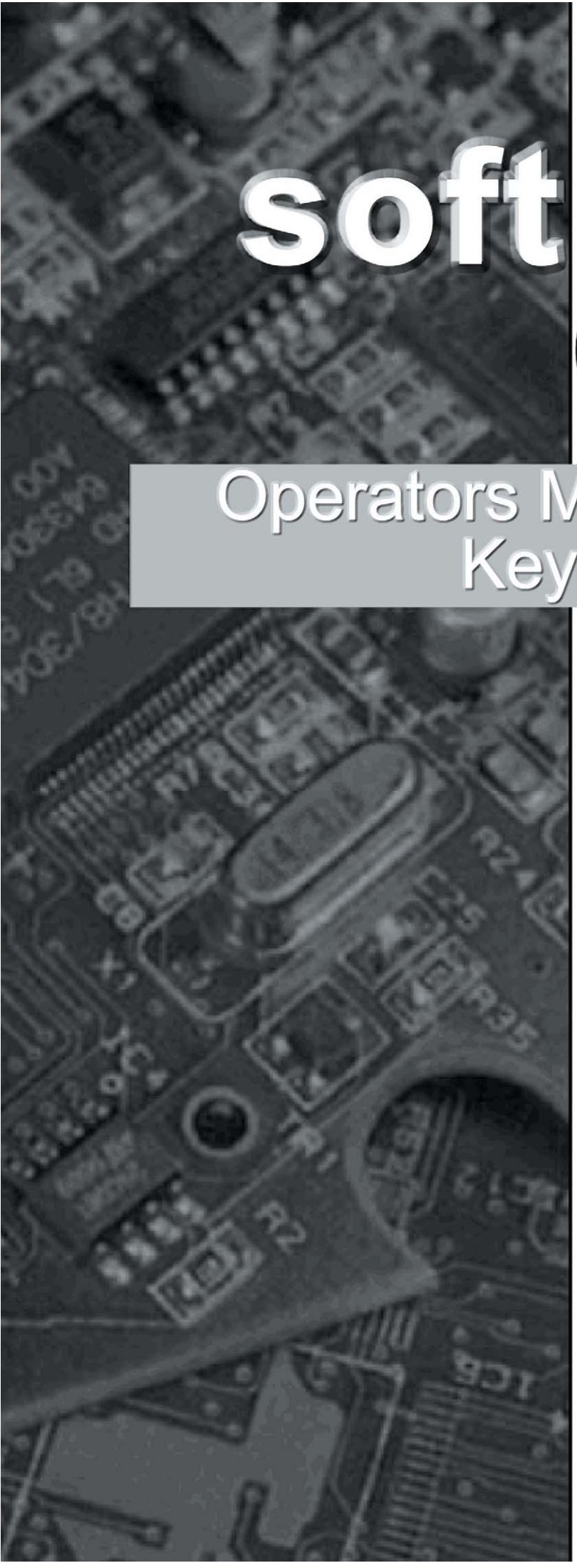


soft drive

Operators Manual LCD. Keypad

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Issue 12: August 2007

NOTE: that units supplied with manuals issue 10 and onwards are fitted with MK3 control board and keypad. These items are not individually interchangeable with components from earlier models.

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1.0 Introduction

A solid state soft start is an electronic system for providing three-phase induction motors with a mechanically smooth start and a controlled level of starting current.

The Softdrive range of soft starters utilises 6 thyristors connected in a full wave power bridge. By varying the thyristor conduction period, the voltage applied to the motor and hence the motor starting torque, is controlled.

The Softdrive range offers ramp up with adjustable pedestal up, current limit ramp override and current limit timer protection. A top of ramp relay is provided for switching a bypass contactor. The soft stop ramp down feature is included as standard, with adjustable pedestal down, which sets the initial voltage level before the ramp down begins, and adjustable zero sense, which sets the switch off voltage.

All units have full fault protection, which monitors the mains supply, motor and also the correct operation of the thyristors.

2.0 Specifications

WARNING:
DO NOT CONNECT POWER FACTOR CORRECTION EQUIPMENT BETWEEN OUTPUT OF UNIT AND MOTOR. ALWAYS CONNECT ON INPUT SIDE AND ENERGISE AFTER THE TOP OF RAMP IS REACHED

2.1 Ratings

Current	Kw @ 400V	Product Code	C.T. Fitted	Burden Resistor	Fuse Rating	Torque Setting Soft Start	Max Cable Size	Torque Setting Fuse
31	15	SAF303-015	1000/1	18	80	SAK6 1NM	10mm	M8 12NM
41	22	SAF303-022	1000/1	12	100	SAK10 2NM	16mm	M8 12NM
56	30	SAF303-030	1000/1	8R2	160	SAK16 2NM	16mm	M8 12NM
70	37	SAF303-037	1000/1	6R8	160	M6 4NM	35mm	M8 12NM
85	45	SAF303-045	1000/1	5R6	200	M6 4NM	35mm	M8 12NM
120	55	SAF303-055	1000/1	3R9	250	M6 4NM	35mm	M8 12NM
145	75	SAF303-075	1000/1	3R3	315	M8 12NM	70mm	M8 12NM
170	90	SAF303-090	1000/1	2R7	400	M8 12NM	70mm	M8 12NM
205	110	SAF303-110	1000/1	2R2	400	M8 12NM	95mm	M8 12NM
250	132	SAF303-132	3000/1	5R6	500	M10 40NM	150mm	M10 40NM
290	160	SAF303-160	3000/1	5R6	550	M10 40NM	150mm	M10 40NM
360	200	SAF303-200	3000/1	4R7	630	M10 40NM	150mm	M10 40NM
430	250	SAF303-250	3000/1	3R9	700	M10 40NM	150mm	M10 40NM
550	315	SAF303-315	3000/1	2R7	800	M12 50NM	2x150mm	M10 40NM
630	355	SAF303-355	3000/1	2R7	900	M12 50NM	2x150mm	M10 40NM
700	400	SAF303-400	3000/1	2R2	1250	M12 50NM	2x150mm	M10 40NM
800	450	SAF303-450	4000/1*	2R2	1250	M10 40NM	BAR	M10 40NM
1000	560	SAF303-560	4000/1*	2R (2x 3R9)	1400	M12 50NM	BAR	M12 50NM
1200	630	SAF303-630	4000/1*	1R7 (2x 3R3)	2000	M12 50NM	BAR	M12 50NM
1400	800	SAF303-800	4000/1*	1R4 (2x 2R9)	2000	M12 50NM	BAR	M12 50NM

* Denotes CT's are supplied loose and NOT fitted to the assembly.
Fuses are required for short circuit protection and type 2 co-ordination
Fuses supplied in sets of 3 with fixings up to 400A but fitted to assembly bars at 500A and above

2.2 Specification

Degree of Protection :	IP20
Ambient Air Temperature :	0 - 60ºC (40º - 60ºC derate Softdrive current by 1.5% per ºC above 40ºC).
Altitude :	2000m without derating *(above derate Softdrive current by 1% per 100m).*
Relative Humidity :	Max. 95% non-condensing.
Frequency of Starts :	12 starts per hour *(above derate current).*
Mains Voltage :	380/415/440 standard ±6% *(220V - 690V available, except on 7.5kW-15kW).*
Frequency :	45Hz to 66Hz *(automatically detected).*
Motor Current :	31A - 1400A in 20 ratings.
Motor Power :	15kW - 800kW @ 400V.
Control Voltage :	110V/220V as specified.
Overload Ratings :	100% continuous 300% for 30 seconds 500% for 5 seconds.
Under-voltage Trip :	Set @ 70% line volts *(adjustment possible - see Page 4).*
Heat Dissipation :	4.5W per amp.
Cooling :	Naturally cooled up to 56A. Fan cooled on all other units. See Section 2.4.
Adjustments :	- LCD keypad with pushbuttons for setting up. - Option of remote LCD keypad with pushbuttons for setting up. - Option of PC adjustment via RS485 - Option of Fieldbus Communications.

2.3 Main Features

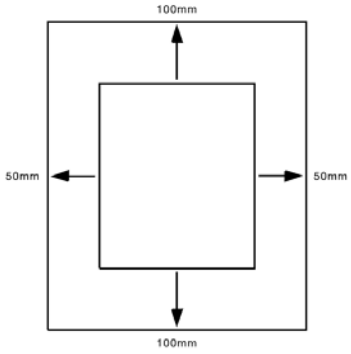
- Ramp-up time programmable from 1 to 240 seconds *(4 minutes).*
- Pedestal up, programmable from 0% - 80% of line voltage.
- Ramp down time, programmable from 1 to 240 seconds *(4 minutes).*
- Pedestal down, programmable from 100% to 30% of line voltage.
- Zero sense switch off voltage, programmable from 80% to 5% of line voltage.
- Current limit, programmable from 100% - 500% of FLC.
- Current limit time out, programmable from 1 to 240 seconds *(4 minutes).*
- Supply under voltage detection. Adjustable by potentiometer on main board.
- Automatic detection of main supply frequency operating between frequency limits of 45Hz to 66Hz.
- Automatic phase rotation detection.
- Security mode access, preventing unauthorised users from changing set up parameters, achieved by entering a four digit code.
- Fault detection. Fault latch to detect open or short circuit thyristors, loss of supply phase, loss of motor connection or board fault.
- Bypass mode with external contactor.
- Mains supply dip ride through allowing mains to be lost for up to 500mS without signalling a fault. If the mains is re-applied within this time then the unit ramps up from zero with a one-second ramp time.
- RS485 compatible serial port allowing the unit to be connected either individually or with other units to a remote PC or on communications network.
- Stack overtemperature protection.
- Motor Thermistor protection.
- Start/Stop/Reset Control integral on keypad.
- Kick-start, voltage programmable from 75% to 90% of line voltage and number of cycles programmable from 5 to 10 cycles.
- Shearpin Overcurrent trip.
- Relay contact outputs for run, top of ramp and fault indication plus 1 programmable relay output.
- Current display, hours run and number of starts indication.
- Electronic overload/dual overload.
- Earth fault motor protection.
- Under-current trip.
- Current Imbalance
- Multi-lingual display. (4th language may be preset to suit customer requirements - contact manufacturer)

2.4 Additional Information

2.4.1 Cooling

For Softdrive mounted in an enclosure, consideration has to be given to ensuring an adequate cooling airflow. The unit should always be mounted vertically, with the minimum clearance around the unit as shown below in Figure 2.0.

Figure 2.0 Clearance around soft start module



When mounting Softdrive inside a cubicle, it is essential to ensure adequate ventilation is provided. Louvres and/or fans may be required to keep the internal temperature of the cubicle down.

If the soft start is by-passed, the heat loss from the soft start is minimal and dependant on additional equipment in the panel it may not be necessary to provide additional ventilation in the cubicle. Heat calculations should be performed to ensure heat rise inside the cubicle is not excessive.

> Please note on Soft start assemblies from 250A through to 1000A the cooling fans switch off automatically after a time period if by-pass contractors are used. This extends fan life considerably.

2.4.2 External Control/Regulation of Resistive Loads

It is also possible to control the output voltage of the Softdrive from 0 - 100% line voltage from an external 0 - 10V source. This means the Softdrive can be used as a regulator for resistive loads such as lighting or heater banks.

Please note, this type of control cannot be used on standard a.c. motors without special equipment such as a high resistance rotor motor being used.

2.4.3 Electromagnetic Compatibility

The Softdrive is designed to BS EN 60947-4-2, the product specific standard for a.c. semi-conductor motor controllers. As such the product is E.M.C. compliant and CE marked through internal mains and control filters.

However, please note, if the Softdrive is being used as a voltage regulator, where it is controlling the load at reduced voltage, a line filter would be necessary to achieve compliance.

Please consult S2S Electronics or your local distributor for filter details.

2.4.4 Dual Overload/Dual Current Limit

This allows for external selection of a second overload, with a second setting for motor set current and overload trip time. The (heat) accumulator for this overload is separate from that of the first.

Selecting a second motor set current will give a new level for start-up current limit, since the current limit level is a percentage of motor full load current.

2.4.5 Transformer Control

The softdrive can be used on power transformers.
SW1/7 must be placed in the 'on' position to activate this function.

2.4.6 Service, Maintenance & Spares

Routine Service

i. Check that the environment has not changed and that no restriction has occurred to the cooling airflow.
ii. Check that the cooling fans (if fitted) are operating correctly.
iii. Check that all connections are tight.
iv. Check mains/control wiring for ageing and deterioration.
v. Visually inspect soft start components, especially circuit boards, for discolouration.

Testing Thyristors

Using an AVO or DVM, it is possible to expose the majority of faulty thyristor conditions, as described in the following sections.

> **WARNING:**
> **THE FOLLOWING TESTS SHOULD BE PERFORMED WITH THE POWER ISOLATED FROM THE SOFT START**

Thyristor Anode/Cathode Short Circuit

With the motor leads dis-connected so as not to interfere with the reading, measure the resistance between the input and the output of each phase of the stack in turn, ie. Between 1/L1 and 2/T1, 3/L2 and 4/T2 and 5/L3 and 6/T3. A normal reading will be in excess of 180Kohm. Any short circuit thyristors should be replaced.

Thyristor Gate/Cathode Connections

With the gate/cathode leads dis-connected from the control card, measure the resistance between the 2 flying leads.
The resistance should be between 7 and 60ohm.
If the meter reads open circuit, first check the crimp connections on the device.

2.5 Protection

2.5.1 Semi-conductor Protection Fuses

All Softdrive units should be protected by high speed semiconductor protection fuses. In order to protect the thyristors against short circuits and earth faults, fit these in the supply line. It is important to ensure the maximum integral I2t does not exceed that of the thyristor.

2.5.2 Overload Protection

If the Softdrive keypad is used, then this has an integral overload built in with instantaneous over and under-current protection. (See Section 8 on setting up).

The Softdrive allows dual overload for applications such as two-speed motors.

Please note if external overloads are fitted, ensure these are compatible for use with electronic soft start.

Protection in ByPass Mode

Where the Softdrive is used with bypass contactors, please note the C.T.'s are still in circuit after the contactor has closed, as long as the bypass contactor is connected to the A2, B2 and C2 terminals on the Softdrive. This method ensures overload, overcurrent and undercurrent protection remain active once the Softdrive is shorted out by the contactor.

Where B2 terminal does not exist, connect bypass to T2 terminal.

2.5.3 Under-Voltage Protection

The Softdrive has under-voltage protection as standard, factory pre-set to 70% of line volts. However, adjustment of this is possible to make the unit more or less sensitive to voltage fluctuations. Table 2.0 below shows some typical values.

