GENERATION 6

ems European Ltd

EnviroStart™ Three Phase Digital Voltage & Power Regulator Installation & Commissioning Guide

Version 2.4 June 2008

Three Phase EnviroStart™ Digital Voltage and Power Regulator

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.**

CONTENTS

1 INTRODUCTION

Thank you for choosing the EnviroStart Digital Voltage and Power Regulator. 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 >150,000 hours continuous use, (fifteen 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

EnviroStart Digital Voltage Regulators and Digital Power Regulators are high specification Speed and Power Controls for systems of up to 1,400A.

The system uses high integrity power thyristor switching systems to provide solid-state control of load or process, eliminating the problems of reliability and maintenance associated with traditional electro-mechanical approaches.

Two systems are available; the Digital Voltage Regulator uses phase-angle thyristor management, providing the very precise control essential on systems with low inertia loads. This controller is ideally suited to coupling with high-slip motors where accurate speed control is provided in a very cost effective manner without the problems and complications associated with frequency conversion and inverters. The Digital Power Regulator uses burst fire, (zero cross), thyristor management suitable for zero harmonic generation control of loads with large system inertias such as heating elements.

The DVR can be connected, via transformers, to provide an easily controlled high current, low voltage system suitable for inductive and trace heating. It could also be used with a suitable rectifier on the low voltage side, to give DC-Regulation for applications such as electro-plating. It would also be possible to use the DVR to soft start transformers where inrush currents may cause nuisance tripping when associated with delicate circuits.

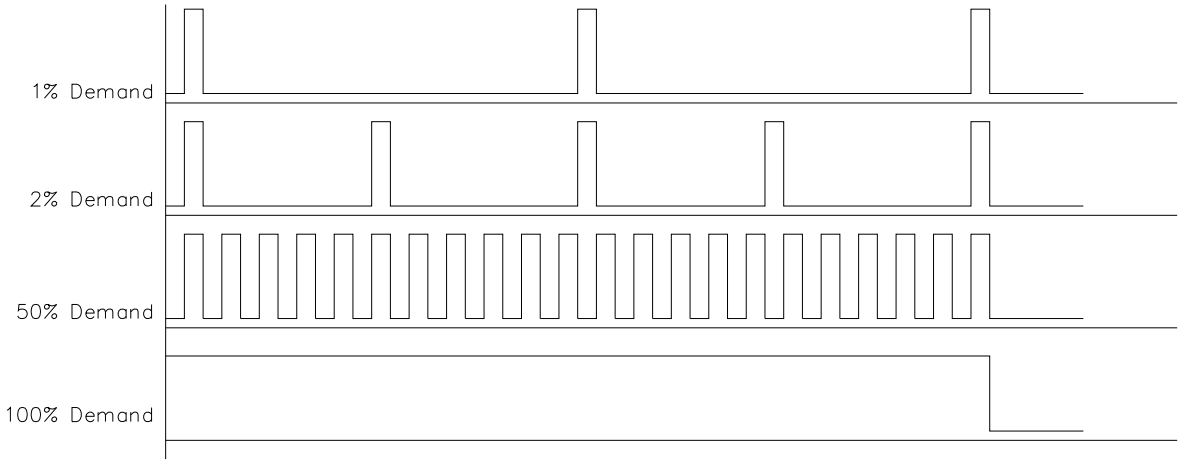
- CONFIGURABLE SPEED (DVR) OR ENERGY CONTROL (DPR) (Motor/Load Dependant 1% to 100%)
- SOFT RAMP UP FROM START AND BETWEEN SET SPEEDS OR POWER CHANGE (DVR).
- INSTANTANEOUS, (< 100μs), POWER STATE CHANGE IN DPR MODE
- FULLY CONFIGURABLE CURRENT LIMIT
- MULTIPLE INPUT CONTROL CAPABILITY (0 – 10V, 4 – 20mA. (5k0 Potentiometer internal or external)
- SWITCHABLE EMERGENCY RUN (DOL Start no retention of run features)
- START/STOP AND EMERGENCY RUN COMMAND FUNCTIONS CONTROLLABLE WITH PNP, (SINK), OR NPN, (SOURCE), INPUT OR SIMPLE CLOSED CONTACT SWITCHING.
- FULL SYSTEM STATUS LED's
- READY, END OF RAMP, (EOR) AND RUN RELAYS. (2x N/O, 2x N/C 2kVA contacts on each)
- ON PCB SYSTEM CPU RESET BUTTON
- 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)
- 208V, 220V, 400V AND 480V 50/60Hz MODELS AVAILABLE

1.2 THE PRINCIPAL OF THE DIGITAL POWER REGULATOR

The **EnviroStart** DPR is a controlled three phase Burst Fire Generator. The fundamental 50Hz input waveform is divided into two second slots with each slot divided into eight domains of thirteen cycles. Full cycles are “passed through” based on the setting of the analogue input into a comparator.

Control is very precise and is definable to 1% where 1 cycle per 100 cycles is allowed through right up to 100% where all 100 cycles per 100 cycles are allowed through. The chart below shows the relationship of the domain waveforms across a typical two second period.

As the load level is increased from the 1% through to maximum, (100%), the software determines where the waveforms are allowed within the eight domains. The algorithm handling this is sampling the drive on a continuous basis and making adjustments to the waveform time position so that at all levels set, the power is evenly distributed across the total time domain and as such power is provided in as even a manner as possible consistent with the level set.

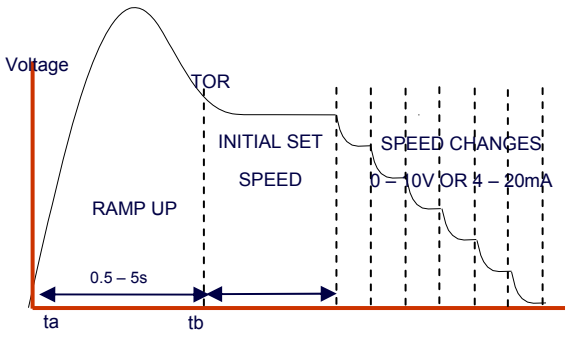


1.3 THE PRINCIPAL OF THE DIGITAL VOLTAGE REGULATOR

The **EnviroStart** DVR is a simple Variable Voltage Drive which, when used in conjunction with a Quadratic, (high slip), motor will provide a cost effective speed control.

Control of the output voltage is infinitely variable depending upon the analogue input to the control circuitry. A basic differentiator establishes the level of the input against the full voltage level sampled from the supply which then controls the firing angle of the thyristors to provide voltage control at the output to the motor.

It is possible to adjust the speed of a motor from “off” through to full speed in a smooth controlled manner. It should be recognized however that as the voltage falls away on a Quadratic motor the torque also drops and care should be taken to ensure that any system where speed control is set to a low RPM, is not liable to stalling.



2 RATING INFORMATION

2.1 CORRECT DVR/DPR SELECTION

The **EnviroStart** must be rated according to the load current, taking proper account of the type of load, (resistive or inductive) and the voltage of the supply.

It may be necessary on certain applications to oversize the unit chosen 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. (Refer to the appropriate Current Data Sheet).

Please note that 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.

2.2 VOLTAGE RATING: 208V, 220V, 400V, 480V

The general ratings for the Digital Voltage Regulators specified in this Installation and Commissioning Guide are based on typical four-pole motor characteristics. **EnviroStart DVR's** will however work effectively on two, six and eight pole motors provided they are Quadratic, (high-slip), Class D, motors with low inertia loads.

Correct choice of fusing and cabling is important with all power control units but more so with both DVR and DPR products that have over-current demands beyond the immediately apparent rating of the load they are supplying.

EnviroStart DPR's should be selected for the application to which they are to be fitted based on the voltage rating of the system and the continuous current rating of the load.

2.3 CE DECLARATION OF CONFORMITY

CE

MANUFACTURERS DECLARATION OF CONFORMITY

This declaration covers all **EnviroStart** DVPR 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

3.1 TECHNICAL SPECIFICATION

SUPPLY VOLTAGE	208V, 220V, 400V and 480V Systems Available
FREQUENCY	50 or 60Hz selected on PCB.
START DUTY	4 x continuous rating for 5s / 3 x for 20s 12 – 75A units) 5 x continuous rating for 5s / 3 x for 30s (85 – 2200A units)
STARTS PER HOUR	12 evenly spaced starts per hour. (Dependant on unit rating)
RAMP UP TIME (DVR)	Dependant on Ramp Destination Voltage, Default 100V/s Link Selectable to be <10mS
CURRENT LIMIT RANGE	2 - 6 x FLC
COOLING	Naturally cooled isolated heatsink up to 45A Fan cooled for 60A and above (Independent 240/110V supply required)
POWER SWITCHING	Fully base-isolated twin thyristor Paks or independent Puks
CONTROL CIRCUITRY	12MHz clocked J-Lead Atmel MPIC
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	Power On/Run/Current Limit/Ramp, Fault/End of Ramp
ON PCB RELAYS	End of Ramp/Ready/Run, Fault (2 N/O, 2 N/C each relay)
RELAY CONTACT RATING	2kVA, 250V AC with 2 N/O and 2 N/C contacts
MECHANICAL PROTECTION	IP43, NEMA 1 sheet metal enclosure or high impact ABS cover on heat sink backplane (depending on current rating)
OPERATING TEMP.	$0^{o}C$ - $+40^{o}C$ @ < 95% RH. (De-rate 20%/$10^{0}C$ above $+40^{o}C$)
STORAGE TEMP.	$-10^{o}C$ - $+60^{o}C$
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 (> 110A units)

3.2 HIGH SPEED FUSES – (110A – 1400A)

Both the **EnviroStart** DVR and DPR have provision for integral High Speed Semiconductor Fuses to be fitted. These are not fitted as standard. Customers requiring integral fuses for the output feed to the load must specify this at the time of order. In general, if BS 88, motor rated fuses are fitted to the incoming supply of the unit as is recommended within IEE 17th Edition Regulations, (this being the applicable regulations document in the UK), then these additional fuses are not necessary.

There is no provision for integral fuses to be fitted to the output of the 11A to 85A **EnviroStart** units.

3.3 HARMONICS

EnviroStart like all electronic systems does produce low-level harmonics during Ramp-Up, and Ramp-Down. Both the DVR and the DPR are however 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.

U.K. electricity council engineering recommendations contained within their documents G5/4 (2002) specifies that the short term generation of harmonics by any electronic system 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%. The specification also details that the concern is primarily with the possibility of damage to frequency dependent components (such as capacitors) through long-term exposure to such harmonics.

