THREE PHASE CONVERTOR TYPES 550 & 551

PRODUCT MANUAL HA052005

Issue 1

WARNING

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

CONTROLLER WARRANTY

For further details on SSD Controller Warranty and Repair
refer to the Standard Conditions of Sale IA058393C

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CONTENTS

INTRODUCTION

All members of the 540 Series of Armature and Field Weakening Controllers accept standard supply voltages in the range 110 to 480 Volts A.C. and provide controlled D.C. output voltages and currents, suitable for powering D.C. Shunt Field motors of up to 400HP (300Kw) rating. The motor Armature Controllers include both regenerative and non-regenerative models.

Non-regenerative Controllers consist of a 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 direction of rotation.

Regenerative Controllers consist of two fully-controlled, fully protected Thyristor bridges together with a sophisticated electronic control system and provide full four-quadrant control i.e. controlled acceleration and deceleration, speed and torque in both directions of rotation.

All models of Armature Controller offer a fixed D.C. supply for Field excitation, some applications however require an extended speed or constant horsepower range of control. For these applications the 540 series includes a Field Weakening Controller. This consists of a half-controlled single phase Thyristor bridge with full transient and overload protection, together with its associated electronic control circuitry.

In all members of the 540 series the control circuitry is totally isolated from the power circuitry, 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 45-65 Hz and possess high immunity to mains borne interference. Those Armature Controllers which employ three phase Main supplies are phase rotation insensitive.

Other standard facilities of the Armature Controllers include Field failure, overtemperature, fuse failure, line and synchronisation loss alarms. The Field Weakening Controllers possess a similar range of protection including Armature over-voltage and Tacho failure/ reversal alarms. All Controllers provide external customer enable/ inhibit inputs for safety interlocks etc.

All units of the range are designed for simple and economical panel mounting using keyhole slots. If it is necessary to remove the controller from the panel, disconnection and reconnection is simplified by plug-in control and auxiliary power connections, leaving only the Main supply, Earth and Armature connections to be made by screw connector.

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 power supply PCB's are used in all types of three phase Armature controller.

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 (or in some cases as an on-board facility), also has output sockets for the connection of an oscilloscope, chart recorder or other instruments.

Briefly, the 540 family is as follows:-

- 540 - Single phase (Line to Neutral or Line to Line), regenerative, four quadrant Armature Controller. For currents up to 50A.
- 541 - As for the 540 but two quadrant, non-regenerative control.
- 545 - Three phase, regenerative, four quadrant Armature Controller. For currents up to 180A, those rated above 110A being fan force ventilated.
- 546 - Identical to the 545 but two quadrant, non-regenerative control only.
- 547 - Three phase, regenerative, four quadrant Armature Controller. For currents up to 360A, all units force ventilated.
- 548 - Identical to the 547 but two quadrant, non-regenerative control only.
- 550 - Three phase, regenerative, four quadrant Armature Controller. For currents up to 720A, all units force ventilated.
- 551 - Identical to the 550 but two quadrant, non-regenerative control only.
- 5401 - Single phase (Line to Neutral or Line to Line). Field Weakening Controller for full strength field currents up to 20A.

In addition to those facilities already mentioned, a comprehensive range of options and auxiliary equipment are available for use with all SSD Controllers to allow, for example, the following modes of control:-

Contactor reversing

Dynamic braking

Multi-drive programming

Programmable process control

Tension/torque contour control

Etc....

TECHNICAL DETAILS

GENERAL

Control Circuits:	Fully isolated from power circuits.
Control Action:	Advanced PI with fully adaptive current loops for optimum dynamic performance.
Control Modes:	Speed Control. Torque (Armature Current) Control.
Speed Control:	By tachogenerator feedback as standard.
Speed Range:	100 to 1 typical with tacho feedback.
Steady State Accuracy:	0.1% typical with tacho feedback.
Adjustments:	For all drive parameters on plug-in 'personality' card.
Protection:	Interline device networks. High energy MOV's. Overcurrent (instantaneous). Overcurrent (inverse/time). Field failure. Tacho failure. Motor overtemperature. Stack overtemperature (Forced vent units). Thyristor "Trigger" failure. Line failure. Zero speed detection. Standstill logic. "Sub Cycle" overcurrent trip with 'Reset'. Absolute fault protection by high speed backup fusing.
Diagnostics:	Principal circuit node and function access. Digital LCD monitoring. LED circuit state indication. LED dynamic trend display. External monitoring/recording/CRT facilities.

ELECTRICAL RATINGS

Power Configuration:	550 -	Two Anti-parallel three phase Thyristor bridges with thyristor arm fusing.
	551 -	One three phase fully controlled Thyristor bridge with thyristor arm fusing.

Power Supply: 3-Phase, 45-65Hz, phase rotation insensitive. No adjustment required for frequency change.

Voltage ranges: 110-240v) 380-415v) ±10% 440-480v)

Control and Fan Supply Voltage: Single Phase, 45-65Hz.

Voltage ranges: 110-120v)) ±10% 220-240v)

Output Ratings

Nominal Power Ratings: (380-415v)	235KW (315HP) 300KW (400HP)
Output Current Ratings: (Armature)	560A 720A
Maximum Ambient Temperature: (See Derating Curve)	35°C (55°C)
Overload Capacity: (Armature Current)	110% continuous.

Output Ratings - All Types:

Output Current Rating: (Field)	16A
Reference Supplies: (For speed and Current setpoints)	+10V ±0.1 at 25mA Max. -10V ±0.1 at 25mA Max.
Unregulated Supplies: (+24v nominal)	+22V to +30V at 50mA Max.
Zero Speed Relay Drive:	+24V (nominal) at 50mA Max. Transient protected.
Drive Operational Relay Drive:	+24V (nominal) at 50mA Max. Transient protected.

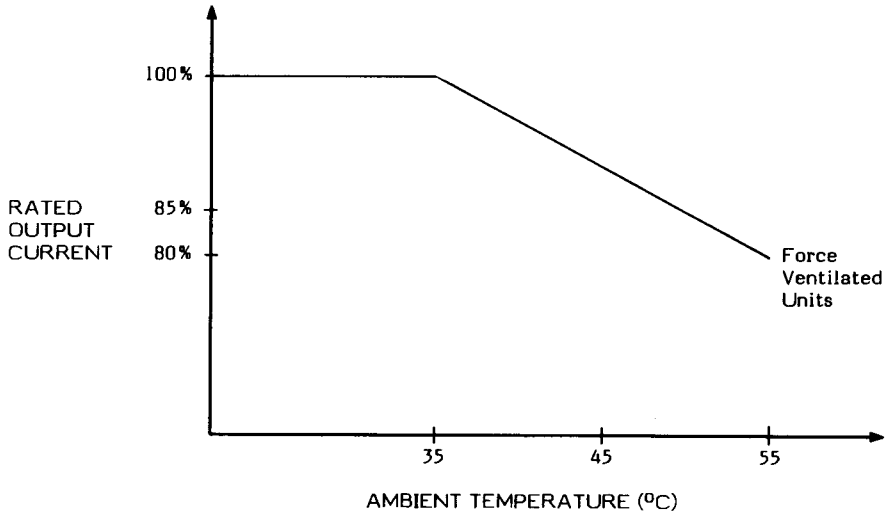
The controller requires two sets of fans, one pair of fans mounted permanently on the unit giving cooling to the high speed fuses and the components mounted on the front of the unit, another blower fan mounted separately as detailed by the installation instruction for force cooling the thyristor stack and heatsinks. If the user has a high pressure air supply the blower fan can be omitted provided ducted air is supplied in accordance with the installation notes.

MECHANICAL DETAILS

Overall Dimensions:

Height:	920mm
Depth:	Convertor 198mm Air duct 140mm Total 338mm
Width:	319mm excluding armature terminals. 350mm including armature terminals.
Weight:	Controller - 65Kg Blower and auxiliary equipment - 14Kg
Blower Throughput*:	1000m^3/hr @ 8mm head *This is the required blower throughput to acheive rated bridge output.
Control Terminations:	Plug-on connectors (with retaining catches)

Power Terminations:	Armature- Busbars each with a pair of M10 nuts and bolts.
	3 Phase Supply - Busbars with captive nuts and M14 screws.
	Earth - Two M8 stud connectors
Access:	Hinge down and lift off cover over power board
	Hinge down and lift off cover over control electronics.
	Control electronics independently hinged.



DERATING CURVES

PRODUCT CODE

Three phase convertors, types 550 and 551.

All members of the three phase convertor range can be fully specified using a 21 digit numerical order code. This Product Code appears as the "Model No." on the convertor rating label, an example of which is shown overleaf.

A rating label is attached to each convertor - on the inner surface of the right hand side panel, or on the top cross-member - always check that all specified parameters are correct.

The 21 digits are split into 10 groups or blocks. The function and number of digits in each block is given below:

BLOCK NO.	NO. OF DIGITS	FUNCTION
1	3	Basic product.
2	4	Output current.
3	1	Input power voltage.
4	1	Field convertor configuration.
5	1	Input auxiliary supply voltage.
6	3	Speed feedback calibration.
7	4	Option switch settings.
8	1	Diagnostic option.
9	1	Blower options.
10	2	Special options.

The 9 blocks are defined as follows:

Block 1: 3 digits identifying the basic product.

550 - 3-Phase, 4 Quadrant (regenerative) convertor) Up to
551 - 3-Phase, 2 Quadrant (non-regenerative) convertor) 720A

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

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: 345.5 AMPERES = CODE 3455
655 AMPERES = 655.0A = CODE 6550

Conversely: CODE 3400 = 340 AMPERES
CODE 6789 = 678.9 AMPERES

Block 3 1 digit identifying the 3-Phase AC power voltage.

0	1	2	3	4	5
110v	115v	208v	220v	240v	380v

6	7	8	9
415v	440v	460v	480v

Block 4: 1 digit identifying field supply configuration.

0 - Externally supplied full-wave rectifier. "Field fail" plug fitted in the "Override" position.

5 - Externally supplied full-wave rectifier.

6 - Externally supplied half-wave rectifier.

8 - 3 phase internally supplied half wave rectified.

Block 5: 1 digit identifying the control supply voltage (AC).

0	1	2	3	4
110v	115v	208v	220v	240v

Block 6: 3 digits identifying the tachogenerator feedback voltage at full speed.

The three digits in this block form a number between 010 and 999 which represents the actual tacho feedback voltage, rounded to the nearest whole number and with leading zeros added where necessary.

For example: 123 VOLTS = CODE 123

45.6 VOLTS = CODE 046

or conversely: CODE 090 = 90 VOLTS ±0.5V

CODE 180 = 180 VOLTS ±0.5V

Block 7: 4 binary digits identifying the setting of the four internal option switches.

Each digit defines the setting of one switch and can take the value 0 (= OFF) or 1 (= ON) as follows:

. . . . . First digit, switch 1:

0 = OFF - Armature current meter reads modulus.
1 = ON - Armature current meter reads ±.

. . . . . Second digit, switch 2:

0 = OFF - Standstill logic disabled.
1 = ON - Standstill logic enabled.

. . . . . Third digit, switch 3:

X X X X 0 = OFF - Setpoint ramp disconnected.
1 = ON - Setpoint ramp connected.

. . Fourth digit, switch 4:

0 = OFF - Setpoint ramp rate 2.5 to 75 seconds.
1 = ON - Setpoint ramp rate 0.25 to 7.5 seconds.

Block 8: 1 digit identifying the On-board diagnostic option.

0 - On-board diagnostic unit not fitted.
1 - On-board diagnostic unit fitted.

Block 9 1 digit identifying the blower fan option

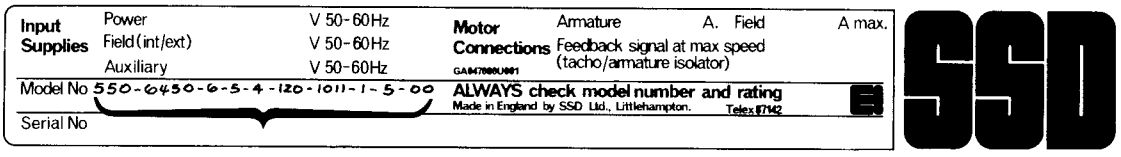
0 - Not supplied
5 - 50Hz unit supplied
6 - 60Hz unit supplied

Block 10: 2 digits identifying special options.

00 - No special options.
01 to 98 - Documented special options.
99 - Undocumented special options; specify requirement.

PRODUCT CODE EXAMPLE

In all communications please quote the full Model No. (Product Code) and Serial No. both of which contain important product information. An explanation of a typical Product Code is shown below.



550 - 6450 - 6 - 5 - 4 - 120 - 1011 - 1 - 5 - 00

BLOCK 1 — Convertor Type = 550
BLOCK 2 — Armature Current = 345A
BLOCK 3 — 3-Phase supply = 415v Voltage
BLOCK 4 — Externally supplied Full-Wave field
BLOCK 5 — Auxiliary Supply = 240v Voltage
BLOCK 6 — Speed Feedback = 120v
BLOCK 7 — Option Switches: S1-ON S2-OFF, S3-ON, S4-ON
BLOCK 8 — On-Board diagnostic Unit Fitted
BLOCK 9 — Blower Fan Supplied 240v ac 50Hz
BLOCK 10 — No Special Options

BASIC INSTALLATION AND WIRING INSTRUCTIONS

A. INSTALLATION

The 550/551 series of motor control units are designed to be mounted onto the back panel in two slightly different ways.

a) By piercing the back panel and providing eight mounting holes, preferably tapped to allow removal of the convertor. See drawing HG049669F.

b) By the use of stand off brackets BA050451 as shown in drawing HG054248F. The bracket must be ordered separately.

B. VENTILATION AND COOLING

The cooling of the 550/551 series of motor control units requires two separate air paths. The main cooling air is drawn through the convertor by a roof mounted centrifugal fan. Secondary cooling air is drawn over the face of the convertor, ie device, fuse and control board side of the heatsinks, by means of two axial fans mounted in the convertor structure.

In normal operation at full power the thyristor bridge produces about 2.5kw of heat which must be removed through the internal duct and roof mounted fan. It is important that adequate space is left to allow free air entry into the transition duct at the rear of the cubicle, a minimum clear gap of 200mm is recommended. Of equal importance is the unimpeded exit of air from the roof of the cubicle, sufficient air flow can only be provided by the fan if it is working against a limited back pressure.

A blower fan and ducting are provided by SSD which ensure that adequate air flow is provided given clear entry and exit air paths, if however a closed air system is required for the application, consultation with SSD Engineering Department would be advisable.

There is some 660 watts transferred from the convertor into the interior of the enclosure by the fuses, devices and exposed surface of the heatsinks. This figure does NOT include any additional heat provided by the interconnecting busbars and other drive associated components eg contactors, chokes etc. It is absolutely essential that this heat is removed from the cubicle, ventilation of $200m^3/hr$ will limit the interior ambient temperature rise to 10^oC due to the output of the convertor alone. Again care must be taken to allow free entry and exit of air to the cubicle, any restriction will limit the efficiency of the fan.

It can be seen that under normal operation the convertor is dissipating about 3KW continuously and the fans are attempting to push this heat into the air surrounding the cubicle. Consideration must be given to the effect of this amount of heat on the surroundings as any significant increase in the ambient temperature around the cubicle will be subsequently be reflected in the temperature inside the cubicle.

Should the installation be such that it is desirable to vent the main air flow path directly out of the building, this is acceptable provided any ducting coupled directly to the top of the cubicle is capable of removing air at $960m^3/hr$ at 8mm head of water. It is essential that the top of the convertor is connected directly to the duct.

C. BASIC WIRING INSTRUCTIONS

The following set of instructions is a description of the wiring requirements for operation as a basic speed controller and should be read in conjuction with the correct wiring diagram. The complexity of drive applications precludes the inclusion of diagrams showing all options, but any drive with specific options requested at order stage will be supplied with its appropriate wiring diagrams, which will supercede the diagrams listed below:

Controller Type	Wiring Diagram Number
550 & 551	HJ050217

D.C. shunt motors vary in the complexity and identification of their terminals. If in doubt, check with SSD - incorrect wiring to motors is a common commissioning problem.

To avoid damaging the drive, never carry out high voltage resistance checks on the wiring without first completely disconnecting the drive from the circuit being tested.

1. Power cables must have a minimum rating of 1.1 x full load current.
2. Control wiring must have minimum cross-section of 0.75 sq.mm. (1.5 sq.mm. is preferable outside cubicle for robustness).
3. All incoming main power supply connections should be separately protected by the correct HRC fuses.
4. A substantial ground or earth connection should be made to the Earth terminal of the drive.
5. The main contactor should be operated by connecting the coil to terminals D12 (Line) and D11 (Neutral). If the coil inrush current on "switch on" is likely to exceed 4 Amps a suitable slave relay must be used.
6. The auxiliary or control Power Supply (single phase 50/60Hz) should be connected to terminals D10 (Neutral) and D9 (Line) with the appropriate external fuse protection. Check that the transformer tapping on the internal Power Supply printed circuit board is connected to the correct voltage.
7. Connect the motor field(-) to terminal D8 and field(+) to terminal D5. If the drive is used with a permanent magnet field motor, or if the field is excited externally, it will be necessary to override the internal field failure protection circuits. This is achieved by moving the connector marked "Field Fail" on the Power Supply printed circuit board to the "Override" position.

