example, the message to the drive —

"change speed reference 1 of drive number 14 to 47.6% in reverse"

would be sent as —

The drive will respond with an acknowledgement, either —

ACK if the message is understood and implemented, or —

NAK if the message is invalid, the data is too long, or the BCC is incorrect.

If a value sent is outside the limits for a parameter, the drive will respond with NAK.

11.8 READING DATA

The drive will send any data to the host, provided that the request is valid. The format of a data request message is —

CONTROL	ADDRESS				PARAM				CONTROL
EOT	1	1	2	2	0	1	1	7	ENQ
Control -D									Control -E

Host request —
reset - address - parameter - end

For example, to find the speed set point 01.17 of drive number 12, send —

The drive replies in the following form —

start - parameter - 5 characters of data - end - BCC

For example —

CONTROL	PARAMETER				DATA				CONTROL	BCC
STX	0	1	1	7	0	4	7	6	ETX	,
Control -B									Control -C	

The reply first confirms that the data sent is the speed reference 1 (01.17); the five characters immediately following give the present setting as a percentage of full speed. The first character is either + or -, to indicate direction of rotation; the remainder is the numerical value. The message reads, "reverse at 47.6% of full speed" in this example.

11.8.1 Repeat Enquiry

The negative acknowledgement NAK (Control-U) can be used at a keyboard to cause the drive to send data repeatedly for the same parameter. It saves time when monitoring the value of a parameter over a period of time.

11.8.2 Next Parameter

To obtain data from the same drive for the next parameter in numerical order, send the positive acknowledgement ACK (Control-F). The drive will respond by transmitting the data relating to the next parameter in sequence.

11.8.3 Previous Parameter

To obtain data from the same drive for the previous parameter in numerical order, send backspace BS (Control-H).

11.8.4. Invalid Parameter Number

If the host sends a parameter number which the drive does not recognize, e.g. 1723, the drive will respond with EOT.

11.9 BLOCK CHECKSUM (BCC)

To ensure that data received can be verified, a block checksum is attached to the end of each command or data response. The BCC is automatically calculated by the sending logic and is derived in the following manner.

First, a binary exclusive-OR is performed on all characters of the message after the start-of-text command parameter.

For example, if the message to be sent to drive number 14 is —

"set speed reference 1 to 47.6% of full speed in reverse"

it is sent as —

Each of the separate digits,

0117 - (space or 0) 4 7 6 and Control-C

is represented by a hexadecimal character and calculated in binary as shown in the following table. The XOR is shown progressively for each character.

Reset	EOT (Control-D)
Serial address	1 1 4 4
Start of text	STX (Control-B) Not included in BCC calculation
	BCC calculation starts here
Parameter	0 1 1 7 (Menu no. and parameter no.)
Reverse	- (a minus sign)
476	(space or 0) 4 7 6
End of message	ETX (Control-C) finally, BCC, calculated as shown

CHARACTER		ASCII CHAR.		XOR	
menu	0	011	0000		
	1	011	0001	000	0001
parameter	1	011	0001	011	0000
	7	011	0111	000	0111
- (minus)		010	1101	010	1010
(space)		010	0000	000	1010
4		011	0100	011	1110
7		011	0111	000	1001
6		011	0110	011	1111
ETX		000	0011	<u>011</u>	<u>1100</u>

The final XOR, underlined, is the BCC if its equivalent decimal value exceeds 31. As the ASCII characters from hex 00 to 1F are used only for control codes, the BCC has to exceed the value of 31 decimal. Whenever the XOR produces a (decimal equivalent) number less than 32, 32 is added. Thus, in the above XOR example,

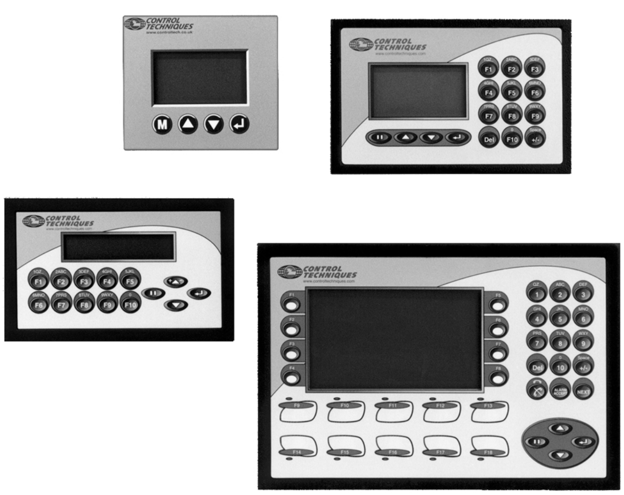
011 1100 = 60 decimal, so that the BCC is character 60

for which the ASCII character is = <

Thus the complete message to set the speed of drive number 14, say, to 47.6% in reverse is as shown in the example message in paragraph 11.7.

12.1 CTIU OPERATOR INTERFACE UNITS

The Control Techniques Interface Units offer a wide range of capabilities depending on the complexity of the application and system. CTIU's were designed for general use with our Mentor II, Quantum III, Unidrive and Commander SE drive series. The display panels use a high-resolution bit-mapped LCD display offering excellent readability due to adjustable backlighting. The units support 300 display pages. Each page can consist of a mix of Drive Menu items, Drive Status points, alarms and fault conditions. These quantities can be displayed as numeric or alphanumeric (text), dynamic bar graphs, live graphs or trends plots. Higher end models offer multiple font sizes and graphical animations. Embedded fields can be designated modifiable, permitting operators to change machine values remotely and send them back to the drive for execution. The CTIU's employ easy to wire screw terminals for the RS-485 multi-drop interdrive field wiring. It also provides a convenient RS-232 nine pin D plug-in connector for easy connection to a PC for configuration. Each Comm port has LED indication of transmit and receive signals for fast field troubleshooting. The **Free** CTIU configuration software is a Windows™ based program that supports approximately 100 PLC manufacturers.



For more information on the CTIU Opterator Interface visit our website at:

www.ctdrives.com/downloads under Marketing Literature.

CTIU then CTIU Brochure.

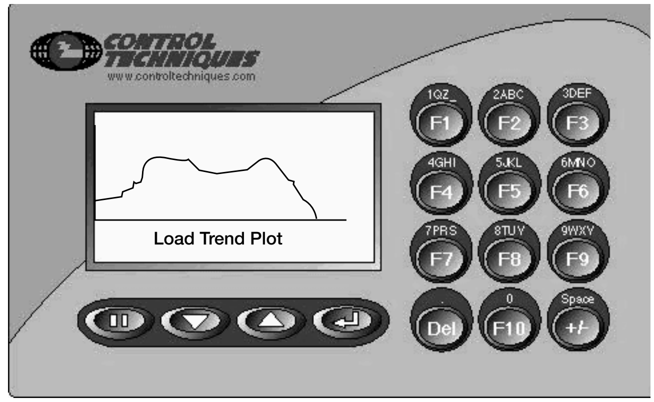


Figure 12-1
Control Techniques Interface Unit

Features

- Selectable Flashing Text
- Scalable Bar Graphs
- Downloadable Drive Recipes
- Wide Supply range 8-32vdc
- Internal Self Test Mode
- Page Password Protection
- Function Key for Drive Control

Programming

- WYSIWYG for display editing, formatting
- Script Language offering
- Math Operations, Timer intervention
- Conditional Branching
- Scheduling Support
- Page Design Wizard
- Function Key Mapping

Control Techniques' CTIU software is free and can be downloaded from our web site:
***www.ctdrives.com/*downloads** *under Software*

12.2 FIELD CONTROL CARD MDA3

The MDA3 Card is standard in Size 1 models (9500-8X02 through -8X06) and enables a Quantum III drive to operate a motor with the motor field under variable current control. Parameters in Menu 06 (Field Control) are provided as standard for use in conjunction with the optional controller.

The MDA3 Card is suitable for motors with field current up to 8 amps, and is installed internally to the drive unit. It can be changed out on site if required.

The MDA3 comprises the card, an input rectifier, and a heat-transfer plate and requires no additional components.

The MDA3 Card, Figure 12-2, is accessible at the bottom right side of the Quantum III and fits between the power board of the drive and the heat sink. Refer to Figure 12-3.

As shown in Fig. 12-2, the rectifier is attached to the heat sink through the access hole provided in the power board. It is attached by a single, central screw (supplied). The heat transfer plate (supplied) MUST be mounted between the rectifier and the heat sink.

The MDA3 card sits partly over the rectifier and is attached to the heat sink by the pillars and screws provided.

Removing the MDA3 Field Control Board

1. Remove the 10-pin ribbon cable connector on PL6.
2. Remove the four (4) leads attached to E3, L11, F+,and F2 on the MDA3 card.
3. Remove the M4 screw, nylon spacer, and hardware that attaches the MDA3 to the power board.
4. Remove the M5 screw that attaches the rectifier through the heat transfer plate to the heat sink. Be careful not to lose the washer and lockwasher.
5. The unit can now be removed by sliding it out the bottom of the Quantum III.

The MDA3 card has a fixed current scaling resistor. The user can scale the current feedback for different maximum currents by setting J1 for 2 amps or 8 amps maximum range and by setting parameter 06.11 as described in paragraph 8.8.

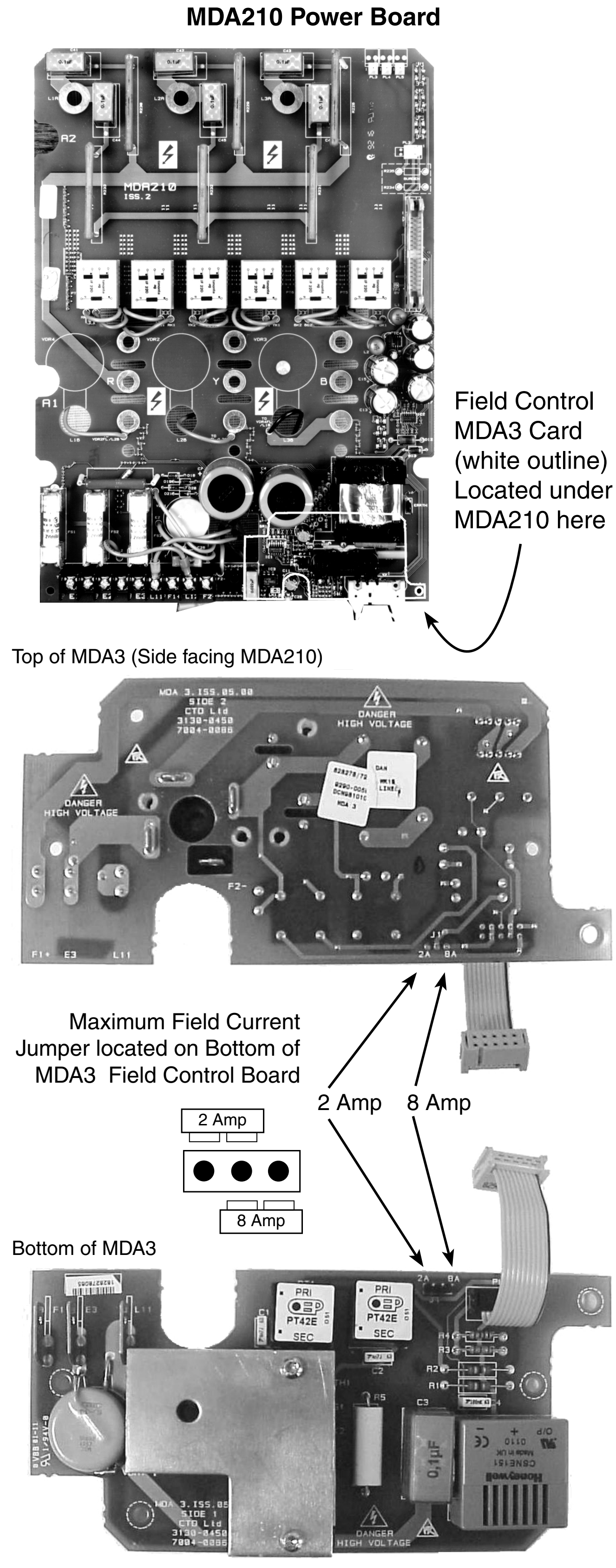


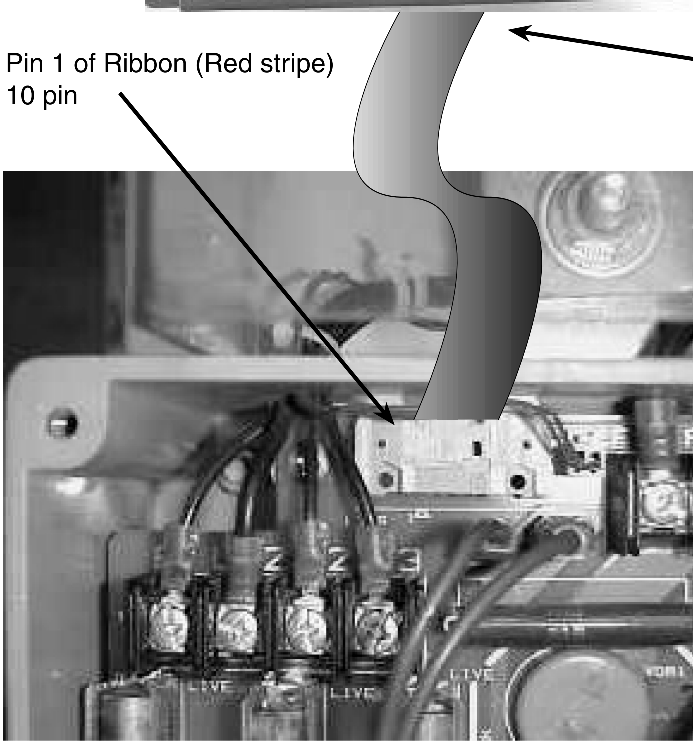
Figure 12-2.
MDA3 Card and Connections

Figure 12-4.
FXM5 Ribbon Connector Locations for
Size 2 and Size 3 Quantums
9500-8X07 thru 9500-8X20

External FXM5 FIeld Controller

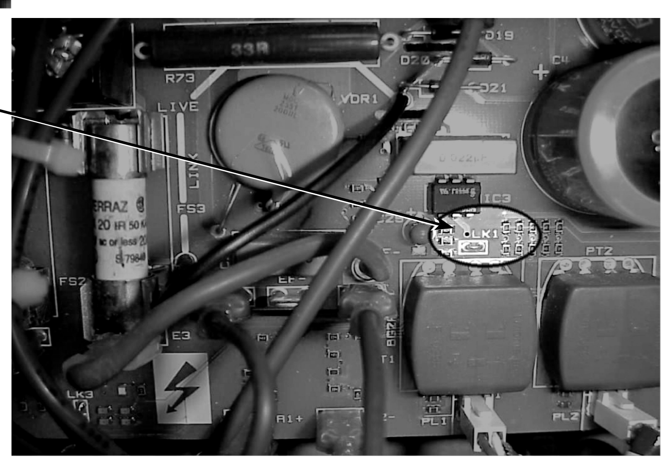
Pin 1 of Ribbon (Red stripe)
10 pin

Pin 1 of Ribbon (Red stripe)
10 pin



Location
of MDA6
Board

Location of LK1
(Inches below and to the right of ribbon connector)



Important Reminder:
Cut LK1 when FXM5 used with
ribbon control.

13.1 IMPORTANT SAFEGUARDS

All work on the drive should be performed by personnel familiar with it and its application. Before performing any maintenance or troubleshooting, read the instructions and consult the system diagrams.

WARNING

MAKE SURE THAT ALL POWER SOURCES HAVE BEEN DISCONNECTED BEFORE MAKING CONNECTIONS OR TOUCHING INTERNAL PARTS. LETHAL VOLTAGES EXIST INSIDE THE CONTROL ANYTIME INPUT POWER IS APPLIED, EVEN IF THE DRIVE IS IN A STOP MODE. A TURNING MOTOR GENERATES VOLTAGE IN THE DRIVE EVEN IF THE AC LINE IS DISCONNECTED. EXERCISE CAUTION WHEN MAKING ADJUSTMENTS. WITH THE CONTROL DRIVING A MOTOR, DO NOT EXCEED TEN (10) DEGREES OF POTENTIOMETER ROTATION PER SECOND. NEVER INSTALL OR REMOVE ANY PC BOARD WITH POWER APPLIED TO THE CONTROL.

13.2 TROUBLESHOOTING OVERVIEW

Fast and effective troubleshooting requires well-trained personnel supplied with the necessary test instruments as well as a sufficient stock of recommended spare parts. Capable electronic technicians who have received training in the control operation and who are familiar with the application are well qualified to service this equipment.

13.2.1 Suggested Training

A. Study the system instruction manual and control drawings.

B. Train in the use of test instruments.

C. Contact Control Techniques for training school schedules or check out our website at www.ctdrive.com/downloads.

D. Obtain practical experience during the system installation and in future servicing.

13.2.2 Maintenance Records

It is strongly recommended that the user keeps records of downtime, symptoms, results of various checks, meter readings, etc. Such records will often help a service engineer locate the problem in the minimum time, should such services be required.

13.2.3 General Troubleshooting

The most frequent causes of drive failure are:

A. Interconnect wire discontinuity, caused by a broken wire or loose connection.

B. Circuit grounding within the interconnections or the power wiring.

C. Mechanical failure at the motor.

DO NOT make adjustments or replace components before checking all wiring. Also monitor all LED indicator lights and display references before proceeding with troubleshooting checks, and check for blown fuses.

It should be noted that modern solid state electronic circuitry is highly reliable. Often problems which appear to be electrical are actually mechanical. It is advised that the motor be checked in the event of any drive problems. Refer to the motor owner's manual for maintenance and repair procedures.

13.2.4 Notes for a Troubleshooting Technician

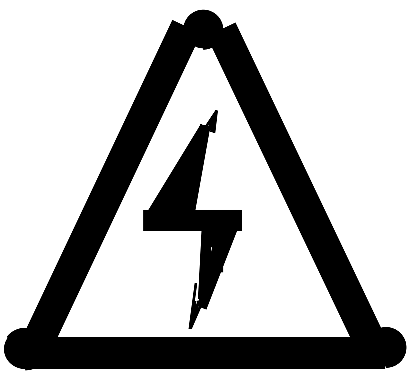
A minimum knowledge of system operation is required, but it is necessary to be able to read the system schematics and connection diagrams.

An oscilloscope (Tektronix 214 or equivalent) may be needed to locate problem areas and to make adjustments. However, the majority of problems can be solved by using a multimeter and by parts substitution.

Multimeters having a sensitivity of 1000 or more ohms per volt on the DC scale are recommended, such as a Triplett Model 630, a Simpson Model 260, or equivalent.

WARNING

WHEN A TEST INSTRUMENT IS BEING USED, CARE MUST BE TAKEN TO INSURE THAT ITS CHASSIS IS NOT GROUNDED EITHER BY A GROUNDING PLUG CONNECTION OR BY ITS CASE BEING IN CONTACT WITH A GROUNDED SURFACE. EXTREME CARE MUST BE TAKEN WHEN USING THE OSCILLOSCOPE SINCE ITS CHASSIS WILL BE ELECTRICALLY HOT TO GROUND WHEN CONNECTED TO THE CONTROL SYSTEM.



DANGER

ELECTRIC SHOCK RISK

Isolate electrical supply before working on this equipment.

13.3 FAULT FINDING

The Quantum III, as a digital drive, has an unprecedented number of diagnostic facilities to assist fault finding.

The following sections describe how these facilities can be used manually to identify a fault. However, it must be remembered that all the information indicated can also be data-logged via the optional serial interface.

Status Indicators

Nine LEDs to the right of the parameter data and index panels present information, continuously updated, about the running condition of the drive and enable basic information to be seen at a glance.

LED Illuminated	Information
Drive ready	The drive is turned on, not tripped.
Drive ready - flashing	The drive is tripped.
Alarm - flashing (overload pending)	The drive is in an overload trip condition or is integrating in the I x t region.
Zero speed	Motor speed < zero speed threshold (programmable).
Run forward	Motor running forward.
Run reverse	Motor running in reverse.
Bridge 1	Output bridge 1 is enabled.
Bridge 2	Output bridge 2 is enabled. (inactive in 1-quadrant models).
At speed	Motor running at the speed demanded by the speed reference.
Current limit	Drive running and delivering maximum permitted current.

Trip Codes

If a fault occurs, the index display shows **triP**, and the data message will flash. The data display shows a mnemonic to indicate the reason for the trip.

The last four trip codes are stored in parameters 10.25 through to 10.28, and are available for interrogation unaffected by power down/up cycles. The data stored in these parameters is updated only by the next trip event.

MNEM.	CODE	REASON FOR THE TRIP
AOC	121	***Armature overcurrent.*** An instantaneous protection trip has been activated due to excess current in the armature circuit.
AOP	126	***Armature open circuit.*** Check armature contactor power poles for continuity. Ensure #4.15–#4.17 is 0 on non-regenerative models (9500-83xx). Ensure ribbon cable under behind control board is properly plugged in. See parameter #10.37.
cL	104	***Current (control) loop open circuit.*** If the input reference is either 4-20mA or 20-4mA, this trip indicates that input current is <3.5mA.
EEF	132	***EEprom failure.*** Indicates that an error has been detected in the parameter set read from the EEprom at power-up.
EPS	103	***External power supply.*** Overcurrent trip at the 24V supply output terminal (TB4-33) has operated, indicating an overload in the external circuit connected to this supply. Investigate and rectify the cause. Remove +24v loads.
Et	102	***External trip.*** Parameter 10.34 = 1. The external trip set up by the user has operated. (Typically motor thermal). This is the normal setup for E-STOP trips. See Appendix C on E-STOP without External Trip.
FbL	119	***Feedback loss.*** No signal from tachometer or encoder. Try Arm Voltage Feedback
Fbr	109	***Feedback reversal.*** The polarity of the feedback tachometer or encoder polarity is incorrect.
FdL	118	***Field loss.*** No current in field supply circuit. On Size 1 units (9500-8X02 thru 8X06) the Field must be setup. See section 8.8 for details. Check Field wiring. Check field ohms against motor nameplate info.
FdO	108	***Field on.*** The user has initiated self-tuning (05.09) and field current has been detected.

MNEM.	CODE	REASON FOR THE TRIP
FOC	106	***Field overcurrent.*** Excess current detected in field current feedback. If current feedback is present and firing angle is phased back, then trip. If Size 2 or 3 drive and FXM5 not used, ensure #6.13 = 0.
hF	100	***Hardware fault.*** A hardware fault has been detected during the self-diagnosis routine performed after power-up. Consult factory.
It	122	***I*** x ***t trip.*** The integrating overload protection has reached trip level. Load exceeded 100% for more than 60 seconds.
Oh	107	***Overheated.*** SCR heatsink over-temperature. (Only on drives installed with heatsink thermals). See #10.33
Pc1	124	***Processor 1 watchdog.*** Indicates a fault in the MDA1 hardware has been detected by malfunctioning of Processor 1 software.
Pc2	131	***Processor 2 watchdog.*** Shows a Processor 2 malfunction, or a user software bug (MD29 option).
PhS	101	***Phase sequence.*** Connections to E1 and E3 are not the same phases as are connected to L1 and L3. Investigate and correct.
PS	125	***Power supply.*** One or more of the internal power supplies is out of tolerance. Remove +/-10v loads (speed pot) from TB1 pins 1 and 2 on MDA2B board and re-try.
ScL	105	***Serial communications inter-face loss.*** (Only in serial comms mode 3) No input data detected.
SL	120	***Supply loss.*** One or more of the power (input) supply phases is open-circuit. Check input line fusing.
th	123	***Thermal.*** Motor protection thermal has initiated a trip indicating windings overheating.
thS	110	***Thermal short circuit.*** Thermal input < 100 (not in effect when motor thermal is used).

IN CASE OF ANY TRIP, all RO parameter values are ‘frozen’ and remain so for interrogation while the cause of the fault is investigated. To enter parameter adjustment mode from the trip mode, press any of the five adjustment keys. To re-enter trip mode, go to Menu 00 and press ◄ .

13.4 Trip Codes

TRIP CODES IN NUMERICAL ORDER		
hF	100	Hardware fault.
PhS	101	Phase sequence
Et	102	External trip.
EPS	103	External power supply.
cL	104	Current (control) loop open circuit.
ScL	105	Serial communications interface loss.
FOC	106	Field overcurrent.
Oh	107	Drive over temperature.
FdO	108	Field on.
Fbr	109	Feedback reversal.
thS	110	Thermal short circuit.
FdL	118	Field loss.
FbL	119	Feedback loss.
SL	120	Supply loss.
AOC	121	Armature overcurrent.
It	122	I x t trip.
th	123	Motor over temperature.
Pc1	124	Processor 1 watchdog.
PS	125	Power supply.
AOP	126	Armature open circuit.
Pc2	131	Processor 2 watchdog.
EEF	132	EEprom failure.

MONITORING KEY DRIVE PARAMETERS

NOTE

If a fault occurs, the following parameters are frozen at the instant of the fault and can therefore be read after the event. This gives valuable information about the operating conditions which existed when the fault occurred. This feature is of great assistance in determining the precise nature and cause of the fault. Reference should be made to the menu diagrams and the full descriptions in Section 10 when analyzing the following parameters.

To enter the parameter adjustment mode from the trip mode, press any of the five adjustment keys. To re-enter the trip mode, go to Menu 00 and press ◄.

01.01 RO Pre-offset speed reference
Range ±1000

01.02 RO Post-offset speed reference
Range ±1000

01.03 RO Pre-ramp reference
Range ±1000

02.01 RO Post-ramp Reference
Range ±1000rpm

03.01 RO Final Speed Demand
Range ±1000

03.02 RO Speed Feedback
Range ±1000

03.03 RO Displayed Speed Feedback
Range ±1999rpm

03.04 RO Armature Voltage
Range ±1000 (direct reading in Volts)

03.05 RO IR Compensation Output
Range ±1000

03.06 RO Speed Error
Range ±1000

03.07 RO Speed Loop Output
Range ±1000

03.08 RO Speed Error Integral
Range ±1000

***03.26** RO Tachometer Input*
Range ±1000

04.01 RO Current Demand
Range ±1000

04.02 RO Final Current Demand
Range ±1000

04.03 RO Over-riding Current Limit
Range ±1000

***04.24** RO Taper threshold 1 exceeded*
Range 0 or 1

***04.25** RO Taper threshold 2 exceeded*
Range 0 or 1

05.01 RO Current Feedback
Range ±1000

05.02 RO Current —Displayed Feedback Amps
Range ±1999

05.03 RO Firing Angle
Range 277 to 1023

***05.11** RO Actual overload*
Range 0 to 199

06.01 RO Back EMF
Range 0 to 1000

06.02 RO Field Current Demand
Range 0 to 1000

06.03 RO Field Current Feedback
Range 0 to 1000

06.04 RO Firing Angle
Range 261 to 1000

06.05 RO IR Compensation 2 Output
Range ±1000

07.01 RO General Purpose Input 1
Range ±1000

07.02 RO General Purpose Input 2
Range ±1000

07.03 RO General Purpose Input 3
Range ±1000

07.04 RO General Purpose Input 4
Range ±1000

07.05 RO Speed Reference Input
Range ±1000

07.06 RO RMS Input Voltage
Range 0 to 1000

07.07 RO Heatsink Temperature
Range 0 to 1000

08.01 RO F1 Input — Run Permit
Range 0 or 1

08.02 RO F2 Input — Default Inch Reverse
Range 0 or 1

08.03 RO F3 Input — Default Inch Forward
Range 0 or 1

08.04 RO F4 Input — Default Run Reverse
Range 0 or 1

08.05 RO F5 Input — Default Run Forward
Range 0 or 1

08.06 RO F6 Input — User-Programmable
Range 0 or 1

08.07 RO F7 Input — User-Programmable
Range 0 or 1

08.08 RO F8 Input — User-Programmable
Range 0 or 1

08.09 RO F9 Input — User-Programmable
Range 0 to 1

08.10 RO F10 Input — User-Programmable
Range 0 to 1

08.11 RO Drive Enable Input
Range 0 to 1

09.01 RO Status 1 Output
Range 0 or 1

09.02 RO Status 2 Output
Range 0 or 1

09.03 RO Status 3 Output
Range 0 or 1

09.04 RO Status 4 Output
Range 0 or 1

09.05 RO Status 5 Output
Range 0 or 1

09.06 RO Status 6 Relay Output
Range 0 or 1

10.01 RO Forward Velocity
Range 0 or 1

10.02 RO Reverse Velocity
Range 0 or 1

10.03 RO Current Limit
Range 0 or 1

10.04 RO Bridge 1 Enabled
Range 0 or 1

10.05 RO Bridge 2 Enabled
Range 0 or 1

10.06 RO Electrical Phase-Back
Range 0 or 1

10.07 RO At Speed
Range 0 or 1

10.08 RO Overspeed
Range 0 or 1

10.09 RO Zero Speed
Range 0 or 1

10.10 RO Armature Voltage Clamp Active
Range 0 or 1

10.11 RO Phase Rotation
Range 0 or 1

10.12 RO Drive Normal
Range 0 or 1

10.13 RO Alarm I x t
Range 0 or 1

10.14 RO Field Loss
Range 0 or 1

10.15 RO Feedback Loss
Range 0 or 1

10.16 RO Supply or Phase Loss
Range 0 or 1

10.17 RO Instantaneous Trip
Range 0 or 1

10.18 RO Sustained Overload
Range 0 or 1

10.19 RO Processor 1 Watchdog
Range 0 or 1

10.20 RO Processor 2 Watchdog
Range 0 or 1

10.21 RO Motor Overtemperature
Range 0 or 1

10.22 RO Heatsink Overtemperature
Range 0 or 1

10.23 RO Speed Loop Saturated
Range 0 or 1

10.24 RO Zero Current Demand
Range 0 or 1

10.25 RO Last Trip
Range 0 to 255

10.26 RO The Trip Before the Last Trip (10.25)
Range 0 to 255

10.27 RO The Trip Before 10.26
Range 0 to 255

10.28 RO The Trip Before 10.27
Range 0 to 255

11.15 RO Processor 1 Software Version
Range 0 to 255

11.16 RO Processor 2 Software Version
Range 0 to 255

12.01 RO Threshold 1 Exceeded
Range 0 or 1

12.02 RO Threshold 2 Exceeded
Range 0 or 1

NUMBER	DESCRIPTION	RANGE
13.01	RO Master counter value	0 to 1023
13.02	RO Slave counter value	0 to 1023
13.03	RO Master counter increment	±1000
13.04	RO Slave counter increment	±1000
13.05	RO Position error	0 to 255
15.01	RO variable 1	±1999
15.02	RO variable 2	±1999
15.03	RO variable 3	±1999
15.04	RO variable 4	±1999
15.05	RO variable 5	±1999
16.01	RO variable 1	±1999
16.02	RO variable 2	±1999
16.03	RO variable 3	±1999
16.04	RO variable 4	±1999
16.05	RO variable 5	±1999

13.5 Fault Finding Chart

The following chart is intended to assist with troubleshooting a typical drive. While not exhaustive, it indicates the general procedure to be adopted.

