

**GENERATION 6**



# **EnviroStart™ Single Phase Motor Energy Control Installation & Commissioning Guide**

**Version 2.1 January 2009**



4A through 25A

# Single Phase EnviroStart™ Motor Energy Control

## **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 areas of the control circuit boards, (except the isolated I/O terminals), can be 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 output connections U, V and W should be treated as being live even if the load is not being driven.
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 load 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.
12. Updated and current Installation and Commissioning Guides are maintained on the EMS (European) web site at <http://www.EnviroStart.com>; always check the web site for latest issue documents before commencing installation.

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# 1 INTRODUCTION

Thank you for choosing the EnviroStart Single Phase Motor Energy Control. The system has been designed with ease of use and set up in mind. The majority of applications will operate effectively without the need to make any changes to the default settings however should such changes be necessary please do read through this Installation and Commissioning Guide so as to better understand the effects of the changes you are making, be aware of the fact that changing things like start up pedestal voltage can impact the time it takes for a motor to get to full speed as such controllable features are inter-related.

EnviroStart has also been designed to provide a long life; components have been selected with reliability in mind and have generally been over-rated for the power of the unit manufactured. Using the standard IQA, (Institute of Quality Assurance), methodologies the expected lifetime of EnviroStart is rated at 100,000 hours continuous use, (eleven and a half years),

In the unlikely event that you do need further support please contact your local EMS (European) Distributor or failing that contact us directly either by e-mail or fax. All details of how to contact us are available on our web site at <http://www.EnviroStart.com>, please remember that we are constantly updating documentation and information about EnviroStart, all such information is posted and publicly available on the web site.

## 1.1 FEATURES

The **EnviroStart** is a high specification digital Soft-Start, Motor Energy Control available in models suitable for motors up to 15A.

In addition to the provision of a soft-start, the **EnviroStart** MEC incorporates state of the art Motor Energy Control technology to substantially reduce the electricity consumption of synchronous electric induction motors whilst they are operating at less than their full load capacity.

- ▶ CONFIGURABLE ENERGY CONTROL , (BOTH FULLY AUTOMATIC AND PRESET)
- ▶ SWITCHABLE SOFT START
- ▶ DOL START TO OVERCOME HIGH INERTIA LOADS
- ▶ SECONDARY BY-PASS CONNECTORS BUILT INTO UNIT
- ▶ FULL SYSTEM STATUS LED's
- ▶ SIMPLE TO INSTALL AND COMMISSION
- ▶ RUGGED HOUSING, IP43, NEMA 1. (Can be fitted into cabinet to increase to IP 65)
- ▶ 110V & 220V, 50/60Hz MODELS AVAILABLE

## **2 CORRECT ENVIROSTART SELECTION**

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

However, on certain applications it may be necessary to oversize the unit to cope with the maximum operating parameters associated with particularly heavy-duty operations such as high repetitive on-load starts or elevated ambient operating conditions. (For this see de-rating details shown on relevant specification sheets).

Please note that these environmental factors (temperature, ventilation, altitude, ambient temperature & relative humidity) do affect sizing and failing to take proper notice of such conditions will invalidate any warranty associated with the system as supplied. Where the **EnviroStart** is expected to operate outside the normal specifications and you are uncertain as to the selection of a unit please contact EMS (European) or your local Distributor, we will always be happy to assist to ensure your application is correctly supported.

### **IMPORTANT NOTE**

**THE ENVIROSTART MOTOR ENERGY CONTROL IS A SOPHISTICATED SOLID STATE MOTOR SOFT START AND ENERGY MANAGEMENT SYSTEM WITH A RANGE OF INBUILT PROTECTION DEVICES AND MONITORING SYSTEMS IT IS HOWEVER NOT A REPLACEMENT FOR PROPERLY RATED CURRENT OVERLOADS AND FUSES WHICH SHOULD BE FITTED FOR MAXIMUM PROTECTION OF THE MOTOR.**

## 2.1 CE DECLARATION OF CONFORMITY



### MANUFACTURERS DECLARATION OF CONFORMITY

This declaration covers all **EnviroStart** SPMEC Control 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, 89/336/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 fulfil 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.

IEC-1000-4-2 Level 3; IEC-1000-4-3 Level 3; IEC-1000-4-4 Level 4; IEC-1000-4-5 Level 3; IEC-1000-4-12 Level 3.

The above is based on test results from an independent test laboratory (Steatite Group Ltd.) to test specification EN 50081-2, EN 50082-1 and EN 50082-2.

