



**EUROTHERM  
DRIVES**

---

## **590A SERIES THREE PHASE CONVERTORS**

**PRODUCT MANUAL**



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

All rights strictly reserved. No part of this document may be stored in a retrieval system, or transmitted in any form or by any means to persons not employed by a Eurotherm group company without written permission from Eurotherm Drives Ltd.

Although every effort has been taken to ensure the accuracy of this document it may be necessary, without notice, to make amendments or correct omissions. Eurotherm Drives cannot accept responsibility for damage, injury, or expenses resulting therefrom.

## **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.

© COPYRIGHT in this document is reserved to Eurotherm Drives Ltd.

## **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.

# WARNINGS AND INSTRUCTIONS

THESE WARNINGS AND INSTRUCTIONS ARE INCLUDED TO ENABLE THE USER TO OBTAIN THE MAXIMUM EFFECTIVITY AND TO ALERT THE USER TO SAFETY ISSUES



**NEVER WORK ON THE CONTROLLER, MOTOR, OR AUXILIARY EQUIPMENT WITHOUT FIRST ISOLATING ALL SUPPLIES TO THE SYSTEM.**

**This is a product of the restricted sales distribution class according to iec 61800-3. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.**

**This product is designated as ‘professional Equipment’ as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.**

**APPLICATION AREA:** Industrial (non consumer) motor speed control utilising dc shunt machines.

**PRODUCT MANUAL:** The product manual is to provide a description of how the product works and is not intended to describe how the apparatus works into which it may be installed.

This product manual is to be made available to all persons who are required to: design an application install and service or any other associated operation with this product.

**APPLICATION ADVICE:** Applications advice and training is available from Eurotherm Drives Ltd.



**INSTALLATION:** Ensure that mechanically secure fixings are used as recommended.

**ENSURE THAT THE ENCLOSURE INTO WHICH THIS PRODUCT IS MOUNTED IS SUITABLE FOR THAT ENVIRONMENT (NOTE: THIS PRODUCT MAY BE IP00 OR IP20 AND HENCE REQUIRES FURTHER PROTECTION TO AVOID PERSONAL INJURY).**

Ensure that cooling and air flow around the product are as recommended.

Ensure that cables and wire terminations are as recommended and clamped to required torque.

Ensure that the installation and commissioning of this product are carried out by a competent person.

Ensure that the product rating is not exceeded.



**APPLICATION RISK:** The integration of this product into other apparatus or system is not the responsibility of Eurotherm Drives Ltd as to its applicability, effectivity or safety of operation or of other apparatus or systems.

Where appropriate the user should consider some aspects of the following risk assessment.



**RISK ASSESSMENT:** Under fault conditions or conditions not intended.

- |  |   |
|--|---|
| 1. The motor speed may be incorrect.           | } In these situations the users own risk  |
| 2. The motor speed may be excessive            | } assessment should provide either        |
| 3. The direction of rotation may be incorrect. | } sufficient guarding to prevent risk of  |
|  | injury or additional redundant monitoring |
|  | and safety systems.                       |

4. The motor may be energised unless the installation specifically prevents unexpected or unsequenced energisation of the motor.

5. Due to the use of electricity in this product, only competent persons may install or service this product and avoiding the danger of death by electrocution or burning by using established safe working practices.

In these situations the users own risk assessment should provide for example lockable isolators to provide safe working conditions.

NOTE: During power loss the product will not operate as specified.

**MAINTENANCE:** Maintenance and repair should only be performed by competent persons using only the recommended spares (or return to factory for repair). Use of incorrect parts may create a hazard and risk of injury.



**WHEN REPLACING A PRODUCT IT IS ESSENTIAL THAT ALL USER DEFINED PARAMETERS THAT DEFINE THE PRODUCTS OPERATION ARE CORRECTLY INSTALLED BEFORE RETURNING TO USE. FAILURE TO DO SO MAY CREATE A HAZARD AND RISK OF INJURY.**

**PACKAGING:** The packaging is combustible and if disposed of in this manner incorrectly may lead to the generation of toxic fumes which are lethal.

**WEIGHT:** Consideration should be given to the weight of the product when handling.

**REPAIRS:** Repair reports can only be given if sufficient and accurate defect reporting is made by the user.

Remember, the product without the required precautions can represent an electrical hazard and risk of injury, and that rotating machinery is a mechanical hazard and risk of injury.

**PROTECTIVE INSULATION:**

1. All exposed metal insulation is protected by basic insulation and bonding to earth i.e. Class 1.

NOTE: Earth bonding is the responsibility of the installer.

2. All signal terminals (terminals 1-39) are SELV, i.e., protected by double insulation (Class 2). The purpose of this protection is to allow safe connection to other low voltage equipment and is not designed to allow these terminals to be connected to any unisolated potential.

Ensure all wiring rated for highest system voltage.

NOTE: Thermal sensors contained within the motor are to be double insulated.

**ENCLOSURE:**

To maintain compliance with the European Low Voltage Directive Standards VDE 0160 (1994)/EN50178(1998) the unit should be mounted inside a suitable control cubicle requiring a tool for opening.

**RCDS:** Compatible with Type B RCDs only.

**CONTROLLER WARRANTY:** For further details on Eurotherm Drives Controller Warranty and Repair refer to the Standard Conditions of Sale IA058393C.

**EUROTHERM DRIVES RESERVE THE RIGHT TO CHANGE OR ALTER THE SPECIFICATION OF THIS PRODUCT WITHOUT NOTICE**

## TABLE OF CONTENTS

SECTION	Page No.	SECTION	Page No.
1. INTRODUCTION	1-1	8. DIAGNOSTIC TEST FACILITIES	8-1
1.1 545/590A Upgrade	1-1	8.1 Description of Diagnostic Test Unit	8-1
1.2 545 to 590A Conversion Chart	1-2	8.2 Diagnostic Test Procedure	8-1
1.3 590A Introduction	1-4	8.3 Connection/Disconnection of Diagnostic Test Unit	8-1
2. TECHNICAL SPECIFICATIONS	2-1	8.4 Drive Condition Indicators Description	8-1
2.1 Specification		8.5 Drive Condition Indicators Status Recognition	8-3
2.1.1 Control	2-1	8.5.1 Stop Condition	8-3
2.1.2 Power	2-2	8.5.2 Start Condition	8-4
2.2 Output Ratings	2-3	8.5.3 Diagnostic Test Unit - Voltage Measurements	8-7
2.2.1 Armature Rating	2-3		
2.2.2 Field Rating	2-4		
2.3 Mechanical Details	2-4		
3. PRODUCT CODE	3-1	9. 590 "ALL-IN-ONE" POWER BOARD	9-1
4. INSTALLATION & WIRING INSTRUCTIONS	4-1	Power Circuit Configuration 35/70/110/150/180(4Q)	
4.1 Installation	4-1	Power Board Layout for 2Q	
4.2 Ventilation & Cooling	4-1	Power Board Layout for 4Q	
4.3 Basic Wiring Instructions	4-1	590 Power Board (AH385621)	9-6
4.4 Notes on Wiring	4-5	10 THE EUROPEAN DIRECTIVES AND THE 'CE' MARK.	10-1
4.5 Additional Installation Requirements for UL508	4-6	10.1 Eurotherm EMC 'CE' Mark Validity Chart	10-2
Outline & Wiring Diagrams	4-7	Certificates	10-6
4.6 EMC Installation Guidelines	4-19	11 . SPARES KITS AND SPARE PART IDENTIFICATION LIST	11-1
5. TERMINAL DESCRIPTIONS	5-1	12. SERVICE INFORMATION	12-1
5.1 Control Board	5-1	12.1 Maintenance	12-1
5.2 Power Board	5-5	12.2 Customer Assistance Facilities	12-1
6. BLOCK DIAGRAM DESCRIPTION	6-1	Disposal & Packaging	12-2
6.1 Power Configuration	6-1	Power Circuit Configuration 150A (4Q)	
6.2 The Control Operation	6-1	Power Circuit Configuration 150A (2Q)	
6.3 Start and Stop Sequencing	6-4	Power Circuit Configuration 270A (4Q)	
BLOCK DIAGRAMS		Power Circuit Configuration 270A (2Q)	
7. BASIC SETTING UP & OPERATING INSTRUCTIONS	7-1	Power Circuit Configuration 450A (4Q)	
7.1 Preset Adjustment Description	7-1	Power Circuit Configuration 450A (2Q)	
7.2 Option Switches	7-2	Power Circuit Configuration 720A (4Q)	
7.3 Calibration	7-4	Power Circuit Configuration 720A (2Q)	
7.3.1 Speed Calibration	7-4	Layout Ext Stack (4Q)	
7.3.2 Armature Current Calibration	7-4	Layout Ext Stack (2Q)	
7.3.3 Field Voltage Calibration	7-5	Circuit Diagram External Stack Controller Schematic HB057453C	
7.4 Before Attempting to Connect Power	7-5	Modification List	
7.5 Preparation	7-5		
7.6 Checking the Drive & Setting Up	7-6		
7.7 Running Performance Adjustments	7-7		

# 1. INTRODUCTION

## 1.1 545/590A UPGRADE

The 545 Series product has been applied successfully in a wide variety of applications by machine builders and OEM's.

This short note is designed to make a quick comparison between the two products and to show just how convenient the application of 590A will be.

TERMINALS: Control terminals now numbered 1 - 39. Starting at terminal 4 there is direct exchange between 545 and 590A.

A1 - 4	
A12 - 15	
B1 - 16	NO POSITIONAL CHANGE OF FUNCTION
B12 - 27	
C1 - 28	
C12 - 39	

Terminals 1 to 3 are new for the 590A, refer to section 5-1. Power terminals refer to section 5-2.

DIAGNOSTICS: No change of functionality. Existing 5570 diagnostic unit can still be used.

NOTE: Logical diagnostics e.g. 5 now +15V is enable  
0V is disable.

This eases the interpretation of logical diagnostics.

CONDITION INDICATORS (LEDS): Removal of LED4 (trigger fault).

PRESETS: New plug-in preset board with 11 presets. P1 - P10 have identical function as before. P11 allows adjustment of field supply voltage.

OPTION SWITCHES: Extra options now available on S8 and S9. Direct exchange is:

S1 - S8/1	
S2 - S8/2	NO CHANGE IN FUNCTIONALITY
S3 - S8/3	
S4 - S8/4	

CALIBRATION: Armature current, field voltage of speed feedback are now achieved by switch able parameters. This allows a very quick and simple commissioning period.

BLOCK DIAGRAM: No change to the functionality, the products are interchangeable.

MECHANICAL PACKAGE: Now uses the common chassis of the 590 product range. Included is;  
Auxiliary supply voltage 110/240v without tap change.  
Stack supply voltage 220/500v as standard.  
Field supply rating 10A and 20A.

ENCLOSURE PROTECTION: IP00 and IP20 versions available.

INTERNATIONAL STANDARDS: UL508

EMC STANDARDS: Refer to Section 10

## 1.2 545 TO 590A CONVERSION CHART

### Control Terminals A

Function	545	590A
LV Signal Common	A1	4
Armature Current Compensation	A2	5
Setpoint Ramp Reset	A3	6
Setpoint Ramp Input	A4	7
Setpoint Ramp Output	A5	8
Input No 1	A6	9
Input No 2	A7	10
Inverted Sub-Total	A8	11
Input No 3	A9	12
Total Setpoint	A10	13
+10V Reference	A11	14
-10V Reference	A12	15

### Control Terminals B

LV Signal Common	B1	16
DC Tachogenerator Input	B2	3 (17) *
Current Demand Isolate	B3	18
Current Demand Output	B4	19
Auxiliary Current Input	B5	20
Select Auxiliary Input	B6	21
Auxiliary Current Limit (+)	B7	22
Main Current Limit	B8	23
+10V Reference	B9	24
Auxiliary Current Limit (-)	B10	25
Buffered Tacho	B11	26
Buffered Current	B12	27

Note:-

- 1) 545 Terminal B1 has been replaced on the 590A by Terminal 3 for DC Tachogenerators. Terminal 17 can be used if wire lengths are short.
- 2) When using an AC Tachogenerator use terminals 2 & 3 on the 590A.

**Control Terminals C**

LV Power Common	C1	28
Thermistor Input	C2	29
Auxiliary Enable	C3	30
Start Supply	C4	31
Enable	C5	32
Stop	C6	33
Start	C7	34
Ready	C8	35
Zero Speed Relay Drive	C9	36
Drive Operational Relay Drive	C10	37
+24V	C11	38
External Fault Reset	C12	39

**Power Terminals**

AC Field Supply	D1	D1
No Connection	D2	
No Connection	D3	
AC Field Supply	D4	D2
DC Field +ve	D5	D4
No Connection	D6	
No Connection	D7	
DC Field -ve	D8	D3
Aux Supply Live (L)	D9	D8
Aux Supply Neutral (N)	D10	D7
Contactor Supply Neutral(N)	D11	D6
Contactor Supply Live (L)	D12	D5

### 1.3 590A INTRODUCTION

The 590A series of motor speed controllers are designed as components which are fitted into a standard enclosure with associated control equipment. The controllers accept standard three phase supply voltages in the range 220 to 500 Volt AC. and provide controlled DC. output voltage and current for the armature and variable voltage for the field, and are suitable for powering DC. shunt field and permanent magnet motors.

Control of the 590 series is implemented by means of analog and digital control loops which provides many advanced features.

The motor armature controllers include both regenerative and non-regenerative models. Non-regenerative controllers consist of one fully-controlled thyristor bridge with full transient and overload protection, together with its associated electronic control circuitry, and provide accurate speed and/or torque control in one selected direction of rotation.

Regenerative controllers consist of two fully-controlled thyristor bridges together with a sophisticated electronic control of acceleration and deceleration, speed and torque in both directions of rotation.

All models of armature controller provide an adjustable field supply as standard. The regulator consists of a full-wave half controlled single phase thyristor bridge with transient and overload protection. The regulator provides a fixed voltage which is adjustable by either potentiometer or option selection switches.

The control circuit is totally isolated from the power circuit, thus simplifying the interconnection of controllers within a system and improving operator safety. The control circuitry adjusts automatically to accept supply frequencies in the range 50-60 Hz and possesses high immunity to supply borne interference. The armature controllers are phase rotation insensitive.

All units are designed for simple and economical panel mounting using keyhole tags. If it is necessary to remove the controller from the panel, disconnection and reconnection is simplified by plug-in control connectors.

Standardisation of parts wherever possible throughout the range reduces the variety of spare parts required to maintain a multi-drive system. For example, the same basic control and trigger PCB's are used in all types of three phase armature controller regardless of horsepower or bridge configuration.

This manual covers the following models from the 590A series.

Three phase, regenerative, four quadrant armature controllers.

590A - for currents up to 720 Amps.

598A - external stack option for currents exceeding 721 Amps.

Three phase non-regenerative, two quadrant armature controllers.

591A - for currents up to 720 Amps.

599A - external stack option for currents exceeding 721 Amps.

Commissioning and the location of faults (both within the controller and external to it), are greatly assisted by built in Condition Indicators which show the status of the various system alarms. Further assistance is available by use of the optional Diagnostic Test unit type 5570 which provides access to 27 alarms, inputs and principal circuit nodes throughout the Controller. This unit, which is available as a portable hand-held instrument has output sockets for the connection of an oscilloscope, chart recorder or other instruments.

## 2. TECHNICAL SPECIFICATIONS

### 2.1 SPECIFICATION

#### 2.1.1 Control

Enclosure Rating:	IP00, to be built into a suitable cubicle.
Control Circuits:	Fully isolated from power circuit. (SELV)
Output Control:	Fully controlled 3-phase Thyristor Bridge. Microprocessor implemented phase control over extended firing range. Intended for use on 50Hz or 60Hz supplies with a frequency compliance range of 45 to 65Hz. Phase control circuits are phase rotation insensitive.
Control Action:	Advanced PI with fully adaptive current loops for optimum dynamic performance.
Speed Control:	By analog tach as standard. (AC or DC)
Speed Range:	100 to 1 typical with tach feedback. (DC)
Steady State Accuracy:	0.1% Analog Tach Feedback. (DC) Note: Long term analog accuracy is subject to tach temperature stability
Adjustments:	All adjustments are in software can be altered by on-board pushbuttons or via serial communications. An LCD display provides monitoring of adjustment parameters and levels in addition to diagnostic facilities.
Protection:	Interline device networks. High energy MOV's. Overcurrent (sub cycle over current trip with reset). Overcurrent (inverse time). Field failure. Tach failure. Motor over temperature. Thyristor Stack over temperature (force ventilated units). Zero speed detection. Standstill logic.
Diagnostics:	Principal circuit mode and function access. Digital LCD monitoring. LED circuit state indication. LED dynamic trend display. External monitoring/recording/CRT facilities.
Operating Temperature Range:	0°C — +55°C Derate linearly above 35°C for force cooled units. Derate linearly above 45°C for naturally cooled units.
Storage:	-25°C — +55°C Protect from direct sunlight. Ensure dry, corrosive free environment.
Transport Temperature:	-25°C — +70°C
Humidity:	85% Relative humidity maximum. Relative humidity is temperature dependent. If the ambient temperature falls the relative humidity will rise and may ultimately cause condensation. This should be avoided.

---

Climatic Conditions: Class 3k3, as defined by EN50178 (1998).

Atmosphere: Non-flammable, non-condensing.

Pollution Degree: 2

Installation/Overvoltage Category : 3

Electrical Safety Standards: UL508, VDE0160 (1994), EN50178 (1998)

EMC Standards: See Section 10.

### 2.1.2 Power

Configuration: 590A, 598A\* Two Anti-parallel three phase Thyristor bridges.  
591A, 599A\* One three phase fully controlled Thyristor bridge.  
\* External stack options

Mains Supply: 3-Phase, 50/60 Hz, earth referenced (TN) and non-earth referenced (IT)

Operating Supply Tolerance:  $\pm 10\%$

Voltage ranges: 220 to 500Vac - Standard product  
110 to 220Vac - Special option  
220 to 660Vac - External stack module (598/599)

Supply Current: (0.9 x I<sub>dc</sub>) Amps AC rms.

Fan Supply Voltage: 110-120V } +/-10% Single Phase 50/60Hz  
(Force Vent Units) 220-240V } +/-10% Single Phase 50/60Hz

Rating: 110VA when fitted

Contactors Supply: As control voltage  
110-120V } +/-10% Single Phase 50/60Hz  
220-240V } +/-10% Single Phase 50/60Hz

Rating: As contactor specification

Control Supply: 110-240V } +/-10% Single Phase 50/60Hz

Rating: 30VA

Note: No selection required for control supply voltage

Reference Supplies: (For speed and current setpoints) +10V +/- 0.01 at 5mA Max.  
-10V +/- 0.01 at 5mA Max.

DC Supply: +24V Nominal Internally Regulated.  
Maximum output capability 6W or 250mA.  
Auxiliary loading should be totalled before specification to check DC supply loading if excessive fit a separate power supply.

## 2.2 OUTPUT RATINGS

### 2.2.1 ARMATURE RATING

	590/1									598/9						
Output Current Ratings (Armature) <sup>1</sup>	35A	70A	110A	150A	180A	270A	360A	450A	720A	950A	1100A	1388A	1600A	1800A	2300A	2800A
Nominal Power Rating @ 460V DC Assuming 95% Motor Efficiency	15KW (20HP)	30KW (40HP)	45KW (60HP)	60KW (80HP)	75KW (100HP)	110KW (150HP)	150KW (200HP)	190KW (250HP)	300KW (400HP)	395KW (530HP)	455KW (610HP)	575KW (770HP)	660KW (880HP)	745KW (1000HP)	950KW (1275HP)	1150KW (1550HP)
Maximum Rating Ambient <sup>2</sup>	45°C	45°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C	35°C
Cooling: Forced(F)/Natural(N) Fan: Integral(I)/Separate(S)	N -	N -	F I	F I	F I	F I	F I	F S <sup>3</sup>	F S							
Overload Capacity Available (Armature Current) <sup>4</sup>	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Field Current Rating	10A	10A	10A	10A	10A	10A	20A	20A	20A	30A						
Maximum Supply Voltage	500V	500V	500V	500V	500V	500V	500V	500V	500V	660V	660V	660V	660V	660V	550V <sup>5</sup>	550V <sup>8</sup>
Maximum Field Supply Voltage	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V	500V
Power Loss	105W	210W	330W	450W	540W	710W	1080W	1350W	2160W	2850W	3300W	4164W	4800W	5400W	6900W	8400W
Installation Drawing HG:	055805	055805	055806	055806	386968	055807	057208	057209	057449 <sup>6</sup>	057829 <sup>7</sup>						

<sup>1</sup> Altitude derating, nominal sea level to 500 metres, derate above 500 metres at 1% per 200 metres up to maximum of 5,000 metres.

<sup>2</sup> Derate linearly at 1% per degree centigrade for temperature exceeding the maximum rating ambient. Maximum operating ambient is 55°C.

<sup>3</sup> A lower current version limited to 360Amps is available with an integral fan (HG057208).

<sup>4</sup> The standard overload capacity available is 200% for 10 seconds, 150% for 30 seconds. The 720 Amp Chassis has no overload capacity at maximum current, whereas at output currents less than 650 Amps overload capacity is as normal.

<sup>5</sup> External Stack assemblies at 660V are not available above 2000 Amps without reference to Eurotherm Drives Internal Sales Department.

<sup>6</sup> For Installation Drawings for 720A Stock Assembly see: HG049669 Standard Mounting / HG054248 Bracket Mounting.

<sup>7</sup> Installation Drawings for External Stack Thyristor assemblies available on application to Eurotherm Drives Engineering Department.

## 2.2.2 FIELD RATING

Output current ratings:

590A/0350-590A/2700 } i.e. from 35A build to 270A build 10A  
 591A/0350-590A/2700 }  
 590A/4500 - 590A/7200 } i.e. from 450A build to 720A build 20A  
 591A/4500 - 591A/7200 }

598A } i.e. external stack builds 30A  
 599A }

## 2.3 MECHANICAL DETAILS

### GENERAL

1. All controllers should be mounted vertically in the cubicle to allow good air flow across the cooling fin. Naturally cooled units should be given special consideration to permit cool air entry into and hot air exit below and above the controller.
2. If the enclosure is totally enclosed the metal surface dissipates 50 watt sq.metre for a 10°C temperature rise.

### 590A AND 591A CONVERTORS

#### RATING UP TO 180A:75KW (100HP)

Mounting Centres: Vertical - 400mm (15.75")  
 Horizontal - 200mm (7.87")

	<u>Rating up to 70A</u> <u>30KW (40HP)</u>	<u>Rating up to 150A</u> <u>60KW (80HP)</u>	<u>Rating up to 180A</u> <u>75KW (100HP)</u>
Overall Width:	250mm (9.8")	250mm (9.8")	250mm (9.8")
Overall Height:	415mm (16.5")	440mm (17.3")	500mm (19.7")
Overall Depth:	170mm (6.7")	170mm (6.7")	170mm (6.7")
Weight:	10Kg-14Kg (22lbs-30lbs)	15Kg (33.2lbs)	17Kg (37.5lbs)
Nominal Blower Throughput:		100m3/Hour	300m3/Hour
Minimum Airflow Clearance:	100mm (4") above 100mm (4") below	100mm (4") above 100mm (4") below	100mm (4") above 100mm (4") below
Control Terminations:	Plug-on connectors with retaining catches.		
Power Terminations:	Bus-bars with 8mm screws and captive nuts.		
	⊕ Earth termination 6mm screw and captive nut.		
Access:	Hinge-up cover for control circuit terminals and Diagnostics socket. Hinge-out Control Printed Board with its own independent cover.		

#### RATING UP TO 270A:110KW (150HP)

Mounting Centres:	Vertical - 400mm (15.75") Horizontal - 200mm (7.87")
Overall Width:	250mm (9.8")
Overall Height:	500mm (19.7")
Overall Depth:	210mm (8.3")
Weight:	20Kg (44lbs)
Minimum Airflow Clearance:	150mm (6") above and 100mm (4") below
Nominal Blower Throughput:	350m3/Hour
Control Terminations:	Plug-on connectors with retaining catches.
Power Terminations:	L1/L2/L3 Bus-bars with 8mm bolts and Belville washers. A+/A- Bus-bars with 8mm nuts, bolts and Belville washers.
	⊕ Earth termination 6mm screw and captive nut.
Access:	Hinge-up cover for control circuit terminals and Diagnostics socket. Hinge-out Control Printed Board with its own independent cover.

**RATING UP TO 450A:190KW (250HP)**

Mounting Centres: Vertical - 600mm (23.6")  
Horizontal - 200mm (7.87")

Overall Width: 250mm (8.75mm") (322mm (12.7") over dc terminals)

Overall Height: 705mm (27.75") Integral Fan  
675mm (26.6") Roof Fan

Overall Depth: 252mm (9.9")

Weight: 30Kg (66lbs)

Minimum Airflow 100mm (4") below } Integral Fan  
Clearance: 150mm (6") above }  
100mm (4") below duct for roof fan } Roof Fan

Nominal Blower 490m3/Hour Integral Fan

Throughput:

Control Terminations: Plug-on connectors with retaining catches.

Power Terminations: L1/L2/L3 Bus-bars with 12mm bolts and Belville washers.  
A+/A- Bus-bars with 10mm nuts, bolts and Belville washers.  
⊕ Earth termination 10mm stud and Belville washer.

Access: Hinge-up cover for control circuit terminals and Diagnostic Socket.  
Hinge-out Control Printed Board with its own independent cover.

**RATING UP TO 720A:300KW (400HP)**

Mounting Centres: (see drawing)

Overall Width: 319mm (12.6") (362mm over dc terminals)

Overall Height: 920mm (36.2") (Module only not including fan equipment and ducting).

Overall Depth: 194mm (7.6") to mounting plane.  
140mm (5.5") behind mounting plane.

Weight: 65Kg (143lbs)

Minimum Airflow See installation drawings HG049669F and HG045248F.

Clearance:

Nominal Blower 1000m3/Hour @ 80 mbar for rated output.

Throughput:

Control Terminations: Plug-on connectors with retaining catches.

Power Terminations: L1/L2/L3 Bus-bars with 14 mm bolts and Belville washers.  
A+/A- Bus-bars with 10mm nuts bolts and Belville washers.  
⊕ Earth termination 8mm bolts and Belville washers in 2 alternate positions.

Access: Hinge-up cover for control circuit terminals and Diagnostic Socket.  
Hinge-out Control Printed Board with its own independent cover.

**TERMINALS - Tightening Torque**

The following table should be referred to when making connections to the controller.

**Power Board Terminal Blocks 4 lb-in (0.45Nm)**

**Control Board Terminal Blocks 5 - 7 lb-in (0.56 - 0.79Nm)**

<b>Product Current Rating (A)</b>	<b>Terminations</b>	<b>Maximum Tightening Torque</b>		
0 - 180A	L1, L2, L3, A+, A- GROUND ⊕	M8	12.2lb.ft.*	16.5Nm*
		M6	5.0lb.ft.	6.8Nm
181A - 270A	L1, L2, L3, A+, A- GROUND ⊕	M8	12.2lb.ft.	16.5Nm
		M6	5.0lb.ft.	6.8Nm
271A - 450A	L1, L2, L3 A+, A- GROUND ⊕	M12	42.2lb.ft.	57.2Nm
		M10	24.2lb.ft.	32.8Nm
		M10	24.2lb.ft.	32.8Nm
451A - 720A	L1, L2, L3 A+, A- GROUND ⊕	M14	67.1lb.ft.	91.0Nm
		M10	24.2lb.ft.	32.8Nm
		M8	12.2lb.ft.	16.5Nm

**Note:\*** M8 CHEESEHEAD SCREW, TIGHTENING TORQUE 8.1lb.ft. 11Nm

### 3. PRODUCT CODE

#### 590A AND 591A THREE PHASE CONVERTERS

All members of the three phase product range can be fully specified using a digit numerical order code.

Block No	No of Digits	Function
1	4	Basic Product
2	4	Output Current
3	1	Supply Voltage (Power)
4	1	Supply Voltage (Auxiliary)
5	2	Special Builds

The 5 blocks are defined as follows:

Block 1: 4 Digits identifying the basic product.

590A: 3 phase, 4 Quadrant (regenerative) convertor 35A to 720A.

591A: 3 phase, 2 Quadrant (non-regenerative) convertor 35A to 720A.

598A: 3 phase, 4 Quadrant (regenerative) external stack controller.

599A: 3 phase, 2 Quadrant (non-regenerative) external stack controller.

Block 2: 4 digits identifying the DC output current rating.

590A/591A: The digits in this block represent a number between 000.0 and 999.9. To form the code from the numbers, the decimal point is suppressed and leading zeros are added where necessary.

Examples: 234.5 Amps Code 2345

Conversely: Code 1234 123.4 Amps

598A/599A: 5 digits identifying the DC output current rating.

The digits in this block represent a number between 0000.0 and 2800.0. To form a code from the numbers, the decimal point is suppressed and leading zeros are added where necessary

Examples: 1250 Amps Code 12500

Conversely: Code 11250 1125 Amps

Block 3: 1 Digit identifying the nominal 3 Phase AC power, supply Voltage.

0 110V

1 115V

2 208V

3 220V

4 240V

5 380V

6 415V

7 440V

8 460V

9 480V

A 500V

B 550V 598A/599A External Stacks only

C 600V 598A/599A External Stacks only

D 660V 598A/599A External Stacks only

Block 4: 1 Digit identifying the auxiliary AC control supply Voltage.

0 110V

1 115V

2

3 220V

4 240V

Block 5: 2 Digits identifying special option

0 No special options

01 to 99 Documented special options

## 4. BASIC INSTALLATION AND WIRING INSTRUCTIONS

### 4.1 INSTALLATION

The 590A series motor speed controllers are designed as components which are to be fitted with other control equipment in a suitable enclosure. The control units are all designed to mount directly onto a flat surface. They should be fastened by means of bolts or screws through the fixing points at each corner. These points are in the form of keyholes and slots to simplify fastening or removal.

Please see the relevant installation drawings in this manual for overall dimensions and positions of fixing holes and to identify size of holes and fixings.

Note: The fixing centres of 590A series controllers are designed to allow use of 100mm grid fixing.

### 4.2 VENTILATION AND COOLING

In normal operation the drive unit needs to dissipate heat and must, therefore, be mounted to permit the free flow of cool air vertically through the circuit board area, over the fuses and across the heat sink area at the back.

The normal maximum ambient operating temperatures are:-

Naturally ventilated unit: 45°C (113°F)

Fan-force cooled units: 35°C (95°F)

For operation above these limits derating of the controller may be necessary, refer to the electrical specification within this manual or the engineering department of Eurotherm Drives.

Care should be taken to ensure that the mounting surface is also cool and that any heat generated by the adjacent equipment is not transmitted to the drive unit.

As a general rule allow about (150mm) 6" of clear space above and below the drive for free air flow.

### 4.3 BASIC WIRING INSTRUCTIONS

The following set of instructions is a description of the wiring requirements of a 590A series controller configured in the General Purpose mode for operation as a basic speed controller. The complexity of connection when configured in any other mode for specific drive applications, precludes the inclusion of diagrams showing all wiring options. Special options are usually part of a customer specific system and connection diagrams of these controllers form part of the information provided for the system.

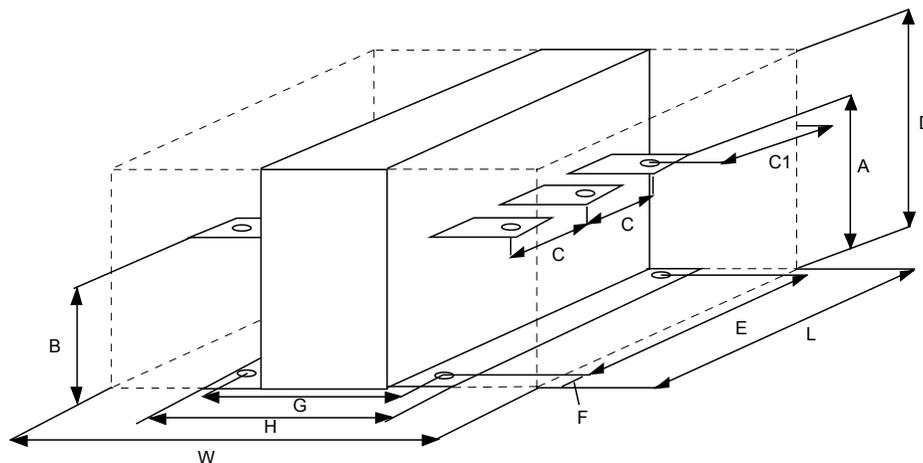
Information showing the connections required to provide a basic speed control system when using a 590 series controller are given in wiring diagram HJ 387211.

1. Power cables must have a minimum rating of 1.1 x full load current. (1.25 x FLC when required to comply with UL requirements).
2. Control wiring must have a minimum cross-sectioned area of 0.75mm<sup>2</sup> (square millimetre).
3. All incoming main ac power supply connections must be protected with High Speed semiconductor fuses. The rating of these fuses being as shown below:-

#### EUROPEAN STYLE FUSES

PRODUCT CODE BLOCK 2	BS88 TYPE FUSE		DIN TYPE FUSE		THYRISTOR A2T @ 125°C JUNCTION TEMPERATURE
	FUSE RATING	PART NUMBER	FUSE RATING	PART NUMBER	
0010 to 0350	35A	CH110353	40A	CH570044	800 A <sup>2</sup> T
0351 to 0700	75A	CH120753	80A	CH570084	8,000 A <sup>2</sup> T
0701 to 1100	110A	CH120114	160A	CH580164	8,000 A <sup>2</sup> T
1101 to 1800	150A	CH120154	200A	CH580025	15,000 A <sup>2</sup> T
1801 to 2700	300A	CH130035	550A	CH590554	125,000 A <sup>2</sup> T
2701 to 4500	-----	-----	700A	CH590075	320,000 A <sup>2</sup> T
4501 to 7200	-----	-----	800A	CH590085	500,000 A <sup>2</sup> T

4. Motor overload protection is provided in the controller by means of the thermal device in the motor winding. This protection cannot be evaluated by UL hence it is the responsibility of the installer and/or the local inspector to determine whether the overload protection is in compliance with the National Electric Code or Local Code requirements
5. A substantial ground or earth connection (Protective Earth) should be made to the earth terminal of the 590A drive, the protective earth connection being indicated by the IEC grounding symbol (as defined in IEC 417 symbol 5019) . On the 720/800A chassis two M8 terminals are provided **BOTH MUST BE** connected to protective earth/ground.
6. The motor protective earth/ground connection should be run in parallel with the motor supply conductors ideally inside the same conduit/screen/armour and be connected near to the drive to a separate independent protective earth/ground star point. **DO NOT RUN THE MOTOR PROTECTIVE EARTH/GROUND VIA THE 590 CONTROLLER EARTH/GROUND TERMINAL. CONNECT DIRECTLY TO ENCLOSURE EARTH/GROUND.**
7. A 3 phase contactor should be connected in the main ac power supply connections with a rating suitable for the controller concerned. The contactor does not switch current and is primarily for isolation and sequencing of the power bridge. The main contactor must be energised directly from the controller by connecting the coil to terminals D5 (Line) and D6 (Neutral). No additional series contacts or switches are permitted since they will interfere with the sequencing of the controller and cause unreliability and possible failure.  
Notes:
  1. If the 3-phase contactor has a coil with an inrush greater than 3 Amps a slave relay must be used to drive the contactor
  2. The contactor and slave relay (if required) must have coil voltages compatible with the controller auxiliary supply voltage.
  3. A dc contactor can be used but the sequencing must be adjusted to accommodate its use, an auxiliary normally open volt-free contact of the contactor must be connected in series with the "enable" input C5 to disable the drive unit after the contactor is closed.
8. A 3 phase ac line reactor should be fitted in series with the incoming main 3 phase ac power supply. (Eurotherm Drives stock a series of reactors suitable for this duty, mechanically designed to connect directly to the controller ac supply terminals). The reactor should be connected between the controller and the ac contactor for optimum protection and safety. Refer to HG386828C for selection of AC LINE REACTOR.
9. EMC filters should only be fitted on the mains side of the contactor.
10. The auxiliary or control supply (single phase 50/60Hz) should be connected to terminals D8 (Line) and D7 (Neutral) with suitable external fuse protection. The steady state current absorbed by the controller is nominal, the external fuse is determined chiefly by considering the contactor holding VA and the controller cooling fans.  
Notes:
  1. Auxiliary supply range 110V-240V. No tapping required when switch mode power supply is used.
  2. The auxiliary supply must be connected directly to the incoming supply, no series switches or contacts are permitted without consultation with Eurotherm Drives Engineering Department.
11. Connect the motor field (-) to terminal D3 and field (+) to terminal D4. If the motor has no field connections, a permanent magnet motor, or if the field is derived externally, it will be necessary to override the field fail detector by ensuring that switch S9/5 is on.



CHOKE TYPE	RATING (DC)	DIMENSIONS (mm)												Mtg Hole	Terminal
			A	B	C	C1	D	E	F	G	H	L	W		
CO055192	35A	50○H			50	27.5	130	140	7.5	50	70	155	260	∅7	M8
CO055193	70A	50○H			50	27.5	130	140	7.5	72.5	92.5	155	302.5	∅7	M8
CO055253	110A	50○H	108	85	60	35	160	170	10	76	101	190	341	∅9	M6 I/P & M8 O/P
CO055255	180A	50○H	108	85	60	35	160	170	10	101	127	190	366	∅9	M6 I/P & M8 O/P
CO057960	270A	50○H	110	110	80	60	255	200	40	170	200	280	380	∅13	M8
CO057961 <sup>1</sup>	360A	50○H	125	145	80	60	255	200	40	170	200	280	380	∅13	M10
CO057962	550A	25○H	200	157	110	73	306	250	58	189	220	366	398	∅13	∅13
CO057963	720A	25○H	200	157	110	73	306	250	58	189	220	366	398	∅13	∅13
CO387886 <sup>1</sup>	360A	50○H	135	145	80	60	255	200	40	170	200	280	380	∅13	∅11/∅13
CO463036 <sup>2</sup>	35A	485○ H	108	85	60	35	160	170	10	76	101	190	341	∅9	M8
CO463037 <sup>2</sup>	70A	242○ H	108	85	60	35	160	170	10	90	116	190	355	∅9	M8
CO463038 <sup>2</sup>	110A	154○ H	108	85	60	35	160	170	10	102	128	190	367	∅9	M8
CO463039 <sup>2</sup>	180A	113○ H	108	85	57	37	255	200	40	170	200	280	380	∅13	M6 I/P & M8 O/P

Schematic representation only, providing basic installation detail. If in doubt refer to drawing.

- Notes: 1. CO057961 suitable for use with 545 series and CO387866 suitable for use with 590 series.  
2. Specially for use with EMC filters.

 <b>EUROTHERM DRIVES</b>	ISS	DATE	DRWN:	CHKD	TITLE:	DRAWING NO:	SHT 1
	7	21.04.97	FEP		Outline Drawing for 3-phase Line Chokes for DC Controllers	HG386828C	OF 1 SHTS

12. If an external field supply is required to the controller for application reasons this supply should be connected to terminals D1 and D2. The magnitude of this voltage is determined by the desired field voltage. (For more information on this subject see terminal block descriptions). The supply must be protected externally with suitable fuses. **The supply must always be derived from the Red and Yellow phases of the main power supply with Red phase connected to terminal D1 and Yellow phase to terminal D2.**

Note: It is important that the connection of the external field supply is consistent when using an externally supplied field regulator. To ensure correct operation Red phase and Yellow phase are required to be those phases connected to terminals L1 and L2 respectively of the main power connections.

It is relatively simple to change the controller from an internal to an external field type.

The red wire of the field wire loom sitting on the RED phase internal terminal (F1) must be moved to the FE-R terminal adjacent to D1 and the yellow wire of the YELLOW phase internal terminal (F1) must be moved to the FE-Y terminal adjacent to D2.

13. The main ac power is connected to bus bar terminals L1, L2 and L3, there is no specific phase connection to these three terminals as the controller is phase rotation independent. The connections must be made via the correct high speed semiconductor fuses, the main contactor and the ac line reactor.
14. The motor armature should be connected to bus bar terminals A+ and A-. If a dc contactor is used the poles should be interposed between the controller terminals and the motor terminals.  
Note: When the controller is operating in a regenerative mode for extended periods acting as a load generator for another machine it is advisable to fit additional protection in the armature circuit. A dc fuse or a high speed circuit breaker will provide this protection, if in doubt consult the Eurotherm Drives Engineering Department.

15. For normal operation the speed demand signal is connected to the "Setpoint Ramp Input" terminal 7. This input is scaled so that:-

+10V input = maximum forward speed demand (+100%)

-10V input = maximum reverse speed demand (-100%)

The speed demand signal can be generated by connecting the two ends of an external 10K potentiometer to the +10V reference terminal 14 and -10V reference terminal 15, the wiper of the potentiometer being connected to the "setpoint ramp input" as the speed reference.

For non-reversing applications and 2 quadrant controller (591,etc) the speed demand only needs to operate between 0V and +10V, the anti-clockwise end of the potentiometer should then be connected to signal ground terminal 4. Three other terminals are provided as speed setpoint inputs: terminal 9 Setpoint No1, terminal 10, Setpoint No.2 both giving direct speed demand by-passing the setpoint ramp generator, terminal 12, Setpoint No. 3, provides a direct inverting speed demand which bypasses the setpoint generator.

16. The controller has the capability of operating with two forms of feedback:-  
i) Analog DC tach  
ii) Analog AC tach

#### **USE OF AC TACH IS RESTRICTED TO 2 QUADRANT 591A ONLY.**

If an analog DC tach is required this should be connected with its negative terminal connected to terminal 4 and its positive terminal connected to terminal 3. It is important that this signal cable is a screened twisted pair cable throughout its entire length. The screen should be grounded or earthed only at one end, any other grounding arrangement may cause problems.

If an AC tach is used it should be connected to terminals 1 and 2. It is important that this signal cable is a screened twisted pair throughout its entire length. The screen should be grounded or earthed only at one end, any other grounding arrangements may cause problems.

Note: Selection of AC tach or DC tach is made via option switch S 1, located on the control board.

17. The Main Current Limit is adjustable by means of potentiometer P7 (under the front cover of the controller). For normal operation the Main Current Limit terminal 23 should be connected to the +10V Reference terminal 24. This gives adjustment on P7 of 0 to 200% full load current. If external control of Main Current Limit is required, this is achieved by applying a variable voltage to terminal 23 so that 0 to 10 Volts gives 0 to 200% F.L.C. (when potentiometer P7 turned fully clockwise).
18. If the motor is fitted with over-temperature sensing devices such as thermostats, microtherms or PTC thermistors these should be connected between terminals 28 and 29. If more than one temperature sensing device is fitted they should be connected in series, if none are fitted terminals 28 and 29 must be linked to allow the drive to run. Thermistors must have a working resistance of 200 Ohms or less rising 2000 Ohms at over-temperature.
19. The Enable and Auxiliary Enable terminals 32 and 30 must be connected to 31 in order that the drive may run. However, external normally closed interlock contacts may be connected in series with 30. Interruption of the supply to terminal 30 will disable the drive and the Ready and Drive Operational outputs.  
 Note: The Thermistor/microtherm and Field failure alarms normally disable the drive only while a fault exists; if the fault clears, because the motor cools down for example, the motor will restart automatically. However, these alarms can be made to latch the drive in the disabled state indefinitely by connecting 30 to 37 instead of 31 (any external interlock contacts connected in the 30 to 37 link will also be latched in this manner). In this mode a Thermistor/microtherm, Field failure or external interlock alarm condition can only be cleared, and the motor restarted, by removal of the start i.e. stop and the reapplication of start  
 To provide the latching of the health condition without requiring the use of external wiring, switch S8/5 can be used
20. Stop/Start control is normally provided either from two momentary contacts or from a single holding contact.

i) Momentary contacts:-

Connect normally closed STOP contact between terminals 31 and 33.  
 Connect normally open START contact between terminals 33 and 34.

Note: Additional STOP push-buttons should have normally closed contacts and should be wired in series with main STOP push-buttons between terminals 31 and 33.

ii) Single holding contact:-

Connect between terminals 31 and 34.  
 Open contact to STOP.  
 Close contact to START.

#### 4.4 NOTES ON WIRING

1. Indicator lamps, annunciators, etc, for "Drive On" condition should be switched by an auxiliary contactor of the main contactor, not by the controller auxiliary relay.
2. All connections made to terminal blocks must be isolated signal voltages.
3. To avoid damaging the drive NEVER carry out high voltage resistance or dielectric strength tests without first completely disconnecting the drive from the circuit being tested.
4. If in doubt about the connection of the dc motor to the controller check with Eurotherm Drives Engineering Department.

#### 4.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR UL 508

##### AMERICAN STYLE FUSES (For use where compliance to UL 508 is required)

PRODUCT CODE BLOCK 2	CONTROLLER RATING AMPS	THYRISTOR I <sup>2</sup> T		SEMICONDUCTOR FUSES		
		MAX JUNC	25°C	RATING	I <sup>2</sup> T	PART NO. LITTELFUSE OR EQUIV.
0010 TO 0350	35	800	1,100	40	1,000	L50S 40
0351 TO 0700	70	8,000	11,000	80	5,000	L50S 80
0701 TO 1100	110	8,000	11,000	125	10,000	L50S 125
1101 TO 1500	150	15,000	20,000	175	20,000	L50S 175
1501 TO 1800	180	15,000	20,000	175	20,000	L50S 175
1801 TO 2700	270	80,000	110,000	300	60,000	L50S 300
2701 TO 3600	360	320,000	405,000	400	110,000	L50S 400
3601 TO 4500	450	320,000	405,000	500	175,000	L50S 500
4501 TO 7200	720	500,000	660,000	800	450,000	L50S 800

NOTE: Semiconductor fuses are acceptable as Branch circuit short-circuit protection for the solid-state motor controllers only.

##### ELECTRICAL RATING. (3 Phase Supply Capacity.)

These products are suitable for use on a circuit capable of delivering not more than the indicated RMS symmetrical amperes at 500 VAC maximum. As required by UL508 para 66.2 the specified fuse selection as defined must be strictly adhered to in order to provide short circuit protection.

