VEC-200

Vector Drive
Hardware Reference,
Installation, and Troubleshooting

Electro-Craft ® *Servo Products*

Electro-Craft

VEC-200

Vector Drive
Hardware Reference,
Installation, and Troubleshooting

P/N 0013-1026-001 Revision A

Reliance Motion Control, Inc.

6950 Washington Avenue South
Eden Prarie, MN 55344
612-942-3600
Technical Support: 800-328-3983

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL AND OTHER APPLICABLE MANUALS IN THEIR ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

DC BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE DC BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE DC BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE DRIVE IS CAPABLE OF OPERATING AT AND MAINTAINING ZERO SPEED. THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES TO INDICATE THAT THE DRIVE IS OPERATING OR MAY OPERATE AT OR NEAR ZERO SPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE DRIVE CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Table of Contents

1.0 Becoming Familiar with the Manual 1-1

1.1 Finding Information 1-1
1.2 Assumptions About the Audience 1-2
1.3 Taking Safety Precautions 1-2
1.4 If You Want to Know More 1-2
1.5 Getting Assistance from Reliance Motion Control 1-2

2.0 About the Drive 2-1

2.1 Identifying the Drive by Model Number 2-1
2.2 1-10 HP VEC-200 Drive Components and Locations 2-2
2.3 Regulator Board Description 2-4
2.3.1 Jumper Locations and Settings 2-6
2.3.1.1 Analog Input Speed Reference Jumper 2-6
2.3.1.2 Analog Output Jumper 2-7
2.3.2 Wiring the Terminal Strip 2-8
2.3.3 RS-232 Communication Port 2-8
2.3.4 Ribbon Cable Assembly and Connectors 2-8
2.3.5 Keypad/Display 2-9
2.4 Drive Kit Options 2-10

3.0 Planning Before Installing 3-1

3.1 Requirements for the Installation Site 3-1
3.1.1 Making Sure Environmental Conditions are Met 3-1
3.1.2 Verifying the Site Provides for Recommended Air Flow Clearances 3-2
3.1.3 Determining Total Area Required Based on Drive Dimensions 3-3
3.1.4 Verifying Power Module A-C Input Ratings Match Available Power 3-4
3.2 Wiring Requirements for the Drive 3-4
3.2.1 Meeting Terminal Strip Input and Output Specifications 3-4
3.2.2 Determining Wire Size Requirements 3-4
3.2.2.1 Conduit Entry Opening Sizes 3-4
3.2.2.2 Recommended Power Wire Sizes 3-4
3.2.2.3 Recommended Control and Signal Wire Sizes 3-4
3.2.2.4 Recommended Motor Lead Lengths 3-5
3.2.3 Selecting A-C Input Line Branch Circuit Fuses 3-5
3.2.4 Meeting Speed Feedback Specifications (Vector Regulation Only) 3-6
3.2.5 Verifying Power Module Output Current Rating is Greater Than Motor Full Load Amps 3-6

4.0 Mounting the Drive, Grounding, and Finding Wire Routing Locations 4-1

4.1 Mounting the Drive 4-1
4.1.1 Verifying the Drive's Watts Loss Rating 4-1
4.2 Routing A-C Input, Motor Output, Ground, and Control Wiring for the Drive 4-1
4.3 Grounding the Drive 4-4

5.0 Installing A-C Input Power Wiring 5-1

5.1 Installing Transformers and Reactors (Optional) 5-1
5.2 Installing Fuses for Branch Circuit Protection 5-1
5.3 Installing a Required External/Separate Input Disconnect 5-3
5.4 Installing Power Wiring from the A-C Input Line to the Drive's Power Terminal Strip 5-3

6.0 Installing A-C Output Power Wiring 6-1

6.1 Installing Output Contactors (Optional) 6-1
6.2 Installing Mechanical Motor Overload Protection (Optional) 6-1
6.3 Installing Output Wiring from the Drive Output Terminals to the Motor 6-1
6.4 Installing a Snubber Resistor Braking Kit (Optional) 6-1

7.0 Wiring the Regulator Board Terminal Strip 7-1

7.1 Stopping the Drive 7-5
7.1.1 Compliance with EN 60204-1: 1992 7-5
7.2 Wiring a Motor Encoder to the Drive 7-6
7.2.1 Motor Encoder Cable Kit Contents 7-6
7.2.2 Installing the Motor Encoder Cable 7-7
7.3 Wiring the Signal and Control I/O 7-9
7.4 Wiring the Drive to an IQ-550 Positioning Module 7-16

8.0 Completing the Installation 8-1

8.1 Checking the Installation 8-1
8.2 Powering Up After Installation Is Complete 8-2

9.0 Troubleshooting the Drive 9-1

9.1 Test Equipment Needed to Troubleshoot 9-1
9.2 Drive Alarms and Faults 9-1
9.3 Verifying That D-C Bus Capacitors are Discharged 9-1
9.4 Checking Out the Power Modules with Input Power Off 9-2

Appendices

Appendix A
Technical Specifications A-1

Appendix B
Drive Regulation Overview B-1

Appendix C
Compliance with EN 60204-1: 1992 ..... C-1

Index Index-1

List of Figures

Figure 2.1 - Identifying the Drive Model Number 2-1
Figure 2.2 - 1-5 HP Drive Components and Locations 2-2
Figure 2.3 - 7.5-10 HP Drive Components and Locations 2-3
Figure 2.4 - Regulator Board Components and Locations 2-5
Figure 2.5 - Jumper J1 Settings for Analog Input Speed Reference 2-6
Figure 2.6 - Jumper J17 Settings for Analog Outputs 2-7
Figure 2.7 - Typical Terminal Strip Connections 2-8
Figure 2.8 - Keypad/Display 2-9

Figure 3.1 - Recommended Air Flow Clearances 3-2
Figure 3.2 - Drive Dimensions 3-3
Figure 3.3 - Motor Lead Lengths 3-5

Figure 4.1 - Wire Routing Locations for 1-5HP Drives 4-2
Figure 4.2 - Wire Routing Locations for 7.5-10HP Drives 4-3

Figure 5.1 - Typical A-C Input Electrical Connections 5-2

Figure 7.1 - Two-Wire Start/Stop Sample Control Wiring 7-3
Figure 7.2 - Three-Wire Start/Stop Sample Control Wiring 7-4
Figure 7.3 - Motor Encoder Cable Kit 7-6
Figure 7.4 - VEC-200 Drive Control Terminal Strip Connections 7-8
Figure 7.5 - Typical IQ-550 Positioning Module/VEC-200 System Control Connections 7-19

Figure 9.1 - D-C Bus Voltage Terminals (1-10 HP Drives) 9-2

Figure B.1 - Volts/Hertz Regulation Block Diagram B-2
Figure B.2 - Vector Regulation Block Diagram B-3

List of Tables

Table 2.1 - Power Ratings 2-1
Table 2.2 - Available Kits and Options 2-10

Table 3.1 - Environmental Conditions 3-1
Table 3.2 - Drive Dimensions and Weights 3-3
Table 3.3 - Recommended Power Wire Sizes for 1-10 HP Drives 3-4
Table 3.4 - Recommended Terminal Strip Wire Sizes 3-4
Table 3.5 - A-C Input Line Fuse Selection Values 3-5

Table 6.1 - Snubber Resistor Braking Kits 6-2
Table 6.2 - Snubber Transistor Braking Kit 6-2

Table 7.1 - Motor Encoder Cable Part Numbers 7-6
Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip 7-9
Table 7.3 - P5 Terminal Strip and Encoder Connections 7-17
Table 7.4 - P5 Terminal Strip and VEC-200 Connections 7-18

Table A.1 - Service Conditions A-1
Table A.2 - Operating Conditions A-1
Table A.3 - Terminal Strip Input Specifications A-2
Table A.4 - Terminal Strip Output Specifications A-2
Table A.5 - Encoder Specifications (Vector Regulation Only) A-2
Table A.6 - Input Signal Response Times (Worst Case) A-3

1.0 BECOMING FAMILIAR WITH THE MANUAL

This chapter provides help in finding information in the manual and describes the intended audience. Also included are references to other related publications and instructions on receiving assistance from Reliance Motion Control.

1.1 Finding Information

This instruction manual describes the VEC-200 drive's Power Module and regulator hardware. It does not cover the VEC-200 software. For additional software information, refer to the Electro-Craft VEC-200 Vector Drive Software Start-Up and Reference Manual (0013-1029-001).

As an aid in finding information in this manual, each chapter is briefly described here:

- Chapter 1 - *Becoming Familiar with the Manual* Provides information on how the manual is organized and where to find additional information.
- Chapter 2 - *About the Drive* Identifies drive components and shows their locations.
- Chapter 3 - *Planning Before Installing* Presents information that must be considered when planning a drive installation.
- Chapter 4 - *Mounting the Drive, Grounding, and Finding Wire Routing Locations* Describes how to mount the drive and properly ground it.
- Chapter 5 - *Installing A-C Input Power Wiring* Describes incoming A-C line components and how to properly connect them.
- Chapter 6 - *Installing A-C Output Power Wiring* Describes output A-C line components and how to properly connect them to the motor.
- Chapter 7 - *Wiring the Regulator Board Terminal Strip* Provides information on the I/O wiring that connects to the terminal strip on the Regulator board.
- Chapter 8 - *Completing the Installation* Provides instructions on how to perform a final check of the installation before power is applied.
- Chapter 9 - *Troubleshooting the Drive* Describes the equipment that is needed to troubleshoot the drive and how to measure D-C bus voltage. Replacement part lists are also provided.
- Appendix A - *Technical Specifications* Lists drive specifications in table form.
- Appendix B - *Drive Regulation Overview* Briefly describes volts/hertz and vector regulation.
- Appendix C - *Compliance with EN 60204-1: 1992* Lists the sections of standard EN 60204-1: 1992 that the VEC-200 drive complies with.

The thick black bar shown on the right-hand margin of this page will be used throughout this instruction manual to signify new or revised text or figures.

1.2 Assumptions About the Audience

This manual is intended for qualified electrical personnel. It is task-oriented and is organized according to a logical progression of steps to be followed to install and troubleshoot the drive.

1.3 Taking Safety Precautions

Dangers, warnings, and cautions are used in this manual to point out potential problem areas. All three types of precautions are enclosed in a box to call attention to them.

DANGER

A DANGER ALERTS A PERSON OF A CONDITION WHICH COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

A WARNING ALERTS A PERSON OF A CONDITION WHICH COULD RESULT IN POTENTIAL BODILY INJURY IF PROCEDURES ARE NOT FOLLOWED.

CAUTION: A caution alerts a person of a condition which could result in damage to, or destruction of the equipment.

1.4 If You Want to Know More

Refer to the following related publications as necessary for more information:

- 0013-1029-001 Electro-Craft VEC-200 Vector Drive Software Start-Up and Reference Manual
- 0013-1022-002 IQ-Series® Installation Manual for the IQ550 Position Control Module

1.5 Getting Assistance from Reliance Motion Control

If you have any questions or problems with the products described in this instruction manual, contact your local Reliance Motion Control representative. In the United States, Reliance Motion Control is staffed between 7:00 AM and 5:00 PM (CST), Monday through Friday at 1-800-328-3983 or via fax at 1-612-942-3636. A 24-hour Bulletin Board Service (BBS) is available 7 days a week at 1-612-942-3618.

In Europe, Electro-Craft Ltd. staff can be reached between 8:30 and 17:30 local time, Monday through Friday at (+44)1270 580142 or via fax at (+44)1270 580141.

2.0 ABOUT THE DRIVE

This chapter describes how to identify the drive using the model number matrix. Major components of each drive group are also shown.

The VEC-200 A-C drive is a PWM drive that provides vector and general purpose (volts/hertz) regulation for a wide range of applications.

In vector mode, the drive can provide high dynamic response, maintain full rated motor torque to zero speed, and precisely control motor speed in both directions using encoder feedback.

In general purpose (volts/hertz) mode, the drive is suited for a broad range of applications requiring adjustable speed control of motors.

2.1 Identifying the Drive by Model Number

Each VEC-200 A-C drive can be identified by its model number. See figure 2.1. This number appears on the shipping label and on the drive's nameplate. The drive's model number includes the Power Module and the regulator. Drive power ratings are provided in table 2.1.

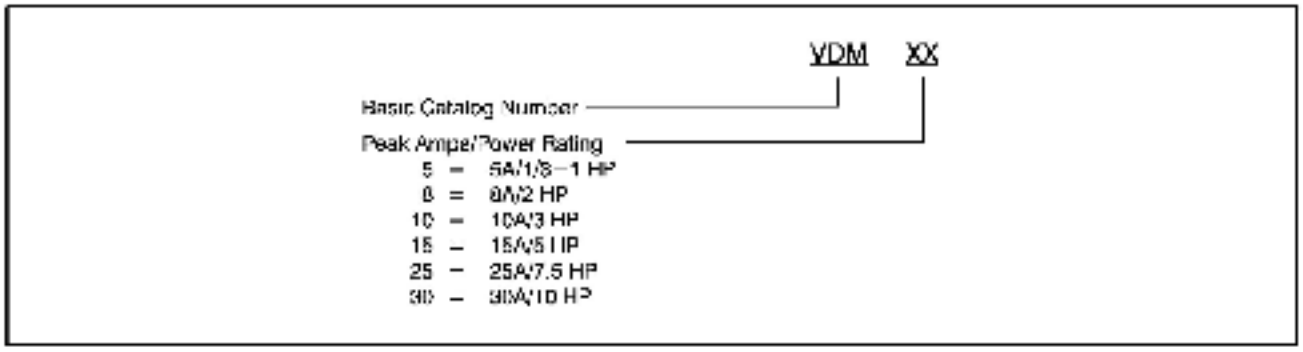


Figure 2.1 - Identifying the Drive Model Number

Table 2.1 - Power Ratings

Model Number	Input Volts (A-C)	Input KVA	Input Amps	Output Amps[1][2]	Power Loss Watts (Full Load)
VDM5	380-460 VAC +/−10%	2.0	2.5	2.1	60
VDM8	380-460 VAC +/−10%	3.3	4.2	3.4	100
VDM10	380-460 VAC +/−10%	5.1	6.4	5.3	140
VDM15	380-460 VAC +/−10%	7.9	9.9	8.2	180
VDM25	380-460 VAC +/−10%	10.7	13.4	11.1	210
VDM30	380-460 VAC +/−10%	13.4	16.8	14.2	250

Note: The above ratings are at 2 KHz.

(1) With Volts/Hz Regulation (110% continuous output current can be achieved)

(2) With Vector Regulation (150% overload for one minute)

2.2 1-10 HP VEC-200 Drive Components and Locations

The 1-10 HP VEC-200 drives have the following main components. The identification numbers provided correspond to the numbers used in figures 2.2 and 2.3.

1. Fan Assembly
2. Membrane Switch (Keypad/Bracket)
3. Regulator Printed Circuit Board (PCB)
4. Capacitor PCB
5. Current Feedback PCB
6. Internal Fan Assembly

