ROCKSTARTER

Multifunction Outlet Starter

User Manual

Version: 4, February 2024

Designed and manufactured in Australia by Ampcontrol Pty Ltd

AMPCONTROL®

WARNING!

The **warning** symbol highlights a potential risk of **injury or death**.

Please share these warnings with other operators.

CAUTION!

The **caution** symbol highlights a potential risk of **damage to equipment**.

Please share these cautions with other operators.

NOTE

The **note** symbol highlights **key information**.

Please share these notes with other operators.

ENVIRO

The **enviro** (environmental) symbol highlights areas which may have an impact on the surrounding **fauna and/or flora**.

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Before You Begin

Thank you for purchasing the Ampcontrol Rockstarter.

WARNING!

In the interests of **safety and correct equipment operation**, please take the time to read and understand the content in this manual.

Ampcontrol Contact Details

7 Billbrooke Close, Cameron Park, NSW, 2285

P +61 1300 267 373 | F +61 2 4903 4888

EMAIL: customerservice@ampcontrolgroup.com

WEB: ampcontrolgroup.com

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DEFINITIONS

Term	*Definition*
CB	Circuit Breaker
CCM	Cable Connection Module
EC	Earth Continuity
EFLO	Earth Fault Lockout
EL	Earth Leakage
ELV	Extra Low Voltage
EMF	Electro-Motive Force
FC	Frozen Contactor
FLC	Full Load Current
Healthy	A state in which nothing should trip during the transition of the state under test
HMI	Human Machine Interface
LCM	Load Connection Module
LOV	Loss of Vacuum
MC	Main Contactor
MEM	Main Electronics Module
OL	Overload
OTS	Outlet Test System
Outlet	The interface that sits on the load side of the Main Contactor
Rockstarter	Integrated starter with AS/NZS 2081 protection for underground hard rock mines
RTD	Resistive Termination Device
Running	Main contactor closed and main contactor auxiliary indication in correspondence with the main contactors state (i.e. indicating that the main contactor is closed).
SC	Short Circuit
Start	A sequence beginning with a start command being issues from the PLC, the completion of several outlet pre-energising checks leading up to the closing of the main contactor
Stopped	Main contactor open and main contactor auxiliary indication in correspondence with the main contactor state (i.e. indicating that the main contactor is closed).
Trip	A fault condition which requires the opening of the main contactor or the circuit breaker (fault dependent) to clear the fault, or prevents the closing of the main contactor or circuit breaker
TXF	Transformer
UC	Under current
UV	Under Voltage

1 SAFETY AND OTHER WARNINGS

For safety reasons, the Rockstarter must be installed, operated and serviced only by competent personnel. Please read and understand this instruction manual completely before installing, operating or servicing this equipment. Failure to install or operate this equipment in accordance with the instructions contained in this manual may create hazardous operating conditions.

1.1 Safe Use of Equipment

The equipment supplied has been designed and manufactured to ensure safe operation. The equipment must only be used within the design parameters.

The instructions within this manual must be observed as an aid towards achieving the safest possible installation.

Persons responsible for installation, maintenance, or operation, must observe the following instructions:

1.1.1 Changes to Equipment

Changes in the design and modifications to the equipment are not permitted. Unauthorised changes made to the hardware or operating firmware will void the manufacturer's warranty and may compromise the integrity of the system into which it is installed and other connected equipment.

1.1.2 Equipment Knowledge

Experience with, or understanding of, this equipment is essential for the safe installation and removal of the equipment. Therefore, please read and understand this manual prior to use. Competency based training courses are recommended and are available on request.

1.1.3 Manual Handling

Precautions have been taken to ensure all equipment is safe to handle and free from sharp edges. However, care should always be taken when handling enclosures and gloves should be worn.

1.1.4 Installation

Correct operation and safety depend on the Rockstarter and associated equipment being installed and configured correctly. Mechanical and or electrical installation and maintenance of plant and equipment must only be carried out by appropriately qualified personnel and must be tested thoroughly prior to operation.