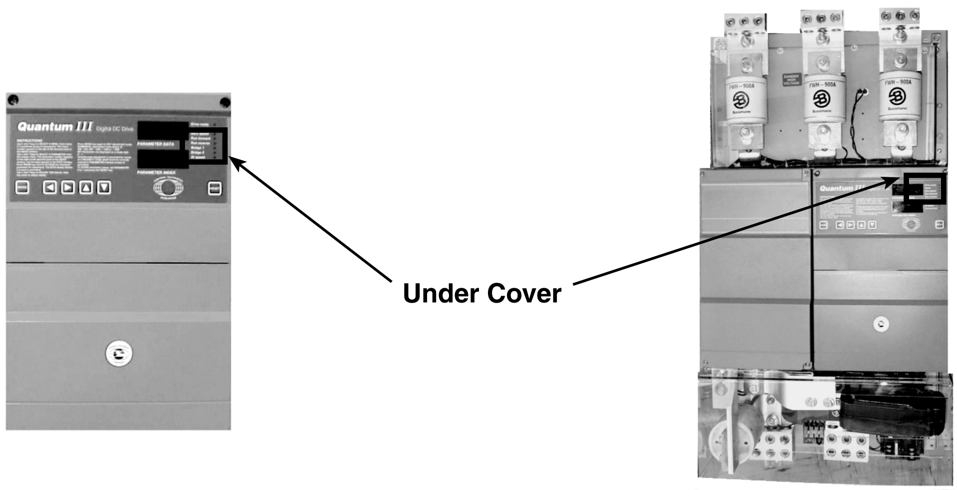
SYMPTOM	INDICATIONS	ACTION
MOTOR DOES NOT ROTATE	Drive ready LED off	NO POWER TO REGULATOR: Check regulator supply voltage on terminals E2, E2, E3. Check regulator/field fuses FS1, FS2, FS3. If failed, suspect problem in field regulator circuit or faulty field bridge.
	Drive ready LED flashing:	
	FdL displayed	FIELD LOSS: Check field connections. Check fuses FS1 & FS2 and field bridge. Check MDA-3 or FXM5 field regulator card, if used. Check if field regulator is fully set up (param 6.13).
	AOC displayed	ARMATURE OVERCURRENT TRIP: Check phase sequence & rotation: L1 same phase as E1 L2 same phase as E2 L3 same phase as E3 Check for short circuit or ground fault on output terminals A1, A2.
	PS displayed	POWER SUPPLY FAULT: Remove wires from pins 1 and 2 on MDA2 Board and retry Replace MDA2 PCB. If fault persists, replace power PCB.
	AOP displayed	ARMATURE OPEN CIRCUIT: Check wide ribbon cable conection under cover. Insure fully seated. Check motor connections and brushes. Check contactor sequencing and all fuses in AC and DC power circuit. See parameter #10.37

SYMPTOM	INDICATIONS	ACTION
MOTOR DOES NOT ROTATE	Drive ready and run LED on:	
	Current limit LED off	DRIVE NOT ENABLED: Connect ENABLE terminal 31 to 0V terminal 40. Check parameter #5.17 = 0 NO SPEED DEMAND: Connect reference on terminal 3 if used, and parameters 01.01 and 02.01 should follow reference.
	Current limit LED on	MOTOR MECHANICALLY STALLED or FAULT IN FIELD CIRCUIT. Check Field Voltages
	Drive ready LED on. Run and inch LEDs off	NO RUN COMMAND: Check control wiring. Refer to Menu 8 input parameters.
MOTOR STARTS BUT STOPS IMMEDIATELY	Drive ready LED flashing:	
	FbL displayed	TACH LOSS: Check tach/encoder connections and polarity. Try running in Armature Voltage Feedback
	SL displayed	PHASE LOSS: Check E1, E2, E3 Wires Check 3-phase supply and line fuses. (See below) Ensure SCR gate leads correctly connected. Check L2 AC Input Fuse
	AOC displayed	ARMATURE OVERCURRENT TRIP: Check 3-phase supply and line fuses (See below). Ensure SCR gate leads correctly connected. Check phase sequence and rotation: L1 same phase as E1 L2 same phase as E2 L3 same phase as E3 Check motor for ground faults and short circuits.
	Line fuse or DC fuse blown	SHORT CIRCUIT ON OUTPUT: Check connections between A1 and A2 and motor. Test motor for armature short circuit, short circuit between interpole and field, and ground fault. Perform Ohmmeter checks. INTER-BRIDGE FAULT (4Q ONLY): Replace the Power PCB. FAULTY SCR: Contact factory.

SYMPTOM	INDICATIONS	ACTION
MOTOR RUNS FOR A SHORT TIME AND STOPS	Alarm LED flashing while motor runs: It displayed	SUSTAINED OVERLOAD: Check mechanical load. Check field supply at motor field terminals. Measure Field Amps
MOTOR ROTATES IN ONLY ONE DIRECTION		Check if drive is a Non-Regen model 9500-83xx Check if reference is Uni-Polar Check: #4.14 through 4.17 # 1.10 # 4.05, 4.06
MOTOR SLOWS DOWN UNDER LOAD	Current limit LED on	DRIVE IN CURRENT LIMIT: Compare DC current with drive rating. Check value of HP/current scaling resistors. Check mechanical load. Check current limit settings 04.05 and 04.06. If used, check current limits 04.04 and 04.07. Check current taper 04.22 and 04.23. Check field supply at motor field terminals. Measure Field Amps.
DEFECTIVE SPEED CONTROL	Speed range limited	SPEED REFERENCE RANGE INCORRECT: Check range of potentiometer or internal reference. #7.05 SPEED CLAMPS OPERATING: Check max and min speed 01.06 through 01.09. OFFSET PRESENT: Check 01.04. FEEDBACK INCORRECT: Check setting of feedback selector jumpers and max. speed potentiometers.
	Speed unstable or overshoot excessive	SPEED LOOP GAINS INCORRECTLY SET: Enable Autotune 05.09. Adjust 03.09, 03.10, and 03.11. CURRENT LOOP GAIN INCORRECTLY SET: Adjust 05.12, 05.13, and 05.14.
	Motor runs only at top speed.	INCORRECT SPEED REFERENCE: Check speed potentiometer. Measure Voltage at Pin 3 - TB1 TACH LOSS: (If tach loss detector inhibited) Check tach connections and polarity. FIELD CURRENT TOO LOW. INCORRECT FEEDBACK SCALING Check setting of SW1. DRIVE OPERATING IN CURRENT CONTROL: Check setting of parameters 04.12 and 04.13.

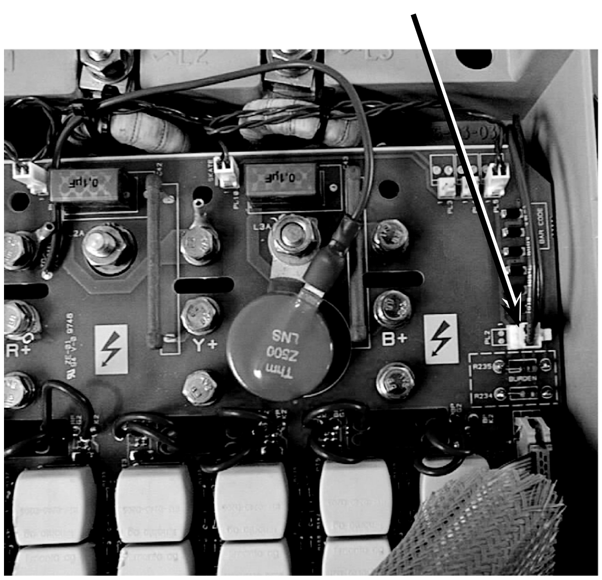
SYMPTOM	INDICATIONS	ACTION
MOTOR COMMUTATOR SPARKING		MECHANICAL PROBLEMS IN MOTOR: Check brushes and electrical neutral. ARMATURE VOLTAGE TOO HIGH: Tach feedback: Reduce field current. Set armature voltage clamp 03.15. Armature voltage feedback: Reduce motor voltage by limiting max speed 01.06 and 01.07. Weaken field if necessary to restore speed.
	Sparking on acceleration	CURRENT LIMIT TOO HIGH: Check parameters 04.05 and 04.06. CURRENT SLEW RATE TOO HIGH: (esp. solid-frame motor) Check parameter 05.04.
	Brushes and/or commutator worn	Replace brushes and/or overhaul commutator. If wear was rapid, check for contamination by oil mist or corrosive vapors.
MOTOR DOES NOT HOLD ZERO SPEED(FOR REGEN MODELS ONLY)	Overhauling load rotates motor at low speed No holding torque	Standstill logic is enabled Set parameter 05.18=0
NO DISPLAY		Check Fuses Check Ribbon Cable behind Cover -- Insure fully seated
FUSES BLOW		Disconnect F+ and F- wires of drive, unless FXM5 used.
DISPLAY CONTINUALLY FLASHES	In a circular manner like during power up	Check pin 32 (RESET) on TB4 of the MDA2 PCB. A closure to common will cause this. The programmable relay PGM2 activated by terminal 12 on the relay board TB1 could be active. A stuck key on the membrane keypad will also cause this. Lower the front cover and remove the keypad mylar tail. If this stops the RESET, the problem is a stuck key.

13.6 Quantum III Heatsink Temperature Sensor Location

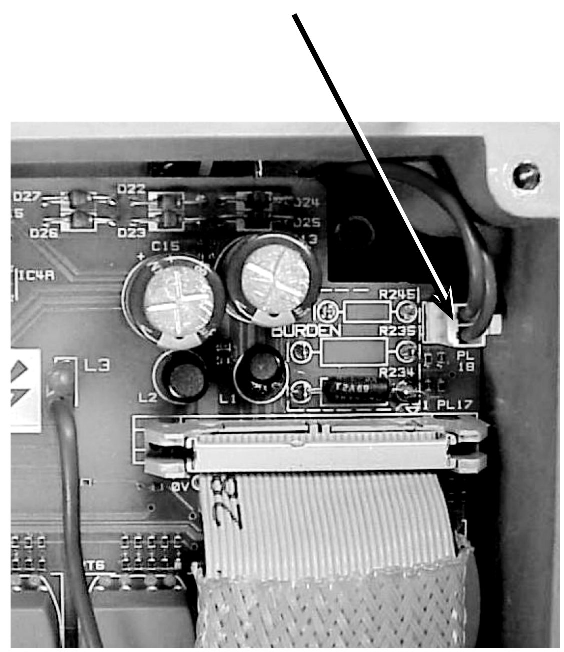


Size 1 — Plug PL2

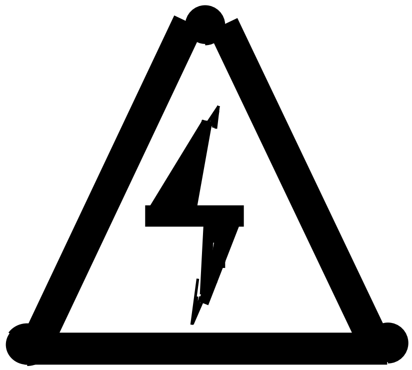
Note: Not Applicable on 9550-8X02 or 8X03 Models



Size 2 & 3 — Plug PL18



14.1 REPLACING COMPONENTS ON THE DRIVE UNIT



DANGER

ELECTRIC SHOCK RISK

Isolate electrical supply before working on this equipment.

14.2 ROUTINE MAINTENANCE

Only minor adjustments should be necessary on initial start-up, depending on the application. In addition, some common sense maintenance needs to be followed.

KEEP IT CLEAN: The control should be kept free of dust, dirt, oil, caustic atmosphere and excessive moisture.

KEEP IT COOL: The control should be located away from machines having a high ambient temperature. Air flow across heatsinks must not be restricted by other equipment within an enclosure.

KEEP CONNECTIONS TIGHT: The equipment should be kept away from high vibration areas that could loosen connections or cause chafing of wires. All interconnections should be retightened at time of initial start-up and at least every six months.

WARNING

THE DC MOTOR MAY BE AT LINE VOLTAGE EVEN WHEN IT IS NOT IN OPERATION. THEREFORE, NEVER ATTEMPT TO INSPECT, TOUCH OR REMOVE ANY INTERNAL PART OF THE DC MOTOR (SUCH AS THE BRUSHES) WITHOUT FIRST MAKING SURE THAT ALL AC POWER TO THE CONTROL AS WELL AS THE DC POWER TO THE MOTOR HAS BEEN DISCONNECTED.

The motor should be inspected at regular intervals and the following checks must be made:

A. See that both the inside and outside of the motor are not excessively dirty. This can cause added motor heating, and therefore, can shorten motor life.

B. If a motor blower is used, make sure that the air passages are clean and the impeller is free to rotate. If air filters are used, they should be cleaned at regular intervals or replaced if they are disposable. Any reduction in cooling air will increase motor heating.

C. Inspect the commutator and brushes. Replace the brushes if needed. Make sure that the proper brush grade is used.

D. The motor bearing should be greased per the manufacturer's instructions as to type of grease and maintenance frequency. Overgreasing can cause excessive bearing heating and failure. Consult the instructions supplied with the motor for more details.

The following outlines the correct method for replacing components such as pcb's, fuses, field rectifiers, etc., after location by fault diagnosis.

WARNING

THE DRIVE MAIN ISOLATOR MUST BE SWITCHED OFF BEFORE STARTING REPAIR WORK.

14.3 PERSONALITY BOARD MDA-2 REMOVAL (ALL MODELS)

See Figure 7-4.

Record all wire connections.

With the hinged panel closed, remove the wires connected to the Terminal Block and all communications and encoder cables on the MDA-2 Personality Board. Unscrew the four screws which secure the board to the panel. Ease the Personality Board gently out of the 96-pin socket which connects it to the Control Board (MDA-1).

14.4 CONTROL BOARD MDA-1 REMOVAL (ALL MODELS)

See Figure 7-4.

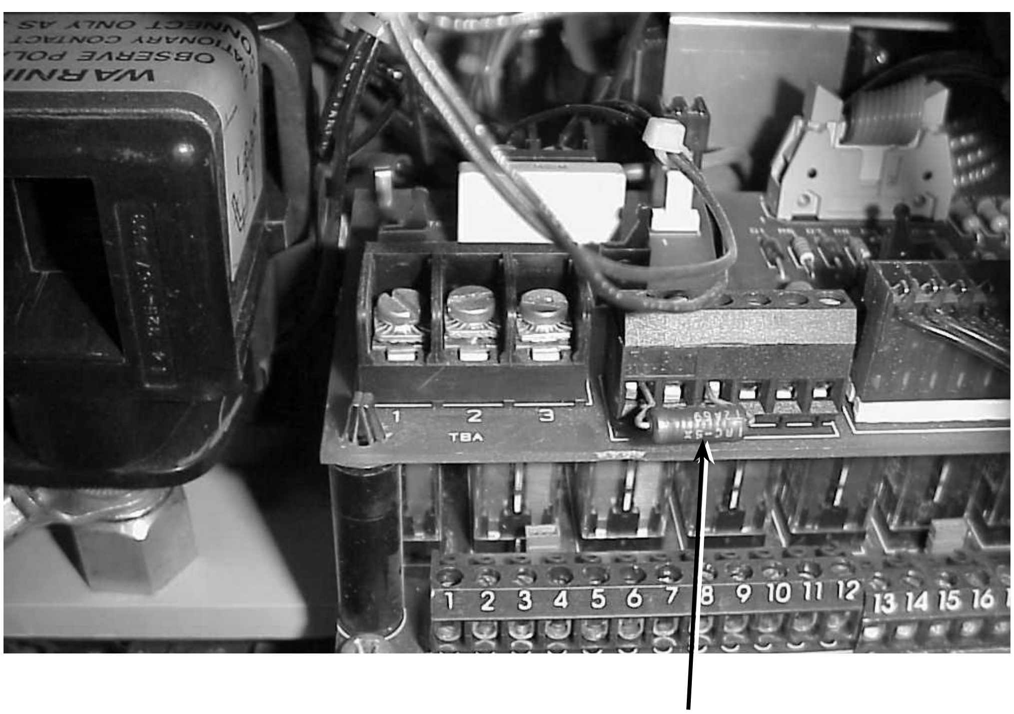
Remove the two lid screws located above the Display Panel and swing the hinged panel forward (unless this has been done earlier). Remove the four (4) screws located on the backside of the panel which hold the Display Panel to the Control Board. Undo the two screws securing the Control Board to the hinged panel. Disconnect the 34-pin Ribbon Cable, and gently ease the Control Board out of the 96-pin plug which connects it to the Personality Board (unless this has already been removed.)

14.5 INSPECTION OF THE CONTACTOR/ FUSE CHASSIS (MODELS 9500-8X02 THROUGH 9500-8X06)

See Figure 14-1.

To open the unit for inspection of the contactor/ fuse chassis, undo the two screws located above the display panel and swing the hinged panel forward.

If replacing a Size 1 Quantum III, simply pull off the entire TBS connector (as it is removable) with the correct HP scaling resistor still attached, and place it on to the replacement drive. This will ensure the replacement is correctly scaled to your existing motor. (See photo below.)



Horsepower Scaling Resistor

14.6 REMOVAL OF THE CONTACTOR/ FUSE CHASSIS FROM THE MOLDED BASE (MODELS 9500-8X02 THROUGH 9500-8X06)

See Figure 14-1.

Remove the green ground wire from the grounding bar. Remove the three nuts and washers which hold the bussbars to the molded base at the L1, L2, L3 end of the drive. Remove the three wires marked 1, 2, 3 from the studs. Remove the two nuts and associated washers holding the bussbars to the molded base on the left hand side of the drive. Remove the two phillips screws located next to the L1 fuseblock and the A-fuseblock which hold the chassis to the molded base. Remove the two screws located on the sides of the drive which hold the chassis to the base. Remove the Chassis from the base by pulling straight off. Disconnect the 34-pin ribbon cable at PL1 on the SCR PCB found in the base. Remove the J1 connector and the J4,5,6,7 stake on the connectors on the 9500-4030 board.

14.7 FIELD RECTIFIER—CHANGING

1. Low HP models 9500-8X02 to -8X06.

A Field Regulator MDA-3 is used. Refer to the Options Section for installation instructions.

2. Medium HP models 9500-8X07 to 9500-8X11.

See Figure 14-2. Remove the left cover by loosening the four (4) screws. Remove the AC armature buss bar by removing the nut and associated hardware from the top of the buss bar and remove the threaded bolt from the bottom. Disconnect the "stake on" wiring, making sure to mark the location of each wire. Remove the rectifiers by removing two (2) threaded bolts. Replace the defective rectifiers and reinstall on the heatsink using the two threaded bolts. Re-install the A2 buss bar. Insure all mechanical connections are tightened to eliminate any "resistance" connections.

3. High HP models 9500-8315 to 9500-8320 and 9500-8312 to 9500-8314.

See Figure 14-3. Remove the left cover by loosening the four screws. Disconnect the "stake on" wiring, making sure to mark the location of each wire. Remove the rectifiers by removing two (2) threaded bolts. Replace the defective rectifiers and reinstall on the heatsink using the two threaded bolts. Reconnect all wiring.

4. On all Quantum III models:

a. Clean all old compound from the heatsink.

b. Check that the part number of the new component is compatible with the old one.

c. Spread a thin layer of heatsink compound on the base of the rectifier and secure it to the heatsink.

14.8 REPLACEMENT OF FUSES

14.8.1 Low HP Models 9500-8X02 to 9500-8X06

See Figure 14-1.

Open the unit as outlined in paragraph 14.5. The line fuses 1FU, 2FU, and 3FU and armature fuse 4FU are located at the top of the unit. Remove the nuts from the top of the fuse and the bolts securing the bottom, along with associated hardware. Remove the defective fuse(s) and reinstall, insuring all mechanical connections are tight.

The transformer primary fuses 5FU and 6FU, and secondary fuse 7FU are mounted on top of the transformer in clip holders for ease of maintenance.

The field fuses FS1 and FS3 are located on the power board and are accessible from the bottom of the unit without opening the hinged cover. They are mounted in clip holders for ease of maintenance.

14.8.2 Medium HP Models 9500-8X07 to 9500-8X11

See Figure 14-2.

To replace the line fuses 1FU, 2FU, and 3FU, remove the protective plexiglass cover at the top of the panel. Remove the defective fuse(s) by removing the two (2) nuts and associated hardware. Replace the fuse(s), insuring all mechanical connections are tightened. Replace the protective cover.

The armature fuse (on regenerative units only) 4FU and T1 transformer fuses 5FU, 6FU, and 7FU are located at the bottom of the panel. Remove the protective plexiglass cover. The armature fuse is located on the left side and is replaced by removing the two(2) nuts and hardware.

The T1 transformer fuses are located on top of the transformer in clip holders. Insure all mechanical connections are tightened and replace the protective cover.

To replace field fuses FS1, FS2 and FS3 on the MDA6 power board, loosen the four screws to remove the left plastic cover. The fuses are located on the left corner in clip holders.

To replace the FS1, FS2 and FS3 fuses on the MDA5 snubber board, remove the left cover as detailed above. Also remove two (2) screws in top of right hinged cover. The fuses are located on the left side, center, and right side of the board.

14.8.3 High HP Models 9500-8315 to 9500-8320

See Figure 14-3.

The line fuses 1FU, 2FU, and 3FU are located on the right side of the panel. Remove the protective cover and unbolt the fuse(s) from the line and drive buss connections. Replace fuse(s), insuring all mechanical connections are tightened.

The T1 transformer primary fuses 5FU and 6FU and secondary fuse 7FU are located on top of the transformer in clip holders.

To replace the fuses in the 9500-4040 line suppressor board, loosen the four(4) screws to remove the protective plexiglass cover. The fuses are located on the right side of the board in clip holders. Replace all protective covers.

14.8.4 High HP Models 9500-8315 to 9500-8320 and 9500-8112 to 9500-8114

To replace the field fuses FS1, FS2 and FS3 on the MDA6 power board, loosen the four screws to remove the left plastic cover. The fuses are located on the left corner in clip holders.

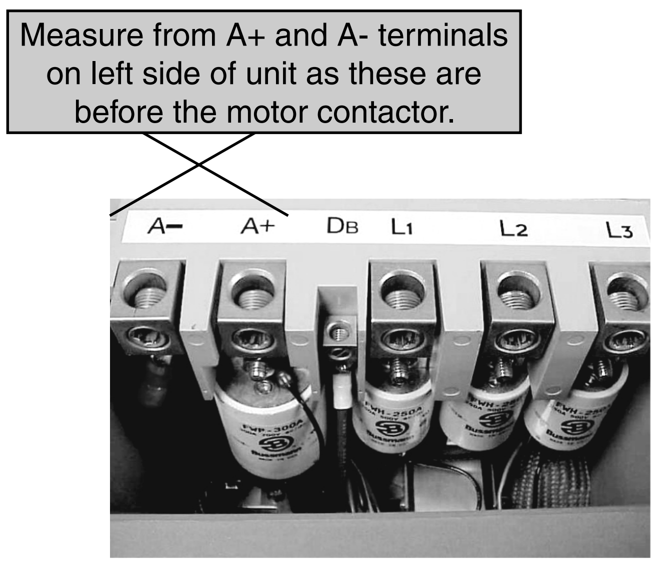
To replace FS1, FS2, and FS3 on the SD1 snubber board, loosen the two screws on the top of the metal hinged cover and swing it down. The SD1 boards are located on the heat sinks. Remove the two nuts and associated hardware to replace the defective fuse(s). Replace hardware and tighten nuts. Fasten hinged metal panel.

14.9 Drive Power Element Evaluation

The tables on the following page provide expected resistance measurements from key power terminal points in an effort to determine whether there is a faulty power device within the drive.

CAUTION

Obviously, these resistance measurements must be done with Power Off (and locked out). If the AC input for the drive comes directly from the secondary of an isolating transformer (with no disconnect in between), the power leads L1, L2 and L3 would need to be removed to obtain the tabulated readings.



Note: Fuses should be checked first so that measurements are valid from the L1, L2 and L3 lugs.

14.9 Drive Power Element Evaluation (cont.)

SCR power bridge checks	
Terminal	**Resistance (approx)**
	High resistance scale
L1-gnd	greater than 1 meg ohms
L2-gnd	greater than 1 meg ohms
L3-gnd	greater than 1 meg ohms
L1-L2	greater than 1 meg ohms
L2-L3	greater than 1 meg ohms
L3-L1*	5 to 100 ohms
A1-L1**	greater than 1 meg ohms
A1-L2**	greater than 1 meg ohms
A1-L3**	greater than 1 meg ohms
A2-L1**	greater than 1 meg ohms
A2-L2**	greater than 1 meg ohms
A2-L3**	greater than 1 meg ohms
A1-A2	greater than 1 meg ohms
0v - gnd***	greater than 1 meg ohms

Drive Size	**Field Bridge Checks**		
	Terminal		Reading
	(+) lead	(-) lead	Diode check setting ****
Size 1	L1	F+	OL
	L2	F+	OL
	L3	F+	0.5
	L1	F-	OL
	L2	F-	OL
	L3	F-	OL
	F-	F+	1
Size 2 Size 3	L1	F+	0.5
	L2	F+	0.5
	L3	F+	0.5
	L1	F-	OL *****
	L2	F-	OL
	L3	F-	0
	F-	F+	0.5

* This will be the resistance of the control transformer primary winding and is dependant upon what primary voltage setting is
If 5FU or 6FU is removed from the transformer, the reading will "count" up to about 500 Kohms or greater
(meter is charging capacitor in switch mode power supply)

** The A1 and A2 connections referenced are located on the side of the unit (ahead of the motor contactor) for Size 1 & 3 drives

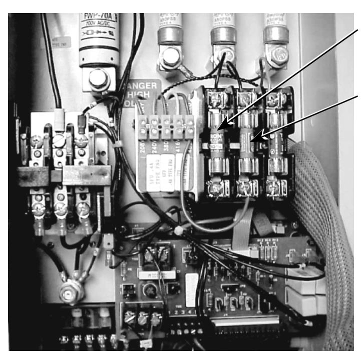
** The A1 and A2 connections referenced are located on the top of the unit (ahead of the motor contactor) for Size 2 drives

*** This is assuming that signal common of the drive was not intentionally earth grounded

**** In diode check most meters read forward voltage drop of the diode, these readings may vary from meter to meter

***** Remove 5FU or 6FU

Field Connections
GND or Ground is the Heat Sink Lug
Ov is under the cover (pin 20 or 40)



5FU
6FU

** Reading will be about 90 Ohms as this is through the transformer primary winding. If 5FU or 6FU is removed, the reading should be about 20Meg Ohms like L1-L2.

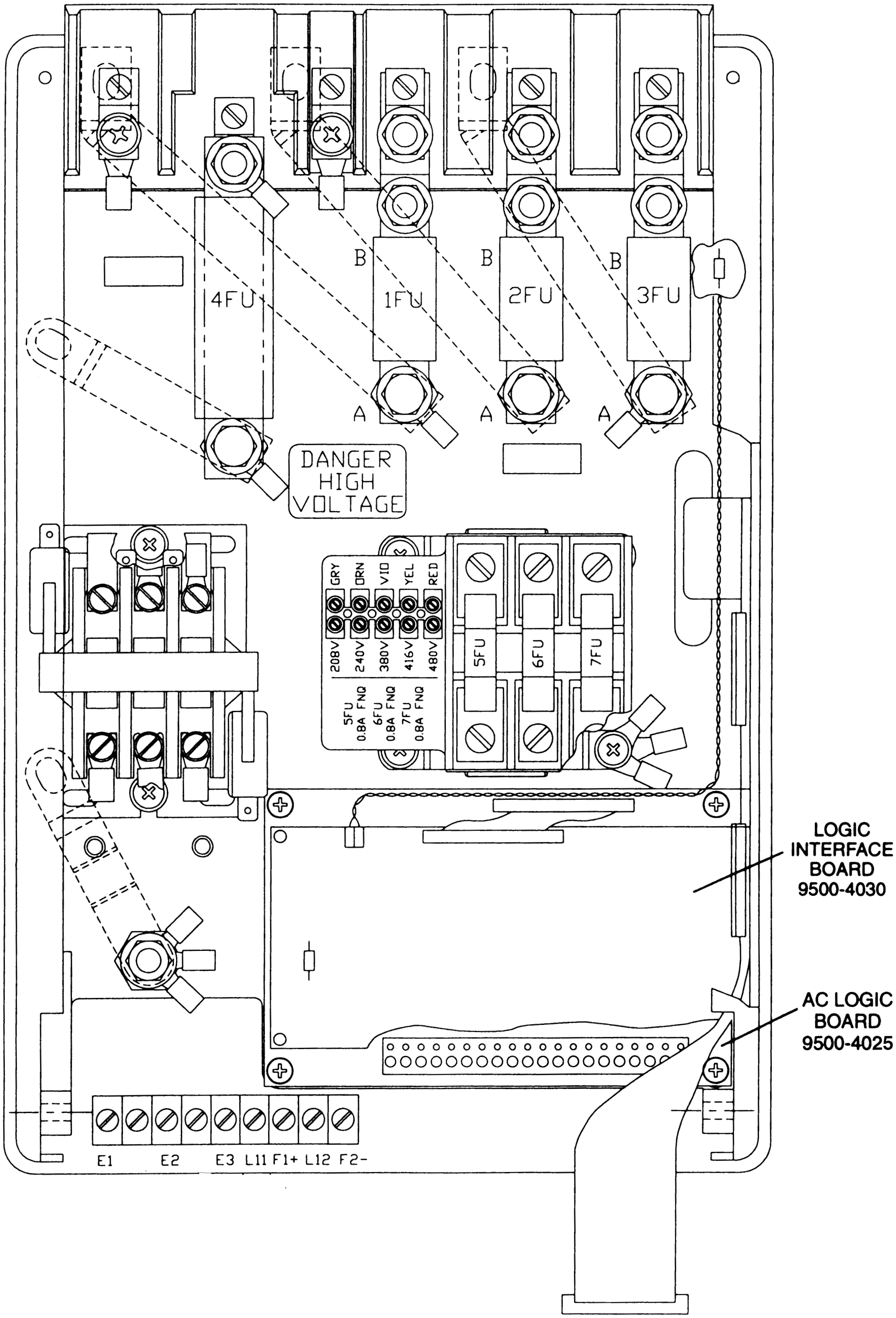
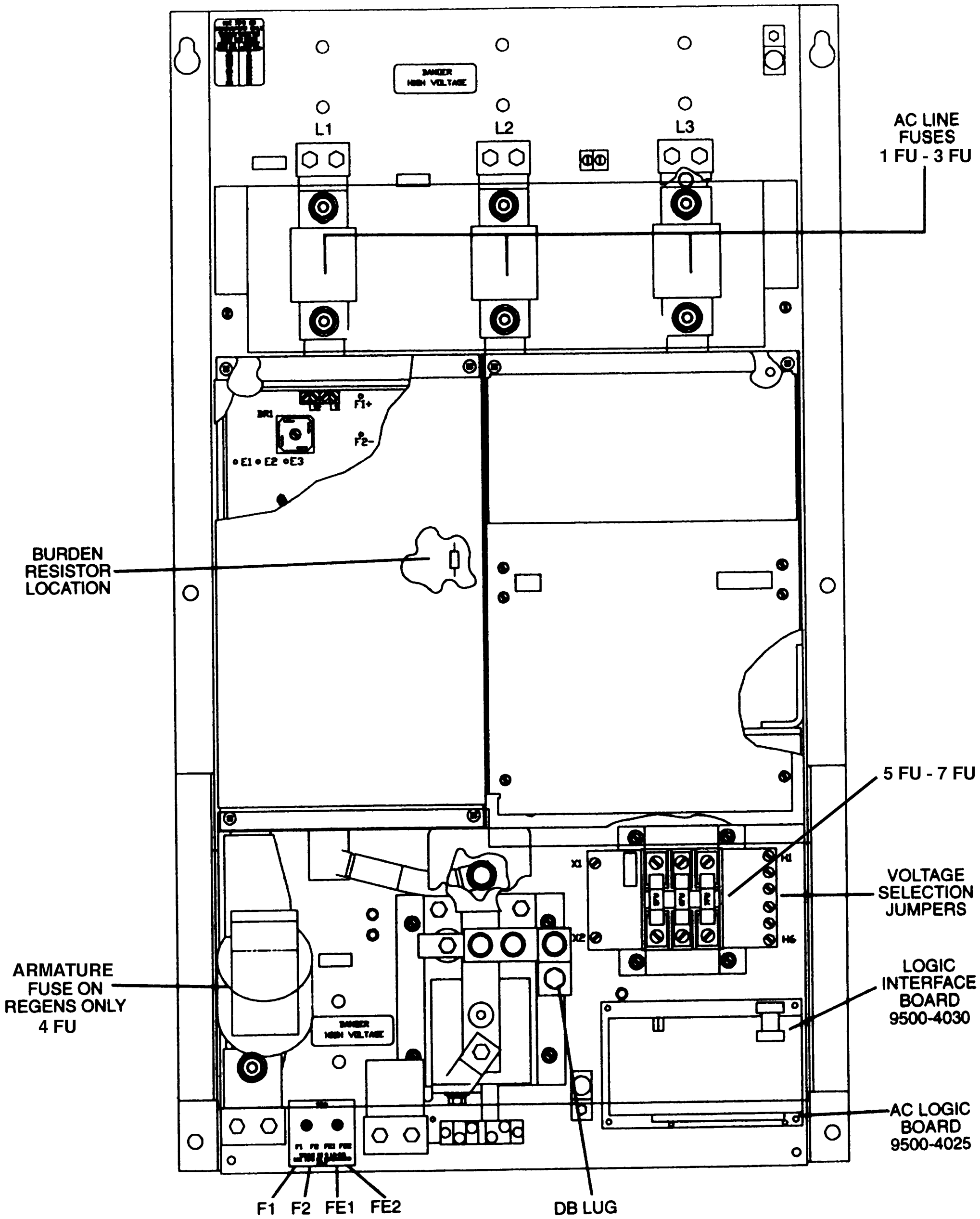


