EUROTHERM
DRIVES

564 SERIES BRUSHLESS SERVO MOTOR CONTROLLERS

PRODUCT MANUAL

A WARNING GIVES THE READER INFORMATION WHICH IF DISREGARDED COULD CAUSE INJURY OR DEATH

HA387330 ISSUE 2

WARRANTY

Eurotherm Drives warrants the goods against defects in design, materials and workmanship for the period of 12 months from the date of delivery on the terms detailed in Eurotherm Drives Standard Conditions of Sale IA058393C.

Eurotherm Drives reserves the right to change the content and product specification without notice.

INTENDED USERS

This manual is to be made available to all persons who are required to configure, install or service the equipment described herein or any other associated operation.

How to Use this Manual

This manual provides information to support the installation and operation of the 564 Series Servo Drive Controllers. A description of each of the chapters is given here to assist in locating and using the information contained within the manual.

Chapter 1 - PRODUCT OVERVIEW

This chapter contains a brief description of the drive controller including a technical specification of the equipment. The purpose of this chapter is to familiarise the reader with the purpose and scope of the equipment.

Chapter 2 - PRE-INSTALLATION PLANNING

This chapter contains a functional description of the equipment, wiring information and a description of the signals on the input/output terminals. The purpose of this chapter is to allow the user to understand the function of the equipment and to assist in designing a particular installation configuration.

Chapter 3 - INSTALLATION PROCEDURE

This chapter contains information regarding the physical mounting arrangements, cable and fuse selection. The purpose of this chapter is to provide guidelines for the safe and efficient installation of the equipment. The theory of, and requirement for, dynamic braking is also explained within this chapter.

Chapter 4 - SETTING UP AND COMMISSIONING

A description of the user adjustments and switch settings to configure the drive for a particular application. The purpose of this chapter is to guide the user through pre- and post-power on checks and provide running performance adjustment procedures. Information on the function and set-up of DIP switches and potentiometers is also described.

Chapter 5 - DIAGNOSTICS AND FAULT FINDING

A description of the procedures to diagnose and trace faults on the equipment. The purpose of this chapter is to guide the user through the on-board diagnosis and fault finding facilities.

Chapter 6 - SERVICING

This chapter provides the routine maintenance and repair procedures. A parts list is also provided within this chapter. The purpose of this chapter is to assist returning the controller to service following a fault condition.

Appendix A - WIRING TO STANDARD SERVO MOTORS

This Appendix contains wiring diagrams showing connection information to interface the 564 controller to a selection of standard servo motors.

Appendix B - STANDARD FORMS

Warnings and Instructions

WARNINGS!

ONLY QUALIFIED PERSONNEL WHO THOROUGHLY UNDERSTAND THE OPERATION OF THIS EQUIPMENT AND ANY ASSOCIATED MACHINERY SHOULD INSTALL, START-UP OR ATTEMPT MAINTENANCE OF THIS EQUIPMENT. NON-COMPLIANCE WITH THIS WARNING MAY RESULT IN PERSONAL INJURY AND/OR EQUIPMENT DAMAGE.

NEVER WORK ON ANY CONTROL EQUIPMENT WITHOUT FIRST ISOLATING ALL POWER SUPPLIES FROM THE EQUIPMENT.

THE DRIVE MOTOR MUST BE CONNECTED TO AN APPROPRIATE SAFETY EARTH. FAILURE TO DO SO PRESENTS AN ELECTRICAL SHOCK HAZARD.

THIS EQUIPMENT CONTAINS HIGH VALUE CAPACITORS. FAILURE TO ALLOW TIME FOR CAPACITOR DISCHARGE, PRIOR TO REMOVING EQUIPMENT COVERS, PRESENTS AN ELECTRICAL SHOCK HAZARD.

Cautions

This equipment was tested before it left our factory. However, before installation and start-up, inspect all equipment for transit damage, loose parts, packing materials etc.

This product conforms to IP20 protection. Due consideration should be given to environmental conditions of installation for safe and reliable operation.

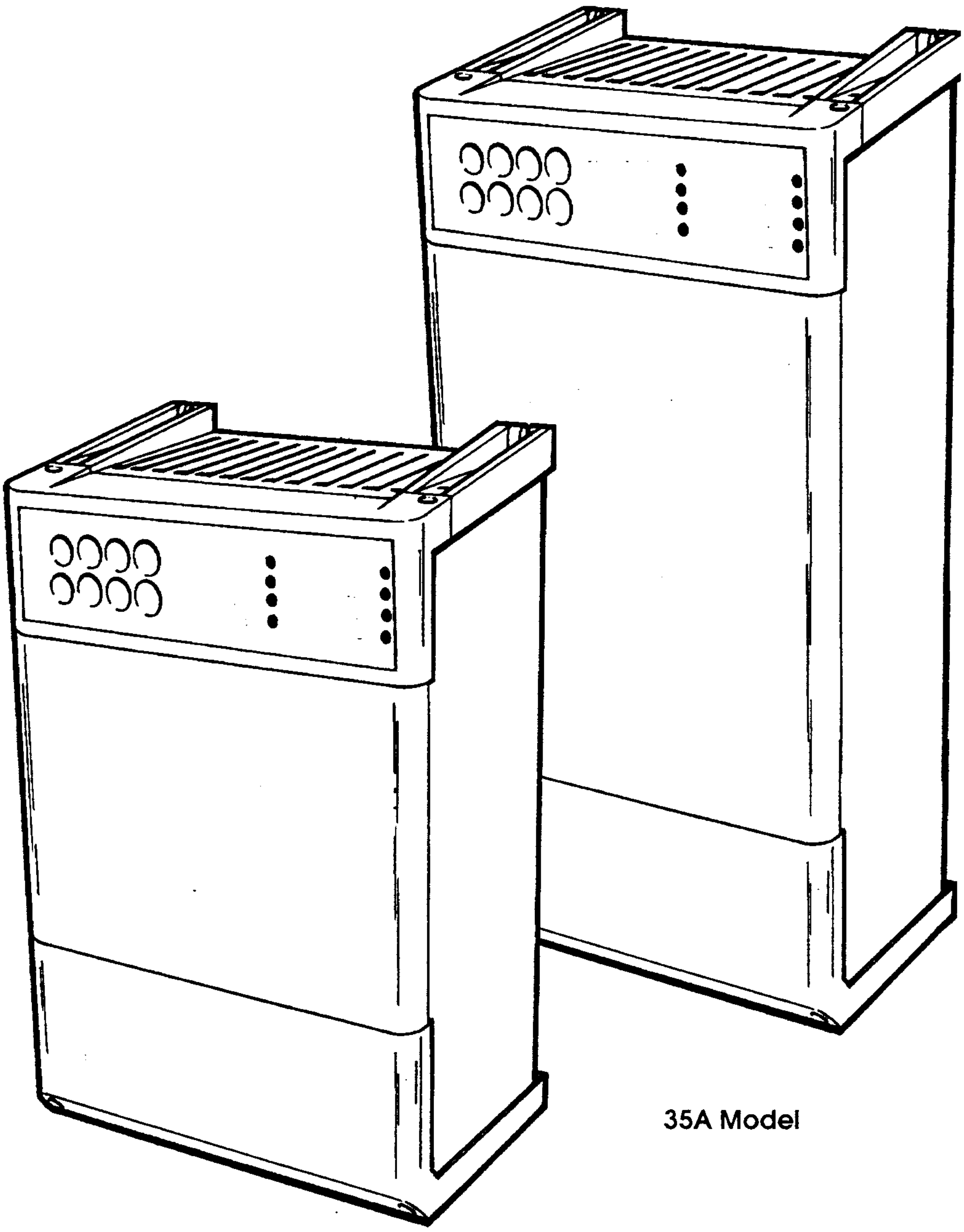
Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.

Static Sensitive Devices

This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.

Illustration of Equipment

564 Series



35A Model

5A, 12A & 20A Models

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Chapter 1

PRODUCT OVERVIEW

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Chapter 1 - PRODUCT OVERVIEW

1.1 DESCRIPTION

The 564 Series of servo-controllers operate 3-phase AC servo-motors fitted with a brushless tachogenerator and devices for sensing rotor position, up to a maximum rating of 35 amps continuous. The 564 Series servo-controller can be used for torque and speed control in a 4-quadrant mode (fully reversing and braking) and satisfies the highest demands on dynamic control response and control accuracy.

Commissioning and fault finding (both within the unit and external to it) are greatly assisted by built-in Condition Indicators which display the status of the various system alarms. Further assistance is available by use of the optional Diagnostic Test Unit (type 5570). The Diagnostic Test Unit provides access to 27 alarms, inputs and principle circuit nodes throughout the Controller. This unit, which is available as a portable hand-held instrument also has output sockets for the connection of external monitoring equipment e.g. an oscilloscope.

1.2 PRODUCT RANGE

The 564 Series is available in four models as follows;

5 amp continuous (10 amp peak)
12 amp continuous (24 amp peak)
20 amp continuous (40 amp peak)
35 amp continuous (70 amp peak)

The 5, 12 and 20 amp (continuous) models are housed in identical (type 1) chassis. The 35 amp (continuous) model is housed in a chassis of similar appearance but slightly larger in length (type 2), refer to Figure 1.1. The model is identified by the product code, refer to paragraph 1.5.

1.2.1 Equipment Supplied

The following equipment is supplied as standard with the 564 Series drive controllers;

1) Servo Drive

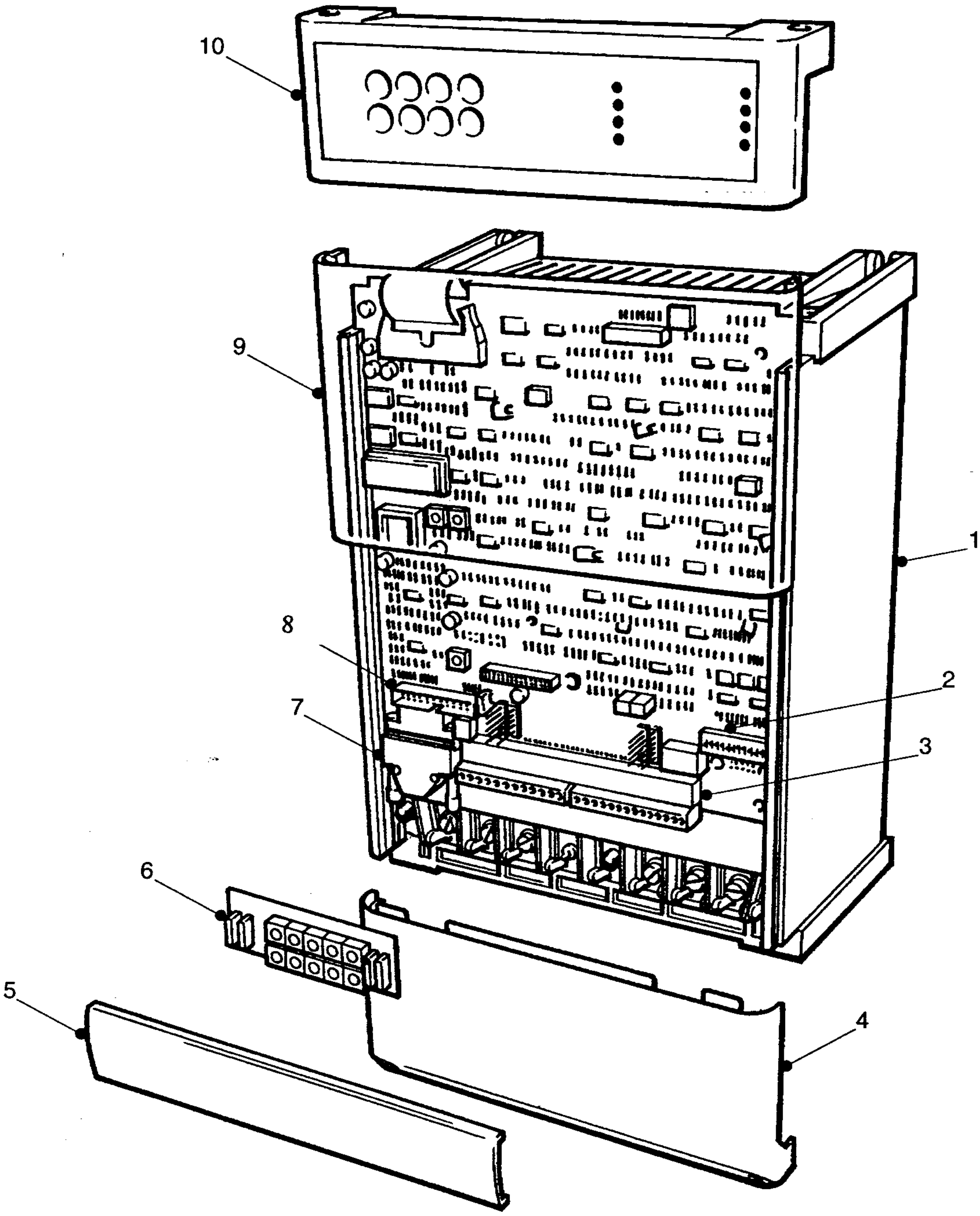
2) Product Manual

3) D-connector (for motor feedback signals)

4) External Brake Resistor

1.3 COMPONENT IDENTIFICATION

This manual refers to various components within the equipment which are accessible to the user for installation purposes. To assist with location and identification of these components, an exploded view of the controller is given in Figure 1.1.



Item	Description	Item	Description
1	Drive Controller	6	Preset Board
2	DIP Switches	7	15-Way, D-Type Connector
3	Control Board Terminals	8	Diagnostic Socket
4	Lower Drive Cover	9	Aluminium Front Panel
5	Power Board Terminals Cover	10	Upper LED Panel

Figure 1.1 – 564 Series Controller Exploded View

1.4 TECHNICAL SPECIFICATION

The following paragraphs provide technical information regarding the features and performance characteristics of the 564 Series drive controllers.

1.4.1 General

Control Circuits:	Single level isolation from power circuits.
Speed Control:	Full proportional gain and integral action by potentiometers on the preset board. Derivative action is set by component selection, also on the preset board.
Current Control:	Proportional gain is adjusted via a potentiometer on the preset board.
Control Range:	1:10000 (dependant on feedback quality)
Steady State Accuracy:	0.1% Typical
Torque Control:	1 direct setpoint input 0-200% nominal current User adjustable current limit
Protection:	Overcurrent detection Overvoltage detection Undervoltage detection Motor overtemperature detection Controller overtemperature detection The following signals are provided for external monitoring: Motor speed Drive current Ramp output Drive health Motor at standstill
Diagnostics:	LED diagnostics are provided for the following: Power ON Healthy Brake Standstill Drive alarms

1.4.2 Electrical Ratings - Power Circuit

	5 amp	12 amp	20 amp	35 amp
Power supply voltage (max)	460+10%	460+10%	460+10%	480+10%
Power supply voltage (min)	380-10%	380-10%	380-10%	380-10%
Power supply frequency	45-65Hz	45-65Hz	45-65Hz	45-65Hz
Max. recommended motor volts	450	450	450	450
DC link voltage	560 †	560 †	560 †	560 †
Peak current (approx 1 s)	200%	200%	200%	200%

† Calculated using $\frac{3V_{rms}}{\pi}$

1.4.3 Electrical Ratings - Control Circuit

The following ratings relate to all builds within the 564 Series.

Reference Supplies (for speed and current setpoints)	+10V ±0.1V, 10mA max.
	-10V ±0.1V, 10mA max.
+24V Supply	24V ±10%, 200mA max.
Relay Contacts (terminals 22-24)	240V ac, 3A max.

1.4.4 Mechanical Details

	Type 1 Chassis	Type 2 Chassis
Dimensions (H x W x D)	318 x 228 x 157	468 x 228 x 157
Weight	9kg (approx.)	17kg (approx.)
Mounting holes diameter	Clearance for M6 fixings	Clearance for M6 fixings
Mounting holes centres	300 x 200	450 x 200
Cooling	Forced ventilation	Forced ventilation

1.4.5 Environmental Details

Humidity	85% relative humidity at 40°C (non condensing)
Altitude	Above 1000m derate 1% per 100m
Atmosphere	Non flammable, non corrosive and dust free
Operating temperature	0°C to 40°C (derate 1.5% per °C above 40°C up to 55°C
Storage temperature range	-20°C to +50°C short term (<100 hours)
	0°C to +50°C long term
Enclosure	Chassis mounted, IP20

1.5 PRODUCT CODE

All 564 Series units are fully identified using an seven block numeric code of the form 564-XXXX-X-X-X-XX-XX. This code details the drive calibration and settings on despatch from the factory. The product code appears as the "Model No." on the rating label at the side of the unit. Details of each block of the product code are given in Table 1.1.

Table 1.1 - Product Code Block Descriptions

Block No.	Variable	Description
1	564	3 digits identifying the basic product.
2	XXXX	4 digits specifying continuous output current; ('XXXX' = XXX.X amps); '0050' = 5.0 amps '0120' = 12.0 amps '0200' = 20.0 amps '0350' = 35.0 amps.
3	X	1 digit specifying the nominal supply voltage (±10%); '5' = 380V '6' = 415V '7' = 440V '8' = 460V e.g. '6' in block 3 indicates a nominal supply voltage of 415V ±10%
4	X	1 digit identifying speed feedback source; '0' = 3-phase brushless tacho '2' = Brushless tacho with built-in scaling (±10V)
5	X	1 digit code identifying inclusion of an external choke (35A model only); '0' = No choke separately supplied '1' = Choke separately supplied
6	XX	2 digit code specifying standard options; '00' = No option fitted
7	XX	2 digit code specifying special options; '00' = No special options '01'-'99' = Documented special options (refer to HP 387266)

Chapter 2

PRE-INSTALLATION PLANNING

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Chapter 2 - PRE-INSTALLATION PLANNING

2.1 FUNCTIONAL OVERVIEW

2.1.1 Principles of Operation

The controller operation described in the following paragraphs is referenced to the functional block diagram (Figure 2.1) which shows the Control PCB, Preset PCB and front panel drive status indicators. The Power PCB circuits and output switching arrangements are not described but are shown for completeness in Figure 2.2 for the 5, 12 & 20 Amp models and Figure 2.3 for the 35 Amp model.

