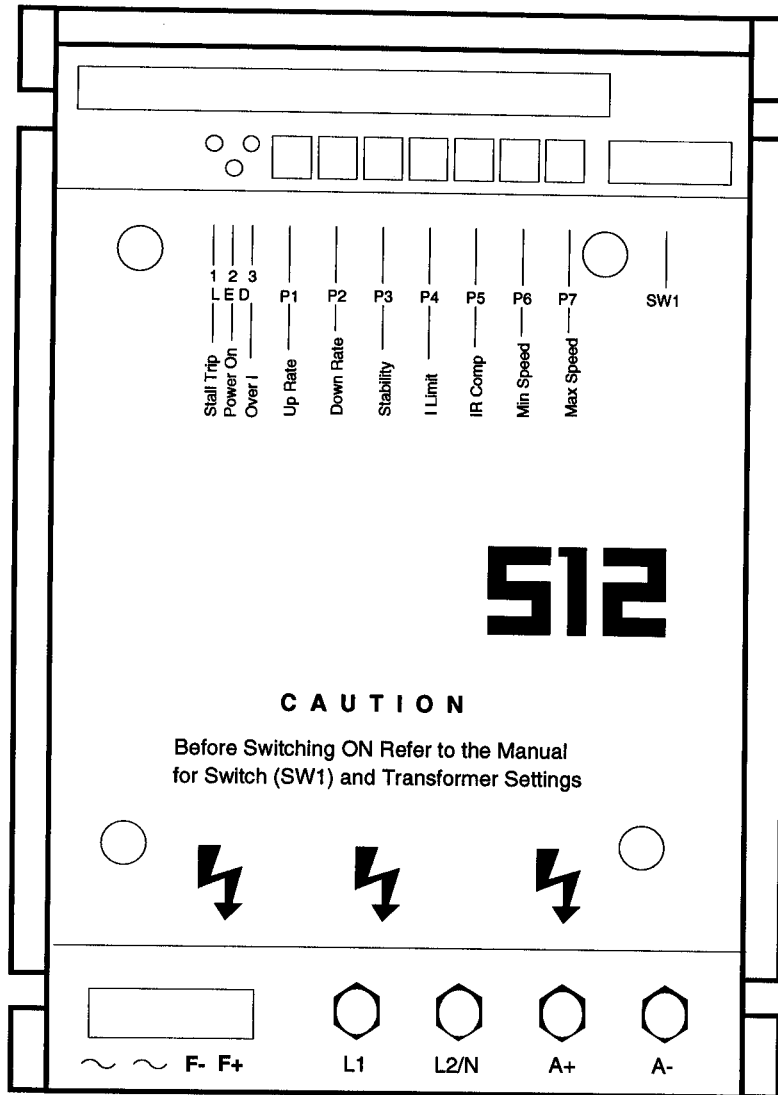




EUROTHERM DRIVES



S12

PRODUCT MANUAL

CONTROLLER WARRANTY

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



WARNING



This equipment contains hazardous voltages and hazardous rotating mechanical components (fans).

Loss of life, severe personal injury or property damage can result if instructions contained in this manual are not followed.

Only qualified personnel should work on this equipment, and only after becoming familiar with all safety instructions regarding installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance of the equipment

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

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WARNING

**NEVER WORK ON THE CONTROLLER
WITHOUT FIRST ISOLATING ALL
SUPPLIES TO THE SYSTEM.**

SINGLE PHASE CONVERTOR

TYPE 512

PRODUCT MANUAL

HA056554

Issue 8

Table of Contents

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GENERAL DESCRIPTION

The Eurotherm Drives 512 controller is suitable for speed and torque control of permanent magnet and shunt wound dc motors.

Three models are available:-

| | |
|--------|------------|
| 512/08 | 8A DC FLC |
| 512/16 | 16A DC FLC |
| 512/32 | 32A DC FLC |

The controllers are designed to operate from a single phase mains supply in the range 110 - 415 V.AC 50 or 60Hz. A simple transformer tap arrangement allows the controller to be programmed to suit the applied voltage.

The controller employs a full-wave 1/2 controlled thyristor/diode power bridge arrangement in two isolated base packages, this allows both heatsink and/or control board to be safely connected to earth.