8. The type of field connection for which the controller was built is indicated in the model number code, Block 4. If the code is 5 or 6, the correct A.C. supply voltage must be applied to terminals D1 and D4 to give required field voltage. Special high speed fuses for the A.C. supply to the field rectifier are mounted on the Power Supply printed circuit board. Plug on wire connections from these fuses are used to select full or half wave field supply.

   If the code is 8, the field is supplied from an internally connected 3 phase half wave bridge no connections are required to terminals D1 and D4.

9. The main power supply is connected to bus bar terminals L1, L2, L3 . These connections should be made via the correct rated HRC fuses and the normally open contacts of the main contactor.

10. The motor armature should be connected to bus bar terminals A(+) and A(-) (this circuit should be protected by a D.C. rated fuse or D.C. circuit breaker if high energy motor loads are present. If in doubt, consult SSD Engineering Department).

11. For normal operation the speed demand signal is connected to the "Setpoint Ramp Input" terminal A4. This input is scaled so that:-

    +10V input = forward speed demand.

    -10V input = reverse speed demand.

    This ±10v demand signal can be generated easily from an external potentiometer with its ends connected to the +10V Reference (terminal A11) and the -10V Reference (terminal A12). For non-reversing applications and 2 quadrant controller 551 setpoint input signal only needs to vary from 0 to +10 Volts. Terminal A1 should be used for the 0 Volt connection to the setpoint potentiometer in this case. The setpoint potentiometer should be between 2K and 10K ohms in value. All connections to the setpoint circuit should be by means of screened cable. The screen should be grounded or earthed ONLY AT THE MOTOR CONTROLLER END.

12. The tachogenerator speed feedback signal should be connected with negative to 0v terminal B1 and positive to tacho input terminal B2, (for forward motor rotation). It is important that this signal cable is screened over its entire length. The screen should be grounded or earthed ONLY AT THE MOTOR CONTROLLER END. Any other grounding arrangement may cause problems.

13. 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 B8 should be connected to the +10V Reference terminal B9. 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 B8 so that 0 to 10 Volts gives 0 to 200% F.L.C. (when potentiometer P7 turned fully clockwise).

14. Motor Over Temperature sensing devices, such as thermostats, microtherms or P.T.C. thermistors should be connected (in series if more than one) to terminals C1 and C2. If over temperature protection is not required, terminals C1 and C2 must be linked to allow the drive to run.

15. The Enable and Auxiliary Enable terminals C5 and C3 must be connected to C4 in order that the drive may run. However, external normally closed interlock contacts may be connected in series with C3. Interuption of the supply to terminal C3 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 C3 to C10 instead of C4 (any external interlock contacts connected in the C3 to C10 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.

16. 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 C4 and C6.

    Connect normally open START contact between terminals C6 and C7.

    NOTE: Additional STOP push-buttons should have normally closed contacts and should be wired in series with main STOP push-buttons between terminals C4 and C6

    (ii) Single holding contact:

    Connect between terminals C4 and C7

    Open contact to STOP.

    Close contact to START.

17 The blower fan if supplied should be connected to the auxiliary supply via a set of 4A HRC fuses.

    NOTE: The blower fan will be supplied at the same voltage as is specified for the auxiliary supply under product code block 3.

D. NOTES ON WIRING

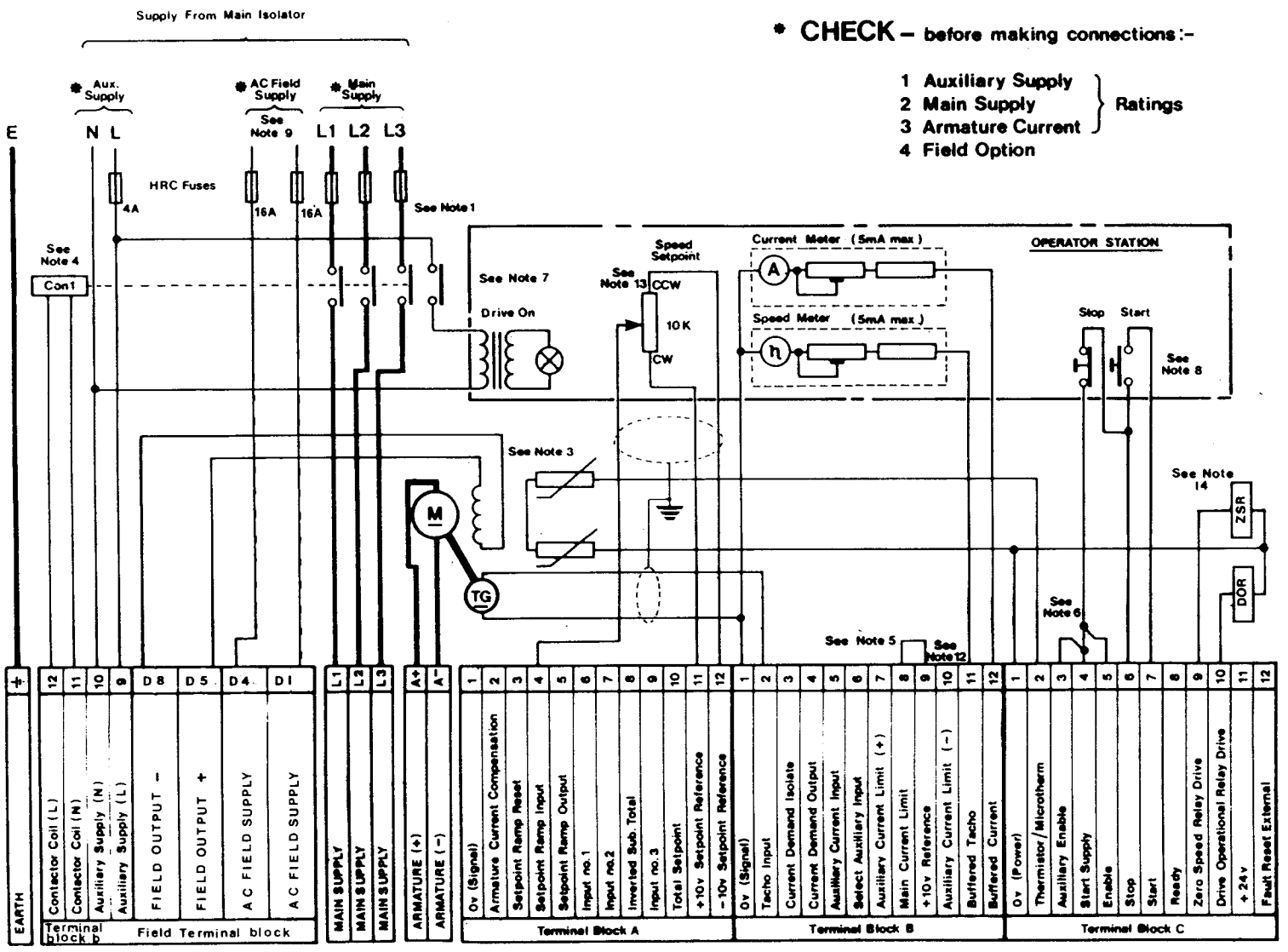
1. Indicator lamps, annunciators etc, for "Drive On" condition should be switched by an auxiliary contact of the main contactor - not by the controller internal relay.

2. All connections made to Terminal Blocks A,B and C MUST BE ISOLATED VOLTAGES.

3. To avoid damaging the drive, never carry out high voltage resistant checks on the wiring without first completely disconnecting the drive from the circuit being tested.

DO NOT SCALE | THIRD ANGLE PROJECTION | GENERAL DRAWING PRACTICE TO BS308/ BS 3939

ISS	DATE
1	18-6-86
2	4-7-86
3	4-8-86

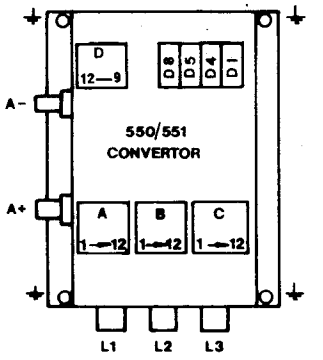


* **CHECK** – before making connections :-

1 Auxiliary Supply
2 Main Supply
3 Armature Current
4 Field Option
} Ratings

NOTES :-

1 Power cables to have minimum rating 1·1 x full load current. HRC fuses to be rated accordingly.
2 Control wiring to have minimum cross section of 0·75 sq mm
3 If motor is not fitted with over temperature protection thermistors fit link between terminals C1 & C2.
4 The contactor must be operated via a suitable relay if its coil inrush current during pick-up exceeds 4A.
5 Current limit 0 to +10V = 0 to 200%. Link to terminal B9 normally.
6 If customer interlocks are required insert switches in place of link between terminals C3 & C4.
7 Indicator lamps must be switched by auxiliary contacts on contactor – not by controller internal relay.
8 Additional stop buttons must be of normally closed type and wired in series with the stop button shown.
9 All units require an external a.c field supply connected to terminals D1 and D4, which is suitably rated for the field current. Use 2·5mm if using full bridge capability of 16A.
10 Observe good engineering practice with installation. Ensure that signal wires are separated from high voltage or high current cables. Use screen cables on tacho and setpoint connections.
11 The blower fan if fitted should be supplied via a separate 4A fuse from the auxiliary supply.
12 Auxiliary current limit (−) is applicable only to 550 Convertors.
13 Connection shown is normal for 550 Convertor. For 551 Convertor the CCW terminal is usually connected to 0v signal (Terminal A1 or B1).
14 Optional relay connections DOR and ZSR



DRAWN D.J.H.	MATERIAL	DIMS IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)	ASSEMBLED ON	SCALE	TITLE 550/551 Convertor. Basic Wiring Diagram.
CHECKED		GENERAL TOLERANCE X = ± 0.4, X.X = ± 0.2, X.XX = ± 0.1, HOLES < Ø7mm −0·02 + 0·07			
DESIGN APPROVAL	FINISH		Shackleton system drives		DRAWING NUMBER HJ 050217 D
MANF. APPROVAL					SHT. 1 OF 1 SHTS.

KE043008D

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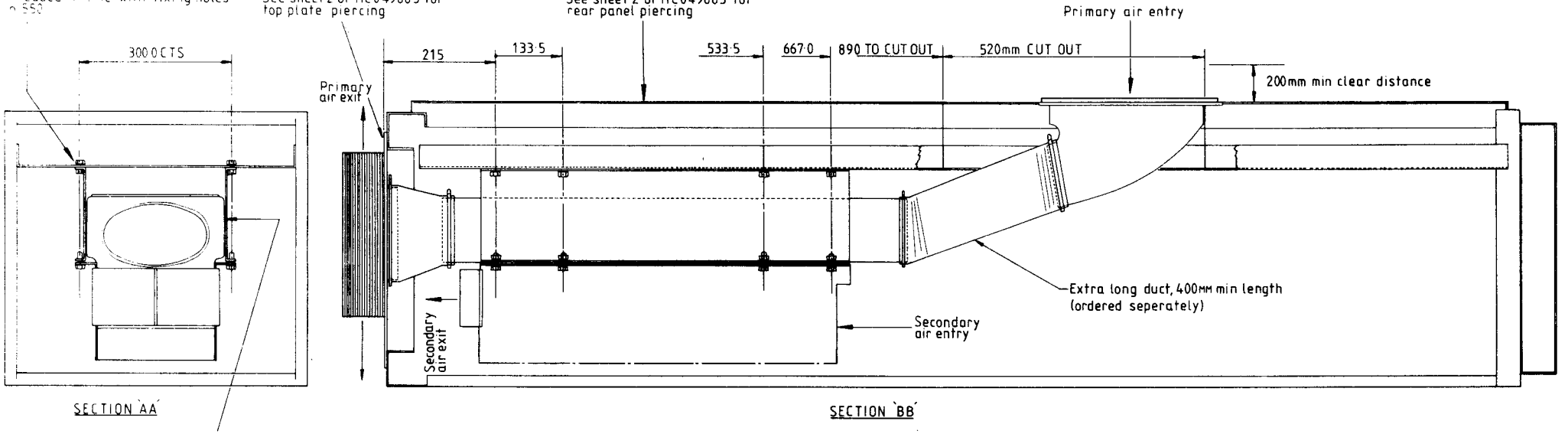
8 M8 holes in back plate preferably threaded in line with fixing holes ø 550

See sheet 2 of HC049663 for top plate piercing

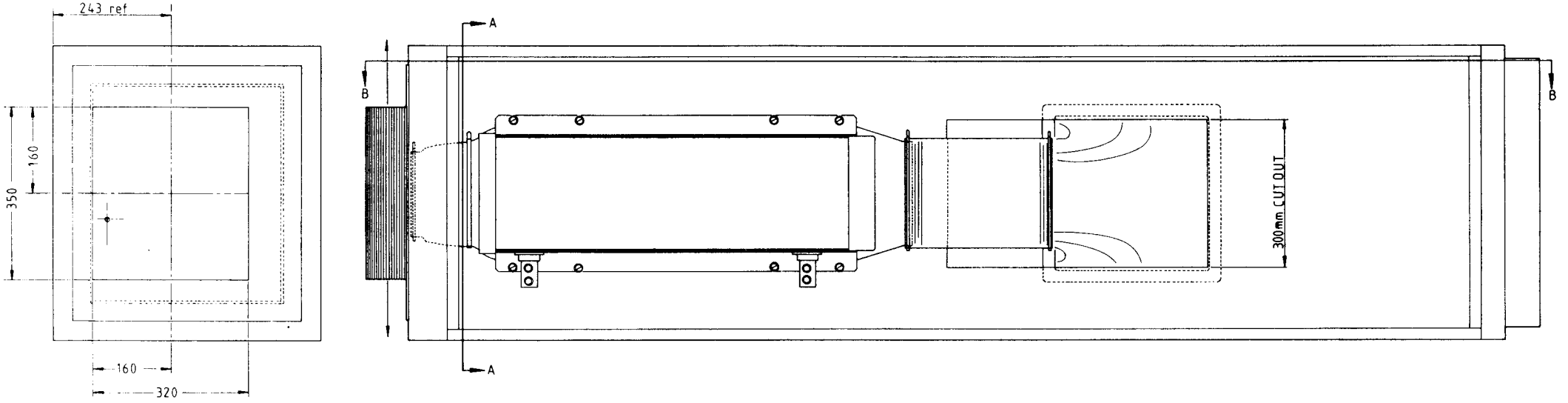
See sheet 2 of HC049663 for rear panel piercing



SECTION AA

SECTION BB

2 off support brackets BA 050451 (ordered seperately)



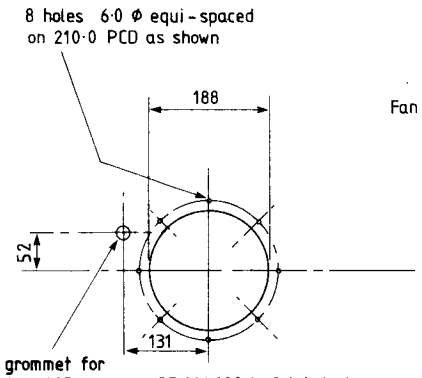
For cut out details & outline drawing see HG 049669F

DRAWN	MATERIAL	DIMS. IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)	ASSEMBLED ON	SCALE 1:6	TITLE 550/1 & 576/7 INSTALLATION (ALTERNATIVE BRACKET MOUNTED)	
CHECKED		GENERAL TOLERANCE X ± 0·4, XX ± 0·2, XXX ± 0·1, HOLES ø 7mm 0·2 · 0·7				
DESIGN APPROVAL	FINISH				DRAWING NUMBER HG 054248 F	SHT 1 OF 1 SHTS
MANF APPROVAL						