+24V Reference

The +24V reference at Control PCB terminal 14 is an internally generated power supply voltage. It is a regulated 24V ±10% floating power supply derived from the mains power input by means of a 3-phase rectifier and a Switched Mode Power Supply (SMPS) circuit. Three return (0V) connections are made via Control PCB terminals 1, 8 and 16 and decoupling to the controller earth connection is provided by a capacitor.

The +24V reference is also used to power two continuously rated dc fans which provide a cooling air flow.

The front panel drive status POWER indicator is lit when all power supplies are present.

Internal Supplies/References

The Supply/Reference circuit produces stabilised power supplies of +15 ±0.25V (diagnostic Z1), -15 ±0.25V (diagnostic Z2) and +5 ±0.1V (diagnostic Z5) which are derived from the +24V. Also produced are stabilised supplies of +10 ±0.1V (diagnostic Z3) and -10 ±0.1V (diagnostic Z4) which are output via Control PCB terminals 17 and 15 and can be used locally as precision reference sources for control signals up to a maximum load of 10mA.

Start/stop Control

Under normal (ie, no fault) conditions the controller is made active by connecting Control PCB terminals 11 and 14 via an external closing contact. The +5V Enable signal (diagnostic Z21) operates the Quench Control circuit which in turn removes the 'quench' condition inhibiting the Ramp Generator, the Speed Loop PI circuit and the Underlap/Buffer circuit by switching the Quench signal (diagnostic Z20) from +5V to 0V. Opening the external contact removes the +5V Enable signal and allows the controller to return to the 'quench' condition.

WARNING!

THIS METHOD OF STARTING AND STOPPING ONLY PROVIDES OPERATIONAL CONTROL OF THE ASSOCIATED SERVO MOTOR. IT MUST NOT BE USED WHEN ANY MAINTENANCE TASKS ARE TO BE PERFORMED ON THE MOTOR AND/OR ANCILLARY EQUIPMENT.

Under fault (ie, alarm) conditions an Alarm signal is received from the Alarm Detection circuit which overrides the Enable signal to produce the 'quench' condition.

The front panel drive status RUN indicator is lit when the controller is active and not lit when it is held in the 'quench' condition.

Speed Reference

The Setpoint 1 I/P signal (diagnostic Z6) received via Control PCB terminal 5 is a speed reference input with magnitude scaling (0 to 100%) provided by preset P4 and a polarity reversal facility provided by switch SW1 and the associated amplifier. The input is derived from an external source or the ±10V reference supplies and has a range of +10V (full speed forward) to -10V (full speed reverse).

The Setpoint 2 I/P signal (diagnostic Z7) received via Control PCB terminal 6 is a speed reference input with a polarity reversal facility provided by switch SW2 and the associated amplifier. The input is derived from an external source or the ±10V reference supplies and has a range of +10V (full speed forward) to -10V (full speed reverse).

The Setpoint 3 I/P Ramp signal (diagnostic Z8) received via Control PCB terminal 7 is a speed reference input with adjustable rate limiting provided by a Ramp Generator and a polarity reversal facility provided by switch SW3 and the associated amplifier. The Ramp Generator is linear in operation with either a fast ramp span (0.1 to 3s) or a slow ramp span (2.5 to 30s) selected by means of RAMP RANGE switch SW4 while the up and down ramp rates are independently set by means of RAMP RATES presets P1 and P2 respectively. The input is derived from an external source or the ±10V reference supplies and has a range of +10V (full speed forward) to -10V (full speed reverse). Zero volts (0 ±0.2V) corresponds to zero speed. The ramp waveform is also output via Control PCB terminal 9 as the Ramp O/P signal for external use and is held at zero when the 'quench' condition is applied.

The summed setpoint and offset signals are also buffered by an amplifier and output via Control PCB terminal 3 as the Total Setpoint O/P signal (diagnostic Z9) in the range ±10V for external use with other controllers.

Speed Feedback Processing

The speed feedback processing circuit has two functions which generate signals corresponding to the speed and rotor position information received from the associated servo motor.

The Tacho Phase U, Tacho Phase V and Tacho Phase W signals input on pins 4, 5 and 6 of Connector 1 are derived from a 3-phase ac tachometer (ie, brushless tachometer) and referenced to the Tacho Centre signal input on pin 3 of Connector 1. When connected (as an alternative to the electronic tachometer input) these input signals are converted into a varying dc output which is then available as the Speed Feedback signal.

The Rotor Position R (diagnostic Z25), Rotor Position S (diagnostic Z26) and Rotor Position T (diagnostic Z27) signals input on pins 13, 14 and 15 of Connector 1 represent the rotor position at any particular instant. The signals (in the range 0 to +24V) are converted into a digital 3-bit address word for the Look Up Table.

Speed Feedback

The two optional inputs to the Speed Feedback circuit are obtained either as a direct signal from an electronic tachometer powered by the +15V and -15V supplies output via pins 10 and 9 of Connector 1 or as a processed signal derived from a 3-phase ac tachometer.

For the electronic tachometer option the ELECTRONIC TACHO switch SW6 is closed to select the Electronic Tacho signal which is input directly from the servo motor via pin 1 of Connector 1. For the 3-phase ac tachometer option the BRUSHLESS TACHO switch SW7 is closed to select the Speed Feedback signal from the Speed Feedback Processing circuit. Both signals are in the form of a varying dc signal in the range ±10V with positive polarities representing the normal direction of rotation.

Speed scaling is provided by select-on-test resistor SOTR1 while the SPEED CAL preset P5 (in conjunction with SPEED RANGE switches SW8 and SW9) provides adjustment of the maximum speed.

The Actual Speed O/P signal (diagnostic Z10) produced by the Speed Feedback circuit is in the range +10V (full speed forward) to -10V (full speed reverse) and provides a summing input to the Speed Error circuits. If required, a derivative (D-term) response can be added by means of select-on-test capacitor SOTC1 which effectively increases the AC loop gain of the controller. This prevents overshoot from occurring when the setpoint (ie, speed reference input) is derived from a manual operation or tends to be unstable.

The Actual Speed O/P signal is also applied to the Zero Speed Detection circuit and is available via Control PCB terminal 4 for external use with suitable speed indicators.

Zero Speed Detection

The Actual Speed O/P signal produced by the Speed Feedback circuit is continuously monitored by the Zero Speed Detection circuit which turns on a transistor switch whenever the signal level is within a speed 'window' set by predetermined threshold values. The transistor switch can be used to drive an external relay circuit via Control PCB terminal 21.

The front panel drive status N=/0 indicator is lit when the servo motor speed is not zero.

Speed Error

The Setpoint 1, Setpoint 2 and Setpoint 3 Ramp input signals are summed together with a speed offset adjustment in the range ±1% provided by SPEED OFFSET preset P3 and the combined output compared with the Actual Speed O/P signal from the Speed Feedback circuit. The resultant Speed Error signal in the range +10V (full speed forward) to -10V (full speed reverse) represents any difference which is present between the required and actual servo motor speed and provides the input to the Current Demand circuits. The proportional gain applied to this error is adjustable via P6 and the integral time constant adjustable via P7.

Current Demand

The Speed Error signal is applied to the Speed Loop PI circuit which contains a 2-term (Proportional plus Integral) amplifier with a very high DC loop gain to achieve accurate steady state speed control plus good dynamic performance by correctly optimising the low and high frequency gain for small and large signals. The proportional loop gain (P-term) can be adjusted in the range x2 to x50 by means of the GAIN preset P6 and the integral time constant (I-term) can be adjusted in the range 0.1ms to 100ms by means of the TIME CONSTANT preset P7.

If fitted, select-on-test capacitor SOTC2 reduces the P-term range and increases the I-term range while select-on-test resistor SOTR1 adjusts the P-term range only. In installations where no drift is permissible with zero setpoint input a 10M resistor can be fitted in the SOTC2 position.

Under normal conditions (ie, speed mode) the output of the Speed Loop PI circuit provides the Current Demand signal but this can be isolated via a solid-state switch when the normally open-circuit Current/Speed signal on Control PCB terminal 20 is connected to +24V (ie, torque mode). In the torque mode therefore the Current Demand signal is provided by the Current Input signal which is input via Control PCB terminal 10.

Main Current Limiting

The Current Demand signal determines the magnitude of the servo motor current and clamping the maximum excursions of this signal therefore limits the maximum peak current. The level of clamping (diagnostic Z12) is determined by the CURRENT LIMIT preset P9 which selects a portion of the Current Limit signal input via Control PCB terminal 13. Normally this signal is locally connected to the +10V reference source at Control PCB terminal 17 and the clamping level range of 0V to +10V corresponds to 0 to 200% of motor current. The Current Limit signal can also be derived from an external source which allows the maximum range of motor current to be programmed according to other requirements.

The level of the Current Demand signal is monitored by the Inverse Time circuit which also receives the I Average signal from the I Average circuit and has a limit level (diagnostic Z13) of 0V to +10V (= 0 to 100%) provided by the AVERAGE CURRENT LIMIT preset P10. The circuit acts as an overload integrator and reduces the main current limit setting progressively to 100% at a rate proportional to the magnitude for any overload current value between 100% and 200%. During overload conditions the inverse time constant allows 200% current for approximately one second after which the level is automatically reduced to 100% on an exponential time curve. Reduction of the load allows a return to the 200% capability with the resetting time being inversely proportional to the load duration (ie, less load allows faster reset times).

Secondary Current Limiting

The Direction Clamps circuit receives the Current Demand signal processed by the Inverse Time circuit and applies two secondary current limits which independently act on the demands for positive and negative motor current.

A +24V Positive Clamp signal via Control PCB terminal 19 limits the motor current to ≈ 0 in the positive direction and Negative Clamp signal via Control PCB terminal 18 limits the motor current to ≈ 0 in the negative direction. However, the main current limits set by the CURRENT LIMIT preset P9 always override the secondary current limits in order to maintain safe values of motor current. These inputs would be used for machine end stops etc.

Current Demand Processing

A comparator checks the polarity of the ±10V (= ±200%) Current Demand signal (diagnostic Z11) and outputs an appropriate Current Demand Sign signal to the Look Up Table which is an EPROM addressed by the three Rotor Position signals received from the Speed Feedback Processing circuit. (The MODE SELECT switches SW10 and SW11 are not used in this application). The Look Up Table is programmed to apply trapezoidal correction to the Current Demand signal and the resultant 8-bit parallel output word is applied to two Digital-to-Analog (D/A) converters.

The D/A converters also receive the Current Demand signal (in modulus form) and generate I1 Demand (diagnostic Z15) and I3 Demand (diagnostic Z17) signals which represent, respectively, the phase 1 and phase 3 current required. Both signals are in the range ±10V (= ±200%) and provide summing inputs to the Current Control Loop circuits.

Current Feedback

Measurement of the phase 1 and phase 3 currents is provided by the I1 Feedback (diagnostic Z16) and I3 Feedback (diagnostic Z18) signals which are output from two DC current transformers (DCCTs) connected in series with the motor power wiring. Both signals are voltage levels in the range 0 to ±10V (±3V = ±100%) and provide the feedback inputs required for summing with the corresponding demand signals in the Current Control Loop circuits.

The feedback signals are also used by the I Average circuit to produce an I Average signal for the Inverse Time circuit. The I Average circuit additionally produces a voltage level in the range 0 to +10V (= 0 to 200%) representing the full load current which is output via Control PCB terminal 12 as the Current O/P (Modulus) signal (diagnostic Z14) for external monitoring equipment. This signal is also compared with the Over Current signal from the Power PCB for overcurrent detection.

Current Control Loop

The I1 Demand signal is summed with the I1 Feedback signal and the I3 Demand signal is summed with the I3 Feedback signal, the resultant outputs being processed by two identical P Loop (proportional) circuits to produce the Phase 1 Voltage Demand and Phase 3 Voltage Demand signals. Both signals are also used by the Phase 2 Generator circuit to produce the required Phase 2 Voltage Demand signal.

The three voltage demand signals are applied to individual comparators each one of which also receives a common second input from the Sawtooth Generator whose current gain (ie, magnitude) is controlled by the Current O/P (Modulus) signal. Predetermined current gain is set by adjustment of the CURRENT GAIN preset P8.

Dynamic Braking

Dynamic braking (using an external resistor) is activated by the Brake signal when, during deceleration or with an overhauling load, the reverse energy flow from the servo motor causes the level of the Link Volts signal (diagnostic Z19) to rise from +6.0V (nominal) to +7.5V (ie, actual DC Link Volts potential is greater than +750VDC).

The front panel drive status BRAKE indicator is lit during the time that dynamic braking is taking place.

Alarm Detection

The Alarm Detection circuit monitors the status of six fault signals from various sources and generates an Alarm signal to 'quench' the controller when a fault condition is detected. A second output drives a 'health' relay whose contacts can be used to switch external alarm circuits via Control PCB terminals 22 to 24. Fault conditions are also identified by various combinations of the front panel drive status HEALTH, FAULT 1, FAULT 2 and FAULT 3 indicators as described in Table 5.1 of Chapter 5 (Diagnostic Fault Finding).

NOTE: The Alarm Detection circuit is latched and requires the Enable signal to be removed then re-applied in order to restore controller operation after a fault has been rectified.

The six fault signals monitored for alarm detection are as follows:

1) **> Current:** Active when the Current O/P (Modulus) signal exceeds the Over Current signal or the Short Circuit signal is present.

2) **> Volts:** Active when the Over Volts signal exceeds the overvoltage trip level.

3) **< Volts:** Active when the Under Volts signal is below the undervoltage trip level.

4) **Motor Overtemp:** Active when servo motor internal temperature is in excess of 125°C.

5) **Controller Overtemp:** Active when the controller internal case temperature is in excess of 80°C.

6) **Missing Preset:** Active when the Preset PCB is not fitted or is defective.

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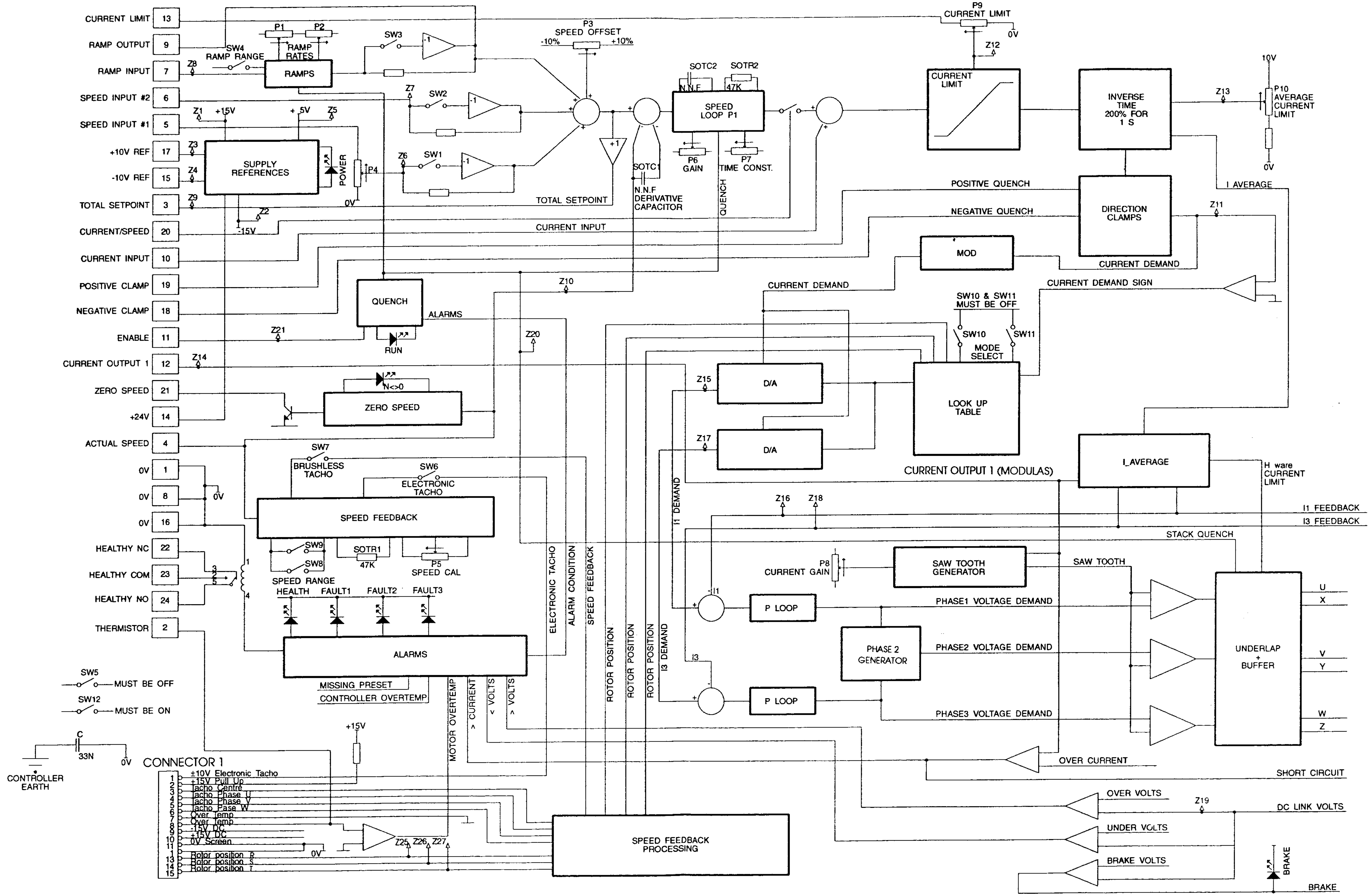