Table 2.0 - Supply Undervoltage Trip Resistance

	70% Volts U/V	90% Volts U/V
220V	470R	350R
380V	244R	174R
415V	217R	154R
440V	201R	141R
550V	147R	100R
690V	104R	66R

The above settings are to set the undervoltage to approximately 70% of line voltage. R9 is an adjustable potentiometer so this level of undervoltage can be increased or decreased. To make the unit more sensitive to undervoltage, the resistance of R9 should be decreased.

To make the unit less sensitive to undervoltage, the resistance of R9 should be increased. R9 resistance can be checked through test points TP1 and TP2 on the firing card.

Adjustment should only be made when the Softdrive has no power connected

Please note the trip circuitry monitors the line voltages applied to the thyristor stack, not the control supply voltage. Also note, the Softdrive has an option of 500ms ride-through on the second menu.

If selected, the Softdrive will ignore a voltage dip for this time period to avoid nuisance tripping. If the voltage dip is for longer than this period, the unit will trip out on ride through fault.

2.5.4 Heatsink Overtemperature Protection

The Softdrive is fitted with heatsink overtemperature protection internally wired into the control card as standard. If trip occurs a manual reset is necessary.

2.5.5 Thermistor Motor Protection

The Softdrive will accept a PTC Thermistor input direct from the motor with a trip level of 3.3 k Ohms and reset level of 1.65 k Ohms required. A manual reset is necessary.

2.5.6 Current Imbalance

The Softdrive has an adjustable current imbalance protection which can be adjusted to give protection against 10% - 30% imbalance. If not required this feature can be switched out.

2.5.7 Earth Fault Motor Protection

The Softdrive has earth fault trip for motor protection .
This requires an additional core balance CT. There are three different sizes that can be supplied to suit the rating of the Softdrive. The value of earth fault burden resistor on the firing card is also selected to suit the rating of the Softdrive.

By connecting a core balance transformer to J2 terminals 5 & 6, then the system can give earth fault motor protection. The trip current can be set to between 100 and 6000 mA, with the trip delay set between 1 and 10 seconds. For correct calibration, the core balance CT is supplied to suit the rating of the Softdrive, as is the value of earth fault burden resistor which is fitted on test.

Please Note: On assemblies over 255A 3 separate CT's should be used as apposed to single core balance CT.

Adjustments for earth fault levels increases to 1A-60A on these units.

2.5.8 Instantaneous Overcurrent

The Softdrive has an integral overcurrent that operates during a running sequence. This will protect against instantaneous overloads by tripping the soft start if an overcurrent is detected.
This level is adjustable between 70% and 500% current.

2.5.9 Undercurrent

The softstart has an integral undercurrent trip function that operates during a running sequence. This will protect against an underload by tripping the soft start if the current is too low. The level is adjustable from 0 to 90% current and the trip time is adjustable from 0 to 15 seconds.

3.0 Installation

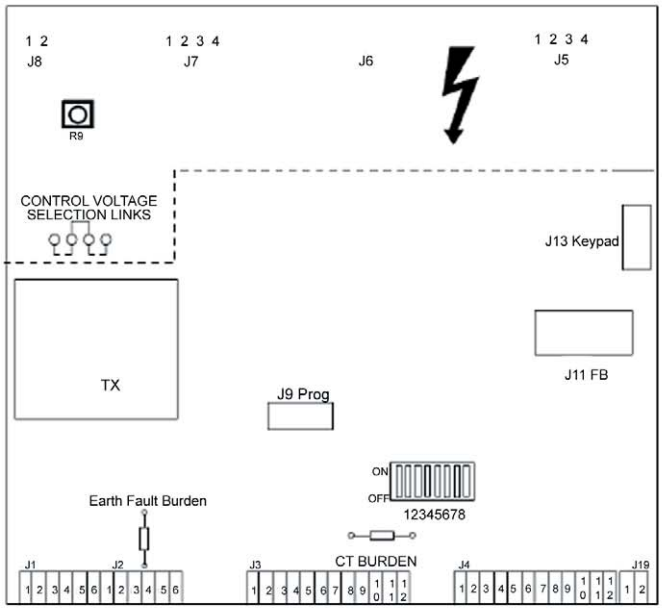
This Section looks at the installation of the Softdrive along with the power and control connections with regard to the section 2.4.1 the Softdrive must be:

- Installed in a suitable control cabinet with adequate cooling.
- Power and control cables should be segregated in the panel.
- Control connections should run no more than 3m in length.
- Coil suppression on large contactors may be required.
- Connection between Soft Start and Door mounting keypad should only be made with approved cable and should be no more than 3m in length

3.1 Firing Card

All control connections on the Softdrive are wired directly onto the control firing card within the assembly, and the terminal layout is shown below.

The main firing card is interfaced with the keypad through a ribbon cable. The keypad mounts on the assembly itself, or on the front of the panel.



* Relay contacts are rated for 5A at 240VAC and 30VDC but are limited to 50VA for an AC11 (coil Switching) duty.

Please note - for thermistor input: This is designed for a PTC thermistor. Trip level is set at 3.3 kohms and reset level is 1.65 kohms. A manual reset is required in all cases when the Softdrive trips on motor overtemperature.

Please refer to circuit diagram 3.0 and 3.1 for Soft Stop and Hard Stop.

3.2 Terminal Function

Connector No:	Pin No:	Description	
J1	1	Heatsink Overtemp Input (Internally Wired)	
J1	2	OV. Heatsink Overtemp Input (internally Wired)	
J1	3	Motor Thermistor Input	
J1	4	Ov. Motor Thermistor Input	
J1	5	Second Overload Select Input	
J1	6	Ov. Second Overload Select Input	
J2	1	NC	
J2	2	NC	
J2	3	NC	
J2	4	NC	
J2	5	Earth Fault core	
J2	6	Balance Current Transformer (Optional)	
J3	1	Fan O/P	
J3	2	Fan O/P	
J3	3	Soft Stop I/P NC	
J3	4	Soft Stop I/P NC	
J3	5	Fault Reset I/P NO	
J3	6	Fault Reset I/P NO	
J3	7	External Control I/P 0-10 Volts	
J3	8	External Control I/P 0 Volts	
J3	9	Stop I/P NC	
J3	10	Stop I/P NC	
J3	11	Current Transformer 1 I/P	
J3	12	Current Transformer 2 I/P	
J4	1	C.T Common I/P	
J4	2	Run I/P NO	
J4	3	Run I/P NO	
J4	4	Run O/P COM*	
J4	5	Run O/P NC*	
J4	6	Run O/P NO*	
J4	7	Fault O/P COM*	
J4	8	Fault O/P NC*	
J4	9	Fault O/P NO*	
J4	10	TOR O/P COM*	
J4	11	TOR O/P NC*	
J4	12	TOR O/P NO*	
J5	1	Cathode Thyristor 1 Connection }	
J5	2	Gate Thyristor 1 Connection }	Blue
J5	3	Gate Thyristor 4 Connection }	Phase
J5	4	Cathode Thyristor 4 Connection }	
J6	1	Cathode Thyristor 2 Connection }	
J6	2	Gate Thyristor 2 Connection }	Yellow
J6	3	Gate Thyristor 5 Connection }	Phase
J6	4	Cathode Thyristor 5 Connection }	
J7	1	Cathode Thyristor 3 Connection }	
J7	2	Gate Thyristor 3 Connection }	Red
J7	3	Gate Thyristor 6 Connection }	Phase
J7	4	Cathode Thyristor 6 Connection }	
J8	1	Control Supply Input	
J8	2	Control Supply Input	
J9		Firmware Programming Connector	
J11		Fieldbus Connection	
J19	1	Programmable Relay O/P	
J19	2	Programmable Relay O/P	

3.3 Fault Outputs

The run relay is energised following succesfull start initiation.

The fault relay is common to all faults on the Softdrive, and it is shown in its de-energised condition. This is energised when the control supply is live. The relay de-energises when a fault is detected including an overload condition.

The top of ramp relay is energised when the unit reaches full output.

The programmable relay can be programmed to duplicate the function of the run, fault or top of ramp relays, or provide an output in the event of an overload trip.

3.4 Output Connections/Power Connections

Two sets of output connections are standard on the Softdrive, one set for the motor and the other for bypass contactor connection. This is so that the C.T.'s are not shorted out in bypass mode and continue to provide current monitoring for the Electronic Overload and Under/ Over Current Protection.

3.4.1 Power Connections on 800A-1400A Assemblies

Please note that the protection is still available in by-pass mode on the 800 Amp-1400 Amp assemblies but these do not have separate power connections for a by-pass contactor.

The protection CT's are also provided loose and these should be connected to ensure they remain in circuit during starting and running to ensure continued protection. The CT's should be fitted as close to the drive as possible and if cable runs between CT's and Soft Start are longer than 0.5m screened cables should be used.

3.5 Control Supply Connections on 31A to 1000A Units

The control supply input requires connection of 110V/220V to terminals J8, 1 and 2 at the top of the main control firing card. On SAF303-15 to SAF303-30 units the control supply is connected internally to terminals CL1 and CL2 which are located along side the input and output terminals

The control firing card has an integral control transformer to power the control electronics. This supply should be externally fused and is selectable on the circuit board by a jumper link.

Please note the links are pre-wired for 220V. For 110V the link provided should be fitted in position shown on the circuit board adjacent to the transformer.

3.5.1 Control Supply on 460V-690V Units on Softdrive Units Above 250A

At 460-690V, it is not possible to feed the fans from the mains supply. The fans are therefore taken to the terminals via a fused supply board. This requires a separate 100V/ 240V supply. Control voltage required must be specified at the time of order. These units will therefore have 2 separate control supply inputs.

On the units below 250A, the fans are wired via the control supply input board so only one control supply is required. However the control voltage is still required at the time of order.

3.5.2 Control Supply on Softdrive Units above 1200A

The cooling fans are taken to terminals via fused supply board. This requires a separate 100V/220V supply. The control voltage should be specified at the time of order. These units will therefore have 2 separate control supply inputs.

3.6 Keypad Connections

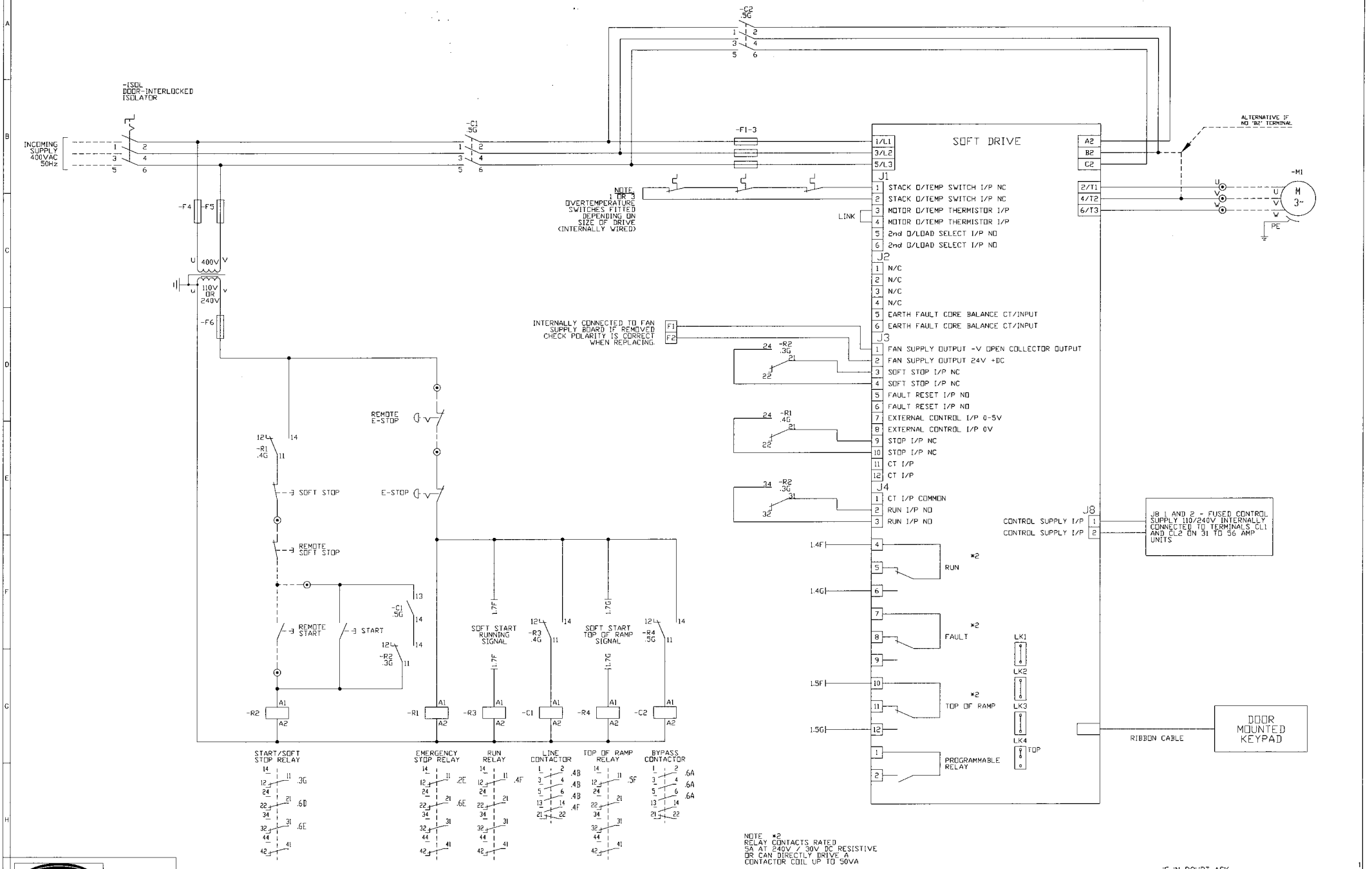
The keypad used with the Softdrive has an LCD display and 3 pushbuttons. All parameters are adjustable through the pushbuttons and all indications/status messages are displayed on the LCD, with 4 languages being selectable on the display.

The maximum length of screened cable run between controller and keypad is 3 metres to ensure E.M.C. compliance to BS EN 60947-4-2. The keypad also has fault and power LED indications next to the LCD display for quick reference.

The keypad has 3 pushbuttons as standard, designated as 'UP' 'DOWN' and 'ENTER'. These are also labelled 'start', 'stop' and 'reset' and can be configured as such by selection of 'Start/Stop' mode as described in Section 4.3

3.6.1 Keypad on 800A-1400A Assembles

The keypad on 800 Amp-1400 Amp units is provided as a door mounted keypad. As the assembley is IP00 with control card mounted on the top of the asssembley the keypad is provided loose with a 2m cable so it can be mounted on the panel door.