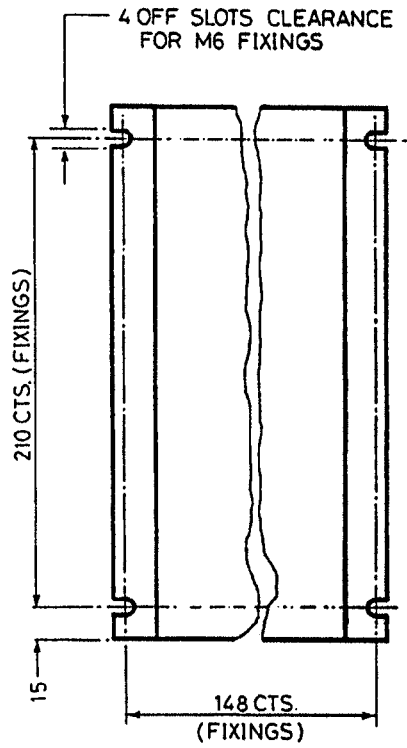
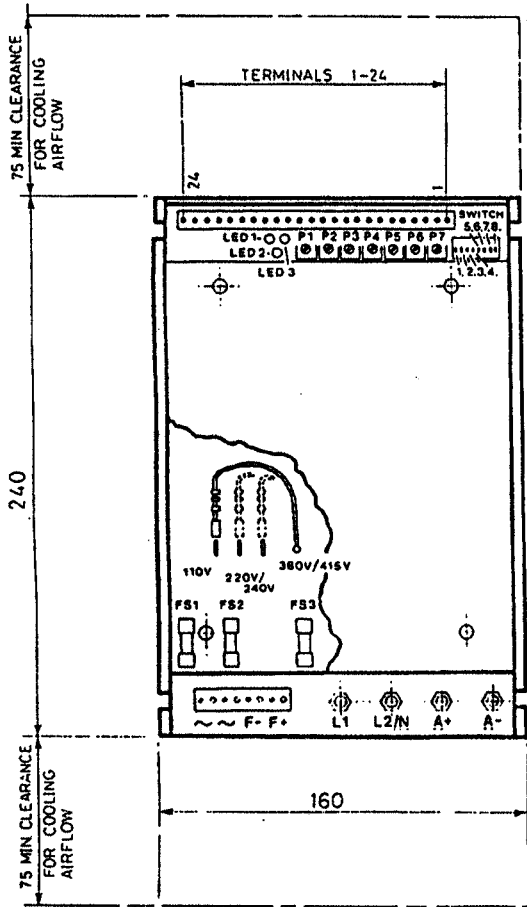
The speed of the DC motor is controlled using linear closed loop control with feedback signal from either armature voltage or tachogenerator, enabling the motor speed to be maintained under variable load conditions.

The current loop within the speed loop always ensures that controlled current levels are applied to the motor, the actual levels being fully user adjustable via a current limit potentiometer and programming switches.

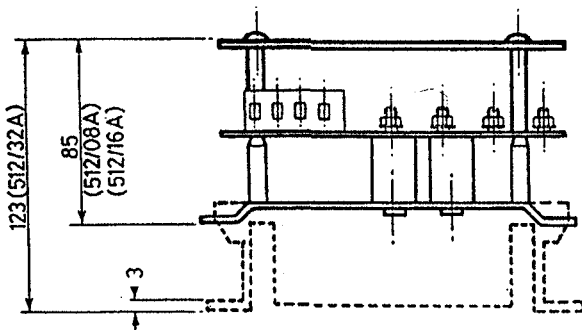
Should the motor stall (e.g. due to excessive load) then the controller will trip and remove current from the motor after approximately 15 seconds. Severe armature current overloads, caused by induced faults, are detected by an instantaneous over-current trip.

High speed fusing and over voltage protection are provided on the field and control circuit.

OUTLINE DRAWING



SCRAP VIEW ON UNDERSIDE



- 1 TERMINALS L1 L2/N A+ & A- ARE M5 STUDS
- 2 TERMINAL BLOCK F+ F- WILL ACCEPT 4mm²
- 3 TERMINALS 1 TO 24 WILL ACCEPT 2.5mm²
- 4 REMOVE LEGEND PLATE FOR ACCESS TO VOLTAGE SELECTION AND FUSES.

ELECTRICAL SPECIFICATION

| PARAMETER | SYMBOL | 512/08 | 512/16 | 512/32 | UNITS |
|---|--------|--|----------|----------|------------------|
| INPUT RATINGS | | | | | |
| SUPPLY VOLTAGE (link selectable) | Vs | 110/120 220/240 } ± 10% 380/415 | | | VOLTS AC |
| RATED CURRENT | Is | 12 | 24 | 48 | AMPS AC |
| SUPPLY FREQUENCY | fs | 50/60 ± 2 | | | Hz |
| OUTPUT RATINGS | | | | | |
| NOMINAL ARMATURE VOLTAGE | Va | 90 (110/120) 180 (220/240) 320 (380/415) | | | VOLTS DC |
| MAX (100%) ARMATURE CURRENT | Ia | 8 ± 10% | 16 ± 10% | 32 ± 10% | AMPS DC |
| NOMINAL MOTOR POWER AT 320 VDC ARMATURE | Pm | 2.25 | 4.5 | 9 | kW |
| MAX OVERLOAD | | 150% for 15s | | | |
| MAX DC FIELD CURRENT | If | 2 | | | AMPS DC |
| DC FIELD VOLTAGE | Vf | 0.9 x Supply Voltage(Vs) | | | VOLTS DC |
| MAX PERMISSIBLE FORM FACTOR | | 1.5 | | | |
| I ² t FUSING | | 300 | | | A ² S |
| TYPICAL HEAT DISSIPATION AT MAXIMUM CURRENT | | 25 | 50 | 75 | W |

ENVIRONMENTAL

| | | |
|-----------------------|---|--|
| ENCLOSURE | : | Chassis Mounting IP00 |
| OPERATING TEMPERATURE | : | -0 to +40° C (Derate 1.5%/Degree above 40° C |
| HUMIDITY | : | 85% R.H. at 40 Degree C (non condensing) |
| ALTITUDE | : | Above 1000m Derate 1%/100m |
| WEIGHT | : | 1.5kg - 512/08 1.6kg - 512/16 2.9kg - 512/32 |

