EMS (European) Ltd

EnviroStart
Three Phase
Motor Energy Controller
Installation & Commissioning Guide

Version 10 May 2003

3 Phase EnviroStart Motor Energy Control Manual

Version 7 September 2002

IMPORTANT WARNING

Failure to read and comply with this manual may result in damage to the EnviroStart Unit and driven equipment and may render the warranty invalid.

1. **Only a competent electrician should carry out the electrical installation.**
2. **EnviroStart must be earthed with an earthing conductor connected to the earthing terminal.**
3. **Before installation check the motor rating plate and Section Two of this manual to ensure that the EnviroStart is correctly rated for the application.**
4. **Internal components and circuit boards (except the isolated I/O terminals and the PCB) are at mains potential when the EnviroStart is connected to a three-phase supply. The voltage is extremely dangerous and may cause death or severe injury if you come into contact with it.**
5. **When the EnviroStart is connected to the mains, the motor connections U, V and W should be treated as being live even if the motor is not running.**
6. **The control I/O terminals are isolated from mains potential but the relay outputs may have dangerous voltages present even if the mains are not connected.**
7. **Do not make any connections when the EnviroStart is connected to live mains.**
8. **Do not make voltage withstand tests on any part of the EnviroStart without isolating the unit.**
9. **Do not touch IC-circuits on the PCB. Certain items are static-sensitive and static voltage discharge may destroy the components.**
10. **Make sure no power-factor correction capacitors are connected to the motor cable except in a safe manner. (See body text of this document for details).**
11. **Make sure the cover is closed before applying mains voltage to the EnviroStart.**

CONTENTS

1 INTRODUCTION

1.1 FEATURES

The **EnviroStart** is a high specification digital Soft-Start Motor Energy Control for motors up to 1,400A.

In addition to a full featured soft-start, the **EnviroStart** incorporates state of the art Motor Energy Control (MEC) technology to substantially reduce the electricity consumption of synchronous electric induction motors.

- CONFIGURABLE ENERGY CONTROL
- CONFIGURABLE SOFT START (Initial voltage ramp times from 0.5 – 240s.)
- SOFT STOP CONFIGURABLE
- CONFIGURABLE CURRENT LIMIT
- STALLED-ROTOR OR SLOWING-ROTOR PROTECTION
- CONFIGURABLE KICK-START
- TOP OF RAMP AND RUN RELAYS. (5A, 240V N/O contacts on each).
- SYSTEM STATUS LED's
- FULL LOGIC SCR SWITCHING AND FAULT DETECTION
- SIMPLE TO INSTALL AND COMMISSION
- RUGGED HOUSING – IP43, NEMA 1. (Can be fitted into cabinet to increase to IP65)
- ON-BOARD CONFIGURABLE SUPPLY VOLTAGE AND FREQUENCY SETTINGS
- 240V/415V (Switchable) and 415V/690V (Switchable) MODELS AVAILABLE

2 RATING INFORMATION

2.1 CORRECT ENVIROSTART SELECTION

The **EnviroStart** must be rated according to the motor rated current (FLC).

However, on certain applications it is necessary to oversize the unit to cope with the maximum operating parameters associated with particularly heavy-duty operations.

Application load type and inertia, and the number of starts per hour will substantially affect sizing.

Please note that environmental factors (temperature, ventilation, altitude, ambient temperature & relative humidity) also affect sizing. Where the **EnviroStart** will operate outside the normal specifications please contact EMS (European) or your local Distributor for advice.

2.2 VOLTAGE RATING: 240V/415V & 415V/690V

The general ratings in this installation and commissioning guide are based on typical four-pole motor characteristics. **EnviroStart** will however work effectively on two, six and eight pole motors provided they are synchronous in operation.

Ratings are based on the motor rated current. The cable and fuses have to be sized in accordance with the rated output of the unit applicable to the voltage selected on the PCB.

2.3 CE DECLARATION OF CONFORMITY

CE

MANUFACTURERS DECLARATION OF CONFORMITY

This declaration covers all **EnviroStart** units.

This product fulfils the following European Community Directives when applied as follows:

Low Voltage Directive

The above products fulfil the Low Voltage Directive 73/23/EEC and 93/68/EEC amendment for industrial equipment, however, they must be installed to general good electrical engineering practices and regulations by a suitably qualified person with strict reference to the instructions in the product's Technical Manual.

EMC Directive

The above products are intended to be a component in a system or a machine. They must be mounted into an appropriate enclosure and system designed to fulfill the CE directives plus IEC and local industrial standards. Units must be installed by a suitably qualified person to comply with general good electrical engineering practices and regulations with strict reference to the instructions in the product's Technical Manual. To meet all EMC directives, the above products are available with an optional RFI Filter.

The above is based on test results from an independent test laboratory (Steatite Group Ltd.) to test specification EN50081-2, EN50082-1 and EN50082-2.

Dated: February 28, 1999

3 SPECIFICATION

3.1 TECHNICAL SPECIFICATION

SUPPLY VOLTAGE	240V or 415V selected on PCB (690V Units Available)
FREQUENCY	50 or 60Hz selected on PCB.
START DUTY	4 x continuous rating for 5s / 3 x for 20s (5 to 37kW units) 5 x continuous rating for 5s / 3 x for 30s (55 to 800kW units)
STARTS PER HOUR	12 evenly spaced starts per hour.
ENERGY CONTROL	30%, 40% (default), 50%, 70% maximum voltage reduction
PEDESTAL RANGE	25 -100% of supply voltage (6% -100% DOL Torque)
RAMP UP ADJUSTMENT	0.5 - 240s
RAMP DOWN	1 – 120s (Independent of Ramp Up)
KICK START	On or Off
KICK START LEVEL	70% or 90% Volts
KICK START TIME	0.25, 0.5, 1 or 2s
CURRENT LIMIT TIME	Current limit time extendable to 240s
CURRENT LIMIT RANGE	1.5 - 4.5 x FLC (Normal ramp hold time 30s)
STALLED ROTOR PROTECTION	Fault trip in case of sudden over current, reflecting asynchronous rotor speed
COOLING	Naturally cooled isolated heatsink up to 45A Fan cooled for 60A and above (240/110V supply required)
THERMAL CUT OUT	Automatically cuts out in event of over-temperature
POWER SWITCHING	Fully base-isolated thyristor Paks or independent Puks
CONTROL CIRCUITRY	24MHz clocked Atmel MPIC with independent watch keeper and protocol management systems on control motherboard.
CONTROL SUPPLY	Derived from three phase input
FAULT DETECTION	Shut Down and Lockout on Phase Loss, Supply Loss, Motor Fault, Thyristor and Internal Fault.
LED INDICATIONS	Ramp Up / Power On / Run / In Current Limit / Top of Ramp
ON PCB RELAYS	Run and Top of Ramp (N/O)
RELAY CONTACT RATING	1.2kVA, 250V AC maximum
MECHANICAL PROTECTION	IP43, NEMA 1 sheet metal enclosure or high impact ABS cover on heat sink backplane (depending on kW rating)
OPERATING TEMP.	$0^{o}C$ - $40^{o}C$ @ < 95%RH. (De-rate 20%/$10^{0}C$ above $40^{o}C$)
STORAGE TEMP.	$-10^{o}C$ - $+60^{o}C$ (One Year Max)
ALTITUDE	2000m above sea level – De-rate Amps by 1%/100m above 2000m
EU DIRECTIVES	Meets EMC and Low Voltage Directives
UL LISTING	Listed for US and Canadian use - File E192379 (55 to 800kW units)

3.2 HIGH SPEED FUSES – (55 to 800kW)

The **EnviroStart** has provision for integral High Speed Fuses. These are not fitted as standard. Customers requiring integral fuses must specify this at the time of order.

3.3 HARMONICS

EnviroStart like all electronic systems does produce low level harmonics during Ramp Up, Ramp Down and Energy Control and when not at full or zero volts.

UK Electricity Council Engineering Recommendations G5/3 and G5/4 specifies 'Short Term Generation' of harmonics not to be covered by the recommendations as the issue is with possible damage to frequency dependent components (such as capacitors) due to long term exposure. **EnviroStart units produce negligible harmonic levels during operation.**

The recommendations state that the harmonic content on a typical 100kVA supply should not exceed 56A of 5th harmonic and 40A of 7th harmonic. Assuming a 415V supply this equates to one motor of around 145A, therefore the maximum 5th harmonic is 37% and the 7th 28%.

Typical test values* of harmonic currents on an **EnviroStart** controlled motor operating in Energy Save Mode would be 8% for 5^{th} Harmonic and 1% for 7th harmonic.

Recommendations are unlikely to be exceeded in normal operation.

**Based on tests carried out on a 22kW motor by University Of Surrey Industrial Electronics Group November 1988, verified on current Generation V product in June 2001.*

3.4 HEAT LOSES

EnviroStart have a power loss of 1.2W/A per phase at full conduction. These losses cause heat to be generated that is safely dissipated through the aluminium heatsink. See Section 4.9.

3.5 HEAT DISSIPATION

In order to keep the unit operating within its design limits any proposed additional enclosure must be capable of safely dissipating the energy generated by the **EnviroStart**.

