Chapter 2

PRE-INSTALLATION PLANNING

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Chapter 2 PRE-INSTALLATION PLANNING

INTRODUCTION

This chapter contains a functional description of the 620 Vector Drive to enable a sound understanding of the system, and notes for consideration prior to installation.

FUNCTIONAL OVERVIEW

The 620 Vector enables very high performance control of 3-phase AC induction motors fitted with a compatible encoder. It offers the user great system flexibility, allowing easy integration into various control schemes. The plain language Man-Machine Interface (MMI) greatly simplifies setting up and commissioning the 620 Vector.

A simplified block diagram of a 620 is shown in Figure 2.2. This illustrates the basic internal arrangement of the drive with the circuitry split between the control circuits and power circuits.

The control circuits are common to all types of the 620 Vector Drive.

Chassis types 5 and 7 use a slightly different power circuit from types 4 and 6. The general principles of operation remain the same, however.

Control Circuits and Software

The control circuits and software element contain the intelligence of the 620 Vector series. They comprise a sophisticated microprocessor system with digital and analogue inputs and outputs, the MMI and circuits to interface between the microprocessor and the inverter circuits.

Speed feedback signals from the motor shaft encoder are processed by the microprocessor to determine the rotational speed of the shaft. An PI algorithm within the software uses this information to produce varying gate drive signals to the inverter circuits. These signals cause the inverter to output the required voltage and frequency for a particular motor speed.

Analogue inputs to the microprocessor are digitised and can be used to set parameters such as speed.

Digital inputs to the microprocessor signal various commands and conditions such as stop, start and required direction of rotation.

Digital outputs from the microprocessor (e.g. Health) can be used by external control equipment.

A detailed block diagram of the logical blocks which comprise the control circuits and software is shown in Figure 2.5.

Power Circuits

The 3-phase supply input on terminals L1, L2 and L3 is rectified to give a DC output to the DC Link capacitors, which smooth the DC power. The DC power is fed to the inverter circuits, which convert the fixed voltage DC into three phase variable frequency and voltage drive outputs to the motor. The frequency and voltage are set by the gate drive signals from the microprocessor.

During motor deceleration or at other times when the motor acts as a generator, energy flows from the motor into the DC link capacitors and causes the DC link voltage to rise. The drive will trip if the DC link voltage rises above a pre-set level, to avoid damage to the drive.

Dynamic Braking

If the dynamic braking option is fitted, an external brake resistor is switched across the DC Link by the Dynamic Brake Switch to dissipate the excess energy and prevent the drive from tripping.

Chapter 3 describes the power and resistance rating requirements for the dynamic braking resistor.

Built-in diagnostics

Number and logic diagnostics are values and settings that can be displayed via the diagnostic menu within the MMI. These values are read-only and are provided for the user to determine operating or fault conditions. Refer to Chapter 6 for further information and descriptions of the diagnostics.