OUTPUT CURRENT	SUPPLY CAPACITY RMS SYMMETRICAL AMPS
35	5,000
70	5,000
110	10,000
150	10,000
180	10,000
270	10,000
360	18,000
450	18,000
720	30,000

##### FIELD TERMINAL KITS AVAILABLE FOR POWER CABLE CONNECTION.

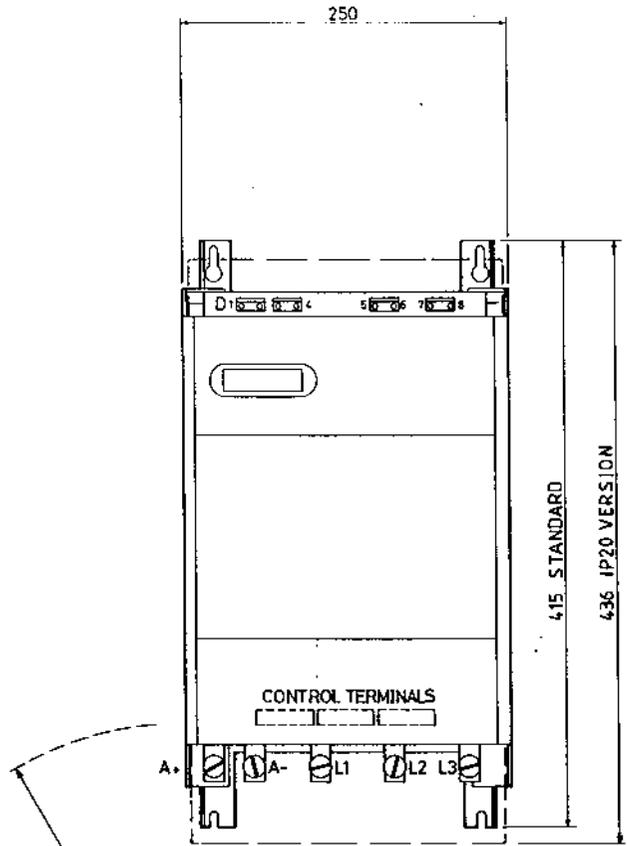
Kit Part Number.	Controller Rating	Number of Lugs.	Purpose	Wire Size
LA386000U035	35 Amps	5	AC/DC	8 AWG (8.4mm <sup>2</sup> )
LA386000U070	70 Amps	5	AC/DC	4 AWG (21.2mm <sup>2</sup> )
LA386000U110	110 Amps	3	AC	2 AWG (33.6mm <sup>2</sup> )
		2	DC	1/0 AWG (53.5mm <sup>2</sup> )
LA386000U150	150 Amps	3	AC	1/0 AWG (53.5mm <sup>2</sup> )
		2	DC	3/0 AWG (85mm <sup>2</sup> )
LA386000U180	180 Amps	3	AC	3/0 AWG (85mm <sup>2</sup> )
		2	DC	4/0 AWG (107.5mm <sup>2</sup> )
LA386000U240	240 Amps	10 [1]	AC/DC	1/0 AWG (53.5mm <sup>2</sup> )
LA386000U270	270 Amps	6 [1]	AC	1/0 AWG (53.5mm <sup>2</sup> )
		4 [1]	DC	2/0 AWG (67.5mm <sup>2</sup> )
LA386000U320	320 Amps	10 [1]	AC/DC	3/0 AWG (85mm <sup>2</sup> )
LA386000U450	450 Amps	6 [1]	AC	250 kcmil (127mm <sup>2</sup> )
		4 [1]	DC	300 kcmil (152mm <sup>2</sup> )
LA386000U720	720 Amps	10 [1]	AC/DC	600 kcmil (304mm <sup>2</sup> )

Note [1] On the kits 2 cables and lugs are required per terminal.

Note: As required by the national electrical code, it is the responsibility of the installer and/or the local Inspection Authority to ensure adequate motor overload protection. A motor thermistor/thermostat may be sufficient, but depending upon the local code requirements, an external overload protection device may be necessary.

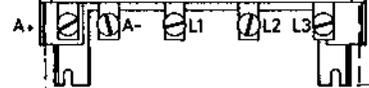
##### MOTOR OVERLOAD

As external running motor overload protective device must be provided by the installer. However, as required by the national electrical code, it is the responsibility of the installer and/or the local Inspection Authority to ensure adequate motor overload protection. A motor thermistor/thermostat may be sufficient, but depends upon the local code requirements.

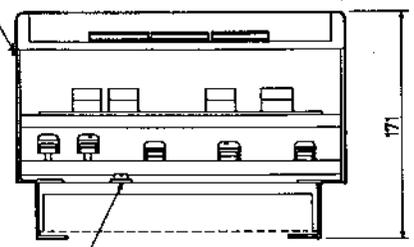


415 STANDARD  
436 IP20 VERSION

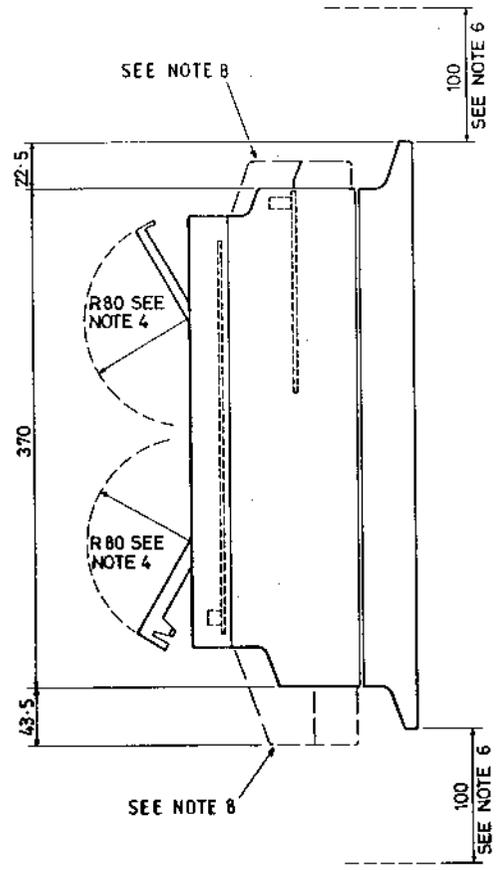
CONTROL TERMINALS



R 250 SEE NOTE 3



EARTH TERMINAL M6



SEE NOTE 8

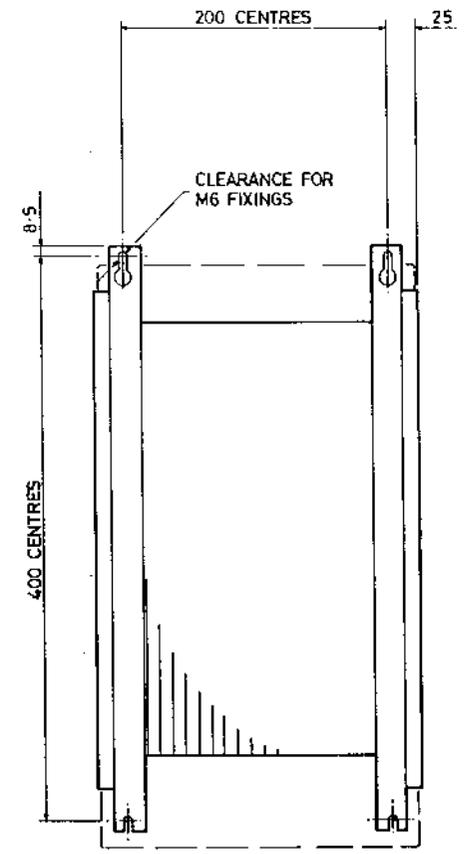
R 80 SEE NOTE 4

R 80 SEE NOTE 4

SEE NOTE 8

100  
SEE NOTE 6

100  
SEE NOTE 6



CLEARANCE FOR M6 FIXINGS

REAR VIEW FIXING CENTRES

NOTES.

1. CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
2. TERMINAL BLOCKS D1 - D8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
3. FRONT COVER CAN PASS THROUGH 180° (CVR HOUSES CONT. PCB) (ONLY 90° NECESSARY SEE NOTE 7)
4. ANCILLARY COVERS CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
5. EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS SUPPLIED. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
6. AT LEAST 100mm CLEARANCE ABOVE AND BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
7. IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
8. OPTIONAL TOP AND BOTTOM COVERS FOR IP20 PROTECTION.

DATE	11.1.88
TRACED	
BY	W.S. 88
APPROVED	
DESIGNED	
BY	W.S. 88
DATE	21.4.89
30.1.92	
5/4/92	
20.2.96	

DESIGNED	KHW
CHECKED	
BY	DP
DATE	
APPROVED	

MATERIAL	
FINISH	

DRILL BY HAND APPLY OVER FINISH EXCEPT FOR PUNCH AND TACCOLES		
DRILL	Ø - 0.02	±0.02 / ±0.02
REWORK	Ø - 0.02	±0.02 / ±0.02

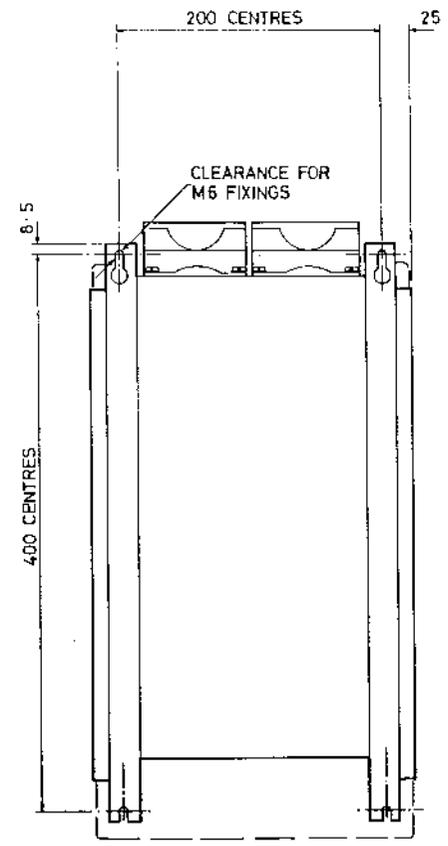
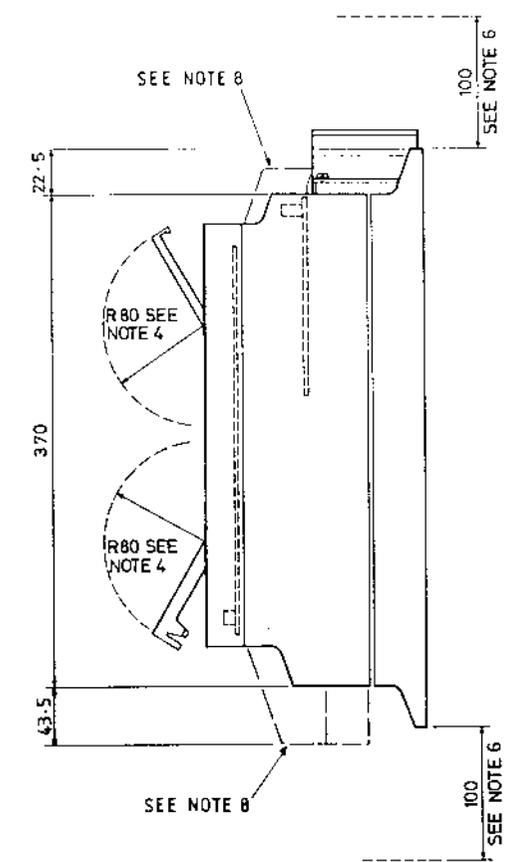
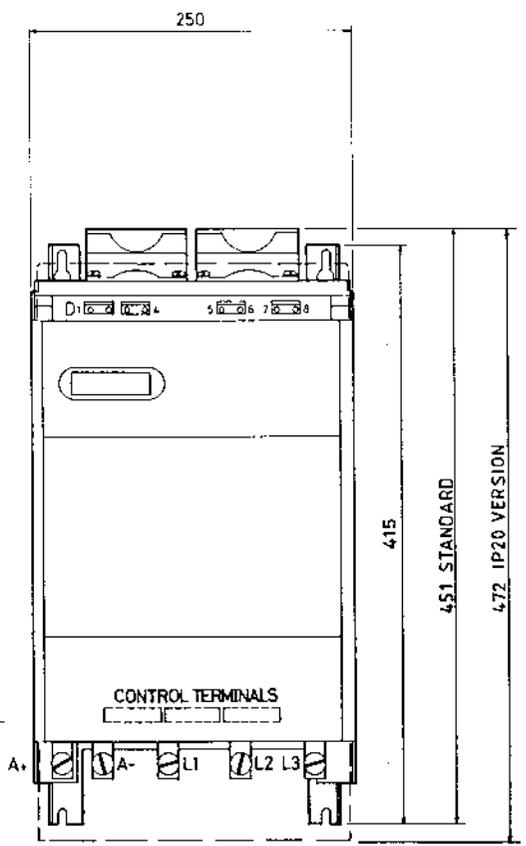
MANUFACTURED BY	570 / 590 SERIES
SCALE	N.T.S.

TITLE	DC DIGITAL DRIVES
	35A & 70A STACK ASSY
DRAWING NUMBER	110 055005
REV	001



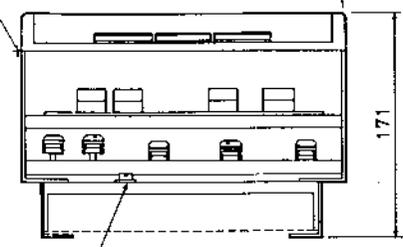
LITTLEHAMPTON ENGLAND





REAR VIEW FIXING CENTRES

R250 SEE NOTE 3



EARTH TERMINAL M6

NOTES.

- CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
- TERMINAL BLOCKS D1-D8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS
- FRONT COVER CAN PASS THROUGH 180° (CVR HOUSES CONT PCB) (ONLY 90° NECESSARY SEE NOTE 7)
- ANCILLARY COVERS CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
- EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS SUPPLIED. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
- AT LEAST 100mm CLEARANCE ABOVE AND BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
- IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
- OPTIONAL TOP AND BOTTOM COVERS FOR IP20 PROTECTION.

DATE	11.6.88
TRACED	
17.5.88	
A.A. (L.C.)	
TERMINAL BLOCKS	
WERE DESIGNED	
21.4.88	
50102	
344	
20.2.96	

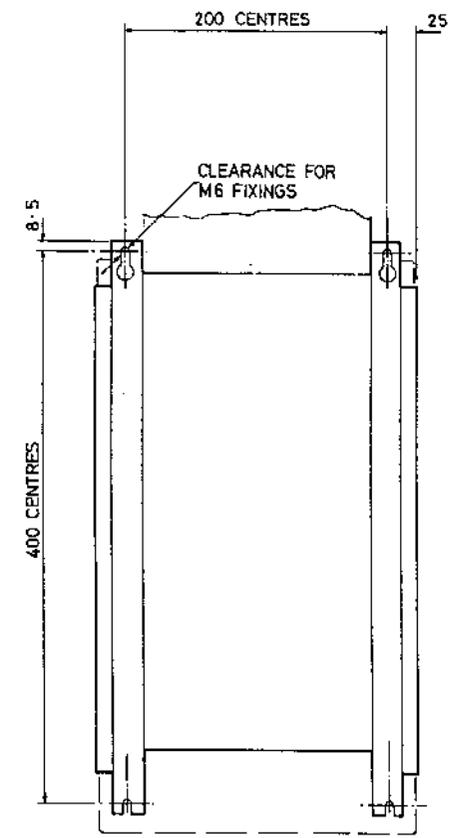
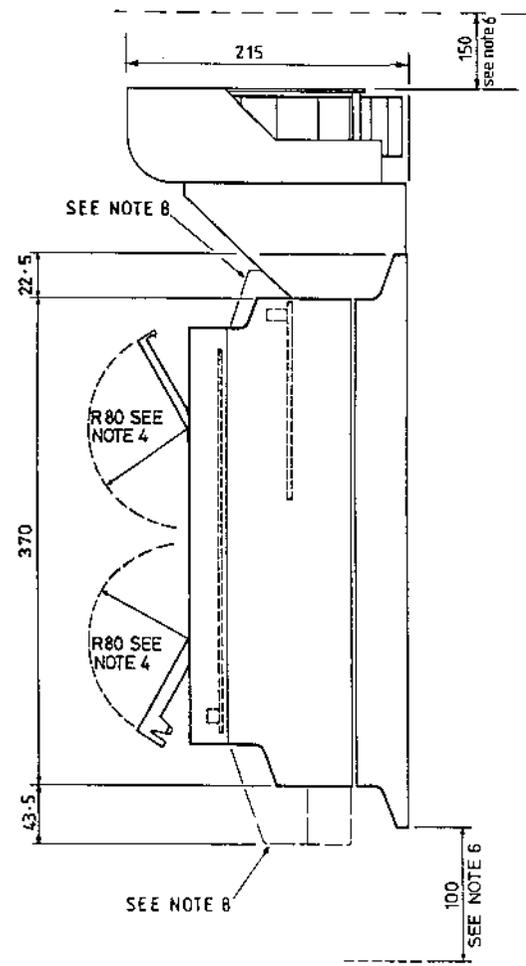
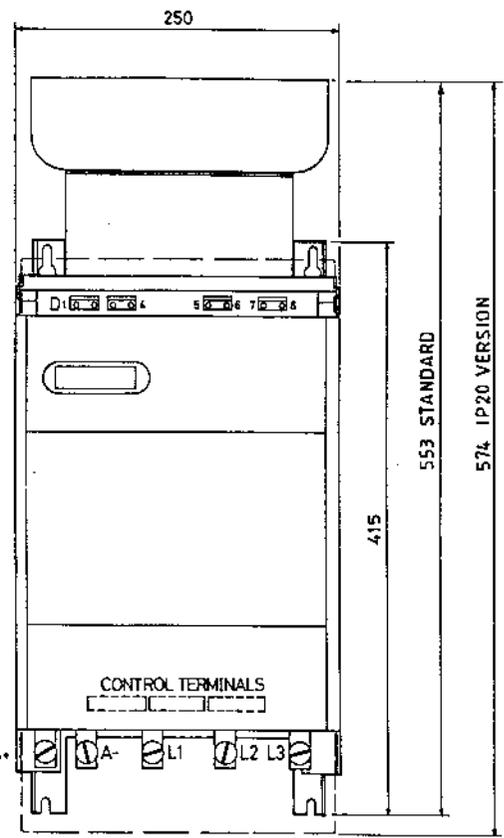
DRAWN	KHW
CHECKED	AP
DESIGN	
APPROVAL	
DATE	

MATERIAL	
FINISH	

DIMS. IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINS AND LACQUER)	
GENERAL	±0.25
FINISH	±0.10
TOLERANCE	±0.10

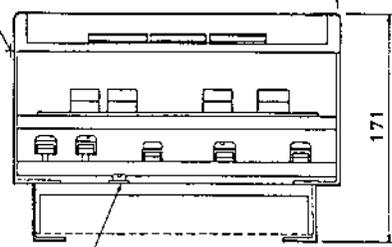
ASSEMBLED ON	570/590 SERIES
SCALE	N.T.S.

TITLE/DIGITAL DRIVES	
110A & 150A STACK	
ASSYS	
UNIVERSITY	
HC 065806 E	



REAR VIEW FIXING CENTRES

R250 SEE NOTE 3



EARTH TERMINAL M6

NOTES.

1. CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
2. TERMINAL BLOCKS D1-D8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
3. FRONT COVER CAN PASS THROUGH 180° (CVR HOUSES CONT. PCB) ONLY 90° NECESSARY SEE NOTE 7)
4. ANCILLARY COVERS CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
5. EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS SUPPLIED. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
6. AT LEAST 150mm CLEARANCE ABOVE AND 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
7. IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
8. OPTIONAL TOP AND BOTTOM COVERS FOR IP20 PROTECTION.

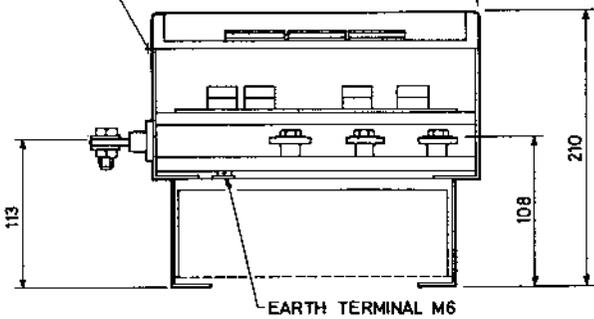
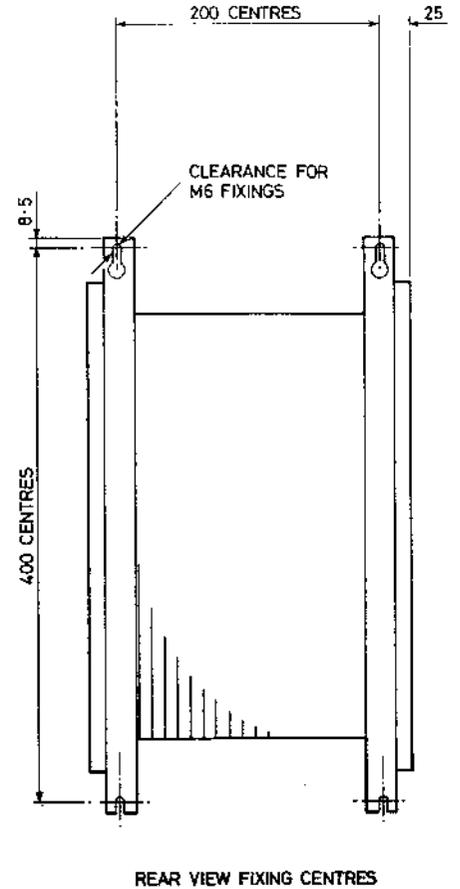
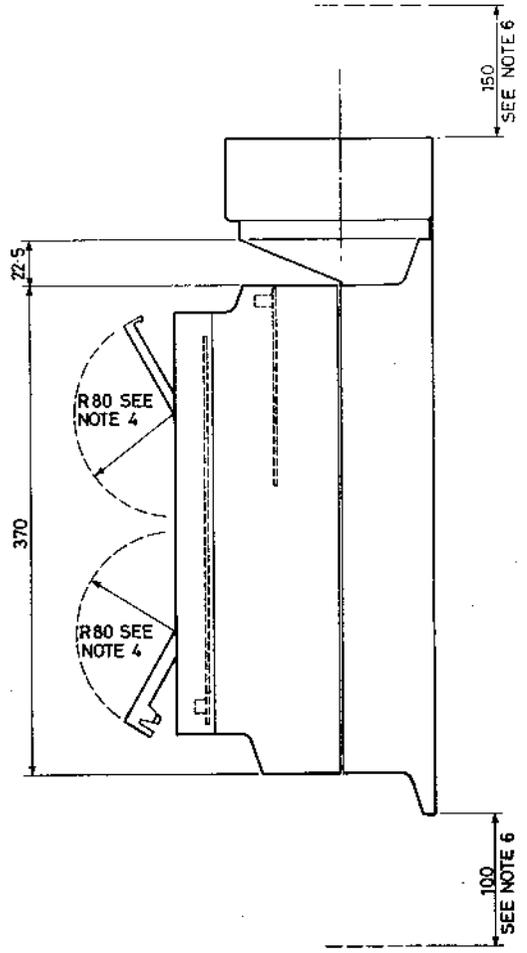
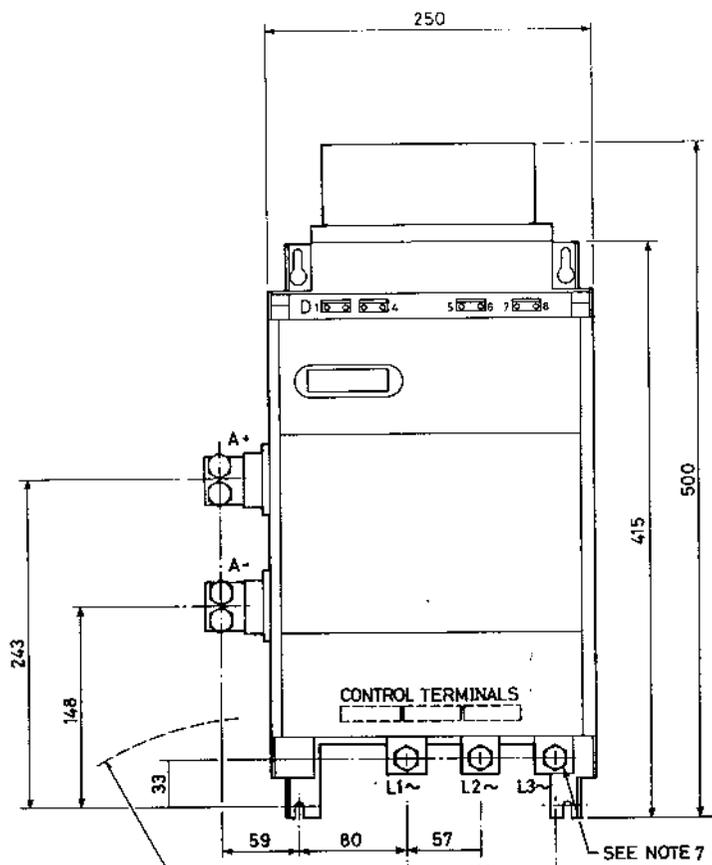
DATE	25.1.96
DESIGNER	B. S. H.
CHECKED	A.P.
DESIGN APPROVED	
DATE	1.10.2.96

DRAWN	KHW	MATERIAL	
CHECKED	A.P.	FINISH	
DESIGN APPROVED			
DATE			

UNITS IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINS AND LACQUERS)

SIMPLIFIED DIMENSIONS: 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 8.0, 10.0, 12.5, 15.0, 20.0, 25.0, 30.0, 40.0, 50.0, 60.0, 80.0, 100.0, 125.0, 150.0, 200.0, 250.0, 300.0, 400.0, 500.0, 600.0, 800.0, 1000.0

ASSEMBLY TO	570/590 SERIES	SCALE	N.T.S	TITLE	DCC DIGITAL DRIVE 180A STACK
<b>590</b>	LITTLEHAMPTON ENGLAND TELEX 87162	<b>ASSY</b>			
					HG386958 F



- NOTES.**
- CONTROL TERMINALS ARE PLUG-IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
  - TERMINAL BLOCKS D1 - D8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
  - FRONT COVER CAN PASS THROUGH 180° (CVR HOUSES CONT. PCB) (ONLY 90° NECESSARY SEE NOTE 8)
  - ANCILLARY COVERS CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
  - EARTH CONNECTION IS M6 ALL OTHER CONNECTIONS ARE M8. ALL NECESSARY FIXINGS FOR ELECTRICAL CONNECTIONS SUPPLIED. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
  - AT LEAST 150mm CLEARANCE ABOVE AND 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
  - ALL HEAVY CURRENT M8 HEX. HD. BOLTS, NUTS AND BELVILLE WASHERS.
  - IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.

DATE	BY	CHKD	TRACED
17.5.84	KHW		
18.5.84			
18.5.84			
18.5.84			
18.5.84			

DESIGNER	KHW	MATERIAL	
CHECKED		FINISH	
APPROVED			
DATE			

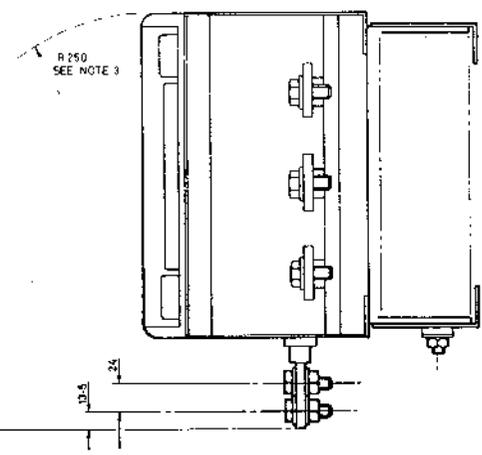
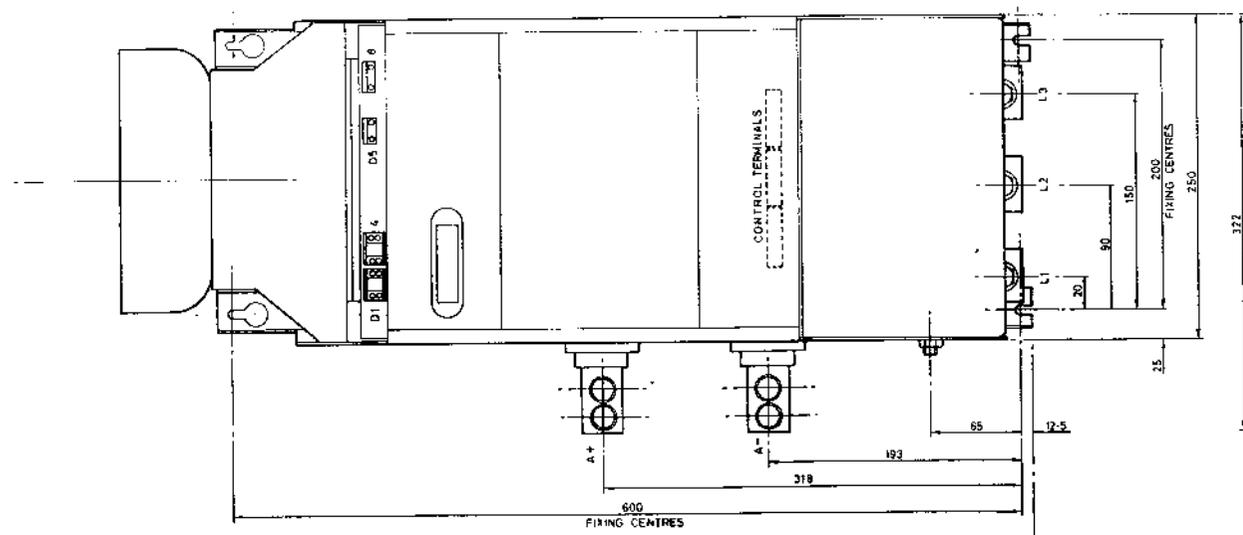
UNITS IN M.M. APPLY OVER FINISH	
REWORK	
REVISION	

DESIGNED BY  
**570 / 590 SERIES**

**SSO** LITTLEHAMPTON ENGLAND TELEX 87142

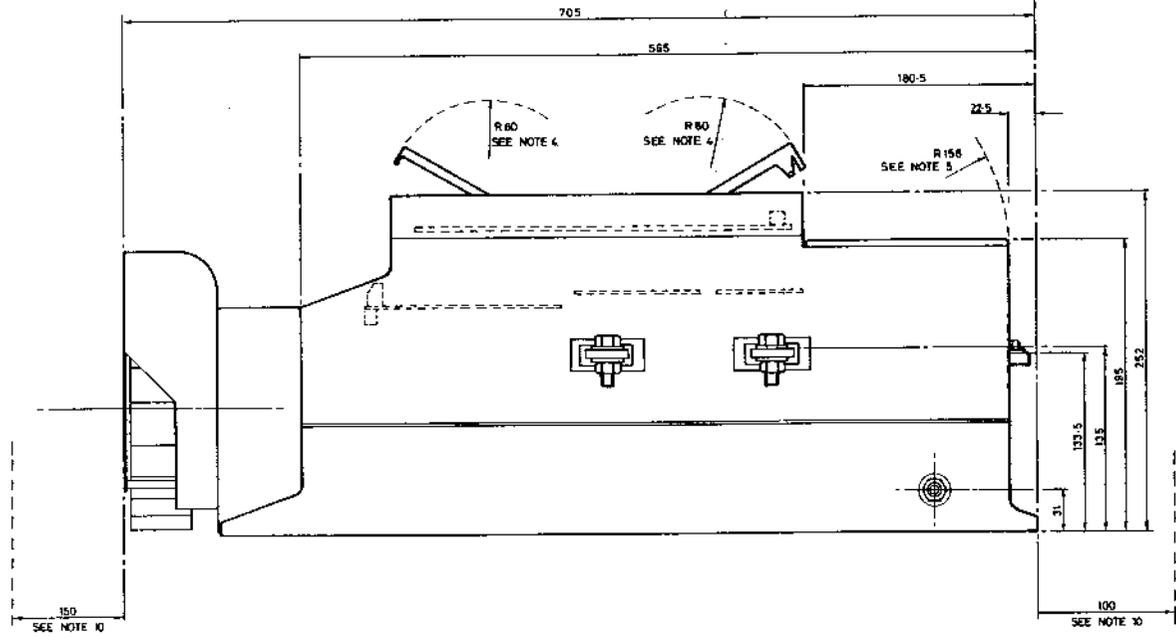
SCALE		TITLE DC DIGITAL DRIVES 270A STACK ASSY.
DRAWING NUMBER	HG 055807 F	REV. 01

CLEARANCE FOR M.B. FIXINGS.



NOTES

1. CONTROL TERMINALS ARE PLUG IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
2. TERMINALS D1 TO 4 ARE CAPABLE OF ACCEPTING 4.0mm<sup>2</sup> CABLE AND D5 TO 8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
3. FRONT COVER CAN PASS THROUGH 180° (COVER HOUSES CONTROL P.C.B). IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
4. ANCILLARY FLAPS (2 OFF) CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
5. ANCILLARY COVER CAN PASS THROUGH 90° OR CAN BE COMPLETELY REMOVED.
6. A+ & A- CONNECTIONS ARE M10 HEX. HD. BOLTS, NUTS & BELVILLE WASHERS.
7. L1, L2 & L3 CONNECTIONS ARE M12 HEX. HD BOLTS & BELVILLE WASHERS.
8. EARTH CONNECTION IS M10 STUD, NUT & BELVILLE WASHERS.
9. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
10. AT LEAST 150mm ABOVE AND 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.



DATE  
 22.7.88  
 3.5.89  
 30.1.92  
 5.4.94

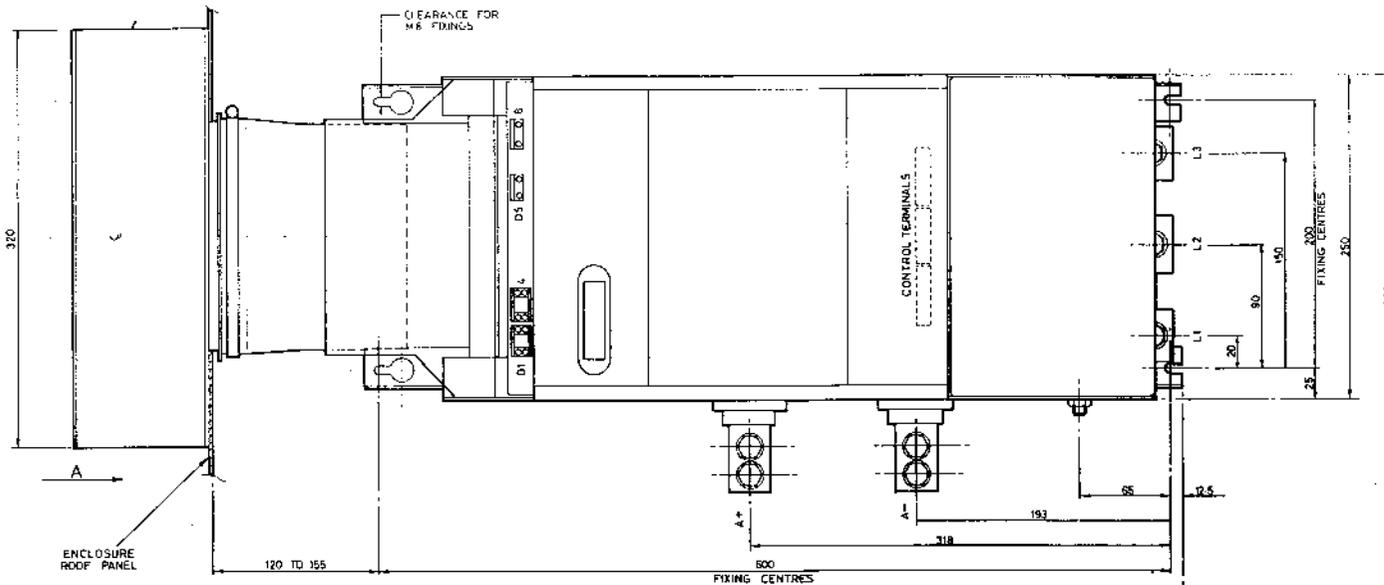
Drawn **KHW**  
 Checked **AS**

DIMS. IN MM. APPLY OVER FINISH  
 UNLESS STATED OTHERWISE  
 GENERAL TOLERANCE ±0.15  
 HOLE ±0.05  
 HOLE ±0.07

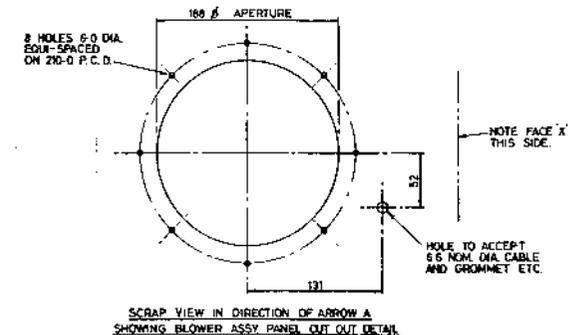
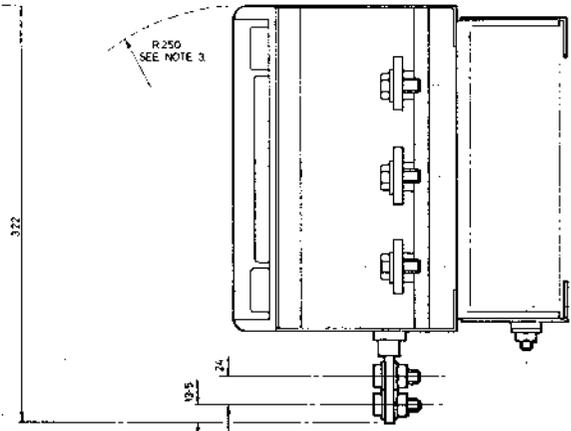
ASSEMBLED ON  
**570/590 SERIES**  
 LITTLEHAMPTON ENGLAND  
 THE NEW WEAR

SCALE 1:2  
 TITLE DC DIGITAL DRIVES  
 360A STACK ASSY.  
 DRAWING NUMBER  
 HG 057208 F

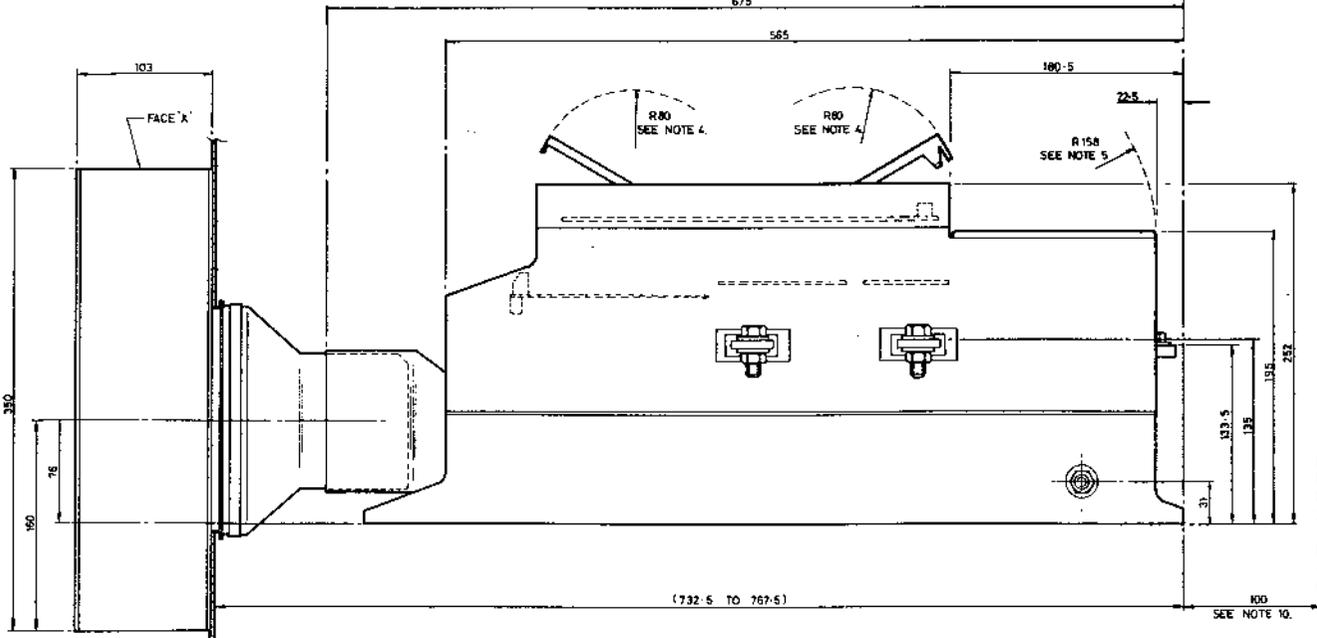
SEE NOTE 11



ENCLOSURE ROOF PANEL



SCRAP VIEW IN DIRECTION OF ARROW A SHOWING BLOWER ASSY PANEL CUT OUT DETAIL



NOTES

1. CONTROL TERMINALS ARE PLUG IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE W/10 CLAMP STYLE LOOPS.
2. TERMINALS D1 TO 4 ARE CAPABLE OF ACCEPTING 4.0mm<sup>2</sup> CABLE AND D5 TO 8 ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
3. FRONT COVER CAN PASS THROUGH 180° COVER HOUSES CONTROL P.C.B.) IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
4. ANCILLARY FLAPS (2 OFF) CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
5. ANCILLARY COVER CAN PASS THROUGH 90° OR CAN BE COMPLETELY REMOVED.
6. A+ & A- CONNECTIONS ARE M10 HEX. HD BOLTS, NUTS AND BELVILLE WASHERS.
7. L1, L2 & L3 CONNECTIONS ARE M12 HEX. HD BOLTS AND BELVILLE WASHERS.
8. EARTH CONNECTION IS M10 STUD, NUT AND BELVILLE WASHER.
9. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
10. AT LEAST 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR
11. AIR EXITS (4 POSITIONS) MUST NOT BE OBSTRUCTED.

DATE	DESCRIPTION
A 22.2.89	
B 3.5.89	
1 10/1/92	
2 30/1/92	
3 31/3/94	

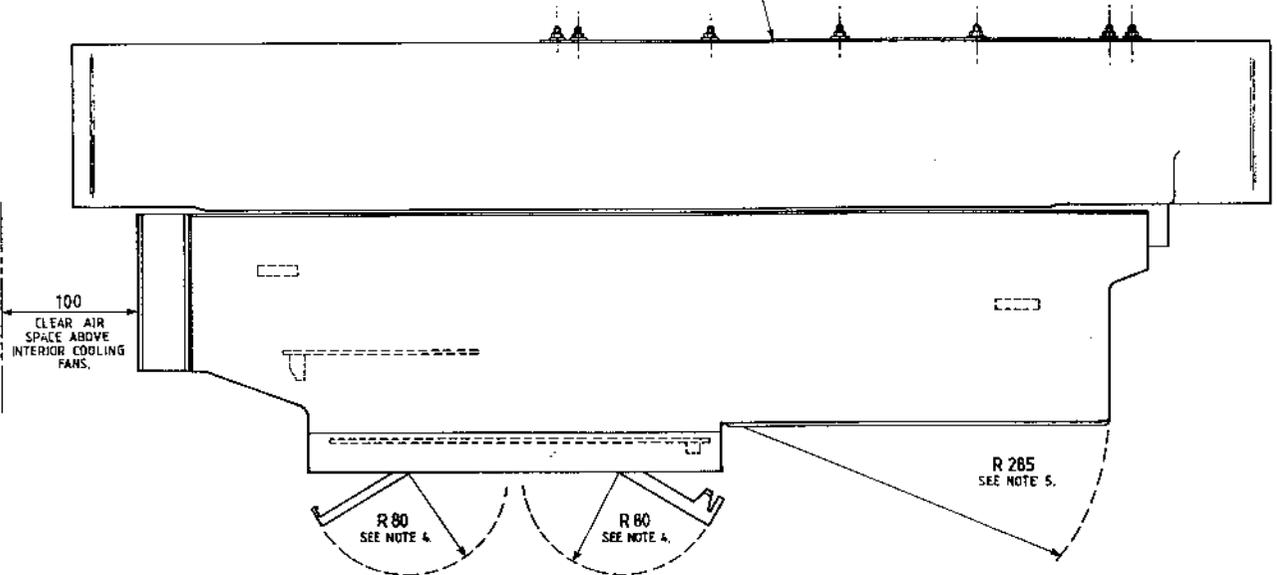
DRAWN	KHW	MATERIAL
CHECKED	Jr	FINISH

DIM'S. IN MM. APPLY OVER FINISH (EXCEPT FOR PANE AND LAYOUT)	
UNIT	MM
TOLERANCE	±0.1

ASSEMBLED ON	SCALE
570/590 SERIES	1:2
LITTLEHAMPTON ENGLAND	
TELEX 87142	

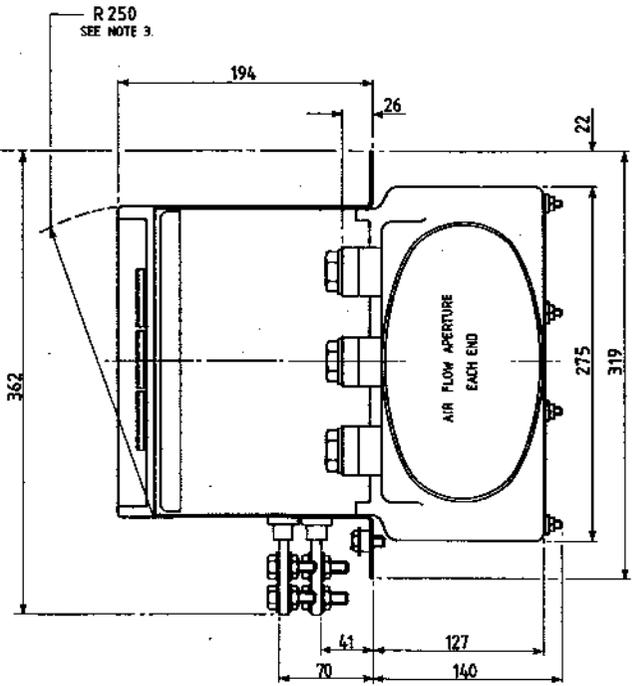
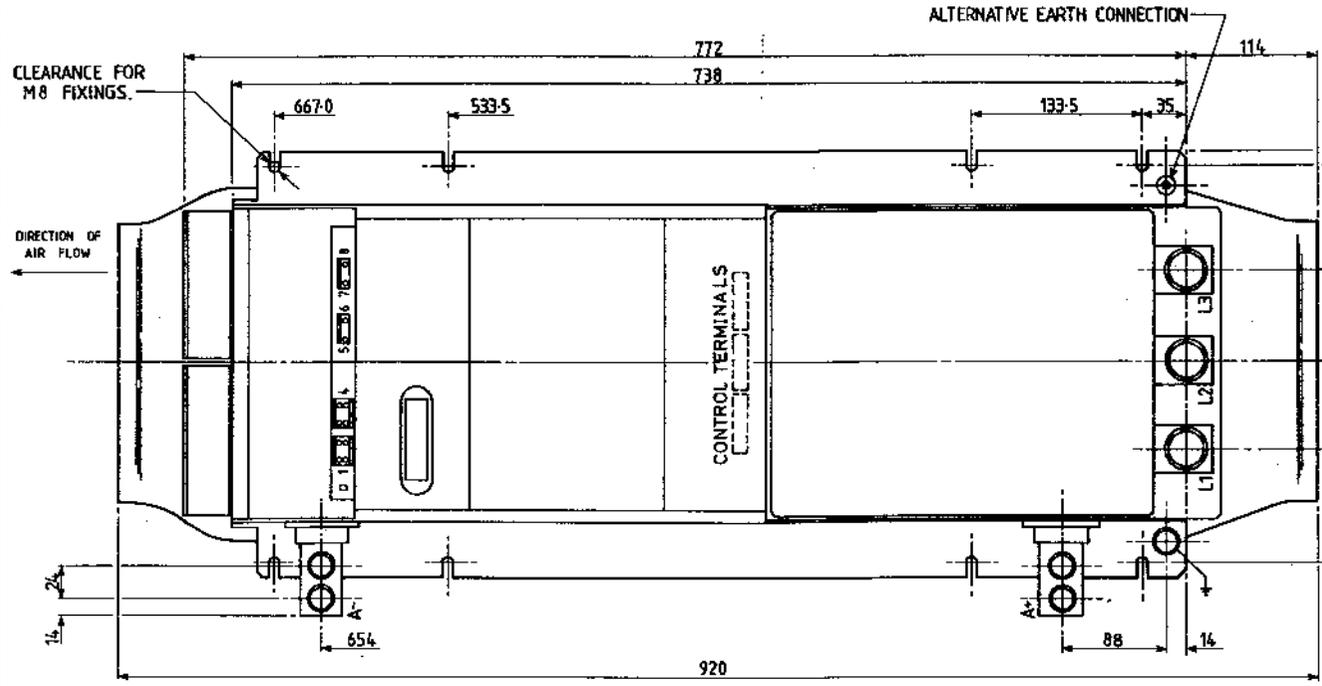
TITLE	DC DIGITAL DRIVES 450A STACK ASSY.
DRAWING NUMBER	HG 057209 F

REMOVABLE REAR COVER (SEALED) FOR INSPECTION & CLEANING PURPOSES.