#### Harmonised Standards Applicable

BS EN 6094.4.4 (which calls on EN 56011); EN 55022; EN 51000.4.2;  
EN 61000.4.3; EN 51000.4.4; EN 61000.4.5; EN 61000.4.6; EN 61000.4.8;  
EN 61000.4.11; BS EN 50081.1; BS EN 50081.2; BS EN 50082.2; EN 6094.4.2;  
IEC-947-4-1; IEC-68-2-6, (NFC2076; BV1); IEC-947-4-2.  
EN 60439; EN 60831.1, EN 60831.2, EN 61921.2003

Electrical Requirements Specification G5/4 - 2 (2008)

Dated: September 2009

### 3. GENERAL SPECIFICATION

#### TECHNICAL SPECIFICATION

<b>SUPPLY VOLTAGE</b>	Nominal 110V or 220V Single Phase AC (Non Floating Neutral)
<b>FREQUENCY</b>	50Hz or 60Hz (Defined at Time of Ordering)
<b>STARTS PER HOUR</b>	≤45 starts at T <sub>amb</sub> +20°C
<b>START DUTY</b>	3 x Unit FLA for 5s at T <sub>amb</sub> +20°C
<b>DOL KICK START TIME</b>	2.5s
<b>SOFT START TIME</b>	Selectable Logarithmic Ramp 3s
<b>LED INDICATORS</b>	Power-on (Green) / Yellow (Optimize) / Fault Condition (Red)
<b>COOLING</b>	Naturally Cooled Isolated “Cold Wall” Back Plane Enclosure
<b>CONTROL CIRCUIT</b>	12MHz clocked Atmel MPIC
<b>POWER SWITCHING</b>	Isolated Base Triac
<b>CONTROL SUPPLY</b>	Integrated Transformer Providing PCB Supply from Mains Supply
<b>MECHANICAL RATING</b>	IP43, NEMA 1 Galvanized Metal Enclosure
<b>EU DIRECTIVES</b>	Meets all EMC and Low Voltage Directives
<b>UL DIRECTIVES</b>	Complies with all UL Requirements for Power Control Electronic Systems
<b>OPERATING HUMIDITY</b>	Up to 95% Non Condensing (Conformally Coated Systems Can Be Provided)
<b>OPERATING TEMP</b>	-15°C to +40°C (De-rate current by 20%/10°C)
<b>ALTITUDE</b>	4000m Above Sea Level. De-rate Current by 1%/100m Above 4000m

#### 3.2 GENERAL CONSIDERATIONS

1. The installer should be a competent person for installation of electrical goods.
2. The power should be disconnected before installation and only put back on once installation is complete.
3. The only motors for which the Single Phase EnviroStart is suitable are 110v AND 220V AC single-phase induction motors. (Also known as “Cage” or “Squirrel Cage” motors). EnviroStart cannot be used on DC motors, Switched Reluctance motors or any form of Three Phase motor.
4. Check that the current rating of the unit is the same or higher than the full load current (FLA) of the motor, which should be on the nameplate of the motor. If in doubt contact the motor manufacturer or supplier.
5. Use the correct size of cable for the current rating of the unit, (See Section 3.11)
6. The EnviroStart must be installed as the last piece of equipment before the motor.

### 3.3 HARMONICS

The **EnviroStart** Single Phase Motor Energy Control, like all electronic systems, does produce low-level harmonics during operation. The SDPMEC is however a controlled systems, switching taking place at or very near to the zero crossover points of the waveforms therefore significantly reducing radiated and communicated harmonic content.

As the **EnviroStart** units produce negligible harmonic levels during normal running it is excluded from the constraints of such specifications by definition; however with our policy of ensuring maximum compliance and minimum environmental pollution our design standards ensure that we fall well below the limits set. Typical test values\* of harmonic currents on an **EnviroStart** controlled motor operating in Energy Save Mode yielded <14% for 5<sup>th</sup> Harmonic and <4% for 7th harmonic, significantly within the accepted and specified limits.

Maximum limits are unlikely to be exceeded in normal operation even during ramp up and ramp down periods.

\*Taken from test report produced by CTS Ltd of Bromsgrove, Worcestershire 18<sup>th</sup> July 2003

### 3.4 HEAT LOSSES

For heat calculation purposes it should be assumed that EnviroStart units have a power loss of 4W/A at full conduction,

### 3.5 CONTROL PANELS/CABINETS WITH MULTIPLE UNITS

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.

### 3.6 IMMUNITY FROM INTERFERENCE

**EnviroStart** generally has a high level of immunity to externally generated interference and as a zero volt switching control is a minimal contributor.

### 3.7 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.

### 3.8 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.

### 3.9 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**.



### 3.10 INPUT/OUTPUT CONTROL CONNECTIONS

To avoid 'interference pick up' all input and output control cables should be kept as short as possible and should wherever possible, be shielded. If noise free lines cannot be guaranteed, an interposing relay with suitable suppression must be used, this should be mounted as close to the **EnviroStart** as possible.