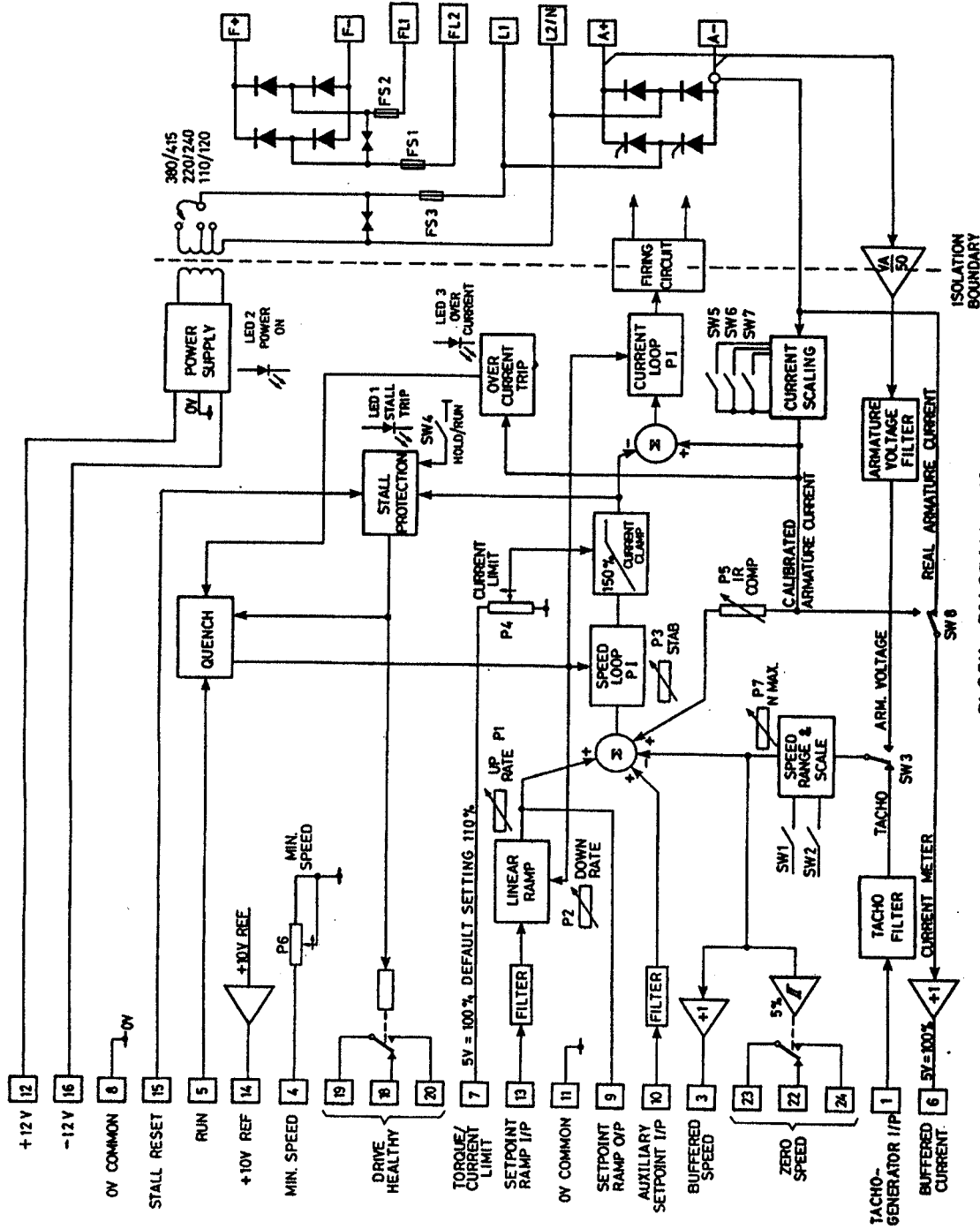
SPEED CONTROL

| | | |
|--------------------------|---|----------------|
| CONTROL ACTION | CLOSED LOOP PROPORTIONAL/INTEGRAL CONTROL WITH ADJUSTABLE STABILITY | |
| SPEED FEEDBACK | ARMATURE VOLTAGE | TACHOGENERATOR |
| 0 - 100% LOAD REGULATION | 2% TYPICAL | 0.1% TYPICAL |
| MAX TORQUE/SPEED RANGE | 20:1 | 100:1 |
| OVERLOAD | 150% FOR 15 SECONDS | |

TORQUE CONTROL

| | |
|----------------|---|
| CONTROL ACTION | CLOSED LOOP PROPORTIONAL/INTEGRAL |
| ACCURACY | 2% TYPICAL |
| OVERSPEED | AVAILABLE |
| OVERLOAD | NONE 100% CONTINUOUS Consideration must be given to the motor as it may overheat at low speed. |

BLOCK DIAGRAM



HH 057526 D

BLOCK DIAGRAM 512

TERMINALS 2, 17 & 21 NOT USED

TERMINAL DESCRIPTIONS

CONTROL TERMINALS


1. Tachogenerator Feedback : Positive voltage (350V maximum). Proportional to motor speed.
3. Speed Meter Output : 0-10V at 0-100% speed. Load 1mA maximum. Short circuit protected.
4. Minimum Speed : Connect to bottom of speed demand potentiometer, (~30% for 10k). Adjust minimum speed by P6.
5. Run : Connect to 0V common to run.
6. Current Meter Output : SW8 ON, Current meter output scaled for 0-5V representing 0-100% Full Load Current. (i.e. depends on position of current calibration switches, SW5, 6 and 7). N.B. 7.5V is 150%.

SW8 OFF, Current meter output scaled for 0-5V representing 0-100% controller rated current. Load 10mA Maximum. Short circuit protected.
7. Torque/Auxiliary Current Limit : 0-7.5V for 0-150% of Full Load Current. No connection gives 110% Full Load Current. I Limit (P4) gives 0-100% of Torque/Auxiliary Limit setting.
8. 0V Common : Signal Ground for Control Inputs.
9. Setpoint Ramp O/P : Output of ramp. (0-10V).
10. Auxiliary Speed Demand I/P : 0-10V for 0-100% speed. Non ramped.
11. 0V Common : Signal Ground for Control Inputs.
12. +12V : Positive Power Supply rail Maximum load 20mA.
13. Setpoint Ramp Input (wiper of speed ref pot) : 0-10V for 0-100%. Ramp rate adjustable by P1 and P2.