Figure 14-1.
5-100 HP Quantum III Unit

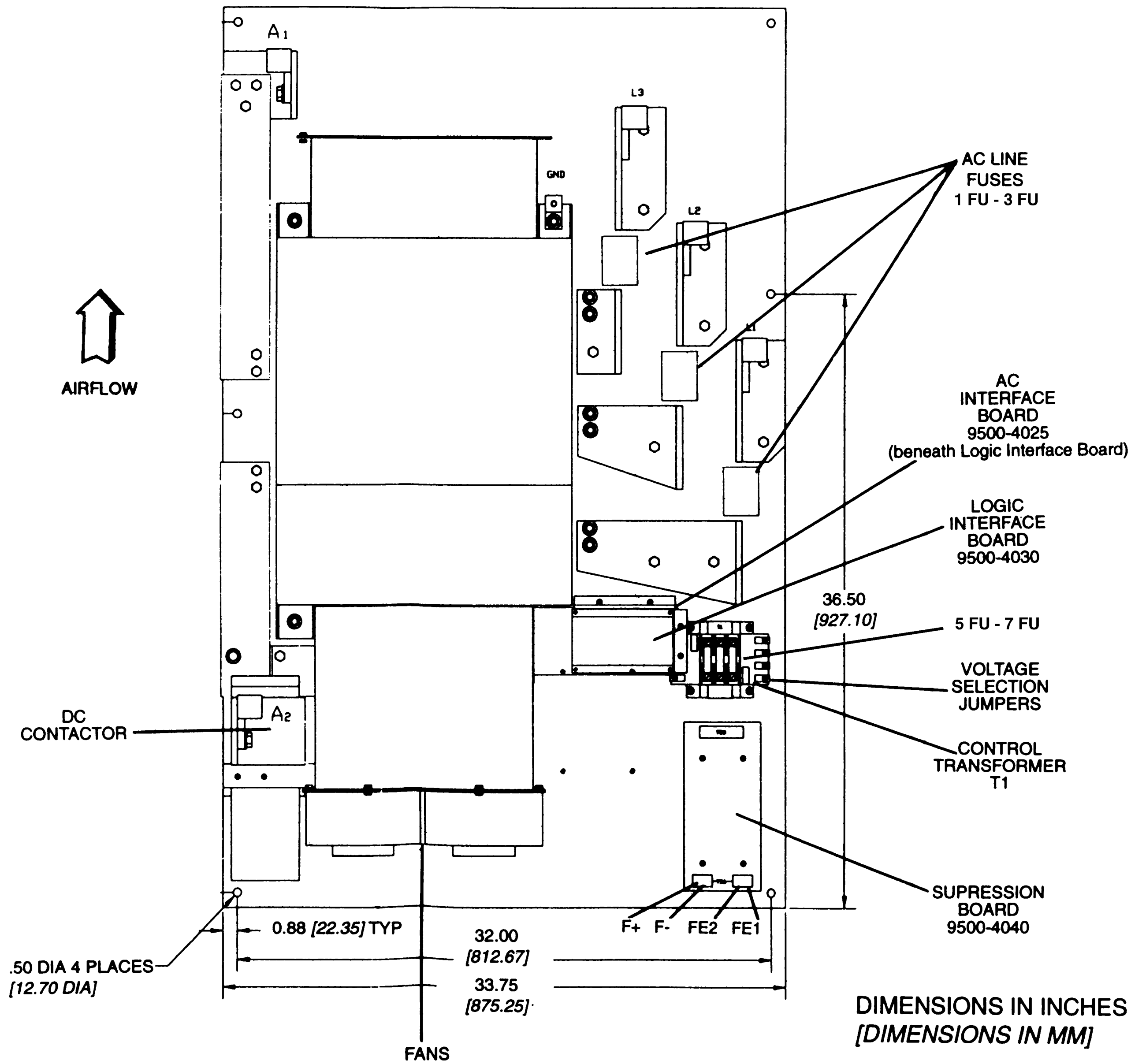


L1
L2 - Main 3 phase AC supply to control
L3

FE1 - Field Economy connections. Jumper for
FE2   full field. Used with Field Economy Kit 2200-9201

F1 - Motor Field Connections
F2

Figure 14-2.
75-400 HP Quantum III Unit



L1
L2 - Main 3 phase AC supply to control
L3

A1
A2 - Armature Connections

F1
F2 - Motor Field Connections

FE1 - Field Economy connections. Jumper for
FE2 full field. Used with Field Economy Kit 2200-9201

Figure 14-3.
250-1000 HP Quantum III Unit

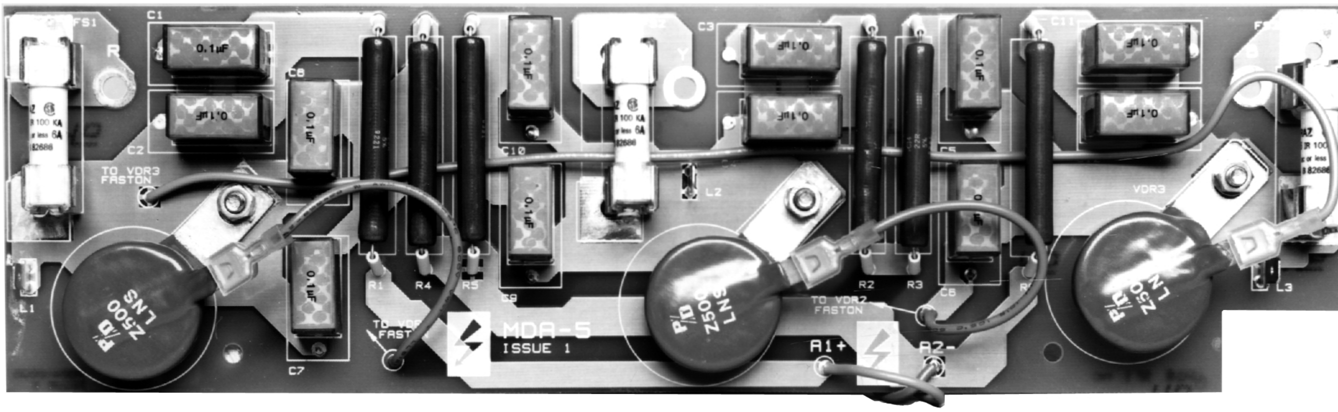


Figure 14-4.
9300-5308 MDA5 Snubber Board

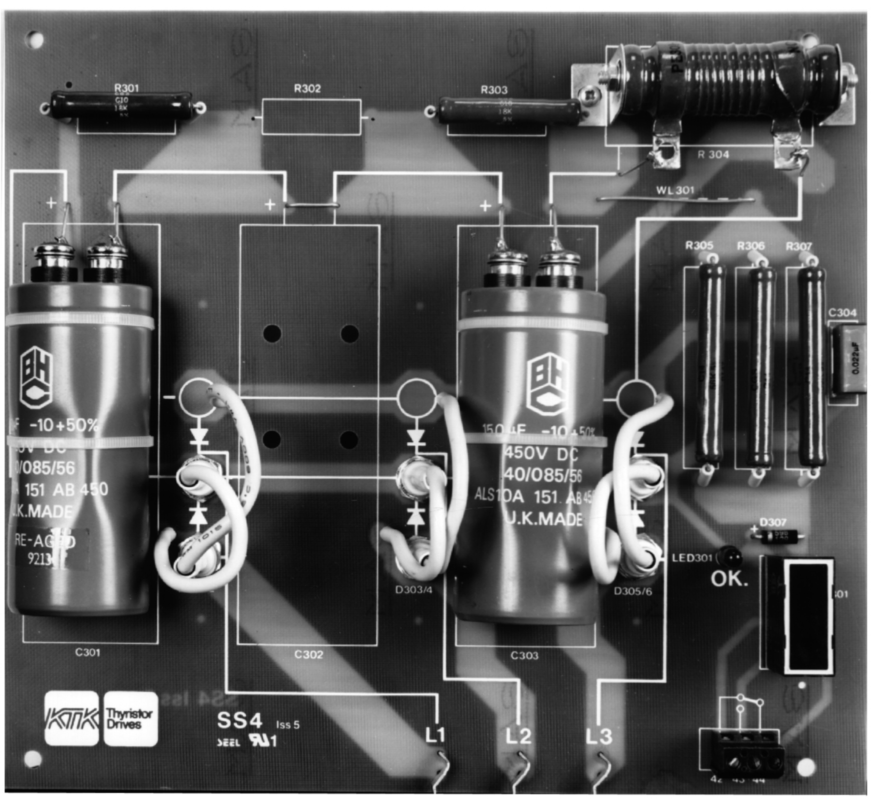


Figure 14-5.
9300-1014 Board

15.1 QUANTUM III SPARE PARTS KITS

Control Techniques offers a Spares Kit "A" and Kit "B" for each Quantum III model. They represent a significant savings over purchasing the items separately.

Kit "A" will be minimal coverage:

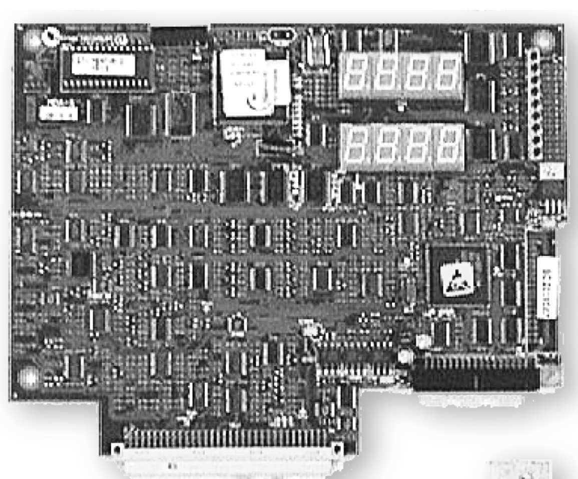
- 1 set burden resistors
- 6 line fuses (also 2 armature fuses for regen)
- 6 transformer fuses
- 6 power board fuses **

Kit "B" will offer more coverage and include:

- 1 Interface board (9500-4025)
- 1 MDA-1 control board
- 1 contactor (except larger units)
- 6 line fuses (also 2 armature fuses for regen) *
- 6 transformer fuses
- 6 power board fuses **

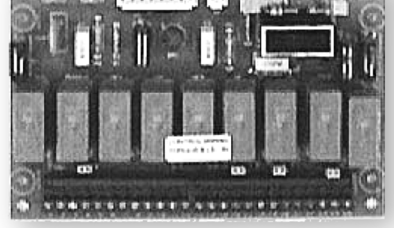
**   Quantity may vary for large units*
*** Quantity 12 for 150-400HP, 480V units*

Complete listing on following page.



MDA1 CPU Board

Drive Fuses



9500-4025 AC Interface Board

15.2 SPARE PARTS KITS

Consult your local distributor or Control Techniques Service Center for pricing.

Kit part number

9500-8302-SP-A	Spare parts Kit “A”	
9500-8303-SP-A	Spare parts Kit “A”	
9500-8305-SP-A	Spare parts Kit “A”	
9500-8306-SP-A	Spare parts Kit “A”	
9500-8307-SP-A	Spare parts Kit “A”	
9500-8308-SP-A	Spare parts Kit “A”	
9500-8309-SP-A	Spare parts Kit “A”	
9500-8310-SP-A	Spare parts Kit “A”	
9500-8311-SP-A	Spare parts Kit “A”	
9500-8315-SP-A	Spare parts Kit “A”	
9500-8316-SP-A	Spare parts Kit “A”	
9500-8317-SP-A	Spare parts Kit “A”	(2 line fuses)
9500-8318-SP-A	Spare parts Kit “A”	(2 line fuses)
9500-8319-SP-A	Spare parts Kit “A”	(12 line fuses)
9500-8320-SP-A	Spare parts Kit “A”	(12 line fuses)
9500-8602-SP-A	Spare parts Kit “A”	
9500-8603-SP-A	Spare parts Kit “A”	
9500-8605-SP-A	Spare parts Kit “A”	
9500-8606-SP-A	Spare parts Kit “A”	
9500-8607-SP-A	Spare parts Kit “A”	
9500-8608-SP-A	Spare parts Kit “A”	
9500-8609-SP-A	Spare parts Kit “A”	
9500-8610-SP-A	Spare parts Kit “A”	
9500-8611-SP-A	Spare parts Kit “A”	
9500-8302-SP-B	Spare parts Kit “B”	
9500-8303-SP-B	Spare parts Kit “B”	
9500-8305-SP-B	Spare parts Kit “B”	(less contactor)
9500-8306-SP-B	Spare parts Kit “B”	(less contactor)
9500-8307-SP-B	Spare parts Kit “B”	(less contactor)
9500-8308-SP-B	Spare parts Kit “B”	(less contactor)
9500-8309-SP-B	Spare parts Kit “B”	(less contactor)
9500-8310-SP-B	Spare parts Kit “B”	(less contactor)
9500-8311-SP-B	Spare parts Kit “B”	(less contactor)
9500-8315-SP-B	Spare parts Kit “B”	(less contactor)
9500-8316-SP-B	Spare parts Kit “B”	(less contactor)
9500-8317-SP-B	Spare parts Kit “B”	(2 line fuses)
9500-8318-SP-B	Spare parts Kit “B”	(2 line fuses)
9500-8319-SP-B	Spare parts Kit “B”	(12 line fuses)
9500-8320-SP-B	Spare parts Kit “B”	(12 line fuses)
9500-8602-SP-B	Spare parts Kit “B”	
9500-8603-SP-B	Spare Parts Kit “B”	
9500-8605-SP-B	Spare parts Kit “B”	(less contactor)
9500-8606-SP-B	Spare parts Kit “B”	(less contactor)
9500-8607-SP-B	Spare parts Kit “B”	(less contactor)
9500-8608-SP-B	Spare parts Kit “B”	(less contactor)
9500-8609-SP-B	Spare parts Kit “B”	(less contactor)
9500-8610-SP-B	Spare parts Kit “B”	(less contactor)
9500-8611-SP-B	Spare parts Kit “B”	(less contactor)

In addition to spare parts kits, individual parts are available. Locate your drive on the following pages.

15.3 REPLACEMENT PARTS INFORMATION

Parts listed in this manual are current at time of printing. For older models, instructions follow for parts replacement. Consult our website at: **www.ctdrives.com/service**.

SOFTWARE AND HARDWARE COMPATIBILITY:

Mentor II and Quantum III have been manufactured with 3 distinct levels of software:

Mentor II	Versions 2, 3, 4 and 5
Quantum III	Version 4 & 5 only

Different levels of software require specific issues of control, power and field boards.
For proper replacement, consult Service Center with following information:

MDA1 Control	Software version - located on top, upper left corner of board on the E-Prom

Interface boards - two models available - they are not interchangeable:

MDA2	First version Board - Software version, located lower right corner of board. **NOTE:** Accommodates MD21 only
MDA2B	Second version Board - Software version, located lower right corner of board. **NOTE:** Accommodates MD29 only
MDA3 Field Board	Issue number located on upper right corner
MDA75(R) MDA210(R)	Issue number located on front, right corner of board MDA6 Power Board

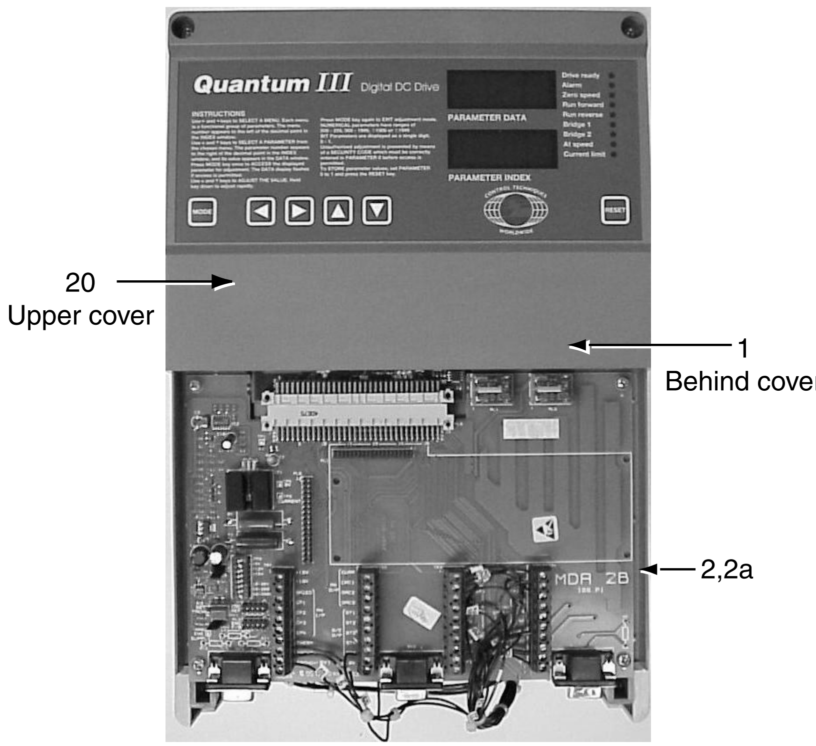
OPTION BOARDS REPLACEMENTS:

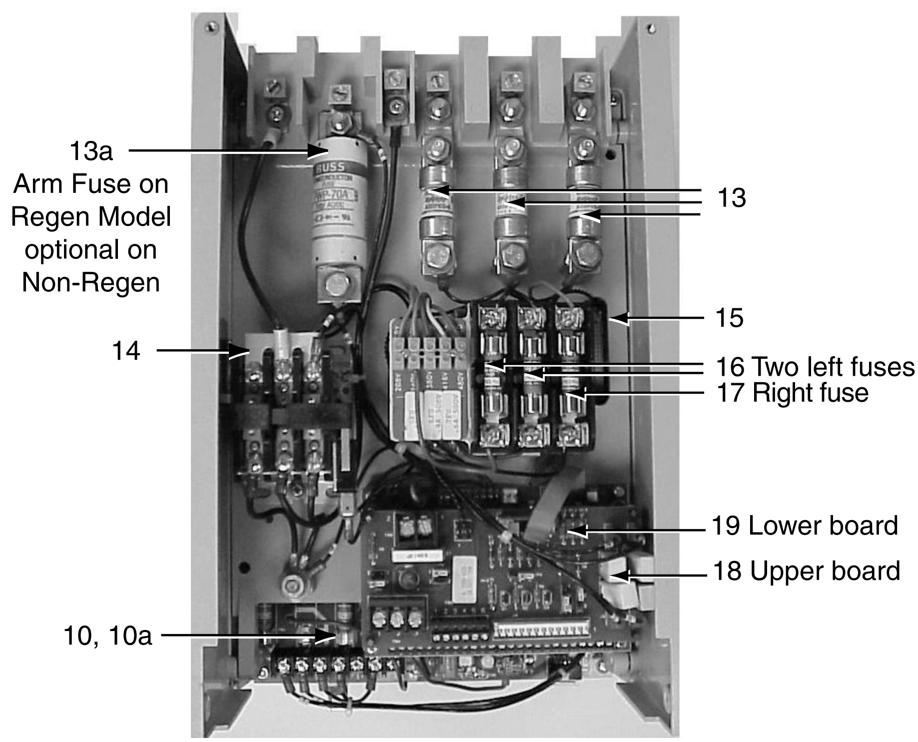
FXM4 FIELD REGULATOR	Unit is discontinued. Use FXM5 kit, Issue 2 only.
FXM5 FIELD REGULATOR	Require issue number for compatibility with drive. Issue 2 requires Mentor II/Quantum III to have V4.2 software or above. This option sold as kit only through local Distributor or Control Techniques Drive Center.
MD21 APPLICATIONS PROCESSOR	This option being phased out in current designs with the MD29. *These assemblies are not directly interchangeable.* When kit is discontinued, programmed PC boards may be purchased through the Service Center based on availability. If kit number is not known, please supply control part number, CPU chip number and E-Prom for proper replacement.
MD29 APPLICATIONS PROCESSOR	This option is only compatible with control with MDA2B interface. This option is sold as kit only through local Distributor or Control Techniques Drive Center.

Consult local Drive Center if upgrade is desired. It is suggested, however, to replace the boards as currently used in your control for best results.

15.4 QUANTUM III DC CONTROL Size 1 Non-Regen

Models illustrated may differ slightly from parts list for similar controls.





QUANTUM III NON-REGEN MODELS

Size 1 Model Range

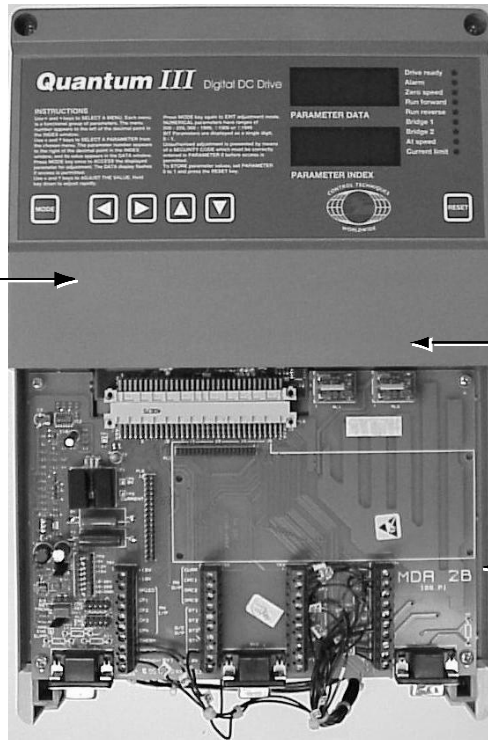
Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

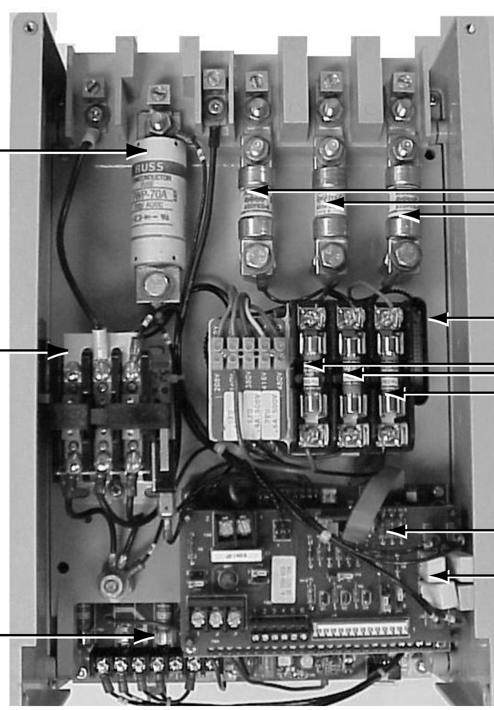
ITEM	ITEM DESCRIPTION	KIT B	9500-8302	9500-8303	9500-8305	9500-8306
	Model Number ——————>		9500-8302	9500-8303	9500-8305	9500-8306
	Horsepower @ 240vac ——>		3-10, 240V	15, 240V	20-30, 240V	40-50, 240V
	Horsepower @ 480vac ——>		5-20, 480V	25-30, 480V	40-60, 480V	75-100, 480V
			M45	M75	M155	M210
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-75 POWER BOARD - V4		9204-0116	9204-0116	N/A	N/A
04	MDA-210 POWER BOARD -V4		N/A	N/A	9204-0118	9204-0118
05	MDA-3 FIELD CONTROL BOARD		9290-0059	9290-0059	9290-0059	9290-0059
06	THYRISTOR MODULES (3)		2435-4114	2435-9114	2435-1324	2435-1324
07	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514
08	CURRENT TRANSFORMER		3225-0292	3225-0292	3225-0292	3225-0292
09	VARISTORS		N/A	N/A	2482-1501	2482-1501
10	FUSE, POWER BOARD (3), 6A	6	3707-600600	3707-600600	3707-600600	3707-600600
10A	FUSE, POWER BOARD (3), 10A	4	3707-601000	3707-601000	3707-601000	3707-601000
11	FAN, 24V, 3" X 3"		N/A	N/A	3251-2400**	3251-2400***
	FAN, 110V (old design) 5" x 5"		N/A	N/A	N/A	4821-1001
12	FAN, FINGER GUARD		N/A	N/A	3251-2402**	3251-2402***
	FAN, FINGER GUARD (old design)		N/A	N/A	N/A	4805-1001
13	FUSE, 1-3FU	6	3701-505500	3701-508000	3701-522500	3701-525000
14	ARMATURE CONTACTOR, MC	1	3513-032	3513-105		
14A	ARMATURE CONTACTOR, MC				3850-1007	3850-1007
15	TRANSFORMER		3082-15903	3082-15903	3082-16463	3082-16463
16	FUSE, TRANSFORMER (2)	4	3708-500040	3708-500040	3708-500080	3708-500080
17	FUSE, TRANSFORMER (1)	2	3708-500060	3708-500060	3708-500125	3708-500125
18	115VAC RELAY INTERFACE BRD	1	9500-4025	9500-4025	9500-4025	9500-4025
19	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030
20	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201
21	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202
22	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024
23	MOUNTING BRACKETS (2)		9500-5035B	9500-5035B	9500-5035B	9500-5035B
24	SPARE PARTS KIT A		9500-8302-SP-A	9500-8303-SP-A	9500-8305-SP-A	9500-8306-SP-A
25	SPARE PARTS KIT B		9500-8302-SP-B	9500-8303-SP-B	9500-8305-SP-B	9500-8306-SP-B

Notes **Kit A consists of:**
Set burden resistors, line fuses, transformer and power board fuses
* For use with MD29 option only.
** Added on up-dated style.
*** Changed on up-dated style.

15.5 QUANTUM III DC CONTROL Size 1 Regen

Models illustrated may differ slightly from parts list for similar controls.





QUANTUM III REGEN MODELS

Size 1 Model Range

Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

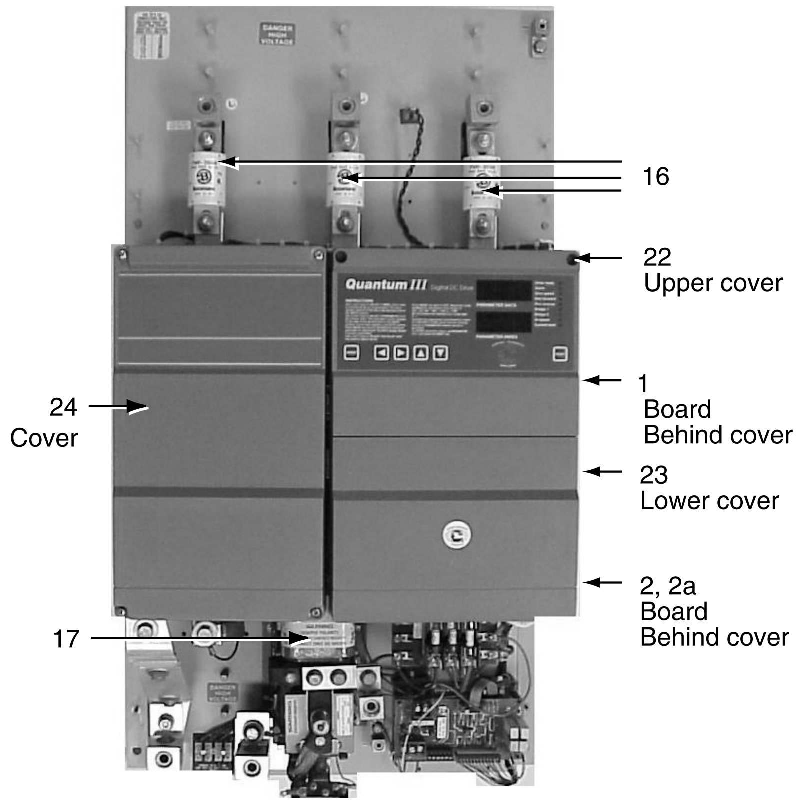
ITEM	ITEM DESCRIPTION	KIT B	9500-8602	9500-8603	9500-8605	9500-8606
	Model Number ——————->		9500-8602	9500-8603	9500-8605	9500-8606
	Horsepower @ 240vac ———>		3-10, 240V	15, 240V	20-30, 240V	40-50, 240V
	Horsepower @ 480vac ———>		5-20, 480V	25-30, 480V	40-60, 480V	75-100, 480V
			M45R	M75R	M155R	M210R
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-75R POWER BOARD - V4		9204-0117	9204-0117	N/A	N/A
04	MDA-210R POWER BOARD -V4		N/A	N/A	9200-0119	9200-0119
05	MDA-3 FIELD CONTROL BOARD		9290-0059	9290-0059	9290-0059	9290-0059
06	THYRISTOR MODULES (6)		2435-4114	2435-9114	2435-1324	2435-1324
07	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514
08	CURRENT TRANSFORMER		3225-0292	3225-0292	3225-0292	3225-0292
09	VARISTORS		N/A	N/A	2482-1501	2482-1501
10	FUSE, POWER BOARD (3)	6	3707-600600	3707-600600	3707-600600	3707-600600
10A	FUSE, POWER BOARD (3)	4	3707-601000	3707-601000	3707-601000	3707-601000
11	FAN, 24V, 3" X 3"		N/A	N/A	3251-2400**	3251-2400***
	FAN, 110V (old design) 5" x 5"		N/A	N/A	N/A	4821-1001
12	FAN, FINGER GUARD		N/A	N/A	3251-2402**	3251-2402***
	FAN, FINGER GUARD (old design)		N/A	N/A	N/A	4805-1001
13	FUSE, 1-3FU	6	3701-505500	3701-508000	3701-522500	3701-525000
13A	FUSE, 4FU	2	3701-707000	3701-710000	3701-720000	3701-730000
14	ARMATURE CONTACTOR, MC	1	3513-032	3513-105		
14A	ARMATURE CONTACTOR, MC				3850-1007	3850-1007
15	TRANSFORMER		3082-15903	3082-15903	3082-16463	3082-16463
16	FUSE, TRANSFORMER (2)	4	3708-500040	3708-500040	3708-500080	3708-500080
17	FUSE, TRANSFORMER (1)	2	3708-500060	3708-500060	3708-500125	3708-500125
18	115VAC RELAY INTERFACE BRD	1	9500-4025	9500-4025	9500-4025	9500-4025
19	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030
20	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201
21	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202
22	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024
23	MOUNTING BRACKETS (2)		9500-5035B	9500-5035B	9500-5035B	9500-5035B
24	SPARE PARTS KIT A		9500-8602-SP-A	9500-8603-SP-A	9500-8605-SP-A	9500-8606-SP-A
25	SPARE PARTS KIT B		9500-8602-SP-B	9500-8603-SP-B	9500-8605-SP-B	9500-8606-SP-B

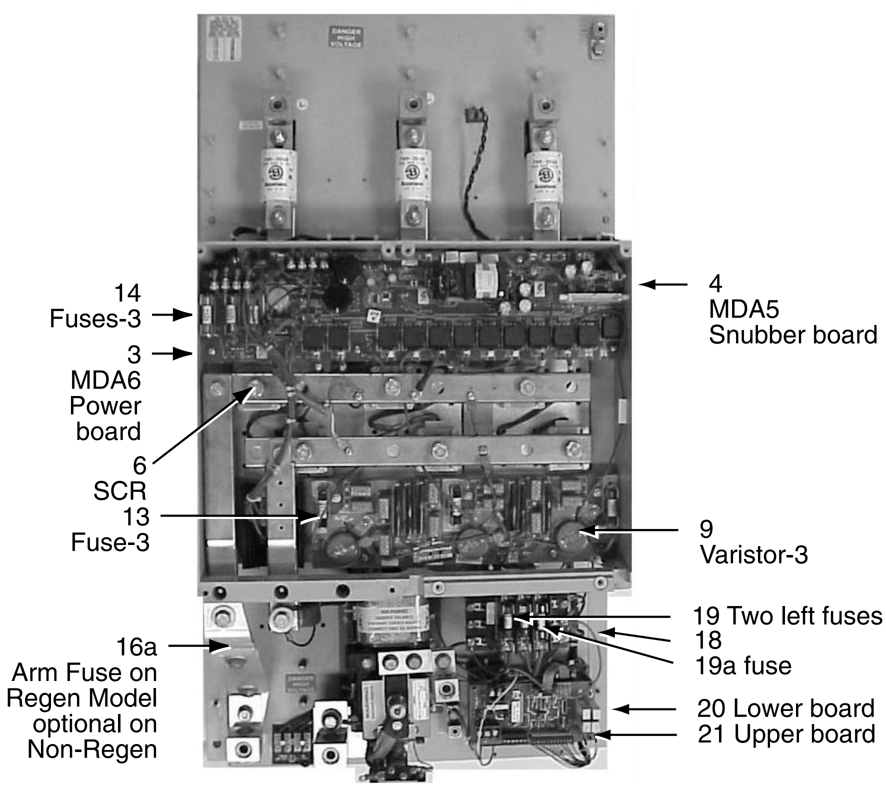
Notes **Kit A consists of:**
Set burden resistors, line & armature fuses, transformer and power board fuses

* For use with MD29 option only.
** Added on up-dated style.

15.6 QUANTUM III DC CONTROL Size 2 Non-Regen

Models illustrated may differ slightly from parts list for similar controls.