When fitting into enclosures up to IP65/NEMA 2 specification, for 205A units and below, fitting louvers of the minimum specification (described in Section 3.9 - Table of Power Losses) above and below the **EnviroStart** will normally be sufficient.

Above 205A additional fans must be fitted to the control panel in addition to those fitted to the **EnviroStart**. The following information will help the user to select a fan to keep the temperature rise within the control panel to a 10^{o}C rise above ambient.

3.6 SELECTING A FAN

Take the heat dissipation figure of the required **EnviroStart** model from Section 3.9 Table of Power Losses. Compare this figure with the fan heat disposal figure in Section 3.10 - Table of Fan Data. Select a fan with a greater heat disposal figure.

For example, **EnviroStart** 90kW Model gives a heat dissipation figure of 632W, requiring a 7600N model fan with filter equivalent to cooling of 805W.

3.7 CONTROL PANELS WITH MULTIPLE ENVIROSTARTS

If more than one **EnviroStart** is to be installed in a single enclosure the heat dissipation figures should be added together before selecting cooling system requirements.

3.8 COOLING FAN POSITION

The fans should be positioned below the **EnviroStart** power assembly to allow cool air to be drawn into the path of the power assembly fans. Outlet Filters or louvers should be positioned close to the top of the Enclosure and in the path of the airflow. These should be approximately double the fan apertures.

3.9 POWER LOSSES

MODEL	POWER ASSEMBLY LOSSES IN W.	CONTROL & FAN LOSSES	TOTAL LOSSES	MINIMUM LOUVRE AREA (TWO REQUIRED)
TPMEC - 5.5	45	10	55	0.0156 Sq. M
TPMEC - 7	58	10	68	0.0156 Sq. M
TPMEC - 11	90	10	100	0.0156 Sq. M
TPMEC - 15	108	10	118	0.0156 Sq. M
TPMEC - 22	162	10	172	0.0156 Sq. M
TPMEC - 30	216	50	266	0.0625 Sq. M
TPMEC - 37	270	50	320	0.0625 Sq. M
TPMEC - 55	306	50	356	0.0625 Sq. M
TPMEC - 63	432	50	482	0.0625 Sq. M
TPMEC - 75	522	50	572	0.0625 Sq. M
TPMEC - 90	612	50	662	0.1 Sq. M
TPMEC - 110	738	50	788	0.1 Sq. M
TPMEC - 132	918	70	988	See Sections 3.6 - 3.8
TPMEC - 150	1,044	70	1,114	See Sections 3.6 - 3.8
TPMEC - 186	1,224	85	1,309	See Sections 3.6 - 3.8
TPMEC - 225	1,476	85	1,561	See Sections 3.6 - 3.8
TPMEC - 260	1,710	85	1,795	See Sections 3.6 - 3.8
TPMEC - 315	2,088	135	2,223	See Sections 3.6 - 3.8
TPMEC - 375	2,412	135	2,547	See Sections 3.6 - 3.8
TPMEC - 450	2,880	160	3,040	See Sections 3.6 - 3.8
TPMEC - 500	3,440	160	3,600	See Sections 3.6 - 3.8
TPMEC - 630	3,960	260	4,220	See Sections 3.6 - 3.8
TPMEC - 800	4,500	300	5,100	See Sections 3.6 - 3.8

USE TABLE OF FAN DATA BELOW TO SELECT CORRECT CABINET FAN

3.10 COOLING FAN DETAIL

The fans should be positioned below the **EnviroStart**.

PAPST FAN MODEL NO.'S	FLOW RATE EXC. FILTER (L/s.)	FLOW RATE INC. FILTER (L/s.)	HEAT DISP. EXC. FILTER (W)	HEAT DISP. INC. FILTER (W)
8500N/8550N	10.4	8.3	117	93
4600N/4650N	38.7	31	477	382
7600N/7650N	87.3	71	1,010	808
7400N/7450N	106	85	1,166	935
6028S/6078	106	93.3	1,283	1,026

4 INSTALLATION

4.1 IMMUNITY FROM INTERFERENCE

EnviroStart generally has a high level of immunity to externally generated interference. However the following good practices should be observed:

4.2 COIL SUPPRESSION

Any coil that is connected to the **EnviroStart**, shares a common control supply or is mounted in the same enclosure must be suppressed using RC circuits.

4.3 LIGHTNING STRIKES/VERY HIGH VOLTAGE TRANSIENTS

In areas subject to frequent lightning strikes or other high voltage transients, a suitably rated metal oxide varistor (MOV) or transient voltage suppressor (TVS) should connect each input line to earth.

4.4 CONTROL VOLTAGE TRANSIENTS

Where the control supply to the **EnviroStart** is thought to be subject to mains-borne interference a suitable line filter with transient interference suppression should be fitted between the control supply and the **EnviroStart**.

4.5 INPUT/OUTPUT CONTROL CONNECTIONS

To avoid 'interference pick up' all input/output control cables should be kept as short as possible and should be within the rating of the input or output connection to the **EnviroStart**. If this cannot be guaranteed, an interposing relay with suitable suppression must be used, mounted as close to the **EnviroStart** as possible.

4.6 EMISSIONS

EnviroStart units produce relatively low Radio Frequency Interference (RFI) compared with frequency inverters and no external filters are required in normal circumstances.

4.7 BY-PASS CONTACTOR

In the unlikely event that the **EnviroStart** is only used for 'soft-starting', a by-pass contactor can be used to short the unit at top of ramp to eliminate the need for cooling.

The by-pass contactor should be DOL rated. Normally it will not be switching current but it will be expected to be able to do so under fault conditions.

4.8 VENTILATION

The **EnviroStart** must be mounted vertically with the cooling fan(s) (if fitted) directing the air upwards. A free space of 85 mm must be allowed above and below the unit. See section 3.4 & 3.5 for further information.

4.9 ADDITIONAL ENCLOSURES

The **EnviroStart** generates heat at a rate of around 3.6W/A of current flowing (3PH system). This must be dissipated through the enclosure to ensure that the temperature within the enclosure does not rise more than 10^{o}C above Tamb^{o}C.

4.10 COS. PHI CORRECTION (Power Factor Correction)

Power factor correction capacitors **must never** be connected to the output of the **EnviroStart**. They must be fitted to the supply side of the line contactor and switched when the **EnviroStart** is not running.

4.11 SLIP-RING MOTORS

EnviroStart units are suitable for Slip Ring Motors provided that a single stage resistance is added (during starting) to the rotor circuit, this having a resistance of approximately 10-20% rotor Ohms, (RΩ). This is typically going to be 0.3 – 0.5Ω. This gives the motor a similar torque characteristic to that of a standard squirrel cage motor. Care must be taken when considering high starting torque loads.

4.12 LOAD SIZE

The **EnviroStart** must be connected to a motor to operate.

The motor and the **EnviroStart** should be matched for both kW and FLC rating. Motors, which regularly operate at below 10% of their kW rating, are not suitable for use with **EnviroStart** control as this low level operation may cause instability of thyristor firing resulting in the motor stalling.

5 CONNECTION

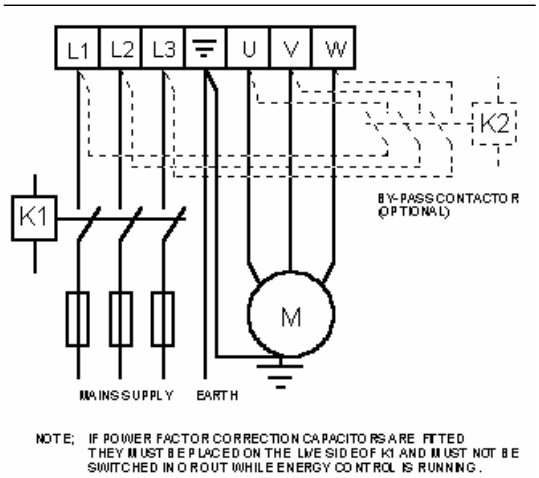
5.1 TERMINAL FUNCTION AND LOCATION

TERMINAL	LOCATION	FUNCTION
L1	Power Assembly	Red Phase Input
L2	Power Assembly	Yellow Phase Input
L3	Power Assembly	Blue Phase Input
U	Power Assembly	Red Phase Output
V	Power Assembly	Yellow Phase Output
W	Power Assembly	Blue Phase Output
240V or 110V	Power Assembly	Cooling Fan Supply Voltage (60A & above)
EARTH	Power Assembly	Earth
K1 & G1	PCB	Thyristor 1 Cathode & Gate
K2 & G2	PCB	Thyristor 2 Cathode & Gate
K3 & G3	PCB	Thyristor 3 Cathode & Gate
K4 & G4	PCB	Thyristor 4 Cathode & Gate
K5 & G5	PCB	Thyristor 5 Cathode & Gate
K6 & G6	PCB	Thyristor 6 Cathode & Gate
1-2*[1]	PCB	Start (must be kept closed to run)
3-4*[2]	PCB	Emergency Run
5-6*[3]	PCB	Run Relay RL2 NO
7-8*	PCB	Top Of Ramp Relay RL1 NO
10V/10V	PCB	10V AC Control Voltage
CT1	PCB	CT1 +tve Input (on 55 to 800kW)
CT2	PCB	CT2 +tve Input (on 55 to 800kW)
CT3	PCB	CT Common Input (on 55 to 800kW)
400*[5]	PCB	Control Transformer Tapping 400/460V*[5]
200*[5]	PCB	Control Transformer Tapping240V*[5]
COM	PCB	Transformer Common
0V	PCB	Control Transformer Tapping 0V
OT/OT	PCB	Over Temperature Input (on 55 to 800kW)
GND	PCB	Internal Ground

NOTES

1. Terminals 1-2 should be permanently linked (via switch or link of cable) to start the unit when the line contactor comes in. When the connection between terminals 1-2 is open circuit but the unit is still powered up the unit will soft stop.
2. Terminals 3-4 can be used to provide emergency run in the event of the **EnviroStart** shutting down on fault.
3. Terminals 5-6 energise when the **EnviroStart** is running and provide a 'circuit healthy' relay for indication or to retain the line contactor so that it de-energises in the event of a fault.
4. Terminals 7-8 energise when soft start is complete at top of ramp. It can be used to energise a loading system either through a PLC or other mechanical means. It can also be used to bypass the **EnviroStart** completely if Energy Control is not required.
5. Care should be taken to ensure the voltage settings are correct.