- | | | | | | |
|-----|-------------------------|---|---|---|---|
| 14. | 10V Precision Reference | : | Load 10mA maximum. Short circuit protected. Temperature compensated. (Use as reference for setpoints). | | |
| 15. | Stall Reset | : | Momentarily connect to +12V (terminal 12) to reset from stall or from hold condition. Connect permanently to terminal 12 when operating in a torque mode. | | |
| 16. | -12V | : | Negative Supply Rail 20mA maximum load. | | |
| 18. | N/C | } | Health Relay (Volt free) | | |
| 19. | Co | | | } | De-energised on stall trip Contact rating 240V @ 3A AC or 24V @ 3A DC. |
| 20. | N/O | | | | |
| 22. | N/C | } | Zero Speed Relay (Volt free) | | |
| 23. | Co | | | } | De-energised at zero speed (5% approximately) Contact rating 240V @ 3A AC or 24V @ 3A DC. |
| 24. | N/O | | | | |

Terminals 2, 17 and 21 are not used.

POWER TERMINALS

| <u>Terminal</u> | <u>Function</u> |
|---|--|
| L1 } L2/N } | Main supply terminals, M5 fixing. If a line and neutral supply is used, the neutral should be connected to L2/N. Supply must be correctly fused. |
| A+ } A- } | D.C. Output from controller to motor armature M5 fixing. Polarity will effect direction of rotation. |
| F+ } F- } | Field rectifier output to motor field winding. (2A Maximum). Polarity will effect direction of rotation. |
| FL1 } FL2 } | Input to field rectifier. This is supplied from any A.C. voltage source depending on the required field voltage. |
|  | Located in the bottom left corner of the heat fin to allow the heat fin to be earth, M5 ground fixing. |

CUSTOMER ADJUSTMENTS

- P1 Ramp Up Rate : Rotate clockwise for faster acceleration to set speed (linear, 1 to 20 seconds).
- P2 Ramp Down Rate : Rotate clockwise for faster deceleration to lower (or zero) speed (linear, 1 to 20 seconds).
- P3 Speed Loop Stability : Optimises system stability. Rotate clockwise for faster response (Excess adjustment may cause instability).
- P4 I Limit : Set the output current over the range 0-100% of scaled output, (see table 1 for scaled current output). In cases where current scaling does not match motor current rating, scale drive for higher rating and use I Limit to reduce maximum output current. Rotate clockwise to increase output current.
- P5 IR Comp : Optimises speed regulation against load change when using armature voltage feedback (SW3 on) rotate clockwise to increase compensation (excess adjustment may cause instability). Turn anticlockwise when tacho feedback is used (SW3 off).
- P6 Minimum Speed : Controls minimum motor speed. Rotate clockwise to increase minimum speed (approximately 30% when using a 10k ohm speed demand potentiometer).
- P7 Maximum Speed : Controls maximum motor speed. Rotate clockwise to increase maximum speed (see customer option switches SW1 and SW2 for range of control, table 2).

OPTION SWITCHES

- SW3 (OFF) TACHOGENERATOR : Drive using tachogenerator feedback for speed control.
- SW3 (ON) Va : Drive using armature voltage for speed control.
- SW4 (OFF) RUN : Drive ready to operate when power applied and 'Run' input Terminal (5) connected to 0V common.
- SW4 (ON) HOLD : As RUN but drive will not operate until a momentary connection is made between terminal 15 (stall reset) and terminal 12 (+12V).
- SW8 (OFF) CURRENT METER : Buffered Current meter output (Terminal 6) indicates 5V at 100% controller current e.g. 8, 16 or 32 Amp = 5V depending on build option.
- SW8 (ON) CURRENT METER : Buffered Current output (Terminal 6) indicates 5V for 100% of full load current i.e. depends on position of SW5, 6 and 7.

OPTION SWITCHES

Full speed tachogenerator/armature feedback voltage.

| SW1 | SW2 | FEEDBACK VOLTAGE | |
|-----|-----|------------------|--|
| OFF | ON | 10 - 25V | USE P7 TO TRIM MAXIMUM SPEED TO REQUIRED VALUE. |
| ON | ON | 25 - 75V | |
| OFF | OFF | 75 - 125V | |
| ON | OFF | 125 - 325V | |

TABLE 1

- Example: (a) Customer wishes to run motor at 1500 rpm with a 60V/1000 rpm tachogenerator.
Feedback voltage = 90V
From Table 1 set SW1 OFF SW2 OFF adjust P7 to give desired speed.
- (b) Customer wishes to run motor at 2000 rpm with 320V armature.
Feedback voltage = 320V.
From Table 1 set SW1 ON SW2 OFF adjust P7 to give desired speed.

Note: It is necessary to set these switches for both tachogenerator and armature voltage feedback.