NOTES

1. CONTROL TERMINALS ARE PLUG IN STYLE TERMINALS CAPABLE OF ACCEPTING 1.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
2. TERMINALS D1 TO 4 ARE CAPABLE OF ACCEPTING 4.0mm<sup>2</sup> CABLE AND D5 TO B ARE CAPABLE OF ACCEPTING 2.5mm<sup>2</sup> CABLE INTO CLAMP STYLE LOOPS.
3. FRONT COVER CAN PASS THROUGH 180° (COVER HOUSES CONTROL P.C.B.) IT IS NOT NECESSARY TO OPEN FRONT COVER WHEN ELECTRICAL CONNECTIONS ARE BEING MADE.
4. ANCILLARY FLAPS (2 OFF) CAN PASS THROUGH 180° AND CAN BE LATCHED IN OPEN POSITION.
5. ANCILLARY COVER CAN PASS THROUGH 90° OR CAN BE COMPLETELY REMOVED.
6. A+ & A- CONNECTIONS ARE M10 HEX. HD. BOLTS, NUTS & BELVILLE WASHERS.
7. L1, L2 & L3 CONNECTIONS ARE M14 HEX. HD. BOLTS & BELVILLE WASHERS.
8. EARTH CONNECTION IS M8 (2 POSITIONS).
9. MECHANICAL MOUNTING FIXINGS ARE NOT SUPPLIED.
10. AT LEAST 100 mm ABOVE AND 100mm BELOW CONVERTER MUST BE PROVIDED FOR COOLING AIR.
11. OVALS ENDS SUITABLE FOR 178 (7") I/D FLEXIBLE AIR DUCTING.
12. MINIMUM AIR VELOCITY OF 16 M/S REQUIRED FOR COOLING CONVERTER.
13. MAIN COOLING AIR FLOWS IN A SEALED STREAM LINED PATH.
14. SEE SHEET 2 FOR AIR FLOW COMPONENTS.
15. SEE HG 049669 F FOR TYPICAL INSTALLATION.  
SEE HG 054248 F FOR ALTERNATIVE TOP OF PANEL MOUNTING.



DATE	BY	CHKD	APP'D
A 22.5.89			
4.5.89			
2.30.92			
4.5.94			

DRAWN	KHW
CHECKED	R

MATERIAL	
FINISH	

DIM. IN M.M. APPLY OVER FINISH (EXCEPT FOR HOLE AND LOCUS)			
GENERAL	B	HP	
TOLERANCE	F3	F7	H9
			H11

APPROVED ON  
**570/590 SERIES**

LITTLEHAMPTON  
ENGLAND  
TELEX 97142

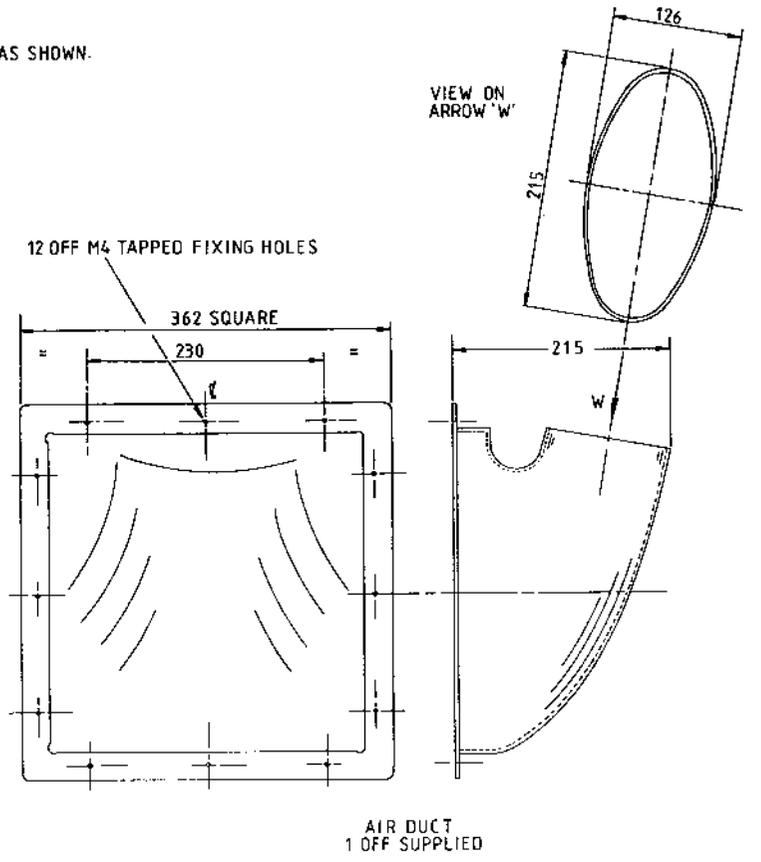
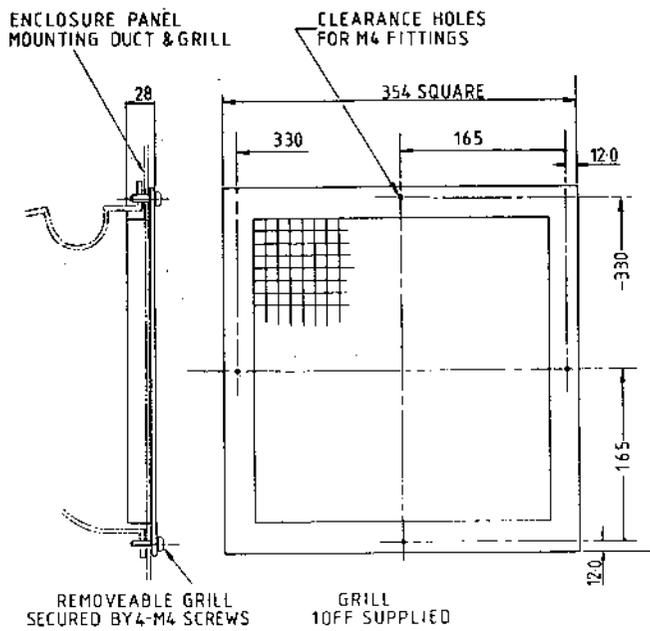
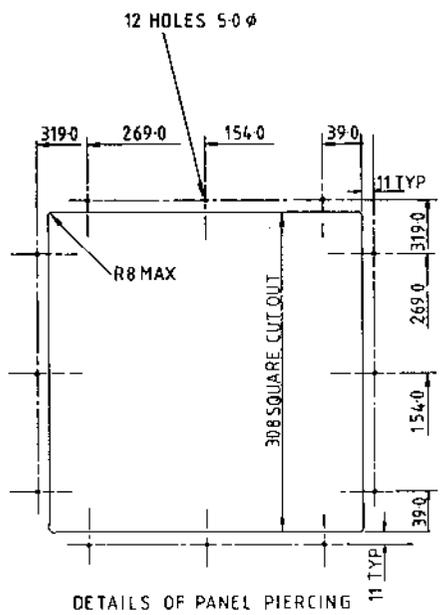
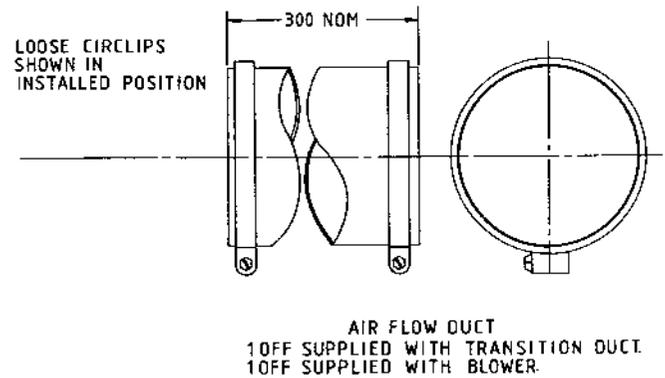
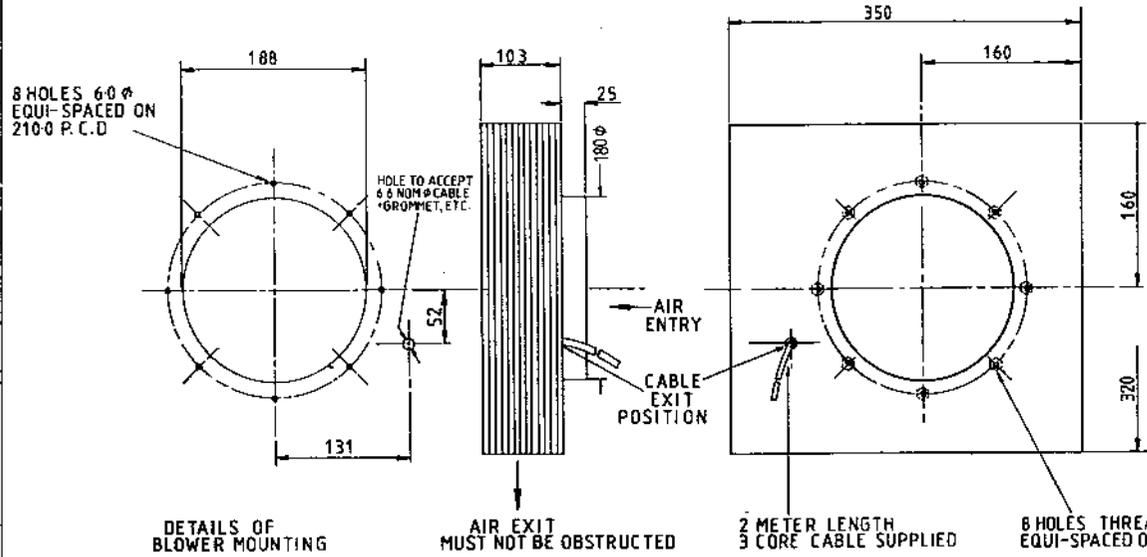
SCALE 1:2

TITLE DC DIGITAL DRIVES  
720A STACK OUTLINE  
DRG.

ORIGIN NUMBER

HG 057449 F

1 of 2



DATE	BY	DATE
22.5.89	A	
2.9.89	L	
4.8.90	L	
30.7.92	L	
15.4.94	L	

DRAWN	SYDNEY	MATERIAL
CHECKED	DR	FINISH
SPECIAL APPROVAL		
WARRANTY REMOVE		

DIAMS. IN M.M. APPLY OVER FINISH EXCEPT FOR DIMS AND TAPPETS.

GENERAL DIMS TO BS 308/B5 3539

DESIGNED BY 570/590 SERIES

SCALE

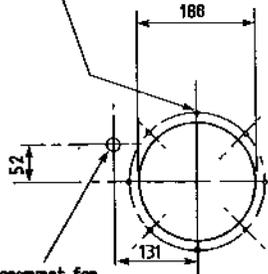
Shackleton system drives

TITLE DC DIGITAL DRIVES 720A STACK OUTLINE DRG.

DRAWING NUMBER HG 057449 F

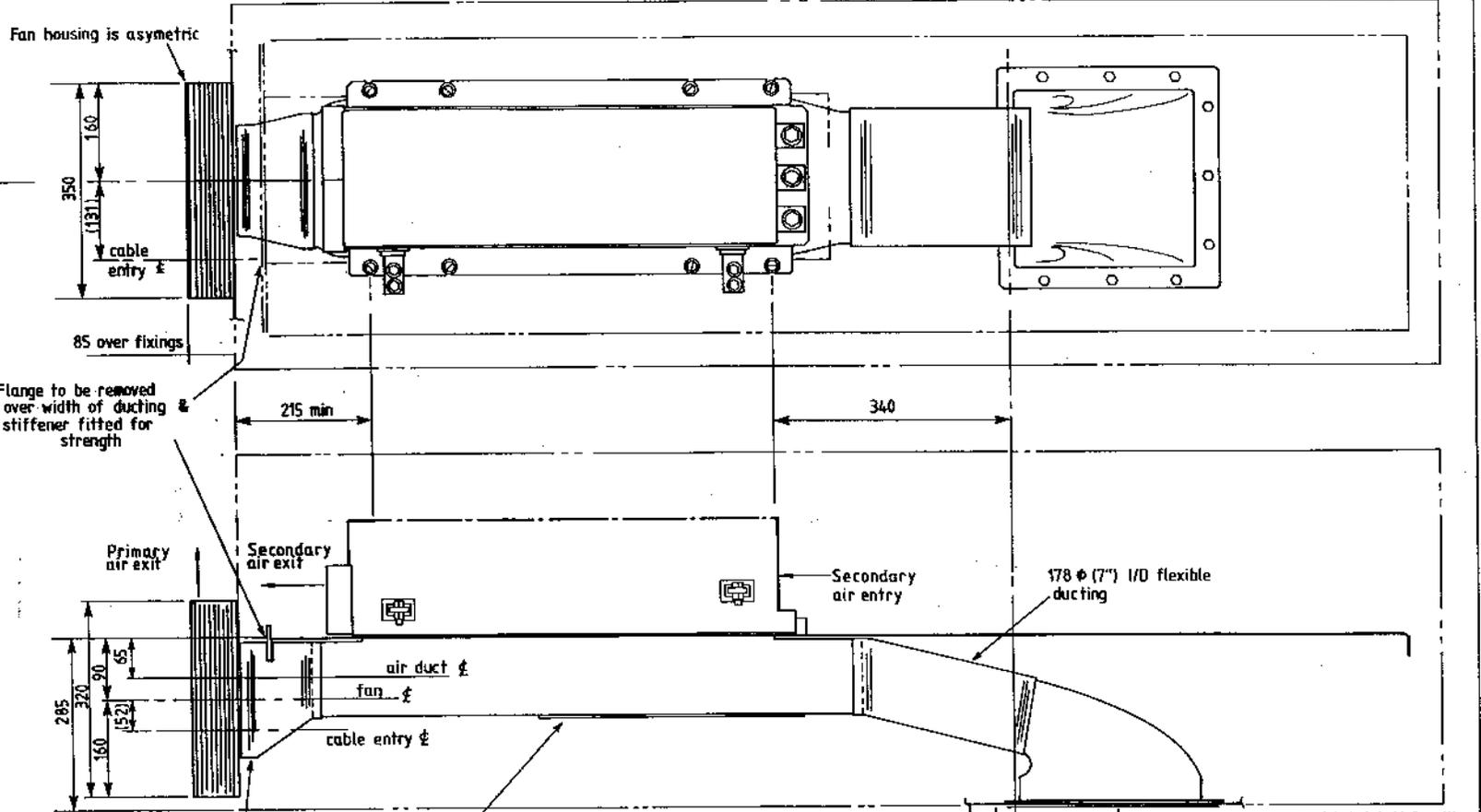
2 OF 2 SHEETS

8 holes 6.0  $\phi$  equi-spaced on 210.0 PCD as shown



Fit suitable grommet for 6.6mm  $\phi$  cable (SSD grommet OF 044208 in 9 $\phi$  hole is suitable).

**BLOWER ASSY. MOUNTING DETAILS**



Primary air exit

Secondary air exit

Secondary air entry

178 (7") I/D flexible ducting

air duct  
fan

cable entry

200mm MIN CLEAR DISTANCE

178 (7") I/D flexible ducting

Removable panel for inspection and cleaning

8 holes 8.5  $\phi$  or fit M8 hankbushes.

Primary air entry

Transition duct (air inlet) & grille assy. Duct fitted by 8 screws into tapped bushes in duct. Screws at # 4 off are longer and retain grille. Note that the grille covers duct fixing screws. (Fixing screws M4 Thread).

300 cts  
277/280

755

621.5

221.5

88

72

1000

**DETAIL OF TYPICAL PANEL APERTURE**

20x45

110

330

280

165

318

50

6

**DETAIL OF TRANSITION DUCT APERTURE.**

DATE	13-6-83
BY	B7/8/85
CHECKED	C 16-7-86
DESIGN	1 4-8-86
APPROVAL	3 22-9-89
REVISION	5 30-1-92

DRAWN	SEM	MATERIAL	
CHECKED		FINISH	
DESIGN			
APPROVAL			
REVISION			

SHIMS, IN NEAR APPLY OVER FINISH EXCEPT FOR PAINT AND LACQUER!!

GENERAL 1:2 = 1:1 1:10 = 1:10 1:100 = 1:100  
FOR ENDS 1:2 = 1:1 1:10 = 1:10 1:100 = 1:100

545/570/590 SERIES

**SSD Shackleton system drives**

SCALE 1:4

TITLE DC DRIVES 720A STACK ASSY. STANDARD MTG.

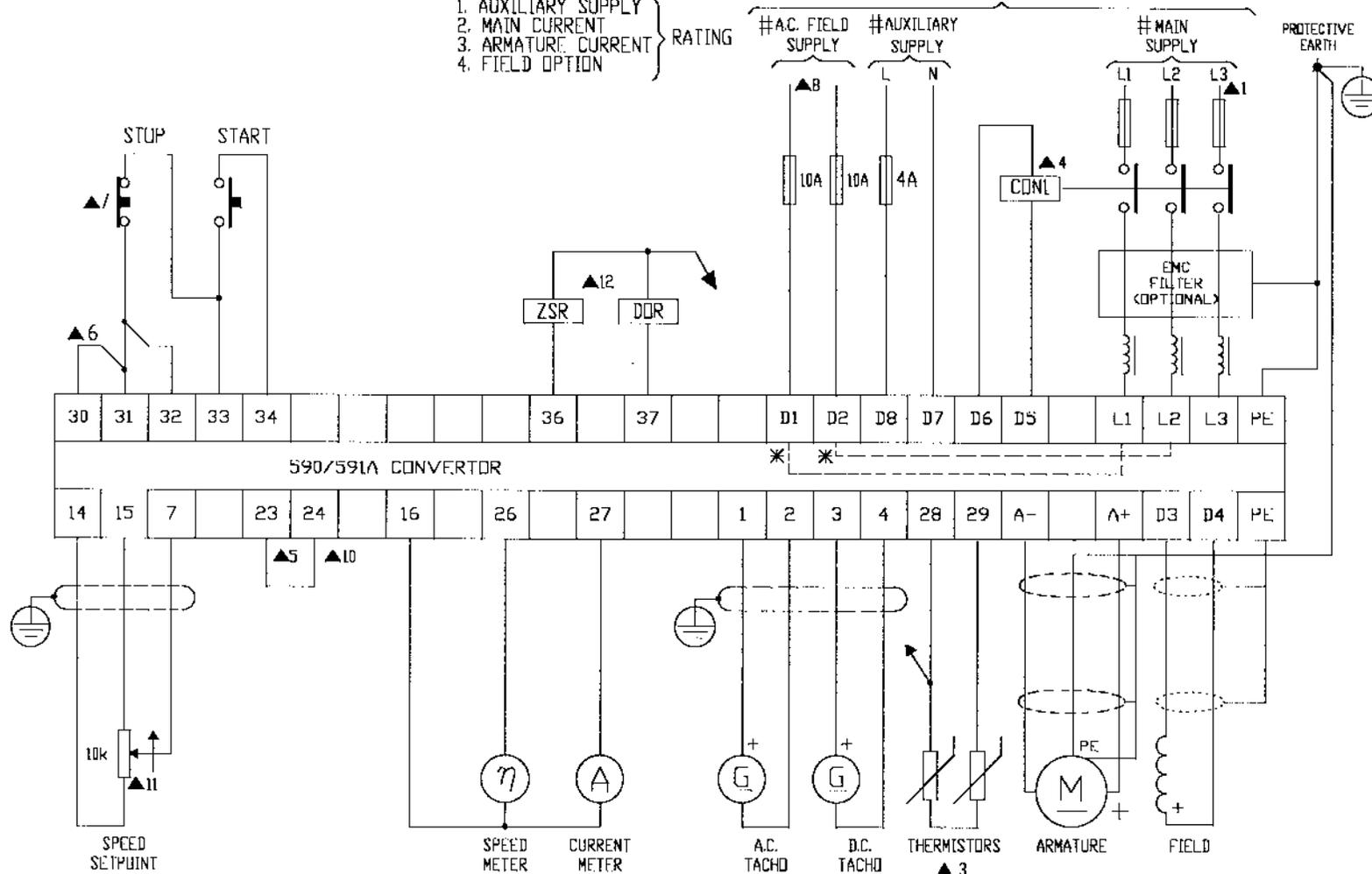
REVISION NUMBER 1

HG 049669 F

# CHECK BEFORE MAKING CONNECTIONS:-  
 1. AUXILIARY SUPPLY  
 2. MAIN CURRENT  
 3. ARMATURE CURRENT  
 4. FIELD OPTION

SUPPLY FROM MAIN ISOLATOR

NOTES:-



1. POWER CABLES TO HAVE MINIMUM RATING L1 x FULL LOAD CURRENT. HRC FUSES TO BE RATED ACCORDINGLY.
2. CONTROL WIRING TO HAVE MINIMUM CROSS SECTION OF 0.75sqmm.
3. IF MOTOR IS NOT FITTED WITH OVER TEMPERATURE PROTECTION THERMISTORS FIT LINK BETWEEN TERMINALS 28 & 29.
4. THE CONTACTOR MUST BE OPERATED VIA A SUITABLE RELAY IF ITS COIL INRUSH CURRENT DURING PICK-UP EXCEEDS 3A.
5. CURRENT LIMIT 0 TO +10V = 0 TO 200%. LINK TO TERMINAL 24 NORMALLY.
6. IF CUSTOMER INTERLOCKS ARE REQUIRED INSERT SWITCHES IN PLACE OF LINK BETWEEN TERMINALS 30 & 31.
7. ADDITIONAL STOP BUTTONS MUST BE OF NORMALLY CLOSED TYPE AND WIRED IN SERIES WITH THE STOP BUTTON SHOWN.
8. UNITS WITH THE EXTERNAL FIELD SUPPLY OPTION REQUIRE CONNECTION OF THE A.C. SUPPLY TO TERMINALS D1 & D2.
9. OBSERVE GOOD ENGINEERING PRACTICE WITH INSTALLATION. ENSURE THAT SIGNAL WIRES ARE SEPARATED FROM HIGH VOLTAGE OR HIGH CURRENT CABLES. USE SCREEN CABLES ON TACH AND SETPOINT CONNECTIONS.
10. AUXILIARY CURRENT LIMIT (-) IS APPLICABLE ONLY TO 590A CONVERTORS.
11. CONNECTION SHOWN IS NORMAL FOR 590A CONVERTOR. FOR THE 591A CONVERTOR THE ECW TERMINAL IS USUALLY CONNECTED TO 0V SIGNAL (TERMINAL 4 OR 16)
12. OPTION RELAY CONNECTIONS DDR AND ZSR

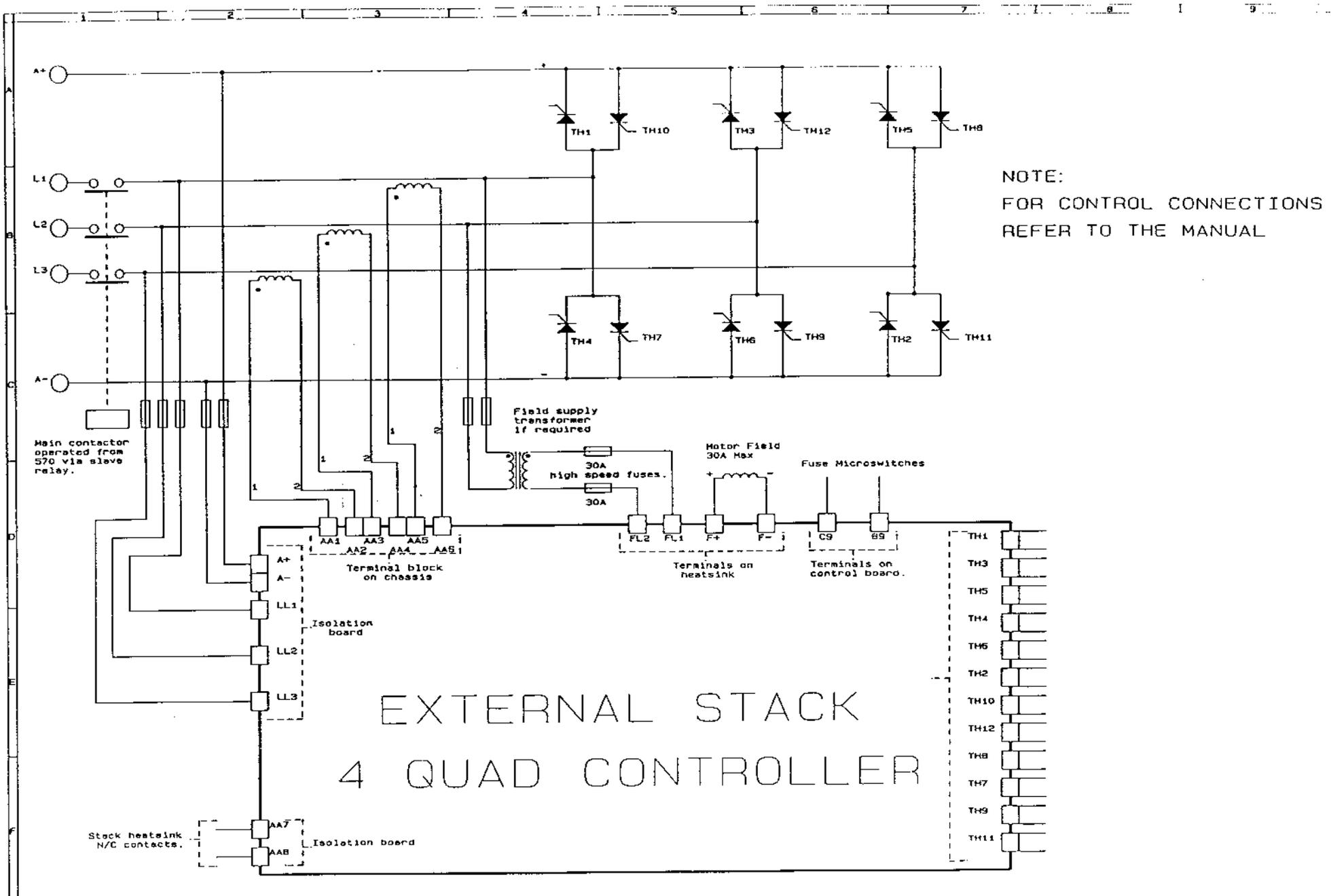
\* USE INTERNAL FIELD CONNECTION FOR EMC COMPLIANCE

REFER TO SECTION 2.4 FOR THE TIGHTENING TORQUE RATINGS OF THE TERMINAL BLOCKS.

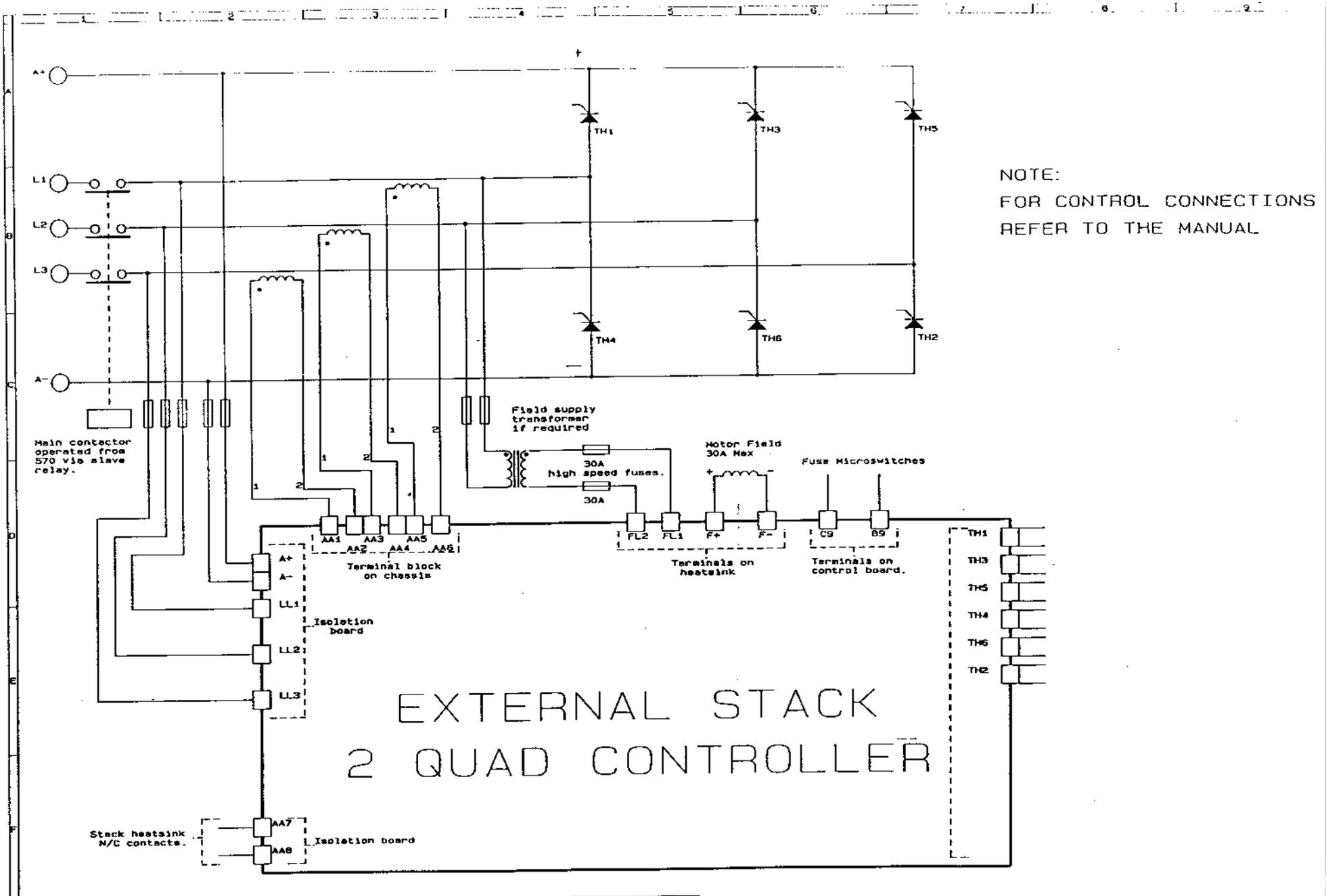
©1994 EURO THERM DRIVES

DRAWN MJB	CHECKED JFS	DATE 03/08/93	A 18/11/94	B 25/09/96	C	ELECTRICAL SYMBOLS GENERALLY TO BS 3939	TITLE CIRCUIT DIAGRAM FOR 590/591A CONVERTOR	USED ON	
								DRAWING NUMBER HJ 387211 D	SHT. 1 OF 1

KEYSIDE SS A LANCASHIRE ASSOCIATED ENGINEERING



CAD FILENAME: 578_2.SCH		NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS DIAGRAM RE-PLOT ONLY.					TITLE		USED ON	
DRAWN	CHECKED	D-D-E	1	000000	000000	000000	000000	ELECTRICAL SYMBOLS TO BS 3939	© SSD 19 89	
ANW	<i>[Signature]</i>								DRAWING NUMBER	
C.A.D. LINK	DESIGN APP.		A	B	C	1	2		HB058299D	
								WIRING DIAGRAM FOR		SHT. 1
								4 QUAD EXTERNAL STACK		OF 5
								SSD LITTLEHAMPTON ENGLAND TELEX 87142		
								EI		



CAD FILENAME: 578_4.SCH		NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS DIAGRAM RE-PLOT ONLY.					ELECTRICAL SYMBOLS TO BS 3939		TITLE WIRING DIAGRAM FOR 2 QUAD EXTERNAL STACK		USED ON		SSD 19 89	
DRAWN ANW	CHECKED <i>ADK</i>	D R-4	1 000044	00-1080	000000	1 1984	2 000000	SSD LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HB058299D		SHT. 4 OF 5		
C.A.D. LINK	DESIGN APP.	A	B	C	1	2	EI							

## 4.6 EMC INSTALLATION GUIDELINES

### INTRODUCTION

This section provides installation guidelines for drive modules and systems to maximise their ‘Electro Magnetic compatibility’ (EMC) in their intended operating environment. All installers must read this section and apply the advice which is relevant to their application. **Pass on this information to others as is appropriate.**

All power drive systems have the potential to produce electrical emissions, both radiated and conducted back into the AC supply. This is due to the inherent operation of all drives by switching large voltages and currents rapidly in order to control the motor. Because the drives internal control electronics operates continuously in very close proximity to the electrically noisy power switching elements, drives are inherently immune to any additional external electrical noise.

Great care has been taken in the design and selection of suitable EMC filters to provide the correct level of interface suppression, ease of installation and to ensure that electrical safety is not compromised. The EMC performance can only be guaranteed to be within the limits specified when the 590 drive modules are installed together with the recommended EMC filters and line chokes in accordance with the following instructions.

The subject of EMC is explored in more detail in a separate Eurotherm Application Manual entitled “EMC Installation Guidelines for Modules and Systems”, part number HA388879, available from your local Eurotherm office.

### EMC FILTERS TO REDUCE LINE CONDUCTED NOISE

An EMC supply filter may be used with each 590 drive module to reduce the line conducted noise. For higher current product 300 amp filter modules will be used in parallel. The 590 range of industrial DC drives can be supplied with filters to meet the ‘industrial’ Class A EMC environment when used with the specified 2% minimum line chokes as listed below. All ac supply filters should only be fitted on the mains side on the contactor.

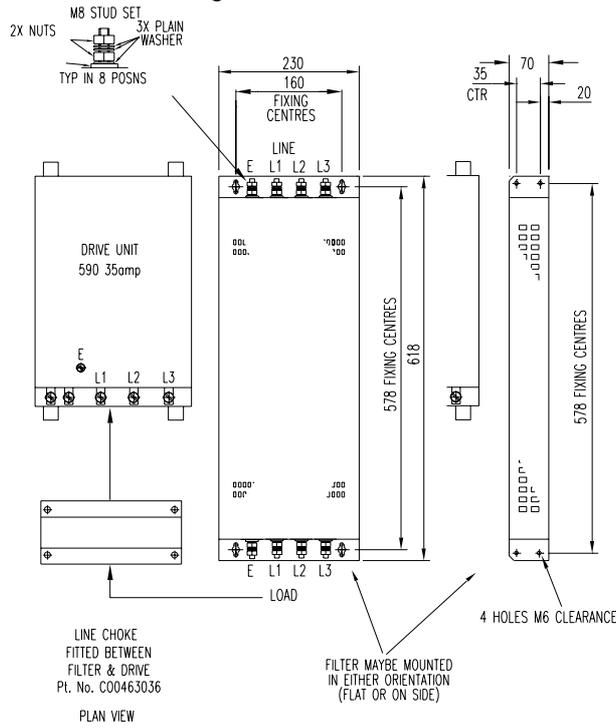
Table A - AC Supply Filter and Line Choke Part Numbers for Conformance with EN55011 Class A.

<b>Eurotherm Product</b>	<b>Armature Current Rating</b>	<b>Eurotherm Filter Part No.</b>	<b>Total Filter Watt Loss</b>	<b>Eurotherm EMC Line Reactor</b>
590 / A, D, L	35 Amp	1 off CO388965U035	25W	CO463036
"	70 Amp	1 off CO388965U110	75W	CO463037
"	110 Amp	1 off CO388965U110	75W	CO463038
"	150, 180 Amps	1 off CO388965U180	158W	CO463039
"	270 Amps	1 off CO389456	50W	CO057960
"	360 Amps	1 off CO389456	50W	CO057961
"	450 Amps	2 off CO389456	100W	CO057962
"	720 Amps	2 off CO389456	100W	CO057963
"	800 Amps	3 off CO389456	100W	CO057963

Table B - AC Supply Filter Part Numbers for ‘non CE marked’ Product.

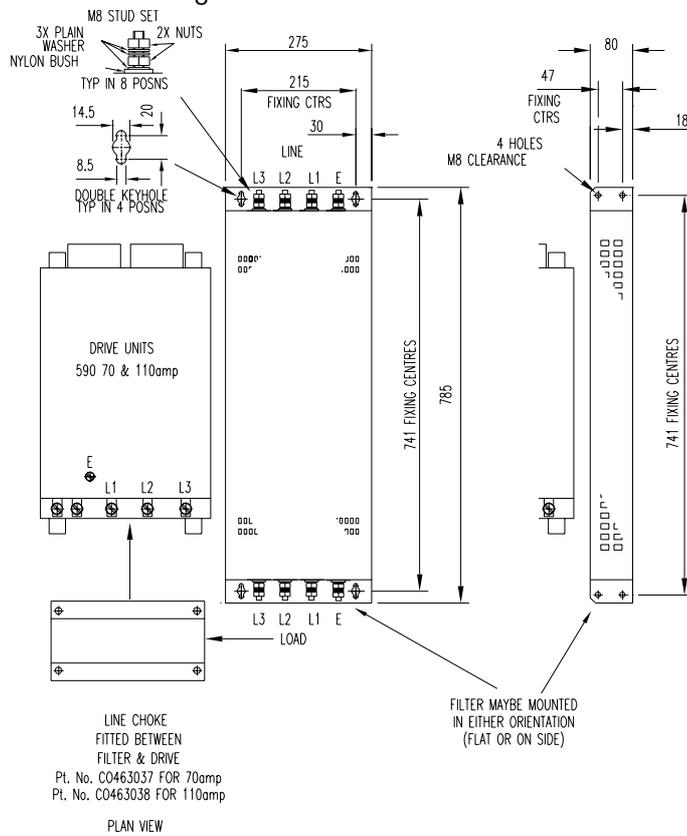
<b>Eurotherm Product</b>	<b>Armature Current Rating</b>	<b>Eurotherm Filter Part No.</b>	<b>Total Filter Watt Loss</b>	<b>Line Choke Requirement</b>
590 / A, D, L	950, 1100 Amps	3 off CO389456	150W	2 % minimum, refer to Eurotherm Drives
"	1388 Amps	4 off CO389456	200W	
"	1600, 1800 Amps	5 off CO389456	250W	
"	2300 Amp	7 off CO389456	350W	
"	2800 Amp	8 off CO389456	400W	

Figure 4.1 Filter Mounting Details Part No. CO388965U035 for 590 35amp



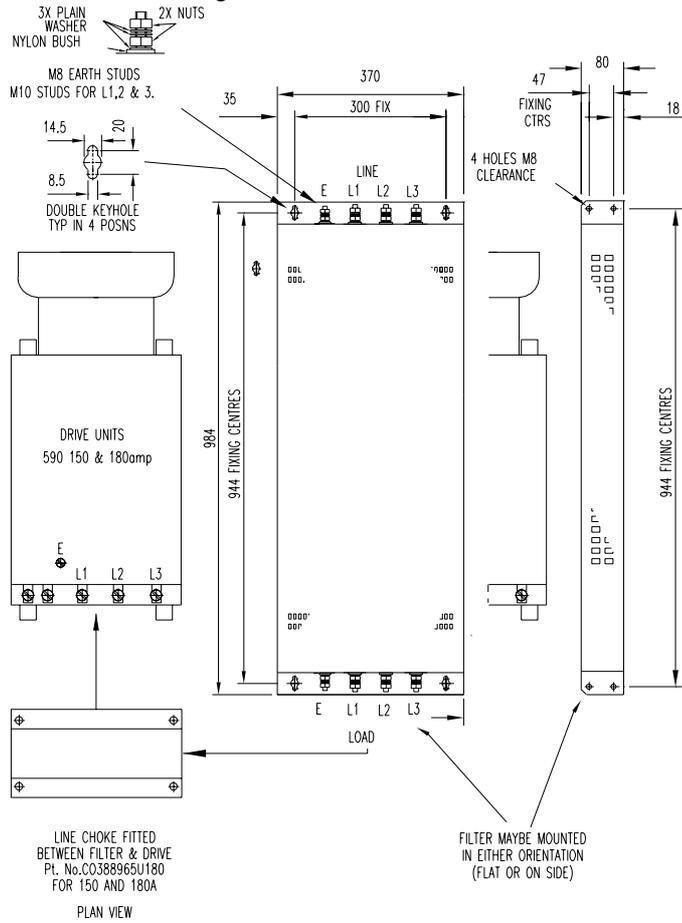
FILTER MOUNTING DETAILS  
Part No CO388965U035  
FOR 590 35amp

Figure 4.2 Filter Mounting Details Part No. CO388965U110 for 590 70 & 110amp



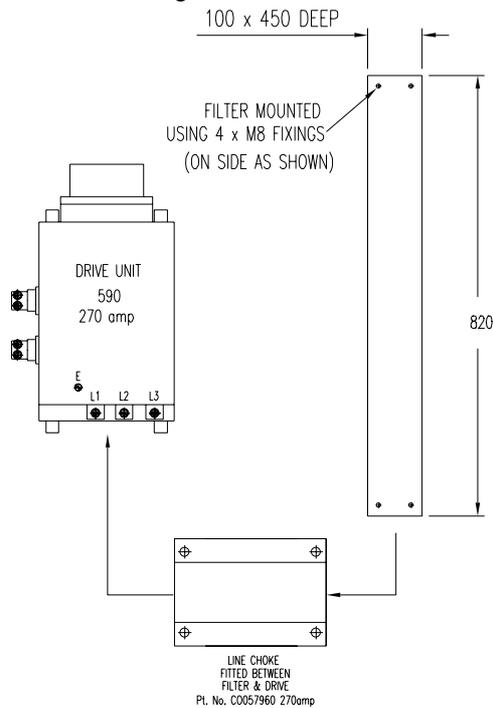
FILTER MOUNTING DETAILS  
Part No CO388965U110  
FOR 590 70 & 110amp

Figure 4.3 Filter Mounting Details Part No. CO388965U180 for 590 360 amp



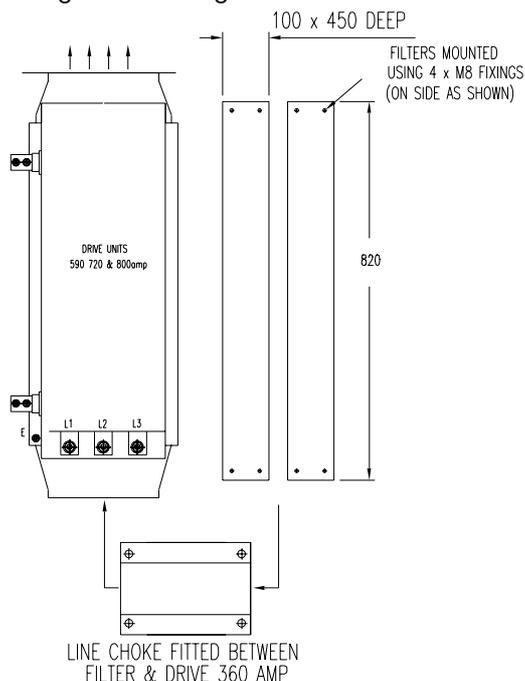
FILTER MOUNTING DETAILS  
Part No CO388965U180  
FOR 590 150 & 180amp

Figure 4.4 Filter Mounting Details Part No. CO389456 for 590 270 amp



FILTER MOUNTING DETAILS  
Part No CO389456  
FOR 590 270amp

Figure 4.5 Filter Mounting Details using 2x Part No. CO389456 for 590 360amp



FILTER MOUNTING DETAILS USING 2 x Part No. CO389456 for 590 360 AMP

These filters and chokes may be mounted to the left, right, above, below or spaced behind the product, but can be mounted in two orientations i) flat against the wall or ii) projecting out from the wall, mounting arrangements are shown in figures 4.1 - 4.5. When filters CO389456 are mounted in parallel, they should be spaced 40mm apart for ventilation.

The CO389456 filter flying leads may reach 100°C under normal operating conditions and should be separated by at least one cable diameter and be adequately ventilated. Never bunch the leads together.

**Note: For 590 drives the specified EMC line choke in table A or B must still be used between the 590 and its filter. This is to ensure reliability of both the filter and the drive.**

The EMC filter and line choke should be mounted as close to the 590 drive module as possible. The connection between the 590, choke and filter must always be as short as possible taking care not to obstruct any ventilation spacing and be segregated from all other cables. If this cable/busbar exceeds 0.6m in length then it must be replaced with a screened/armoured cable, with the screen/armour earthed at both the filter, choke and inverter ends with large-area contact surfaces, preferably with metal cable glands. The routing of the cables/busbars between the filter, choke and drive module should be chosen to ensure their close proximity. Failure to achieve this will result in **increased conducted emissions**. The connection between the 590 drive module and the motor must be installed away from all other cables or wires. Ideally the filter and choke will be mounted onto the same metallic panel as the drive. The RF connection between the drive, filter and panel should be enhanced as follows:-

- Remove any paint/insulation between the mounting points of the EMC filter, choke and 590 drive module and panel.
- Liberally apply petroleum jelly over the mounting points and securing threads to prevent corrosion. alternatively conducting paint could be used on mounting panels.
- If the proceeding is not possible, then the RF earth bond between the filter and 590 drive module is usefully improved by making an additional RF earth connection using wire braid of at least 10 mm<sup>2</sup> cross sectional area (due to skin effect).

