

User's Manual:

SMARTSTART[®]

6000 Series

Models:

6R15 – 6R830

6V400 – 6V630





(General Warning)

Read & familiarise yourself with the warnings detailed on Page 1 of the manual before proceeding.



(High Voltage Warning)

Read all operating instructions before installing, wiring, operating, servicing or inspecting the Smartstart®. Ensure that the instruction manual is made available to the final user of the product as well as all personnel involved in any aspect of installation, adjustment or maintenance.

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IMPORTANT – Read this first !!



Read all operating instructions before installing, wiring, operating, servicing or inspecting the Smartstart®. Ensure that the instruction manual is made available to the final user of the product as well as all personnel involved in any aspect of installation, adjustment or maintenance.

Your Smartstart® must be applied and installed by a suitably qualified and experienced electrical tradesperson in accordance with this manual, good engineering practice and all local rules and regulations.



There are hazardous voltages inside the Smartstart® whenever it is connected to an electrical supply.

The Smartstart® contains high energy circuits that may be hazardous. Do not operate with the covers removed or the doors of the enclosure in which it is installed open. Do not touch the terminals of the Smartstart® or any associated motor and wiring when it is energised, even if the Smartstart® and motor are stopped. Electric shock may result.

Do not modify this equipment electrically, mechanically or otherwise. Modification may create safety hazards as well as voiding the UL listing of models so listed.

The Smartstart® is designed to drive an appropriately rated and otherwise suitable 3 phase induction motor. It is not suitable for single phase motors or other types of motor or non-motor load. Use with inappropriate load types may create a safety hazard.

Where the Smartstart® is used as a component part of another product, it is the purchaser's responsibility to ensure that the final product meets all of the necessary safety, EMC, regulatory, operational and other requirements for that product. Requirements for the purchaser's final product may be substantially different to the requirements for stand-alone inverters.

The Smartstart® is intended for use only in fixed wiring applications. It is not intended for use on a flexible supply cable.

Mount the Smartstart® on a vertical, incombustible surface such as metal or masonry. Do not place combustible or flammable material near the Smartstart®. Failure to observe these precautions may create a fire hazard

The Smartstart® is manufactured under strict quality control arrangements, however additional and independent safety equipment must be installed if the application is such that failure of the product may result in personal injury or property damage.

Ensure the Smartstart® is applied in a manner that does not adversely affect the proper operation of other equipment or systems, particularly those that have a safety function.

Install emergency stop circuitry that removes power from the Smartstart® and does not depend on any feature of the product for proper and safe operation.

The Smartstart® has features that may be used to cause an automatic restart in certain circumstances. The overall application (machine etc) must be designed such that automatic restart is not hazardous.

Do not install this equipment in locations where mechanical damage to the enclosure is possible. In particular, consider vehicles, vandalism and attack by insects or animals. Severe equipment damage and safety hazards may result.

Introduction

Receiving:

Inspect the Smartstart® for any shipping damage. If any damage is found, report it to the carrier immediately. Remove cover of starter and visually check for damage.

Do not attempt to operate the Smartstart® if any obvious damage exists or suspect damage has occurred.

After the initial inspection, the Smartstart® can be repacked and stored in a clean, dry location until it is required for use.

Handling & Storage:

To ensure the starter is protected before installation, handle and store the equipment in its packaging.

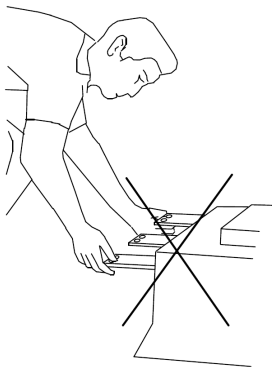
DO NOT store this equipment in an area where the ambient temperature will fall below -20°C or rise above 70°C. DO NOT store this equipment in areas that are subject to condensation or corrosive atmosphere. Proper storage is necessary to ensure satisfactory startup and performance.

Handling on Installation:

The Smartstart® 6000 range comprises 3 sizes with various weights and dimensions.

An appropriate handling device must be used with large starters. 'Handling points' have been provided to aid lifting.

The precautions described below must be followed:



Use handling points where provided to lift larger units.

Software:

This manual applies to the Smartstart® 6000 series software revision R0.96K. The Software revision can be viewed on the 'Dash Board' (Display) of the Smartstart.



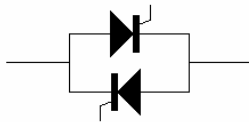
DO NOT handle the starter by the power terminals/busbar.

Introduction

Smartstart® 6000

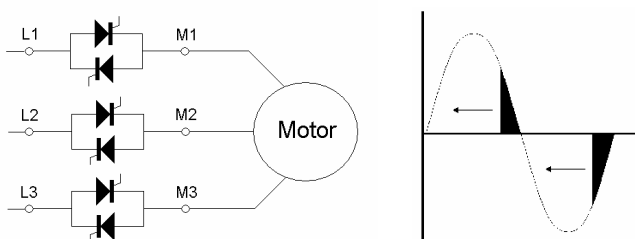
Basic Soft Starter Operation

The Zener Smartstart® is a reduced voltage controller designed for starting standard 3 Phase induction motors. The unit is solid state, using a microprocessor to control inverse parallel (back to back) pairs of SCR's.



An SCR/thyristor is a semiconductor device that latches when triggered. Once triggered it allows current to flow in one direction only and turns off at zero current.

The firing angle of the SCR's are controlled to achieve the desired acceleration of the motor.



Soft Starters provide the following benefits:

1. Reduced stresses and wear on the mechanics of the system
2. Reduced starting currents
3. Minimise voltage dips on the supply
4. Lowered Peak demand charges
5. Eliminate belt slippage on fans
6. Smooth acceleration of motor / load

Zener 'SMART-TORQ®' Torque Control Feature

The Zener Smartstart® 6000 incorporates a closed loop torque control system to provide better control over starting & stopping 3 phase induction motors. Conventional voltage ramp control systems typically produce low torque at low speeds. When starting & stopping variable torque loads (e.g Pumps) this can result in a very rapid acceleration or deceleration with a non linear change in motor speed.

The Smartstart® 6000 series overcomes these issues by regulating the torque in the motor to match the load type during the acceleration & deceleration. This essentially allows a constant torque to be produced in the motor. The continual monitoring of the motor characteristics during the ramp also allows instantaneous adjustment of the starter output to allow for changes in load conditions.

The 'SMART-TORQ®' control system provides smooth starting & stopping, allowing ramp profiling to produce a linear acceleration and deceleration of the motor speed. There are many benefits with variable torque loads such as pumps and fans by achieving a linear ramp profile and greater control over deceleration. With pump applications this provides better control to minimise water hammer problems.

SMART-TORQ Benefits include:

1. A true linear acceleration of the load and motor for all load types.
2. Reduced peak inrush starting currents.
3. Reduced stresses and wear on the mechanics of the system
4. Ramp profiling to better match type of load such as variable torque loads. Better control of pumps and fans, without rapid initial ramp but linear ramp.
5. Reduced heating in motor at low speeds.
6. No instability due to changing power factor. Closed loop system to monitor and react to changing power factor.
7. No instability due to slot ripple in 3 wire and 6 wire operation.
8. Better control of deceleration through closed loop torque control system.

The Smartstart® also offers user access to ramp profiling parameters to fine tune the Torque Control System to achieve more application specific performance requirements. See Page 34 for more information.

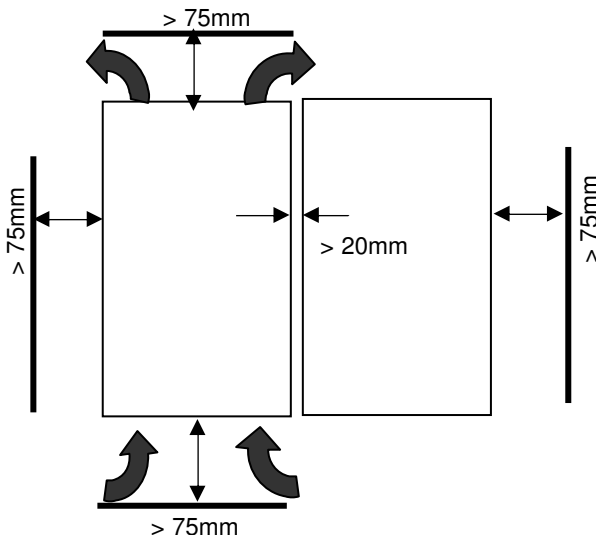
Installation - Mechanical

Mechanical Installation



The Smartstart® should be installed by qualified electrical personnel only. The following should be considered when installing the Smartstart.

- Mount in a vibration free environment.
- Mount vertically and away from heat radiating sources.
- Do not mount in direct sunlight or on hot surfaces.
- Mount in a suitable enclosure for the environment in which it is to operate, the total heat dissipation must be considered.
- Do not drill holes into the Smartstart® enclosure.
- Do not allow metal shavings or any other conductive material to enter the enclosure or damage may result.



Heat Dissipation



The Smartstart® is cooled by temperature controlled internal fans. Installing a bypass contactor will reduce the heat dissipated and the ventilation required. Soft Starters generally dissipate approximately 4.5watts per Amp when operated without a bypass contactor.

The heat dissipated can be calculated by;

Continuous Duty:

$$P = (FLC \times 4.5)$$

Bypass Duty:

$$P = (FLC \times SC \times 4.5 \times t \times N) / 3600$$

Where;

- P = Power dissipated in Watts
- FLC = Nameplate FLC of Motor
- SC = Average starting current expressed per unit of FLC
- t = Starting time
- N = Number of starts per hour

When installing the Smartstart® in an enclosure or switch board it is necessary to consider the heat dissipated and then the ventilation required.

The following formula's will assist in determining whether ventilation is required and how much.

Ventilated Enclosure:

$$V = (3.1 \times P) / T$$

- Where;
- V = Airflow required in m3/hour
 - P = Power dissipated in Watts
 - T = Temperature differential in °C (inside – outside)

Non Ventilated Enclosure:

$$A = P / (T \times k)$$

- Where;
- A = Exposed surface area of cabinet in m2
 - P = Power dissipated in Watts
 - T = Temperature differential in °C (inside – outside)
 - k = Heat transmission constant (5 for Painted metal)

Installation - Mechanical

Dimensions

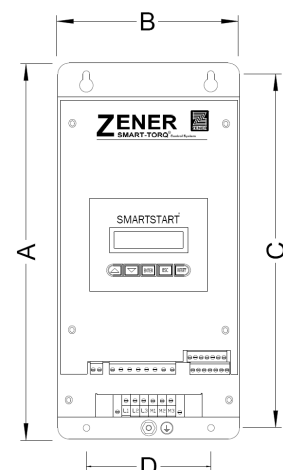
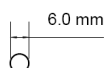
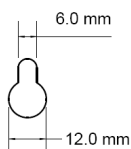
(All Dimensions in mm)

Model:	Chassis	A	B	C	D	Depth
6R015B2	B2	335	162	315	111	172
6R030B2	B2	335	162	315	111	172
6R060B2	B3	440	162	420	111	172
6R080B2	B3	440	162	420	111	172

Mounting Holes:

Top

Bottom

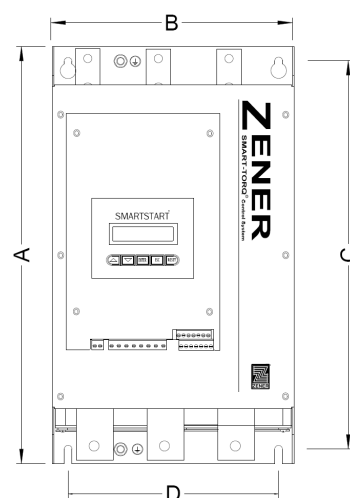
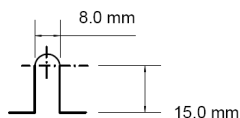
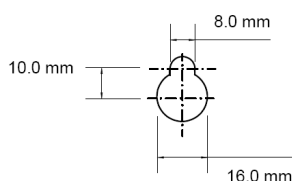


Model:	Chassis	A	B	C	D	Depth
6R10000	A2	430	248	400	216	232
6R19000	A2	430	248	400	216	232
6R22000	A2	430	248	400	216	232

Mounting Holes:

Top

Bottom

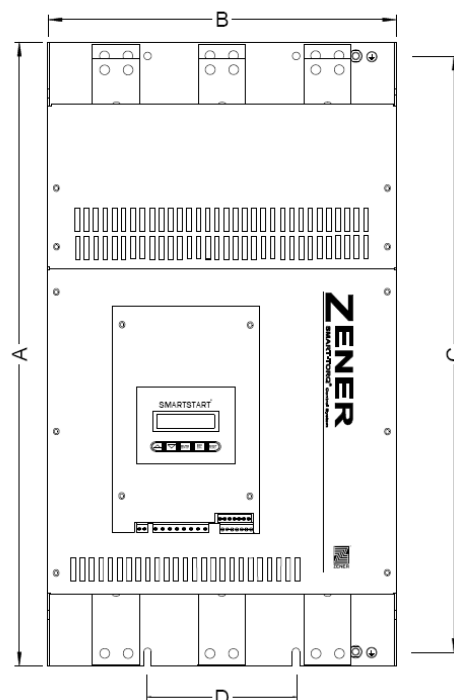
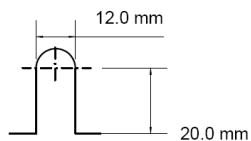
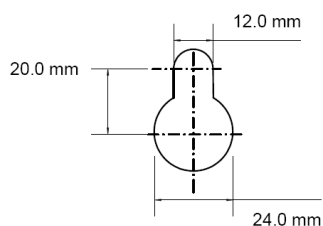


Model:	Chassis	A	B	C	D	Depth
6R36000	A3	670	375	640	159	285
6R58000	A3	670	375	640	159	285
6R83000	A3	670	375	640	159	285

Mounting Holes:

Top

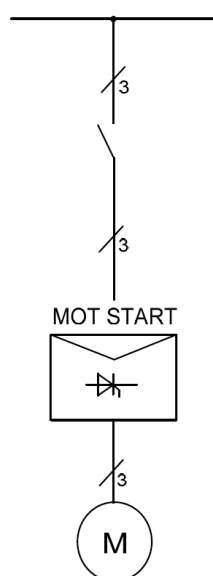
Bottom



Installation - Power Wiring

Power Wiring

The Zener SS6000 is installed between the mains and cable to the motor. If a mains or isolation contactor is used it is best controlled by the SS6000 'Line relay'.



3Wire / 6wire: The standard connection of an electronic soft starter is 3 wire. An alternative connection is 6 wire or inside delta connection. This is commonly used when replacing a star/delta type motor starter.

Bypass / Continuous: The Smartstart® can operate with or without a bypass contactor. Some models include an integral bypass contactor. The bypass contactor reduces the heat dissipation of the soft starter as the semiconductors are bypassed after the ramp time.



Select cables & install in compliance with local regulations

Motor Protection:

The Smartstart 6000 provides advanced motor protection with user selectable overload classes, over & under current protection, phase imbalance and thermistor protection. It is important that the power wiring is followed correctly to ensure proper protection and starter performance.

Refer to page 18 and 28 for more details regarding motor protection.

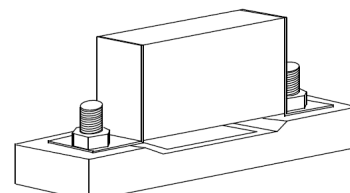
Semiconductor Fuses

Semiconductor fuses are recommended for all electronic soft starters to provide protection of the thyristors in the event of an output short circuit. Semiconductor fuses are strongly recommended for applications such as submersible pumps.

Semiconductor fuses are optional with all models.

- For smaller models (15 – 80Amp) fuse kits are available.

Semi-conductor Fuse



Fuse Holder

Refer to instruction sheet for more details and dimensions.

- For larger models semiconductor fuse kits are available.
- Refer to page 33 for more details on semiconductor fuses.