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 <8% for 5th Harmonic and <1% 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.

**Based on tests carried out on a 22kW motor by University Of Surrey Industrial Electronics Group November 1988, re-verified on current Generation V product in July 2003.*

3.4 HEAT LOSSES

For heat calculation purposes it should be assumed that EnviroStart units have a power loss of 1.2W/A per phase at full conduction, (3.6W/A maximum for the three phase). These losses cause heat to be generated that is safely dissipated through the aluminium heatsink. Also see Section 3.5 through 3.9 and 4.7 below.

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 units of ≤205A fitting louvers of the minimum dissipation capacity (described in Section 3.10 - Table of Power Losses), both above and below the **EnviroStart** will normally be sufficient.

For units of ≥205A additional fans must be fitted to the cabinet 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°C rise above ambient.

3.6 SELECTING A FAN

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

3.8 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 CABINET COOLING FAN DETAIL

The fans should be positioned in the cabinet, wherever possible, below the **EnviroStart**. The aperture to which the fans are fitted should always be large enough to allow free flow of air, any filters fitted should be selected to minimise their interruption to air flow. Such filters should be regularly inspected to ensure that they are clean.

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	805
7400N/7450N	106	85	1,166	935
6028S/6078	106	93.3	1,283	1,026

3.10 POWER LOSSES

MODEL	POWER ASSEMBLY LOSSES IN W.	CONTROL & FAN LOSSES	TOTAL LOSSES	MINIMUM LOUVRE AREA (TWO REQUIRED)
TPDVPRG6 -12	45	10	55	0.0156 Sq. M
TPDVPRG6-16	58	10	68	0.0156 Sq. M
TPDVPRG6 - 23	90	10	100	0.0156 Sq. M
TPDVPRG6 - 30	108	10	118	0.0156 Sq. M
TPDVPRG6 - 45	162	10	172	0.0156 Sq. M
TPDVPRG6 - 60	216	50	266	0.0625 Sq. M
TPDVPRG6 - 75	270	50	320	0.0625 Sq. M
TPDVPRG6 - 85	306	50	356	0.0625 Sq. M
TPDVPRG6 - 120	432	50	482	0.0625 Sq. M
TPDVPRG6 - 145	522	50	572	0.0625 Sq. M
TPDVPRG6 - 170	612	50	662	0.1 Sq. M
TPDVPRG6 - 205	738	50	788	0.1 Sq. M
TPDVPRG6 - 255	918	70	988	See Sections 3.6 - 3.8
TPDVPRG6 - 290	1,044	70	1,114	See Sections 3.6 - 3.8
TPDVPRG6 - 340	1,224	85	1,309	See Sections 3.6 - 3.8
TPDVPRG6 - 410	1,476	85	1,561	See Sections 3.6 - 3.8
TPDVPRG6 - 475	1,710	85	1,795	See Sections 3.6 - 3.8
TPDVPRG6 - 580	2,088	135	2,223	See Sections 3.6 - 3.8
TPDVPRG6 - 670	2,412	135	2,547	See Sections 3.6 - 3.8
TPDVPRG6 - 800	2,880	160	3,040	See Sections 3.6 - 3.8
TPDVPRG6 - 900	3,440	160	3,600	See Sections 3.6 - 3.8
TPDVPRG6 - 1100	3,960	260	4,220	See Sections 3.6 - 3.8
TPDVPRG6 - 1400	4,500	300	5,100	See Sections 3.6 - 3.8

USE TABLE OF FAN DATA IN SECTION 3.9 TO SELECT CORRECT CABINET FAN

4 GENERAL INSTALLATION CONSIDERATIONS

4.1 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.

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 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.

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. (See also Section 3.3 – Harmonics).

4.7 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 sections 3.4 through 3.10 for further information).

4.8 ADDITIONAL ENCLOSURES

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

4.9 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, (or isolator), and switched by the line contactor, (or isolator), so they are never in direct line with the **EnviroStart**.

4.10 LOAD SIZE

The **EnviroStart** DVR must be connected to a motor for the system to operate. The motor and the **EnviroStart** should be matched to the FLC rating of the motor. The DVR will only effectively provide control on a Quadratic, (high-slip), motor. If fitted to a standard induction motor there may be a degree of instability as the output voltage is dropped. (No speed control will be achieved with a standard synchronous or asynchronous induction motor)

The **EnviroStart** DPR should be rated according to the full running RMS current of the load. The load can be configured either Star or Delta however in Star it is necessary that a Neutral be fitted to the system, (load on each leg can be unbalanced in this case); in Delta the legs should have a balanced load.

It is important to make an assessment of the load type and frequency of starts as well as the operating ambient conditions when selecting a suitable **EnviroStart** unit. High frequency of starts, elevated ambient temperatures or significant altitude should be treated carefully and consideration given to selecting the next size of **EnviroStart** up from that which would be selected simply on kW or FLC ratings alone. (See the derating information on the current Specification Sheets).

4.11 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
TPDVPRG6 – 12	16A	14A/0.75mm/16AWG		**TPDVPRG6 - 255**	250M300A	204A/50mm/2/0AWG
TPDVPRG6 - 16	20M32A	21A/1.5mm/14AWG		**TPDVPRG6 - 290**	315M400A	259A/70mm/4/0AWG
TPDVPRG6 - 23	25A	30A/2.5mm/12AWG		**TPDVPRG6 - 340**	355A	321A/95mm/300MCM
TPDVPRG6 - 30	32M50A	41A/4mm/10AWG		**TPDVPRG6 - 410**	400A	374A/120mm/350MCM
TPDVPRG6 - 45	50A	53A/6mm/6AWG		**TPDVPRG6 - 475**	500A	440A/150mm/400MCM
TPDVPRG6 - 60	63M100A	75A/10mm4AWG		**TPDVPRG6 - 580**	560A	500A/185mm/700MCM
TPDVPRG6 - 75	80A	75A/10mm/3AWG		**TPDVPRG6 - 670**	670A	600A min/800MCM
TPDVPRG6 - 105	100M160A	100A/16mm3AWG		**TPDVPRG6 - 800**	800A	850A min
TPDVPRG6 - 120	125A	136A/25mm/2AWG		**TPDVPRG6 - 900**	900A	950A min
TPDVPRG6 - 145	160A	167A/35mm/1/0AWG		**TPDVPRG6 - 1100**	1100A	1200A min
TPDVPRG6 - 170	200M250A	204A/50mm/2/0AWG		**TPDVPRG6 - 1400**	1400A	1500A min
TPDVPRG6 - 205	200M250A	14A/0.75mm/16AWG				

Connections on 12A through 75A are direct onto the thyristor packs using M5 screws. From 105A through to 1400A M8 thread bolt screws are used. A single termination point recommended on 105A through to 205A, a double termination point recommended for 255A through 670A and four termination points recommended on units above 670A.

The above detail refers to new installations. In cases where the **EnviroStart** is being fitted into an existing installation then the cable should be rated according to the fuses already fitted. (IEE 17th Regulations). The AWG and MLM designations are per Table 310-16 of NEC 2005 and relate to copper conductors. (60^{o}F up to 100A and 75^{o}F above 101A).

4.11 BUS BAR CONNECTIONS

Where used, bus bars are either pure aluminium or, on systems rated at 255A and above, are nickel plated copper. All bus bars are duel rated, in that either aluminium or copper connectors can be used with them however on the aluminium bus bars it is recommended that a small amount of thermal grease be used if copper connectors are being used.

5 CONNECTIONS

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) Integrated fan supply on units manf. after February 2006
EARTH	Power Assembly	Earth
K1 (L1) & G1	PCB	Thyristor 1 Cathode & Gate
K2 (U) & G2	PCB	Thyristor 2 Cathode & Gate
K3 (L3) & G3	PCB	Thyristor 3 Cathode & Gate
K4 (V) & G4	PCB	Thyristor 4 Cathode & Gate
K5 L3) & G5	PCB	Thyristor 5 Cathode & Gate
K6 (W) & G6	PCB	Thyristor 6 Cathode & Gate
1,2,3,4[1]	PCB	External Analogue Control
5,6,7,8[2]	PCB	Start (must be kept closed for system to run)
9,10,11,12[3]	PCB	Emergency Run
13,15	PCB	AC Mains Input From Control Transformer (208V, 220V, 400V, 480V), Providing 10 – 15V AC
14	PCB	DC Common Rail (At PCB Earth Potential)
16	PCB	DC Input 7V – 24V (External PCB logic circuit supply)
17,18	PCB	Current Sense Input from Fitted CT
19,20,21	PCB	EOR Relay Changeover Contact Pair (End of Ramp)
22,23,24	PCB	EOR Relay Changeover Contact Pair (End of Ramp)
25,26,27	PCB	Run/Fault Relay Changeover Contact Pair
28,29,30	PCB	Run/Fault Relay Changeover Contact Pair
31,32,33	PCB	Power On/Ready Relay Changeover Contact Pair
34,35,36	PCB	Power On/Ready Relay Changeover Contact Pair
Link 1 - 2	PCB	When Linked Reduces Ramp Rate from 100V/s to being ≤10ms from any Two Points (DVR Mode Only)
220V/400V	PCB	PCB Supply To Control Transformer (Tapping 220V)
GROUND	PCB	Internal Ground