Figure 2.1 – Control PCB Functional Block Diagram

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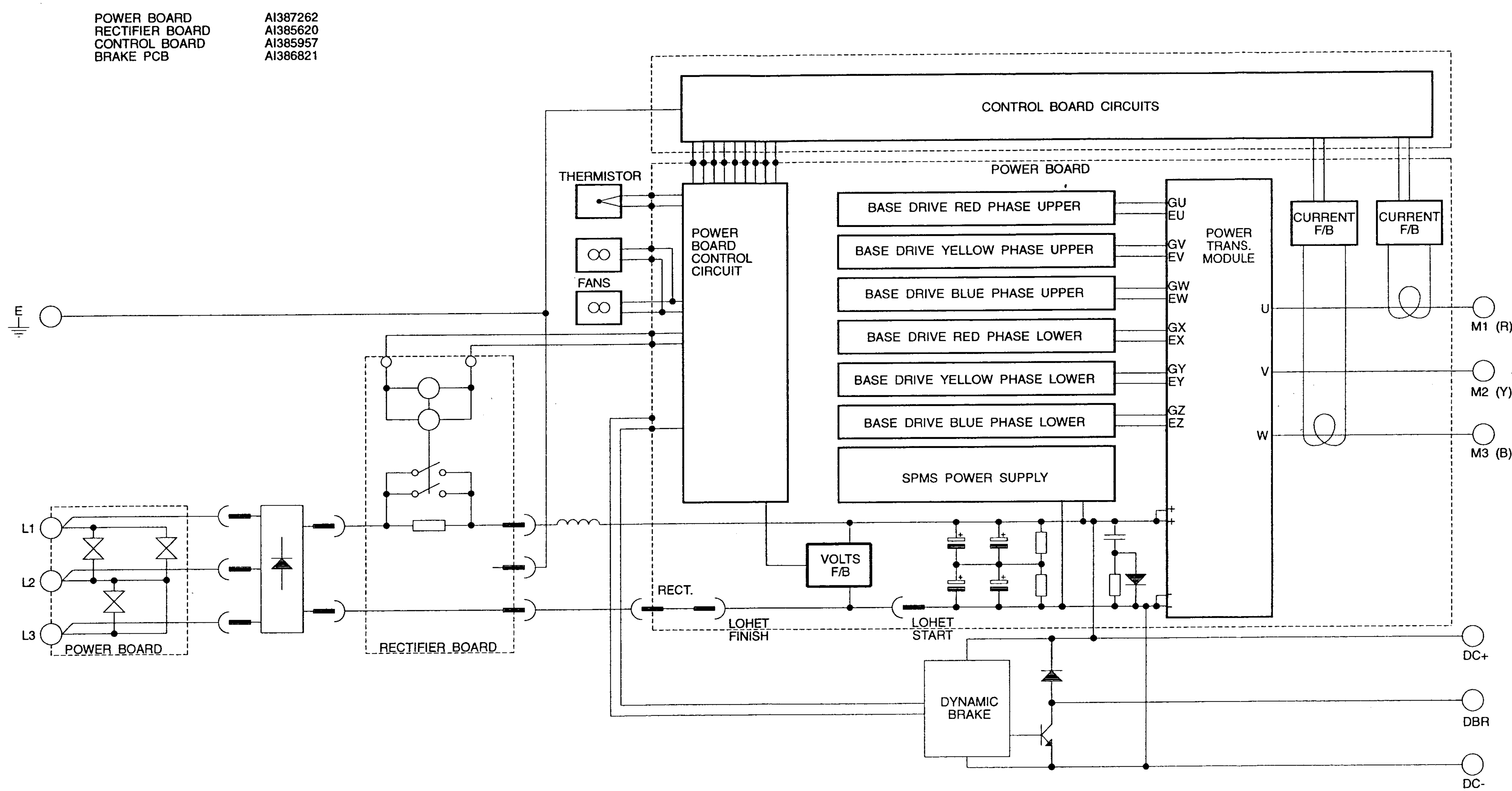

Figure 2.2 - Schematic Power Diagram (5, 12 & 20 Amp Models)

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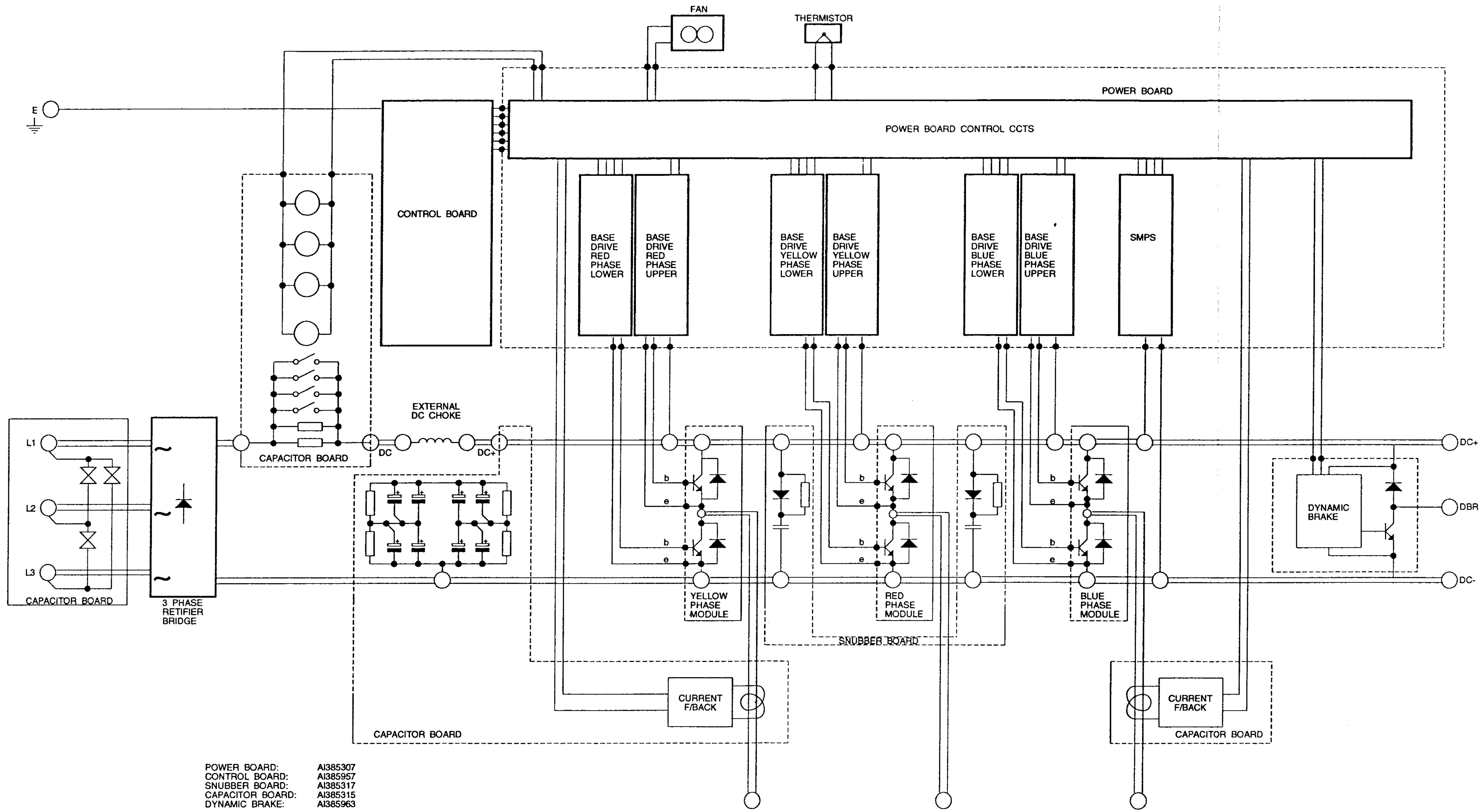

Figure 2.3 – Schematic Power Diagram (35 Amp Models)

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2.2 BASIC WIRING DIAGRAMS

General wiring diagrams are provided for the 5, 12 & 20 Amp models in Figure 2.4, and for the 35 Amp model in Figure 2.5. A minimum connection diagram is shown in Figure 2.6.

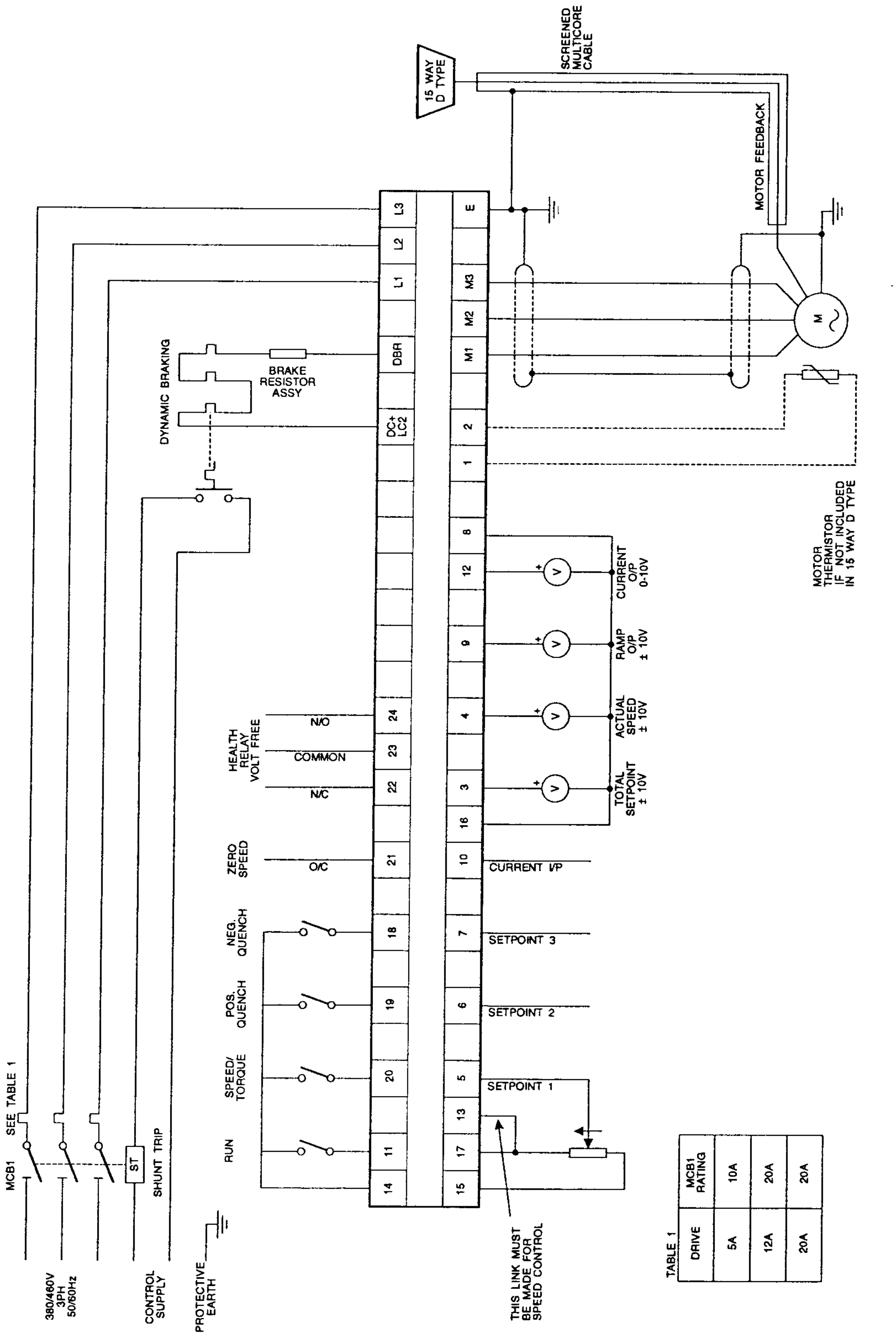

Figure 2.4 - General Wiring Diagram (5, 12 and 20 Amp Models)

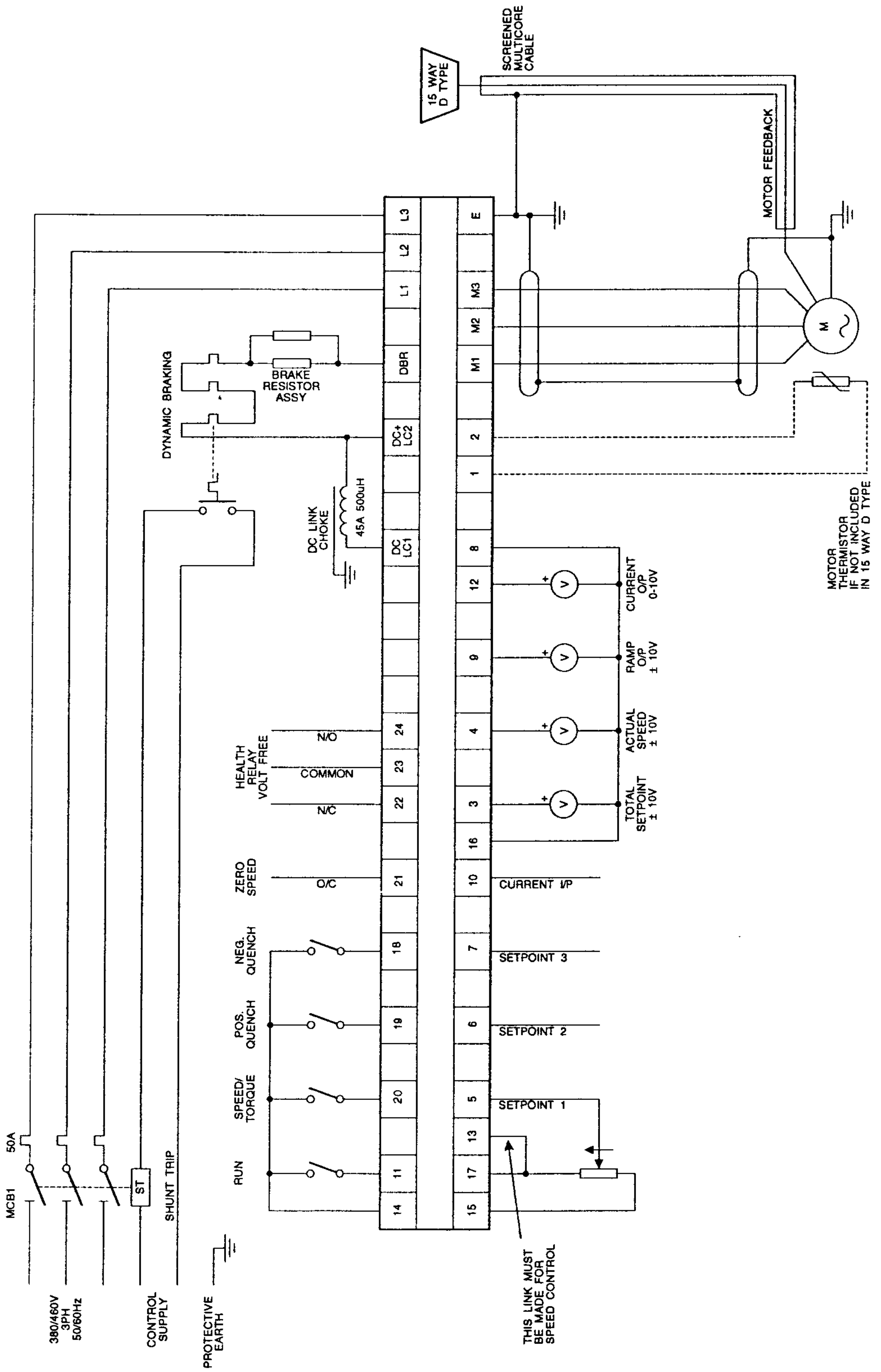

Figure 2.5 - General Wiring Diagram (35 Amp Model)

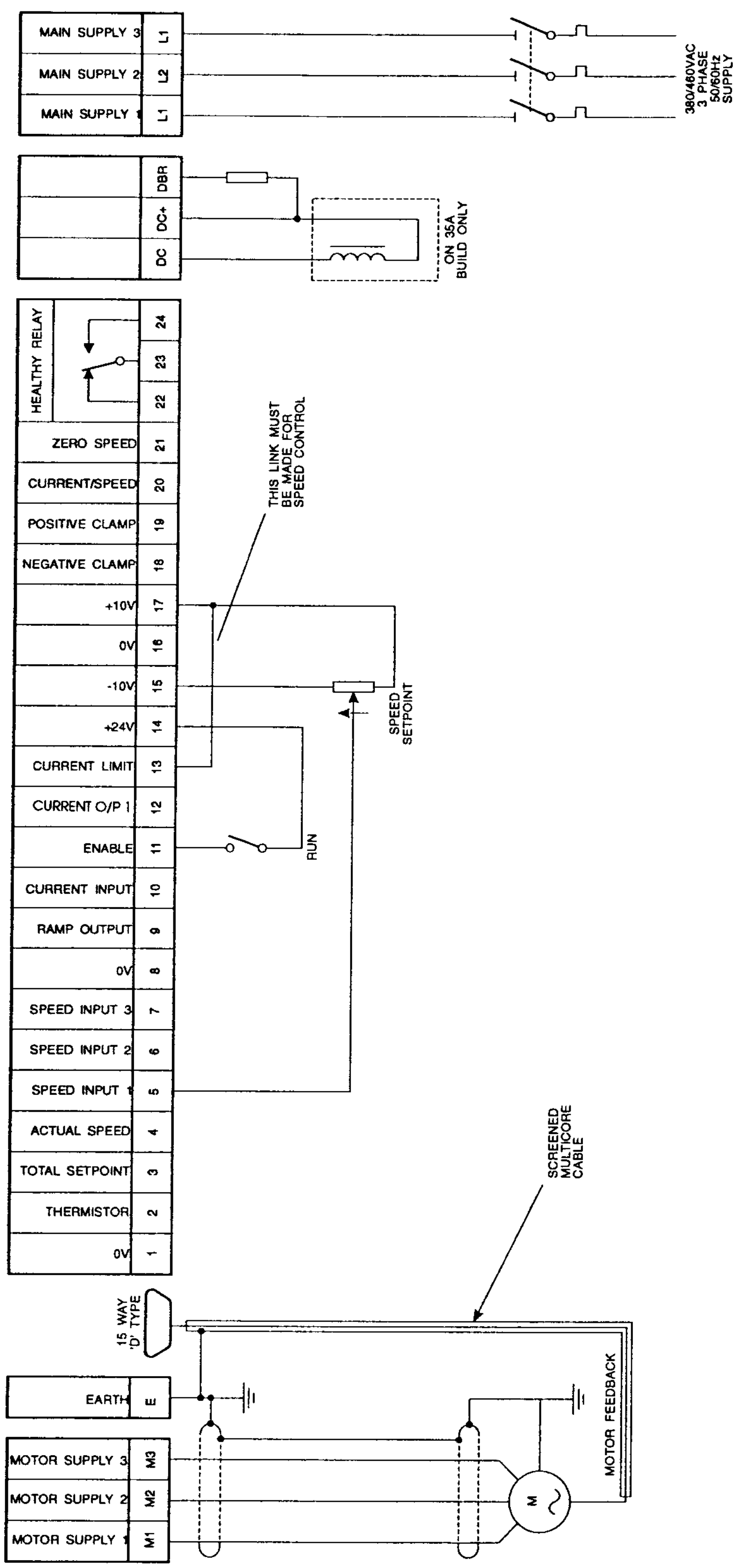

Figure 2.6 – Minimum Connection Diagram

2.3 TERMINAL DESCRIPTIONS

Terminals are provided on both the power board and the control board to allow reliable interface connections with the external devices. The signals carried by these terminals are detailed in the following paragraphs.