**NOTE:** Metal surfaces such as eloxized or yellow chromed e.g. with cable mounting or 35 mm DIN rails, screws and bolts have a high RF impedance which can be very detrimental for EMC performance.

A low RF impedance path must be provided between the motor frame and back panel on which the drive, choke and EMC filters are mounted. This low impedance RF path should follow the path of the motor cables in order to minimise the loop area. **Failure to do so will result in increased conducted emissions.**

This will normally be achieved by:-

1. Bonding the armour of the motor supply cables at one end to the motor frame and at the other to the cubicle back panel. Ideally 360° bonding is required, which can be achieved with cable glands.
2. Ensuring that conduit containing the motor supply cables are bonded together using braid. The conduit shall also be bonded to the motor frame and the cubicle back panel.

Care should be taken to ensure that the protective earth (PE) conductor exiting from the filter is connected to the protective earth connection of the choke and 590 drive module. Any additional RF earth such as a cable screen **is not a protective earth**. The EMC filter must be **permanently earthed** to prevent the risk of electric shock under abnormal operating instances (such as the loss of one phase of the AC supply). Permanent earthing can be achieved by either:

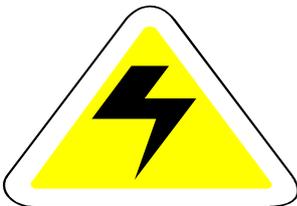
- Using a copper protective earth conductor of at least 10 mm<sup>2</sup> or
- Installing a second conductor in parallel connection with the protective conductor to a separate protective earth terminal.

Each conductor shall on its own meet the requirements for a protective earth conductor. On all recommended EMC filters two protective earth connections are provided for permanent earthing.

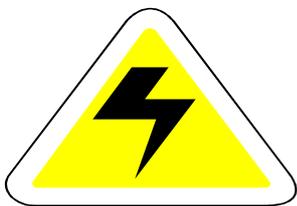
The recommended EMC filters are designed to operate from normal three-phases supplies which are balanced with respect to earth (earth referenced supplies). This minimises the earth leakage current due to the filter capacitors between phase and earth. On some specific customer sites the supply may not be balanced with respect to earth (non-earth referenced supplies). The earth leakage currents would increase and interfere with the operation of any earth-fault monitoring equipment. In addition the EMC performance of the filter will be degraded. Eurotherm Drives do not recommend the use of AC supply filters on non earth-referenced supplies.

**As with all power electronic drives the conducted emissions increase with motor cable length. EMC conformance to the stringent limits is only guaranteed up to a cable length of 50. This length can be increased. Refer to Eurotherm Drives for more information.**

If **one EMC filter** is to be used in an enclosure, then this filter should be mounted as close to the incoming AC supply to the enclosure as possible.



The CO389451 filter flying leads may reach 100°C under normal operating conditions. Leads should be separated to at least one cable diameter and adequately ventilated. **Never bunch leads together.**



### **IMPORTANT WARNINGS !**

The recommended EMC filters are designed to work with supplies which are balanced with respect to earth (i.e. earthed referenced supplies). On some specific customer sites the supply may not be balanced with respect to earth. The recommended standard EMC filters are not recommended be used on such supplies. Refer to Eurotherm Drives for more information.

The EMC filters contain capacitors phase-to-phase and phase-to-earth. Discharge resistors are fitted, but the filters, terminals and wiring must not be touched for a period of 5 minutes after the removal of the AC supply. **Not adhering to this warning can result in electric shock.**

The EMC filter must only be used with a **permanent earth** connection using one of the following alternatives:

- a) Using a copper protective earth conductor of at least 10 mm<sup>2</sup> or
- b) Installing a second conductor in parallel with the protective conductor to a separate protective earth terminal on the filter or inverter. The conductor on its own shall meet the requirements for a protective earth conductor. Refer to the following section regarding safety considerations with earth-fault detection systems.

## **INTERACTION WITH EARTH-FAULT MONITORING SYSTEMS AND SAFETY CONSIDERATIONS**

Due to the EMC filter internal capacitors between phase and earth, on initial connection of the AC supply a pulse of current will flow in the earth. This has been minimised in the recommended EMC filters, but may still trip out any RCD (Residual Current Detector) in the earth system. In addition high frequency and DC components of earth leakage currents will flow under normal operating conditions. Under certain fault conditions, larger DC protective earth currents may flow. The protective function of some RCDs cannot be guaranteed under such operating conditions. Eurotherm Drives do not recommend the use of RCDs, but where their use is mandatory, they should be capable of correct operation with DC and AC protective earth currents (such as type B RCDs as in amendment 2 of IEC755) and have adjustable trip amplitude and time characteristics, to prevent nuisance tripping on initial power connection. RCDs used with 590 drive modules and other similar equipment are **not suitable for personnel protection**. Another means of providing personal safety must be provided for, see EN50178/VDE0160.

## **MINIMISING RADIATED EMISSIONS**

All 590 drive modules can be made to comply with the most stringent radiated emission limits of EN55011 (1991) Class B by simply mounting inside an enclosure with 10 dB attenuation between 30 and 100 MHz (which would typically be the attenuation provided by a metal cabinet with no aperture greater than 0.15m) and screening any control and signal cabling outside of the enclosure. The control and signal cables should be terminated at the entrance to the enclosure. Outside of the enclosure all cables must be screened. Inside the enclosure the radiated magnetic and electric fields will be high, due to proximity, and any components fitted inside the enclosure must be sufficiently immune. Remember that the EN55011 radiated emission measurements are made between 30 MHz and 1 GHz in the far field, at a distance of between 10m and 30 m. No limits are specified lower than 30 MHz, or in close proximity. Emissions from individual components tend to be additive.

The cable between the enclosure and the motor must be screened or armoured (both field and armature) and should also contain the motor protective earth connection. The screen/armour must be earthed at both ends by connecting it to both the motor frame and the entrance to the cubicle, ideally in 360° termination's via cable glands (to meet the most stringent emission requirements). Screen to earth connections via 360° bonding is 75% more effective than earthing via pigtailed (Note some motor gland boxes and conduit glands are made of plastic, if this is the case then braid must be connected between the screen and the chassis, in addition at the motor end ensure that the screen is electrically connected to the motor frame since some terminal boxes are insulated from the frame by gasket/paint). Often the screens are terminated on a power screen rail at the entrance to the enclosure using 'u' clips to achieve a near 360° screen band. The integrity of the screen must be maintained over the entire length of the cable between the enclosure and motor. If the cable is broken to insert terminals, contactors, chokes, fuses etc., then the screen must be connected over the shortest possible distance. Note some hazardous area installations may preclude direct earthing at both ends of the screen, in this case earth the other end via a 1 µF, 50VAC capacitor. The motor protective earth should be connected to the drive module motor protective earth connection.

If a shielded cable is not available, lay unshielded motor cables in a metal conduit which will act as a shield. The conduit must be continuous with a direct electrical contact to the drive module and motor housing. If links are necessary, use braid with a minimum cross sectional area of 10 mm<sup>2</sup>.

### **Safety earthing always takes precedence over EMC earthing.**

The use of screened cable without an EMC filter is not recommended, as line-conducted interference will increase substantially and the capacitive coupling of the output cable to earth will result in high earth-leakage currents.

To ensure the correct operation of the 590 drive module, some control and signal cables (encoder, all analogue inputs and communications) have to be screened back to the drive terminals inside the enclosure. The screen integrity must be continuous right back to the drive if not connected to the cubicle. Always minimise the length of screen stripped back to make this connection. The screen should only be connected at the drive end. If high frequency noise is still a problem, earth at the non drive end via a 0.1 µF capacitor.

## **SCREENING AND EARTHING WHEN MOUNTED IN AN ENCLOSURE**

Make sure the requirements of EN60204 are adhered to with electrical equipment for machines. Satisfactory EMC performance is only achievable when the 590 drive module, filter, choke and associated equipment is mounted on a conducting metal mounting panel. Beware of constructions using insulating mounting panels or undefined mounting structures. A single point earthing strategy should be followed as closely as possible for a single drive module mounted in an enclosure as shown in figure 4-6. The protective earth connection (PE) to the motor must run inside the screened cable between the motor and 590 drive module, where it is to be connected near to the motor protective earth terminal on the drive module as shown in figure 4-6. (Note in accordance with EN60204 only one protective earth conductor is permitted at each earth terminal contacting point). Local wiring regulations may require the protective-earth connection of the motor to be connected locally but this will not cause shielding problems due to the relatively high RF impedance of the local earth connection.

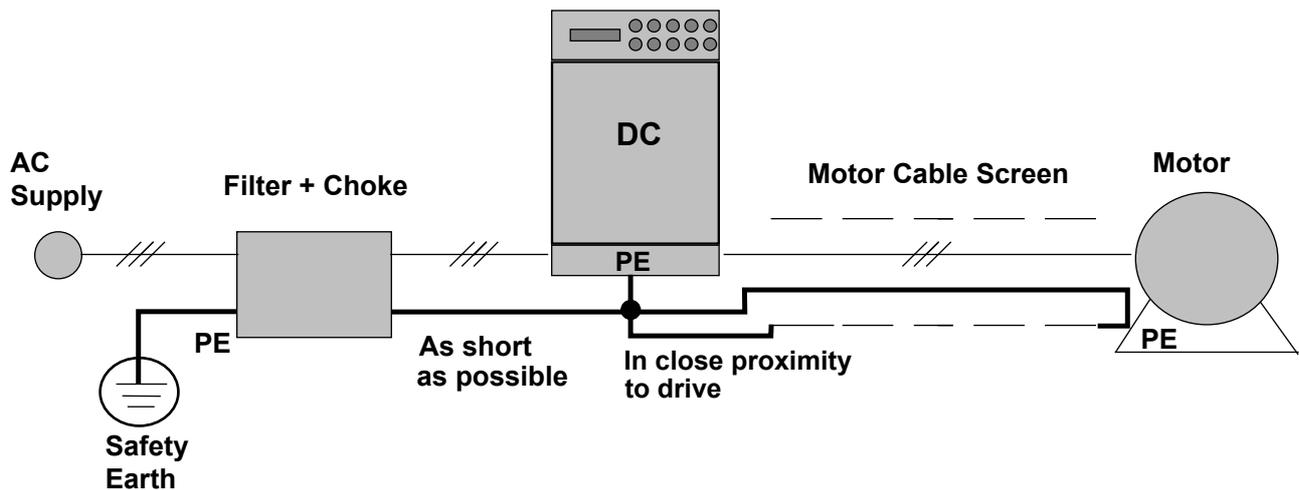


Fig. 4-6: Screening and earthing of a single 590 drive module.

When more than one piece of electrical equipment is fitted inside an enclosure, care must be taken to ensure that noise flowing in the earth connection does not couple into other equipment. A star-point earthing policy separating noisy from quiet earths is strongly recommended. Five separate earths branches should be provided for:

- ◆ Clean earth busbar      The Clean earth busbar is used as a reference point for all signal and control cabling. This may be further subdivided into an analogue and a digital reference busbar, each separately connected to the star earthing point. The digital reference is also used for any 24V control.
- ◆ Dirty earth busbar      The dirty earth busbar is used for all power earths (i.e. protective earth connections)
- ◆ Enclosure metalwork busbar      The enclosure metalwork busbar is used for all parts of the cubicle including panels, doors and back plate. It is also used as a reference for any 110 or 220V control used and for the control transformer screen.
- ◆ Power screen busbar      The power screen busbar is only for power screened cables which **do not** have to go directly to the 590 drive module (such as motor cables, braking choppers and their resistors) or to other drive modules (refer to appropriate Product Manual to identify these). Noise coupled onto the incoming screens must flow to earth directly so as not to contaminate the rest of the cubicle. Hence the power screen busbar should be placed as close to the point of cable entry as possible.
- ◆ Signal/control screen busbar      The signal/control screen busbar is to be used for signal/control screened cables which do not have to go directly to the 590 drive module. This busbar should also be placed as close as to the point of cable entry as possible.

For optimum EMC performance, copper rails with a substantial cross-section should be used for the busbar. Screened cables are best 'u' clamped to the busbars to ensure an optimum HF connection.

The five separate earth busbars should be insulated from the mounting panel and connected to a single earth point (star point) near the PE or PEN terminal of the main supply. Flexible large cross-section cable to ensure a low HF impedance should be used. The arrangement of the busbars should be such that the connection to the single earth point are as short as possible. Fig. 4-7 shows an implementation of a star-point earthing policy.

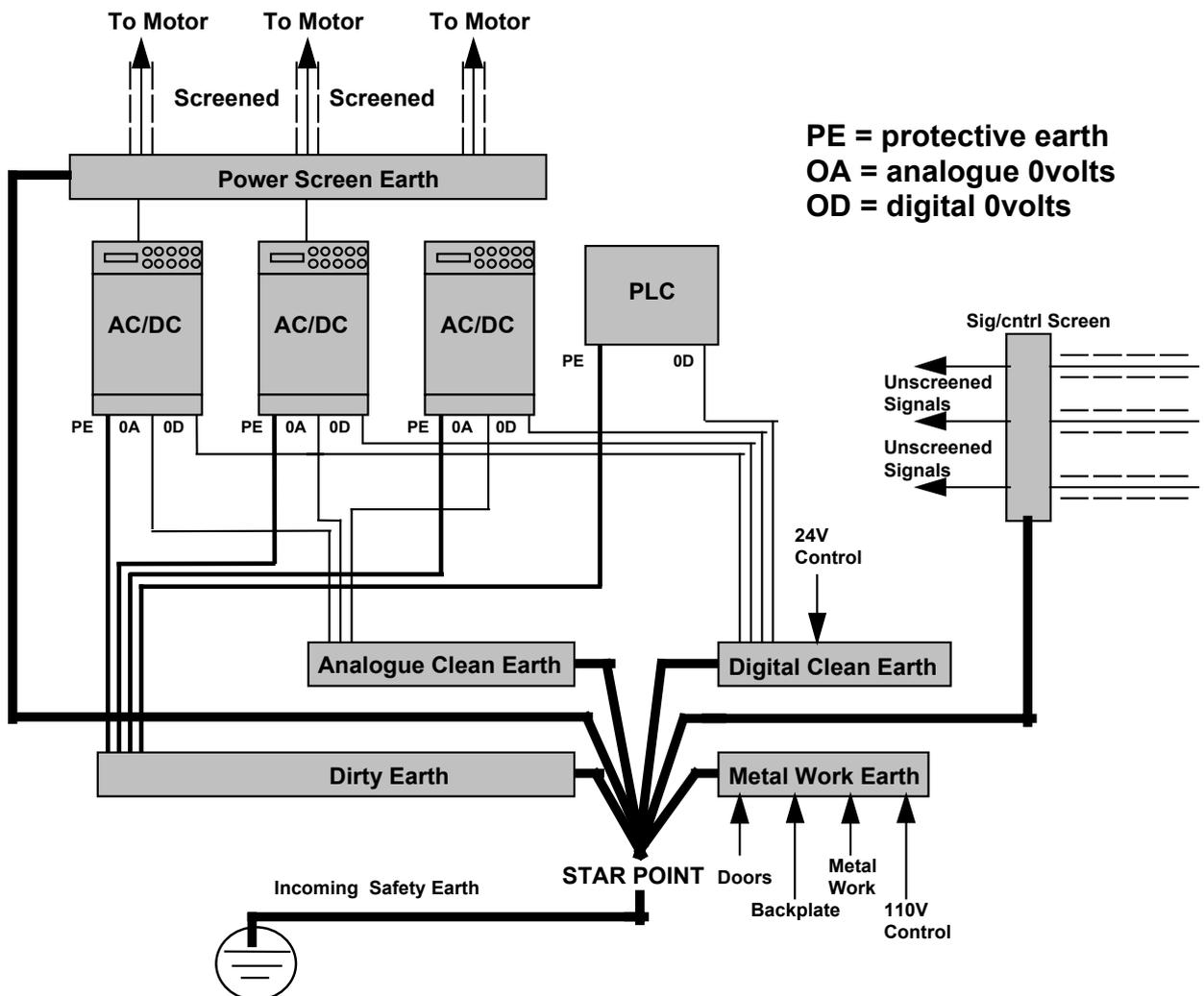


Fig. 4-7: Implementation of star-point earthing policy for multi-drive installation

#### OTHER LAYOUT CONSIDERATIONS

The proximity between the source and victim circuit has a large effect on radiated coupling. The electromagnetic fields produced by drive modules falls off rapidly with distance from the cabling/enclosure. It should be remembered that the radiated fields from EMC compliant drive systems are measured at least 10m from the equipment over the frequency band 30 to 1000 MHz (as required by EN55011, referenced by the generics and the drive product specific standard). Any equipment placed closer to the drive system than this will see larger magnitude fields, particularly very close to the drive. No magnetic/electric field sensitive equipment should be placed within 0.25m of the following parts of a drive system:

- 590 Drive module
- EMC output filters
- Input or output chokes/transformers
- Cable between 590 Frequency Inverter and Motor (even when screened/armoured)
- Connections to external braking chopper and resistor (even when screened/armoured)
- AC/DC brushed motors (due to commutation)
- DC link connections (even when screened/armoured)
- Relays and contactors (even if they are suppressed)

Often the coupling between electrically 'noisy' and 'sensitive' cables is a problem. This can be minimised by separating parallel runs by at least 0.25m, and minimising the length of parallel runs. For long parallel runs (>10 m) the separation should be increased proportionally. For example if the parallel runs were 50 m then the separation would be  $(50/10) \times 0.25$  m = 1.25 m.

In addition the coupling between two cables which must cross is minimised if they cross over at 90°. Hence sensitive cables should cross the cables to the motor, DC link and braking chopper circuit at 90°, and should never be run close to them or in parallel for any great length.

Never run supply, DC link or motor cables in the same bundle as the signal/control and feedback cables, even if they are screened.

From experience the following equipment is defined as particularly sensitive and care must be taken in the installation:

- Any transducers which produce low level analogue outputs (<1 volt) e.g. load cells, strain gauges, thermocouples, piezoelectric transducers, anometers, LVDT's
- A.M. radios (long and medium wave only)
- Video cameras and closed circuit TV
- Office personal computers
- Capacitive devices such as proximity sensors and level transducers
- Mains borne communication systems
- Equipment not suitable for operation in the intended EMC environment i.e. with insufficient immunity to new EMC standards

## 5. TERMINAL DESCRIPTIONS

### 5.1 CONTROL BOARD TERMINAL DESCRIPTIONS

\* These Terminals should be left open-circuit if not used.

1. AC TACH INPUT
2. AC TACH INPUT

These terminals provide input for AC tach speed measurement, rectification and filtering are provided. Selection of AC tach feedback is made via switch 1 selection. The maximum value of AC tach voltage at full speed must not exceed 200V peak.

Refer to calibration section - for maximum speed adjustment.

3. DC TACH INPUT (Alternative input on terminal 17)

These terminals provide input for DC tach speed measurement.

Selection of DC tach feedback is made via switch 1 selection.

For forward motor rotation corresponding to a positive Total Setpoint signal, the Tach feedback voltage at terminal 3 (or 17) must be positive with respect to 0V. Tach feedback voltages up to 200V should be applied direct to terminal 3 (or 17) If the full speed Tach feedback exceeds 200V, an additional calibration resistor must be added, external to the controller.

Refer to calibration section - for maximum speed adjustment.

4. 0V  
Zero Volt reference.

5. ARMATURE CURRENT COMPENSATION OUTPUT

This output is a Buffered Bipolar Armature Current Feedback Signal of  $\pm 1.11V = \pm 100\%$  Full Load Current.

In Armature Voltage Feedback applications, up to 11% IaRa Compensation can be derived from this Output, adjustable by an external control potentiometer. The control should be a 10K Ohm potentiometer, connected between Terminals 5 and 4 with its wiper connected to Terminal 9 or 10.

6. SETPOINT RAMP RESET\*

Connect to 0V to reset the Setpoint Ramp Output to zero volts, otherwise leave open circuit. The reset is instantaneous and independent of the setting of preset potentiometers P1 and P2.

Note: Option switch, S8/6 allows the setpoint ramp generator reset to be disconnected from the drive internal reset.

7. SETPOINT RAMP INPUT\*

Speed reference input to the Setpoint Ramp circuit. Maximum input =  $\pm 10V$  with respect to 0V, input impedance = 200K Ohms. See also Inverted Subtotal, terminal 11 and Total setpoint terminal 13.

8. SETPOINT RAMP OUTPUT

Under steady-state conditions this output voltage will equal the input voltage on Terminal 7. However, when the input voltage is changed, the output will follow at a constant rate dependant upon the settings of presets P1 and P2. These are the Positive Rate and Negative Rate potentiometers, sometimes referred to as Up Rate and Down Rate respectively. They are adjustable over the range 0.25 to 7.5 seconds when Option Switch S8/4 is ON and 5 to 75 seconds when S8/4 is OFF. Note that "Positive" and "Negative" do not refer to the actual polarity of the Setpoint Ramp Output but to the direction in which it is changing. For example if the Setpoint Ramp Input is more positive than it's Output then the rate of change will depend on the setting of the Positive Rate Control. Conversely, if the Input is more negative than the Output, the rate will depend on the setting of the Negative Rate control.

When Option Switch S8/3 is ON the Setpoint Ramp Output is summed internally with any inputs appearing at Terminals 9,10 and 12. When S8/3 is OFF the Output is internally isolated from the other inputs but may be connected externally to 9,10 or 12 if required.

The Ramp Output is reset to zero if Terminal 6 is connected to 0V or if the Run/Inhibit signal is in the Inhibit state (LED 5 not lit). See also Inverted Subtotal, terminal 11 and terminal 13 Total Setpoint.

9. INPUT NO. 1\*  
Speed Reference input. Maximum input = +/-10V with respect to 0V, input impedance = 20K Ohms.  
See also Inverted Subtotal, terminal 11 and Total Setpoint terminal 13
10. INPUT NO. 2\*  
Speed Reference input. Maximum input = +/-10V with respect to 0V, input impedance = 20K Ohms.  
See also Inverted Subtotal, terminal 11, and Total Setpoint, terminal 13.
11. INVERTED SUBTOTAL OUTPUT  
Equal to the inverted Algebraic sum of Input No. 1, Input No. 2 and the Setpoint Ramp Output provided that Option Switch S8/3 is ON, otherwise equal only to the inverted algebraic sum of Inputs No. 1 and Input No. 2. See also Total Setpoint, terminal 13 .
12. INPUT NO. 3\*  
Inverted Speed reference input. Maximum input = +/-10V, input impedance = 20K Ohms. This input is of the opposite sense to Inputs No. 1, No. 2 and the Setpoint Ramp Input i.e. if maximum forward speed is required, it can be achieved by applying +10V, to Input No. 1 (or Input No. 2 or the Setpoint Ramp Input) or by applying -10V to Input No. 3. See also Total Setpoint, terminal 13.
13. TOTAL SETPOINT OUTPUT  
This buffered output is the inverted sum of the Inverted Subtotal Output and Input No. 3. Thus it is equal to Input No. 1, plus Input No. 2, plus the Setpoint Ramp Input (if applicable - see 6 and 8), minus input No. 3. The maximum output is limited to approximately +/-11V. In 591A and 599A controllers a Total Setpoint signal of +10V represents a demand for full speed. In the 590A and 598A regenerative controllers +10V demands full forward speed and -10V demands full reverse speed.
14. +10V PRECISION REFERENCE  
Setpoint reference supply. This supply is short-circuit proof, but for normal operation the load on Terminal 14 plus Terminal 24 should not exceed a total of 5mA.
15. -10V PRECISION REFERENCE  
Setpoint reference supply. This supply is short-circuit proof, but for normal operation the load current should not exceed 5mA. This supply is not normally used in the case of non-regenerative controllers (types 591A and 5994).
16. 0V Zero voltage reference.
17. TACH INPUT - Refer to Terminal 3
18. CURRENT DEMAND ISOLATE\*  
Connect terminal 18 to 0V to cause disconnection of the current demand signal from the input of the current loop. This facility may be required in some Torque Control or special applications where the Current Demand signal is input to the Current Loop via Terminal 20 (See 20 and 21). For Speed Control applications this Terminal is normally left open circuit.
19. CURRENT DEMAND OUTPUT\*  
This Current Demand signal is the output from the speed loop integrator. It is connected directly to the input of the Current Loop except when Current Demand Isolate is at 0V (See Terminal 18 description).  
In Speed Control applications the voltage at terminal 19 depends upon the motor speed and load conditions. Zero volts represents a demand for zero Armature current while +10V and -10V represent a demand for +200% and -200% of Full Load Current respectively.  
In the case of 591A and 599A Controllers the Current Demand signal must be positive for Armature current to flow. The maximum level of this signal is later modified by the Current Limit circuit (according to the input voltages of terminals 22,23 and 25) before comparison with the Current Feedback signal.
20. AUXILIARY CURRENT INPUT\*  
This Terminal allows direct access to the input of the Current Loop and is used for some Torque Control and special applications. An input at this Terminal will be connected to the input of the Current Loop if Terminal 21 is connected to 0V. Connect Terminal 18 to 0V to prevent addition of the current Demand signal to the Auxiliary Current Input Signal. An Auxiliary Current Input of 0V represents a demand for zero Armature current while +10V and -10V represent a demand for (+200%) and -200% of full Load Current respectively. In the case of 591A and 599A controllers the Auxiliary Current Input signal must be positive for Armature current

to flow. The maximum level of this signal is later modified by the Current Limit circuit (according to the input voltages at terminals 22,23 and 25) before comparison with the Current Feedback signal

21. SELECT AUXILIARY CURRENT INPUT\*

If this Terminal is connected to 0V any input at terminal 20 will be connected through to the input of the Current loop and will be added to the Current Demand Signal (see also Current Demand Isolate, Terminal 18). In Speed Control applications Terminal 21 is normally left open circuit.

22. AUXILIARY CURRENT LIMIT (+) POSITIVE \*

This input provides independent control of the positive Armature current limit, from zero up to the maximum allowed by the Main Current Limit setting (see terminal 23 description). If this facility is not required Terminal 22 should be left open circuit, in which case Auxiliary Current Limit (+) is disabled by an internal pull-up resistor and control reverts to the Main Current Limit.

The control voltage range at Terminal 22 is 0 to +10V = 0 to +200% Full Load Current. The input impedance is approximately 25K Ohms. Because of the internal pull-up resistor adjustment of the terminal voltage can be made by an external resistor connected between 22 and 0V. Alternative methods of control are a potentiometer (ends connected to 24 and 0V, wiper to 22) or an analog voltage in the range 0 to +10V. Negative voltage MUST NOT normally be applied to this input.

23. MAIN CURRENT LIMIT

The Main Current Limit provides symmetrical control of both positive and negative Armature current limits. If different positive and negative current limits are required see 22 and 25 when external control of the Main Current Limit is not required 23 should be connected to +10V (Terminal 24). The input voltage at Terminal 23 supplies the Main Current Limit preset potentiometer P7, thus the actual current limit value depends upon the voltage at 23 and the setting of P7. Assuming that P7 is set fully clockwise, the control voltage range at Terminal 23 is 0 to +10V = 0 to +/-200% Full Load Current (0 to +200% Full Load Current in the case of 591A and 599A controllers). A negative input voltage MUST NEVER be applied to this Terminal.

24. +10V PRECISION REFERENCE

Setpoint reference supply. This supply is short-circuit proof but for normal operation the load on Terminal 14 plus Terminal 24 should not exceed a total of 5mA.

25. AUXILIARY CURRENT LIMIT (-) NEGATIVE \*

This input provides independent control of the negative Armature current limit, from zero up to the maximum allowed by the Main Current Limit setting (see terminal 23 description). If this facility is not required (and in all 591A and 599A applications) Terminal 25 should be left open circuit, in which case the Auxiliary Current Limit (-) is disabled by an internal pull-up resistor and control reverts to the Main Current Limit.

The control voltage range at Terminal 25 is 0 to -10V = 0 to -200% Full Load Current. The input impedance is approximately 25K Ohms. Because of the internal pull-up resistor adjustment of the Terminal voltage can be made by an external resistor connected between terminal 25 and 0v. Alternative methods of control are a potentiometer (ends connected to 15 and 0V, wiper to 25) or an analog voltage in the range 0 to -10V. Positive voltages MUST NOT normally be applied to this input.

26. BUFFERED TACH OUTPUT

This output has the same polarity as the Tach input voltage on Terminal ( 1&2 for AC Tachs, or 3, or 17, for DC Tachs) but is attenuated so that 0 to +/-100% Full Speed is represented by an output of 0 to +/-10V. The output is short-circuit proof and may be used to supply speed indicator or speed sensing circuits up to a maximum load current of 5mA.

27. BUFFERED CURRENT OUTPUT

This output is short-circuit proof and may be used to supply Armature current Indicators or sensing circuits up to a maximum load current of 5mA. Modulus or Bipolar outputs are available depending upon the setting of Option Switch S8/1. For centre-zero indicators S8/1 should be ON (UP) so that the output is Bipolar i.e. positive and negative Armature currents are represented by positive and negative outputs at Terminal 27.

For end-zero indicators S8/1 should be OFF (DOWN) so that the output represents the Modulus of the Armature current i.e. both positive and negative Armature currents are represented by a positive output at terminal 27. In either case an output of 10V represents an Armature current of 200% Full Load, 5V represents 100% Full Load Current etc. In 591A and 599A applications the setting of S8/1 is immaterial since these units only produce positive Armature current.

28. OV  
Zero Volt reference

29. THERMISTOR/MICROTHERM

Motor overtemperature sensors should be connected between Terminals 28 and 29. The drive will be disabled if the external resistance between 28 and 29 exceeds 1.8K Ohms +/-200 Ohms (see 35 and 37 Terminal descriptions). **THE DRIVE MAY RESTART AUTOMATICALLY WHEN THE RESISTANCE (I.E. MOTOR TEMPERATURE) FALLS** - see Terminal 30 description. Suitable temperature sensors are thermostatic switches (e.g. microtherms) or a pair of series connected P.T.C. thermistors. If over temperature sensors are not used Terminals 28 and 29 must be linked.

30. AUXILIARY ENABLE

This input is normally connected to Terminal 31. If required, external normally-closed interlock contacts may be inserted between Terminals 30 and 31.

The drive will be disabled when the input to 30 is open circuit or if the input voltage is less than approximately +10V (see 35 and 37 Terminal descriptions) and enabled at +24V.

NOTE:

The Thermistor/microtherm and Field failure alarms normally disable the drive only while a fault exist; if the fault clears, because the motor cools down for example, the motor will restart automatically. However, these alarms can be made to latch the drive in the disabled state indefinitely by connecting 30 to 37 (any external interlock contacts connected in the 30 to 31 link will also be latched in this manner). In this mode a Thermistor/microtherm, Field failure or external interlock alarm condition can only be cleared, and the motor restarted, by operating the start/stop controls. Also see option switch S8/5

31. START SUPPLY

This terminal is normally connected to Terminals 30 and 32 and to the Start/Stop control circuit.

In systems employing separate momentary contact Start and Stop switches, 31 should be connected to the normally closed Stop contact. If a single maintained contact Start/Stop switch is used it should be connected between Terminals 31 and 34. The Start supply is present whenever the Auxiliary Supply is on (see D7 and D8 terminal descriptions).

32. ENABLE

Normally connected to Terminal 31, the drive will be disabled when this input is open circuit or when the input voltage is less than approximately +10V, and enabled at +24V.

33. STOP

In systems employing separate Start and Stop controls this Terminal is wired to the common interconnection point of the two switches. If a single maintained contact switch is used for Start/Stop control then no connections should be made to this Terminal. (See also 31 and 34 Terminal description).

34. START

When the Start Supply from Terminal 31 is applied to this Terminal via the Start control, the internal contactor control relay will be energised. This in turn will energise the (external) three phase supply contactor. If separate Start and Stop controls are used 34 should be connected to the normally open, momentary contact of the Start switch. When Stop/Start control is by a single maintained contact it should be connected between Terminals 31 and 34. See also Terminal 31 description.

35. READY OUTPUT

This is the output of a fault detector circuit which monitors 8 internal Alarm signals. Its output is approximately +24V volts at 50mA maximum and may be used to supply an external indicator or relay connected between Terminals 35 and 0V. The drive will run when this output is high (+24V) and the Enable input Terminal 32 is high (+24V).

The Ready Output will be high when all of the following condition are met:-

- 1) Single phase Auxiliary Supply present, fuse FS1 good and the Preset board correctly inserted.
- 2) Drive synchronised to supply frequency in the range 45 to 65 Hz.
- 3) Three phase supply present, fuses all good ( FS2, FS3 and FS4)
- 4) Field current present (or Field Failure override selected) and Stack Thermal Trip not open (force ventilated units only).
- 5) Start instruction issued, contactor control relay latched, three phase contactor closed.
- 6) Resistance between Terminals 0V and 29 (Thermistor/microtherm) less than approximately 1.8K Ohms +/-200 Ohms.

- 7) Auxiliary Enable input voltage (Terminal 30) +24V.
- 8) Armature current waveform normal.

36. ZERO SPEED RELAY DRIVE

This output is intended to supply a +24 volt (D.C.) relay at an output current not exceeding 50mA. The relay should be connected between Terminals 36 and 0V; it will be energised when the Speed Feedback signal is lower than the Standstill Threshold set by preset potentiometer P4 (P4 has a range of +/-0.5 to +/-4% of Full Speed).

37. HEALTH RELAY DRIVE

This output is intended to drive a 24 volt (D.C.) relay at an output current not exceeding 50mA. The relay should be connected between Terminals 37 and 0V; it will be energised when terminal 37 is high (+24V nominal) and de-energised when 37 is low (0V).

When the Auxiliary Supply is connected to the drive the relay will energise and will only be de-energised if the Ready Output (Terminal 35) is disabled while the Start Supply is present at Terminal 34.

This output can also be used to latch the Thermistor/microtherm, Field failure and external interlock alarms -( see Terminal 30 description.) by linking 30 to 37.

The Health output at terminal 37 depends upon the Stop/Start condition of the drive, as follows:

- i) When the drive is in the Start condition (Start Supply present at Terminal 34), the output at 37 depends upon the Ready Output at 35,
  - i.e. 37 will be high if 35 is high,
  - 37 will be low if 35 is low.
- ii) When the drive is in the Stop condition the output at Terminal 37 will always be high, even though the Ready Output is low.

38. +24V (NOMINAL)

This is a +24V unregulated D.C. supply which may be used to supply the Enable and Fault Reset (External) inputs (maximum output 6W or 250mA).

39. FAULT RESET (EXTERNAL)

If external Fault Reset control is required connect this Terminal to +24V (38) via a normally open momentary contact.

## 5.2 POWER BOARD TERMINAL DESCRIPTIONS

NOTE: Power board terminals are located on the power board behind the control board and are given the prefix 'D', so as to avoid confusion with control terminals.

D1 } EXTERNAL AC SUPPLY TO FIELD BRIDGE  
 D2 }

NOTE: The actual magnitude required will depend upon the motor field rating and the setting of the field option switches S9/1 - S9/4 and P11.

1. When using an external AC input, it is important to have the correct phase relationship on the terminals. The supply must be delivered from L1 (red) and L2 (yellow) phased directly or indirectly through a transformer:

**L1 MUST BE CONNECTED TO D1**  
**L2 MUST BE CONNECTED TO D2**

2. The voltage applied to the external AC terminals must not exceed **500V**.

D3 FIELD OUTPUT NEGATIVE  
 D4 FIELD OUTPUT POSITIVE

The DC output voltage at these terminals will depend upon the AC supply voltage and the field bridge regulator option switches S9/1 - S9/4 and P11.

D5 MAIN CONTACTOR COIL L

This terminal is the switched output from the contactor control relay and is derived from the auxiliary supply at terminal D8. The output is internally fused at 3A, hence contactor coils having a high pick-up current must be operated via a slave relay.

NOTE:- The contacts of the Contactor Control Relay are suppressed by a series connected resistor (680 ohms) and capacitor (22nF) to protect the relay contacts. Users should be aware that when the contactor Control relay is “De-energised”, a leakage current of approximately 2mA can be expected and this should be considered when interfacing to these terminals. Typically, there could be the energisation of very sensitive relays.

#### D6 MAIN CONTACTOR COIL N

This terminal is internally connected to the auxiliary supply neutral and provides a convenient connection point for the contactor coil neutral connection.

#### D7 AUXILIARY SUPPLY (NEUTRAL)

#### D8 AUXILIARY SUPPLY (LIVE)

These terminals are the auxiliary connections for the control power switch mode supply, contactor control relay supply and cooling fan supply (when force cooled). The voltage applied to these terminals is product code dependent (only for fan supply). The switch mode power supply is auto ranging from 110 - 240, 50/60 Hz.

### Additions to Technical Manual

#### Subject-External Supply Terminals D1 & D2

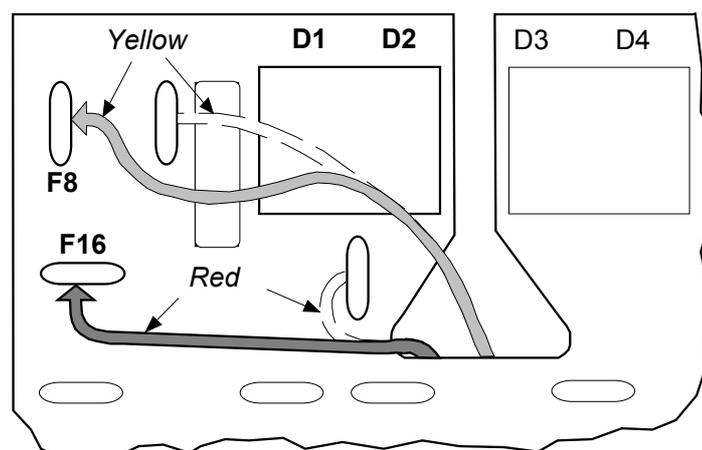
These terminals are used for the External AC Supply connection (for the Motor Field Supply) when the Internal AC Supply is unused. The following actions must be taken:

- 1) These terminals are now **energised** when “Internal Field Supply” option is used, and the 3 phase supply (L1/2/3) is energised. Protection is available via the on-board Field supply fuses FS2, FS3.
- 2) When utilising the “External AC Supply” connection, internal wiring links **must** be removed and connected to staging posts provided.

The internal wiring links (Red and Yellow) are identified by the following procedure (*refer to sheet 2*)

- a) Isolate the Drive
- b) Loosen control board fixing screws (2 off) and orientate control board to allow access to power board.
- c) Identify internal field supply link (colour-Red) where it is connected by “Faston” at the left hand side of Terminal D1. Remove this link from the faston connection and place on staging post “F8” located to the left. (*To enable positive identification of the correct link, Faston F8 should now be connected to FS2, and L1. Verify by continuity test*)
- d) Identify internal field supply link (colour-Yellow) where it is connected by “Faston” at the mid-point below terminals D1 & D2. Remove this link from the faston connection and place on staging post “F16” located to the left. (*To enable positive identification of the correct link, Faston F16 should now be connected to FS3, and L2. Verify by continuity test*)
- e) The External Field Supply can now be connected via externally mounted fast acting 20 Amp fuses. (*Note that the phase of D1 must be derived from L1, and the phase of D2 must be derived from L2*).

POWER BOARD AH385621



## 6. BLOCK DIAGRAM DESCRIPTION

### 6.1. POWER CONFIGURATION

Three phase power is supplied to the AC input terminals (L1, L2 and L3) of the drive via an external isolating contactor. The phase rotation (phasing) of the supply is unimportant. Three auxiliary fuses (FS2, FS3 and FS4 ) protect the internal power wiring and suppression networks.

The thyristor stack is fully suppressed to prevent damage caused by over voltage or supply borne transients.

#### FIELD SUPPLY

The DC supply for field excitation is available from terminals D3 (positive) and D4 (negative), and is adjustable to suit the application by using S9/4 and P11.

The field current is measured using a small AC current transformer to provide an isolated logic signal which falls to zero and inhibits the drive in the event of "field failure" (Diagnostic 7). The field failure condition can be overridden when required by the selection of option switch S9/5 .

#### AUXILIARY SUPPLY

The auxiliary single phase AC supply which power the drive electronics is connected to terminals D8 (line) and D7(neutral). The line supply is fused via a 3Amp control fuse (FS1), to the switch mode power supply (110V - 240V) and the contactor control relay within the drive, it also provides the fan supply in force ventilated units.

#### CONTACTOR CONTROL

The contactor control relay is operated from the isolated low voltage drive at terminal 31 via external Stop/Run pushbuttons., or maintained run contact. Its suppressed power contacts provides a switched version of the auxiliary line voltage on terminal D5 (line) and D6 (neutral) to energise the isolating contactor. The contactor control relay may be de-energised in the event of detecting abnormally high armature current in the motor and will hence remove the 3-phase supply from the drive. Drive Condition Indicator LED 4 will be extinguished and until the Fault Reset push button is operated (or the external reset from terminal 39) the isolating contactor cannot be re-energised. The switching capability of the internal relay is 3 Amps inductive up to 240V AC max. For contactors with higher voltage or current ratings, an external slave relay should be interposed between the internal relay and the three phase isolating contactor.

#### SYNCHRONISATION

Isolated synchronising signals to ensure the correct firing sequence of the six or twelve bridge thyristors are derived from the fused 3-phase supply lines via two high impedance differential amplifiers and an optically coupled isolator. The synchronising circuits are insensitive to variation of the following supply parameters.

- i) Phase Rotation
- ii) Supply voltage (over the range 220-500V +/-10%)
- iii) Supply frequency (over the range 50-60Hz +/-5%)

This caters for all world wide supply conditions.

If one or more of the supply lines is lost or if a fuse (FS2-FS4) ruptures the drive is held in inhibit, Indicator 3 will extinguish and no power will be delivered to the load.

### 6.2. THE CONTROL OPERATION

#### ISOLATION

The drive control circuits are fully isolated from the Auxiliary and 3-Phase Mains Supplies and this is indicated on the block diagram by the dotted isolation boundary on the right;

- i.e.
1. Armature current is sensed by the 2 line AC current transformers to provide an isolated and normalised signal of 1.1V = 100% Full Load.
  2. Synchronising signals are provided by two high impedance differential amplifiers and an opto-isolator.
  3. Thyristor gate pulses are independently isolated by 6 or 12 pulse transformers on the trigger board.
  4. Field current is sensed via an AC current transformer to provide an isolated field failure alarm signal.

5. An isolated speed feedback signal is provided by a tach or from the armature voltage using a 5590 Armature voltage isolation amplifier. It is then normalised to 10V = 100% Full Speed.

6. Isolated control power supplies are generated from the Auxiliary Supply by the switch mode supply transformer.

7. Control of the 3-phase contactor coil is isolated by allowing Start and Stop buttons to operate an internal slave relay driven from a low voltage (24 Volts nominal control signal).

#### POWER SUPPLIES

Stabilised internal supplies of +/-15 volts DC (Diagnostics 1 and 4 respectively) and +/-10 volts DC (reference quality) are generated from the single phase Auxiliary Supply via the switch mode transformer. The external +/-10V DC supplies (Diagnostics 2 and 3 respectively) are buffered within the drive. A smoothed unstabilised rail of 24 Volts Dc nominal, is available at terminal 38 for higher current requirements. These rails are protected against accidental short term overloads and fuse, FS1 (3A) on the Power Supply P.C.B. protects the wiring.

#### SPEED REFERENCE

4 Quadrant Operation: The speed signal is ten volts positive, to ten volts negative, corresponding to full speed forward and full speed reverse and is fed into terminal 7, Setpoint Ramp Input (Diagnostic 11). It can be generated by connecting a potentiometer (typical value 10K Ohms) from +10V (terminal 14) and -10V (terminal 15), or by feeding in +/-10 volts from an external source. Zero volts corresponds to zero speed.

2 Quadrant Operation: The speed signal is ten volts positive, to zero volts, corresponding to full speed forward and zero speed, and is fed into terminal 7, Setpoint Ramp Input (Diagnostic 11). It can be generated by connecting a potentiometer (typical value 10K Ohms) from a +10V (Terminal 14) and 0V (Terminal 4), or by feeding in +10 to 0 volts from an external source.

The setpoint is rate limited by a linear ramp generator which has independent adjustable Up (P1) and Down (P2) rates. The span on these rates is also adjustable using switch S8/4. The Setpoint Ramp Output is brought out to terminal 8 so that other drives may share it as a common setpoint. The Ramp Output is reset to zero when the drive is in an inhibit condition, it may also be reset externally by applying 0V to terminal 6, (when this function is not required terminal 6 is left open circuit).

Three alternative input channels are available which by-pass the ramp unit, these are labelled Setpoint No. 1, (terminal 9, Diagnostic 12), Setpoint No.2, (terminal 10, Diagnostic 13), and Setpoint No.3, (terminal 12, Diagnostic 14), they each have the same sensitivity as the main input channel.

The total sum of the input is available as Total Setpoint on a buffered output terminal 13(diagnostic 15).

The algebraic summation of all these input channels is:

Ramp input (7) + SP.No.1(9) + SP. No.2(10) -SP.No.3(12) = Total SP.(13)

An Inverted Subtotal is also available on terminal 11, which is the summation of two inputs:

SP.No.1(9) + SP.No.2(10) = Inverted Subtotal(11)

#### NOTE:

The Setpoint Ramp Output is only available internally if option switch S8/3 is closed, otherwise it is completely isolated from the rest of the drive.

It is recommended that all setpoint connections are made using screened leads. Unused inputs can be left open circuit.

#### SPEED FEEDBACK

Speed feedback can be provided by either an AC or DC tach, via the selection switch S1 and the appropriate terminals i.e.

AC Tach - Terminals 1 & 2

DC Tach - Terminal 3 (Positive)

Terminal 4 (Negative) 0V

Note: Terminal 17 is an alternative connection to Terminal 3.

When using an AC tach, internal rectification and filtering is provided. Additional filtering, if required is also provided by S8/8 (time constant 10ms).

The speed feedback is scaled within the drive using the calibration switches for coarse adjustment:

S2 - 0/100 Volts

S3 - 0/ 90 Volts

S4 - 0/ 9 Volts

This allows an adjustment calibration factor for full speed up to 199 Volts. P10 on the preset board will allow fine adjustment of the top speed.

If tach voltages exceed 200V then external resistors should be added.

The drive also contains protective circuitry such that in the event of loss of speed feedback (i.e. tach failure) the motor speed will not rise excessively. This action occurs when the speed feedback term is less than 0.5% to 4%, (adjustable using trimpot. P4 on the Preset Board) and limits the maximum output voltage of the drive. This condition still allows rated armature current to be produced at low speed and when the speed feedback term exceeds this level, (confirming tach operation) the limit is removed and normal control action is resumed.