### 3.11 EMISSIONS

**EnviroStart** units produce relatively low Radio Frequency Interference (RFI) compared with frequency inverters and no external filters are required in normal circumstances. (See also Section 3.3 – Harmonics).

### 3.12 CABLE AND INPUT FUSE RATINGS

Incoming fuses and power cables should generally comply with the ratings as shown in the table below. It is recommended that all cable be tri-rated compliant with BS 6231 and that all fuses be motor rated, bolt fitting, compliant with BS 88 Part 2. (It is not necessary to use motor rated fuses if the unit is being used in DPR Mode).

MODEL	FUSE RATING	CABLE RATING		MODEL	FUSE RATING	CABLE RATING
110-SPMECG6-4A	5A	14A/0.75mm/20AWG		220-SPMECG6-4A	5A	14A/0.75mm/20AWG
110-SPMECG6-10A	10A	14A/1.5mm/18AWG		220-SPMECG6-10A	10A	14A/1.5mm/18AWG
110-SPMECG6-25A	25A	14A/2.5mm/14AWG		220-SPMECG6-25A	25A	14A/2.5mm/14AWG
110-SPMECG6-4A/60	5A	14A/0.75mm/20AWG		220-SPMECG6-4A/60	5A	14A/0.75mm/20AWG
110-SPMECG6-10A/60	10A	14A/1.5mm/18AWG		220-SPMECG6-10A/60	10A	14A/1.5mm/18AWG
110-SPMECG6-25A/60	25A	14A/2.5mm/14AWG		220-SPMECG6-25A/60	25A	14A/2.5mm/14AWG

The above detail refers to new installations, where the **EnviroStart** is fitted into an existing installation; cable should be rated according to the fuses already fitted.

## 4. INSTALLATION

### 4.1 GENERAL PROCEDURES

The majority of 4A and 10A Single Phase **EnviroStart** units will be shipped pre-wired with five core cable suitable for the current rating of the unit. If this is the case then ignore the following section as it is not relevant to your installation. (Refer to the wiring diagram at the end of this Installation and Commissioning Guide for details of the cable connections).

When ready to install the unit, unscrew and remove the lid. Make ready your connection cables from the supply and to the motor to be controlled and thread them through the glands found on the side of the unit. Make the ends of the cable off and connect into the terminals, which are found on the circuit board. Make sure the earth cables are connected between the box, lid and circuit board terminal block and replace the lid.

If the **EnviroStart** has been pre-wired then the cable supplied may be either numbered or colour coded.

#### In the case of Colour Coded Cables

Brown	Supply Feed Positive
Blue	Supply Neutral, Return
Red	Motor Feed Positive
Black	Motor Neutral, Return
Green/Yellow	Earth

#### In the case of Numbered Cables

1	Supply Feed Positive
2	Supply Neutral Return
3	Motor Feed Positive
4	Motor Neutral Return
5	Earth

EnviroStart provides terminals for the incoming mains supply and also a set of auxiliary connections to provide supply for additional components that cannot be optimized such as secondary fans in refrigeration systems and condenser pumps in freezers.

The controlled output to the motor is found on a separate connector set clearly marked "Motor". Under no circumstances should the supply voltage be applied to this connector block.

### 4.1.1 4A AND 10A PCB CONNECTOR IDENTIFICATION

TERMINAL	LOCATION	FUNCTION
L	PCB	Supply Input Positive
L	PCB	Supply Input Positive Auxiliary
N	PCB	Supply Input Neutral
N	PCB	Supply Input Neutral Auxiliary
E	PCB	Supply Input Earth
E	PCB	Supply Input Earth Auxiliary
MOTOR L	PCB	Motor Feed Positive
MOTOR N	PCB	Motor Feed Neutral
MOTOR E	PCB	Motor Feed Earth

### 4.1.2 25A CONNECTOR IDENTIFICATION

TERMINAL	LOCATION	FUNCTION
Input L	Base Plate Connector	Supply Input Live
Input N	Base Plate Connector	Supply Input Neutral
Motor L	Base Plate Connector	Motor Feed Live
Motor N	Base Plate Connector	Motor Feed Neutral
Earth	Base Plate Connector	Earth

## 4.2 SETTING UP

All EnviroStart DIP Switches are polled continuously and it should be possible to make changes whilst the unit is running to change between operational modes. It is however good practice to make changes whilst the unit is switched off to ensure that the software is not “hung” or “corrupted” as a result of a spike being transmitted to the chip during “live” switching.