QUANTUM III NON-REGEN MODELS

Size 2 Model Range

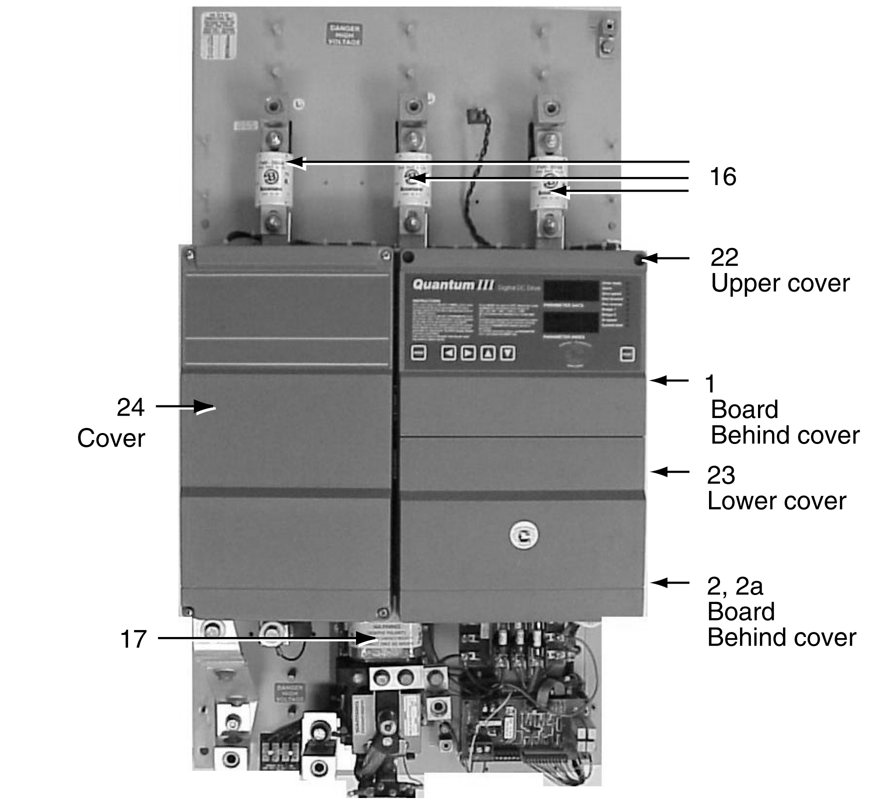
Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

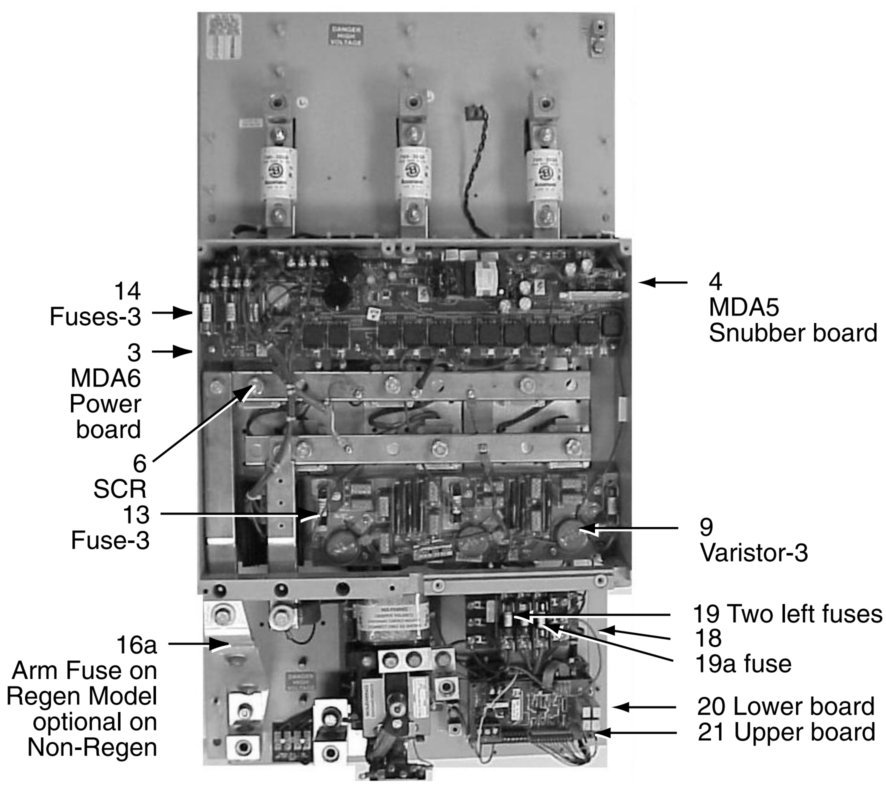
ITEM	Model Number ——————> Horsepower @ 240vac ——> Horsepower @ 480vac ——> ITEM DESCRIPTION	KIT B	9500-8307 75, 240V 150, 480V M350	9500-8308 100, 240V 200, 480V M420	9500-8309 125, 240V 250, 480V M550	9500-8310 150, 240V 300, 480V M700	9500-8311 200, 240V 400, 480V M825
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-6 POWER BOARD - V4		9204-0112	9204-0112	9204-0112	9204-0112	9204-0112
04	MDA-5 SNUBBER BOARD		9290-0006	9290-0006	9290-0006	9290-0006	9290-0006
05	SS4 SURGE SUPP. BOARD		N/A	N/A	N/A	N/A	N/A
06	THYRISTOR MODULES (6)		2436-7310	2436-7310	2436-7310	N/A	N/A
	THYRISTOR HEATSINK ASSY (3)		N/A	N/A	N/A	2438-3223	2438-3223
07	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514	2426-2514
08	CURRENT TRANSFORMER		3225-0292	3225-0292	3225-0292	3225-0293	3225-0293
09	VARISTORS, MDA-5		2482-1501	2482-1501	2482-1501	2482-1501	2482-1501
10	VARISTORS, MDA-6		2481-2520	2481-2520	2481-2520	2481-2520	2481-2520
11	FUSE, 2A		N/A	N/A	N/A	N/A	N/A
12	FUSE, 30A		N/A	N/A	N/A	N/A	N/A
13	FUSE, MDA-5 (3)	6	3707-600600	3707-600600	3707-600600	3707-600600	3707-600600
14	FUSE, MDA-6 (3)	6	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000
15	FAN (2)		3900-010	3900-010	3900-010**	3900-010	3900-010
15A	BRIDGE RECTIFIER		N/A	N/A	N/A	N/A	4013-805
16	FUSE, 1-3FU	6	3701-535000	3701-545000	3701-560000	3701-570000	3701-590000
17	ARMATURE CONTACTOR, MC		3850-1008	3850-1008	3850-1008	3850-1004	3850-1004
18	TRANSFORMER		3572-0150P08-16	3572-0150P08-16	3572-0250P13-20	3572-0250P13-20	3572-0250P13-20
19	FUSE, TRANSFORMER, 5,6 FU	4	3708-500100	3708-500100	3708-500150	3708-500150	3708-500150
19A	FUSE, TRANSFORMER, 7FU	2	3708-500200	3708-500200	3708-500320	3708-500320	3708-500320
20	115VAC RELAY INTERFACE BOARD	1	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025
21	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030	9500-4030
22	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201	3582-0201
23	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202	3582-0202
24	COVER, LEFT, GREEN		3581-0206	3581-0206	3581-0206	3581-0206	3581-0206
25	LABEL, GRAY & GOLD FOR ABOVE		3571-0023	3571-0023	3571-0023	3571-0023	3571-0023
26	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024	3573-0024
27	SPARE PARTS KIT A		9500-8307-SP-A	9500-8308-SP-A	9500-8309-SP-A	9500-8310-SP-A	9500-8311-SP-A
28	SPARE PARTS KIT B		9500-8307-SP-B	9500-8308-SP-B	9500-8309-SP-B	9500-8310-SP-B	9500-8311-SP-B

Notes: Kit A consists of:
Set burden resistors, line fuses, transformer and power board fuses

15.7 QUANTUM III DC CONTROL Size 2 Regen

Models illustrated may differ slightly from parts list for similar controls.





QUANTUM III REGEN MODELS

Size 2 Model Range

Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

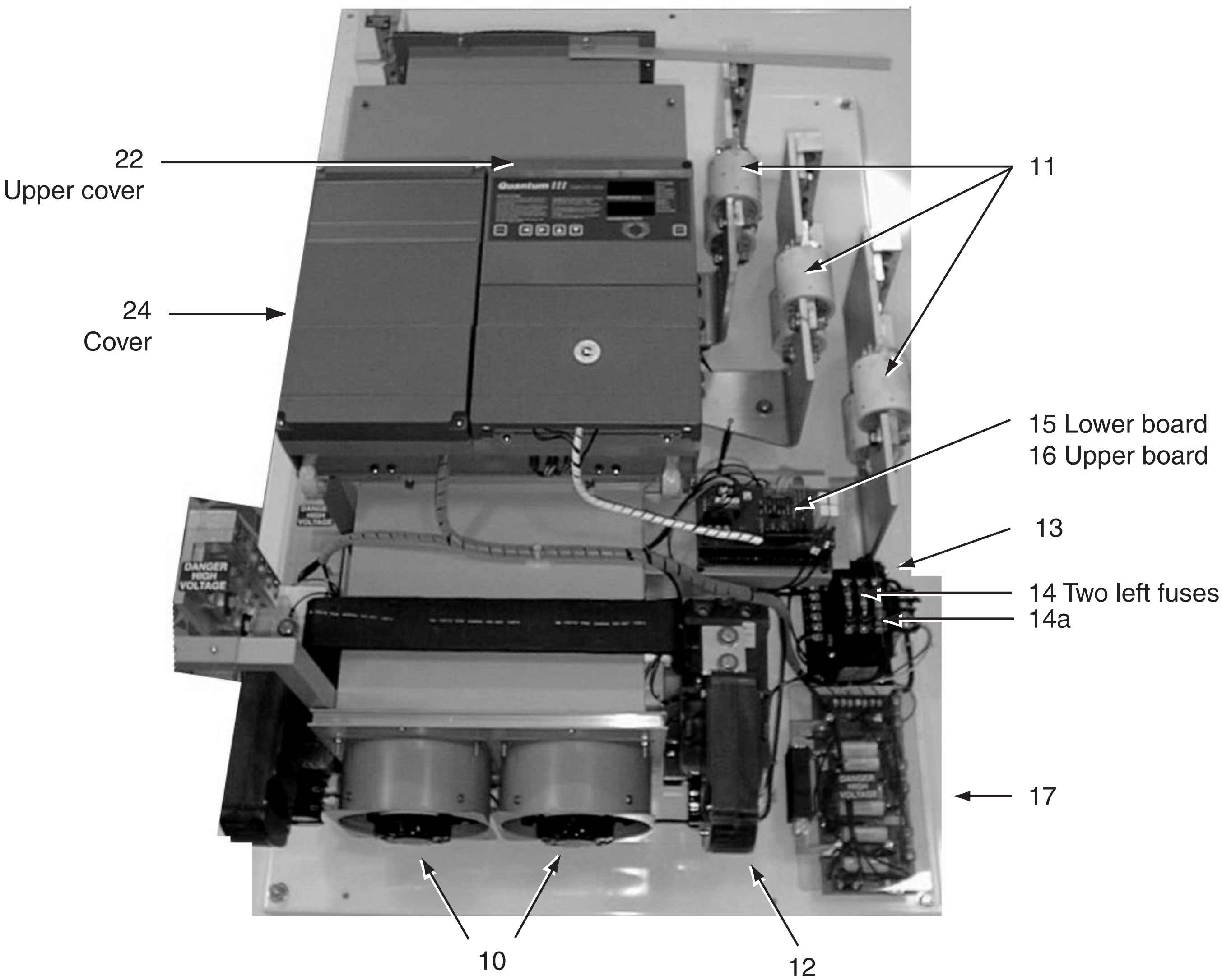
ITEM	ITEM DESCRIPTION	KIT B							
	Model Number ———————>		9500-8607	9500-8608	9500-8609	9500-8610	9500-8611	9500-8612***	9500-8613***	9500-8614***
	Horsepower @ 240vac ———>	KIT	75, 240V	100, 240V	125, 240V	150, 240V	200, 240V	250/500HP	300/600HP	500/1000HP
	Horsepower @ 480vac ———->	B	150, 480V	200, 480V	250, 480V	300, 480V	400, 480V			
			M350R	M420R	M550R	M700R	M825R	M900R	M1200R	M1850R
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127	9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429	9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-6 POWER BOARD - V4		9204-0112	9204-0112	9204-0112	9204-0112	9204-0112	9204-0112	9204-0112	9204-0112
04	MDA-5 SNUBBER BOARD		9290-0006	9290-0006	9290-0006	9290-0006	9290-0006	N/A	N/A	N/A
05	SS4 SURGE SUPP. BOARD		N/A	N/A	N/A	N/A	N/A	9290-0008	9290-0008	9290-0008
06	THYRISTOR MODULES (12)		2436-7310	2436-7310	2436-7310	N/A	N/A	N/A	N/A	N/A
	THYRISTOR HEATSINK ASSY (3)		N/A	N/A	N/A	2438-3224	2438-3224	2438-3235	2438-3235	2438-3235
07	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514	2426-2514	2426-2514	2426-2514	2426-2514
08	CURRENT TRANSFORMER		3225-0292	3225-0292	3225-0292	3225-0293	3225-0293	3225-0650	3225-0650	3225-0650
09	VARISTORS, MDA-5		2482-1501	2482-1501	2482-1501	2482-1501	2482-1501	N/A	N/A	N/A
10	VARISTORS, MDA-6		2481-2520	2481-2520	2481-2520	2481-2520	2481-2520	2481-2520	2481-2520	2481-2520
11	FUSE, 2A		N/A	N/A	N/A	N/A	N/A	4341-0002	4341-0002	4341-0002
12	FUSE, 30A		N/A	N/A	N/A	N/A	N/A	4347-0030	4347-0030	4347-0030
13	FUSE, MDA-5 (3)	6	3707-600600	3707-600600	3707-600600	3707-600600	3707-600600	N/A	N/A	N/A
14	FUSE, MDA-6 (3)	6	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000
15	FAN (2)		3900-010	3900-010	3900-010**	3900-010	3900-010			
15A	BRIDGE RECTIFIER		N/A	N/A	N/A	N/A	4013-805			
16	FUSE, 1-3FU	6	3701-535000	3701-545000	3701-560000	3701-570000	3701-590000			
16A	FUSE, 4FU	2	3701-745000	3701-760000	3701-770000	3701-790000	3701-710001			
17	ARMATURE CONTACTOR, MC		3850-1008	3850-1008	3850-1008	3850-1004	3850-1004			
18	TRANSFORMER		3572-0150P08-16	3572-0150P08-16	3572-0250P13-20	3572-0250P13-20	3572-0250P13-20			
19	FUSE, TRANSFORMER, 5,6 FU	4	3708-500100	3708-500100	3708-500150	3708-500150	3708-500150			
19A	FUSE, TRANSFORMER, 7FU	2	3708-500200	3708-500200	3708-500320	3708-500320	3708-500320			
20	115VAC RELAY INTERFACE BOARD	1	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025			
21	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030	9500-4030			
22	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201	3582-0201			
23	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202	3582-0202			
24	COVER, LEFT, GREEN		3581-0206	3581-0206	3581-0206	3581-0206	3581-0206			
25	LABEL, GRAY & GOLD FOR ABOVE		3571-0023	3571-0023	3571-0023	3571-0023	3571-0023			
26	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024	3573-0024			
27	SPARE PARTS KIT A		9500-8607-SP-A	9500-8608-SP-A	9500-8609-SP-A	9500-8610-SP-A	9500-8611-SP-A			
28	SPARE PARTS KIT B		9500-8607-SP-B	9500-8608-SP-B	9500-8609-SP-B	9500-8610-SP-B	9500-8611-SP-B			

Notes: **Kit A consists of:**
Set burden resistors, line & armature fuses, transformer and power board fuses

* For use with MD29 option only.
** This model uses 3 fans.
*** These models do not include cooling fans, contactor, fuses or AC interface.

15.8 QUANTUM III DC CONTROL Size 3 Non-Regen

Models illustrated may differ slightly from parts list for similar controls.



QUANTUM III DC CONTROL Size 3 Non-Regen

Size 3 Model Range

Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

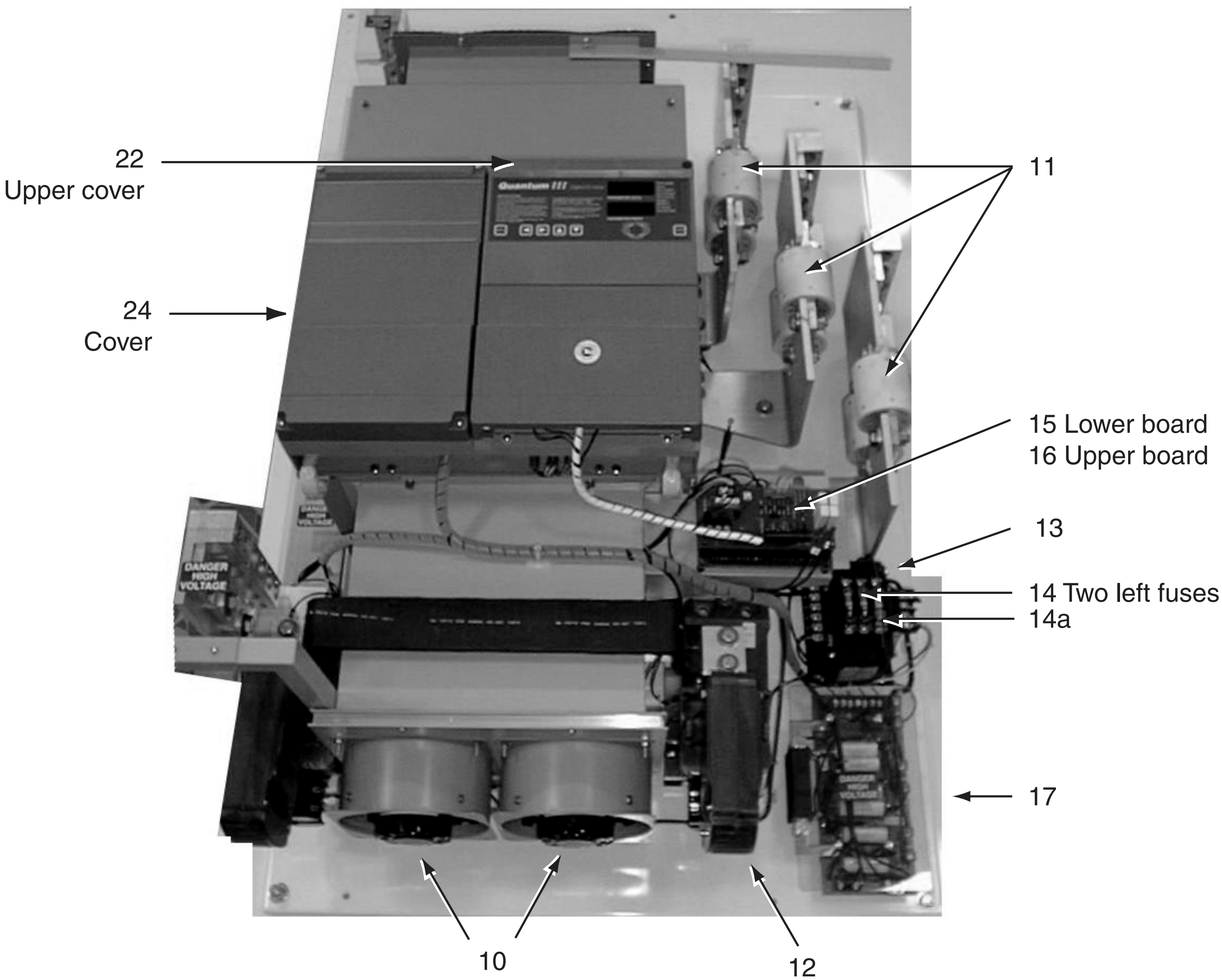
ITEM	ITEM DESCRIPTION	KIT B	9500-8315	9500-8316	9500-8317	9500-8318	9500-8319	9500-8320
	Horsepower @ 240vac ——>		250, 240V	300, 240V		400,240V		500, 240V
	Horsepower @ 480vac ——>		500, 480V	600, 480V	700, 480V	800, 480V	900, 480V	1000, 480V
			M1850	M1850	M1850	M1850	M1850	M1850
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-6 POWER BOARD - V4		9204-0112	9204-0112	9204-0112	9204-0112	9204-0112	9204-0112
04	SS4 SURGE SUPP. BOARD		9290-0008	9290-0008	9290-0008	9290-0008	9290-0008	9290-0008
05	THYRISTOR HEATSINK ASSY (3)		2438-3234	2438-3234	2438-3234	2438-3234	2438-3234	2438-3234
06	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514	2426-2514	2426-2514
07	CURRENT TRANSFORMER		3225-0650	3225-0650	3225-0650	3225-0650	3225-0650	3225-0650
08	VARISTORS, MDA-6		2481-2520	2481-2520	2481-2520	2481-2520	2481-2520	2481-2520
09	FUSE, MDA-6 (3)	6	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000
10	FAN (2)		3900-003	3900-003	3900-003	3900-003	3900-003	3900-003
11	FUSE, 1-3FU	6	3701-510001	3701-512001				
		2			3701-514001	3701-516001		
		12					3701-590000**	3701-510001**
12	ARMATURE CONTACTOR, MC		3850-1004	3850-1004	3850-1004	3850-1004	3850-1004	3850-1004
13	TRANSFORMER		3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26
14	FUSE, TRANSFORMER, 5,6 FU	4	3708-500300	3708-500300	3708-500300	3708-500300	3708-500300	3708-500300
14A	FUSE, TRANSFORMER, 7FU	2	3708-500620	3708-500620	3708-500620	3708-500620	3708-500620	3708-500620
15	115VAC RELAY INTERFACE BOARD	1	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025
16	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030	9500-4030	9500-4030
17	SUPPRESSOR BOARD		9500-4040	9500-4040	9500-4040	9500-4040	9500-4040	9500-4040
18	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201	3582-0201	3582-0201
19	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202	3582-0202	3582-0202
20	COVER, LEFT, GREEN		3581-0206	3581-0206	3581-0206	3581-0206	3581-0206	3581-0206
21	LABEL, GRAY & GOLD FOR ABOVE		3571-0023	3571-0023	3571-0023	3571-0023	3571-0023	3571-0023
22	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024	3573-0024	3573-0024
23	SPARE PARTS KIT A		9500-8315-SP-A	9500-8316-SP-A	9500-8317-SP-A	9500-8318-SP-A	9500-8319-SP-A	9500-8320-SP-A
24	SPARE PARTS KIT B		9500-8315-SP-B	9500-8316-SP-B	9500-8317-SP-B	9500-8318-SP-B	9500-8319-SP-B	9500-8320-SP-B

Notes: Kit A consists of:
Set burden resistors, line fuses, transformer and power board fuses

* For use with MD29 option only.

15.9 QUANTUM III DC CONTROL Size 3 Regen

Models illustrated may differ slightly from parts list for similar controls.



QUANTUM III
DC CONTROL
Size 3
Regen

Size 3 Model Range

Notes: Part numbers listed are most current at time of printing.
Parts for higher voltage controls may vary. Consult Service Center.

ITEM	ITEM DESCRIPTION	KIT B	9500-8615	9500-8616	9500-8617	9500-8618	9500-8619	9500-8620
	Horsepower @ 240vac ———>		250, 240V	300, 240V		400,240V		500, 240V
	Horsepower @ 480vac ———>		500, 480V	600, 480V	700, 480V	800, 480V	900, 480V	1000, 480V
			M1850R	M1850R	M1850R	M1850R	M1850R	M1850R
01	MDA-1 CONTROL BOARD - V5	1	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114	9200-0114
02	MDA-2 INTERFACE BOARD - V4		9200-0127	9200-0127	9200-0127	9200-0127	9200-0127	9200-0127
02A	*MDA-2B INTERFACE		9200-0429	9200-0429	9200-0429	9200-0429	9200-0429	9200-0429
03	MDA-6 POWER BOARD - V4		9204-0112	9204-0112	9204-0112	9204-0112	9204-0112	9204-0112
04	SS4 SURGE SUPP. BOARD		9290-0008	9290-0008	9290-0008	9290-0008	9290-0008	9290-0008
05	THYRISTOR HEATSINK ASSY (3)		2438-3235	2438-3235	2438-3235	2438-3235	2438-3235	2438-3235
06	FIELD DIODE BRIDGE		2426-2514	2426-2514	2426-2514	2426-2514	2426-2514	2426-2514
07	CURRENT TRANSFORMER		3225-0650	3225-0650	3225-0650	3225-0650	3225-0650	3225-0650
08	VARISTORS, MDA-6		2481-2520	2481-2520	2481-2520	2481-2520	2481-2520	2481-2520
09	FUSE, MDA-6 (3)	6	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000	3707-602000
10	FAN (2)		3900-003	3900-003	3900-003	3900-003	3900-003	3900-003
11	FUSE, 1-3FU	6	3701-510001	3701-512001				
		2			3701-514001	3701-516001		
		12					3701-590000**	3701-510001**
11A	FUSE, 4FU	1	3701-712001	3701-714001	N/A	N/A	N/A	N/A
12	ARMATURE CONTACTOR, MC		3850-1004	3850-1004	3850-1004	3850-1004	3850-1004	3850-1004
13	TRANSFORMER		3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26	3572-0500P20-26
14	FUSE, TRANSFORMER, 5,6 FU	4	3708-500300	3708-500300	3708-500300	3708-500300	3708-500300	3708-500300
14A	FUSE, TRANSFORMER, 7FU	2	3708-500620	3708-500620	3708-500620	3708-500620	3708-500620	3708-500620
15	115VAC RELAY INTERFACE BOARD	1	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025	9500-4025
16	HP & TACH SCALING BOARD		9500-4030	9500-4030	9500-4030	9500-4030	9500-4030	9500-4030
17	SUPPRESSOR BOARD		9500-4040	9500-4040	9500-4040	9500-4040	9500-4040	9500-4047
18	COVER, UPPER GREEN		3582-0201	3582-0201	3582-0201	3582-0201	3582-0201	3582-0201
19	COVER, LOWER GREEN		3582-0202	3582-0202	3582-0202	3582-0202	3582-0202	3582-0202
20	COVER, LEFT, GREEN		3581-0206	3581-0206	3581-0206	3581-0206	3581-0206	3581-0206
21	LABEL, GRAY & GOLD FOR ABOVE		3571-0023	3571-0023	3571-0023	3571-0023	3571-0023	3571-0023
22	KEYPAD LABEL		3573-0024	3573-0024	3573-0024	3573-0024	3573-0024	3573-0024
23	SPARE PARTS KIT A		9500-8615-SP-A	9500-8616-SP-A	9500-8617-SP-A	9500-8618-SP-A	9500-8619-SP-A	9500-8620-SP-A
24	SPARE PARTS KIT B		9500-8615-SP-B	9500-8616-SP-B	9500-8617-SP-B	9500-8618-SP-B	9500-8619-SP-B	9500-8620-SP-B

Notes: Kit A consists of:
Set burden resistors, line & armature fuses, transformer and power board fuses
* For use with MD29 option only.
** These models use 6 fuses.

MODEL	CONTINUOUS CURRENT		HORSEPOWER		KW RATING		FUSE (1)		BURDEN (2) (OHMS)	XFMR FUSES 500V, FNQ (8)			LUGS
	AC	DC	240V	500V	240	500	LINE	ARM		5FU	6FU	7FU	
9500-8302	8.4 10 16.7 24.0 31.3	10.2 12.3 20.4 29.26 38.2	2.5 3 5 7.5 10	5 7.5 10 15 20	2.44 3.0 4.9 7.0 9.1	5.1 6.2 10.2 14.6 19	55A 500V	-	- 127 26.1 14.0 9.53	.4A	.4A	.6A	(6) MODIFIED LA-2 9500-003
9500-8303	35.5 45.4	43.3 55.4	- 15	25 30	- 13.3	21.7 27.7	80A 500V	-	8.06 5.90	.4A	.4A	.6A	(6) MODIFIED LA-2 9500-003
9500-8305	59 72.7 86.5	72 88.6 105.5	20 25 30	40 50 60	17.3 21.3 25.4	36.0 44.3 53.0	225A 500V	-	4.32 3.40 2.80	.8A	.8A	1.25A	(6) MODIFIED LA-2 9500-003
9500-8306	103 118 141	125 143 172	- 40 50	75 - 100	30.0 34.3 41.3	62.5 71.5 86.0	250A 500V	-	2.32 2.0 1.65	.8A	.8A	1.25A	(5) MODIFIED LA-2 9500-003 (1) 250MCM 3075-010
9500-8602	8.4 10 16.7 24.0 31.3	10.2 12.3 20.4 29.26 38.2	2.5 3 5 7.5 10	5 7.5 10 15 20	2.44 3.0 4.9 7.0 9.1	5.1 6.2 10.2 14.6 19	55A 500V	70A 500V	- 127 26.1 14.0 9.53	.4A	.4A	.6A	(6) MODIFIED LA-2 9500-003
9500-8603	35.5 45.4	43.3 55.4	- 15	25 30	- 133	21.7 27.7	80A 500V	100A 500V	8.06 5.90	.4A	.4A	.6A	(6) MODIFIED LA-2 9500-003
9500-8605	59 72.7 86.5	72 88.6 105.5	20 25 30	40 50 60	17.3 21.3 25.4	36.0 44.3 53.0	225A 500V	200A 500V	4.32 3.40 2.80	.8A	.8A	1.25A	(6) MODIFIED LA-2 9500-003
9500-8606	103 118 141	125 143 172	- 40 50	75 - 100	30.0 34.3 41.3	62.5 71.5 86.0	250A 500V	300A 500V	2.32 2.0 1.65	.8A	.8A	1.25A	(5) MODIFIED LA-2 9500-003 (1) 250MCM 3075-010

(1) SEE CHART FOR VALUES.

(2) SEE CHART FOR VALUES.

(3) MOTOR FIELD - 8AMPS MAX
NOTE: CONNECTION SHOWN IS FOR 300VDC FIELD.
FOR 150VDC - REMOVE JUMPER FROM
F2 TO F3 AND CONNECT F1 TO F3 AND F2 TO F4

(4) SHIELDING: USE BELDEN CABLE #83394 OR EQUIVALENT FOR TWO CONDUCTOR OR BELDEN CABLE #83395 OR EQUIVALENT FOR THREE CONDUCTOR. CONNECT SHIELD AT CONTROL END ONLY. TAPE BRAID AT EACH END TO PREVENT CONTACT WITH MACHINE OR OTHER WIRES. DO NOT GROUND SHIELD.

(5) OPTIONAL SPEED POT CONNECTION FOR REGEN DRIVES ONLY.

(6) COOLING FANS ON MODELS 9500-8306/8606 ONLY.

(7) DESIGNATIONS IN BRACKETS [ ] REFER TO REGENERATIVE MODELS ONLY 9500-8602 THRU 9500-8606.

(8) SEE CHART FOR VALUES.

(9) OPTIONAL MOTOR THERMAL INPUT IF USED
SET PARAMETER 10.32 = 0 WHEN FAULT OCCURS,
DRIVE DISPLAY WILL SHOW THE FAULT.