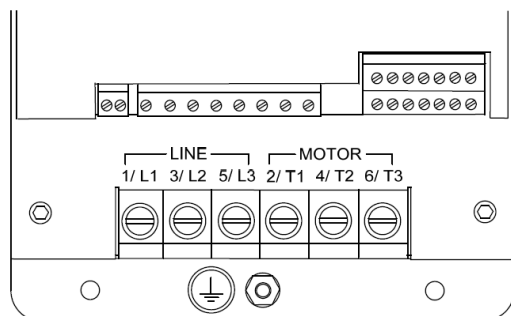
Installation - Power Terminals (up to 80Amp)

3 Wire with integral Bypass

Only Models; 6R015B2
6R030B2
6R060B2
6R080B2

Power Terminations

Model:	Max cable size	Tightening Torque
6R015B2	6 / 10mm ²	1.5 – 1.8 Nm
6R030B2	6 / 10mm ²	1.5 – 1.8 Nm
6R060B2	35mm ²	3.2 – 3.7 Nm
6R080B2	35mm ²	3.2 – 3.7 Nm
Earth	M6 stud	-



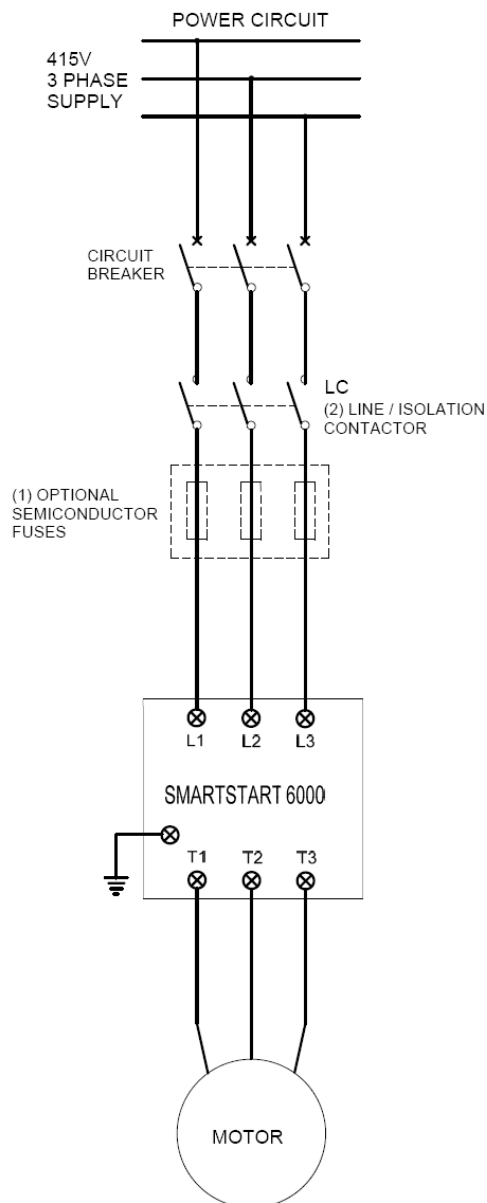
Semiconductor Fuse kit (Optional)

Model:	Description	Part No.
6R015B2	Fuse Kit to suit 15A	TQ00020
6R030B2	Fuse Kit to suit 30A	TQ00021
6R060B2	Fuse Kit to suit 60A	TQ00022
6R080B2	Fuse Kit to suit 80A	TQ00023
-	Fuse Kit Cover	TQ00024

Refer to instruction sheet for more details and dimensions.

Semiconductor Fuse Replacement

Model:	Description	Part No.
6R015B2	Semiconductor Fuse	TF
6R030B2	Semiconductor Fuse	TF
6R060B2	Semiconductor Fuse	TF
6R080B2	Semiconductor Fuse	TF



- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Line Contactor controlled by the Soft Starter (see Control Wiring Page 14 & Application Drawings Page 36-38)
- (3) Models 6R15 to 6R80 include an integral Bypass Contactor. With these models an external Bypass Contactor is not required



**Refer to page 13
For Control Wiring**

Installation - Power Terminals (100A model and above)

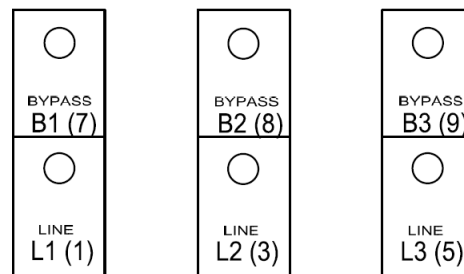
Power Terminations

Model:	Chassis	Busbar Hole	Bolt Size	Earth Stud
6R10000	A2	1x 8.5mm	M8	M8
6R19000	A2	1x 8.5mm	M8	M8
6R22000	A2	1x 8.5mm	M8	M8
6R36000	A3	2x 10.4mm	M10	M8
6R58000	A3	2x 10.4mm	M10	M8
6R83000	A3	2x 10.4mm	M10	M8
6V40000	A3	2x 10.4mm	M10	M8
6V63000	A4	2x 10.4mm	M10	M8

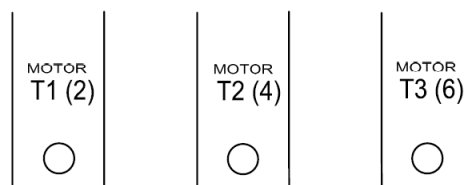
(All soft starters include a bolt kit)

Chassis A2:

TOP



BOTTOM



Semiconductor Fuse kit (Optional)

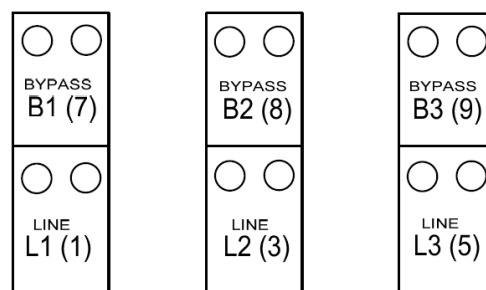
Model:	Description	Part No.
6R10000	Fuse Kit to suit 6R100	TQ00025
6R19000	Fuse Kit to suit 6R190	TQ00026
6R22000	Fuse Kit to suit 6R220	TQ00027
6R36000	Fuse Kit to suit 6R360	TQ00028
6R58000	Fuse Kit to suit 6R580	TQ00029
6R83000	Fuse Kit to suit 6R830	TQ00030

Semiconductor Fuse Replacement

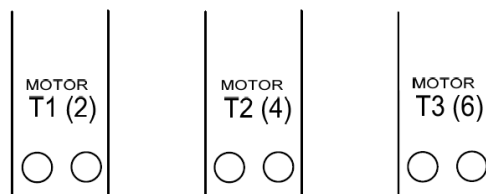
Model:	Description	Part No.	Qty per Starter
6R10000	Semiconductor Fuse (200A)	TF	
6R19000	Semiconductor Fuse (400A)	TF	
6R22000	Semiconductor Fuse (400A)	TF	
6R36000	Semiconductor Fuse (630A)	TF	
6R58000	Semiconductor Fuse (500A)	TF	
6R83000	Semiconductor Fuse (700A)	TF	

Chassis A3:

TOP



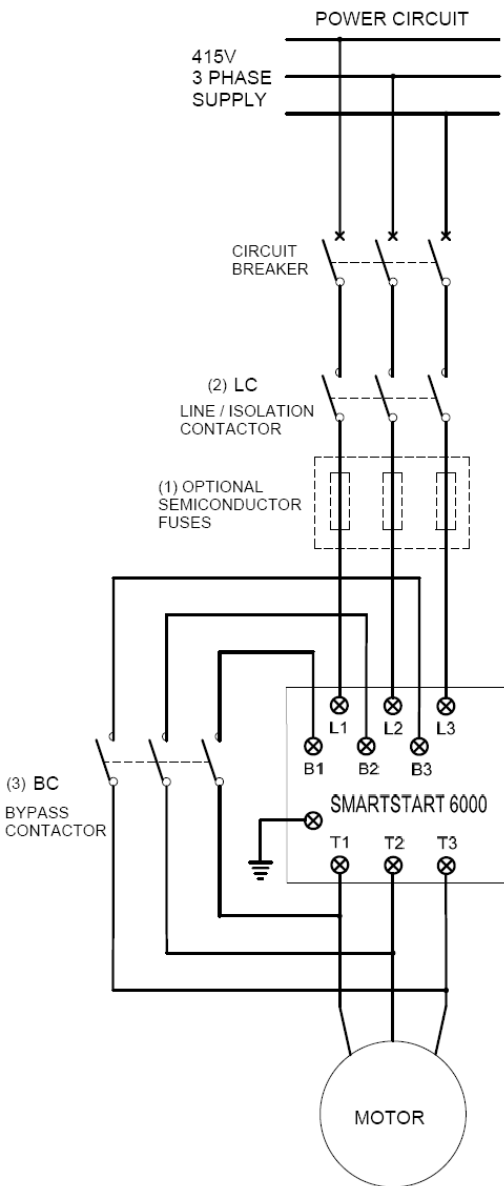
BOTTOM



Installation - Power Wiring

(100A model and above)

3 Wire Bypass



- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Line Contactor controlled by the Soft Starter (see Control Wiring Page 14 & Application Drawings Page 36-38)
- (3) Bypass Contactor controlled by the Soft Starter (see Control Wiring Page 14 & Application Drawings Page 36-38)

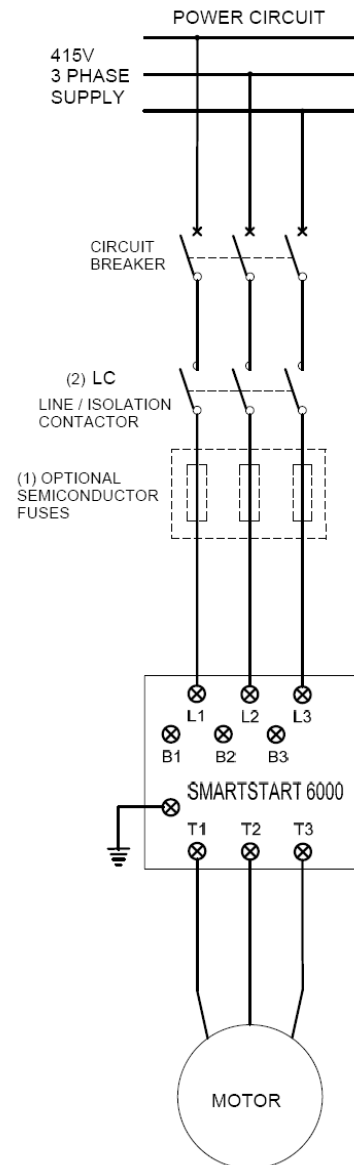


**Refer to page 13
For Control Wiring**

3 Wire Continuous

(Without Bypass Contactor)

NOTE: The SS6000 must have the appropriate rating to operate without a bypass contactor.



- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Line Contactor controlled by the Soft Starter (see Control Wiring Page 14 & Application Drawings Page 36-38)



**Refer to page 13
For Control Wiring**

Installation - Power Wiring

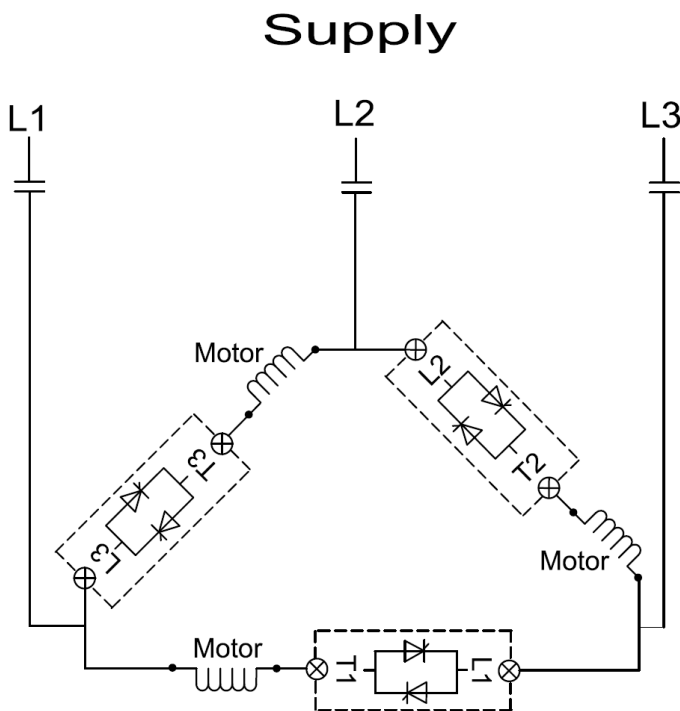
(100A model and above)

Using 6 wire Configuration

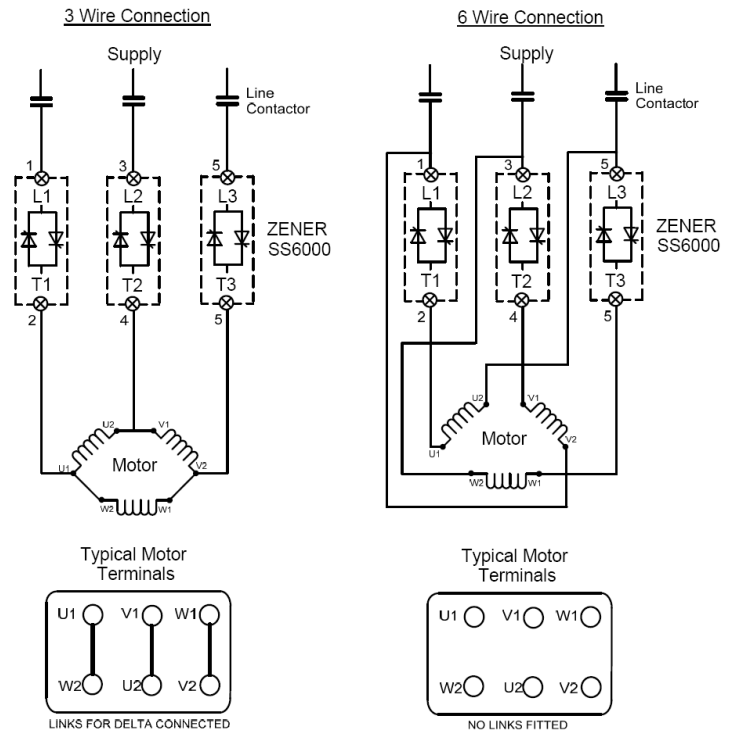
The Smartstart 6000 can be configured to operate in 6 wire mode. 6 wire mode may be the preferred method due to:

1. Possible reduction in the size of starter required, saving on space and /or cost.
2. Wiring may already be present if a start/delta type starter was previously used.
3. Reduced motor cable size.

The major advantage is that the current in the SCR is 58% less than it would be for the same motor connected in 3 wire. The diagram below illustrates how the motor is connected in 6 wire, also known as inside delta.



The following illustrates the difference between 3 wire & 6 wire connection:



Current Monitoring & Torque Control:

For the torque control to operate correctly the C.T's need to monitor the 'line' current and not the 'Phase' currents. For this reason the C.T's normally supplied internally, need to be relocated external to the soft starter.