2.3.1 Power Board Terminals

WARNING!

THE POWER BOARD 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.

The signals carried by the power board terminals for the 5, 12 and 20 Amp versions of the 564 Series Drive Controller are described in Table 2.1. The location of the terminals is shown in Figure 2.4.

The signals carried by the power board terminals for the 35 Amp version of the 564 Series Drive Controller are described in Table 2.2. The location of the terminals is shown in Figure 2.5.

Table 2.1 – 5, 12 and 20 Amp Drive Controller – Power Board Terminals

Terminal	Terminal Description
DBR	A Power Output for the connection of a dynamic braking resistor. Refer to paragraph 3.4 for further details.
M1, M2, M3	Power outputs forming the three phase supply connection for the motor. **Caution** These terminals must be wired according to an approved wiring diagram for the type of motor concerned. Refer to Appendix A of this manual.
EARTH	Power Earth. This terminal should be connected to a protective earth.
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-). This terminal is also used for connection to a braking resistor.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, in the range 380-460V ±10% AC line-to-line.
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.

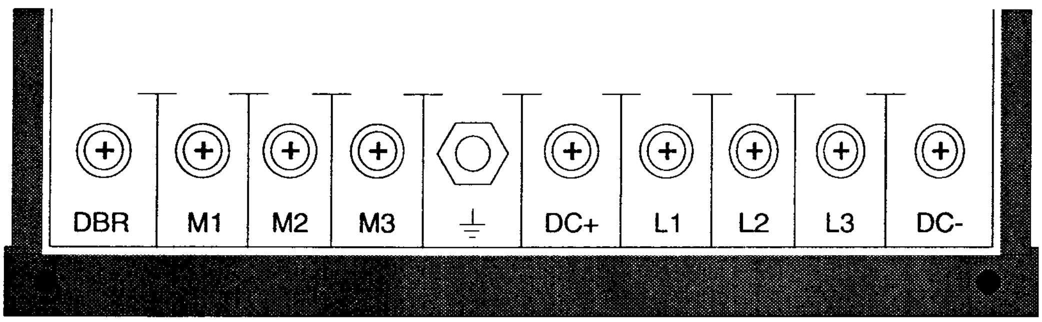

Figure 2.4 – 5, 12 and 20 Amp Drive Controller – Power Board Terminals

Table 2.2 – 35 Amp Drive Controller – Power Board Terminals

Terminal	Terminal Description
M1, M2, M3	Power outputs forming the three phase supply connection for the motor. **Caution** These terminals must be wired according to an approved wiring diagram for the type of motor concerned. Refer to Appendix A of this manual.
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 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-). This terminal is also used for connecting a braking resistor and external link choke.
DC	Power input/output. This terminal is used in conjunction with the DC+ terminal for connection of an external link choke.
DBR	Power input/output for the connection of a dynamic braking resistor. Refer to paragraph 3.4 for further details.
L1, L2, L3	Power inputs. These terminals are the 3-phase mains supply input, in the range 380-480V ±10% AC line-to-line.

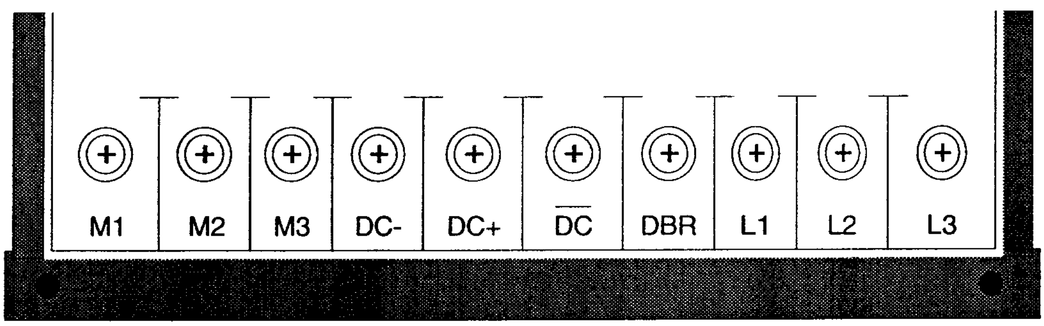

Figure 2.5 – Power Terminals - 35 Amp Drive Controller – Power Board Terminals

2.3.2 Control Board Terminals

The control board terminals are identical for all variants of 564 Drive Controller. The signals carried by the control board terminals are described in Table 2.3.

Table 2.3 -Control Board Terminal Description

Terminal Number	Terminal Description
1	0V (SIGNAL). Reference This terminal provides a zero volt reference for signals only. NOTE: The 0V terminals 1,8 & 16 are connected internally
2	THERMISTOR. Analogue Input This terminal is a thermistor input, used to monitor the external motor temperature. The controller monitors the voltage at this input and generates a motor overtemperature alarm should the voltage exceed a preset level. This terminal is connected in parallel with connector 1 pin 7 and is used when the motor thermistor is located in the power terminal box of the motor.
3	TOTAL SETPOINT. Analogue Output This signal is a voltage corresponding to the total setpoint value generated by the signals applied to the speed setpoint inputs at terminals 5, 6 and 7 plus the speed offset. An output in the range 0 to ±10V corresponding to 0 to ±100% full speed for speed meter. Output impedance ≈1kΩ. Diagnostic Z9.
4	ACTUAL SPEED OUTPUT. Analogue Output An output in the range 0 to ±10V corresponding to 0 to ±100% full speed for speed meter. Output impedance ≈1kΩ. Diagnostic Z10
5	SPEED SETPOINT 1 (VARIABLE RANGE). Analogue Input An input in the range ±10V. Scaled by potentiometer P4 (100% scaling) and inverted by closing DIP switch 1 (refer to Chapter 4). Input impedance ≈100kΩ. Diagnostic Z6.
6	SPEED SETPOINT 2 (FIXED RANGE). Analogue Input An input in the range ±10V. It can be inverted by closing DIP switch 2 (refer to Chapter 4). Input impedance ≈100kΩ. Diagnostic Z7.

(continued)

Table 2.3 _ Control Board Terminal Descriptions (continued)

Terminal Number	Terminal Description
7	SPEED SETPOINT 3 (RAMP). Analogue Input. The signal applied to this input is connected to an internal linear ramp generator and should be in the range 0 to ±10V corresponding to 0 to ±100% full speed. The signal is inverted by closing DIP switch 3. The ramp time is adjustable using P1 & P2 on the preset board and can be switched between a 3 second or 30 second range using DIP switch 4 on the preset board (refer to Chapter 4). Input impedance ≈100kΩ. Diagnostic Z8.
8	0V (SIGNAL). Reference Refer to terminal 1.
9	RAMP OUTPUT. Analogue Output This signal is the output of the ramp function with input at terminal 7. When the input on terminal 7 is altered, the output will follow at a constant rate depending on the setting of potentiometers P1 and P2 (clockwise rotation of P1 and P2 = shorter ramp rate) and DIP switch 3. Output impedance ≈1kΩ.
10	CURRENT INPUT. Analogue Input This terminal provides direct access to the input of the current loop for torque control applications. For this purpose the speed controller is disabled by connecting terminal 20 (Current/Speed) to +24V. This terminal accepts a voltage in the range of 0 to ±10V corresponding to ±200% nominal current of the controller. It should be left open circuit for speed control. Input impedance ≈100kΩ.
11	ENABLE. Digital Input This terminal provides the controller enable function. The controller does not begin operation until a +24V signal is applied to this terminal. On opening the enable signal between terminal 11 and terminal 14, the drive is quenched and does not supply torque (no braking). Input impedance ≈ 47kΩ. Diagnostic Z21
12	CURRENT OUTPUT 1 (MODULUS). Analogue Output This output gives a signal in the range 0 to 10V corresponding to 0 to 200% nominal current of the controller. Output impedance ≈1kΩ. Diagnostic Z14.

(continued)

Table 2.3 – Control Board Terminal Descriptions (continued)

Terminal Number	Terminal Description
13	EXTERNAL CURRENT LIMIT. Analogue Input The voltage applied to this terminal sets the peak current to a value in the range 0-200%. It is normally linked to terminal 17. An input voltage in the range 0 - 10V corresponds to 0 - 200% peak current. Input impedance ≈100kΩ. Diagnostic Z12.
14	+24V (NOMINAL). Reference This is an internally generated, unregulated DC supply in the range 20V to 30V which may be used to supply the enable and quench inputs. The maximum load on this supply should not exceed 50mA.
15	-10V PRECISION REFERENCE. Reference This internally generated -10V regulated supply may be used as a source for the setpoint signals up to a maximum load of 10mA. Diagnostic Z4.
16	0V (SIGNAL) Reference Refer to terminal 1
17	+10V PRECISION REFERENCE. Reference This internally generated +10V regulated supply may be used as a source for the setpoint signals up to a maximum load of 10mA. Diagnostic Z3
18	SELECTIVE ROTATION QUENCH (NEGATIVE). Digital Input This input is used to reduce the current supplied in the negative direction of rotation to approximately 0% of the controller nominal current. Connect to a +24V DC source for current reduction, otherwise leave open circuit. Input impedance ≈20kΩ.
19	SELECTIVE ROTATION QUENCH (POSITIVE). Digital Input This input is used to reduce the current supplied in the positive direction of rotation to approximately 0% of the controller nominal current. Connect to a +24V DC source for current reduction, otherwise leave open circuit. Input impedance ≈20kΩ.

(continued)

Table 2.3 _ Control Board Terminal Descriptions (continued)

Terminal Number	Terminal Description
20	CURRENT/SPEED. Digital Input This terminal selects between speed loop operation and torque/current control operation. Connecting this terminal to a +24V DC source disconnects the speed loop in applications requiring pure torque/current control. This terminal should be left open circuit if not used. Input impedance ≈50kΩ.
21	ZERO SPEED OUTPUT. Digital Output This terminal provides an open collector output which is switched to 24V as soon as the motor speed drops to 1/500 = 0.2% of the maximum speed. This output may be used to drive an external relay coil of 24V, 50mA maximum connected between terminal 21 and terminal 14 (+24V DC). An internal flywheel diode and pull up resistor are integrated on the control board. Alternatively this output may be used to drive a NC, CNC or PLC input directly.
22	HEALTHY RELAY CONTACT (NC). Volt Free Contact. This terminal is the normally closed contact of the 'healthy' relay whose change-over contact is terminal 24. (The relay is energised when the controller is Healthy.) Maximum load 240V, 3.0A.
23	RELAY CONTACT (COMMON). Volt Free Contact This is the common relay contact which is switched to terminal 22 or 24 according to the status of the internally generated controller 'HEALTH' alarm signal. NOTE: Drive ready to operate → Terminals 23 and 24 internally connected Drive NOT ready to operate → Terminals 23 and 22 internally connected
24	HEALTHY RELAY CONTACT (NO). Volt Free Contact. This terminal is the normally open contact of the 'healthy' relay whose change-over contact is terminal 22. (The relay is energised when the controller is Healthy). Maximum load 240V, 3.0A.

Chapter 3

INSTALLATION PROCEDURE

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Chapter 3 - INSTALLATION PROCEDURE

3.1 INSTALLATION PRECAUTIONS

Caution

This product conforms to IP20 protection. Due consideration should be given to environmental conditions of installation for safe and reliable operation.

When installing the 564 Drive Controller ensure that the precautions which follow are observed:

1) Mechanically secure fixings are used, as recommended in paragraph 3.2.1.
2) The enclosure into which this product is mounted is suitable for the working environment.
3) The cooling and airflow around this product is as recommended in paragraph 3.2.2.
4) The cables and wire terminations are as recommended and securely clamped.
5) The installation and commissioning of this equipment is carried out only by competent personnel in accordance with safe working practices.

3.2 MECHANICAL INSTALLATION

3.2.1 Mounting

The 564 Series Drive Controller should be mounted vertically on a flat, vertical surface. It is fixed using 4 x M6 bolts or screws through fixing points provided to each corner at the rear of the unit. The fixing points are in the form of keyholes and slots to simplify fastening or removal. The overall dimensions of the unit and the positions of the fixing points are given in Figure 3-1 for the 5, 12 and 20 Amp variants, and in Figure 3-2 for the 35 Amp variant.

3.2.2 Ventilation

In normal operation the drive dissipates heat and must be mounted to allow the free flow of air vertically through the circuit board area, over the fuses and heatsink. Care should be taken to ensure that the mounting surface is also cool and that any heat generated by adjacent equipment is not transmitted to the 564 Series drive unit.

The maximum ambient operating temperature is 40°C. If the unit is required to operate beyond this limit, derating will be required (refer to paragraph 1.3.5 in chapter 1 of this manual).

For adequate natural ventilation of the Drive Controller, a minimum of 150mm clearance above and below the unit must be maintained. Side-by-side mounting of two or more Drive Controllers is permissible providing the 40°C ambient operating temperature is not exceeded.

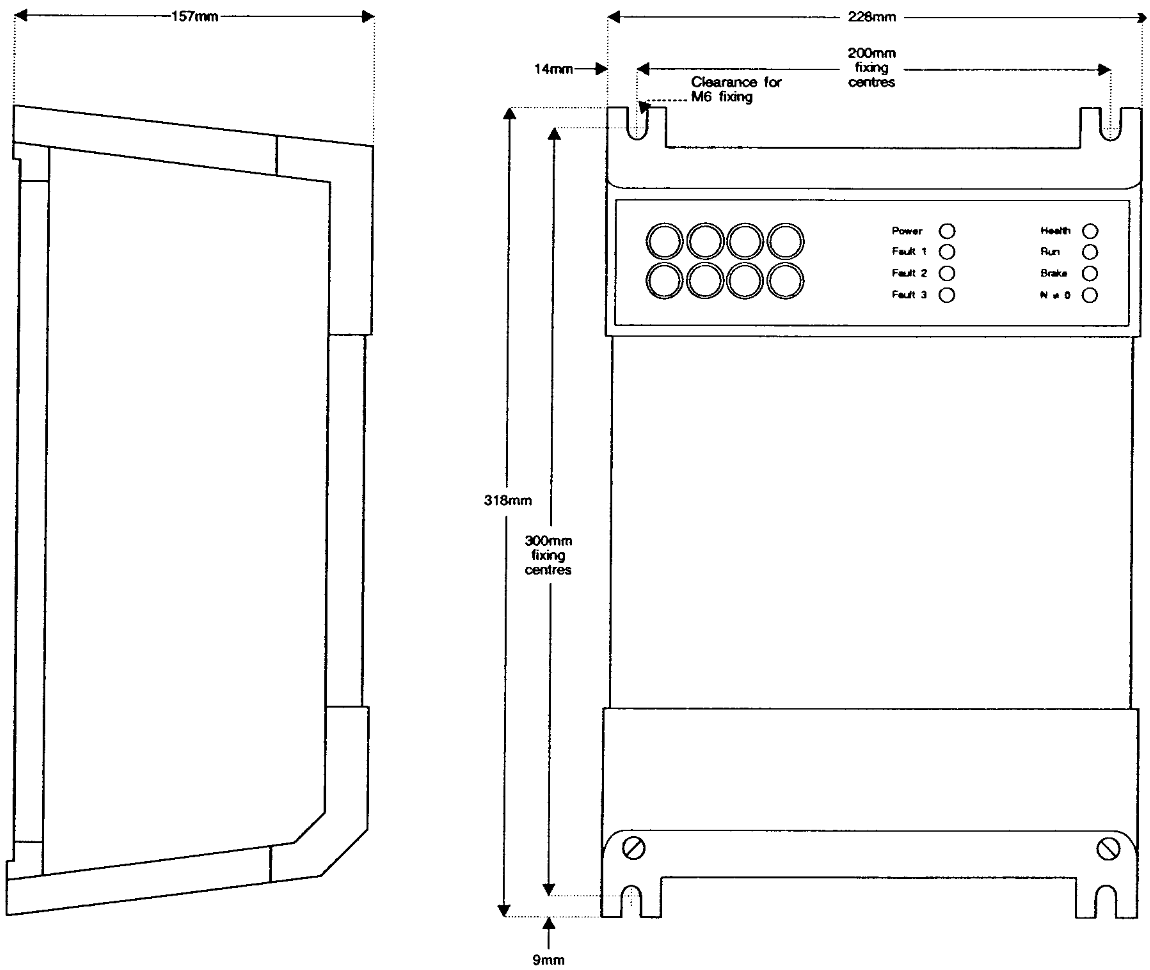

Figure 3.1 - 564 Series Controller (5, 12 & 20 Amp Variants) Mounting Arrangements