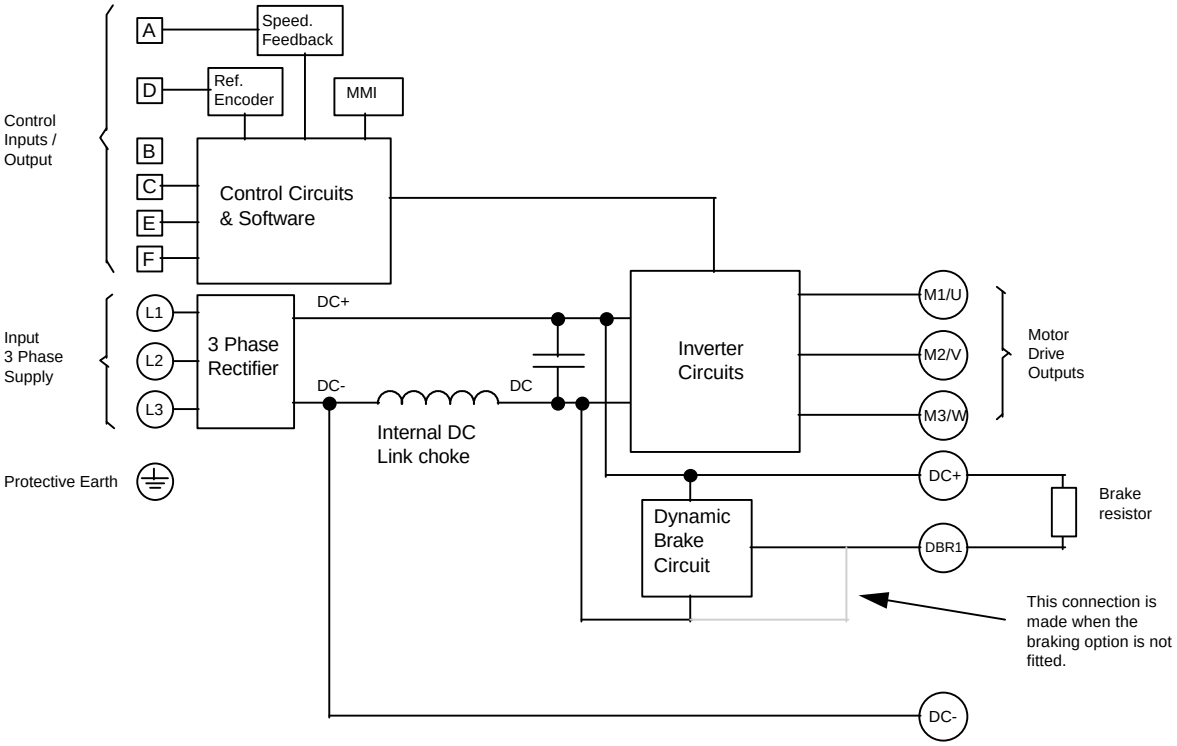

Figure 2.1 - Type 4 Simplified Block Diagram

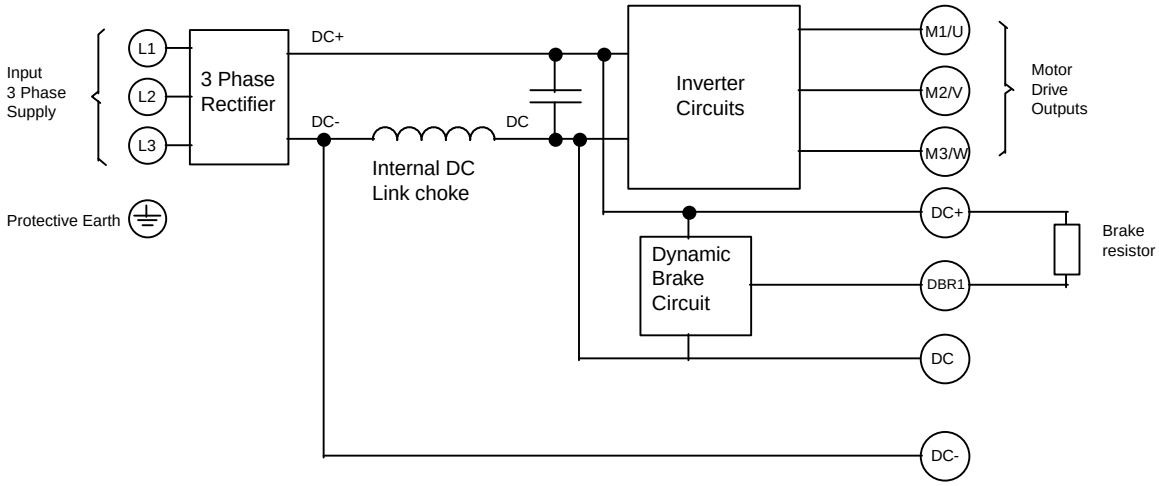

Figure 2.2 - Type 5 Simplified Block Diagram

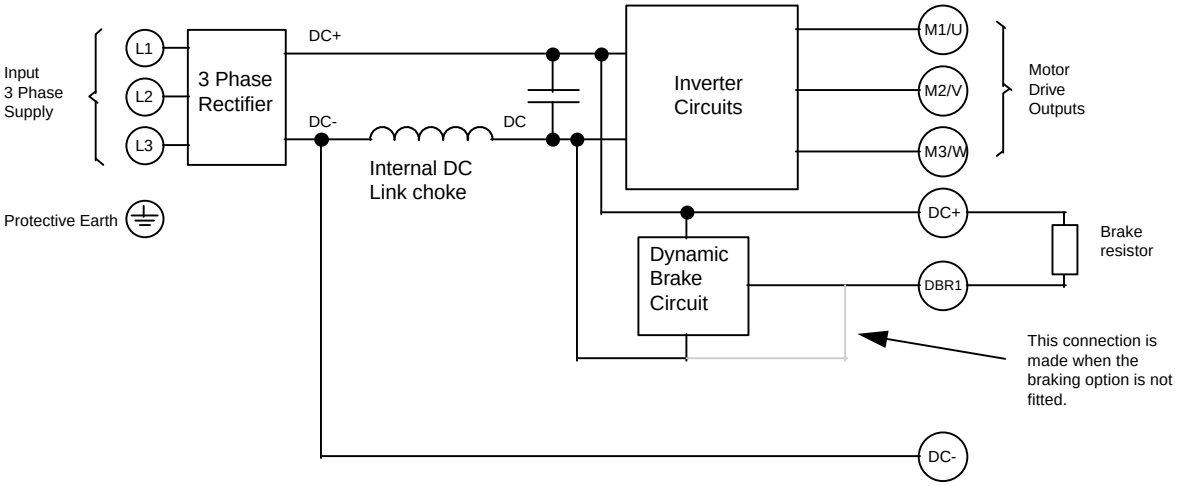

Figure 2.3 - Type 6 Simplified Block Diagram

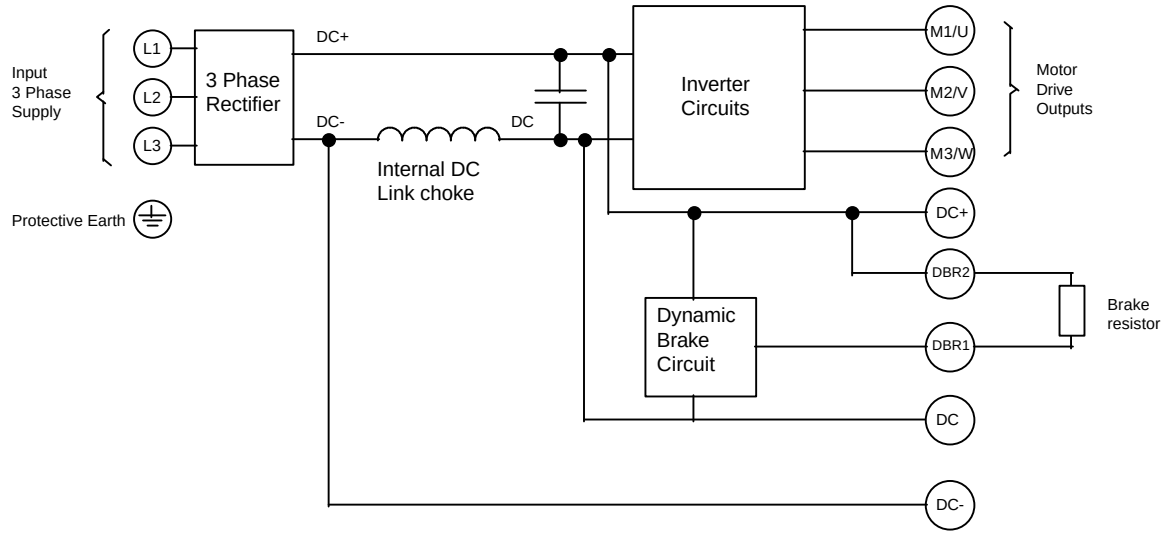

Figure 2.4 - Type 7 Simplified Block Diagram

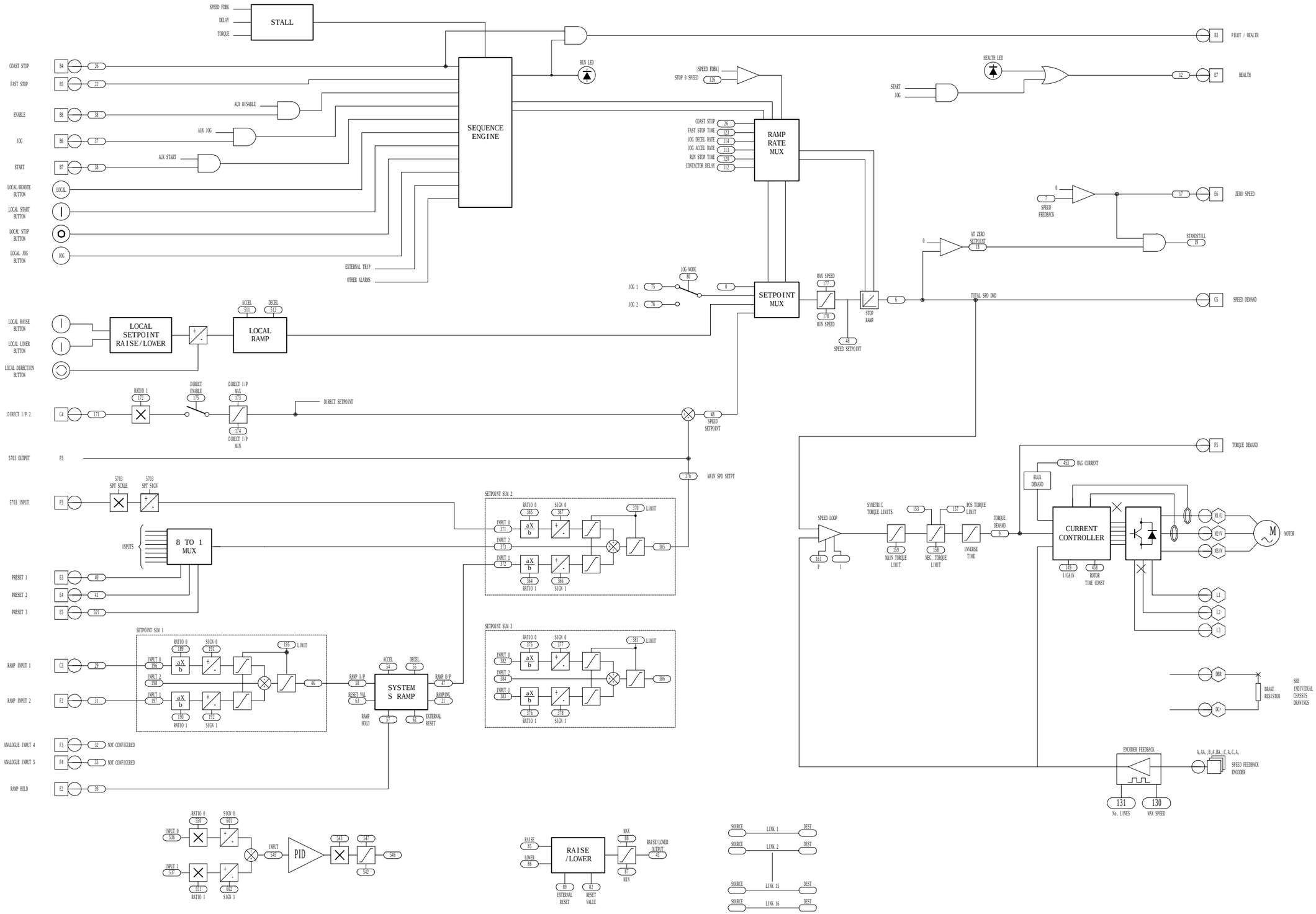

Figure 2.5 Functional Block Diagram

INSTALLATION WIRING DIAGRAMS

This section shows all the necessary wiring details for connecting up a 620 Vector series drive.

Figure 2.6 shows the minimum configuration required for basic operation of the Drives.

Figure 2.7 shows a full connection diagram to utilise all the features of the Drives.

All the 620 Vector Drives are wired similarly. The main difference between the variants (other than power rating and physical size) is the capacity of the upstream circuit breaker (MCB1 in Figure 2.7) and the layout of the power terminals. The MCB details are listed in Table 2-1, and the power terminals are shown in Figures 2.10 to 2.13.