Current Calibration

| SW5 | SW6 | SW7 | FULL LOAD CURRENT | | |
|-----|-----|-----|-------------------|-----|-----|
| | | | CONTROLLER OPTION | | |
| | | | 08 | 16 | 32 |
| OFF | OFF | OFF | 1A | | |
| ON | OFF | OFF | 2A | | |
| OFF | ON | OFF | 3A | | |
| ON | ON | OFF | 4A | 8A | 16A |
| OFF | OFF | ON | 5A | 10A | 20A |
| ON | OFF | ON | 6A | 12A | 24A |
| OFF | ON | ON | 7A | 14A | 28A |
| ON | ON | ON | 8A | 16A | 32A |

TABLE 2

Example. Customer wishes to run 14 Amp Motor

Option 1 Using **512/16**

From table 2 set SW7 ON, SW6 ON, SW5 OFF
= 14 Amp

Option 2 Using **512/32**

From table 2 set SW7 OFF, SW6 ON, SW5 ON
= 16 Amp

Turn down I Limit (P4) to give 14 Amps.

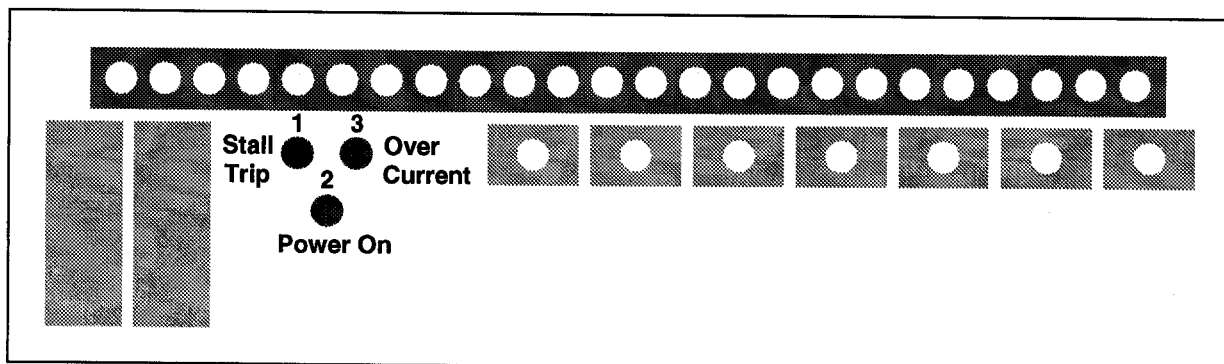
CONTROL TRANSFORMER TAPPING

The controller is shipped with the control transformer tapping set to maximum input voltage 380/415V to prevent accidental damage by the user.

The tapping link should be set to an appropriate position for the intended supply voltage. Failure to do so will give unpredictable electrical operation.

DIAGNOSTICS

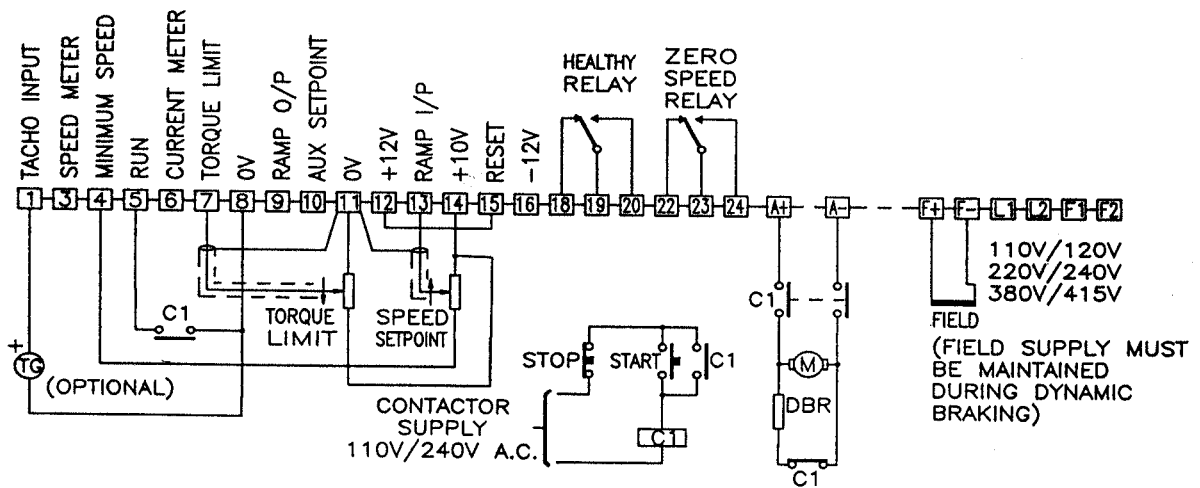
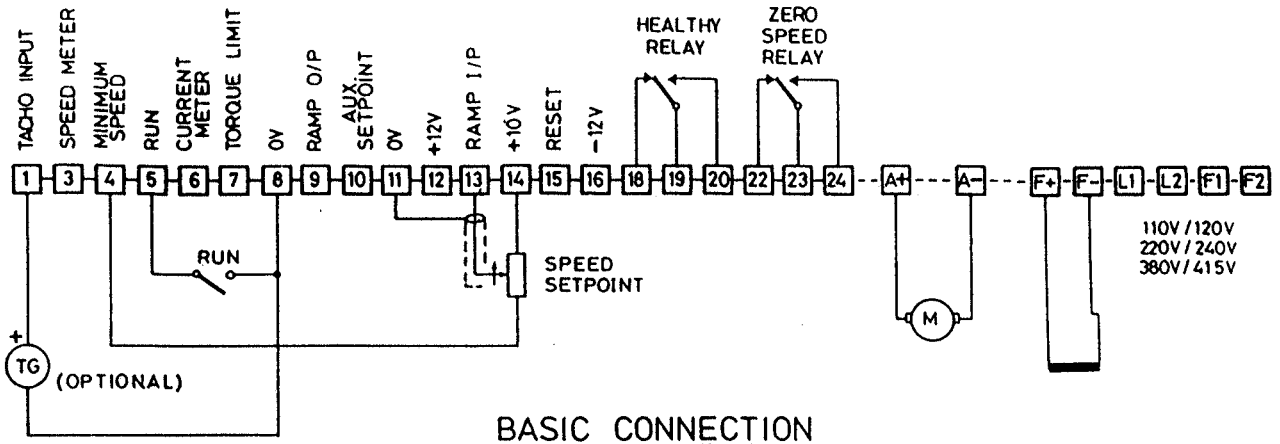
- LED 1 STALL TRIP : Illuminated when drive detects a Stall Condition or Hold on power on (SW4 ON).
- LED 2 POWER ON : Illuminated when power is applied to drive control circuit (L1, L2/N).
- LED 3 OVER CURRENT : Illuminated when current exceeds approximately 3.5 times full load current.