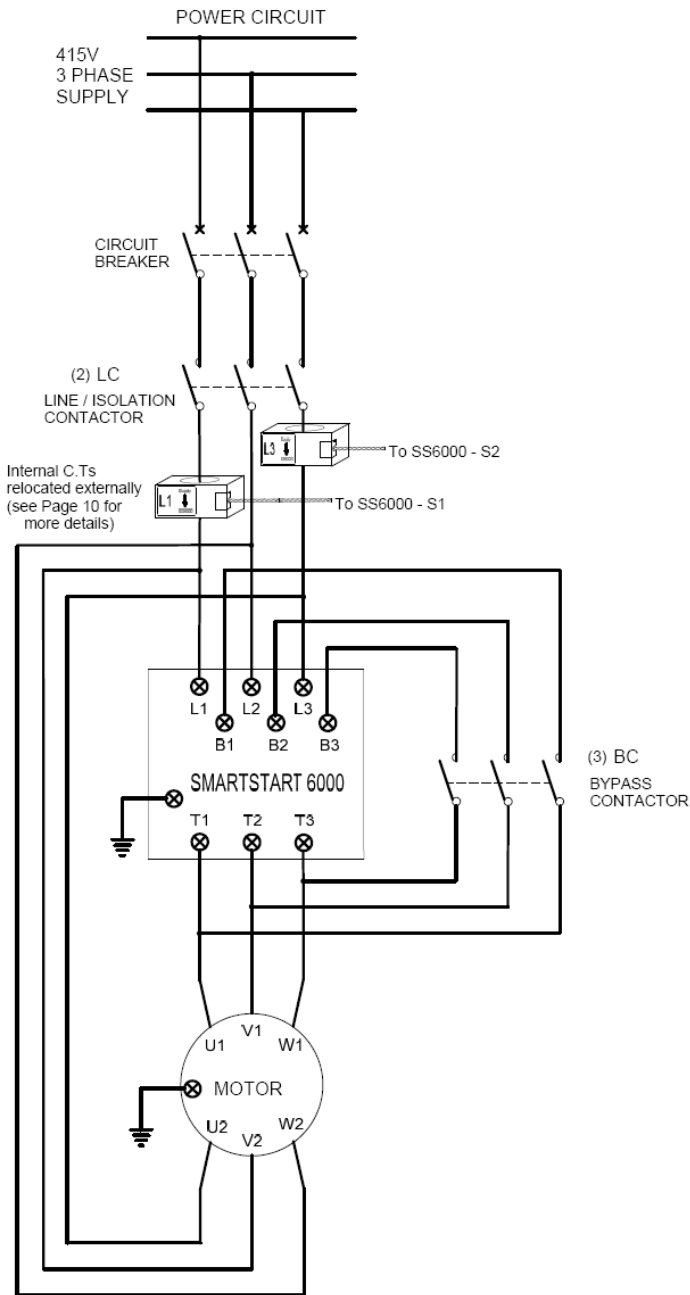
It is critical that the C.T's be installed in the correct phase and in the correct direction. Page 12 provides instructions as to where the C.T's are to be located.



Refer to page 12
For details on correctly installing
external C.T's

Installation - Power Wiring (100A model and above)

SS6000 : 6 wire Bypass



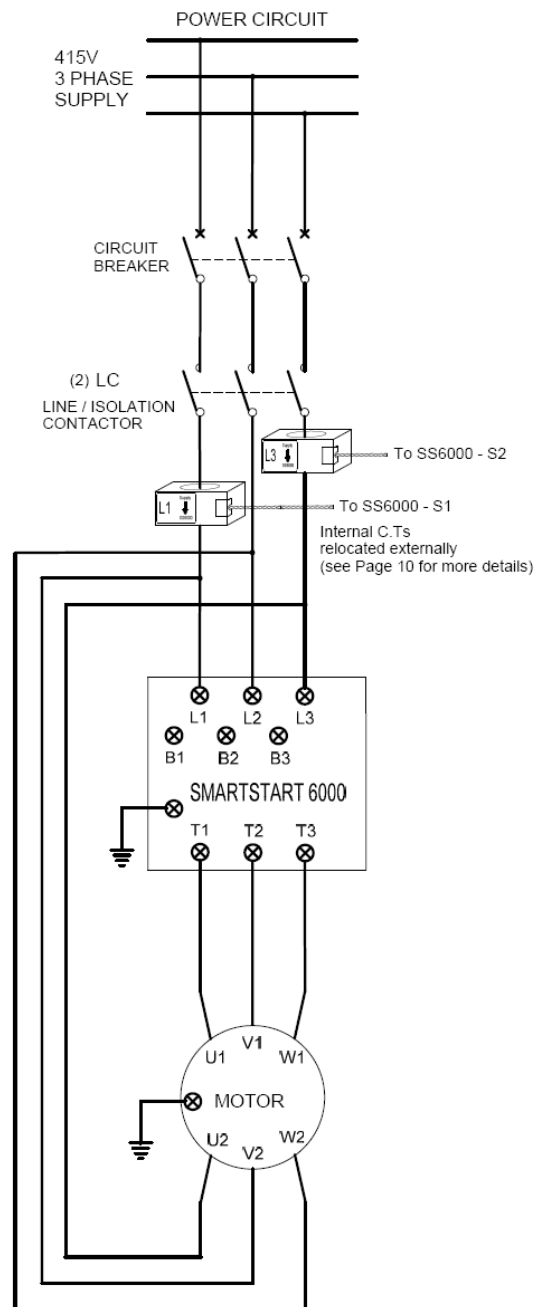
- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Line Contactor controlled by the Soft Starter
(see Control Wiring Page 14 & Application Drawings Page 36-38)
- (3) Bypass Contactor controlled by the Soft Starter
(see Control Wiring Page 14 & Application Drawings Page 36-38)



**Refer to page 13
For Control Wiring**

**Refer to page 12
For details on correctly
installing external C.T's**

SS6000 : 6 wire Continuous



- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Line Contactor controlled by the Soft Starter
(see Control Wiring Page 14 & Application Drawings Page 36-38)



**Refer to page 13
For Control Wiring**

**Refer to page 12
For details on correctly
installing external C.T's**

Installation - Power Wiring

(100A model and above)

Relocating the Internal Current Transformers for 6 wire operation.

The SS6000 comes standard with internal Current Transformers (C.T's) for monitoring the current during acceleration, deceleration and when in bypass.

It is important that the SS6000 be wired in a manner to ensure the C.T's are always monitoring the motor current. For this reason 9 terminals are provided. This is important to ensure continual protection of the soft starter, the motor and the load. The correct installation of the C.T's is crucial for optimum performance of the SS6000 torque control system. In some situations such as 6 wire operation, it may be necessary to relocate the C.T's external to the SS6000. For 6 wire operation the C.T's are to be installed on the incoming line supply cables so that the line current is monitored (not the phase currents).

The SS6000 can be purchased with C.T's external by ordering 'prepared for 6 wire';

Part no.	Description:
TF60015	Prepare for 6 wire: 6R100-220
TF60016	Prepare for 6 wire: 6R360-830

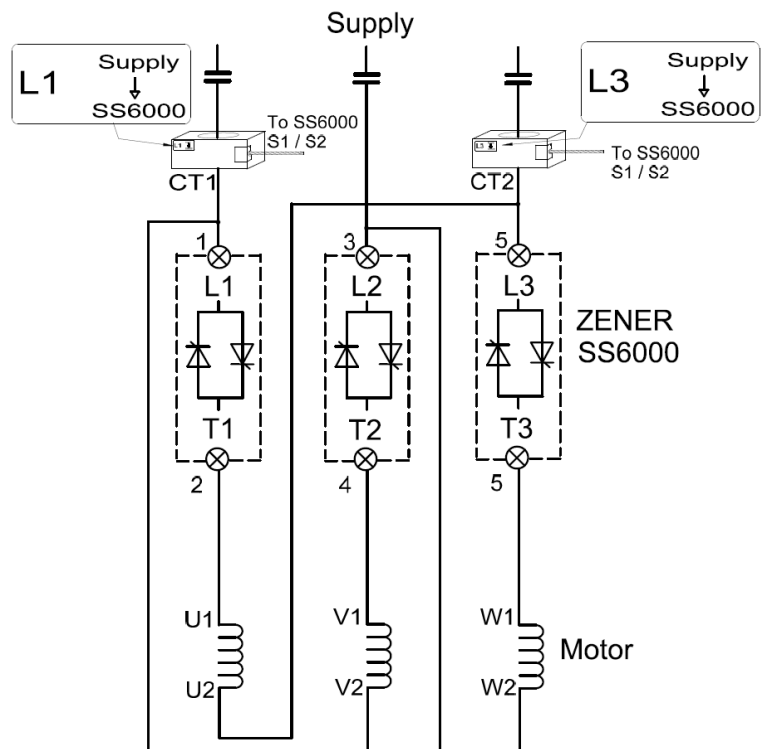
Installation of external C.T's

When relocating the C.T's external to the soft starter it is important to ensure the following:

1. C.T's are installed on L1 & L3
2. C.T's are installed in correct direction
P1 label = line side
3. C.T's are terminated with correct phasing.
S1 = Red
S2 = Black

The C.T's supplied with the SS6000 has a label which shows the correct phase and direction.

If the C.T's are not installed correctly the SS6000 will display a fault or a 'C.T Phase error'.



Check for correct installation

If a CT phase error occurs the problem may be identify under the menu 'Starter Diagnosis'. '+L1 / +L3' should be displayed.

> If L2 is displayed move the CT from L2 phase.

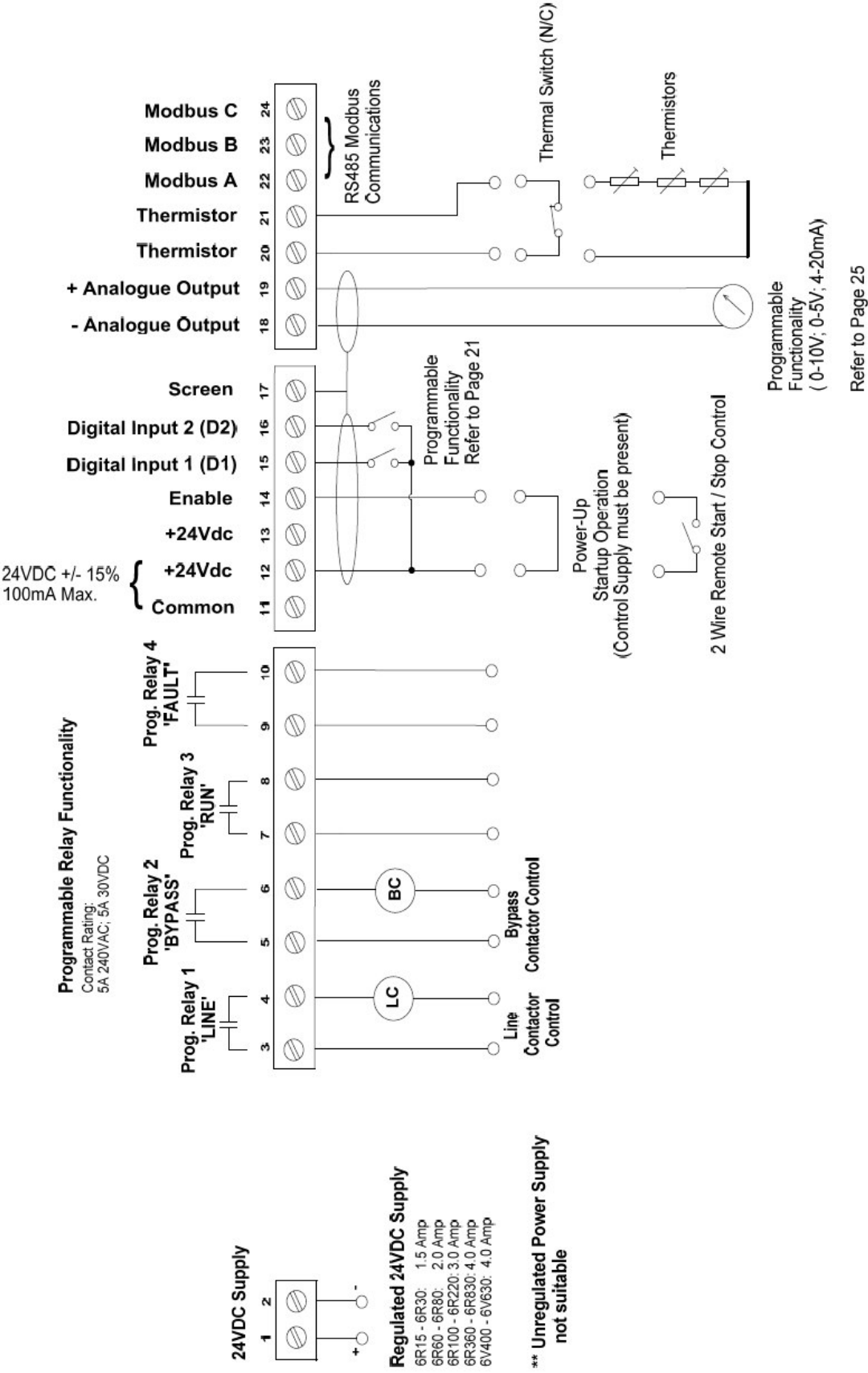
> If a "-" is displayed, the direction of the corresponding CT needs to be reversed.

Refer to page 25 for menu location

Control Wiring

Control Wiring Overview






Typical Configuration of Control Terminals



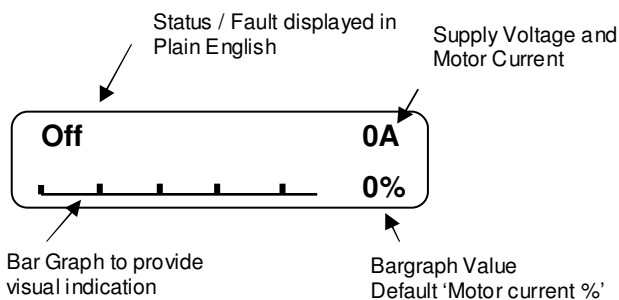
Programming

Local Control Panel / Remote Console

The local control panel consists of 5 push buttons and a plain English display to simplify programming.

-  Increase the value or change selection. Navigate up through menu / submenus.
-  Decrease the value or change selection. Navigate down through menu / submenus.
-  Allows access to menu, submenus & saves the parameter entered.
-  Escapes from current menu position without saving.
-  Manual reset of a trip (if enabled).

Operating Status Indication



▪ 'Off'

The Smartstart® has control power applied but not enabled.

▪ 'Standby'

The Smartstart® has been enabled to start and the run relay energized to bring in the line contactor (if installed). The Smartstart® will initiate a start immediately 3 phase supply is applied. Supply Voltage is displayed.

▪ 'Accel'

The Smartstart® is accelerating the motor. Ramp time completed (%) & Motor Current (A) displayed

▪ 'At Speed'

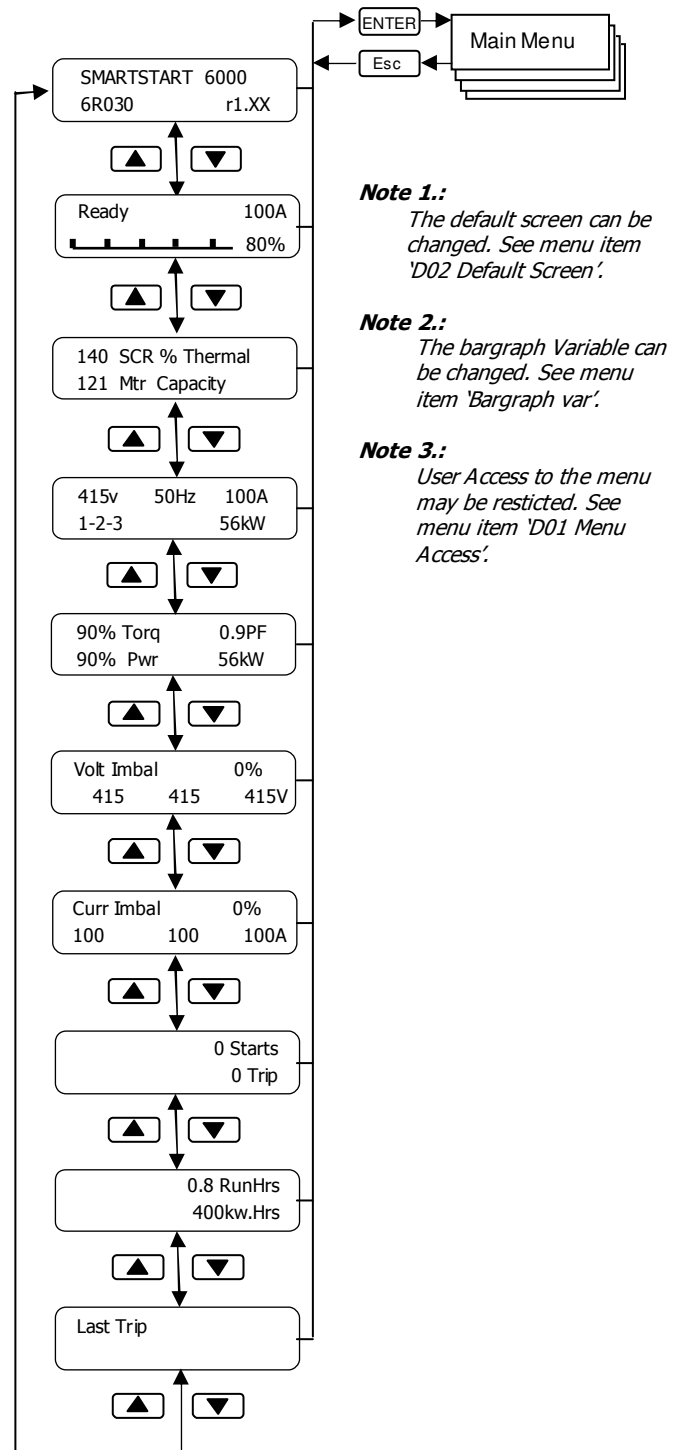
The motor is at full speed, the accel time period may not be complete. Ramp time completed (%) & Motor Current (A) is displayed.