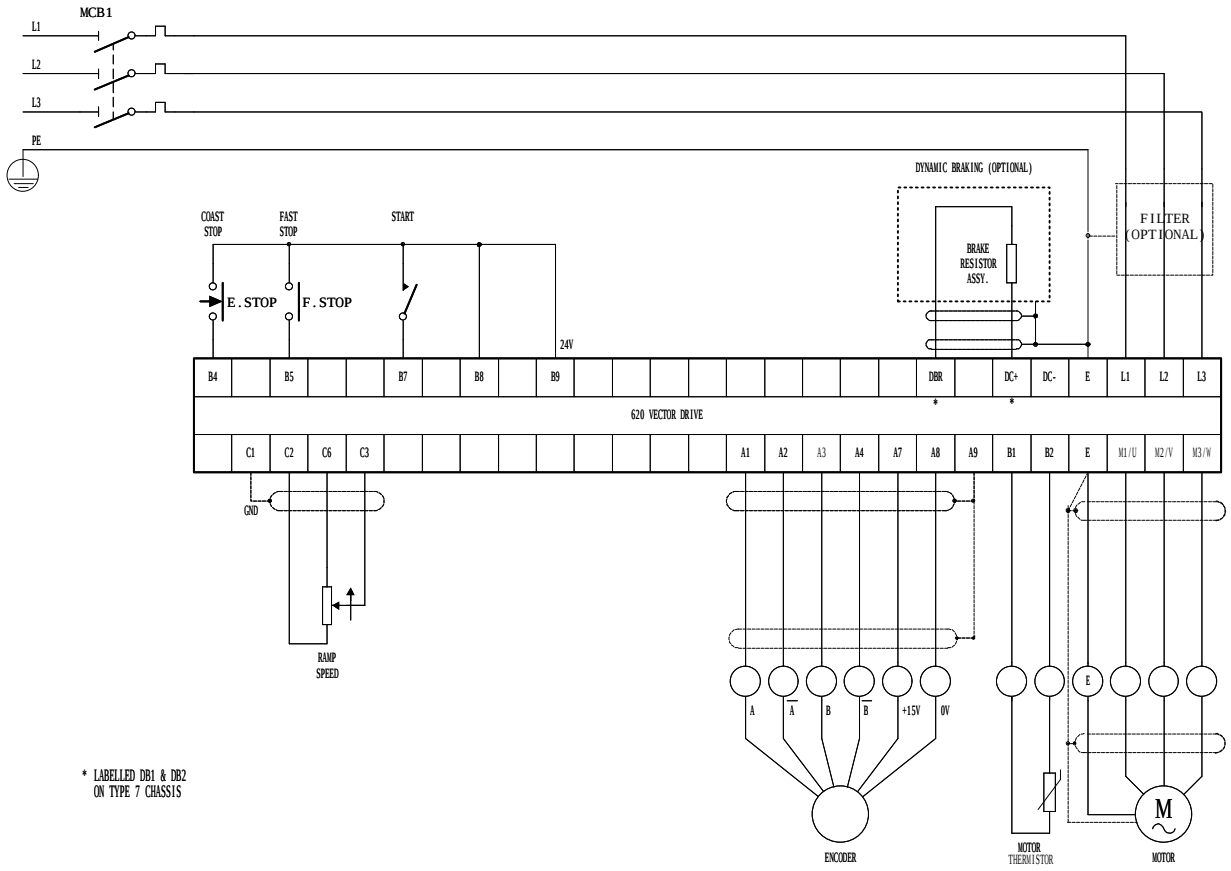

Figure 2.6 - Minimum wiring configuration for 620 series drives

Full Installation

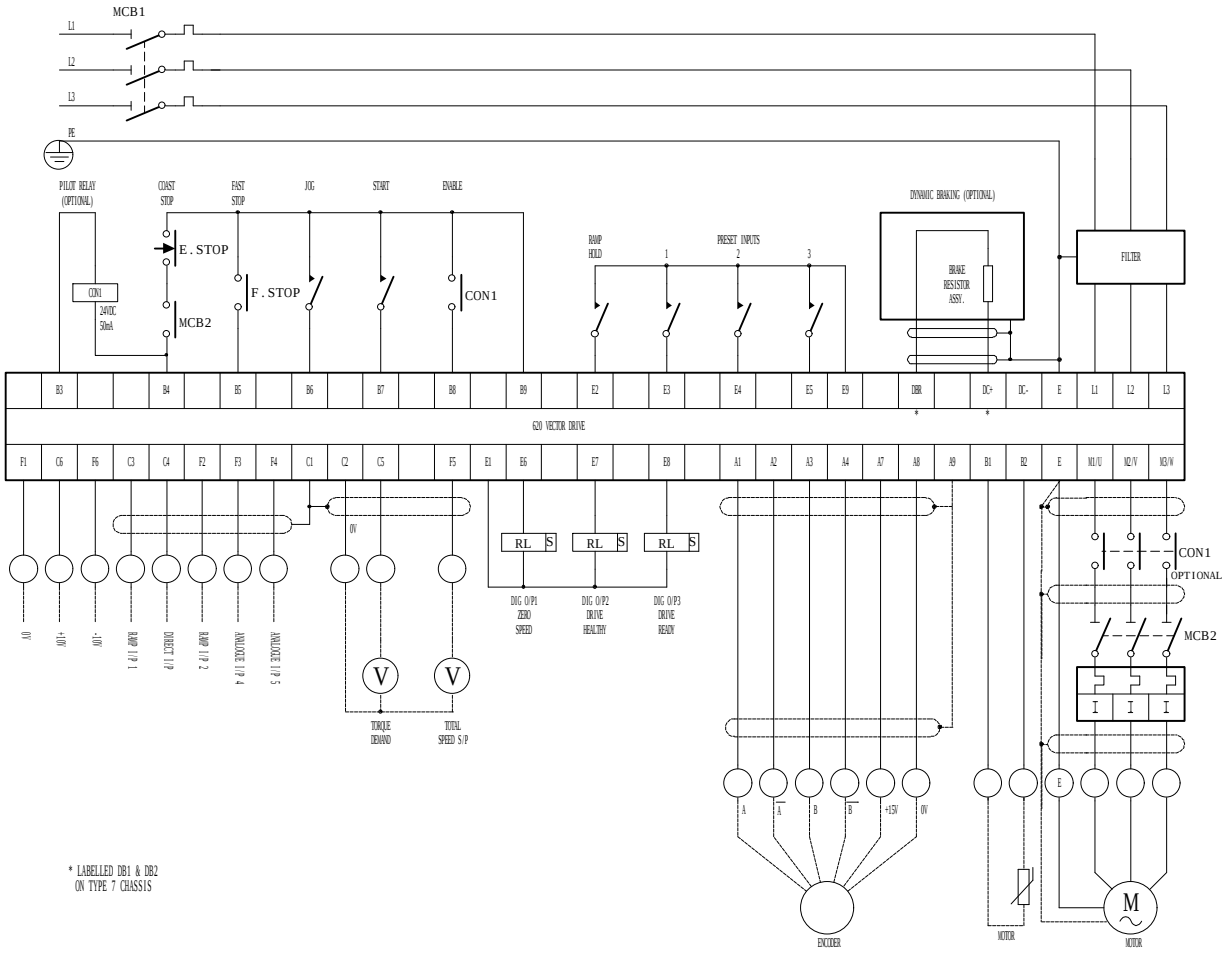

Figure 2.7 - Full wiring diagram for 620 series drives

Differences between Drives

Each of the drive variants requires different rating breakers for MCB1. The requirements are shown in Table 2-1. (Entries with N/A indicate that the drive rating is not available for that type at that voltage.)

MCB2 should be rated according to the full load current of the motor.

Table 2-1 MCB requirements

Type	Power (kW)	208-240v	380-460v
4	0.75	10 A	10 A
	1.1	10 A	N/A
	1.5	10 A	20 A
	2.2	20 A	10 A
	4.0	20 A	20 A
	5.5	N/A	20 A
	7.5	N/A	20 A
	5.5	30 A	N/A
5	7.5	40 A	N/A
	11.0	N/A	32 A
	15.0	N/A	40 A
6	11.0	63 A	N/A
	15.0	100 A	N/A
	18.0	N/A	50 A
	18.5	100 A	N/A
	22.0	N/A	63 A
	30.0	N/A	100 A
	37.0	N/A	100 A
7	22.0	125 A	N/A
	30.0	160 A	N/A
	37.0	200 A	N/A
	45.0	N/A	125 A
	55.0	N/A	160 A
	75.0	N/A	200 A

TERMINAL DESCRIPTIONS

Terminals are provided for both the control and power connections to allow reliable connections with external devices and power supplies. The function of these terminals is described in tables 2.2 to 2.7.

Control Board Terminals

The control board terminals are identical for all variants of the 620 Vector Drive. The layout of the control board terminals is given in Figure 2.9, and the functions are described in Table 2.5. See Chapter 1 "**ELECTRICAL RATINGS**" for control terminal specification.

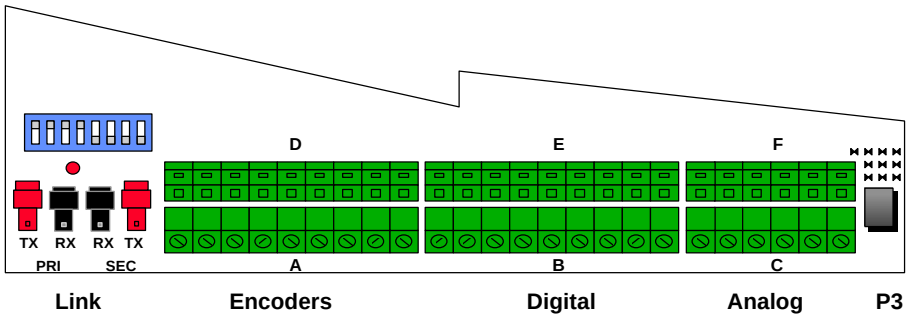