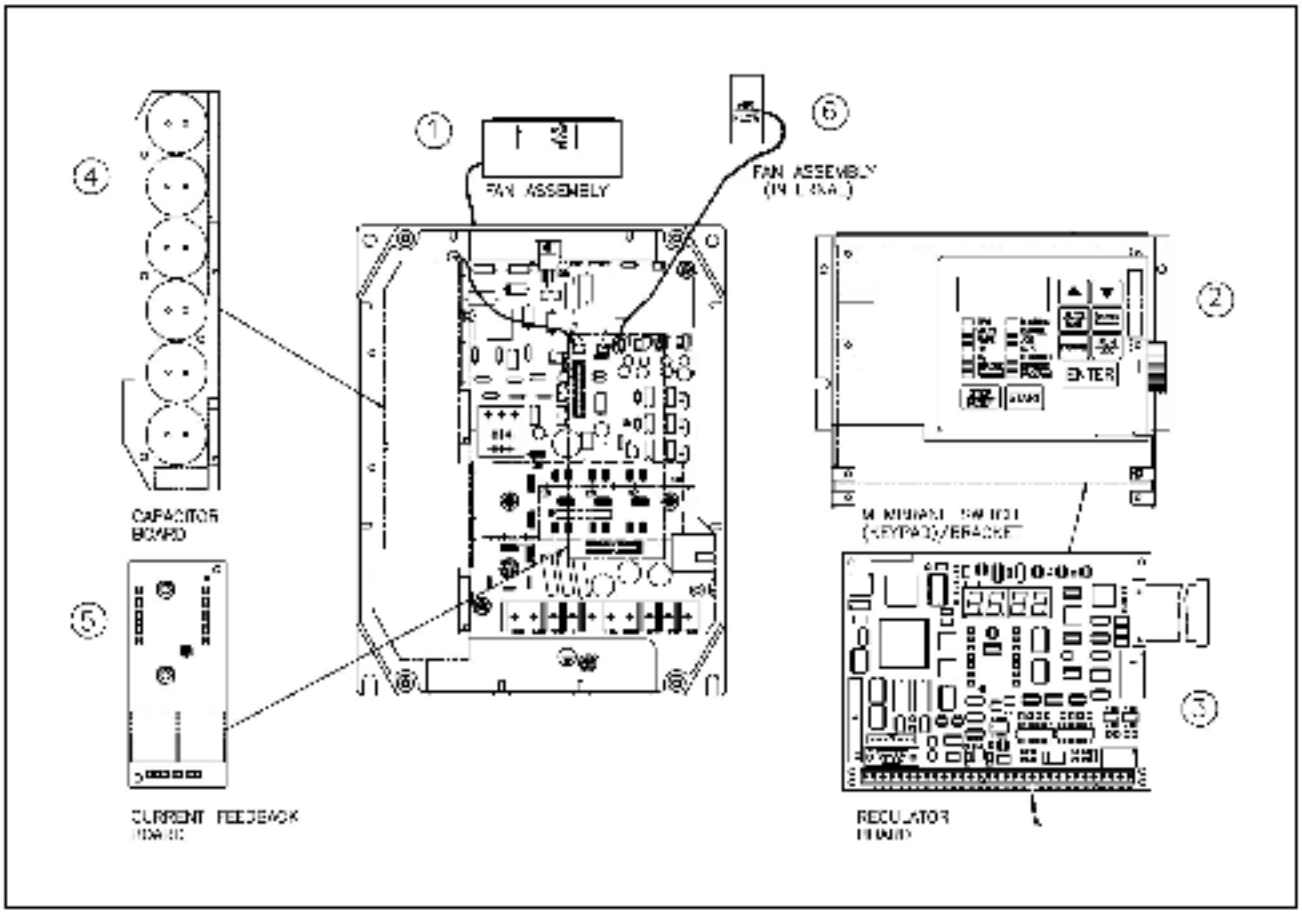


Figure 2.2 - 1-5 HP Drive Components and Locations

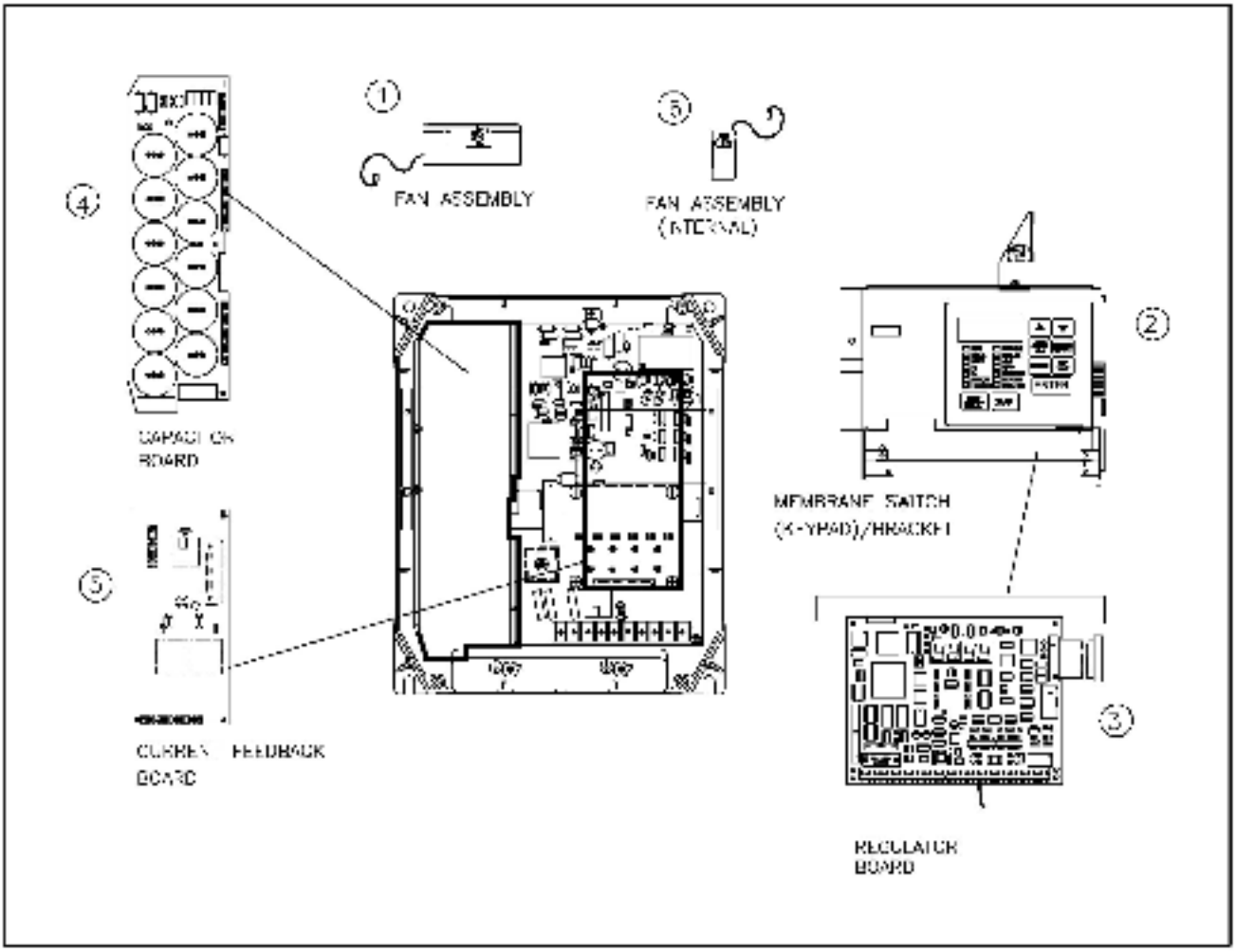


Figure 2.3 - 7.5-10 HP Drive Components and Locations

2.3 Regulator Board Description

VEC-200 drive regulation is performed by a microprocessor on the Regulator board. See figure 2.4. Drive operation is adjusted by the parameters entered through the keypad. The Regulator board accepts power circuit feedback signals, an external speed reference signal, internal heat sensor feedback, as well as data from an encoder that is attached to the motor when set up for vector regulation. The Regulator board provides:

- PWM gating signals to the IGBT power devices

Based on the output of the control loop, the regulator sends PWM gating signals through the Current Feedback board to isolated drivers. These drivers switch the Insulated Gate Bi-polar Transistors (IGBTs), producing a Pulse Width Modulated (PWM) waveform that corresponds to the speed (vector regulation) or frequency (volts/hertz regulation) reference. The IGBTs can be switched at either a 2, 4 or 8 kHz carrier frequency.

- Form A and B contacts for drive status indicators

The Form A and B contacts are under control of the user via programmable parameters. A Form A or B transition can indicate drive status. The contacts are rated for 5 Amps resistive load at 250 VAC/ 30 VDC and are made available through the terminal strip.

- Display data for a four-character display and fourteen indicator LEDs

The four-character display is used to indicate drive parameters, parameter values, and fault codes. The fourteen single LEDs indicate drive status and mode, as well as identifying drive outputs whose values are displayed on the four-character display.

- An analog output signal

The analog output is a scaled voltage (0-10 VDC) or current (4-20 mA) signal proportional to either motor speed (RPM) or motor torque or current (%TORQUE). The current selection (via jumper J17) requires a user-supplied external power supply for operation. The analog output signal is available through the terminal strip.

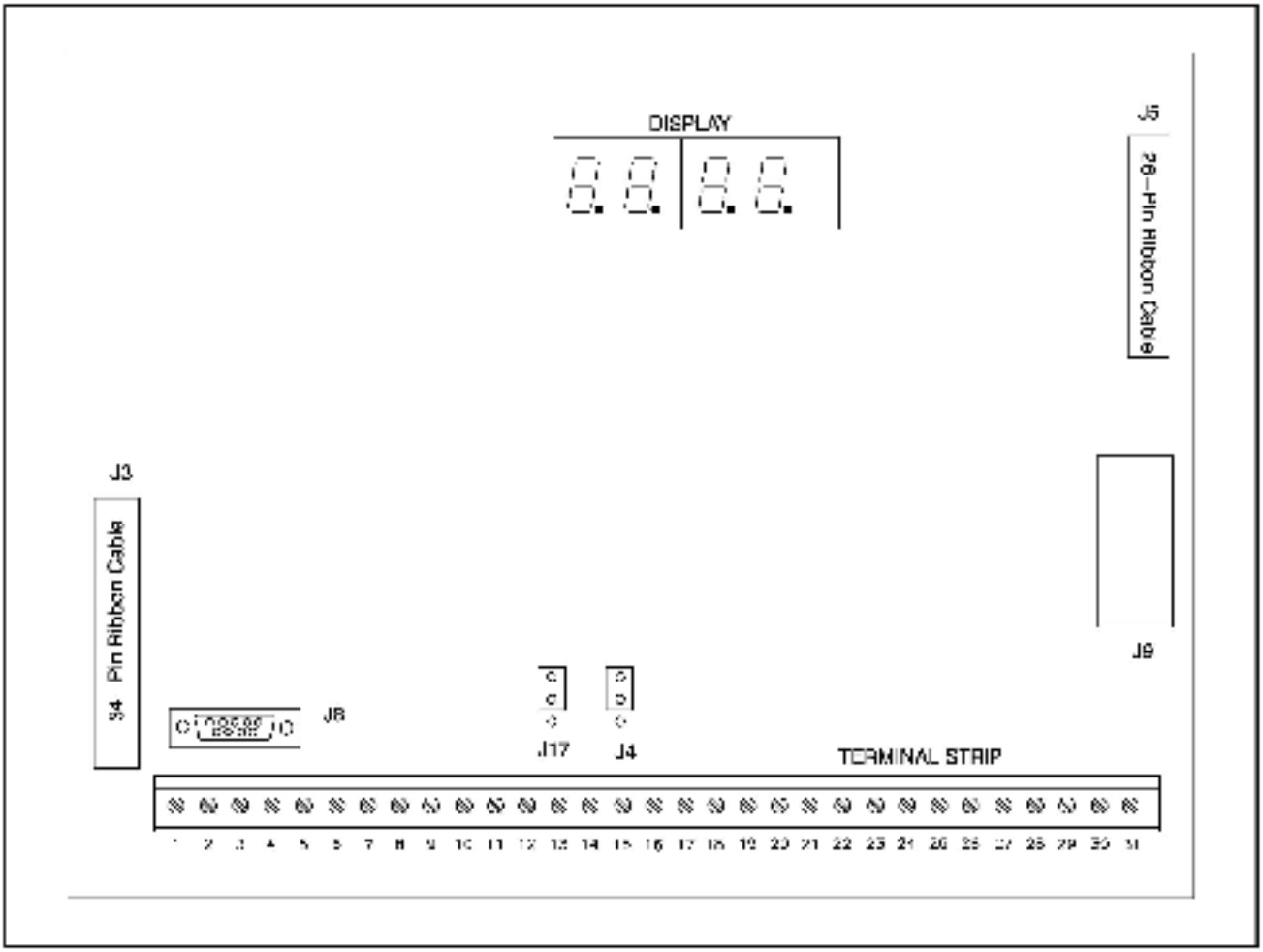


Figure 2.4 - Regulator Board Components and Locations

2.3.1 Jumper Locations and Settings

Jumpers J4 and J17 on the Regulator board are factory-set for voltage in and voltage out signals. Refer to figure 2.4 for their locations on the Regulator board. If you need to change the jumpers' settings, use the following procedures.

CAUTION: Do not alter the setting of any jumper not described in this instruction manual. Failure to observe this precaution could result in damage to or destruction of the equipment.

2.3.1.1 Analog Input Speed Reference Jumper

Jumper J4 is the analog speed/torque (U.000) reference jumper. This jumper selects either +/− 10 VDC or 0-20 mA speed input in conjunction with the following parameters: Terminal Block Analog Input Gain (P.010), Terminal Block Analog Input Offset (P.009), and Terminal Block Analog Input Invert (P.011). Note that if the position of jumper J4 is changed after the parameters are configured, the software will not recognize that the input reference or polarity has been changed. Verify that parameters P.009, P.010, and P.011 are correct before starting the drive. Refer to instruction manual 0013-1029-001 for more information.

Use the following procedure to set jumper J4:

DANGER

D-C BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE D-C BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 1. Turn off A-C input power to the drive and wait five minutes.

Step 2. Remove the cover from the drive by unscrewing the four attaching screws.

Step 3. Verify that the D-C bus voltage is zero by following the procedure in section 9.3.

Step 4. Locate jumper J4 on the Regulator board. Refer to figure 2.4.

Step 5. Locate pin 1 on jumper J4. Move the jumper to the desired setting as shown in figure 2.5.

Step 6. Re-attach the cover.

Step 7. Re-apply A-C input power.

Step 8. Verify that Terminal Block Analog Input Offset (P.009), Terminal Block Analog Input Gain (P.010), and Terminal Block Analog Input Invert (P.011) are correctly set. Refer to instruction manual 0013-1029-001 for more information.

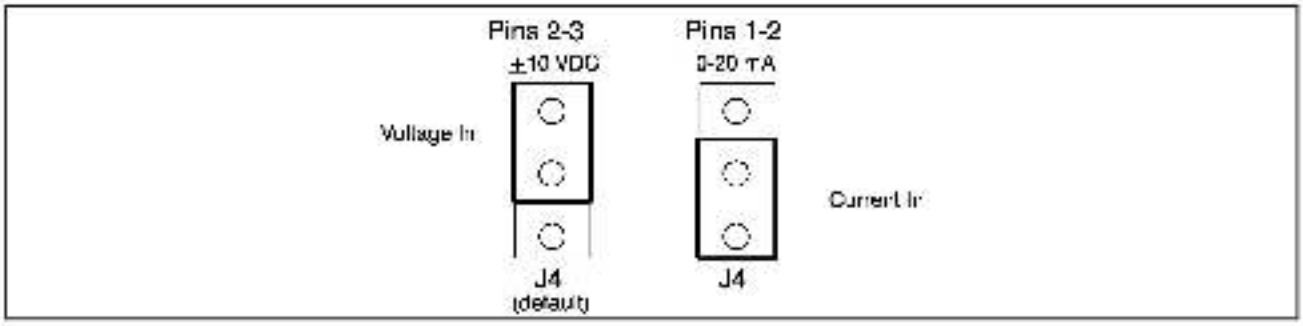


Figure 2.5 - Jumper J4 Settings for Analog Input Speed Reference

2.3.1.2 Analog Output Jumper

Jumper J17 is the analog output jumper. This jumper selects either a 0-10 VDC or 4-20 mA scaled signal output that is programmable for either speed or torque, parameter P.012. The jumper only selects a 0-10 VDC source voltage or 4-20 mA sink current to represent speed or torque.

Use the following procedure to set jumper J17:

DANGER

D-C BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE D-C BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 1. Turn off A-C input power to the drive and wait five minutes.

Step 2. Remove the cover from the drive by unscrewing the four attaching screws.

Step 3. Verify that the D-C bus voltage is zero by following the procedure in section 9.3.

Step 4. Locate jumper J17 on the Regulator board. Refer to figure 2.4.

Step 5. Locate pin 1 on jumper J17. Move the jumper to the desired setting as shown in figure 2.6.

Step 6. Re-attach the cover.

Step 7. Re-apply A-C input power.

Step 8. Verify that parameter P.012 is set correctly for either speed or current.

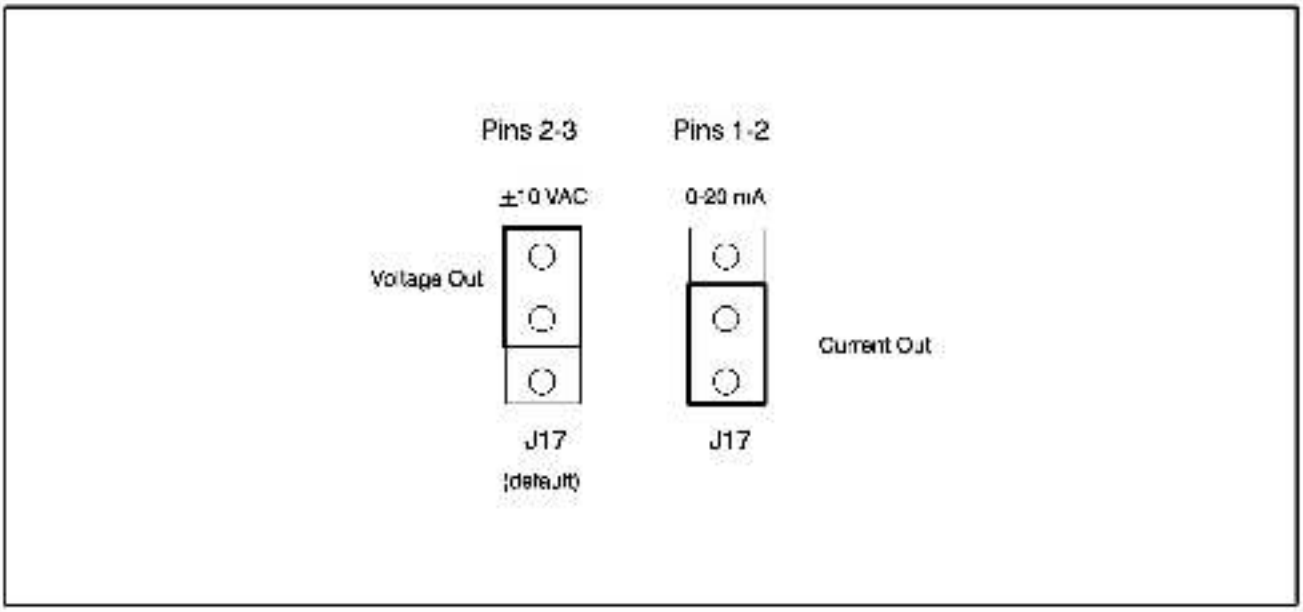


Figure 2.6 - Jumper J17 Settings for Analog Outputs

2.3.2 Wiring the Terminal Strip

The terminal strip on the Regulator board provides terminals for connecting customer I/O devices. See figures 2.4 and 2.7. The following terminals are provided:

- Terminals 1-3: RS-232 connections
- Terminals 4-9: encoder connections
- Terminals 10-11: analog output connections
- Terminals 12-15: analog speed/torque reference connections
- Terminals 16-25: 24V D-C digital input connections
- Terminals 26-27: optional dynamic braking control connections
- Terminals 28-31: status relay connections

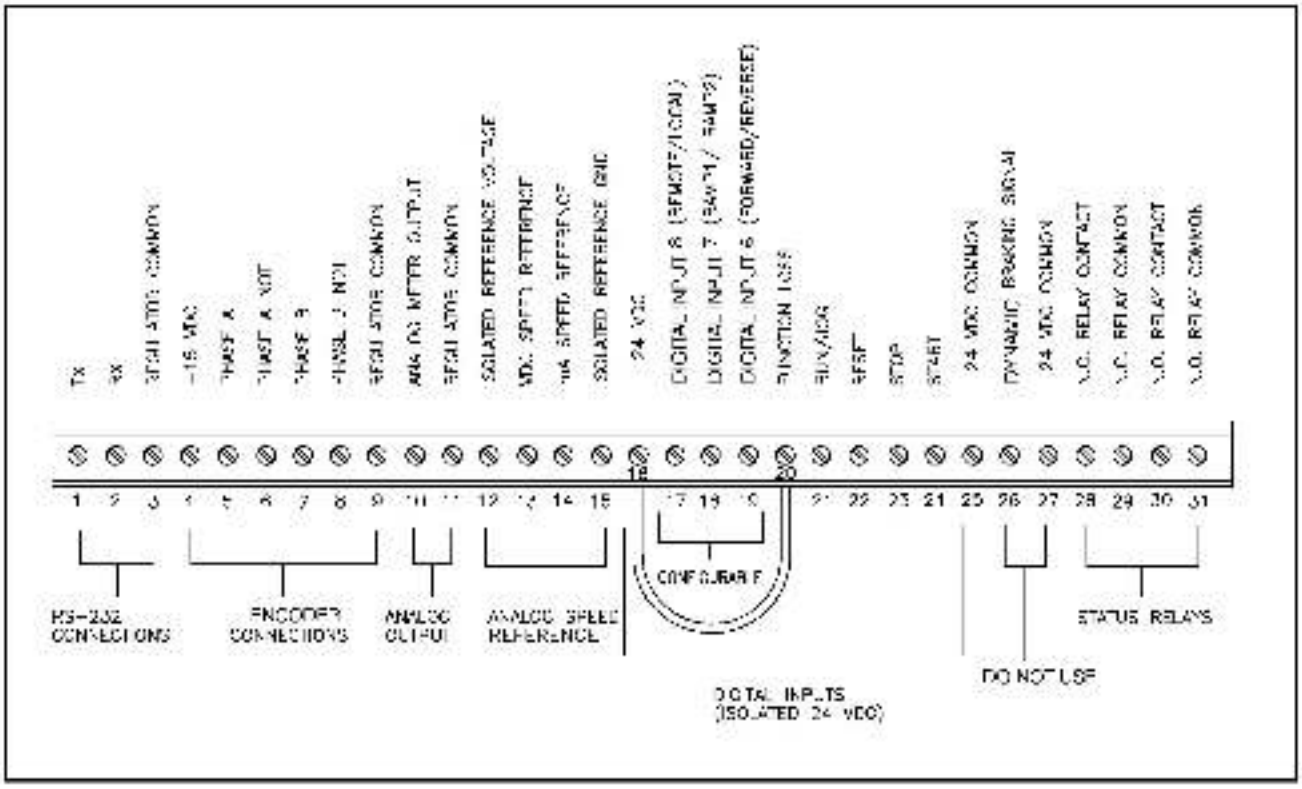


Figure 2.7 - Typical Terminal Strip Connections

2.3.3 RS-232 Communication Port

The Regulator board contains a 9-pin D-shell RS-232 communication port (J8). The RS-232 port is not currently used with the VEC-200 drive.