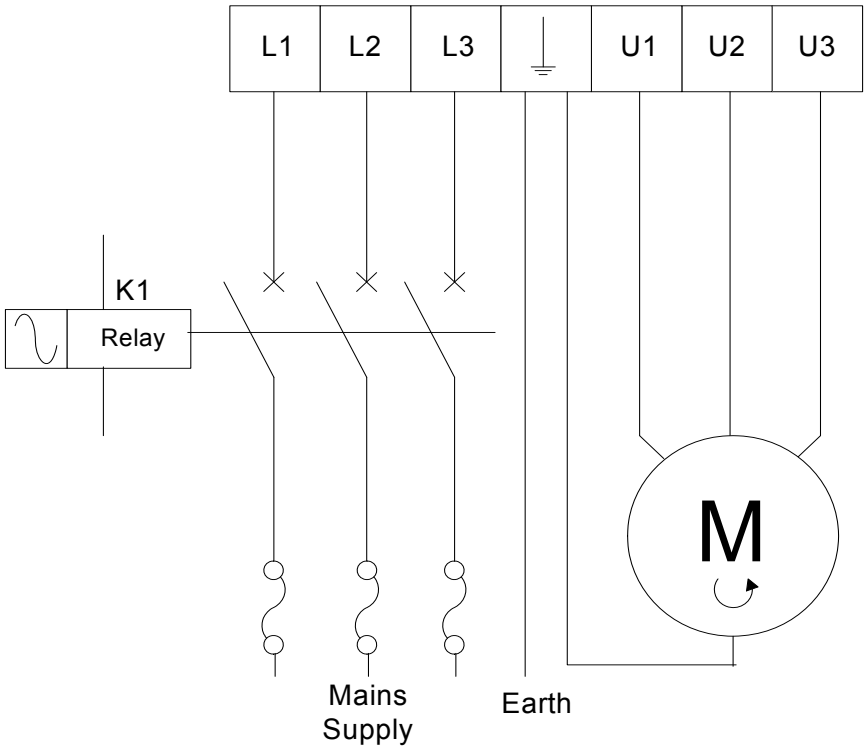
NOTES

1. Terminals 1, 2, 3, 4 provide for an external analogue input drive for a potentiometer, a 0V – 10V supply or a 4mA – 20mA supply. Connections should be made per details following. For the system to respond to these inputs DIP Switch 2 should be in the ON position otherwise **EnviroStart** will respond to the PCB mounted Speed potentiometer. It should be noted that the Maximum and Minimum potentiometers on the PCB remain in control of the upper and lower limits of the range irrespective of input source and location. (See Section 7.2 for wiring details)

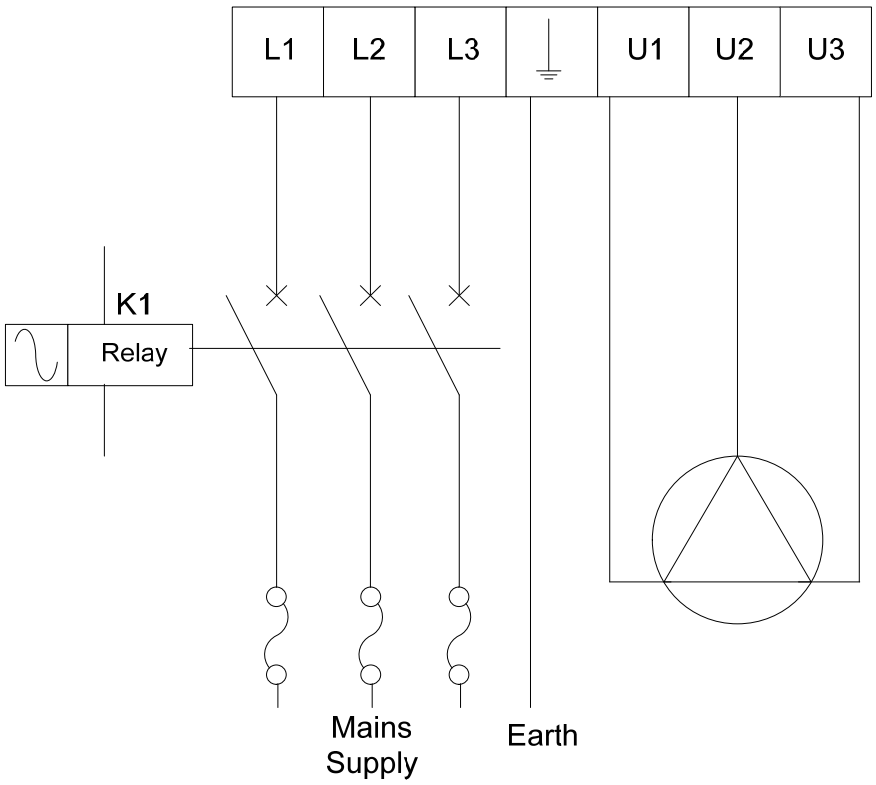
Conn. 1	Analogue Input +10V
Conn. 2	Analogue Input 4 - 20mA Input
Conn. 3	Analogue Input 0 - 10V Input
Conn. 4	Analogue Input Ground

2. Terminals 5, 6, 7, 8 should be permanently linked (via switch or link) per the diagrams below to cause the unit to provide drive. The circuit is designed to accommodate, direct switching, NPN, (sink) or PNP (source) switching should it be necessary to switch directly from a PLC or other micro device. When the connection between the terminals is open circuit but the unit is still powered up the drive output will cease.
3. Terminals 9, 10, 11, 12 should be permanently linked (via switch or link) per the diagrams below to enable the emergency run function. The circuit is designed to accommodate, direct switching, NPN, (sink) or PNP (source) switching should it be necessary to switch directly from a PLC or other micro device. When the connection between the terminals is open circuit but the unit is still powered up the system will stop providing drive output.

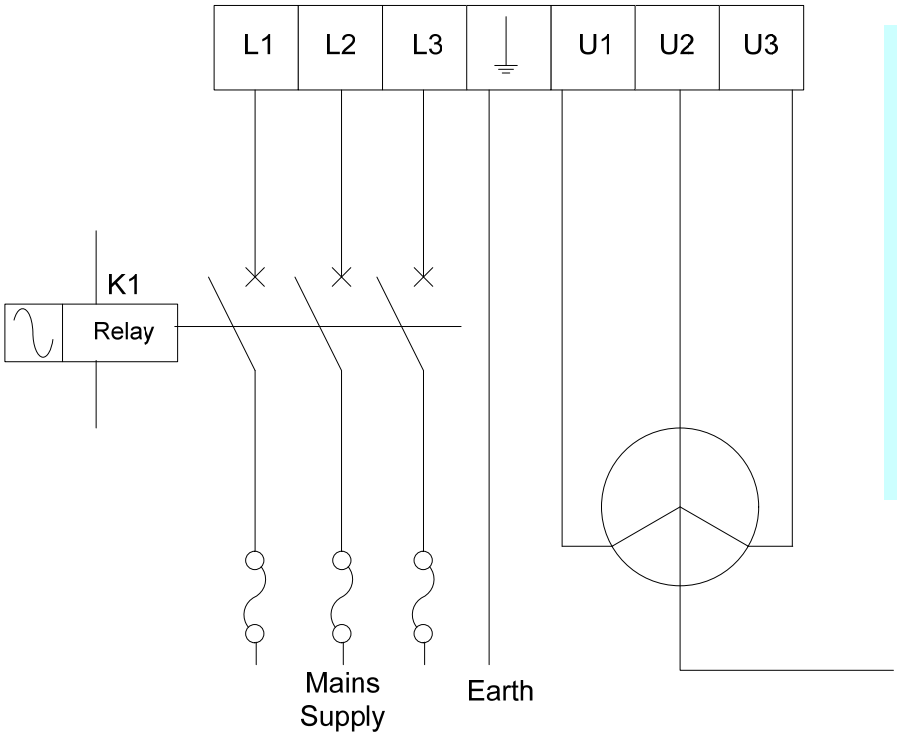
5.2 MAINS CONNECTION SCHEMATIC – DVR IN DELTA MODE



5.3 MAINS CONNECTION SCHEMATIC - DPR IN DELTA MODE



5.4 MAINS CONNECTION SCHEMATIC – DPR IN STAR MODE

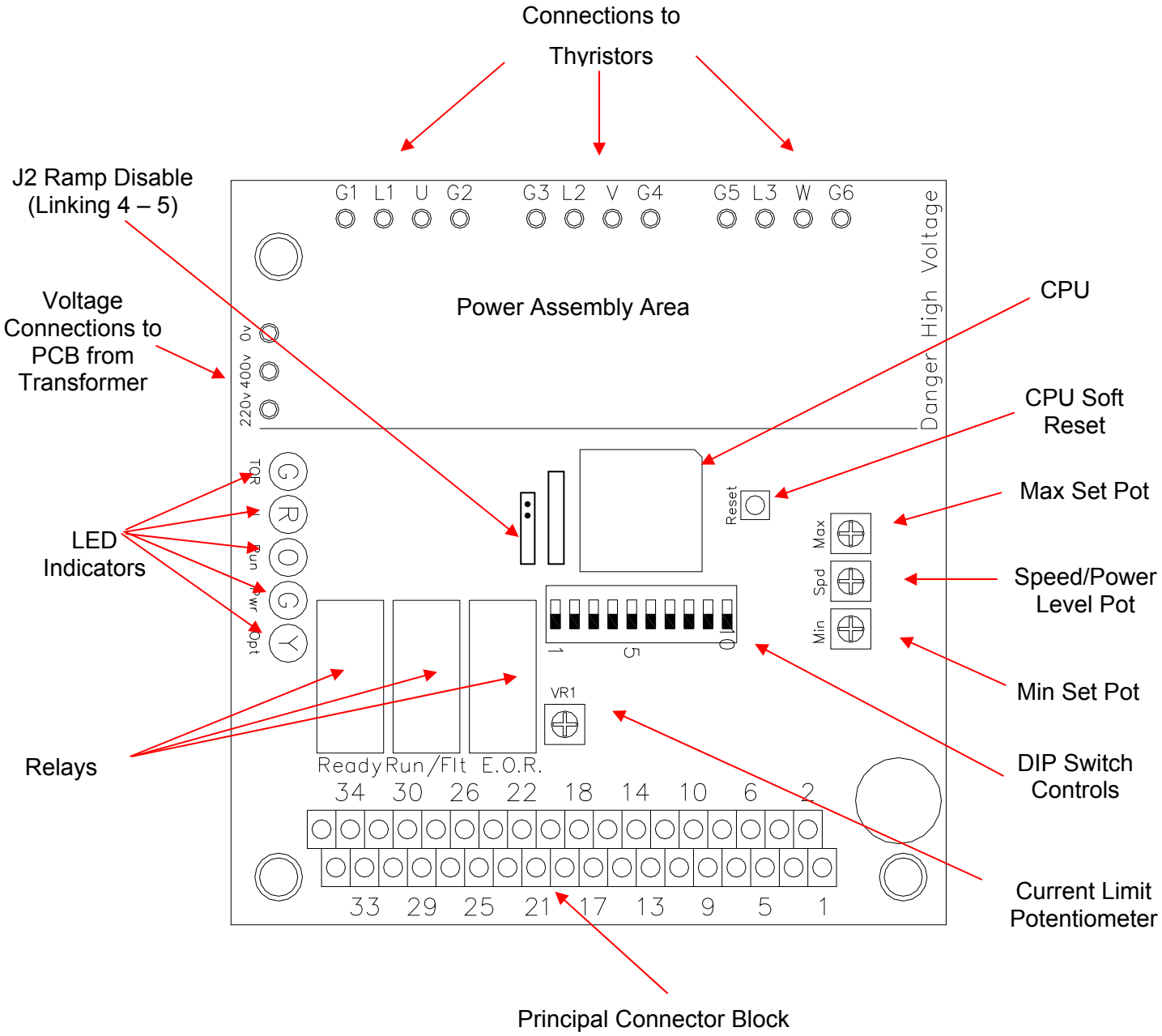


If the system is configured with a neutral then it is effectively wired in single phase mode DIP Switch 6 **MUST** be in the "ON" position if a neutral is present.