ADJUSTMENT	FUNCTION	DEFAULT SETTING	RESULT	SEE SECTION
Switch 1	Energy Saving Mode Select	OFF	Energy Savings Enabled	4.3.3
Switch 2	Auto – Manual Savings Select	OFF	Automatic	4.3.3
Switch 3 & 4	Energy Saving Level	ON OFF	Level 2 Energy Savings	4.3.3
Switch 5	Soft Start	OFF	Soft Start Disabled	4.3.4
Switch 6	Two Minute Time Delay	OFF	Time Not Enabled	4.3.5

After making sure all the connections are correct, the unit can be switched on. (It is recommended that any switching of the motor be carried out by switching the supply to the EnviroStart and not by switching the load). As power is applied the green Power-on LED should light up on the front of the unit, the motor should start turning immediately, ramping from stationary to full speed. It will take approximately 2.5s after the motor has reached its top of ramp speed before the energy saving routine is initiated. Depending upon the operational mode selected, fully automatic or fixed pedestal voltage, (see below), the optimization routine will then take approximately fifteen seconds to fully establish itself at which point the amber Energy Save LED will come on. (During this time it is likely that the Red Fault LED may flicker, this indicates only that the unit is establishing the parameters for an acceptable energy saving level for the motor). Depending upon mode and the level of savings being achieved the amber Energy Save LED may be on constantly or flicker on and off; either condition is perfectly normal.

During the course of normal operation, the red Fault LED may flicker on and off occasionally as the optimization process establishes the torque limits for the motor and load combination; this is perfectly normal.

## **4.3 COMMISSIONING**

It is necessary to establish the “safe operating level” mode for the EnviroStart with the given motor-load combination. In the first instance, unless otherwise directed, always try the default setting for the unit; this is Automatic Mode – Level 2, as indicated within the Table 2 below. If the motor runs up, EnviroStart goes into saving mode, (as indicated by the amber Run LED flickering on and off) and the motor remains stable throughout any load variations, (including re-starts if the unit is externally controlled by say a thermostat or PLC), then you may want to try Automatic Mode – Level 1. This level will provide a slightly higher degree of saving if the motor-load combination can handle the voltage and current reductions created by the EnviroStart. If the motor becomes unstable and is unable to maintain the load torque requirement then try Automatic Mode – Level 3, and so on to Level 4. If the Automatic Mode levels do not provide a capability to maintain the motor load demands then move to the Pedestal Voltage Modes, shown in Table 3. This Mode provides four operating levels. If Automatic Mode – Level 4 has not worked then move to Pedestal Voltage Mode Level 1 and work through to Level 4. If none of the Automatic Modes works then one of the Pedestal Voltage Modes, will.

### **4.3.1 ESTABLISHING ENERGY SAVINGS**

Establishing the current and voltage levels without energy savings can be achieved by setting DIP Switch 1 into the ON position thereby disabling energy savings. The motor will be supplied with full current and full voltage as though the EnviroStart was not in circuit. Measuring the current and voltage in this condition and then referencing that against the current and voltage with SIP Switch 1 in the OFF position will allow you to determine the savings levels being achieved by the EnviroStart. In this always be careful to establish the power levels over a period of time rather than spot checks, as these can be unreliable indicators or true power.

### **4.3.2 FAULT CONDITIONS**

If the motor sounds as though it is running unevenly or appears to stall at any time during its operation then please see the instructions below, on backstop settings.

If the fault light comes on for more than a short period, switch off the unit for five minutes to allow the EnviroStart to cool and then switch on again. If the fault lamp comes back on

straight after the unit has been switched off, the unit is faulty and should be replaced. (Please note there are no user serviceable parts within the EnviroStart).

### 4.3.3 ENERGY SAVING MODES

#### 4.3.3.1 AUTOMATIC SAVING MODE

The unit can be switched between DOL (Direct on Line) and Energy Saving mode by altering DIP Switch 1 as Table 1 below shows. This action should not be undertaken by anyone other than qualified electrical engineers.

**Note the circuit board is live and at 240V/110V AC. Therefore, unless you are an experienced electrician, the unit should be switched off before the lid is removed and any settings changed, and the lid should be replaced and secured prior to switching on again.**

**Table 1 Energy Save Mode Selection**

SWITCH 1	ENERGY SAVING MODE
ON	Energy Saving Disabled
OFF	Energy Saving Enabled (Default)

Once the unit is operating in Energy Saving Mode the following settings can be made. The settings correspond to limiting how far the voltage applied to the motor will drop. The lower the drop in voltage the more power savings will be achieved. The reason for the settings is that there are thousands of different types of motors on thousands of different applications. Some of these applications would benefit from not dropping the voltage as far as is possible as they may go into an unstable or stall condition. The unit should be tried with its default settings, (Automatic Mode – Level 2), which should work in the majority of cases. If the motor appears to be stopping and starting or stalling after a short period of operation, switch the unit off and change the settings to the next step towards minimum optimization and retry. This should improve matters, if it does not move to the next setting and try again.