2.3.4 Ribbon Cable Assembly and Connectors

The flat-ribbon cable connector (J3) on the left side of the Regulator board provides a means of attaching optional communication boards to the VEC-200 drive. See figure 2.4. This connector is not currently used with the VEC-200 drive.

2.3.5 Keypad/Display

The front panel keypad/display is used to program and operate the VEC-200 drive. See figure 2.8.

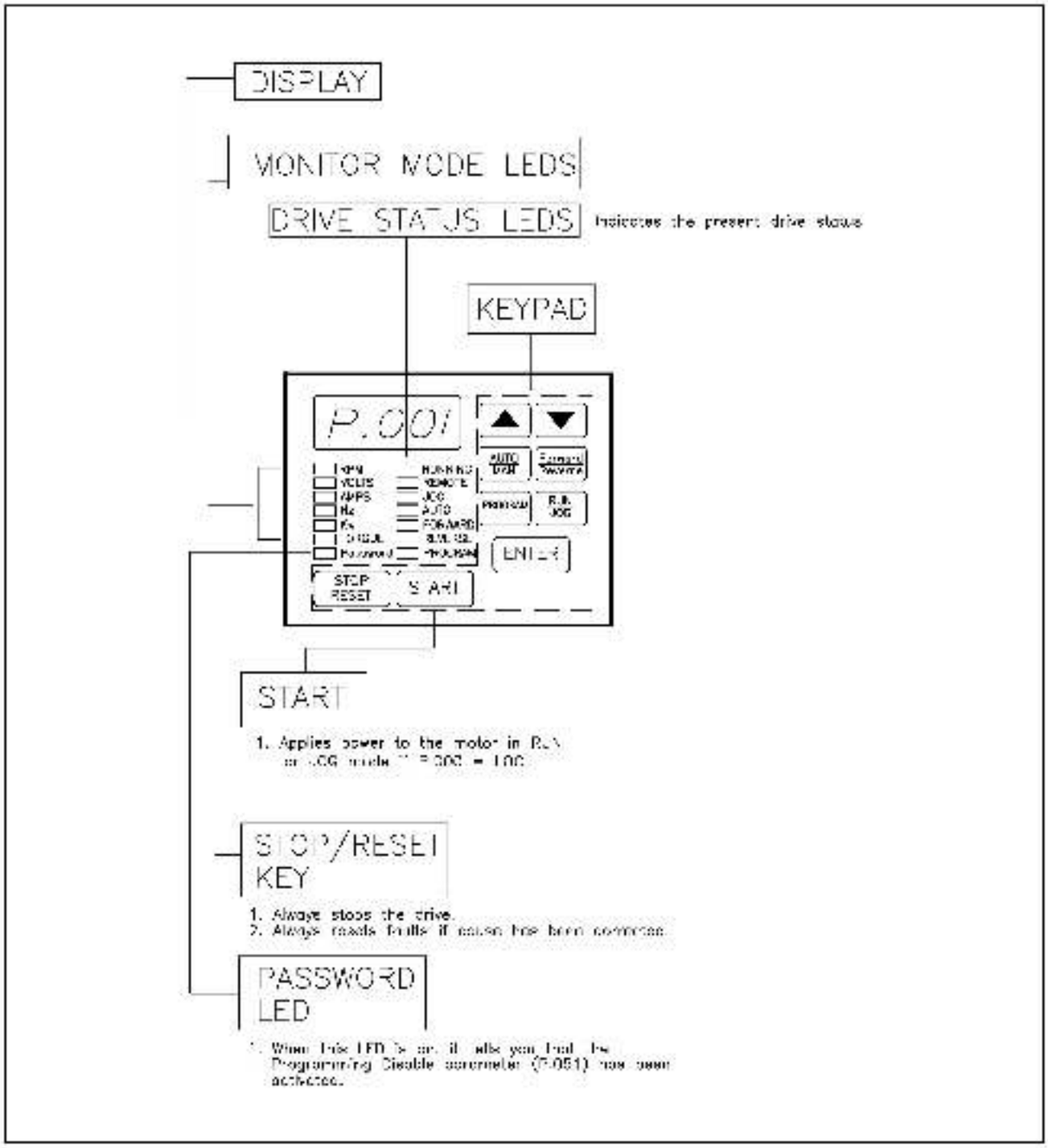


Figure 2.8 - Keypad/Display

2.4 Drive Kit Options

Table 2.2 provides a listing of the available VEC-200 kit options.

Table 2.2 - Available Kits and Options

Kit Description	Option Kit Model Number	Instruction Manual
Snubber Resistor Braking	2SR40400[1] 2SR40600[2] 2SR41200[3] 2SR41800[3]	Included with kit
Snubber Transistor Only	2ST40027	Included with kit
Motor Encoder Cable	9109-0020-XXX XXX = cable length 010 = 10 ft. 025 = 25 ft. 050 = 50 ft. 075 = 75 ft.	See Section 7.2

(1) 1-3 HP VEC-200 Drives
(2) 2-5 HP VEC-200 Drives
(3) 7-10 HP VEC-200 Drives

3.0 PLANNING BEFORE INSTALLING

This chapter provides information that must be considered when planning a VEC-200 installation. Installation site requirements, drive requirements, and wiring requirements are presented.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL AND OTHER APPLICABLE MANUALS IN THEIR ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

CAUTION: Use of power correction capacitors on the output of the drive can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the drive. Remove power correction capacitors before proceeding. Failure to observe this precaution could result in damage to or destruction of the equipment.

3.1 Requirements for the Installation Site

It is important to properly plan before installing a VEC-200 drive to ensure that the drive's environment and operating conditions are satisfactory. Read the following recommendations before continuing with drive installation.

3.1.1 Making Sure Environmental Conditions are Met

Before deciding on an installation site, consider the following guidelines:

- Verify that the drives can be kept clean, cool, and dry.
- The area chosen should allow the space required for proper air flow as defined in section 3.1.2.
- Be sure that the drives are away from oil, coolants, or other airborne contaminants.
- Do not install the drive above 1000 meters (3300 feet) without derating output power. For every 91.4 meters (300 feet) above 3300 feet, derate the output current 1%.
- Verify that the drive location will meet the environmental conditions specified in table 3.1.

Table 3.1 - Environmental Conditions

Condition	Specification
Operating Temperature (Ambient)	0° to +40° C (32° to 104°F)
Storage Temperature (Ambient)	−40° to −65°C (−40° to +149°F)
Humidity	5%-95% (non-condensing)

3.1.2 Verifying the Site Provides for Recommended Air Flow Clearances

Be sure there is adequate clearance for air ventilation around the drive. For best air movement, do not mount VEC-200 drives directly above each other. Refer to figure 3.1 for recommended air flow clearances.

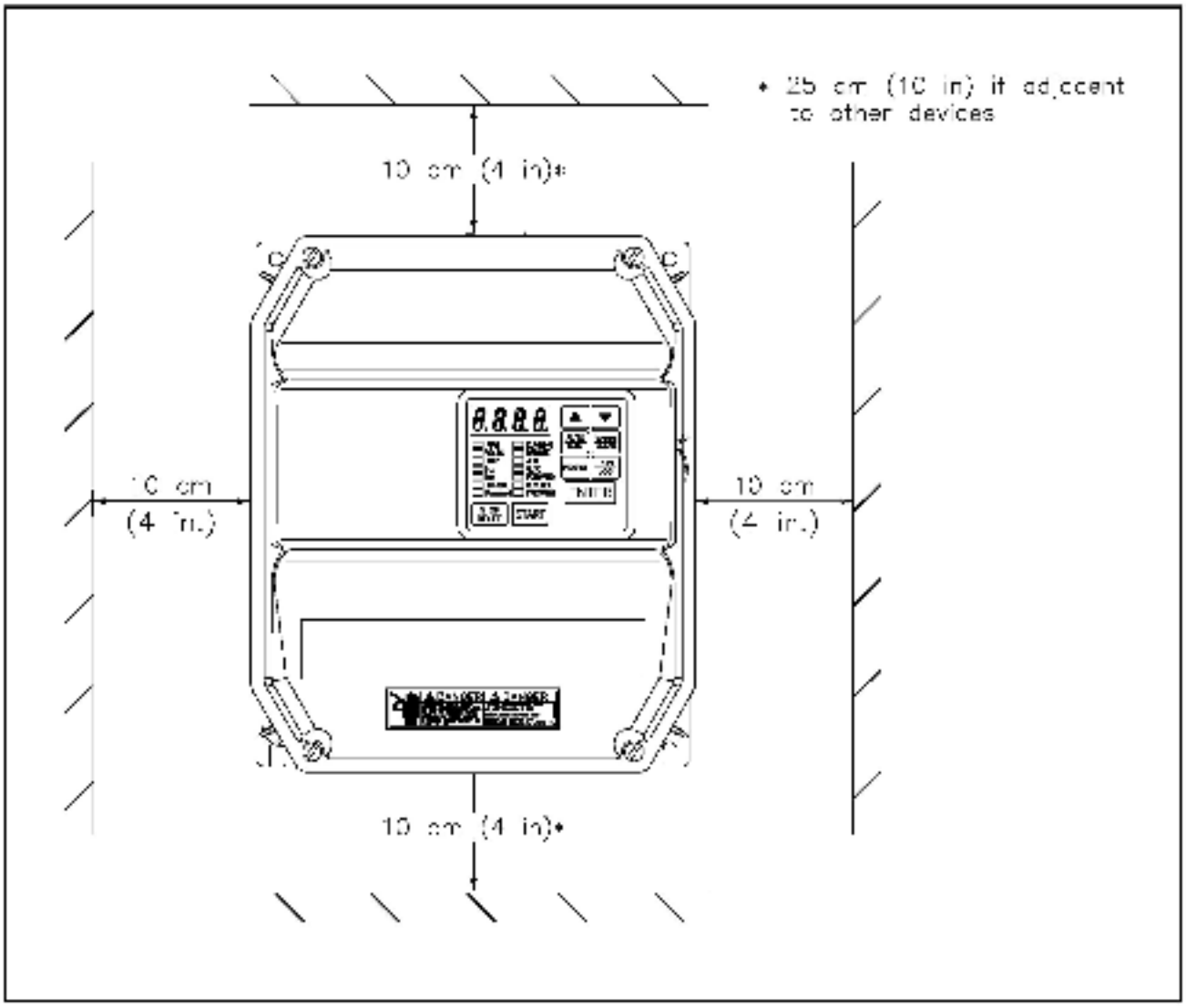


Figure 3.1 - Recommended Air Flow Clearances

3.1.3 Determining Total Area Required Based on Drive Dimensions

Overall drive dimensions are illustrated in figure 3.2 as an aid in calculating the total area required by the VEC-200 drives. Drive dimensions and weights are listed in table 3.2.

Table 3.2 - Drive Dimensions and Weights

VEC-200 Drive	Dim. A	Dim. B	Dim. C	Dim D.	Dim. E	Weight
VDM5 VDM8 VDM10 VDM15	222.3 mm 8.75"	280.7 mm 11.05"	198.1 mm 7.80"	254.3 mm 10.01"	200.0 mm 7.87"	6.3 kg 14 lbs
VDM25 VDM30	280.6 mm 11.05"	338.4 mm 13.32"	248.0 mm 9.76"	309.1 mm 12.17"	200.0 mm 7.87"	9 kg 20 lbs

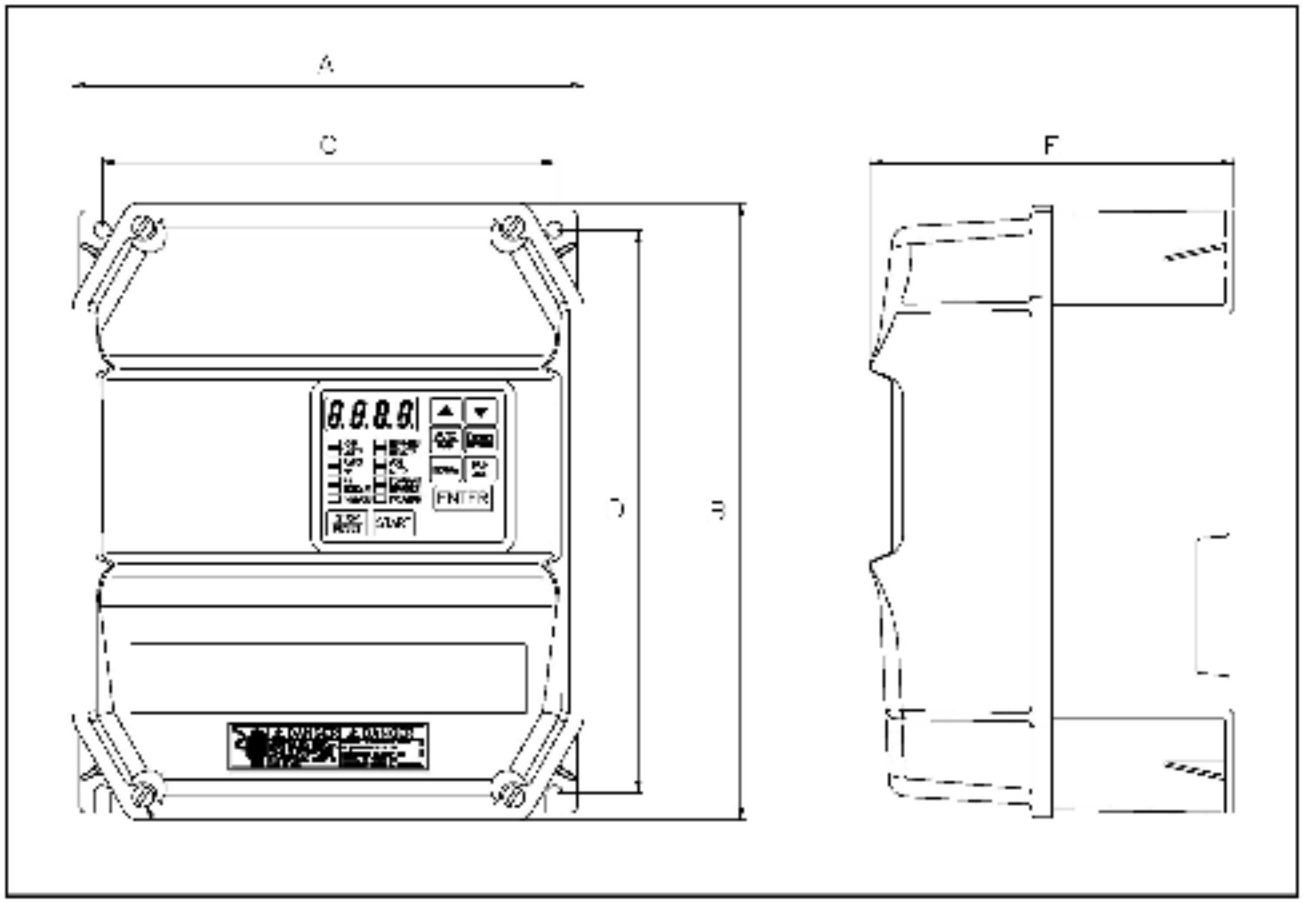


Figure 3.2 - Drive Dimensions

3.1.4 Verifying Power Module A-C Input Ratings Match Available Power

It is important to verify that plant power will meet the input power requirements of the VEC-200 drive's Power Module circuitry. Refer to table 2.1 for input power rating specifications. Be sure input power to the drive corresponds to the drive nameplate voltage and frequency.

3.2 Wiring Requirements for the Drive

Certain drive requirements should be checked before continuing with the drive installation. Wire sizes, branch circuit protection, speed feedback (for vector regulation), and E-stop wiring (see chapter 7), are all areas that need to be evaluated.

3.2.1 Meeting Terminal Strip Input and Output Specifications

The terminal strip on the Regulator board provides terminals for 24 VDC power for the eight remote control inputs. Refer to tables A.3 and A.4 for control input and output specifications.

3.2.2 Determining Wire Size Requirements

Wire size should be determined based on the size of conduit openings, NEC/CEC regulations, and applicable local codes.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

3.2.2.1 Conduit Entry Opening Sizes

It is important to accurately determine the size of the conduit openings so that the wire planned for a specific entry point will fit through the opening. Conduit opening sizes are shown in figures 4.1 and 4.2.

3.2.2.2 Recommended Power Wire Sizes

Input power wiring should be sized according to applicable codes to handle the drive's continuous-rated input current. Output wiring should be sized according to applicable codes to handle the drive's continuous-rated output current. See table 3.3 for recommended power wire sizes.

Table 3.3 - Recommended Power Wire Sizes for 1-10 HP Drives

Type of Wiring	Terminals	Size of Wire
A-C Input Power	R/L1, S/L2, T/L3	12 to 18 AWG, 3 to 0.9 (mm^2)
Output Power	U/T1, V/T2, W/T3	

3.2.2.3 Recommended Control and Signal Wire Sizes

The recommended wire sizes to connect I/O signals to the terminal strip on the Regulator board are shown in table 3.4.

Table 3.4 - Recommended Terminal Strip Wire Sizes

Terminals	Wire Size
1 to 31	14 to 20 AWG, 2 to 0.5 (mm^2)

3.2.2.4 Recommended Motor Lead Lengths

The following motor lead lengths are recommended to reduce line disturbances and noise. See figure 3.3.

- For applications using one motor, individual motor lead lengths should not exceed 76 meters (250 feet) per phase.
- For applications where multiple motors are connected, total motor lead length on each phase should not exceed 76 meters (250 feet). Also, each motor connection should not exceed 76 meters (250 feet). The VEC-200 drive can only update one motor when applied as a vector controller.

When total lead length exceeds 76 meters (250 feet), nuisance trips can occur. These trips are caused by capacitive current flow to ground. If the motor lead length must exceed these limits, output line reactors or other steps must be taken to correct the problem.

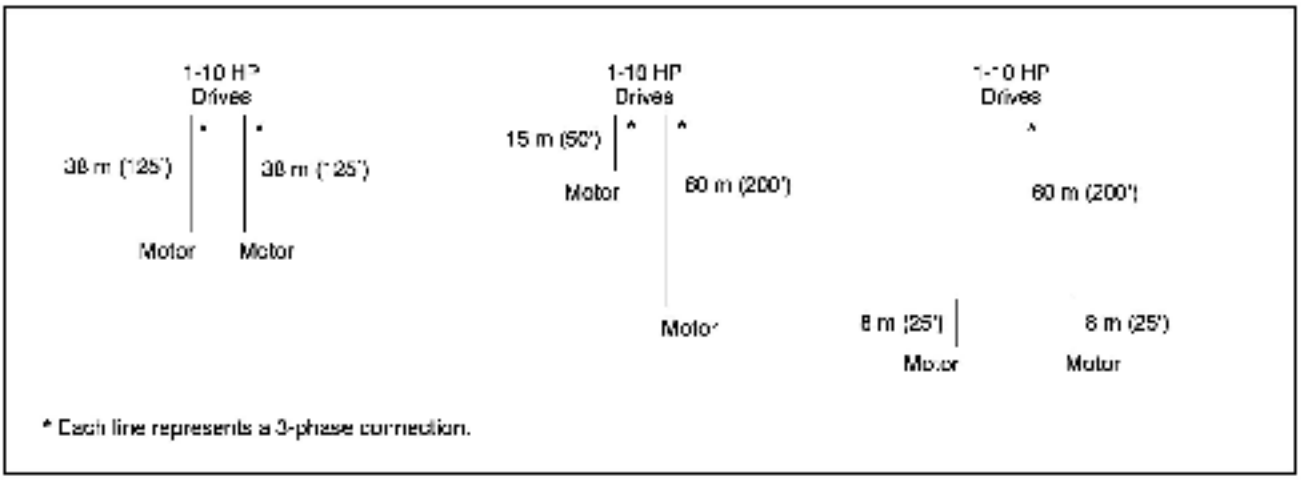


Figure 3.3 - Motor Lead Lengths

3.2.3 Selecting A-C Input Line Branch Circuit Fuses

CAUTION: The NEC/CEC requires that upstream branch circuit protection be provided to protect input power wiring. Install the fuses recommended in table 3.5. Do not exceed the fuse ratings. Failure to observe this precaution could result in damage to or destruction of the equipment.