▪ **'Run Bypass or Cont.'** The ramp time is complete and the bypass contactor operated or SCR's are in full conduction. Motor Current (A) is displayed.

▪ 'Decel'

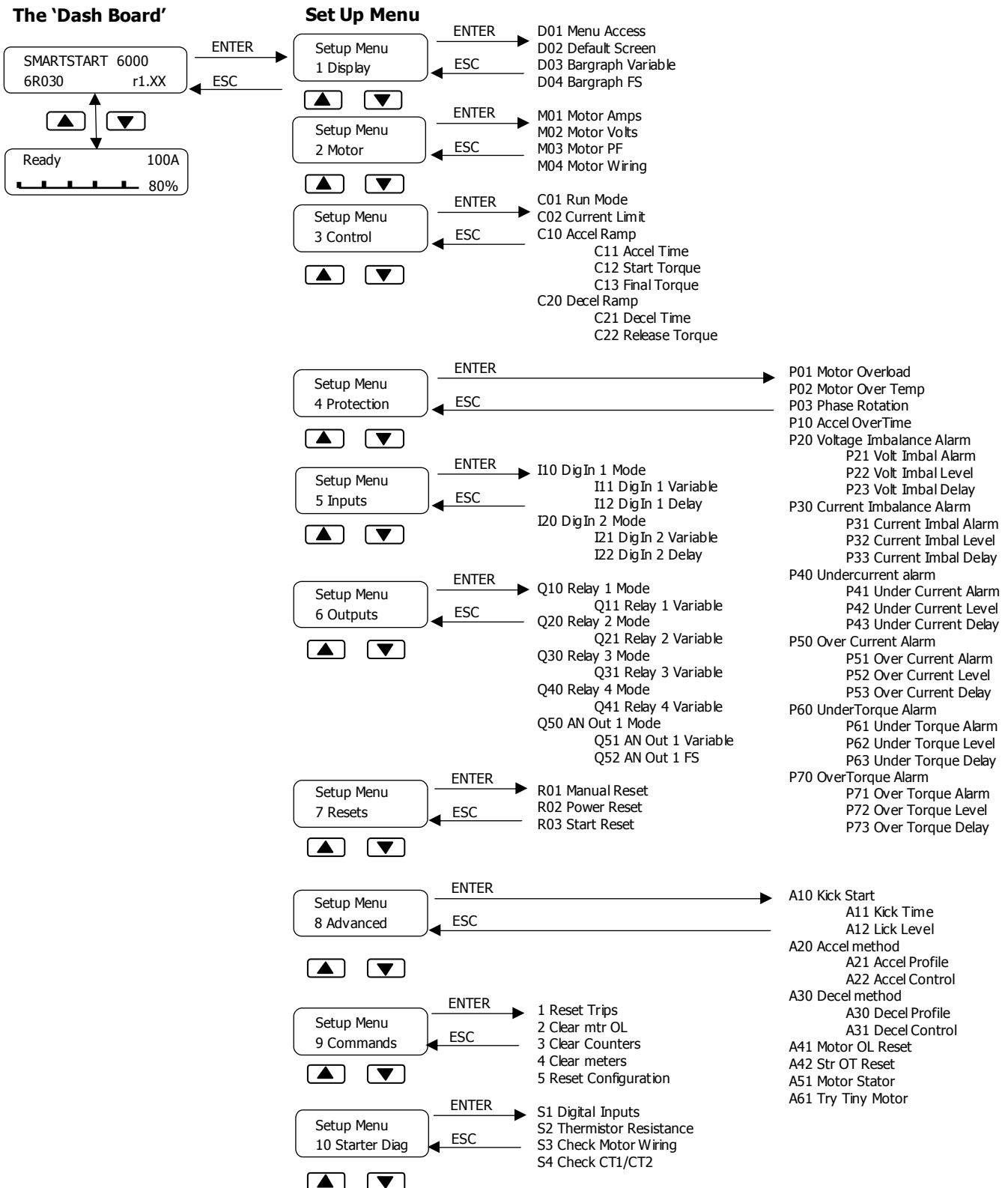
The Smartstart® is decelerating the motor. Ramp time completed (%) & Motor Current (A) is displayed.

The Menu Map (Dash Board)



Programming

Menu Map Overview

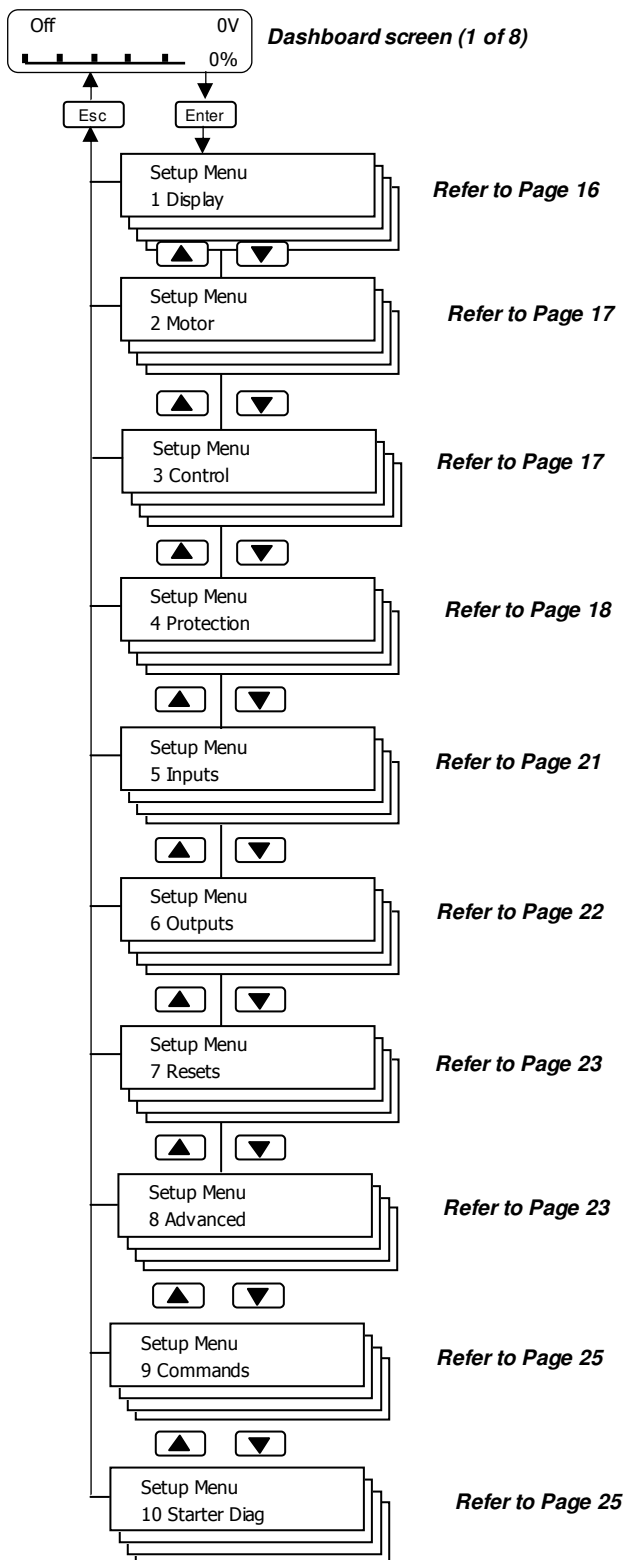


Programming

Menu Navigation

Note: to change any parameters the SS6000 must be disabled. Remove the link in the Enable input (term. 14) or the external enable circuit.

The Main Menu



Setup Menu

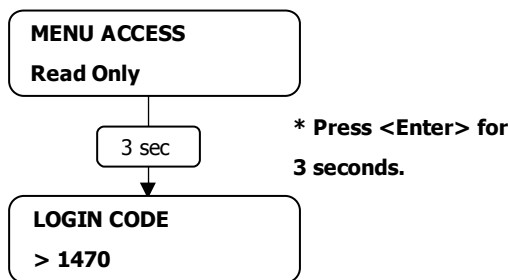
1 Display

D01 Menu Access:

Sets the desired user access to menu

▲	Selection: Disabled; Setup; Read only
▼	Default: Setup
ENTER	To save changes
ESC	To exit without saving

If the menu access is disabled a user access code is required to access the menu. The access code is 1470.



D02 Default Screen:

The default screen is the dashboard screen that the Soft Starter will return to - on power up, exit or time-out from the menu.

▲	Selection: Overview; Thermal; Electrical; Power; Volt imbal; Curr imbal; Counters; meters
▼	Default: Overview
ENTER	To save changes
ESC	To exit without saving

D03 Bargraph Var.:

Sets the bargraph variable to monitor & Display.

▲	Selection: Mtr current; Mtr Torque; Mtr Thermal; SCR Thermal; Active Power; Power Factor
▼	Default: Mtr Current
ENTER	To save changes
ESC	To exit without saving

D04 Bargraph FS.:

Adjust the full scale of the bar graph meter as a percentage.

▲	Selection: 100;120;150;200;300;400;600
▼	Default: 300%
ENTER	To save changes
ESC	To exit without saving

Programming

Setup Menu

2 Motor

M01 Motor Amps:



Adjust to the value of motor full load current (FLC) indicated on the motor rating plate, even if connected in 6 wire (inside delta).

▲	Range:	40% to maximum unit rating
▼	Default:	Maximum rating of unit
ENTER	To save changes	
ESC	To exit without saving	

M02 Motor Volts:

Adjust the value to the motor nameplate voltage.

▲	Range:	199 – 481V
▼	Default:	415V
ENTER	To save changes	
ESC	To exit without saving	

M03 Motor PF:

Adjust to the value to the motor Power Factor as indicated on the motor rating plate.

▲	Range:	0.60 – 0.98
▼	Default:	0.90
ENTER	To save changes	
ESC	To exit without saving	

M04 Motor Wiring: (select models only)

Select the wiring configuration of the soft starter.



▲	Range:	3 Wire; Std 6 Wire; Alt 6 Wire
▼	Default:	3 Wire
ENTER	To save changes	
ESC	To exit without saving	

Setup Menu

3 Control

C01 Run Mode:

Set to the configuration of the Smartstart 6000.



▲	Range:	Bypass; Continuous
▼	Default:	Bypass
ENTER	To save changes	
ESC	To exit without saving	

C02 Current Limit:

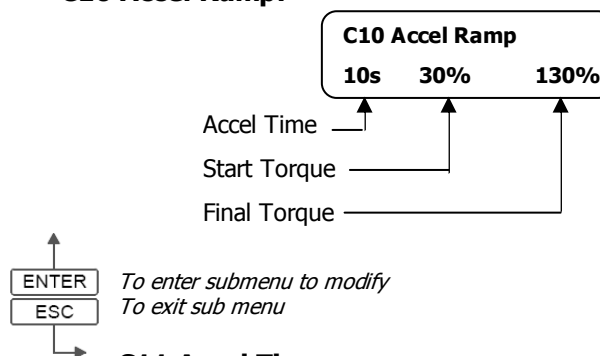


The current limit is expressed as a percentage of the entered motor Amps (FLC). This current limit setting operates during the ramp time only and will over-ride the torque settings. Reducing the current limit will limit the torque available to the motor and load. If set too low it may prevent the motor from accelerating or reaching full speed.

▲	Range:	150 to 450% FLC
▼	Default:	450%
ENTER	To save changes	
ESC	To exit without saving	

Appendix A – Page 35 provides a guide to starting parameters for various load types.

C10 Accel Ramp:



C11 Accel Time:



Adjust this to vary the time taken to ramp the voltage to full supply voltage or the torque to reach the 'finish torque'. The accel time will affect the actual current during starting – the faster the rate of acceleration the higher the start current.

▲	Range:	1 to 60 seconds
▼	Default:	10 s
ENTER	To save changes	
ESC	To exit without saving	

C12 Start Torque:



The initial torque provided when a start is initiated. Adjust to the lowest setting which allows the motor to turn on a start command. This is entered as a percentage of nominal Torque (FLT). This setting will be dependent on the torque required by the load.

▲	Range:	15% to 200%
▼	Default:	30%
ENTER	To save changes	
ESC	To exit without saving	

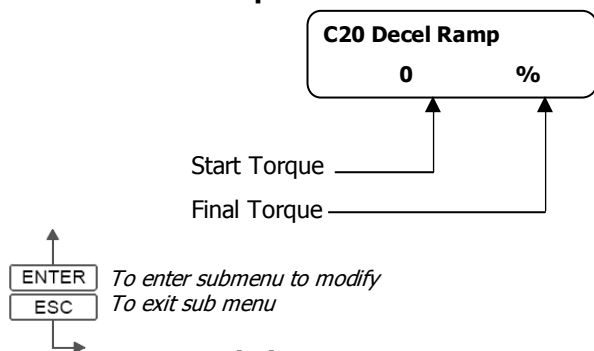
Programming

C13 Final Torque: (torque control only)

This sets the torque provided at the end of the acceleration period. This is entered as a percentage of nominal Torque (FLT).

▲	Range: 15 to 200%
▼	Default: 130%
ENTER	To save changes
ESC	To exit without saving

C20 Decel Ramp:



C21 Decel Time:

The time taken to decelerate the motor to the 'release torque setting'.

▲	Range: 0 to 120 seconds
▼	Default: 0 s
ENTER	To save changes
ESC	To exit without saving

C22 Release Torq:

The Smartstart 6000 will decelerate the motor at the 'decel time' rate until the torque reaches the release torque value entered. This is entered as a percentage of nominal Torque (FLT).

▲	Range: 0 to 100%
▼	Default: 2%
ENTER	To save changes
ESC	To exit without saving

In pump applications the deceleration provided by the Smartstart 6000 will reduce problems with water hammer with greater control of the motor torque & speed. The Smartstart 6000 has advanced settings to customise the control of the motor during acceleration and deceleration. Refer to Menu 'Advanced Controls' on page 25 for more details.

Setup Menu

4 Protection

P01 Mtr Overload:



The Smartstart 6000 continuously monitors the motor current (even in bypass) and calculates the temperature rise of the motor. The tripping curves are based on the protection classes as defined by IEC60947-4-2. Refer to page 29 for more details on overload class curves. Select the overload protection class suitable for the motor & load combination. This protection is type R1, thus will not reset the thermal capacity when power is removed or motor is stopped. This prevents the motor from restarting if the motor is too hot.

▲	Range: 2;10a;10;15;20;25;30;disabled
▼	Default: 10
ENTER	To save changes
ESC	To exit without saving

The overload setting must be selected according to the motor manufacturers recommendations.

P02 Mtr OverTemp:

Provides overload protection of the motor by monitoring the actual motor temperature. A thermistor or NC switch can be connected directly to terminals 20 and 21. This will operate in conjunction with P02 Mtr Therm OL.

▲	Range: Thermistor; NC switch; disabled
▼	Default: NC switch
ENTER	To save changes
ESC	To exit without saving

PTC type:

- i. Trip resistance 3000 ohms
- ii. Reset 1650 ohms
- iii. Thermistor Fault <20ohms

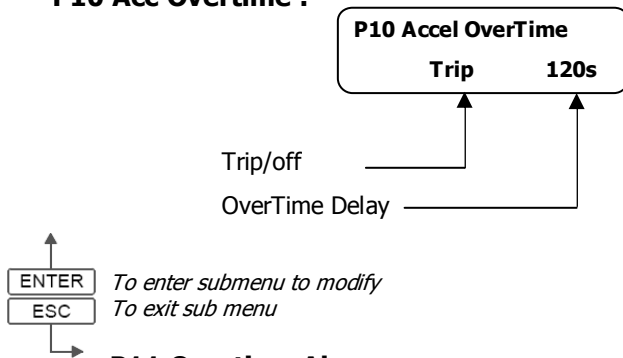
P03 Ph Rotation:

Selectable phase sequence protection to inhibit motor operation if a prohibited phase sequence is detected such as reverse operation. Ideal for pumping applications.