Figure 2.8 - Control Board Terminals

	Front / Lower	Back / Upper	
Link Fibre Optics. (620L only)	Red	N/A	Transmit Primary
	Black	N/A	Receive Primary
	Black	N/A	Receive Secondary
	Red	N/A	Transmit Secondary

	Feedback Encoder			**Reference Encoder (620Adv & 620L only)**	
	A	1	1	A	
	/A	2	2	/A	
	B	3	3	B	
	/B	4	4	/B	
A	Z	5	5	Z	**D**
	/Z	6	6	/Z	
	Power (15v)	7	7	Power (15v)	
	0v	8	8	0v	
	GND	9	9	GND	
	Digital I/O			**Aux. Digital I/O**	
	Thermistor 0v	1	1	0v	
	Thermistor	2	2	Digital I/P 1	
	Pilot / Health	3	3	Digital I/P 2	
	Coast Stop	4	4	Digital I/P 3	
B	Fast Stop	5	5	Digital I/P 4	**E**
	Jog	6	6	Digital O/P 1	
	Start	7	7	Digital O/P 2	
	Enable	8	8	Digital O/P 3	
	24v	9	9	24v	
	Analogue I/O			**Aux. Analogue I/O**	
	GND	1	1	0v	
	0v	2	2	Analogue I/P 3	
	Ramp I/P 1	3	3	Analogue I/P 4	
C	Direct I/P 2	4	4	Analogue I/P 5	**F**
	Analogue O/P 1	5	5	Analogue O/P 2	
	+10v	6	6	-10v	

Figure 2.9 - 620 Terminal Layout

Table 2.2 - Control Board Terminal Descriptions

Terminal Number	Terminal Description - *Feedback Encoder*
A1	A Channel A
A2	/A
A3	B Channel B
A4	/B
A5	Z Channel Z
A6	/Z
A7	15v Isolated Power supply for an encoder, connected internally to D7
A8	0v Isolated Power for an encoder, connected internally to D8
A9	GND connected internally to D9
NOTES	• For improved noise immunity run an individually shielded twisted pair per channel from the drive to the encoder. • In the case of a single-ended encoder, connect /A, /B and /Z from the drive to 0v at the encoder end. • See also DIP Switches page 12 • For electrical ratings, refer to Chapter 1.