A-C input line branch circuit protection fuses must be used to protect the input power lines. Recommended fuse values are shown in table 3.5. The input fuse ratings listed in table 3.5 are applicable for one drive per branch circuit. No other load may be applied to that fused circuit.

Table 3.5 - A-C Input Line Fuse Selection Values

Model Number	Horsepower Rating	380-460V A-C Input Line Fuse Rating(1)
VDM5	1	6A
VDM8	2	8A
VDM10	3	12A
VDM15	5	25A
VDM25	7.5	25A
VDM30	10	35A

(1) Recommended fuse type for 1–10 HP drives: UL Class J, 600V, time delay, or equivalent.

3.2.4 Meeting Speed Feedback Specifications (Vector Regulation Only)

VEC-200 drives set up for vector regulation require an encoder for closed loop operation. Encoder specifications are provided in table A.5. Drives set up for volts per hertz regulation do not require an encoder for feedback because they operate in the open loop mode.

3.2.5 Verifying Power Module Output Current Rating is Greater Than Motor Full Load Amps

Verify that the VEC-200 output current rating is greater than the motor's full load current (amps). Table 2.1 lists the output current values.

4.0 MOUNTING THE DRIVE, GROUNDING, AND FINDING WIRE ROUTING LOCATIONS

This chapter shows how to mount the drive and properly ground it. Also shown are the conduit entry areas where wiring is to be routed in and out of the drive.

4.1 Mounting the Drive

Attach the drive to the vertical surface selected using the four (4) mounting holes provided. Refer to figure 3.2 and table 3.2 for drive mounting dimensions. Use the following user-supplied mounting screws:

- 1-5HP drives: 1/4-20
- 7.5-10HP drives: 5/16-18

4.1.1 Verifying the Drive's Watts Loss Rating

When mounting the drive inside of another enclosure, you should examine the watts loss rating of the drive as shown in table 2.1. This table lists the typical full load power loss watts value under all operating carrier frequencies. Ensure adequate ventilation is provided based on the drive's watts loss rating.

4.2 Routing A-C Input, Motor Output, Ground, and Control Wiring for the Drive

All wiring should be installed in conformance with the NEC/CEC and applicable local codes. Signal wiring, control wiring, and power wiring must be routed in separate conduits to prevent interference with drive operation. Figures 4.1 and 4.2 show the wire routing, grounding terminal, and power terminal strips of the VEC-200 drives.

CAUTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to or destruction of the equipment.

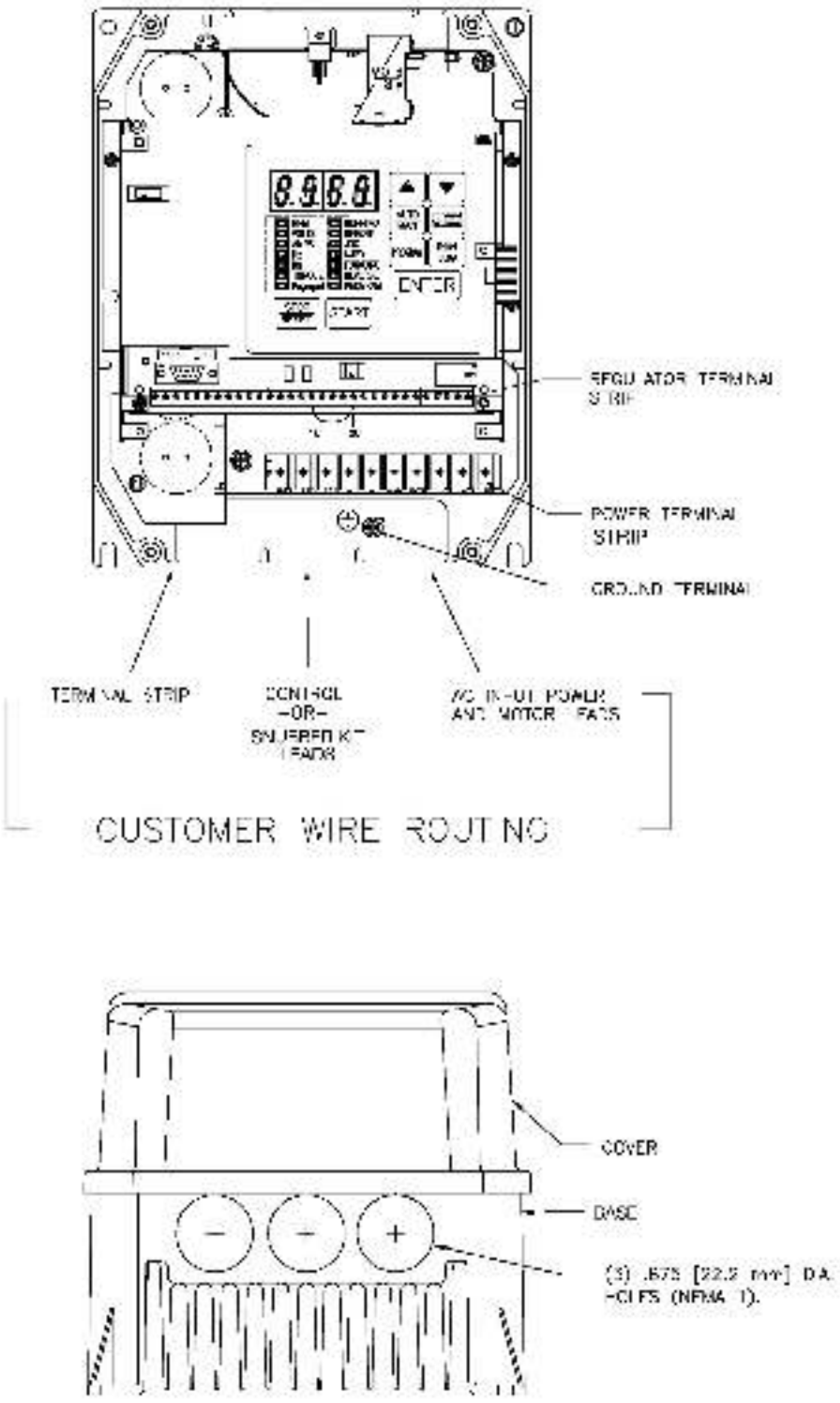


Figure 4.1 - Wire Routing Locations for 1-5HP Drives

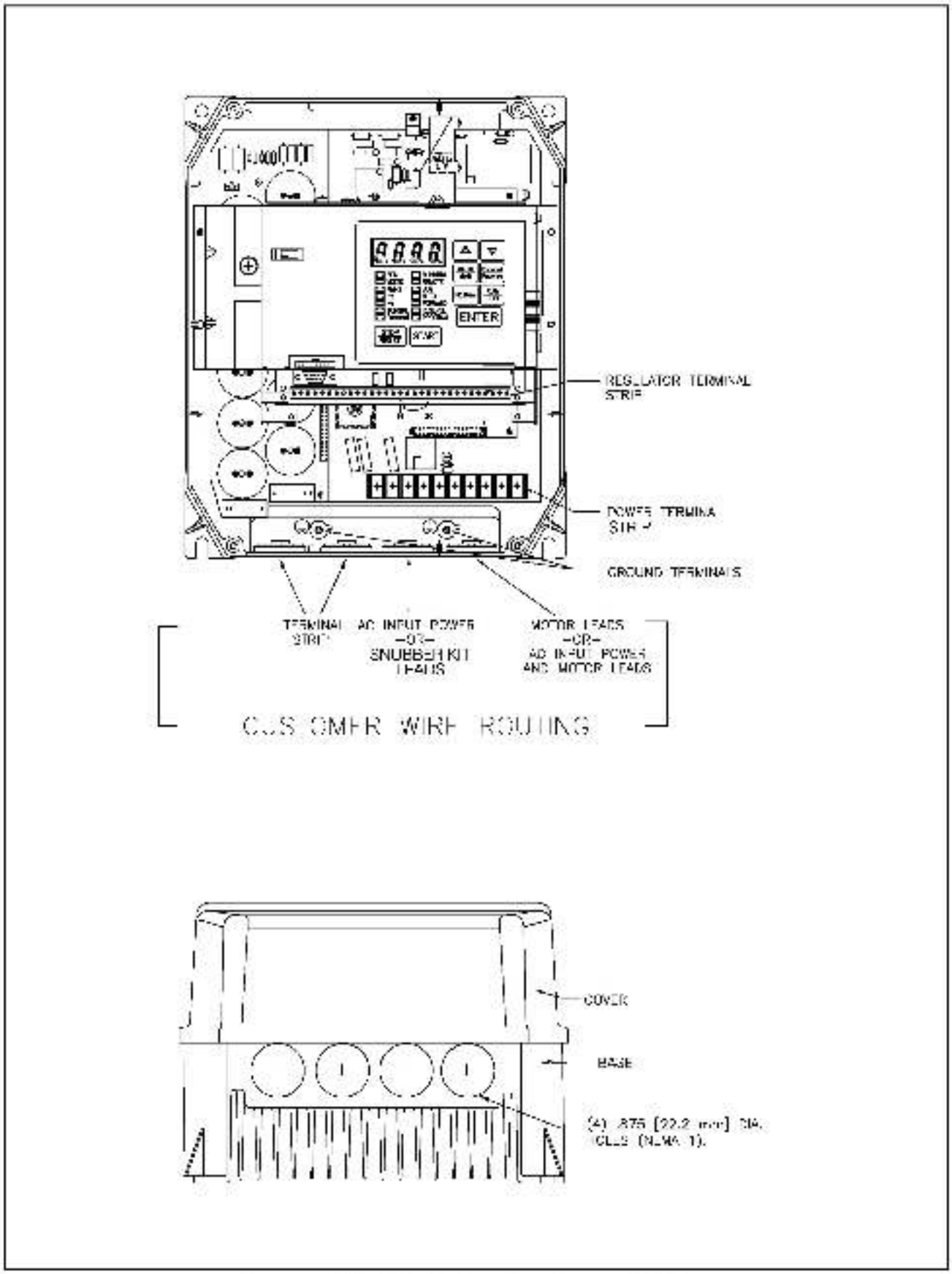


Figure 4.2 - Wire Routing Locations for 7.5-10HP Drives

4.3 Grounding the Drive

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Use the following steps to ground the drive:

Step 1. Remove the drive's cover.

Step 2. Run a suitable equipment grounding conductor unbroken from the drive ground terminal to the earth ground conductor. See figures 4.1 and 4.2.

Step 3. Connect a suitable grounding conductor to the motor frame, the remote control station (if used), and the transformer. Run each conductor **unbroken** to earth ground.

Note that to conform with CSA requirements, when adding more than one grounding conductor wire to a single chassis ground, twist the conductors together.

Step 4. Re-attach the drive's cover.

5.0 INSTALLING A-C INPUT POWER WIRING

This chapter describes incoming A-C line components and how to install them.

5.1 Installing Transformers and Reactors (Optional)

Input isolation transformers might be needed to help eliminate the following:

- Damaging A-C line voltage transients from reaching the drive.
- Line noise from the drive back to the incoming power source.
- Damaging currents that could develop if a point inside the drive becomes grounded.

Observe the following guidelines when installing an isolation transformer:

- A power disconnecting device must be installed between the power line and the primary of the transformer.
- If the power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the in-rush current (10 to 12 times full load current) of the transformer.
- An input isolation transformer rated more than 1000 KVA for 460 VAC with less than 5% impedance should NOT be used directly ahead of the drive without additional impedance between the drive and the transformer.

CAUTION: Distribution system capacity above the maximum recommended system KVA (1000 KVA for 460 VAC) requires the use of an isolation transformer, a line reactor, or other means of adding similar impedance to the drive power input. Failure to observe these precautions could result in damage to or destruction of the equipment.

CAUTION: When the A-C line is shared directly with other SCR-rectified drives, a line reactor or optional snubber resistor braking kit might be required to alleviate excess D-C bus voltage. Failure to observe these precautions could result in damage to or destruction of the equipment.

In applications requiring the use of an output reactor, contact your Reliance Motion Control sales representative for assistance.

5.2 Installing Fuses for Branch Circuit Protection

Install the required, user-supplied branch circuit protection fuses according to NEC/CEC guidelines. The fuses must be installed in the A-C line before the drive input terminals. See figure 5.1. Fuse value selections are provided in table 3.5.

WARNING

THE NEC/CEC REQUIRES THAT UPSTREAM BRANCH PROTECTION BE PROVIDED TO PROTECT INPUT POWER WIRING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

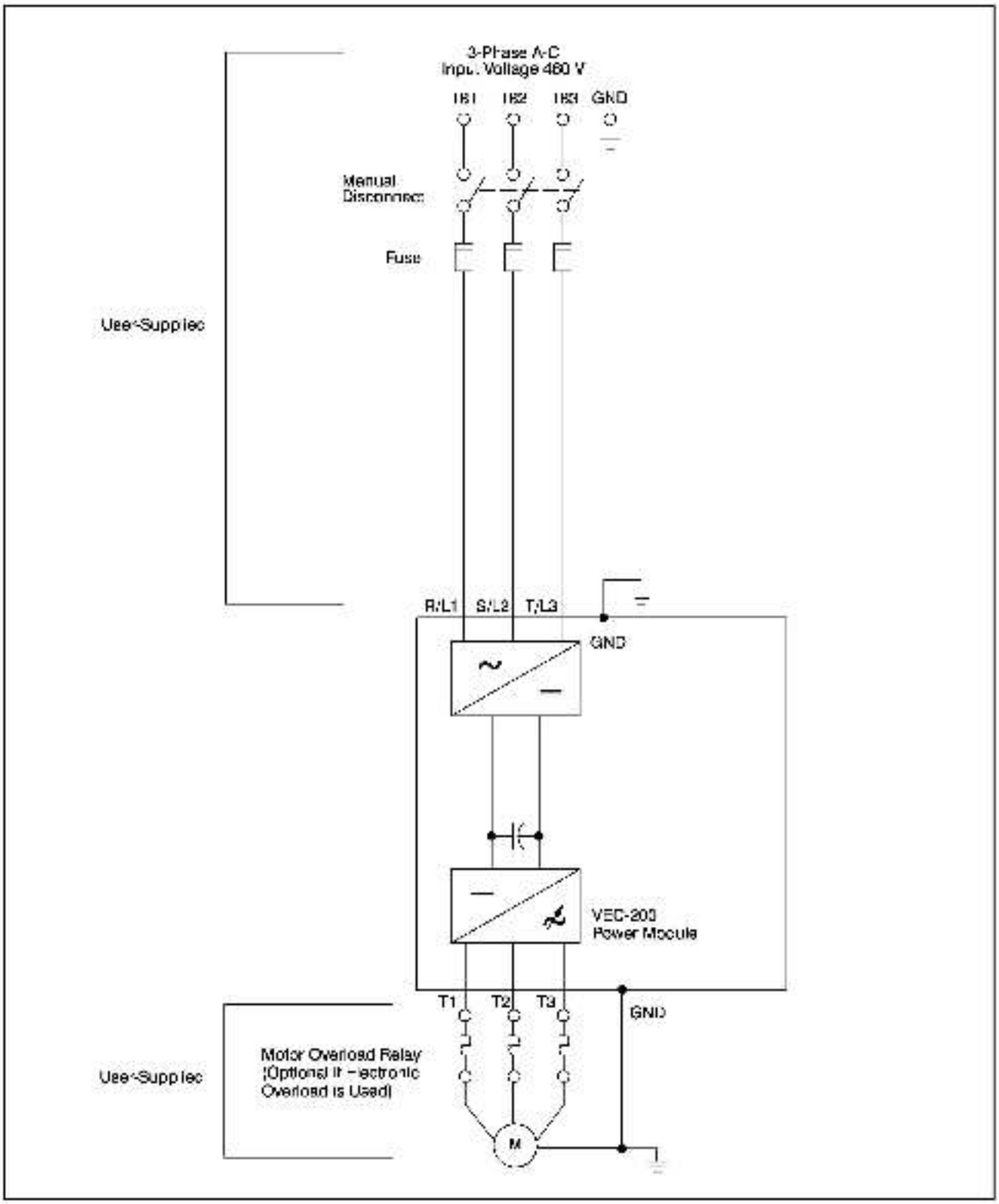


Figure 5.1 - Typical A-C Input Electrical Connections

5.3 Installing a Required External/Separate Input Disconnect

An A-C input disconnect must be installed in the A-C line before the drive input terminals in accordance with NEC/CEC guidelines. The disconnect should be sized according to the in-rush current as well as any additional loads the disconnect might supply. Note that the trip rating for the inrush current (10-12 times full load current) should be coordinated with that of the input isolation transformer, if used. Refer to section 5.1 for additional information.

5.4 Installing Power Wiring from the A-C Input Line to the Drive's Power Terminal Strip

Use the following steps to connect A-C input power to the drive:

Step 1. Wire the A-C input power leads by routing them according to drive type. Refer to figures 4.1 and 4.2. Table 3.3 contains the recommended power wiring sizes.

On 1-5HP drives, route the power leads through the bottom right opening of the drive base.

On 7.5-10HP drives, route the power leads through the bottom middle-right opening of the drive base. If the snubber resistor braking option is used, route the power leads through the bottom right opening.

CAUTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to or destruction of the equipment.

Step 2. Connect the three-phase A-C input power leads (three-wire 380-460 VAC) to terminals R/L1, S/L2, T/L3 on the power terminal strip.

Step 3. Tighten the input power terminals to 1.35 Nm (12 lb-in).

6.0 INSTALLING A-C OUTPUT POWER WIRING

This chapter provides instructions on wiring output contactors, motor overload protection, and output wiring to the motor.

6.1 Installing Output Contactors (Optional)

Output contactors provide a positive means of disconnecting the motor from the drive. If the application requires the use of output contactors, contact your Reliance Motion Control representative for assistance.

6.2 Installing Mechanical Motor Overload Protection (Optional)

To provide the motor with overload protection, the NEC requires that a motor thermostat, internal to the motor, be installed or an electronic thermal motor overload relay, sized to protect the motor, be installed between the motor and the drive's output terminals.

The Motor Overload Enable parameter (P.040) can be used in place of the electronic thermal motor overload relays in single motor applications. Note, however, that temperature measuring devices integral to the motor are the best way to thermally protect A-C motors under all conditions. Parameter P.040 must be enabled to provide overload protection. Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001) for more information.

In multiple motor applications (V/Hz regulation), each motor is to have its own user-supplied overload protection.