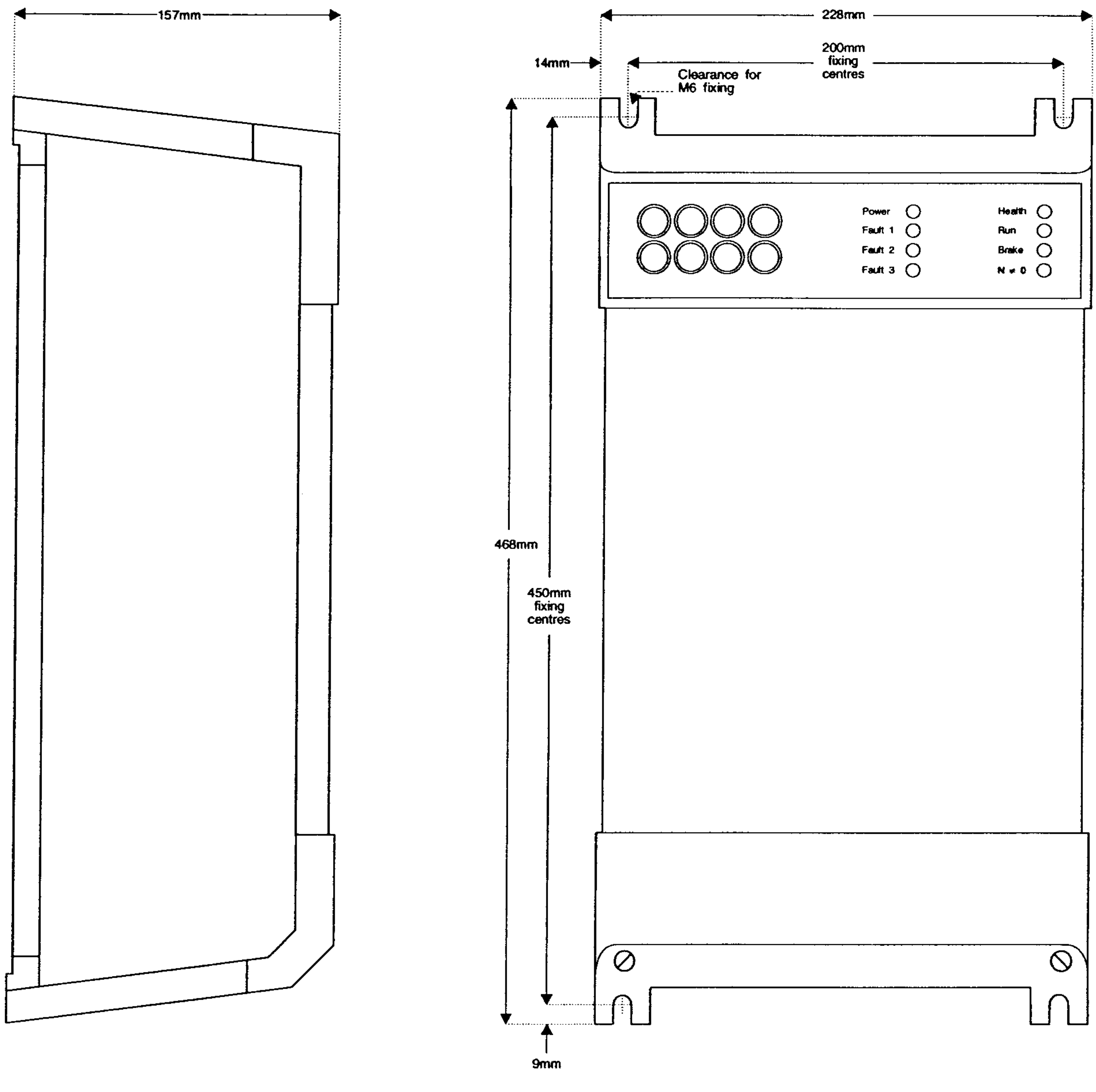

Figure 3.2 – 564 Series Controller (35 Amp Variant) Mounting Arrangements

3.3 ELECTRICAL INSTALLATION

The following instructions describe the wiring requirements for operation of the 564 Series controllers as basic speed controllers. The variety of specific drive applications precludes the inclusion of diagrams showing all wiring options.

3.3.1 Power Wiring

Caution

Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.

All relevant national standards and local electricity board regulations of installations must be observed.

Power cables must have a minimum rating of 1.1 x full load current.

Power cables (particularly 3-phase motor cables) must be routed well away from cables carrying setpoints, feedback signals and from the screened motor feedback cables, as well as cables from other electronic equipment in the same plant.

The main power supply should be three phase and within the voltage tolerances specified in paragraph 1.3.2 of this manual. The supply should be connected to power board terminals L1, L2 and L3 of the 564 drive.

Protection

The incoming mains supply should be protected as shown below:

Controller Type	Fuse or Circuit Breaker	Cable Diameter (mm^2)†
564-0050	10A	1.5
560-0120	20A	1.5
560-0200	20A	2.5
560-0350	50A	6.0

† - Assuming the conductors are in free air.

The fuses are standard type with slow-blow characteristic or a circuit breaker.

NOTE: These are typical values only. If in doubt please observe your national standards or local electricity supply regulations.

Earthing

WARNING!

THE DRIVE MOTOR MUST BE CONNECTED TO AN APPROPRIATE SAFETY EARTH. FAILURE TO DO SO CONSTITUTES AN ELECTRICAL SHOCK HAZARD.

A substantial earth connection should be made to the earth terminal of the drive.

3.3.2 Control Wiring

For normal speed control operation, the speed demand signal is connected to one of the three speed inputs provided (control board terminals 5 to 7). Terminal 1 may be used for the 0V connection of the setpoint signal. The maximum speed is ±10V = full speed when control board terminal 6 or 7 is used and is variable by P4 on the preset board when terminal 5 is used.

The enable signal to the 564 Series drive is provided by connecting a single holding contact between control board terminal 11 (enable) and terminal 14 (+24V) - open contact to stop, close contact to start

A relay change-over contact indicating drive healthy/alarm is provided on control board terminals 22 to 24 of the 564 drive. Any alarm which causes the drive healthy relay to de-activate is internally latched by the drive and the source of the alarm is indicated by the LEDs on the front of the drive. Once latched, such an alarm can be cleared only by removing and re-applying the main supply to the drive, or removing and re-applying the enable signal (terminal 11).

3.3.3 Motor Wiring

Feedback signals (e.g. rotor position, motor thermistor and tacho signals) are taken from the motor to the drive, multi-core screened cable should be used to carry these signals from the motor to the 15-way 'D'-Type plug on the 564 control board.

The cable must be screened over the entire length and the screen must be connected to earth only at the controller end. The total cable length should not exceed 50 metres. Refer to Appendix A.

The motor cables (as well as feedback such as rotor signals and tacho feedback) MUST be wired according to an Eurotherm Drives approved wiring diagram for the type of motor concerned. The motor cables are not interchangeable and may only be connected in one way to terminals M1, M2 and M3. Wiring diagrams for a selection of motors are given in Appendix A in this manual. For connection to motor types not listed in Appendix A, refer to the Eurotherm Drives Engineering Department.

3.4 DYNAMIC BRAKING

3.4.1 Introduction

During deceleration, or with an overhauling load, the motor acts as a generator. Energy flows back from the motor into the DC link capacitors within the drive. This causes the DC link voltage to rise. If the DC link voltage exceeds 800V then the drive will trip to protect the capacitors and the inverter power devices. The amount of energy that can be absorbed in the capacitors is relatively small. Dynamic braking is a means of increasing the braking capability of the drive by dissipating the excess energy in a high power resistor connected across the DC link (refer to Figure 3.3).

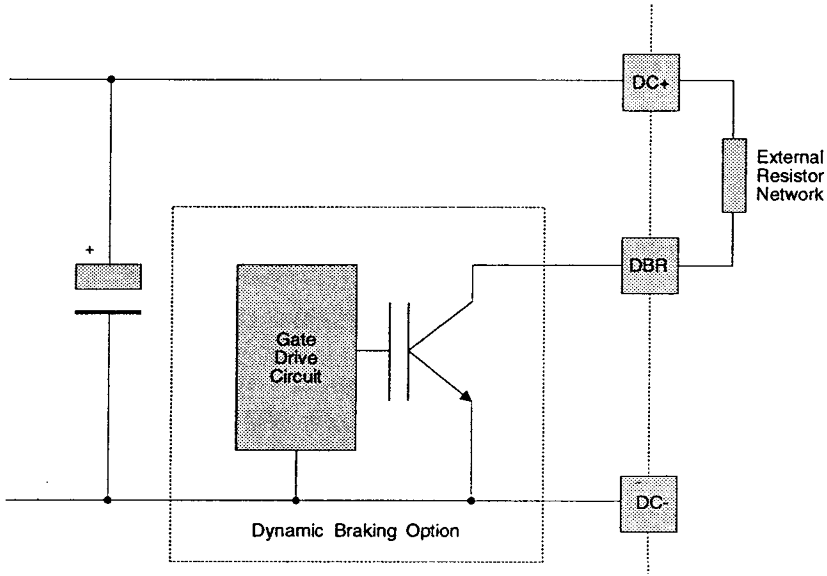

Figure 3.3 - The Dynamic Braking Option

When the DC link voltage rises above 750V, the brake unit switches the external resistor network across the DC link. The brake unit switches off again when the DC link voltage falls below 750V. The amount of energy produced by the motor during regeneration depends upon the RAMP DOWN TIME parameter and the inertia of the load.

Note: The dynamic braking option is designed to cope with short term stopping or braking only.
It is not rated for a continuously overhauling load.

All 564 units are supplied with an externally mounted braking resistor which will allow each unit to perform a limited amount of braking. There will be applications where the resistor capacity will be exceeded and additional braking resistors will need to be added. The following paragraphs should be used as a guide to calculate the braking requirements of the system.

3.4.2 Brake Resistor Selection

Brake resistor assemblies must be rated to absorb both peak braking power during deceleration and the average power over the complete cycle.

Peak braking power $P_{pk} = \frac{0.0055J \times (n_1{}^2 - n_2{}^2)}{t_b}$ (kW)

Average braking power $P_{av} = \frac{P_{pk}}{t_c}$

J - total inertia (kgm^2)
n_1 - initial speed (rpm)
n_2 - final speed (rpm)
t_b - braking time (s)
t_c - cycle time (s)

Information on the peak power rating and the average power rating of the resistors must be obtained from the resistor manufacturer. Alternatively if this information is not available then a large safety margin must be incorporated to ensure that the resistors are not overloaded. Eurotherm Drives can supply suitable brake resistor assemblies as detailed below;

Part number		CZ057146
Resistance value		56Ω
Max. average power rating		220W @ 20°C ambient; derate 4% per 10°C above 20°C
Peak power rating	0.1s	2.2kW
	1.0s	1.0kW
	2.0s	700W
	5.0s	300W
	10.0s	220W
Mounting centres		285mm
Overall length		300mm
Overall width		32mm
Fixing		M4
Electrical connection		M4

By connecting these resistors in series and in parallel the braking capacity can be selected for the application.

It is recommended that a thermal overload device is connected in series with the brake resistor. The overload trip should be set to prevent the average power in the resistor bank exceeding the resistor rating.

Details of the connection of the externally mounted braking resistors as supplied with the 564 unit is shown in Figure 3.4.

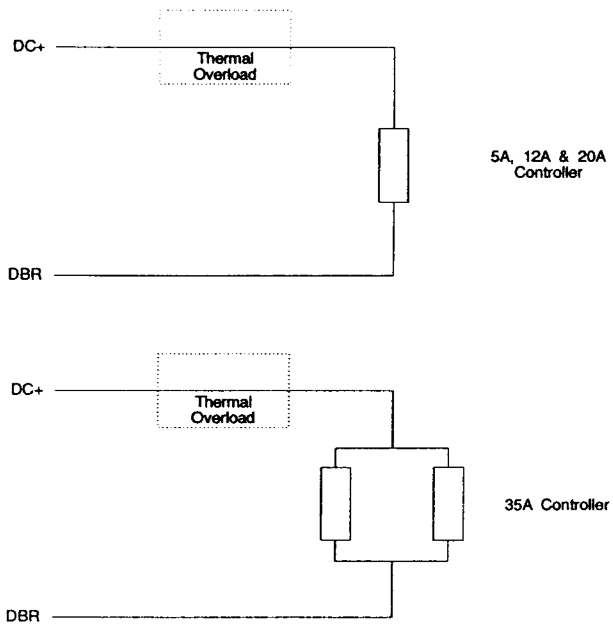

Figure 3.4 – The Externally Mounted Braking Resistor (as supplied)

3.4.3 Specification of the Dynamic Braking Switch

Controller rating	5A to 20A	35A
Current rating	15A	20A
Max duty cycle	30%	30%
Min resistor value	50Ω	25Ω

Chapter 4

SETTING-UP AND COMMISSIONING

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Chapter 4 – SETTING UP & COMMISSIONING

4.1 SETTING-UP PROCEDURE

The following procedures describe how to set-up an installed drive controller. An exploded view of the controller which identifies the location of the items discussed in this Chapter is shown in Chapter 1, Figure 1.1.

Caution

Allowing a brushless motor to run to an uncontrolled high speed can result in serious damage to the motor as well as the controller. This can happen if the motor is not wired correctly, thus the importance of following this chapter carefully cannot be overstated.

4.1.1 Preparation

1) Prevent application of the main power supply by removal of the supply fuses, or isolate via the supply circuit breaker.

2) Disconnect the load from the motor shaft, if possible.

3) Check that the external run contacts are open.

4) Check that the preset board is fitted on the bottom of the control board.

5) On the preset board, check the potentiometers are in the factory set condition as described in Table 4.1. Refer to Figure 4.1 for the location of these potentiometers on the preset board.

Table 4.1 – Factory Set Potentiometer Position

Potentiometer	Adjustment
P1 } P2	MID
P3	MID
P4	MID
P5	MID
P6	FULLY ACW
P7	FULLY ACW
P8	FULLY ACW
P9	FULLY ACW
P10	FULLY ACW

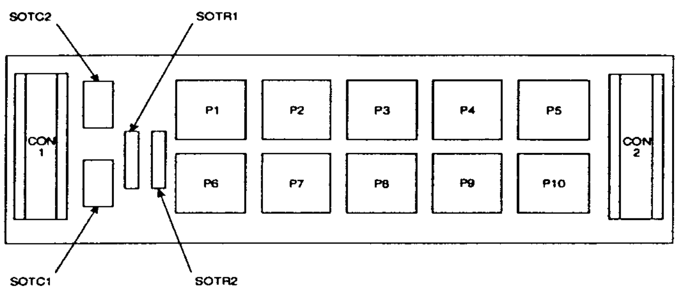

Figure 4.1 – Preset Board Component Layout

6) The DIP switches on the control board should now be set to give the required characteristics, according to Table 4.2.

Table 4.2 – DIP Switches

Switch	Description	Normal Setting
SW1	FUNCTION: Invert setpoint 1 input (ON = Invert input) This switch is used to invert the polarity of setpoint 1, this allows the direction of rotation to be changed for a particular setpoint polarity. The magnitude of the setpoint can also be reduced via P4.	OFF
SW2	FUNCTION: Invert setpoint 2 input (ON = Invert input) This switch is used to invert the polarity of setpoint 2, this allows the direction of rotation to be changed for a particular setpoint polarity.	OFF
SW3	FUNCTION: Invert setpoint 3 input (ON = Invert input) This switch is used to invert the polarity of setpoint 2, this allows the direction of rotation to be changed for a particular setpoint polarity.	OFF
SW4	FUNCTION: Ramp rate (ON = 2.5 - 30s, OFF = 0.1 - 3s) This switch is used to select either a fast or slow ramp rate, this selection applies to both ramp up and down times, although these are individually adjusted by P1 and P2.	OFF
SW5	FUNCTION: Not Used This switch **MUST** be left in the **OFF** position	**OFF**

(continued)

Table 4.2 – DIP Switches (continued)

Switch	Description	Normal Setting
SW6	FUNCTION: Electronic Tacho feedback (ON = enabled) This switch is used if the motor is fitted with an electronic tacho. This tacho will output a ±10V signal which is applied to pin 1 of the 15-way, D-type connector (Connector 1).	OFF
SW7	FUNCTION: 3-phase brushless tacho speed feedback (ON = Enabled) This switch is used if the motor is fitted with a brushless 3 phase tacho which is connected to pins 3, 4, 5 and 6 of the 15-way, D-type connector (Connector 1).	ON
SW8 & SW9	FUNCTION: Selection to the speed range These two switches are used to select the speed range. Speed range is adjustable via P5. Ensure the maximum speed does not exceed the motor rating. Speeds given are for 10V/1000rpm AC tacho, for electronic tachos use SW8 OFF, SW9 ON. SW8 SW9 Max Speed OFF OFF 4000 OFF ON 6000 ON OFF 1750 ON ON 2600	OFF, OFF
SW10 & SW11	FUNCTION: Not Used unless running with motor for which there is not a wiring diagram. See POWER ON note 7. Normally these switches would be left in the **OFF** position.	**OFF, OFF**
SW12	FUNCTION: Not Used This switch **MUST** be left in the **ON** position	**ON**

7) Check that the drive is wired in accordance with the wiring instructions in Chapter 2 and Appendix A of this manual.

Paragraphs 4.2 and 4.3 detail the user adjustments necessary to ensure satisfactory operation of the controller. This involves adjusting the potentiometers as summarised in Table 4.3 and possible adjustment of DIP switch settings as summarised in Table 4.2. It is important that paragraphs 4.2 and 4.3 are followed step-by-step in the sequence given.

Table 4.3 – Potentiometers

Potentiometer	Function	Adjustment
P1 } P2	Ramp time adjustment	0.1s to 30s CLOCKWISE to decrease ramp time. Fast ramp times SW4 OFF, slower ramp times SW4 ON.
P3	Speed loop offset	±1% of full speed
P4	Scaling of setpoint 1 terminal 5	Clockwise to INCREASE speed
P5	Tacho scaling (maximum speed)	Clockwise to INCREASE speed
P6	Speed loop gain	Clockwise to INCREASE gain
P7	Speed integral time constant	CLOCKWISE to decrease time constant
P8	Current proportional gain	Clockwise to INCREASE gain
P9	Peak current limit	0-200% I_N - Clockwise to INCREASE current
P10	Average current	0-100% I_N - Clockwise to INCREASE current

4.2 POWER ON

1) On completion of the checks given in paragraph 4.1.1, main 3-phase power may be applied to terminals L1, L2 and L3.

2) Check the drive condition indicator LEDs are illuminated as follows;

POWER	ON	HEALTH	ON
FAULT 1	ON	RUN	OFF
FAULT 2	ON	BRAKE	OFF
FAULT 3	ON	$N \neq 0$	OFF

If this is not the case, refer to the LED diagnosis chart given in Chapter 5 of this manual.