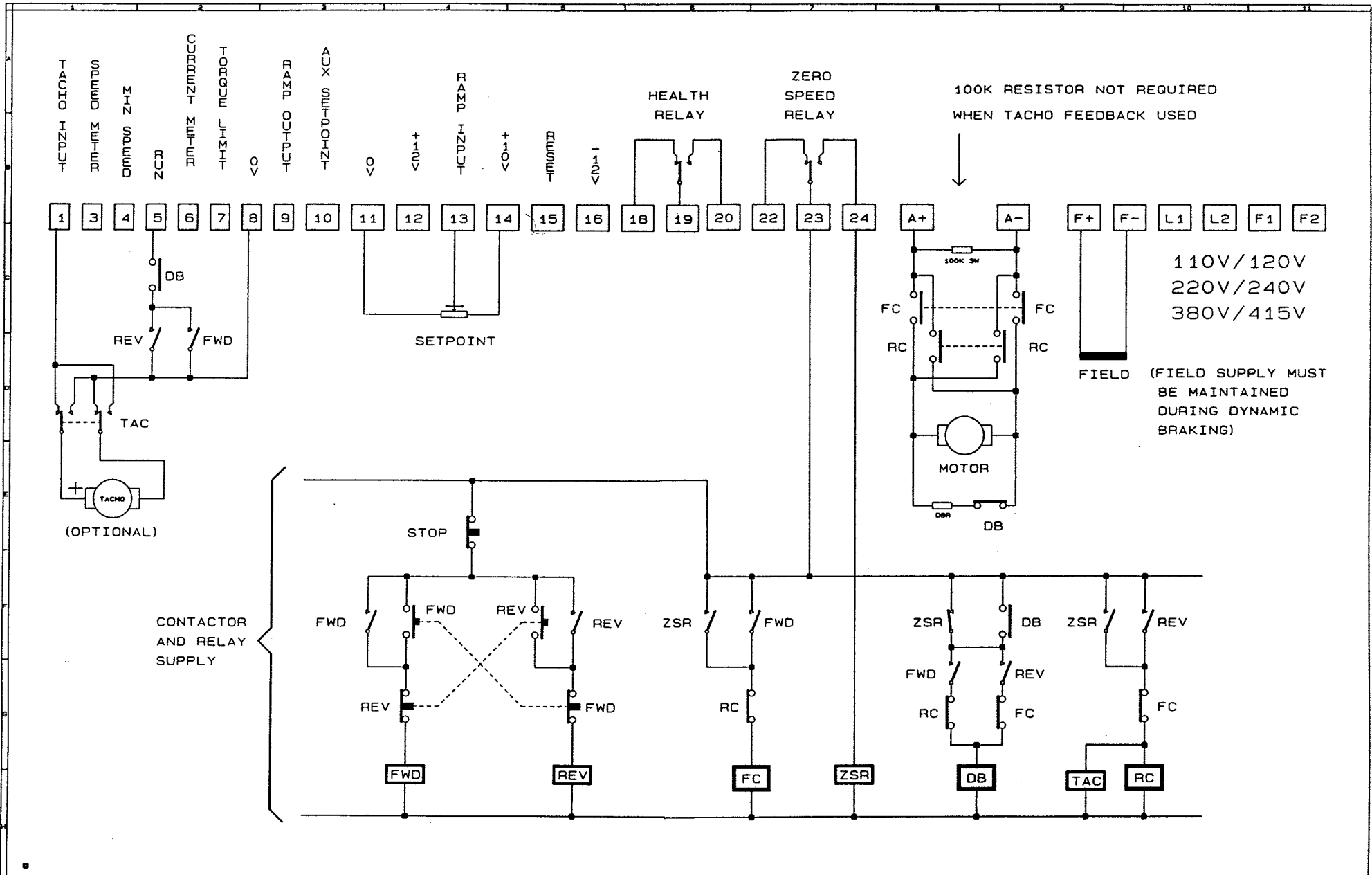


- PROTECTION** : Adjustable maximum current up to 150% for 15s.
- Fused (2 Amp) field and control circuits, overvolts and transient suppression on AC lines.
- : If motor is fitted with a thermistor then a resistance sensing relay may be used to interrupt run signal.
- RS stock number 349 822.

- SAFETY WARNING** : If the "0V" common terminal is connected to earth, an earth fault on the Run Input wiring will cause the drive to start.