6.3 Installing Output Wiring from the Drive Output Terminals to the Motor

Use the following steps to connect the A-C output power wiring from the drive to the motor:

Step 1. Wire the three-phase A-C output power motor leads by routing them according to drive type. Refer to figures 4.1 and 4.2. Table 3.3 contains the recommended power wiring sizes.

On 1-10HP drives, route the motor leads through the bottom right opening of the drive base.

CAUTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to or destruction of the equipment.

Step 2. Connect the three-phase A-C output power motor leads to terminals U/T1, V/T2, W/T3 on the power terminal strip.

Step 3. Tighten the three-phase A-C output terminals to 1.35 newton-meters (12 lb-in) maximum.

6.4 Installing a Snubber Resistor Braking Kit (Optional)

Snubber resistors can be used to dissipate regenerative power which is produced either during rapid deceleration or from overhauling loads. When a snubber resistor kit is installed, if the DC bus voltage rises above normal levels, the VEC-200 drive automatically switches the snubber resistors on to absorb the excess energy.

A snubber resistor braking kit can be ordered either with snubber resistors at various wattage ratings or, in cases where the resistors are user-supplied, as a transistor switching unit only. Step-by-step installation instructions are provided with the kits. Table 6.1 lists the available model numbers for snubber resistor braking kits, along with their wattage and resistance ratings. Table 6.2 lists the specifications for the available snubber transistor braking kit.

Table 6.1 - Snubber Resistor Braking Kits

Model Number	Continuous Watt Dissipation	Instantaneous Watt Dissipation	Resistance (ohms)
2SR40400	400	4000	120
2SR40600	600	6000	75
2SR41200	1200	12000	40
2SR41800	1800	18000	25

Table 6.2 - Snubber Transistor Braking Kit

Model Number	Minimum Resistance (ohms)	Amps Rating (RMS)
2ST40027	25	27

7.0 WIRING THE REGULATOR BOARD TERMINAL STRIP

This chapter describes how to wire the Regulator board terminal strip for stop, speed feedback, and remote control signals.

The terminal strip has the following signals available, as shown in figures 7.1 and 7.2. Table 7.1 provides additional information. Note that when the Control Source Select parameter (P.000) is set to remote (rE), the drive will be controlled by the signals connected to the terminal strip. Refer to instruction manual 0013-1029-001 for more information on how parameter P.000 is used to specify where the drive is controlled from.

RS-232 Connections (Terminals 1-3)

- Terminal 1: Transmit (Tx)
- Terminal 2: Receive (Rx)
- Terminal 3: Regulator Common

The RS-232 terminals are not currently used with the VEC-200 drive.

Encoder Connections (Terminals 4-9)

- Terminal 4: +15 VDC
- Terminal 5: Phase A
- Terminal 6: Phase A Not
- Terminal 7: Phase B
- Terminal 8: Phase B Not
- Terminal 9: Regulator Common

A speed feedback device (encoder) must be installed if vector regulation (P.048=1) is used.

Analog Output Connections (Terminals 10 and 11)

- Terminal 10: Analog Meter Output
- Terminal 11: Regulator Common

The output of this terminal is either 0-10 VDC or 4-20 mA as determined by the setting of jumper J17 on the Regulator board. The analog output must also be programmed via parameter P.012 for an indication of speed and direction or percent of torque.

Analog Speed/Torque Reference Connections (Terminals 12-15)

- Terminal 12: Isolated Reference Voltage
- Terminal 13: VDC Speed/Torque Reference
- Terminal 14: mA Speed/Torque Reference
- Terminal 15: Isolated Reference Ground

The analog speed/torque (U.000) reference is either +/−10 VDC or +/−20 mA, as determined by the setting of jumper J4 on the Regulator board. The analog reference must also be programmed via parameters P.009, P.010, and P.011.

Digital Input Connections (Terminals 16-25)

- Terminal 16: +24 VDC (Current Limited) (For remote control digital inputs only)
- Terminal 17: Digital Input 8 (Remote/Local) - Programmable
- Terminal 18: Digital Input 7 (Ramp1/Ramp2) - Programmable
- Terminal 19: Digital Input 6 (Forward/Reverse) - Programmable
- Terminal 20: Function Loss
- Terminal 21: Run/Jog
- Terminal 22: Reset
- Terminal 23: Stop
- Terminal 24: Start
- Terminal 25: +24 VDC Common

When a user-installed function loss input, a coast-to-stop pushbutton, or another external interlock is installed, the factor-installed jumper connecting terminals 16 and 20 must be removed so that a contact will open to stop the drive.

Terminals 17, 18, and 19 (remote control inputs 8, 7, and 6) are programmed using parameters P.007, P.008, and P.031 through P.036. Factory default settings are shown here in parentheses. Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001).

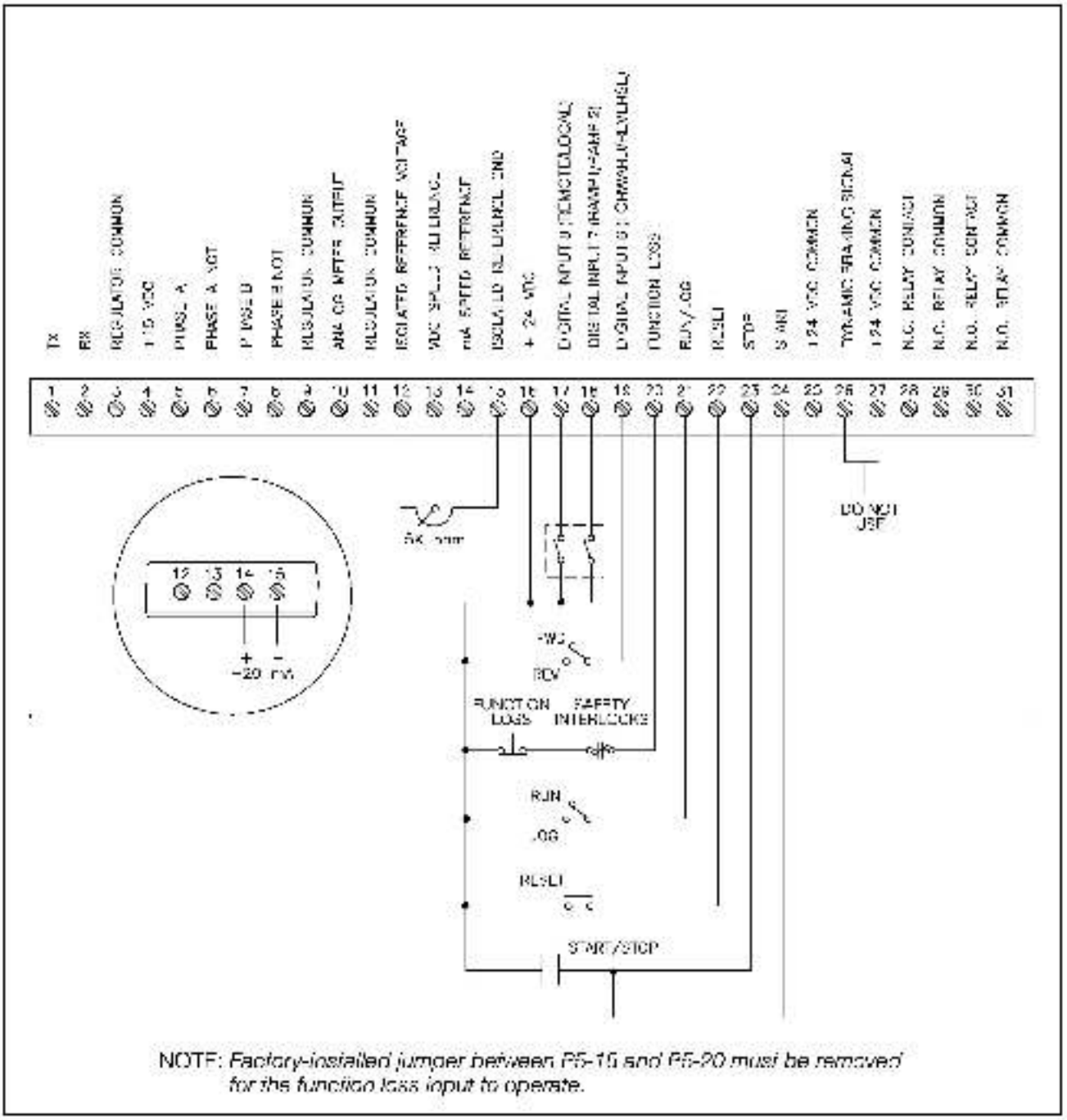
Dynamic Braking Connections (Terminals 26 and 27)

- Terminal 26: Dynamic Braking Signal (future option)
- Terminal 27: +24 VDC Common

Status Relay Connections (Terminals 28-31)

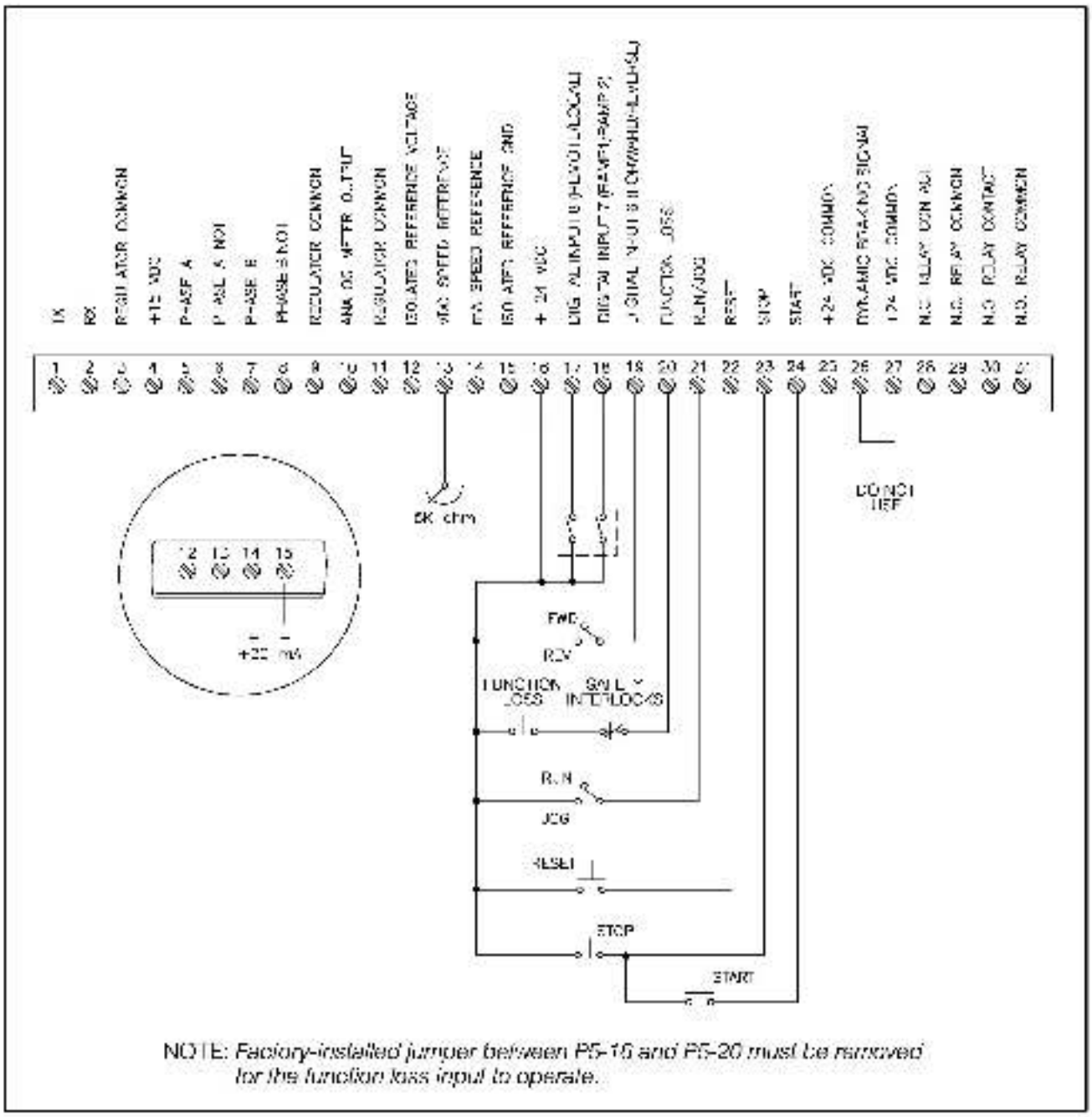
- Terminal 28: N.C Relay Contact
- Terminal 29: N.C. Relay Common
- Terminal 30: N.O. Relay Contact
- Terminal 31: N.O. Relay Common

Relay contact closure is programmable through parameter P.013. Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001) for more information.



NOTE: *Factory-installed jumper between P5-19 and P5-20 must be removed for the function loss input to operate.*

Figure 7.1 - Two-Wire Start/Stop Sample Control Wiring



NOTE: *Factory-installed jumper between P5-19 and P5-20 must be removed for the function loss input to operate.*

Figure 7.2 - Three-Wire Start/Stop Sample Control Wiring

7.1 Stopping the Drive

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE DRIVE CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Depending upon the requirements of the application, the VEC-200 drive can be configured to provide either a coast-to-rest or a ramp-to-rest operational stop without physical separation of the power source from the motor. A coast-to-rest stop turns off the transistor power device drivers. A ramp-to-rest stop fires the transistor power device drivers until the motor comes to a stop, and then turns off the power devices. The user can also program zero speed with power maintained to the motor, but in this condition, the drive is not actually stopped. See the description of terminals 23 and 24 or Stop Mode (P.025) for more information on how to configure the operational stop.

In addition to the operational stop, the user must provide a hardwired emergency stop external to the drive. The emergency stop circuit must contain only hardwired electromechanical components. Operation of the emergency stop must not depend on electronic logic (hardware or software) or on the communication of commands over an electronic network or link.

7.1.1 Compliance with EN 60204-1: 1992

This section applies to users who must comply with EN 60204-1: 1992, part 9.2.5.4, Emergency Stop.

The VEC-200 drive coast-to-rest stop is a category 0 operational stop. The ramp-to-rest stop is a category 1 operational stop. In addition, it is possible to implement a category 2 stop, with power maintained to the motor at zero speed.

The required external hardwired emergency stop must be either a category 0 or 1 stop, depending on the user's risk assessment of the associated machinery. In order to fully comply with EN60204-1: 1992, part 9.2.5.4, at least one of the two stop methods must be a category 0 stop. Refer to Appendix C for more information.

7.2 Wiring a Motor Encoder to the Drive

This section describes the Motor Encoder Cable kit that is used to connect an A-C motor's encoder to a VEC-200 drive. If you are using the VEC-200 drive with an IQ-550 positioning module, proceed to section 7.4

7.2.1 Motor Encoder Cable Kit Contents

The Motor Encoder Cable kits are supplied as a complete assembly as shown in figure 7.3. The cable used contains four twisted-pairs (2-3 twists per inch) enclosed in a plenum-grade jacket. The twisted-pairs can be identified by the wire's insulation color. The cable jacket on the non-connector cable end is already stripped back about 3.5 in (89 mm) to expose the wire pairs. Motor encoder cable kit part numbers are listed in table 7.1.

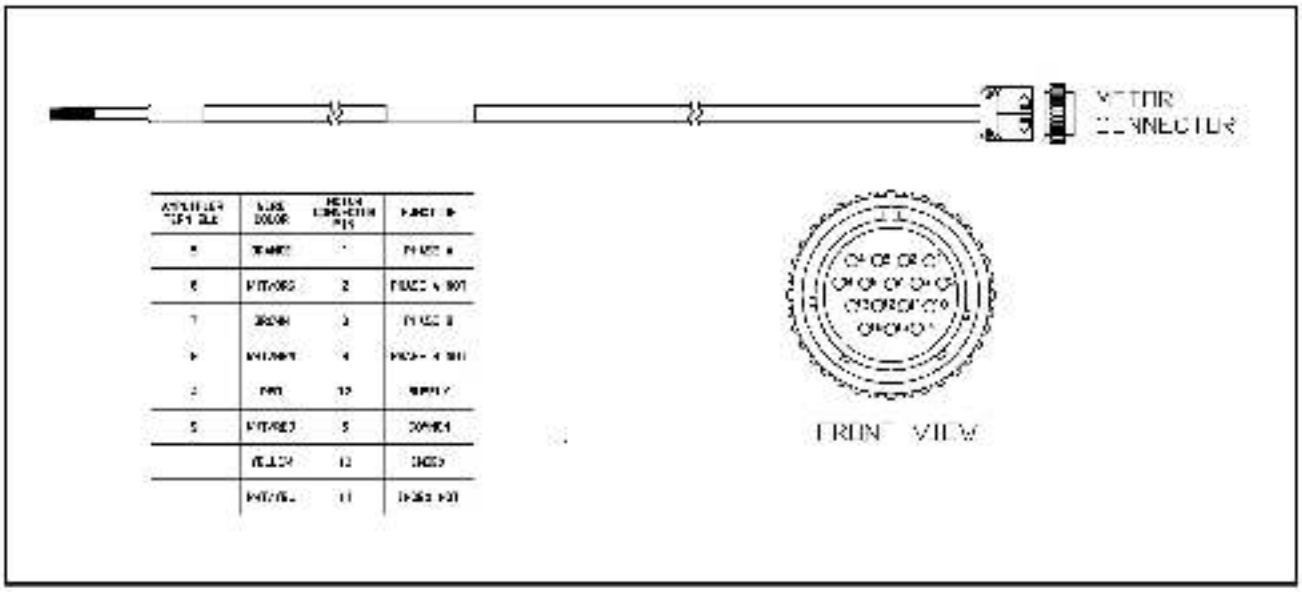


Figure 7.3 - Motor Encoder Cable Kit

Table 7.1 - Motor Encoder Cable Part Numbers

Model Number	Length ft (m)
9109-0020-010	10 (3.05)
9109-0020-025	25 (7.62)
9109-0020-050	50 (15.2)
9109-0020-075	75 (22.9)

7.2.2 Installing the Motor Encoder Cable

DANGER

DO NOT INSTALL MODIFICATION KITS WITH POWER APPLIED TO THE DRIVE. DISCONNECT AND LOCK OUT INCOMING POWER BEFORE ATTEMPTING SUCH INSTALLATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Install all wiring in conformance with the NEC/CEC and all other applicable local codes. Refer to figures 7.3 and 7.4 when making wire connections to the VEC-200 drive's control terminal strip.

Step 1. Insert the cable's keyed connector into the motor's encoder connector and tighten the outer ring securely.

CAUTION: Do not route the motor encoder cable in the same conduit with power wiring. This may cause interference with drive operation. Failure to observe this precaution could result in damage to or destruction of the equipment.

Step 2. Route or run the encoder cable the entire length from the motor to the VEC-200 drive's enclosure.

Step 3. If not already done, loosen the four (4) captive screws on the drive cover and remove the cover.

Step 4. Continue routing the cable to the drive through the opening at the bottom left (far left) of the drive.

Step 5. After ensuring that the wires in the cable can reach the drive terminal strip, cut off the excess cable.

Step 6. Carefully remove (as required) the cable's outer jacket. Strip about 1/4 inch (6.3 mm) of insulation from each wire.