Terminal Number	Terminal Description - *Digital I/O (Default configuration)*
B1	Thermistor/Microtherm 0v Terminals B1 and B2 must be linked if over temperature sensors are not used. The use of a motor temperature sensor is always recommended.
B2	Thermistor/Microtherm It is good practice to protect AC motors against sustained thermal overloads by fitting temperature sensitive resistors (thermistors) or switches in the windings of the machine. Thermistors have a low resistance (typically 200Ω) up to a reference temperature (125°C). Above this temperature, their resistance rises rapidly to greater than 2000Ω. Motor over temperature sensors should be connected in series between terminals B1 and B2. A motor over temperature alarm will be indicated if the external resistance between B1 and B2 exceeds 2.6kΩ ±200Ω. The alarm is reset at 1.1kΩ ±200Ω.

Terminal Number	Terminal Description - *Digital I/O (Default configuration)*
B3	Pilot/Health (Open Collector 50mA Sink) This output may be used to drive a pilot relay for an output contactor. The contactor will be brought in on power up or by a drive start by software. It is dropped out unconditionally, bypassing the software if COAST STOP (B4) is low or open circuit. It will also drop out in the event of an alarm becoming active.
B4	Coast Stop When the Coast Stop input is at +24v, the drive operates normally. When the Coast Stop is at 0v or open circuit, the drive no longer operates. The motor coasts to rest.
B5	Fast Stop When the Fast Stop input is held at 24v, the drive operates as required by the inputs. When the Fast Stop is at 0v or open circuit, the drive provides a controlled or fast stop as defined by the Fast Stop parameters.

Table 2.2 - Control Board Terminal Descriptions (Continued)

Terminal Number	Terminal Description - *Digital I/O (continued)*
B6	Jog[1] When the Jog input is held at 24v the drive jogs, provided input B7 (Start) is held low and B4 (Coast Stop), B8 (Enable) & B5(Fast Stop) are held high. When the Jog input is removed the drive will ramp down to zero at the Jog Ramp Rate.
B7	Start [2] When a high input is applied to this terminal the drive will operate provided there are no alarms, B6 (Jog) is held low, B4 (Coast Stop), B8 (Enable) & B5(Fast Stop) are held high. When the input is removed the drive will perform a regenerative stop to zero speed.
B8	Enable The Enable input provides a means of electronically inhibiting drive operation. If the enable input is low (false) all control loops[3] will be inhibited and the drive will not function.
B9	+24v power Internally generated +24v supply which can be used for digital inputs. Maximum load is 200mA.

Terminal Number	Terminal Description - *Analogue I/O (Default configuration)*
C1	GND Analogue screen connection.
C2	Signal 0v
C3	Ramp I/P 1 A bi-directional input that is summed with F2 to form the input to the System Ramp. +10v = Full speed - 10v = Reverse full speed
C4	Direct I/P 2 Trim input direct into speed loop with high speed coupling. Used for external loops, i.e. position controllers. +10v = 100% Speed trim - 10v = -100% Speed trim
C5	Analog O/P 1 Speed feed-back
C6	+10v Voltage reference

Terminal Number	Terminal Description - *Reference Encoder (620L version only)*
D1	A Channel A
D2	/A
D3	B Channel B
D4	/B
D5	Z Channel Z
D6	/Z
D7	15v Isolated Power supply for an encoder, connected internally to A7
D8	0v Isolated Power for an encoder, connected internally to A8
D9	GND connected internally to A9
NOTES	• For improved noise immunity run an individually shielded twisted pair per channel from the drive to the encoder. • In the case of a single-ended encoder, connect /A, /B and /Z from the drive to 0v at the encoder end. • See also DIP Switches page 12 • For electrical ratings, refer to Chapter 1.

[1] Jog is not operational in local mode.

[2] Start is not operational in local mode.

[3] Except the PID

Table 2.2 - Control Board Terminal Descriptions (Continued)

Terminal Number	Terminal Description - *Aux. Digital I/O (Default Configuration)*
E1	0v 0v for digital inputs.
E2	Digital I/P 1 (RAMP HOLD) If the input is held true, the System Ramp output is frozen at the last value irrespective of the Ramp Setpoint Input. When false, the System Ramp output follows the Ramped Setpoint with a delay determined by the Ramp time parameters. Ramp Hold is overridden by Ramp Reset.
E3 E4 E5	Digital I/P 2,3,4 (PRESET SELECT 1, 2, 3) These digital inputs are used to select 1 of 8 preset inputs as shown below: SELECT 3 / 2 / 1 — Preset Selection 0v / 0v / 0v — **PRESET 1** selected 0v / 0v / 24v — **PRESET 2** selected 0v / 24v / 0v — **PRESET 3** selected 0v / 24v / 24 — **PRESET 4** selected ... / ... / ... — ... 24v / 24v / 24v — **PRESET 8** selected The preset inputs are set using the MMI. By default the presets are connected to one of the speed demand inputs.
E6	Digital O/P 1 (ZERO SPEED) Default configuration. Active High at Zero speed. .
E7	Digital O/P 2 (Health) Default configuration. Active High while the drive is Health or START / JOG are low.
E8	Digital O/P 3 (Ready) Default configuration. Active High once the drive has successfully completed is pre-start checks and if Enabled will run.
E9	+24v power as terminal B9

Terminal Number	Terminal Description - *Aux. Analogue I/O*
F1	0v
F2	Analog I/P 3 Default configuration. Ramped input 2, a bi-directional input that is summed with C3 to form the input to the System Ramp. +10v = Full speed - 10v = Reverse full speed
F3	Analog I/P 4 Not configured by default.
F4	Analog I/P 5 Not configured by default.
F5	Analog O/P 2 Default configuration. Torque demand output. +10v = 150% forward output torque - 10v = 150% reverse output torque
F6	-10v Voltage reference

DIP Switches

The control PCB also houses a set of dual in-line package (DIP) switches, located to the left of the terminals. The twelve switches are numbered, starting with 1 on the left.

The switches are ON when in the UP position (towards the centre of the drive) and OFF when in the DOWN position (towards the edge of the drive).