If there is no neutral and DIP Switch 6 is "ON" then the system will indicate that there is a Thyristor Trigger Fault

5.5 PCB SWITCH AND CONTROL LOCATION

TPDVPRG6 PCB DETAILS

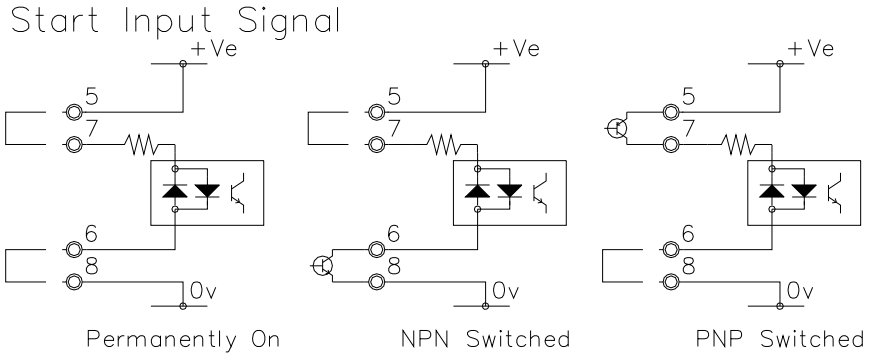


5.6 START AND STOP FUNCTION

The controlled load is started and stopped by making contact between connector pins 5 - 7 and 6 - 8 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.

The input circuit is capable of handling both direct start, having connector pins 6 and 8 linked and then making the link between connector pins 5 and 7 either via a switch or permanently so that the load starts on power being supplied or from a logic high, (source) or logic low, (sink) from a PLC system.

or logi



VOLTAGE SELECTION

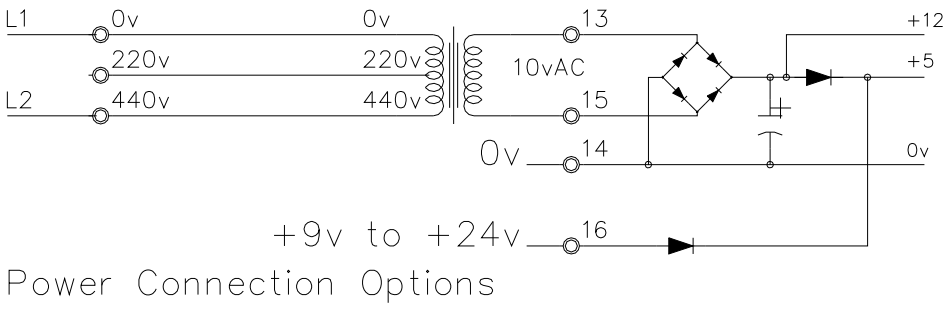
WARNING: Please check these setting are correct before first starting the unit.

All 220/400V units are shipped with the voltage set at 400V; 208/480V units are shipped with the voltage set at 480V.

Should you require that the operating voltage of the unit be changed from 400V to 200V, (ROW), or from 480V to 208V, (USA), swap the position of the 400V and 220V marked push-on connectors found on the underside of the PCB.

In the event that you wish to supply the LP PCB, (5.5kW though 37kW), from an external source then you should disconnect the supply leads from the PCB terminals and connect a 208V AC (USA), or 220V AC (ROW) supply between the lead that was on the 0V terminal and the lead that was on the 220V terminal. The lead that was on the 400V terminal could be “docked” safely on the 220V pin of the PCB, removed completely or insulated and secured elsewhere. (It is recommended that it be docked to the 220V terminal of the PCB as this is isolated and secure.

All units are supplied with a transformer suitable for use with the voltage you specified on your order. The fundamental requirement is that there be 10V AC fed to the PCB at connector pins 13 and 15. Should you require you can maintain the logic +5V DC on the PCB by providing between 7V and 24V DC on the 0V and +24V connectors 14 and 16.



6 COMMISSIONING

6.1 PRE-COMMISSIONING CHECKS FOR BOTH DVR & DPR

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

1. Check that the voltage for the PCB and frequency selection is correct.
2. Ensure that the correct Mode, (DVR or DPR has been selected for the application)
3. Ensure that the correct analogue control function has been selected, either Internal, (on PCB), or External and that the control method has been selected, Potentiometer, Voltage or Current.
4. If the **EnviroStart** is being used in DPR Mode then ensure that the correct wiring configuration has been selected to suit the load. Star or Delta. In Star a Neutral must be used. (It is not necessary to have balanced loads on each of the phases).
5. Ensure that unit fans (if fitted) are connected to the correct voltage and are free to rotate
6. Ensure that all Switch and Potentiometer settings are set to default. (Section 7.0)
7. Check that the **EnviroStart** is connected correctly as per the preceding connection diagrams.
8. 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. (See Section 4.9).
9. Ensure that a suitable time has elapsed since the **EnviroStart** was last run/started.

6.2 COMMISSIONING INSTRUCTIONS DVR

1. Ensure that DIP Switch 5 is set to DVR Mode (OFF)
2. If the unit is being controlled by the PCB potentiometers then set these as follows:
   - Min potentiometer fully anticlockwise
   - Max potentiometer fully clockwise
   - Speed potentiometer fully clockwise
3. Give the start command to the PCB.
4. Check rotation, if the direction of rotation is incorrect then change over two of the output phase connections marked U, V and W.
5. The above setting should cause the motor to start turning, if it does not then check through all DIP Switch settings on PCB and ensure that all Pre Commissioning Checks per 5.4 are complete.
6. If the motor starts and is rotating in the correct direction then adjustment of the speed potentiometer should adjust the speed of the motor according to the potentiometer position. (Quadratic, high slip motors only).
7. If external analogue control is being used via connectors 1 through 4 then the change of either the external potentiometer or the 0V – 10V, 4mA – 20mA should cause the motor speed to vary according to the input level. 0V or 4mA is being stationary with 10V or 20mA being full speed.

6.3 COMMISSIONING INSTRUCTIONS DPR

1. Ensure that DIP Switch 5 is set to DPR Mode (ON)
2. If the unit is being controlled by the PCB potentiometers then set these as follows:
    - Min potentiometer fully anticlockwise
    - Max potentiometer fully clockwise
    - Speed potentiometer fully clockwise
3. Give the start command to the PCB
4. The above setting should cause maximum power to be delivered to the load. If it does not then check through the DIP Switch settings on the PCB and ensure that all the Pre - Commissioning Checks per 5.4 are complete.
5. Variation of the analogue control Voltage or Current should now adjust the power delivered to the load in direct proportion to the Voltage or Current applied.

Ensure that the load you are controlling is capable of being adjusted across the whole range of power levels that are allowed by the setting of the Min and Max potentiometers on the PCB. Having the Min potentiometer set too low may cause early failure of the load system. The Min and Max levels are set using a suitable calibrated volt meter and measuring the output levels to the load on Star between U, V, or W and Neutral and on Delta between any two of U, V or W.

7 USER CONTROL FUNCTIONS

7.0 DEFAULT SETTINGS

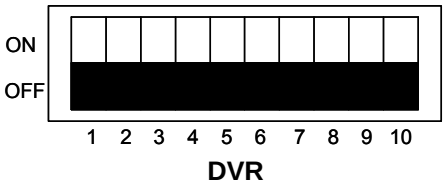
The unit is set to the 'Default Settings' before leaving the factory. These should be tried first and further adjustments only made where necessary to 'fine tune' the **EnviroStart**.

ADJUSTMENT	FUNCTION	DEFAULT SETTING	RESULT	SEE SECTION
Switch 1	Operational or Test Mode	OFF	Operational	7.1
Switch 2	PCB or External Control	OFF	PCB Potentiometer Control	7.2
Switch 3	0 – 10V/4-20mA Select	OFF	0 – 10V (See Switch 2)	7.2
Switch 4	Normal/Emergency Run Mode	OFF	Normal	7.3
Switch 5	DVR or DPR Mode	OFF	DVR Mode	7.4
Switch 6	Delta/Star Configuration	OFF	Delta	7.5 & 5.4
Switch 7	50Hz/60Hz Operation	OFF	50Hz	7.6
Switch 8, 9 and 10	Current Limit Ballast Selection	According to Unit Size	N/A	7.7
Min Potentiometer	Sets Minimum Limit	Fully Anticlockwise	Set Minimum	7.2
Speed/Level Potentiometer	Sets Output Level	Fully Clockwise	Maximum Output	7.2
Max Pot	Sets Maximum Limit	Fully Clockwise	Set Maximum	7.2
J2 Link 4 - 5	Disables DVR Ramp	Open	100V/s	7.8
Potentiometer VR1	Current Limit	Mid Rotation	Medium Power at Start of Ramp	7.7

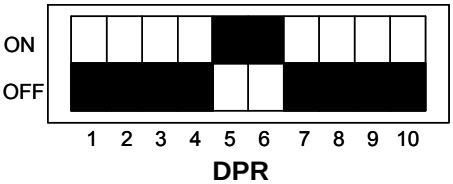
SEE SECTION 5.3 FOR A DIAGRAM TO LOCATE THE ABOVE SETTINGS ON THE RELEVANT PCB. (SEE ALSO APPENDIX 5 FOR A PHOTOGRAPH OF THE PCB)

Note that changes in switch settings will not take effect if made while the unit is driving a load, except for the three Control Potentiometers and VR1 - Current Limit Set. The **EnviroStart** must be stopped and re-started for changes to take effect; this can be easily affected using the PCB CPU reset switch.

DEFAULT SETTINGS - DIP SWITCH POSITIONS



DVR



DPR

7.1 OPERATIONAL OR TEST MODE SELECTION

This switch selects whether the unit is in Operational Mode, (DVR or DPR), or in Test Mode. Test Mode has no user definable functions and is entirely for use during manufacture.