NOTE: *This cable consists of four twisted-pair wires. The twisted-pair wires can be identified by the wire's insulation color. The two wires identified as* INDEX *and* INDEX NOT (yellow and yellow/white) *are not connected to the VEC-200 drive. Secure these wires so they do not interfere with the other connections.*

Step 7. Refer to figure 7.3 for twisted-pair color coding and function. Place a lead number label on each wire.

CAUTION: Make sure electrical commons are not intermixed in the drive. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Step 8. Wire each lead to the corresponding position on the drive's control terminal strip. Tighten all connections to 7 lb-in (.79 nm).

Step 9. Re-install the drive cover.

Step 10. Check all motor and VEC-200 drive wiring. Refer to chapter 3 for wiring information.

Step 11. Turn power on and check for proper drive operation.

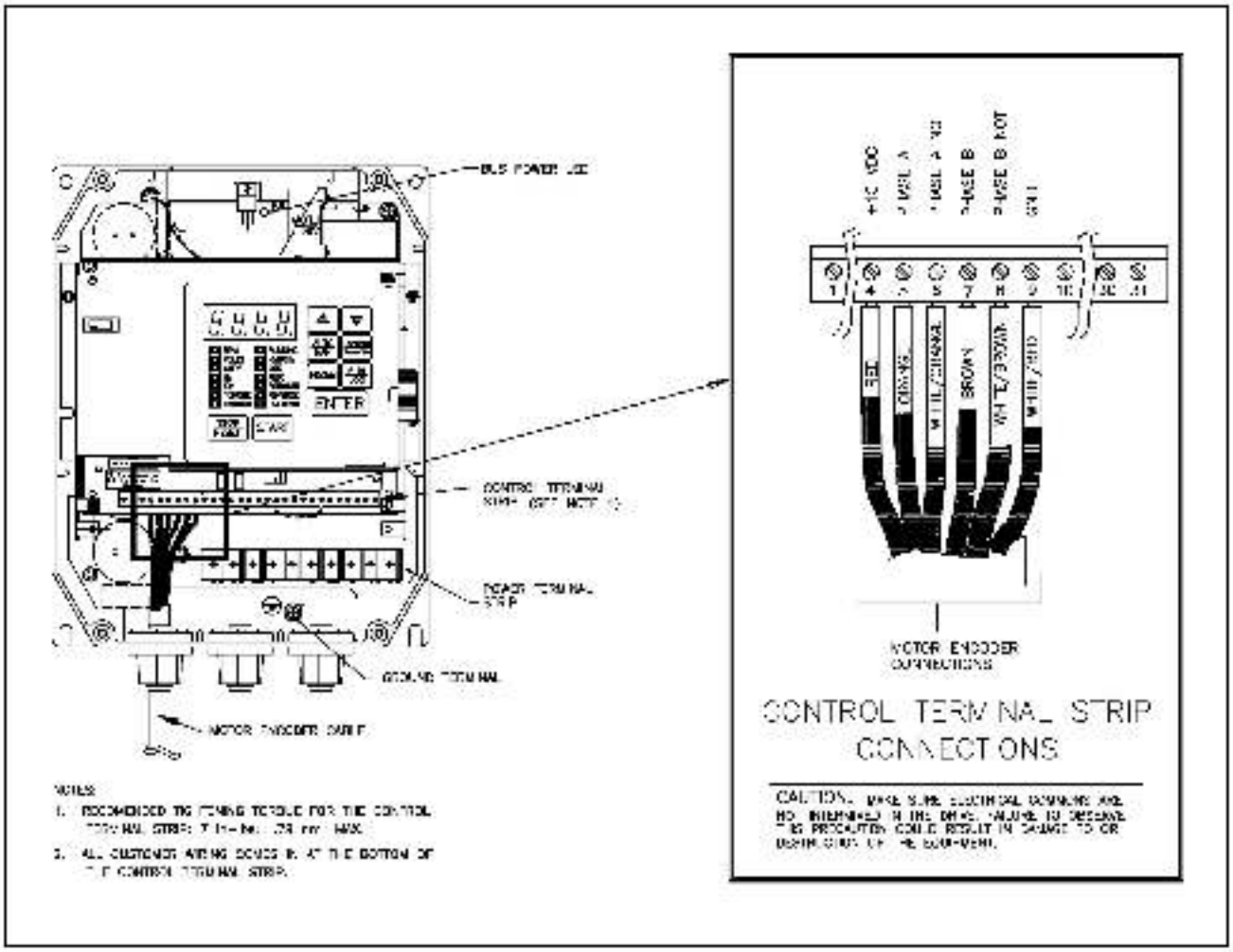


Figure 7.4 - VEC-200 Drive Control Terminal Strip Connections

7.3 Wiring the Signal and Control I/O

Wire the drive's signal and control I/O to the terminal strip as shown in table 7.2.

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip

Terminal Number	Description	Parameters/Wiring Connections
	Wiring RS-232 Signals	
1 2 3	RS-232 Transmit RS-232 Receive RS-232 Signal/Regulator Common	Not used.
	Wiring Encoder Inputs	
4-9	Encoder Wiring	See section 7.2.
	Wiring Analog Outputs	
10 11	0-10 VDC or 4-20 mA Analog Output Reference Regulator Common	The setting of parameter P.012 selects the terminal strip analog output source (either speed or torque). Jumper J17 must also be set. See figure 2.6.

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

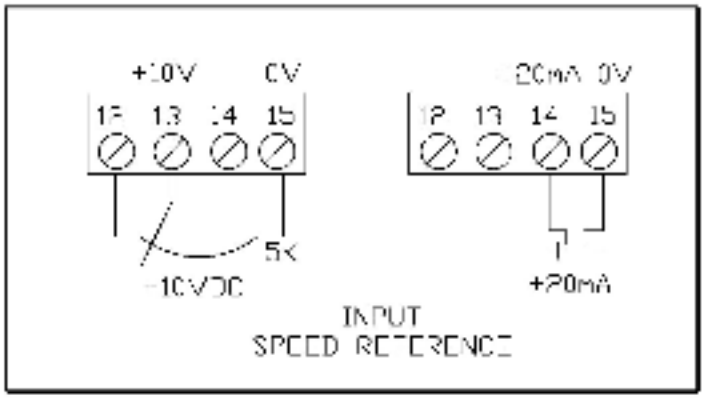
Terminal Number	Description	Parameters/Wiring Connections
Wiring Analog Speed Reference Inputs		
12 13 14 15	Isolated Reference Voltage (+15VDC) Analog Speed/Torque Reference Input Voltage (+/− 10 VDC) Analog Speed/Torque Reference Input Current (0-20mA) Isolated Speed/Torque Reference Common (Voltage/Current)	The following parameters must be set: P.000: Control Source Select P.009: Terminal Block Analog Input Offset P.010: Terminal Block Analog Input Gain P.011: Terminal Block Analog Input Invert Refer to the VEC-200 Software Startup and Reference Manual (0013-1029-001) for additional parameter information. Jumper J4 must also be set. See figure 2.5. 

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

Terminal Number	Description	Parameters/Wiring Connections
Wiring a Remote/Local Input		
16	+24 VDC Power Supply	Current limited for remote input logic use only.
17	Digital Input 8 (Remote/Local)	Digital input 8 is control function programmable through parameter P.007.

WARNING

IF A MAINTAINED START CONTACT IS USED WHEN THE CONTROL SOURCE = rE, SWITCHING FROM LOCAL TO REMOTE FROM THE TERMINAL STRIP WILL CAUSE POWER TO BE APPLIED TO THE MOTOR IF THE REMOTE START CONTACT IS CLOSED. STAY CLEAR OF ROTATING MACHINERY IN THIS CASE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

The initial factory setting is as a Remote/Local switch (see wiring diagram below). The input may be re-configured as a Ramp 1/Ramp 2 selector switch, a Forward/Reverse switch, or as a selection input for the multi-speed presets.

The following parameters must be set:

P.000: Control Source Select
(Only active when P.000 = rE)

P.006: Second Menu Password

P.007: Terminal Block Digital Inputs Configure (Selects and assigns a control function to digital inputs 6 to 8).

P.008: Terminal Block Speed Reference Select (Analog, Motor Operated Potentiometer (MOP), or Multi-speed Presets)

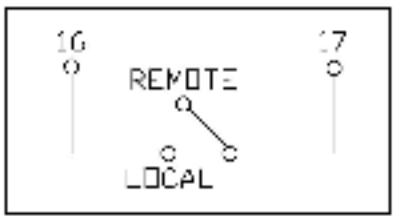
Note that based on the settings of parameters P.000, P.007, and P.008, the following parameters can affect digital input 8.

P.023: MOP Accel/Decel

P.024: MOP Reset Configuration

P.031 to P.038: Presets 1-8

Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001) for additional information.



Terminal 17 On = Local Control
Diagram shows factory setting.

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

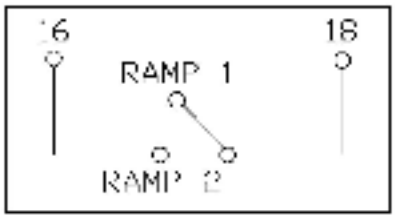
Terminal Number	Description	Parameters/Wiring Connections
Wiring an Additional Ramp Input		
18	Digital Input 7 (Ramp1/Ramp2)	Digital input 7 is control function programmable through parameter P.007. The initial factory setting is as a Ramp 1/Ramp 2 selector switch (see wiring diagram below. The input may be re-configured as a Forward/Reverse switch, MOP decrement function switch, or as a selection input for the multi-speed presets. The following parameters must be set: P.000: Control Source Select P.001: Accel Time 1 (Ramp 1) P.002: Decel Time 1 (Ramp 1) P.006: Second Menu Password P.007: Terminal Block Digital Inputs Configure (Selects and assigns a control function to digital inputs 6 to 8). P.008 Terminal Block Speed Reference Select (Analog, Motor Operated Potentiometer (MOP), or Multi-Speed Presets) P.017: Accel Time 2 (Ramp 2) P.018: Decel Time 2 (Ramp 2) P.027: Reverse Disable Note that based on the settings of parameters P.000, P.007, and P.008, the following parameters can affect digital input 7. P.023: MOP Accel/Decel P.024: MOP Reset Configuration P.031 to P.038: Presets 1-8 Refer to the VEC-200 Software Startup and Reference Manual (0013-1029-001) for additional information.  Terminal 18 On = Ramp 2 Diagram shows factory setting.

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

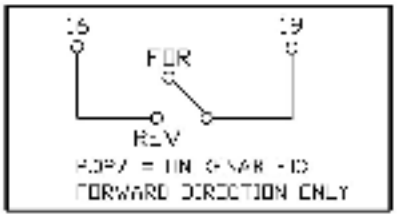
Terminal Number	Description	Parameters/Wiring Connections
Wiring a Forward/Reverse Input		
19	Digital Input 6 (Forward/Reverse)	Digital input 6 is control function programmable through parameter P.007. The initial factory setting is as a Forward/Reverse selector switch (see wiring diagram below). The input may be re-configured as an MOP increment function switch or as a selection input for the multi-speed presets. The following parameters must be set: P.000: Control Source Select P.006: Second Menu Password P.007: Terminal Block Digital Inputs Configure (Selects and assigns a control function to digital inputs 6 to 8). P.008: Terminal Block Speed Reference Select (Analog, Motor Operated Potentiometer (MOP), or Multi-Speed Presets) P.027: Reverse Disable Note that based on the settings of parameters P.000, P.007, and P.008, the following parameters can affect digital input 6. P.023: MOP Accel/Decel P.024: MOP Reset Configuration P.031 to P.038: Presets 1-8 Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001) for additional information.  Terminal 19 On = Reverse Direction Diagram shows factory setting. From the encoder end of the motor, clockwise rotation indicates forward motor movement.

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

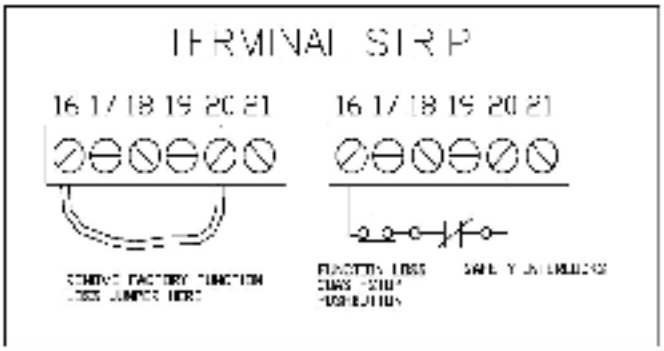
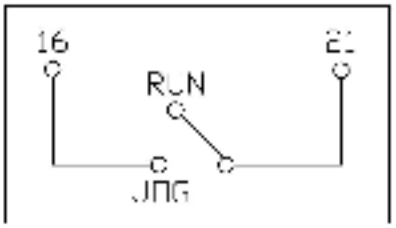
Terminal Number	Description	Parameters/Wiring Connections
		Wiring a Function Loss Input
20	Digital Input 5 (Function Loss)	The following parameters must be set: P.000: Control Source Select P.026: Function Loss Selection A signal must be present at terminal 20 for the drive to be able to start. See figures 7.1 and 7.2. The drive is shipped from the factory with a jumper between terminals 16 and 20 which provides the signal. The function loss input should be in series with the drive's external interlocks. In this case, the jumper must be removed before the connections are made. See figure 2.7.  Terminal 20 Asserted = No Function Loss
		Wiring a Run/Jog Input
21	Digital Input 4 (Run/Jog)	The following parameters must be set: P.000: Control Source Select P.020: Jog Speed Reference P.021: Jog Ramp Accel Time P.022: Jog Ramp Decel Time 

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

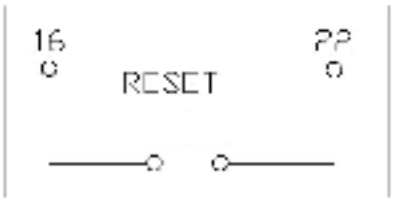
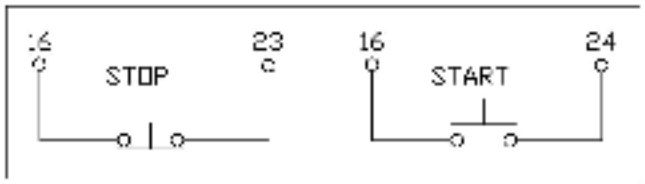
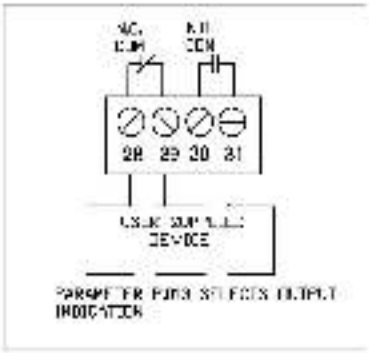
Terminal Number	Description	Parameters/Wiring Connections
	Wiring the Reset Input	
22	Digital Input 3 (Reset)	The following parameter must be set: P000: Control Source Select  Terminal 22 On = Reset
	Wiring the Stop/Start Inputs	
23	Digital Input 2 (Stop)	The following parameter must be set: P000: Control Source Select P025: Stop Mode  Terminal 23 Off = Stop Terminal 24 On Transition = Start
24	Digital Input 1 (Start)	
25	24 VDC Isolated Common	
	Dynamic Braking	
26	Dynamic Braking Control Signal	Not Used.
27	+24 VDC Isolated Common	

Table 7.2 - Wiring Signal and Control I/O to the Terminal Strip (Continued)

Terminal Number	Description	Parameters/Wiring Connections
Wiring the Output Status Relays		
28	Normally-Closed Contact (Form B)	Both Form A and Form B contacts are rated for 250 VAC/30 VDC at 5 amps resistive or 2 amps inductive load.
29	Normally-Closed Contact Common (Form B)	
30	Normally-Open Contact (Form A)	The following parameter must be set:
31	Normally-Open Contact Common (Form A)	P.013: Output Relay Configuration
		Note that depending on the setting of parameter P.013, the relay coil will energize (the normally-open contact will close and the normally-closed contact will open). Refer to the VEC-200 Software Start-Up and Reference Manual (0013-1029-001) for more information.
		

7.4 Wiring the Drive to an IQ-550 Positioning Module

This section describes how to connect an IQ-550 Positioning Module (IQ-550) to a VEC-200 Vector drive. Connections will be made with the Motor Encoder Cable kit (see section 7.2) and the P5 Terminal Block Cable (P/N 9101-2125-005), which are purchased separately. Connections between the P5 terminal strip and the VEC-200 drive are made with user-supplied signal wire.

Follow the steps below to connect the IQ-550 to the VEC-200 drive. Refer to figures 7.4 and 7.5 and tables 7.3 and 7.4 for additional wiring information.

Step 1. Connect the P5 Terminal Block Cable to the IQ-550 Positioning Module.

a. Connect the 25-pin male D-shell connector to the P5 connector on the IQ-550 module.

b. Connect the 25-pin female D-shell connector to the P5 terminal strip.

c. Mount the P5 terminal strip adjacent to the IQ-550 module, and between the IQ-550 module and the VEC-200 drive.

Step 2. Connect the encoder cable from the motor encoder to the P5 terminal strip.

a. Insert the encoder cable's keyed connector onto the motor's encoder connector and tighten the outer ring securely.

b. Route the encoder cable the entire length from the motor to the P5 terminal strip.

c. After ensuring that the wires in the cable can reach the terminal strip, cut off the excess cable.

d. Carefully remove (as required) the cable's outer jacket. Strip about 1/4 inch (6.3 mm) of insulation from each wire.

NOTE: *This cable consists of four twisted-pair wires. The twisted pairs can be identified by the wire's insulation color.*

e. Refer to table 7.3 for twisted-pair color coding and function. Place a lead number on each wire.

f. Wire each lead to the corresponding position on the P5 screw terminal strip.

Table 7.3 - P5 Terminal Strip and Encoder Connections

Wire Color	Motor Pin Connection	Function	P5 Terminal Strip
Orange	1	Phase A	10
White/Orange	2	Phase A not	23
Brown	8	Phase B	11
White/Brown	9	Phase B not	24
Yellow	10	Phase I	12
White/Yellow	11	Phase I not	25
Red	12	+5 V Supply	2
White/Red	6	Supply Common	15

Step 3. Connect the wire leads between the VEC-200 drive and the P5 terminal strip using user-supplied signal wire (14–20 AWG (2 to .05mm^2)). Note: For encoder connections A, $\overline{A}$, B and $\overline{B}$, use twisted-pair wire with at least 2–3 twists per inch.

a. If not already done, loosen the four (4) captive screws on the VEC-200 drive's cover and remove the cover from the drive base.

b. Route the wires through the opening at the bottom left (far left) of the drive.

c. After ensuring that the wires can reach the P5 terminal strip, cut off the excess wire.

d. Strip about 1/4 inch (6.3 mm) of insulation from each wire.

e. Refer to table 7.4 for function. Place a lead number on each wire.

CAUTION: Do not connect terminal #4 (encoder power supply) on the VEC-200 terminal strip to terminal #2 (–5 VDC encoder supply voltage) on the IQ-500 terminal strip. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

f. Wire each lead from the P5 terminal strip to the corresponding position on the VEC-200 terminal strip. Torque the terminal strip hardware to 7 in-lb.

g. Re-attach the cover to the drive.

