Chapter 2

PRE-INSTALLATION PLANNING

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FUNCTIONAL OVERVIEW

Principles of Operation

584S Frequency Inverters are microprocessor based 3-phase inverters used to control the speed of standard 3-phase induction motors. An extensive range of configuration options are available to the user. A menu structure controlled using the man-machine interface (MMI) allows access to various options and adjustable parameters.

A simplified block diagram of a 584S is presented in Figure 2.1. This shows the basic internal arrangement of the drive with the circuitry split between the control circuits, and the power circuits. The functions of the control circuits are further expanded in Figure 2.2.

Power Circuits

The 3-phase supply is input on terminals L1, L2 and L3 and is rectified to give a DC output to the inverter circuits. The connection between the rectifier and inverter is called the DC link and comprises a positive and negative DC connection with an in-line choke.

Dynamic Braking

The in-line choke and DC link capacitors, smooth the DC voltage prior to input to the inverter power stage. 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 trips if the DC link voltage rises above the over voltage trip level. If the dynamic braking option is used, an external brake resistor is switched to be in parallel with the capacitors and absorbs the energy when the DC link voltage rises to the braking level. Voltage detection is performed by the control circuits and the switching is performed by the optional dynamic brake circuit. Refer to Chapter 3 for further details of the dynamic braking option.

Motor Drive Output

The inverter circuits convert the DC input to the 3 phase output used to drive the motor. The GATE DRIVE signals generated by the control circuits control the inverter circuits to reproduce the 3-phase MOTOR DRIVE OUTPUTS. The frequency and amplitude are determined by the control inputs and by the parameters set up via the MMI.

Control Circuits and Software

The control circuits and software block in Figure 2.1 are expanded in the functional block diagram Figure 2.2. This diagram shows software configuration options. It is not representative of the hardware since most of the functions are performed entirely by software.

Inputs to the control circuit are provided by physical connections to the control board terminals (identified on the left and right hand edges of the block diagram) and by parameters set via the MMI display (as explained in the "KEY" of Figure 2.2).

Parameters

Parameters are values or options that are programmed via the Setup Parameters and System menus within the MMI structure. These are usually set up during installation and commissioning and are not changed during normal operation.

Number parameters assign a value to a variable, eg. **PRESET SPEED 1** which determines the motor speed if **PRESET SPEED 1** is selected.

Logic parameters are used to control switching functions, eg. **AUTO SETPOINT SELECT** which controls a software switch to select one of a number of sources of the auto setpoint.

Refer to Chapter 4 for further information on the MMI and parameter descriptions.

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 5 for further information and descriptions of the diagnostics.

Analogue Inputs/Outputs

Analogue inputs to the control board have a range as indicated in the associated function block, eg. 0V to +10V. The range of values represented by analogue outputs can be selected or adjusted as indicated by their associated function blocks in Figure 2.2.

Digital Inputs/Outputs

Digital inputs to the control board are usually provided by external switch contacts. 0V and +24V outputs (not shown) are provided for reference purposes. Digital outputs are provided by the three relay contact pairs, two of which are programmable. Refer to Table 2.5 for further information on all control board input and outputs.

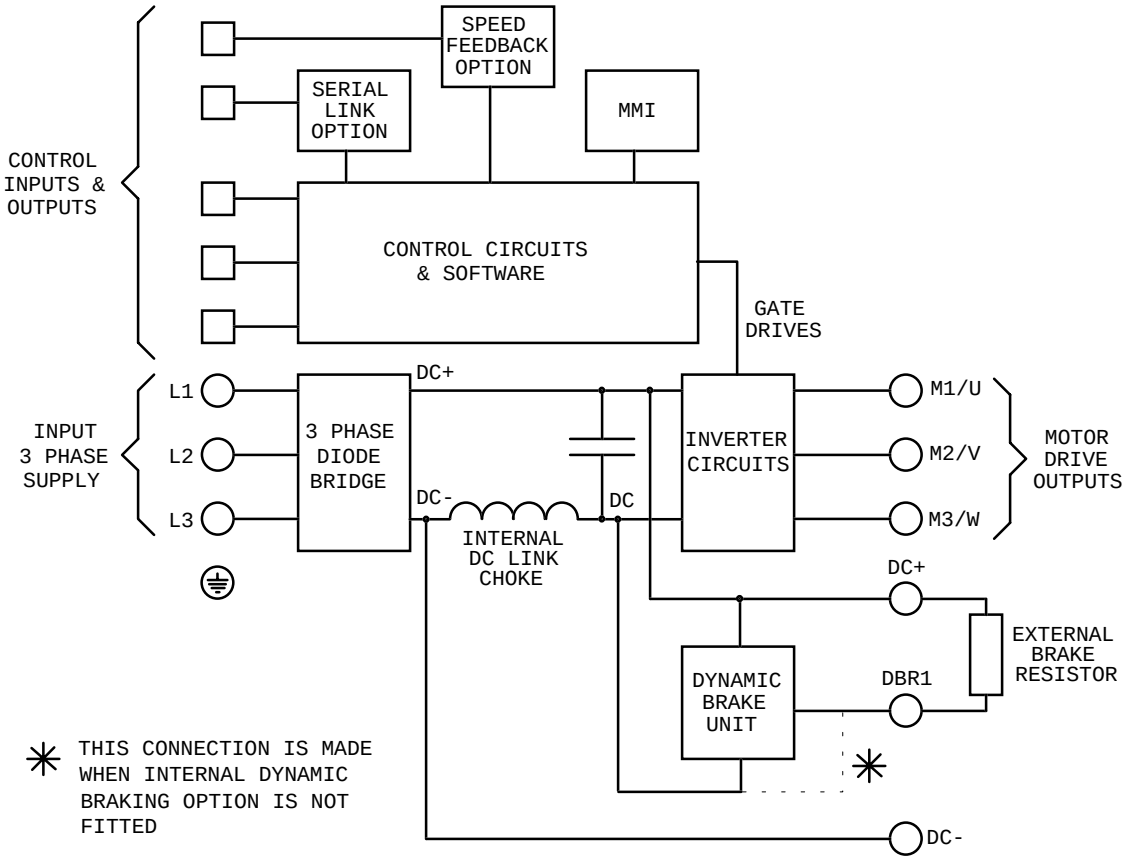

Figure 2.1A - Simplified Block Diagram (584S Type 4)