5.2 MAINS CONNECTION SCHEMATIC DRAWING

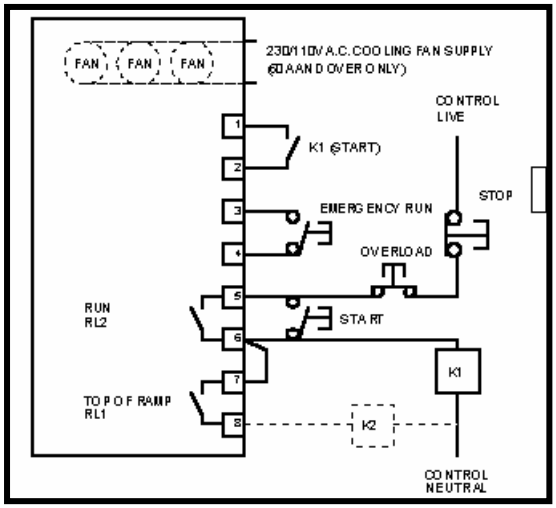


NOTES

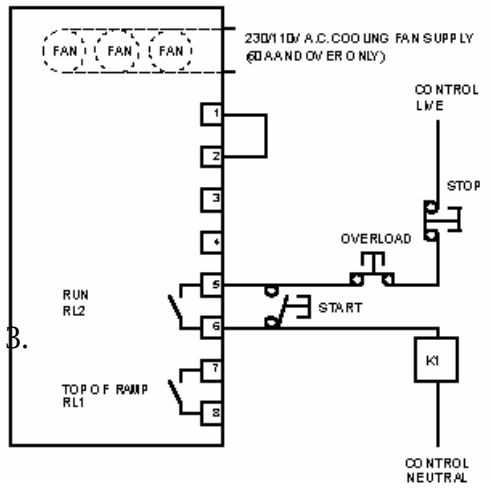
1. The start connection across Terminals 1-2 (K1 Auxiliary) can be permanently linked to start up as soon as K1 closes.
2. RL2 acts as a retaining contact for the start pushbutton. In the event of a fault, RL2 will open 5-6 and de-energise K1, provided the start pushbutton is not made.
3. Under an emergency condition the **EnviroStart** can be made to operate as a 'contactor' by connecting terminals 3 and 4.

   Care should be taken if this is done as the unit will ignore any faults in other parts of the system.

5.3 CONTROL CONNECTIONS UTILISING ALL FEATURES



5.4 CONTROL CONNECTIONS MINIMUM REQUIREMENTS



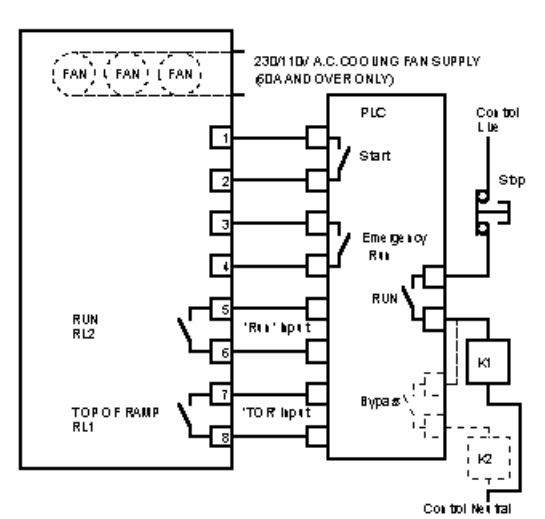
3.

NOTES

1. The unit will start up as soon as K1 closes.

2. RL2 acts as a retaining contact for the start pushbutton. In the event of a fault, RL2 will open 5-6 and de-energise K1, provided the start pushbutton is not made.

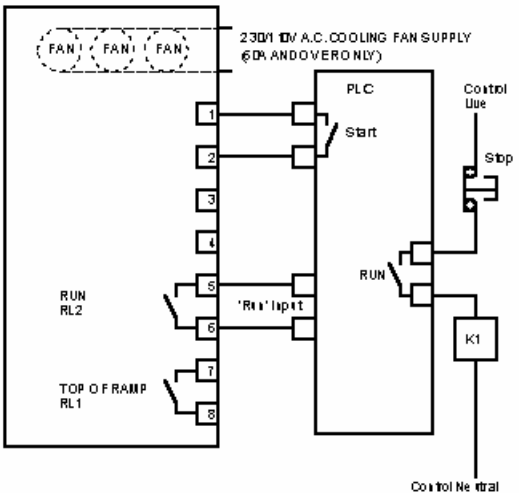
5.5 CONTROL CONNECTIONS – AUTOMATIC START/EMERGENCY RUN



NOTES

1. The unit will start as soon as K1 closes and then "start" is made, The **EnviroStart** will stop when "start" is opened.
2. If the RUN input is not made shortly after the start signal is given there is a fault and the PLC should open K1 and lock out.
3. Under an emergency condition the unit can be forced into continuous conduction by connecting terminals 3 and 4. Care should be taken when doing this as the **EnviroStart** will ignore any external faults whilst operating in this condition.

5.6 CONTROL CONNECTIONS AUTOMATIC START



NOTES

1. The **EnviroStart** will start as soon as K1 closes and then "start" is made. The **EnviroStart** will stop when "start" is opened.
2. If the RUN input is not made shortly after the start signal is given there is a fault and the PLC should open K1 and lock out.

COMMISIONING

5.7 PRE-COMMISSIONING CHECKS

IMPORTANT*:* Before installation checks the motor rating plate and Section 2 of this manual to ensure that the EnviroStart is correctly rated for the application.

1. Check that Selection Link is in correct position & Frequency Selection is correct.
2. Ensure that Fans (if fitted) are connected to the correct voltage.
3. Ensure that all Switch, Jumper and Potentiometer settings are set to default.
4. Check that the unit is connected correctly as per the proceeding connection diagrams.
5. Ensure any PFC Capacitors if fitted are placed on the input side of the unit and are only switched in or out when the **EnviroStart** is not running.
6. Ensure that a suitable time has elapsed since the **EnviroStart** was last run/started.

5.8 COMMISSIONING INSTRUCTIONS

1. Check that all settings are at 'Default' and the pre-commissioning steps have been followed.

   Give the start command.

   This setting should give satisfactory start.

Carry Out the following procedure only if the default start sequence established proves unsatisfactory.

2. Turn the Limit potentiometer fully clockwise to its maximum setting
3. Set Switch 1.1 - 1.3 to the maximum ramp time
4. Set switch 1.7 - 1.8 to give the minimum pedestal voltage
5. Start the motor. The motor should begin to rotate immediately. If a delay occurs, switch off. If LED1 flashes reverse the input phases and re-start (non reversing software only) Set switch 1.7-1.8 to the next highest setting then restart, allowing at least 6 minutes between starts
6. Repeat this until the optimum pedestal is found
7. With the Pedestal set the Ramp can now be adjusted on switch 1.1-1.3

This setting should give a satisfactory start.

If you have a high inertia load and starting is not satisfactory the following procedures should be carried out.