**Note the circuit board is live and at 240V/110V AC. Therefore, unless you are an experienced electrician, the unit should be switched off before the lid is removed and any settings changed, and the lid should be replaced and secured prior to switching on again.**

**Table 2 Automatic Saving Level Selection**

SWITCH 2	SWITCH 3	SWITCH 4	ENERGY SAVING
OFF	OFF	OFF	Max. Saving. Level 1
OFF	ON	OFF	Level 2 (Default)
OFF	OFF	ON	Level 3
OFF	ON	ON	Min. Saving. Level 4

#### 4.3.3.2 FIXED BACKSTOP SAVING MODE

In the event that the automatic mode of energy savings is not satisfactory then you can place the unit into a “fixed backstop voltage” condition however this should be done in very controlled environments as the system will not then operate dynamically and should full power be required on the motor it will not be available. See Table 3 below.

**Table 3 Pedestal Voltage Saving Level Selection**

SWITCH 2	SWITCH 3	SWITCH 4	PEDESTAL VOLTAGE
ON	OFF	OFF	≈ 70% Supply Voltage (≈30% Savings)
ON	ON	OFF	≈ 80% Supply Voltage (≈20% Savings)
ON	OFF	ON	≈ 85% Supply Voltage (≈15% Savings)
ON	ON	ON	≈ 90% Supply Voltage (≈10% Savings)

The voltages shown in Table 3 are not absolute but indications only. Input voltage and load conditions will cause the output voltage to change from that shown based on a supply voltage of 220V.

#### 4.3.4 SOFT START

In the event that you want a soft start function, for example, with a water pumping application, then this can be enabled by putting DIP Switch 5 into the ON position. This switch will enable a 3s ramp start prior to a 2.5s DOL period after which time the system will go into energy save mode.

#### 4.3.5 REFRIGERATION APPLICATION SETTING

In all cases where EnviroStart is fitted to refrigeration compressors, a minimum period of two minutes should elapse between stopping and starting the compressor motor. This is to allow the system to shed its backpressure. In many systems such as those manufactured by Cornelius, you will find that the thermostat has a built in timer, in applications where such a timer does not exist, it is imperative that you observe the two minute rule especially during set up and commissioning when frequent stop-start cycles are undertaken.

Certain system compressors may stall in the event of a restart within the two-minute period with EnviroStart fitted. These are generally, but not always, systems with a mechanical thermostat fitted. If you experience problems with the unit re-starting in such conditions then use the inbuilt timer feature of EnviroStart by switching DIP 6 into the “ON” position. This will cause the unit to always wait two minutes before a restart is allowed ensuring backstop pressures are equalized within the compressor circuit. (Default value is “OFF”).

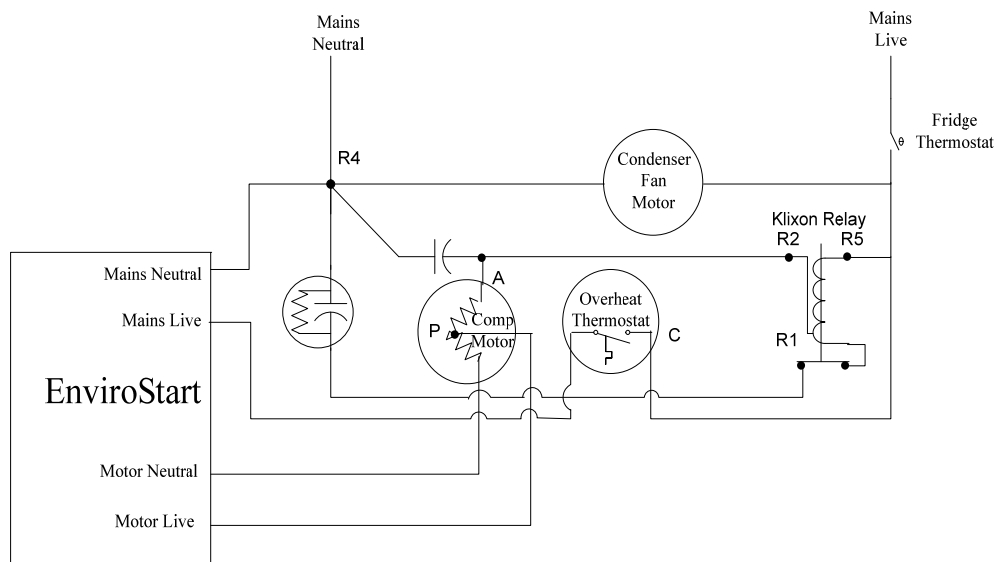
## 4.4 PCB MOUNTED LED INDICATORS

<b>LED 1</b>	Energy Save Enabled	On to indicate that unit is running in energy save mode and is within a pre-set band of energy savings around the level as is set by DIP Switches 2, 3 and 4.
<b>LED 2</b>	Power On	Illuminates when unit is powered and ready to operate, indicates that initialisation self test has been completed. When flashing it indicates that the two minute “delay-start” timer, (enabled through DIP Switch 6), is running. The flashing light will stop as the motor starts after the two minute period.
<b>LED 4</b>	Current Limit	Illuminates when a fault condition is detected by the control software. This light may flash periodically as the system operates, indicating that a temporary “stall mode” has been detected. This is normal and is quite acceptable.