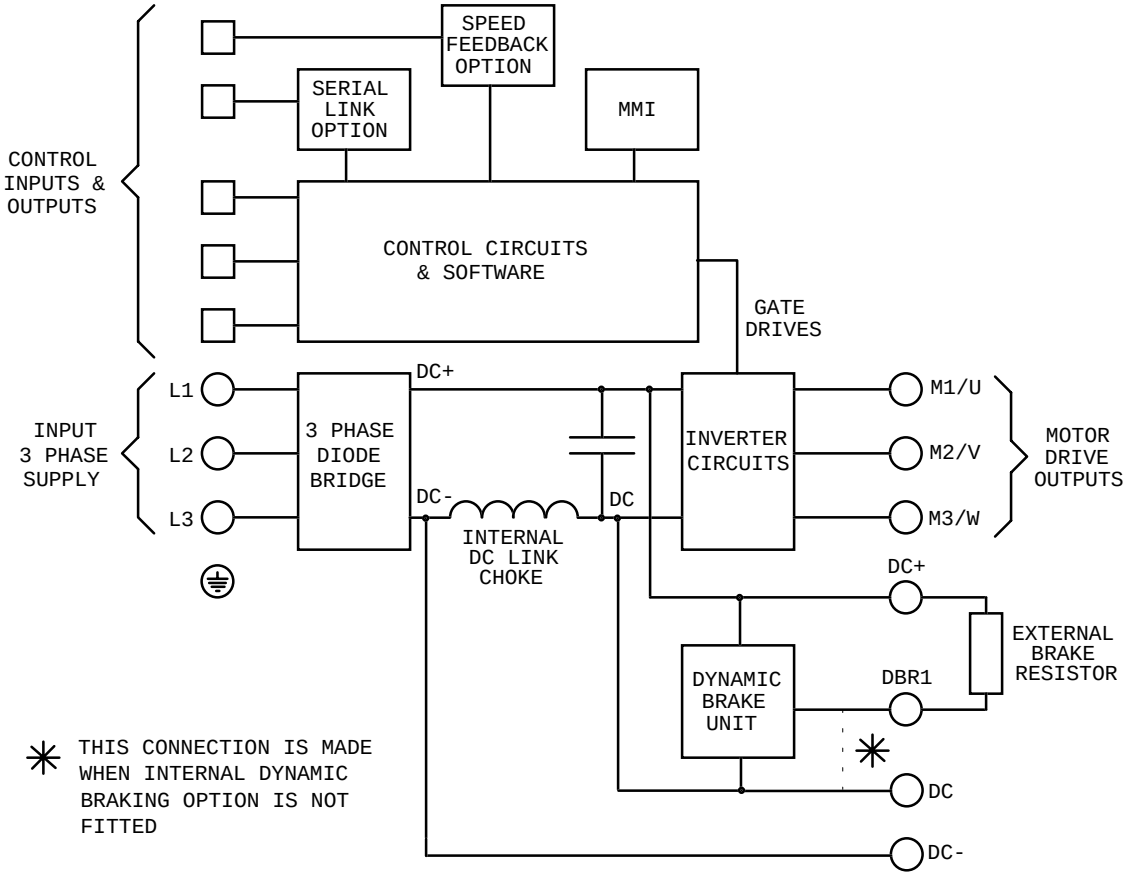

Figure 2.1B - Simplified Block Diagram (584S Type 5)

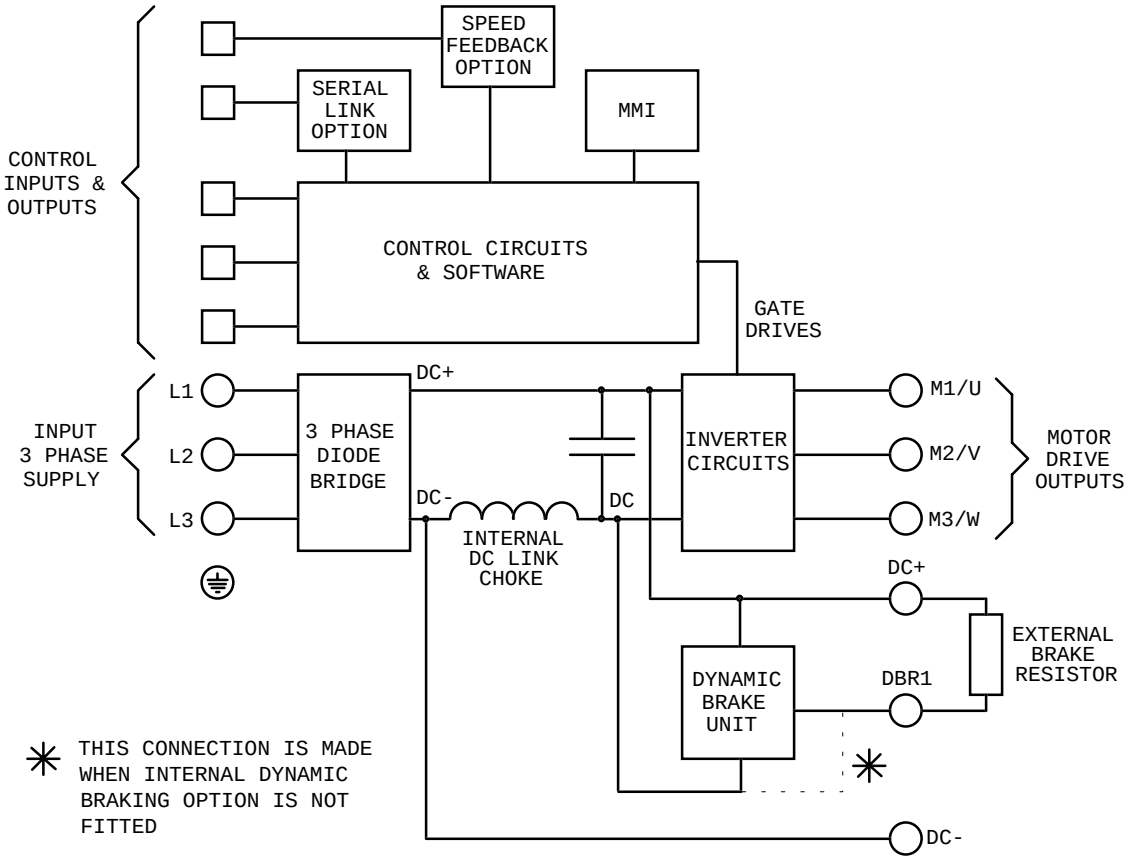

Figure 2.1C - Simplified Block Diagram (584S Type 6)