Armature voltage feedback is available by using the armature voltage isolation unit 5590

#### ZERO SPEED SENSING

When the speed feedback signal is less than 0.5% to 4% (as set by P4) the Zero Speed Relay Driver is energised such that external terminal 36 sources +24V to drive an external relay.

#### SPEED ERROR

The combined setpoints are compared with the tach feedback signal on an error amplifier (Diagnostic 17) such that the Speed Signal is always made equal to the Total Setpoint. An offset trimpot P3 is available on the Preset Board to allow the offsets to be reduced to zero. It is not possible to achieve zero speed on demand of a zero speed setpoint without the motor shaft creeping round at a very low speed however accurately the offset is trimmed. However, if absolute zero speed is required, then operating Option Switch S8/2 will enable the Standstill Logic. This will operate when the Total Setpoint is below 0.5% and the motor speed is below 4% - 0.5% as set by trimpot P4. In this condition a quench action is employed and no firing pulses are applied to the thyristor bridge. If however the Total Setpoint or the speed feedback exceed the thresholds the Standstill Logic will be disabled, the quench action removed and firing pulses are again applied to the thyristor bridge, thus allowing armature current to flow.

The gain of the Error Amplifier is adjustable (by P5 on the Preset Board) over a 10 to 1 range to provide control of the stability and dynamic performance of the drive. This adjustment does not affect the steady state speed holding accuracy of the drive.

#### CURRENT DEMAND

The error signal is passed through a 2-Term (Proportional plus Integral) amplifier (Diagnostic 18) which ensures very high DC loop gain, thus achieving accurate steady state speed control and good dynamic performance by correctly optimising the low and high frequency gain of the system for small and large signals. The Integral time constant is adjustable over a 10 to 1 range using trimpot P6 on the Preset Board. The output of this 2-Term amplifier becomes the armature Current Demand signal under normal condition and is also available on external terminal 19. However it may be isolated from the following stages by a solid state switch when terminal 18 (Diagnostic 19) is connected to 0V, (otherwise this terminal is left open circuit). The auxiliary current input (terminal 20), diagnostic 20 can also provide the Current Demand signal or be algebraically added to the 2 Term output. via a solid state switch. If this facility is required terminal 21 (Diagnostic 21) must be connected to 0V, otherwise this terminal is left open circuit.

#### MAIN CURRENT LIMIT

The Armature Current Demand signal then controls the magnitude of armature current and hence clamping the maximum excursion of this signal limits the maximum armature current that can flow. The reference for the clamp is taken from trimpot P7 on the Preset Board. The top of this potentiometer is available externally at terminal 23 and is normally connected to terminal 24 (+10V), thus +10V as measured on the wiper of P7 (Diagnostic 24) corresponds to 200% armature current can be programmed according to some other control strategy.

For any current setting between 110% and 200% of full load, the actual current level is monitored by an overload integrating circuit. The output of this circuit pulls down the current limit setting progressively to 110% at a rate which is proportional to the overload magnitude,

i.e., An inverse time characteristic which typically allows 200% current for ten seconds after which the level is automatically reduced to 110% , on a time curve which would allow 150% for about 30 seconds, and so on.

Reduction of the overload produces resetting of the overload capability in the same way.

i.e. The lower the current level is taken below 100%, and the longer it spends below 100%, then the faster the reset for 200% capability.

#### AUXILIARY CURRENT LIMITS

Two auxiliary current limit clamps are also provided, one acting on the demand for positive current, the other acting on the demand for negative current (in 4 quadrant converters only). These clamps are programmed via external terminal 22, Auxiliary Current limit Positive (diagnostic 22) and 25, Auxiliary Current Limit Negative (Diagnostic 23). A positive reference value on 23, or a negative reference value on 25 will limit the armature current between these values from  $\pm 10V = 200\%$  to  $0V = 0\%$ . However the Main Current Limit reference from trimpot P7 will always override the auxiliary clamps, thus always maintaining safe values of armature current. If these auxiliary clamps are not required then external terminals 23 and 25 should be left open circuit.

#### CURRENT FEEDBACK

The three phase power lines are passed through two AC current transformers which are used to provide an isolated measure of armature current, which is then scaled by calibration switches:-

S5 0 - 700 Amps  
S6 0 - 90 Amps  
S7 0 - 9 Amps

The calibration switches should be set to a value as required by the motor nameplate. It is essential to ensure that the rating of the power stack is not exceeded during this calibration procedure and also that the switches are selected only when the drive is in a quench (or non operational condition).

The normalised current feedback signal (Diagnostic 26) is also available for an indicator display of armature current via a buffered output and is available on terminal 27, normalised to  $5V \equiv 100\%$  full load. For convenience of display, in 4 quadrant converters this signal may be bi-directional or unidirectional depending upon the condition of option switch S8/1.

#### CURRENT CONTROL LOOP

The final current demand (Diagnostic 25), after the Main and Auxiliary Current Limits, is compared with the armature current feedback signal in the current loop controller. The current loop controller has Proportional plus Integral action. Trimpot P8 controls the Proportion term and Trimpot P9 controls the Integral time constant. Refer to the setting up procedure to optimise P8 and P9 for the specific motor in use.

The output of the current loop controller, the phase angle single (Diagnostic 27), then controls the conduction angle of the thyristors and hence the DC output voltage of the stack

### 6.3. START AND STOP SEQUENCING

#### READY OUTPUT

To control the safe start up and shut down of the drive under normal and fault condition a single inhibit signal (Indicator 6) is generated by an eight input "AND" gate. When all eight inputs are present indicating that no fault condition exist, the Ready Output (Terminal 35) is switched to +24 volts. The Ready Output may be used to produce synchronous starting of multimotor drive systems.

## ALARM SIGNALS

The inputs to the eight input "AND" gate are:

1) PRESET BOARD: The Preset board is electrically interlocked. In the event of its removal or absence the drive is quenched and Indicator 1 is extinguished (Note: removal of the preset board whilst the drive is operating is not recommended).

2) 3-PHASE PRESENT: To ensure that all three phases of the incoming supply are present and of sufficient amplitude, a detection circuit utilising an optoisolator produces a logic level indication. This also detects the loss of any of the supply or suppression fuses FS2-FS4. Indicator 3 will extinguish if these requirements are not satisfied.

3) FIELD FAILURE: In the event of Field Failure (when the field current drops below 110mA) or if the field supply or fuses FS3 and 4 and are lost the output from the field detection circuit falls (Diagnostic 7) and the drive is quenched.

4) P.L.L. SYNCHRONISATION: To ensure that the 3-Phase supply to the drive lies in the range 45-65Hz. Indicator 2 illuminates when synchronisation is complete.

5) THERMISTOR/MICROTHERM: It is good practice to protect DC motors against sustained thermal overloads by fitting temperature sensitive resistors in the field and interpole windings of the machine. These devices have a low resistance (typically 200 Ohms) up to a reference temperature (125°C) and above this their resistance rapidly increases to about 2 Kiloohms. They should be wired in series and connected between 0 volts and the thermistor input (terminal 29). A sensing circuit within the drive detects the change in resistance and produces a high logic level (Diagnostic 6) provided the resistance is low. The signal drops if the motor temperature exceeds 125°C and thereby quenches the drive.

**NOTE:** This method of stopping the drive does not operate the three phase isolating contactor, it only phases back the firing pulses to give zero DC output to the armature. **THE DRIVE MAY RESTART AUTOMATICALLY WHEN THE MOTOR TEMPERATURE FALLS.** Never work on the drive, motor, or ancillary equipment without first isolating the main supply.

Note: see terminal description 30 and option switch S8/5 which can be used to prevent the drive operating again when the motor temperature has fallen.

7) AUXILIARY ENABLE: Terminal 30 on the drive is normally connected to +24 volts at Terminal 31 to enable the drive to run. Alternatively may be connected to +24 volts at Terminal 37 if latching of the Thermistor/microtherm, Field failure and external interlock alarms is required. Removing the signal from Terminal 30 will quench the drive.

**NOTE:** That this method of stopping and starting the drive does not operate the three phase isolating contactor, it only phases back the firing pulses to give zero DC output to the armature. It should only be used for short term stops and never used if an operator can work on the motor or ancillary equipment without tripping the contactor and locking off the supply isolator.

8) START INSTRUCTION: The Start/Stop instruction is applied through terminal 31 via the external Start/Stop wiring. During the stop sequence, it is essential that the motor armature current is reduced to zero before the 3-phase isolating contactor is opened. This is achieved in the drive at switch off by a time delay (of approximately 30ms) before the contactor control relay is de-energised.

The start supply is taken from terminal 34 which is normally +24 volts. If excessive armature current levels are detected (400% for 3ms) an instantaneous latching trip is operated. (refer to option switch S8/7) This trip can be arranged to de-energise the contactor, thus isolating the 3 phase supply. Reset of the overcurrent trip can only be achieved by removing the start instruction and operating the fault reset push button or by applying +24V to terminal 39 through a momentary closed contact.

Only when all eight alarms are present is the Ready Output (Terminal 35) switched to +24 volts.

## ENABLE

An external Enable (Terminal 32 ) is gated with the Ready Output to produce the final inhibit signal. The drive may therefore be held in a quench condition by removing the external Enable, although the 3-phase isolating contactor is still closed.

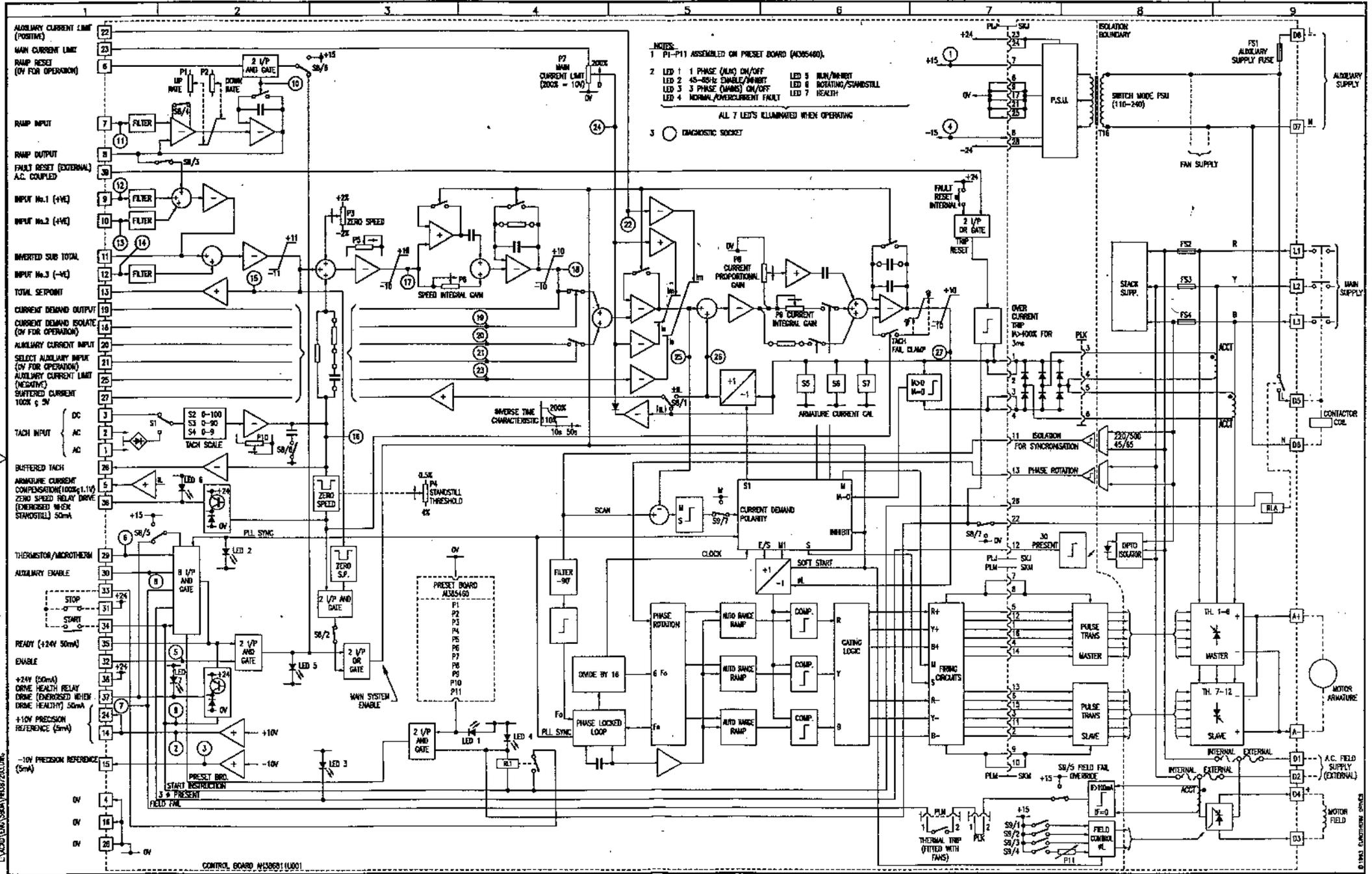
Terminal 32 must be externally connected to +24 volts before the final drive inhibit is removed and Indicator 6 is illuminated.

NOTE: That this method of stopping and starting the drive only phases back the firing pulses to give zero DC output to the armature. It should only be used for short term stops and never used if an operator can work on the motor or ancillary equipment without tripping the contactor and locking off the supply isolator.

## DRIVE HEALTH

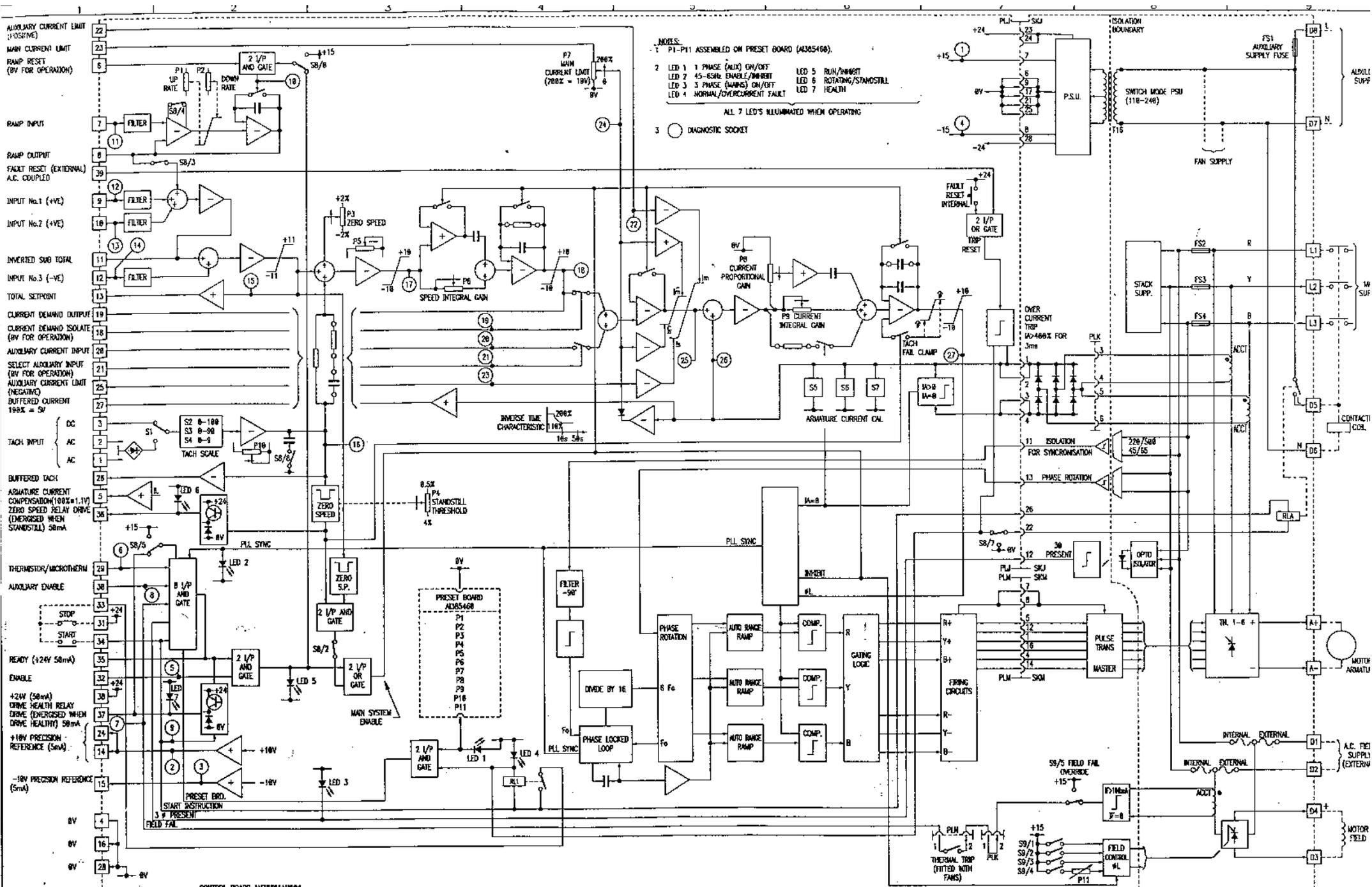
To enable rapid fault finding in multidrive systems each drive is provided with a Drive Health output (terminal 37). When the drive is healthy this output provides +24 volts to drive an externally connected relay and Indicator 7 is illuminated. If the drive becomes un-healthy (i.e. any alarm channel indicated a fault condition) Indicator 7 is extinguished and terminal 37 falls to 0 volts, after a short time delay.

The drive is always defined as healthy when no start instruction is applied to terminal 34 (i.e.37 will always be high under this condition). The drive will become un-healthy when a start instruction is applied and any one of the alarm channels indicates a fault condition (i.e. if 34 is high but 35 is low).



L3-ADD (REV. 5/94) HESTER/ELC

© 1993 EURO THERM DRIVE



DRAWN MDN	CHECKED DTS	DATE 15/06/93 19/08/93 29/03/94 18/07/94 17/05/95	ELECTRICAL SYMBOLS GENERALLY TO BS 3939  EURO THERM DRIVES Ltd.	TITLE  BLOCK DIAGRAM 591A/599A	USED ON  DRAWING NUMBER HH 387204 D	SHT. OF
--------------	----------------	--	---	---	--	------------

## 7.0 BASIC SETTING UP AND OPERATING INSTRUCTIONS

### 7.1 PRESET ADJUSTMENT DESCRIPTION

Check the preset potentiometer settings on the larger plug-in card which is accessible under the front cover. The potentiometers are normally factory set to positions which will provide adequate performance in most load/controller configurations. It is recommended that initially the presets are left in these positions and that fine tuning of the system is done, if necessary, at the end of the commissioning process.

The one exception to this is the main current limit preset; note the setting of this control and then turn it fully anticlockwise. The initial setting of the presets should thus be as follows:

<u>POT No.</u>	<u>DESCRIPTION</u>	<u>NORMAL INITIAL SETTING</u>
1	<u>Setpoint ramp up rate</u> Clockwise rotation gives more rapid acceleration.	Midway
2	<u>Setpoint ramp down rate</u> Clockwise rotation gives more rapid deceleration.	Midway
3	<u>Zero speed</u> It should not be necessary to adjust this initially on a new factory tested drive.	About midway
4	<u>Standstill threshold</u> Sets low speed drive quench level if the standstill logic switch S8/2 is set to the on position . Clockwise sets lower speed.	Midway
5	<u>Speed Proportional</u> Clockwise increases speed loop gain	20% Clockwise
6	<u>Speed Integral</u> Clockwise decreases speed loop integral time constant.	20% Clockwise
7	<u>Main Current Limit</u> Clockwise increases current limit up to max. 200% FLC* short-term overload.	Fully anti-clockwise (Zero current)
8	<u>Current Proportional</u> Clockwise increase current loop gain.	Midway
9	<u>Current Integral</u> Clockwise decreases current loop integral time constant.	Fully anti-clockwise
10	<u>Speed Calibration</u> Clockwise increases motor speed.	About midway
11	<u>Field</u> Field Voltage O/P clockwise increases output voltage (see S9/4)	Fully anti-clockwise

## 7.2 OPTION SWITCHES

There are two user selectable option switches S8 and S9, which are located under the lower flap of the control board. Selection should only be made when the controller is isolated.

### S8/1 BUFFERED CURRENT SIGNAL (terminal 27)

UP = ON = Armature current meter reads  $\pm$  Amps. For applications employing a centre-zero meter.

DOWN = OFF = Meter reads modulus. For applications employing a uni-directional meter.

DEFAULT:ON

NOTE: In 546 and 548 units the Armature Current Meter will always read + Amps, regardless of the setting of switch S1, since these convertors cannot produce negative output current.

### S8/2 STANDSTILL LOGIC

UP = ON = Standstill logic enabled. This will disable the drive whenever the Total Setpoint is zero and the speed is below the standstill threshold set by P4.

DOWN = OFF = Standstill logic inoperative.

DEFAULT:OFF

### S8/3 SETPOINT RAMP CONNECTION

UP = ON = Setpoint Ramp Output internally summed with Input No. 1 and Input No. 2.

DOWN = OFF = Setpoint Ramp Output internally disconnected from the summing amplifier (but still available at terminal 8).

DEFAULT:ON

### S8/4 SETPOINT RAMP RANGE

UP = ON = Setpoint ramp rate adjustable from 0.25 to 7.5 seconds.

DOWN = OFF = Setpoint ramp rate adjustable from 2.5 to 75 seconds.

DEFAULT:OFF

### S8/5 HEALTH LATCH ENABLE

UP = ON = Prevents drive restart when fault condition removed (eg, on over-current reset, or motor thermistor reset, drive will not automatically restart) To allow drive to restart, terminal 34 (start) must be taken low (eg, 0V).

DOWN = OFF = Drive restarts automatically on fault reset.

DEFAULT:ON

### S8/6 EXTERNAL RAMP RESET

UP = ON = Setpoint ramp reset by either drive quench or terminal 6 to 0V.

DOWN = OFF = Setpoint ramp reset only by terminal 6 to 0V (allows external use of setpoint ramp).

DEFAULT: ON

### S8/7 CONTACTOR DROP OUT ON OVER- CURRENT

UP = ON = Contactor does not drop out on over-current trip (this can prevent burning of contactor poles in certain configurations).

DOWN = OFF = Contactor drops out on over-current.

DEFAULT: OFF

### S8/8 TACH FILTER (10ms time constant)

UP = ON = Tach filter of 10ms time constant applied to the speed feedback to attempt to remove tach ripple.

Note that this option will have a destabilising effect on the speed loop stability and a reduction in speed loop gain P5, may be required.

DOWN = OFF = No tach filter.

DEFAULT: OFF

### S9/1 HALF WAVE FIELD SUPPLY

UP = ON = Half wave rectification field supply. Typically using 415V single phase supply the field voltage will be 180V DC nominal.\*

DOWN = OFF = No field supply from this option.

DEFAULT: OFF

**S9/2 FULL WAVE FIELD SUPPLY**

UP = ON = Full wave rectification field supply. Typically using 415V single phase supply the field voltage will be 360V DC nominal.\*  
 DOWN = OFF = No field supply from this option.  
 DEFAULT: ON

**S9/3 3 PHASE HALF WAVE FIELD SUPPLY**

ON = UP = 3 phase half wave field supply. Typically when operating from 3 phase 460/480V supply the field voltage will be 300V DC nominal.\*  
 DOWN = OFF = No field supply from this option  
 DEFAULT: OFF

**\* If more accurate field voltage setting is required, refer to option switch S9/4 and P11.**

**S9/4 ADJUSTABLE FIELD SUPPLY**

ON = UP = Adjustable field supply used in conjunction with P11. The adjustment range is typically from 10% to 100% of full wave rectification.  
 OFF = DOWN = No field supply form this option.  
 DEFAULT: OFF

**S9/5 FIELD FAILURE OVER-RIDE**

ON = UP = Field failure condition over-ridden, typically when operating with a permanent magnet motor, or a shunt machine with very low field current, the field failure alarm is made inactive.  
 DOWN = OFF = Field failure alarm active.  
 DEFAULT: OFF

**S9/6 RESERVED**

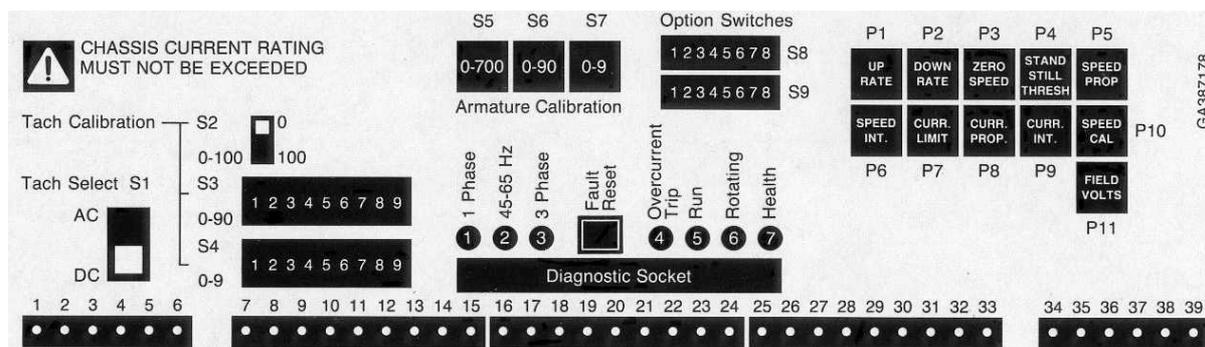
DEFAULT: OFF (Factory set)

**S9/7 2Q/4Q OPERATION**

ON = UP = 2 Quadrant operation only, for use with 591A and 599A products.  
 DOWN = OFF = 4 Quadrant operation only for use with 590A and 598A products.  
 DEFAULT: Factory set (NOTE: No malfunction will occur if S9/7 is left off on any product).

**S9/8 RESERVED**

DEFAULT: ON (Factory set)



### 7.3 CALIBRATION

**THE CONTROLLER IS NOT PRE-CALIBRATED TO ORDER DURING MANUFACTURING, HENCE IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THAT THE CORRECT CALIBRATION PROCEDURE HAS BEEN FOLLOWED.**

**NOTE: DO NOT ADJUST THE CALIBRATION SWITCHES WHEN THE DRIVE IS OPERATIONAL.**

#### 7.3.1 SPEED CALIBRATION

Select the source for tach feedback using switch S1 (refer to description for S1).

Adjust calibration switches:      S2      0 / 100 Volts  
   S3      0 - 90    Volts  
   S4      0 - 9     Volts

to obtain the tach feedback voltage at full speed.

Check motor name plate for maximum speed, do not exceed this value.

For full speed tach voltages greater than 200 Volts an external resistor, value RE, is required in series with the tach.

When the maximum value is selected (ie, 199) then RE is approximately given by the formula,

$$RE = \frac{\text{tach volts} - 200}{5} \quad \text{K ohms}$$

The power dissipation of this resistor is given by the formula

$$PE = 5 (\text{tach volts} - 200) \quad \text{mW.}$$

#### 7.3.2 ARMATURE CURRENT CALIBRATION

Before calibration, check the motor name plate for the value of rated current.

Ensure that the power chassis has the appropriate rating value.

Do not exceed the motor name plate value, or the chassis rated value.

Set the calibration switches to motor full load current minus 1 amp.

Use calibration switches:      S5      0 - 700 Amps  
   S6      0 - 90 Amps  
   S7      0 - 9    Amps

NOTE: Settings above 720 are invalid. 598A and 599A are calibrated by burden resistors in the chassis. Calibration in these circumstances is set by the combined value of the burden resistors and S5,S6, and S7 should be set to zero.

$$RB = \frac{2200}{\text{Full Load Current}} \quad \text{ohms}$$

NOTE: Full load current = 100% rating

and  $\frac{1}{RB} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$

Values are selected in the factory on the basis of the best combination of standard resistor values.

NOTE: The armature current calibration switches should not be changed to increase the current above the factory set value without consulting Eurotherm Drives Limited Engineering Department.

### 7.3.3 FIELD VOLTAGE CALIBRATION

Field voltage calibration is set by selection of the option switches S9/1/2/3/4 (see S9 description). When S9/4 is selected, the field voltage can be adjusted by preset P11. By using the selection of S9/4 and P11, the most accurate setting of field voltage can be achieved.

### 7.4 BEFORE ATTEMPTING TO CONNECT POWER

#### CAREFULLY CHECK

1. Auxiliary power supply voltage is correct.
2. Main power supply voltage is correct.
3. Armature voltage and current ratings.
4. Field option, voltage and current rating.
5. All external wiring circuits -
  - Power connections
  - Control connections
  - Motor connections
6. For damage to equipment or wiring.
7. For loose ends, clippings, drilling chips, etc, lodged in the drive or electrical equipment.
8. Inspect the motor, in particular the commutator for any extraneous matter. If an air line is available it is recommended to blow over the commutator.
9. Check that the brushes are properly seated and that the brush spring tensions are adequate. If possible check that the motor (and vent fan motor when fitted) can be turned freely by hand.

#### ENSURE:

1. That rotation of the machinery in either direction will not cause a hazard.
2. That nobody else is working in another part of the equipment that can be affected by powering up.
3. That other equipment will not be adversely affected by powering up.

### 7.5 PREPARATION

1. Prevent the Main 3-phase power supply and single phase auxiliary supply from becoming connected to the drive by removing the main external HRC fuses.
2. Disconnect the load from the motor shaft if possible.
3. If there is any doubt about the integrity of a particular installation, insert a high wattage resistor ie, fire elements, in series with the motor armature.
4. Check that the calibration has been satisfactorily implemented and is suitable for the DC machine to which it is connected. Refer to section 7.3.
5. Check the preset potentiometer settings on the larger plug-in card which is accessible under the front cover. The potentiometers are normally factory set to positions which will provide adequate performance in most load/controller configurations. It is recommended that initially the presets are left in these positions and that fine tuning of the system is done, if necessary at the end of the commissioning process.

Refer to Section 7.1

The one exception to this is the main current limit preset; note the setting of this control and then turn it fully anticlockwise. Refer to section 7.1.

6. Set option switches.

Refer to section 7.2

7. Plug a Diagnostic Test Unit type 5570 into the socket on the control printed circuit board, observing correct orientation of the connector (see Diagnostic Test Facility, section 8.3). This unit is not essential to the successful commissioning of a drive, but it very much simplifies the procedure and can save a considerable amount of time.

## 7.6 CHECKING THE DRIVE AND SETTING UP

1. When all the preceding steps are completed the auxiliary power supply can be connected to terminals D7 and D8 (but do not connect the Main 3-phase power supply at this stage). Immediately check that the correct voltage appears between D7 and D8.

2. Now check:

i) The drive condition indicators - these are seven LED lamps at the lower right-hand corner of the Main Control printed circuit board. LED No's 1, 4 and 7 should be on.

ii) Check the +24V (nominal) supply at terminal 38 (with respect to 0V) .

iii) If a Diagnostic Test Unit (5570) is available, check the  $\pm 15V$  supplies at switch positions 1 and 4.

iv) Check the +10V supply rail: Switch to diagnostic test point 2 or measure the voltage between terminals 14 (+10V) and (0V).

v) Check the -10V supply rail: Switch to diagnostic test point 3 or measure the voltage between terminals 15 (-10V) and (0V).

3. If a Diagnostic Test Unit is available, check that all other test point readings are as shown in Diagnostic Chart, SECTION 8.5.3

4. Check that a speed demand signal is available. This will normally appear as an input to the Setpoint Ramp on terminal 7 (diagnostic test point 11)

Additional setpoint inputs may also appear at:

Input No 1 (+), terminal 9 (Diag. 12)

Input No 2 (+), terminal 10 (Diag 13)

Input No 3 (-), terminal 11 (Diag 14)

NOTE: The sum of the setpoint voltages appears at terminal 13 (Diagnostic 15) as the Total Setpoint voltage.

5. If possible, check the polarity of the tach signal by rotating the motor shaft manually in the "forward" direction (ie, the direction which should correspond to a positive setpoint at terminal 7:

The voltage at terminal 3 (or 26) should go positive.(when using a dc tach)

The voltage at Diagnostic test point 16 should go negative.(when using a dc or ac tach)

6. Press the "Drive Start" pushbutton or otherwise initiate START:

The Main 3-phase contactor should pull in and latch via the control relay with the drive.

Press the "Drive Stop" pushbutton or otherwise initiate STOP:

The main contactor should drop out, de-energised. If not disconnect all power supplies and check the Stop/Start circuit and contactor wiring.

NOTE: The main contactor should **NEVER** be operated by any means other than the drive internal contactor control circuit as shown in the wiring diagram HJ387211D.

**WARNING: DO NOT PROCEED FURTHER UNLESS THE STOP/START CIRCUITS AND CONTACTOR OPERATE CORRECTLY.**

7. Turn off all power supplies to the equipment and when the whole system is totally isolated and safe, reconnect the Main 3-phase power supply.

8. Turn on Auxiliary single phase supply.

9. Turn on Main 3-phase supply.

10. Turn the Speed Setpoints to zero so that the Total Setpoint voltage is zero ,terminal 13, Diagnostic 15.

11. Check that the Main Current Limit preset (P7) is set to zero (fully anticlockwise).

12. Initiate "Drive Start" and immediately check that the correct field voltage appears between terminals D3 and D4. Note that this will be high voltage DC, so proceed with extreme caution. Do not continue if this is not correct, but switch off all supplies and recheck the Calibration and Option Switches. Check that the motor ventilation fan, if fitted, is rotating in the correct direction. Check the direction visually as the fan starts since a centrifugal fan may produce considerable air flow even when rotating in the wrong direction.

13. Check that all Drive Condition Indicators except LED 6 are lit. Refer to the Diagnostic section 8.4 for explanation of the LED functions. In particular note that any exterior interlocks in the Enable and Auxiliary Enable circuits will affect the conditions of LED's 5 and 7.

14. Check that the Standstill Logic is switched OFF (Option Switch S8/2).

NOTE:

a) During the following stages (15 and 16) be ready to stop the drive immediately should the motor try to overspeed.

b) Before altering any connections make sure that all Auxiliary and Main power supplies are totally isolated from the drive and equipment and that the motor is stationary.

15. Adjust the Speed Setpoint so that the Total Setpoint voltage is about 0.5 volts (terminal 13, Diagnostic 15).

Slowly increase the Main Current Limit setting up to about 20% FLC (ie, not more than 1 volt at Diagnostic test position 24). Since the Total Setpoint is set to 0.5V the motor speed should increase to only 5% of full speed. If this speed is exceeded, reversed connection of the tach or field is implied, quickly turn the Main Current Limit (P7) to zero (anticlockwise).

Disconnect all supplies and reverse either the field or tacho connections, then reconnect the supplies and repeat the test. If the motor still runs out of control check the tacho and the continuity of its wiring. **PROCEED ONLY WHEN THIS TEST IS SATISFACTORILY COMPLETED.**

16. With the Main Current Limit (P7) set to about 20% FLC slowly increase the Total Setpoint voltage to +1 volt (terminal 13, Diagnostic 15). The motor should now run at about 10% Full Speed and LED 6 should light.

NOTE:

When correctly connected and operating normally at constant speed the Speed Feedback voltage (Diagnostic 16) will be equal to the Total Setpoint voltage (Diagnostic 15) but of opposite polarity. Under these conditions the Speed Error voltage (Diagnostic 17) will be zero. If this condition cannot be achieved, the system is probably in current limit (this is most likely at this stage if the load is coupled to the motor). Increase the setting of the Main Current Limit (P7) slowly until motor accelerates to the set speed and the Speed Error signal falls to zero.

17. Check the motor direction; if it is incorrect disconnect all supplies and reverse both tach and field connections.

18. 590A and 598A drives only:

Adjust the Total Setpoint voltage to about -1V and check that the motor runs in control in the reverse direction.

19a. 590A and 598A drives:

Set the Speed Setpoint to zero and adjust the Speed Zero preset potentiometer (P3) for minimum shaft creep (Alternatively the Speed Zero potentiometer may be used to adjust the balance of maximum speed in forward and reverse directions).

19b. 591A and 599A drives:

Set the Speed Setpoint to zero. Turn the Speed Zero preset potentiometer (P3) clockwise until the motor shaft turns, then back-off P3 until the shaft just stops turning.

20. Gradually increase the Speed Setpoint to maximum and check that the shaft speed is nominally correct. If fine adjustment of the top speed is required, the Maximum Speed potentiometer (P10) provides  $\pm 10\%$  trim.

NOTE:

If the load is connected to the motor it may be necessary to increase the Main Current Limit control (P7) setting to achieve full speed.

21. 590A and 598A drives only:

Reverse the Speed Setpoint and check the maximum reverse speed.

22. Reset the Main Current Limit (P7) to its original position, which was noted in part 7.1 of this procedure. If in doubt set the control (P7) to 60% clockwise rotation (6V measured at Diagnostic 24) corresponding to a maximum armature current of 1.2 times Full Load. Fully clockwise rotation of P7 (10V measured at Diagnostic 24) corresponds to an armature current level of twice full load.

Note that if the drive runs into an overload condition, the current is automatically reduced on an inverse time characteristic back to 110% of full load. If the overload facility is not required, the Main Current Limit potentiometer (P7) should be turned progressively anticlockwise, almost to the midway position - this will limit the current to just above Full Load.

## 7.7 RUNNING PERFORMANCE ADJUSTMENTS

1. Disconnect all supplies and connect the motor to its load. Set the speed setpoint to zero, reconnect the supplies and switch on. Increase the speed setpoint and check that the drive runs smoothly under load; the speed should be stable and the armature current should be steady.

The Proportional and Integral potentiometers (P5, P6, P8 and P9), as preset by Eurotherm Drives Limited, will provide stable and responsive performance under most load conditions. Thus if instability is observed it is important to first check the load and couplings:

If there is a cyclic variation of the armature current check the mechanical couplings to the load - this is a common cause of apparent instability in either the speed or motor current. If speed instability is present check whether the repetition rate of the instability is related to any of the mechanical revolution rates of the load - if it is the instability frequency will vary with speed. This form of instability may be reduced by adjustment of the drive presets, but total elimination of the problem may require improvement of the load characteristics.

2. Instability due to incorrect setting of the drive control parameters can occur and is recognisable because its frequency will be relatively independent of the drive speed. If this form of instability is present, or if the application demands that the drive is trimmed for optimum response, then the stability controls may be adjusted as follows. Note that while the speed stability and response may be improved without the use of a Diagnostic Unit or Oscilloscope it is difficult to optimise the current response without such instrumentation. Consequently, the following procedure assumes that both instruments are available.

3. Current Loop Adjustment (P8 and P9)

With all power supplies disconnected, disconnect the field wires from terminals D3 and D4, labelling each wire clearly so that it can later be reconnected with the correct polarity. Ensure that option switch is in the ON position (to override the field fail alarm)

NOTE:

i. It is now possible to operate the drive in a stalled condition. Great care must be taken not to damage the motor by overheating. If the motor is fitted with a force ventilation fan arrange that it is connected and running during the test. In any case **DO NOT** remain in the stalled condition for long periods.

ii. Although the field supply is disconnected the motor may still produce some torque due to residual or compound field flux. It is essential therefore, to mechanically lock the motor shaft, or apply sufficient load to prevent rotation during the following procedure.

4. To achieve Full Load Current it is necessary to override the Tach Failure Alarm/Clamp:  
Disconnect the Tach (+) wire from terminal 3 and then link terminal 3 to  $\pm 10V$  (terminal 14, 15, or 24).

5. The optimum setting of the Current Proportional and Integral presets (P8 and P9) depends, to some extent, on the setting of the Main Current Limit (P7). Thus P7 should be correctly adjusted to suit the load, before adjustment of P8 and P9 is attempted.

6. When the Main Current Limit control is correctly set, proceed as follows:

If the Speed Setpoint is applied via the Setpoint Ramp, set the Ramp Rate presets P1 and P2 fully clockwise and Option Switch S8/4 UP (ON), to provide the fastest ramp rate. Set the Speed Proportional and Integral presets (P5 and P6) fully clockwise to provide the fastest rate of change of Current Demand signal (observable at Diagnostic 25).

Connect the Diagnostic Unit to the Control printed circuit board (accessed via the outer cover - observe correct orientation of plug into the socket). Connect the Oscilloscope to the output sockets on the Diagnostic Unit and switch to Diagnostic 26. This provides access to a safe, isolated signal representing the armature current waveform where  $\pm 1.1V = \pm 100\%$  full load current.

7a. 590A and 598A drives:

Reconnect the supplies and switch on. Observe the armature current waveform while changing the polarity of the Current Demand signal (by varying the Speed Setpoint). With each change of Current Demand polarity the current should increase rapidly, but without overshoot and then remain steady. If necessary adjust P8 and P9 slowly to obtain a Critically Damped performance, ie the fastest response possible without overshoot, as shown in Figure 3.

Figures 1 and 2 show typical armature current waveforms where P8 and P9 are incorrectly set and indicate the adjustment required to improve the drive performance, to conform with that of Figure 3.

In general, clockwise rotation of the presets will improve the speed of response, but rotating the controls too far will tend to introduce overshoot.

7b. 591A and 599A drives:

Reconnect the supplies and switch on. While observing the armature current waveform, suddenly increase the Current Demand Signal by rapidly increasing the Speed Setpoint from zero to +10V (then reduce the Setpoint to zero again; note that the armature current will return more rapidly to zero if the Speed Zero preset is set anticlockwise). With each increase of Current Demand the current should increase rapidly, but without overshoot and then remain steady. If necessary adjust P8 and P9 slowly to obtain a Critically Damped performance, ie the fastest response possible without overshoot, as shown in Figure 3.\*

Figures 1\* and 2\* show typical armature current waveforms where P8 and P9 are incorrectly set and indicate the adjustment required to improve the drive performance, to conform with that of Figure 3\*.

In general, clockwise rotation of the presets will improve the speed of response, but rotating the controls too far will tend to introduce overshoot.

\* Note that in 591A and 599A non-regenerative drives the current waveform will increase from zero instead of the negative value shown in the figures.

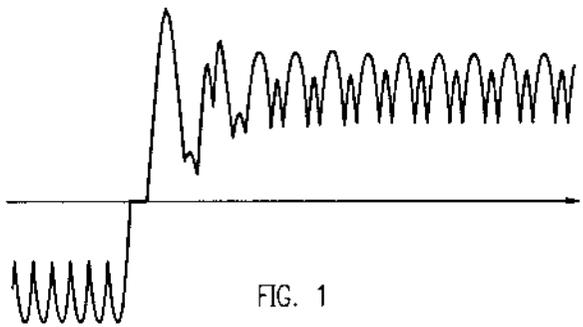


FIG. 1

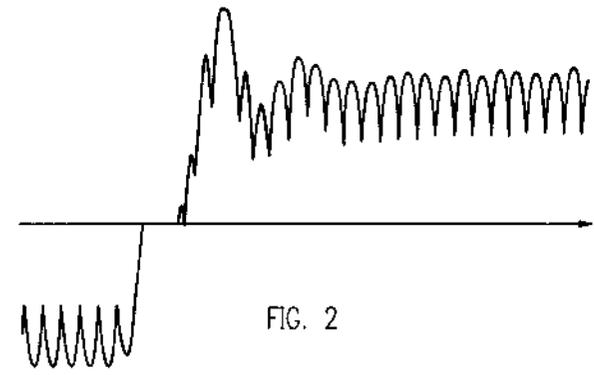


FIG. 2

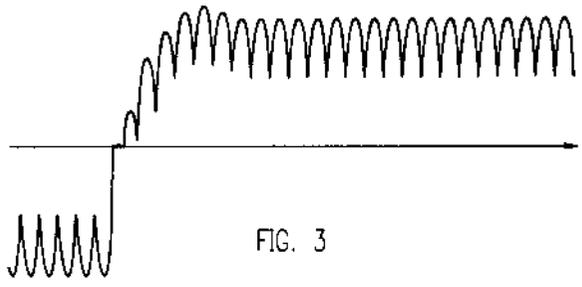


FIG. 3

REP005112 255 A 00001106

©1993 EUROTHERM DRIVES

DRAWN	CHECKED DTS	DATE	ELECTRICAL SYMBOLS GENERALLY TO BS 3939	TITLE	USED ON
TRACED MDN	DESIGN APP.	16/06/93		590/591 ARMATURE CURRENT WAVEFORMS	DRAWING NUMBER HC 358974 D
A			EUROTHERM DRIVES Ltd.		

8. When the Current Loop response adjustment is completed, switch off the drive and disconnect all supplies.

**REMOVE THE LINK FROM BETWEEN TERMINAL 3 AND THE 10V SUPPLY AND THEN RECONNECT THE TACHO (+) WIRE TO TERMINAL 3.**

Return S9/5 back to its original position and reconnect the field wires to terminals D3 and D4, ensuring that they are replaced in their original positions, ie with correct polarity. Remove any mechanical devices previously used to lock the motor shaft.

**9. Speed Loop Adjustment (P5 and P6)**

If the Speed Setpoint is applied via the setpoint ramp turn P1 and P2 fully clockwise and switch S8/4 UP (ON). Set the Speed Setpoint to zero. Switch the Diagnostic Unit to position 16 so that the Oscilloscope displays the scaled Tacho Feedback signal ( $\pm 10V = \pm$  full speed).

10. Reconnect the supplies and initiate Start. Apply a small step change (about 20%) to the Speed Setpoint input and observe the speed response. If necessary adjust the Speed Proportional and Speed Integral presets (P5 and P6) gradually to obtain a Critically Damped performance, ie the fastest response possible without overshoot, as shown in Figure 4, Curve (c). In general, clockwise rotation of the presets will improve the rate of response, but advancing the controls too far will tend to introduce overshoot. The optimum setting of P5 and P6 will be a compromise between the two extremes shown in Curves (a) and (b), Figure 4.

11. When the Speed Loop adjustment is completed reset Option Switch S8/4 to its original position.

12. If the Speed Setpoint is applied via the Setpoint Ramp, then the acceleration and deceleration rates of the drive, in response to a change of input, are individually adjustable by the Positive and Negative Rate presets, P1 and P2. The fastest rates are achieved by setting the controls fully clockwise. The range of the potentiometers can be selected by Option Switch S8/4 to be either 0.25 to 7.5 seconds, or 2.5 to 75 seconds to Full Speed.

13. Reset Option Switch S8/2 (Standstill Logic) to its original position. Note that if it is desired to eliminate shaft creep at zero setpoint in 590A and 598A regenerative drives then this switch should be set to the UP (ON) position. This provides a "deadband" about zero speed which is adjustable by the Standstill Threshold preset (P4) over the range  $\pm 0.5$  to  $\pm 4\%$  of Full Speed. The armature current will be totally interrupted when the shaft speed is within the band set by P4 and the Total Setpoint voltage is zero, at any other time the drive will operate normally.