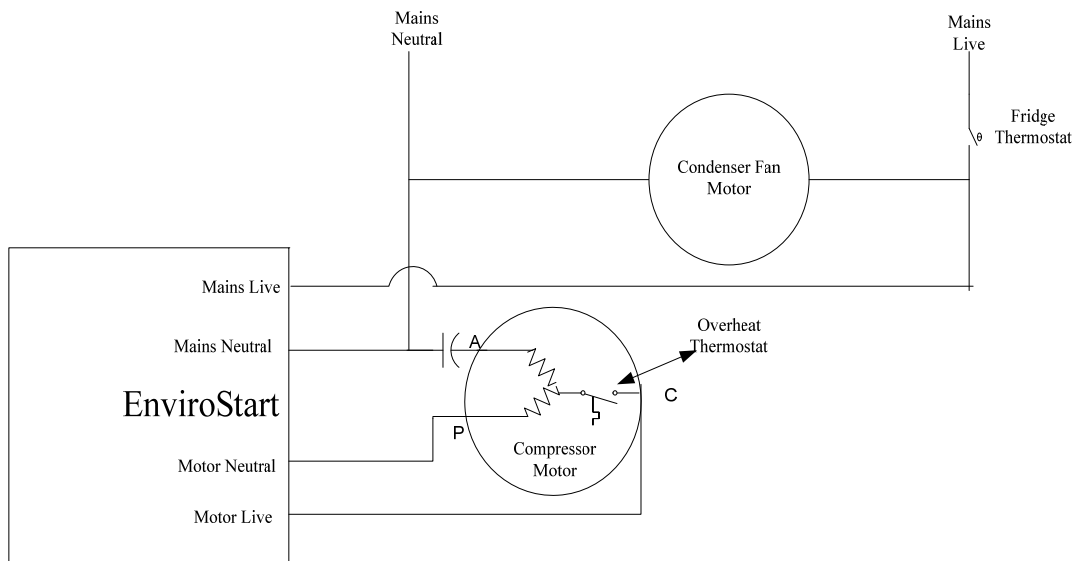
## 5. INSTALLATION

### 5.1 REFRIGERATION COMPRESSOR INSTALLATION DIAGRAMS

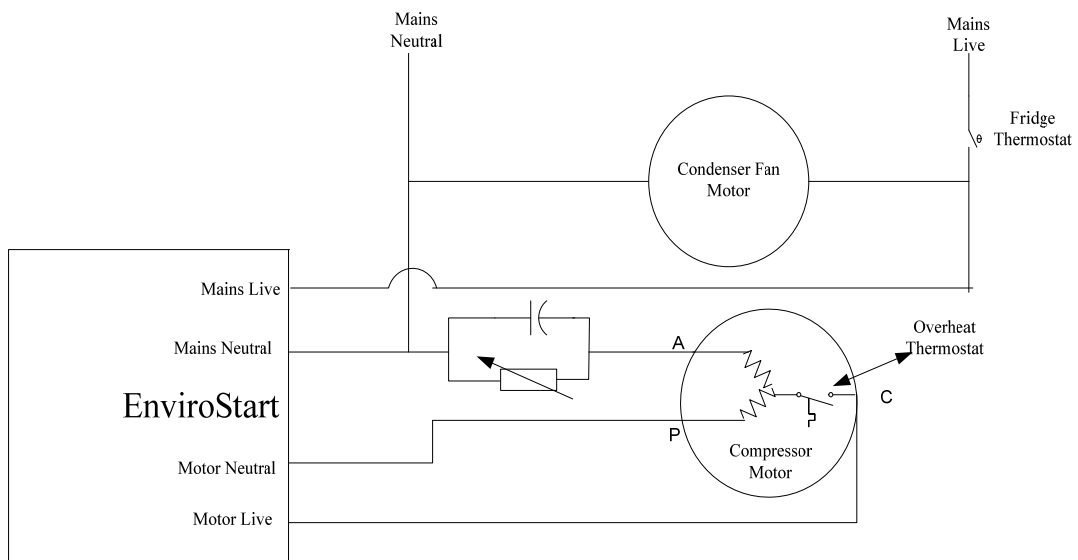
#### CSR Two Capacitors - Capacitor Start, Capacitor Run