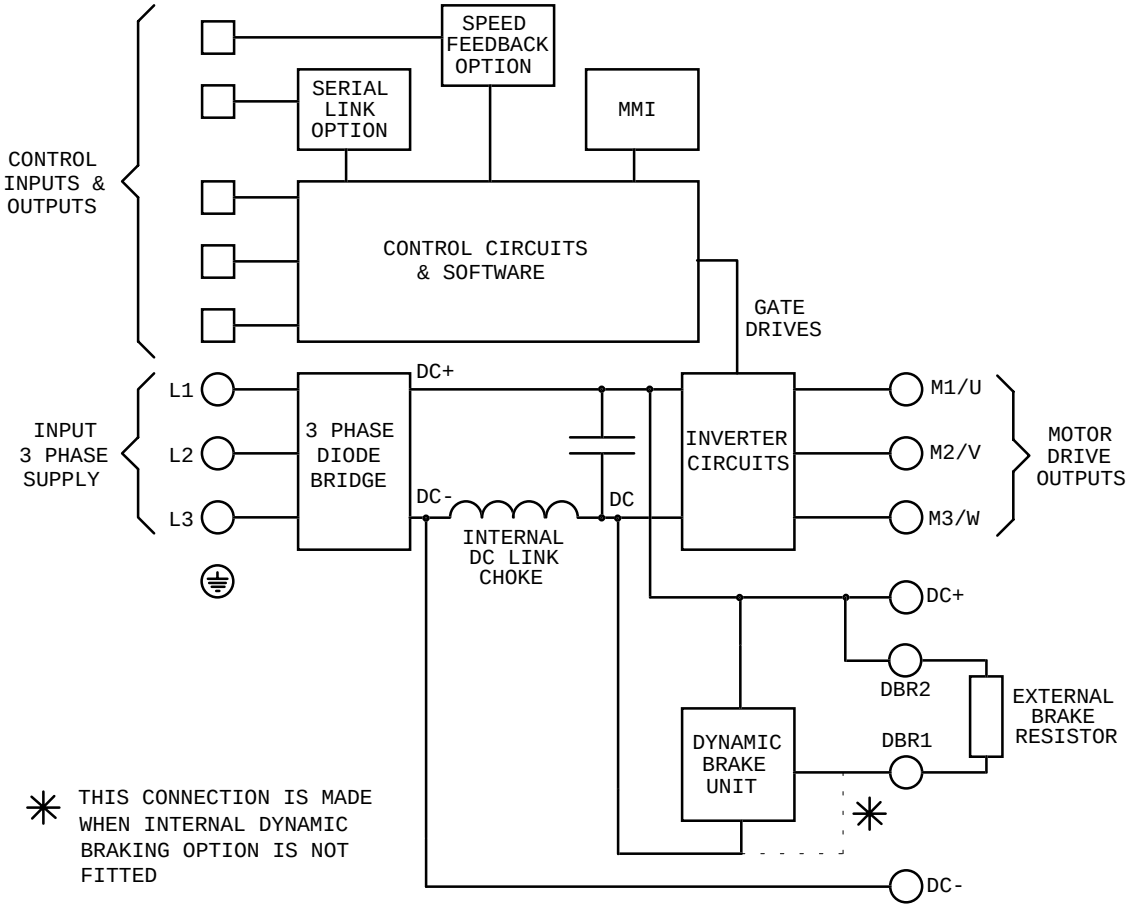

Figure 2.1D - Simplified Block Diagram (584S Type 7)

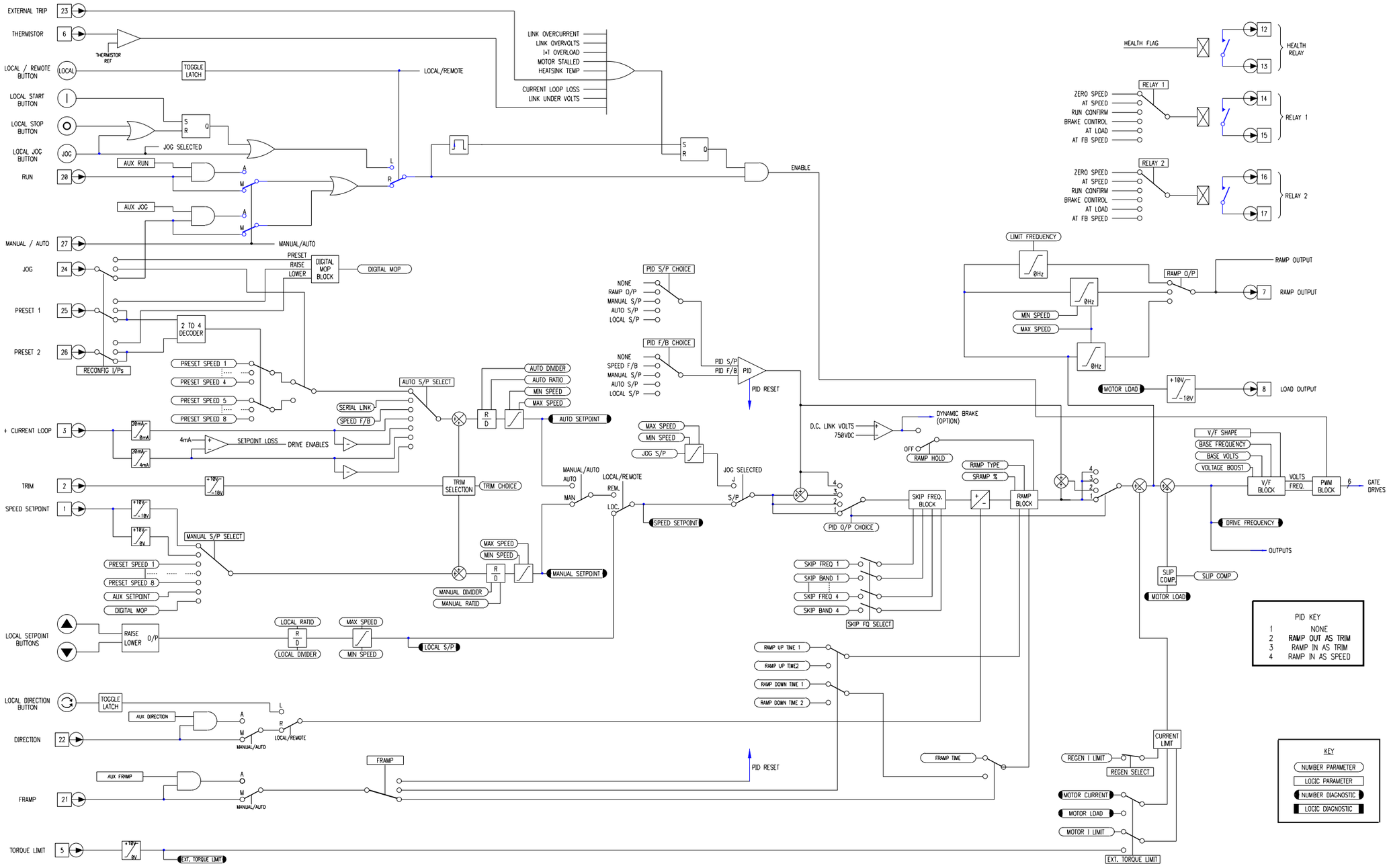

Figure 2-2 Functional Block Diagram

BASIC WIRING DIAGRAMS

General wiring diagrams are provided for the 584S types 4, 5, 6 & 7 in Figures 2.3 to 2.6 respectively. A minimum connection diagram is shown in Appendix A, Figure A.1 .