**NOTE:**

The setting of the Zero Speed preset P3 will effect the symmetry of operation of the Standstill Logic about zero.

14. The drive should now be ready to operate. It is now essential to check the remaining control circuitry for correct operation. In particular, check that all Emergency Stop buttons and external interlocks work efficiently.

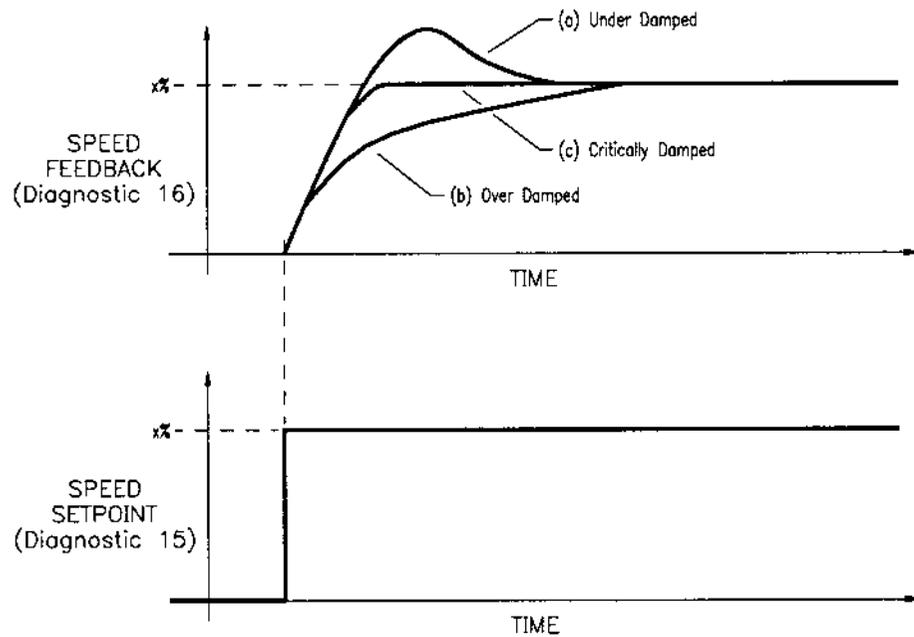


FIG. 4

KE385112 SS, A 2500P.LIMB

©1993 EUROTHERM DRIVES

DRAWN	CHECKED DTS	DATE	ELECTRICAL SYMBOLS GENERALLY TO BS 3939	TITLE	USED ON
TRACED MDN	DESIGN APP.	15/08/93	EUROTHERM DRIVES Ltd.	590/591	DRAWING NUMBER
		A		TYPICAL SPEED RESPONSE CURVES	HC 358975 D

## **8. DIAGNOSTIC TEST FACILITY**

### **8.1 DESCRIPTION OF DIAGNOSTIC TEST UNIT**

The drive is fitted with a multi-pin socket near the lower edge of the Main Control printed circuit board to allow connection of a type 5570 Diagnostic Test Unit.

The Diagnostic Test Unit is 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.

1. A digital voltmeter to permit accurate measurement of steady state signals.
2. An analog voltage "Trend Indicator" in the form of a row of LED displays which span signal levels in the range  $\pm 10V$ . This is a fast responding indicator which shows the magnitude of rapidly changing signals.
3. A pair of output sockets (standard 4mm) to enable signals to be monitored externally on an oscilloscope.

Under normal operating conditions, all signals which appear on the Diagnostic Test Unit are isolated from the main power supplies and field and armature circuits.

### **8.2 DIAGNOSTIC TEST PROCEDURE**

The Diagnostic Test Unit should always be used in conjunction with the drive condition indicators located on the main control printed circuit board.

In attempting to determine causes of fault conditions it is essential to follow the normal setting up procedure for the drive as set out in the appropriate sections of this manual.

If you reach a stage in the set-up procedure where the required conditions are not satisfied:

#### **FIRST**

Look at the DRIVE CONDITION INDICATORS and refer to the Indicator Description Chart ( Section 8.4).

#### **SECOND**

Look at the DRIVE CONDITION INDICATORS and compare with the Status Recognition Chart (Section 8.5.1 and 8.5.2).

#### **THIRD**

Check the voltage indicated by the 5570 DIAGNOSTIC TEST UNIT and compare with the Voltage Measurement Chart (Section 8.5.3).

### **8.3 CONNECTION AND DISCONNECTION OF THE DIAGNOSTIC TEST UNIT**

#### CONNECTION:

1. Disconnect the Auxiliary and Power Supplies from the drive.
2. Insert the Diagnostic Unit Plug into the Socket, ensuring that Polarising Tab and Slot are correctly aligned.

#### DISCONNECTION:

1. Disconnect the Auxiliary and Power Supplies from the drive.
2. Remove Diagnostic Unit Plug.

### **8.4 DRIVE CONDITION INDICATORS - DESCRIPTION**

LED1: 1 PHASE (AUXILIARY SUPPLY) ON/OFF

ON: Single phase auxiliary supply on.

- OFF: a) Single phase supply or fuse FS1 failed.  
b) Preset PCB not fitted or plugged in correctly.

LED2: 45-65HZ ENABLE/INHIBIT

ON: Phase locked loop synchronised.

OFF: Phase locked loop not synchronised to main 3-phase power supply.

LED3: 3-PHASE POWER SUPPLY

ON: 3-Phase power supply connected.

- OFF:
- a) 1 Phase or more not connected.
  - b) Main contactor not closed.
  - c) Main fuse failure check .
  - d) Coding fuse failure check FS2, FS3, FS4.

LED4: NORMAL/OVER CURRENT FAULT

ON: Armature Current Normal.

OFF: Armature Current has exceeded 300% full load. In this condition the main contactor will be automatically tripped. See Option Switch S8/5 and S8/7 .The entire system must be checked thoroughly to ascertain the cause of the failure. The drive can be restarted after such a fault by either pressing the "FAULT RESET" pushbutton or externally by applying +24V (from terminal 38) to terminal 39 and removing the start input.

LED5: RUN/INHIBIT

ON: Indicates that both "READY" signal (on terminal 35) and "ENABLE" signal (on terminal 32 and diagnostic 5) are present. The drive will now start.

OFF: Either "READY" or "ENABLE" signals have been removed.

NOTES:

- a) The "READY" signal depend upon each of the following signals being in its enabled condition:
  - i) Single phase (auxiliary supply) On/Off (LED1).
  - ii) 45-65HZ Enable/Inhibit (LED2).
  - iii) 3-Phase (Main Supply) On/Off (LED3).
  - iv) Overcurrent trip (LED4).
  - v) Motor Thermistor/Microtherm (DIAGNOSTIC 6).
  - vi) Field Fail (DIAGNOSTIC 7).
  - vii) Auxiliary Enable (DIAGNOSTIC 8).
  - viii) Start Instruction (DIAGNOSTIC 9).
- b) The "ENABLE" signal depends on the external connection of +24V (Nominal) to Enable terminal 32, normally from START SUPPLY terminal 31.

LED6: ROTATING/STANDSTILL

ON: Indicates the motor shaft is rotating. (Speed signal exceeds STANDSTILL THRESHOLD set by potentiometer P4. Adjustment range 0.5 to 4%).

OFF: Motor shaft speed is less than standstill threshold.

LED7: HEALTH

ON: Drive Health normal.

OFF: Drive in fault condition.

NOTES:

- a) In the STOP condition the "HEALTH" signal only requires that the internal supply rails are present.
- b) In the START condition the "HEALTH" signal requires the READY signal (terminal 35) to be present.

## 8.5 DRIVE CONDITION INDICATORS STATUS RECOGNITION

### 8.5.1. STOP CONDITION

CONDITION REFERENCE							STOP CONDITION	
	1 PHASE (AUX) ON/OFF						<ul style="list-style-type: none"> <li>● LED ON</li> <li>○ LED OFF</li> <li>⊗ EITHER</li> </ul>	
	45-65HZ ENABLE/INHIBIT							
	3-PHASE (MAINS) ON/OFF							
	NORMAL/OVERCURRENT FAULT							
	RUN/INHIBIT							
	ROTATING/STANDSTILL							
	NORMAL/ALARM							
	1	2	3	4	5	6	7	CONDITIONS/CHECKS
A	●	○	○	●	○	○	●	NORMAL STOP CONDITION
B	○	○	○	○	○	○	○	NO AUXILIARY SUPPLY CHECK: 1. Auxiliary AC. supply voltage on terminal D9 with respect to terminal D10 2. Auxiliary supply fuse F1.
C	○	○	○	●	○	○	●	PRESET BOARD NOT FITTED. CHECK: 1. Preset board inserted correctly.
E	●	○	○	●	○	●	●	DRIVE INCORRECTLY INDICATES SHAFT ROTATING. CHECK: 1. Speed feedback signal (diagnostic 16). 2. Voltage on terminal 3 with respect to terminal 4 3. Voltage on terminal 2 with respect to terminal 1 4. Preset board potentiometer P10.

## 8.5.2 START CONDITION

CONDITION REFERENCE							START CONDITION	
	1 PHASE (AUX) ON/OFF						<ul style="list-style-type: none"> <li>● LED ON</li> <li>○ LED OFF</li> <li>⊗ EITHER</li> </ul>	
	45-65HZ ENABLE/INHIBIT							
	3-PHASE (MAINS) ON/OFF							
	NORMAL/OVERCURRENT FAULT							
	RUN/INHIBIT							
	ROTATING/STANDSTILL							
	NORMAL/ALARM							
	1	2	3	4	5	6	7	CONDITIONS/CHECKS
A	●	○	○	●	○	○	●	NORMAL STOP CONDITION
F	●	●	●	●	●	⊗	●	NORMAL RUN CONDITION
G	●	○	○	●	○	○	●	DRIVE REMAINS IN STOP CONDITION. STATUS LEDS DO NOT CHANGE WHEN START BUTTON PRESSED. CHECK: 1. Drive is receiving Start Instruction (Diagnostic 9). 2. Continuity of stop line terminals 31 to 33. 3. Continuity of start line terminals 33 to 34.
H	●	○	○	●	○	○	○	ALARM CONDITION - START INSTRUCTION PRESENT BUT DRIVE NOT RECEIVING 3-PHASE. CHECK: * 1. Main contactor is pulled in. 2. Contactor coil connections (terminals D11 and D12). 3. Coil voltage is correct. 4. Coil resistance i.e. not open circuit. 5. All three phases present on drive input terminals L1, L2 and L3. WARNING! High voltages appear on these terminals. 6. Fuses F2, F3, and F4. WARNING! Isolate Drive from supply before checking.
I	●	●	○	●	○	○	○	ALARM CONDITION - SPECIAL CASE OF ABOVE ONE PHASE ONLY MISSING. CHECK: * Items 5 and 6 in H above.
J	●	●	●	●	●	●	●	NORMAL RUN CONDITION - SHAFT ROTATING
K	●	●	●	●	○	○	●	DRIVE INHIBITED BY 'ENABLE' SIGNAL AT 32. CHECK: 1. Drive enable (diagnostic 5). 2. Continuity between terminal 32 and start supply 31 or 32 and +24V (Nominal) supply 38, as appropriate.

### 8.5.2 START CONDITION

Continued...

CONDITION REFERENCE							START CONDITION	
	1 PHASE (AUX) ON/OFF						<ul style="list-style-type: none"> <li>● LED ON</li> <li>○ LED OFF</li> <li>⊗ EITHER</li> </ul>	
	45-65HZ ENABLE/INHIBIT							
	3-PHASE (MAINS) ON/OFF							
	NORMAL/OVERCURRENT FAULT							
	RUN/INHIBIT							
	ROTATING/STANDSTILL							
		NORMAL/ALARM						
	1	2	3	4	5	6	CONDITIONS/CHECKS	
L	●	●	●	●	●	○	●	<p>NORMAL RUN CONDITION - SHAFT STATIONARY IF INCREASING SETPOINT HAS NO EFFECT THEN: FOR SPEED CONTROL MODE CHECK:</p> <ol style="list-style-type: none"> <li>1. Total Setpoint (diagnostic 15) is responding to the setpoint input.</li> <li>2. That the total Setpoint is positive in 591A units.</li> <li>3. Main current limited (diagnostic 24) is not at zero.</li> <li>4. Auxiliary current limits (diagnostics 22 and 23) are not at zero.</li> <li>5. That the current demand is <u>not</u> isolated (diagnostic 19).</li> <li>6. Motor armature connections (with supplies isolated).</li> <li>7. Tacho connections correct diagnostics 15 and 16).</li> <li>8. Motor not stalled. Diagnostic 26 indicates armature current.</li> </ol> <p>FOR TORQUE (CURRENT) CONTROL <u>ONLY</u> CHECK:</p> <p>Items 2, 3, 5, 7 and</p> <ol style="list-style-type: none"> <li>8. Auxiliary current input (diagnostic 20) is not at zero.</li> <li>9. Auxiliary current input is selected (diagnostic 21).</li> </ol>

## 8.5.2 START CONDITION

Continued...

CONDITION REFERENCE							START CONDITION	
	1 PHASE (AUX) ON/OFF						<ul style="list-style-type: none"> <li>● LED ON</li> <li>○ LED OFF</li> <li>⊗ EITHER</li> </ul>	
	45-65HZ ENABLE/INHIBIT							
	3-PHASE (MAINS) ON/OFF							
	NORMAL/OVERCURRENT FAULT							
	RUN/INHIBIT							
	ROTATING/STANDSTILL							
	NORMAL/ALARM							
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>CONDITIONS/CHECKS</b>
F	●	●	●	●	●	⊗	●	NORMAL RUN CONDITION
M	●	●	●	●	○	○	○	DRIVE INHIBITED BY AUXILIARY ENABLE, OVERTEMPERATURE ALARM, FIELD FAILURE ALARM OR INTERMITTENT SUPPLY LOSS. CHECK: * <ol style="list-style-type: none"> <li>1. Auxiliary enable (Diagnostic 8).</li> <li>2. Thermistor/Microtherm (Diagnostic 6).</li> <li>3. Field Fail (Diagnostic 7).</li> <li>4. Field voltage on terminals D5 and D8.</li> <li>5. Field circuit continuity (isolate supplies before checking).</li> <li>6. Observe LEDs 2 and 3 for intermittent, momentary loss of Supply.</li> </ol> WHERE AC SUPPLY TO THE FIELD RECTIFIER IS EXTERNAL CHECK: 7. AC voltage on terminal D4 and D1. FOR FORCE VENTILATED CONTROLLERS ONLY. CHECK: 8. Rotation of fans as stack thermal trip is in series with field fail.
N	●	○	○	○	○	○	○	ALARM CONDITION - OVERCURRENT FAULT, IF SETTING UP DRIVE FOR FIRST TIME OR SETTINGS HAVE BEEN ADJUSTED, INDICATES EXTREME INSTABILITY. CAREFULLY FOLLOW DRIVE SETTING UP PROCEDURE. ** OTHERWISE, CHECK: All external connections, in particular, motor supply and supply connections**  * If terminal 30 is connected to 37 these alarm conditions will latch, they may be reset by operating the Stop/Start controls. ** To reset the drive, fault reset must be operated, when the start instruction has been removed ,and the drive restarted.

### 8.5.3 DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
1	INTERNAL +15V SUPPLY	Aux. Power ON	+15V $\pm$ 0.25V Max. 100Hz ripple=25mV peak to peak
2	EXTERNAL +10V SUPPLY Note: These supplies are buffered from internal reference supplies and have a maximum output current capability of 5mA.	Aux. Power ON	+10V $\pm$ 0.1V Max. 100Hz ripple=5mV peak to peak
3	EXTERNAL -10V SUPPLY Note: These supplies are buffered from internal reference supplies and have a maximum output current capability of 5mA.	Aux. Power ON	-10V $\pm$ 0.1V Max. 100Hz ripple=5mV peak to peak
4	INTERNAL -15V SUPPLY	Aux. Power ON	-15V $\pm$ 0.25V Max. 100Hz ripple=25mV peak to peak
5	DRIVE ENABLE Enable = +24V(Nominal) on terminal 32 Inhibit = open circuit to terminal 32	Enable Inhibit	+15V 0V
6	MOTOR THERMISTOR/MICROTHERM	Motor temperature correct Motor over temperature	+15V 0V
7	FIELD FAIL Notes: 1. This signal is interlocked with the internal temperature sensor (force ventilated units only) and the internal ACCT connectors.  2. Internally supplied field will normally excite when the 3-phase power is connected to the drive i.e. only in the run condition, with the main contactor energised.  3. Excitation of externally controlled field will depend on the application.  4. Permanent magnet motor, field weakening and remote field supply applications will employ field failure override. This will provide a constant 'field normal' signal.	Field AND Interlocks Nominal  Field OR Interlocks Fail	+15V  0V
8	AUXILIARY ENABLE Enable = +24V (Nominal) on terminal 30 Inhibit = Open circuit to terminal 30	Enable Inhibit	+15V 0V
9	START INSTRUCTION START=+24V STOP = 0V	Run Stop	+15V 0V

### 8.5.3 DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
10	SETPOINT RAMP RESET (SEE S8/6) Enable = Open circuit to terminal 6 Reset to Zero = Connect terminal 6 to 0V	Ramp Enable AND Run Ramp Reset OR Stop	+15V 0V
11	SETPOINT RAMP INPUT Connects directly to terminal 7 and measures the incoming speed demand signal. If terminal 7 is not used the voltage measured should be zero.	<u>Variable Input:</u>  100% forward speed demand Zero speed or terminal 7 not used 100% reverse speed demand*	+10V 0V -10V
12	INPUT NO 1 Connects directly to terminal 9 and measures the incoming speed demand signal. If terminal 9 is not used the voltage measured should be zero.	<u>Variable Input:</u>  100% forward speed demand Zero speed or terminal 9 not used 100% reverse speed demand*	+10V 0V -10V
13	INPUT NO 2 Connects directly to terminal 10 and measures the incoming speed demand signal. If terminal 10 is not used the voltage measured should be zero.	<u>Variable Input:</u>  100% forward speed demand Zero speed or terminal 10 not used 100% reverse speed demand*	+10V 0V -10V
14	INPUT NO 3 Connects directly to terminal 12 and measures the incoming speed demand signal. If terminal 12 is not used the voltage measured should be zero. Note: That input No 3 is of the opposite sense to all other speed inputs.	<u>Variable Input:</u>  100% forward speed demand Zero speed or terminal 12 not used 100% reverse speed demand*	-10V 0V +10V
15	TOTAL SETPOINT This is the sum of all the speed demand signals, i.e. Input No 1, plus Input No 2, plus Setpoint Ramp Input (if S8/3 is closed), minus Input No 3. It is clamped to a maximum output of $\pm 11V$ .	<u>Variable Signal:</u>  100% forward speed demand Zero speed 100% reverse speed demand	+10V 0V -10V
16	SPEED FEEDBACK This is the scaled and buffered tachogenerator speed feedback signal (under steady state conditions it should be of opposite polarity but equal in magnitude to the Total Setpoint measured on diagnostic 15).	<u>Variable Signal:</u>  100% forward speed Zero speed 100% reverse speed	-10V 0V +10V
17	SPEED ERROR This is of opposite polarity to the difference between the Total Setpoint and speed feedback voltages. The magnitude of this signal is dependent on the setting of the Speed Proportional Gain (P5) and includes any Zero Speed offset value.	Run - Variable Signal Normal Steady State value  Stop - Total Setpoint = 0V Total Setpoint $\neq$ 0V	up to $\pm 10V$ Approx 0V  0V $\pm$ 0.2V up to $\pm 10V$
18	CURRENT DEMAND This signal is held to zero except in the run condition when it is released by Main System Enable. Main System Enable depends on the "Run/Inhibit" signal (LED 5) and on the Standstill Logic (if switch S8/2 is closed).	Run - Variable Signal -590A/598A -591A/599A  Stop - (or Standstill)	$\pm 10V$ 0 to +10V  0V $\pm$ 0.1V

\*590A drives only

### 8.5.3 DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
19	CURRENT DEMAND ISOLATE Connects directly to terminal 18. Note: 1. For speed control operation leave terminal 18 open circuit. 2. For current control operation connect terminal 18 to 0 Volts.	Speed control  Current control	+15V  0V
20	AUXILIARY CURRENT INPUT Connects directly to terminal 20.  Only operational if selected (See Diagnostic 21).	<u>Variable Input</u> (if used): Positive Bridge current = 200% FLC* Zero Current  Negative Bridge current = 200% FLC* (590A/598A only)  * FLC = Full Load Current	+10V  0V  -10V
21	SELECT AUXILIARY INPUT Connects directly to terminal 21. Note: 1. To select input connect terminal 21 to 0 Volts . 2. To disconnect input leave terminal 21 open circuit.	Select Input  Disconnect Input	0V  +15V
22	AUXILIARY CURRENT LIMIT (POSITIVE) Connects directly to terminal 22. Note: 1. This positive current limit only operates up to the limit set by the Main Current Limit preset (P7) at Diagnostic 24. 2. If no special limit is required leave terminal 22 open circuit.	Terminal 22 open circuit.  <u>Variable Input</u> : Positive current limit = 200% FLC* Positive current limit zero  *FLC = Full Load Current	+12V $\pm$ 2V  +10V 0V
23	AUXILIARY CURRENT LIMIT (NEGATIVE) Connects directly to terminal 25. Note: 1. This negative current limit only operates up to the limit set by the Main Current Limit preset (P7) at Diagnostic 24. 2. If no special limit is required leave terminal 25 open circuit. 3. IN ALL 591A/599A APPLICATIONS TERMINAL 25 MUST BE OPEN CIRCUIT.	Terminal 25 open Circuit (see note 3).  <u>Variable Input</u> : Negative current limit = 200% FLC* Negative current limit zero  *FLC = Full Load Current	-12V $\pm$ 2V  -10V 0V

### 8.5.3 DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
24	<p><b>MAIN CURRENT LIMIT</b> Overrides Auxiliary Current Limits (see Diagnostic 22 and 23).</p> <p>Scaling: 0 to +10V equivalent to 0 to 200% Full Load Current (FLC).</p> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>i. When set between 0 and 5.5V (0 to 110% FLC*) the set current is available continuously.</li> <li>ii. When set between 5.5 and 10V (110 to 200% FLC*) the current is controlled by an overload inverse time characteristic. The absolute limit is fixed at the set value and the current is allowed to exceed 110% FLC* for a short time before it is automatically cut back to 110%. The time allowed in this over current region depends on the magnitude of the overload e.g. 150% load is permitted for approximately 30 seconds before cut back starts. 200% load is permitted for approximately 10 seconds before cut back starts.</li> </ul>	Variable Voltage depending upon the input to terminal 25 (normally +10V) and the setting of the Main Current Limit Potentiometer P7.	0 to +10V
25	<p><b>TOTAL CURRENT DEMAND (INVERTED)</b> This is the net current demand signal (inverted). It is limited by the current limit settings and the overload inverse time characteristic. It is held to zero except in the run condition when it is released by the Main System Enable. The Main System Enable depend on the "Run/Inhibit" signal (LED5) and on the Standstill logic (if switch S8/2 is closed).</p>	<p><u>Variable demand in run condition:</u> Positive Bridge Current = 200% FLC* Zero Current. Negative Bridge Current = 200% FLC* (590A/598A only) In stop condition. * FLC = Full Load Current</p>	<p>-10V 0V +10V 0V</p>
26	<p><b>CURRENT FEEDBACK</b> Measured armature current signal.</p> <p>This is an isolated signal which is directly proportional to the Armature Current. Under steady state condition it should be of opposite polarity but reduced in magnitude to the Total Current Demand signal at Diagnostic 25.</p>	<p><u>Variable signal in run condition:</u> Positive Bridge Current = 200% FLC* Zero Current. Negative Bridge Current = 200% FLC* (590A only) * FLC = Full Load Current</p>	<p>+2.2V 0V -2.2V</p>

### 8.5.3 DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
27	<p>PHASE ANGLE This signal is held to zero except in the run condition when it is released by Main System Enable.</p> <p>Main System Enable depends on the "Run/Inhibit" signal (LED5) and on the Standstill Logic (if switch S8/2 is closed). Signal value is limited if no tach feedback signal is present in order to help prevent over speeding of the motor.</p>	<p><u>Variable Signal in run condition:</u> Positive phase angle. (590A/598A only)</p> <p>Zero phase angle.</p> <p>Negative phase angle.</p> <p>Tach loss (i.e. No tach signal)</p>	<p>up to +10V</p> <p>0V</p> <p>up to -10V</p> <p>Limited to <math>\pm</math> (4.7V<math>\pm</math>0.2V)</p>

## 9 590 "ALL IN ONE" POWER BOARD (REF AH058426U002/003)

### DESCRIPTION

A new 590 Power Board has been introduced that includes in one single PCB all the circuits of the previous split-in-three power board (referred to next as the "old" board), namely the power supplies, trigger and snubber circuits.

The salient differences between the two boards are described below.

### POWER SUPPLIES AND FANS

The power supplies for the controller are generated from the single-phase auxiliary supply via a direct-on-line SMPS operating over a wide voltage range of 110Vac to 240Vac +/-10% and frequency of 40Hz to 70Hz.

Therefore there is no need to make an auxiliary tap change as per "old" board.

However, on stacks fitted with fans, an appropriate choice of fan connections is still required (in series for 240V aux. or in parallel for 110V aux).

There is also more power available from this supply up to 17W externally, ie in addition to powering the control electronics and the trigger pulses for the armature and field circuits.

### CODING

Thyristor stack synchronisation and phase rotation signals are generated on the main power supply PCB rather than on a daughter board as before.

### FUSES

There is only one 3A slow-blow fuse that protects the auxiliary circuits, varistors, contactor coil and fan circuits. The power supply is self-limiting and does not require a separate fuse as before with the "old" board.

### FEEDBACK CIRCUITS

The controller gives closed loop control of the parameters required by the motor. Since these parameters are controlled, feedback must be provided to the controller.

#### Armature Current Feedback

This is achieved by means of 2 (rather than 3 as per "old" board/chassis) ac current transformers with the third ac line current being derived from the measured two. The ac feedback is rectified and fitted with a selected burden to yield the desired voltage signal for a given current level as per "old" board.

### CONTACTOR SUPPLY (See Circuit Diagram HJ387075D)

The controller needs a power contactor, DC or AC, in series with the main power path, to ensure correct power up sequencing. This contactor is directly initiated by the an isolating relay; the isolating relay drives the contactor coil with the same voltage as that of the auxiliary supply by default (as per "old" board). This is achieved (see Drawing attached) by a brown wire connection from "COIL LIVE" (F28) to "RELAY" (F25) and a blue wire connection from "COIL NEUTRAL (F21)" to CONTACTOR RETURN (F26)". However, if an alternative supply is required for the contactor coil, the brown wire should be "parked" to itself (F22) AND the blue wire should be moved from "COIL NEUTRAL (F21)" to "RELAY" (F25). Then the external coil supply can be switched via a volt-free contact between terminals D5 and D6.

### EXTERNAL FIELD SUPPLY CONNECTIONS

There are now two new "staging posts" **FL1 and FL2** (F8 and F16) which act as the intermediate connection between L1, L2 and the integral field controller bridge (see Drawing attached). If an external field ac connection is required, then this should be brought into Terminals D1 (line L1) and D2 (line L2) AND the red and yellow faston wires should now be moved from **FL2 (F8) AND FL1 (F16)** into **FE1 (F19) and FE2 (F18)** respectively.

### TRIGGER PLUGS

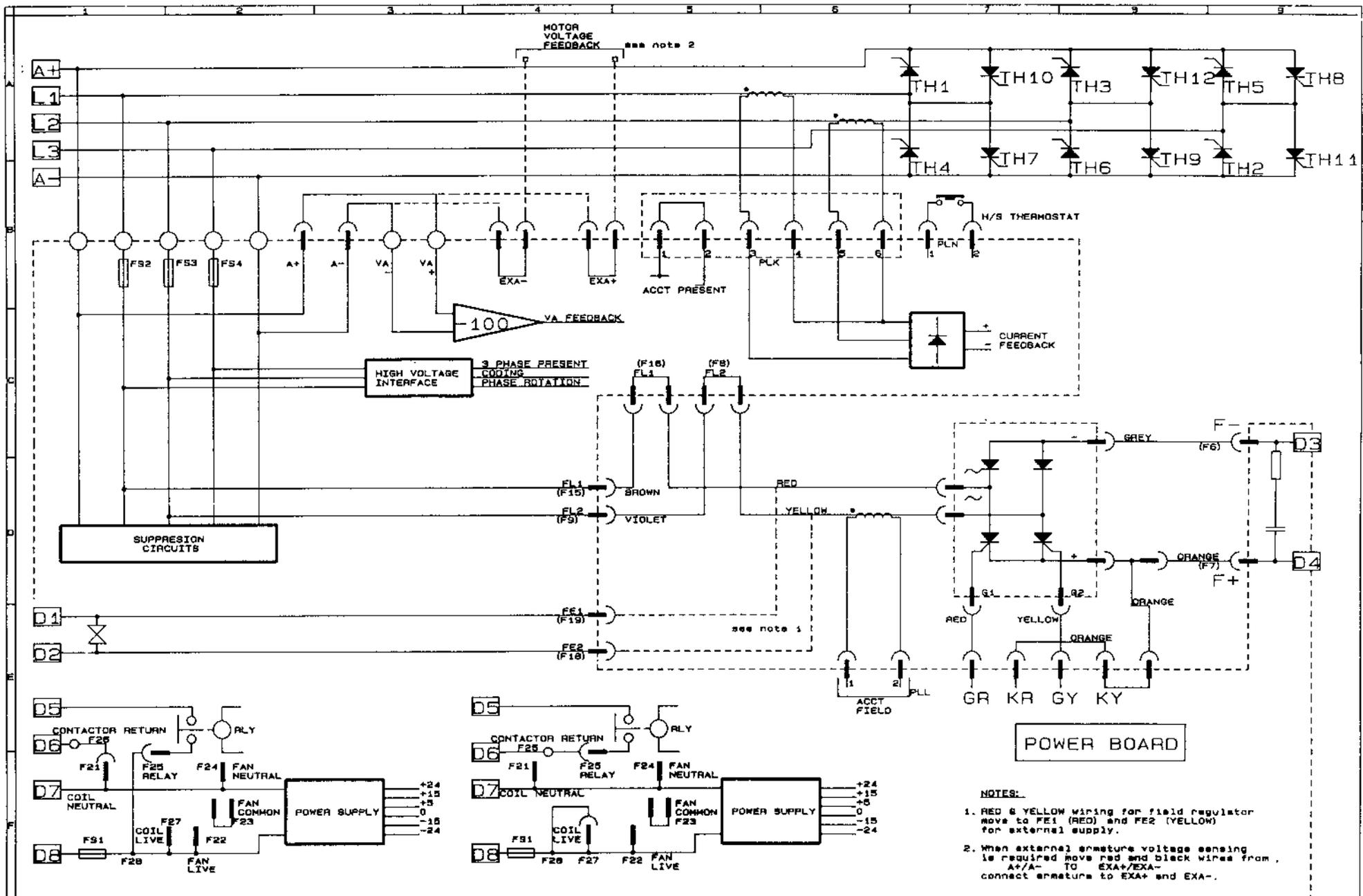
There are new moulded plugs for the trigger connections to the thyristor gate/cathode terminals. This allows the trigger pulses to be removed from the thyristor pack end rather than the pulse transformer end as per "old" board. Otherwise the trigger circuits remain exactly the same.

## COOLING FAN CONNECTIONS

When the controller is fitted with heatsink cooling fans then these fans are connected to FAN LIVE (F27) FAN NEUTRAL (F24) and where appropriate FAN COMMON (F23). If the auxiliary supply is 110/115V and two cooling fans are fitted, the two fans are connected in parallel to FAN LIVE (F27) and FAN NEUTRAL (F24) and similarly, if the auxiliary supply is 220/240V then the two fans are connected in series, the FAN COMMON (F23) providing the centre point. Where a single fan is used this is matched to the auxiliary supply and therefore always connected to FAN LIVE (F27) and FAN NEUTRAL (F24).

## INSTRUCTIONS FOR REMOVAL OF 590S POWER SUPPLY BOARD UP TO 150HP

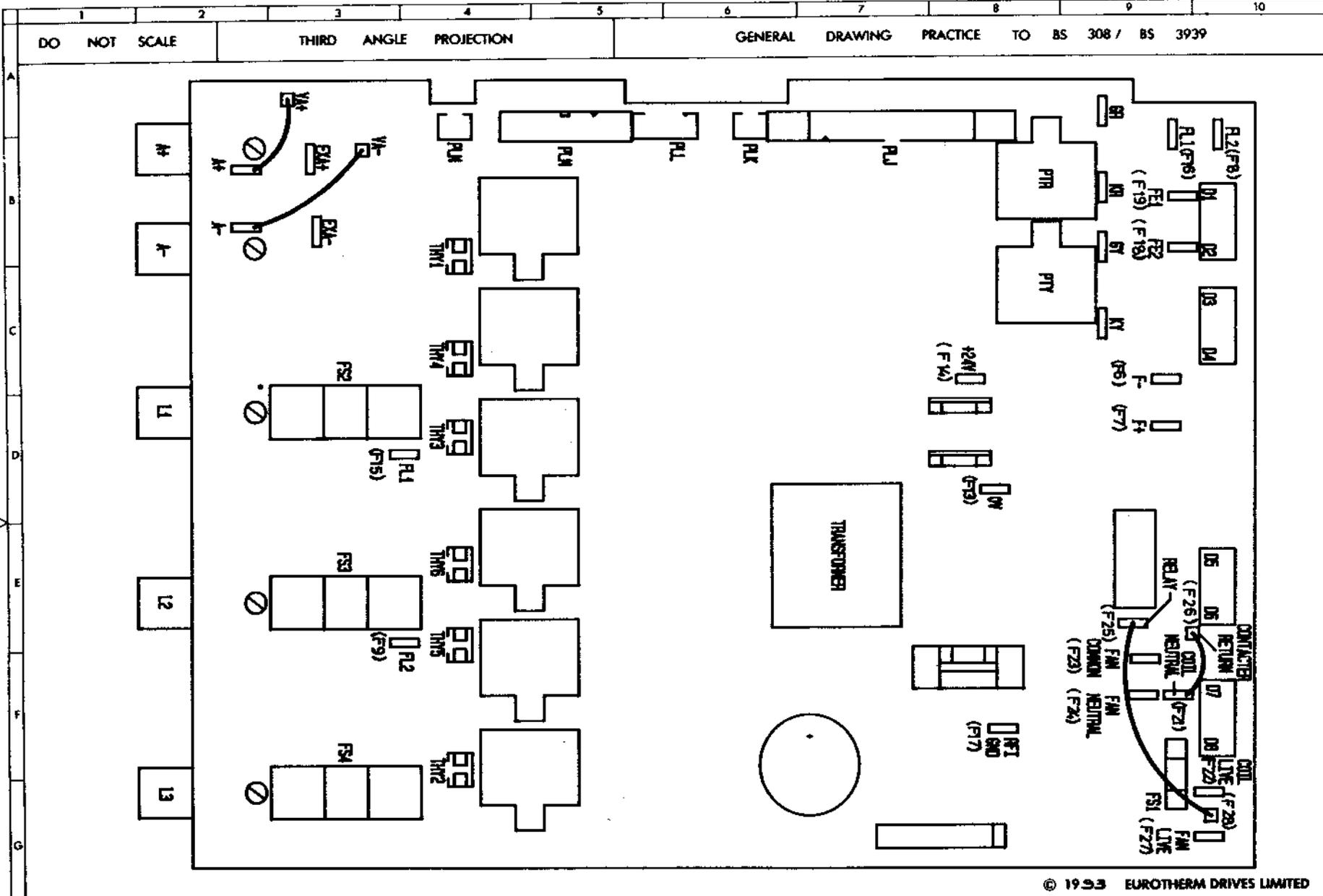
- 1) REMOVE ALL POWER TO THE DRIVE. You will need a Phillips head screwdriver, a flat head screwdriver, and a needle nose pliers to remove the board.
- 2) PRIOR TO HANDLING ANY CIRCUIT BOARD, A GROUND STRAP SHOULD BE USED TO PREVENT ELECTROSTATIC DISCHARGE FROM DAMAGING THE BOARD.
- 3) Remove controller door assembly from the front of the drive by disconnecting the two ribbon cables from the power supply board and unclipping the hinge connectors holding the door to the chassis by using a flat head screwdriver.
- 4) Remove the 2 thin black bars from the top and bottom of the stack assembly chassis. Do not remove the screws holding the power board down. These should be removed after completing steps 5 and 6.
- 5) Carefully disconnect the following:
  - (a) All external wires connected to terminals D1 and through D8. BE CAREFUL NOT TO LOOSEN THE GREEN TERMINAL BLOCKS FROM THE BOARD ITSELF.
  - (b) Red and brown wires connected to stake F16 and yellow and violet wires connected to stake F8 (upper left part of board).
  - (c) Grey wire connected to terminal D3 (F6), field negative supply, and orange wire connected to terminal D4 (F7), field positive supply (upper left part of board).
  - (d) Red, orange, and yellow gate wires located on the upper left part of the board.
  - (e) Green and yellow (RFI) ground wire (F17) (upper right part of board).
  - (f) Fan wires connected to stakes F23, F24, and F27, if necessary (upper right part of board).
  - (g) PLL, PLK, PLM plug in connectors, if necessary (left side of board).
  - (h) Violet coding wire adjacent to fuse FS2 and brown coding wire adjacent to fuse FS3 (lower part of board).
- 6) Remove SCR Gate Leads using needle nose pliers. Gently pull the pink gate lead guide by gripping the centre of the guide with pliers. DO NOT PULL THE GATE LEADS OUT BY THE WIRES. THIS COULD DAMAGE THE GATE LEAD GUIDE AND RENDER THE GATE LEADS USELESS. CAUTION: WHEN REINSTALLING THE POWER SUPPLY BOARD, REMEMBER THAT THE GATE LEAD GUIDES MUST HAVE THE RED GATE LEAD WIRES FACING TO THE INSIDE AND YELLOW GATE LEAD WIRES SHOULD BE FACING TO THE OUTSIDE.
- 7) Remove the screws and the top, centre, and bottom of the board. BE CAREFUL TO CAPTURE LOCK WASHERS ON THE FIVE BOTTOM SCREWS.
- 8) Now everything is disconnected and the board can be removed. To remove the Power Supply Board, slide it to the right hand side of the power chassis. Once the board is as far to the right as possible, tilt the left side of the board up and out. Remove the board carefully, as there are some components that could be damaged if the board is mishandled.
- 9) To reinstall a new power supply board, reverse the steps in the outlined procedure above.



- NOTES:
1. RED & YELLOW wiring for field regulator move to FE1 (RED) and FE2 (YELLOW) for external supply.
  2. When external armature voltage sensing is required move red and black wires from A+/A- TO EXA+/EXA- connect armature to EXA+ and EXA-.

CAD FILENAME: P:\590\PCBCAD\590WIRE.SCH				NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS CIRCUIT DIAGRAM. RE-PLDT ONLY			
DRAWN SB	CHECKED <i>[Signature]</i>	DESIGNED P-D	DESIGNED S-D	DESIGNED S-D	DESIGNED S-D	TITLE 4 QUAD PWR CIRCUIT DC CONTROLLER 35/70/110/150/180A (SINGLE Bd. CONSTRUCTION)	STD OR SMT EUROTHERM DRIVES 19 93
KE059669 I.ee 2		A	B	C	D	DRAWING NUMBER HJ387075 D	SHT. 1 OF 1

EUROTHERM DRIVES Ltd.



ISS	DATE
A	4.3.93
B	14.4.93
C	8.9.93

© 1993 EUROTHERM DRIVES LIMITED

DRAWN	E.J.T.	MATERIAL	
CHECKED	<i>[Signature]</i>	FINISH	

DIMS. IN M.M. APPLY OVER FINISH  
(EXCEPT FOR PAINT AND LACQUER)

X = ± 0.4  
 XX = ± 0.2  
 XXX = ± 0.1

HOLES < 7 mm  
 .02 ± 0.07

ASSEMBLED ON 590

SCALE N.T.S.

TITLE POWER BOARD LAYOUT FOR 2Q



DRAWING NUMBER HC387068D

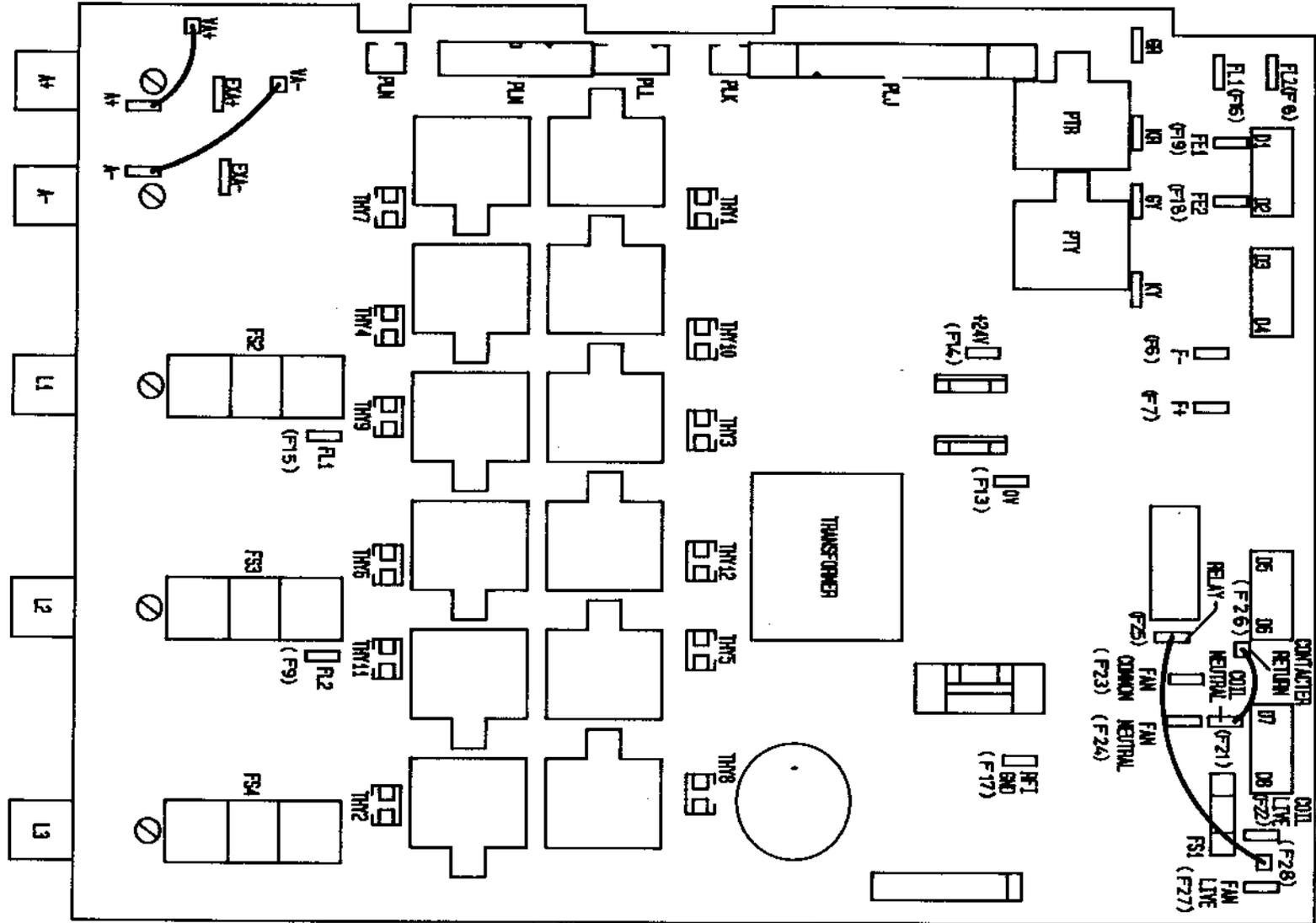
DO NOT SCALE

THIRD ANGLE PROJECTION

GENERAL DRAWING PRACTICE TO BS 308 / BS 3939

ISS DATE

A 4.3.93  
B 14.4.93  
C 2.9.93



© 1993 EURO THERM DRIVES LIMITED

DRAWN E.J.T.

MATERIAL

CHECKED gpe

FINISH

DIMS. IN M.M. APPLY OVER FINISH  
(EXCEPT FOR PAINT AND LACQUER)

GENERAL	X	= ± 0.4	HOLES < φ 7mm
	XX	= ± 0.2	
TOLERANCE	X.XX	= ± 0.1	-0.02 + 0.07

ASSEMBLED ON 590

SCALE N.T.S.

TITLE POWER BOARD  
LAYOUT FOR 4Q

EURO THERM DRIVES

DRAWING NUMBER HC387069D

SHT. 1  
OF 1

## 590 POWER BOARD (AH385621)

Replaces AH055050 From August 1995.  
Power supply specification as AH385851 described above.

### Product Type

590/7200 (4Q 720amp)  
591/7200 (2Q 720amp)

### Subject of enhancement

Power Board now updated to AH385621U001 (Sep 1995)  
This item has been updated to include improvements including:  
Surface Mount Technology  
Revised SMPS (as 590/592)  
Removal of Coding Module

### Compatibility

This part does not allow upgrading of existing Power Board (AH055050/385128). Repair/Service of existing product will continue to use identical parts as originally fitted.