Table 7.4 - P5 Terminal Strip and VEC-200 Connections

Wire Color	VEC-200 Connection	Function	P5 Terminal Strip
user-supplied	5	Phase A	10
user-supplied	6	Phase A not	23
user-supplied	7	Phase B	11
user-supplied	8	Phase B not	24
user-supplied	9	Supply Common	15
user-supplied	13	Torque Ref.	8
user-supplied	15	Torque Common	21
user-supplied	24	Enable	17
user-supplied	25	–24VDC Common	16
user-supplied	29	Ready to Run	20

Step 4. Remove jumpers W5 and W6 from the IQ-550 logic board. Both the W5 and W6 jumpers must be removed in order to source 24VDC to the VEC-200. Refer to the IQ-Series Installation Manual for the IQ-550 Position Control Module for details on jumper location and removal.

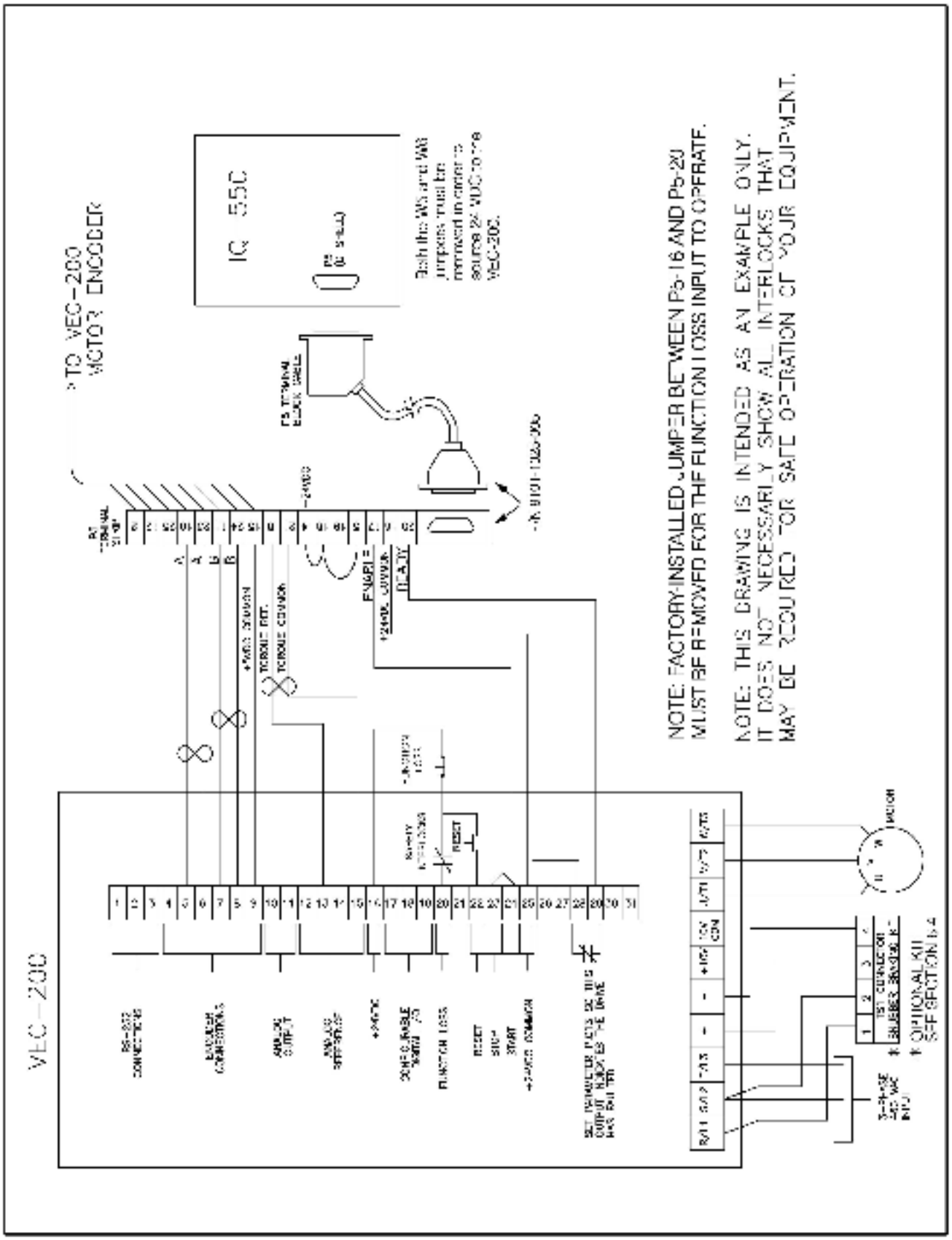


Figure 7.5 - Typical IQ-550 Positioning Module/VEC-200 System Control Connections

8.0 COMPLETING THE INSTALLATION

This chapter provides instructions on how to perform a final check of the installation before power is applied to the drive.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START AND ADJUST IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

8.1 Checking the Installation

Use the following procedure to verify the condition of the installation:

DANGER

D-C BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE D-C BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 1. Turn off, lock out, and tag the input power to the drive. Wait five minutes.

Step 2. Verify that the D-C bus voltage is zero. Refer to section 9.3.

Step 3. If a function loss coast-stop pushbutton has been installed, verify that it has been wired correctly. Be sure the factory-installed jumper at terminals 16 and 20 has been removed so that the coast-stop pushbutton will work.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE OF THE DRIVE CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Step 4. Remove any debris, such as metal shavings, from around the drive.

Step 5. Check that there is adequate clearance around the drive.

Step 6. Verify that the wiring to the terminal strip and the power terminals is correct.

Step 7. Check that the wire size is within terminal specification and that the wires are tightened properly.

Step 8. Check that user-supplied branch circuit protection is installed and correctly rated.

Step 9. Check that the incoming A-C power is rated correctly.

Step 10. Check the motor installation and length of motor leads.

Step 11. Disconnect any power correction capacitors connected between the drive and the motor.

Step 12. Check that the rating of the transformer (if used) matches the drive requirements and is connected properly.

Step 13. Verify that a properly-sized ground wire is installed and a suitable earth ground is used. Check for and eliminate any grounds between the motor frame and the motor power leads. Verify that all ground leads are unbroken.

Step 14. Uncouple the motor from any driven machinery to initially start the drive.

8.2 Powering Up After Installation is Complete

Use the following procedure to verify that the drive is installed correctly and is receiving the proper line voltage:

Step 1. Turn the drive's input power disconnect to the On position.

Step 2. Apply power to the drive.

Step 3. Follow the start-up procedure in instruction manual 0013-1029-001.

9.0 TROUBLESHOOTING THE DRIVE

This chapter describes how to troubleshoot the drive and the equipment that is needed to do so. Also provided is information on clearing faults.

9.1 Test Equipment Needed to Troubleshoot

An isolated multimeter will be needed to measure D-C bus voltage and to make resistance checks.

9.2 Drive Alarms and Faults

The drive will display alarm and fault codes to assist in troubleshooting when a problem develops during self-tuning or drive operation.

If an alarm condition occurs, the drive will continue to run and the alarm code will flash on the display as a 2- or 3-digit code.

If a fault occurs, the drive will coast-to-stop and the fault code will flash on the display as a 2- or 3-digit code.

Refer to the VEC-200 Software Startup and Reference Manual (0013-1029-001) for more information on drive alarms and faults.

9.3 Verifying That D-C Bus Capacitors are Discharged

DANGER

D-C BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE D-C BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

The VEC-200 drive's D-C bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components:

Step 1. Turn off and lock out A-C input power. Wait five minutes.

Step 2. Remove the drive's cover.

Step 3. Verify that there is no voltage at the drive's A-C input power terminals.

Step 4. Measure the D-C bus potential with a voltmeter at the D-C bus power terminals. See figure 9.1.

Step 5. Once the drive has been serviced, re-attach the drive's cover.

Step 6. Re-apply A-C input power.

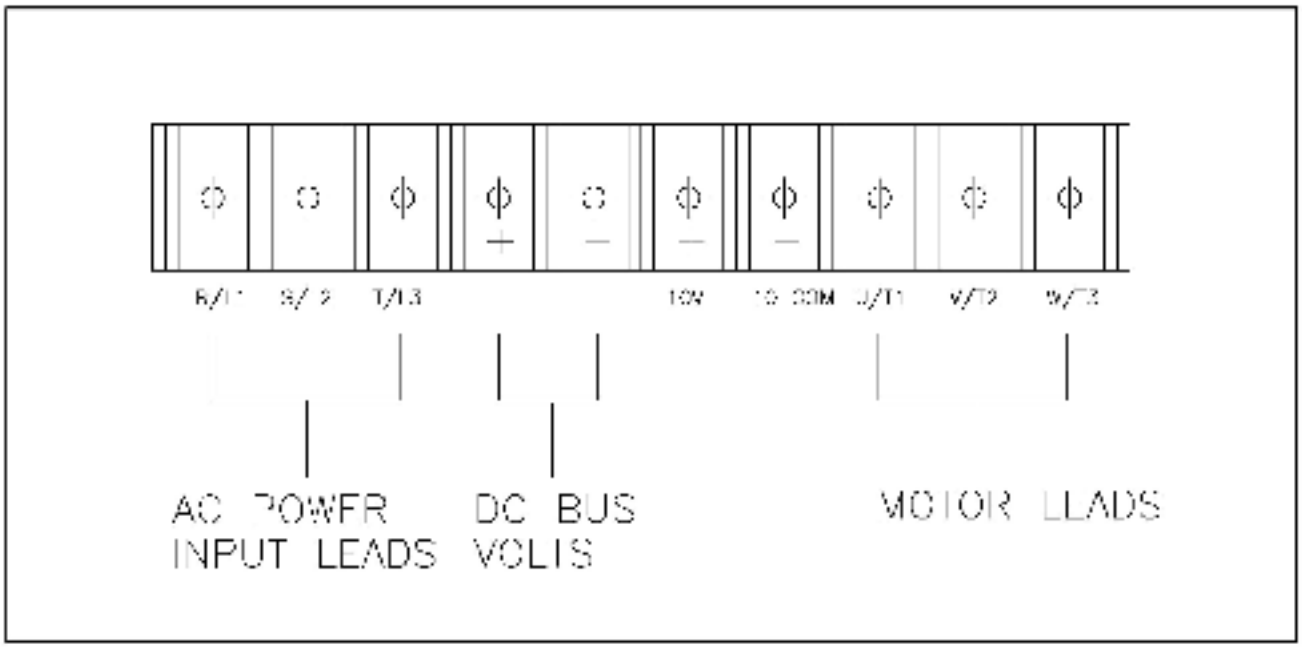


Figure 9.1 - D-C Bus Voltage Terminals (1-10 HP Drives)

9.4 Checking Out the Power Modules with Input Power Off

Use the following procedure to check the drive's Power Module circuitry with power off:

DANGER

D-C BUS CAPACITORS RETAIN HAZARDOUS VOLTAGES AFTER INPUT POWER HAS BEEN DISCONNECTED. AFTER DISCONNECTING INPUT POWER, WAIT FIVE (5) MINUTES FOR THE D-C BUS CAPACITORS TO DISCHARGE AND THEN CHECK THE VOLTAGE WITH A VOLTMETER TO ENSURE THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL COMPONENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 1. Turn off and lock out A-C input power. Wait five minutes.

Step 2. Remove the drive's cover.

Step 3. Verify that there is no voltage at the drive's A-C input power terminals.

Step 4. Check the D-C bus potential with a voltmeter as described in section 9.3 to ensure that the D-C bus capacitors are discharged.

Step 5. Disconnect the motor from the drive.

Step 6. Check all A-C line and D-C bus fuses.

Step 7. Re-attach the drive's cover.

Step 8. Re-apply A-C input power.

Appendix A

Technical Specifications

Table A.1 - Service Conditions

A-C Line Distribution System Capacity (maximum) for 460 VA-C Units	1000KVA, three-phase with 25,000 amps symmetrical fault current capacity with a line impedance of less than 8%
Control Method	All-digital flux vector, sinusoidal pulse width modulated (PWM)
Displacement Power Factor	0.96
Line Frequency	50/60Hz (±2 Hz)
Line Voltage Variation	−10% to +10%
Line Dip Ride Through	Maximum 500 milliseconds - vector Adjustable up to 999.9 seconds (See P.042) - volts/Hz
Motor Lead Lengths	76 meters (250 feet) total
Analog Speed Reference Accuracy	0.5%
Acceleration Adjustment Range	0.1 to 999.9 seconds (within the ability of current)
Carrier Frequency	2 Hz, 4 Hz, or 8 Hz, software-selectable
Current Limit Adjustment	U.006 to 150% (based on drive nameplate rating) - vector 50 to 110% (based on drive nameplate rating) - volts/Hz
Service Factor	1.0
Speed Adjustable Range	From 0 RPM to maximum speed
Speed Regulation	0.05% long term steady state or 0.1% for a 20 millisecond period (typical) - vector motor slip dependent - volts/Hz
Speed Setpoint Resolution	±1 RPM with local keypad, ±4095 of rated RPM with personal computer
Torque Control Response	180 to 220 Hz
Torque Linearity	±3% with optimal parameter setting (typical) (see parameter U.005)

Table A.2 - Operating Conditions

Temperature: Ambient Operating Ambient Storage	 0°C to 40°C (32°F to 104°F) -40°C to 65°C (-40°F to 149°F)
Humidity	5 to 95% non-condensing humidity
Altitude	To 1000 meters (3000 feet) above sea level without derating. For every 91.4 meters (300 feet) from 1001 to 3033 meters (3300 to 10,000 feet), derate the current by 1%. Contact your Reliance Motion Control representative sales office for operation above 3033 meters (10,000 feet).

Table A.3 - Terminal Strip Input Specifications

Signal Type	Terminal(s)	Specification
Speed Reference Input	12-15	10 V (@ 50K ohm Input Impedance or 20 mA)
Digital Inputs (1 - 8)	16	+24 VD-C Isolated Supply
	17	Remote/Local
	18	Ramp1/Ramp2
	19	Forward/Reverse
	20	Function Loss
	21	Run/Jog
	22	Reset
	23	Stop
	24	Start

Table A.4 - Terminal Strip Output Specifications

Signal Type	Terminal(s)	Specification
Analog Output	10 -11 scaled signal	0-10 VD-C or 4-20 mA
Dynamic Braking Resistor	26 - 27	Not Used.

Table A.5 - Encoder Specifications (Vector Regulation Only)

Specification	Rating
Motor Poles	2, 4, 6, or 8 poles
Overcurrent Fault Trip	200% load (based on drive nameplate rating)
Overload Current Rating	150% for 1 minute (based on drive nameplate rating)
Speed Control Range	1:600 with 1024 PPR
Speed Control Response	15 Hz (typical)
Speed Feedback	15 V differential quadrature, incremental encoder (512 PPR, 1024 PPR, 2048 PPR, 4096 PPR)
Service Factor	1.0

Table A.6 - Input Signal Response Times (Worst Case)

These are the maximum times from transitioning the input to the drive reacting to the input.		
Signal Type and Source	**Volts/Hertz Regulation**	**Vector Regulation**
Keypad START	150 milliseconds	130 milliseconds
Terminal Strip:		
START	126 milliseconds	105 milliseconds
STOP, RESET, FL	75 milliseconds	75 milliseconds
Multispeed Select	75 milliseconds	75 milliseconds
Analog Speed/Trim Reference	16 milliseconds	5 milliseconds
Analog Torque Reference	N/A	0.5 milliseconds

Appendix B

Drive Regulation Overview

The VEC-200 is a digital drive that provides closed loop vector or open loop volts/hertz regulation of A-C motors. The Volts/Hz or Vector Mode Select parameter (P.048) is used to select the type of regulation for the application. See figures B.1 and B.2 for block diagrams of both regulators.

Volts/Hertz Regulation

Volts/hertz regulation provides general purpose open loop A-C drive control. It does not use a speed feedback device. In this type of control, the regulator maintains a programmed ratio of voltage to an output frequency, which provides constant or variable motor torque across a wide speed range. An internal function generator calculates the output motor voltage based on requested frequency and user-specified motor characteristics. The control loop output switches the power device gates, generating a pulse-width-modulated (PWM) waveform to the motor.

Vector Regulation

Vector regulation allows dynamic closed-loop performance in an A-C drive similar to that achieved with a D-C drive. Torque is constant across the motor's base speed range in both forward and reverse directions. The drive uses two digital control loops, speed and torque, to obtain vector performance.

The speed loop reference can be an internal or an external source. Speed loop feedback is provided by an encoder attached to the motor's shaft. A trim parameter is summed with the speed reference to provide a torque reference, or to adjust a user-specified Torque Reference parameter, for the torque control loop. An internally-generated flux reference is also fed to the torque loop. The torque will vary to maintain the motor at the requested speed. The torque control loop output switches the power device gates, generating a pulse-width-modulated (PWM) waveform to the motor.