584S Type 4

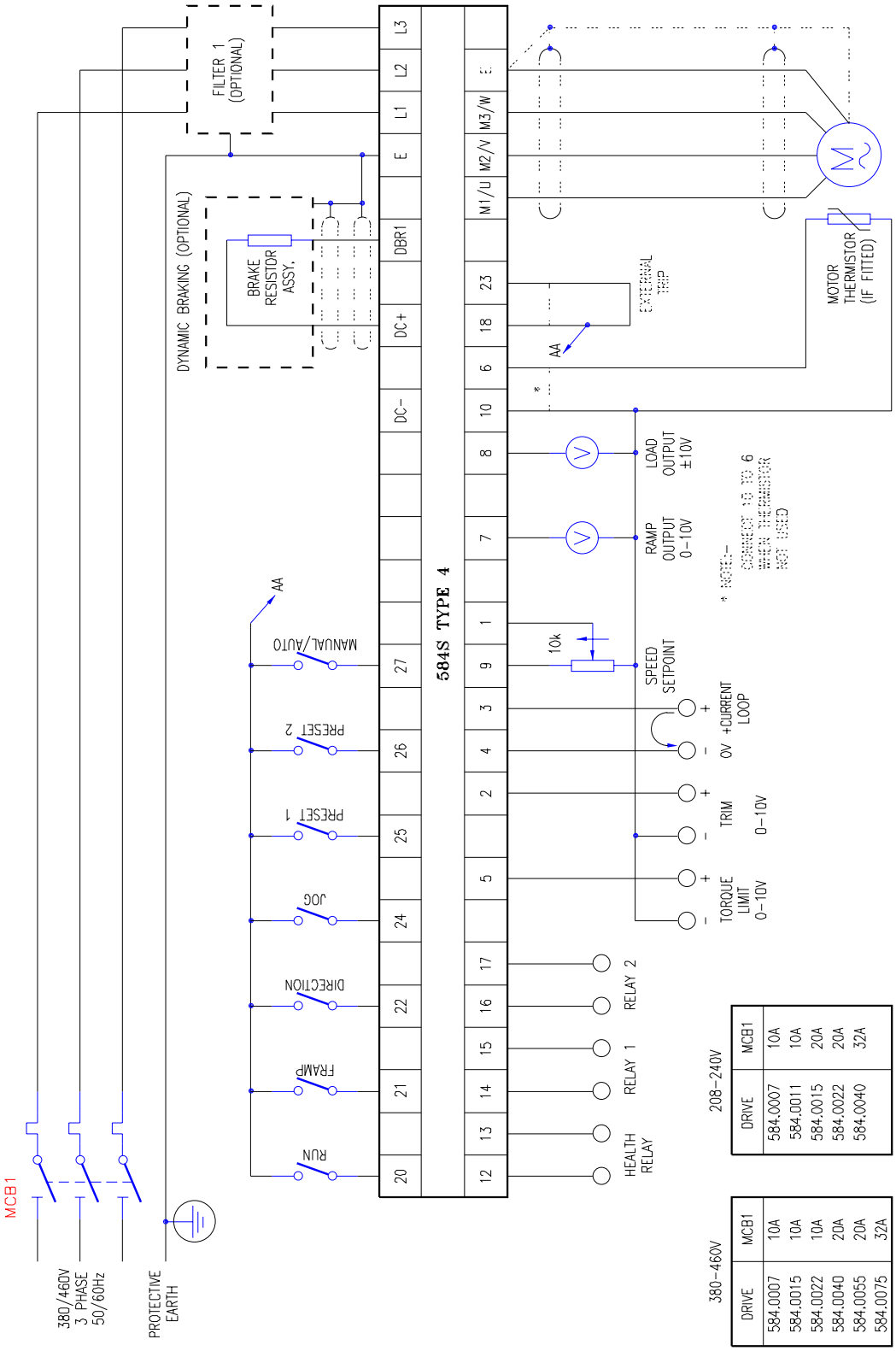

Figure 2.3 - General Wiring Diagram (584S type 4)

584S Type 5

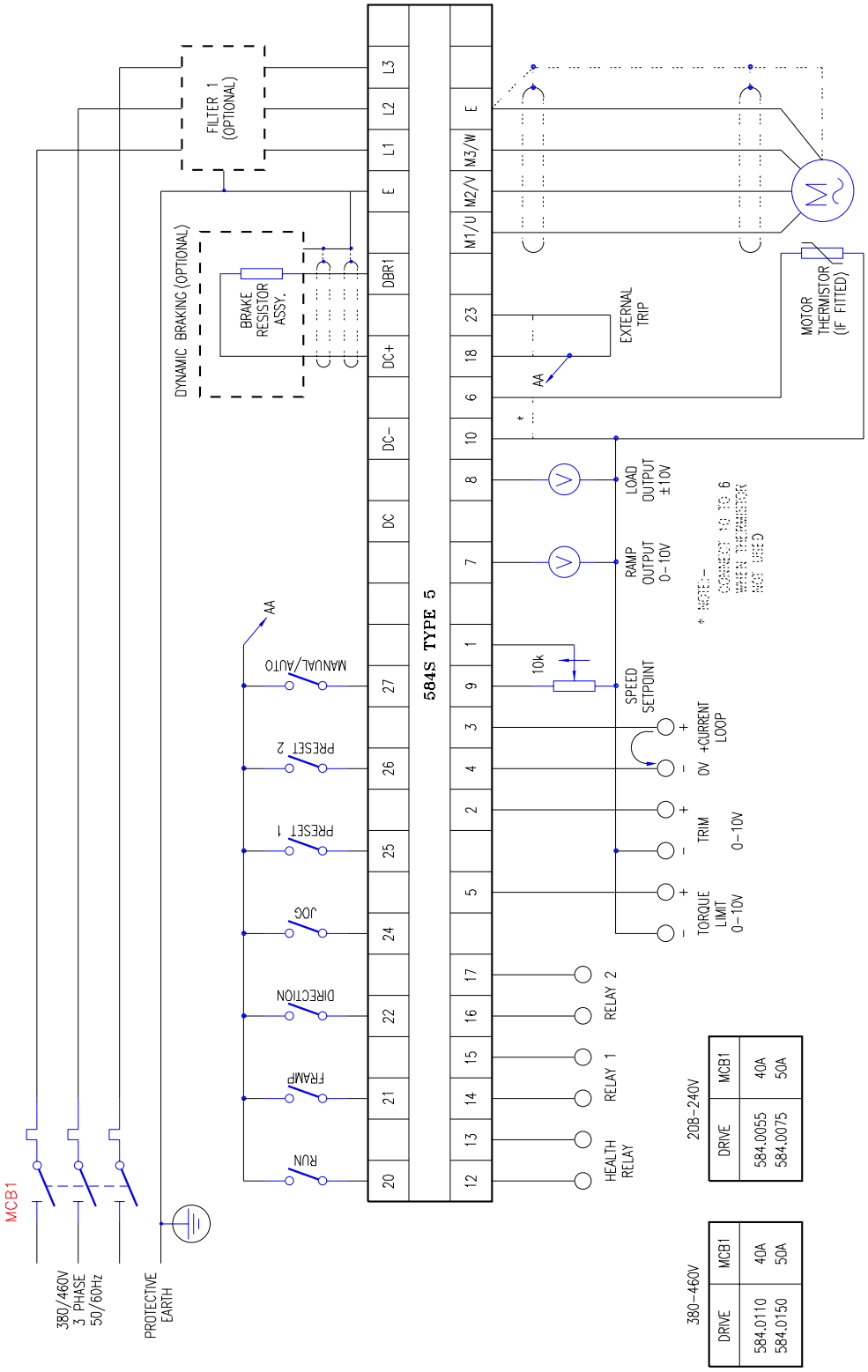

Figure 2.4 - General Wiring Diagram (584S type 5)