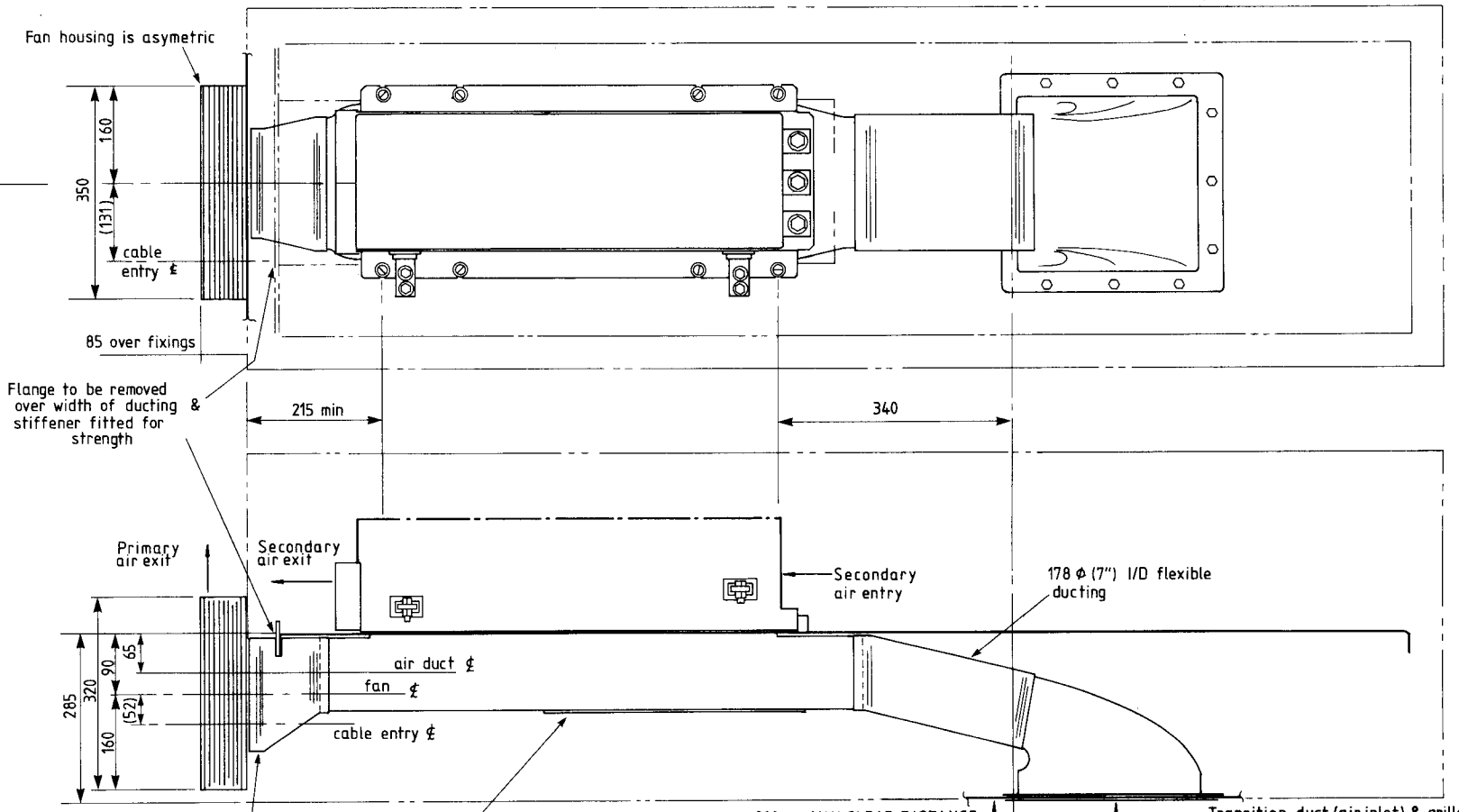
Shackleton system drives

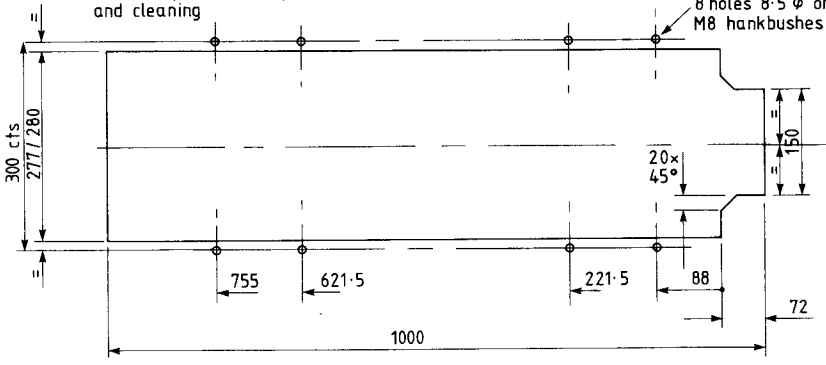
SS DATE
A 29 7 86
1 4 8 86

DO NOT SCALE | THIRD ANGLE PROJECTION | GENERAL DRAWING PRACTICE TO BS 308 / BS 3939

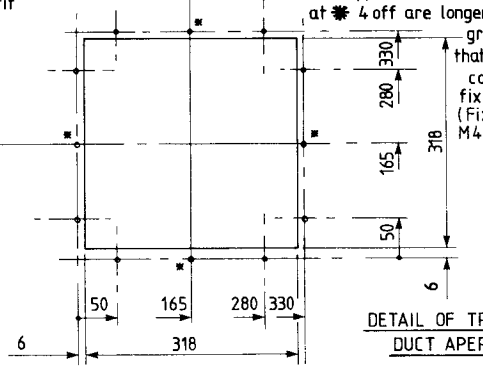


BLOWER ASSY. MOUNTING DETAILS





DETAIL OF TYPICAL PANEL APERTURE



DETAIL OF TRANSITION DUCT APERTURE.

DATE	
A	13-6-83
B	7/8/85
C	16-7-86
1	4-8-86
2	22 9 89

DRAWN S&M | CHECKED | DESIGN APPROVAL | MANF. APPROVAL | MATERIAL | FINISH

DIMS. IN M.M APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)
GENERAL TOLERANCES X = ±0·4, X.X = ±0·2, X.XX = ±0·1 | HOLES Φ 7mm +0·02 +0·07

ASSEMBLED ON

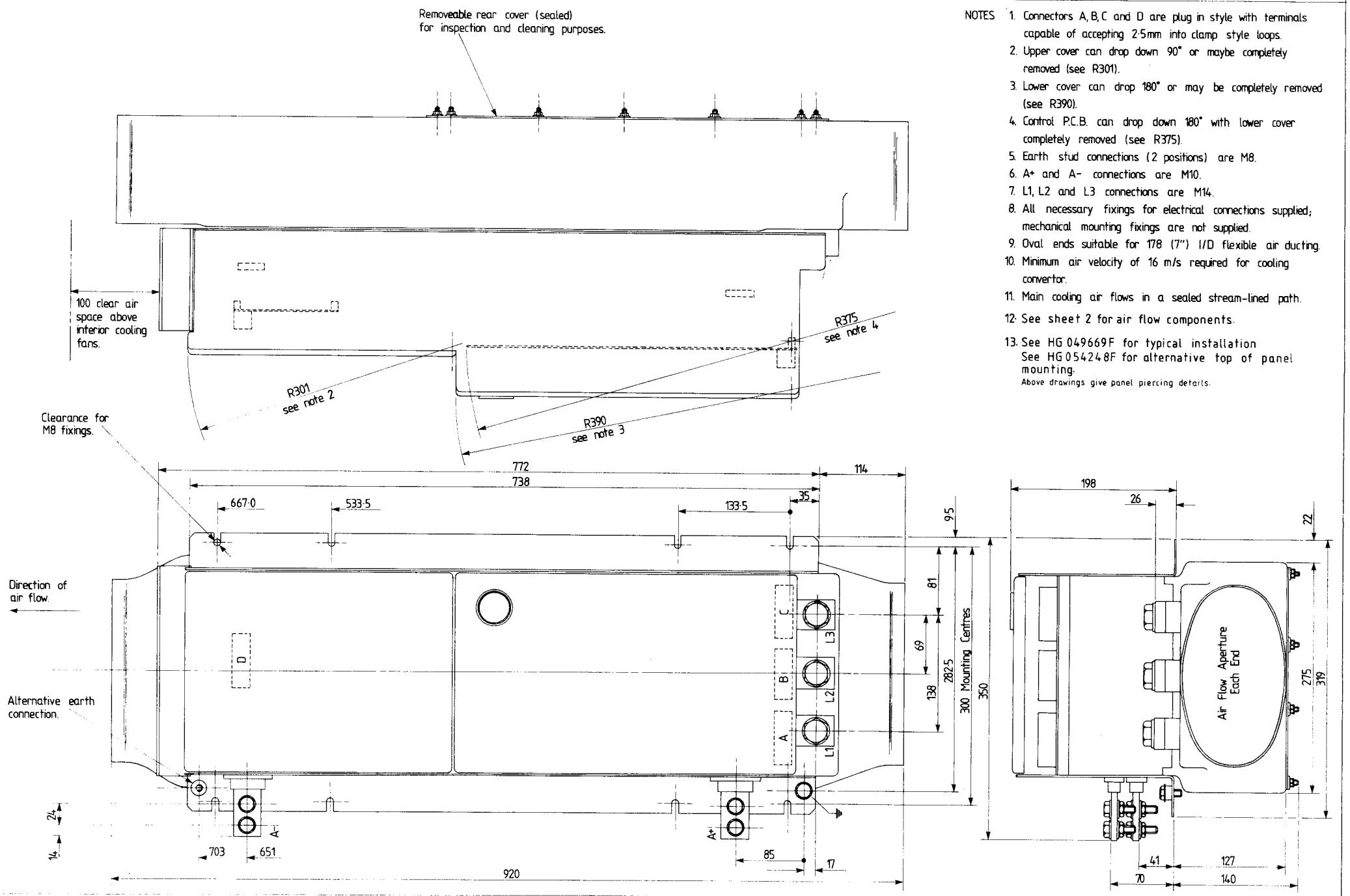
Shackleton system drives

SCALE 1:4

TITLE 550/1 & 576/7 INSTALLATION DRAWING

DRAWING NUMBER HG 049669 F | SHT. 1 OF 1 SHTS.

DO NOT SCALE | THIRD ANGLE PROJECTION | GENERAL DRAWING PRACTICE TO BS 308 / BS 3939



NOTES

1. Connectors A, B, C and D are plug in style with terminals capable of accepting 2·5mm into clamp style loops.
2. Upper cover can drop down 90° or maybe completely removed (see R301).
3. Lower cover can drop 180° or may be completely removed (see R390).
4. Control P.C.B. can drop down 180° with lower cover completely removed (see R375).
5. Earth stud connections (2 positions) are M8.
6. A+ and A- connections are M10.
7. L1, L2 and L3 connections are M14.
8. All necessary fixings for electrical connections supplied; mechanical mounting fixings are not supplied.
9. Oval ends suitable for 178 (7") I/D flexible air ducting.
10. Minimum air velocity of 16 m/s required for cooling convertor.
11. Main cooling air flows in a sealed stream-lined path.
12. See sheet 2 for air flow components.
13. See HG 049669F for typical installation
    See HG 054248F for alternative top of panel mounting.
    Above drawings give panel piercing details.

	DATE	
S.	A 7 1 83	
	B 16 7 86	
	1 4 8 86	

DRAWN P.A.W. | CHECKED | DESIGN APPROVAL | MANF APPROVAL | MATERIAL | FINISH

DIMS. IN M.M APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)
GENERAL TOLERANCES X ± 0·4, XX ± 0·2, XXX ± 0·1, HOLES ·0 7mm -0·02 - 0·07

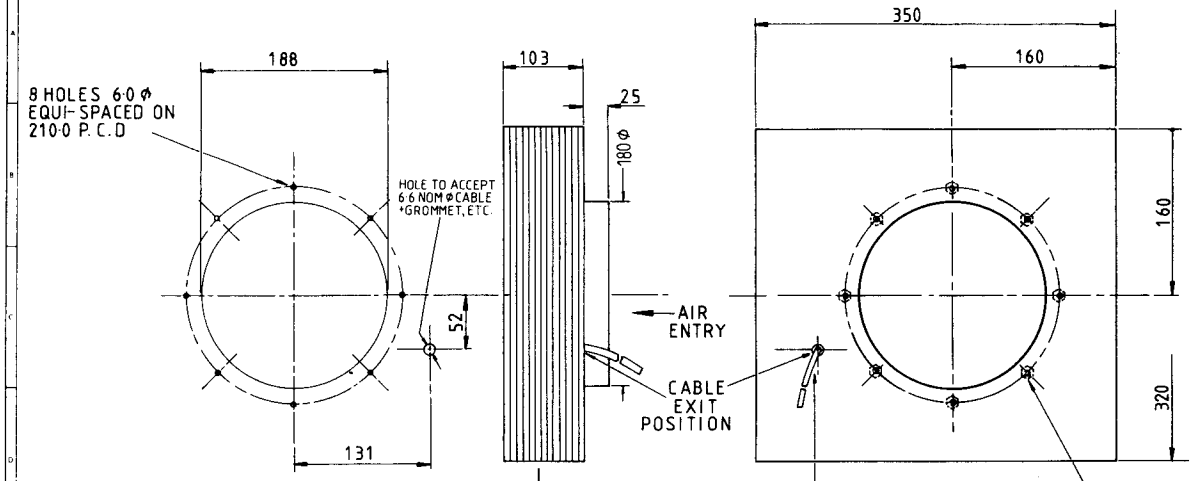
ASSEMBLED ON | SCALE 1:2

Shackleton system d

TITLE 550/551 OUTLINE DRAWING

DRAWING NUMBER 049663 | SHT 1 OF 2 SHTS

DO NOT SCALE | THIRD ANGLE PROJECTION | GENERAL DRAWING PRACTICE TO BS 308/BS 3939

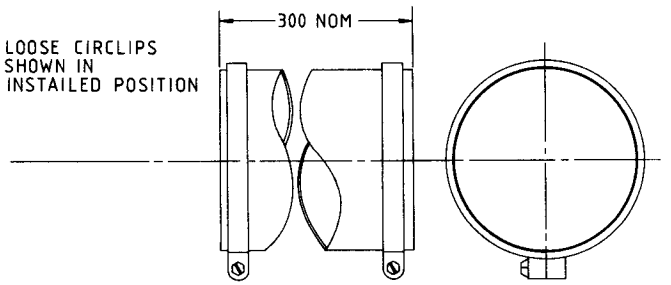


DETAILS OF BLOWER MOUNTING

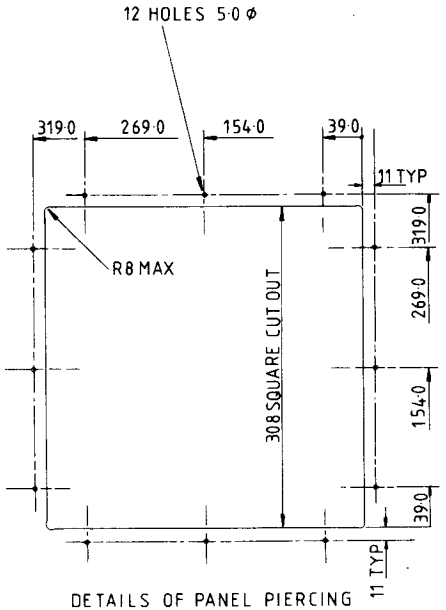
AIR EXIT MUST NOT BE OBSTRUCTED

2 METER LENGTH 3 CORE CABLE SUPPLIED

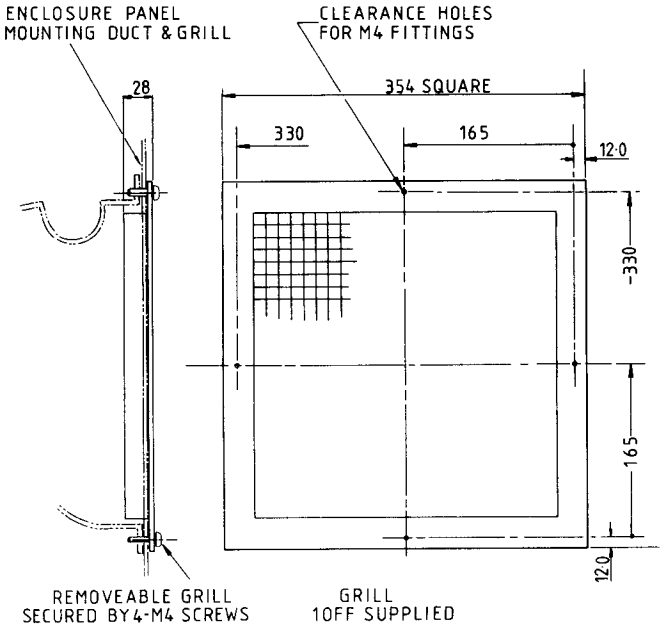
8 HOLES THREADED M5 EQUI-SPACED ON 210·0 ø P.C.D AS SHOWN.



AIR FLOW DUCT
1 OFF SUPPLIED WITH TRANSITION DUCT
1 OFF SUPPLIED WITH BLOWER.

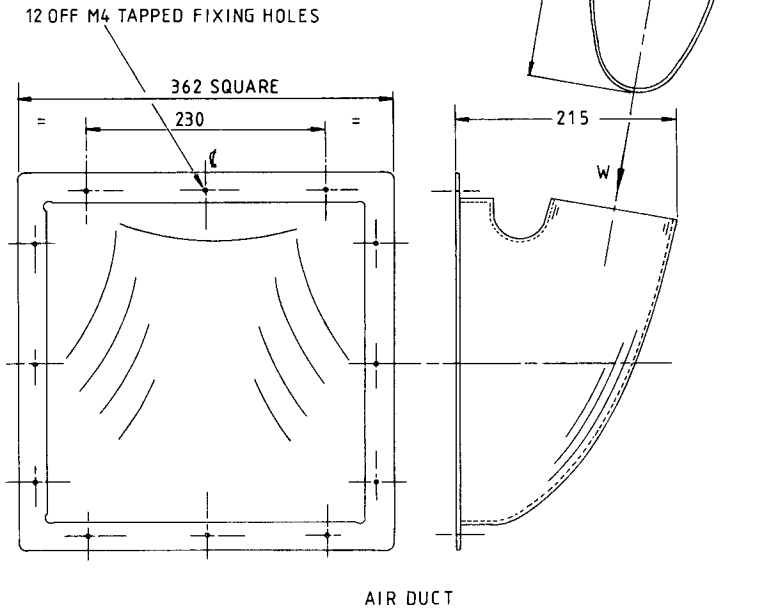


DETAILS OF PANEL PIERCING



REMOVEABLE GRILL SECURED BY 4-M4 SCREWS

GRILL 1 OFF SUPPLIED



AIR DUCT 1 OFF SUPPLIED

DATE 29-7-86	DRAWN Sydney	MATERIAL	DIMS. IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)	ASSEMBLED ON	SCALE	TITLE 550/551 OUTLINE DRAWING
	CHECKED		GENERAL TOLERANCE X ±0.4, XX ±0.2, XXX ±0.1; HOLES ø 7mm ±0.02 - 0.07	Shackleton system drives		DRAWING NUMBER HC 049663 F SHT 2 OF 2 SHTS
	DESIGN APPROVAL	FINISH				
	MANF APPROVAL					

CONTROLLER TERMINAL DESCRIPTIONS

TERMINAL BLOCK A

A1 0V(SIGNAL)

Zero Volt reference for signal currents only i.e. currents originating from Terminal Blocks A and B. Must not be used as a return point for currents originating from Terminal Block C.