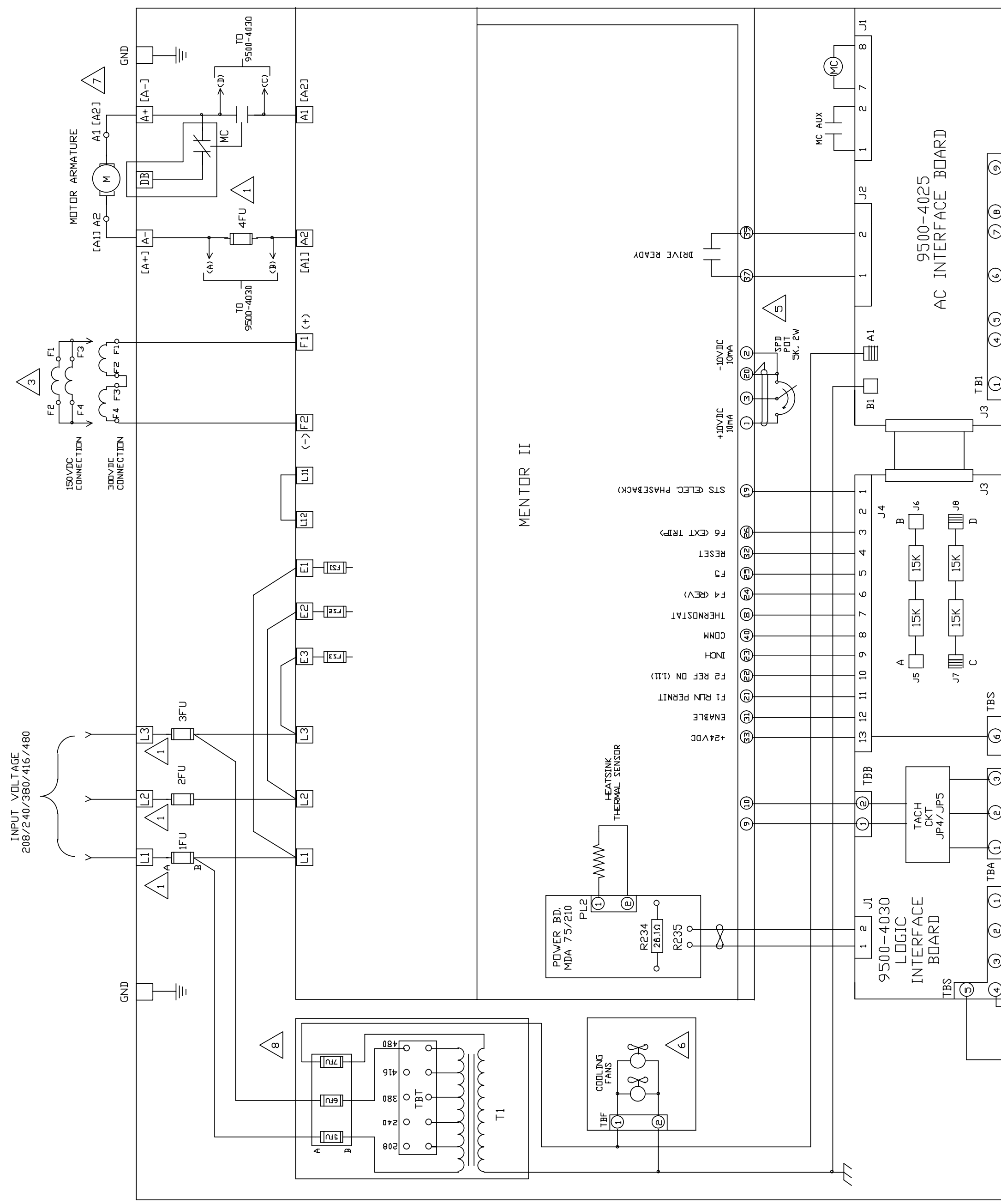


Figure A-1.
Interconnect Diagram, 5-100 HP
Quantum III Controls, (9500-1300-I), Sheet 1

MODEL	CONTINUOUS CURRENT		HORSEPOWER		KV RATING		FUSE 1		BURDEN	
	AC	DC	240V	500V	240	500	LINE	ARM	R234	R235
9500-8307	209	255	75	150	61.2	127.5	350A 500V	–	5.11Ω 3W	23.3Ω 3W
-8308	277	338	100	200	81.1	169	450A 500V	–	3.16Ω 3W	–
-8309	351	428	125	250	102.7	214	600A 500V	–	2.49Ω 3W	–
-8310	417	508	150	300	121.9	254	700A 500V	–	2.15Ω 3W	64.9Ω 3W
-8311	554	675	200	400	162	338	900A 500V	–	1.58Ω 3W	–
9500-8607	209	255	75	150	61.2	127.5	350A 500V	450A 700V	5.11Ω 3W	23.3Ω 3W
-8608	277	338	100	200	81.1	169	450A 500V	600A 700V	3.16Ω 3W	–
-8609	351	428	125	250	102.7	214	600A 500V	700A 700V	2.49Ω 3W	–
-8610	417	508	150	300	121.9	254	700A 500V	900A 700V	2.15Ω 3W	64.9Ω 3W
-8611	554	675	200	400	162	338	900A 500V	1000A 700V	1.58Ω 3W	–

1. SEE CHART FOR VALUES

2. DB POLE NOT AVAILABLE ON MODELS 9500-8310/9500-8610, 9500-8311/ 9500-8611

3. MOTOR FIELD - 10AMPS MAX
NOTE: CONNECTION SHOWN IS FOR 300VDC FIELD.
FOR 150VDC - REMOVE JUMPER FROM
F2 TO F3 AND CONNECT F1 TO F3 AND F2 TO F4
REFER TO MOTOR NAMEPLATE FOR PROPER FIELD CONNECTION.
QUANTUM III HAS A FIXED FIELD VOLTAGE OUTPUT. THE AVERAGE DC VOLTAGE IS EQUAL TO .675 TIMES THE LINE TO LINE VOLTAGE

4. SHIELDING: USE BELDEN CABLE #83394 OR EQUIVALENT FOR TWO CONDUCTOR OR BELDEN CABLE #83395 OR EQUIVALENT FOR THREE CONDUCTOR. CONNECT SHIELD AT CONTROL END ONLY. TAPE BRAID AT EACH END TO PREVENT CONTACT WITH MACHINE OR OTHER WIRES. DO NOT GROUND SHIELD.

5. OPTIONAL SPEED POT CONNECTION FOR REGEN DRIVES ONLY.

6. OPTIONAL MOTOR THERMAL INPUT IF USED
SET PARAMETER 10.32 = 0 WHEN FAULT OCCURS,
DRIVE DISPLAY WILL SHOW THE FAULT.

7. FOR THE 125 TO 200HP RANGE USE A 150VA TRANSFORMER WITH THE FOLLOWING FUSES:
PRIMARY SIDE (5FU & 6FU) FNQ-R-1 (1A REJECTION TYPE) FUSE.
SECONDARY (7FU) USE A 2A FUSE.

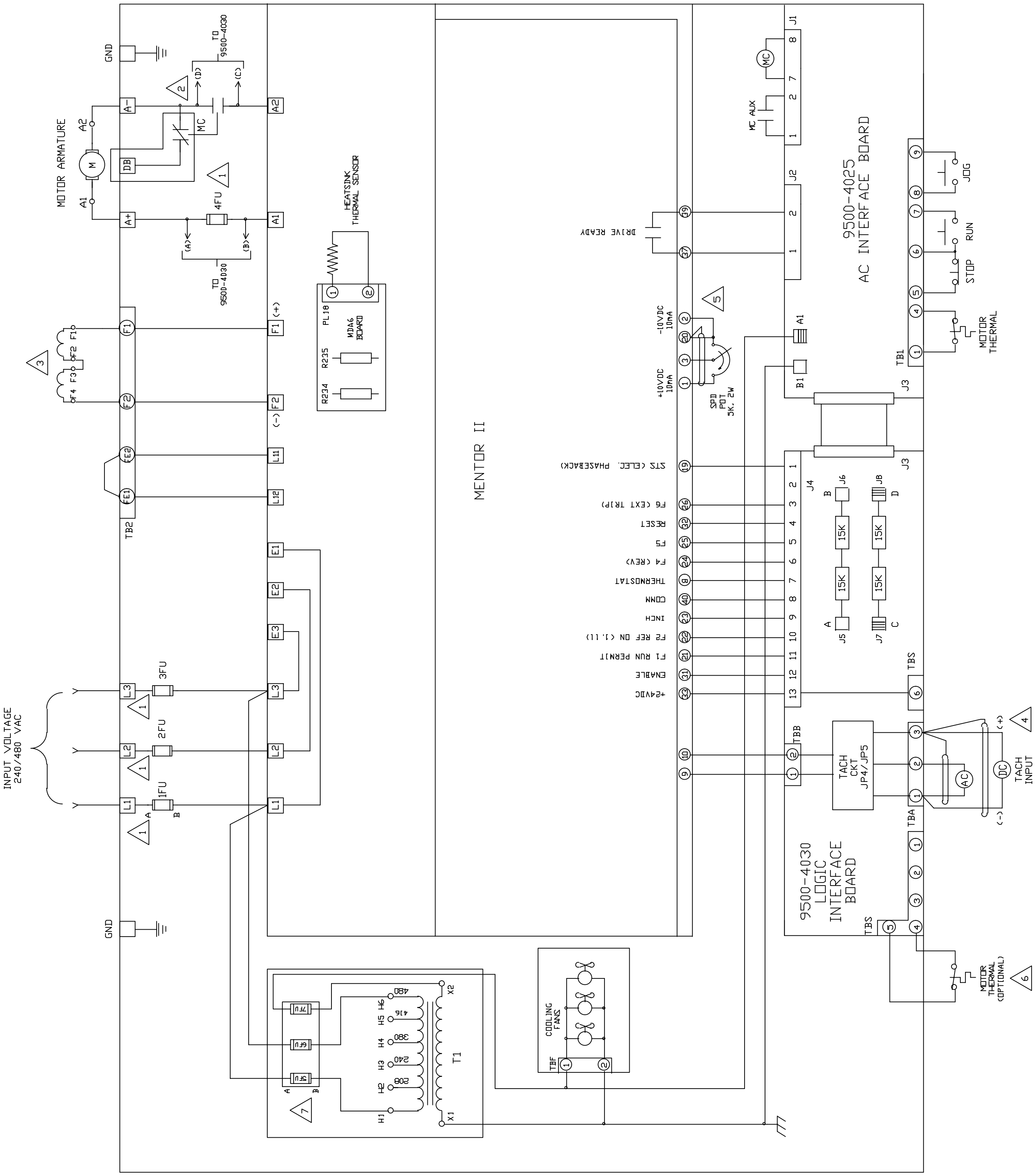


Figure A-2. Interconnect Diagram, 75-400 HP, Quantum III Controls, (9500-1300-I), Sheet 2

MODEL	CONTINUOUS CURRENT		HORSEPOWER		KW RATING		FUSE △1		BURDEN △2		
	AC	DC	240V	500V	240	500	LINE	ARN	R234	R235	R236
9500-8315	672	820	250	500	197	410	1000A 500V	-	1.33Ω 3W	64.9Ω 3W	-
-8316	808	985	300	600	236	493	1200A 500V	-	1.58Ω 3W	3.4Ω 3W	-
-8317	943	1150	350	700	276	575	1400A 500V	-	1.65Ω 3W	2.15Ω 3W	-
-8318	1025	1250	400	800	300	625	1600A 500V	-	1.33Ω 3W	2.49Ω 3W	64.9Ω 3W
-8319	1205	1470	450	900	353	735	(2)900A 500V	-	1.33Ω 3W	1.65Ω 3W	64.9Ω 3W
-8320	1328	1620	500	1000	389	750	(2)1000A 500V	-	1.33Ω 3W	1.33Ω 3W	64.9Ω 3W
9500-8615	672	820	250	500	197	410	1000A 500V	1200A 700V	1.33Ω 3W	64.9Ω 3W	-
-8616	808	985	300	600	236	493	1200A 500V	1400A 700V	1.58Ω 3W	3.4Ω 3W	-
-8617	943	1150	350	600	276	575	1400A 500V	-	1.65Ω 3W	2.15Ω 3W	-
-8618	1025	1250	400	800	300	625	1600A 500V	-	1.33Ω 3W	2.49Ω 3W	64.9Ω 3W
-8619	1205	1470	450	900	353	735	(2)900A 500V	-	1.33Ω 3W	1.65Ω 3W	64.9Ω 3W
-8620	1328	1620	500	1000	389	750	(2)1000A 500V	-	1.33Ω 3W	1.33Ω 3W	64.9Ω 3W

△1 SEE CHART FOR VALUES

△2 DB POLE NOT AVAILABLE ON MODELS 9500-8310/9500-8610, 9500-8311/9500-8611

△3 MOTOR FIELD - 10AMPS MAX
NOTE: CONNECTION SHOWN IS FOR 300VDC FIELD.
FOR 150VDC - REMOVE JUMPER FROM
F2 TO F3 AND CONNECT F1 TO F3 AND F2 TO F4
REFER TO MOTOR NAMEPLATE FOR PROPER FIELD CONNECTION.
QUANTUM III HAS A FIXED FIELD VOLTAGE OUTPUT. THE AVERAGE DC VOLTAGE IS EQUAL TO .675 TIMES THE LINE TO LINE VOLTAGE

△4 SHIELDING: USE BELDEN CABLE #83394 OR EQUIVALENT FOR TWO CONDUCTOR OR BELDEN CABLE #83395 OR EQUIVALENT FOR THREE CONDUCTOR. CONNECT SHIELD AT CONTROL END ONLY. TAPE BRAID AT EACH END TO PREVENT CONTACT WITH MACHINE OR OTHER WIRES. DO NOT GROUND SHIELD.

△5 OPTIONAL SPEED POT CONNECTION FOR REGEN DRIVES ONLY.

△6 OPTIONAL MOTOR THERMAL INPUT IF USED
SET PARAMETER 10.32 = 0 WHEN FAULT OCCURS, DRIVE DISPLAY WILL SHOW THE FAULT.

△7 FOR THE 125 TO 200HP RANGE USE A 150VA TRANSFORMER WITH THE FOLLOWING FUSES:

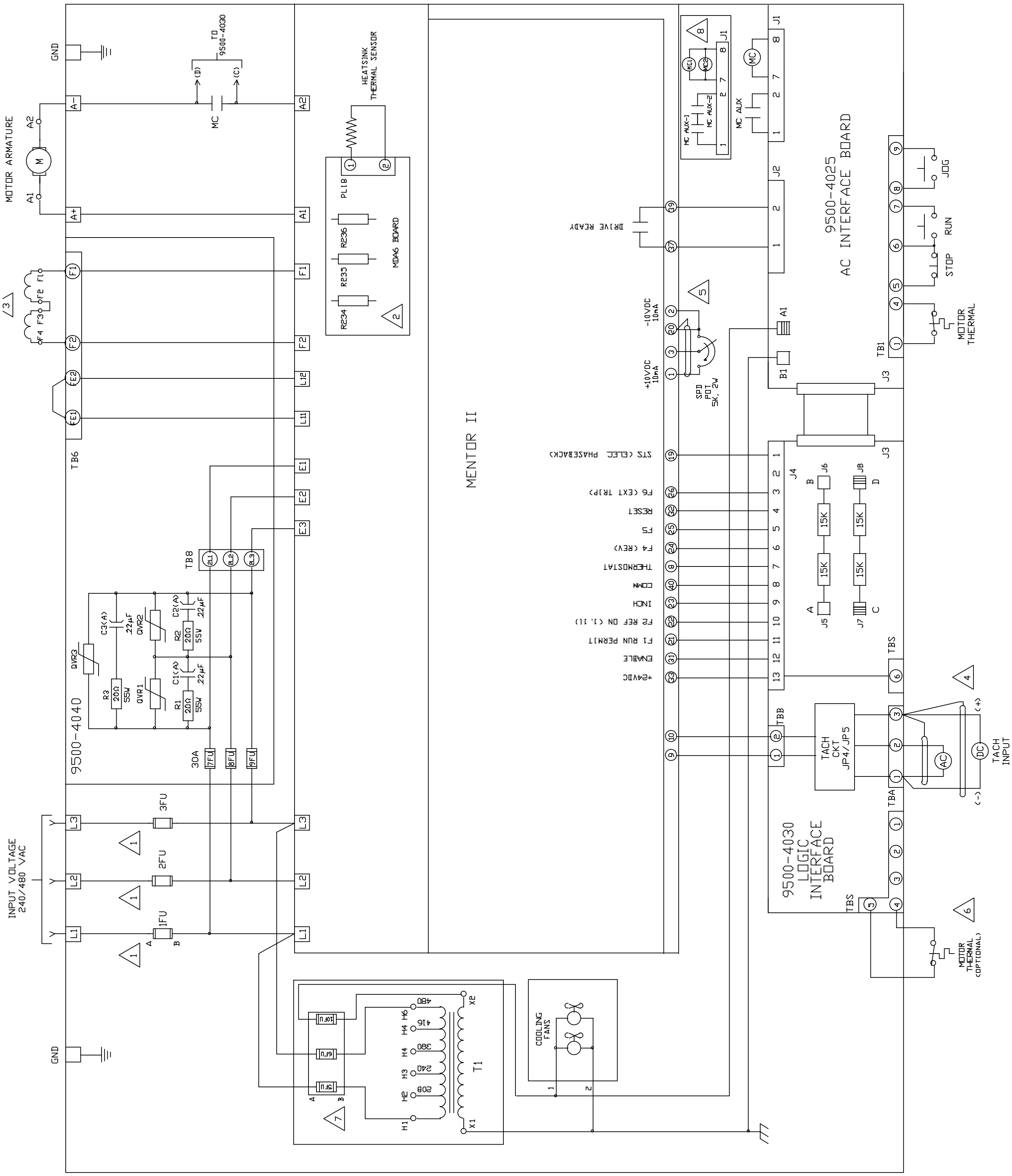


Figure A-3. Interconnect Diagram, 500-1000 HP Non-Regenerative Quantum III Controls, (9500-1300-I), Sheet 3

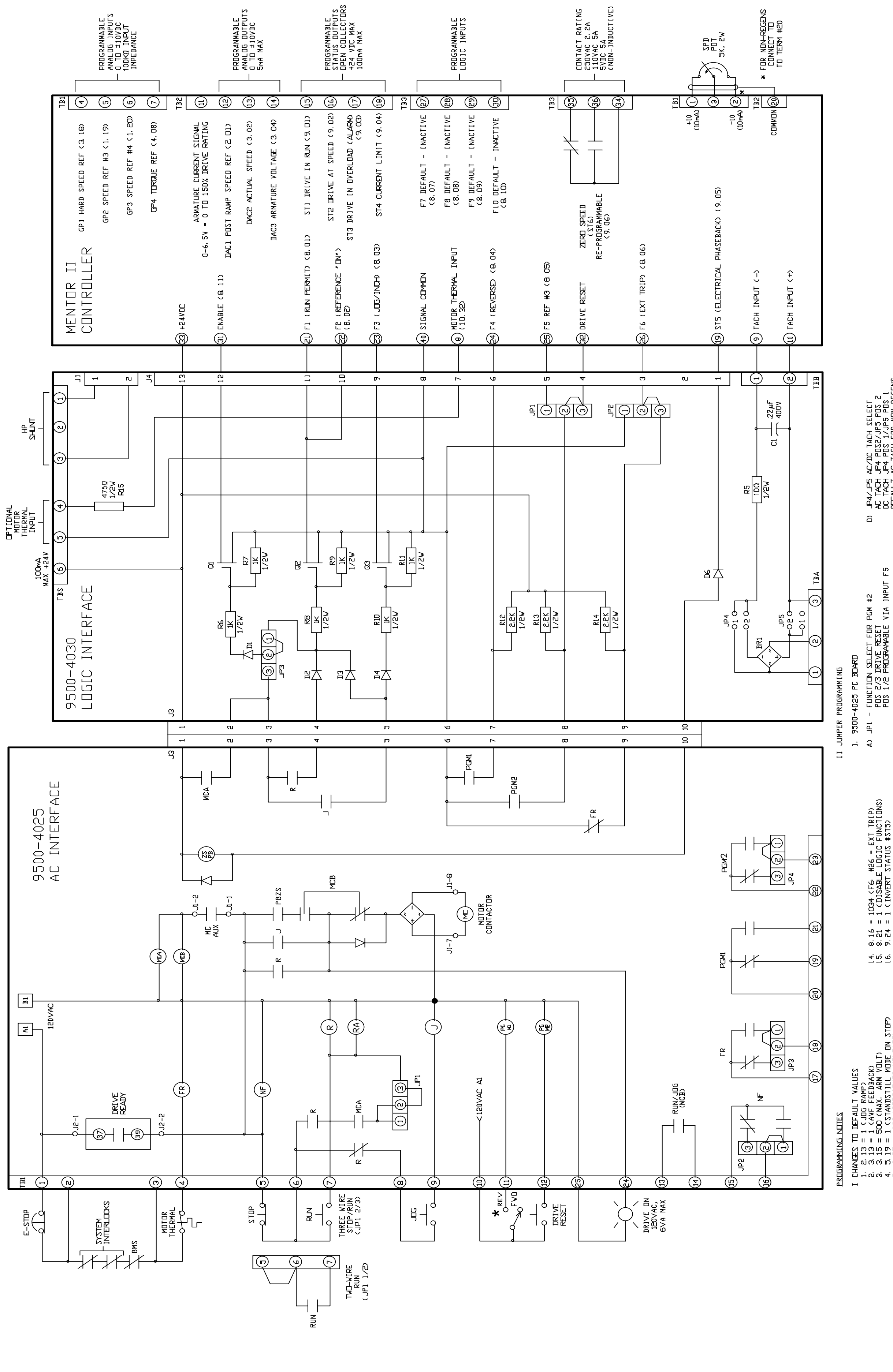


Figure A-4.
Interconnect Diagram, 5-1000 HP Quantum III Controls, (9500-1300-I), Sheet 4

CUSTOM POWER-UP DISPLAYS

We are occasionally asked, "Can your Drives be made to display something specific of a User's own choice? " Yes, the display on our current family can be made to "power-up" displaying a quantity that the User selects. Typically, people like to see the Drive display Motor RPM or Motor Amps for example.

Mentor II/Quantum III Drives

Mentor II and Quantum III Drives power-up to display parameter 0.00 which is one of the special locations where storing or the internal security code can be entered. Having this pop up whenever the drive powers up however, is not very useful. One could simply set parameter #11.18 (named Boot-up parameter) with the parameter location that one desires and save it away.

The table below lists a few popular registers that one might want to select as the power up display.

For example, if one wanted Armature Voltage to be displayed upon power up, they would just need to set parameter 11.18 = 304 and save.

Machine Speed

Example 1)

One can calibrate parameter #3.16 so that actual machine speeds can be read from location #3.03. For example suppose you have an Extruder that when the drive is displaying 1000 (100% speed) at #3.02 the actual extruder screw is turning at 120 Screw RPM. To make this happen you would simply place 120 into #3.16.

Example 2)

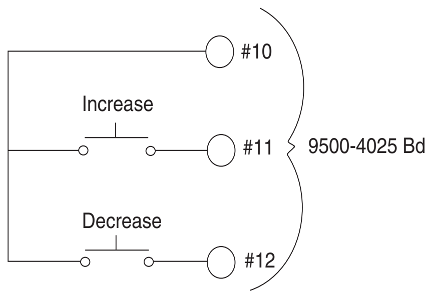
You have a Melt Pump that puts out 500# / Hr at full speed of the motor. Simply set #3.16=500 and location #3.03 will read out lbs/ Hour based on the motor speed.

VARIABLE	PARAMETER LOCATION	COMMENTS
Armature Voltage	#3.04	Displays actual armature voltage
% Speed	#3.02	Shows 0 to 1000=100.0% Speed
Armature Amps	#5.02	Can be in Amps if 5.05 set right
AC Line Voltage	#7.06	
Motor/Machine Speed	#3.03	Can be in User Units (see below)

In short, any machine quantity that is linearly proportional to motor speed can be read out on parameter #3.03 with the proper scaling factor in #3.16. i.e., FPM, YPM, Bottles/Min etc.

Increase/Decrease MOP Function (with no memory)

The following example utilizes the *Forward/Reverse* input as the increase input and the *Reset* input as the decrease input. If *Forward/Reverse* and *Reset* are required, external relays may be used with the available logic inputs.



Additional Wire Connections

1. Connect terminal #15 to #27 of MDA-2 Bd.
2. Connect terminal #16 to #28 of MDA-2 Bd.
3. Terminal #21 (9500-4025Bd) to #1 (MDA-2 Bd).
4. Terminal #20 (9500-4025Bd) to #3 (MDA-2 Bd).
5. Terminal #19 (9500-4025Bd) to #20 (MDA-2Bd).

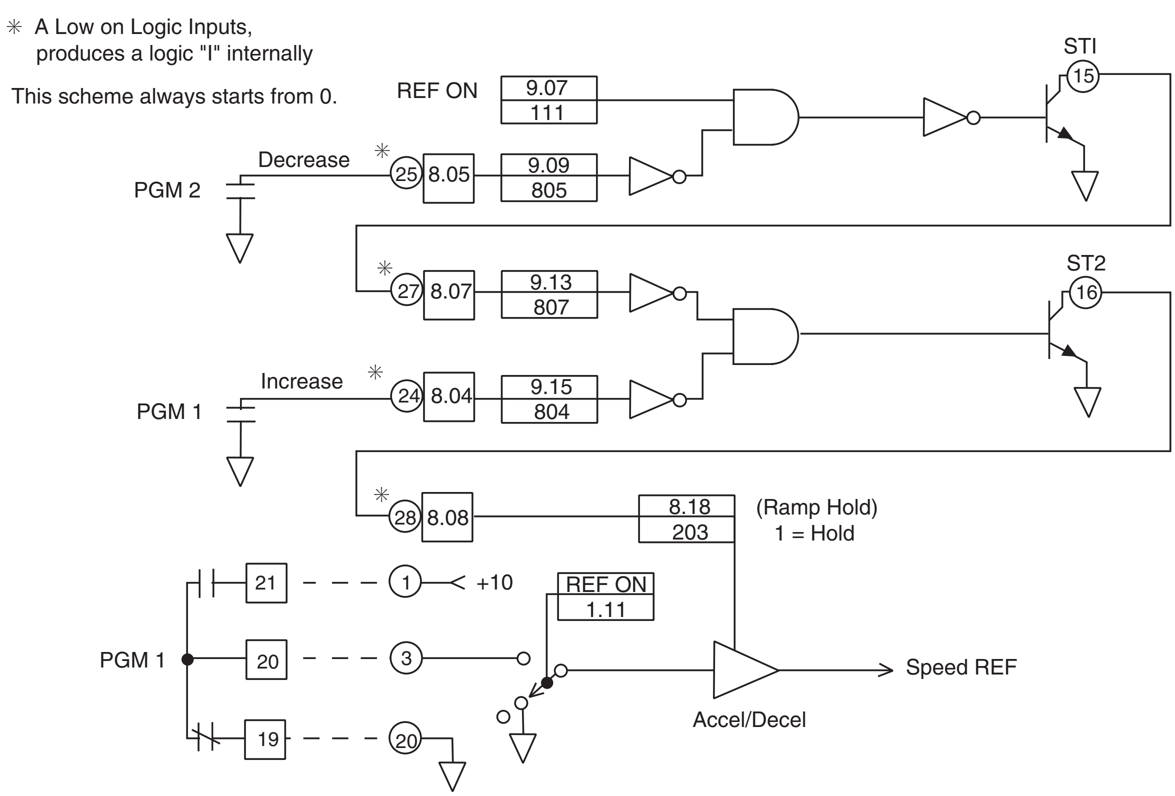
Jumper Program Changes

9500-4030 PC Board — Change jumper JP1 from position 2-3 to position 1-2. This disables *Remote Reset* button to allow it's use as the *Decrease* function.

Program Changes

8.14 = 000
8.15 = 000
8.18 = 203
9.07 = 111
9.08 = 0
9.09 = 805
9.10 = 1
9.11 = 1
9.13 = 807
9.14 = 1
9.15 = 804
9.16 = 1
9.17 = 0

Basic Flow Diagram of Increase/Decrease Logic



Quantum III/Mentor II with Field Boost Transformer

Quantum *III*/Mentor *II* with Field Boost Transformer

For 240 VAC applications requiring 240 VDC armature and 240 VDC field voltage.

V_{FLD} (max) = .9 [V_{PRI} + V_{sec}]

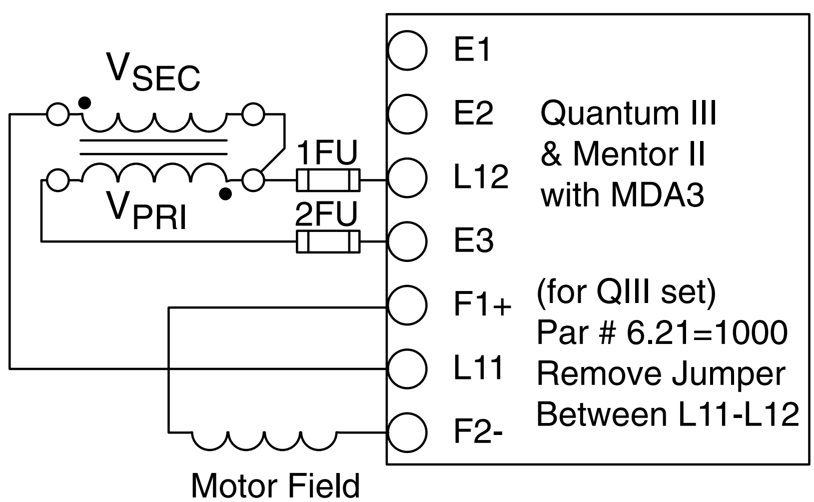
V_{PRI} = Supplied Line Voltage

$VA_{(T1)} = 1.5 \times I_F \times V_{SEC}$

$V_{SEC} = \frac{V_{FLD}}{0.9} - V_{pri}$

NOTES:

1. Transformer T1 can be either an Isolation Transformer as shown or an Auto Transformer.
2. E1 and E3 must also be connected to L1 and L3 respectively as per the User Guide.
3. Fuse 1FU should be sized to protect the secondary winding. Fuse 2 FU should be sized to protect the primary winding



Quantum III Zero Reference Start Circuit Interlock

I.Two Wire Control

Parameter Changes:

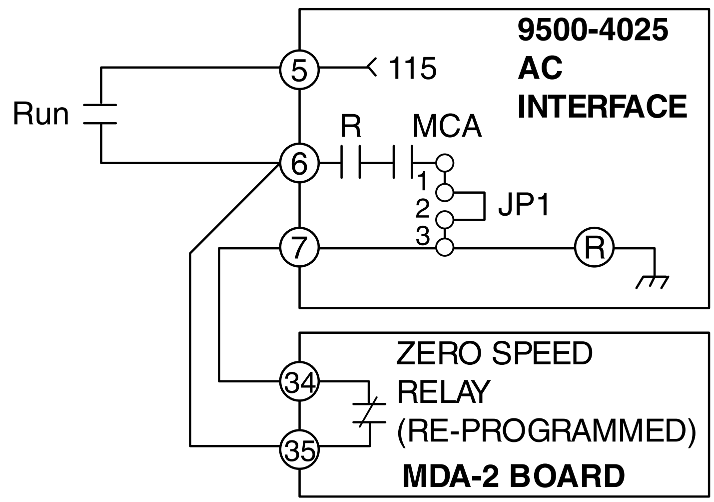
PR 9.25	=	1201
PR 12.03	=	705
* PR 12.04	=	015

*This parameter set % of reference where "zero speed" relay is energized.

Description of Operation:

The zero speed relay has been reprogrammed to energize when the speed pot reference (or external reference into Terminal #3 on the MDA-2 Board) is greater than 1.5% of full speed. The state of this relay as shown above is a closed connection when the reference is less than 1.5%. If the run contact is closed, the drive will start since the "zero speed" contact is closed. Once the contactor picks-up, this zero speed contact is "sealed-in" by the Run (R) an Motor Contactor Auxiliary (MCA) contacts.

If the speed pot is set greater than 1.5%, the drive will not start since the "zero speed" relay contact is open.



II. Three Wire Control

Parameter Changes:

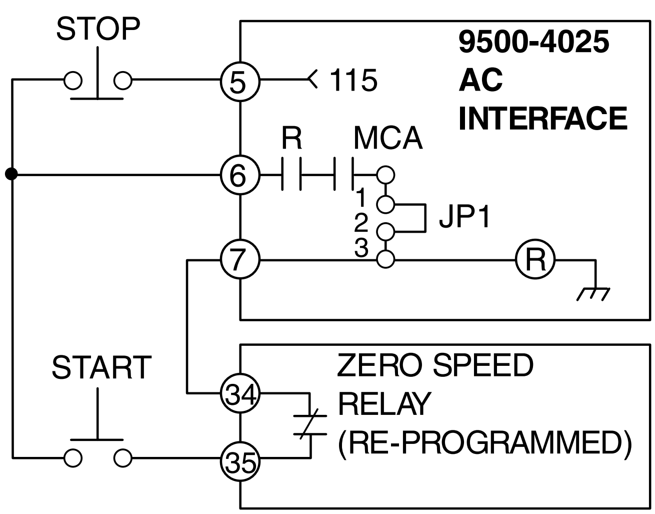
PR 9.25	=	1201
PR 12.03	=	705
* PR 12.04	=	015

*This parameter set % of reference where "zero speed" relay is energized.

Description of Operation:

The zero speed relay contact has been reprogrammed to energize when the speed pot reference (or external voltage reference into terminal #3 on the MDA-2 Board) is greater than 1.5%.

This contact "blocks" the start button until the speed pot reference is set to less than 1.5%. Once the drive is started, the circuit is "sealed-on".