584S Type 6

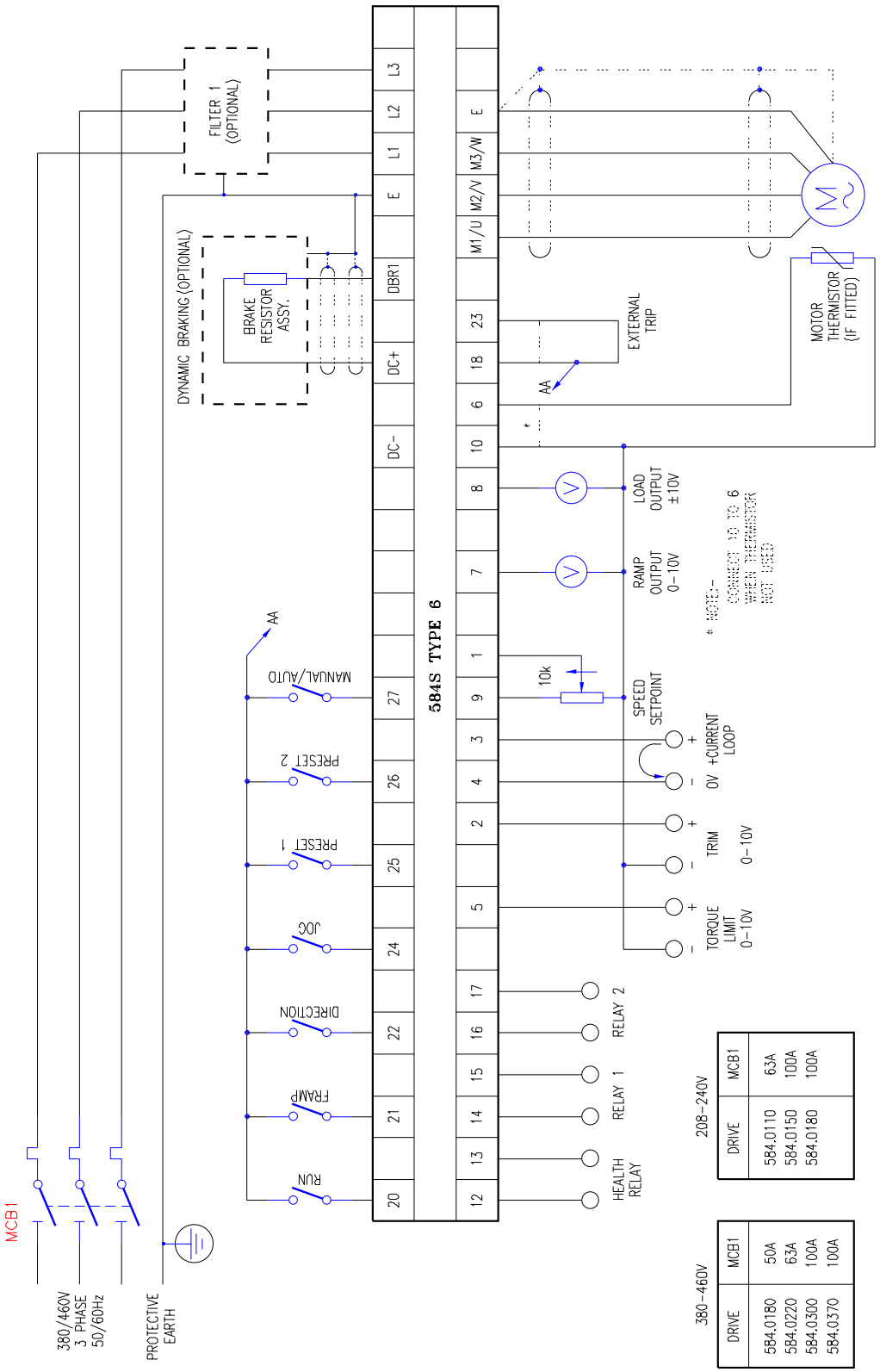

Figure 2.5 - General Wiring Diagram (584S type 6)