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MODIFICATIONS

		DATE
A	FIRST ISSUE	17.07.07
B	CUSTOMER COMMENTS ADDED	26.07.07

TITLE: SCHEMATIC DIAGRAM OF FIGURE 3.0 SIZE 1-5 SOFT START SOFT STOP

CUSTOMER: S2S ELECTRONICS Ltd.

NOTES: -

IF IN DOUBT ASK

TYPICAL

SCALE	DRAWN	CHECKED	APPROVED
N/A	S.S. 19.07.07	DATE	DATE

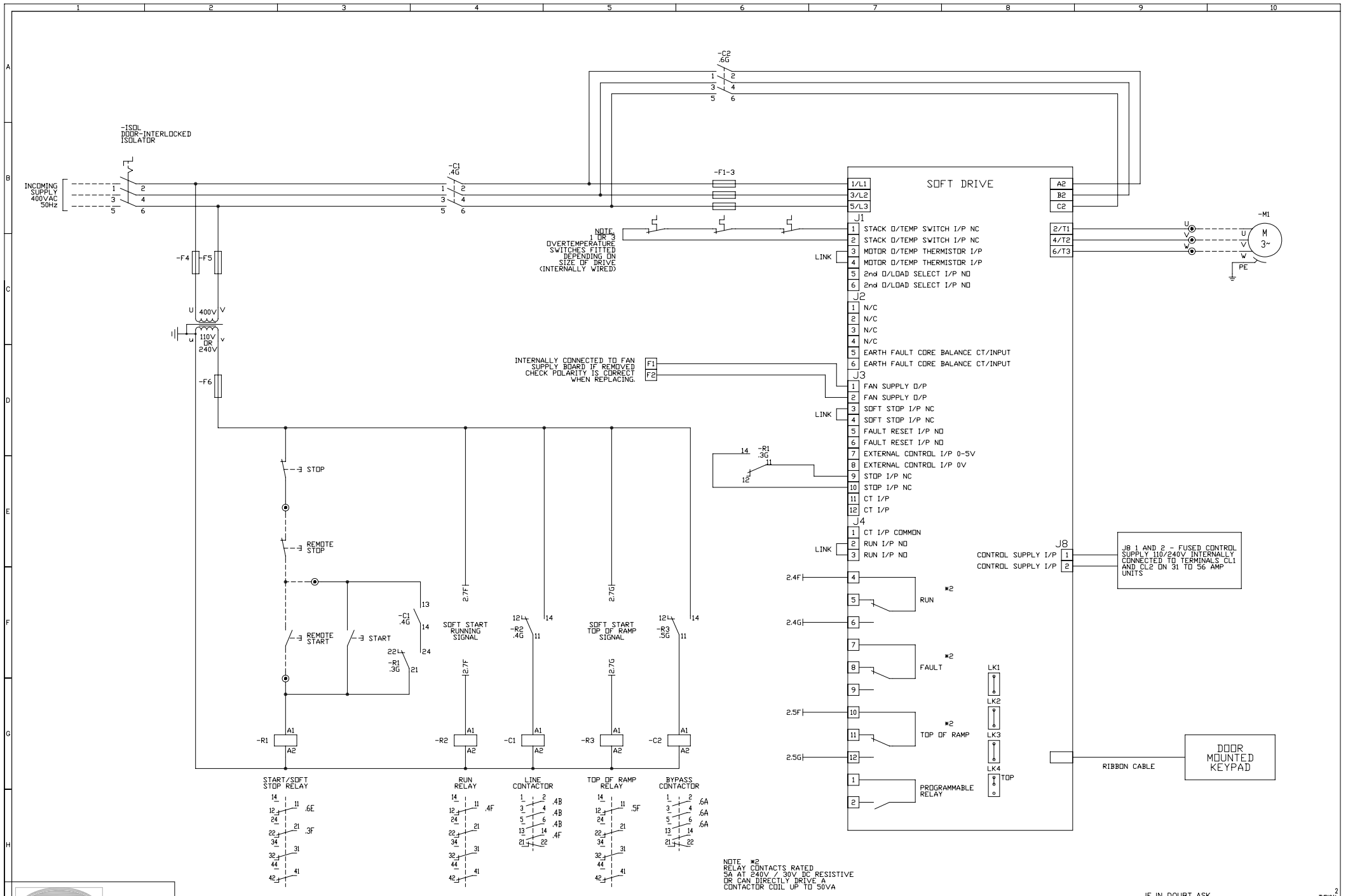
JOB No. S2S

DRAWING No. 2S0-S01

DRAWING CODE No. 250-501

REV B

SHEET 1 OF 2



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MODIFICATIONS												
A	FIRST ISSUE	DATE 17.07.07	C		DATE	E		DATE	G		DATE	
B	CUSTOMER COMMENTS ADDED	DATE 26.07.07	D		DATE	F		DATE	H		DATE	

TITLE: SCHEMATIC DIAGRAM OF FIGURE 3.0 SIZE 1-5 SOFT START HARD STOP
CUSTOMER: S2S ELECTRONICS Ltd.

NOTES: -

IF IN DOUBT ASK

2 TYPICAL

SCALE	DRAWN	CHECKED	APPROVED
N/A	S.S. 19.07.07	DATE	DATE

JOB No. S2S
DRAWING No. 2S0-S02
DRAWING CODE No. 2S0-S02
REV B
SHEET 2 OF 2

4.0 Programming Operation

WARNING PLEASE ENSURE DRIVE IS IN 'MENU' MODE NOT 'DIRECT' MODE BEFORE ATTEMPTING TO PROGRAM THE SOFTDRIVE UNIT. OTHERWISE 'START' MAY BE ACTIVATED.

4.1 Introduction

All the parameters of the unit are programmable by the 3 keys ('UP', 'DOWN' and 'ENTER') and the 2 by 16 character LCD display.
The display shows a description of the parameter to be changed together with the value itself. In addition, status information, eg. running and current limit, can be displayed simultaneously while changing parameters.

4.2 Initialisation

When power is first applied to the unit, the parameters are retrieved from a non-volatile store ready to be displayed or changed. If the stored parameters are found to be corrupted for any reason, then the unit will revert to a set of default parameters which the user may then modify to suit the application.

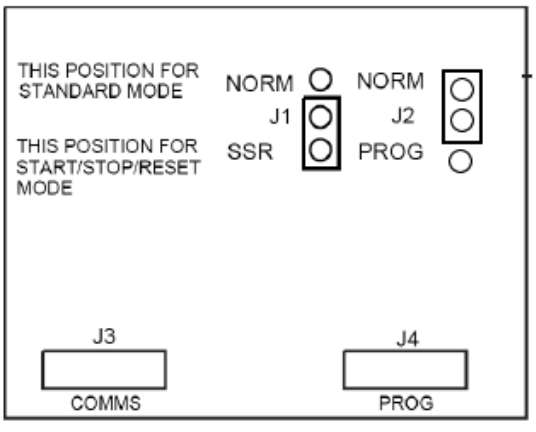
4.3 Start/Stop Via Keypad

To configure the Softdrive unit to control the unit via it's own pushbuttons, instead of via conventional pushbuttons, it is necessary to make the following modifications. This will allow 'start/stop' and 'reset' to be achieved through the keypad's 'UP', 'DOWN' & 'ENTER' keys.

i. SW1/8 on the main control card should be set to the 'on' position.

ii. Link J1 on the back of the keypad itself should be set for 'start/stop' mode (see diagram below). Please note: to get to this link, it will be necessary to remove the plastic cover from the rear of keypad.

When in this mode the keys are configured as below:



BACK VIEW OF KEYPAD

J2 is used for programming during test.
'Start' : 'UP' Button
'Stop' : 'DOWN' Button
'Reset' : 'ENTER' Button

The 'stop' selected is Soft Stop and as such, please note an 'emergency stop' pushbutton will still be required

Connections to Control Card should be made as follows:
i. Soft Stop input linked out (J3 Pins 3 & 4.)
ii. Hard stop input linked (J3 Pins 9 & 10.)

4.3.1 Start/Stop Mode

Assuming the Softdrive has been set up to operate in 'Start/Stop/Reset' configuration, the user then has two options upon initialisation of the Softdrive. The system initialises in 'Direct' Mode meaning the pushbuttons are active and depressing start will activate the start sequence. By depressing the 'STOP' and 'RESET' simultaneously the drive will enter 'Menu' Mode, meaning parameters can be changed in the usual way, utilizing 'UP', 'DOWN' & 'ENTER' keys. Once this is complete, the Softdrive can be returned to 'Direct' Mode by once again depressing the 'DOWN' and 'ENTER' keys simultaneously. The display will not show current in 'Menu' Mode. It is necessary to revert to 'Direct' Mode for current display.

PLEASE NOTE: WHEN SET UP FOR ''START/STOP/ RESET' IN THE ABOVE FORMAT THE SOFTDRIVE ENTERS INTO 'DIRECT MODE' MEANING, IF THE 'START' PUSHBUTTON IS DEPRESSED, A START WILL IMMEDIATELY OCCUR.

4.4 Displaying Parameters

After initialisation, or if the unit has been left for more than approximately 30 seconds, the display will revert to show the text 'SOFTDRIVE'. From this situation the parameters can be viewed or modified by pressing the 'UP' key. If the security access is not enabled, the display will show the first of the menu options (see Security Mode for further reference).

The parameters are displayed as two menus. The first of the menus contains the most commonly used parameters:-

- Pedestal Up	- Ramp Up	- Ramp Down
- Current Limit	- Pedestal Down	- Zero Sense

The second menu contains the parameters less frequently used, which are only likely to be changed at installation. These will be discussed in more detail later in this guide.

To view the parameters press the 'DOWN' key to move down the menu and the 'UP' key to move up the menu.

4.5 Changing Parameters

The first line of the display generally shows a description of the parameter, the second line shows the value of the parameter plus associated unit. When the required parameter to be changed is reached the 'ENTER' key should be pressed. The cursor bar will then move to the second line of the display indicating that the parameter may be changed.

To change the parameter the 'UP' and 'DOWN' keys are used, keeping either key pressed continuously will cause the value to change rapidly.

The value will not be allowed to go outside limits appropriate to that parameter. When the required value is reached the 'ENTER' key should again be pressed. The value will be updated and the cursor bar returned to the first line, pressing the 'UP' or 'DOWN' key will now cause the menu to scroll up or downwards once again.

4.6 Changing Switches

Access to the other menu is gained as an option from the first. The second menu contains parameters termed switches eg. 'Bypass Mode On/Off'. In this situation, the option is selected in exactly the same way, however, when 'ENTER' is pressed, the parameter toggles between On and Off as the 'UP' and 'DOWN' keys are pressed. Pressing 'ENTER' updates the parameter and returns the cursor bar to the menu option.

4.7 Security Mode

The unit provides a restricted access mode whereby access to the parameters cannot be gained without a four digit code. To enable the security mode a suitable code must first be entered. This is done by first selecting the Access Code option in the second menu, then pressing the 'ENTER' key. The existing code will be displayed and can be modified by using the 'UP' and 'DOWN' keys to change each of the four digits in turn, pressing 'ENTER' to move on to the next digit. After the fourth digit has been entered the cursor bar will return to the menu option. Please note, this mode will not be active in 'Direct' Mode.

When the code has been entered, the security mode can be enabled by selecting the Security Mode option in the second menu. Pressing 'ENTER' will move the cursor bar to the second line of the display and the 'UP' and 'DOWN' keys can then be used to change from Off to On.

Once enabled, the user will be required to enter the security code to gain access to the menus. On pressing any key the user will be presented with the Access Code option, the code is then entered as described above.

If the correct code is entered the user may then access the menus as before.

It is suggested that the Security Mode can only be enabled once setting up is complete and that the code be kept in a safe place.

IT IS STILL POSSIBLE TO START/STOP OR RESET THE DRIVE WHILST THE SECURITY MODE IS ACTIVE.

4.9 Switch Settings on SW1

1	ON	NOT USED
2	ON	NOT USED
3	OFF	FAN O/P ENABLE
4	ON	3 WIRE START
5	ON	RAPID CLOSE TO SYNC
6	ON	EXTENDED FAULT
7	ON	TRANSFORMER OPERATION
8	ON	REMOTE COMMS DISABLED

Defaults are all switches OFF

5.0 Menus

5.1 Main Menu

Parameter	Limits	Description
Pedestal Up	0-80% line volts (default 25%)	Sets initial voltage from which unit ramps up.
Ramp Up Time	1-240 secs (default 30 secs)	Sets the time the unit takes to ramp from set pedestal up voltage to top of ramp.
Current Limit	100-500% (default 300%)	Sets current limit as % of FLC through feedback from internal CT. This effectively stops ramp from continuing.
Pedestal Down	100-30% line volts (default 100%)	Sets voltage from which motor starts to ramp down.
Ramp Down Time	1-240 secs (default 30 secs)	Sets the time the unit takes to ramp down from pedestal down voltage to zero sense voltage.
Zero Sense	80-5% line volts (default 5%)	Sets the voltage at which the unit is switched off after a ramp down.

DEFAULT IS FACTORY SETTING

5.2 Second Menu

Parameter	Limits	Description
Current Limit Trip Time	1-240 secs (default 20 secs)	If drive is in current limit in excess of this time, the unit will trip or resume ramp (see resume on trip)
Resume on Trip	On/Off (default off)	If switched off the unit will trip after the current limit time, if switched on the unit will resume ramping.
Current Limit on Soft Stop	On/Off (default off)	If switched on the current limit operates during soft stop, reducing voltage on ramp down until current falls.
Kick Start	On/Off (default off)	If switched on this provides a pulse of voltage before the ramp begins, this assists high stiction loads
Kick Voltage	75-90% line volts (default 75%)	Sets % of line voltage if kick start selected.
Kick Cycle	5-10 cycles (default 5)	Sets the number of cycles of conduction of kick start voltage.
Auto Phase	On/Off (default off)	If switched off, the unit will monitor phase sequence and trip if incorrect. If switched on, the unit will automatically compensate for any supply phase rotation.

Parameter	Limits	Description
ByPass Mode	On/Off (default off)	If switched on, the unit may be operated with a bypass contactor via the TOR relay. One second after reaching TOR the unit checks the contactor has closed by looking for a short circuit between input and output. If not found, a bypass fault will be indicated.
Over-Current	70-500% Motor set current (default 500%)	Sets the shearpin instantaneous overcurrent trip level as a % of the motor set current (see Motor Set Current). Active when the unit has reached top of ramp (TOR).
Under-Current	0-90% Motor set current (default 70%)	Sets the minimum current as a % of the motor set current (see Motor Set Current). If the unit is below this current for longer than a programmed period (see Under Current Time) then the unit trips. Active only when TOR reached.
Under-Current Time	0-15 secs (default 15 secs)	Sets the time the unit must be below minimum current (see Under-Current) before the unit trips.
C.T. Burden	10-1000 Normally set to drive size on test	Tells the unit the value of current transformer burden resistor fitted. This will be factory set to suit the size of the unit. The value is entered as 10 times the value of resistor eg. 8.2 ohms would be entered as 82.
C.T. Ratio	1-4 Normally set to drive size on test	Tells the unit the turns ratio of the current transformer fitted. This will be factory set to suit the size of the unit. The value: 1 represents 1000:1 2 represents 2000:1 3 represents 3000:1 4 represents 4000:1
Motor Set Current	1-2000A Normally set to drive size on test	Sets the nominal operating current of the motor (this need not be the motor full load current). All other programmed current parameters are set as a percentage of this.
Overload	1-30 secs (default 5 secs)	Sets the overload trip time at 6 times the motor set current (see Motor Set Current). This then determines the trip time for a given current overload.