▲	Range: Ignore; 1-2-3; 3-2-1;
▼	Default: Ignore
ENTER	To save changes
ESC	To exit without saving

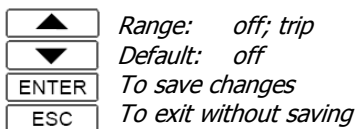
Programming

P10 Acc Overtime :



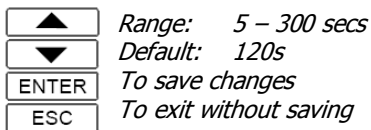
P11 Overtime Alarm:

Protection against the start time exceeding the preset acceleration or ramp time.

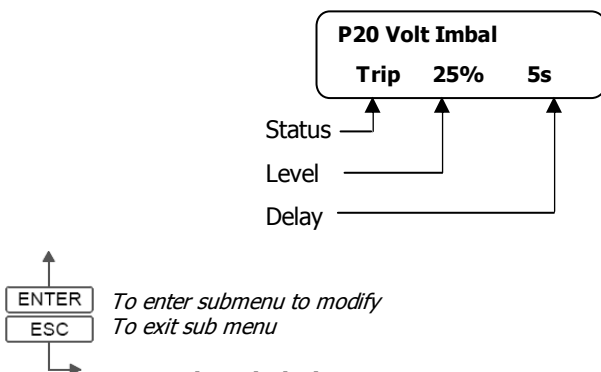


P12 Overtime Del:

The time exceeding the set ramp time before a trip on Accel overtime occurs.

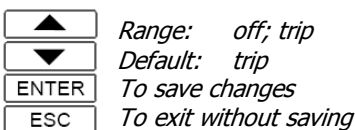


P20 Volt Imbal :



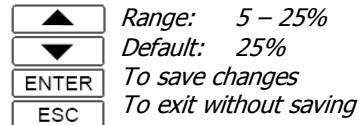
P21 Volt Imbal Alarm:

Provide protection against a supply voltage imbalance.



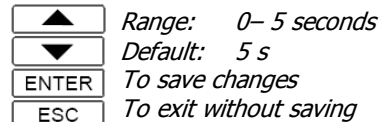
P22 Volt Imbal Level:

Adjust to set the voltage imbalance threshold, as a percentage of the average phase voltage.

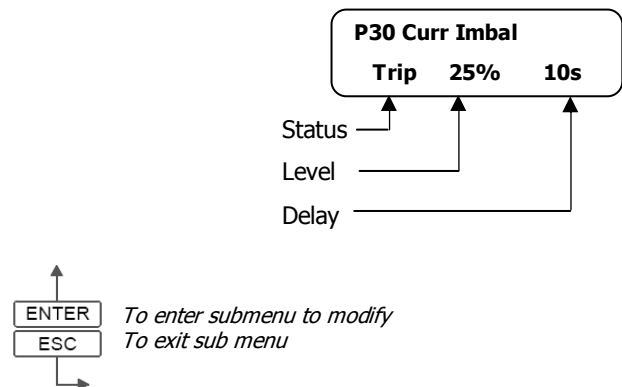


P23 Volt Imbal Delay:

Adjust to set a delay for the voltage imbalance trip.

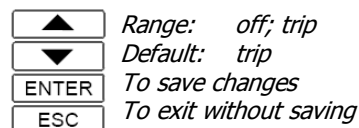


P30 Curr Imbal:



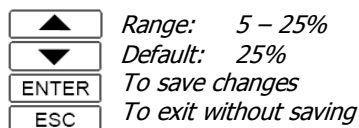
P31 Curr Imbal Alarm:

Protection against a current imbalance.



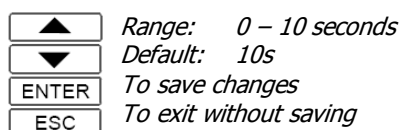
P32 Curr Imbal Level:

Set the current imbalance threshold, as a percentage of the average phase current.



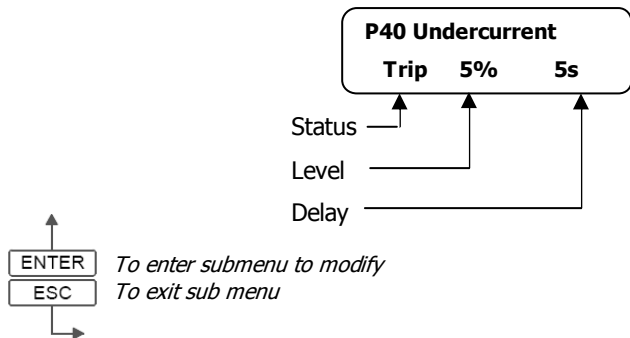
P33 Curr Imbal Delay:

Set a delay for the current imbalance trip.



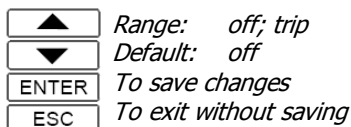
Programming

P40 Undercurrent:



P41 Undercurrent Alarm:

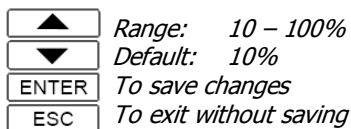
Protection against under current. This protection is not active during accel & decel period.



Ideal for detecting loss of load or low load conditions such as belt breakages or blocked water pipes

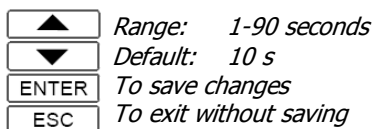
P42 Undercurrent Level:

Adjust to the desired trip threshold, as a percentage (%) of the Motor Amps.

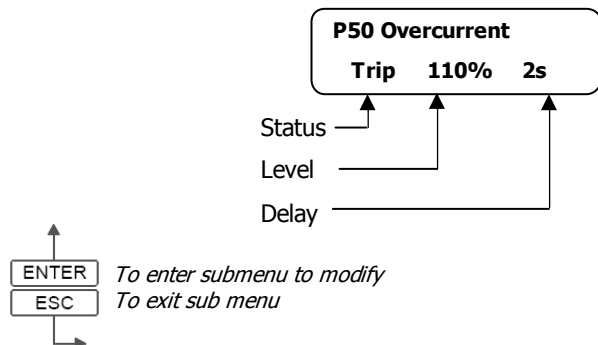


P43 Undercurrent Delay:

Adjust to set the time period that the current must fall below the threshold before a trip occurs.

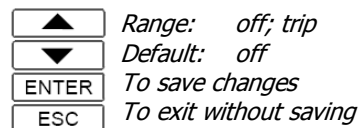


P50 Overcurrent:



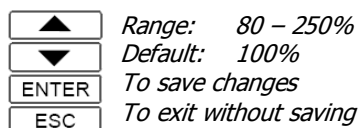
P51 Overcurrent Alarm:

Provide protection against over current. This protection is not active during the accel & decel period.



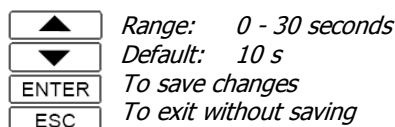
P52 Overcurrent Level:

Adjust to the desired trip threshold, as a percentage (%) of the Motor Amps.

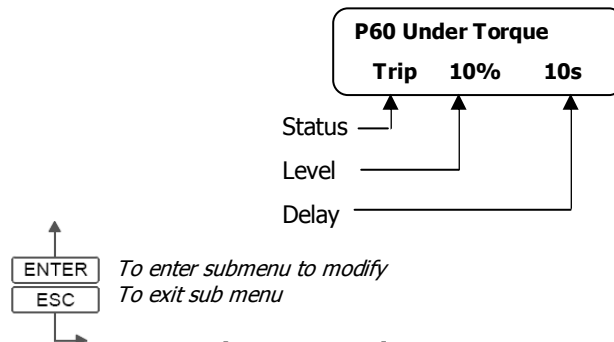


P53 Overcurrent Delay:

Adjust to set the time period that the current must exceed the threshold before a trip occurs.

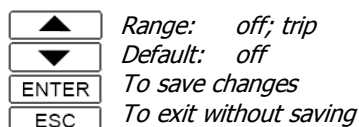


P60 Under Torque:



P61 Under torque Alarm:

Provide protection against under-torque. This protection is not active during the accel & decel period.



Programming

P62 Under Torque Level:

Adjust to the desired trip threshold, as a percentage of nominal torque.

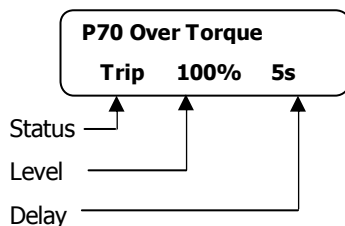
▲	Range: 10 – 100%
▼	Default: 10%
ENTER	To save changes
ESC	To exit without saving

P63 Under Torque Delay:

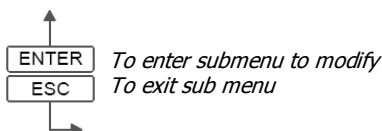
Adjust to set the time period that the torque must fall below the threshold before a trip occurs.

▲	Range: 1 - 90 seconds
▼	Default: 10 s
ENTER	To save changes
ESC	To exit without saving

P70 Over Torque (Electronic Shear Pin):



Electronic Shear Pin or protection against over torque. This protection is not active during the accel & decel period.



P71 Over Torque Alarm:

Provide protection against excess torque. This protection is not active during the accel & decel period.

▲	Range: off; trip
▼	Default: off
ENTER	To save changes
ESC	To exit without saving

P72 Over Torque Level:

Adjust to the desired trip threshold, as a percentage of nominal torque.

▲	Range: 80 – 250%
▼	Default: 100%
ENTER	To save changes
ESC	To exit without saving

P73 Over Torque Delay:

Adjust to set the time period that the torque must exceed the threshold before a trip occurs.

▲	Range: 0 - 30 seconds
▼	Default: 10 s
ENTER	To save changes
ESC	To exit without saving

Setup Menu

5 Inputs

I10 DigIn 1 Mode

Activates digital input 1.

▲	Range: Enable; Invert; Disable
▼	Default: Enable
ENTER	To save changes
ESC	To exit without saving

I11 DigIn 1 Variable

Set the functionality of digital input 1.

▲	Range: ESO; Remote trip; Remote reset
▼	Default: Remote Reset
ENTER	To save changes
ESC	To exit without saving

I12 DigIn 1 Delay

Set the delay that the digital input needs to be active for the Soft starter to respond.

▲	Range: 0.0 – 30.0 seconds
▼	Default: 3.0
ENTER	To save changes
ESC	To exit without saving

I20 DigIn 2 Mode

Activates digital input 2.

▲	Range: Enable; Invert; Disable
▼	Default: Disable
ENTER	To save changes
ESC	To exit without saving

I21 DigIn 2 Variable

Set the functionality of digital input 2.

▲	Range: ESO; Remote trip; Remote reset
▼	Default: Disabled
ENTER	To save changes
ESC	To exit without saving

Programming

I22 DigIn 2 Delay

Set the delay that the digital input needs to be active for the Soft starter to respond.

▲	Range:	0.0 – 30.0 seconds
▼	Default:	-
ENTER	To save changes	
ESC	To exit without saving	

Setup Menu

6 Outputs

Q10 Relay 1 Mode

Activates Relay 1.

▲	Range:	Enable; Invert; Disable
▼	Default:	Enable
ENTER	To save changes	
ESC	To exit without saving	

Q11 Relay 1 Variable

Set the functionality of Relay 1.

▲	Range:	See table on page 26
▼	Default:	Line Ctrl
ENTER	To save changes	
ESC	To exit without saving	

Q20 Relay 2 Mode

Activates Relay 2.

▲	Range:	Enable; Invert; Disable
▼	Default:	Enable
ENTER	To save changes	
ESC	To exit without saving	

Q21 Relay 2 Variable

Set the functionality of Relay 2.

▲	Range:	See table on page 26
▼	Default:	Bypass Ctrl
ENTER	To save changes	
ESC	To exit without saving	

Q30 Relay 3 Mode

Activates Relay 3.

▲	Range:	Enable; Invert; Disable
▼	Default:	Enable
ENTER	To save changes	
ESC	To exit without saving	

Q31 Relay 3 Variable

Set the functionality of Relay 3.

▲	Range:	See table on page 26
▼	Default:	Motor On
ENTER	To save changes	
ESC	To exit without saving	

Q40 Relay 4 Mode

Activates Relay 4.

▲	Range:	Enable; Invert; Disable
▼	Default:	Enable
ENTER	To save changes	
ESC	To exit without saving	

Q41 Relay 4 Variable

Set the functionality of Relay 4.

▲	Range:	See table on page 26
▼	Default:	Trip Alarm
ENTER	To save changes	
ESC	To exit without saving	

Q50 An Out 1 Mode

Activate and set the signal type for Analogue Output 1.

▲	Range:	Disabled ; 0-10v; 0-5v; 0-20mA; 4-20mA
▼	Default:	Disabled
ENTER	To save changes	
ESC	To exit without saving	

Q51 An Out 1 Variable

Set the functionality of Analogue Output 1.

▲	Range:	See table on page 26
▼	Default:	Current
ENTER	To save changes	
ESC	To exit without saving	

Q52 An Out 1 FS (Full Scale)

Set the full scale of the Analogue output signal.

▲	Range:	50 – 500%
▼	Default:	200%
ENTER	To save changes	
ESC	To exit without saving	

Example: 20mA = 400% Current
20mA = 200% Torque

Programming

Setup Menu

7 Resets

R01 Manual Reset

Activate or de-activate the manual reset ie. The reset on the local console.

▲	Range:	Enable; Disable
▼	Default:	Disable
ENTER	To save changes	
ESC	To exit without saving	

R02 Power Reset

Activate or de-activate reset on removal of control supply.

▲	Range:	Enable; Disable
▼	Default:	Enable
ENTER	To save changes	
ESC	To exit without saving	

R03 Start Reset

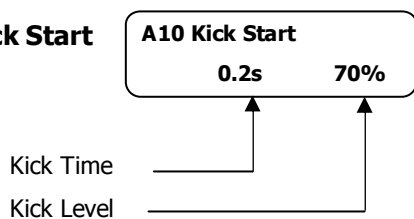
Activate or de-activate reset on a start command.

▲	Range:	Enable; Disable
▼	Default:	Disabled
ENTER	To save changes	
ESC	To exit without saving	

Setup Menu

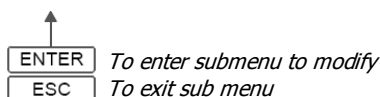
8 Advanced

A10 Kick Start



Set to provide a kick during starting. This provides an adjustable torque boost to the motor when a start is initiated. This will also result in a higher start current during the kick duration.

When a kick time of 0.0 seconds is selected 'Disabled' will be displayed.



A11 Kick Time

Set to the time of the kick

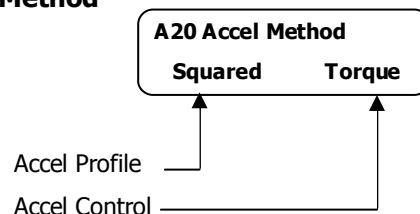
▲	Range:	0.0 – 2.0 seconds
▼	Default:	0.0 (Disabled)
ENTER	To save changes	
ESC	To exit without saving	

A12 Kick Level

Set the level of kick as a percentage % of Locked Rotor Current.

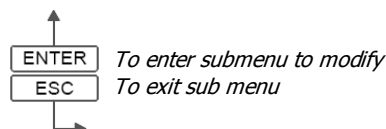
▲	Range:	50 – 100%
▼	Default:	70%
ENTER	To save changes	
ESC	To exit without saving	

A20 Accel Method



The acceleration method allows adjustment of the acceleration profile and acceleration control. This provides advanced control of the motor during the ramp time to better match the type of load or application.

See Appendix A on Page 34-35 for more details.



A21 Accel Profile

Select the type of acceleration profile to match the type of load or application.