A2 ARMATURE CURRENT COMPENSATION OUTPUT

This output is a Buffered Bipolar Armature Current Feedback Signal of ±1.11v = ±100% Full Load Current.
This terminal is also used in Field Weakening applications where it is connected directly to Terminal A2 of the Field Controller (Model 5401).

A3 SETPOINT RAMP RESET*

Connect to 0v(Signal) to reset the Setpoint Ramp Output to zero volts, otherwise leave open circuit. The reset is instantaneous and independant of the setting of preset potentiometers P1 and P2.

A4 SETPOINT RAMP INPUT*

Speed reference input to the Setpoint Ramp circuit. Maximum input = ±10v with respect to 0v(Signal), input impedance = 200K Ohms. See also Inverted Subtotal, A8 and Total Setpoint, A10.

A5 SETPOINT RAMP OUTPUT

Under steady-state conditions this output voltage will equal the input voltage on Terminal A4. 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 refered to as Up Rate and Down Rate respectively. They are adjustable over the range 0.25 to 7.5 seconds when Option Switch S4 is ON and 2.5 to 75 seconds when S4 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 that its 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 S3 is ON the Setpoint Ramp Output is summed internally with any inputs appearing at Terminals A6, A7 and A9. When S3 is OFF the Output is internally isolated from the other inputs but may be connected externally to A6, A7 or A9 if required.

The Ramp Output is reset to zero if Terminal A3 is connected to 0v(Signal) or if the Run/Inhibit signal is in the Inhibit state (LED 6 not lit). See also Inverted Subtotal, A8 and Total Setpoint, A10.

A6 INPUT No.1*

Speed Reference input. Maximum input = ±10v with respect to 0v(Signal), input impedance = 20K Ohms. See also Inverted Subtotal, A8 and Total Setpoint, A10.

A7 INPUT No.2*

Speed Reference input. Maximum input = ±10v with respect to 0v(Signal), input impedance = 20K Ohms. See also Inverted Subtotal, A8 and Total Setpoint, A10.

A8 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 S3 is ON, otherwise equal only to the inverted algebraic sum of Inputs No.1 and Input No.2. See also Total Setpoint, A10.

A9 INPUT No.3*

Inverse 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 A10.

A10 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 A3 and A5), minus input No.3. The maximum output is limited to approximately ±11v. In the 551 controller a Total Setpoint signal of +10v represents a demand for full speed. In the 550 regenerative controller +10v demands full forward speed and -10v demands full reverse speed.

A11 +10v PRECISION REFERENCE

Setpoint reference supply. This supply is short-circuit proof, but for normal operation the load on Terminal A11 plus Terminal B9 should not exceed a total of 25mA.

A12 -10V PRECISION REFERENCE

Setpoint reference supply. This supply is short-circuit proof, but for normal operation the load current should not exceed 25mA. This supply is not normally used in the case of non-regenerative controllers (type 551).

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

TERMINAL BLOCK B

B1 0V(SIGNAL)

Zero voltage reference for signal current only i.e. currents originating from Terminal Blocks A and B. Must not be used as a return point for currents originating from Terminal Block C.

B2 TACHO INPUT

For 'forward' motor rotation, corresponding to a positive Total Setpoint signal, the Tacho feedback voltage at Terminal B2 must be positive with respect to 0v(Signal). Tacho feedback voltages up to 200v should be applied direct to Terminal B2 with calibration resistors (mounted on the plug-in Cablibration Board) selected according to the formula:-

R19 + R20 = (Full speed Tacho volts - 10)K Ohms.

If the full speed Tacho feedback voltage exceeds 200v an additional calibration resistor must be added, external to the controller. In this case the resistors should be selected according to the formula:-

R19 + R20 + External Cal Resistor
= (Full Speed Tacho volts - 10)K Ohms,

such that R19 + R20 does not exceed 190K Ohms.

In applications employing DCVT feedback (i.e. where Product Code Block 10 = 13), the calibration resistors should be selected according to the formula:-

R19 + R20 = (DCVT Output Voltage at Full Speed - 1)K Ohms.

In all cases the calibration resistors should be of a robust, high stability type.

The input impedance at this terminal depends on the value of the calibration resistors but will lie in the range 10 to 50K Ohms (1 to 50K Ohms in DCVT applications).

B3 CURRENT DEMAND ISOLATE*

Connect B3 to 0v(Signal) 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 B5 (See B5 and B6). For Speed Control applications this Terminal is normally left open circuit.

B4 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 B3 Terminal description).
In Speed Control applications the voltage at B4 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 the 551 Controller 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 at Terminals B7, B8 and B10) before comparison with the Current Feedback signal.

B5 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 B6 is connected to 0v(Signal), Terminal B1. Connect Terminal B3 to 0v(Signal) 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 the 551 controller 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 B7, B8 and B10) before comparison with the Current Feedback signal.

B6 SELECT AUXILIARY INPUT*

If this Terminal is connected to 0v(Signal) any input at Terminal B5 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 B3). In Speed Control applications Terminal B6 is normally left open circuit.

B7 AUXILIARY CURRENT LIMIT (+)*

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 B8 Terminal description). If this facility is not required Terminal B7 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 B7 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 B7 and 0v(Signal). Alternative methods of control are a potentiometer (ends connected to B9 and B1, wiper to B7) or an analogue voltage in the range 0 to +10v. Negative voltages MUST NOT normally be applied to this input.

B8 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 B7 and B10. When external control of the Main Current Limit is not required B8 should be connected to +10v (Terminal B9). The input voltage at Terminal B8 supplies the Main Current Limit preset potentiometer P7, thus the actual

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

current limit value depends upon the voltage at B8 and the setting of P7. Assuming that P7 is set fully clockwise, the control voltage range at Terminal B8 is 0 to +10v - 0 to ±200% Full Load Current (0 to +200% Full Load Current in the case of the 551 controller). A negative input voltage MUST NEVER be applied to this Terminal.

B9 +10V PRECISION REFERENCE

Setpoint reference supply. This supply is short-circuit proof but for normal operation the load on Terminal A11 plus Terminal B9 should not exceed a total of 25mA.

B10 AUXILIARY CURRENT LIMIT (-)*

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 B8 Terminal description). If this facility is not required (and in all the 551 applications) Terminal B10 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 B10 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 B10 and 0v(Signal). Alternative methods of control are a potentiometer (ends connected to A12 and B1, wiper to B10) or an analogue voltage in the range 0 to -10v. Positive voltages MUST NOT normally be applied to this input.

B11 BUFFERED TACHO OUTPUT

This output has the same polarity as the Tachogenerator input voltage on Terminal B2 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.

B12 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 1. For centre-zero indicators S1 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 B12.

For end-zero indicators S1 should be OFF (DOWN) so that the ouput represents the Modulus of the Armature current i.e. both positive and negative Armature currents are represented by a positive output at B12. In either case an output of 10v represents an Armature current of 200% Full Load, 5v represents 100% Full Load Current etc. In 551 applications the setting of S1 is immaterial since these units only produce positive Armature current.

TERMINAL BLOCK C

C1 0V(POWER)

Zero Volt connection for power currents only i.e. current originating from Terminal Block C. This terminal must not be used as a return point for signal currents originating from Terminal Blocks A and B.

C2 THERMISTOR/MICROTHERM

Motor overtemperature sensors should be connected between Terminals C1 and C2. The drive will be disabled if the external resistance between C1 and C2 exceeds 1.8K Ohms ±200 Ohms (see C8 and C10 Terminal descriptions). The drive may restart automatically when the resistance (ie. motor temperature) falls - see C3 Terminal 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 C1 and C2 must be linked.

C3 AUXILIARY ENABLE

This input is normally connected to Terminal C4. If required, external normally-closed interlock contacts may be inserted between Terminals C3 and C4.
The drive will be disabled when the input to C3 is open circuit or if the input voltage is less than approximately +10v (see C8 and C10 Terminal descriptions).

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 C3 to C10 instead of C4 (any external interlock contacts connected in the C3 to C10 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.

C4 START SUPPLY

This terminal is normally connected to Terminals C3 and C5 and to the Start/Stop control circuit.

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

In systems employing separate momentary contact Start and Stop switches, C4 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 C4 and C7. The Start supply is present whenever the Auxiliary Supply is on (see D9 and D10 Terminal descriptions), provided that an overcurrent Trip has not occured. If such a Trip does occur the Start Supply can be restored by operating the Fault Reset button (under the front cover of controller), or by applying +24v (from Terminal C11) to Terminal C12.

C5 ENABLE

Normally connected to Terminal C4. The drive will be disabled when this input is open circuit or when the input voltage falls below approximately +3v; an input voltage exceeding approximately +12v will then be required to re-enable the drive.

C6 STOP

In systems employing seperate 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 connection should be made to this Terminal. (See also C4 and C7 Terminal description).

C7 START

When the Start Supply from Terminal C4 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 C7 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 C4 and C7. See also C4 and C6 Terminal descriptions.

C8 READY OUTPUT

This is the ouput of a fault detector circuit which monitors 8 internal Alarm signals. Its output is approximately +22 to +30 volts at 50mA maximum and may be used to supply an external indicator or relay connected between Terminals C8 and C1. The drive will run when this output is high (+22v to +30v) and the Enable input Terminal C5 is high (+12v to +30v).

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

1) Single phase Auxiliary Supply present, fuse FS9 good, Calibration and Preset printed circuit boards correctly inserted.
2) Start instruction issued, contactor control relay latched, three phase contactor closed.
3) Three phase supply present, fuses FS1 to FS6 all good.
4) Drive synchronised to supply frequency in the range 45 to 65 Hz.
5) Field current present (or Field Failure overide selected) Stack Thermal Trip not open and stack suppression and fuses ok.
6) Resistance between Terminals C1 and C2 (Thermistor/microtherm) less than approximately 1.8K Ohms ±200 Ohms.
7) Auxiliary Enable input voltage (Terminal C3) approximately +10v to +30v.
8) Armature current waveform normal.

Note that if an abnormal current waveform is detected, Drive Condition Indicator LED 4 will not light. If this occurs press the Fault Reset button which is located beneath the controller front cover. Alternatively apply +24v (from Terminal C11) to the Fault Reset (External) Terminal, C12.

C9 ZERO SPEED RELAY DRIVE

This output is intended to supply a 24 volt (D.C.) relay at an ouput current not exceeding 50mA. The relay should be connected between Terminals C9 and C1; it will be energised when the Speed Feedback signal is lower that the Standstill Threshold set by preset potentiometer P4 (P4 has a range of ±0.5 to ±4% of Full Speed).

C10 DRIVE OPERATIONAL 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 C10 and C1; it will be energised when C10 is high (+24V nominal) and de-energised when C10 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 C8) is disabled while the Start Supply is present at Terminal C7.

This output can also be used to latch the Thermistor/microtherm, Field failure and external interlock alarms - see C3 Terminal description.

The Drive Operational output at C10 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 C7), the output at C10 depends upon the Ready Output at C8,
i.e. C10 will be high if C8 is high,
C10 will be low if C8 is low.

(ii) When the drive is in the Stop condition the output at Terminal C10 will always be high, even though the Ready Output is low.

C11 +24V (NOMINAL)

This is a +22 to +30v unregulated D.C. supply which may be used to supply the Enable and Fault Reset (External) inputs.

C12 FAULT RESET (EXTERNAL)

If external Fault Reset control is required connect this Terminal to Terminal C11 via a normally open momentary contact.

TERMINAL BLOCK D

D1 AC FIELD SUPPLY
D4 AC FIELD SUPPLY

External A.C. input to the Field Recitifier Bridge. Controllers with Field Options 5 or 6 (Product Code Block 4) require an A.C. input to these Terminals. The actual input required will depend on the Motor Field rating and the Field Rectifier configuration. The input voltage may be calculated as follows:-

For Field Option 5 (Full-wave Rectifier Bridge):-

Required AC input voltage
= 1.1 x Rated Field voltage

For Field Option 6 (Half-wave Rectifier Bridge):-

Required AC input voltage
= 2.2 x Rated Field voltage

In all Controllers which contain a Field Supply (i.e. Field Options 5 and 6) the A.C. supply to the Field Rectifier is internally fused at 16A (fuses FS7 and FS8).

In the case of option 8 the field is supplied from an internally connected 3 phase half wave supply which is fused by the coding fuses at 20A (fuses FS14, 15, 16). Maximum current is limited to 8A D.C. by the terminal block.

D5 FIELD (+)
D8 FIELD (-)

Motor Field Connections.
The D.C. output voltage at these Terminals will depend upon the A.C. supply voltage and the Field Rectifier configuration.
For controllers fitted with field option 8 the output voltage may be calculated as follows:

DC output voltage = 0.67 x 3 phase supply voltage

D9 AUXILIARY SUPPLY (L)
D10 AUXILIARY SUPPLY (N)

Mains input to the control supply transformer and the contactor control relay. The input to these Terminals is product code dependent - ensure that the input voltage complies with the selected control transformer tapping - application of the wrong supply voltage may cause damage to the controller.
If at any time the transformer tapping is changed it is essential that the Controller Rating Label is amended to show the correct voltage and Block 3 code.

D11 CONTACTOR COIL (N)

This Terminal is internally connected to Terminal D10 and provides a connection point for the contactor neutral wire.

D12 CONTACTOR COIL (L)

This is the switched output from the contactor control relay and is derived from the line supply at Terminal D9. The line supply is internally fused at 3A (FS9), hence contactors having a high inrush current during pick-up must be operated via a suitable slave relay.

D2 NO CONNECTION*
D3 NO CONNECTION*
D6 NO CONNECTION*
D7 NO CONNECTION*

These unused positions provide additional isolation between adjacent high voltage Terminals, they MUST NOT be used as interconnection points for any control or power wiring.

*NOTE

On field options 5 and 6 terminals D2, 3, 6, 7 do not exist. The two standard 4 way connectors are replaced by a 4 way terminal block numbered for consistancy from right to left D1, D4, D5 and D8 respectively.

BLOCK DIAGRAM DESCRIPTION

A. POWER CONFIGURATION

Three phase power is supplied to the AC input terminals (L1, L2 & L3) of the drive via an external isolating contactor. The phase rotation (phasing) of the supply is unimportant. Six semiconductor fast blow fuses (FS1, 2, 3, 4, 5 and 6) are incorporated in the package to protect the thyristor stack. Three auxiliary fuses (F14, F15 & F16) protect the internal power wiring and indicators fuses FS17 and FS18 protect the suppression.

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 D5 (positive) and D8 (negative). It is obtained from an on board half or full wave diode bridge rectifier (according to Product Code). The AC supply for this rectifier is applied through terminals D1 and D3. The field rectifier is always protected by two high speed semiconductor fuses (F7 & F8) contained in the drive, regardless of where the field AC supply is derived. Non linear surge suppressors protect the rectifier from supply borne transients.

The field current is measured using a small AC current transformer to provide an isolated logic signal which falls to zero and stops the drive in the event of "field failure" (Diagnostic 7). The field failure condition can be over ridden when required by the internal link labled "Field Fail Override".

AUXILIARY SUPPLY

The auxiliary single phase AC supply which powers the drive electronics is connected to terminals D9 (line) and D10 (neutral). The line supply is fused via a 3 Amp control fuse (F9) to the multitapped power supply transformer and to 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 C4 via external Stop/Run pushbuttons. Its suppressed power contacts provides a switched version of the auxiliary line voltage on terminal D12 (line) and D11 (neutral) to energise the isolating contactor. The contactor control relay will 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 5 will be extinguished and until the Fault Reset push button is operated (or the external reset from terminal C12) 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 a signal isolating transformer and two optically coupled isolators. The synchronising circuits are insensitive to variation of the following supply parameters:

i) Phase Rotation
ii) Supply voltage (over the range 220-480V ±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 (FS14, 15 and 16) ruptures the drive is held in inhibit, Indicator 3 will extinguish and no power will be delivered to the load.

B. 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 3 line AC current transformers to provide an isolated and normalised signal of 1.1v = 100% Full Load.
2. Synchronising signals are provided by a signal AC current transformer and two optoisolators.
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 tachogenerator or from the armature voltage via an externally connected DC voltage transformer. It is then normalised to 10v = 100% Full Speed.
6. Isolated control power supplies are generated from the Auxiliary Supply by the control 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 & 4 respectively) and ±10 volts DC (reference quality) are generated from the single phase Auxiliary Supply via the control supply transformer. The external ±10v DC supplies (Diagnostics 2 & 3 respectively) are buffered within the drive. A smoothed unstabilised rail of 24 Volts DC nominal, is available at terminal C11 for higher current requirements. These rails are protected against accidental short term overloads and fuse F9 (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

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NOTES:

1 P1-P10 ASSEMBLED ON PRESET BOARD (AI046821C001). TACHO CALIBRATION RESISTORS R19 & R20 (&C12), CURRENT CALIBRATION RESISTORS R123A-E (Rs) ASSEMBLED ON CALIBRATION BOARD (AI 046789C001).