Earth fault trip current is set on display as $\frac{\text{Actual trip current in mA}}{10}$

Parameter	Limits	Description
Mains Loss Ridethrough	On/Off (default off)	If switched on, supply can be lost for up to 500 ms without a fault being indicated. If supply is re-instated within 500 ms a quick ramp of one second is applied.
Ext. Control	On/Off (default off)	If switched on, it allows the output voltage of the unit to be controlled from 0-100% line volts by a 0-10V control input.
Security	On/Off (default off)	If switched on, a 4 digit access code is required to gain access to the menus to restrict unauthorised access.
Access Code	0000-9999 (default 0000)	Sets the unit's access code.
Diagnostic Address	0-255 (default 255)	Diagnostic address facility. Allows further staus information and fault codes to be displayed
Language	1-4 (default 1 English)	Sets the language displayed on text: 1-English 2-French 3-German 4-Alternative Language (default Danish)
Imbalance	On/Off (default on)	Current imbalance protection. Active only when TOR reached.
% Imbalance	10-30% (default 20%)	Current imbalance trip level.
Programmable Relay	0-4	0-OFF 1-RUN 2-BYPASS 3-FAULT 4-OVERLOAD
Lock Control	On/Off (default off)	Disable Start/Stop/Reset Function of keypad
Port 0 Delay	10-100 (default 25)	Adjust to correct PC comms problems
Field Bus	On/Off (default on)	Disable remote control via Fieldbus (Port 0 only)
Second Motor Set Current	1-2000A (default 22A)	Sets the nominal motor current for the second overload.
Overload Trip Time 2	1-15 secs (default 5 secs)	Sets the overload trip time at 6 times the motor set current for the second overload.
Earth Fault Trip Level	100-6000 mA (default 1000 mA) #	Earth fault trip current level. Actual value is displayed value x by 10
Earth Fault Trip Delay Time	1-10 secs (default 1 sec)	Earth fault must be present for this time period before drive trips.

5.3 Status Display

The LCD Keypad of the Softdrive displays as standard a number of messages to indicate the status of the Soft Start.

These are shown below.

Message	Description
'Running'	Softdrive Running
'Stopping'	Softdrive Stopping
'TOR'	Softdrive has reached top of ramp
'Current Limit'	Softdrive has reached current limit setting.

Also indicated on the keypad is a real time current display during running and starting. Please note, if the menu is being viewed, this will be obscured until the display reverts back to the default display.

A power and a fault L.E.D. are also on the front of the keypad indicating 'power on' and 'fault trip' respectively.

Fault	Description	Notes	Remedy
1	General	Indicates any of the following: Undervoltage:	Check undervoltage setting and mains
		Supply Loss	Check incoming fuses and mains
		Thyristor open/ short circuit	Check thyristors
		Loss of output phase	Check connections on motor side
2	Ridethrough Time Out	Indicates 500ms timer on mains ride-through has timed out	Check incoming mains supply for dips
3	Bypass Fault	Indicates bypass contactor has not energised in one second time allowed	Check function of bypass contactor
4	Phase Sequence	Phase rotation fault is detected	Check for correct phase rotation on Softdrive input
5	No Supply on Run request	When unit is started no mains is present	Check mains is being applied correctly and correct sequence for start circuit
6	'Time Out'	Softdrive has tripped on current limit timer meaning the set current level is present for length of time set in current limit trip time	Increase current limit setting if motor is stalling early in acceleration profile or increase limit time period if motor is stalling at end of acceleration period. High inertia drives may require combination of both
7	Overload Trip	Softdrive tripped on overload.	Check overload has been set up as described in this manual. If genuine overload, the drive times out before a restart is allowed. % overload is shown on display.
8	Over Current	Softdrive trips on over current. Active during TOR period not starting/stopping	Check over current settings and check that there is no mechanical reason for trip condition.
9	Under Current	Softdrive trips on under current. Active during TOR period not starting/stopping	Check under current settings and check that there is no mechanical reason for trip condition.
10	Current Imbalance	Current Imbalance between phases. Detection only operative after TOR/Bypass reached	On new installation check that both current transformers are connected with same polarity. For genuine imbalance check supply voltage balanced or check motor.
11	'Motor O/T'	Thermistor trip activates	Motor getting too warm, check motor and number of starts and reduce if necessary.
12	'Stack O/T'	Softdrive tripped on over temperature.	Softdrive getting too warm. Check number of starts and reduce if necessary.
13	Earth Trip	Softdrive trips on earth fault	Check motor cables and motor for earth fault
14	Supply Failure	Indicates loss of supply after start up.	Check mains and fuses
15	Thyristor Fault	Indicates thyristor has failed on open/ short circuit	Check thyristor gate / cathode resistance and anode/cathode resistance
22	Red Thyristor		
23	Yellow Thyristor		
24	Blue Thyristor		
25	Failed to synchronise on start	Unable to synchronise with mains wave form	Check mains for noise

In standard mode only faults 1-13 are displayed. It is possible to extend the fault codes to allow more advanced interogation of the unit. This function can be activated by SWI/6 being switched 'on'.

7.0 Communications via RS485 Serial Link

It is possible to control a Softdrive from a PC.
To achive this an RS232 to RS485 Converter would be required from the PC to the Softdrive port 0 socket (J11).
S2S can either provide a Windows based system on disk or downloaded from our web site.

The link allows the drives to be programmed via PC. And also allows feedback from Softdrives showing running current and any fault feedback. 'Start', 'Stop' and 'Reset' is also available using the control system.

7.1 Communications via Fieldbus

It is also possible to connect the Softdrive on a Devicenet or Profibus DP Network. This is achieved using an optional protocol converter connected to Port 0 (J11) on the Softdrive.

Please see separate communications manual for more details.

8.0 Setting-Up

Referring back to the schematic drawings of Section 3.0, the run sequence is as follows:

The control supply is applied, and, after a delay of approximately 0.5 seconds, the fault relay energises.

The start circuit can then be operated, after which the run relay will immediately energise. After a delay of approximately 0.5 seconds, sufficient to allow any size of line contactor to energise, the Softdrive will commence ramping up. The fault detection circuitry is now enabled. Any fault in the supply, the Softdrive, or the power line connections will cause the fault and run relays to de-energise and the drive to trip.

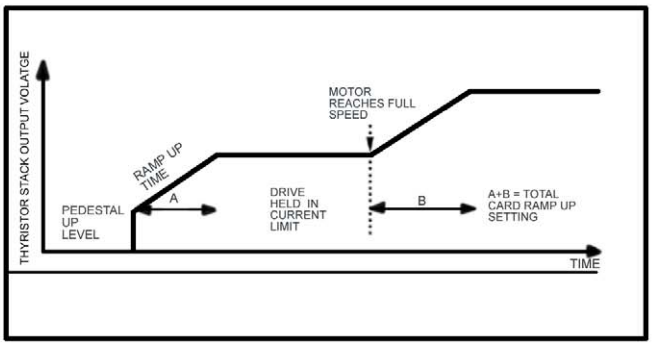
Under normal operation though, the stack output voltage will ramp up until the current limit level is reached, and the voltage ramp is clamped. The motor will continue to accelerate under current limit control, and providing the current level is set high enough to give sufficient torque, the motor will reach full speed. The current will then reduce to normal running levels, and the voltage will continue ramping to full. If not, and the drive is held in current limit for the period of the current limit timer, then the drive will trip.

Providing full line voltage is reached, the ByPass/TOR relay will energise.

When a stop is initiated, the Bypass/TOR relay immediately de-energises, and the thyristor stack output voltage starts to ramp down. At the end of the ramp down period, after the thyristors have switched off, the run relay de-energises and releases the line contactor.

For a hard stop, the line contactor and bypass contactors are immediately de-energised.

8.1 Set-Up and Operating Procedure for Standard Soft Start and Soft Stop



Typical ramp up profile

8.1.1 Soft Start Ramp Up

It should be noted that whilst adjustment of parameters is available, while the motor is running, any changes to parameters through the up and down keys will not be input to the processor until the 'ENTER' key is pressed.

The Softdrive acceleration has 3 main parameters; the pedestal up, the ramp time, and the current limit level.

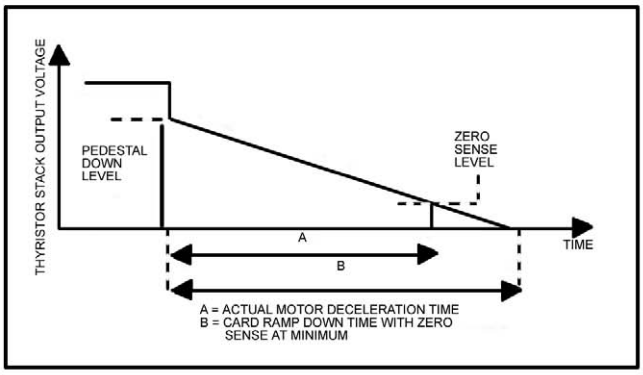
The ramp time should be set to meet the user requirements or application needs. The pedestal should be set to a level where sufficient torque is available to just start the motor turning, and the current limit level should be set to ensure acceleration is achieved and enough torque is produced to get the motor up to full speed. If the current limit setting is too low, the motor may stall or, coupled with too low a pedestal, may not even turn. In either of these cases, the current limit timer will operate, which will have the effect of tripping the drive or continuing the ramp up sequence. (The current limit timer and drive trip facility are user changeable. Please see Section 5.2 on Second Menu Adjustment).

Bear in mind that when held in current limit, the voltage is clamped and acceleration may be extended beyond the set ramp time.

Please also note that in some applications, the motor may be up to full speed before the ramp is complete, as the motor can achieve full speed at less than full mains voltage.

8.1.2. Soft Stop Ramp Down

The Softdrive deceleration has 3 main parameters; pedestal down, ramp down and zero sense.



The ramp down time should be set to meet the user requirements or application needs. The pedestal down level should be set to a point where the motor starts to decelerate from full speed. This adjustment is present to avoid a period of non-deceleration that is seen when the ramp down commences from full mains voltage. The zero sense level should be set to a point where the motor has just stopped, to offer maximum control of the deceleration profile.

8.1.3 Motor Overload

The motor overload has 4 parameters. These are motor set current, overload trip time, C.T. ratio and C.T. burden. The last 2 parameters are factory pre-set, and should not need user adjustment. The parameters for these are shown in Section 2.1, and should only need alteration if the Softdrive is being used on a motor with a different power to the given rating of the drive.

Therefore, the only adjustment necessary for the user is the set current which should be set for the motor FLC in amps and the trip time which is adjustable from 1 - 30 seconds based on an overload of 6 x FLC for this time. The graph at the end of this section shows the corresponding curves for the set trip times. This ideally should be set to match the thermal capacity of the motor. In the absence of motor data, a trip time of 10 seconds would offer protection to most machines.

A '0' setting on the overload means the overload is not in circuit and an external overload can be utilized.

Once the motor has gone into an overload condition, the soft start can not be reset until a time period has elapsed. The reset time is based on the percentage overload at time of trip. status display on the keypad will show a counter from 100 down to 0. This indicates reset time and a reset is not possible until the dispaly has counted down to 50 or less.

8.1.3.1 Dual Overload/Dual Current Limit

The second overload is selected when J1 terminals 5 & 6 are together. Selecting the second overload provides for setting a second motor set current and overload trip time. The (heat) accumulator for this overload is separate from that of the first.

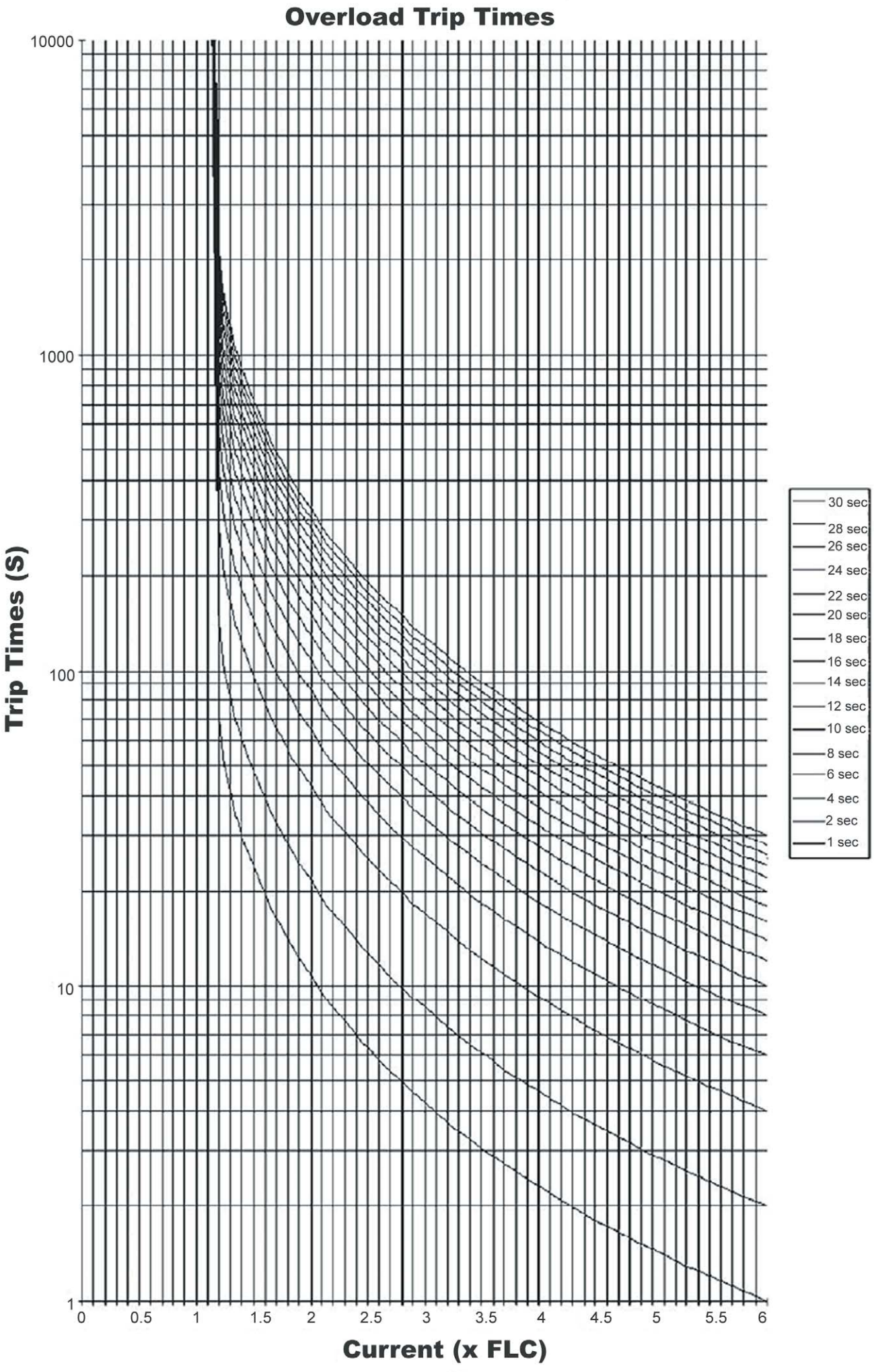
8.1.4 Motor Undercurrent

The undercurrent protection circuit monitors the current drawn by the motor during full speed running (i.e. when the Softdrive has reached TOR and the motor is up to speed).