584S Type 7

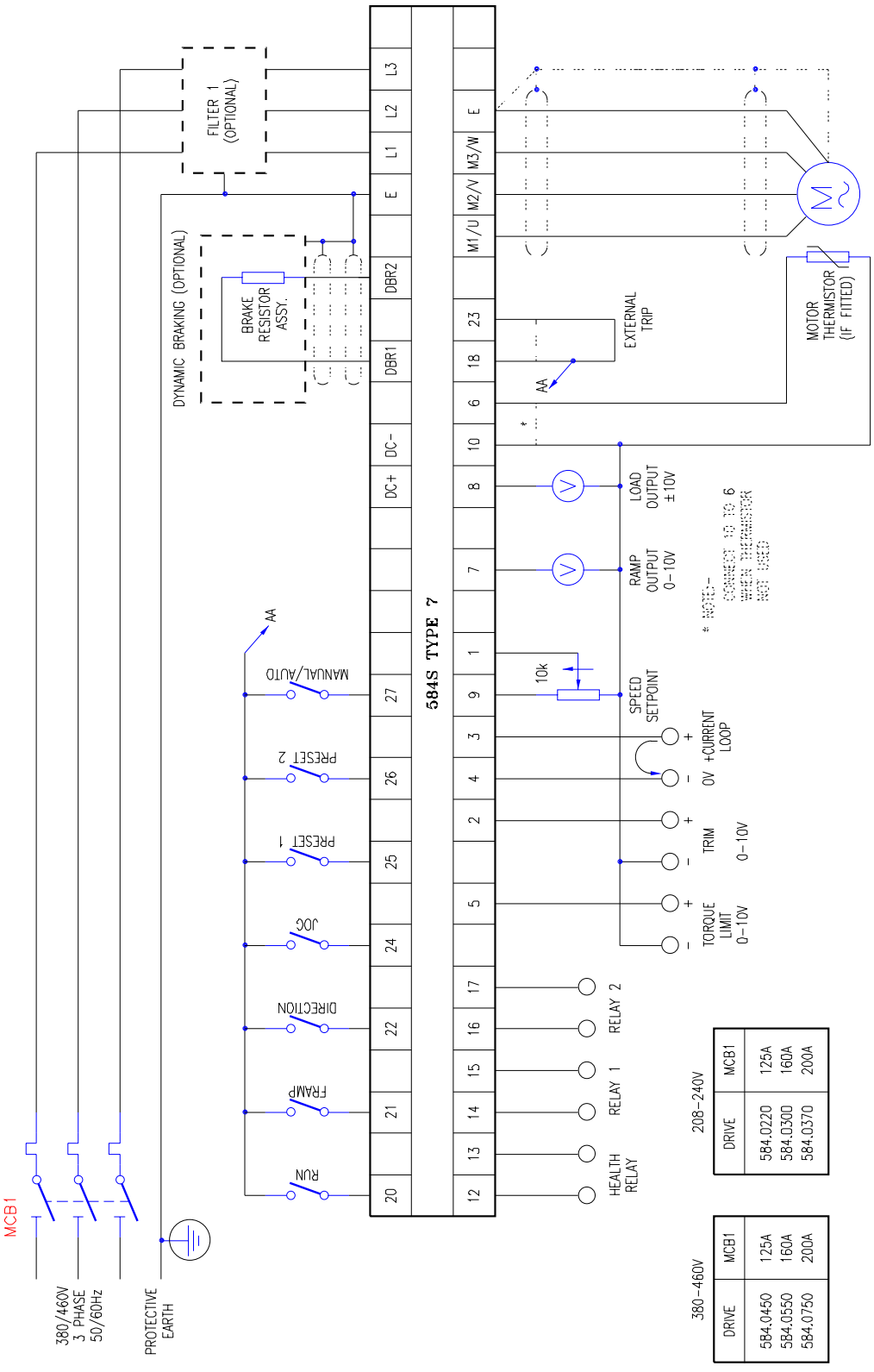

Figure 2.6 - General Wiring Diagram (584S type 7)

TERMINAL DESCRIPTIONS

Terminals are provided for both the power connections and the control connections to allow reliable interface connections with external devices. The function of these terminals is described in tables 2.1-2.4.

Power Terminals

WARNING!

THE POWER TERMINALS CARRY ELECTRICAL POWER WHICH CAN BE LETHAL. NEVER WORK ON ANY CONTROL EQUIPMENT OR MOTORS WITHOUT FIRST REMOVING ALL POWER SUPPLIES FROM THE EQUIPMENT.

584S Type 4

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.
PE / ⏚	Power earth. These terminals must be connected to a permanent protective earth (ground).
⏚	Motor earth connection. This terminal may be used for the protective earth connection to the motor.

Table 2.1 - 584S (TYPE 4) - Power Terminals

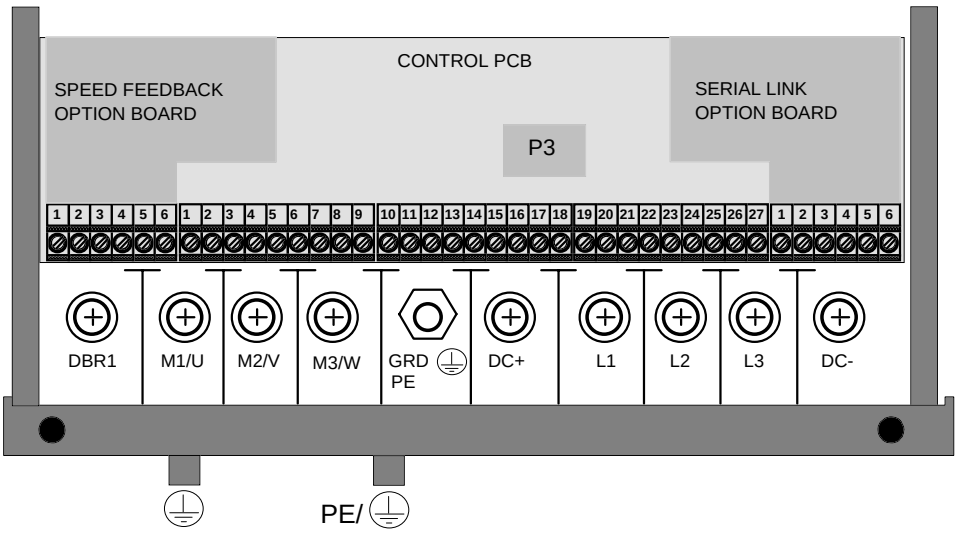

Figure 2.7 - 584S (TYPE 4) - Power Terminals

584S Type 5

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.
PE / ⏚	Power earth. This terminal must be connected to a permanent protective earth (ground).
⏚	Motor earth connection. This terminal may be used for the protective earth connection to the motor.

Table 2.2 - 584S (TYPE 5) - Power Terminals

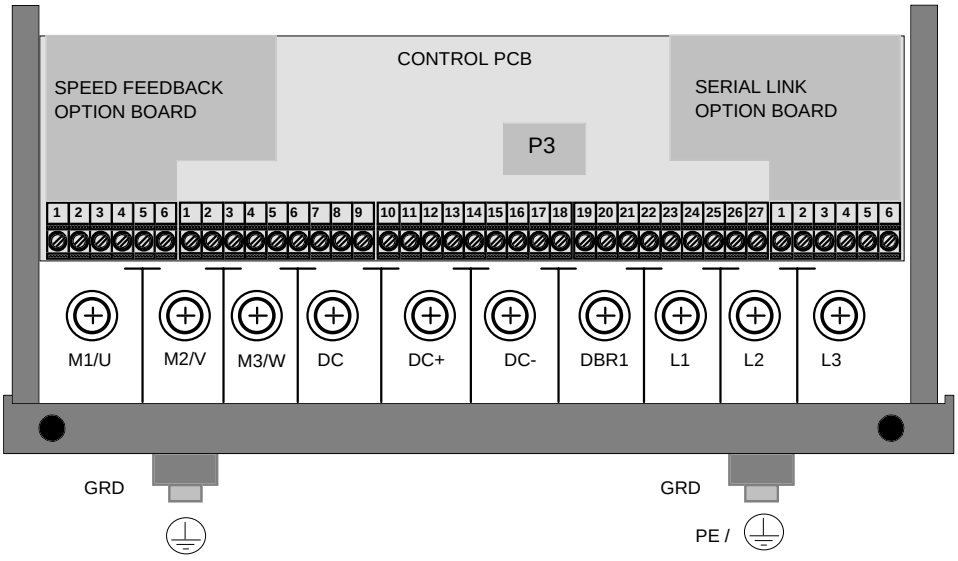

Figure 2.8 - 584S (TYPE 5) - Power Terminals

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.
PE / ⏚	Power earth. This terminal must be connected to a permanent protective earth (ground).
⏚	Motor earth connection. This terminal may be used for the protective earth connection to the motor.