8. Turn the Current Limit to minimum, fully anti-clockwise

   Start the motor --- the motor should not move

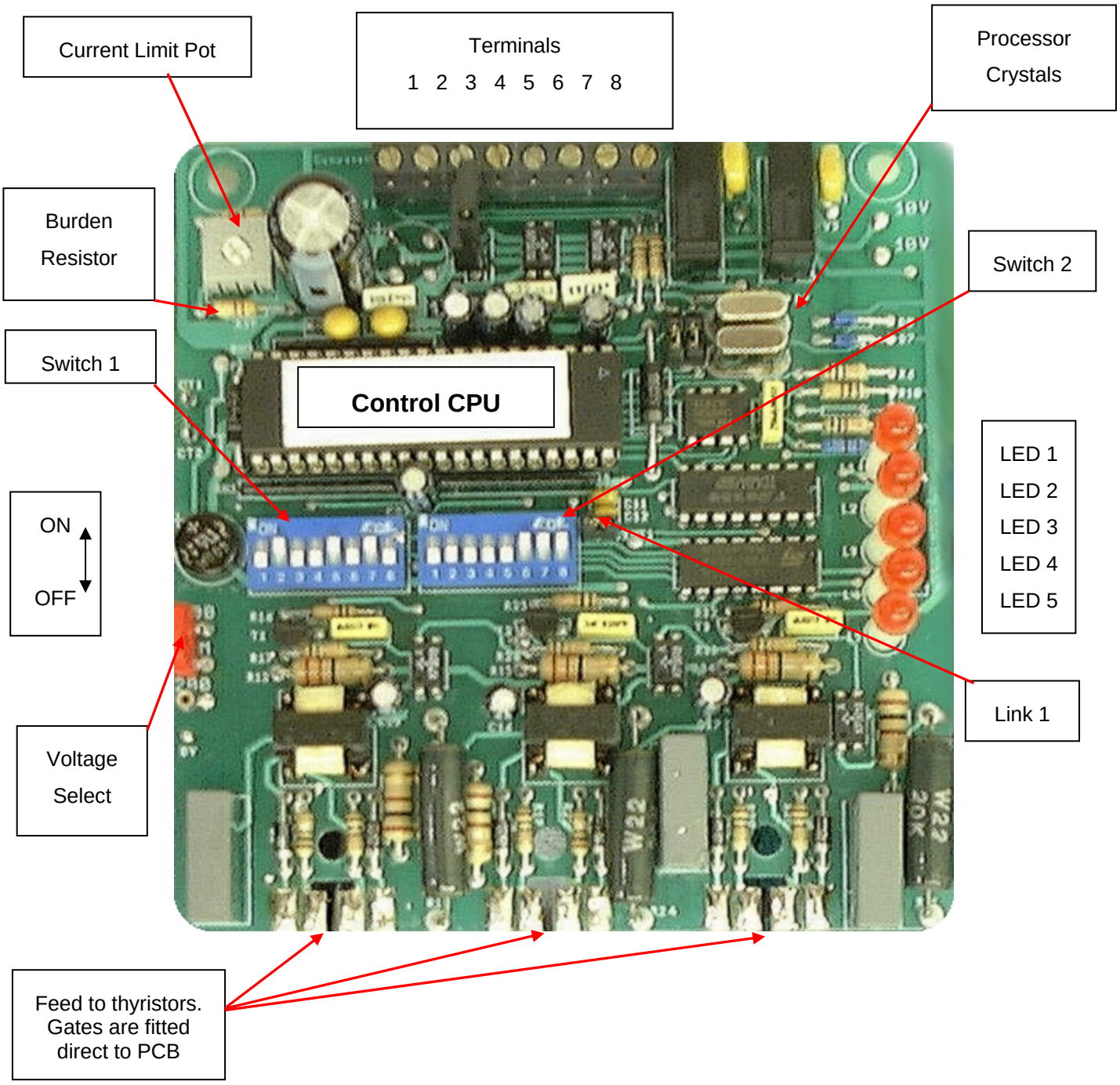
   Slowly turn the potentiometer clockwise until the motor has sufficient current to accelerate the load to full speed. The Current Limit should not be set too low, as this will cause motor overheating and tripping of the thermal overload in the supply system
9. With the Current Limit set, the ramp time may need reducing to give the required starting time

5.9 SETTING FEATURES

When satisfactory start is achieved the user control functions can be set using Section 6.

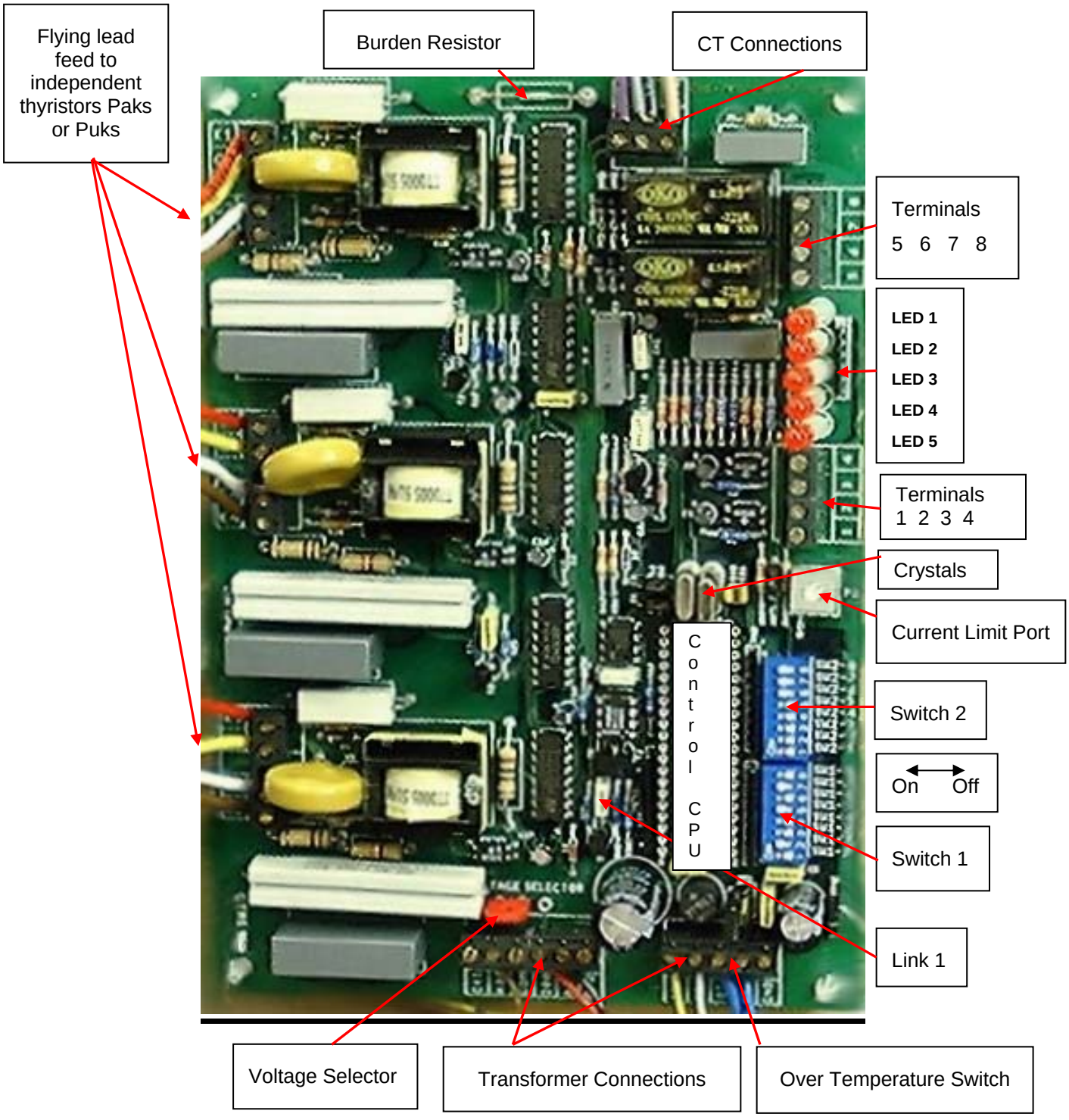
5.10 PCB SWITCH AND CONTROL LOCATION

TPMEC-5.5 to TPMEC-37 PCB DETAILS



5.11 PCB SWITCH AND CONTROL LOCATION

TPMEC-55 to TPMEC-800 PCB DETAILS



6 USER CONTROL FEATURES

6.1 DEFAULT SETTINGS

The unit is set to the 'Default Settings' before leaving the factory. These should be tried first and further adjustments only made where necessary to 'fine tune' the **EnviroStart**.

ADJUSTMENT	FUNCTION	DEFAULT SETTING	RESULT	SEE SECTION
Switch 1.1, 1.2 & 1.3	Ramp Up Time	OFF, ON, OFF	Ramp set at 20s.	6.4
Switch 1.4 & 1.5	Energy Control	OFF & ON	Max is set at 40% Voltage	6.2
Switch 1.6	Fault Detection	OFF	Enabled at all times	6.13
Switch 1.7, 1.8 & 2.3	Pedestal Voltage	ON, OFF, OFF	Set at 40% Voltage	6.3
Switch 2.1	Soft Stop Enable	OFF	No Soft Stop	6.7
Switch 2.2	50/60Hz Select	OFF	50Hz	6.5
Switch 2.3	See Pedestal Voltage (above)	OFF	Pedestal Voltage < 100%	6.3
Switch 2.4	Load Monitoring	OFF	Normal	6.14
Switch 2.5	Kick Start Enable	OFF	Kick Start Off	6.10
Switch 2.6	Kick Start Level	ON	70% Voltage	6.10
Switch 2.7 & 2.8	Kick Start Time	ON & ON	Set at 0.25s	6.11
Voltage Selector Link	Unit Operational Voltage	400	415V	6.16 (Important)
Link 1	Energy Control	Link Open	Enabled	6.2
Rotary Pot. P1	Current Limit	Fully Clockwise	Disabled	6.6

SEE SECTION 5.10 FOR A DIAGRAM TO LOCATE THE ABOVE SETTINGS ON THE RELEVANT PCB.