Quantum III E-Stop without External Trip

E-Stop without External Trip

In some applications it is desirable to have two stop modes:

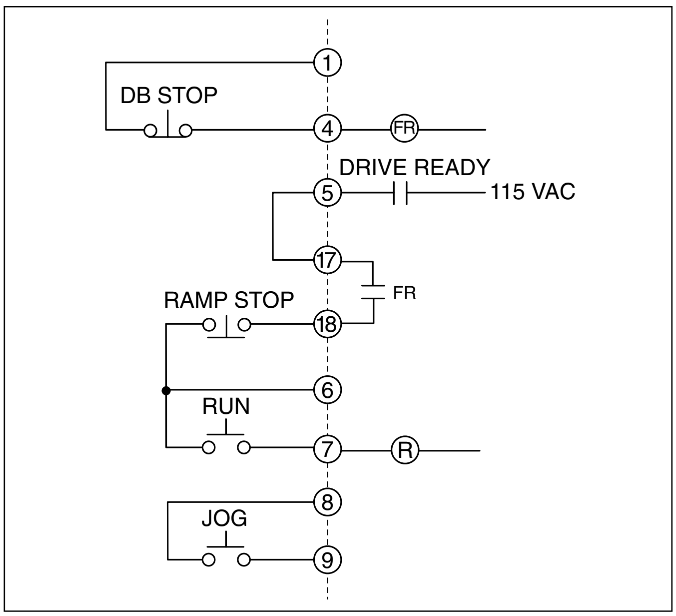
(1) Ramp Stop

(2) Dynamic Braking Stop

The Quantum III is capable of both type stops in it's standard default configuration with the exception that when a dynamic braking stop command is given (via E-Stop), the drive will fault on Et (External trip). In order to re-start the drive the reset pushbutton must be depressed to reset the fault. In some systems this may not be desirable.

The drive may be reconfigured such that an “Et” fault does not occur with a DB (Dynamic Braking) stop.

Three Wire Run/Stop Pushbuttons



Step 1)

JP3 on 9500-4030 board (Upper interface board)

Pos. 2-3

Step 2)

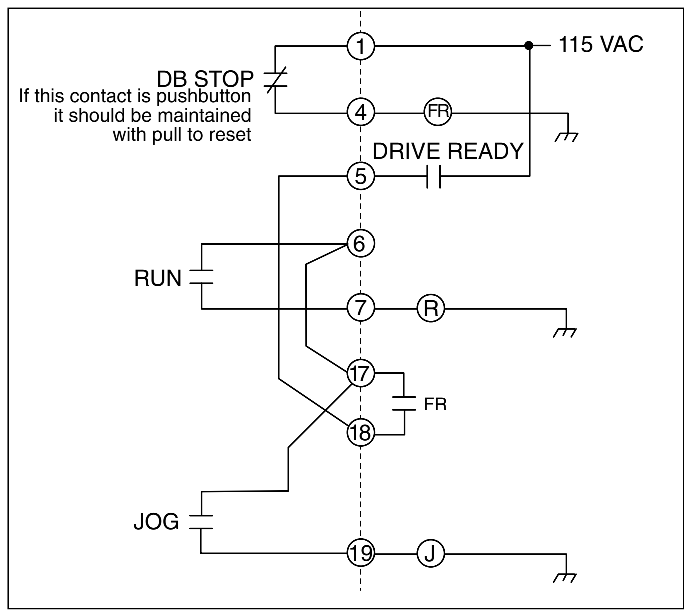
Change Parameter # 8.16 = 517

Press Reset

Set # XX.00 = 1

Press Reset

Two Wire Control Run/Ramp Stop + DB Stop



Step 1) 9500-4030 board (Upper interface board)

JP3 = Pos. 2-3

Step 2) 9500-4025 board (Lower relay board)

JP1 = Pos. 1-2 (see 8.11.1)

Step 3) Change Parameter # 8.16 = 517

Press Reset

XX.00 = 1

Press Reset

See Following Page For Jumper Locations

**After performing above steps, check to make sure that #10.34 =0.
If it is not, make it 0 then perform a STORE.**

Other Jumper Selections on 9500-4030 Interface Board

JP1 Selection to determine the meaning of 115 VAC Programmable Input #2 (TB1 Pin 12)

Position	1-2	Select Digital Reference #3 (Parameter #1.19) as the Speed Reference i.e. for Thread or Drool Speed
Position	**2-3**	**Remote Drive Reset**

JP2 Selection to determine the meaning of the FR (Fault Relay) Output (TB1 Pins 17 & 18)

Position	1-2	External Trip Inactive. FR Relay output contacts usable
Position	**2-3**	**Loss of 115 VAC from TB1 Pin 4 will cause External Trip**

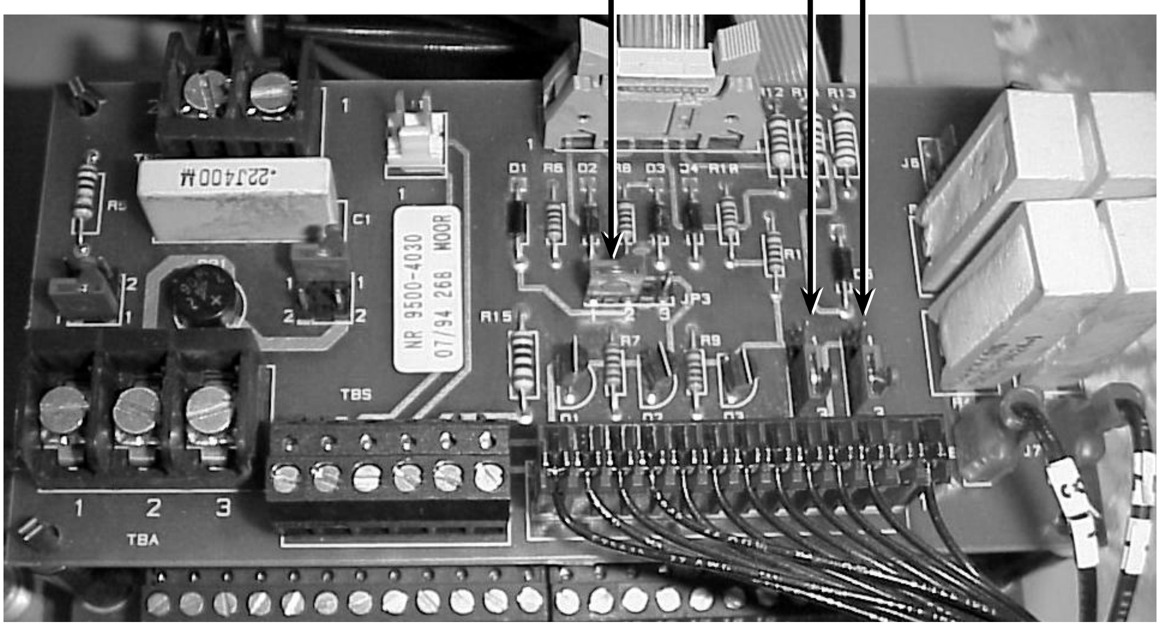
JP3 Selection to determine how the Drive is to stop

Position	**1-2**	**COAST STOP (Armature Contactor Opens upon STOP input)**
Position	2-3	RAMP STOP (Reference is ramped to zero then Armature Contactor Opens)

Items in **bold** are factory settings.

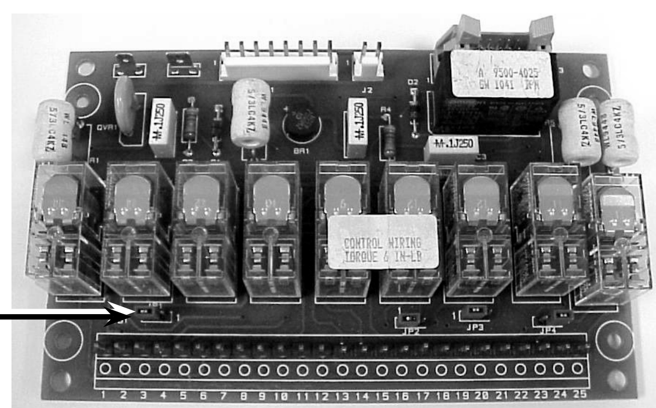
JP3 JP2 JP1

9500-4030



9500-4025

JP1



Separate Jog Accel & Decel Ramps

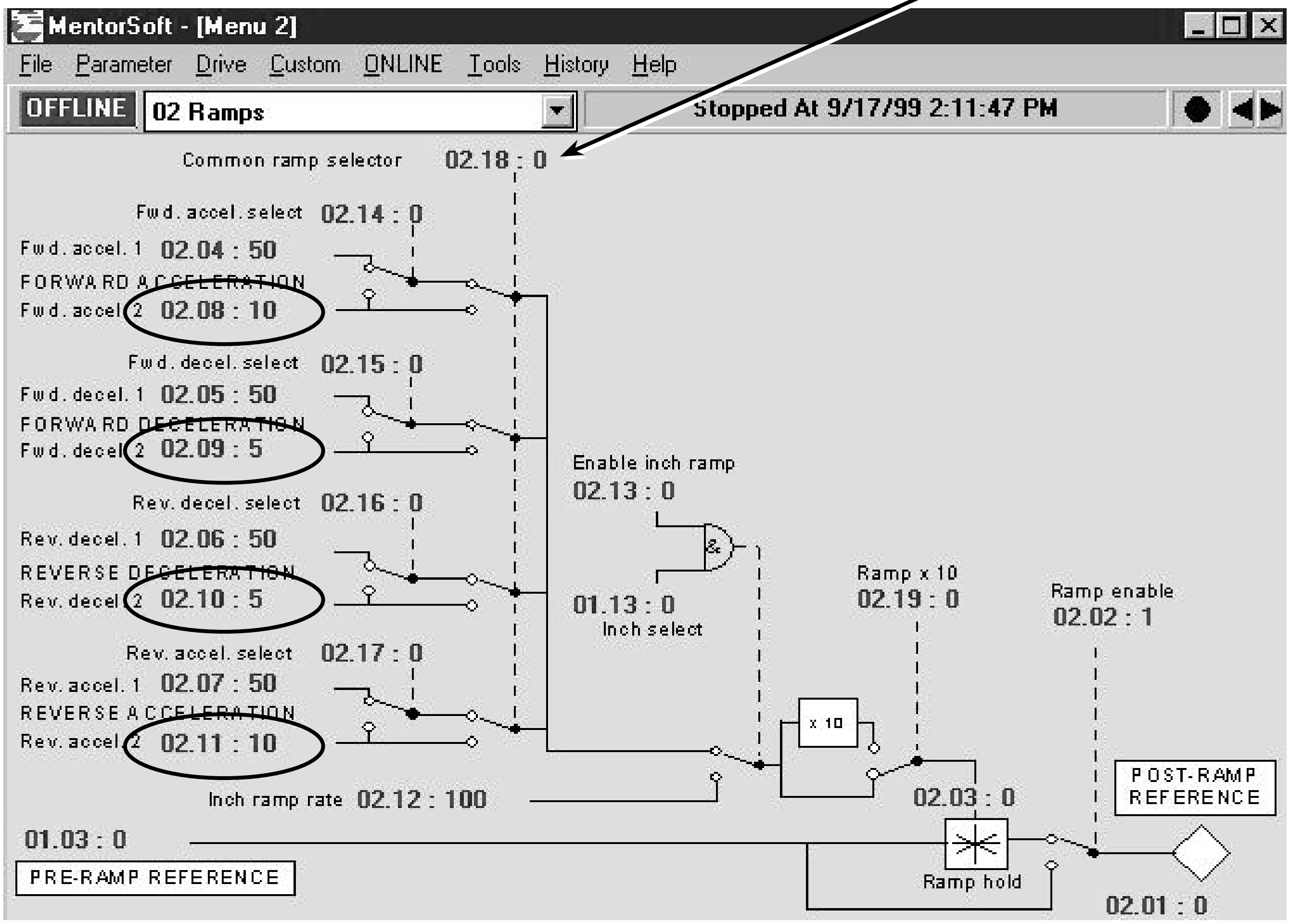
When using the jog function to index a machine into position, it is often desirable to have a smooth accel and quick decel control once the desired position is reached. The Quantum III has a myriad of accel and decel rates for a run reference but has only one overall Jog Accel/Decel rate. If you need a separate Jog Accel and a Jog Decel rate the following configuration changes can provide you with this functionality. This scheme uses set #2 of the Run Accel/Decel Rates during the Jog period instead of the singular Jog Rate. The time delay programmed by parameter #9.12 maintains the selection of these rates for 2 seconds after the Jog command is removed. Otherwise the rate selector would switch to Accel/Decel set #1. This time can be adjusted to accommodate jog decel rates greater than 2 seconds. This delay just needs to be slightly greater than the Jog decel rate set into #2.09 or #2.11.

Separate Jog Accel and Decel Rates

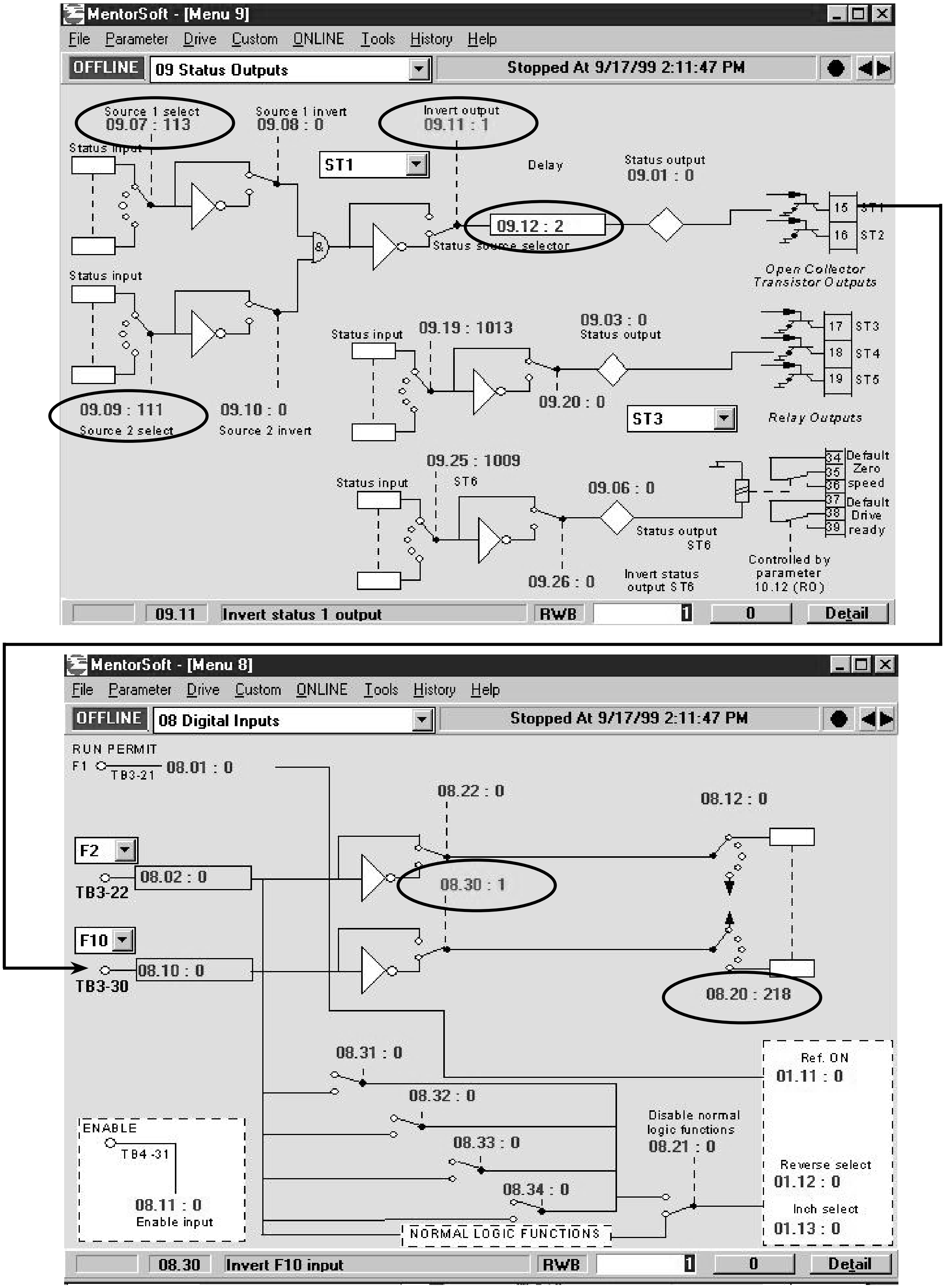
PARAMETER NUMBER	CHANGE VALUE TO:	NOTES
2.08	1-1999	Set to Desired Jog Fwd Accel Ramp Rate ie. 10=1 second
2.09	1-1999	Set to Desired Jog Fwd Decel Ramp Rate ie. 5=0.5 seconds
2.10	1-1999 *	Set to Desired Jog Rev Accel Ramp Rate ie. 10=1 second
2.11	1-1999 *	Set to Desired Jog Rev Decel Ramp Rate ie. 5=0.5 seconds
2.13	0	Disable the Normal Jog Ramp Rate
8.20	218	Direct this result to Run Accel/Decel Rates Bank Selector
8.30	1	Invert F10 Input (TB3-30)
9.07	113	Look at the Jog Command with AND gate input #1
9.09	111	Look at the Drive Ref On with AND gate input #2
9.11	1	Invert this result
9.12	2	Sustain this result for 2 seconds following a Jog command

Install a Jumper wire between TB2-15 (ST1 Logic Resultant) and TB3-30 (F10 input) on the MDA2 or MDA2B interface board terminal strip.
* Reverse assumes use with a Regen Drive Model.
Note: Fast Jog Deceleration implies the use of a Regen Drive Model. With Non-Regenerative models the decel rate is a function of the machine load/friction. If a fast jog decel is needed in this instance, perhaps the application of Dynamic Braking could be utilized.

Separate Jog Accel and Decel Rates (continued)



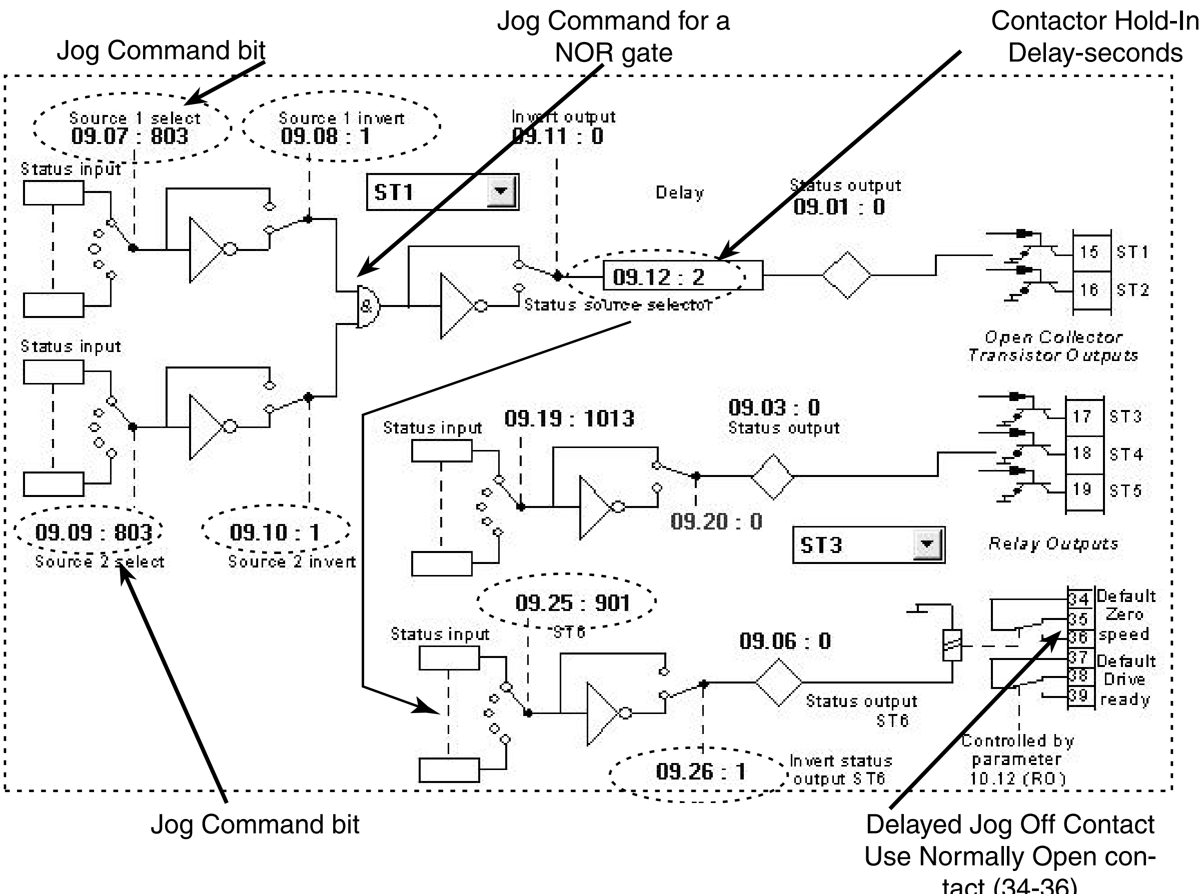
Separate Jog Accel and Decel Rates (continued)



"Contactor-Less" Jog
Delayed Motor Contactor Hold-In

When jogging, the "banging" of the contactor on Quantum III can be rather annoying not to mention causing things on the panel to vibrate loose and also tends to accelerate general wear and tear on this electromechanical device. It is often desirable to hold the contactor "in" for a couple of seconds after a jog (anticipating more jogging) then "dropping out" the motor contactor. This can provide a "contactorless" jog feel and reduce the effects mentioned above.

This application note illustrates how to utilize the "built-in" logic function and time-delay blocks to embellish the Jog function provided in the Quantum III.



To complete this Quantum III application one would make the following wiring connections:

FROM	TO
pin 34 of TB3 on the MDA2B board	pin 13 of the AC Interface Board
pin 36 of TB3 on the MDA2B board	pin 24 of the AC Interface Board
pin 14 of the AC Interface Board	pin 5 of the AC Interface Board

These connections will provide a method for this delayed off contact to hold in the contactor but only after the contactor has been picked up by an initial Jog request. (The RUN/JOG contact, TB13-14 on the AC Interface board, is used as a permissive for the delayed contact created above).

A similar approach could be used for a Mentor II but one would need to make the necessary translations. (Jog F and Jog R would be the inputs to the NOR gate).

In practice, this Jog Hold-In scheme may not be effective with non-regenerative models (9500-83xx) on machine loads with low friction and higher inertia or loads that tend to coast for a while. For this reason, this scheme is probably most effective with regenerative models.

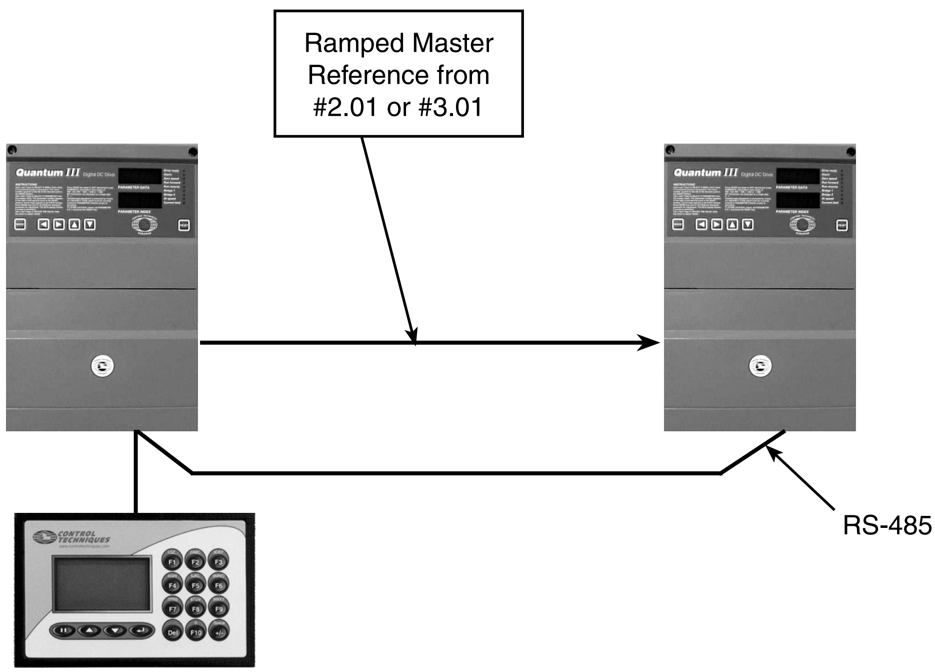
A Simple Ratio Control Scheme

We're often asked:

"How could one achieve simple ratio control without encoder feedback and without the MD-29 and associated programming costs?"

The User in these cases did not need or want digital lock nor want to upgrade from DC tachs but would like to give the Operator digital control of ratio.

With the CTIU, the Line Speed setpoint could be directly entered by the Operator or trimmed with Up/Down arrows. The Ratio could be directly entered by the Operator or trimmed with Up/Down arrows also. By using the CTIU, Fault Messages, general Drive Info such Arm V, Arm Amps, %Load, Motor RPM etc could also be brought to the User in simple terms as well.



Line Speed=1000FPM	**-Reads #3.02 of Master**
FPM Setpoint=1000FPM	**-Writes to #1.18 of Master**
Draw Ratio=1.234	**-Writes to analog input scaling parameter**
Draw Roll = 1234FPM	**-Reads #3.02 of slave**

For more Application Notes visit our website at:

www.ctdrives.com/downloads under Application Notes.

Thread/Drool Speed

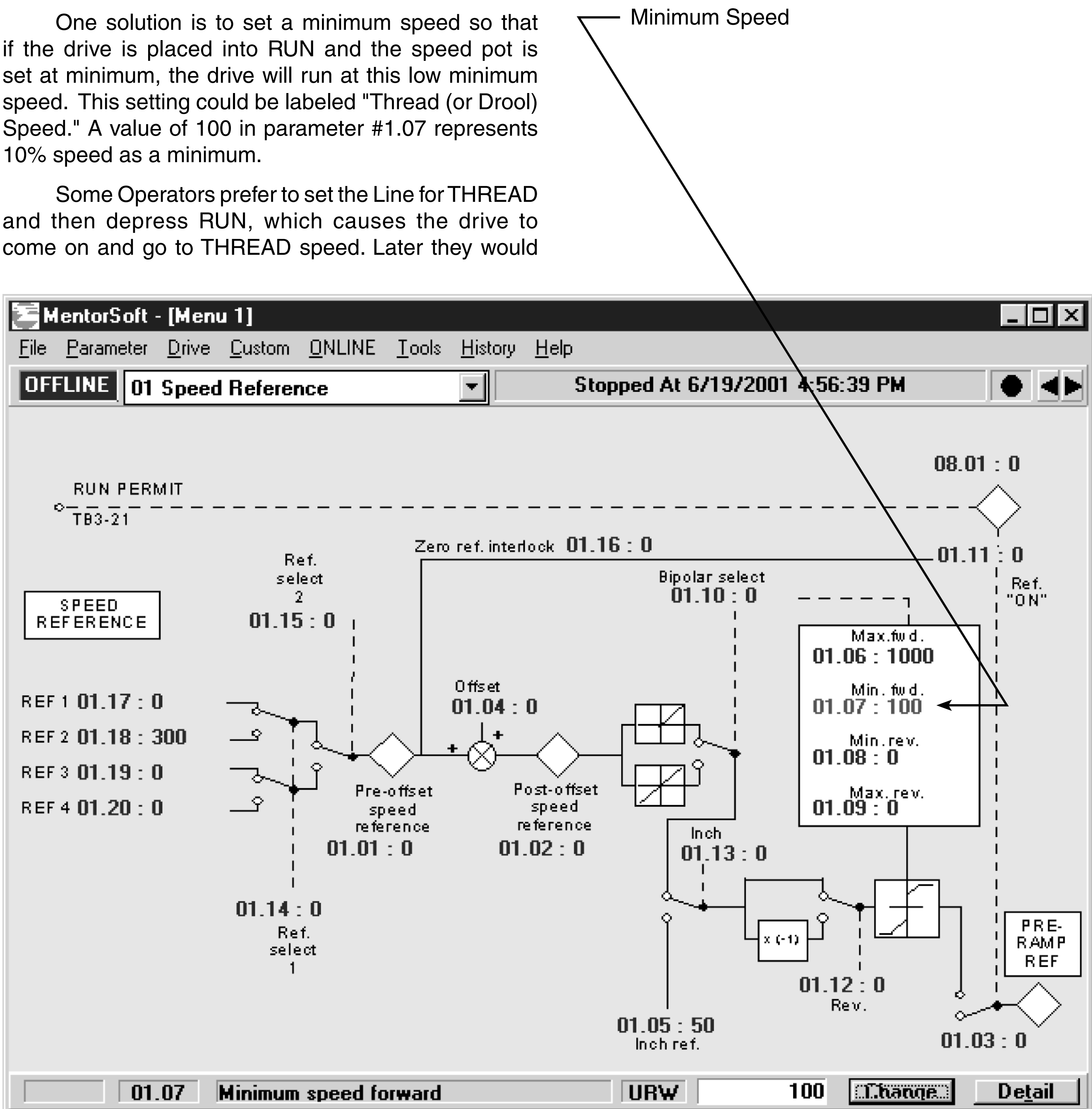
Many process lines need to run a drive section for a time at a Thread-up speed or other low speed while the machine is in stand-by. For instance, in the case of an Extruder, the screw is often kept turning at a low “Drool” speed until the line is ready to transition to RUN speed.

Solution #1

One solution is to set a minimum speed so that if the drive is placed into RUN and the speed pot is set at minimum, the drive will run at this low minimum speed. This setting could be labeled "Thread (or Drool) Speed." A value of 100 in parameter #1.07 represents 10% speed as a minimum.

Some Operators prefer to set the Line for THREAD and then depress RUN, which causes the drive to come on and go to THREAD speed. Later they would switch from THREAD to RUN SPEED and maybe later at some point switch back to THREAD if for example they need to make a machine adjustment.

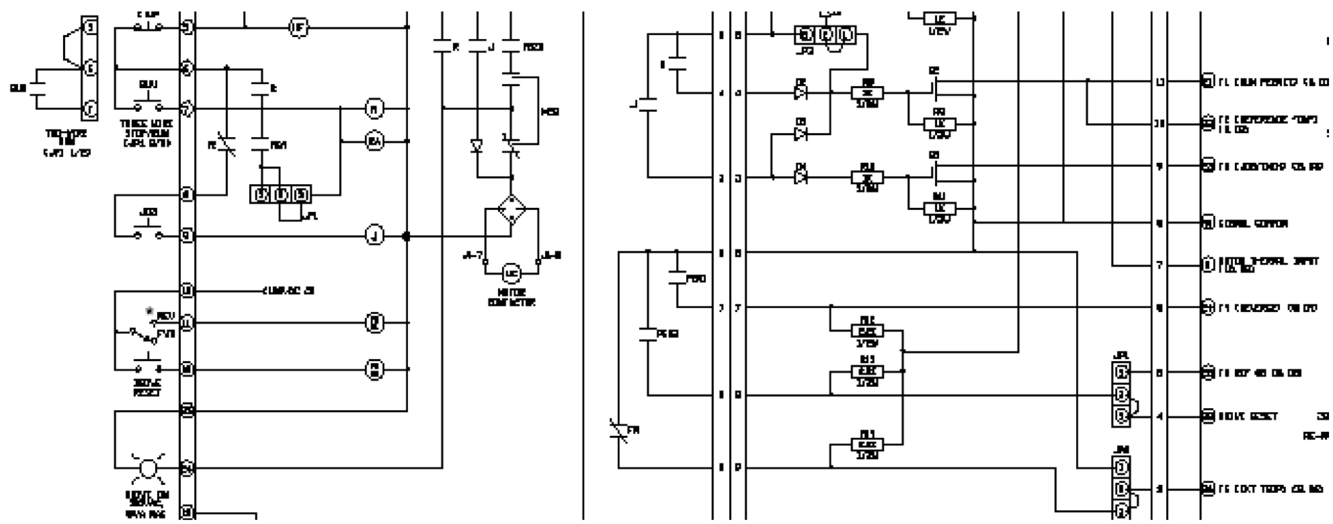
Minimum Speed



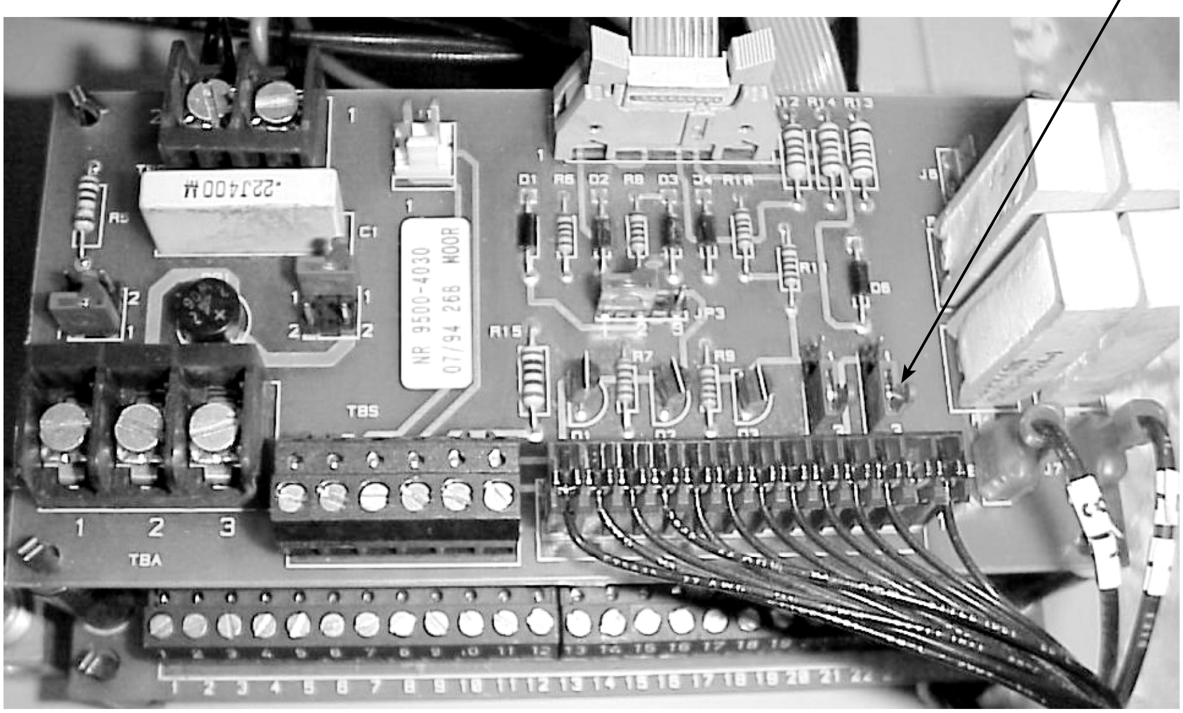
Solution #1

This solution uses one of the two programmable inputs to command an internal digital speed preset, which would command this other speed when desired. One of the 115v inputs that could be used for this purpose is already setup for an alternate reference selection and is available on TB1 pin 12 of the 9500-4025 AC Interface Board. This input is shipped from the factory as an External Fault Reset function, however, if this function is not needed, this input is ideal for this purpose.