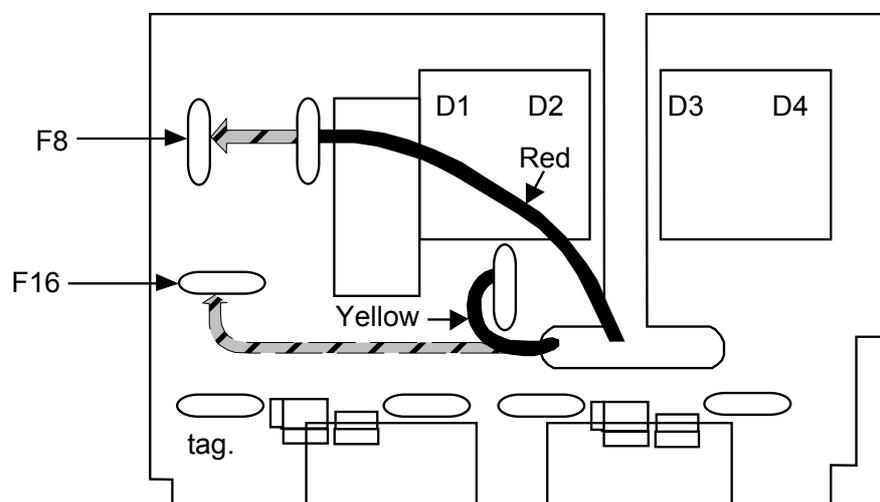
### Additions to Technical Manual

Subject-External Supply Terminals D1 & D2

These terminals are used for the External AC Supply connection (for the Motor Field Supply) when the Internal AC Supply is unused. The following actions must be taken:

- 1) These terminals are now **energised** when “Internal Field Supply” option is used, and the 3 phase supply (L1/2/3) is energised. Protection is available via the on-board Field supply fuses FS2, FS3.
- 2) When utilising the “External AC Supply” connection, internal wiring links **must** be removed and connected to staging posts provided.  
The internal wiring links (Red and Yellow) are identified by the following procedure
  - a) Isolate the Drive
  - b) Loosen control board fixing screws (2 off) and orientate control board to allow access to power board.
  - c) Identify internal field supply link (colour-Red) where it is connected by “Faston” at the left hand side of Terminal D1. Remove this link from the faston connection and place on staging post “F8” located to the left. *(To enable positive identification of the correct link, Faston F8 should now be connected to FS2, and L1. Verify by continuity test)*
  - d) Identify internal field supply link (colour-Yellow) where it is connected by “Faston” at the mid-point below terminals D1 & D2. Remove this link from the faston connection and place on staging post “F16” located to the left. *(To enable positive identification of the correct link, Faston F16 should now be connected to FS3, and L2. Verify by continuity test)*
  - e) The External Field Supply can now be connected via externally mounted fast acting 20 Amp fuses. *(Note that the phase of D1 must be derived from L1, and the phase of D2 must be derived from L2).*

POWER BOARD AH385621



## 10 The European Directives and the 'CE' Mark

### CEMEP

Until recently each European drives manufacturer and importer has been interpreting the EMC directive and 'CE' marking requirements differently. This has led to considerable confusion and frustration in the market place. To provide a unified approach, the European machines and drives manufactures, via their national trade associations have formed the 'European Committee of Manufacturers of Electrical Machines and Power Electronics', termed CEMEP. This committee has produced a document entitled "Recommendations for Application of Power Drive Systems (PDS), European Council Directives - CE Marking and Technical Standardisation", which will be followed by all major European Drives manufacturer. A copy is available from your local trade association or from your local Eurotherm Drives office.

### EMC DIRECTIVE

#### 'CE' EMC Responsibility

The subject of CE marking and EMC is explored in more detail in a separate Eurotherm Application manual entitled 'EMC Installation Guidelines for modules and systems', part number HA388879, available from your local Eurotherm Drives office. The following sections are the minimum necessary for basic understanding.

Eurotherm Drives are adhering to the CEMEP recommendations on 'CE' marking for EMC. According to SI No. 2372, implementing the EMC directive into UK law, the requirement to CE mark for EMC, applies only to **relevant apparatus** that has '**intrinsic function**' to the **end user** and which is placed on the market (**supplied**). The majority of drive modules/systems sold by Eurotherm Drives will be incorporated into a higher system/apparatus or machine which includes (at least) the motor, cable and a driven load before providing intrinsic function to the end user. As such the majority of Eurotherm Drives products are categorised as **components** (CEMEP validity field 2) and it would be incorrect for Eurotherm Drives to apply the CE mark or produce an EC Declaration of Conformity in respect of EMC. It is the manufacturer/supplier/installer of the relevant apparatus (with the intrinsic function to the end user) who must demonstrate conformance to the EMC directive

However, in a minority of cases, single drives may have intrinsic function to the end user. An example is that of '**add on**' intrinsic function, where an existing fixed speed motor application (such as a fan or a pump) is converted to variable speed with an **add on** drive module (CEMEP validity field 1). In this application Eurotherm Drives CE mark its drive module and issue an EC declaration of conformity. Because the validity of the 'CE' mark for EMC is not known when the product is manufactured, the 'CE' mark will be applied via the product manual, and will not be on the product label. From 1997, when the 'CE' mark for the Low Voltage Directive becomes mandatory, the CE mark will appear on the product label, but its validity for EMC can only be identified from the product manual.

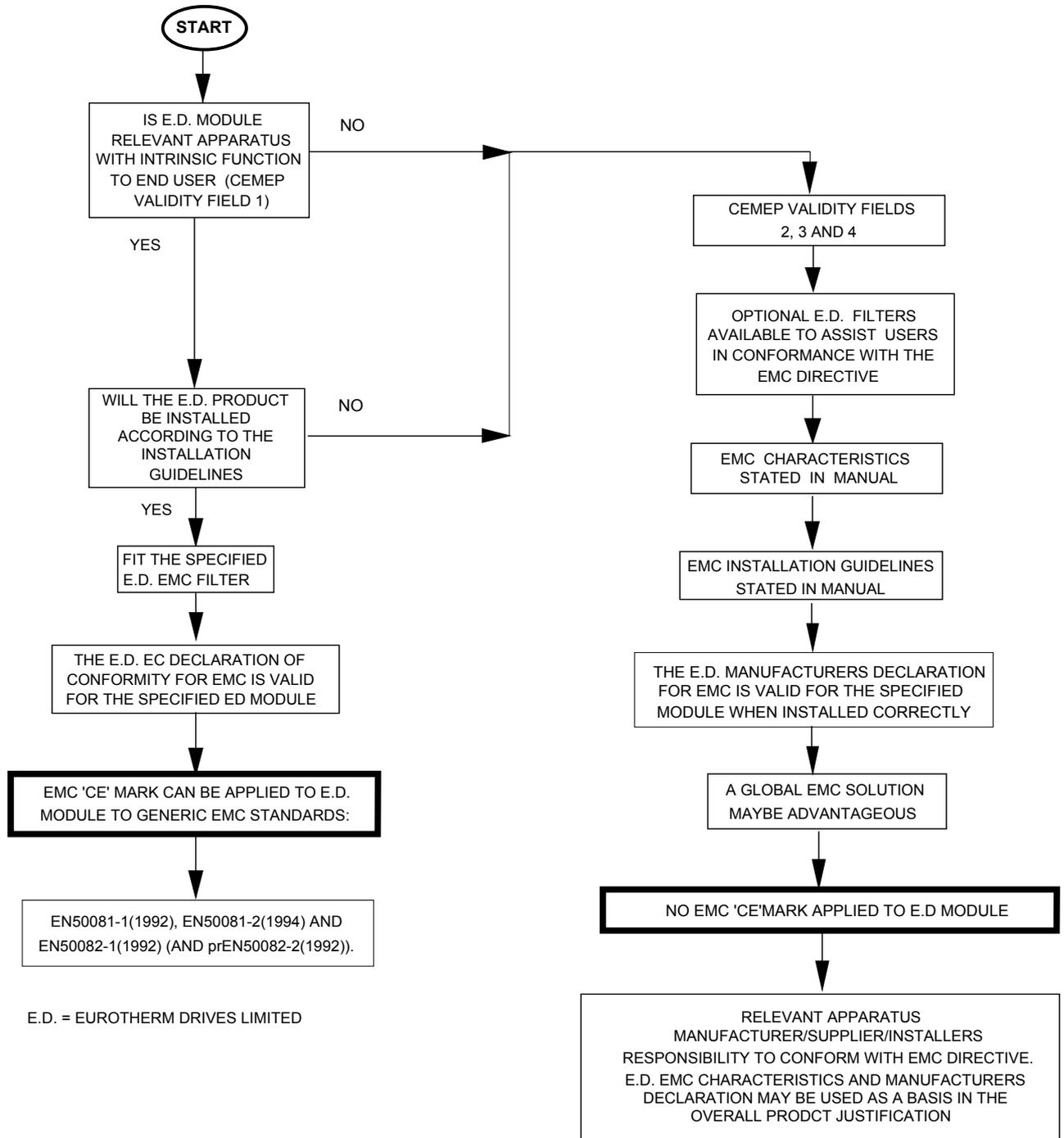
The validity of the 'CE' mark can be identified from the flowchart in figure 10.1, refer to SI No. 2372 for clarification of relevant apparatus.

To assist manufacturers/suppliers/installers of relevant apparatus, Eurotherms 590 drive modules are EMC compliant to EN50081-2 (1994) and prEN50082-2 (1992), when fitted with the specified filter and choke and installed according to these instructions, (as confirmed by the Manufacturers EMC declaration to be found at the end of this chapter).

Manufacturers/suppliers/installers of relevant apparatus (CEMEP validity fields 3 & 4) may use this compliance as a basis for their own justification of overall compliance with the EMC Directive.

It must be clearly understood by the customer before installation commences who is legally responsible for conformance with the EMC Directive. Misappropriation of the CE mark is a criminal offence.

**Figure 10.1 Eurotherm EMC 'CE' Mark Validity Chart**



## CONSIDERATION OF EMC ENVIRONMENT

When considering the relevant EMC emission and immunity standards it is important to distinguish between the following classes of EMC environments:

	Residential, supplied directly from public electricity supply 		Commercial and light industry, supplied directly from public electricity supply 		Industrial installation with a separate transformer station 	
	RF emission	Immunity	RF emission	Immunity	RF emission	Immunity
<b>Basic and Generic Standards</b>	EN55011 (Class B) or EN50081-1(1992)	EN50082-1(1992) see below for referenced standards	EN55011 (Class B) or EN50081-1(1992)	EN50082-1(1992) see below for referenced standards	EN55011 (Class A) or EN50081-2(1994)	EN50082-2 (1992) see below for referenced standards
<b>New EMC Product Standard (draft) for Power Drive Systems</b>  IEC-22G/31/FDIS <sup>+</sup> (will become EN 61800-3)	Unrestricted distribution (CEMEP-1): < 25 A Class B > 25 A Class A  Restricted distribution (CEMEP-2) Class A	see below  ↓	EMC measures do not have to be implemented  If interference in a neighbouring installation occurs, the operator is responsible for taking measures to prevent interference. In this case the required emission levels must be adhered to at the point of supply to the effected neighbouring installation.	see below  ↓	EMC measures do not have to be implemented  If interference in a neighbouring installation occurs, the operator is responsible for taking measures to prevent interference. In this case the required emission levels must be adhered to at the point of supply to the effected neighbouring installation.	see below  ↓
<sup>+</sup> This new Product Standard Draft has not yet been finally passed and more important, is not EC approved. An EC Declaration of Conformity for EMC can only be issued with the approval of a "Competent Body". It is anticipated this standard will be officially released during Q 3/4 1996.  * New standards to be introduced in the near future	Standards for immunity: IEC801-2 (IEC1000-4-2*): Electrostatic discharge (e.g. from electrostatically charged persons) IEC801-3 (IEC1000-4-3/6*): Electromagnetic fields (e.g. from portable telephones) IEC801-4 (IEC1000-4-4*): Fast electrical transients (burst) (e.g. from opening contacts in inductive circuits) IEC801-5 (IEC1000-4-5): Voltage surges (e.g. on local lightning strikes).					

**Figure 10-2: EMC Emission and Immunity Standards applicable to 590 drive modules and similar equipment**

When using the generic EMC standards, the 'Residential, commercial and light industry' emission limits (Class B) are more stringent than the 'Industrial' (class A) limits, and so equipment which meets EN50081-1(1992) automatically meets EN50081-2(1994). Similarly, the 'Industrial' immunity requirements are more stringent than the 'Residential, commercial and light industry' requirements, and equipment which meets prEN50082-2(1992) automatically meets EN50082-1(1992).

More and more Product Specific standards are being released with less onerous EMC requirements than the Generic Standards. When the new EMC Drive Product Standard for Power Drive System (EN61800-3) becomes available (Q 3/4 1996), EMC filters will only be **mandatory** in 'residential' type EMC environments (if this is the most appropriate standard to use for demonstrating conformance of the relevant apparatus). EMC competent bodies are today using the draft EMC Drive Product Standard to demonstrate conformance using the technical construction file route. The EMC Drive Product Standard as CEMEP is discussed in more detail in the Eurotherm Application manual entitled 'EMC Installation Guidelines for modules and systems', part number HA388879, available from your local Eurotherm Drives office.

It is important for the customer to identify what EMC standards are to be applied to the final machine/system and in what EMC environment it will operate, so that any additional compliance costs can be minimised. It should be remembered that when two or more EMC compliant components are combined to form the final machine/system, the resulting machine/system may not be compliant. Emissions from combined components tend to be additive, whilst the immunity remains constant.

## FILTER SELECTION AND LINE CHOKE

590 drive modules can be 'CE' marked (as in CEMEP validity field 1) when used with the specified specially designed EMC filters to comply with the mains terminal limits of EN55011 Class B (or EN50081-1) as indicated previously, and when installed in accordance with the **EMC installation instructions** in this Product Manual (chapter 4). The Class A limit allows product to be used in 'industrial' EMC environments. Refer to **Consideration of EMC environments**, in this chapter for more details. The specified EMC filters for the 590 drive modules are summarised in table A and B in Chapter 4 EMC Installation guidelines. The fitment of the specified EMC filter and line chokes is **mandatory** where 'CE' marking is applied.

If the customer is treating the 590 drive module as a **component for supply to EMC competent professional assemblers** (CEMEP validity field 2) and is taking the EMC responsibility, then the filters are optional and may assist the customer in achieving EMC compliance. In this situation the customer may also achieve compliance by less expensive more global measures depending on the limits to be achieved, such as the use of a combination of global or local filtering and screening methods, natural mitigation through distance or use of distributed parasitic elements of the existing installation.

## FILTER INSTALLATION

The required EMC emission and immunity performance, and 'CE' marking of 590 drive modules can only be achieved when the **EMC installation instructions** in Chapter 4 are adhered to.

## SPECIFICATION OF ACHIEVABLE EMC EMISSION AND IMMUNITY

590 drive modules with the option to be 'CE' marked meet the following EMC emission limits provided they are installed with the specified EMC filters and line chokes for 'CE' marking in accordance with the EMC installation instructions.

Port	Phenomenon	Basic standard	Level	Generic standard
Enclosure Port	radiated	EN55011 (1991)	Class B (cubicle mount)	EN50081-1 (1992)
			Class A (wall mount)	EN50081-2 (1994)
AC Power Port	conducted (with specified filter)	EN55011 (1991)	Class A	EN50081-2 (1992)
AC Power Port	conducted ( <b>no filter</b> )	EN55011 (1991)	130dB $\mu$ V @ 150kHz* (common mode) 130dB $\mu$ V @ 150kHz* (differential mode) Reducing with frequency by 20dB/decade	

\* 50 metres screened motor cable.

All 590 drive modules meet the following EMC immunity performance criteria as defined in prEN50082-2 (1992) when installed and used as recommended.

Port	Phenomenon	Test Standard	Level	Acceptance Criterion	Generic Standard
Enclosure Port	ESD	IEC 1000-4*	6 kV CD, 8 kV AD	self recovery	EN50082-1 (1992)  Draft prEN50082-2 (1992)
	RF Field	IEC 1000-4	10 V/m, 1 kHz AM	no change	
Power Ports	Fast Transient	IEC 1000-4,	2 kV	self recovery	
	Burst, Surge	IEC 1000-4	1 kV (P-P), 2 kV (P-E) available late 1996	self recovery	
Signal & Control	Fast Transient Burst	IEC 1000-4	2 kV	self recovery	
Power Interfaces	Fast Transient Burst	IEC 1000-4	2 kV	self recovery	

\* only for cubicle mount.

The EMC filters for 590 drive modules may be flash tested in circuit up to DC 2850 V for 1 min Ensure all other equipment that may be damaged by such flash testing has been suitably isolated/removed/short circuited as applicable. Due to the internal capacitors between phase and earth, the DC voltage should be wound up slowly, to prevent excessive earth current. For similar reasons AC flash testing cannot be performed due to the excessive earth leakage current. Repeated flash testing is not recommended as it may degrade the insulation.

## EMC RESPONSIBILITY OF MANUFACTURERS/SUPPLIERS/INSTALLERS

For end users of 590 drive modules, a correctly installed power drive system (PDS) created from the supplied 590 will be compliant with the generic emission standards EN50081-2(1994) and for immunity prEN50082-2(1992) as previously indicated. Manufacturers/suppliers/installers of relevant apparatus may use this compliance as a basis for their own justification of overall compliance with the EMC Directive.

If it is the responsibility of the manufacturer/supplier/installer to establish EMC conformity and to 'CE' mark. There are three methods of demonstrating conformity:

- 1) Self certification to a relevant standard
- 2) Third party testing to a relevant standard
- 3) Writing a technical construction file stating the technical rationale as to why the relevant apparatus is compliant. An EMC "competent body" must then assess this and issue a technical report or certificate to demonstrate compliance.

Upon demonstrating EMC compliance an EC-Declaration of Conformity for the apparatus or machine may be issued and a 'CE' mark applied.

**Professional end users with EMC expertise who are using drive modules and cubicle systems defined as components who supply, place on the market or install the relevant apparatus must take responsibility for demonstrating EMC conformance and applying the 'CE' mark and issuing an EC Declaration of Conformity.**

## Eurotherm Guide

More information is available in a separate Eurotherm Guide entitled "Short Form Overview of European Directives for Variable Speed Drives and Applications" part number HA389770 available from your local Eurotherm Drives office.

**Certificates**

<b>590A/D/L (35 - 800 Amps)</b>				
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 2em; font-weight: bold;">CE</div> <div style="text-align: center;"> <p><b>EC DECLARATIONS OF CONFORMITY</b></p> <p>Date CE marked first applied: 09/01/98</p> </div> </div>				
<b>EMC Directive</b>		<b>Low Voltage Directive</b>		
<p>In accordance with the EEC Directive 89/336/EEC and amended by 92/31/EEC and 93/68/EEC, Article 10 and Annex 1, (EMC DIRECTIVE)</p> <p>We Eurotherm Drives Limited, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment) is in accordance with the relevant clauses from the following standards:-</p> <p>BSEN50081-2 (1994), BSEN50082-1# (1998) and draft prEN50082-2#* (1992)</p>		<p>In accordance with the EEC Directive 73/23/EEC and amended by 93/68/EEC, Article 13 and Annex III, (LOW VOLTAGE DIRECTIVE)</p> <p>We Eurotherm Drives Limited, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment), is in accordance with the following standard :-</p> <p>EN50178 (1998)</p>		
<b>MANUFACTURERS DECLARATIONS</b>				
<b>EMC Declaration</b>		<b>Machinery Directive</b>		
<p>We Eurotherm Drives Limited, address as below, declare under our sole responsibility that the above Electronic Products when installed and operated with reference to the instructions in the Product Manual (provided with each piece of equipment) is in accordance with the relevant clauses from the following standards:-</p> <p>BSEN50081-2 (1994), BSEN50082-1# (1992), draft prEN50082-2#* (1992)</p>		<p>The above Electronic Products are components to be incorporated into machinery and may not be operated alone. The complete machinery or installation using this equipment may only be put into service when the safety considerations of the Directive 89/392/EEC are fully adhered to.</p> <p>Particular reference should be made to EN60204-1 (Safety of Machinery - Electrical Equipment of Machines).</p> <p>All instructions, warnings and safety information of the Product Manual must be adhered to.</p>		
 <p>Dr Martin Payn (Conformance Officer)</p>				
<p><i>For information only.</i></p> <p># Compliant with these immunity standards without specified EMC filters.</p>				
<p><b>EUROTHERM DRIVES LIMITED</b> <span style="float: right;">An Invensys Company</span></p> <p>NEW COURTWICK LANE, LITTLEHAMPTON, WEST SUSSEX BN17 7RZ</p> <p>TELEPHONE: +44(0)1903 737000 FAX: +44(0)1903 737100</p> <p>Registered Number: 1159876 England. Registered Office: Invensys House, Carlisle Place, London, SW1P 1BX</p> <p style="font-size: 0.8em;">File Name: I:\Manuals\590A Contoller\HA387179 Issue 10\10.WRD <span style="float: right;">© 2001 EUROTHERM DRIVES LIMITED</span></p>				
ISS:	DATE	DRN: MP	CHKD: JMC	DRAWING NUMBER: HK389957.919
A	09/01/98	 <b>EUROTHERM DRIVES</b>		<p>TITLE:</p> <p style="text-align: center;">Declarations of Conformity</p> <p style="text-align: right; font-size: 0.8em;">SHT 6 OF 1 SHTS</p>

Issued for compliance with the EMC Directive when the unit is used as *relevant apparatus*.

This is provided to aid your justification for EMC compliance when the unit is used as a component.

The drive is CE marked in accordance with the low voltage directive for electrical equipment and appliances in the voltage range when installed correctly.

Since the potential hazards are mainly electrical rather than mechanical, the drive does not fall under the machinery directive. However, we do supply a manufacturer's declaration for when the drive is used (as a component) in machinery.

## 11. SPARES KITS AND SPARE PART IDENTIFICATION LIST

All spares requirements for the 590A/591A product family can be specified using an alpha-numeric code. For installations of 5 or more drives we recommend the holding of a complete spare drive. For installations of up to 5 drives we recommend the holding of a Spares Kit which can be ordered using the Product Code and therefore saves time, obtains the best price and reduces the risk of poor spares coverage.

Note: rationalisation of drive rating can dramatically reduce the spares holdings.

Block No	No of Digits	Function
1	7	Spares Order
2	4	Product (590A/591A)
3	10	Item (Kit or Part)
4	4	Current Rating
5	1	Supply Voltage (Power)
6	1	Supply Voltage (Auxiliary)
7	2	Special Options

The 7 blocks are defined as follows:

- Block 1: SPARE4 (Identifies Spares Order)
- Block 2: 590A (3 phase, 4 Quadrant regenerative convertor 35A to 720A.)  
591A (3 phase, 2 Quadrant non-regenerative convertor 35A to 720A.)  
4 Digits identifying spares for specific product i.e. 590A or 591A.
- Block 3: 10 Digits identifying the specific Part (see list of available spares below)
- Block 4: 4 Digits identifying the DC output current rating (see section 3)
- Block 5: 1 Digit identifying the nominal 3 Phase AC power supply voltage (see section 3)
- Block 6: 1 Digit identifying the auxiliary AC control supply (see section 3)
- Block 7: 2 Digits identifying special options  
0 No special options  
01 to 98 Documented special options

<u>ITEM</u>	<u>ITEM CODE REFERENCE</u>
KIT	KIT
CONTROL BOARD	CONTROL_DR
POWER BOARD (ALL IN ONE)	POWER_ALL
POWER BOARD (DISCRETE)	POWER
TRIGGER BOARD	TRIGGER
SUPPRESSION BOARD	SUPP
ARMATURE THYRISTOR	THYRISTOR
FIELD REGULATOR	FIELD_REG
FIELD THYRISTOR	FIELD_THY
FIELD DIODE	FIELD_DIOD
AUXILIARY FUSE	FUSE_AUX
CODING FUSE	FUSE_CODE
STACK TEMPERATURE SWITCH	TEMP_SW
STACK FAN INTERNAL	FAN_INT
STACK FAN EXTERNAL	FAN_EXT
FAN CAPACITOR	FAN_CAP

EXAMPLE: SPARE4/590A/KIT/0350/6/0/00

(Spares Kit Complete: 590A, 35AMP, 415 Volt 3 Phase, 110 Volt Auxiliary, No Special Options)

EXAMPLE: SPARE4/591A/CONTROL\_DR/7200/6/0/00

(Control Board in enclosure,591A,720AMP, 415 Volt 3 Phase,110 Volt Auxiliary, No Special Options)

**TABLE 1 - PRODUCT RATING 590A**

PRODUCT RATING 590A	35.0 AMP	70.0 AMP	110.0 AMP	150.0 AMP	180.0 AMP	270.0 AMP	360.0 AMP	450.0 AMP	720.0 AMP	XXXX.X AMP ②
SPARES KIT PART No. ①	SPARE_4/590A/0350/KIT/③/④/0	SPARE_4/590A/0700/KIT/③/④/0	SPARE_4/590A/1100/KIT/③/④/0	SPARE_4/590A/1500/KIT/③/④/0	SPARE_4/590A/1800/KIT/③/④/0	SPARE_4/590A/2700/KIT/③/④/0	SPARE_4/590A/3600/KIT/③/④/0	SPARE_4/590A/4500KIT/③/④/0	SPARE_4/590A/7200/KIT/③/④/0	SPARE_5/598A/****/KIT/③/④
CONTROL BOARD	CONTROL_DR	CONTROL_DR	CONTROL_DR	CONTROL_DR						
POWER BOARD	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER	POWER	POWER	POWER
TRIGGER BOARD	-	-	-	-	-	-	TRIGGER	TRIGGER	TRIGGER	TRIGGER
SUPPRESSION BOARD	-	-	-	-	-	-	SUPP	SUPP	SUPP	SUPP
ARMATURE THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	CONTACT E.D. Ltd.
FIELD REGULATOR	FIELD_REG	FIELD_REG	FIELD_REG	-						
FIELD THYRISTOR	-	-	-	-	-	-	-	-	-	FIELD_THY
FIELD DIODE	-	-	-	-	-	-	-	-	-	FIELD_DIOD
AUXILIARY FUSE	FUSE_AUX	FUSE_AUX	FUSE_AUX	FUSE_AUX						
CODING FUSE	FUSE_CODE	FUSE_CODE	FUSE_CODE	CONTACT E.D. Ltd.						
STACK TEMP. SWITCH	-	-	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	CONTACT E.D. Ltd.
STACK FAN INTERNAL	-	-	FAN_INT	FAN_INT	FAN_INT	FAN_INT	FAN_INT	-	FAN_INT	CONTACT E.D. Ltd.
STACK FAN EXTERNAL	-	-	-	-	-	-	-	FAN_EXT	FAN_EXT	CONTACT E.D. Ltd.
FAN CAPACITOR	-	-	-	-	FAN_CAP	-	FAN_CAP	-	-	CONTACT E.D. Ltd.

- ① Spares Kit includes all listed items
- ② Spares Kit is complete Control Chassis
- ③ Supply Voltage (Power) Refer to Section 3
- ④ Supply Voltage (Aux) Refer to Section 3

**TABLE 2 - PRODUCT RATING 591A**

PRODUCT RATING 591A	35.0 AMP	70.0 AMP	110.0 AMP	150.0 AMP	180.0 AMP	270.0 AMP	360.0 AMP	450.0 AMP	720.0 AMP	XXXX.X AMP ②
SPARES KIT PART No. ①	SPARE_4/591A/0350/KIT/③/④/0	SPARE_4/591A/0700/KIT/③/④/0	SPARE_4/591A/1100/KIT/③/④/0	SPARE_4/591A/1500/KIT/③/④/0	SPARE_4/591A/1800/KIT/③/④/0	SPARE_4/591A/2700/KIT/③/④/0	SPARE_4/591A/3600/KIT/③/④/0	SPARE_4/591A/4500KIT/③/④/0	SPARE_4/591A/7200/KIT/③/④/0	SPARE_5/599A/****/KIT/③/④
CONTROL BOARD	CONTROL_DR	CONTROL_DR	CONTROL_DR	CONTROL_DR						
POWER BOARD	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER_ALL	POWER	POWER	POWER	POWER
TRIGGER BOARD	-	-	-	-	-	-	TRIGGER	TRIGGER	TRIGGER	TRIGGER
SUPPRESSION BOARD	-	-	-	-	-	-	SUPP	SUPP	SUPP	SUPP
ARMATURE THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	THYRISTOR	CONTACT E.D. Ltd.
FIELD REGULATOR	FIELD_REG	FIELD_REG	FIELD_REG	-						
FIELD THYRISTOR	-	-	-	-	-	-	-	-	-	FIELD_THY
FIELD DIODE	-	-	-	-	-	-	-	-	-	FIELD_DIOD
AUXILIARY FUSE	FUSE_AUX	FUSE_AUX	FUSE_AUX	FUSE_AUX						
CODING FUSE	FUSE_CODE	FUSE_CODE	FUSE_CODE	CONTACT E.D. Ltd.						
STACK TEMP. SWITCH	-	-	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	TEMP_SW	CONTACT E.D. Ltd.
STACK FAN INTERNAL	-	-	FAN_INT	FAN_INT	FAN_INT	FAN_INT	FAN_INT	-	FAN_INT	CONTACT E.D. Ltd.
STACK FAN EXTERNAL	-	-	-	-	-	-	-	FAN_EXT	FAN_EXT	CONTACT E.D. Ltd.
FAN CAPACITOR	-	-	-	-	FAN_CAP	-	FAN_CAP	-	-	CONTACT E.D. Ltd.

- ① Spares Kit includes all listed items
- ② Spares Kit is complete Control Chassis
- ③ Supply Voltage (Power) Refer to Section 3
- ④ Supply Voltage (Aux) Refer to Section 3

## 12. SERVICE INFORMATION

### 12.1 MAINTENANCE

Solid state control equipment is very reliable and will give many years of trouble free operation.

However, it is good practice for the user to exercise a regular maintenance program for this equipment. Below is a typical sequence, but this may need to be modified by the actual conditions.

#### **BEFORE PERFORMING ANY MAINTENANCE ON THIS PRODUCT ENSURE THAT ALL CIRCUITS ARE ISOLATED AND LOCKED OFF.**

At six monthly intervals check:

mounting fixtures	}	
power connections	}	do not use a
signal connections	}	compressed air
that for force vent units, the fan is able to rotate without obstruction.	}	gun for cleaning
that the ventilation spaces above and below are free from any obstruction.	}	
that all covers are firmly installed.	}	

Note: 720Amp controllers and have removable rear access covers to all cleaning of air- path (see HG 049669)

Maintenance is always enhanced by the availability of spares sufficient to minimise down time.

Never forget that maintenance is more effective if your engineers have been properly trained. Eurotherm Drives operate a training program especially tailored for your requirement.

### 12.2 CUSTOMER ASSISTANCE FACILITIES

Eurotherm Drives operate a range of customer assistance facilities:

- Sales
- Service/Commissioning
- Repairs
- Technical
- Training
- System Design & Build

<b>PLEASE BEFORE MAKING CONTACT -</b>	WHAT IS THE PRODUCT?
	WHAT IS THE MODEL NUMBER?
	WHAT IS THE SERIAL NUMBER?
	FAULT LOG REPORT
	COMMISSIONING PARAMETERS
	MOTOR NAME-PLATE DETAILS

**A LEGIBLE, CLEAR, AND CONCISE FAX IS THE BEST METHOD TO BEGIN THE ASSISTANCE YOUR REQUIRE.**

Sales: Sales department will be able to quote price and delivery of replacement product and/or spares. Training and system design information is also available.

Service/Commissioning: Service department will be able to advise costs and availability of a Service Engineer to visit your installation to resolve your problem.

Technical: Technical advice can be given, prepare your enquiry properly to avoid confusion.

Repairs: Before returning equipment to the factory, ensure all details are checked

NOTE: IT IS IMPORTANT THAT THE RETURNED MATERIAL IS PROTECTED, TYPICALLY FROM INGRESS OR PACKAGING MATERIALS. E.G POLYSTYRENE/STYROFIL CHIPS WHICH MAY DAMAGE THE PRODUCT AND LEAD TO INCREASED REPAIR CHARGE AND REPAIR TIME.

## Disposal

This product contains materials which are consignable waste under the Special Waste Regulations 1996 which complies with the EC Hazardous Waste Directive – Directive 91/689/EEC.

We recommend you dispose of the appropriate materials in accordance with the valid environmental control laws. The following table shows which materials can be recycled and which have to be disposed of in a special way.

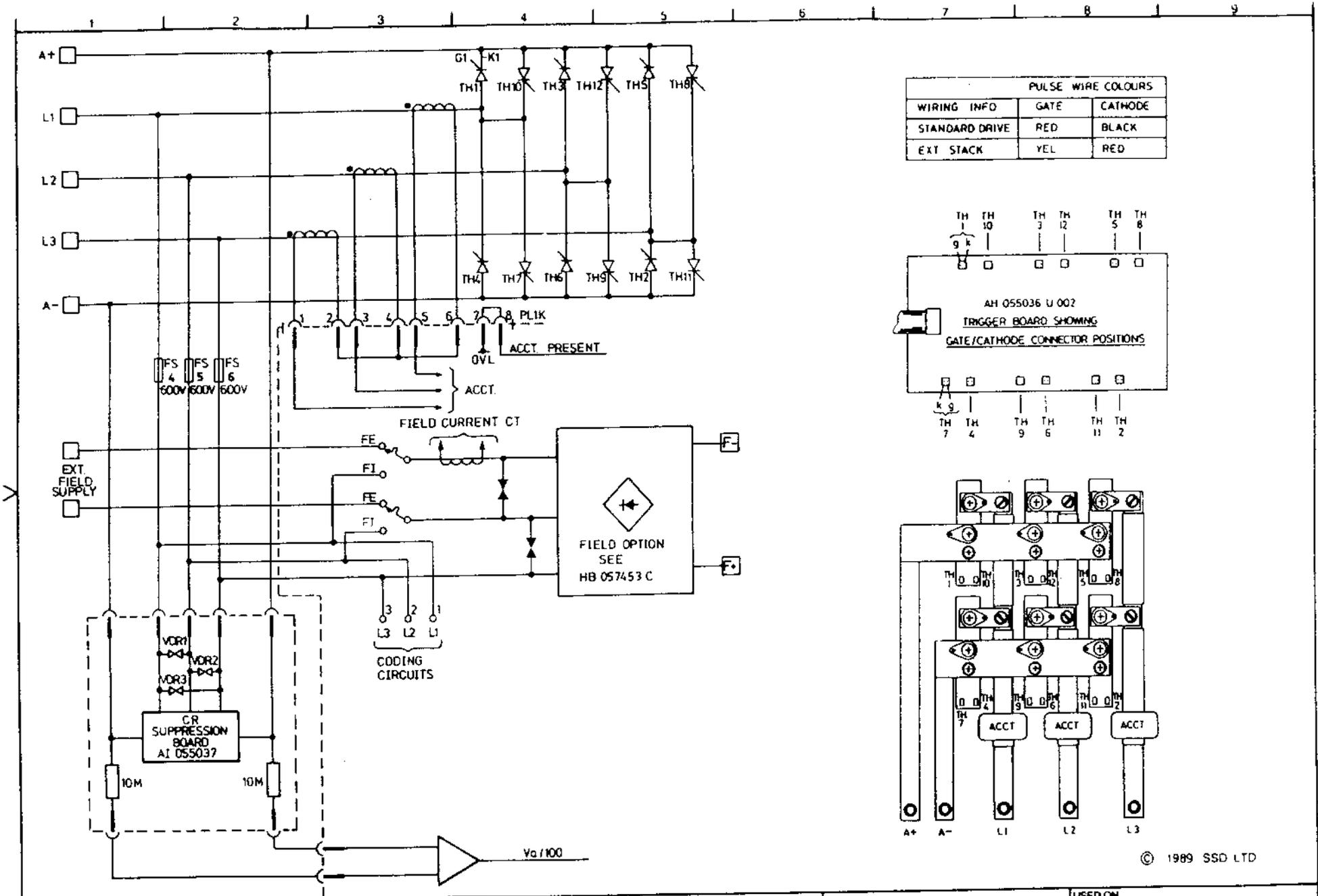
Material	Recycle	Disposal
Metal	Yes	No
Plastics material	Yes	No
Printed circuit board	No	yes

The printed circuit board should be disposed of in one of two ways:

1. High temperature incineration (minimum temperature 1200°C) by an incinerator authorised under parts A or B of the Environmental Protection Act.
2. Disposal in an engineered land fill site that is licensed to take aluminium electrolytic capacitors. Do not dispose of in a land fill site set aside for domestic waste.

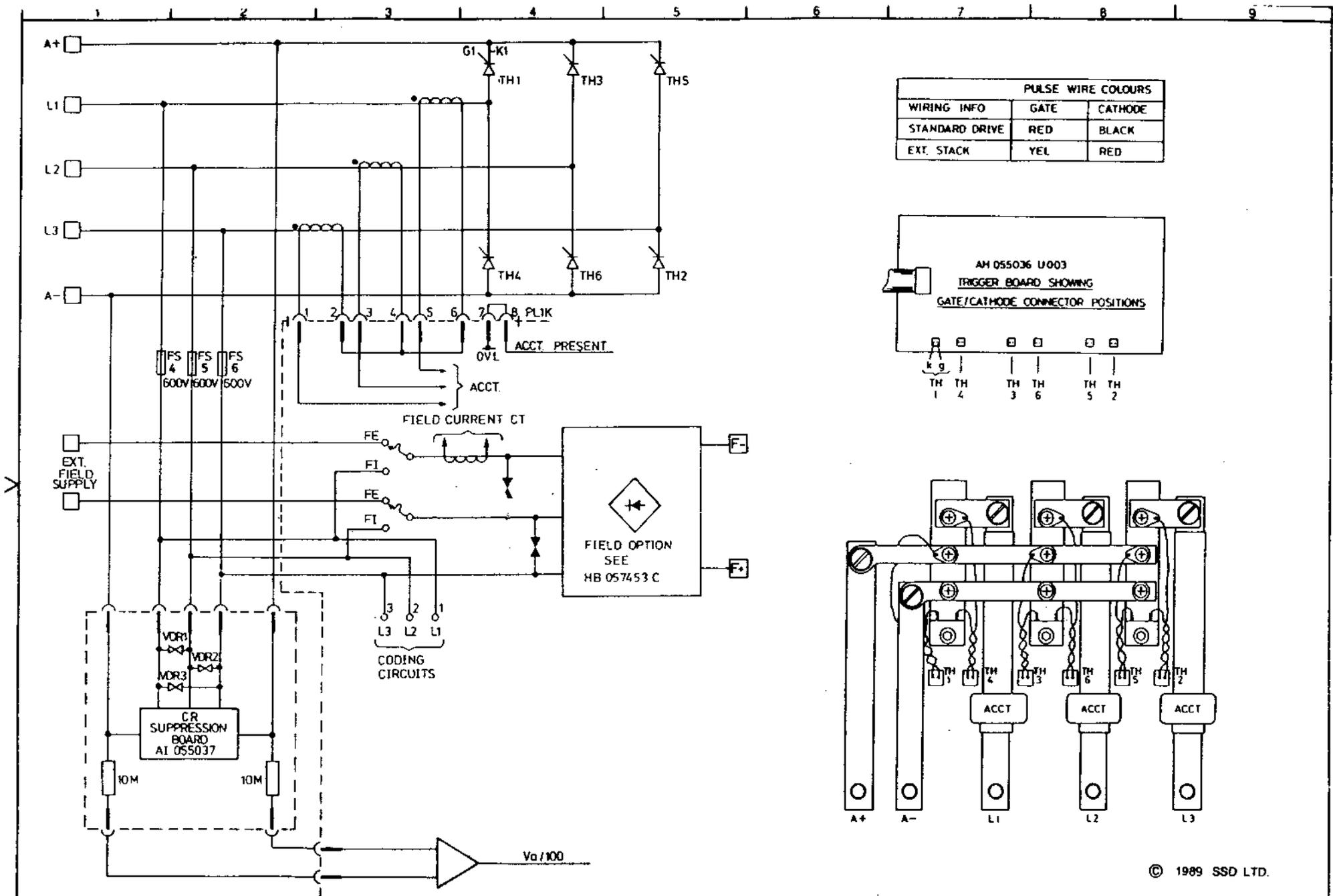
## Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.

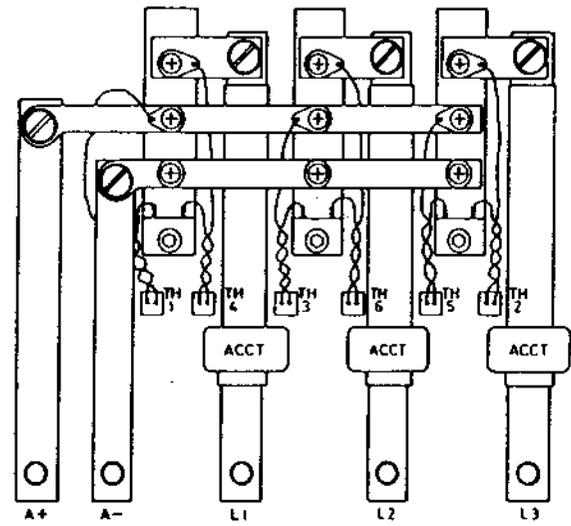
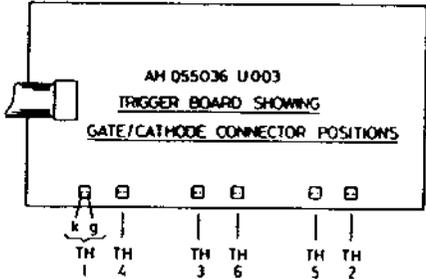


DRAWN WS	CHECKED GDR	DATE A 13 6 89 B 4 3 91 7 30 1 92	ELECTRICAL SYMBOLS TO BS 3939	TITLE DC CONTROLLER 35/70/110/150 AMP. 4 QUAD POWER CIRCUIT	USED ON 570/590 SERIES
TRACED PB/ EDES			SSD LITTLEHAMPTON ENGLAND TELEX 87142	DRAWING NUMBER HJ 057470	SHT 1 OF 1

© 1989 SSD LTD



PULSE WIRE COLOURS		
WIRING INFO	GATE	CATHODE
STANDARD DRIVE	RED	BLACK
EXT. STACK	YEL	RED

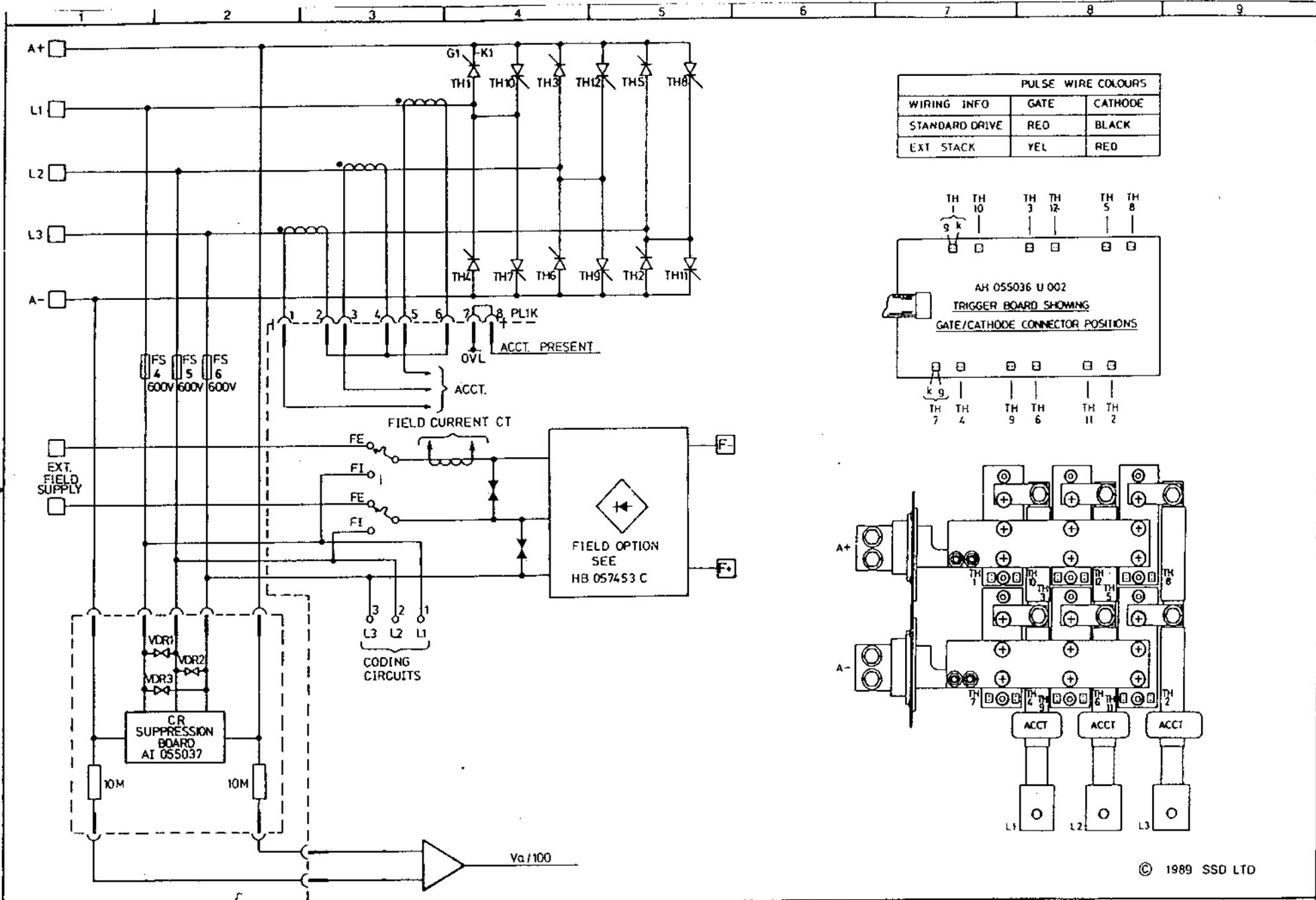


© 1989 SSD LTD.