Note that changes in switch settings will not take effect if made while the unit is running. The unit must be powered down and re-started for changes to take effect.

6.2 ENERGY SAVING

Energy Control enables 90 seconds after top of ramp. LED1 flashes to indicate Energy Control is working.

The **EnviroStart** saves energy by sensing how hard the motor is working and adjusting the power supplied to the motor accordingly.

This is achieved (when not at full load) by delaying the thyristor firing at each half-cycle, which reduces voltage to the motor

The degree of saving allowed can be user-configured by adjusting the maximum firing delay allowed (at no load condition) and can be adjusted to maximise Energy Control according to the type of motor load.

Where motors are subjected to gentle load application it is possible to allow Maximum Energy Control. Examples of this would include escalators and most conveyor belts. Where motors are subjected to high shock loads Energy Control should be set to minimum so the **EnviroStart** can respond without stalling.

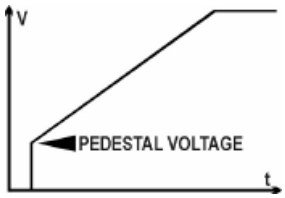
Where the motor is subjected to light loads Energy Control can be increased to maximum. If any motor slowdown is noted upon loading decrease Energy Control by one setting till this disappears.

SWITCH 1.4	SWITCH 1.5	Maximum Firing Delay % Volts	Energy Control
OFF	OFF	30 (Nom B/Stop 150V)	Maximum*
OFF	ON	40 (Nom B/Stop 330V)	Default
ON	OFF	50 (Nom B/Stop 380V)	Less
ON	ON	60 (Nom B/Stop 400V)	Minimum

Closing link 1 disables Energy Control. This is useful for testing Energy Control performance and measuring energy savings , ensure in such circumstances that you wait 90 seconds for optimisation to enable.

***Note Maximum energy control setting may cause motor instability or stalling, and should only be used in continuous low load environments.**

6.3 PEDESTAL VOLTAGE



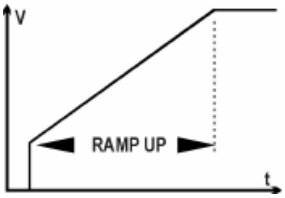
This sets the initial voltage that is applied to the motor. This is adjusted to a level so that the motor starts to accelerate smoothly and immediately.

It should normally not be necessary to adjust Pedestal voltage except where motors are started on-load with high loads. If there is a delay between startup and the motor starting to turn, increase the Pedestal Voltage until this disappears.

Switch settings are as follows:

SWITCH 1.7	SWITCH 1.8	SWITCH 2.3	PEDESTAL VOLTS
ON	ON	OFF	25 %
ON	OFF	OFF	40 % (Default)
OFF	ON	OFF	55%
OFF	OFF	OFF	70%
OFF	OFF	ON	100% (DOL start)

6.4 RAMP UP



The Ramp Up switches adjusts the time from the initial Pedestal setting to full output voltage. Switch settings as follows:

SWITCH 1.1	SWITCH 1.2	SWITCH 1.3	RAMP UP TIME
OFF	OFF	OFF	60s
OFF	OFF	ON	30s
OFF	ON	OFF	20s (Default)
OFF	ON	ON	10s
ON	OFF	OFF	5s
ON	OFF	ON	3s
ON	ON	OFF	1s
ON	ON	ON	0.5s

6.5 SUPPLY FREQUENCY SELECT

This switch function should be set to reflect the supply frequency of the three-phase mains supply.

SWITCH 2.2
Selects either 50Hz or 60Hz supply
Default is 50Hz

6.6 CURRENT LIMIT

Motors using DOL starters typically draw a peak starting current about 8x their operating current.

The Power Environmental Systems **EnviroStart** can be set to limit this starting current to a preset maximum during the Ramp Up.

When Current Limit is activated, the **EnviroStart** monitors current during Ramp Up. If the current exceeds the set limit, ramp us is stopped and voltage held constant until the current falls below the preset limit, then ramp up is continued.

After a pre-set time (30s default) the Current Limit is released to ensure full acceleration takes place.

Current Limit is useful to start high inertia loads. Where supply restrictions place effective limits on maximum starting current this feature will allow the starting of larger motors.

Potentiometer P1 sets the maximum current that the **EnviroStart** will allow to the motor at any given time. This is particularly important for the start ramp characteristic setting.

For normal loads set P1 fully clockwise to disable Current Limiting.

6.7 SOFT STOP ENABLE

Switch 2.2 is used to enable the Soft Stop characteristic of the **EnviroStart.** The default condition is with the switch in the OFF position which has Soft-Stop disabled. In the ON position, Soft Stop is enabled, providing the motor with a controlled shut down function on turn off. The ramp down is equivalent to the ramp up set by switches 1.1, 1.2 and 1.3 with the features described below.

The ramp down feature is a triple ramp. First the unit drops the voltage immediately to 60% voltage then the unit decreases the voltage to 40% in the same space of time as set up in the ramp-up settings section 6.4. Once the unit reaches 40% volts, the unit shuts down.

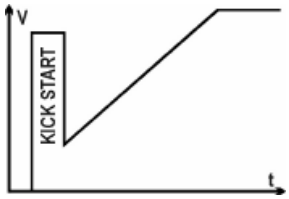
6.8 TOP OF RAMP (Contacts 7 and 8 N/O)

Energises when output reaches full voltage. This can be used to energise a loading system or to bring in a by-pass contactor.

6.9 RUN RELAY (Contacts 5 and 6 N/O)

Energises when the **EnviroStart** is running. It can be used as 'Circuit Healthy Relay' to give indication or to retain the line contactor so that the contactor de-energises should a fault occur.

6.10 KICK START



On some high stiction (high static friction) loads, a better mechanical start can sometimes be achieved by using the Kick Start feature to overcome the resistive torque.

If the load is not of this type, this feature should be turned off.

Kick Start	Switch 2.5 enables Kick Start function when ON (Default is OFF)
Kick Start Level	Switch 2.6 sets Kick Start volts to 90% when Off. 70% when ON (Default is ON)

6.11 KICK START TIME

SWITCH 2.7	SWITCH 2.8	KICK START TIME
ON	ON	0.25s (Default)
ON	OFF	0.5s
OFF	ON	1s
OFF	OFF	2s

6.12 LED INDICATIONS

LED 1	Ramp Up	Illuminates constantly during ramping up Flashes during Energy Control
LED 2	Power On	Illuminates when power is to unit
LED 3	Run	Illuminates when unit has been given a start command and no fault is detected
LED 4	Current Limit	Illuminates when line current is at the Current Limit level
LED 5	Top Of Ramp	Illuminates when **EnviroStart** output is at end of ramp time

6.13 FAULT DETECTION

The **EnviroStart** has a fault detection circuit to protect itself from a short circuit switching device or a loss of a supply phase. Fast changing loads can, in rare cases, cause nuisance tripping during operation. Setting switch 1.6 ON, whilst reducing the overall protection to the motor and the control circuit, can be used to avoid this.

The fault detection is still present during starting.

This fault detection circuit should not be used in the place of a motor overload.

SWITCH 1.6	FAULT DETECTION
OFF	On at all times
ON	On during Start up and Off while running

6.14 CURRENT MONITORING

On certain types of motors the **EnviroStart** may not monitor Motor Current correctly, causing the current to become unstable. Altering the settings on Switch 2.4 should eliminate this rarely encountered problem.

SWITCH 2.4	CURRENT MONITORING
OFF	Default
ON	Wide

6.15 OVER TEMPERATURE TRIP (55 to 800kW)

If the **EnviroStart** heatsink goes above 90^{o}C, the heatsink over-temperature trip will open and turn off the **EnviroStart**. This trip will automatically reset once the temperature drops below 70^{o}C. To prevent automatic restart, the **EnviroStart** must be connected as per the connection drawings and instructions.

6.16 VOLTAGE SELECTION

WARNING: Please check this setting before first starting the unit.

Use the voltage selection link to select either a 240V or 415V supply by setting the link against the 240 or 400 settings on the PCB.

If the unit is supplied to special order for a voltage above 415V, the voltage selector should be set for 240V by putting the link on the “240” link pins on the PCB and an independent 240V AC must be fed to the PCB transformer terminals CV1 and CV2.

6.17 STALLED-ROTOR OVER-CURRENT PROTECTION

The unit will detect a sudden increase in current and shut the unit down in a fault condition. In the event of a stalled rotor condition being detected and the unit going into “fault condition” as a result of this detection the PCB must be powered down before it may be restarted.

6.18 START AND STOP FUNCTION

The controlled motor is started and stopped by making contact between terminals 1 and 2 on the PCB. This is a zero voltage contact set. It is important that no control current or voltage be fed to these terminals as this will result in damage to the control microprocessor.