1.1.5 Operation

As safety depends on the Rockstarter functioning correctly it is highly recommended that all safety functions of the Rockstarter be periodically tested to ensure correct operation.

1.2 Supplementary Documentation

The Rockstarter’s User Manual is expected to be read in conjunction with the following documentation:

- MAG-196 OTS User Manual
- MAG-199 OTS Application User Manual
- MAG-204 OTS Dashboard User Manual

1.3 Requirements for Safe Operation

- All settings must be implemented in accordance with the user's fault and touch potential control studies
- Upstream protection must be implemented in accordance with the user's fault and touch potential control studies
- The terminal compartment cover must not be removed unless the Rockstarter's circuit breaker is open
- Through Feed gland plates must not be removed unless the Rockstarter has been isolated upstream
- The internal covers must not be removed unless the Rockstarter has been isolated upstream.
- The internal covers must be replaced after termination work has been completed and before upstream isolation is removed
- Upstream isolation must be carried out in accordance with user's risk assessments and operating procedures
- All requirements for safe operation should be integrated into the user's own work procedures
- All gland plates and covers must be installed when in operation
- Gland plates and covers must maintain the Rockstarters IP65 rating, we recommend using Ampcontrol type tested gland plates and covers
- Earthing must be in compliance with all regulations that the installation is subject to
- Users must periodically confirm the correct operation of E-stop as per their risk assessment
- Use certified and appropriately rated lifting equipment for all manual handling
- The Rockstarter must be installed, operated and serviced only by authorised and competent personnel
- The user is responsible for implementing a change management strategy to ensure all settings are configured in compliance with site protection and touch potential studies
- The through feed kit must only be used in conjunction with the Ampcontrol designed mounting bar
- The Rockstarter is not designed for use in explosive atmospheres
- Do not operate in direct sunlight
- Do not operate the Rockstarter outside of its electrical or mechanical ratings
- The Rockstarter is designed for underground or indoor use

2 RECEIVING AND STORAGE

2.1 Receiving

All possible precautions are taken to protect the equipment against damage during shipment; however, before accepting delivery, check all items against the packing list. If there is evidence of physical damage or missing items, please notify Ampcontrol immediately.

In the case of any discrepancies to the packing list. Keep a record of any claims and correspondence. Photographs are recommended.

Where practicable do not remove protective covers prior to installation unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, retain and store any approval documentation for your safety file as applicable prior to wrapping being discarded.

2.2 Inspection

Equipment that is found to be damaged or has been modified away from its published specification must not be used. Please contact Ampcontrol if the equipment is suspected to be different than that ordered or if it does not match the published specifications.

2.3 Transportation

Ensure the Rockstarter is appropriately secured during transportation, ideally the Rockstarter should be installed on the mounting frame for additional protection.

Care must be taken when strapping the Rockstarter. Avoid strapping over the Emergency Stop Switch, HMI, CB handle, and earth stud. Avoid strapping over any sharp or protruding parts.

Figure 1: Strapping Considerations

2.4 Storage after Delivery

When the equipment is not to be installed immediately, proper storage is important to ensure protection of equipment and validity of warranty.

All equipment should be stored indoors between 0–40 ˚C, preferably on shelves and protected from moisture and sunlight.

The Rockstarter must be stored lying flat on its back, alternatively it is recommended to use the Rockstarter's optional Mounting Frame to provide additional protection whilst.

2.5 Unpacking of Equipment

The method of packing used will depend on the size and quantity of the equipment. The following cautions should be interpreted as appropriate.

CAUTION!

Take care when unpacking crates as the **contents may have shifted during transport**.

Take care when moving the equipment. **Ampcontrol recommends the use of lifting aids** where necessary to prevent strain or injury. Refer to the specifications (Section 11) for specific weights.

ENVIRO

The disposal of packaging materials, replaced parts, or components must comply with environmental restrictions without polluting the soil, air or water.