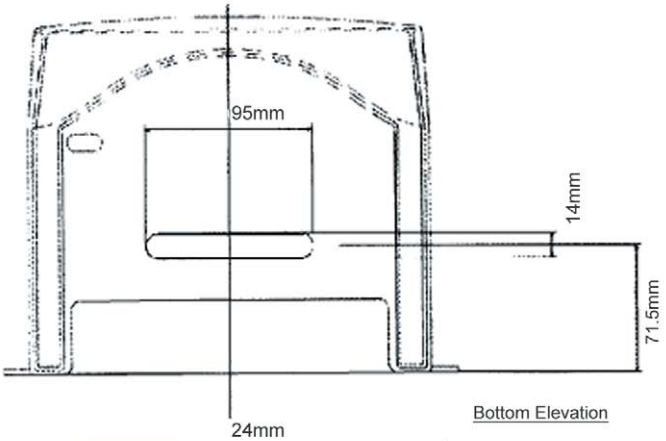
The trip level is adjustable from 0 - 90% of motor set current, and trip time is adjustable from 1 - 15 seconds. To avoid any nuisance tripping, set the undercurrent level to 0%.

8.1.5 Shearpin Instantaneous Overcurrent Protection

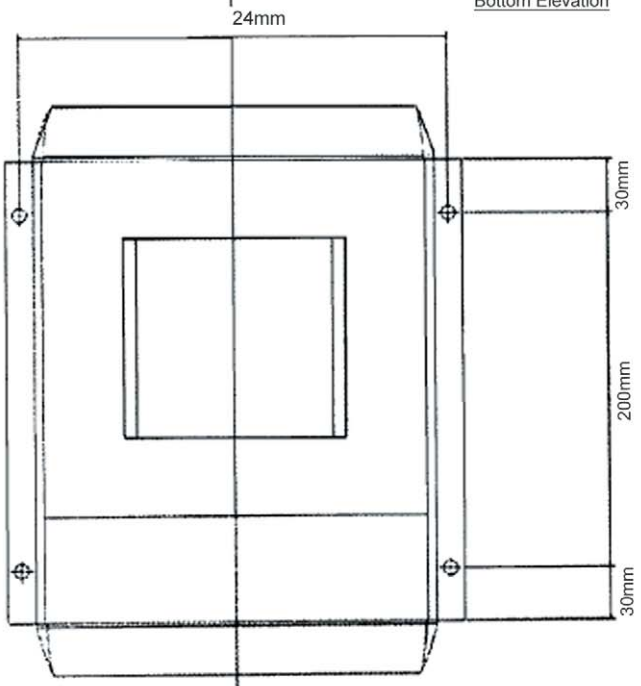
The 'shearpin' instantaneous overcurrent protection only operates during full speed running, and this trips the drive immediately the current exceeds the set value, adjustable from 70 - 500% FLC. To avoid any nuisance tripping, the level should be set for 500%.


Overload Trip Times
10000
1000
100
10
1
Trip Times (S)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Current (x FLC)
30 sec
28 sec
26 sec
24 sec
22 sec
20 sec
18 sec
16 sec
14 sec
12 sec
10 sec
8 sec
6 sec
4 sec
2 sec
1 sec

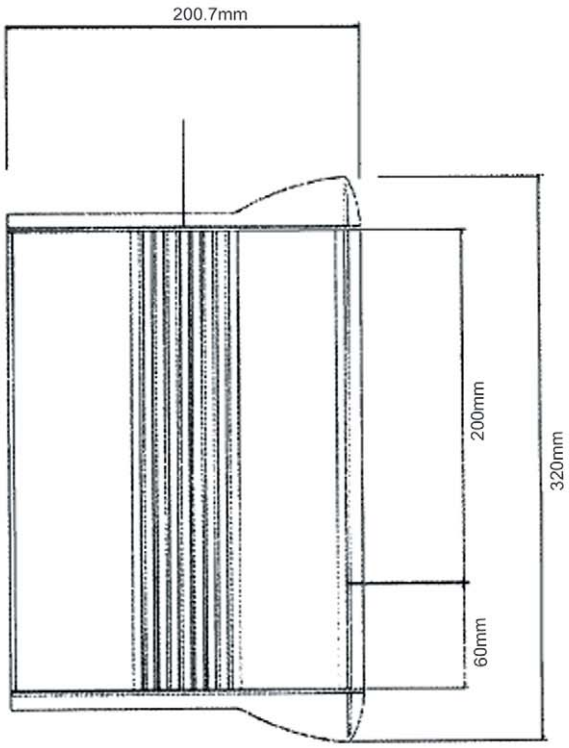
Appendix 1.0
Softdrive Dimensions



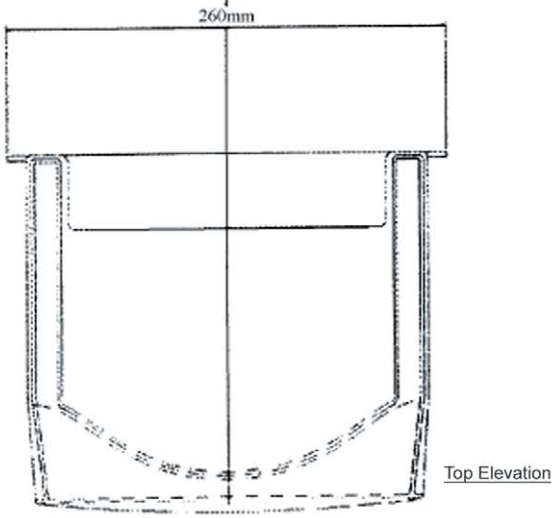
Bottom Elevation



Front Elevation



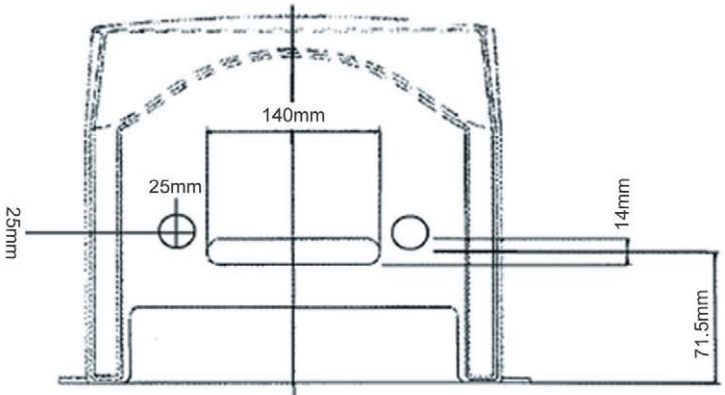
Side Elevation



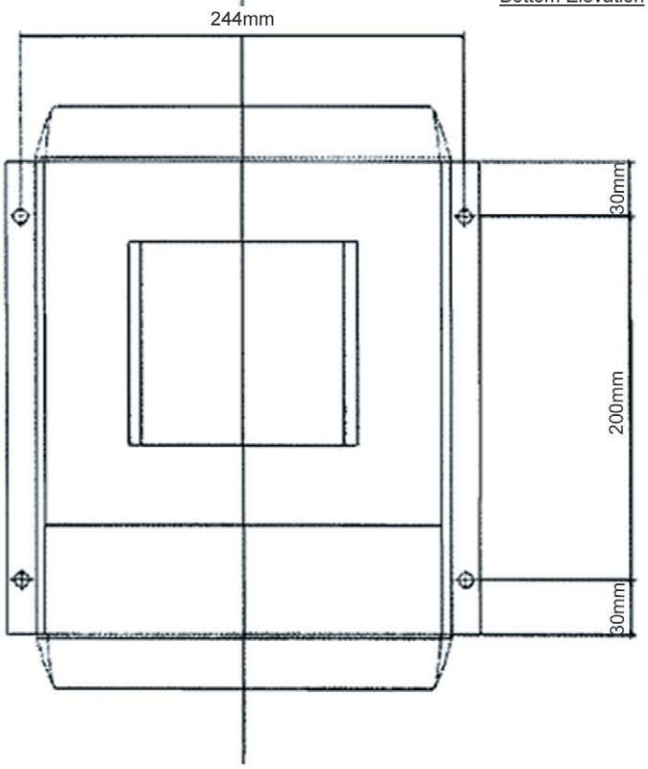
Top Elevation

Soft Start Size 1
31-41 AMP
Unit Weight - 7kg

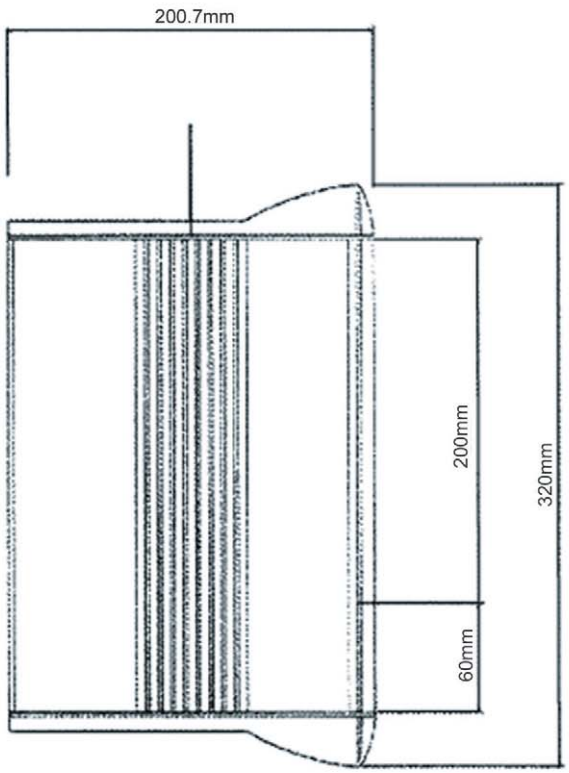
Appendix 1.0
Softdrive Dimensions



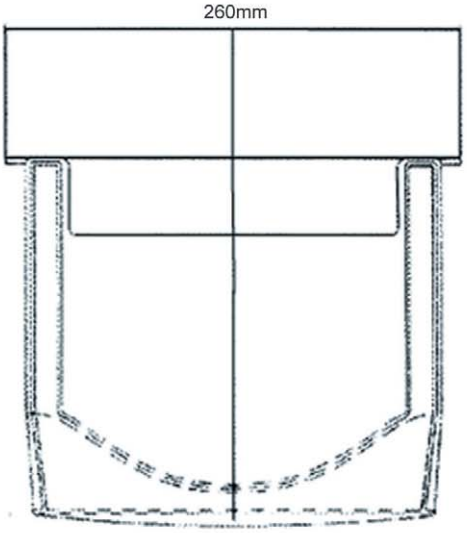
Bottom Elevation



Front Elevation

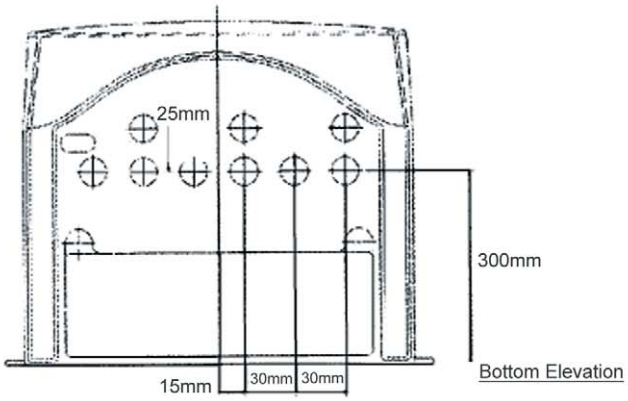


Side Elevation

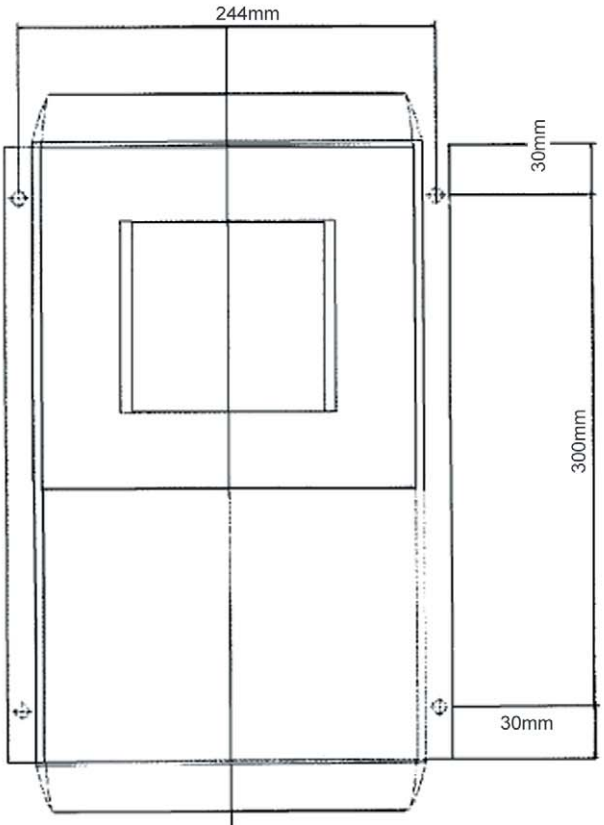


Top Elevation

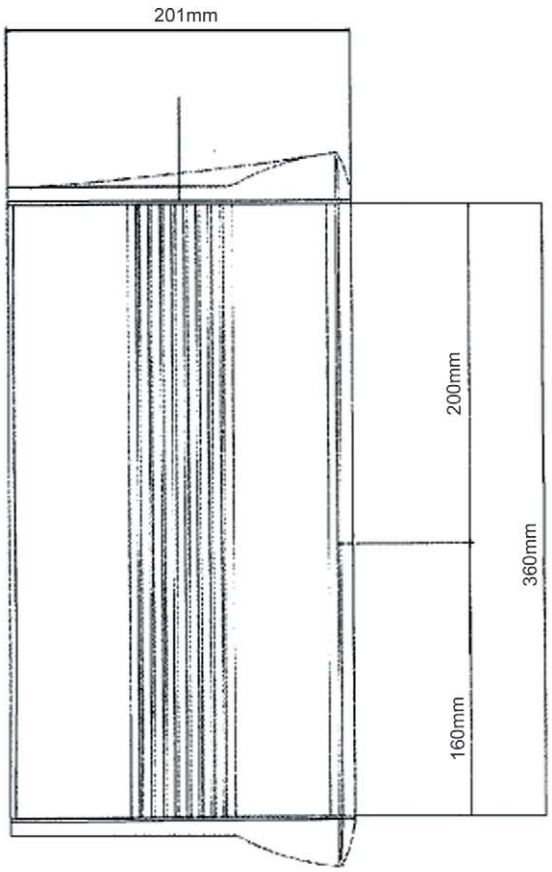
Soft Start Size 2
56 Amp
Unit Weight 7Kg