6.19 EMERGENCY RUN FUNCTION

In the event of control failure it is possible to force the thyristors into full permanent conduction allowing the motor to start DOL and run DOL. This feature is enabled when terminals 1 and 2 are linked for start and terminals 3 and 4 are linked together. Terminals 3 and 4 should be linked like this in emergency conditions only and should used only if the user is experienced. Corrective action should be taken to remedy the fault creating the need for this action as soon as possible.

INSTALLATION AND COMMISSIONING GUIDE

END

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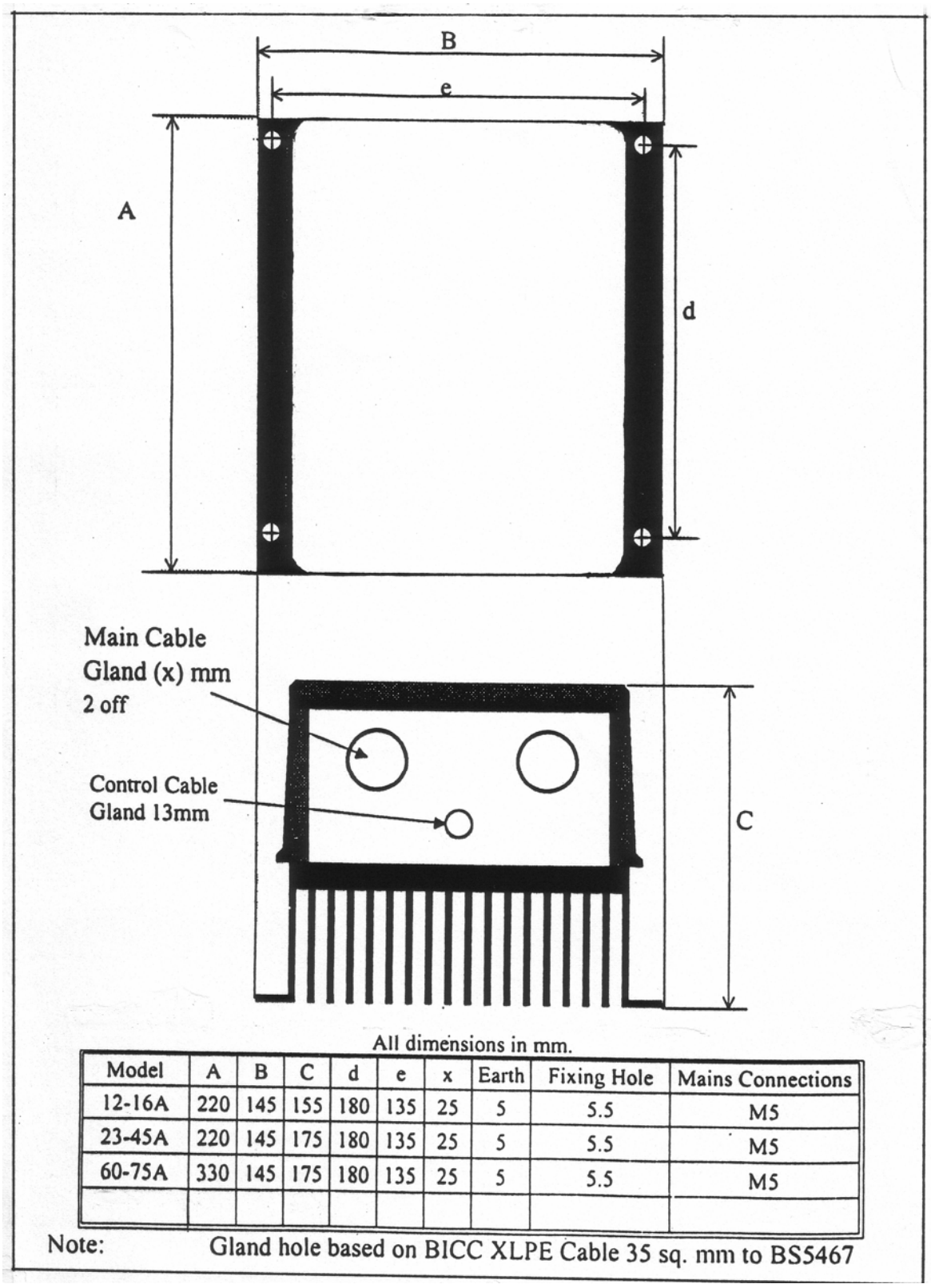
Appendix 1

Mechanical Drawing 12 – 75A (not to scale)

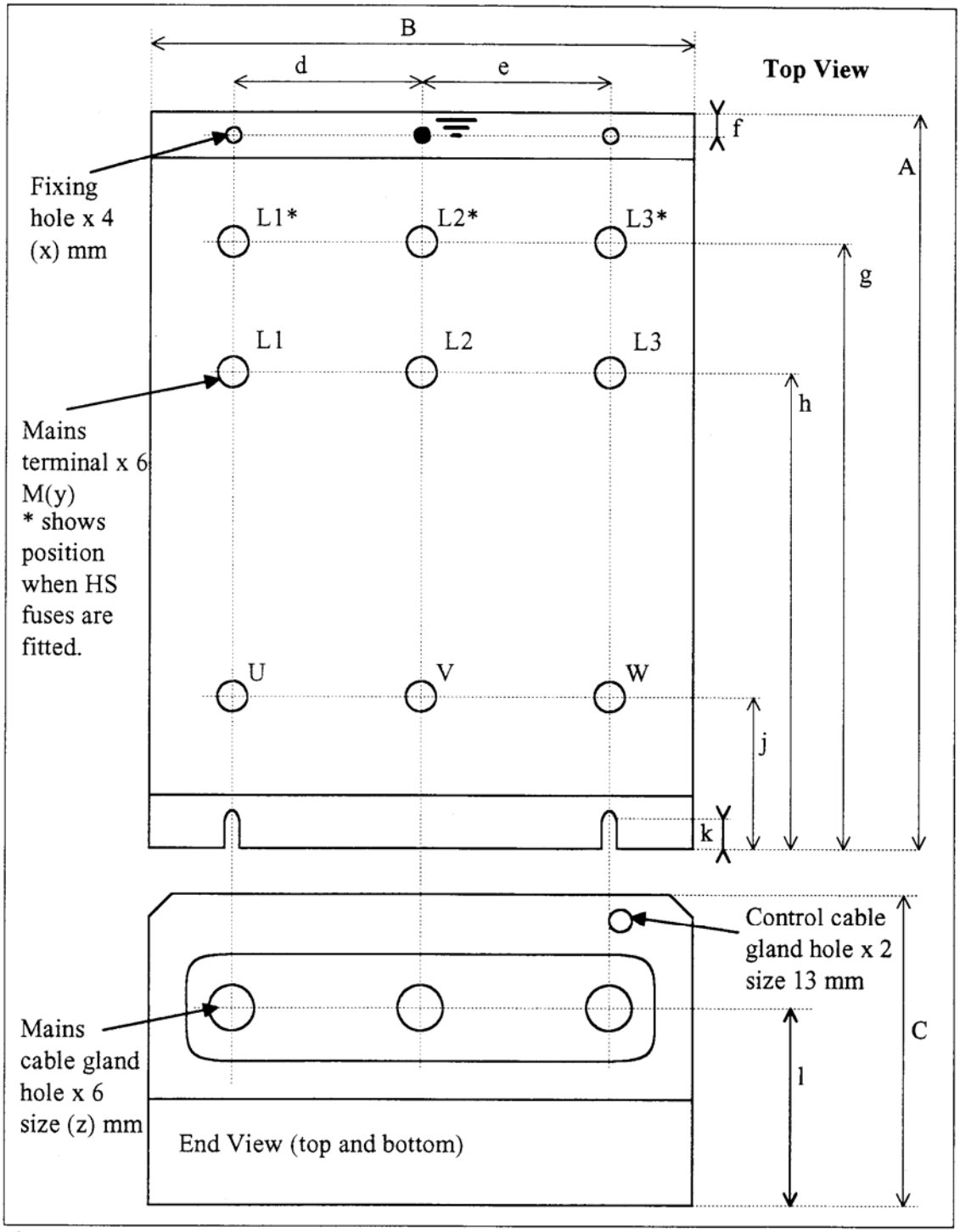


All dimensions in mm.