Table 2.3 - 584S (TYPE 6) - Power Terminals

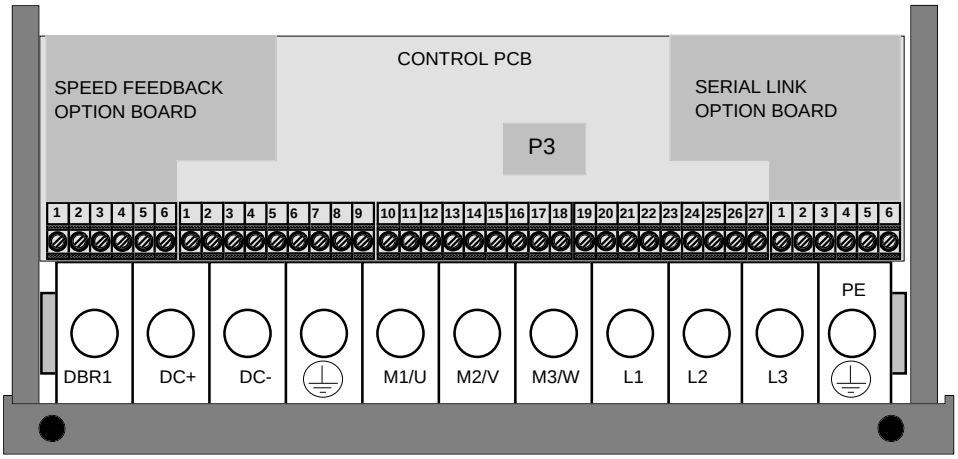

Figure 2.9 - 584S (TYPE 6) - Power Terminals

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 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.
PE / ⏚	Power earth. This terminal must be connected to a permanent protective earth (ground).
⏚	Motor earth connection. This terminal may be used for the protective earth connection to the motor.

Table 2.4 - 584S (TYPE 7) - Power Terminals

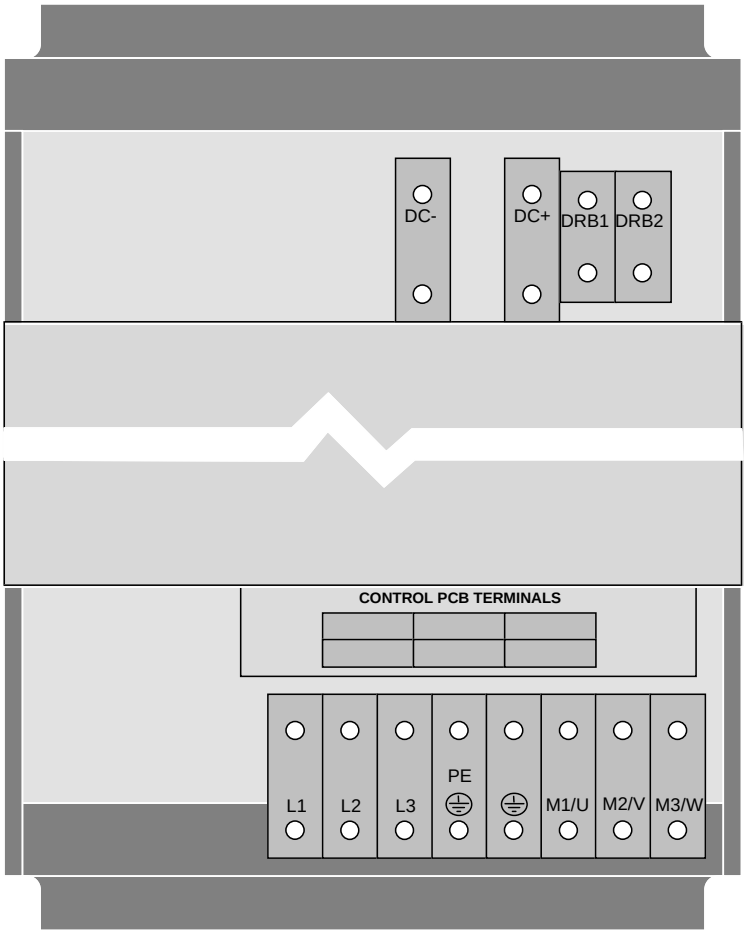

Figure 2.10 - 584S (TYPE 7) - Power Terminals

Control Terminals

The control terminals are identical for all variants of the 584S Frequency Inverter. The functions of the control board terminals are described in Table 2.5. See Chapter 1 "**ELECTRICAL RATINGS**", Table 1.1 for control terminal specification.

NOTE: In Table 2.5 the names of the parameters are presented in a different font, eg. **MAX SPEED**, to indicate that they may be adjusted using the MMI (see Chapter 4).

Table 2.5 - Control Board Terminal Descriptions

Terminal Number	Terminal Description
1	SPEED SETPOINT. Analogue Input An input in the range 0 to 10V, or ± 10V, selectable from the MMI. This signal sets the motor speed in the range: +10V = **MAX SPEED** forward 0V = **MIN SPEED** -10V = **MAX SPEED** reverse Where **MAX** and **MIN SPEED**s are set from the MMI Input impedance = 94kΩ.
2	TRIM. Analogue Input An input in the range ± 10V. This signal adjusts the motor speed as follows:- (a) When trim is acting on an analog type main setpoint i.e., 0 ➠ 10V or 0 ➠ 20mA, then: +10V = **MAX SPEED** forward 0V = **MIN SPEED** -10V = **MAX SPEED** reverse Where **MAX** and **MIN SPEED**s are set from the MMI. (b) When trim is acting on a digital type main setpoint i.e., preset speed or serial link setpoint, then: +10V = **LIMIT FREQUENCY** forward 0V = 0Hz -10V = **LIMIT FREQUENCY** Reverse Where limit frequency is set from MMI. Note:- Regardless of trim scaling, all setpoints are ultimately clamped between **MAX SPEED** and **MIN SPEED**. Input impedance = 94kΩ.
3	+ CURRENT LOOP. Analogue current loop input (connect return to terminal 4) A current loop input in the range 0 - 20mA, 20 - 0mA, 4 - 20mA or 20mA - 4mA as selected from the MMI. This input allows automatic adjustment of motor speed. For example, with 4 - 20mA selected: 4mA = **MIN SPEED** 20mA = **MAX SPEED** Where **MAX** and **MIN SPEED**s are set from the MMI. Input impedance = 235Ω.
4	0V. Reference This terminal provides a zero volt reference for analogue signals only or current loop connection.