Interconnect Diagram



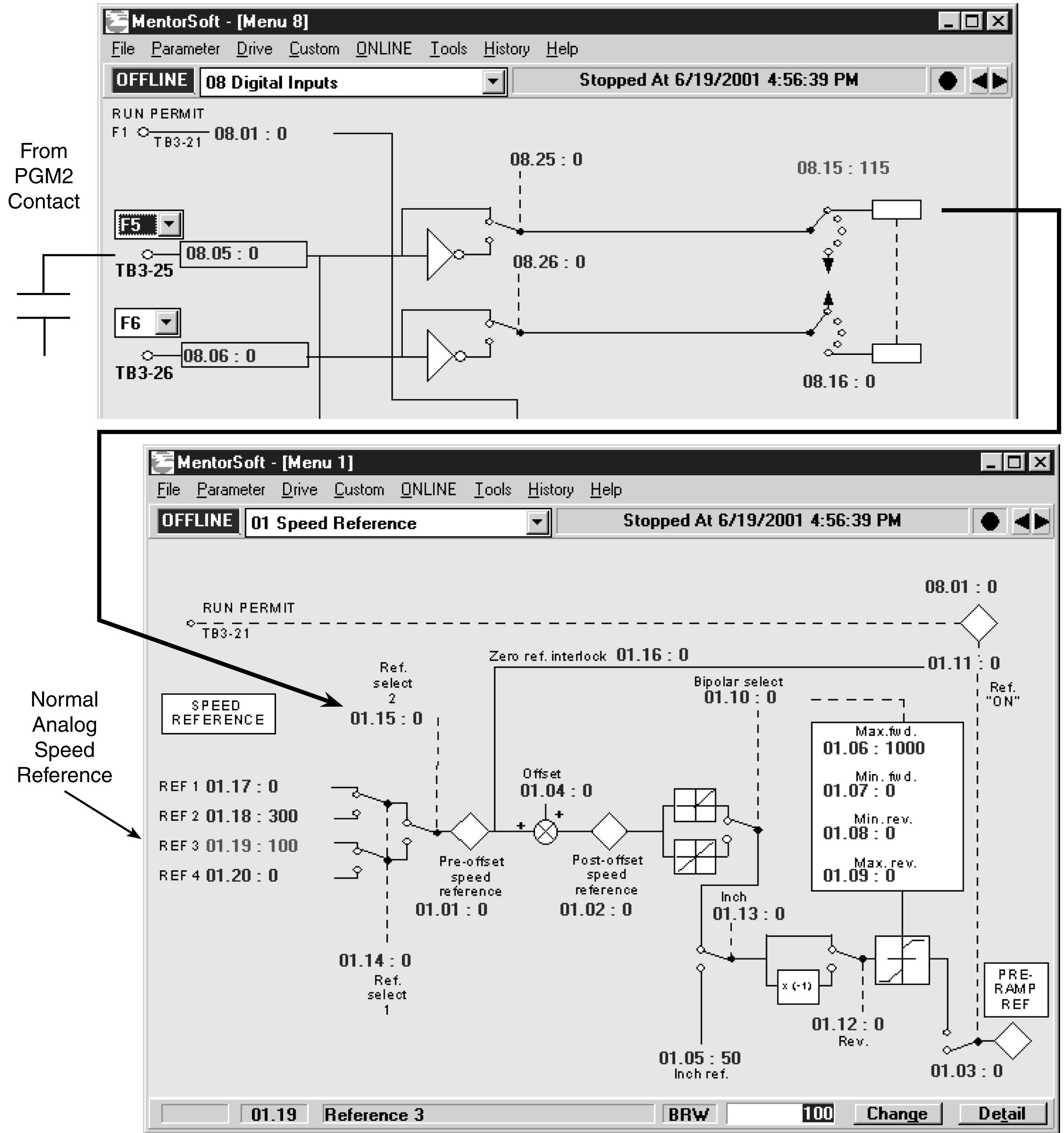
A Run Speed/Thread Speed selector switch could be tied between TB1 pins 10 and 12 of the 9500-4025 AC Interface Board. This will cause the relay PGM2 to operate based on this selector switch. Now all one would have to do is change the setting of the JP1 jumper on the 9500-4030 Interface Board to position 1-2.



9500-4030 AC interface Board

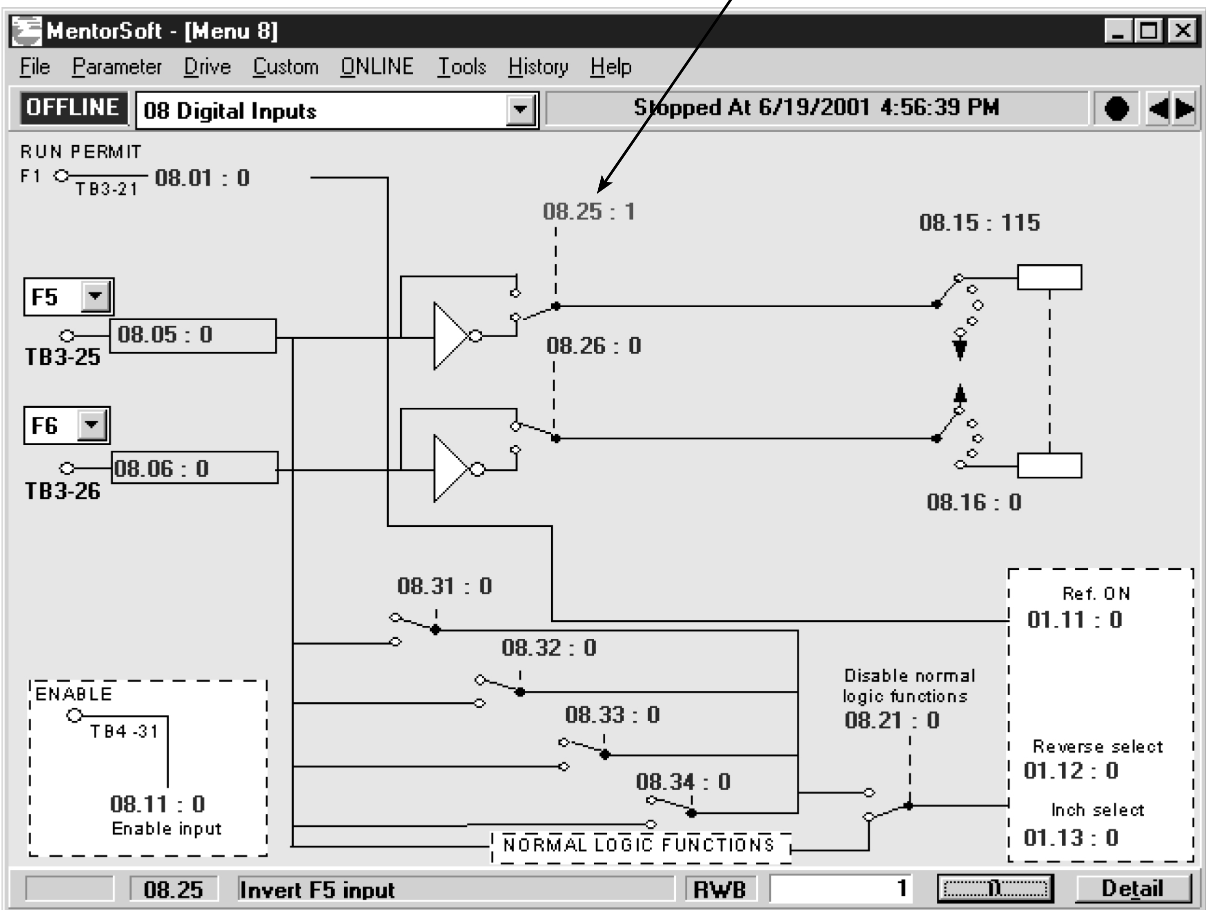
This will change the assignment of this function from the DRIVE RESET to the F5 input (pin 25 of the Drive itself).

This input was pre-configured in the factory to switch bit parameter #1.15 which selects between Ref #1 and Ref #3 (if #1.14=0).

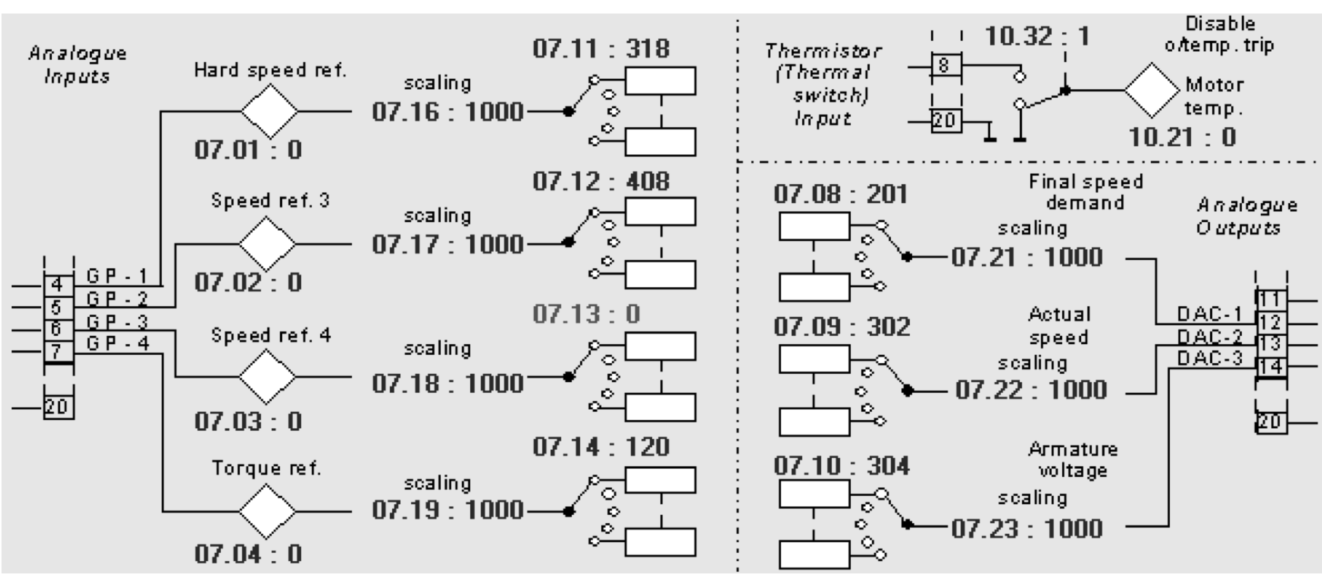


Setting parameter #8.15 =115 will direct the alternate low speed selector switch to change the state of #1.15 from a 0 to a 1. This can be wired and tested before the drive is actually placed into RUN by observing parameter #1.01. The previous example shows #1.19 set for 100 which would represent 10% speed (if all was calibrated). In the above setup, Ref #1 (parameter #1.17) normally comes from the analog Speed Reference input on pin 3 of TB1 under the Drive cover, and for this example would be active without closing a contact to pin 12 of TB1 (the alternate low speed input we configured). The alternate speed would be selected when a contact closes to pin 12 of the 9500-4025 Relay Interface Board.

If it is desired that this alternate slow speed is normally selected and the speed pot reference selected if the contact to pin 12 is made, one would only need to invert the function of the F5 input. This can be accomplished by setting #8.25=1 as shown below.



Note: The default destination for Analog Input GP3 pin 6 is reference parameter #1.19. For this parameter register to be free for our own purposes, we must change or eliminate the destination pointer of GP3 from writing to #1.19. This can be achieved by setting # 7.13=0 and depressing RESET.



Alternatives

If you do not use the Fwd/Rev input on the drive and wish to use this input for Run/Thread speed selection instead, simply connect your Run/Thread Speed selector switch between TB1 pins 10 and 11 of the 9500-4025 AC Interface Board. This will cause the relay PGM1 to operate based on this selector switch. Disregard moving the jumper on the 9500-4025 Relay board.

You must re-program the F4 input (#8.14) from Reverse (112) to become 115. So set #8.14= 115.

If it is desired that this alternate slow speed is normally selected and the speed pot reference selected when the contact to pin 11 is made, one would only need to invert the function of the F4 input. So, set #8.24 = 1.

For more Application Notes visit our website at:

www.ctdrives.com/downloads under Application Notes.