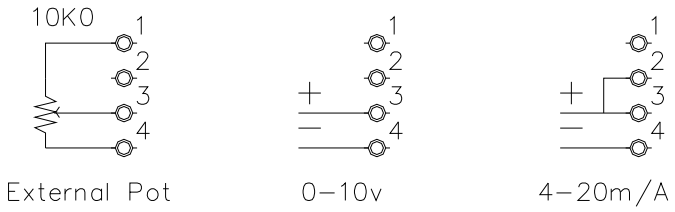
SWITCH 1
Selects either Operational or Test Mode
Default is Operational

7.2 PCB OR EXTERNAL ANALOGUE CONTROL SELECTION

The **EnviroStart** DVR and DPR are controlled through analogue means, either from the onboard potentiometers or from external input onto connector pins 1 through 4.

This switch function should be set to determine whether control of the load is internal, (on PCB), or external.

SWITCH 2
Selects either Internal or External Analogue Control
Default is Internal (PCB Potentiometer Control)



External Analogue Input

The basis of control is that upper and lower limits are set on the Minimum and Maximum potentiometers on the Control PCB., (defining the extent of the control). The Speed potentiometer on the Control PCB, or if external source is selected, external potentiometer, 0 – 10V or 4 – 20mA, control the voltage out to the driven load in DVR Mode or the power out in DPR Mode (see Section 1.2).

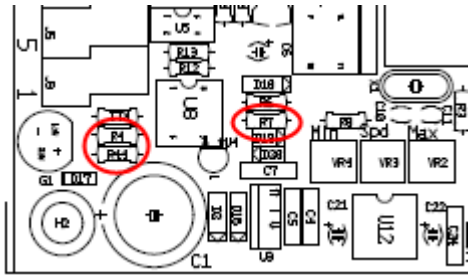
Output is directly proportional to the input signal.

SWITCH 3
Selects either 0 – 10V or 4 – 20mA Control
Default is 0 – 10V

Should you want to use an external analogue input sensor without an interface it is possible to modify the DVPR PCB to provide power for an 8 – 28V sensor. This PCB modification changes the ratio of the incoming voltage divider and so means that the unit can only be used with the sensor powered from the DVPR PCB; if you use an externally powered sensor then the control will be affected.

To provide power from the DVPR PCB for the external sensor you will need to change two components on the PCB itself. (This should not be attempted unless you are capable and

experienced in making such changes). R44 which is currently 10k0 should be changed to 150R, and R7 which is currently 4k7 should be taken out of circuit.



See Appendix 6 on Page 40.

With the above modifications made you can supply the transducer 8 – 28V using the 12V available on Connector 9 of the DVPR PCB and then if the sensor output is 4 – 20mA feed this into Connectors 2 and 3, (linked), or, if the sensor output is 0 – 10V then feed this just into Connector 3.

7.3 EMERGENCY RUN FUNCTION SELECTION

This switch function selects between Normal Operation and Emergency Run.

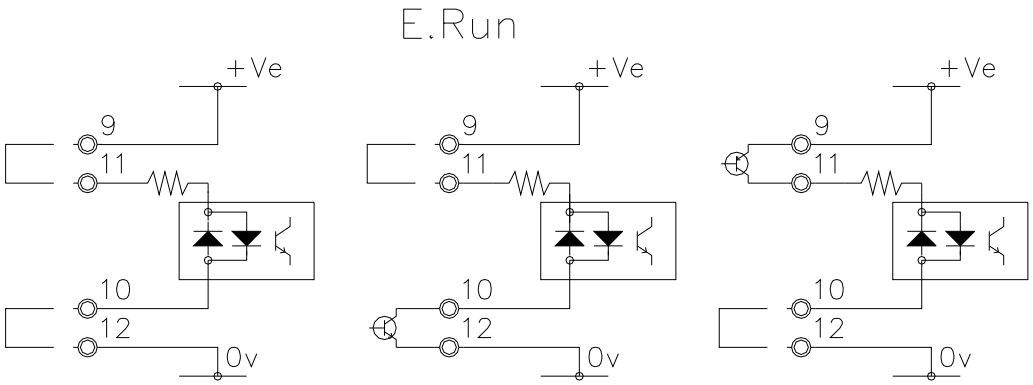
SWITCH 4
Selects Normal or Emergency Run
Default is Normal Operation

In the event of control circuit failure it is possible to force the thyristors into full permanent conduction allowing the motor to start and run direct on line, (DOL). This feature is enabled when connectors 10 and 12 are linked and connectors 9 and 11 are also linked. In this condition it is not necessary to have a start signal or condition on pins 5 through 8.

In this condition the Yellow LED illuminates aperiodically, flashing three times in quick succession followed by an off period of twice the on period of the three flashes. It is not recommended that units be left operating in the Emergency Run condition for any extended period of time however periods of up to 336 hours are acceptable.

During the time that the unit is operating in Emergency Run you should expect the system to generate greater heat than it would during normal operation, this is to be expected as the thyristors are firing continuously.

The input circuit is capable of handling both direct start, having connector pins 9 and 11 linked and then making the link between connector pins 10 and 12 either via a switch or permanently so that the motor starts on power being supplied or from a logic high, (source) or logic low, (sink) from a PLC system.



7.4 DVR OR DPR MODE SELECTION

This switch function switches between DVR and DPR Mode of operation

SWITCH 5
Selects either DVR or DPR Operation
Default is DVR

7.5 DELTA OR STAR CONFIGURATION SELECTION

This switch selects between Delta and Star configuration.

SWITCH 6
Selects either Delta or Star Configuration
Default is Delta

It is important that in DVR Mode that the switch be in the Delta Mode otherwise the motor will not rotate as the system will be expecting a Neutral to be connected.

In DPR mode the system can be either Delta or Star. In Delta mode the three legs must be load balanced to within ±5%, in Star configuration this is not necessary as there is a configured Neutral. It is possible to have different load types on each of the three legs. In such a configuration the **EnviroStart** must be selected to accommodate the maximum loaded leg current.

7.6 SUPPLY FREQUENCY SELECTION

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

SWITCH 1.7
Selects either 50Hz or 60Hz supply
Default is 50Hz

7.7 RAMP CURRENT LIMIT SETTING

The current limit function operates in DVR Mode only and provides control to limit current excursions during the course of all ramps changes, either up or down. (Except when Link made on J2 enabling ≤ 10ms ramp, in this condition current limiting is disabled).

In the case of motors started direct on line it would be expected to see a peak starting current of about eight times the motor rated FLC. Resistive loads can also demonstrate inrush currents of up to four or five times normal running current.

To set the current limit function it is necessary to have DIP Switches 1.8 through 1.10 set to reflect the correct unit current rating. The software will be defined according to the unit size, version suffix “A” for units from 12A through to 105A, suffix “B” for units from 120A through to 410A and suffix “C” for units from 475A through to 1400A.

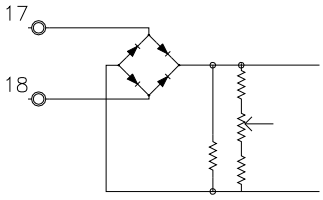
PART NUMBER	SWITCH 8	SWITCH 9	SWITCH 10
TPDVPRG6 – 12/120/475	ON	ON	ON
TPDVPRG6 – 16/145/580	OFF	ON	ON
TPDVPRG6 – 23/170/670	ON	OFF	ON
TPDVPRG6 – 30/205/800	OFF	OFF	ON
TPDVPRG6 – 45/255/900	ON	ON	OFF
TPDVPRG6 – 60/290/1100	OFF	ON	OFF
TPDVPRG6 – 75/340/1400	ON	OFF	OFF
TPDVPRG6 – 105/410	OFF	OFF	OFF

These switches will be set at manufacture to the rating of the unit and need not be changed unless the **EnviroStart** is being used on a smaller load than that for which it was manufactured.

When the current limit potentiometer, VR1, is turned away from its default condition of fully clockwise then a variable degree of current limit will be enabled which will extend from a maximum current excursion of approximately 5 - 8x motor FLC when the potentiometer is fully clockwise to a limit of approximately 1.5x motor FLC when the potentiometer is fully anticlockwise. **EnviroStart** monitors the current drawn by the thyristors during ramp up, if the current exceeds the limit set by VR1 then the ramp is stopped and voltage held constant until the current falls below the preset limit, following which time the ramp up is continued. If the set current limit is reached during ramp up then the Red LED 4 will light. It is not unusual during ramp up, particularly of larger motors, to see LED 4 flickering on and off.

Current limit is useful to start high inertia loads where supply restrictions place may have placed limits on maximum starting current allowed.

For normal loads set VR1 between middle and fully clockwise to disable current limiting and provide maximum power to the motor defined by only the initial pedestal voltage and ramp period settings.



Current Sensing Cct.

7.8 RAMP RATE DISABLE IN DVR MODE (J2 Pins 4 and 5)

This link is only operational when the DVPR is in DVR Mode. The effect of making this link is to pull pin 4 of J2 to OV on pin 5, this disables the default voltage transition rate of 100V/s and ensure that the transition rate between the current point and transition-to set point, (analogue input on connector pins 1 through 4, or set by PCB potentiometer), takes place in ≤10ms. This should not be used unless you are certain that you understand the impact of such high potential dv/dt at the DVPR output terminals. It may be necessary to provide additional snubber networks if transitions of ≥ 200V are involved.

7.9 SYSTEM READY RELAY (Contacts 31 through 36)

This relay energises when power is applied to the **EnviroStart** and indicates that the PCB and all logic functions are operational. It is an indication of the system being available for operation and remains enabled throughout the running of the unit.

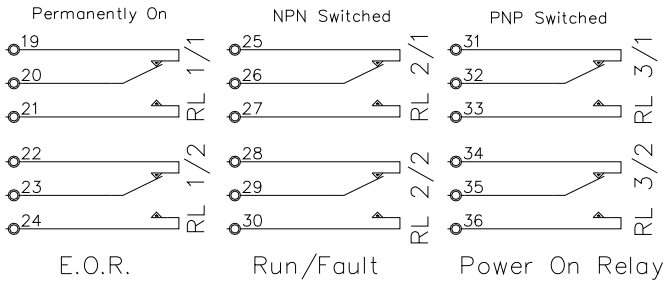
7.10 RUN/FAULT RELAY (Contacts 25 through 30)

This relay energises when the start signal is applied to the **EnviroStart**. It does not indicate that the motor, (in DVR Mode) is turning or that the load, (in DPR Mode) is at the power level set by the input controls; it merely indicates that there is a legitimate start signal applied to the control circuit. This relay can be used in reciprocal fashion to provide a fault indication if that is required**.**

When the control circuit, contacts 1 through 4, are used to switch the motor or load on and off there is a 15ms delay between the time that the thyristors stop firing and the operation of the Run Relay, this allows this relay to be used to ensure that items like the Line Contactor are switched at near zero current rather than having them break at full power with the resultant arcing and contact damage that creates

7.11 END OF RAMP RELAY (Contacts 19 through 24)

In DVR Mode this relay energises when the load the **EnviroStart** is controlling has reached the end of ramp from one set point to the next. This relay will change state every time the load moves away from being at the set output level as defined by the Speed/Load Control input signal from either the onboard “Speed Potentiometer” or the External Analogue Signal on connector pins 1 through 4. In DPR Mode this relay energises at the same time as the Run/Fault relay and remains energised whilst a start logic condition remains in place.