Ensure that any timber and cardboard used as **packaging is disposed of in a safe and environmentally responsible manner**.

Where possible, dispose of all waste products i.e. oils, metals, plastic and rubber products by using an approved recycling service centre.

3 PRODUCT DESCRIPTION

3.1 Overview

Ampcontrol's Rockstarter is a multifunction, multi-voltage outlet starter designed for use in underground hard rock mining. It is also suitable for use in tunnelling and other industrial applications.

The Rockstarter controls a single power outlet, rated up to 250 A / 1000 V, incorporating an integrally designed circuit breaker, contactor and protection electronics, all into a single robust unit.

The starter provides all standard outlet protection functions as well as selectable pump and fan operating modes and Ampcontrol's wireless Outlet Test System. An industrial rated, user friendly touch screen display allows for configuration, control and monitoring of the outlet.

3.2 Features

- AS/NZS 2081, AS/NZS 4871 and AS/NZS 3000 compliance
- Type tested enclosure
- Configurable wideband earth leakage
- Configurable earth continuity
- Main contactor failure protection includes frozen contactor protection
- Configurable short circuit and overload
- Motor thermal modelling
- Configurable current imbalance
- Configurable under voltage/under current
- Pump and Fan specific control and protection modes
- Remote start/stop functionality
- Integrated Outlet Test System (OTS) with automated record keeping
- Auxiliary I/O
- E-stop, for local and upstream tripping
- Integrated RFID tag interface (Provided for authorisation and user traceability)
- Ethernet communications – Modbus TCP and remote desktop interface
- Machine identification – Load Connection Module (LCM)
- Accommodates glanded or receptacle terminations on each line/load connection
- Post-blast start option – Currently Not an Option on available models
- Auto Restart after power loss configurability
- Extensible

3.3 Application

The Rockstarter's integrated approach offers a more versatile solution to traditional designs by providing all of the features and protection to enable re-use in a wide range of applications.

The Rockstarter's incoming and outgoing connections may be configured to suit either a glanded cable entry or a restrained receptacle. Utilising the proprietary Through Supply Kit and Wall Mount, installations are extensible within the limitations of the through feed supply rating.

Ampcontrol's integrated Outlet Test System (OTS) provides a fully automated and comprehensive outlet testing facility. The OTS enables the Rockstarter to undergo routine testing quickly and easily, with all test results uploaded to cloud storage. This satisfies statutory testing requirements while also providing a secure and comprehensive record management tool.