2 OPTION SWITCH POSITIONS - S1 ± IL, IfLI METER INSTRUMENTATION
S2 STANDSTILL LOGIC ENABLE
S3 SETPOINT RAMP INPUT ENABLE
S4 SETPOINT RAMP RATE CHANGE

3 LED 1 1 PHASE (AUX) ON/OFF
LED 2 45-65Hz ENABLE/INHIBIT
LED 3 3 PHASE (MAINS) ON/OFF
LED 4 NORMAL/TRIGGER FAULT
LED 5 NORMAL/OVERCURRENT FAULT
LED 6 RUN/INHIBIT
LED 7 ROTATING/STANDSTILL
LED 8 NORMAL/ALARM
} ALL 8 LED'S ILLUMINATED WHEN OPERATING

4 FIT R1 FOR 2 QUAD OPERATION

○ DIAGNOSTIC SOCKET

AUXILIARY CURRENT LIMIT (POSITIVE) B7
MAIN CURRENT LIMIT B8
RAMP RESET (0V FOR OPERATION) A3
RAMP INPUT A4
RAMP OUTPUT A5
FAULT RESET (EXTERNAL) AC COUPLED C2
INPUT N° 1 (+VE) A6
INPUT N° 2 (+VE) A7
INVERTED SUB TOTAL A8
INPUT N° 3 (-VE) A9
TOTAL SETPOINT A10
CURRENT DEMAND OUTPUT B1
CURRENT DEMAND ISOLATE (0V FOR OPERATION) B3
AUXILIARY CURRENT INPUT B6
SELECT AUXILIARY INPUT (0V FOR OPERATION) B9
AUXILIARY CURRENT LIMIT (NEGATIVE) B10
BUFFERED CURRENT 100% ±5V B12
TACHO INPUT B2
BUFFERED TACHO B7
ARMATURE CURRENT COMPENSATION (100% ±11V) A2
ZERO SPEED RELAY DRIVE (ENERGISED WHEN STANDSTILL) 50mA C9
THERMISTOR/MICROTHERM C2
AUXILIARY ENABLE C3
STOP C6
START C7
READY (+24V 50mA) C8
ENABLE C5
+24V (50mA) C10
DRIVE OPERATIONAL RELAY DRIVE (ENERGISED WHEN DRIVE OK) 50mA C4
+10V PRECISION REFERENCE (25mA) A11
-10V PRECISION REFERENCE (25mA) A12
0V SIGNAL B11
0V POWER C1

R19=R20=(TACHO VOLTS÷10)K

P1 UP RATE
P2 DOWN RATE
P3 ZERO SPEED
P4 STANDSTILL THRESHOLD
P5
P6 SPEED INTEGRAL GAIN
P7 MAIN CURRENT LIMIT (200% = 10V)
P8 CURRENT PROPORTIONAL GAIN
P9 CURRENT INTEGRAL GAIN
P10

2 I/P AND GATE
FILTER
S1 S2 S3 S4
R198 SOT
C108 SOT
R199 SOT
C155 SOT
R19 SOT
R20 SOT
C12 SOT
R1 SOT
R42 SOT
R65 SOT
R123 SOT
C86 SOT
R206 SOT
INVERSE TIME CHARACTERISTIC
ZERO SPEED
ZERO S P
8 I/P AND GATE
2 I/P OR GATE
2 I/P AND GATE
LED 1 LED 2 LED 3 LED 4 LED 5 LED 6 LED 7 LED 8
MAIN SYSTEM ENABLE
MISSING PULSE (LATCHED)
PLL SYNC
START INSTRUCTION
3Ø PRESENT
FIELD FAIL
PRESET BRD
CALIBRATION BOARD AI 046789 C001
TACHO BURDEN RESISTORS R19 & R20
CURRENT BURDEN RESISTORS R123
PRESET BOARD AI 046821 C001
P1 P2 P3 P4 P5 P6 P7 P8 P9 P10
SCAN
CLOCK
ENDSTOPS
SOFT START
OVER BIAS
CURRENT DEMAND POLARITY
INHIBIT
FILTER -90°
DIVIDE BY 16
PHASE LOCKED LOOP
PHASE ROTATION
AUTO RANGE RAMP
COMP
GATING LOGIC
FIRING CIRCUITS
T1-6 PULSE TRANS MASTER
T7-12 PULSE TRANS SLAVE
TRIGGER BOARD AM047644U002
TH 1-6 MASTER
TH 7-12 SLAVE
MOTOR ARMATURE
FIELD FAIL OVERRIDE
THERMAL TRIP (FITTED WITH FANS)
HALF WAVE
FULL WAVE
MOTOR FIELD
A.C. FIELD SUPPLY (EXTERNAL)
CONTROL BOARD AM047423U002
POWER BOARD AM047883U

PSU
ISOLATION BOUNDARY
SELECT TAP REQUIRED
240V 120V T16
F9 AUXILIARY SUPPLY FUSE
AUXILIARY SUPPLY
FAN SUPPLY
FUSE PANEL F14 F15 F16 R Y B L1 L2 L3 MAIN SUPPLY
MISSING PULSE DETECTOR
OVER CURRENT TRIP IA >400% FOR 3 MS (300%)
TACHO FAILCLAMP
ISOLATION FOR SYNCRONISATION 220-480V 45-65Hz T15
OPTO ISOLATOR
RLA
FUSES MOUNTED ON HEATSINK
STACK SUPPRESSION MOUNTED ON BUSBARS F1 F4 F2 F5 F3 F6 FS16 FS17
CONTACTOR COIL
ACCT T13 T14 T18 T17
F7 F8

DATE		DRAWN	MATERIAL	DIMS. IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)	ASSEMBLED ON	SCALE	TITLE
29/10/84	1	D.J.H. / M.R.E.		GENERAL TOLERANCES X = ± 0.4, X.X = ± 0.2, X.XX = ± 0.1, HOLES ⌀ 7mm +0·02 + 0·07			3 PHASE 4 QUADRANT BLOCK DIAGRAM 550
4/8/86	2	CHECKED					
		DESIGN APPROVAL	FINISH		Shackleton system drives		DRAWING NUMBER HH 052499F SHT. 1 OF 1 SHTS.
		MANF. APPROVAL					

SIZE A3 (420 x 297)

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NOTES:

1 P1-P10 ASSEMBLED ON PRESET BOARD (AI046821C001). TACHO CALIBRATION RESISTORS R19 & R20 (AC121), CURRENT CALIBRATION RESISTORS R123A-E (R6) ASSEMBLED ON CALIBRATION BOARD (AI046789C001)

2 OPTION SWITCH POSITIONS - S1 —
S2 STANDSTILL LOGIC ENABLE
S3 SETPOINT RAMP INPUT ENABLE
S4 SETPOINT RAMP RATE CHANGE

3 LED 1 1 PHASE (AUX) ON/OFF
LED 2 45-65Hz ENABLE/INHIBIT
LED 3 3 PHASE (MAINS) ON/OFF
LED 4 NORMAL/TRIGGER FAULT
LED 5 NORMAL/OVERCURRENT FAULT
LED 6 RUN/INHIBIT
LED 7 ROTATING / STANDSTILL
LED 8 NORMAL/ALARM
ALL 8 LED'S ILLUMINATED WHEN OPERATING

4 R1 FITTED

DIAGNOSTIC SOCKET

AUXILIARY CURRENT LIMIT (POSITIVE)
MAIN CURRENT LIMIT
RAMP RESET (0V FOR OPERATION)
RAMP INPUT
RAMP OUTPUT
FAULT RESET EXTERNAL A.C. COUPLED
INPUT No 1 (+VE)
INPUT No 2 (+VE)
INVERTED SUB TOTAL
INPUT No 3 (-VE)
TOTAL SETPOINT
CURRENT DEMAND OUTPUT
CURRENT DEMAND SCALATE (-VE FOR OPERATION)
AUXILIARY CURRENT INPUT
SELECT AUXILIARY INPUT (0V FOR OPERATION)
AUXILIARY CURRENT LIMIT (NEGATIVE)
BUFFERED CURRENT (100% = 5V)
TACHO INPUT
BUFFERED TACHO
ARMATURE CURRENT COMPENSATION (100% = 1V)
ZERO SPEED RELAY DRIVE (ENERGISED WHEN STANDSTILL) 50mA
THERMISTOR/MICROTHERM
AUXILIARY ENABLE
STOP
START
READY (+24V 50mA)
ENABLE
+24V (50mA)
DRIVE OPERATIONAL RELAY DRIVE - ENERGISED WHEN DRIVE OK) 50mA
+10V PRECISION REFERENCE (25mA)
-10V PRECISION REFERENCE (25mA)
0V SIGNAL
0V POWER

7 I/P AND GATE
UP RATE P1
DOWN RATE P2
FILTER
2 I/P AND GATE
2 I/P OR GATE
SPEED INTEGRAL GAIN P6
CURRENT PROPORTIONAL GAIN P8
CURRENT INTEGRAL GAIN P9
P7 MAIN CURRENT LIMIT (200% = 10V)
R198 SOT
R89 SOT
C108 SOT
C86 SOT
R106 SOT
R123 S.O.T.
TACHO FAIL CLAMP
INVERSE TIME CHARACTERISTIC
ZERO SPEED
0.5% STANDSTILL THRESHOLD 4%
ENDSTOP S.O.T. R42 SOT
INHIBIT
PLL SYNC
FILTER -90°
DIVIDE BY 6
PHASE LOCKED LOOP
PHASE ROTATION
AUTO RANGE RAMP
COMP
GATING LOGIC
FIRING CIRCUITS
MISSING PULSE DETECTOR
OVER CURRENT TRIP IA >400% FOR 3MS (300%)
FAULT RESET INTERNAL S5
TRIP RESET
CALIBRATION BOARD AI046789C001
TACHO BURDEN RESISTORS R19 & R20
CURRENT BURDEN RESISTORS R123
PRESET BOARD AI046821C001
P1 P2 P3 P4 P5 P6 P7 P8 P9 P10
PRESET BRD
LED 1 LED 2 LED 3 LED 4 LED 5 LED 6 LED 7 LED 8
START INSTRUCTION
3 Ø PRESENT
FIELD FAIL
MAIN SYSTEM ENABLE
CONTROL BOARD AH047423U003

P.S.U.
ISOLATION BOUNDARY
SELECT TAP REQUIRED
F9 AUXILIARY SUPPLY FUSE
AUXILIARY SUPPLY
FAN SUPPLY
FUSE PANEL
MAIN SUPPLY
ISOLATION FOR SYNCRONISATION 220-480V 45-65Hz
OPTO ISOLATOR
CONTACTOR COIL
FUSES MOUNTED ON HEATSINK
STACK SUPPRESSION MTD ON BUSBARS
TH1-6
T2,4,6,7 9 & 11 PULSE TRANS.
TRIGGER BOARD AH047644U003
MOTOR ARMATURE
MOTOR FIELD
HALF WAVE
FULL WAVE
A.C. FIELD SUPPLY (EXTERNAL)
FIELD FAIL OVERRIDE
THERMAL TRIP (FITTED WITH FANS)
POWER BOARD AH047833U015
ISOLATION BOUNDARY

DRAWN	D.J.H./M.R.E.	MATERIAL	DIMS. IN M.M. APPLY OVER FINISH (EXCEPT FOR PAINT AND LACQUER)	ASSEMBLED ON	SCALE
CHECKED			GENERAL TOLERANCES X = ±0.4, X.X = ±0.2, X.XX = ±0.1, HOLES +0.08 +0.00	Shackleton system drives	
DESIGN APPROVAL		FINISH			
MANF. APPROVAL					

TITLE: 3 PHASE 2 QUADRANT BLOCK DIAGRAM 551

DRAWING NUMBER: HH052497F

ISSUE: 1

DATE: 29/10/84 | 4/8/84 | 2

BASIC SETTING UP AND OPERATING INSTRUCTIONS

A. 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 "
   Motor "

   NOTE: Completely disconnect the controller before point to point checking with a buzzer or when checking insulation resistance with a megger.

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.
   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.
9. Blower fan supply is correct.

ENSURE:

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

B. 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 i.e. fire elements, in series with the motor armature.
4. Check the tachogenerator calibration resistors and current calibration resistors on the small plug-in card which is accessible under the front cover.

   NOTE: These resistors should be good quality 2% metal film type.

   Tachogenerator calibration:

   The two resistors R19 and R20 should be roughly equal in value and scaled as follows:

   For full speed tacho voltages of up to 200 volts:

   R19 + R20 = (tacho volts -10)K Ohms

   For full speed tacho voltages greater than 200 volts, fit an external resistor, value RE, in series with the tacho connection to terminal B2 such that:

   (a) R19+R20+RE = (tacho volts -10)K Ohms

   AND:

   (b) R19+R20 does not exceed 190K Ohms.

   DCVT Calibration:

   Where DCVT feedback is used instead of tacho feedback (i.e. Product Code block 9 = 13), R19 and R20 should be roughly equal in value and should be selected according to the formula:

   R19+R20 = (Full speed DCVT output -1)K Ohms.

   Full load armature current calibration:

   Armature current is scaled by resistors R123 A,B,C,D and E. The combined value of all these resistors in parallel should be calculated as follows:

   $$R123 = \frac{2200}{(\text{Full Load Amps} - 1)} \text{ Ohms}$$

   NOTE: The armature current calibration should NEVER be changed to increase the current above the factory set value without prior consultation with SSD Ltd.

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.
   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:

Pot No.	Description	Normal Initial Setting
1.	Setpoint ramp up rate Clockwise rotation gives more rapid acceleration.	Midway
2.	Setpoint ramp down rate Clockwise rotation gives more rapid deceleration.	Midway
3.	Zero speed It should not be necessary to adjust this initially on a new factory tested drive.	About midway
4.	Standstill threshold Sets low speed drive quench level if the standstill logic switch is set to position 1. Clockwise sets lower speed.	Midway

5.	Speed proportional Clockwise increases speed loop gain	20% Clockwise
6.	Speed Integral Clockwise decreases speed loop integral time constant	20% Clockwise
7.	Main Current Limit Clockwise increases current limit up to max. 200% FLC* short-term overload	Fully anti-clockwise (zero current)
8.	Current Proportional Clockwise increase current loop gain	Midway
9.	Current Integral Clockwise decreases current loop integral time constant	Fully anti-clockwise
10.	Speed Calibration Clockwise increases motor speed	About midway

* Full Load Current.

6. Set Option Switch

This is a small 4-toggle (DIL) switch located on the main control board near to the left-hand end of the diagnostic socket. To access the switch it is necessary to remove the push-on protective panel attached to the Main Control printed circuit board.

SWITCH S1: Buffered Current Signal (terminal B12)

UP = ON = Armature current meter reads ± Amps. For applications employing a centre-zero meter.
DOWN = OFF = Meter reads modulus. For applications employing a uni-directional meter.

NOTE:

In the 551 units the Armature Current Meter will always read +Amps, regardless of the setting of switch S1, since these convertors cannot produce negative output current.

Switch S2: 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

Switch S3: 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 A5.)

Switch S4:

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.

For most applications the switches would be set as follows:
S1 set UP (ON) = Current meter reads ± .
S2 set DOWN (OFF) = Standstill logic inoperative.
S3 set UP (ON) = Setpoint ramp connected.
S4 set DOWN (OFF) = Setpoint ramp adjustable from 2.5 to 75 seconds.

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 C). 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.

C. CHECKING THE DRIVE AND SETTING UP:

1. When all the preceding steps are completed the auxiliary power supply can be connected to terminals D9 and D10, (but do not connect the Main 3-phase power supply at this stage). Immediately check that the correct voltage appears between D9 and D10.

2. Now check:

   i) The drive condition indicators - these are eight LED lamps at the lower right-hand corner of the Main Control printed circuit board. LED No's 1, 4, 5 and 8 should be on.

   ii) Check the +24v (nominal) supply at terminal C11 (with respect to C1) to be between 22 and 30 volts.

   iii) If a Diagnostic Test Unit (5570) is available, check the ±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 A11 (+10V) and A1 (Ov).

   v) Check the -10v supply rail:
   Switch to diagnostic test point 3 or measure the voltage between terminals A12 (-10v) and A1 (Ov).

   vi) Check fan and blower option.

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

4. Check that a speed demand signal is available. This will normally appear as an input to the Setpoint Ramp on terminal A4 (diagnostic test point 11).

   Additional setpoint inputs may also appear at:

   Input No. 1 (+), terminal A6 (Diag. 12)
   Input No. 2 (+), terminal A7 (Diag. 13)
   Input No. 3 (-), terminal A9 (Diag. 14)

NOTE:

The sum of the setpoint voltages appears at terminal A10 (Diagnostic 15) as the Total Setpoint voltage.

5. If possible, check the polarity of the tachogenerator signal by rotating the motor shaft manually in the "forward" direction (ie: the direction which should correspond to a positive setpoint at A4):

   The voltage at terminal B2 (or B11) should go positive.
   The voltage at Diagnostic test point 16 should go negative.

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

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

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

   The Main 3-phase contactor should drop out, de-energised. If not disconnect all power supplies and check the Stop/Start circuit and contactor wiring.

   NOTE:

   The Main 3-phase contactor should NEVER be operated by any means other than the drives' internal contactor control circuit, as shown in wiring diagram HJ050217D.

   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 A10, 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 D5 and D8. Note that this will be high voltage DC, so procede with extreme caution. Do not continue if this is not correct, but switch off all supplies and recheck the Product Code.
    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 7, are lit. Refer to the Diagnostic section 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 6 and 8.

14. Check that the Standstill Logic is switched OFF (Option Switch 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 A10, Diagnostic 15).
    Slowly increase the Main Current Limit setting up to about 20% FLC (i.e. 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 tacho 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 A10, Diagnostic 15). The motor should now run at about 10% Full Speed and LED 7 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 tacho and field connections.