Switches 1 to 4 are only significant on 620 Link versions of the drive, which are equipped with fibre-optic communications facilities. The switches control the transmitter output power as follows:

Table 2.3 Transmitter Power DIP Switches

TX Power	TX1 (left)		TX2 (right)	
	Switch 1	Switch 2	Switch 3	Switch 4
Low	Off	don't care	Off	don't care
Medium	On	Off	On	Off
High	On	On	On	On

Switches 5 and 6 are not used.

Switches 7 to 9 control the threshold sensitivity for the feedback encoder: switch 7 controls the A input, switch 8 the B input and 9 the Z input. Switches 10 to 12 control threshold sensitivity for the reference encoder (optional): switches 10 controls the sensitivity for the A input, switch 11 the B input and 12 the Z input.

When the switches are set ON, threshold sensitivity is 4V ± 1V.

When the switches are set to OFF, threshold sensitivity is 9V ± 1V.

Usually the switches will be set to give a threshold of 4V when using a differential encoder, and to 9V when using a single ended encoder.

Power Terminals

WARNING

ELECTRIC SHOCK HAZARD

THE POWER TERMINALS CARRY ELECTRICAL POWER WHICH CAN BE LETHAL. ISOLATE ALL POWER SUPPLIES AND THEN WAIT AT LEAST 3 MINUTES BEFORE REMOVING THE TERMINAL COVER OR WORKING ON ANY CONTROL EQUIPMENT OR MOTORS.

620 Type 4

Table 2.4 - 620 TYPE 4 Power Board Terminals

Terminal	Terminal Description
M1/U, M2/V, M3/W	Power outputs forming the 3-phase supply connection for the motor.
DC-	Power input/output. This terminal is used in conjunction with the DC+ terminal only when two or more controllers are coupled together. It carries a negative DC link voltage.
DC+	Power input/output. This terminal is used for connection to a braking resistor. It is also used in conjunction with the DC- terminal when two or more controllers are coupled together. It carries a positive DC link voltage (typically 600V referred to terminal DC-).
DBR1	Power input/output for the connection of a dynamic braking resistor. Refer to "DYNAMIC BRAKING" for further details. This terminal is connected to the negative side of the link capacitor when the brake option is not fitted.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, 380 - 460V ± 10% or 208 - 240V ± 10% AC line-to-line.
⏚	Power earth. This terminal must be connected to a protective earth (ground).
	See Chapter 1, "MECHANICAL DETAILS" for tightening torque

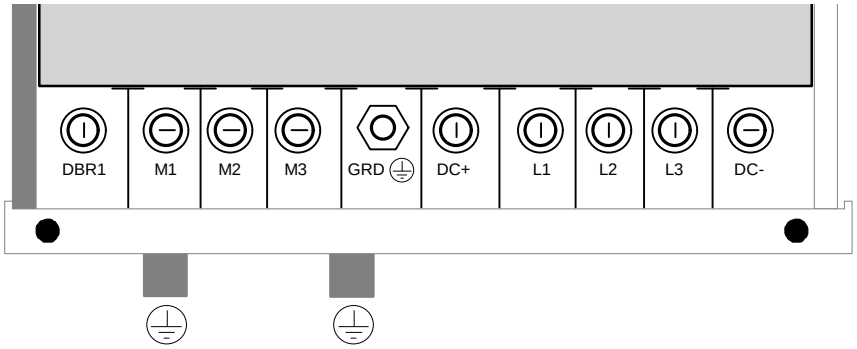

Figure 2.10 - 620 Type 4 Power Terminals

620 Type 5

Table 2.5 - 620 Type 5 Power Board Terminals

Terminal	Terminal Description
M1/U, M2/V, M3/W	Power outputs forming the 3-phase supply connection for the motor.
DC-	Power input/output. This terminal is used in conjunction with the DC+ terminal when two or more controllers are coupled together. It carries a negative DC link voltage.
DC+	Power input/output. This terminal is used for connection to a braking resistor. It is also used in conjunction with the DC- terminal when two or more controllers are coupled together. It carries a positive DC link voltage (typically 600V referred to terminal DC-).
DC	Power input/output. This terminal is connected to the negative side of the D.C. link capacitor. **No customer connection must be made to this terminal.**
DBR1	Power input/output for the connection of a dynamic braking resistor. Refer to "**DYNAMIC BRAKING**" for further details. This terminal is connected to the negative side of the link capacitor when the brake option is not fitted.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, 380 - 460V ± 10% or 208 - 240V ± 10% AC line-to-line.
⏚	Power earth. This terminal must be connected to a protective earth (ground).
See Chapter 1, "**MECHANICAL DETAILS**" for tightening torque	