## PSC Single Capacitor Start and Run (Integral Overheat Thermostat)

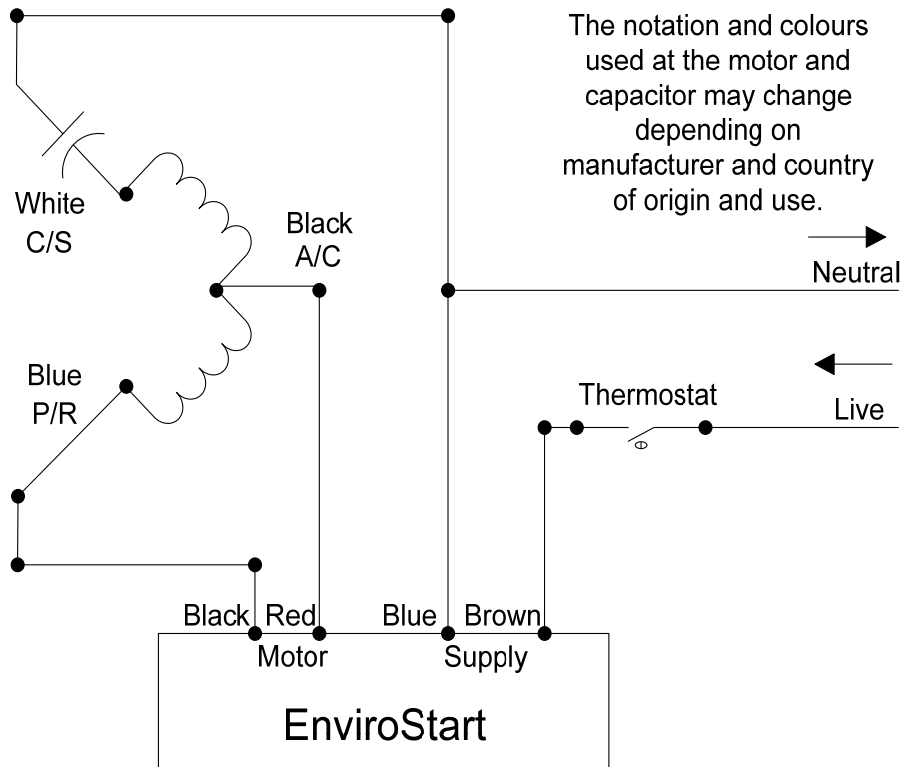


## PTCSCR Single Capacitor Start and Run with variable resistor (Integral Overheat Thermostat)





## 5.2 GENERALISED INSTALLATION DIAGRAM

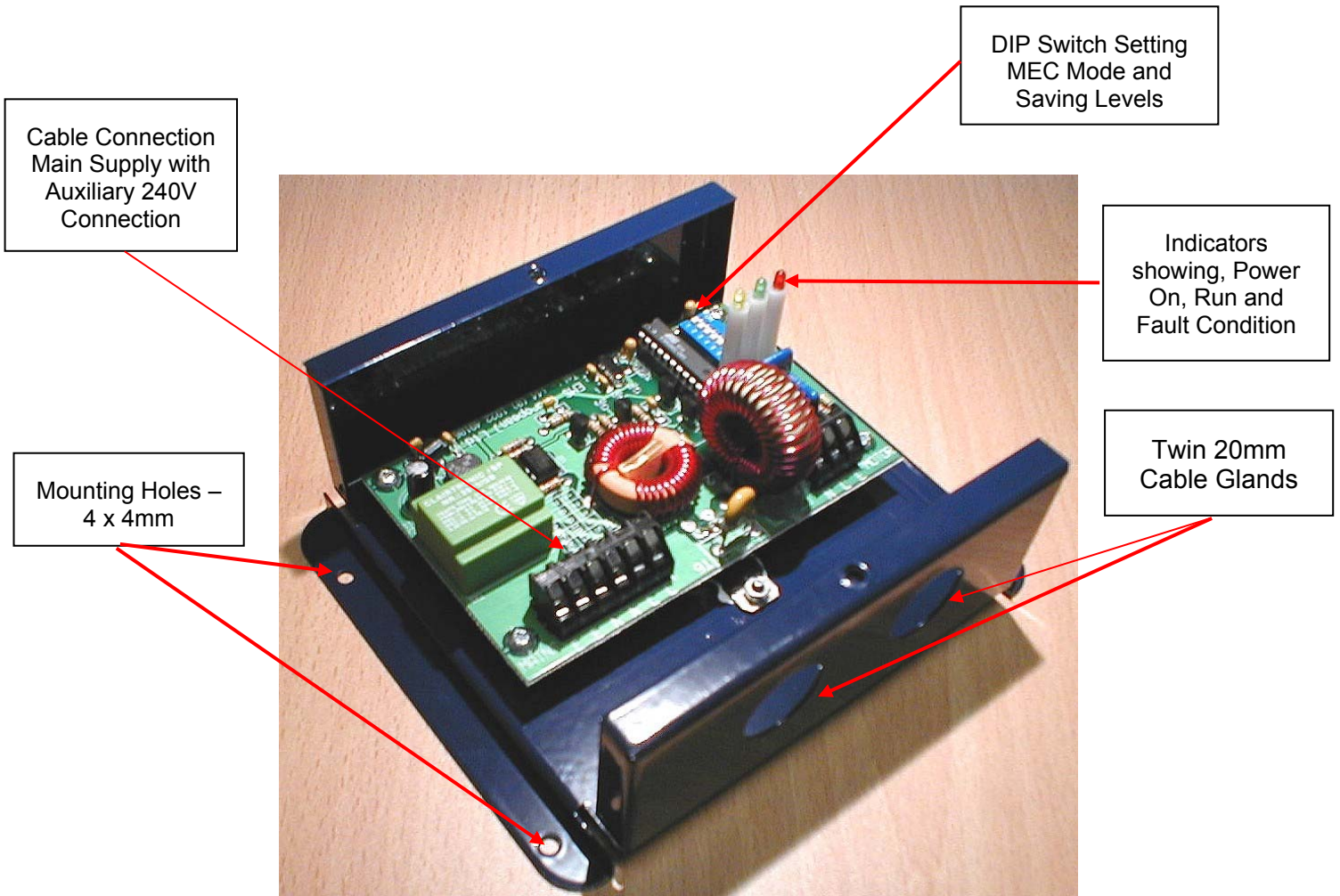