Model	A	B	C	d	e	x	Earth	Fixing Hole	Mains Connections
12-16A	220	145	155	180	135	25	5	5.5	M5
23-45A	220	145	175	180	135	25	5	5.5	M5
60-75A	330	145	175	180	135	25	5	5.5	M5

Note: Gland hole based on BICC XLPE Cable 35 sq. mm to BS5467

Mechanical Drawing 85 – 205A (not to scale)

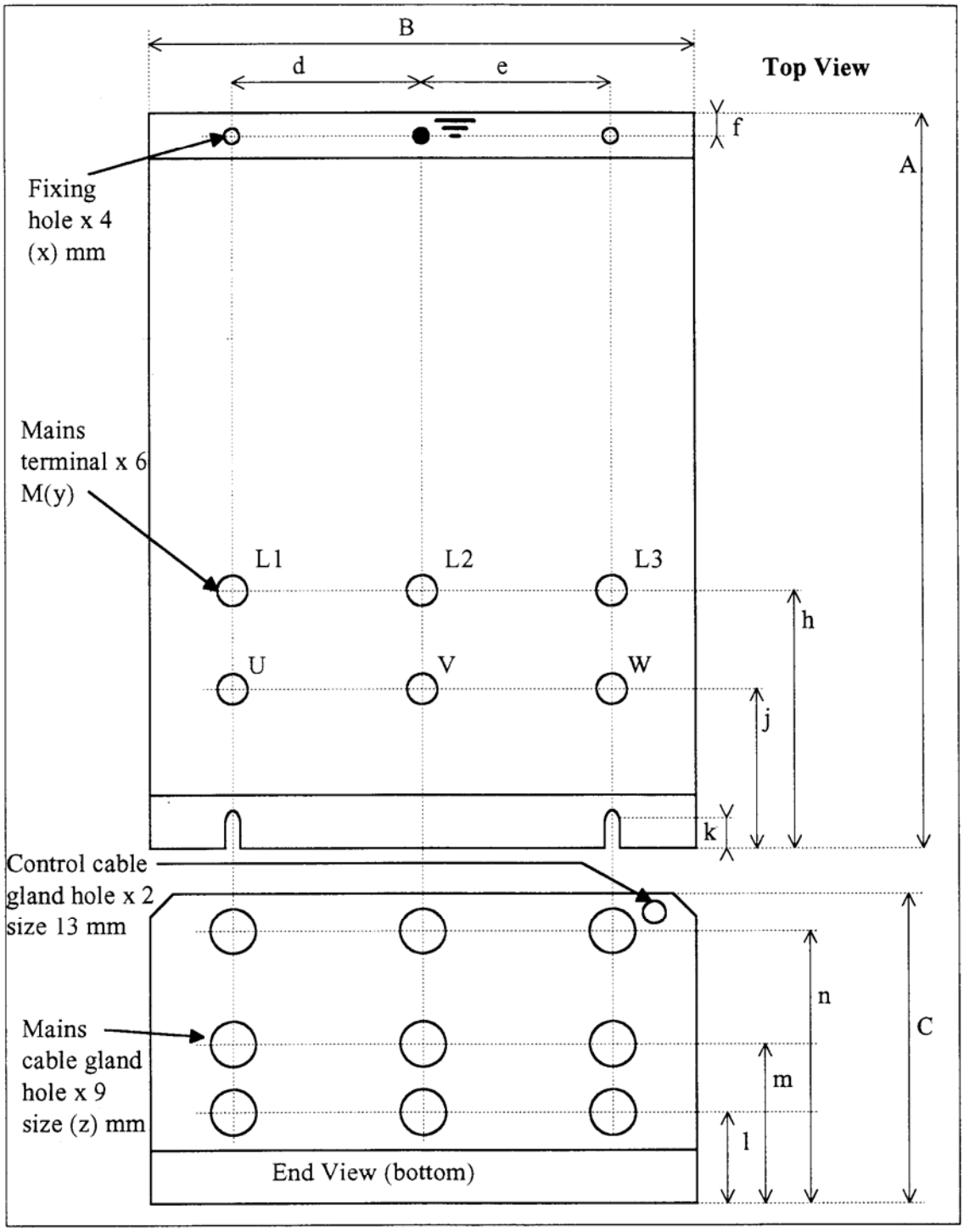


All dimensions in mm.

Model	A	B	C	d	e	f	g	h	j	k	l	x	y	z	Earth
16-45A	325	164	195	50	50	7	250	198.5	65	10	78	6	6	30	6
60-205A	430	254	280	70	70	7	351	271	65	10	178	6	8	30	6

Note - Height of L1, L2, L3, L1*, L2*, L3*, U, V, W corresponds to l.

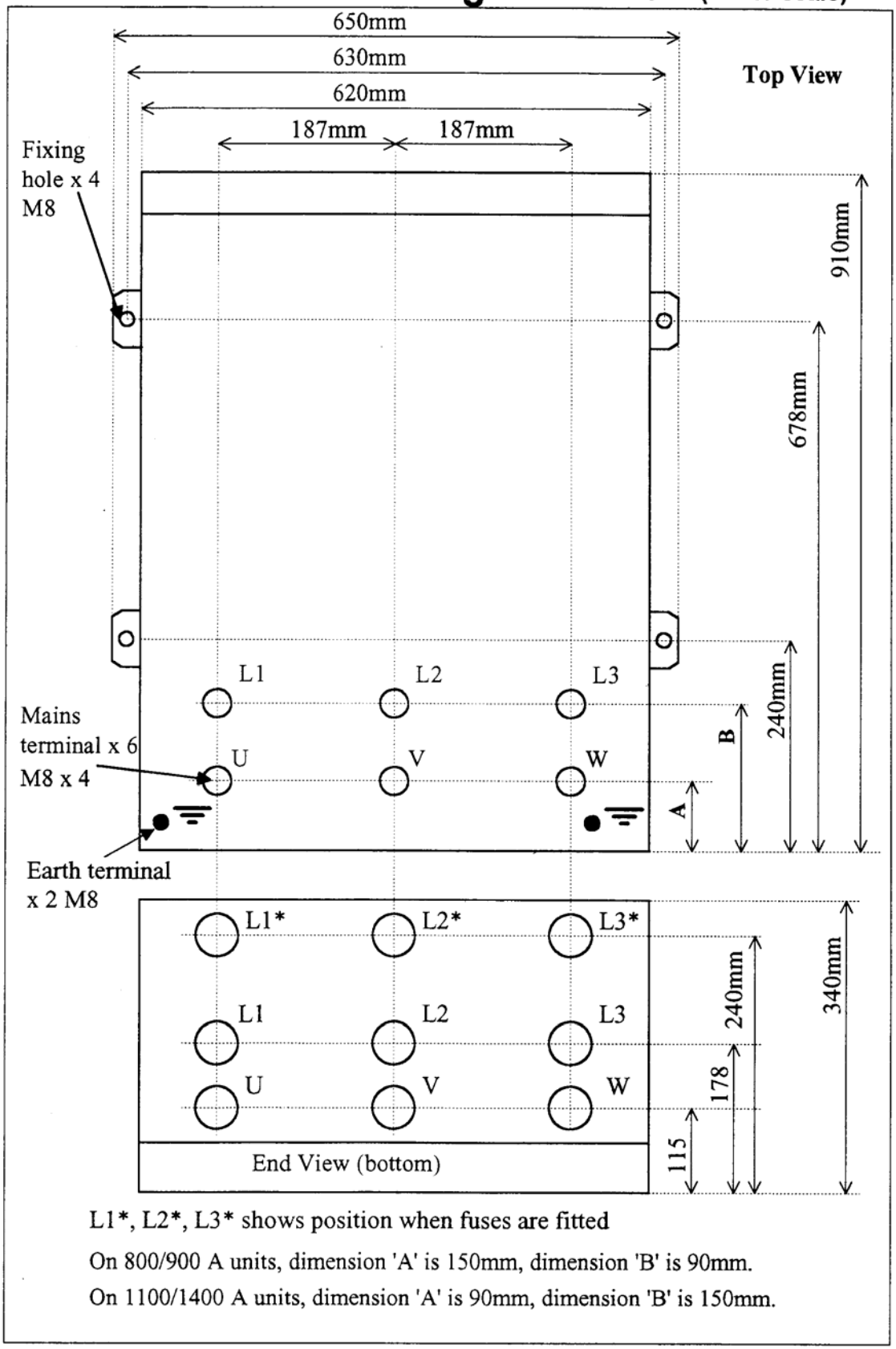
Mechanical Drawing 255-670A (not to scale)



All dimensions in mm.

Model	A	B	C	d	e	f	h	j	k	l	m	n	x	y	z	Earth
255-410A	580	368	228	116	116	8	118	90	10	56	101	168	8	2 x 8	30	8
475-670A	720	462	253	135	135	8	133	101	10	68	120	195	8	2 x 8	40	8
Note - Height of L1, L2, L3 without fuses corresponds to m, with fuses to n, U, V, W corresponds to l																

Mechanical Drawing 800-1400A (not to scale)



L1*, L2*, L3* shows position when fuses are fitted

On 800/900 A units, dimension 'A' is 150mm, dimension 'B' is 90mm.

On 1100/1400 A units, dimension 'A' is 90mm, dimension 'B' is 150mm.

Appendix 2

THE TESTING AND REPLACEMENT OF THYRISTORS

Thyristor Short Circuit Test

With the rate/cathode connections disconnected from the control PCB measure the resistance between the input and the output of each phase of the power assembly in turn and in both directions. A healthy reading will be in excess of IOOkΩ. Any short circuit thyristors should be replaced. Care must be taken to re-connect the gate and cathode connections correctly.

Thyristor Gate-Cathode Test

With the gate and cathode leads disconnected from the control PCB measure the resistance between the two leads. This should be between 7 and 60Ω. If the meter reads open circuit first check the cable continuity and the crimp connectors on the device. Any open circuit thyristor should be replaced.

Thyristor Removal.

Up to 205 A the power assemblies on the Soft Starters and Motor Energy Controls use isolated two-thyristor Pak devices. These devices are manufactured, as an anti-parallel pair so must be changed complete.