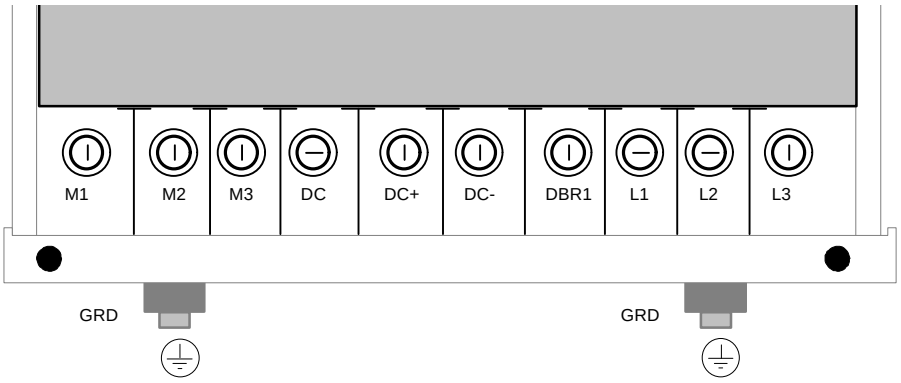

Figure 2.11 - 620 Type 5 Power Terminals

620 Type 6

Table 2.6 - 620 TYPE 6 - Power Terminals

Terminal	Terminal Description
M1/U, M2/V, M3/W	Power outputs forming the 3-phase supply connection for the motor.
DC-	Power input/output. This terminal is used in conjunction with the DC+ terminal when two or more controllers are coupled together. It carries a negative DC link voltage.
DC+	Power input/output. This terminal is used for connection to a braking resistor. It is also used in conjunction with the DC- terminal when two or more controllers are coupled together. It carries a positive DC link voltage (typically 600V referred to terminal DC-).
DBR1	Power input/output for the connection of a dynamic braking resistor. Refer to "DYNAMIC BRAKING" for further details. This terminal is connected to the negative side of the link capacitor when the brake option is not fitted.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, 380 - 460V ± 10% or 208 - 240V ± 10% AC line-to-line.
⏚	Power earth. This terminal must be connected to a protective earth (ground).
	See Chapter 1, "MECHANICAL DETAILS" for tightening torque

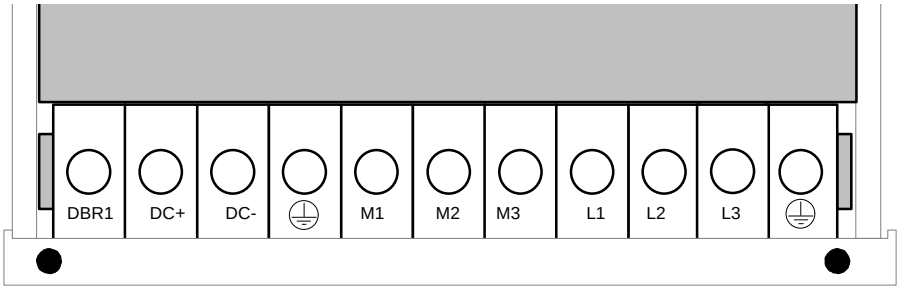

Figure 2.12 - 620 Type 6 Power Board Terminals

620 Type 7

Table 2.7 - 620 TYPE 7 - Power Terminals

Terminal	Terminal Description
M1/U, M2/V, M3/W	Power outputs forming the 3-phase supply connection for the motor.
DC-	Power input/output. This terminal is used in conjunction with the DC+ terminal when two or more controllers are coupled together. It carries a negative DC link voltage.
DC+	Power input/output. This terminal is used in conjunction with the DC- terminal only when two or more controllers are coupled together. It carries a positive DC link voltage (typically 600V referred to terminal DC-).
DBR1	Power output. This terminal is used for connection to a braking resistor. Refer to "DYNAMIC BRAKING" for further details. This terminal is connected to the negative side of the link capacitor when the brake option is not fitted.
DBR2	Power output. This terminal is used for connection to a braking resistor.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, 380 - 460V ± 10% or 208 - 240V ± 10% AC line-to-line.
⏚	Power earth. This terminal must be connected to a protective earth (ground).
	See Chapter 1, "MECHANICAL DETAILS" for tightening torque

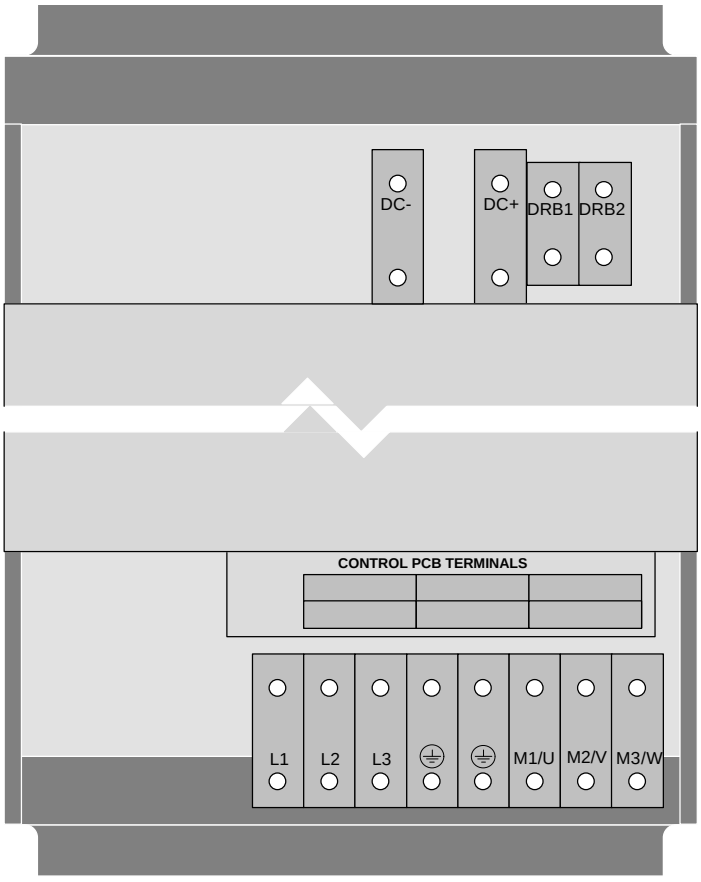

Figure 2.13 - 620 Type 7 Power Terminals

EMC

Refer to Chapter 3 for EMC Installation guidelines.

TERMINATIONS

UL Compression Lug Kit is available for the drives which provide a set of lugs suitable for the following ratings. These lugs must be applied with the correct tooling as described in the Installation Instructions provided with each Lug Kit.

The following terminal kit is available for the connection of Power Cabling.

Product	Supply Voltage	Constant Torque	Quadratic Torque	Kit No.	Lug Size	Amp Part No.
620	380 - 460V	11kW	---	LA389585	#8 AWG	52263-1
	380 - 460V	15kW	---			
	208 - 240V	5.5kW	---			
	208 - 240V	7.5kW	---			