Example: Pump/Fan = Squared

▲	Range:	Linear, Squared
▼	Default:	Squared
ENTER	To save changes	
ESC	To exit without saving	

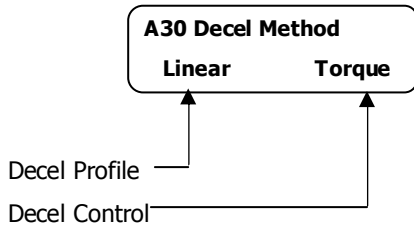
A22 Accel Control

Select the type of Acceleration control to suit the load or application. Torque Control will provide greater control of motor acceleration.

▲	Range:	Torque; Voltage
▼	Default:	Torque
ENTER	To save changes	
ESC	To exit without saving	

Programming

A30 Decel Method



The deceleration method allows adjustment of the deceleration profile and acceleration control of the Soft Starter. This provides advanced control of the motor during the ramp down time to better match the type of load or application. This is especially useful in resolving water hammer related problems.

See Appendix A on Page 34-35 for more details.

ENTER To save changes
ESC To exit without saving

A31 Decel Profile

Select the type of deceleration profile to match the type of load or application.

▲ Range: Linear; Squared
▼ Default: Linear
ENTER To save changes
ESC To exit without saving

A32 Decel Control

Select the type of deceleration control to suit the load or application. Torque control will provide greater control over the deceleration / stopping of a motor under load.

▲ Range: Torque; Voltage
▼ Default: Linear
ENTER To save changes
ESC To exit without saving

A41 Motor Mtr OL Reset

Enter the level for the Motor over load protection to allow a reset.

▲ Range: 10 – 100%
▼ Default: 90
ENTER To save changes
ESC To exit without saving

A42 Str OT Reset

Enter the level for the Starter over temperature protection to allow a reset.

▲ Range: 40 – 90° C
▼ Default: 60° C
ENTER To save changes
ESC To exit without saving

A51 Motor Stator

Enter Details of the Motor Stator.

▲ Range: 1.5 – 5.0%
▼ Default: 3.0%
ENTER To save changes
ESC To exit without saving

A61 Try Tiny Motor

Allows a test of the starter using a small test motor or motor smaller than the starter is rated.

▲ Range: Enable/Disable
▼ Default: Disable
ENTER To save changes
ESC To exit without saving

The soft starter will trip on motor loss if motor current falls below 12% of the entered FLC. This creates a problem for workshop testing or fault finding. If 'Try Tiny Motor' is enabled a start is allowed which ignores this protection. When the control supply is removed this automatically resets to 'disabled'.

Programming

Setup Menu 9 Commands

To clear/reset any of the following a confirmation code is required:

- 1 Reset Trip
- 2 Clr Mtr OL
- 3 Clr Counters
- 4 Clr Meters
- 5 Reset Config
- 11 Clr Stress
- 12 Clr All Data
- 13 Factory Reset

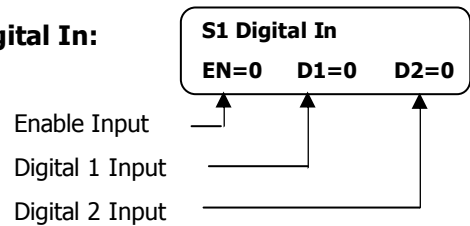
The Confirmation Code is: 1470

Setup Menu 10 Starter Diag

This menu provides indication of inputs and wiring checks.

Each Relay can also be forced on and the Analogue output set for 100%.

S1 Digital In:



0 = No control signal present
1 = Control signal present

S2 Thermistor In:

Displays thermistor resistance in Kohms.

The trip resistance is 3000Ohms and a short circuit is detected when <200Ohms.

S3 Chk Motor Wiring:

Displays detected motor wiring.

Example: 'Correct Mtr 3 wire '

S4 Chk CT1/CT2

Displays detected CT connection.

Example: 'Correct +L1 / +L3'

Programming

Table 1: Output Relay Functionality

Relay Function	
Selection:	Description
<i>Line Ctrl</i>	<i>Control for Line Contactor</i>
<i>Bypass Ctrl</i>	<i>Control for Bypass Contactor</i>
<i>Accel Ramp</i>	<i>Starter in acceleration ramp mode</i>
<i>Decel Ramp</i>	<i>Starter in deceleration ramp mode</i>
<i>Ramping</i>	<i>Starter in Ramp Mode</i>
<i>Up to Speed</i>	<i>motor is up to speed</i>
<i>Motor On</i>	<i>Motor is running</i>
<i>Trip Alarm</i>	<i>A trip alarm is active</i>
<i>Bypass FLT</i>	<i>Bypass contactor failed</i>
<i>Freq Error</i>	<i>Supply frequency range exceeded</i>
<i>Mtr Loss</i>	<i>Output phase(s) Open circuit/motor isolated</i>
<i>Remote Trip</i>	<i>Remote trip active</i>
<i>SCR OL Trip</i>	<i>SCR reached overload level</i>
<i>Mtr OL Trip</i>	<i>Motor reached overload level</i>
<i>Mtr OT Trip</i>	<i>Motor thermistor/switch trip active</i>
<i>Ph Rotation</i>	<i>Rotation trip active</i>
<i>Remote Trip</i>	<i>Remote trip active</i>
<i>Over time</i>	<i>Over time trip active</i>
<i>Volt Imbal</i>	<i>Voltage Imbalance trip active</i>
<i>Curr Imbal</i>	<i>Current imbalance trip active</i>
<i>Under Current</i>	<i>Under current trip active</i>
<i>Over Current</i>	<i>Over Current trip active</i>
<i>Under Torque</i>	<i>Under Torque trip active</i>
<i>Over Torque</i>	<i>Over Torque trip active</i>
<i>Warning Alarm</i>	<i>A warning alarm is active</i>
<i>Test (ON)</i>	<i>Turns relay on</i>

Table 2: Analogue Output Functionality

Analogue Output	
Selection:	Description
<i>Mtr Torque</i>	<i>Estimated torque produced in motor</i>
<i>Mtr Thermal</i>	<i>Estimated Motor temperature of over load</i>
<i>SCR thermal</i>	<i>SCR temperature</i>
<i>Active power</i>	<i>Power consumed kW</i>
<i>Power Factor</i>	<i>Power Factor</i>
<i>Mtr Current</i>	<i>Motor Current</i>
<i>Test (100%)</i>	<i>Maximum output</i>

Fault Diagnosis

Message:	Problem:		
01 PSU LOW VOLT	Control Supply Voltage low	36 MTR UNDERTORQ	Under torque trip as per user setting. See page 20
02 LINE FREQ	Line supply frequency out of range	40 REMOTE TRIP	Trip initiated from external source. Remote input on Digital input 1 or 2. See page 21
03 LINE PH FLT	3 Phase supply problem, open phase	41 ACC OVERTIME	Acceleration time has exceeded set time as per user setting. See page 19
04 LINE PH DIR	Line Phase sequence in wrong direction – User Selectable, see page 18		
05 MTR 3/6 WIRE	Wiring detected different to motor wiring setting.		
06 MOTOR PH FLT	Motor phase did not conduct on start, motor not connected, open motor phase or problem with motor. Incorrect CT phasing and/or insufficient motor current.		
07 CT PHASING	Incorrect CT phasing and/or insufficient motor current.		
10 START FAILED	Motor did not start		
12 OUTPUT FAULT	SCR feedback lost, motor wiring or SCR fault.		
13 MOTOR LOSS	Motor current lost in all 3 phases		
14 BYPASS FAULT	Fault with Bypass Contactor detected		
15 BP POLE FLT	3 Phase/pole fault		
20 STR OVERCURR	Starter instantaneous over current		
21 STR OVERTEMP	Starter heatsink over temperature		
22 STR TEMP FLT	Starter heatsink temperature sensor fault		
23 STR OVERLOAD	Starter thermal overload		
24 MOTOR STALL	Motor Stalled, current after start >300% for 3 seconds.		
25 VOLT IMBAL	Voltage imbalance as per user setting. See page 19		
26 CURR IMBAL	Current imbalance as per user setting. See page 19		
30 MTR OVERLOAD	Motor thermal overload trip as per user setting. See page 18		
31 MTR OVERTEMP	Motor over temperature from thermistor input. See page 18		
32 MTR TEMP FLT	Motor thermistor sensor fault detected. See page 18		
33 MTR OVERCURR	Over current trip as per user setting. See page 20		
34 MTR UNDERCURR	Under current trip as per user setting. See page 20		
35 MTR OVERTORQ	Over torque trip as per user setting. See page 21		

Specifications

Input Voltage:

6R series: 220 to 460Vac
6R15-80: 380Vac to 415Vac

Input Frequency: 50 / 60Hz +/- 3Hz,
Auto detecting

Control Supply: 24Vdc (+15%, -15%)

24VDC Power Supply (min. requirements):

Power Supply O/P: 24VDC Regulated

Peak power requirements:

6R15-30: 1.5 Amps (36W)
6R60-80: 2 Amps (48W)
6R100-220: 3.0Amps (72W)
6R300-880: 4.0 Amps (96W)

These ratings allow for peak current requirements of internal fans

Configurations: 3 wire & 6 wire
Bypass or Continuous
6R15 to 6R80 have integral Bypass Contactor.

Duty:

Light Duty: 300% for 15 secs; 10start/hr
Standard Duty: 300% for 40secs; 10start/hr
400% for 10 secs; 10start/hr
Severe Duty: 450 for 20 secs; 5start/hr
300% for 60 secs; 5start/hr

SCR PIV: Minimum 1400V
SCR configuration: Full-wave
Dv/dt suppression: RC snubber networks
Over Voltage: MOV
Rated Insulation: 2Kv
EMC: Class A (to AS61800 – C-tick)
Current Feedback: Current transformer in circuit at all times.
Control: Torque controlled Ramp or voltage ramp, with current limit override
Standards Compliance: AS31800 C-tick; AS3947.4.2, IEC60947-4-2

Environment:

Enclosure protection: IP00 – IP20
Operating Temp. 0 to 55°C
(derate by 1% / °C >40°C)
Cooling: Temperature controlled forced ventilated
Maximum Altitude: 1000m without derating
Operating position: Vertical
Maximum ambient Pollution: Degree 3 conforming to IEC947-4-2

Inputs:

Digital Inputs: 24Vdc logic
Function : 2x Programmable inputs
1x Enable Input

Thermistor: Thermistor or NC switch
PTC type, Trip Resistance 3000Ohms,
<20ohms detected as Short Circuit.

Outputs:

Digital Output: 4 Programmable Relays
Contact Rating: 5A 250Vac; 5A 30VDC

Analogue Output: 1x Programmable Output
Signal: 0-10V, 0-5V, 4-20mA

Communications: Modbus RS485 with Ethernet Option
(Available in later revision)

Protection:

Motor Overload: Adjustable; Class 10, 10A, 20, 25, 30 type R1, total memory function
SCR Over temp. Heat sink temperature
SCR protection: Current & thermal modelling
Under Current: Adjustable level and trip time
Over Current: Adjustable level and trip time
Under Torque: Adjustable level and trip time
Over Torque: Adjustable level and trip time
Motor Stalled: 300% for 3 seconds (run mode only)
Current limit: Adjustable
Starter Overload: Current & thermal modelling
O/P Short Circuit: Semiconductor fuses (optional)
Voltage imbalance: Input voltage imbalance
Current Imbalance: Input & output current imbalance
Bypass failure: No bypass after ramp time or during run mode
SCR fault: Open or Short circuit SCR
Acc over time: Accel time exceeds set time
Phase reversal: Phase rotation inhibit
Motor Loss: Motor or output open cct
CT fault: Fault with CT's

Human Interface Module (HIM):

Type: Local or remote mountable (IP66)
Display: Backlit LCD (Blue) , English
Menu: Coded & English
Menu Protected: Selectable user access code
Cable type: Ribbon or Cat-5

Essential Services Over-ride (ESO):

Selectable Digital input with 24Vdc logic.

Battery:

Type: CR1220

Thermal Protection

Starter Thermal Protection:

Thermal protection of the soft starter is provided by a temperature sensor located on the heatsink and by calculating the temperature of the thyristor junction with sophisticated modeling of the specific devices used. Fans are powered by 24VDC supply and thermally controlled when the heatsink temperature exceeds 40°C and whilst the motor is ramping.

Motor thermal Protection

The SS6000 provides thermal protection of the motor by providing a thermistor input and also a programmable motor overload protection feature.

The starter continuously monitors the current and calculates the temperature rise of the motor based on the motor data provided. The standard IEC60947-4-2 defines the protection classes giving the starting capacities of the motor (warm or cold) without thermal trips.

The thermal protection displayed by the starter corresponds to the thermal time constant:

- An overload trip will occur and stop the motor, if the motor exceeds the critical temperature rise threshold of 125%
- This feature has a memory function based on the thermal capacity and may not allow a start if the temperature rise is too high.
- The thermal state continues to calculate even when the starter is off and powered down. Simply by turning power off and back on will not reset the thermal state.

Motor thermistor Protection

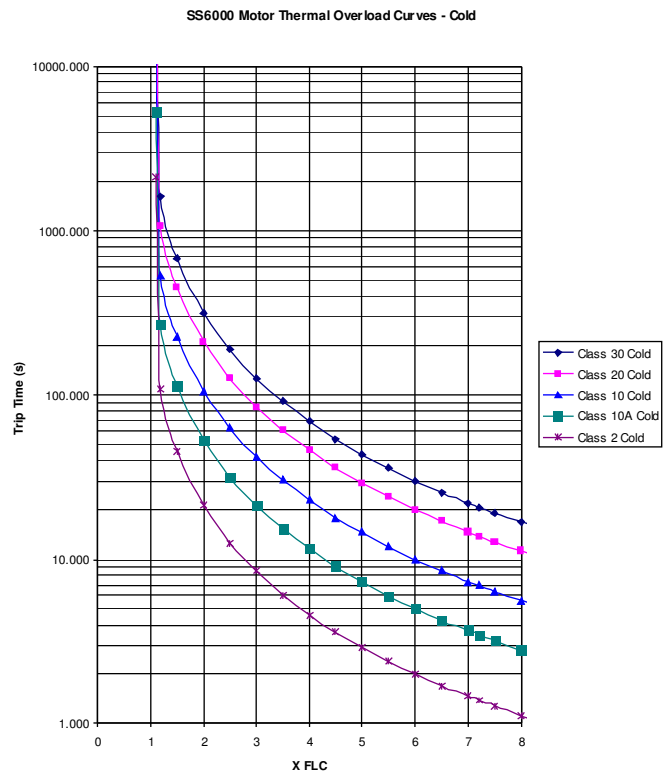
The SS6000 provides an input for a thermistor or normally closed switch. Thermistor / PTC probes integrated in the motor to measure its temperature can be connected to the thermistor input terminals.

This input has a trip resistance of 3000ohms and a resistance of 20ohms or less will be detected as a short circuit.

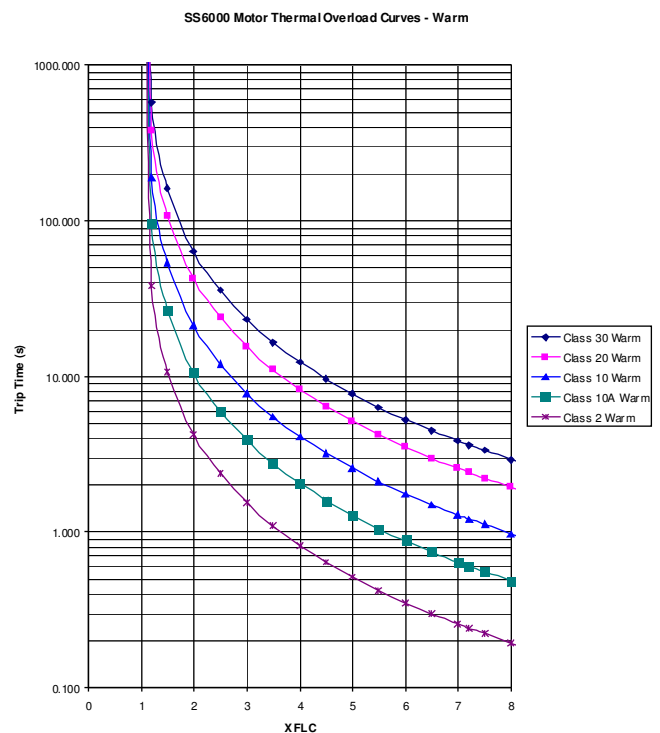
Alternatively, a normally closed thermal switch may be used which open circuits at a specific temperature.