3) Using the Eurotherm Drives diagnostic Unit 5570, check the following diagnostic test points for the values given below;

Test Point	Value
1	+15V ±1V
2	-15V ±1V
3	+10V ±0.1V
4	-10V ±0.1V

If this is not the case, power off and check all external wiring.

4) Set speed setpoint 1, 2 or 3 to about 0.5V (diagnostic 6, 7 or 8 respectively). Set the average current limit (P10) to about 10% of controller current (ie about 1.0V on diagnostic 13).

NOTE: If the motor starts to run to high speed or does not rotate, turn the current limit back down again.

Caution

Do not continue to increase P4 or serious damage may be caused to the motor and/or the controller.

5) Close the enable contacts and slowly increase the peak current limit (P9). The motor should rotate under control at up to 5% of full speed. The actual speed (diagnostic 10) should be equal in value and opposite in sign to the total setpoint (diagnostic 9). Do not proceed until this stage has been satisfactorily completed.

NOTE: If the motor vibrates at standstill or runs uncontrolled at high speed, the motor feedback signals and the motor phases have not been wired in accordance with the wiring diagrams given in Appendix A. If running is erratic but in control this indicates there is a problem with the rotor positions or the tacho, again refer to the wiring diagrams in Appendix A.

Remove the enable signal. Remove power and wait for at least 3 minutes before correcting this wiring.

WARNING!

FAILURE TO ALLOW TIME FOR CAPACITOR DISCHARGE PRESENTS AN ELECTRIC SHOCK HAZARD

6) It is possible to rotate the motor phases using switches SW10 and SW 11, but this should only be done if a wiring diagram for the specific motor being used is not published. To phase the motor correctly proceed as follows;

i) Turn P9 ACW

ii) Enable the drive

iii) Slowly increase P9

iv) Check that the motor is running under control - do NOT allow the motor to overspeed.

v) If the motor is not running under control turn P9 ACW, disable the drive and increment the switch selection as given in Table 4-4.

Table 4.4 - Motor Phase Selection Switches

Selection	SW10	SW11
1	OFF	OFF
2	OFF	ON
3	ON	OFF
4	ON	ON

Repeat the procedure from step i). If all 4 switch selections have been tried without success, physically swap any 2 of the motor phases and repeat this procedure from step i).

7) Once the motor has been phased correctly, the specific user parameters may be adjusted.

8) If the direction of rotation is incorrect for the polarity of the setpoint this may be changed via SW1, SW2 or SW3 depending on which setpoint is being used.

9) Select the appropriate speed range, via switches SW8 and SW9, ie select a range which just includes the maximum speed that the motor will operate to. Make this selection and adjust P5 ACW.

10) Adjust the average current limit P10 (diagnostic 13) to the continuous current rating of the motor in use. Diagnostic 13 gives the percentage of controller current rating, ie 5V = 50% thus for a 10A motor and a 12A controller diagnostic 13 would be set to $10/12 \times 10 = 8.33$. If no diagnostic is available an approximate setting of P10 can be made.

11) Adjust peak current limit P9 (diagnostic 12) to the peak current rating of the motor in use. Diagnostic 12 gives the percentage of the controller nominal current rating ie 5V = 100%. Normally P9 would be fully CW but where either the motor or the mechanics necessitate a limit to the peak torque, the necessary setting can be made.

12) Ensure motor is free/safe to rotate, set all setpoints at zero, enable the drive, adjust the speed offset P3 until the motor is at standstill and $N \neq 0$ is off.

13) Slowly increase the speed setpoint to maximum and check that the maximum speed is reached. Adjust via P5.

14) If a ramped input is being used, the ramp rates may be adjusted via P1 and P2. Longer ramp times are available if switch SW4 is on.

4.3 RUNNING PERFORMANCE ADJUSTMENTS

4.3.1 Current Loop Adjustment

The current loop has a proportional gain adjustment to accommodate motors of differing inductance. Adjust P8 CW until current ripple becomes excessive, then back off slightly. This can be observed on diagnostic 16 and/or 18 or if no diagnostic is available by an increase to motor noise. Excessive CW adjustment of P8 may cause overcurrent trips or unecessary heating of the motor.

4.3.2 Speed Loop Adjustment

The speed loop with motor and load is optimised by adjustment of the speed PID controller;

Potentiometer P6 – P term (Proportional Gain)
Potentiometer P7 – I Term (Integral Time Constant)
Capacitor SOTC1 – D term (Derivative)

When shipped, the 564 Series drives have a proportional gain of 2 to 50 and an integral time constant of 0.1ms to 100ms. These values are suitable for most applications where the torque inertia ratio are as would be found in servo systems. In applications where the dynamics of the system are such that the standard values are not suitable then this may be changed by the addition of extra components (refer to paragraph 4.3.3.

Apply a small step change (about 20%) to the speed setpoint input and observe the speed response using an oscilloscope connected to the diagnostic unit, position 10. If the system allows reversals, this may be performed by applying a small setpoint and using either SW1, SW2 or SW3 to invert the respective setpoint.

With P6 ACW gradually decrease the integral time constant by CW rotation of potentiometer P7. The response curve will move from Over Damped (Curve b) towards Critically Damped (Curve c). Continue to adjust P7 until the curve lies just past Critically Damped (Curve c) towards Under Damped (Curve a). Increase the proportional gain by CW adjustment of potentiometer P6 until overshoot is reduced and response time is optimised. Excessive CW adjustment of either P6 or P7 will introduce excessive overshoot and may induce instability.

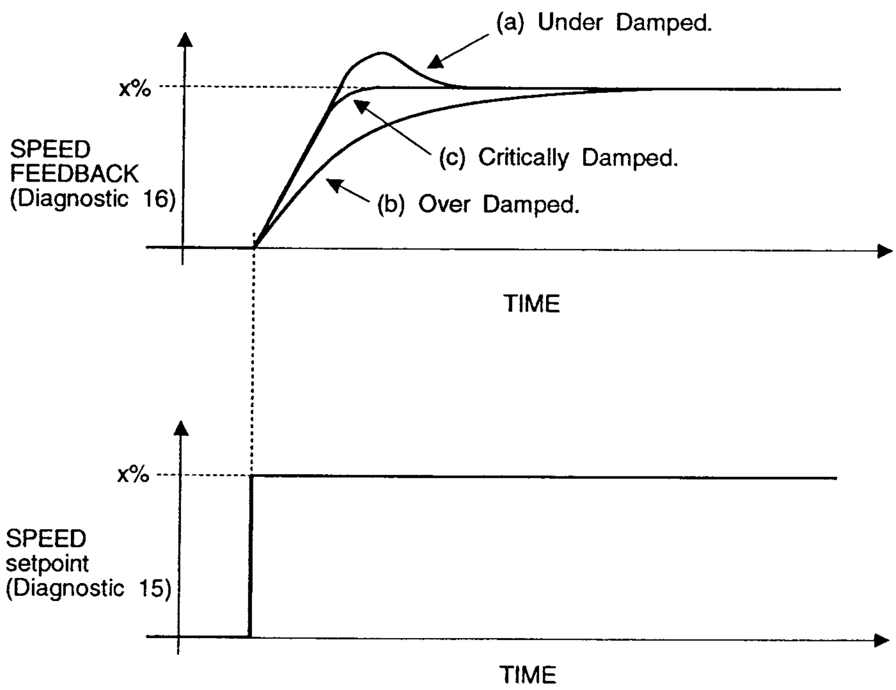

Figure 4.1 – Typical Speed Response Curve

Derivative Action (D)

NOTE: If the setpoint for the speed loop derives from a position controller, it has proven unnecessary to provide derivative action.

If manual operation is used, or jumpy switching of the setpoint is likely to occur, derivative action may be necessary to reach the setpoint without overshooting.

Derivative capacitor SOTC1 increases the AC voltage gain. It should be kept as small as possible, therefore, to keep the gain of the cable noise low. SOTC1 may be altered between values of 0.01μF to 1.0μF.

4.3.3 Further Adjustments

If further alteration of the PID controller terms is required, the following adjustments may be considered;

1) Add a non-polarised capacitor to SOTC2. This has the effect of increasing the Integral Time Constant and reducing the Proportional Gain.

    Integral Time Constant (max)

    0.1 + SOTC2 (μF) seconds

    ie SOTC2 = 100nF = 0.1+0.1 = 0.2 seconds

    Ratio of **Proportional Gain** change

    0.2/(0.2 +SOTC2(μF))

    ie SOTC2 = 100nF = 0.2/(0.2+0.1) = 0.66 thus gain 1.33 to 33, assuming SOTR2 remains unchanged.

2) Change the value of SOTR2. This has the effect of changing the Proportional Gain.

    Proportional Gain (max) approx. SOTR2 (kΩ)

    Proportional Gain (min) approx. SOTR2 (kΩ)/20

    max value 1MΩ, min value 1kΩ

3) In cases where no drift is permissible with zero setpoint, a value of 10MΩ may be fitted to the SOTC2 position.

4.4 LOG SHEET

A copy of a parameters setting log sheet is given in Appendix B of this manual. The log sheet is provided to record all user defined settings and the values of components chosen for the preset board to determine these settings. The log sheet is therefore an important source of reference in the unlikely event of a fault with the unit. Recording the values also allows the settings to be replicated should the preset board require replacement.

Chapter 5

DIAGNOSTICS AND FAULT FINDING

Contents page

Chapter 5 - DIAGNOSTICS AND FAULT FINDING

5.1 DIAGNOSTICS

There are the diagnostic facilities provided by the 564 Series drive controller; the provision of drive status LEDs mounted to the upper right of the front panel, and the provision for an optional Diagnostic Test Unit (type 5570). These are described in the following paragraphs.

5.1.1 The Drive Status LEDs

The drive status LEDs are mounted to the upper right of the front panel and provide a continuous display (whilst the controller is powered) of the drive controller status. The location and names associated with the LEDs is shown in Figure 5.1.

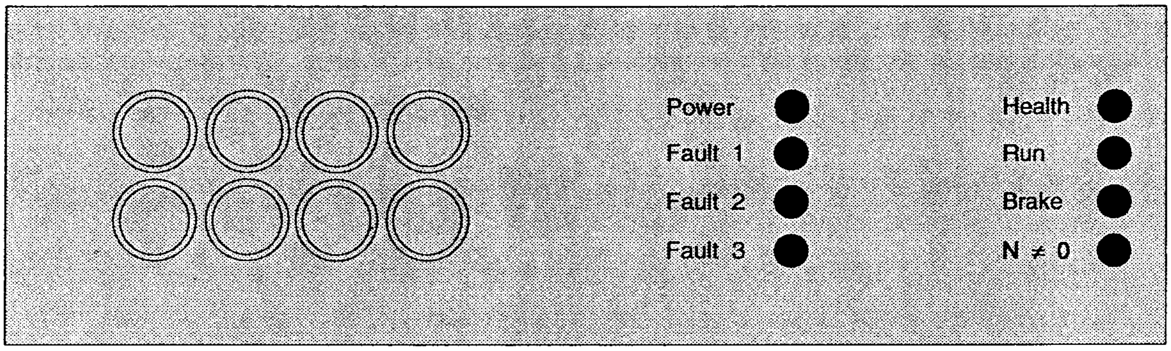

Figure 5.1 – Drive Status LEDs

The status of the drive controller indicated by the LEDs is described in Table 5.1.

5.1.2 The Diagnostic Test Unit

The diagnostic test unit (type 5570) connects to a multi-pin socket at the lower edge of the Control PCB (refer to Figure 2.1 for diagnostic test points (Z1 - Z27)). The diagnostic test unit is a small, portable plug-in module which, when connected to the drive provides access via a selector switch to 27 internal test points. The unit incorporates the following features;

a) A digital voltmeter to permit accurate measurement of steady state signals.

b) An analogue voltage 'trend indicator' in the form of a row of LED displays which span signal levels in the range ±10V. This is a fast responding indicator which shows the magnitude of rapidly changing signals.

c) A pair of output sockets (standard 4mm) allowing signals to be monitored externally on an oscilloscope.

Table 5.1 - Drive Status Indication

LED			Status
POWER			When illuminated, this LED indicates that the internal power supplies are present.
RUN			When illuminated, this LED indicates that the controller is active.
BRAKE			When illuminated, this LED indicates that the dynamic braking switch is on.
$N \neq 0$			When illuminated, this LED indicates that the motor speed is not zero.
HEALTHY			When illuminated, this LED indicates that the controller is operating normally and no fault conditions are present.
FAULT 1, 2 & 3			These LEDs are illuminated to indicate the controller status. The possible combinations and their meaning is as follows;
3	**2**	**1**	
○	○	○	Not used
○	○	●	Overcurrent
○	●	○	Overvoltage
○	●	●	Undervoltage
●	○	○	Motor overtemperature
●	○	●	Controller overtemperature
●	●	○	Preset board missing/not connected
●	●	●	Healthy

5.2 FAULT FINDING

In attempting to determine the causes of fault conditions it is essential to follow the normal setting up procedure described in Chapter 4.

If a stage is reached in the setting up procedure where the required stage is not satisfied, the following possible causes of failure may exist:

a) Failure of mechanics including the electrical wiring

b) Failure of the overriding control system including NC, CNC, PLC.

c) Failure of the motor

d) Failure of the controller

Noises and oscillations proportional to motor speed are usually based on mechanical problems (discontinuous friction, backlash etc.,) Noises and oscillations which are not proportional to the motor speed are usually based on control problems (unstable speed or current loop).

If a fault on the controller is suspected then check the following in the sequence given;

a) Look at the drive status LEDs on the front panel and refer to the fault finding information given in Table 5.2.

b) Check the voltages at the test points with the 5570 Diagnostic Unit as described in paragraph 5.2.1 and compare with the Voltage measurement chart given in Table 5.3.

Table 5.2 - Fault Finding Table

Indication (FAULT 3 2 1)	Alarm	Possible Cause/Remedy
○ ○ ●	Overcurrent	1) Current gain too high. Turn P8 ACW. 2) Speed loop gain too high. Turn P6 ACW. 3) Speed loop integral time constant too short. Turn P7 ACW. 4) Motor has low inductance. Reduce the peak current limit or fit a choke to the motor phases. 5) Power stage of the controller is damaged. Return the unit for repair.

(continued)

Table 5.2 – Fault Finding Table (continued)

Indication (FAULT 3 2 1)	Alarm	Possible Cause/Remedy
○ ● ○	Overvoltage	1) Braking resistor not fitted, or faulty. Fit/replace braking resistor. 2) Deceleration too rapid. Increase the ramp down time. 3) If braking resistors have burnt out, the rating of these will have to be increased. Refer to paragraph 3.4.2. 4) Supply voltage exceeds 460V. Check the supply voltage.
○ ● ●	Undervoltage	1) Supply voltage is below 380V. Check the supply voltage. 2) One phase of the supply is missing. Check the wiring and/or fuses.
● ○ ○	Motor overtemperature	1) The connection to the motor thermistor is broken. Check motor thermistor wiring. 2) The motor has overheated - motor may be under rated. Turn P10 ACW until the average current limit is equal to the motor rating. 3) Motor overheating because of excess current ripple, caused by current gain being set too high. Turn P8 ACW until the motor phase currents contain less ripple.
● ○ ●	Controller overtemperature	1) Ambient temperature too high. Check ventilation. 2) Fans blocked. Check airflow across the controller.
● ● ○	Preset board missing	1) Preset board on the bottom of the control PCB is not present or has become loose. Check for presence of preset board and press home to ensure a reliable connection.

5.2.1 Voltage Measurements

Connect the Diagnostic Test Unit (type 5570) to the control PCB as follows;

a) Disconnect main power from the controller.

b) Open the retainer/ejector lever at each end of the Diagnostic Test Unit socket on the Control PCB.

c) Insert the Diagnostic Test Unit plug into the socket on the Control PCB, ensuring that the polarising tab and slot are correctly aligned. The retaining clips should close automatically as the plug is pushed fully home.

Re-apply power and measure the voltages as shown in Table 5-3. The diagnostic test points are shown in the Control PCB functional block diagram given in Figure 2.1. Record the measurements on the Diagnostic Test Unit voltage measurement log sheet given in Appendix B of this manual.

Disconnection of the Diagnostic Test Unit is the reverse of the connection procedure given above.

Table 5-3 – Diagnostic Test Unit Voltage Measurements

Test Number	Function	Signal in Run Condition
0	Not in use	-
1	+15V	+15V ±0.25V
2	-15V	-15V ±0.25V
3	+10V	+10V ±0.1V
4	-10V	-10V ±0.1V
5	+5V	+5V ±0.1V
6	Setpoint 1	±10V = ±100%
7	Setpoint 2	±10V = ±100%
8	Setpoint 3	±10V = ±100%
9	Total Setpoint	±10V = ±100%
10	Actual Speed	±10V = ±100%
11	Current Demand	±10V = ±200%
12	Peak Current Limit	0-10V = 0-200%
13	Average Current Limit	0-10V = 0-200%
14	Modulus Current Feedback	0-10V = 0-200%
15	Phase 1 Current Demand	10V = ±200%
16	Phase 1 Current Feedback	0 → ±10V (3V = 100%)

(continued)

Table 5-3 - Diagnostic Test Unit Voltage Measurements (continued)

Test Number	Function	Signal in Run Condition
17	Phase 3 Current Demand	±10V
18	Phase 3 Current Feedback	0 → ±10V (3V = 100%)
19	DC Link Voltage (÷100)	5V → 8V (6V nominal)
20	Drive Quenched (+5V = Quenched)	0V ±0.1V
21	Enable (Active High)	5V ±0.1V
22	Sine Reference	Not Used
23	Sine	Not Used
24	Cosine	Not Used
25	Rotor Position Signal R	0 → 5V ±0.1V
26	Rotor Position Signal S	0 → 5V ±0.1V
27	Rotor Position Signal T	0 → 5V ±0.1V

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Chapter 6

SERVICING

Contents..page

Chapter 6 - Servicing

6.1 ROUTINE MAINTENANCE

Routine maintenance of the 564 Series drive controller comprises a periodic inspection to check for a build up of dust or other obstructions that may affect the ventilation of the unit. Obstructions should be removed and any dust must be cleared using dry air.