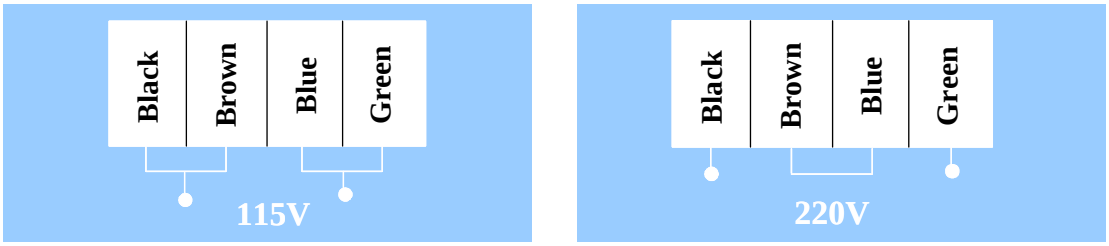
7.12 THYRISTOR FAULT DETECTION SELECTION

The **EnviroStart** DVPR has an intrinsic thyristor fault detection programme running at all times during operation. The system software constantly monitors the correct firing and operation of the thyristors and will stop the system and register a fault condition in the event of either a gate or a junction failure. This operates only above 16% load drive, be that speed of rotation or power, to 100% load drive. This lower end cut off is necessary as the fault detection software may inadvertently see the low firing rate of the thyristors, commensurate with low speed of rotation or low power, as being a thyristor fault and shut the system down when in fact operation was normal.

If the fault exists at the time that a start signal is applied to **EnviroStart** then in the DVR mode the motor may start to turn if the initial phase drive is a functional thyristor pair, usually there will be no more than 90^{o} rotation, in the case of the system being in DPR mode then the firing time will be no more than 20ms. By the time that the system starts to fire the second pair of thyristors the fault will have been detected, and the drive feed will be removed and the fault condition indicator will register with four quick flashes followed by a one second wait period on the yellow Fault LED.

7.13 INTEGRATED FANS

All **EnviroStart** units of 60a and above are fitted with integral cooling fans; in units manufactured up to December 2005 these have to be independently powered with either an 110V AC or 220V AC supply. It is important that the fans are running at all times that the unit is operating. On 60A and 75A systems the fan supplies are made direct onto the single fan that is fitted using insulated Lucar type connectors, on the 110A through 220A the connection for the integrated twin fans will be made onto a marked connector block adjacent to the PCB mounted on the backplane of the system. On systems of 260A and above the fans are dual voltage and should be connected as shown below.



It is very important that only the voltage appropriate to the fan be used otherwise the fans will be damaged which may cause overheating of the **EnviroStart** unit. Always check the fan voltage rating and or connection schema before powering the fans for the first time.

EnviroStart units of 60A through to 300A, manufactured from January 2006 onwards, will have their fans self powered; an additional feed being taken from the incoming supply, via a separate transformer through the Run Relay on pins 25 and 26, (Section 6.14), to the fans input. The purpose of running the feed through the Run Relay is to ensure that the fans are operating only at times when the unit is powered and driving a load. If it is required that the fans be running at all times that the unit is powered, because of high ambient temperature environments, (average ambient ≥ 25^{o}C), then this can be achieved by moving the wires running into the Run Relay I/O on pins 25 and 26 and placing them into the System Ready Relay I/O on pins 31 and 32, (Section 6.13).

On systems of 350A and above the fans will be wired as above to a four way connector block and a transformer supplied which should be mounted, as convenient in a convenient nearby location. A feed will have to be taken from the connector block to the transformer and then back from the transformer to the connector block to feed the fans. The reason for approaching the fan feed in this way is that it allows the safe positioning of the fan supply transformer away from the bus bars and **EnviroStart** power circuits. Appropriate cabling of suitable current rating should be used for the feed and supply and care should be taken noting that the feed from the connector block will be at the three phase RMS voltage of the unit.

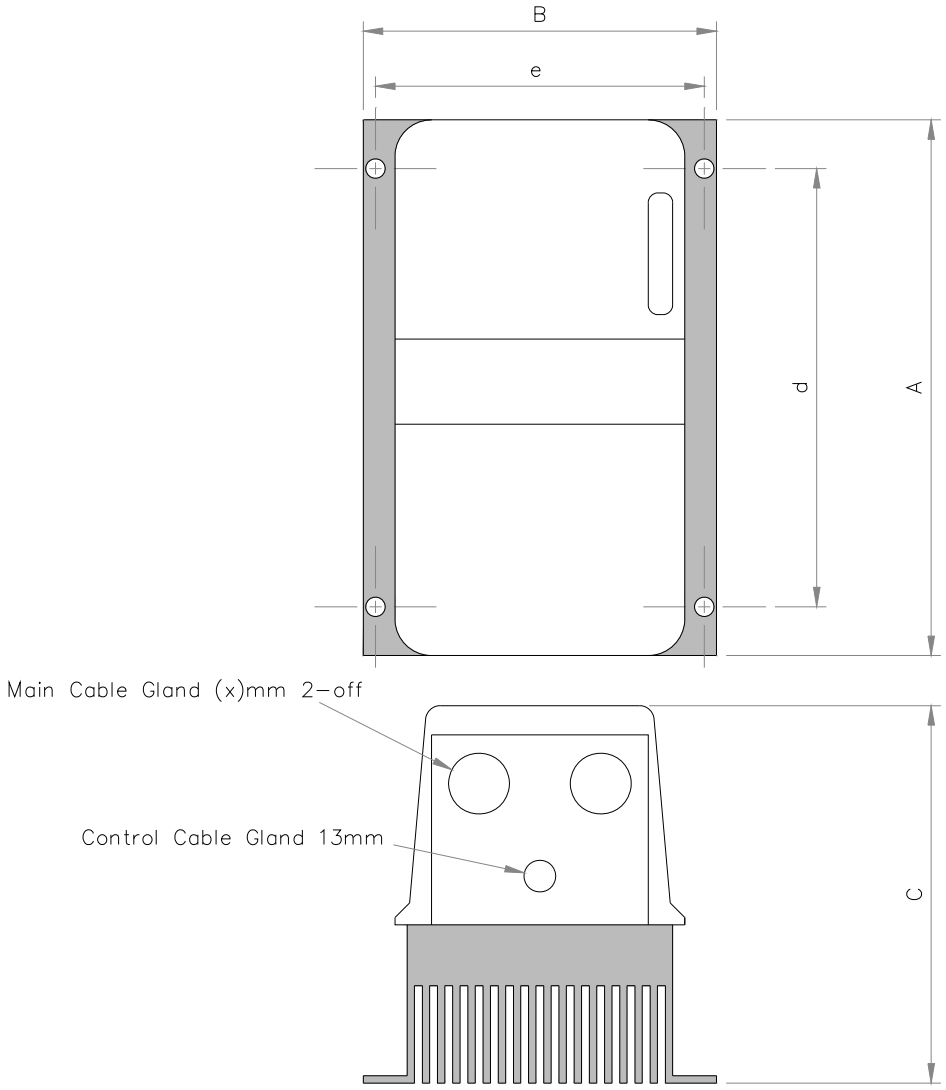
7.13 PCB MOUNTED LED INDICATORS

LED 1	Min Pot Set ≥ Max Pot Phase Missing Emergency Run Thyristor Fault	1. Flashes synchronously to indicate Min Pot set at a level greater than that set on the Max Pot 2. Flashes twice separated by 1s period indicating that a supply or feed phase is missing 3. Flashes three times separated by a 1s period if Emergency Run is selected. 4. Flashes four times separated by a 1s period if a Thyristor Fault is detected. (See 5.4)
LED 2	Power On	Illuminates when unit is powered and ready to operate, indicates that initialisation self test has been completed
LED 3	Run	Illuminates when a legitimate start signal has been received by the control circuit. This LED does not indicate that the motor is turning or that feed is going to the DPR load
LED 4	Current Limit	Illuminates when line current is at the set current limit level. This LED will flash intermittently during start when Current Limit is set below Full Power on VR1
LED 5	End Of Ramp	Illuminates when the load is at the set level. (Speed of rotation or power level)