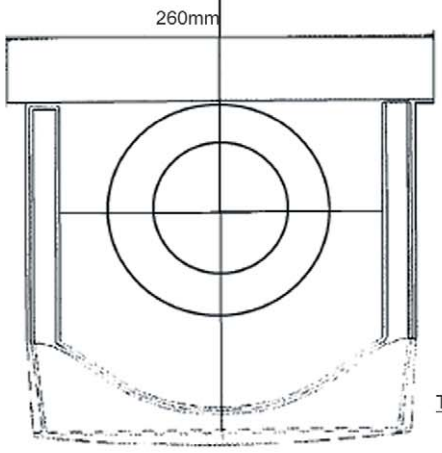
Bottom Elevation



Front Elevation

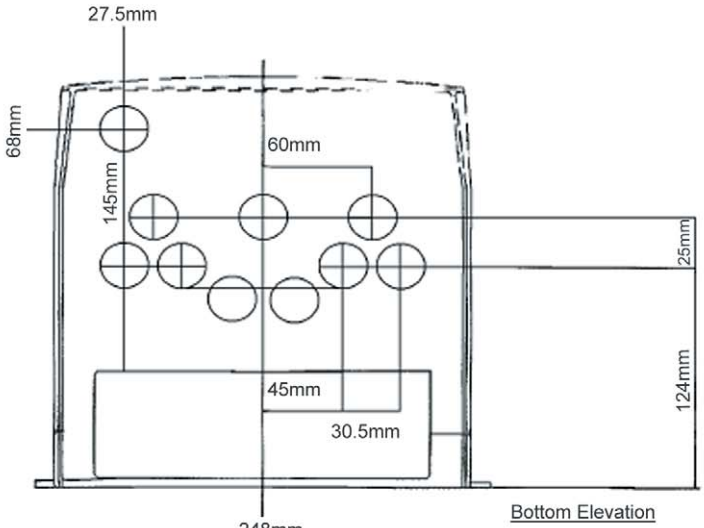


Side Elevation

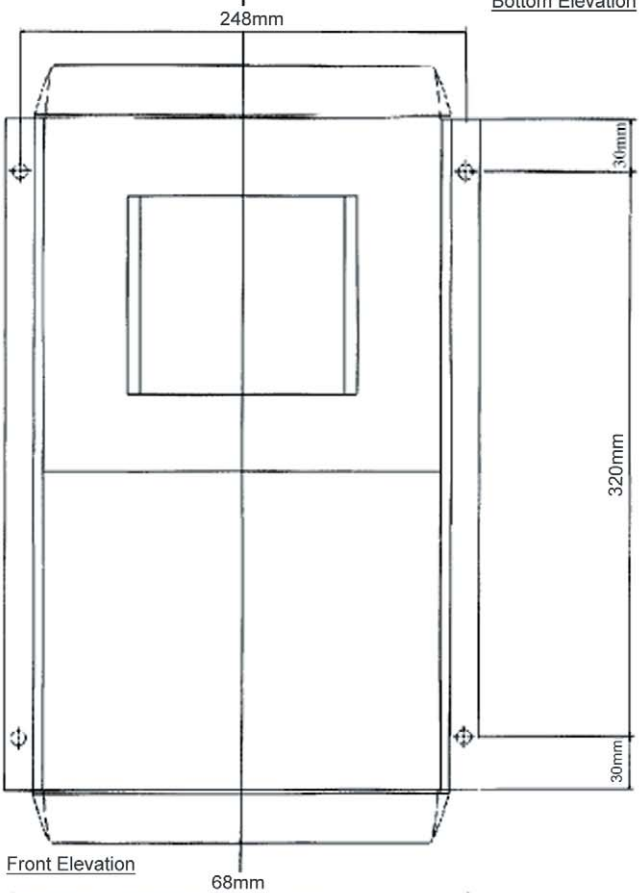


Top Elevation

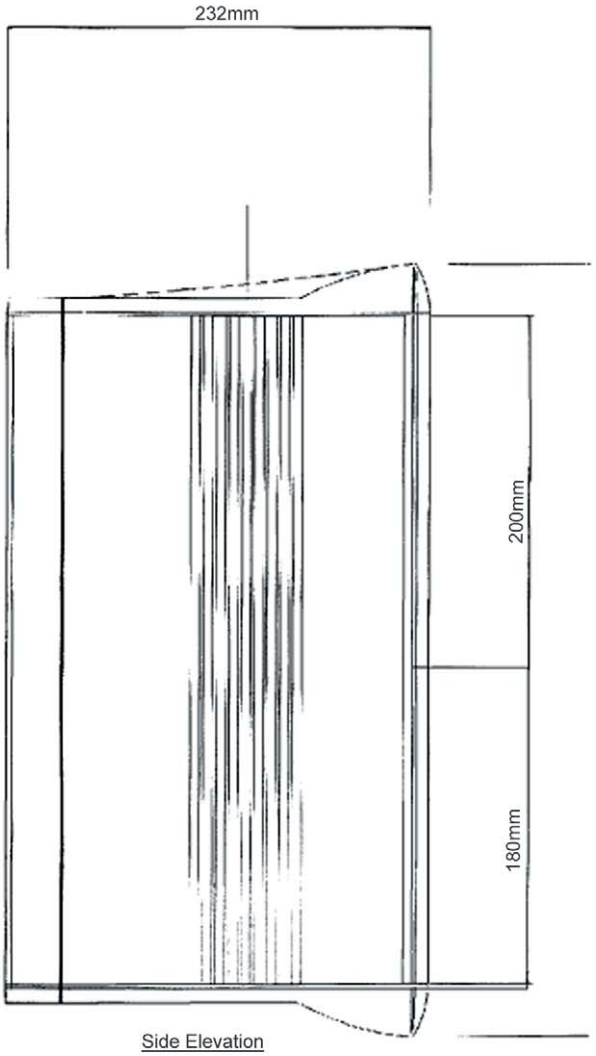
Soft Start Size 3
70-120 AMP
Unit Weight - 13kg



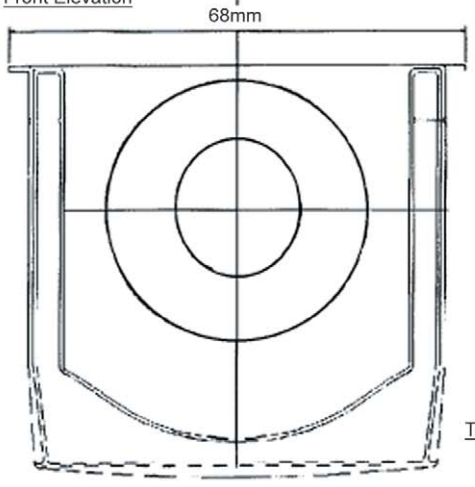
Bottom Elevation



Front Elevation

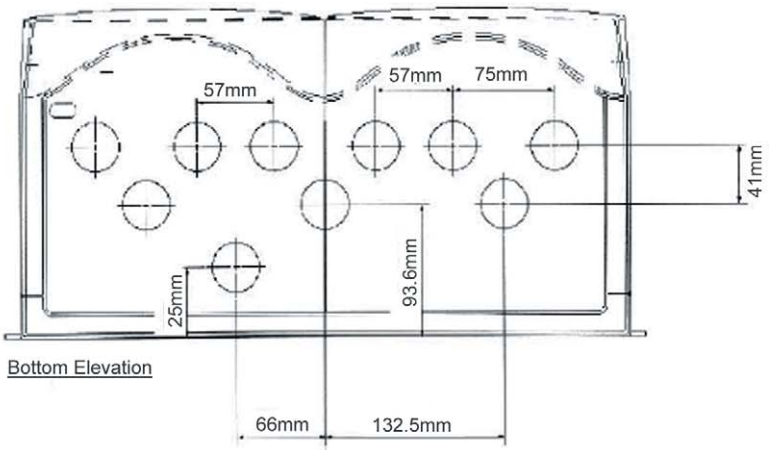


Side Elevation

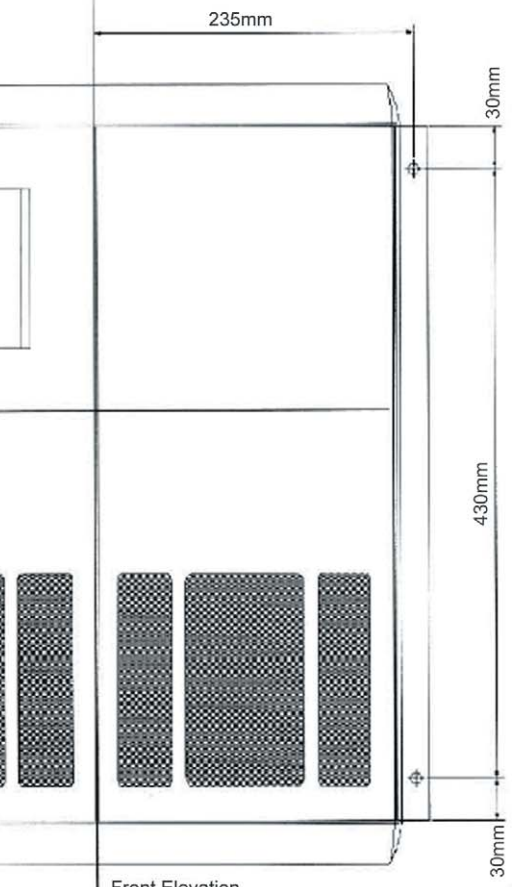


Top Elevation

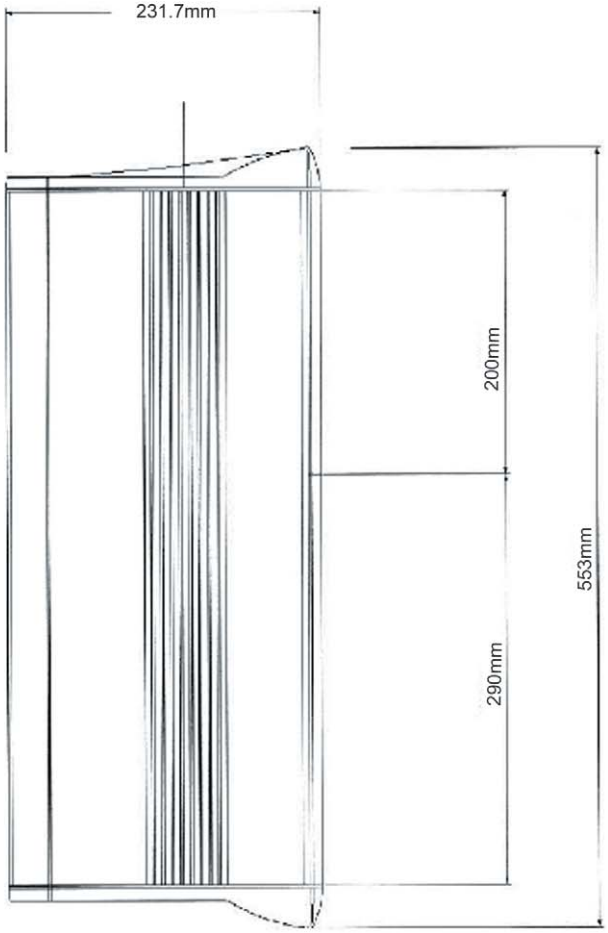
Soft Start Size 4
145-205 AMP
Unit Weight - 17kg