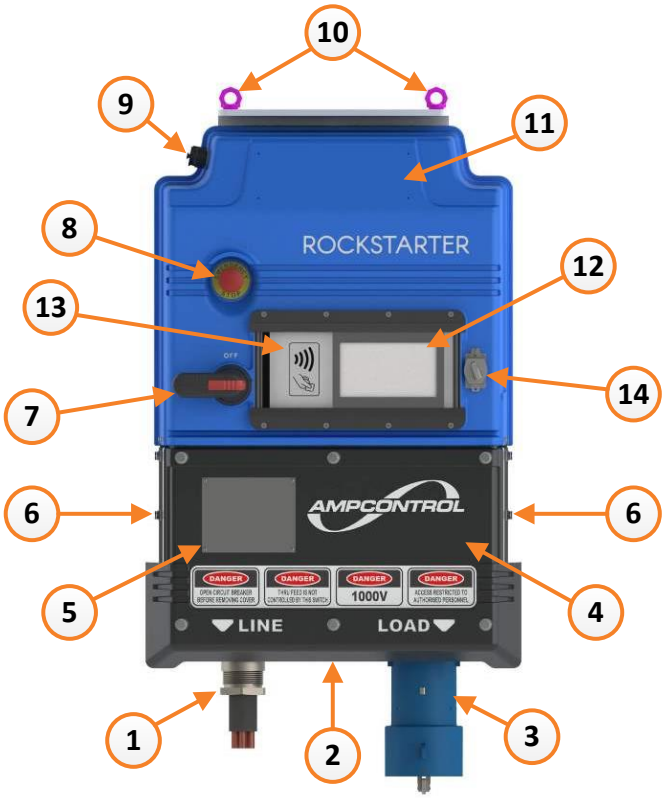


Figure 2: Rockstarter Overview – Single Rockstarter

1. Incoming feed (accepts gland or optional receptacle)
2. Chassis earthing stud
3. Outgoing feed (accepts gland or optional receptacle)
4. Terminal compartment cover
5. Main marking label
6. Through feed
7. Isolator
8. E-stop
9. Ethernet port and auxiliary I/O connector
10. Lifting adaptor (optional)
11. Asset number label (optional)
12. 7” LCD touchscreen
13. RFID tag reader
14. Lock input

WARNING!

In an emergency, the Emergency Stop button located on the front of the Rockstarter will stop the outlet.

NOTE

The asset number label is limited to either a single line of 10 characters with 40 mm high text or two lines, each of 10 characters, with 32 mm high text.

3.4 Configuration Examples

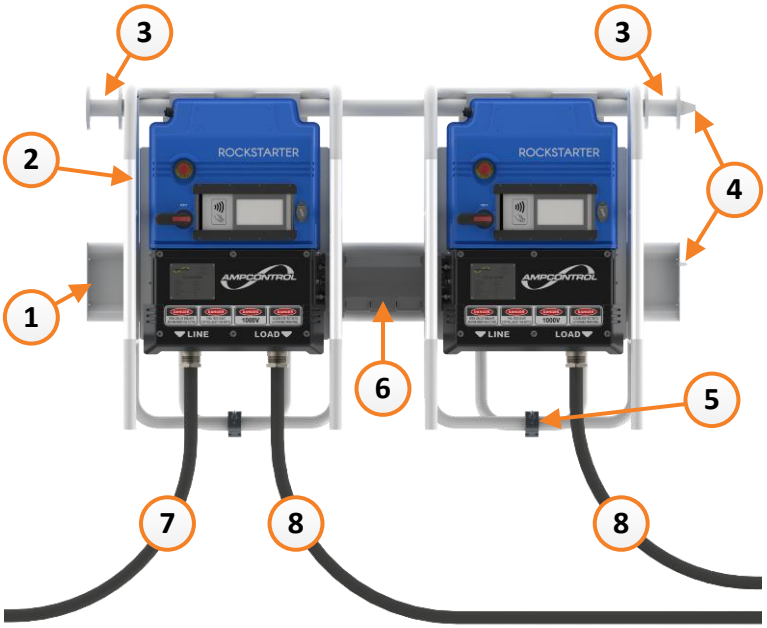


Figure 3: Rockstarter Overview – Two Rockstarters with one incoming feed

1. Wall mount (optional)
2. RKS mounting frame (optional)
3. Wall mount lifting points
4. Wall mount alignment pins
5. RKS mounting frame to wall mount clamp
6. Through feed connection (optional)
7. Incoming feed (glanded shown)
8. Outgoing feeds (glanded shown)