INSTALLATION AND COMMISSIONING GUIDE END

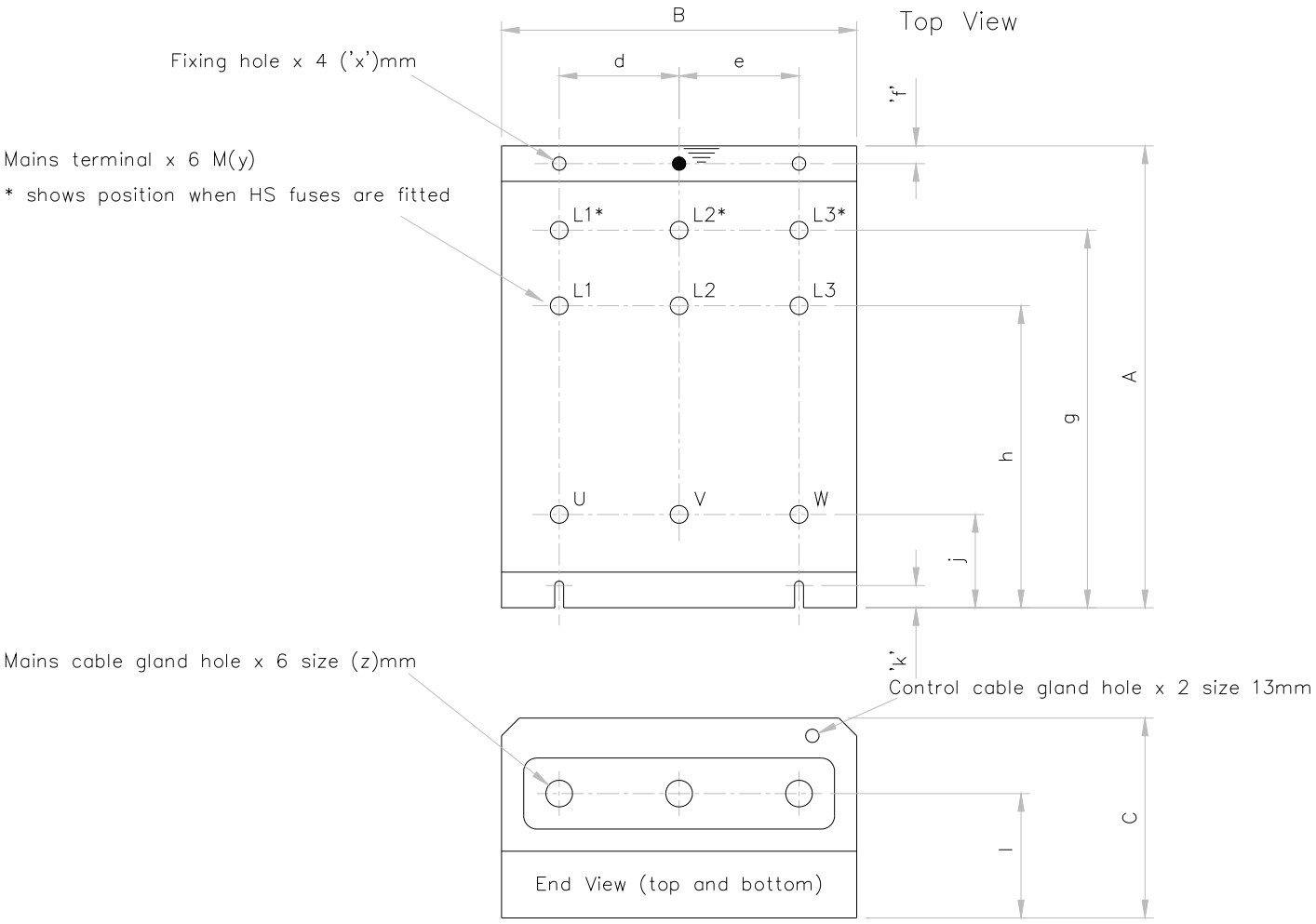
Appendix 1

Mechanical Drawing 12A – 75A (220V & 400V)



MODEL	A	B	C	d	e	x	Earth	Fixing Hole	Mains Connections
5.5–7.5kW	220	145	155	180	135	25	5	5.5	M5
11–22kW	220	145	175	180	135	25	5	5.5	M5
30–37kW	330	145	175	180	135	25	5	5.5	M5

Mechanical Drawing 85A – 205A (220V & 400V)



All dimensions in mm

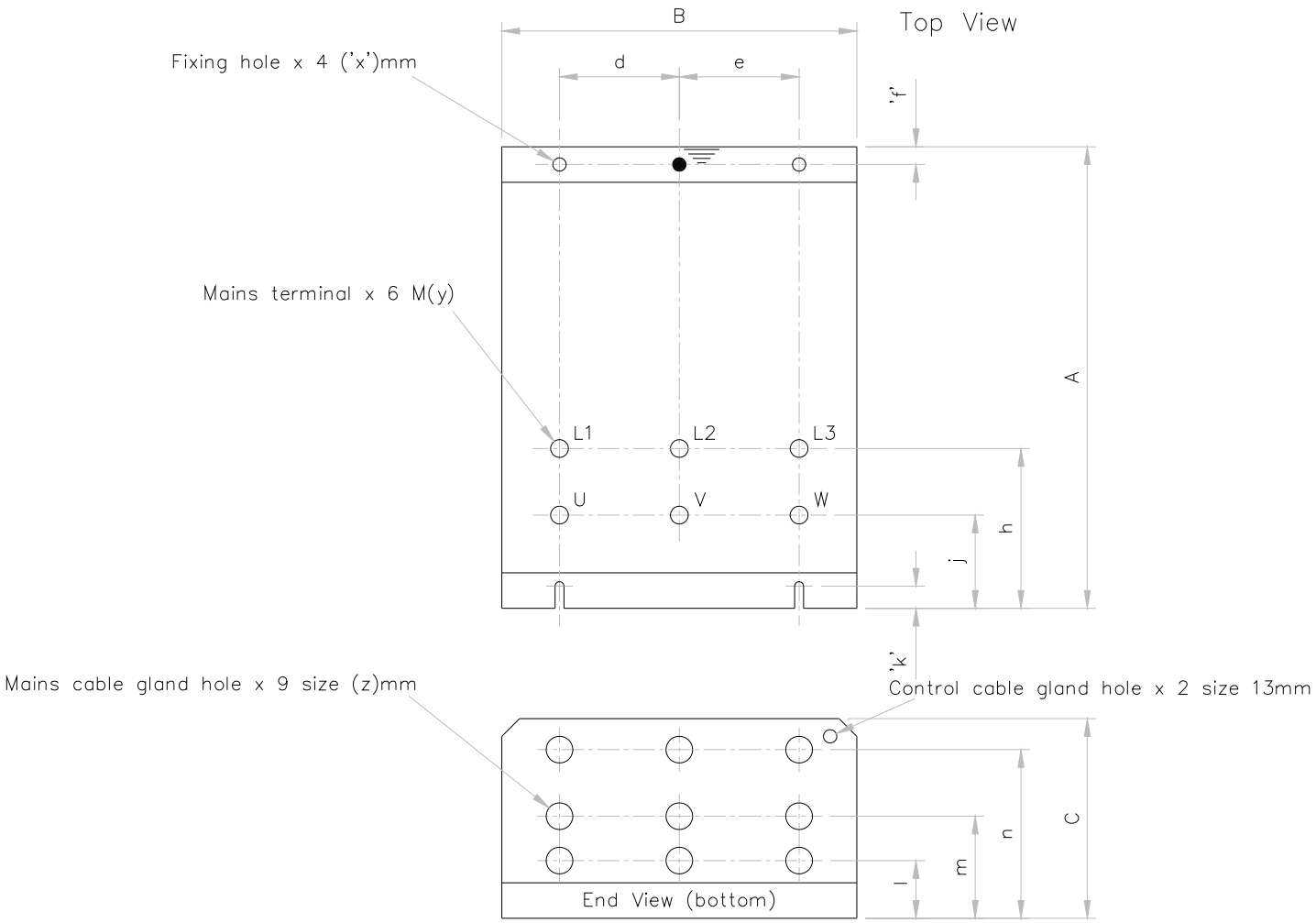
MODEL	A	B	C	d	e	f	g	h	j	k	I	x	y	z	Earth
55–110kW	430	254	280	70	70	7	351	271	65	10	78	6	8	30	6

The dimensions below relate to 575V and 690V units

5.5–37kW	325	164	195	50	50	7	250	198.5	65	10	78	6	8	30	6

Note – Height of L1, L2, L3, L1*, L2*, L3*, U, V, W corresponds to I

Mechanical Drawings 255A – 670A (220V & 400V)

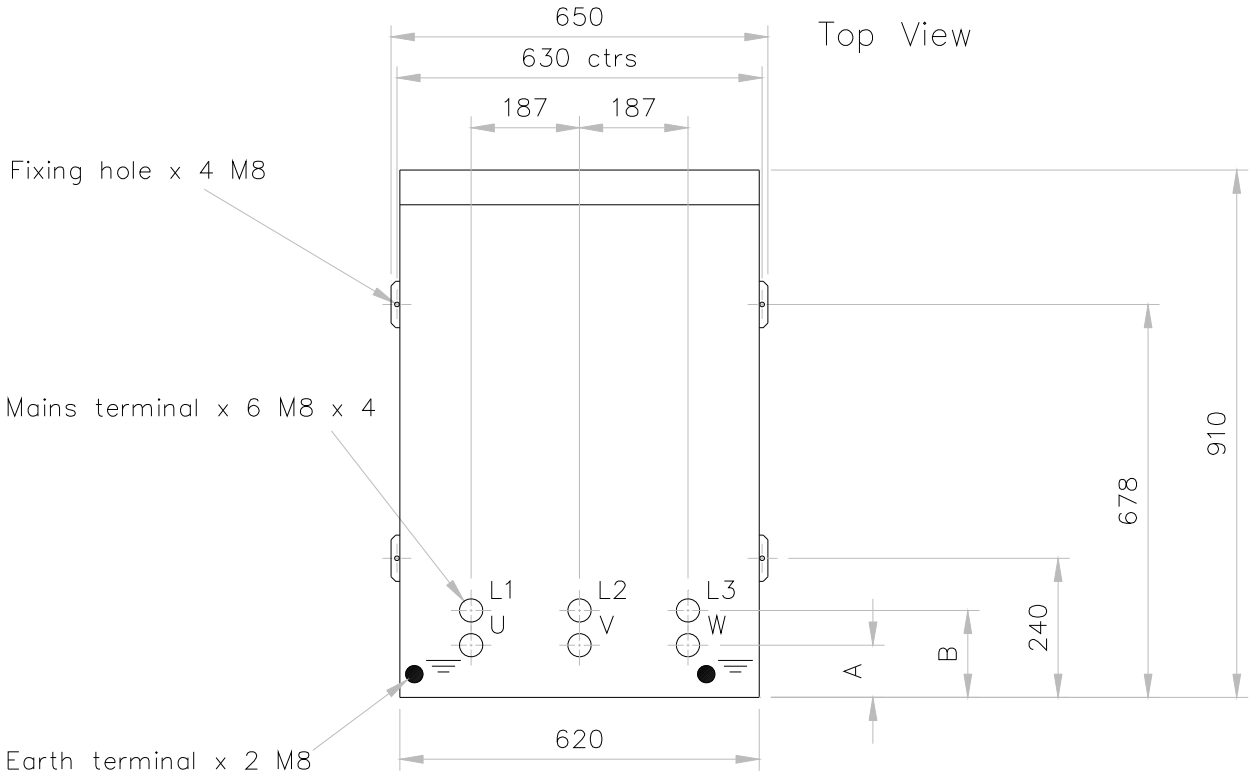


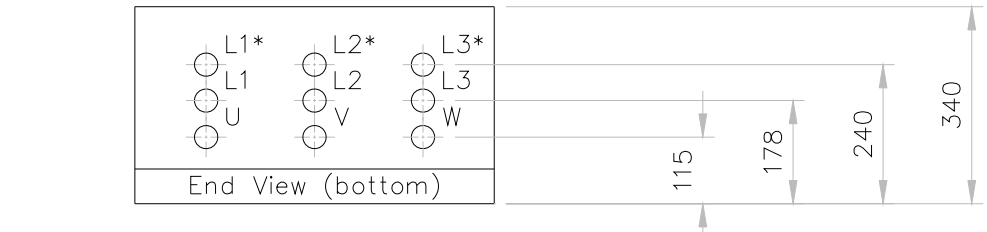
All dimensions in mm

MODEL	A	B	C	d	e	f	h	j	k	l	m	n	x	y	z	Earth
132–225kW	580	368	228	116	116	8	118	90	10	56	101	168	8	2 x 8	30	8
260–375kW	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 n, U, V, W corresponds to l

Mechanical Drawings 800A – 1400A (220V & 400V)





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

MODEL	A	B
450–500kW	150	90
630–800kW	90	150

Appendix 2

THE TESTING, REPLACEMENT AND ASSEMBLY OF THYRISTORS

Thyristor Short Circuit Test

With the gate/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, (positive to negative and negative to positive). 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 7⃠ 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 205A 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.