18. 550 drive only:

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

19a. 550 drive:

    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. 551 drive:

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 ±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. 550 drive 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 B5 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 potentio- meter (P7) should be turned progressively anticlockwise, almost to the midway position - this will limit the current to just above Full Load.

D. 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 SSD, 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 D5 and D8, labelling each wire clearly so that it can later be reconnected with the correct polarity. Transfer the "Field Fail" plug to the "Overide" position on the Power Supply printed circuit board.

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 overide the Tacho Failure Alarm/Clamp: Disconnect the Tacho(+) wire from terminal B2 and then link terminal B2 to ±10V (terminal A11, A12 or B9).

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 S4 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 ouput sockets on the Diagnostic Unit and switch to Diagnostic 26. This provides access to a safe, isolated signal representing the armature current waveform where ±1.1v = ±100% full load current.

7a. 550 drive:

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 below.
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. 551 drive:

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 551 non-regenerative drive the current waveform will increase from zero instead of the negative value shown in the figures.

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

REMOVE THE LINK FROM BETWEEN TERMINAL B2 AND THE 10V SUPPLY AND THEN RECONNECT THE TACHO(+) WIRE TO TERMINAL B2.

Transfer the "Field Fail" plug back to its original position and reconnect the field wires to terminals D5 and D8, ensuring that they are replaced in their original positions i.e. with correct polarity. Remove any mechanical devices previously used to lock the motor shaft.

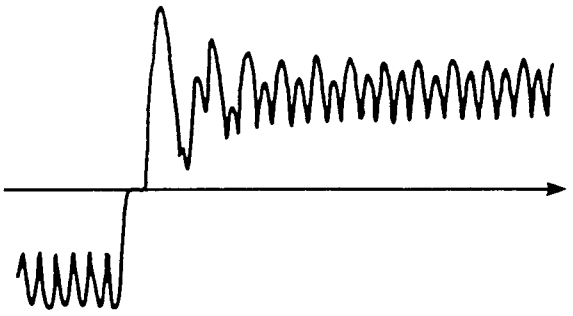


FIGURE 1. ARMATURE CURRENT WAVEFORM: Current Loop controls incorrectly set - Integral Time Constant too short - increase Current Loop Integral Time Constant by rotating P9 anticlockwise.

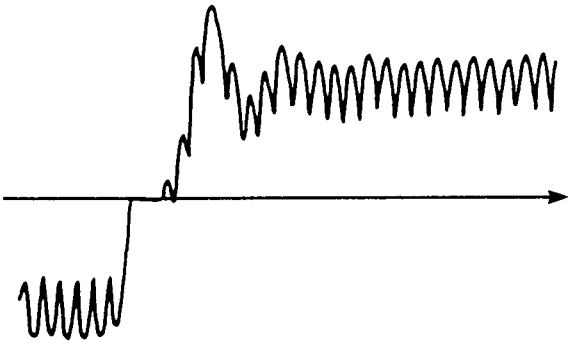


FIGURE 2. ARMATURE CURRENT WAVEFORM: Current Loop controls incorrectly set - Proportional Gain too low - increase Current Loop Proportional Gain by rotating P8 clockwise.

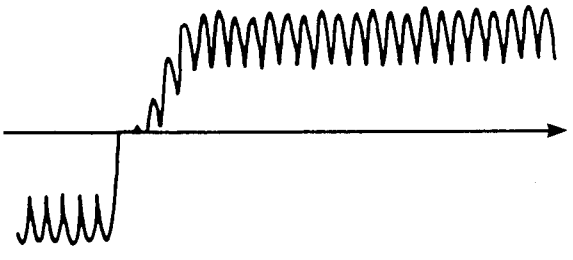


FIGURE 3. ARMATURE CURRENT WAVEFORM: Current Loop Response (P8 & P9) correctly adjusted.

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 S4 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 (±10v = ± 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 i.e. 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 S4 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 S4 to be either 0.25 to 7.5 seconds or 2.5 to 75 seconds to Full Speed.

13. Reset Option Switch S2 (Standstill Logic) to its original position. Note that if it is desired to eliminate shaft creep at zero setpoint in 550 regenerative drive 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 ±0.5 to ±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.

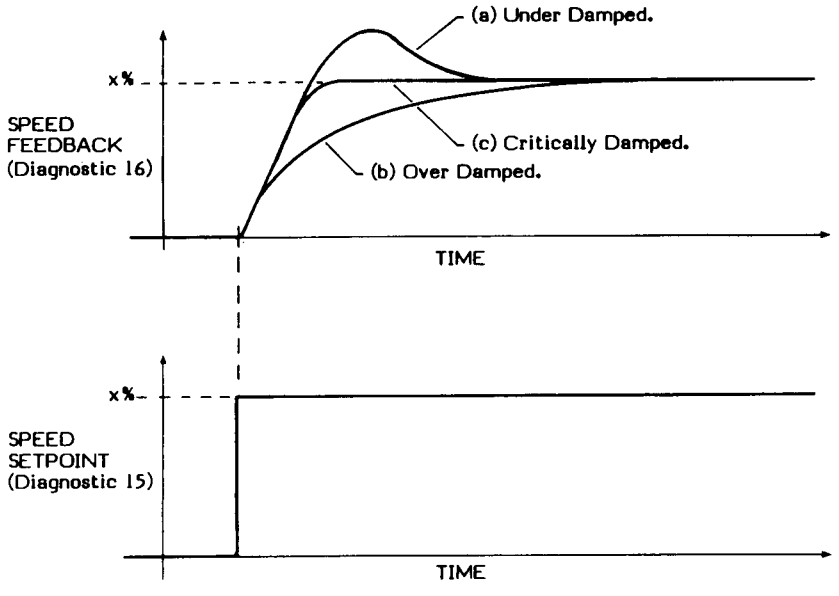


FIGURE 4. TYPICAL SPEED RESPONSE CURVES.

DIAGNOSTIC TEST FACILITY

A. 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 a small, portable, plug-in module which when connected to the drive provides access via a selector switch to 27 internal test points. The unit incorporates the following features.

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 ±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.

On certain models of drive in the 540 series the Diagnostic Test Unit is also available as a built-in feature.

B. 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 (Diagnostic Chart 1)

SECOND

Look at the DRIVE CONDITION INDICATORS and compare with the Status Recognition Chart (Diagnostic Chart 2)

THIRD

Check the voltage indicated by the 5570 DIAGNOSTIC TEST UNIT and compare with the Voltage Measurement Chart (Diagnostic Chart 3)

C. CONNECTION AND DISCONNECTION OF THE DIAGNOSTIC TEST UNIT

CONNECTION:

1. Disconnect the Auxiliary and Power Supplies from the drive.

2. Push back the Retainer/Ejector Lever at each end of the Control PCB Socket.

3. Insert the Diagnostic Unit Plug into the Socket, ensuring that Polarising Tab and Slot are correctly aligned. The Retaining Clips should close automatically as the Plug is pushed home.

DISCONNECTION:

1. Disconnect the Auxiliary and Power Supplies fom the Drive.

2. Push back both Retainer/Ejector Levers, balancing the pressure applied so that the Plug is ejected without tilting.

DIAGNOSTIC CHART 1

DRIVE CONDITION INDICATORS - DESCRIPTION

LED 1: 1 PHASE (AUXILIARY SUPPLY) ON/OFF

ON: Single phase auxiliary supply on.

OFF: a) Single phase supply or fuse FS9 failed.

b) Presets PCB or Calibration PCB not fitted or not plugged in correctly.

LED 2: 45-65 HZ ENABLE/INHIBIT

ON: Phase locked loop synchronized.

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

LED 3: 3-PHASE POWER SUPPLY

ON: 3-Phase power supply connected

OFF: a) 1 Phase or more not connected.

b) Main contactor not closed.

c) Coding fuse failure check FS14, FS15, FS16.

LED 4: NORMAL/TRIGGER FAULT

ON: Armature Current waveform normal

OFF: Abnormal current waveform detected indicating failure of an SCR to trigger or turn on. The drive can only be restarted after such a fault occurs by either pressing the "FAULT RESET" pushbutton or externally by applying +24V (from terminal C11) to reset terminal C12.

LED 5: 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. 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 C11) to terminal C12.

LED 6: RUN/INHIBIT

ON: Indicates that both "READY" signal (on terminal C8) and "ENABLE" signal (on terminal C5 and diagnostic 5) are present. The drive will now start.

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

NOTES:

a) The "READY" signal depends upon each of the following signals being in its enabled condition:

i) Single phase (auxiliary supply) On/Off (LED 1)
ii) 45-65HZ Enable/Inhibit (LED 2)
iii) 3-Phase (Main Supply) On/Off (LED 3)
iv) Normal/Trigger Fault (LED 4)
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 C5, normally from START SUPPLY terminal C4. START SUPPLY is only present when LED 5 is lit.

* Field fail is in series with stack overtemperature switch and suppression fuse protection microswitches.

LED 7: 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.

LED 8: NORMAL/ALARM

ON: Drive condition normal.

OFF: Drive in fault condition.

NOTES:

a) In the STOP condition the "NORMAL" signal only requires that the internal supply rails are present.

b) In the START condition the "NORMAL" signal requires the READY signal (teminal C8) to be present.

DIAGNOSTIC CHART 2

DRIVE CONDITION INDICATORS - STATUS RECOGNITION

CONDITION REFERENCE

1 PHASE (AUX) ON/OFF
45-65 HZ ENABLE/INHIBIT
3-PHASE (MAINS) ON/OFF
NORMAL/TRIGGER FAULT
NORMAL/OVERCURRENT FAULT
RUN/INHIBIT
ROTATING/STANDSTILL
NORMAL/ALARM

STOP CONDITION

● LED ON
○ LED OFF
⊗ EITHER

	1	2	3	4	5	6	7	8	CONDITIONS/CHECKS
A	●	○	○	●	●	○	○	●	NORMAL STOP CONDITION.
B	○	○	○	○	○	○	○	○	NO AUXILIARY SUPPLY. CHECK: (1) Auxiliary A.C. supply voltage on terminal D9 with respect to terminal D10 corresponds to auxiliary power supply transformer tapping selected on power board. (2) Auxiliary supply fuse FS9.
C	○	○	○	●	●	○	○	●	CALIBRATION BOARD NOT FITTED. CHECK: (1) Calibration board inserted correctly.
D	○	○	○	●	●	○	●	●	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 appearing on terminal B2 with respect to terminal B1. (3) Wiring to terminals B2 and B1. (4) Preset board potentiometer P10.

DRIVE CONDITION INDICATORS - STATUS RECOGNITION

CONDITION REFERENCE								START CONDITION	
	1 PHASE (AUX) ON/OFF								
		45-65 HZ ENABLE/INHIBIT							
			3-PHASE (MAINS) ON/OFF						
				NORMAL/TRIGGER FAULT					
					NORMAL/OVERCURRENT FAULT				
						RUN/INHIBIT			
							ROTATING/STANDSTILL		
								NORMAL/ALARM	
	1	2	3	4	5	6	7	8	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 C4 to C6. (3) Continutiy of start line terminals C6 to C7.
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 ie. 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 FS14, FS15, FS16. 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 C5. CHECK: (1) Drive enable (diagnostic 5). (2) Continuity between terminal C5 and start supply C4, OR C5 and +24V (NOMINAL) supply C11, as appropriate.
L	●	●	●	●	●	●	○	●	NORMAL RUN CONDITION - SHAFT STATIONARY IF INCREASING SETPOINT HAS NO EFFECT THEN: FOR SPEED CONTROL MODE CHECK: (1) Total Setpoint (diagnostic 15) is responding to the setpoint input. (2) That the Total Setpoint is positive in the 551 unit. (3) Main current limit (diagnostic 24) is not at zero. (4) Auxiliary current limits (diagnostics 22 and 23) are not at zero. (5) That the current demand is <u>not</u> isolated (diagnostic 19). (6) Motor armature connections (with supplies isolated). (7) Tacho connections correct (diagnostics 15 and 16). (8) Motor not stalled. Diagnostic 26 indicates armature current. (9) Fuses 1-6 inclusive. FOR TORQUE (CURRENT) CONTROL <u>ONLY</u> CHECK: Items 2, 3, 5, 7 and (10) Auxiliary current input (diagnostic 20) is not at zero. (11) Auxiliary current input is selected (diagnostic 21).

● LED ON
○ LED OFF
⊗ EITHER

DRIVE CONDITION INDICATORS - STATUS RECOGNITION

CONDITION REFERENCE

1 PHASE (AUX) ON/OFF

45-65 HZ ENABLE/INHIBIT

3-PHASE (MAINS) ON/OFF

NORMAL/TRIGGER FAULT

NORMAL/OVERCURRENT FAULT

RUN/INHIBIT

ROTATING/STANDSTILL

NORMAL/ALARM

START CONDITION

● LED ON

○ LED OFF

⊗ EITHER

	1	2	3	4	5	6	7	8	CONDITIONS/CHECKS
F	●	●	●	●	●	●	⊗	●	NORMAL RUN CONDITION.
M	●	●	●	●	●	○	○	○	DRIVE INHIBITED BY AUXILIARY ENABLE, OVERTEMPERATURE ALARM, FIELD FAILURE ALARM OR INTERMITTENT SUPPLY LOSS. CHECK*: (1) Auxiliary enable (Diagnostic 8). (2) Thermistor/Microtherm (Diagnostic 6). (3) Field Fail (Diagnostic 7). (4) Field voltage on terminals D5 and D8. (5) Field circuit continuity (isolate supplies before checking). (6) Fuses FS7 and FS8 (isolate supplies before checking). (7) Observe LEDs 2 and 3 for intermittent, momentary loss of supply. WHERE AC SUPPLY TO THE FIELD RECTIFIER IS EXTERNAL (FIELD OPTIONS 4, 5 AND 6). CHECK: (8) AC Voltage on terminal D4 and D1. (9) Rotation of fans as stack thermal trip is in series with field fail. (10) Stack suppression fuses FS17, FS18 as microswitch indicators are in series with field fail.
N	●	●	●	○	●	○	○	○	ALARM CONDITION - TRIGGER FAULT, IF SETTING UP DRIVE FOR FIRST TIME OR SETTINGS HAVE BEEN ADJUSTED INDICATES EXTREME INSTABILITY. CAREFULLY FOLLOW DRIVE SETTING UP PROCEDURE.** OTHERWISE, CHECK: (1) Diagnostic 26. Observe armature waveform on oscilloscope. If one or more Thyristors is not being turned on drive will trip.**
P	●	○	○	●	○	○	○	●	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 C3 is connected to C10 these alarm conditions will latch, they may be reset by operating the Stop/Start controls.

** To reset the drive, fault reset must be operated and the drive restarted.

DIAGNOSTIC CHART 3

DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
1	Internal +15V Supply	Aux. Power ON	+15V ±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 25mA.	Aux. Power ON	+10V ±0.1V Max. 100Hz ripple=5mV peak to peak
3	External -10V Supply	Aux. Power ON	-10V ±0.1V Max. 100Hz ripple=5mV peak to peak
4	Internal -15V Supply	Aux. Power ON	-15V ±0.25V Max. 100Hz ripple=25mV peak to peak
5	Drive Enable Enable = +24V(Nominal) on terminal C5 Inhibit = open circuit to terminal C5	Enable Inhibit	+7V ±4V ≤ -5V
6	Motor Thermistor/Microtherm	Motor temperature correct Motor over temperature	+0.5V ±0.5V -14V ±1.25V
7	Field Fail Notes: 1.This signal is interlocked with the internal temperature sensor the internal ACCT connectors and the suppression fuse microswitches. 2.Internally supplied fields 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 fields will depend on the application. 4.Permanent magnet motor, field weakening and remote field supply applications will employ field failure overide. This will provide a constant 'field normal' signal.	Field AND Interlocks Normal Field OR Interlocks Fail	+0.5V ±0.5V -14V ±1.25V
8	Auxiliary Enable Enable = +24V(Nominal) on terminal C3 Inhibit = Open circuit to terminal C3	Enable Inhibit	+0.5V ±0.5V -14V ±1.25V
9	Start Instruction	Run Stop	+0.5V ±0.5V -14V ±1.25V

DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
10	Setpoint Ramp Reset Enable = Open circuit to terminal A3 Reset to Zero = Connect terminal A3 to A1 (0V) Note: Setpoint ramp output is also reset to zero when run/inhibit LED 6 is out.	Ramp Enable AND Run Ramp Reset OR Stop	-14V ±1.25V 0V ±0.1V
11	Setpoint Ramp Input Connects directly to terminal A4 and measures the incoming speed demand signal. If terminal A4 is not used the voltage measured should be zero.	Variable Input: 100% forward speed demand. Zero speed or terminal A4 not used 100% reverse speed demand*.	 +10V 0V -10V
12	Input No. 1 Connects directly to terminal A6 and measures the incoming speed demand signal. If terminal A6 is not used the voltage measured should be zero.	Variable Input: 100% forward speed demand. Zero speed or terminal A6 not used 100% reverse speed demand*.	 +10V 0V -10V
13	Input No. 2 Connects directly to terminal A7 and measures the incoming speed demand signal. If terminal A7 is not used the voltage measured should be zero.	Variable Input: 100% forward speed demand. Zero speed or terminal A7 not used 100% reverse speed demand*.	 +10V 0V -10V
14	Input No. 3 Connects directly to terminal A9 and measures the incoming inverted speed demand signal. If terminal A9 is not used the voltage measured should be zero. Note: That input No. 3 is of the opposite sense to all other speed inputs.	Variable Input: 100% forward speed demand. Zero speed or terminal A9 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 S3 is closed), minus Input No. 3. It is clamped to a maximum output of ±11V.	Variable Signal: 100% forward speed demand. Zero speed. 100% reverse speed demand*.	 +10V 0V -10V
16	Speed Feedback This is the scaled and buffered tacho-generator 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).	Variable Signal: 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 dependant 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 ≠ 0V	up to ±10V 0V Approx 0V ±0.2V up to ±10V

* 550 drive only.

DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
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 6) and on the Standstill Logic (if switch S2 is closed).	Run - Variable Signal - 550 - 551 Stop - (or Standstill)	±10V 0 to +10V 0V ±0.1V
19	Current Demand Isolate Connects directly to terminal B3. NOTE: 1. For speed control operation leave terminal B3 open circuit. 2. For current control operation connect terminal B3 to B1 (0 Volts).	Speed control. Current control.	-14V ±1.25 0V ±0.1V
20	Auxiliary Current Input Connects directly to terminal B5. Only operational if selected (See Diagnostic 21).	Variable Input (if used): Positive Bridge current = 200% FLC* Zero Current. Negative Bridge current = 200% FLC* (550 only) * FLC = Full Load Current.	 +10V 0V -10V
21	Select Auxiliary Input Connects directly to terminal B6. NOTE: 1. To select input connect terminal B6 to 0 Volts (terminal B1). 2. To disconnect input leave terminal B6 open circuit.	Select Input. Disconnect Input.	0V ±0.1V -14V ±1.25
22	Auxiliary Current Limit (Positive) Connects directly to terminal B7. 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 B7 open circuit.	Terminal B7 open circuit. Variable Input: Positive current limit = 200% FLC* Positive current limit zero. * FLC = Full Load Current.	+12V ±2V +10V 0V
23	Auxiliary Current Limit (Negative) Connects directly to terminal B10. 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 B10 open circuit. 3. IN ALL 551 APPLICATIONS TERMINAL B10 MUST BE OPEN CIRCUIT.	Terminal B10 open Circuit (see note 3). Variable Input: Negative current limit = 200% FLC* Negative current limit zero. * FLC = Full Load Current.	-12V ±2V -10V 0V

DIAGNOSTIC TEST UNIT - VOLTAGE MEASUREMENTS

TEST NO.	DIAGNOSTIC TEST POINT DESCRIPTION	CONDITION	VOLTAGE
24	Main Current Limit Overrides Auxiliary Current Limits (see Diagnostic 22 and 23). Scaling: 0 to +10V equivalent to 0 to 200% Full Load Current (FLC). Characteristics: (i) When set between 0 and 5.5V (0 to 110% FLC*) the set current is available continuously. (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 secs before cut back starts. 200% load is permitted for approximately 10 seconds before cut back starts.	Variable Voltage depending upon the input to terminal B8 (normally +10V) and the setting of the Main Current Limit Potentiometer P7.	0 to +10V
25	Total Current Demand (Inverted) 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 depends on the "Run/Inhibit" signal (LED 6) and on the Standstill logic (if switch S2 is closed).	Variable demand in run condition: Positive Bridge Current = 200% FLC* Zero Current. Negative Bridge Current = 200% FLC* (550 only) In stop condition. * FLC = Full Load Current.	 -10V 0V +10V 0V
26	Current Feedback Measured armature current signal. This is an isolated signal which is directly proportional to the Armature Current. Under steady state conditions it should be of opposite polarity and one fifth the magnitude of the Total Current Demand signal at Diagnostic 25.	Variable signal in run condition: Positive Bridge Current = 200% FLC* Zero current. Negative Bridge Current = 200% FLC* (550 only) * FLC = Full Load Current.	 +2.2V 0V -2.2V
27	Phase Angle 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 6) and on the Standstill Logic (if switch S2 is closed). Signal value is limited if no tacho-generator feedback signal is present in order to help prevent over speeding of the motor.	Variable Signal in run condition: Positive phase angle. (550 only) Zero phase angle. Negative phase angle. Tacho loss (i.e. No tacho signal).	 up to +10V 0V up to -10V Limited to ±(4.7V ±0.2)

SPARE PART INDENTIFICATION LIST

Except where otherwise stated, parts are suitable for all convertors in the range 550 and 551.

PRINTED CIRCUIT BOARDS

		PART NUMBER
Three Phase Control Board	-550.	AH047423U002
	-551.	AH047423U003
Three Phase Trigger Board	-550.	AH047644U002
	-551.	AH047644U003
Power Supply Board		AH047833U015
Calibration Board.		AH046789U003
Preset Potentiometer Board		AH046821U002

Field Suppression Board. . . . . (These P.C.B.'s are Product Code dependent)

3-PHASE SUPPLY VOLTAGE OPTION (PRODUCT CODE BLOCK 3)	FIELD SUPPRESSION BOARD PART NUMBER
0 - 110v 1 - 115v 2 3 - 220v 4 - 240v	LA048620
5 - 380v 6 - 415v	LA048621
7 - 440v 8 - 460v 9 - 480v	LA048622

FUSES

	PART NUMBER
Auxiliary Supply Fuse (FS9), 3A 250v, (1 off used)	CH020033
Coding Supply Fuses (FS14,15 & 16)* (3 off used) - 20A 600v, Ferraz type B77971.	CH220024
Field Supply Fuses (FS7 & 8)* (2 off used) Product Code Dependent (Product Code Block 4.)	
4 or 5- 16A 600v, Ferraz type A77970.	CH260163
8 -8A 440v,Ferraz type G84393	CH200083
Suppression Supply Fuses (FS17 & 18)* (2 off used) - 20A 500v, Ferraz type A76935	CH290024

Main Supply Fuses (FS1, 2, 3, 4, 5 & 6)* (6 off used)

CONVERTOR TYPE (PRODUCT CODE BLOCK 1)	OUTPUT CURRENT RATING (PRODUCT CODE BLOCK 2)	FUSE PART NUMBER
550 & 551	361A to 720A (3610 - 7200)	CS049830

* IMPORTANT NOTE: These are High Speed Semiconductor Protection Fuses, use of any other type invalidates Warranty and may result in serious damage to the controller.

SEMICONDUCTORS

Field Bridge . . . . . .)
Field Bridge VDR (1 off used). . . . . .)
Line VDR (6 off used). . . . . .)

These items are Product Code dependent - select from the chart below:

3-PHASE SUPPLY VOLTAGE OPTION (PRODUCT CODE BLOCK 3)	FIELD BRIDGE PART NUMBER	FIELD VDR. PART NUMBER	LINE VDR. PART NUMBER
0 - 110v 1 - 115v 2 3 - 220v 4 - 240v	CW047591	CK047723	CK049159
5 - 380v 6 - 415v	CW047076	CK047692	CK049160
7 - 440v 8 - 460v 9 - 480v	CW047379	CK047693	CK049161

Thyristors (6 off used).These are Product Code dependent and should be selected from the chart below:

3-PHASE SUPPLY VOLTAGE OPTION (PRODUCT CODE BLOCK 3)	OUTPUT CURRENT RATING (PRODUCT CODE BLOCK 2) 361 TO 720A (3610-7200)
0 = 110v 1 = 115v 2 3 = 220v 4 = 240v	CF049822
5 = 380v 6 = 415v	CF049824
7 = 440v 8 = 460v 9 = 480v	CF049826

* Note that these are all Force Ventilated units.

MISCELLANEOUS	PART NUMBER
Mains Transformer*	C0047686
Field Current Transformer*	C0043469
Pulse Transformer*	C0047522
Main Current Transformer Only – 550	C0049652
– 551	C0049653
Connector, Female, 4 Way (Complete set of 12)	LA047525
Connector, Male, 4 Way, P.C.B. Mounting*	CI047088
Front Cover – Upper	LA047632
– Lower	LA047032
Legend Plate Assembly (Incl. W Buttons) – Diagnostic Version (Product Code Block 8 = 1)	LA048630
– Non-Diagnostic Version (Product Code Block 8 = 0)	LA048631
W Buttons	FI044705
Ribbon Cable Assembly 14 way	CM047819
Ribbon Cable Assembly 24 way	CM049620
Box Clamps	DH049834
Microswitch	DC043486
Overtemperature Switch	DC048854

Blower Fan .....) These items are Product Code dependent –
Blower Fan Capacitor (where applicable).....) select from the chart below:

AUXILIARY SUPPLY VOLTAGE OPTION (PRODUCT CODE BLOCK 5)	STACK FAN (2 OFF)	SUPPLY FREQUENCIES	BLOWER FAN
0 – 110V 1 – 115V	DL049612	50 & 60 Hz	DL044536
3 – 220V	DL049611	50Hz	DL044534
4 – 240V	DL049611	60Hz	DL052575

RECOMMENDED MINIMUM SPARES HOLDING

NOTE: For Product Code dependant items ensure that the correct Part Number is used.

1 off Each type of Printed Circuit Board.

2 off Auxiliary Supply Fuse.

4 off Field Supply Fuses.**

3 off Coding Supply Fuses.**

4 off Suppression Supply Fuses.**

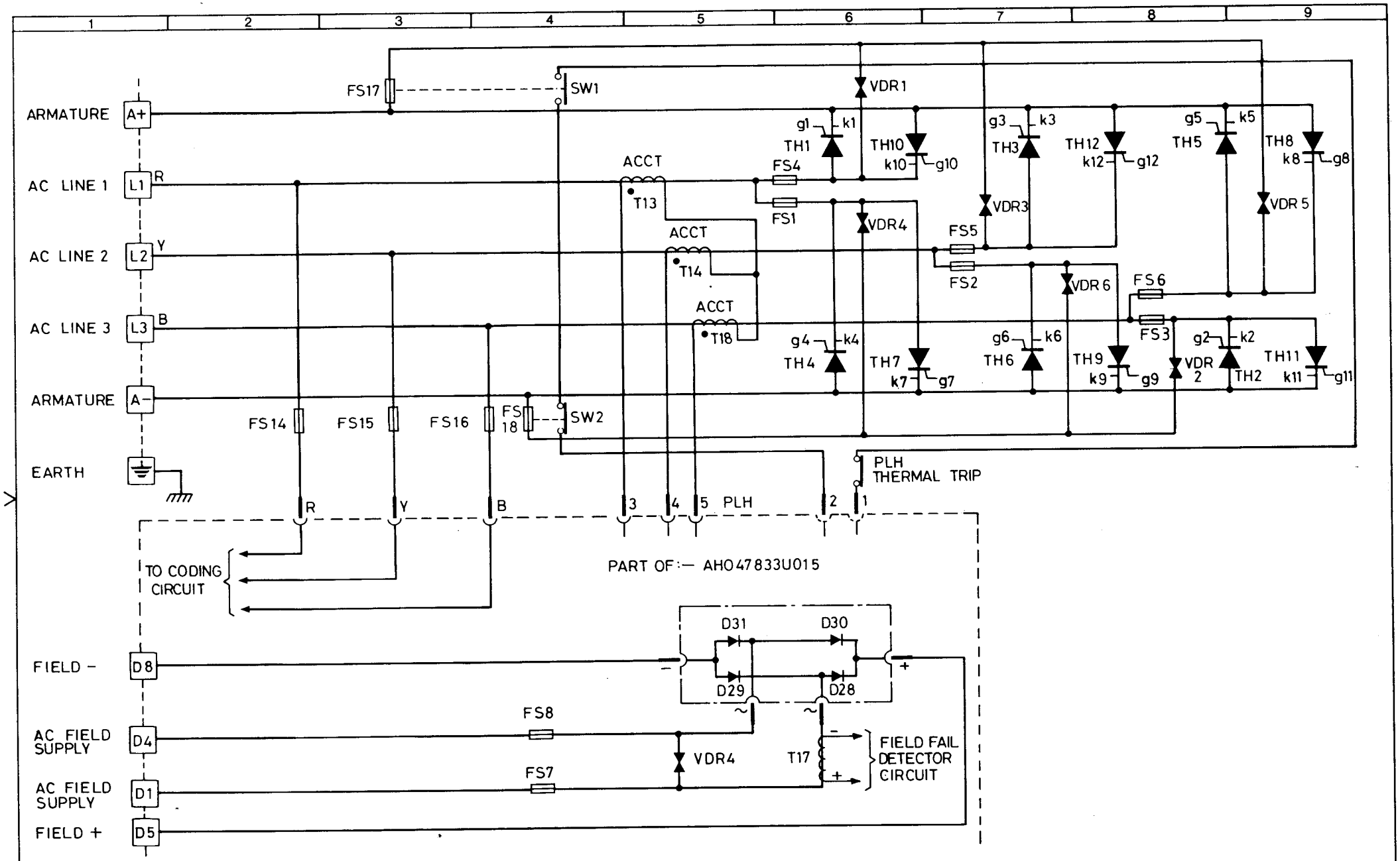
12off Main Supply Fuses.**

4 off Thyristor Packs.

1 off Field Bridge.

* P.C.B. Mounted Components.

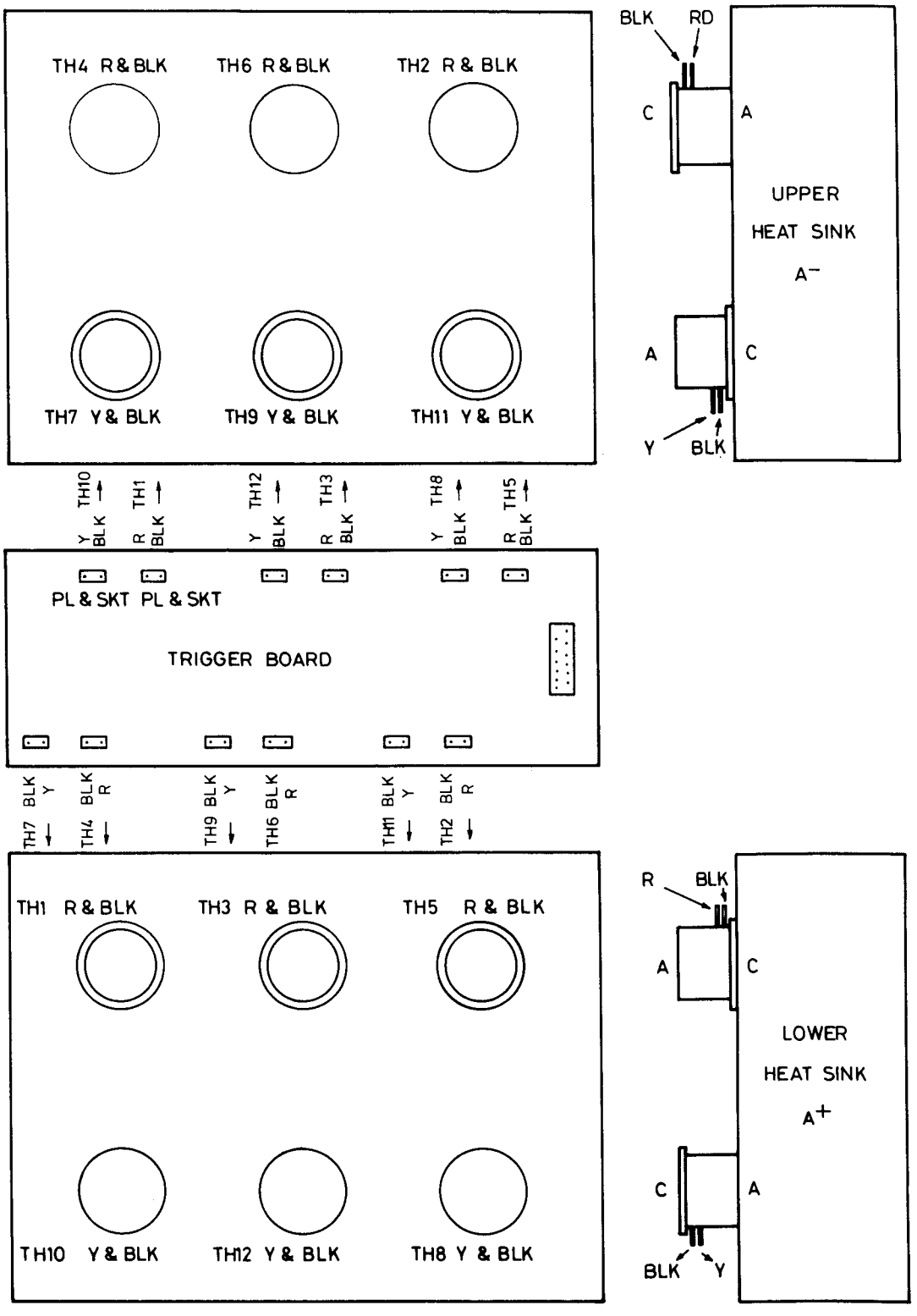
** These are High Speed Semiconductor Protection Fuses, use of any other type invalidates Warranty and may result in serious damage to the controller.



DRAWN PW	CHECKED S.M.	DATE	ELECTRICAL SYMBOLS TO BS 3939	TITLE CIRCUIT DIAGRAM FOR 550 POWER CIRCUIT	USED ON		
TRACED EDES	DESIGN APP.	A 19·10·84	LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HB052477 D	SHT 1 OF 1	
		1 29/10/84					
		2 18.10.85					
		3 4·8·86					
		4 1·8·90					

KE048614D

AARQUE 3443/82



R = RED WIRE PTFE COVERED 19 x·2

BLK = BLACK WIRE PTFE COVERED 19x2

Y = YELLOW WIRE PTFE COVERED 19x2

WIRES FROM EACH PLUG TO BE TWISTED

DRAWN A P

CHECKED S.M.