**INSTALLATION AND COMMISSIONING GUIDE**

**END**

# APPENDIX 1

## CONNECTION AND WIRING DIAGRAM 4A AND 10A



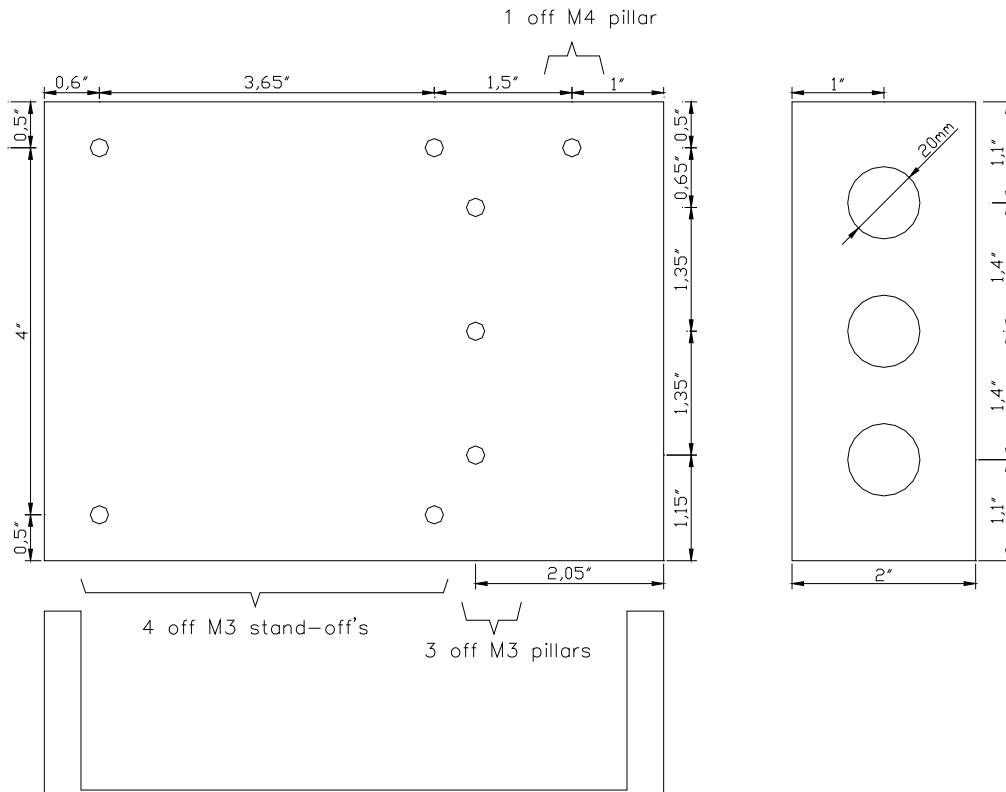
**CONNECTION AND WIRING DIAGRAM 25A**

**NO PICTURE IS  
AVAILABLE AT THIS  
TIME**

## APPENDIX 2

### Mechanical Drawings

#### 25A



#### 4A and 10A