In power assemblies of 255A and above individual hockey-puck devices 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.

Power Assembly, Re-assembly of Pak Devices

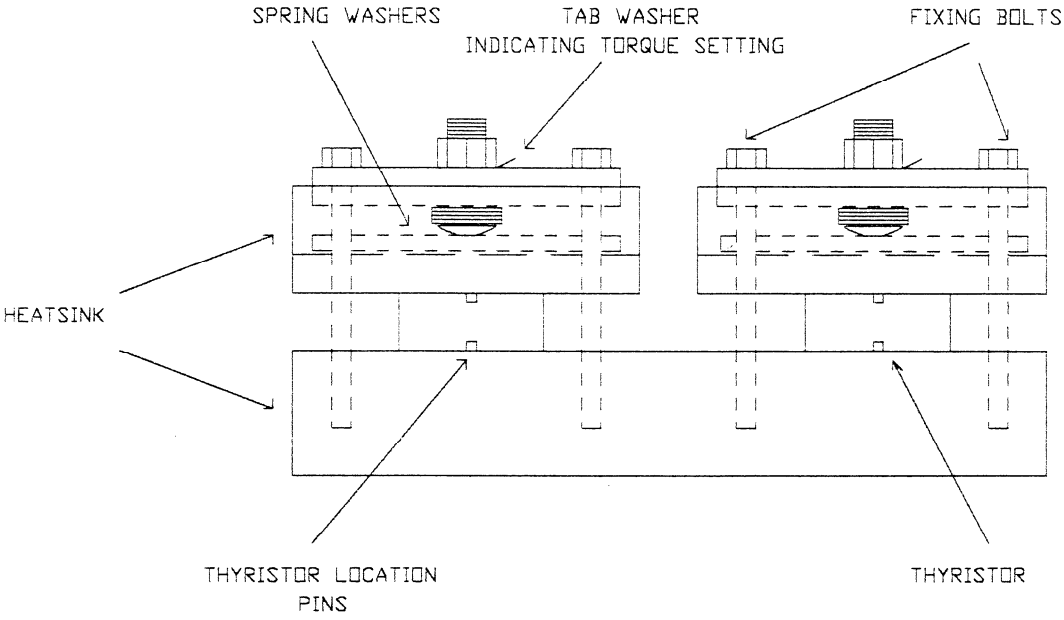
Re-assembly of the power assemblies using Pak devices is very simple. Smear a small amount of heatsink compound onto the base of the new device before fixing. Torque settings are as below.

Size of Unit	Thyristor to Heatsink	Pak Screw Terminals
12-77A	2.5 – 4.0Nm	2.5 – 4.0Nm
95-120A	2.25 – 2.75Nm	4.5 – 5.5Nm
145-205A	2.5 – 5.0Nm	12 – 15Nm

Power Assembly, Re-assembly, 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 that the device is the correct way around and is fitted correctly on the location pin. Fit the top heatsink, similarly ensuring correct location of the pin, and tighten the two fixing bolts evenly until correct torque is achieved, this happens 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:

G1 - U
G2 – L1
G3 - V
G4 – L2
G5 - W
G6 – 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.

THYRISTORS USED IN ENVIROSTART PRODUCTS 12A THROUGH 1400A

PART No.	THYRISTOR TYPE IXYS	AMPS @ T_{case} 85°C	QTY	PART No.	THYRISTOR TYPE WESTCODE	AMPS @ $T_{heatsink}$ 85°C	QTY
TPDVPR-12	MCC19-14io1	18	3	**TPDVPR-255**	N0782-YS140	530	6
TPDVPR-16	MCC26-14io1	27	3	**TPDVPR-290**	N0782-YS140	530	6
TPDVPR-23	MCC56-14io1	60	3	**TPDVPR-340**	N1265-LS140	835	6
TPDVPR-30	MCC56-14io1	60	3	**TPDVPR-410**	N1265-LS140	835	6
TPDVPR-45	MCC95-14io1	116	3	**TPDVPR-475**	N1265-LS140	835	6
TPDVPR-60	MCC95-14io1	116	3	**TPDVPR-580**	N1802-NS140	1216	6
TPDVPR-77	MCC95-14io1	116	3	**TPDVPR-670**	N1802-NS140	1216	6
TPDVPR-95	MCC162-14io1	181	3	**TPDVPR-800**	N2046-NS140	1338	6
TPDVPR-120	MCC162-14io1	181	3	**TPDVPR-900**	N2500-VC140	1684	6
TPDVPR-145	MCC220-14io1	250	3	**TPDVPR-1100**	N2500-VC140	1684	6
TPDVPR-170	MCC250-14io1	287	3	**TPDVPR-1400**	N4085-ZC120	2743	6
TPDVPR-205	MCC310-14io1	320	3				

Appendix 3

GENERAL SPECIFICATION

MODEL	CURRENT	kW @ 400V	kW @ 575V	kW @ 690V	kW @ 220V	WEIGHT kg	CT SPECIFIED	CT RATIO	FANS
TPDVPRG6 – 12	11	5.5	6	7.5	2.2	2	LA2100	1000/1	N/A
TPDVPRG6 - 16	16	7.5	9	11	4	2	LA2100	1000/1	N/A
TPDVPRG6 - 23	23	11	13	15	5.5	3	LA2100	1000/1	N/A
TPDVPRG6 - 30	30	15	18.5	22	7.5	3	LA2100	1000/1	N/A
TPDVPRG6 - 45	45	22	26	30	11	3	LA2100	1000/1	N/A
TPDVPRG6 - 60	60	30	37	45	15	4	LA2100	1000/1	1 X 120mm
TPDVPRG6 - 75	75	37	45	55	22	4	LA2100	1000/1	1 X 120mm
TPDVPRG6 - 105	105	55	63	75	30	15	LA2107	1000/1	2 x 120mm
TPDVPRG6 - 120	120	63	75	90	37	15	LA2108	2000/1	2 x 120mm
TPDVPRG6 - 145	145	75	90	110	45	15	LA2108	2000/1	2 x 120mm
TPDVPRG6 - 170	170	90	110	132	55	16	LA2108	2000/1	2 x 120mm
TPDVPRG6 - 205	205	110	132	150	63	16	LA2108	2000/1	2 x 120mm
TPDVPRG6 - 255	255	132	150	186	75	28	TX008	10000/1	3 x 120mm
TPDVPRG6 - 290	290	150	186	225	90	28	TX008	10000/1	3 x 120mm
TPDVPRG6 - 340	340	186	225	260	110	28	TX008	10000/1	3 x 120mm
TPDVPRG6 - 412	412	225	260	315	132	28	TX008	10000/1	3 x 120mm
TPDVPRG6 - 475	475	260	315	375	150	45	TX008	10000/1	3 x 150mm
TPDVPRG6 - 580	580	315	375	450	186	45	TX008	10000/1	3 x 150mm
TPDVPRG6 - 670	670	375	450	500	215	45	TX008	10000/1	3 x 150mm
TPDVPRG6 - 800	800	450	500	630	260	120	TX009	10000/1	2 x 220mm
TPDVPRG6 - 900	900	500	630	750	315	120	TX009	10000/1	2 x 220mm
TPDVPRG6 - 1100	1100	630	750	900	375	120	TX009	10000/1	2 x 220mm
TPDVPRG6 - 1400	1400	800	900	1200	450	120	TX009	10000/1	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°C at sea level. All units should be selected based on the current rating of the motor to which they are fitted.

Appendix 4

FAN SPECIFICATION

PAPST PART NUMBER.	GD RECTIFIER PART NUMBER	ENVIROSTART SIZE	FREE FLOW AIR RATE	FAN DIAMETER
4600N/4650N	550010A/ 550010B	60A - 410A	160 m^3/hour	120 mm
7400N/7450N	550006A/550006B	475A – 670A	350 m^3/hour	150 mm
N/A	550002A /550002B	800A – 1400A	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.

Appendix 5

HP – kW CONVERSION

HP - kW Conversion

HP Std	Amps	kW @ 120V	kW @ 220V	kW @ 400V	kW @ 570V	kW @ 690V
Single Phase						
1.5	4	0.5	1	N/A	N/A	N/A
3	10	1	2	N/A	N/A	N/A
5	15	1.6	3	N/A	N/A	N/A
Three Phase						
7.5	12	N/A	2.2	5.5	6	8
10	16	N/A	3.5	7.5	9	11
15	23	N/A	5.5	11	11	15
20	30	N/A	7.5	15	15	18.5
25	37	N/A	7.5	18.5	18.5	22
30	45	N/A	9	22	22	30
40	60	N/A	11	30	30	37
50	75	N/A	15	37	37	45
75	95	N/A	22	55	55	63
100	145	N/A	30	75	75	90
125	170	N/A	37	90	90	110
150	205	N/A	45	110	110	132
200	290	N/A	63	150	150	186
250	340	N/A	75	186	186	225
300	410	N/A	90	225	225	260
350	475	N/A	110	260	260	315
400	527	N/A	110	260	315	375
450	580	N/A	132	315	315	375
500	670	N/A	150	375	375	450
550	735	N/A	150	375	450	500
600	800	N/A	186	450	450	500
650	850	N/A	186	450	500	630
700	900	N/A	200	500	500	630
750	1000	N/A	N/A	N/A	N/A	N/A
800	1100	N/A	N/A	N/A	N/A	N/A
850	1150	N/A	225	630	630	800

Reflects Motor Standard Ratings and is not a numerical conversion.

Appendix 6

PCB PHOTOGRAPHS

5.1 LPDVR/SS PCB v 5.5 2005