DESIGN APP.

TRACED EDES

DATE

B 18·9·84

1 29/10/84

ELECTRICAL SYMBOLS TO BS 3939

LITTLEHAMPTON ENGLAND TELEX 87142

TITLE

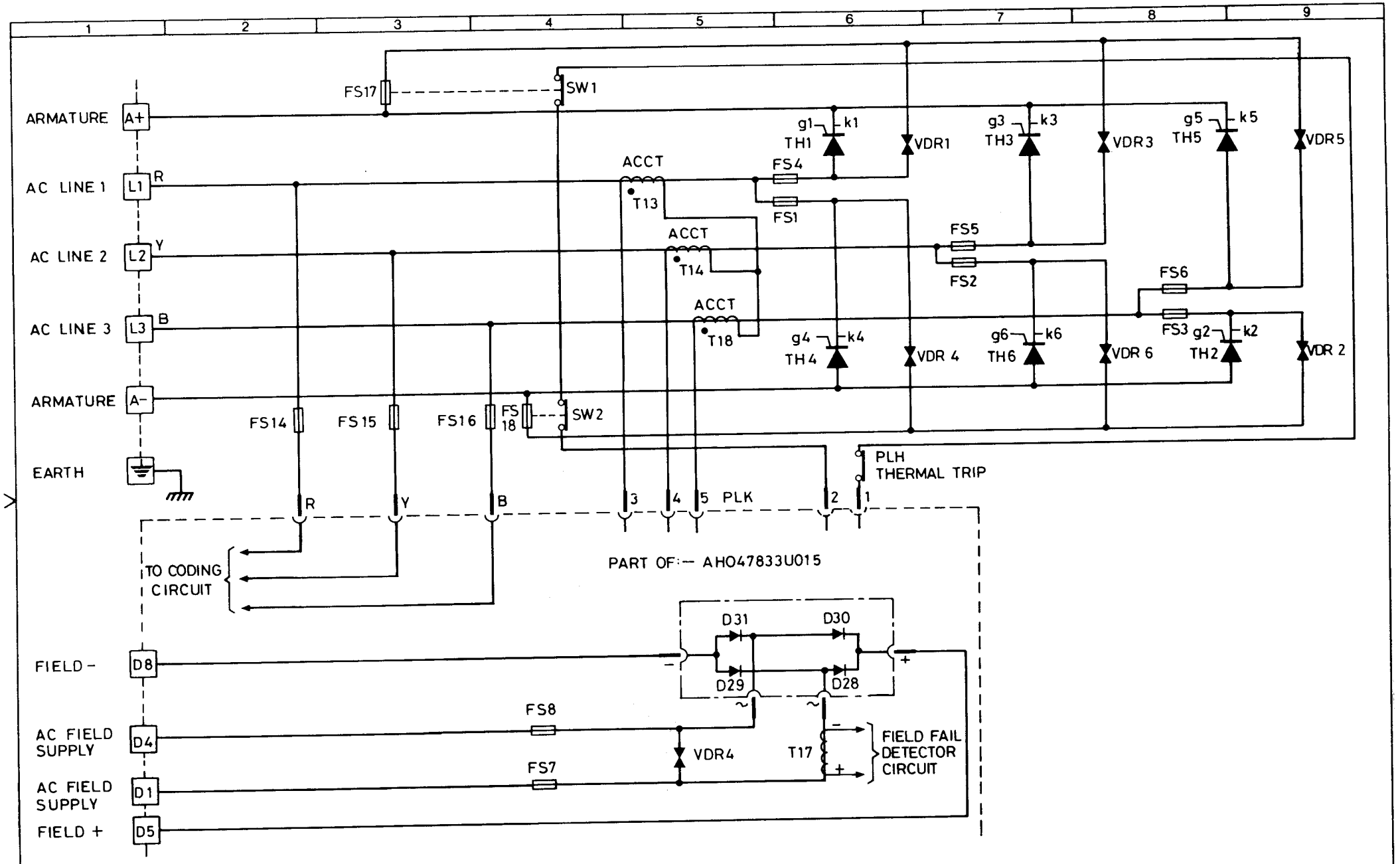
WIRING SCHEMATIC (550 PULSE LEADS)

DRAWING NUMBER HJ049860D

USED ON 550

SHT 1 OF 1

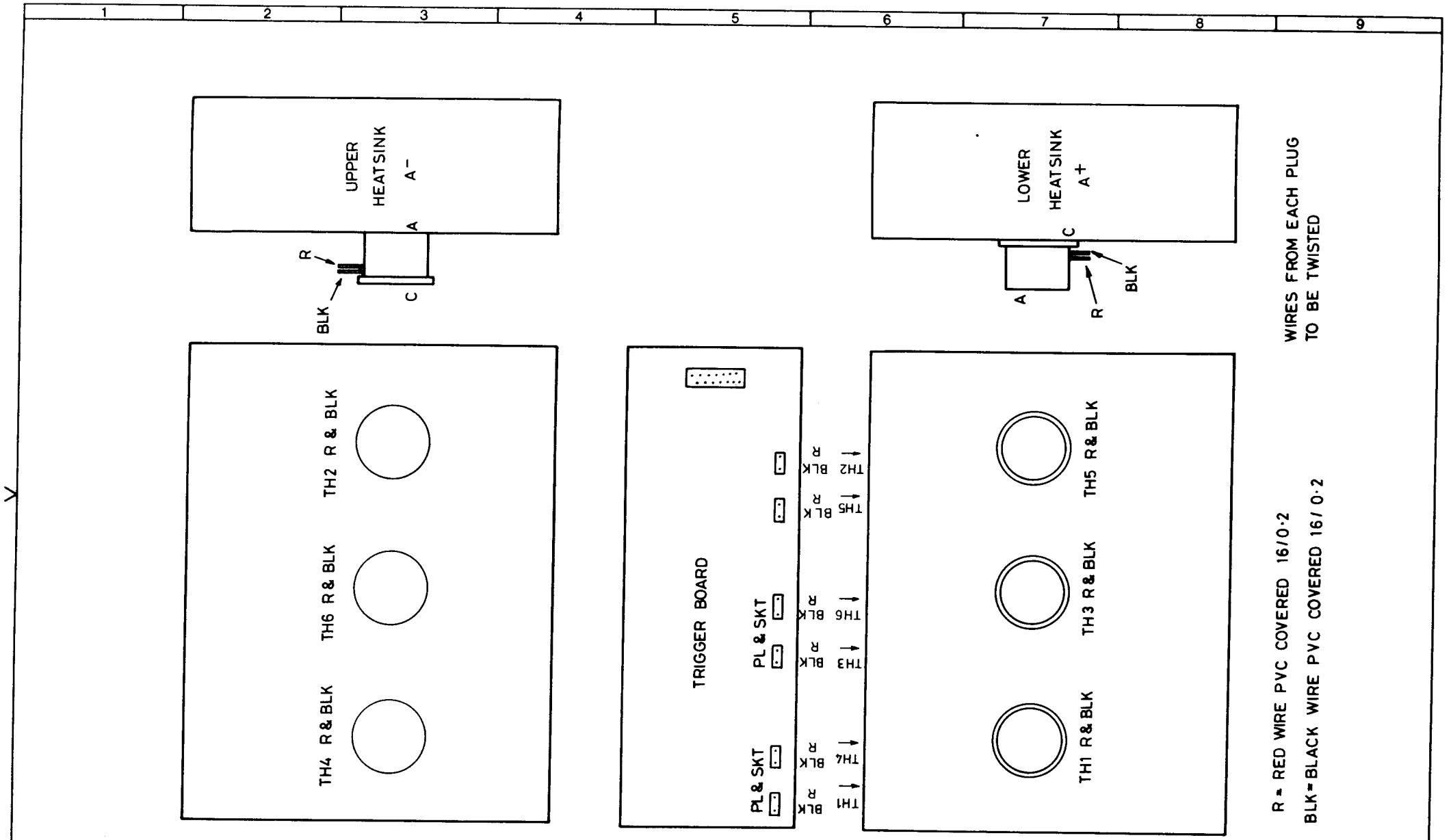
KE048614D



DRAWN PW	CHECKED S.M.	DATE	ELECTRICAL SYMBOLS TO BS 3939	TITLE CIRCUIT DIAGRAM FOR 551 POWER CIRCUIT	USED ON	
TRACED EDES	DESIGN APP	A 19.10.84 1 29/10/84 2 18.10.85 3 4.8.86	LITTLEHAMPTON ENGLAND TELEX 87142		DRAWING NUMBER HB052478D	SHT 1 OF 1

KE048614D

AARQUE 3443/82



DRAWN	CHECKED	DATE	ELECTRICAL SYMBOLS TO BS 3939	TITLE	USED ON
A.P.	S.M.	B 18·9·84	LITTLEHAMPTON ENGLAND TELEX 87142	WIRING SCHEMATIC (551 PULSE LEADS)	551
TRACED	DESIGN APP.	S/S 1 21/10/84		DRAWING NUMBER HJ049881D	SHT 1 OF 1
EDES					

KE048614D

AARQUE 3443/82

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IA058413C Issue D

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Appendix I

ROUTINE MAINTENANCE

Periodic checking of the main air flow path should be carried out to ensure no build up of foreign bodies occur at the entry to the lower heatsink and on the round AC bus bars which entered in the air flow.

Ensure all supplies to cubicle are isolated (see manual title page). Remove main air flow entry grill situated low down in the rear cubicle panel. This grill is secured by four screws passing into tapped holes. Using as large a mirror as possible and a light source that illuminates in one direction look up the air entry path and examine for growth of debris around the first fin and AC bus bar. Experience shows that in the rare occurrences where blockages occur it is at these points. If this is clear the system will be satisfactory. Should a build up be apparent this must be removed, a suitable air line assists in this operation. If the deposits are particularly tenacious the rear cubicle panel may be removed together with the lower ducting from the converter body and this facilitates clearing. Further access may be obtained by removing the cover rear panel. This is held by M6 hex head screws. With the rear panel removed the air flow path is exposed. This panel is sealed with silicone sealant and must re-sealed when re-assembling the unit. All parts must be correctly re-assemblied and secured before re-connecting supplies.

ISS.	MODIFICATION	CP.NO.	DATE	APPROVAL
1	Initial Issue	3241	3.2.90	GR

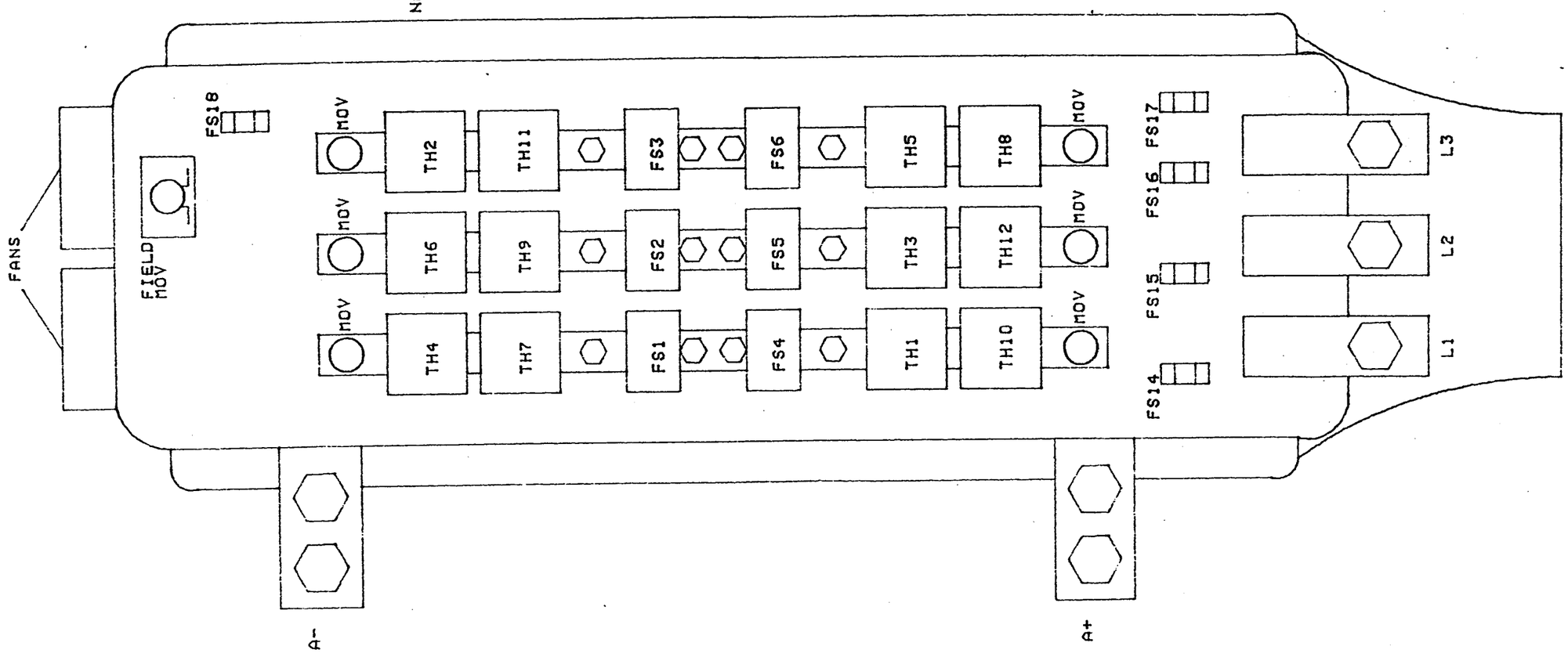
FIRST USED ON	MODIFICATION RECORD 550 and 551 Product Manual

SSD
LITTLEHAMPTON
ENGLAND
TELEX 87142

DRAWING NUMBER	SHT.
ZZ052005C	1 of 1

0 1 2 3 4 5 6 7 8 9

NOTE' CONTROL BOARD, POWER SUPPLY BOARD, AND TRIGGER BOARD REMOVED.



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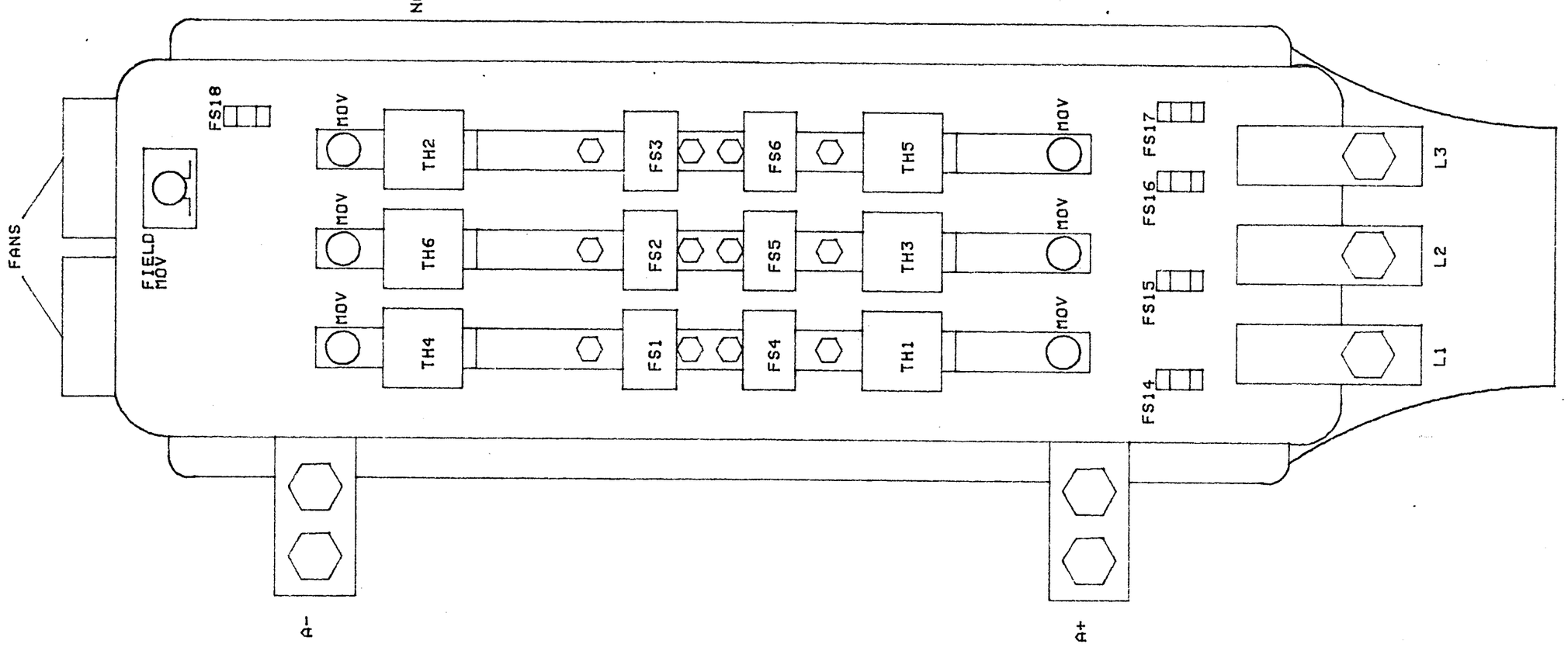
SSDroboCAD	date	7-17-85					drg HJO 48464

NOTE, CONTROL BOARD, POWER SUPPLY BOARD, AND TRIGGER BOARD REMOVED.



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