Table 2.5 - Control Board Terminal Descriptions (Continued)

Terminal Number	Terminal Description
5	TORQUE LIMIT. Analogue Input An input in the range 0 to +10V. When enabled from the MMI, this terminal sets the maximum motor output torque. +10V = 150% output torque 0V = 0% output torque
6	THERMISTOR. Analogue Input Analogue input for motor thermistor. The second lead of the thermistor is connected to terminal 10 (0V). If no thermistor fitted, connect to terminal 10 (0V). Trip at 3kΩ, reset at 1.8kΩ.
7	RAMP OUTPUT. Analogue Output An output in the range 0V to +10V (5mA max) representing drive output frequency. Scaling is set using the **RAMP OUTPUT** parameter. For example: +10V = **MAX SPEED** 0V = **MIN SPEED** or +10V = **LIMIT FREQUENCY** 0V = 0Hz or +10V = **MAX SPEED** 0V = 0HZ
8	LOAD OUTPUT. Analogue Output An output in the range ± 10V (5mA max) representing estimated motor load (torque). +10V = 150% load motoring 0V = 0% load -10V = 150% load regenerating
9	+10V. Reference Internally generated +10V supply for analogue inputs. Maximum load is 5mA.
10	0V. Reference This terminal provides a zero volt reference for analogue signals only.
11	-10V. Reference Internally generated -10V supply for analogue inputs. Maximum load is 5mA.
12 13	HEALTH RELAY HEALTH RELAY. Relay Contacts These terminals are the contacts of the internal 'health' relay. The contacts close to indicate that the drive is powered up and no alarms are present.
14 15	RELAY 1 RELAY 1. Relay Contacts These terminals are the contacts of internal Relay '1' the function of which is configurable from the MMI.

Table 2.5 - Control Board Terminal Descriptions (Continued)

Terminal Number	Terminal Description
16 17	RELAY 2 RELAY 2. Relay Contacts These terminals are the contacts of internal Relay '2' the function of which is configurable from the MMI.
18	+24V. 24V supply for use with digital inputs. Max. load 200mA.
19	0V. 0V for digital inputs.
20	RUN. Digital Input The digital input used to run and stop the drive. +24V = run 0V = stop
21	FRAMP. Digital Input (Configurable) This digital input can be used to select an alternative ramp rate, an alternative ramp **down** rate during stopping or a PID reset. Refer to chapter 4 "Reconfigure inputs" **FRAMP.** +24V = function selected 0V = function deselected
22	DIRECTION. Digital Input This digital input can be used to control the direction of the motor. +24V = reverse 0V = forward
23	EXTERNAL TRIP. Digital Input This digital input can be used to trip the drive. The motor will coast until the trip is reset. If no external trip used, connect to terminal 18 (+24V). +24V = no trip 0V = trip
24	JOG. Digital Input (Configurable) This digital input can be used to implement the jog function. The **JOG SPEED** is set from the MMI. Refer to Table 2.6 for further optional uses of this terminal.

Table 2.5 - Control Board Terminal Descriptions (Continued)

Terminal Number	Terminal Description
25 26	PRESET 1, PRESET 2. Digital Inputs (Configurable) These digital inputs can be used to select 1 of 4 preset speeds as shown below: PRESET 2 state / PRESET 1 state / Preset selection 0V / 0V / **PRESET SPEED 1** selected 0V / +24V / **PRESET SPEED 2** selected +24V / 0V / **PRESET SPEED 3** selected +24V / +24V / **PRESET SPEED 4** selected The preset speeds parameters are set using the MMI. In order to select preset speeds using the PRESET 1 and PRESET 2 terminals, the **AUTO SETPOINT** parameter needs to be set to **DIGITAL PRESET**, and the MANUAL/AUTO terminal needs to be connected to +24V. Refer to Table 2.6 for further uses of these terminals.
27	MANUAL/AUTO. +24V = auto setpoint control 0V = manual setpoint control

Configurable Digital Inputs

The control board terminals 24, 25 and 26 can be configured (Chapter 4, "**RECONFIGURE INPUTS**") to perform alternative functions to those described in Table 2.5. The alternative functions are described in Table 2.6.

Table 2.6 Configurable Digital Inputs

Terminal Number	Terminal Description
24 25 26	SELECT PRESET 1 PRESET 2 These digital inputs are used to select 1 of 8 preset speeds as shown below: SELECT / PRESET 2 / PRESET 1 / Preset Selection 0V / 0V / 0V / **PRESET SPEED 1** selected 0V / 0V / +24V / **PRESET SPEED 2** selected 0V / +24V / 0V / **PRESET SPEED 3** selected 0V / +24V / +24V / **PRESET SPEED 4** selected +24V / 0V / 0V / **PRESET SPEED 5** selected +24V / 0V / +24V / **PRESET SPEED 6** selected +24V / +24V / 0V / **PRESET SPEED 7** selected +24V / +24V / +24V / **PRESET SPEED 8** selected The preset speeds are set using the MMI. Again the **AUTO SETPOINT** parameter needs to be set to **DIGITAL PRESET**, and the MANUAL/AUTO terminal needs to be connected to +24V.
24 25 26	MOP PRESET, RAISE, LOWER. These digital inputs allow the drive to be used in raise speed/lower speed mode in conjunction with raise/lower pushbuttons. The ramp can be reset, by +24V on the MOP PRESET input. The **MOP PRESET SPEED** value can be programmed via the MMI (See Chapter 4). To use the digital MOP, the **MANUAL SETPOINT** parameters needs to be set to **DIGITAL MOP**, and the MANUAL/AUTO terminal needs to be connected to 0V.

Speed Feedback Options

An additional card is necessary to implement speed feedback from a Microtach (ENG block 6 of Product Code). For specification and connection information refer to 5901 Microtach Product Manual, drawing number HA387484. The maximum speed that the 584S will accept from a Microtach depends on its resolution (number of lines per revolution). The limit, in RPM is:

$$\frac{3 \times 10^{6}}{\text{resolution}}$$ with an overriding limit of 24000 RPM.

An additional card is necessary to implement speed feedback from an Encoder (ENW block 6 of Product Code). For specification and connection information refer to Electrical Encoder Receiver Card manual drawing number HA388867. For more information on compatible encoders and line drives see 5902 Electrical Encoder Product Manual, drawing number HA385749. The maximum speed that the 584S will accept from an encoder depends on its resolution (number of lines per revolution). The limit, in RPM is:

$$\frac{6 \times 10^{6}}{\text{resolution}}$$ with an overriding limit of 24000 RPM.

Serial Link Options

An additional card is necessary to implement isolated serial communications. For specification and connection information refer to Appendix B.

TERMINATIONS

UL Compression Lug Kits are available for the inverters which provide sets 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 kits are available for the connection of Power Cabling.

Product	Supply Voltage	Constant Torque	Quadratic Torque	Kit No.	Lug Size	Amp Part No.
584S	380 - 460V	11kW	15kW	LA389585	#8 AWG	52263-1
	208 - 240V	5.5kW	7.5kW			
	380 - 460V	15kW	18kW	LA389586	#6 AWG	52265
	208 - 240V	7.5kW	9kW			

EMC

Refer to Chapter 3 for EMC installation guidelines