CONNECTION DIAGRAM





| | | | | | | | | | |
|-----------------------|-------------|--|--|------------------------------------|--|----------------|--|-----------|--|
| CAD FILENAME: 512_REV | | NO ALTERATIONS OR ADDITIONS TO BE MADE TO THIS CIRCUIT DIAGRAM RE-PLOT ONLY. | | TITLE | | USED ON | | SSD 18 90 | |
| DRAWN | CHECKED | ELECTRICAL SYMBOLS GENERALLY TO BS3939 | | 512 REVERSING WITH DYNAMIC BRAKING | | 512 | | SHIT. 1 | |
| C.A.D. LINK | DESIGN APP. | SSD LITTLEHAMPTON ENGLAND TELEX 87142 | | Ei | | DRAWING NUMBER | | OF 1 | |
| | | | | | | HB058874E | | | |

INSTALLATION INFORMATION

Before connecting A.C. supplies to this equipment.

- 1) Ensure good airflow over heatsink. Maintain clearance above and below controller to 75mm as shown on installation drawing.
- 2) Operating temperature range 0 to +40° C.
- 3) Protect unit from airborne pollutants.
- 4) Avoid vibration.

MOTOR

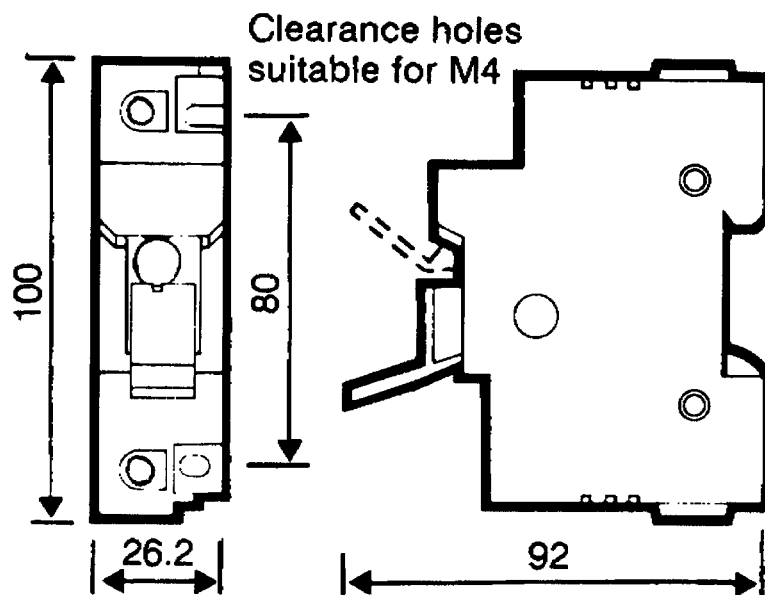
- 1) Ensure motor is mechanically secure and mounted according to manufacturers specifications and practice.
- 2) Inspect brush gear, ensure commutator in good condition and brushes are free to move in brush box and in good condition.
- 3) Check obstructions in motor vents to maintain cooling air path.
- 4) Ensure motor choke (if specified) is correctly wired.
- 5) Ensure motor free to rotate and that pulleys and couplings are correctly aligned.
- 6) Ensure transit damage has not occurred to motor windings or connections. Disconnect the controller before carrying out electrical measurements e.g. insulation resistance.

WIRING

- 1) Control Cabling 0.75 sq.mm. minimum.
- 2) Power cable to be minimum 600 VAC rated at 1.5 x armature current.
- 3) High speed semi-conductor fuses of the correct rating are recommended for incoming supply protection. The 512 is not internally fused (except field and control circuits).

- 4) Ensure good quality earth bonding.
- 5) Isolated control wiring should not be run close to the power cabling. If screened cables are used (recommended on setpoints and Tachogenerators) connect screens to earth only at controller end.
- 6) Eurotherm Drives can supply fuse assemblies which can be bulkhead mounted and also act as convenient supply isolators.

| | | |
|--------|--------------|---------------------------------|
| 512/08 | LA057605U016 | Complete with 16A fuse CH390163 |
| 512/16 | LA057605U032 | Complete with 32A fuse CH390323 |
| 512/32 | LA057605U050 | Complete with 50A fuse CH390054 |



BASIC SETTING UP PROCEDURE

A. BEFORE ATTEMPTING TO CONNECT POWER, CAREFULLY CHECK:-

1. Main power supply voltage is correct.
2. Armature voltage and current ratings are compatible with controller supplied.
3. Field voltage and current ratings are suitable.
4. All external wiring circuits:-

Power connections

Control connections

Motor connections

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

5. Check for damage to equipment.
6. Check for loose ends, clippings, drilling swarf, etc., lodged in the drive or ancillary equipment.
7. Inspect the motor, in particular the commutator for any extraneous matter. If an air supply is available, it is recommended to blow over the commutator. Check the brushes are properly seated and that the brush spring tension is adequate. If possible check that the motor (and vent fan if fitted) can be turned freely by hand.

B. ENSURE:-

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

C. PREPARATION

1. Prevent application of the main power supply by removal of the supply fuses.
2. Disconnect the load from the motor shaft if possible.
3. If there is any doubt as to the integrity of a particular installation, insert a high wattage resistor (i.e. fire bar elements) in series with the motor armature.
4. If it is possible to rotate the motor, and tachogenerator feedback is in use, check that forward rotation results in positive tacho feedback, i.e. terminal 1 is positive with respect to terminal 8 or 11.
5. Check switch selection

| | | |
|-------------------|---|---|
| SW1 SW2 | } | Speed Range (see table 1 on page 11) |
| SW3 | | Tachogenerator/VA (see switch options on page 10) |
| SW4 | | Hold/Run (see switch options on page 10) |
| SW5 SW6 SW7 | } | Current Calibration (see table 2 on page 11) |
| SW8 | | Absolute/Normalised Armature Current. |
6. Check all pots are set anticlockwise.
7. Check transformer supply tap.
8. Check external run contacts are open.
9. Check external set points are all zero.