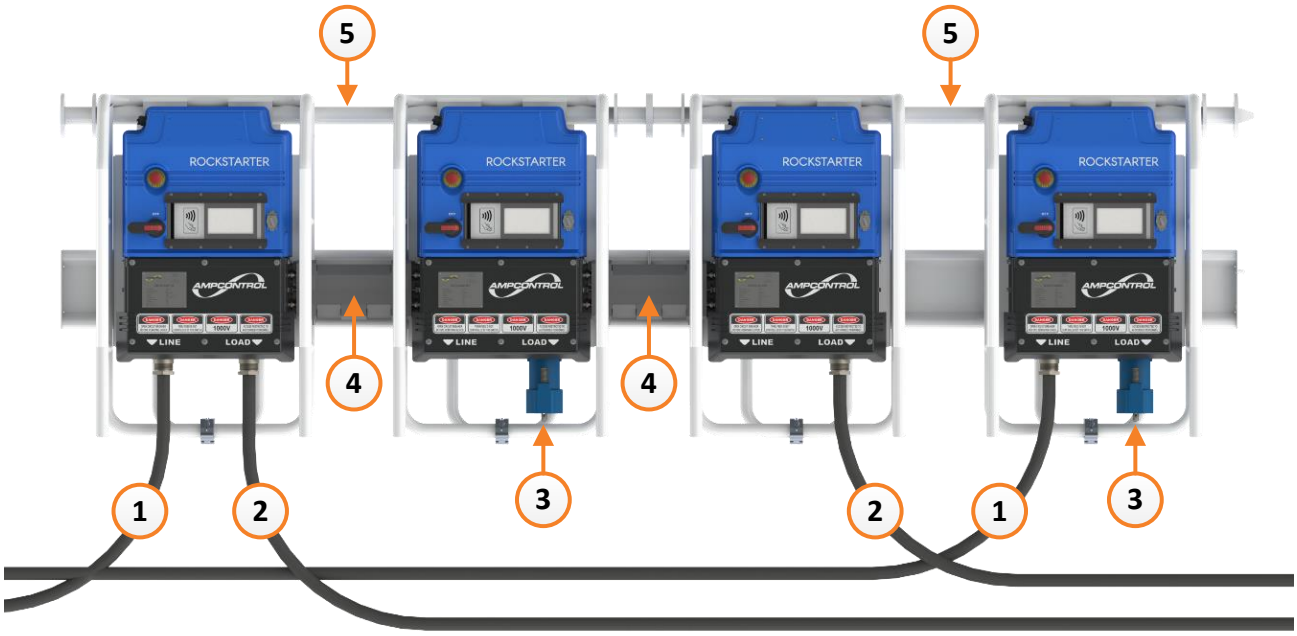


Figure 4: Rockstarter Overview – Four Rockstarters with two incoming feeds

1. Incoming feeds (glanded shown)
2. Outgoing feeds (glanded shown)
3. Outgoing feeds (receptacle shown)
4. Through feed connection (optional)
5. Wall mount (optional)

3.5 Arc Fault Mitigation

The Rockstarter implements high level engineering controls to eliminate the possibility or arcs and faults being generated. This development of the Rockstarters design provides compliance with the requirements of AS/NZS3000:2018 and AS/NZS4871.1:2012 in regard to arc fault protection. Arc Fault Mitigation should not be confused with Arc Fault Containment, containment is a lower level of control against are faults.

Arc Fault Mitigation is achieved through a number of measures. Most notably this includes:

- Electrical grade nylon carriers, cable & buswork retention and insulation. All purposed to increase phase to phase insulation integrity
- Specific design measures to increase phase to phase and phase to earth internal creepage and clearance distances
- A high ingress protection rating (IP65)
- Dedicated internal termination covers to IP2X