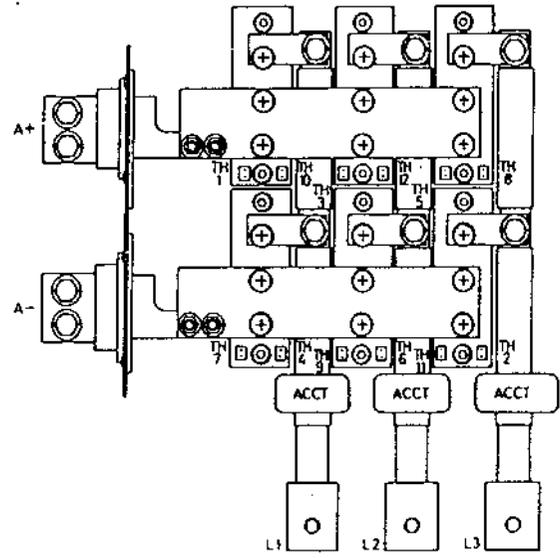
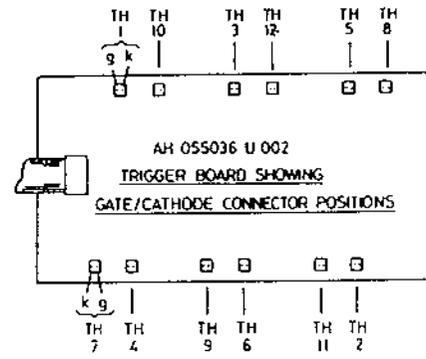
DRAWN WS	CHECKED GOL	DATE 13.6.89 4.3.91 7.30.92	ELECTRICAL SYMBOLS TO BS 3808	TITLE DC CONTROLLER 35/70/110/150A 2 QUAD POWER CIRCUIT	USED ON 570/590 SERIES
TRACED PB/EDES			LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HJ 057471 D
					SHT 1 OF 1

KE0486140

SSS CRAWLEY LTD 28070098

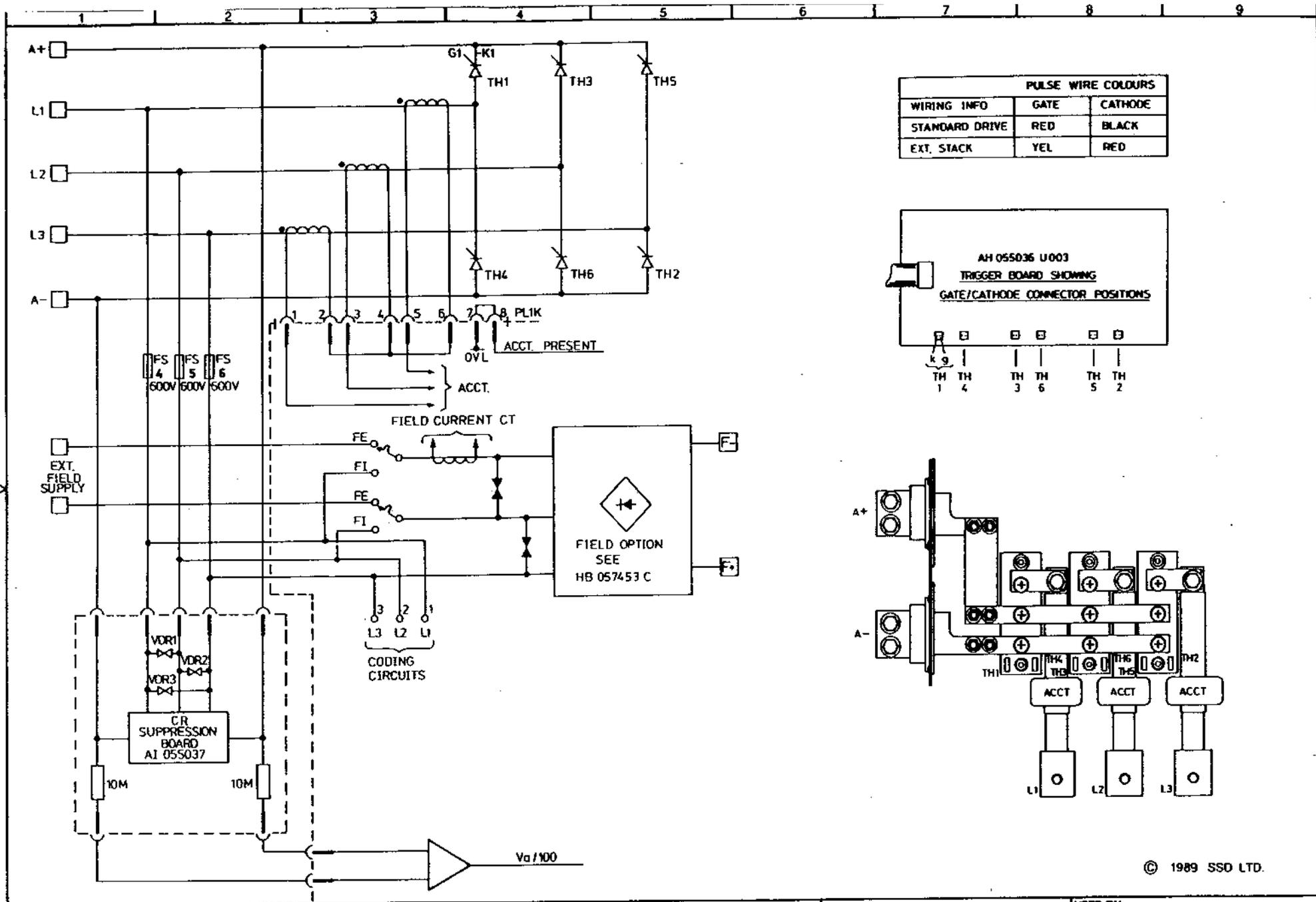


PULSE WIRE COLOURS		
WIRING INFO	GATE	CATHODE
STANDARD DRIVE	RED	BLACK
EXT STACK	YEL	RED

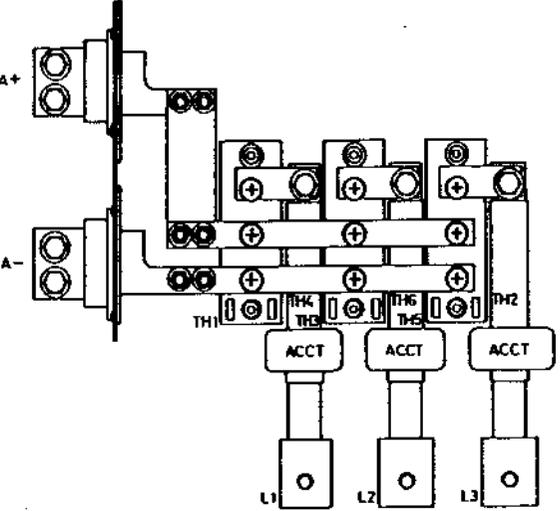
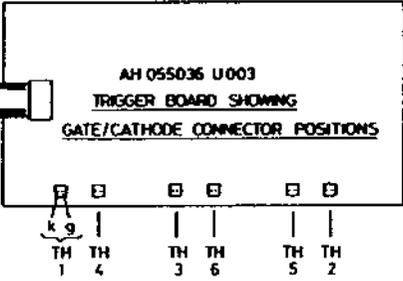


© 1989 SSD LTD

DRAWN WS	CHECKED GDR	DATE 13.6.89 4.5.91	1 30/92	ELECTRICAL SYMBOLS TO BS 3939	TITLE DC CONTROLLER 270A STACK 4 QUAD POWER CIRCUIT	USED ON 570/590 SERIES	DRAWING NUMBER HJ 057472	SHT 1 OF 1
TRACED PB/EDES				LITTLEHAMPTON ENGLAND TELEX 87142				

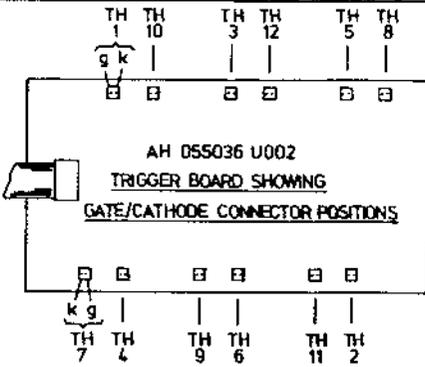
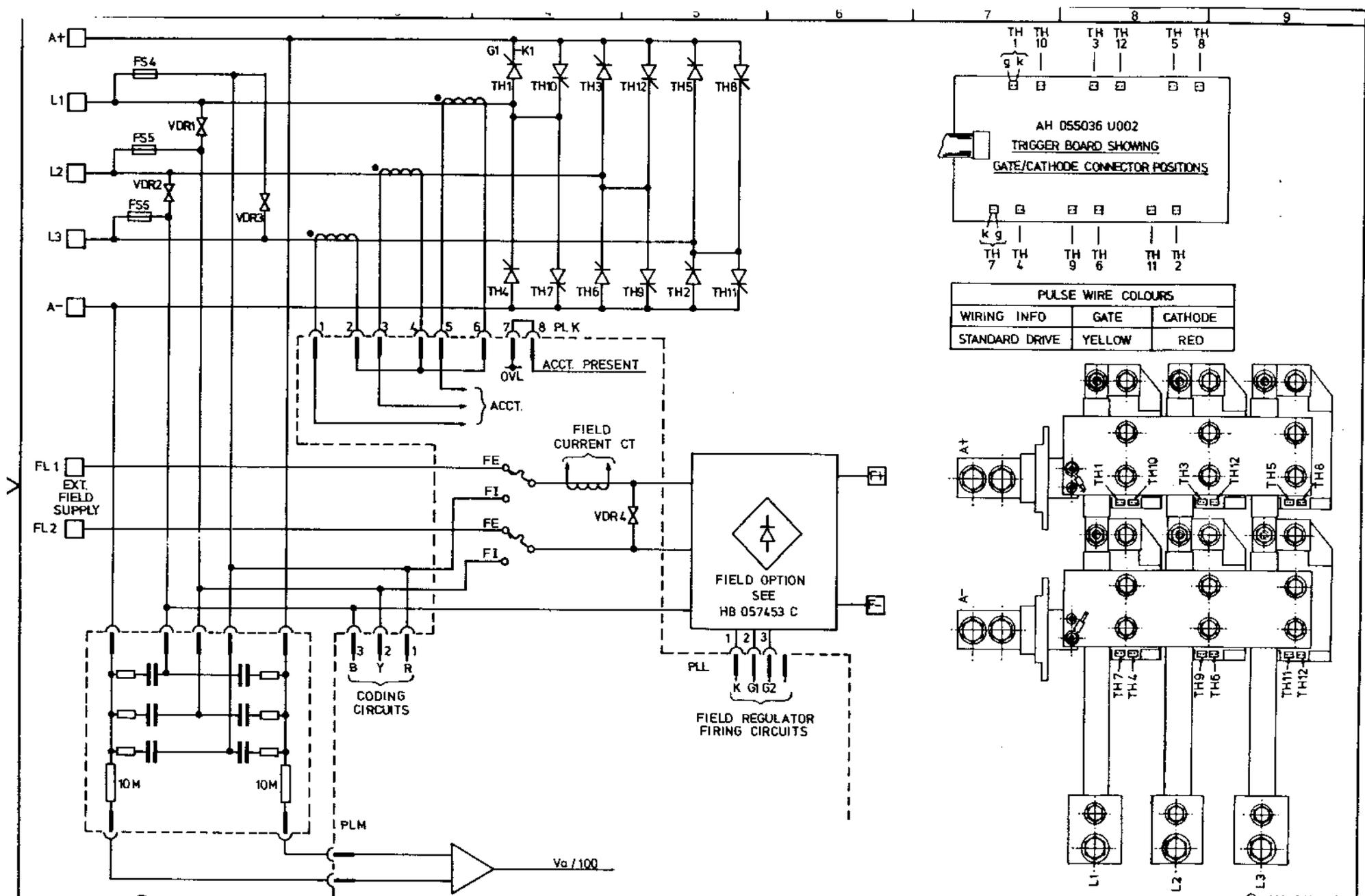


PULSE WIRE COLOURS		
WIRING INFO	GATE	CATHODE
STANDARD DRIVE	RED	BLACK
EXT. STACK	YEL	RED

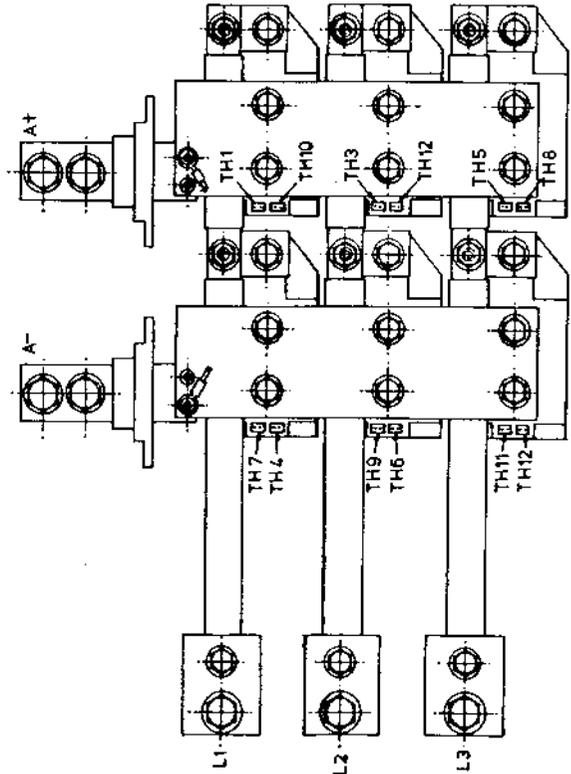


© 1989 SSD LTD.

DRAWN WS CHECKED GDR TRACED PB/EDES	DATE 13-6-89 4-3-91 13/192	ELECTRICAL SYMBOLS TO BS 3939 LITTLEHAMPTON ENGLAND TELEX 87142	TITLE DC CONTROLLER 27DA STACK 2 QUAD POWER CIRCUIT	USED ON 570/590 SERIES DRAWING NUMBER HJ 057473 D	SHIT 1 OF 1
--	-------------------------------------	--	---	---	----------------



PULSE WIRE COLOURS		
WIRING INFO	GATE	CATHODE
STANDARD DRIVE	YELLOW	RED

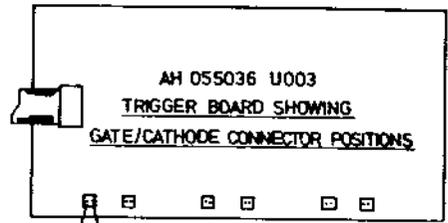
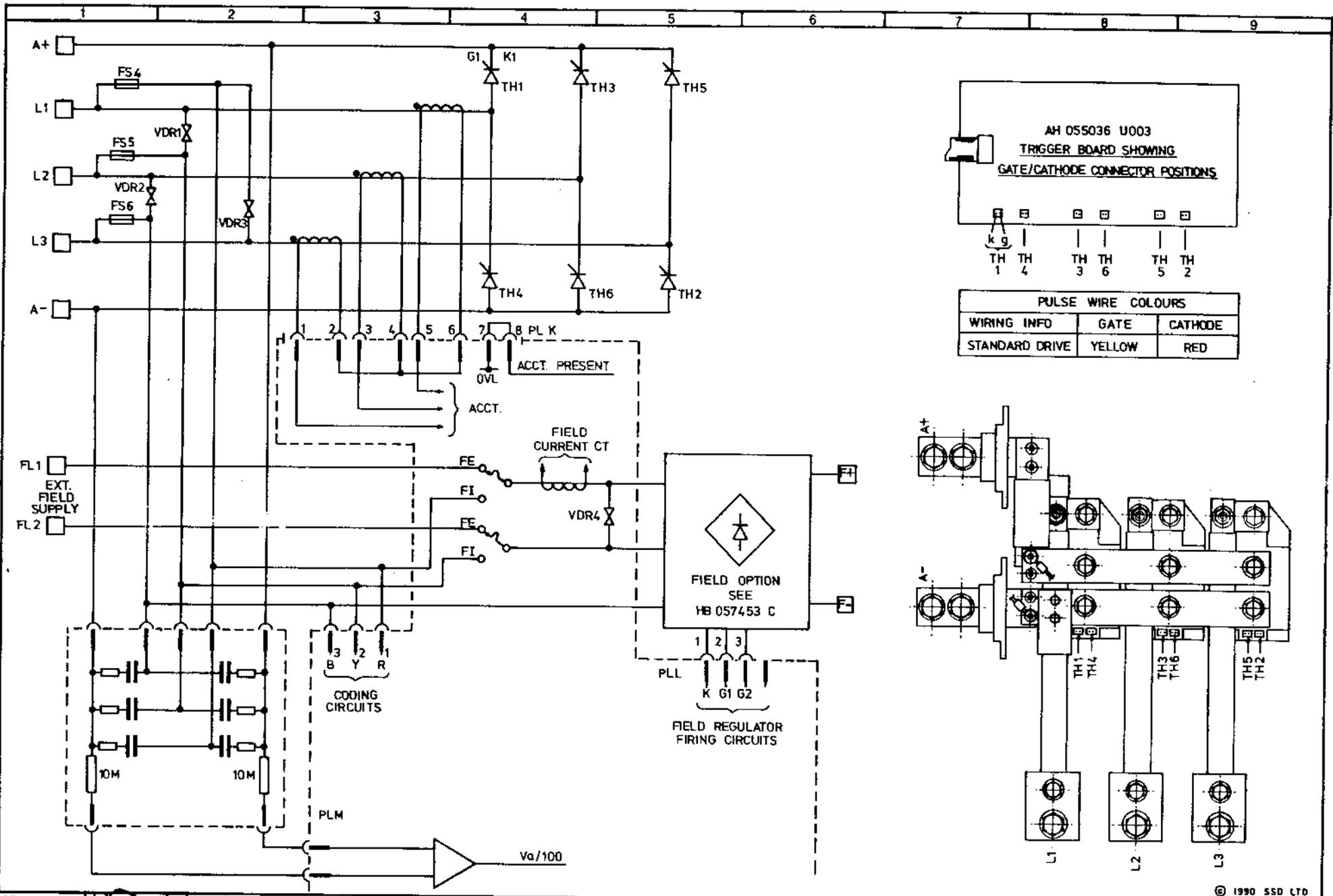


© 1990 SSD LTD

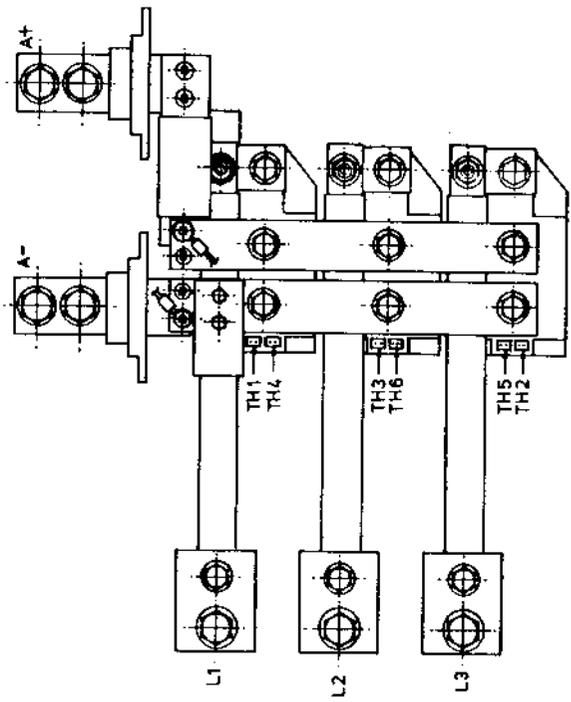
DRAWN G.D.R. TRACED PB/EDES	DATE 16.11.90 23/1/92	ELECTRICAL SYMBOLS TO BS 3839 <b>SSD</b> LITTLEHAMPTON ENGLAND TELEX 87142	TITLE DC CONTROLLER 450A STACK 4 QUAD POWER CIRCUIT	USED ON 570/590 SERIES STACK DRAWING NUMBER HJ 059044 D SHEET 1 OF 1
--------------------------------------	-----------------------------	---	---	---

KE048814D

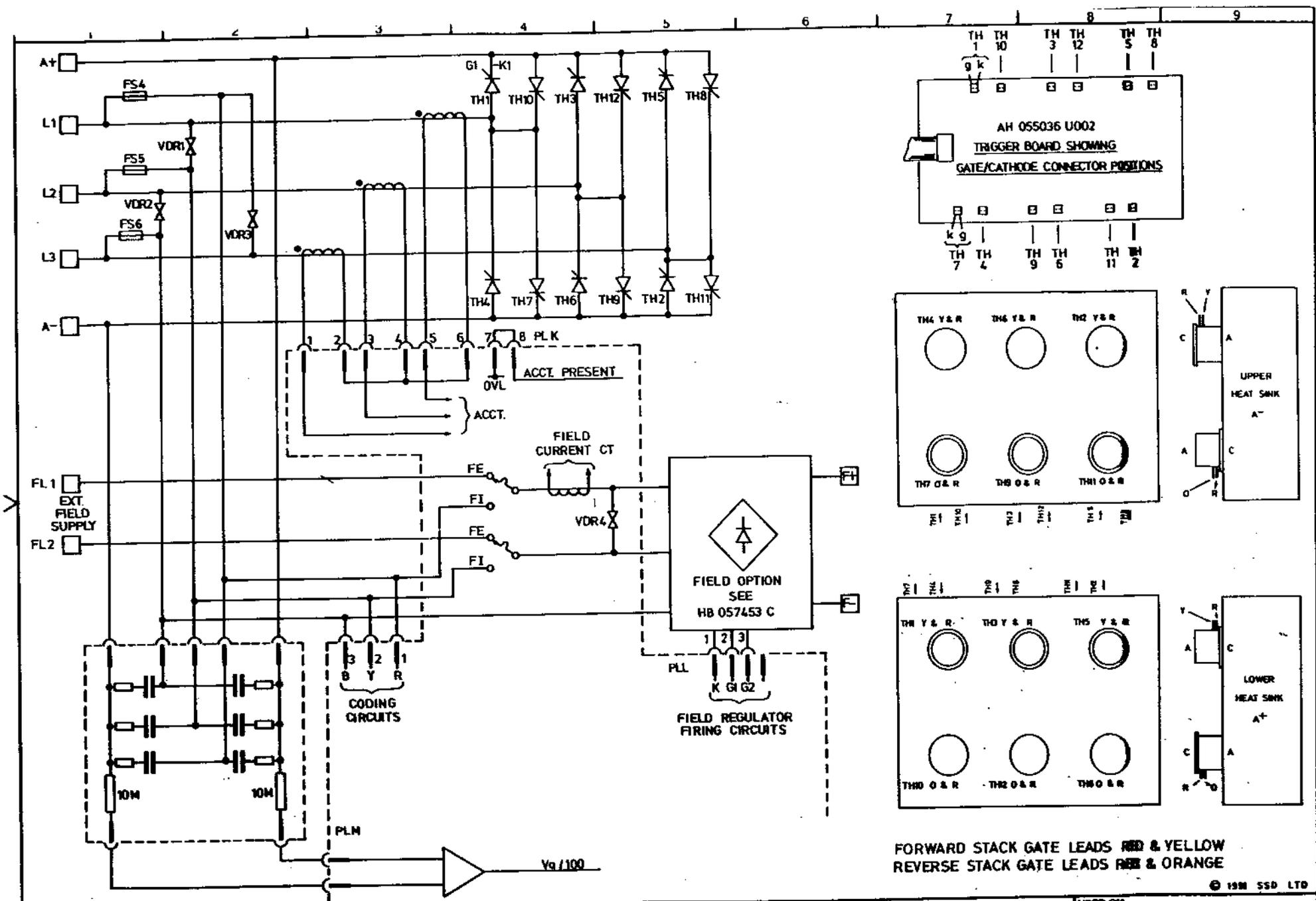
SRS CRAWLEY LTD 280470/98



PULSE WIRE COLOURS		
WIRING INFO	GATE	CATHODE
STANDARD DRIVE	YELLOW	RED



DRAWN G.D.R.	CHECKED <i>[Signature]</i>	DATE 16.11.90	DATE 17/3/92	ELECTRICAL SYMBOLS TO BS 3939	TITLE DC CONTROLLER 450A STACK 2 QUAD POWER CIRCUIT	USED ON 570/590 SERIES	SHT 1 OF 1
TRACED PB/EDES		A 16.11.90	B 17/3/92	<b>SSD</b> LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HJ 059045 D	



FORWARD STACK GATE LEADS RED & YELLOW  
 REVERSE STACK GATE LEADS RED & ORANGE

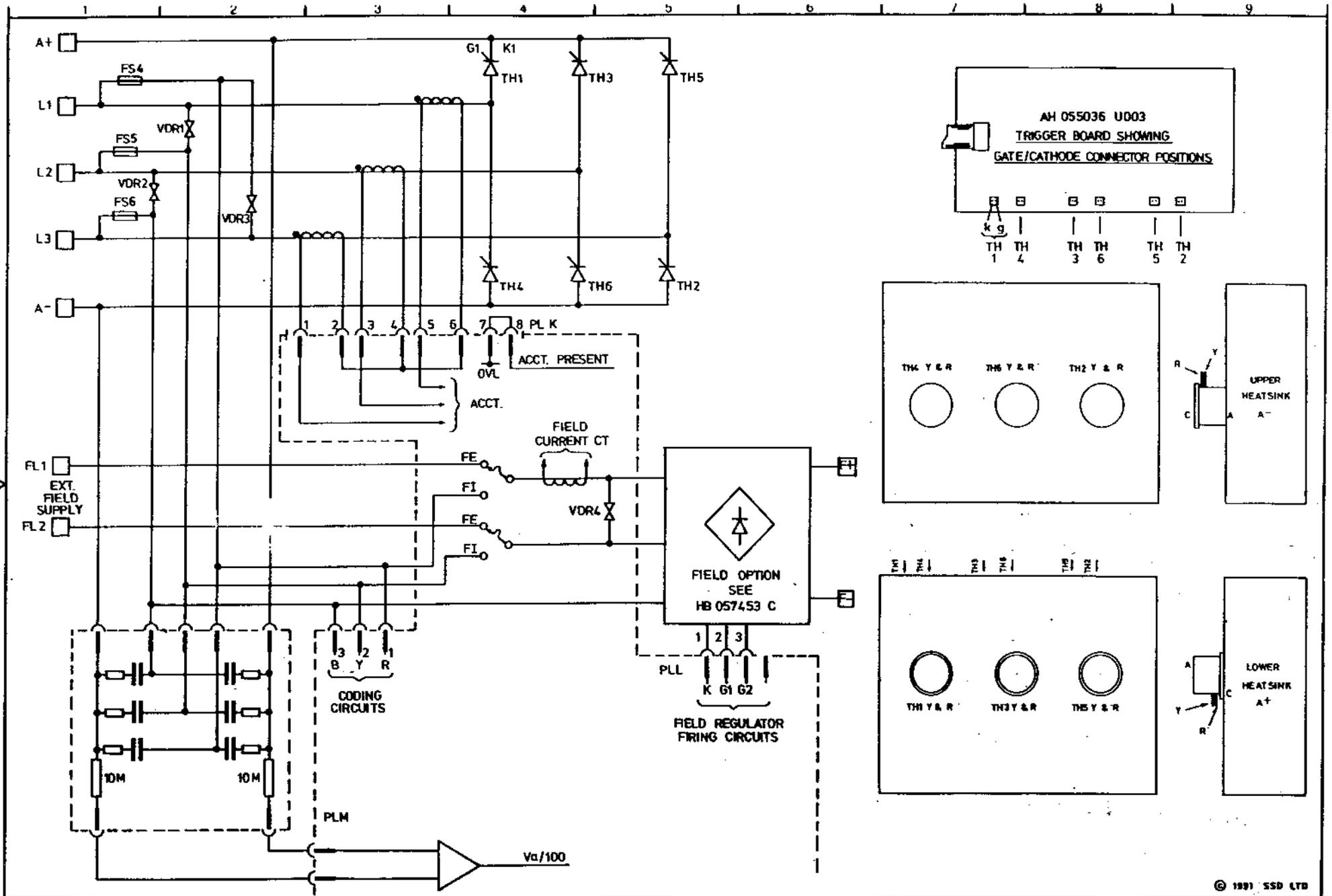
© 1988 SSO LTD

DRAWN CRM	CHECKED GDR	DATE 14/2/91
TRACED		DATE 13/1/92

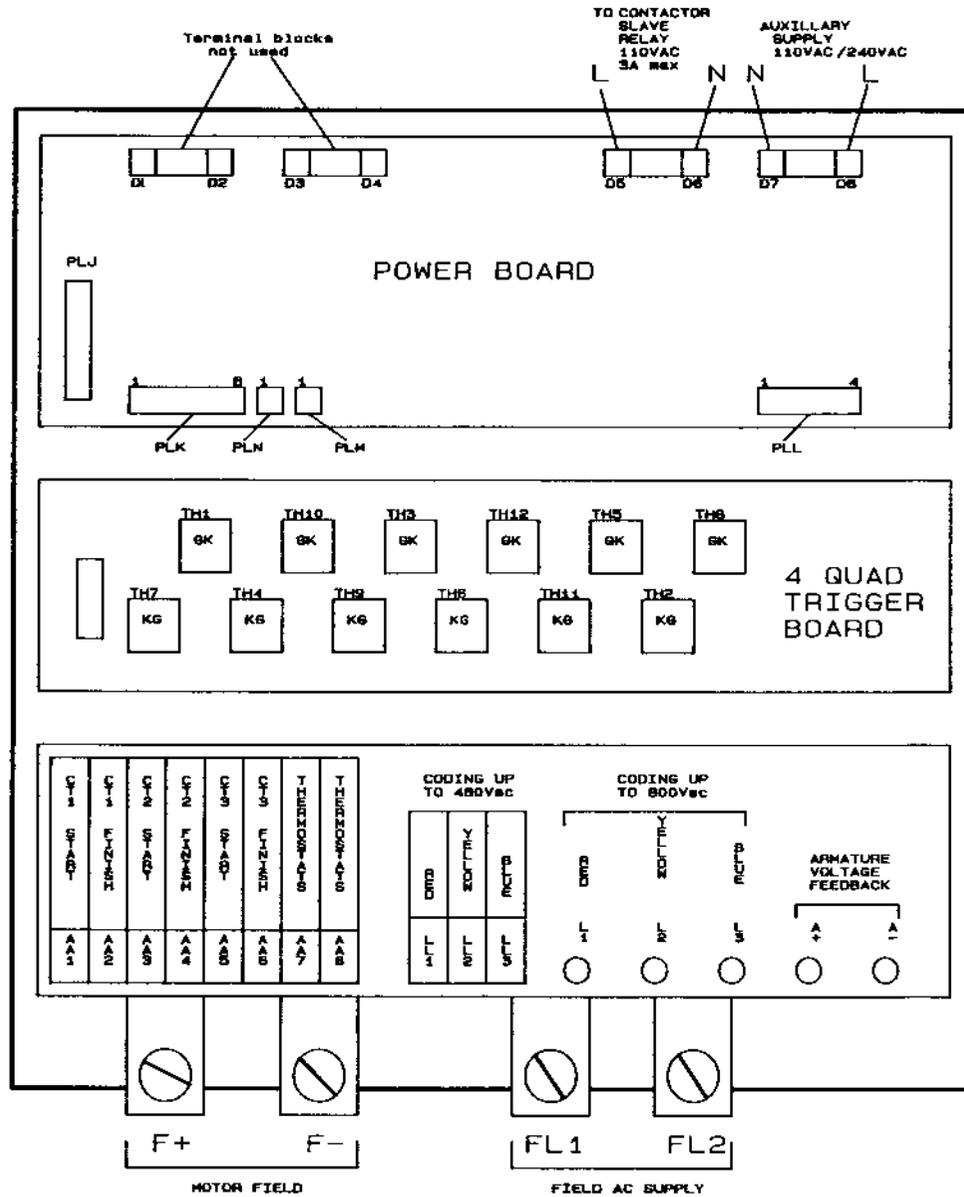
ELECTRICAL SYMBOLS TO BS 3839  
**SSO** LITTLEHAMPTON  
 ENGLAND  
 TELEX 87142

TITLE  
 DC CONTROLLER 720A STACK  
 4 QUAD POWER CIRCUIT

USED ON 570/590 SERIES	SHT 1
DRAWING NUMBER HJ 0562 D	OF 1



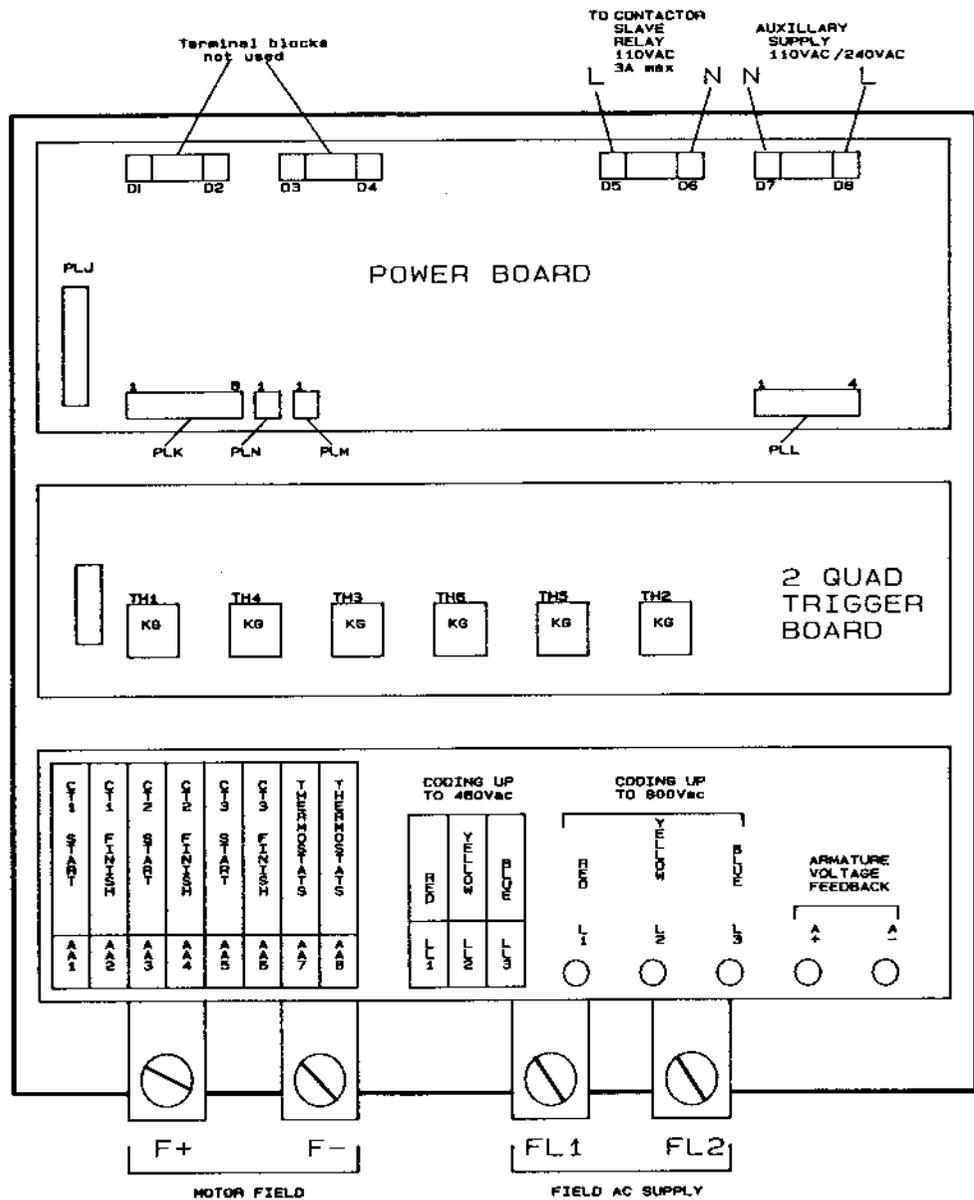
DRAWN CRM	CHECKED GOR	DATE A 14.2.91 B 4.3.91	1 31 92	ELECTRICAL SYMBOLS TO BS 3939	TITLE DC CONTROLLER 720A STACK 2 QUAD POWER CIRCUIT	USED ON 570/590 SERIES
TRACED 				<b>SSD</b> LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HJ 059561 D
						SHT 1 OF 1



Socket identification.  
 PLK - current transformers.  
 PLN - Stack heatsink trip.  
 PLL - Field thyristor firing.

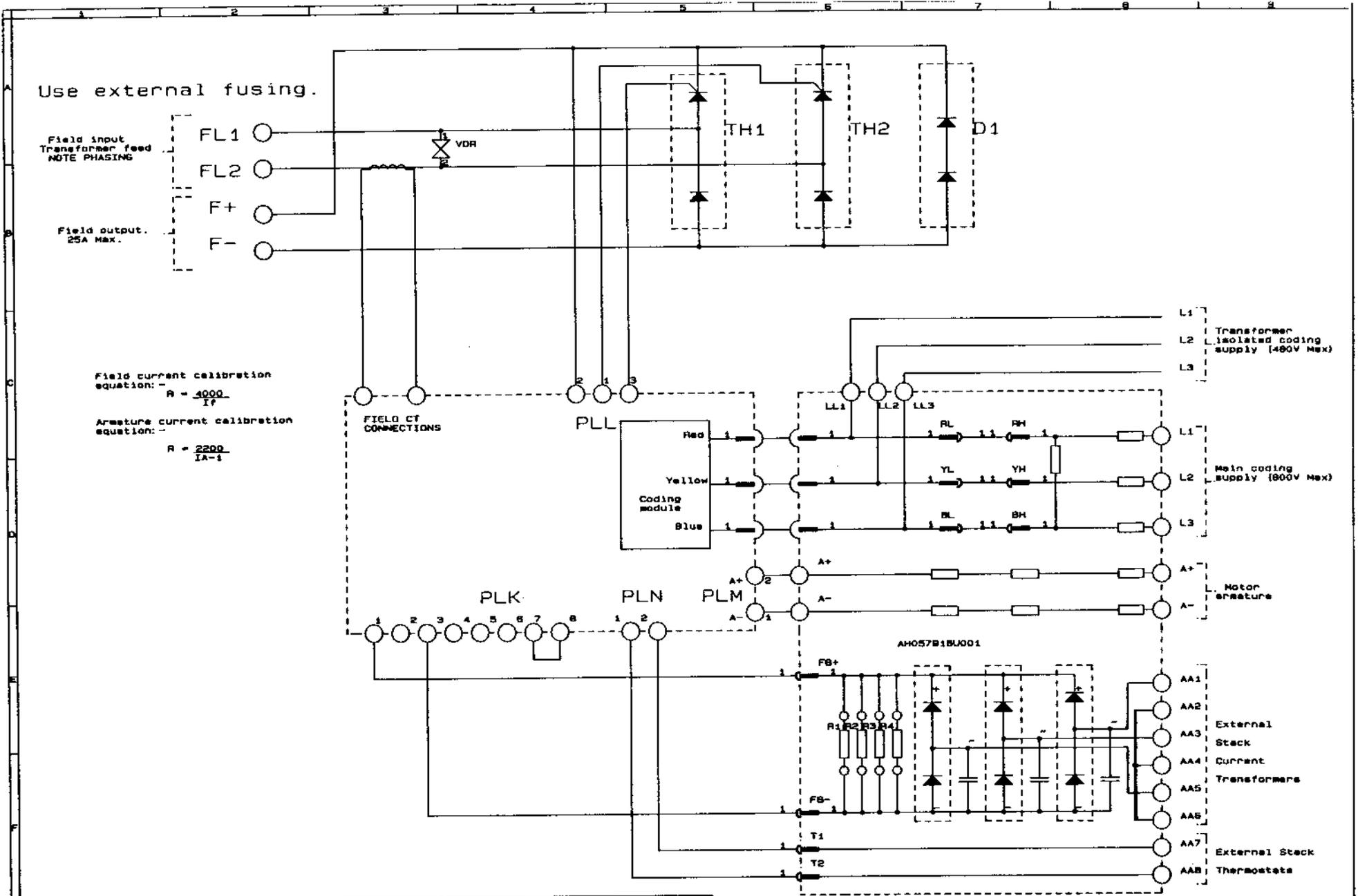
CAD FILENAME: 578_3.SCH		NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS DIAGRAM RE-PLDT ONLY.										
DRAWN ANW	CHECKED <i>[Signature]</i>	DESIGN APP.	APP. 1	APP. 2	ELECTRICAL SYMBOLS TO BS 3939					TITLE LAYOUT EXTERNAL STACK CONTROLLER 4 QUAD	USED ON	SSD 10 89
C.A.D. LINK	DESIGN APP.										DRAWING NUMBER HB058299D	SHT. 2 OF 6
			A	B	C	1	2					



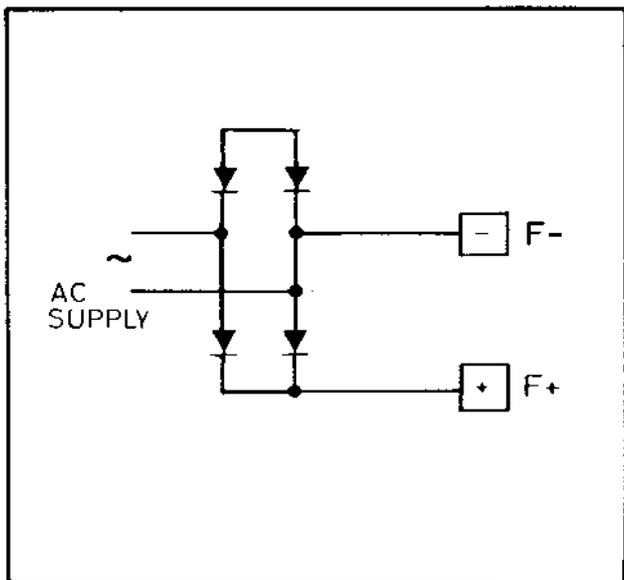


Socket identification.  
 PLK - current transformers.  
 PLN - Stack heatsink trip.  
 PLL - Field thyristor firing.

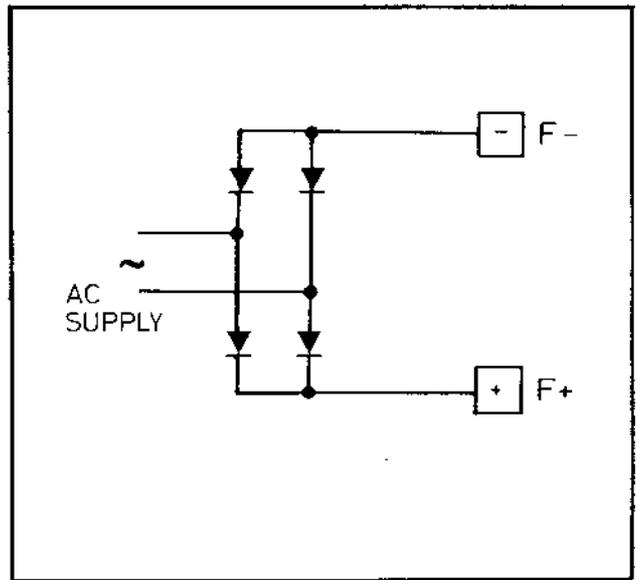
CAD FILENAME: 578_5.SCH		NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS DIAGRAM RE-PLOT ONLY.										ELECTRICAL SYMBOLS TO BS 3939		TITLE		USED ON		SSD 19 89		
DRAWN ANW	CHECKED <i>[Signature]</i>	DESIGN ADP.	A	B	C	1	2	LITTLEHAMPTON ENGLAND TELEX 87142							LAYOUT EXTERNAL CONTROLLER 2 QUAD		DRAWING NUMBER		SHT. 6	
																	HB058299D		OF 5	



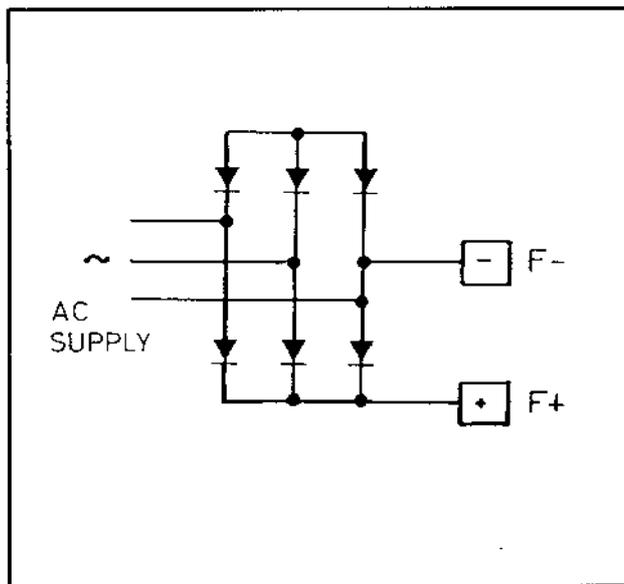
CAD FILENAME: 576_3.ech		NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS DIAGRAM RE-PLOT ONLY.										TITLE		USED ON			
DRAWN	CHECKED	DWG	DESIGN	ORIGIN	REVISION	DATE	BY	NO.	DATE	BY	NO.	ELECTRICAL SYMBOLS TO BS 3939		CIRCUIT DIAGRAM EXTERNAL STACK CONTROLLER		SSD 19 89	
ANW	<i>OK</i>											SSD LITTLEHAMPTON ENGLAND TELEX 97142		EI		DRAWING NUMBER HB058299D	
C.A.D. LINK	DESIGN APP.	A	B	C	1	2										SHT. 3 OF 6	



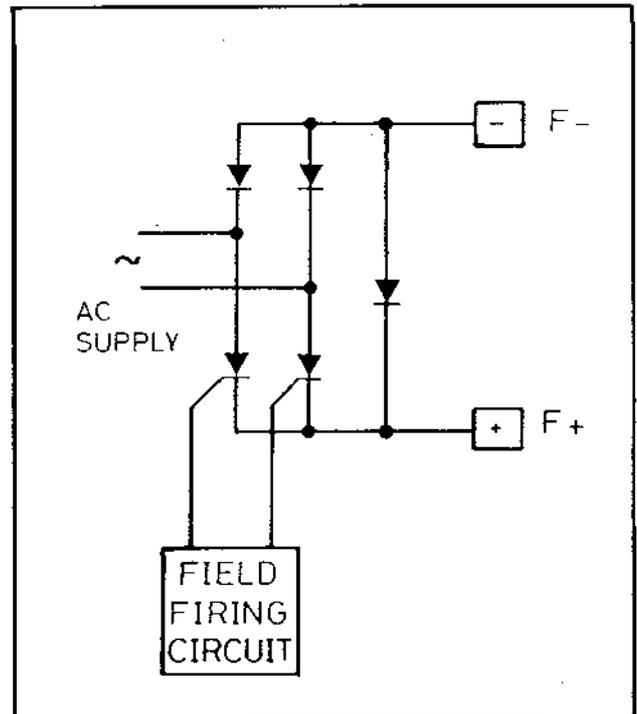
HALF WAVE RECTIFIER



FULL WAVE RECTIFIER



3 PHASE HALF WAVE RECTIFIER



FIELD FIRING CIRCUIT

ISS.	MODIFICATION	C.P. No.	DATE	APPROVAL
	590A Product Manual HA387189 Sheet 1 filed in drawing office.			
8	Page 2-3 Added column 360A in table. Page 2-4 Added “* Suitable ... supplies”. Section 10 LVD Requirements amendments. Page 10-8 Added EC Declaration of Conformity for Electrical Safety.	11219 11388 11454	16.12.96	MP
9	Page 4-19 corrections to Table A. Page 4-3 replaced HG386828 issue 6 with issue 7.	11548 11748	21.04.97	CC
10	Warnings and Instructions page added ‘This is a product ... supply.’ 12-2 Added Disposal and Packaging information. Pages: Warnings and Instructions, 2-1, 2.2, 4.24 Replaced prEN50178(1995) with EN50178(1998) 10-6 Replaced Certificates with updated version. Page 2-1 Added ‘Output Controls’ and re-worded ‘Adjustments’ paragraph. Page 2-2 replaced ‘Electrical Ratings’ with ‘Power’ and re-worded entire section. Chapter 2 - Replaced 45-65Hz with 50/60Hz. Page 4-2 replace ‘DO NOT PROTECTIVELY EARTH/GROUND THE MOTOR THROUGH THE 590 DRIVE’ with ‘DO NOT ... ENCLOSURE’. Page 4-2 added ‘9. EMC ... contactor’ 4-19 added Total Filter Watt Loss columns.	(13114) (13908) 12753	07.09.01	CC

FIRST USED ON	MODIFICATION RECORD	
	590A Product Manual	
 <b>EUROTHERM DRIVES</b>	DRAWING NUMBER	SHT.2
	ZZ387179	OF 2