D. POWER ON

Once all the proceeding steps are completed the supply fuses may be replaced and power applied to the drive. Although fairly general, the following assumes the system to be a simple speed control drive and motor.

1. At switch on the "Power ON" LED should illuminate (LED 2).
2. If "STALL" LED 1 illuminated immediately check position of SW4. To reset momentarily connect terminal 15 (stall reset) and terminal 12 (+12V).
3. Close RUN contact, give drive small speed demand (approximately 10%) and increase auxiliary current limit (if used). Slowly increase main current limit (P4) until the motor starts to rotate. If motor increases speed to more than 10% of full speed turn current limit (P4) fully anticlockwise and/or remove run signal (terminal 5) immediately.

If overspeeding occurred, or the motor rotated in the wrong direction, correct the wiring as follows:-



| Problem | Action |
|--|-----------------------------------|
| a) Direction correct but overspeeding: | Reverse tacho polarity only. |
| b) Direction incorrect and overspeeding: | Reverse field polarity only. |
| c) Direction incorrect but in control: | Reverse tacho and field polarity. |

When armature voltage is used for speed feedback it is direction insensitive and overspeeding due to incorrect feedback cannot occur. So under normal conditions the only problem likely to occur is that of incorrect direction of rotation. This can be corrected by simply reversing the field or armature polarity.

4. Increase speed demand to maximum and check armature voltage does not exceed motor rating, adjust by P7.
5. Set Minimum Speed to required level, adjust by P6.
6. Set Ramp Up P1 and Ramp Down P2 to required rates, (if used).
7. With armature voltage feedback, speed drop will occur as load is applied to motor. Set IR Comp (P5) to remove this effect, excessive compensation may cause instability.
8. Adjust stability Potentiometer P3 to improve transient response, excessive adjustment may cause instability.
9. Monitor armature current on terminal 6, ensure that steady state current does not exceed 100% of controller rating, i.e. voltage not greater than 5V with SW8 OFF.

TROUBLE SHOOTING

| PROBLEM | POSSIBLE CAUSE | REMEDY FIRST TURN OFF THEN:- |
|---|--|---|
| Controller will not Power up. | FS3 Blown | Check supply voltage tapping |
| No "Power On" LED 2 Illuminated | No supply available | Check supply availability and supply fuse if fitted |
| | Incorrect supply voltage applied to controller. | Check supply voltage |
| Motor will not run at switch on | Stop/Run Terminal 5-8/11 not closed | Check control circuit |
| | LED 1 Stall Trip illuminated | Check option Switch SW4 |
| | No setpoint | Check terminals 13 and 7 |
| | No Armature Current | Check P4 setting |
| | No field | Check field voltage and connection, FS1 and FS2 |
| | Motor Jammed | Free obstruction |
| Motor runs and stops. LED 1 Illuminated | Incorrect setting I Limit | Check P4 I Limit |
| | Incorrect Current Calibration | Check current programming switches SW5, 6 and 7 |
| | Motor jammed | Free obstruction |
| | Faulty tachogenerator and/or Coupling | Check tachogenerator (use VA temporarily) |
| Motor runs at full speed only | Reversed tachogenerator or open circuit tachogenerator | Check tachogenerator connections |
| | Open circuit speed reference potentiometer | Check terminal 13 |
| | Minimum speed setting | Check minimum speed P6 |
| Drive Speed Oscillating | Stability P3 | Reduce P3 |
| | IR compensation P5 | Reduce (SW3 off for tachogenerator feedback and P2 anticlockwise) |

| ISS. | MODIFICATION | CP.NO. | DATE | APPROVAL |
|---|---|-----------------------------------|----------|---|
| 1 | Initial Issue | 4102 | 25.08.89 | GDR |
| 2 | Drawing modifications and different current cal. example. | 3011 | 09.04.90 | GDR |
| 3 | All reference to SSD Rapier withdrawn. Amend operating temperature range. Correct reversing circuit. | 3406 | 11.10.90 | GDR |
| 4 | Page 4 $\pm 10\%$ added to Supply Voltage and Max. Armature Current. Page 7 No. 3 Format re-arranged. Page 19 LED1 corrected to LED 2 LED 2 corrected to LED1 Page 14 Wiring No.3 HRC fuses amended to high speed semi-conductor fuses. | 3457 | 19.03.91 | GDR |
| 5 | Safety Warning added to page 11. | 7163 | 14.01.92 | GDR |
| 6 | Change SSD to Eurotherm Drives throughout and change address. Add Warning to first page. | 8265 | 12.03.93 | GDR |
| 7 | Page 19 - Corrected LED 2 to 1. Page 10 - Added "Note". Page 11 - Added "Control Transformer Tapping" paragraph and diagram. | 9681 | 02.11.94 | GDR |
| 8 | Added "1" to telephone codes & removed telex. | 9253 | 14.02.95 |  |
| FIRST USED ON 512 | | MODIFICATION RECORD 512 Manual | | |
|  EUROTHERM DRIVES | | DRAWING NUMBER ZZ056554C | | Sht.1 of 1 Shts |

SALES AND SERVICE

Eurotherm Drives, a division of the Eurotherm International Group of Companies, provides sales and service capability worldwide through Eurotherm Drives Companies, Eurotherm Group Companies and Agents.

Head Office

Eurotherm Drives Limited
New Courtwick Lane
Littlehampton,
West Sussex.
BN17 7PD

Tel: (01903)-721311

Fax (01903)-723938

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