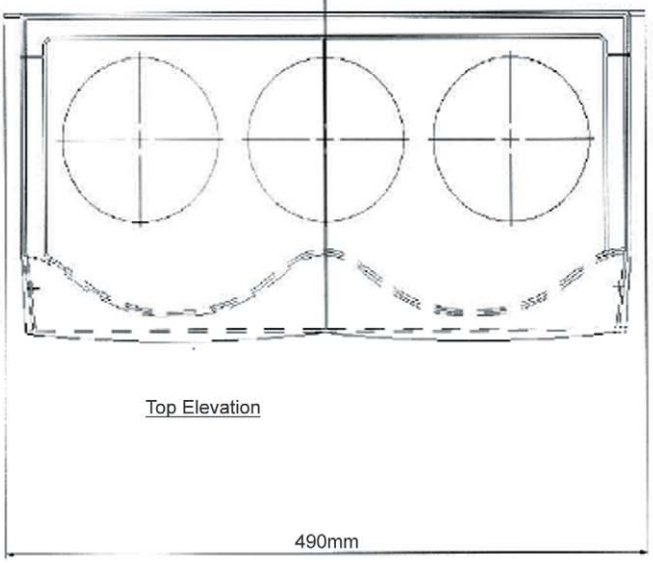
Bottom Elevation



Front Elevation

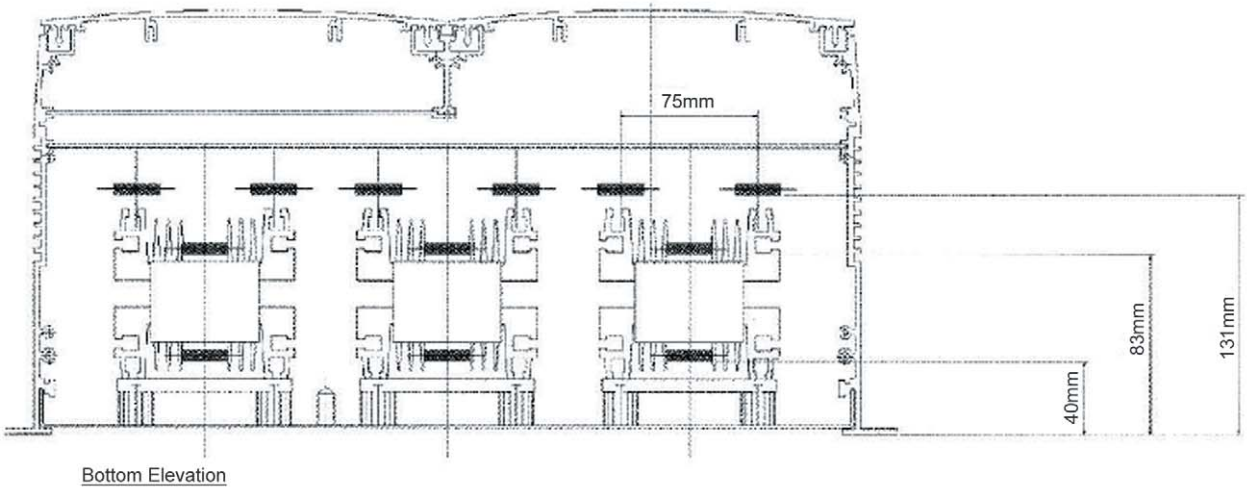


Side Elevation

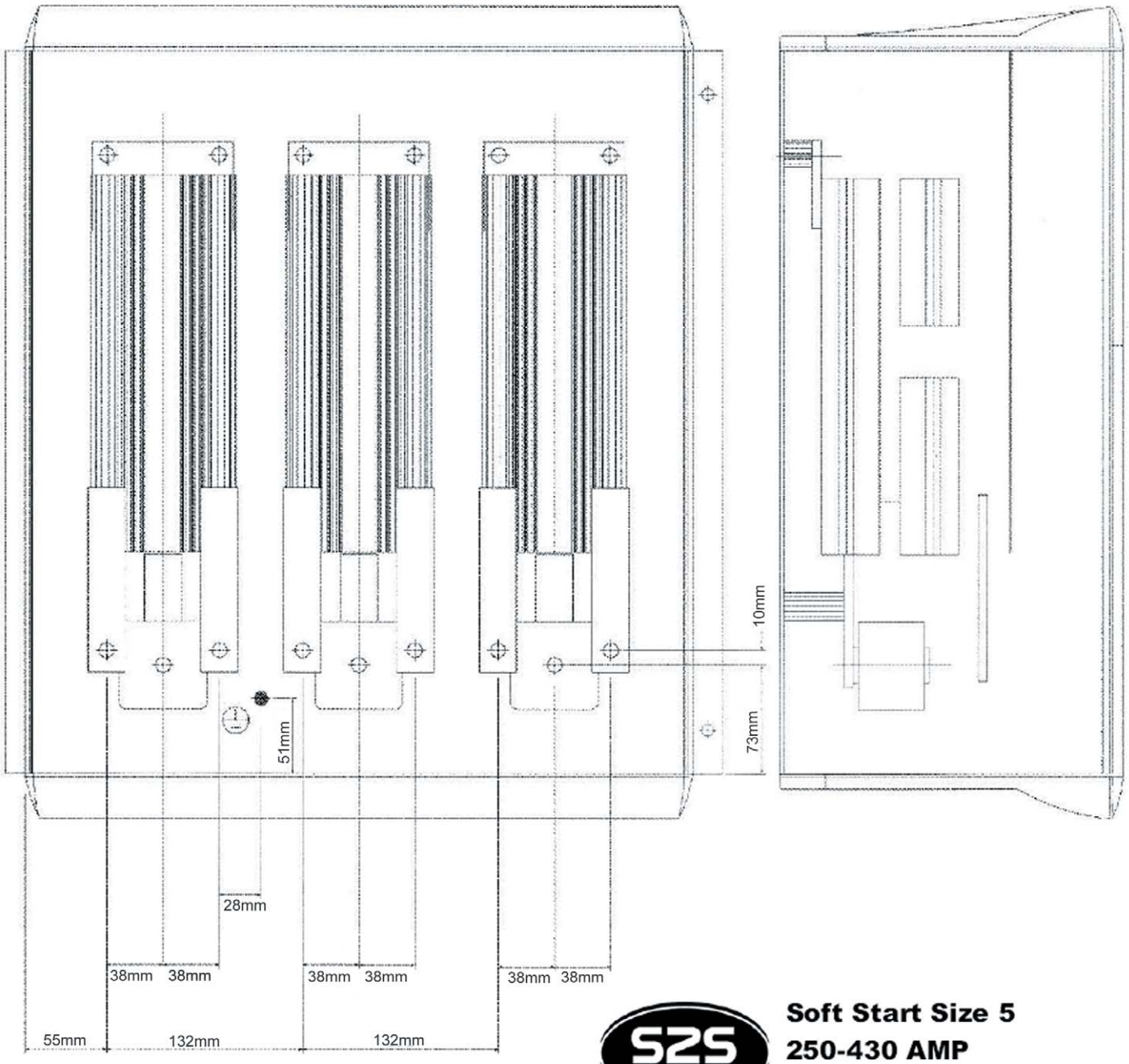


Top Elevation

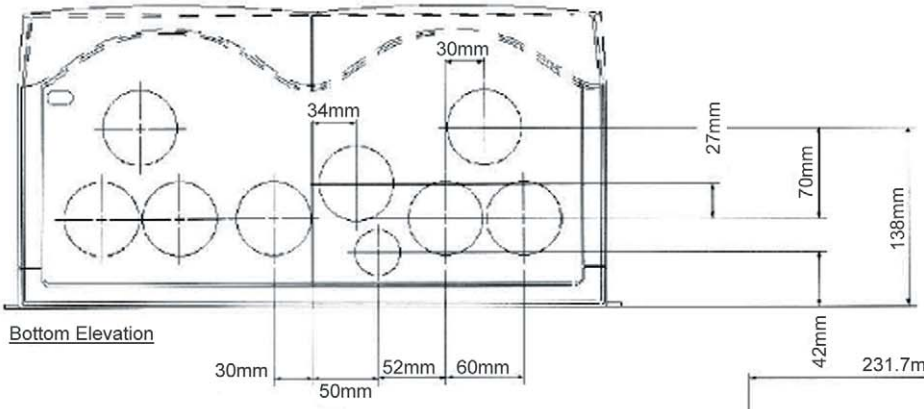
Soft Start Size 5
250-430 AMP
Unit Weight - 25kg



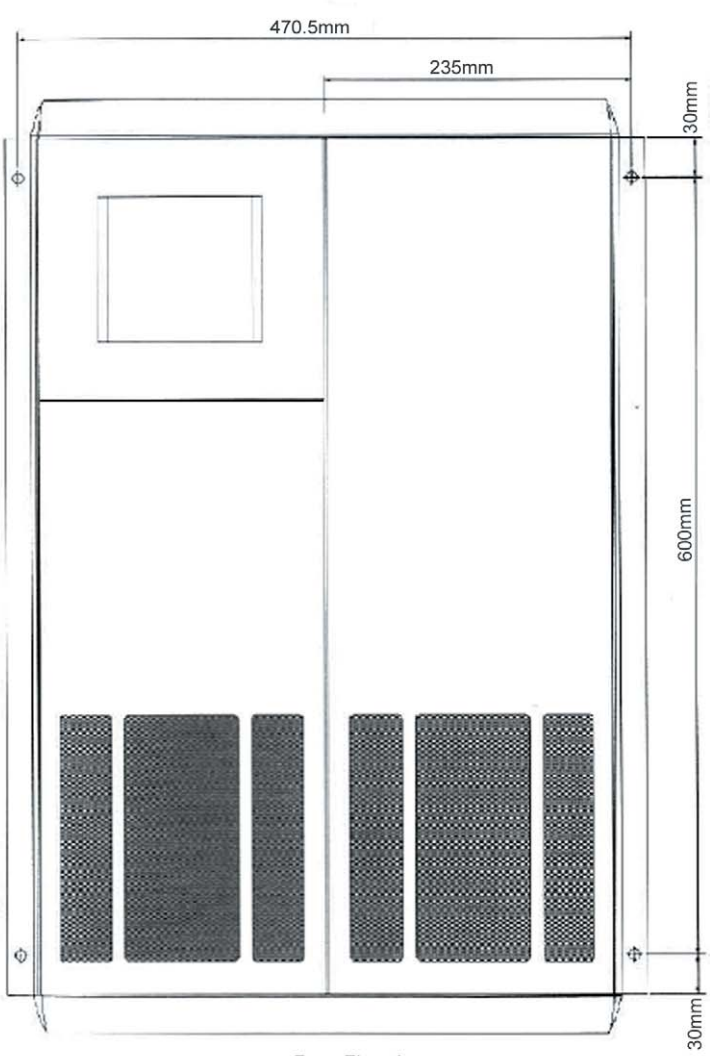
Bottom Elevation



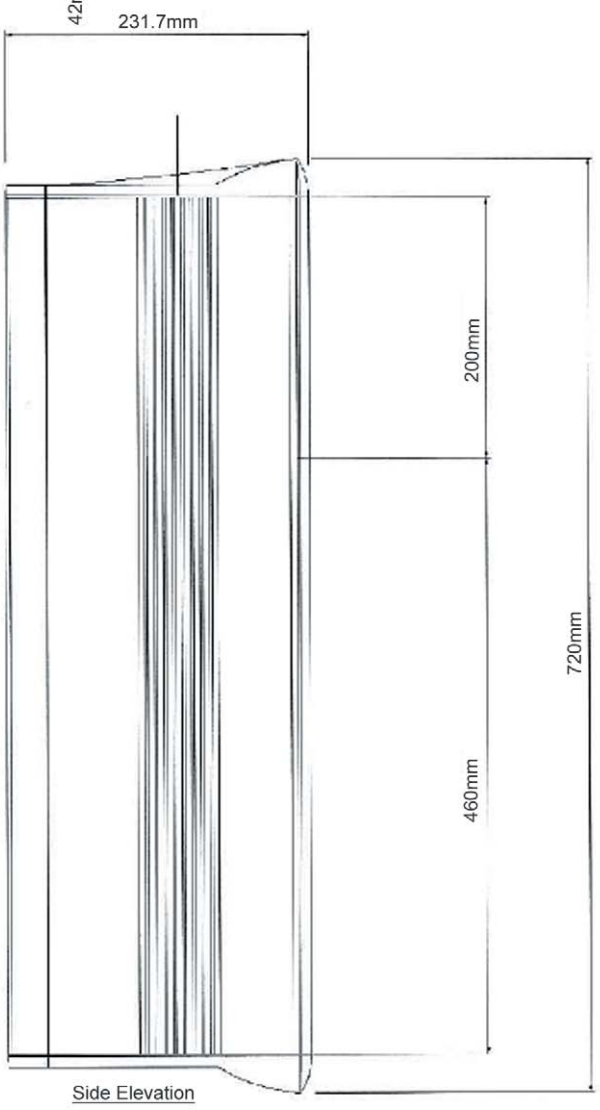
Soft Start Size 5
250-430 AMP
Internal Arrangement