Motor thermal Protection

Cold Curves



Hot Curves



Unit ratings

The following tables provide the maximum motor FLC that should be used on each SS6000 model for specific starting & operating duties.

15A – 80A with Integral Bypass Contactor (380 - 415V)

Light Duty:	Standard Duty:	Severe Duty:	Model	Chassis	Dimensions (mm)
15A	15A	15A	6R015B2	B2	335h 162w 174d
30A	25A	20A	6R030B2	B2	335h 162w 174d
60A	54A	44A	6R060B2	B3	440h 162w 174d
80A	70A	56A	6R080B2	B3	440h 162w 174d

220 -460V 3 Wire Bypass

Light Duty:	Standard Duty:	Severe Duty:	Model	Chassis	Dimensions (mm)
105	92	82	6R10000	A2	430h 248w 232d
193	170	151	6R19000	A2	430h 248w 232d
221	193	172	6R22000	A2	430h 248w 232d
367	321	285	6R36000	A3	670h 375w 285d
586	513	456	6R58000	A3	670h 375w 285d
830	806	716	6R83000	A3	670h 375w 285d

220 -460V 3 Wire Continuous

Light Duty:	Standard Duty:	Severe Duty:	Model	Chassis	Dimensions (mm)
100	88	78	6R10000	A2	430h 248w 232d
178	157	141	6R19000	A2	430h 248w 232d
203	179	161	6R22000	A2	430h 248w 232d
341	302	270	6R36000	A3	670h 375w 285d
534	473	425	6R58000	A3	670h 375w 285d
796	710	641	6R83000	A3	670h 375w 285d

220 -460V 6 Wire Bypass (inside Delta Connection)

Light Duty:	Standard Duty:	Severe Duty:	Model	Chassis	Dimensions (mm)
180	159	140	6R10000	A2	430h 248w 232d
330	290	260	6R19000	A2	430h 248w 232d
380	330	295	6R22000	A2	430h 248w 232d
635	555	490	6R36000	A3	670h 375w 285d
1015	888	789	6R58000	A3	670h 375w 285d
1435	1395	1240	6R83000	A3	670h 375w 285d

Unit ratings

220 -460V 6 Wire Continuous (Inside Delta Connection)

Light Duty:	Standard Duty:	Severe Duty:	Model	Chassis	Dimensions (mm)
173	152	135	6R10000	A2	430h 248w 232d
308	270	240	6R19000	A2	430h 248w 232d
350	310	275	6R22000	A2	430h 248w 232d
590	520	465	6R36000	A3	670h 375w 285d
920	815	735	6R58000	A3	670h 375w 285d
1378	1225	1110	6R83000	A3	670h 375w 285d

Note:

1. The above ratings are based on a 40Degree Ambient. Ratings up to 60degC are available.
2. The bypass contactor is not included unless stated otherwise.

Shipping/Packaging Details

Part No.	Dimensions (mm)	Weight (kg)
6R015B2	380 x 220 x 248	6
6R030B2	380 x 220 x 248	6
6R060B2	488 x 220 x 248	7
6R080B2	488 x 220 x 248	7
6R10000	480 x305 x 290	18
6R19000	480 x 305 x 290	18
6R22000	480 x 305 x 290	18
6R36000	770 x 470 x 430	68
6R58000	770 x 470 x 430	68
6R83000	770 x 470 x 430	68

SS6000 Options

24vdc Power Supplies

Part Number	Description	Comments
TQ60001	24Vdc Power Supply, 36W, 1.5 Amps	Power Supply to suit 6R15 to 6R30
TQ60002	24Vdc Power Supply, 48W, 2.0 Amps	Power Supply to suit 6R60 to 6R80
TQ60003	24Vdc Power Supply, 72W, 3.0 Amps	Power Supply to suit 6R100 to 6R220
TQ60004	24Vdc Power Supply, 96W, 4.0 Amps	Power Supply to suit 6R360 to 6R830

Remote Console Option (H.I.M): Ribbon Cable

Part Number	Description	Comments
TQ60006	Remote Console (IP66) - loose	Available for all models
TF60006	Remote Console (IP66) - fitted	Available for all models
TQ60007	Remote Console (IP66) Cable per 2m	Available for all models
TQ60008	Remote Console (IP66) Cable per 3m	Available for all models
TQ60009	Remote Console (IP66) Cable per 5m	Available for all models
TQ60010	Remote Console (IP66) Cable per m	Available for all models
TF60007	Remote Console (IP66) Cable per 2m – fitted	Available for all models
TF60008	Remote Console (IP66) Cable per 3m – fitted	Available for all models
TF60009	Remote Console (IP66) Cable per 5m – fitted	Available for all models
TF60010	Remote Console (IP66) Cable per m – fitted	Available for all models

Remote SMART Console Option (H.I.M): Cat-5 Cable

Part Number	Description	Comments
TQ60011	Remote Console (IP66) - loose	Available for all models
TF60011	Remote Console (IP66) - fitted	Available for all models
TQ60012	Remote Console (IP66) Cable per m (Max 10m)	Available for all models
TF60012	Remote Console (IP66) Cable per m (Max 10m) - fitted	Available for all models

SS6000 Options

Option Boards

SS6000 Model	Description	Part Number:
All	Option Card : Data Logger & SD port	TQ60005
All	Option Card : Data Logger & SD port - fitted	TF60005
All	Communications: Ethernet Modbus TCP Port & Data Logger	TQ60032
All	Communications: Ethernet Modbus TCP Port + Data Logger - fitted	TF60032
(All models come standard with Modbus RS485)		

Other Options

SS6000 Model	Description	Part Number:
6R100 – 6R220	Prepared for 6 wire	TF60015
6R360 – 6R830	Prepared for 6 wire	TF60016

Semiconductor Fuse Kits

SS6000 Model	Description	Part Number:	Replacement Fuse:
6R015B2	Semiconductor Fuse Kit to suit 6R15	TQ60020	
6R030B2	Semiconductor Fuse Kit to suit 6R30	TQ60021	
6R060B2	Semiconductor Fuse Kit to suit 6R60	TQ60022	
6R080B2	Semiconductor Fuse Kit to suit 6R80	TQ60023	
6R15-6R80	Semiconductor Fuse Kit Cover	TQ60024	
6R10000	Semiconductor Fuse Kit to suit 6R100	TQ60025	
6R19000	Semiconductor Fuse Kit to suit 6R190	TQ60026	
6R22000	Semiconductor Fuse Kit to suit 6R220	TQ60027	
6R36000	Semiconductor Fuse Kit to suit 6R360	TQ60028	
6R58000	Semiconductor Fuse Kit to suit 6R580	TQ60029	
6R83000	Semiconductor Fuse Kit to suit 6R830	TQ60030	

Appendix A

ZENER SMART-TORQ

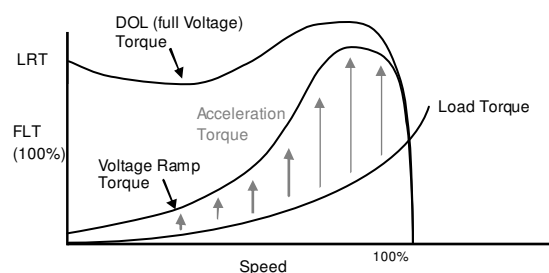
Torque Control System

There are several methods available to soft start a motor. The more traditional methods are Direct-on-line, Star/Delta, Auto transformer and Primary resistance starters. The more sophisticated methods also provide a soft stop and include Soft Starters and Variable Speed drives (VSD's). VSD's can provide a better soft start with significantly lower starting currents and many other benefits including energy savings. However, a Soft Starter may provide a more economical solution to motor starting over the life of the motor.

Soft Starters provide the following benefits:

1. Reduced stresses and wear on the mechanics of the system
2. Reduced starting currents
3. Minimise voltage dips on the supply
4. Lowered Peak demand charges
5. Eliminate belt slippage on fans
6. Smooth acceleration of motor / load

The conventional voltage ramp Soft Starter is a reduced voltage starter and is similar to the traditional methods mentioned above. The problem with voltage ramp soft starters is a non linear acceleration of the motor. This is very noticeable on a pump type load where there is much higher acceleration torque available at the beginning of the start. The diagram below shows the variation in acceleration torque available for both a Direct on line (full voltage) and the voltage ramp type soft start.



'SMART-TORQ[®]' is a Torque Control System developed by Zener to overcome this problem with greater control over the acceleration torque in the motor. The torque is controlled in a manner which suits the type of load to achieve a linear acceleration in motor shaft speed. This control system is also active during the deceleration phase, providing a soft stop where the motor decelerates at a constant rate. This can be used to overcome water hammer problems associated with the closing or slamming of check valves.

ZENER SMART-TORQ Key Benefits:

1. A true linear acceleration of the load and motor for variable & constant torque loads.
2. Reduced stresses and wear on the mechanics of the system
3. Ramp profiling to better match type of load such as variable torque loads. Better control of pumps and fans.
4. Torque Control available in Accel & Decel Modes and 3wire or 6wire motor configuration.
5. Eliminate water hammer problems.
6. Reduced peak current draw, especially at motor pull-in/pull-out operating points.
7. Reduced heating in motor at low speeds.
8. No instability due to changing power factor. Closed loop system to monitor and react to changing power factor.
9. No instability due to slot ripple in 3 wire and 6 wire operation.
10. Better control of deceleration through closed loop torque control system.
11. No external speed sensor required to produce superior performance

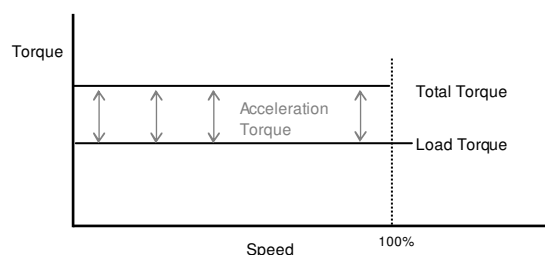
The rate of acceleration is dependent on the additional torque (Acceleration Torque) available in the motor.

Thus, we can achieve a constant or linear rate of Acceleration by providing 'constant' acceleration torque to the motor.

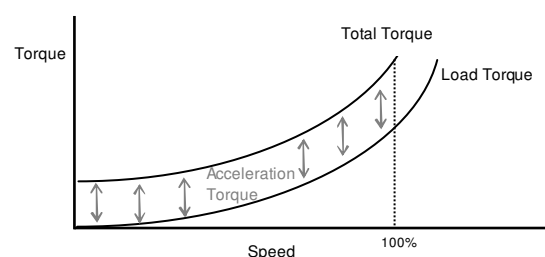
Since the torque required by the load may not be linear, the torque delivered by the soft starter must match that of the load. To achieve this, the torque developed in the motor must be the sum of the 'acceleration torque' and the load torque at a specific speed.

Below illustrates the constant acceleration torque applied for different load types;

1) Constant Torque type Load (eg. Conveyor)



2) Variable Torque type Load (eg. Pump/Fan)



How is this achieved ?

The SMARTSTART[®] 6000 continually monitors start variables such as motor current, voltage and power factor to determine the input electrical power. From the motor parameters, the IR & magnetic losses are used to calculate the Air Gap Power (ie. the power transmitted to the motor shaft). With an instantaneous value of shaft power the instantaneous torque can be determined. With this information we can vary the thyristor conduction to achieve the desired torque. The torque is varied to follow a specific curve, based on the initial torque setting, the final torque setting and the profile selected. The end result is equal acceleration torque over the ramp period to provide a linear acceleration in motor shaft speed. The profile is user adjustable allowing for non-linear torques if required to other or unusual types of loads.

Summary.

The 'SMART-TORQ[®]' Torque Control System provides smoother starting & stopping, allowing ramp profiling to produce a linear acceleration and deceleration of the motor speed. There are many benefits with variable torque loads such as pumps. A linear acceleration and deceleration provides better control to eliminate water hammer problems. The SMARTSTART[®] 6000 combines this superior torque control system with a robust design to suit all types of loads and applications. All models include substantial heatsink mass with temperature controlled force ventilation to accommodate the more severe (heavy) duty applications.

Appendix A

Indicative parameters for different load types

1. Pump (3 wire/Bypass with No Soft Stop)

Factory defaults are intended for general pumping/fan application with no Soft Stop. Enter motor parameters as per motor nameplate.

2. Submersible Pump (3 wire/Bypass with No Soft Stop)

Factory defaults are intended for general pumping application with no Soft Stop. The acceleration time needs to be reduced to 3secs or as per pump/motor manufacturers recommendations. Enter motor parameters as per motor nameplate.

Ref	Page	Parameter	Setting (factory Default)
C11	17	Accel time	3sec (10s)
M01	17	Motor Amps	'Namplate Motor FLC'
M02	17	Motor Volts	'Namplate Motor Volts'
M03	17	Motor PF	'Namplate Motor PF'

3. Pump :(3 wire/Bypass with Soft Stop)

Factory defaults are intended for general pumping application with no Soft Stop. Enter motor parameters as per motor nameplate. Adjust the 'Release Torque' and 'Decel time' to achieve the required soft stop.

Ref	Page	Parameter	Setting (factory Default)
C21	18	Decel time	*15sec (0s)
C22	18	Release Torque	*2% (2%)
M01	17	Motor Amps	'Namplate Motor FLC'
M02	17	Motor Volts	'Namplate Motor Volts'
M03	17	Motor PF	'Namplate Motor PF'

4. Fan :(3 wire/Bypass)

Factory defaults are intended for general pumping application which is similar to that required for a fan. However, the Accel time may need to be increased to allow for longer ramp times of high inertia fans. The Motor Overload Class may also need to be increased with the extended ramp of high inertia fans. Enter motor parameters as per motor nameplate.

Ref	Page	Parameter	Setting (factory Default)
C11	17	Accel time	15+ (10s)
P01	18	Motor Overload	Class 10 /Class 20 (10)
M01	17	Motor Amps	'Namplate Motor FLC'
M02	17	Motor Volts	'Namplate Motor Volts'
M03	17	Motor PF	'Namplate Motor PF'

5. Conveyor: (3 wire/Bypass)

Factory defaults are preset for a variable torque load. The Torque settings will need to be adjusted for a constant torque type load. Enter motor parameters as per motor nameplate.

Ref	Page	Parameter	Setting (factory Default)
C12	17	Start Torque	150% (30%)
C13	18	Final Torque	150% (130%)
A21	23	Accel profile	Linear (Squared)
P01	18	Motor Overload	Class 20 (10)
M01	17	Motor Amps	'Namplate Motor FLC'
M02	17	Motor Volts	'Namplate Motor Volts'
M03	17	Motor PF	'Namplate Motor PF'

6. Compressor: (3 wire/Bypass)

Factory defaults are preset for a variable torque load. The Torque settings will need to be adjusted for a constant torque type load. Enter motor parameters as per motor nameplate.