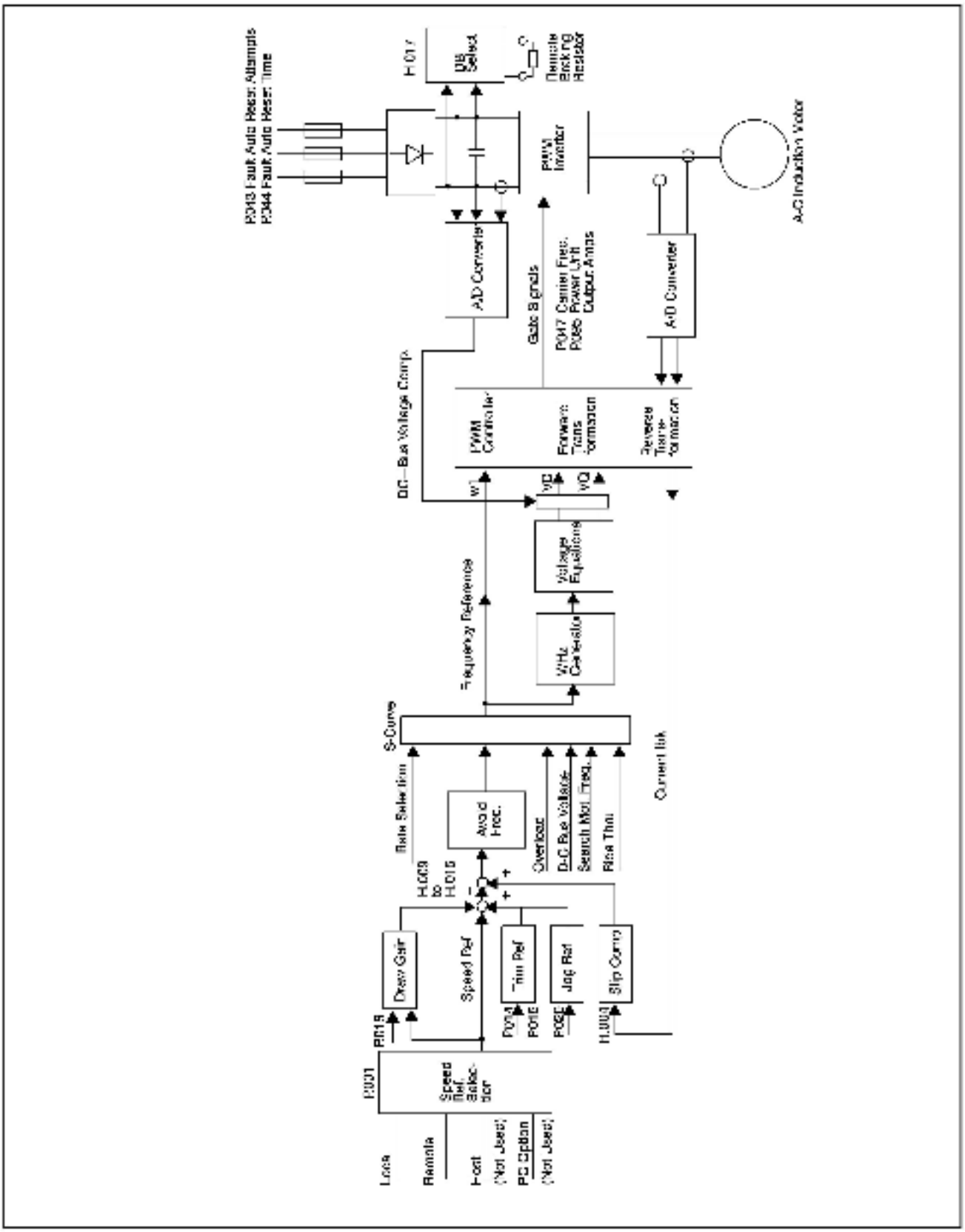


Figure B.1 - Volts/Hertz Regulation Block Diagram

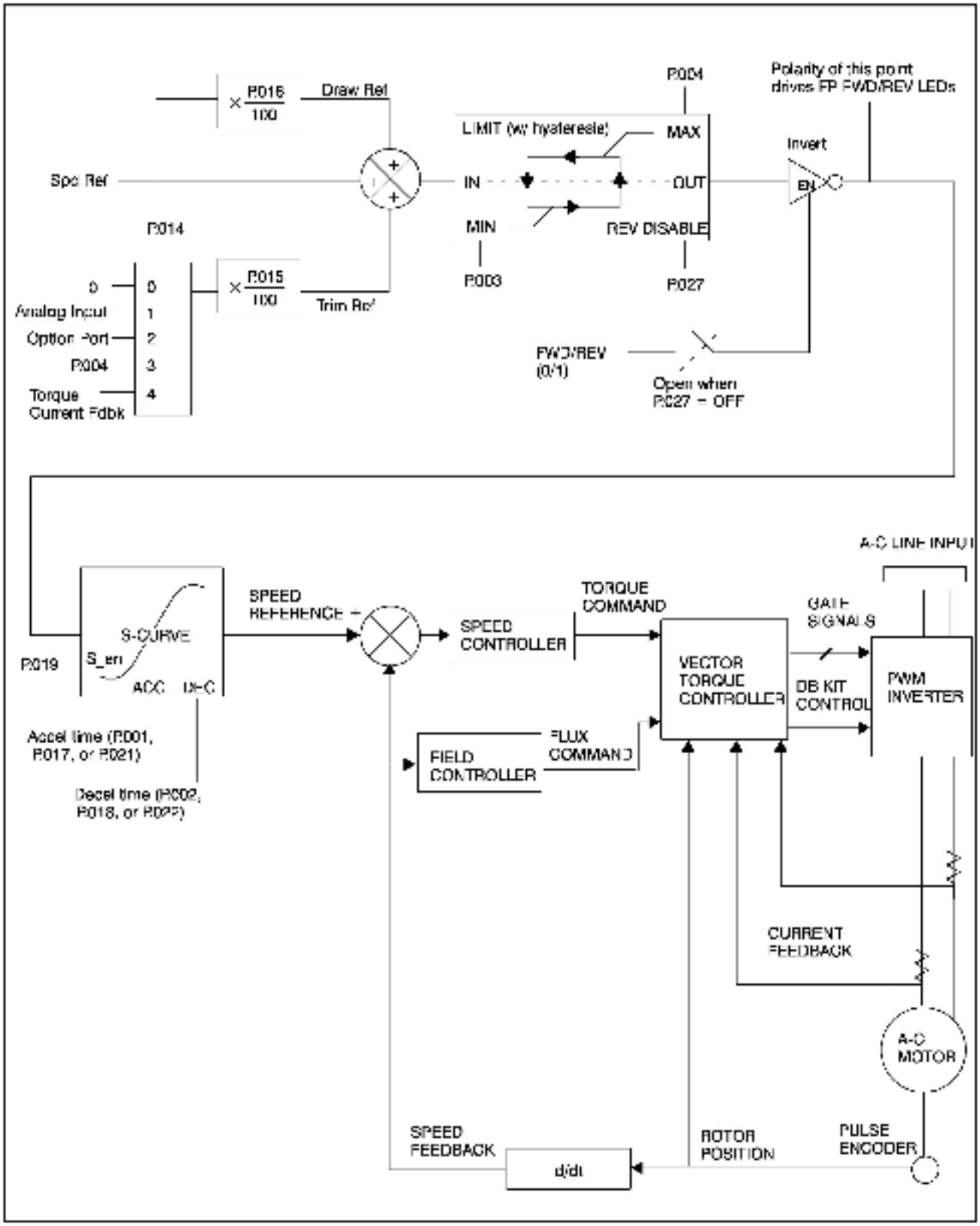


Figure B.2 - Vector Regulation Block Diagram

Appendix C

Compliance with EN 60204-1: 1992

The VEC-200 complies with the following sections of standard EN 60204-1: 1992.

EN60204-1 Section	Title
6	Protection against electrical shock
6.2.1	- Protection by enclosure
6.2.3	- Protection against residual voltages
6.3.1	- Protection by automatic disconnect of supply
6.4	- Protection by the use of PELV (Protective Extra Low Voltage)
7	Protection of equipment
7.2	- Overcurrent protection
7.2.3	- Control circuits
7.2.6	- Transformers
7.5	- Protection against supply interruption or voltage reduction and subsequent restoration
8	Equipotential bonding
8.2.1	- General (the PE terminal)
8.2.2	- Protective conductors (connection points)
8.2.3	- Continuity of the protective bonding circuit
8.2.7	- Protective conductor connecting points
8.3	- Bonding to the protective bonding circuit for operational purposes
8.4	- Insulation failures
8.5	- Bonding to a common reference potential
8.6	- Electrical interferences
9	Control circuit and control functions
9.1.1	- Control circuit supply
9.1.3	- Protection
9.1.4	- Connection of control devices
9.2	- Control functions
9.2.1	- Start function
9.2.2	- Stop function
9.2.3	- Operating modes
9.2.5	- Operation
9.2.5.3	- Stop
9.2.5.6	- Hole-to-run controls
9.2.6	- Combined start and stop controls
9.3	- Protective interlocks
9.3.5	- Reverse current braking
9.4	- Control functions in case of failure
9.4.2.1	- Use of proven circuit techniques and components
9.4.3	- Provisions for redundancy
9.4.3.1	- Earth faults
9.4.3.2	- Voltage interruption

Appendix C

Compliance with EN 60204-1: 1992 (Continued)

EN60204-1 Section	Title
10	Operator interface and machine mounted control devices
10.2.1	- Pushbutton colors
10.8	- Displays
11	Control interfaces
11.2	- Digital input/output interfaces
11.2.1	- Inputs
11.2.2	- Outputs
11.3	- Drive interfaces with analog inputs
11.3.1	- Separation between control and electric drives
11.5	- Communications
12	Electronic equipment
12.2.2	- Electronic control equipment
12.2.3	- Equipotential bonding
12.3	- Programmable equipment
12.3.1	- Programmable controllers
12.3.2	- Memory retention and protection
12.3.3	- Programming equipment
12.3.4	- Software verification
12.3.5	- Use in safety-related functions
13	Controlgear: Location, mounting and enclosures
13.2.3	- Heating effects
13.4	- Enclosures, doors and openings
15	Wiring practices
15.1.1	- General requirements
15.1.3	- Conductors of different circuits
15.2.2	- Identification of the protective conductor
16	Warning signs and item identification
16.2	- Warning signs
16.4	- Marking of control equipment
19	Technical documentation
19.1	- General

Index

A

A-C input
  disconnect, installing, 5-2 to 5-3
  isolation transformer, 5-1
  line branch circuit fuses, 3-5, 5-2
  ratings, 2-1
  wire sizes, 3-4
  wiring, 3-4 to 3-5, 4-1 to 4-4, 5-1 to 5-3
  voltage transients, avoiding, 5-1
A-C output
  wiring, 3-4 to 3-6, 4-1 to 4-4, 6-1 to 6-2
Air flow, 3-1 to 3-2
Alarms, 9-1
Altitude requirements, 3-1, A-1
Analog output, 2-4
  0-10 VDC (J17), 2-4, 2-6 to 2-8, A-2
  4-20mA (J17), 2-4, 2-6 to 2-8, A-2
  wiring, 2-7 to 2-8, 7-1, 7-3 to 7-4, 7-9
Analog speed reference
  input current, wiring, 7-1, 7-3 to 7-4, 7-10, A-2
  input voltage, wiring, 7-1, 7-3 to 7-4, 7-10, A-2
  0-10 VDC (J4), 2-6 to 2-7, 7-1
  4-20mA (J4), 2-6 to 2-7, 7-1
Area required, 3-3
Audience, intended, 1-2

B

Block diagram
  vector regulation, B-3
  volts/hertz regulation, B-2
Board
  Capacitor, 2-2 to 2-3
  Current Feedback, 2-2 to 2-3
  Regulator, 2-2 to 2-9

Braking, snubber resistor, 2-11, 5-1, 6-1 to 6-2

C

Capacitor board, 2-2 to 2-3
Capacitors, D-C bus, 9-1 to 9-2
Carrier frequency, 2-4, A-1
Closed-loop regulation, *see* Vector Regulation
Component locations, 2-2 to 2-3
Conduit size, 4-2 to 4-3
Contacting Reliance Motion Control, 1-2
Contactors, installing output, 6-1
Contacts
  Form A, 2-4, 7-16
  Form B, 2-4, 7-16
Control source, 7-1, 7-3 to 7-4, 7-11
  wiring, 7-3 to 7-4, 7-11
Control, wiring, 2-8 to 2-9, 7-1 to 7-19
Current Feedback board, 2-2 to 2-3

D

D-C bus
  terminals, 9-1 to 9-2
  verifying capacitor voltage, 9-1 to 9-2
Digital input wiring, 2-8 to 2-9, 7-2 to 7-4, 7-9 to 7-16
  8 (remote/local), 7-2 to 7-4, 7-11
  7 (ramp1/ramp2), 7-2 to 7-4, 7-12
  6 (forward/reverse), 7-2 to 7-4, 7-13
  5 (function loss), 7-2 to 7-4, 7-14
  4 (run/jog), 7-2 to 7-4, 7-14
  3 (reset), 7-2 to 7-4, 7-15
  2 (stop), 7-2 to 7-4, 7-15
  1 (start), 7-2 to 7-4, 7-15
Digital output wiring, *see* Status Relays
Dimensions, 3-3
Disconnect, installing A-C input, 5-2 to 5-3
Display, *see* Keypad/Display
Distribution system capacity, A-C line maximum, 5-1
Drive,
  identifying, 2-1
  kits, 2-11

E

Emergency stop, 7-5
EN-60204-1 compliance, 7-5, C-1 to C-2
Encoder motor
  specifications, A-2
  wiring, 2-8 to 2-9, 7-1, 7-6 to 7-8
  see also Speed Feedback
Environmental conditions, 3-1, A-1

F

Fan, 2-2 to 2-3
Faults, 9-1
Form A contacts, *see* Status Relays
Form B contacts, *see* Status Relays
Forward (digital input 6), 2-8 to 2-9, 7-2 to 7-4, 7-13
Frequency, carrier, 2-4, A-1
Frequency, line, A-1

Function loss (digital input 5), 2-8 to 2-9, 7-2 to 7-4, 7-14
wiring, 7-3 to 7-4, 7-14
Fuse
A-C input, 3-5, 5-2

G

Grounding, 4-2 to 4-3, 5-2

H

Humidity, 3-1, A-1

I

Inductor, output, see Output Reactor
Input specifications, terminal strip, A-2
Input, A-C, see A-C Input
Input, digital, see Digital Input Wiring
Installation
A-C input disconnect, 5-2 to 5-3
checking, 8-1 to 8-2
completing, 8-1 to 8-2
encoder, 7-6 to 7-8
fuses, A-C input line branch circuit, 3-5, 5-1 to 5-2
input isolation transformer, 5-1
IQ-550 Positioning module, 7-16 to 7-19
mechanical motor overload protection, 6-1
output contactors, 6-1
planning, 3-1 to 3-6
requirements, 3-1 to 3-6
transformers and reactors, 5-1
IQ-550 Positioning module, 7-16 to 7-19

J

Jog (digital input 4), 2-8 to 2-9, 7-2 to 7-4, 7-14
Jumpers
J4, 2-6 to 2-7
J17, 2-6 to 2-8
location of, 2-5
settings for, 2-6 to 2-8

K

Keypad/display, 2-2 to 2-3, 2-10
Kits
Motor Encoder Cable, 2-11, 7-6
Snubber Resistor Braking, 2-11
Snubber Transistor Only, 2-11

L

Lead lengths, motor, 3-5
LEDs, 2-10
Line branch circuit fuses, A-C input, 3-5, 5-2
Line frequency, A-1
Line noise, avoiding, 5-1
Local (digital input 8), 2-8 to 2-9, 7-2 to 7-4, 7-11
Loss, function, see Function Loss

M

Maximum A-C line distribution system capacity, 5-1, A-1
Mechanical motor overload protection, 6-1
Meter output, 2-8 to 2-9, 7-1, 7-9
Model numbers, 2-1
MOP (motor operated potentiometer), 7-11 to 7-13
Motor
Encoder Cable kit, 2-11, 7-6
lead lengths, 3-5
overload protection, mechanical, 6-1
wiring, 6-1
Mounting dimensions, 3-3 to 3-4

O

Open-loop operation, see Volts/Hertz Regulation
Operating conditions, 3-1, A-1
Option kits, see Kits
Output
analog, see Analog Output
contactors, 6-1
digital, see Status Relays
inductor, see Output Reactor
specifications, terminal strip, A-2
Overload, motor, 6-1

P

Parts
location, see Component Locations
Planning
drive clearances, 3-2 to 3-3
location, 3-1
Power
output, wiring, 3-4 to 3-6, 4-1 to 4-4
input, wiring, 3-4 to 3-5, 4-1 to 4-4, 5-1 to 5-3
Power Module
checking, 8-2
verifying output current rating, 3-4
Power terminals
torque specifications, 5-3
wiring, 3-5 to 3-6, 4-1 to 4-4, 5-1 to 5-3, 6-1 to 6-2

Protection, mechanical motor overload, 6-1
Publications, related, 1-2

R

Ramp1/ramp2 (digital input 7), 2-8 to 2-9, 7-2 to 7-4, 7-12
Ratings
  A-C input, 2-1
  power, 2-1
  fuse, 3-5
Regulation, drive
  vector, block diagram, B-3
  volts/hertz, block diagram, B-2
Regulator board, 2-4 to 2-10
Relays, output status, *see* Status Relays
Remote (digital input 8), 2-8 to 2-9, 7-2 to 7-4, 7-11
Reset (digital input 3), 2-8 to 2-9, 7-2 to 7-4, 7-15
Resistor
  Snubber, Braking kit, *see* Kits
Reverse (digital input 6), 2-8 to 2-9, 7-2 to 7-4, 7-13
Routing, wiring, 4-1 to 4-4
RS-232, 2-8 to 2-9, 7-1, 7-9
Run (digital input 4), 2-8 to 2-9, 7-2 to 7-4, 7-14

S

Selecting operation, *see* Control Source
Site requirements, 3-1
Snubber resistor braking, 2-11, 5-1
  kit, 2-11
Snubber Transistor Only kit, 2-11
Specifications
  conduit opening sizes, 4-2 to 4-3
  dimensions, 3-3
  encoder, 7-6 to 7-8, A-2
  environmental, 3-1, A-1
  inputs, terminal strip, A-2
  outputs, terminal strip, A-2
  speed feedback, A-2
  torque ratings, 5-3
  wire sizes, 3-4 to 3-5
Speed feedback,
  specifications, A-2
  wiring, 2-8 to 2-9, 7-1, 7-6 to 7-8
Start (digital input 1), 2-8 to 2-9, 7-2 to 7-4, 7-15
Status relays, Form A/B, 2-4, 2-8 to 2-9, 7-2 to 7-4, 7-16
Stop (digital input 2), 2-8 to 2-9, 7-2 to 7-4, 7-15
Stopping the drive, 7-5
Switch, membrane, *see* Keypad/Display

T

Terminal strip
  wiring, 2-8 to 2-9, 3-4, 7-1 to 7-19
  input specifications, A-2
  output specifications, A-2
  torque specifications, 5-3
  wire sizes, 3-4
Transformer
  isolation input, installing, 5-1
Transients, A-C line voltage, 5-1

V

Vector regulation, B-1
  block diagram, B-3
Ventilation, *see* Air Flow
Volts/hertz regulation, B-1
  block diagram, B-2

W

Watts loss rating, 2-1, 4-1
Weights, 3-3

Manufacturer's Declaration

Manufacturer:

Reliance Electric Industrial Co.
24701 Euclid Avenue
Cleveland, Ohio 44117 – USA

declares that the product:

VEC-200, A-C Speed Controller for Electric Motors

- *is intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by Directive 89/392/EEC, as amended;*

and that

- *the following harmonized standards have been applied:*

EN 60204-1: Electrical equipment of industrial machines – Part 1: General Requirements

and furthermore declares that the product covered by this Declaration must not be put into service until the machinery into which it is to be incorporated or of which it is a component has been found and declared to be in conformity with the provisions of Directive 89/392/EEC and with national implementing legislation, i.e., as a whole, including the product referred to in this Declaration.

Authorized Representative of the Company:

Place: ***Reliance Electric Industrial Co., Cleveland, Ohio 44117, USA***

Date: ***January 1, 1995***

Signature: 

Name: ***Thomas R. Lenk***

Position: ***Product Development Engineering Manager***

Mail or Fax: **RELIANCE MOTION CONTROL**
Technical Support Group
6950 Washington Avenue South
Eden Prairie, MN 55344
Fax: 612-942-3536

Technical Writing Internal Use.
DIF #_____

RELIANCE MOTION CONTROL

DOCUMENTATION IMPROVEMENT FORM

Manual Number: ___

Page Number:_____

Comments: Please give page numbers and specific paragraphs that the change will affect. Include markups from the document or attach additional pages if necessary.

What improvements will this suggestion provide?_____

Originator:_____ City:_____ State:_____ Zip:_____

Company:_____ Phone:_____

Address:_____ Date:_____

Technical Writing Internal Use

Follow-Up Action

_____

Thank you for your comments . . .

MOTION CONTROL
RELIANCE ELECTRIC

No Postage
Necessary
If Mailed
In The
United States

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 790 EDEN PRAIRIE, MN

POSTAGE WILL BE PAID BY ADDRESSEE

RELIANCE MOTION CONTROL
6950 WASHINGTON AVE S
EDEN PRAIRIE MN 55344-9768

VEC-20
Vector Drive
Hardware Reference,
Installation, and Troubleshooting

0013-1026-001 Revision A

D2-3325-1

Reliance Motion Controls, Inc. / 6560 Washington Avenue South / Eden Prairie, MN 55344 / 612-942-3600 / 800-535-3593

MOTION CONTROL
RELIANCE ELECTRIC