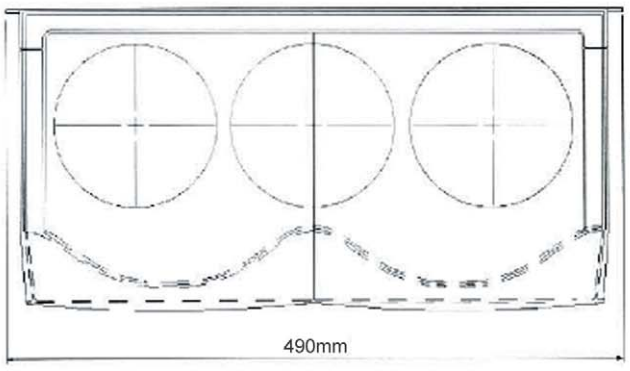
Bottom Elevation



Front Elevation



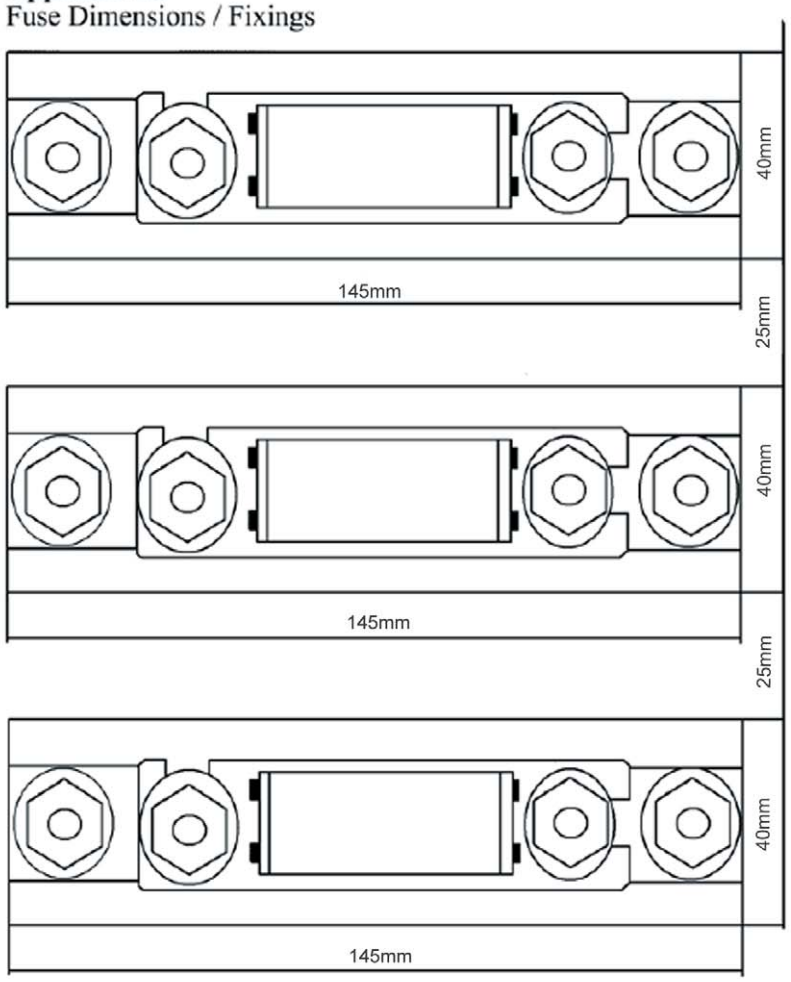
Side Elevation

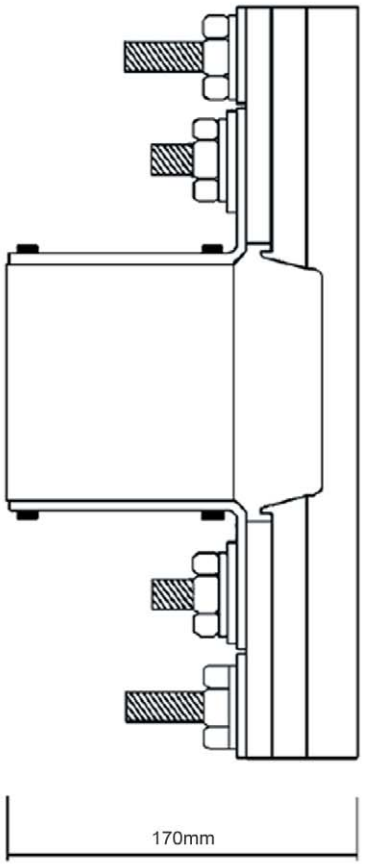


Top Elevation

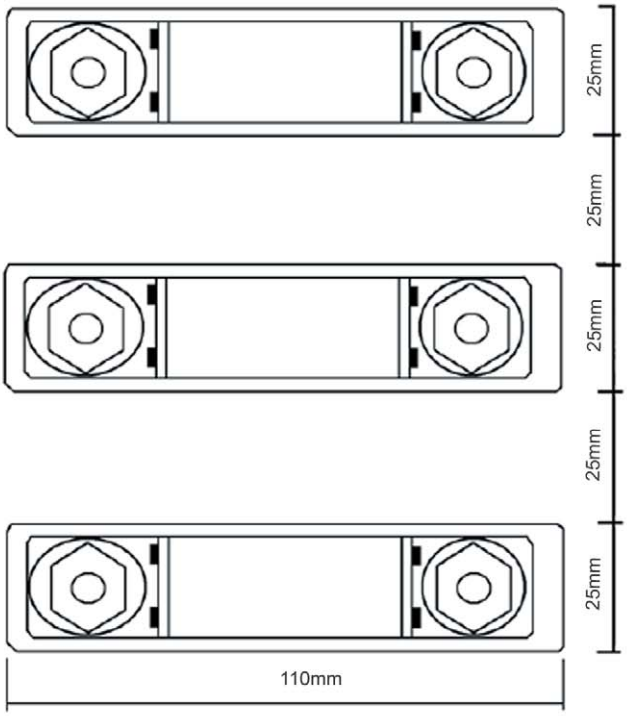
Soft Start Size 6
550-700 AMP
Unit Weight - 42kg

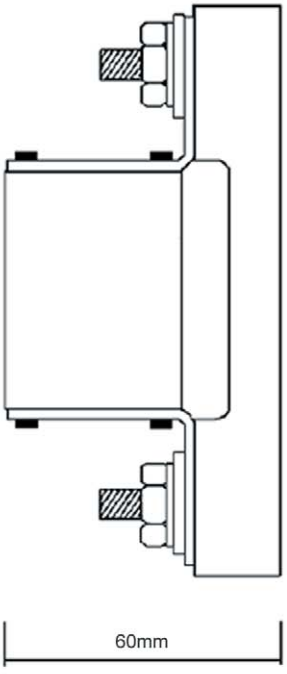
Appendix 2.0
Fuse Dimensions / Fixings





220-400 Amp Fuse

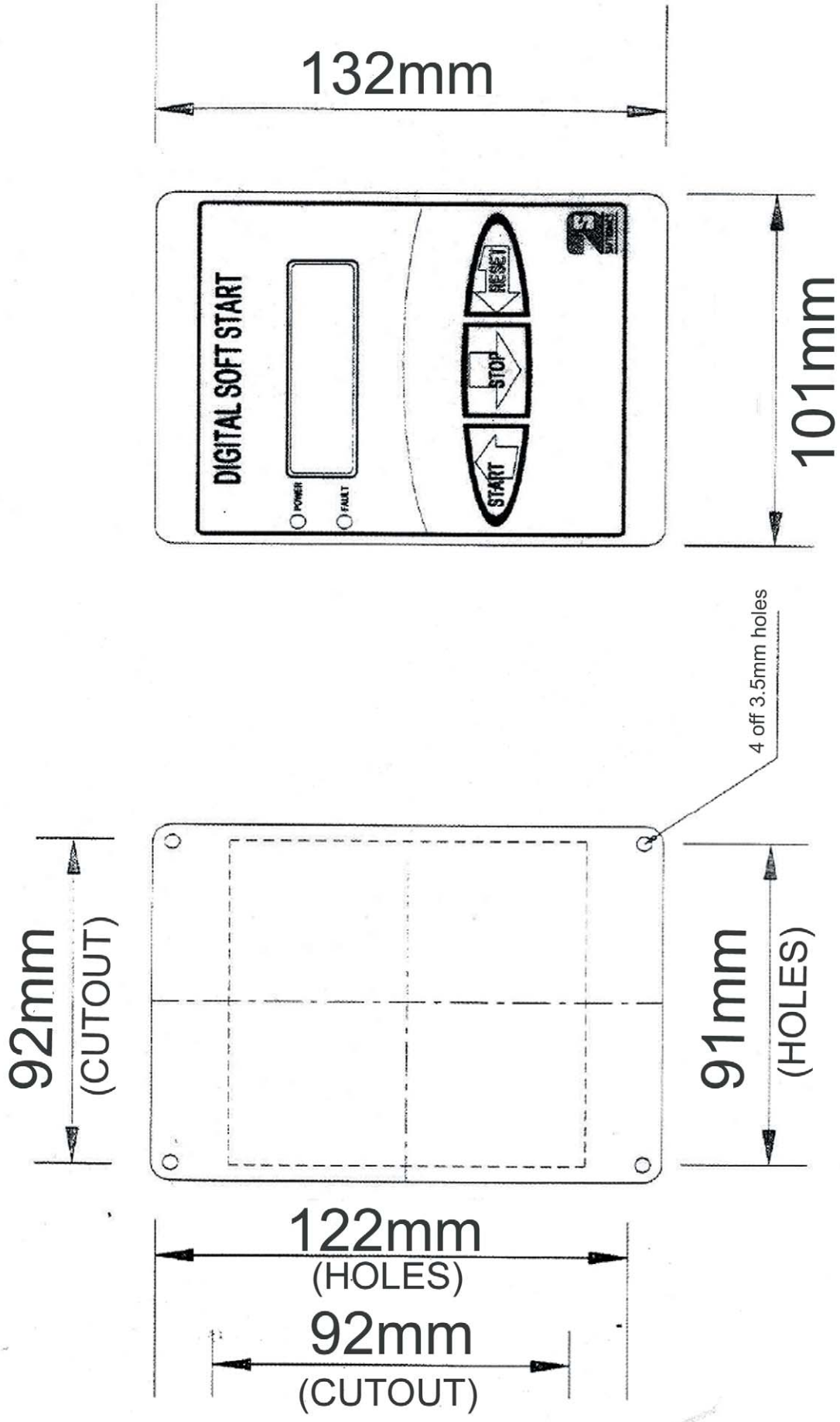




50-200 Amp Fuse

Appendix 3.0
Keypad Door Mounting Kit Dimensions

Soft Start keypad Cutout Detail



Appendix 4.0
Customer's Notes / Parameter Settings

PARAMETER	FACTORY DEFAULT	ADJUST	SETTING
MAIN MENU			
Current Limit	300%	100 - 500%	
Ramp Up Time	30 secs	1 - 240 secs	
Ramp Down Time	30 secs	1 - 240 secs	
Pedestal Up	25%	0 - 80%	
Pedestal Down	100%	100 - 30%	
Zero Sense	5%	80 - 5%	
SECOND MENU			
I Limit Trip time	20 secs	1 - 240 secs	
Resume on Trip	Off	On/Off	
I Limit on Soft Stop	Off	On/Off	
Kick Start	Off	On/Off	
Kick Voltage	75%	75 - 90%	
Kick Cycle	5 cycles	5 - 10 cycles	
Auto Phase	Off	On/Off	
ByPass Mode	Off	On/Off	
Over-Current	500%	70 - 500%	
Under-Current	0%	0 - 90%	
Under-Current Time	15 secs	0 - 15 secs	
C.T. Burden	22	10 - 1000	
C.T. Ratio	3	1 - 4	
Motor Set Current	16	1 - 2000A	
Overload Trip Time	5 secs	1 - 30 secs	
Mains Mode	Off	On/Off	
Ext. Control	Off	On/Off	
Security	Off	On/Off	
Access Code	0000	0000 - 9999	
Diagnostic Address	255	0 - 255	
Language	1 - English	1 - 4	
Imbalance	On	On/Off	
% Imbalance	20%	10 - 30%	
Programmable Relay	4	0 - 4	
Lock Control	0ff	On/Off	
Port 0 Delay	50	0 - 100	
Field Bus	On	On/Off	
2nd Motor Set I	22A	1 - 2000A	
Overload Trip Time 2	**5 secs**	**1 - 30 secs**	
Earth Trip Level	**1000 mA**	**100 - 6000 mA**	
Earth Trip Delay	**1 sec**	**1 - 10 secs**	

Issue Numbers

Issue	Description/Modification	Date	Modified	Checked
1	Initial Issue	28.4.95	AD	PAC
2	Page 5: Ratings to be altered. Page 6: Frequency Band changed. Page 12: Under-voltage resistance setting modified. Page 15/16: Terminal numbers modified. Page 22-25: Drawings modified - remove auxiliary contacts.	1.8.95	AD	PAC
3	Page 5: 170A Burden Resistor value changed.	23.1.96	PAC	AD
	Page 9: $V = f\frac{QV}{t}$	23.1.96	PAC	AD
	Page 9: QV = heat loss	23.1.96	PAC	AD
	Page 12: Section 3.1 Reference to control voltage added.	23.1.96	PAC	AD
	Page 17: Section 3.4 ByPass - text modified and new note on current transformers.	23.1.96	PAC	AD
	Page 25: Drawings modified to show bypass connection.	23.1.96	PAC	AD
	Page 18: New Section 3.4.1 Electromagnetic compatibility.	23.1.96	PAC	AD
	Page 30: ByPass Mode default to 'ON', also description modified.	23.1.96	PAC	AD
	Page 31: Over-current 70-500% description modified.	23.1.96	PAC	AD
	Page 35: Fault 4/ Phase sequence text modified.	23.1.96	PAC	AD
	Page 35: Fault 10/ Current imbalance text added.	23.1.96	PAC	AD
4	Page 14: Added Card Layout Diagram.	29.5.96	AD	PAC
	Appendices 1, 2 & 3 added showing layouts and Set-Up Sheet.	29.5.96	AD	PAC
	Page 22-25: Modified to reflect changes to busbar design for bypass.	20.8.96	AD	PAC

New Format IP20 Design

Issue	Description/Modification	Date	Modified	Checked
5	Page 1: Contents changed.	10.4.97	AD	PAC
	Page 3: Tables changed for new IP20 design.	10.4.97	AD	PAC
	Page 4: Specification change for new IP20 design.	10.4.97	AD	PAC
	Page 4: Features added for new design.	10.4.97	AD	PAC
	Page 6: Section on overload changed to reflect new software available.	10.4.97	AD	PAC
	Page 6: New features added in product.	10.4.97	AD	PAC
	Page 7-12: Section 3 on connections changed to suit new features and new card layout & circuit diagrams.		AD	PAC
	Page 13: Section 4 on programming changed to reflect addition of start/stop mode to new keypad.		AD	PAC
	Page 14-15: New default settings and new parameters added.		AD	PAC
	Page 16: New fault messages added.		AD	PAC
	Page 17-20: Section 8 on setting up altered to suit new features and software options.		AD	PAC
	Page 21: Spares listing changed to reflect IP20 design.		AD	PAC
	Page 22-31: New physical layout diagrams added.		AD	PAC
	Page 32: New parameters setting list added.		AD	PAC
6	Section 8: overload curve added up to 30 seconds.	23.4.98	AD	AG
	Section 7: Addition of communication data.	23.4.98	AD	AG
7	Appendix 1: dimension drawings changed for new frame size page 3 ratings tables changed for new frame sizes	28.3.00 28.3.00	AD AD	IF IF
8	Section 7.1: added on fieldbus connections Page 14. notes on Diagnostic Address facility added. Section 4.8 on transformer control added. Appedix added.	29.10.01	AD	GO
9	P4 - New Board P6 - New Keypad New Layout	11.10.02	AD	GO

Issue	Description	Date	Modified	Checked
10	**Page 1:** Contents moved from inside front cover. **Page 2:** Specification and main features altered to reflect change to MK3 control board. **Page 3:** Removed section 2.4.4 current ramp and 2.4.5 Tacho Feedback. Added 'service maintenance and spares.' **Page 5:** Control card diagram modified to reflect change to MK3 version terminal function modified: J2, 1 to 4 now N.C, J3, 1 & 2 now fan output, J9, Firmware programming connection, J11, Fieldbus Connection, J19, Programmable Relay Output. **Page 6:** Fault outputs changed to reflect addition of programmable relay. **Page 7:** Connection diagram modified to reflect change to MK3 control board. **Page 8:** Same as previous. **Page 9:** Section 4.3 start stop via keypad changed to reflect change from RS422 to RS485 protocol. **Page 10:** Section 4.9 settings on switch SW1 changed to reflect functions available on MK3 control card. **Page 11:** Parameter second menu changed to reflect addition of programmable relay and change to fieldbus protocol. **Page 12:** Removed list of extended fault codes. **Page 13:** Communications protocol changed from RS422 to RS485. **Page 14 & 15:** Removed section 8.2 - optional software. **Page 17:** Section 9 moved to page 3.	10/10/05	GO	AD
11	**Front Page:** Note added. **Page 9:** Start/Stop via keypad alterations.	21/7/06	GO	AD
12	**Page 5:** Section 3.1 Note 'Please refer to circuit diagram 3.0 and 3.1 for standard and by pass configuration' changed to 'Please refer to circuit diagram 3.0 and 3.1 for Soft Stop and Hard Stop. **Page 7 & 8:** Alterations made to circuit diagrams. **Page 10:** 'Switch Settings on SW1, Fan O/P enable' changed from ON to OFF. **Page 11:** Mains Loss Ridethrough description changed from 'If supply is re-installed' to 'If supply is reinstated.' **Page 12:** First paragraph reads as one sentence now. **Page 14:** 'J1 terminals 5 & 6 are linked together.' **Page 14:** 'Dispaly' changed to 'Display' in 8.1.3.	9/8/07 9/8/07 9/8/07 9/8/07 9/8/07 9/8/07 9/8/07	GO GO GO GO GO GO GO	AD AD AD AD AD AD AD