Ref	Page	Parameter	Setting (factory Default)
C12	17	Start Torque	60% (30%)
C13	18	Final Torque	130% (130%)
A21	23	Accel profile	Linear (Squared)
P01	18	Motor Overload	Class 20 (10)
M01	17	Motor Amps	'Namplate Motor FLC'
M02	17	Motor Volts	'Namplate Motor Volts'
M03	17	Motor PF	'Namplate Motor PF'

7. Suggested Protection Settings

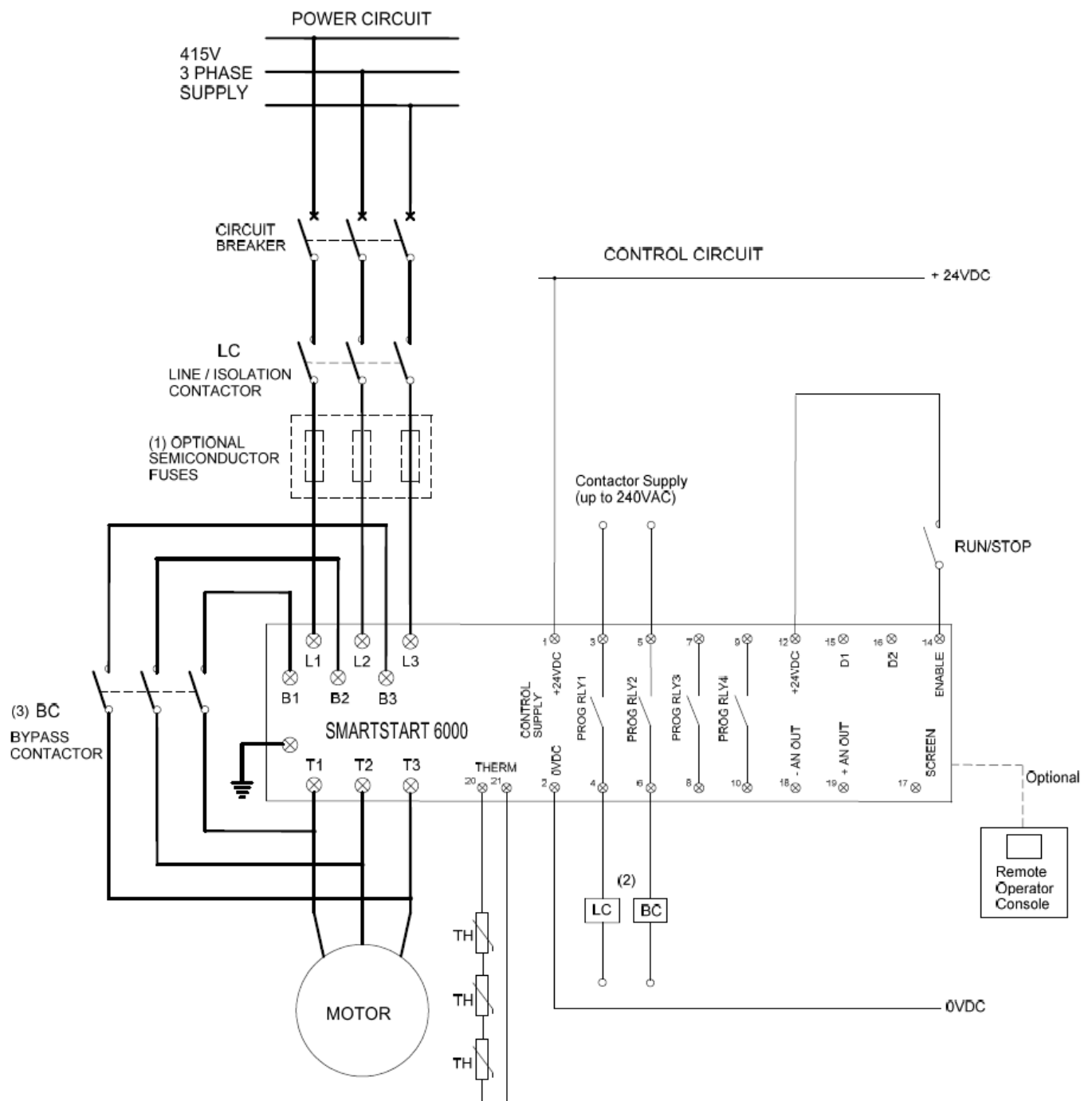
Below are suggested settings to provide additional protection of the motor and load. These are general settings and should be further tuned to suit the application and load conditions.

Ref	Page	Parameter	Setting (factory Default)
P01	18	Motor Overload	Class 10a/10/20 (10)
P02	18	Motor O/Temp	Thermistor (Disabled)
P03	18	Phase Rotation	1-2-3 (Disabled)
P10	19	Accel O/Time	Trip / 5s (Disabled)
P20	19	Volt Imbal.	Trip / 25% / 5s (Default)
P30	19	Current Imbal.	Trip / 25% / 10s (Default)
P41	20	Under Current	Trip / 50% / 10s (Disabled)
P70	21	Over Torque	Trip / 110% / 10 s (Disabled)

Appendix B

Application Diagrams

General Purpose

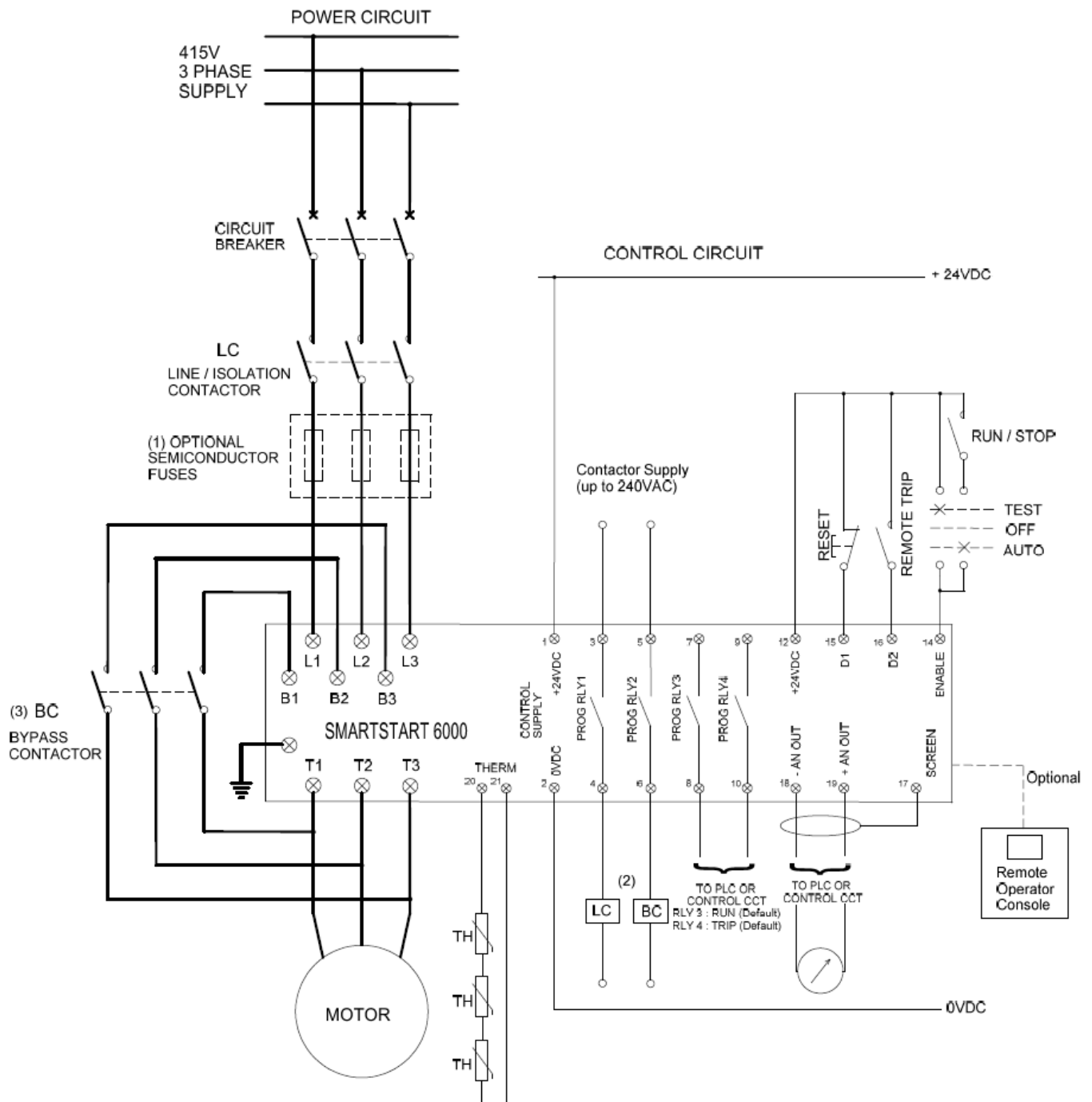


- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Relay Contacts are rated for 5A 240VAC/30VDC inductive. An intermediate relay may be required where peak currents may exceeds this rating.
- (3) Models 6R15 to 6R80 include an integral Bypass Contactor. With these models an external Bypass Contactor is not required

Appendix B

Application Diagrams

Typical Water & Sewerage Pumping

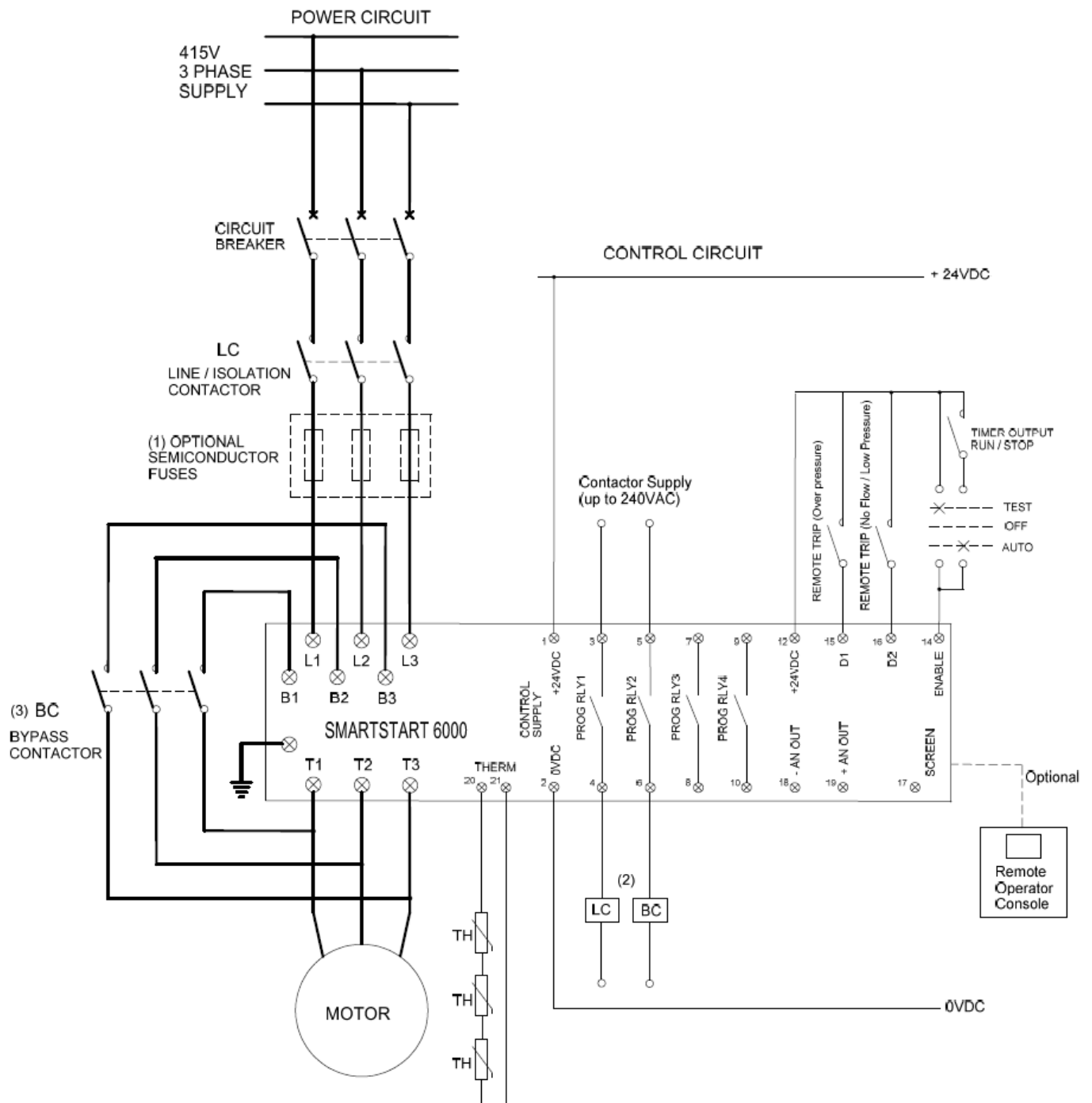


- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Relay Contacts are rated for 5A 240VAC/30VDC inductive. An intermediate relay may be required where peak currents may exceeds this rating.
- (3) Models 6R15 to 6R80 include an integral Bypass Contactor. With these models an external Bypass Contactor is not required

Appendix B

Application Diagrams

Irrigation Pump



- (1) Optional Fast Acting Semiconductor Fuses selected to suit SCR Devices used.
- (2) Relay Contacts are rated for 5A 240VAC/30VDC inductive. An intermediate relay may be required where peak currents may exceeds this rating.
- (3) Models 6R15 to 6R80 include an integral Bypass Contactor. With these models an external Bypass Contactor is not required

Menu Map / Set up Record Sheet

DESIGNATOR: _____

Software Revision: _____

Main menu	Sub menu Level 1	Sub menu Level 2	Default	Setting
1 Display	D02 Default Screen		Overview	
	D03 Bargraph Var.		Mtr Current	
	D04 Bargraph FS		300%	
2 Motor	M01 Motor Amps		Unit Rating	
	M02 Motor Volts		415V	
	M03 Motor PF		0.9	
	M04 Motor Wiring		3 Wire	
3 Control	C01 Run mode		Bypass	
	C02 Current Limit		450%	
	C10 Accel Ramp			
		C11 Accel Time	10	
		C12 Start Torque	30%	
		C13 Final Torque	100%	
	C20 Decel Ramp			
		C21 Decel Time	0	
		C22 Release Torque	2%	
4 Protection	P01 Mtr Overload		Class 10	
	P02 Mtr Over Temp		Disabled	
	P03 Ph Rotation		Ignore	
	P10 Acc OverTime	P11 Overtime Alarm	Off	
		P12 OverTime Delay	120s	
	P20 Volt Imbal Alarm	P21 Volt Imbal Alarm	trip	
		P22 Volt Imbal Level	25%	
		P23 Volt Imbal Delay	5s	
	P30 Curr Imbal Alarm	P31 Curr Imbal Alarm	trip	
		P32 Curr Imbal Level	25%	
		P33 Curr Imbal Delay	10	
	P40 Undercurrent Alarm	P41 Undercurrent Alarm	off	
		P42 Undercurrent Level	10%	
		P43 Undercurrent Delay	10s	
	P50 Overcurrent Alarm	P51 Overcurrent Alarm	off	
		P52 Overcurrent Level	100%	
		P53 Overcurrent Delay	10s	
	P60 Under Torque Alarm	P61 Under Torque Alarm	off	
		P62 Under Torque Level	10%	
		P63 Under Torque Delay	10	
	P70 Over Torque Alarm	P71 Over Torque Alarm	off	
		P72 Over Torque Level	100%	
		P73 Over Torque Delay	10s	

Menu Map / Set up Record Sheet

DESIGNATOR: _____

Software Revision: _____

Main menu	Sub menu Level 1		Sub menu Level 2	Default	Setting
5 Inputs	I10 DigIn 1 Mode			Enable	
		I11 DigIn 1 Variable		Remote Reset	
		I12 DigIn 1 Delay		3.0s	
	I20 DigIn 2 Mode			Disable	
		I21 DigIn 2 Variable		-	
		I22 DigIn 2 Delay		-	
6 Outputs	Q10 Relay 1 Mode			Enable	
		Q11 Relay 1 Variable		Line Ctl	
	Q20 Relay 2 Mode			Enable	
		Q21 Relay 2 Variable		Bypass Ctl	
	Q30 Relay 3 Mode			Enable	
		Q31 Relay 3 Variable		Motor On	
	Q40 Relay 4 Mode			Enable	
		Q31 Relay 4 Variable		Trip	
	Q50 An Out 1 Mode			Disabled	
		Q51 An Out 1 Variable		Current	
Q52 An Out 1 FS			200%		
7 Resets	R01 Manual Reset			Disabled	
	R02 Power Reset			Enabled	
	R03 Start Reset			Disabled	
8 Advanced	A10 Kick Start	A11 Kick Time		0.0s	
		A12 Kick Level		70%	
	A20 Accel Method	A21 Accel Profile		Square	
		A22 Accel Control		Torque	
	A30 Decel Method	A31 Decel profile		Linear	
		A32 Decel Control		Torque	
	A41 Motor OL Reset			90%	
	A42 Str OT Reset			60DegC	
	A51 Motor Stator			3.00%	
9 Commands	1 Reset Trip				
	2 Clr Mtr OL				
	3 Clr Counters				
	4 Clr Meters				
	5 Reset Config				
10 Starter Diag	S1 Digital In				
	S2 Thermistor Resitance				
	S3 Chk Motor Wiring				
	S4 Chk CT1/CT2				