6.2 REPAIR

Repair of the 564 Drive controller is limited to replacement of the control PCB and/or preset board only. Further repair necessitates returning the unit to Eurotherm Drives, refer to paragraph 6.4. Removal and replacement of the control and preset PCBs is given in the following paragraphs. To assist removal/replacement procedures, major sub-assemblies of the controller are identified in the exploded view given in Chapter 1, Figure 1.1.

WARNINGS!

BEFORE ATTEMPTING MAINTENANCE OF THIS UNIT, ENSURE ISOLATION OF THE MAIN SUPPLY TO TERMINALS L1, L2 AND L3.

WAIT FOR AT LEAST 3 MINUTES FOR THE DC LINK TERMINALS (DC+ & DC-) TO DISCHARGE TO SAFE VOLTAGE LEVELS, FAILURE TO DO SO CONSTITUTES AN ELECTRICAL SHOCK HAZARD.

6.2.1 Control PCB

To remove the control PCB, proceed as follows;

1) Using a pozidrive™ screwdriver remove and retain the two screws securing the upper LED panel to the drive.

2) Slide the upper LED panel away from the drive until the 10-way IDC connector on the control board is exposed. Gently pull the connector to remove it from the socket on the control board.

3) Remove the upper LED panel.

4) Slide the aluminium front panel toward the top of the drive until it can be lifted clear to reveal the control PCB beneath.

5) Using a pozidrive™ screwdriver remove and retain the two screws securing the lower drive cover.

6) Release the ejector latches which secure the 26-way IDC socket to the board mounted plug at the upper left of the control PCB. Push the ribbon cable and connector clear of the board.

7) Using a flat-bladed screwdriver unscrew the jackscrews securing the 15-way D-type connector plug to the board mounted socket and pull the plug and cable clear of the board.

8) Grip the upper edge of the control PCB and slide it upwards until it is clear of the drive.

9) Remove the earth wire to the control card.

10) Remove and retain the preset PCB if required by pulling it clear of the control PCB.

11) Remove control terminals (green blocks) from control board.

To replace a control PCB, follow the removal procedure in reverse order.

6.2.2 Preset PCB (uncalibrated)

To remove the preset PCB, proceed as follows;

1) Gain access to the preset PCB remove the lower drive cover as described in paragraph 6.2.1.

2) Pull the preset PCB clear of the control PCB.

To replace the preset PCB proceed as follows;

1) Push the board onto the mating DIL pins on the control PCB, being careful not to bend or otherwise damage the pins.

2) Re-assemble the drive by following steps 1) through 5) in paragraph 6.2.1 in reverse order.

6.3 ASSOCIATED PARTS

The associated parts for the 564 Series drive controllers are identified, with their associated part number, in Table 6.1.

Table 6.1 - Associated Parts

Description	Part Number
Printed Circuit Boards (PCBs) *	
564 Control PCB	AH385957U001
564 Preset PCB (Uncalibrated)	AH386905U001
* The power PCB assembly is not supplied as a separate spares item.	
Miscellaneous	
15-Way 'D'-Type Plug Assembly	LA387347
Braking Resistor	CZ057146
Diagnostic Test Unit	5570

NOTE: Complete spare drive units may be ordered by quoting the complete product code and order number of the original order.

6.4 EUROTHERM DRIVES COMPANIES

UK REGIONAL SALES AND SERVICE

Head Office & South-East Area
Eurotherm Drives Limited
New Courtwick Lane
Littlehampton
West Sussex BN17 7PD
Telephone (01903) 721311
Telex 87142 SSDLTN G
Fax (01903) 723938

North-East Area
Eurotherm Drives Limited
Armstrong House
Armstrong Estate, District 2
Washington
Tyne & Wear NE37 1PR
Telephone (0191) 4155536
Fax (0191) 4155538

Scotland
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Unit 59
Stirling Enterprise Park
Player Road
Stirling FK7 7RP
Telephone (01786) 71674
Fax (01786) 451095

Midlands Area
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Corporation Street
Rugby
Warwickshire CV21 2DW
Telephone (01788) 562011
Fax (01788) 550032

North-West Area
Eurotherm Drives Limited
4 & 5 Chetham Court
Winwick Quay, Calver Road
Warrington
Cheshire WA2 8RF
Telephone (01925) 572111
Fax (01925) 445567

South-West Area
Eurotherm Drives Limited
Almondsbury Business Centre
Great Park Road
Almondsbury
Bristol BS12 4QH
Telephone (01454) 616677
Fax (01454) 615903

OVERSEAS COMPANIES

Australia (Sydney)
Eurotherm International Pty Ltd
6 - 18 Bridge Road, Hornsby
New South Wales 2077
Sydney
Telephone (2) 477 7022
Fax (2) 477 7756

Australia (Melbourne)
Eurotherm International Pty Ltd
12 Overseas Drive, Noble Park
Victoria 3174
Telephone (3) 795 4155
Telex 071 35343
Fax (3) 795 1521

Austria
Eurotherm GMBH
Geiereckstrasse 18/1
A1110 Vienna
Telephone (1) 798 7601
Telex 1132000 EIAUT A
Fax (1) 798 7605

Canada
Eurotherm Drives
530 Seaman Street
Unit 3, Stoney Creek
Ontario L8E 3X7
Telephone (905) 664 8911
Fax (905) 664 5869

Denmark
Eurotherm Danmark A/S
Finsensvej 86
DK-2000 Frederiksberg
Telephone (31) 871622
Fax (31) 872124

France
Eurotherm Vitesse Variable SA (Drives)
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ZA de Courtaboef
91951 Les Ulis Cedex
Telephone (691) 85151
Fax. (691) 85159

Holland
Eurotherm BV
Johan Frisostraat 1
2382 HJ Zoeterwoude
Telephone (71) 411 841
Telex 39073
Fax (71) 414 526

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Eurotherm Ltd
Unit D, 18/F Gee Chang Hong Centre
65 Wong Chuk Road, Aberdeen
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Telex 802 69257 EIFEL HX
Fax (852) 8700148

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I.D.A. Industrial Estate
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Co. Kildare
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Fax (45) 75123

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Herentalsebaan 71-75
B-2100 Deurne, Antwerpen
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Telex 046 33317 EIBNL B
Fax (3) 23321 7363

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(Drives)
Birkenweg 8
D-64665 Alsbach-Haehnlein 1
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Fax (6257) 62094

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Eurotherm Drives SPA
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20030 Lentate Sul Seveso
Milano
Telephone (362) 557308
Fax (362) 557312

Japan
Eurotherm (Japan) Ltd
Marushima Building
28-2 Chuo 1-Chome
Nakano-Ku, Tokyo 164
Telephone (3363) 8324
Fax (3363) 8320

South Africa
EP Normand SA (Pty) Ltd.
PO Box 1073
Eden Vale 1610
Telephone (11609) 7250
Telex 740306
Fax (11609) 7369

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Eurotherm Produkte (Schweiz) AG
Kanalstrasse 17
CH-8152 Glattbrugg
Zurich
Telephone (810) 3646
Fax (810) 8920

Korea
Seoho Electric Ltd
194-53 Anyang 7-Dong
Anyang City
Kyunggi-Do
Korea
Telephone (34368) 6611
Fax (34368) 3311

Spain
Eurotherm Espana SA
Calle La Granja 74
Pol. Ind Alcobendas
28100 Alcobendas
Madrid
Telephone (1) 6616001
Fax (1) 6619093

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30009 Halmstad
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Appendix A

WIRING TO STANDARD SERVO MOTORS

Contents page

A1.1 INTRODUCTION

The diagrams given in the following pages of this Appendix detail the connections required to interface the 564 Series drive controller with a standard servo motor.

A1.2 RECOMMENDED MOTORS

Motors should have the following general specification;

1) 3-Phase trapezoidal windings
2) Hall-effect open collector position sensors
3) 3-Phase AC tacho or electronic tacho
4) Motor voltage - 450V
5) Class F insulation, or better.

A1.3 15-WAY D-TYPE CONNECTOR

Table A1.1 describes the signals carried by the 15-way D-type connector located to the lower left of the control board.

Table A1.1 - 15-Way D-Type Connector Pin Information

Pin Number	Input (I) or Output (O) Signal	Function
1	I	BL-tacho signal ± 10V from tachos with built in electronics for speed scaling.
2	O	Pull-up resistor versus +15V DC.
3	I	Tacho Centre
4	I	Tacho phase U
5	I	Tacho phase V
6	I	Tacho phase W
7	I	Overtemperature alarm in motor (PTC or thermal switch).
8	I	Overtemperature alarm in motor (PTC or thermal switch).
9	O	-15V DC for supplying tacho with built in electronics for speed scaling.
10	O	+15V DC for supplying tacho with built in electronics for speed scaling.
11	O	0V DC connection for screening.
12	O	0V DC
13	I	Rotor position transducer track R.
14	I	Rotor position transducer track S.
15	I	Rotor position transducer track T.

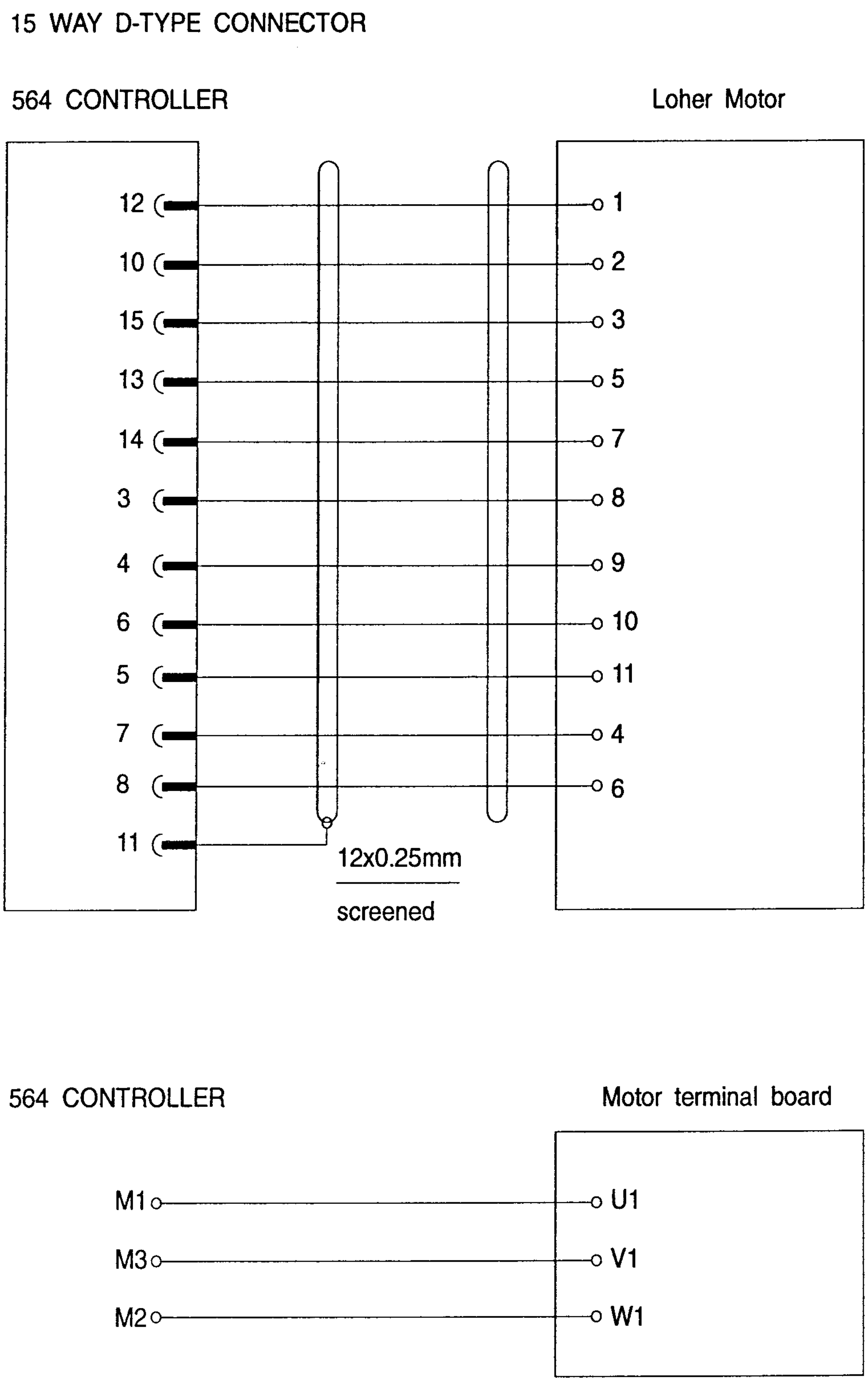
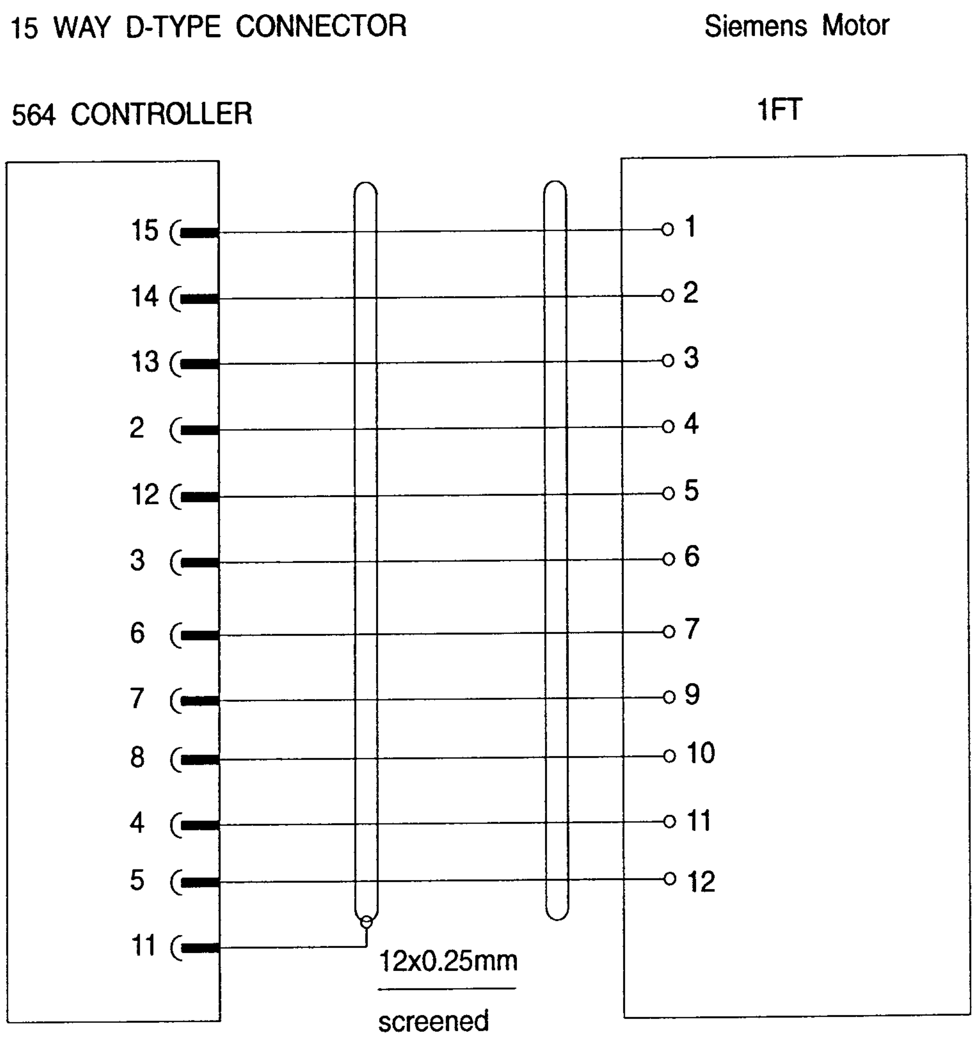