Power assemblies of 205A and above use individual hockey-puk devices that are sandwiched between two aluminium heatsinks. Each thyristor is clamped by two fixing bolts, with a centre bolt compressing spring washers in order to give an indication of correct clamping tension. The centre bolt is not a fixing bolt its only purpose is to set the tension on the spring loaded washers so when the fixing bolts are tightened to the correct torque the centre tab washer is freed. The torque setting on the centre bolt is factory set under no circumstances should be loosened or the torque setting on the spring washers will be lost.

When dismantling, the two fixing bolts should be loosened evenly. Note the polarity of the devices, they are an anti-parallel pair and should be replaced as such.

Re-assembly of Pak Devices

Re-assembly of the power assemblies using Pak devices is very simple. Smear a small amount of heatsink compound onto the base of the new device before fixing. Torque settings are as below..

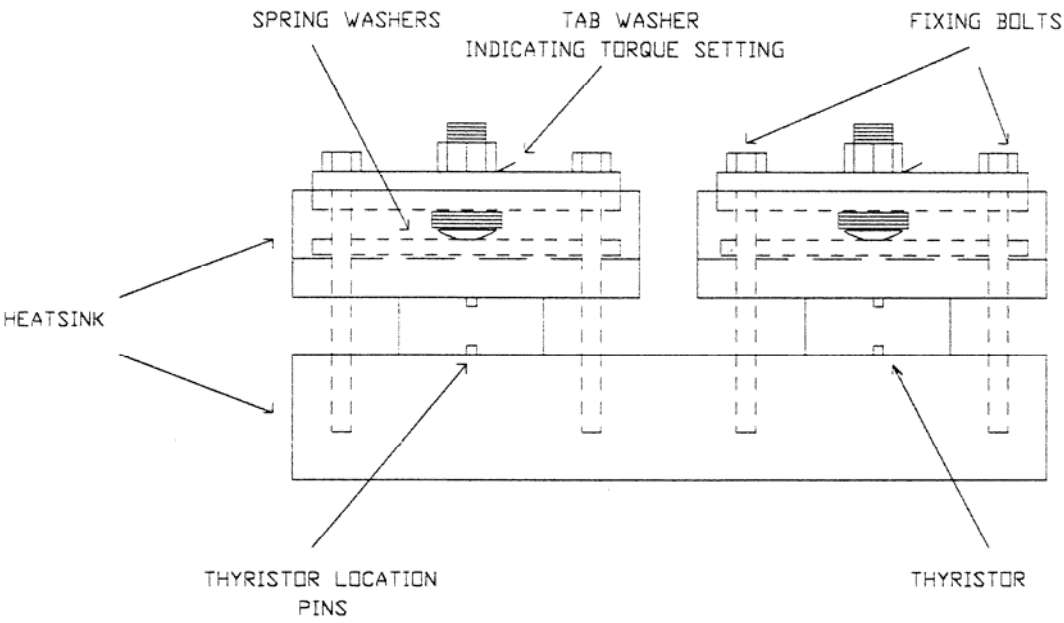
Thyristor to heatsink 6Nm

Screw terminals on Pak 1Nm

Power assembly re-assembly, "Hockey puck" devices.

Connect the gate and cathode leads to the new device. Smear the top and bottom of the new device with a small amount of heatsink compound that must be electrically conductive. Fit the device on the lower heatsink taking care the device is the correct way around and is Fitted correctly on the location pin. Fit the top heatsink and tighten evenly the two fixing bolts. Correct tension is achieved when the spring washers compress enough to just loosen the tab washer under the centre nut.

'Hockey Puck' Stack Assembly



Note - the thyristors should be re-connected as follows:

K1 - U

K2 – L1

K3 - V

K4 – L2

K5 - W

K6 – L3

Control PCB

The control PCB is the least likely item to develop a fault and should only be suspected if all other avenues of investigation concerning the fault have proven negative. Faulty PCBs should be returned to the manufacturer for repair or replacement as there are no user serviceable parts on the PCB.

Appendix 3

BURDEN RESISTORS

There is a burden resistor on each EnviroStart control PCB, be it for a Soft Start, (TPSS) or a Motor Energy Control (TPMEC). The purpose of this burden resistor is to provide accurate feedback voltage into the CPU during the course of the ramp up period of the start sequence. It is critical to the effective operation of the system and is specific to the size of the motor control.

MODEL	CURRENT RATING	BURDEN RESISTOR VALUE
400-TPMEC/SS - 5.5	12	100R/.25W
400-TPMEC/SS - 7	16	62R/0.25W
400-TPMEC/SS - 11	23	68R/0.5W
400-TPMEC/SS - 15	30	56R/0.5W
400-TPMEC/SS - 22	45	36R/0.75W
400-TPMEC/SS - 30	60	27R/0.75W
400-TPMEC/SS - 37	75	22R/0.75W
400-TPMEC/SS - 55	85	22R/0.75W
400-TPMEC/SS - 63	120	27R/2.5W
400-TPMEC/SS - 75	145	22R/2.5W
400-TPMEC/SS - 90	170	20R/2.5W
400-TPMEC/SS -110	205	16R/0.5W
400-TPMEC/SS - 132	255	43R/0.5W
400-TPMEC/SS - 150	290	33R/0.5W
400-TPMEC/SS - 186	340	30R/0.5W
400-TPMEC/SS - 225	410	24R/0.5W
400-TPMEC/SS - 260	475	22R/0.5W
400-TPMEC/SS – 315	580	18R/0.5W
400-TPMEC/SS - 375	670	15R/0.5W
400-TPMEC/SS - 450	800	12R/0.5W
400-TPMEC/SS – 500	900	11R/0.5W
400-TPMEC/SS - 630	1100	9R1/0.5W
400-TPMEC/SS - 800	1400	6R8/0.5W

Should you buy or install a replacement PCB on a unit then please ensure that the correct burden resistor is in place. If you have purchased the PCB recently and specified the size of unit to which it is to be fitted then the burden resistor will be correct as shipped. If you wish to transfer a PCB from one unit to another then transfer the burden resistor from board to board.

Please ensure that you have both the correct burden resistor and that it is well soldered into place. During the course of start up the resistor is conducting quite heavily and will get hot, this is quite normal and should not cause a problem.

Appendix 4

GENERAL SPECIFICATION

MODEL	CURRENT	kW @ 400V	kW @ 690V	kW @ 240V	WEIGHT kg	CT Specified	FANS
400-TPMEC-5.5	11	5.5	7.5	2.2	10	LA2100	N/A
400-TPMEC-7	16	7.5	11	4	10	LA2100	N/A
400-TPMEC-11	23	11	15	5.5	10	LA2100	N/A
400-TPMEC-15	30	15	22	7.5	10	LA2100	N/A
400-TPMEC-22	45	22	30	11	15	LA2100	N/A
400-TPMEC-30	60	30	45	15	15	LA2100	1 X 120mm
400-TPMEC-37	75	37	55	22	15	LA2100	1 X 120mm
400-TPMEC-55	105	55	75	30	15	LA2107	2 x 120mm
400-TPMEC-63	120	63	90	37	15	LA2108	2 x 120mm
400-TPMEC-75	145	75	110	45	15	LA2108	2 x 120mm
400-TPMEC-90	170	90	132	55	16	LA2108	2 x 120mm
400-TPMEC-110	205	110	150	63	16	LA2108	2 x 120mm
400-TPMEC-132	255	132	186	75	28	TX008	3 x 120mm
400-TPMEC-150	290	150	225	90	28	TX008	3 x 120mm
400-TPMEC-186	340	186	260	110	28	TX008	3 x 120mm
400-TPMEC-225	412	225	315	132	28	TX008	3 x 120mm
400-TPMEC-260	475	260	375	150	45	TX008	3 x 150mm
400-TPMEC-315	580	315	450	186	45	TX008	3 x 150mm
400-TPMEC-375	670	375	500	215	45	TX008	3 x 150mm
400-TPMEC-450	800	450	630	260	120	TX009	2 x 220mm
400-TPMEC-500	900	500	750	315	120	TX009	2 x 220mm
400-TPMEC-630	1100	630	900	375	120	TX009	2 x 220mm
400-TPMEC-800	1400	800	1200	450	120	TX009	2 x 220mm

The kW ratings are all based on calculations scheduled with a standard four pole motor operating at a nominal $T_{ambient}$ of $+20^{o}C$ at sea level. All units should be selected based on the current rating of the motor to which they are fitted.

Appendix 5

FAN SPECIFICATION

PAPST Nr.	GD RECTIFIER Nr	ENVIROSTART	Free Air Flow Rate	Physical Size
4600N/4650N	550010A/ 550010B	30kW - 225kW	160 m^3/hour	120 mm
7400N/7450N	550006A/550006B	260kW – 375kW	350 m^3/hour	150 mm
N/A	550002A /550002B	450kW – 800kW	900 m^3/hour	220 mm

Should you need to change any of the fans within your EnviroStart system please ensure that units compatible with the above are used. It is not possible to exchange fans for units of different physical size without damaging the EnviroStart unit.