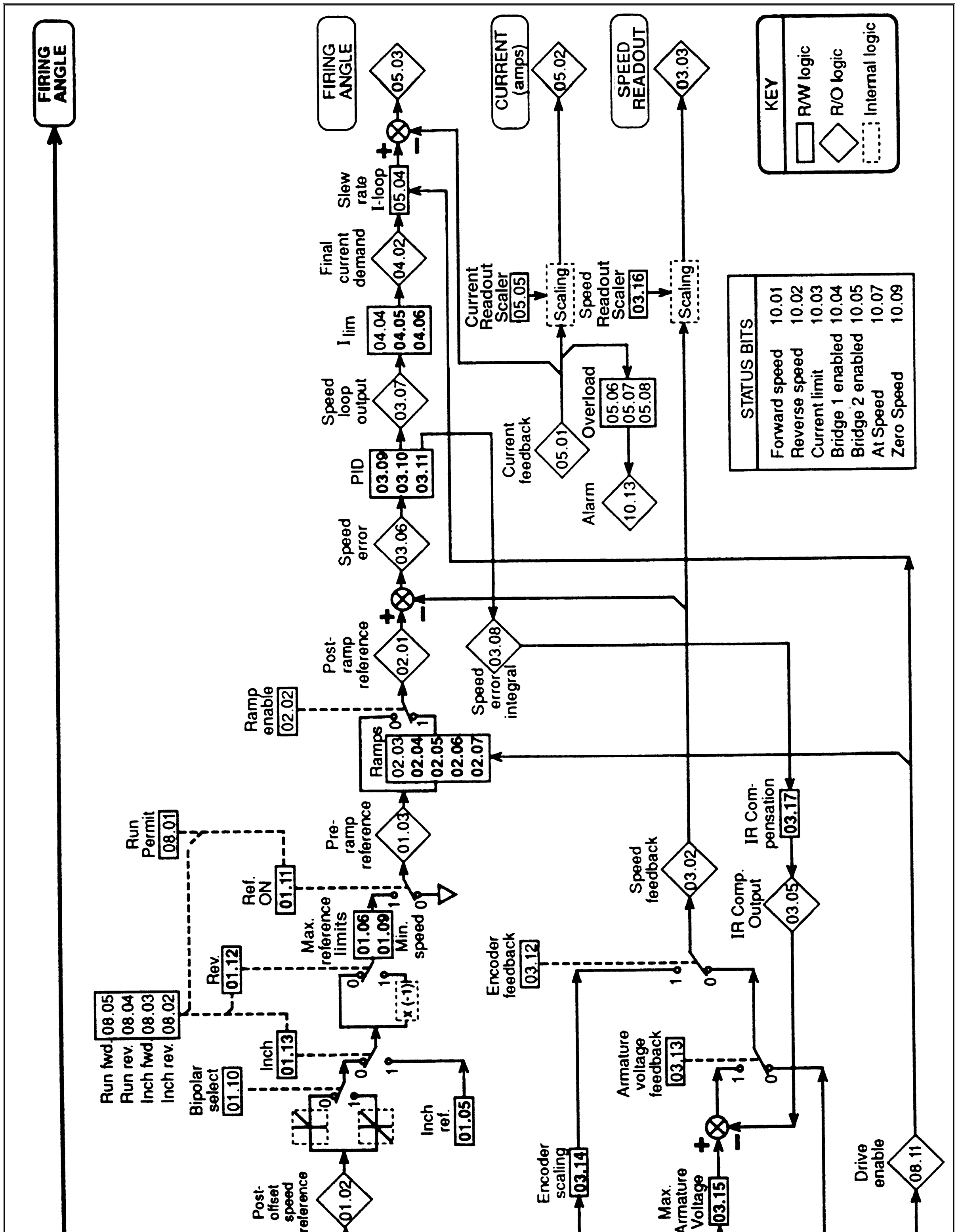


Figure E-1
Parameter Logic Overview

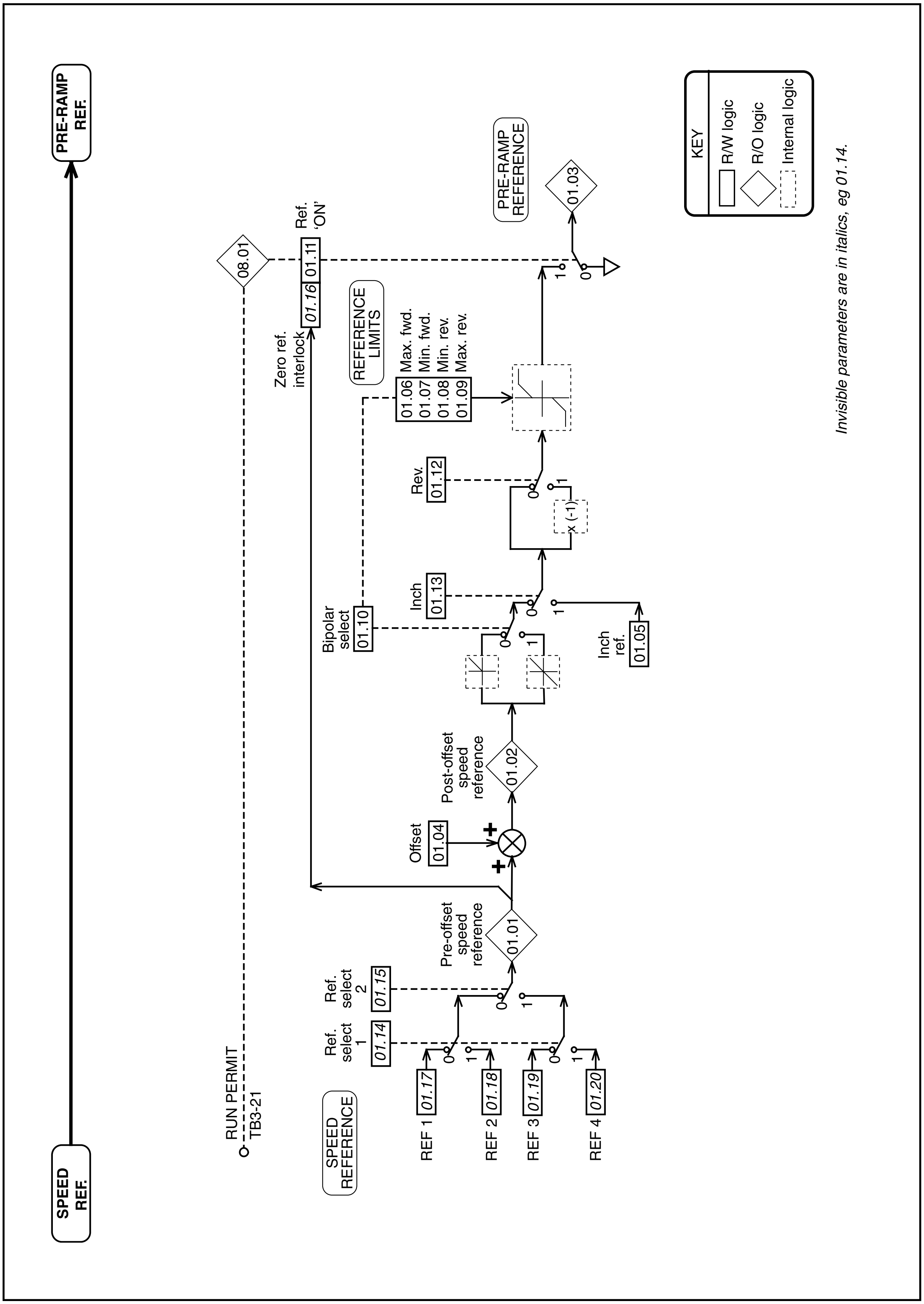


Figure E-2
Menu 01—Speed Reference Selection & Limits

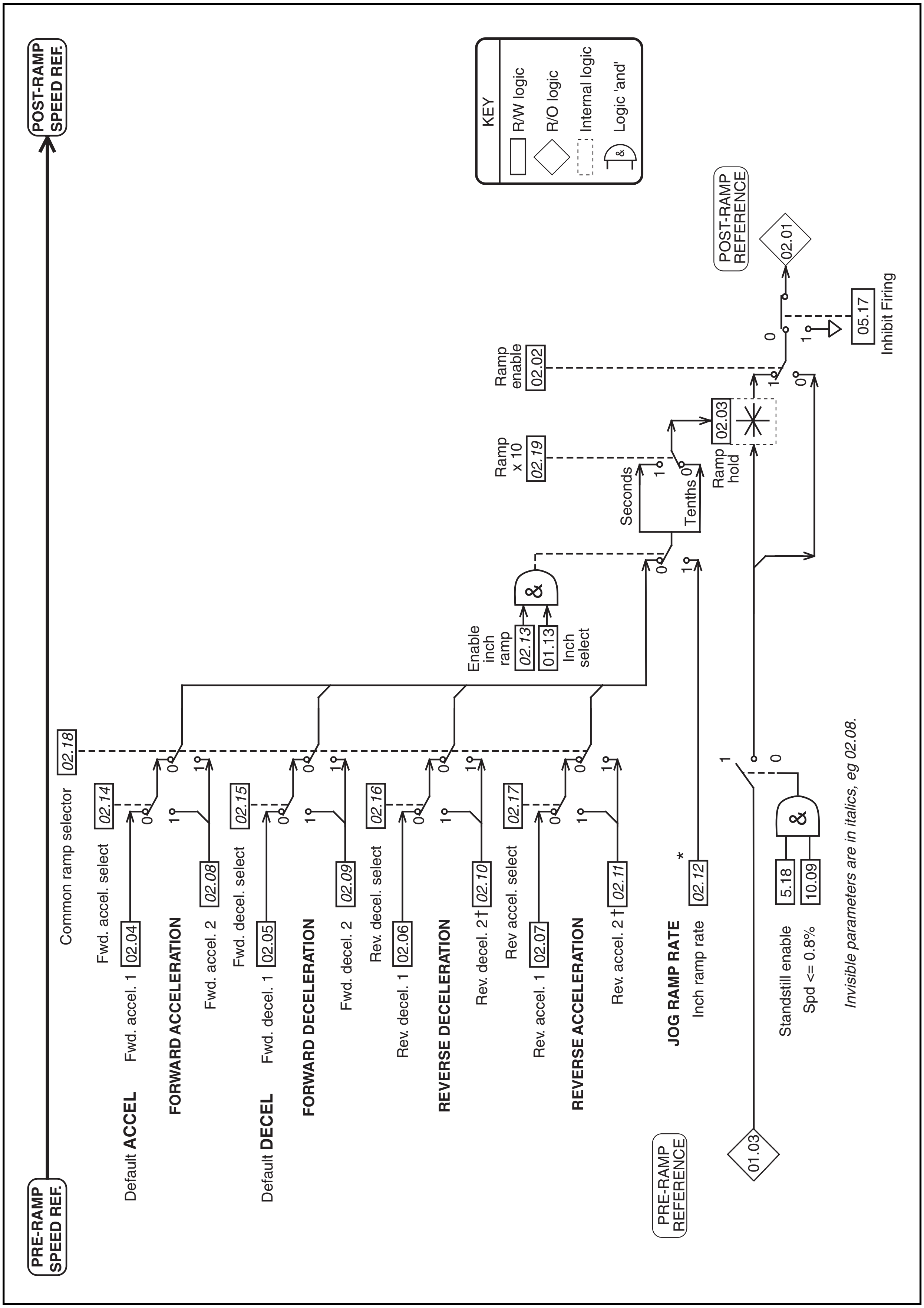


Figure E-3
Menu 02—Ramp Selection

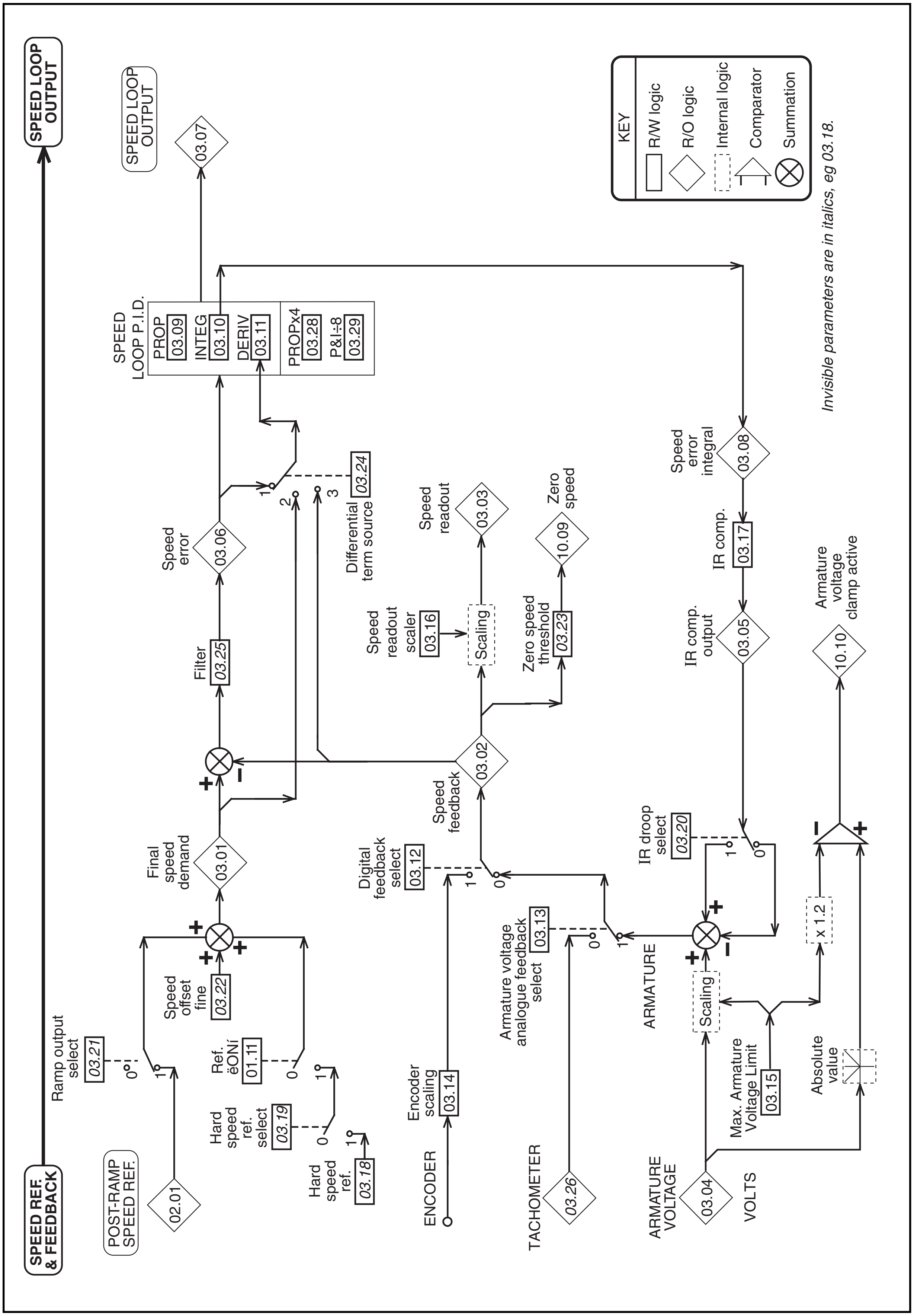


Figure E-4
Menu 03—Feedback Selection & Speed Loop

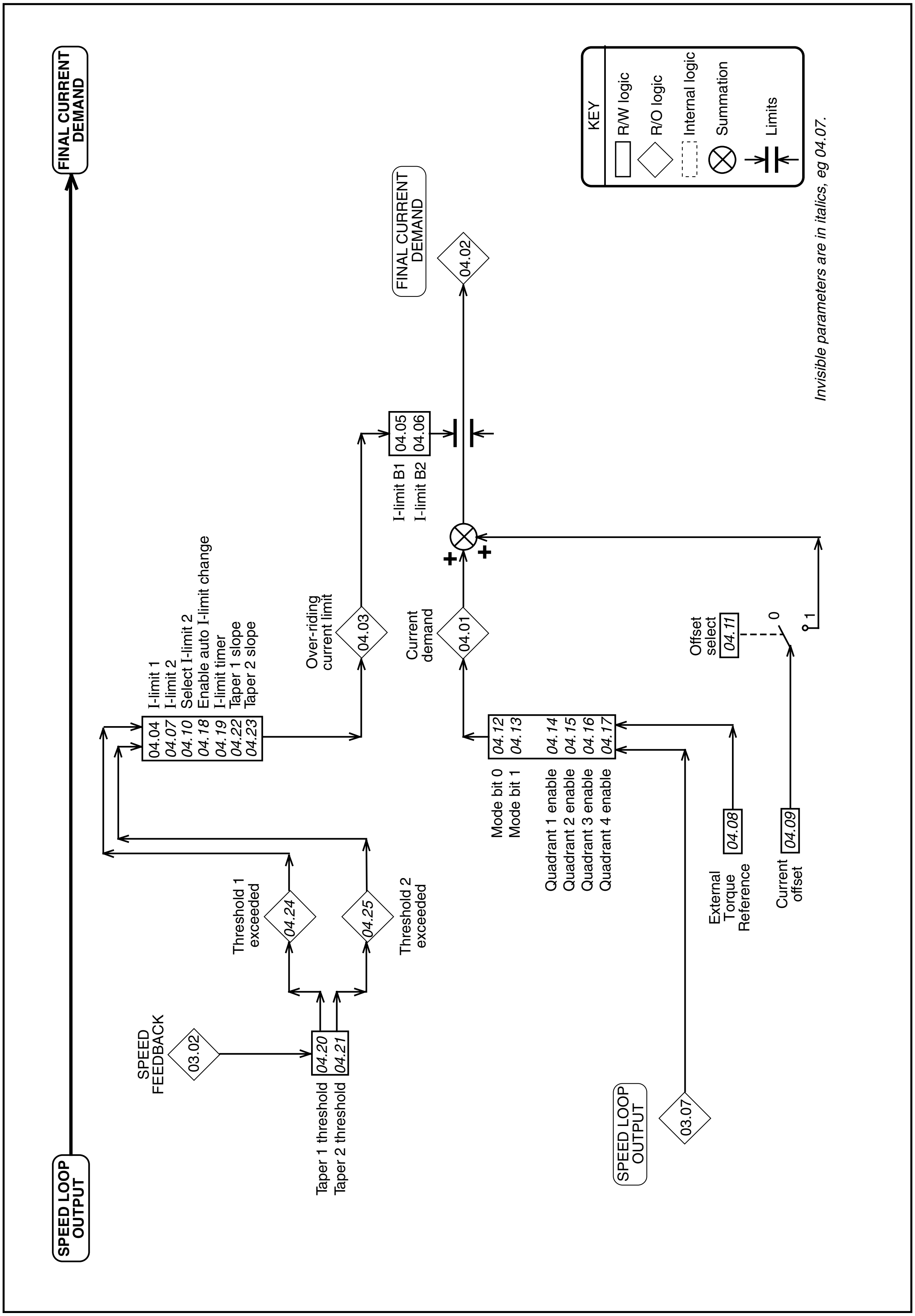


Figure E-5
Menu 04—Current Selection & Limits

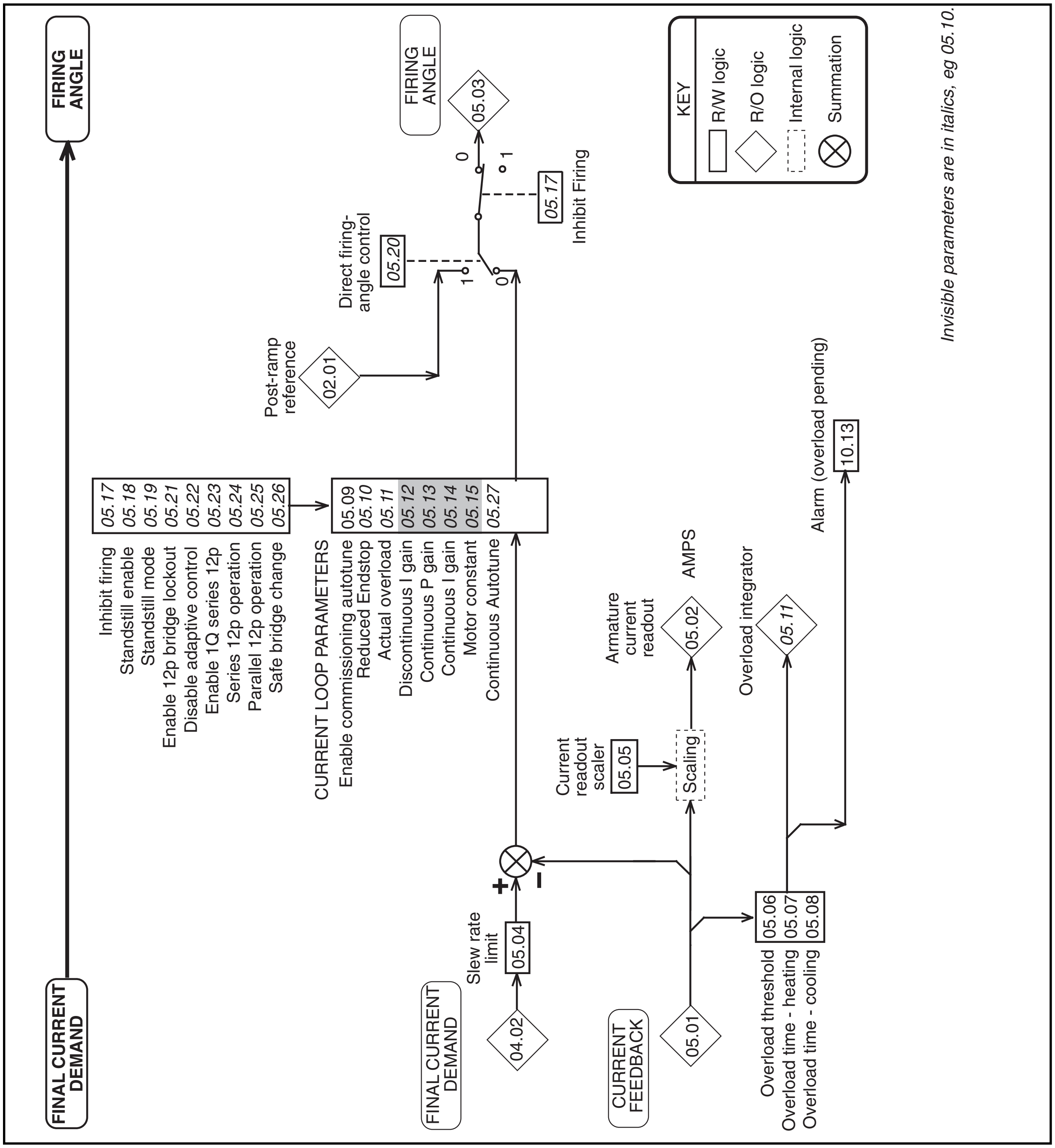
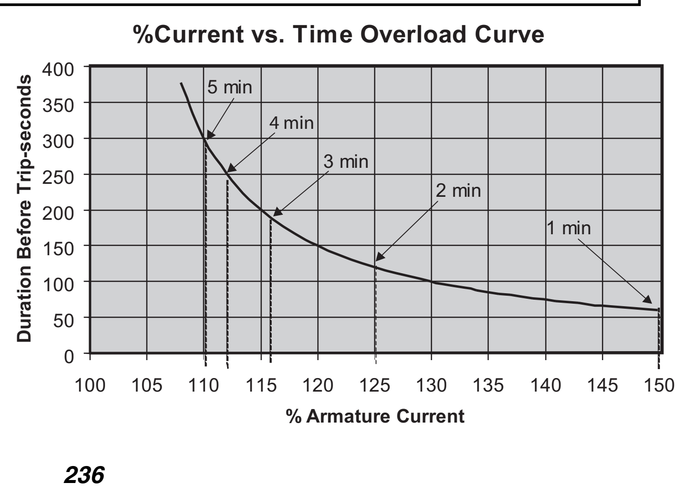


Figure E-6
Menu 05—Current Loop

Figure E-7
Current vs.
Time Overload Curve



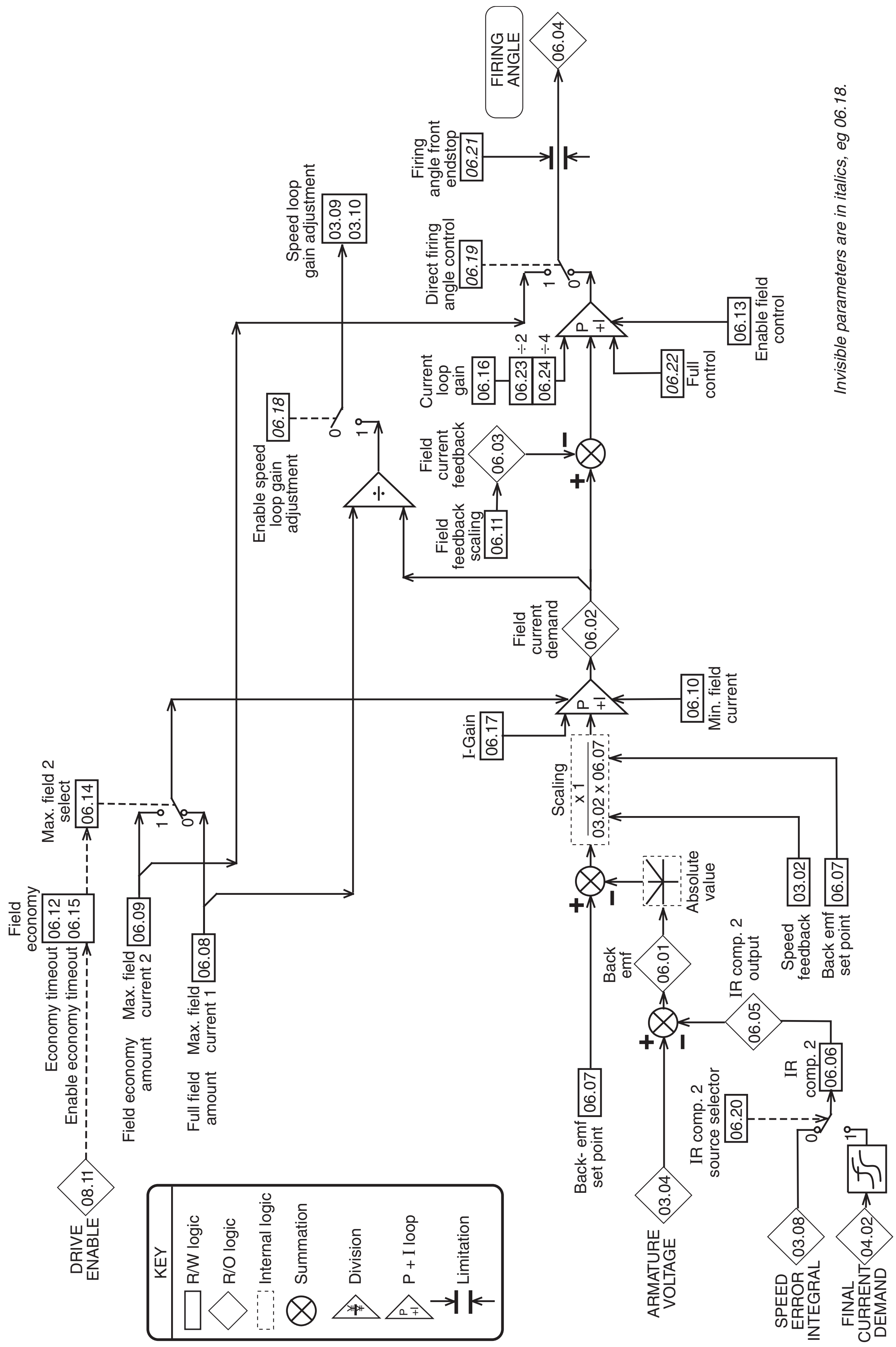


Figure E-8
Menu 06—Field Control

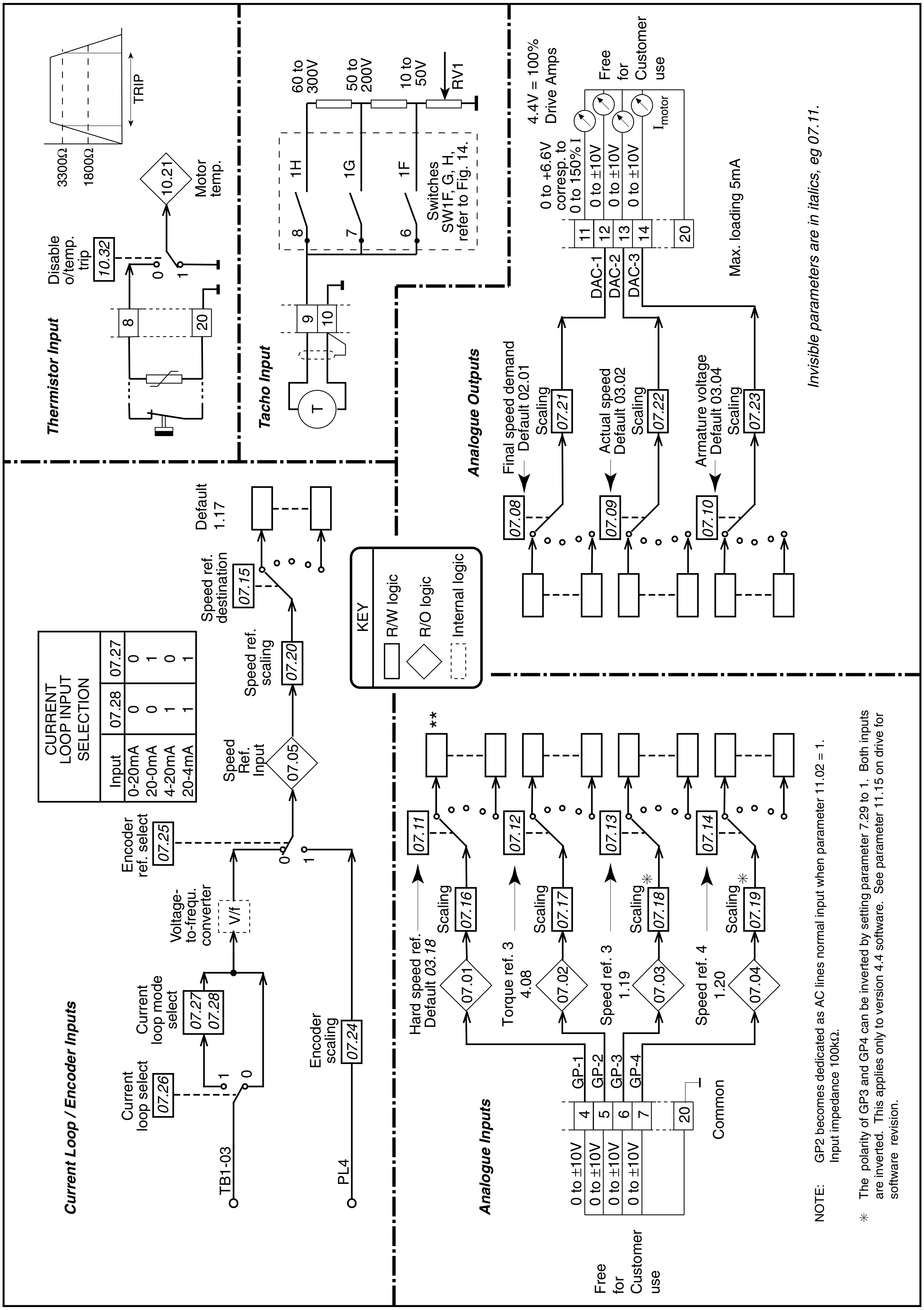


Figure E-9
Menu 07—Analog Inputs & Outputs

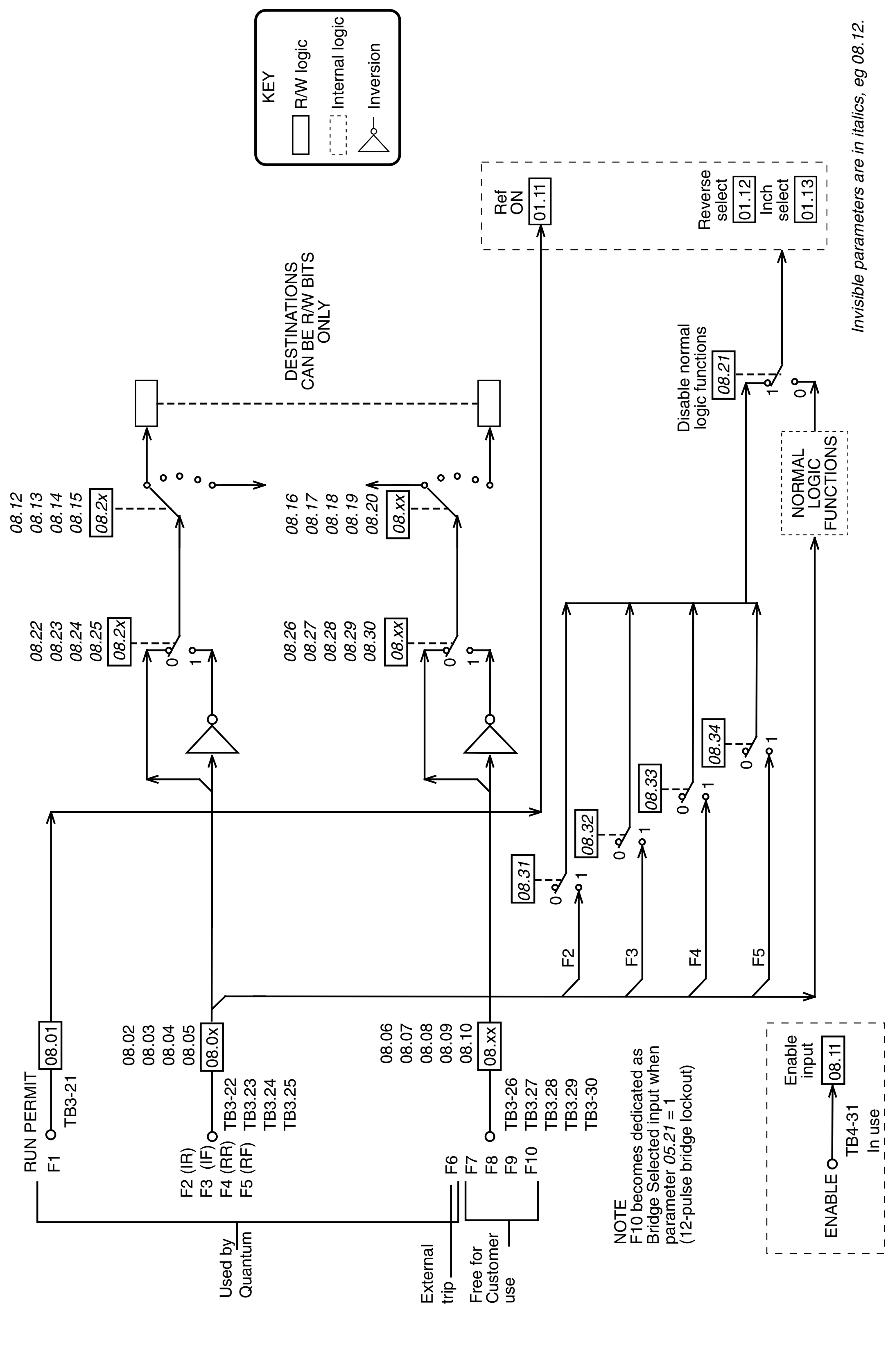


Figure E-10
Menu 08—Logic Inputs

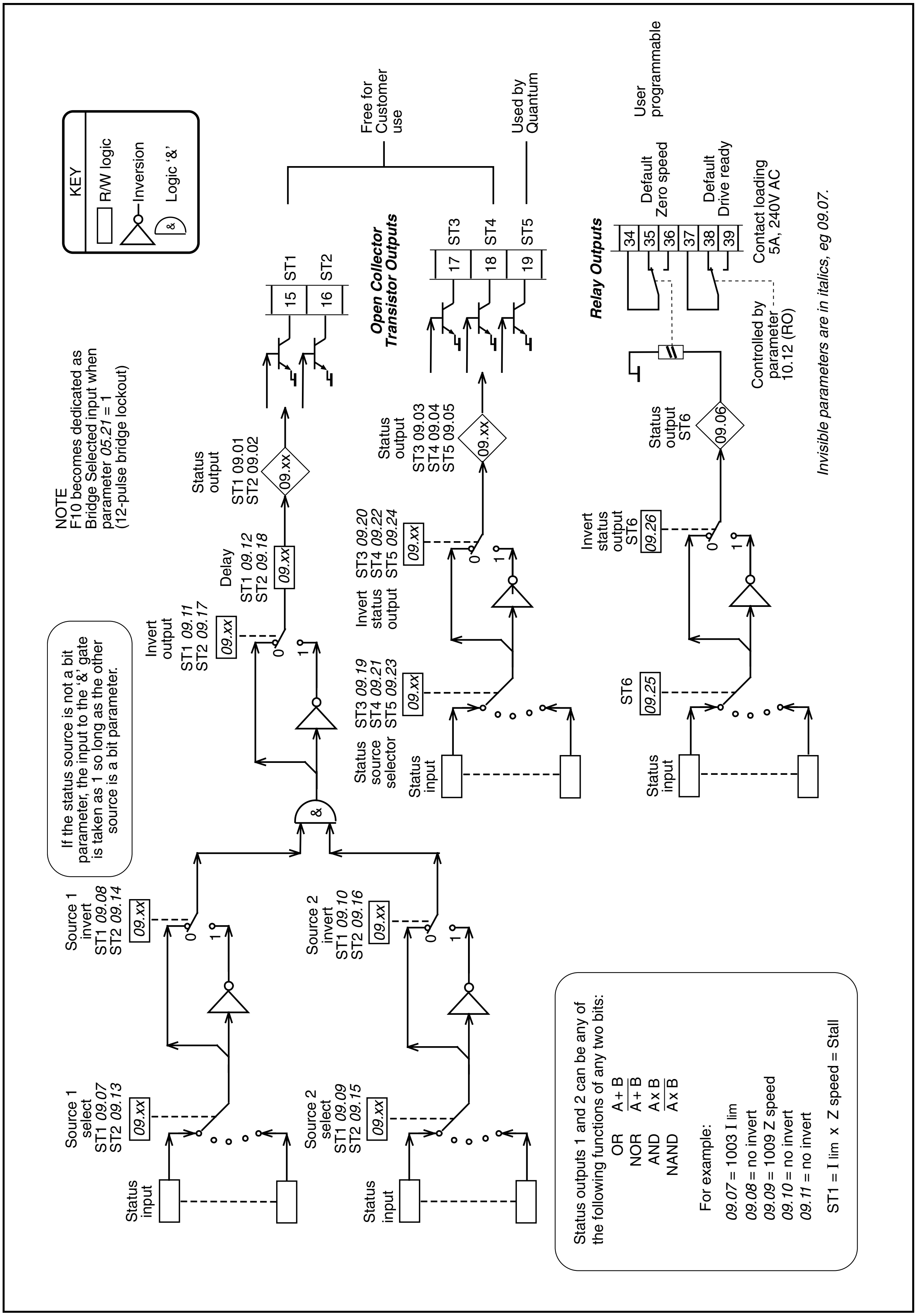


Figure E-11
Menu 09—Status Outputs

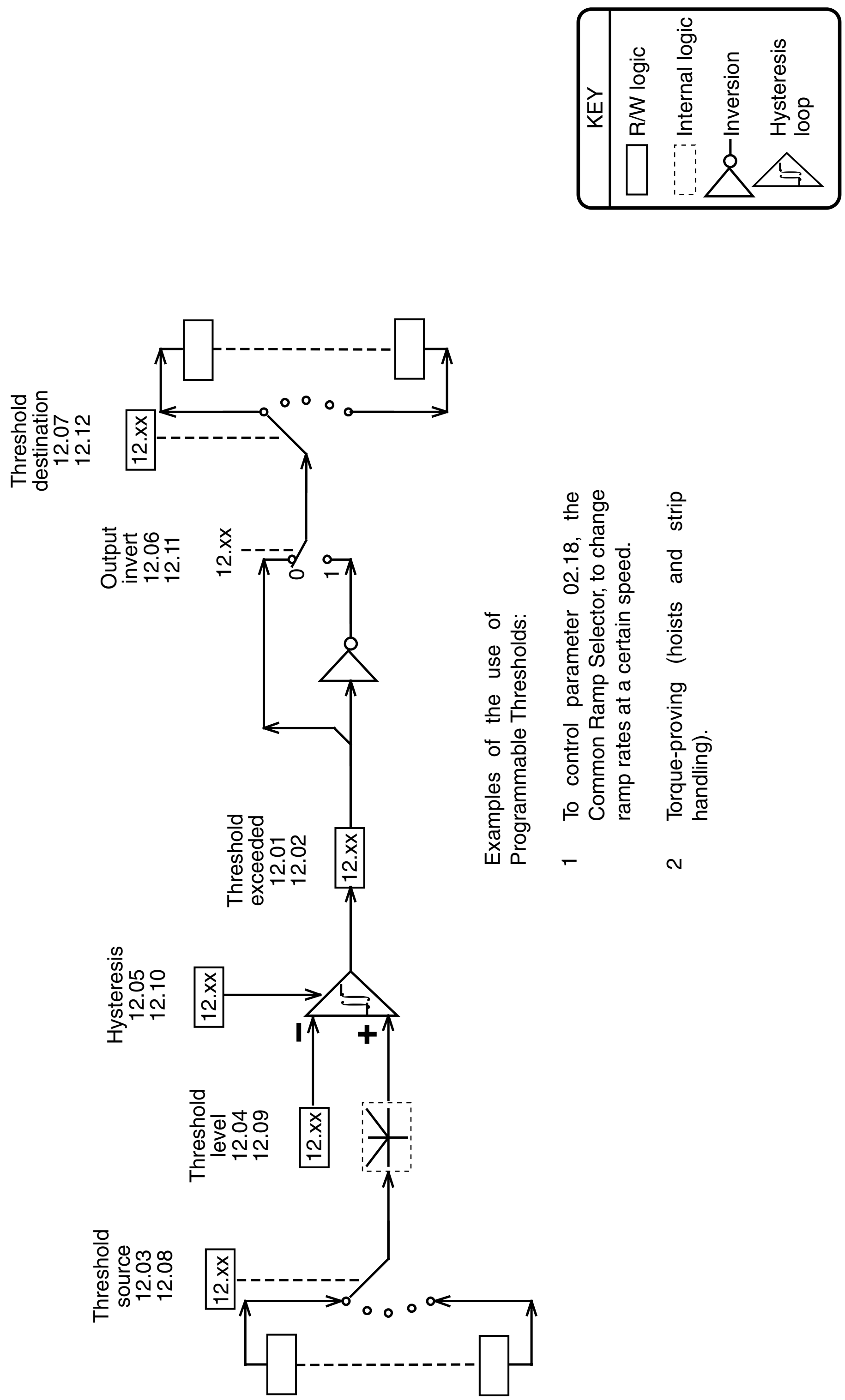


Figure E-12
Menu 12—Programmable Thresholds

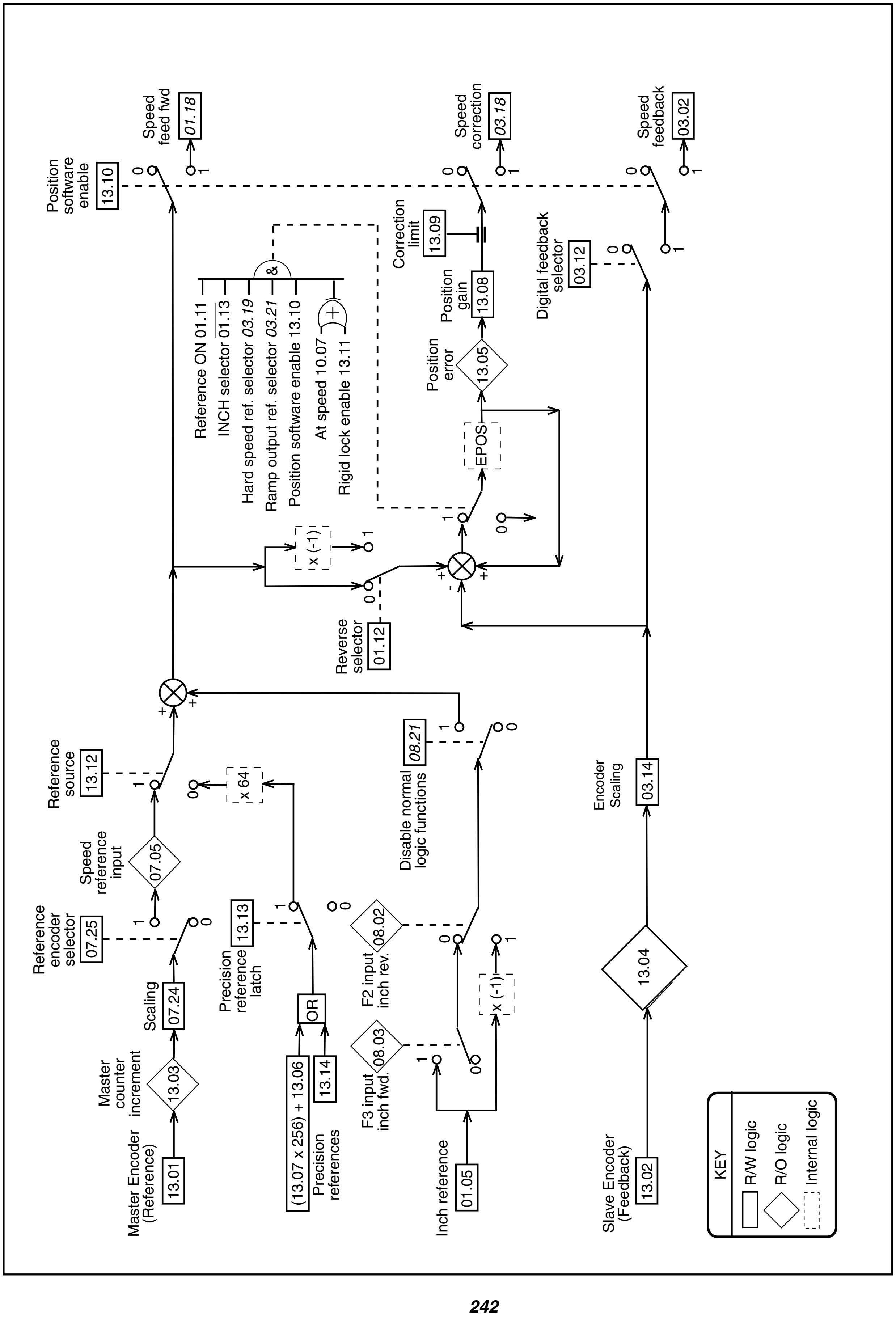


Figure E-13
Menu 13—Digital Lock

SECURITY BASICS

Read/Write Drive parameters that cannot be changed (indicated by that parameter not flashing when the MODE key is depressed), are being protected by a security code. The security code can be the "as shipped factory default code" or a User assigned code, referred to as a Level 3 Security Code.

The "as shipped" security codes for these drives are :

Level 1 xx.00 = 149 Partial Access
(xx means "any menu")

Level 2 xx.00 = 200 Full Access

The Level 3 Security Code parameter is #11.17. The "as shipped" value in this parameter is 149. After a security code is entered, it will remain in effect until power is removed from the drive. If you wish to re-establish this security, you can place a number other than 149 or 200 into xx.00 before walking away from the drive.

User Security Code Assignment

A User can assign their own 3 digit security code within the range of 0-255 by placing it into #11.17 (writing over the 149) and performing a STORE. Note that this does not eliminate or change the Level 1 security code number - 149.

NOTE: Avoid using 233 and 255 as user security codes, these codes are used to reset the drive to "regen" or "non-regen" defaults. If this code is entered in parameter X.00 and the reset button is pushed, the drive will reset to defaults.

From this point forth, access to parameters will require that code to be placed into xx.00. After this code is entered, you must still enter the Level 1 access code to obtain Level 1 parameter change access or the Level 2 access code to gain access beyond Level 1 parameters (full access).

Forgotten Security Codes

People often forget their security codes. You can always see the assigned security code parameter (#11.17) via the serial port with CTFile, DriveCom, Mentor II View or MentorSoft. However, from the Drive, you must go in through the "back door" .

"The Back Door"

To obtain the forgotten security code, you can DEPRESS and HOLD both the MODE key and the LEFT ARROW key and then APPLY POWER to the drive. The Level 3 security code number should immediately appear on the data display, which normally displays the contents of parameter #0.00 upon application of power.

If the power-on or "boot-up" parameter (see parameter #11.18) was changed from the default of #0.00, the Level 3 security code will not immediately appear. You must up or down arrow to any menu xx.00 to see the forgotten security code.

Security Bypass

During initial start-up of the drive, having to enter the security code after each power-up can become a nuisance and slow down the start-up process. To bypass or eliminate the need to enter a security code, one can accomplish this by placing a 0 into parameter #11.17 and performing a Store.

If this bypass is done to speed up the start-up process, you should remember to re-assign the 149 default to #11.17 (and Store) before leaving the job site. Otherwise, the drive will have no parameter access security.

Note: Defaulting the drive parameters (using 233 or 255) does not reset the Level 3 security code. A previously assigned code by the User will remain even after defaulting parameters.

[1] xx.00 refers to - any menu location zero i.e. 00.00 through 16.00

[2] Placing a 001 into xx.00 following by a RESET will perform a parameter store of all R/W parameters

For more Application Notes visit our website at:

www.ctdrives.com/downloads under Application Notes.

Notes

WARRANTY

Control Techniques Drives warrants to the buyer who purchased for use and not for resale that the equipment described in this manual is sold in accordance with CT's published warranty statement (document #GEN-030) and CT's published terms and conditions (document #GEN-031). Copies of these documents may be obtained from any Drive Center or Sales Office listed below, and are availabe as an Acrobat File downloadable from our web site, www.ctdrives.com/downloads.

CHARLOTTE
2617 Interstate Street
Charlotte, NC 28208
Ph: 704-393-3366
Fax: 704-393-0900

CHICAGO
470 Mission Street, Suite 4
Carol Stream, IL 60188
Ph: 630-752-9090
Fax: 630-752-9555

CLEVELAND
6892 West Snowville Road
Brecksville, OH 44141
Ph: 440-717-0123
Fax: 440-717-0133

PROVIDENCE
4 Blackstone Valley Road
Lincoln, RI 02865
Ph: 401-333-3331
Fax: 401-333-6330

TORONTO - CANADA
9999 Highway 48
Markham, ONT, L3P 3J3
PH; 905-475-4699
Fax: 905-475-4694

MINNEAPOLIS
12005 Technology Drive
Eden Prairie, MN
55344-3620
Ph: 952-995-8000
Fax: 952-995-8011

FOR 24-HOUR PRODUCT TECHNICAL ASSISTANCE: **1-800-893-2321**

FOR AUTHORIZED DISTRIBUTOR IN YOUR AREA: **1-800-893-2321**

FOR SPARES, REPAIRS AND PRODUCT TRAINING CONTACT:

CONTROL TECHNIQUES DRIVES, INC.
Americas' Service Center
359 Lang Boulevard, Building B
Grand Island, NY 14072

Phone: 800-367-8067
716-774-1193
Fax: 716-774-8327

After Hours,
Spare Parts: 1-800-893-2321
Spare Parts website: www.ctdrives.com/service

WEB SITE: **www.ctdrives.com**

CONTROL TECHNIQUES

Part No. QUANTUM-UG REV. A1
March 2002

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