Figure A.1 - Connection Diagram for Loher Motors



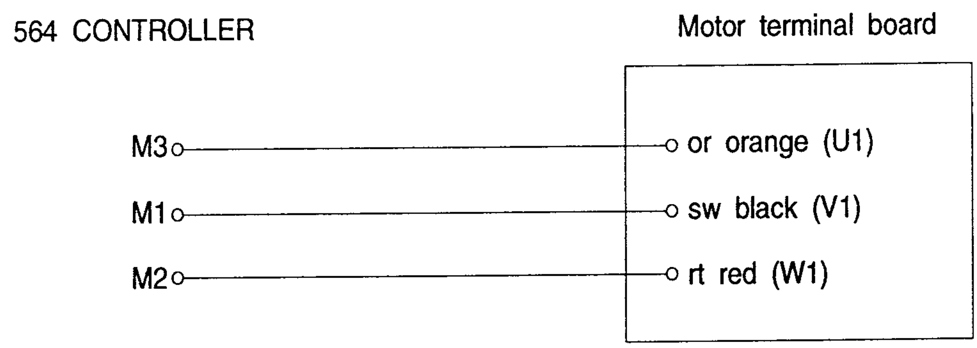


Figure A.2 - Connection Diagram for Siemens 1FT Motors

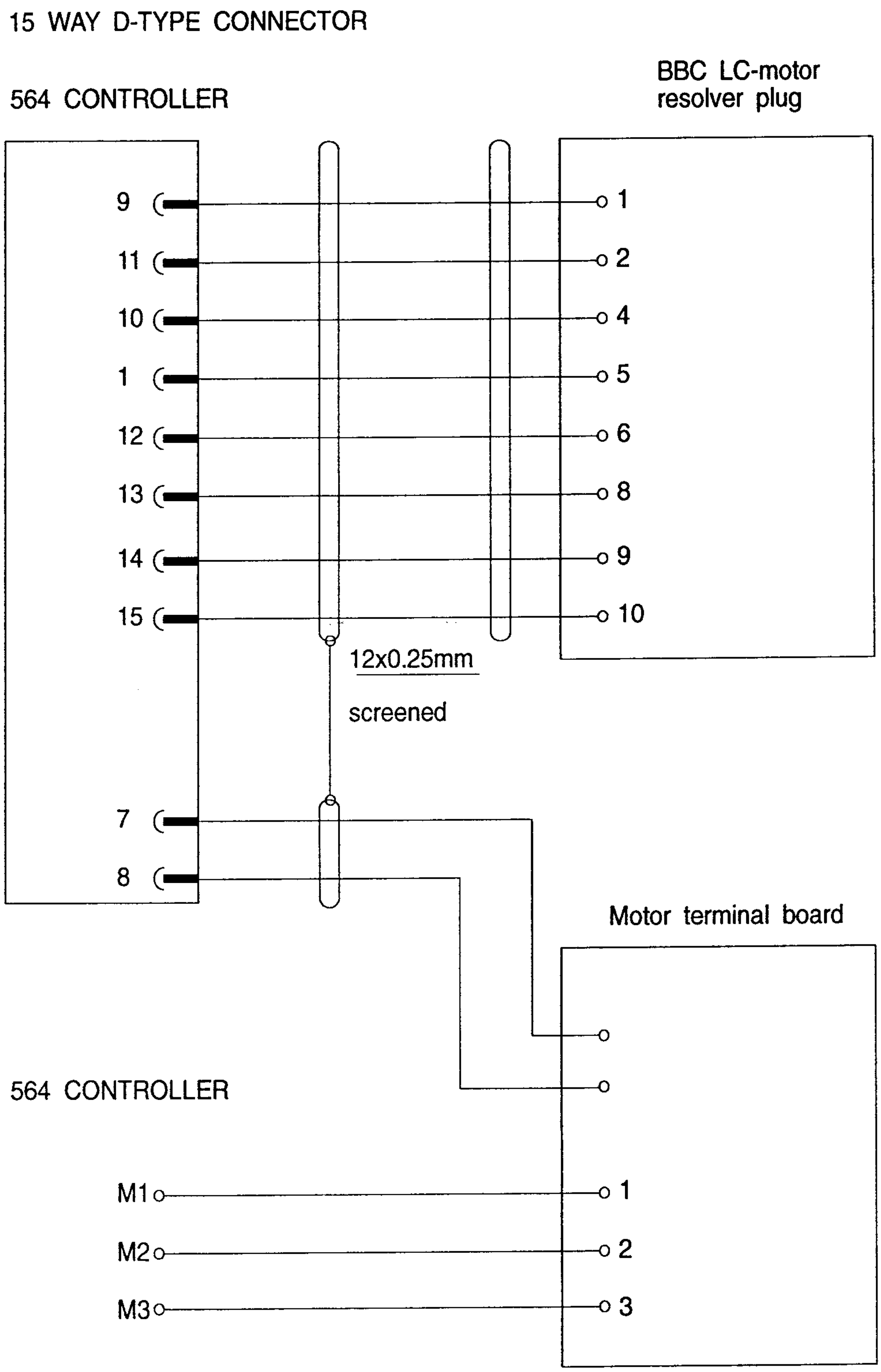


Figure A.3 - Connection Diagram for BBC LC - Motors

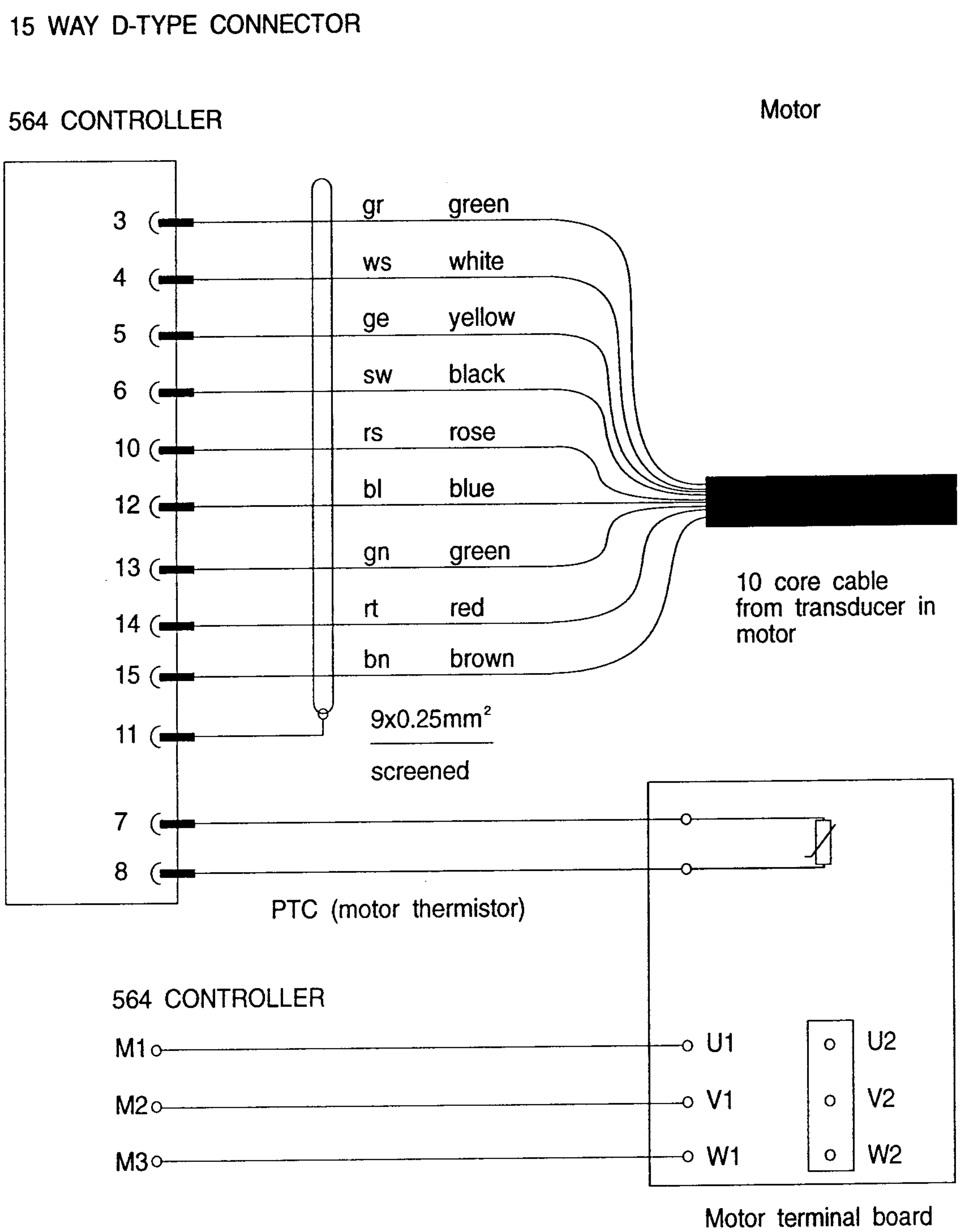
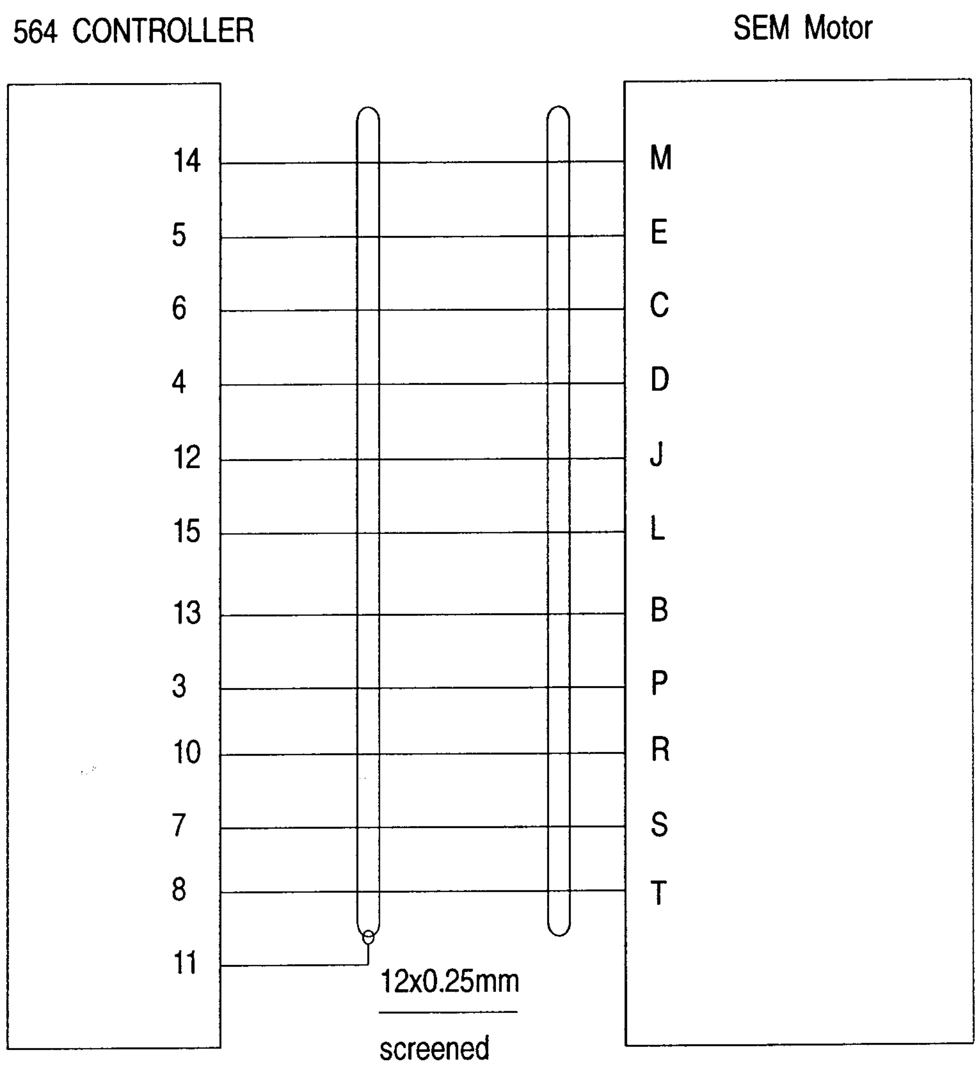


Figure A.4 - Connection Diagram for ATB Motors



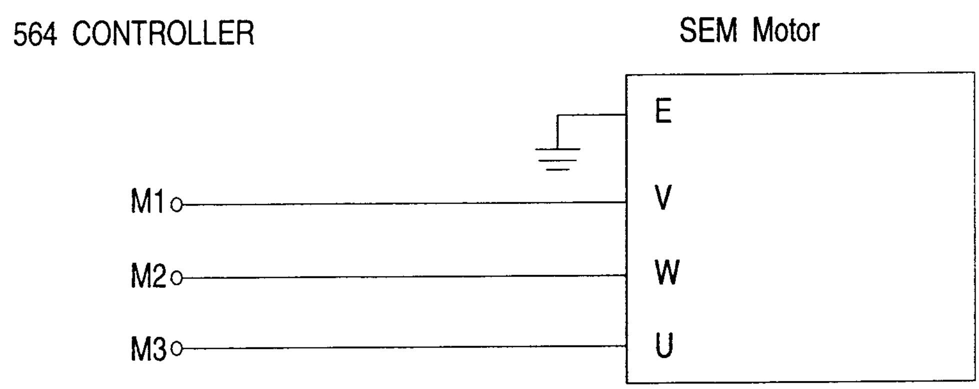


Figure A.5 - Connection Diagram for SEM Motors

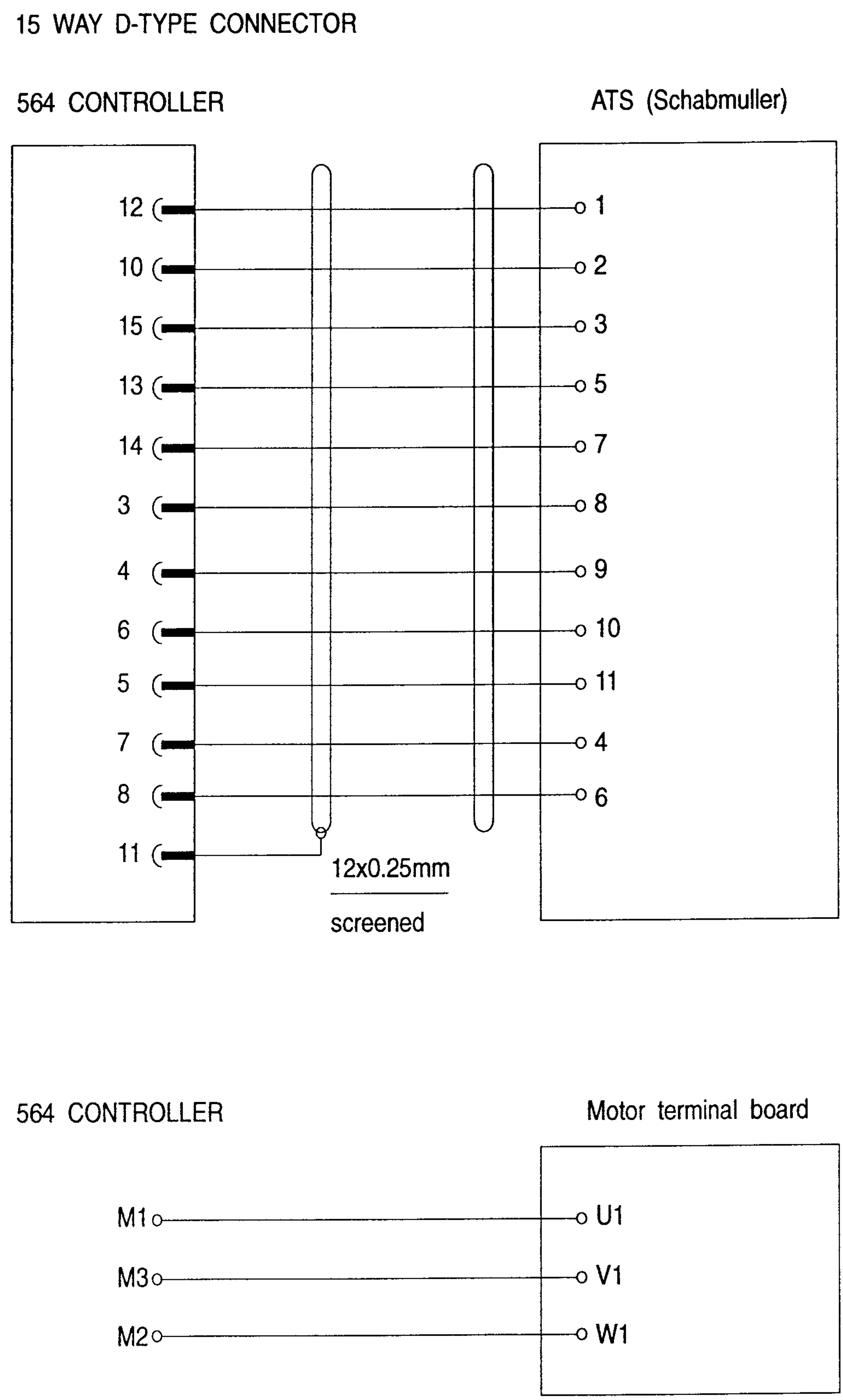


Figure A.6 - Connection Diagram for ATS (Schabmûller)

Appendix B

STANDARD FORMS

Contents page

B1.1 INTRODUCTION

This Appendix contains standard forms which are to be used to record various measurements and settings used for a particular installation of the 564 Series Drive Controller. These sheets should be copied as required.

B1.2 PARAMETERS SETTING LOG SHEET

This sheet should be used to log the values of the components used on the identity board.

B1.3 DIAGNOSTIC TEST UNIT VOLTAGE MEASUREMENT LOG SHEET

This sheet should be used to record voltage measurements made using the Diagnostic Test Unit after commissioning, or whenever fault finding procedures are followed.

Model Number	
Serial Number	

Parameters Setting Log Sheet

Switch Settings	Selected Value
S1	
S2	
S3	
S4	
S5	
S6	
S7	
S8	
S9	
S10	
S11	
S12	

Model Number	
Serial Number	

Diagnostic Test Unit Voltage Measurement Log Sheet

Item	Sig Name	Permitted Value	Measured Value				
0	Not in use	-					
1	+15V	+15V ±0.25V					
2	-15V	-15V ±0.25V					
3	+10V	+10V ±0.1V					
4	-10V	-10V ±0.1V					
5	+5V	+5V ±0.1V					
6	Setpoint 1	±10V = ±100%					
7	Setpoint 2	±10V = ±100%					
8	Setpoint 3	±10V = ±100%					
9	Total Setpoint	±10V = ±100%					
10	Actual Speed	±10V = ±100%					
11	Current Demand	±10V = ±200%					
12	Peak Current Limit	0-10V = 0-200%					
13	Average Current Limit	0-10V = 0-200%					
14	Modulus Current Feedback	0-10V = 0-200%					
15	Phase 1 Current Demand	10V = ±200%					
16	Phase 1 Current Feedback	0 → ±10V (3V = 100%)					
17	Phase 3 Current Demand	±10V					
18	Phase 3 Current Feedback	0 → ±10V (3V = 100%)					
19	DC Link Voltage (÷100)	5V → 8V (6V nominal)					
20	Drive Quenched (+5V = Quenched)	0V ±0.1V					

(continued)

Model Number	
Serial Number	

Diagnostic Test Unit Voltage Measurement Log Sheet (continued)

Item	Sig Name	Permitted Value	Measured Value				
21	Enable (Active High)	5V ±0.1V					
22	Sine Reference	Not Used					
23	Sine	Not Used					
24	Cosine	Not Used					
25	Rotor Position Signal R	0 → 5V ±0.1V					
26	Rotor Position Signal S	0 → 5V ±0.1V					
27	Rotor Position Signal T	0 → 5V ±0.1V					

ISS.	MODIFICATION	ECN No.	DATE	DRAWN	CHK'D
1	Initial Issue	8158	11.11.93	WS	GDR
2	Extensive corrections and modifications.	9626	11.10.94	GDR	[signature]

FIRST USED ON	MODIFICATION RECORD 564 Product Manual
EUROTHERM DRIVES	DRAWING NUMBER ZZ 387330 C SHT. 1 OF 1 SHTS