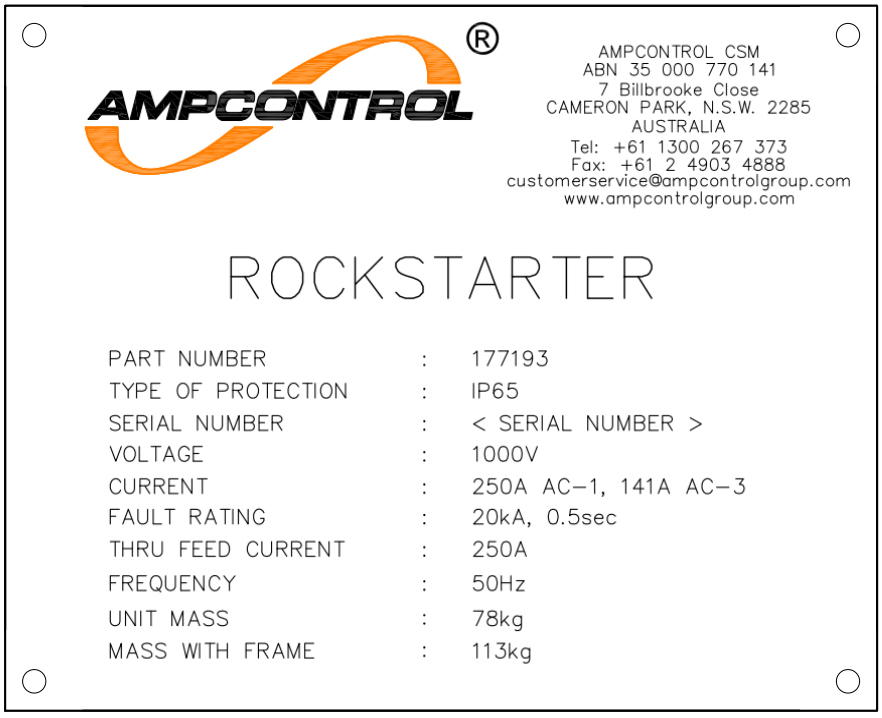


Figure 5: Example of Rockstarter Label

4 INSTALLATION

4.1 General Warnings

These instructions have been designed to assist users of the Rockstarter with installation.

Before the Rockstarter can be installed, there are a number of things that need to be considered and understood to prevent incorrect or unsafe operation of the Rockstarter or the system into which it is installed. Along with relevant competence, and an understanding of the target application, the following points should be considered:

4.1.1 **Ensure that the information provided in this user manual is fully understood.**

It is extremely important that the limitations and functionality of the Rockstarter are understood to prevent incorrect installation and use from creating a potentially dangerous risk. If in doubt as to the nature of the limitations or their implication, consult a competent authority such as a supervisor or Ampcontrol technical representative.

4.1.2 **Ensure that the application into which the Rockstarter is being installed has been properly defined, designed and approved.**

Any system intended to mitigate the risk of injury needs to be properly designed and implemented. Such a system must be the result of structured risk analysis with the outcomes used to define the system requirements. These requirements, in turn, will guide the choice of instrumentation, logic solvers and actuators needed to implement the system. Understanding the needs of the system will ensure proper selection of equipment.

4.1.3 **Ensure that the Rockstarter will properly perform the required functions within the system design.**

It is important to understand how the Rockstarter is intended to interact with other equipment within a system. For safe and reliable use, it is crucial that neither the Rockstarter's logical operation nor its signalling be compromised by incompatibilities with connected equipment.

4.1.4 **Modifications of any form to the Rockstarter are prohibited.**

The Rockstarter as supplied has been designed and manufactured to comply with the requirements of protection standards. If modifications of any form are made to the Rockstarter, the equipment may no longer be fit for use. If any modifications or damage to the Rockstarter is evident, do not use the equipment and contact Ampcontrol for advice.

4.2 Mandatory Installation Practices

The following information must be adhered to when installing the Rockstarter. Failure to adhere to this information may give rise to unsafe operation.

Using the Rockstarter in a manner that exceeds its electrical, functional or physical specifications, or in a way that is contrary to its operating restrictions, may create risks to personnel and/or equipment resulting in injury or death.

- The Rockstarter must be powered within the specified fault level, voltage and current range
- The installation of the Rockstarter must be carried out by suitably trained and qualified personnel
- Identification labels fixed to the Rockstarter must not be damaged, removed or covered
- The installation shall be in accordance with the relevant installation Standards/Codes of Practice
- Rockstarter must not be modified. The unit is built to, and complies with the relevant standards and modifications to its design and construction will render the unit non-compliant
- Complete and accurate records of the installation(s) must be maintained

4.3 Mechanical Installation Information

4.3.1 Rockstarter Dimensions

All dimensions shown are excluding cable glands and receptacles. Ensure there is sufficient space around the unit for mounting hardware, access and cable routing. Consideration must be given to cable tolerances.

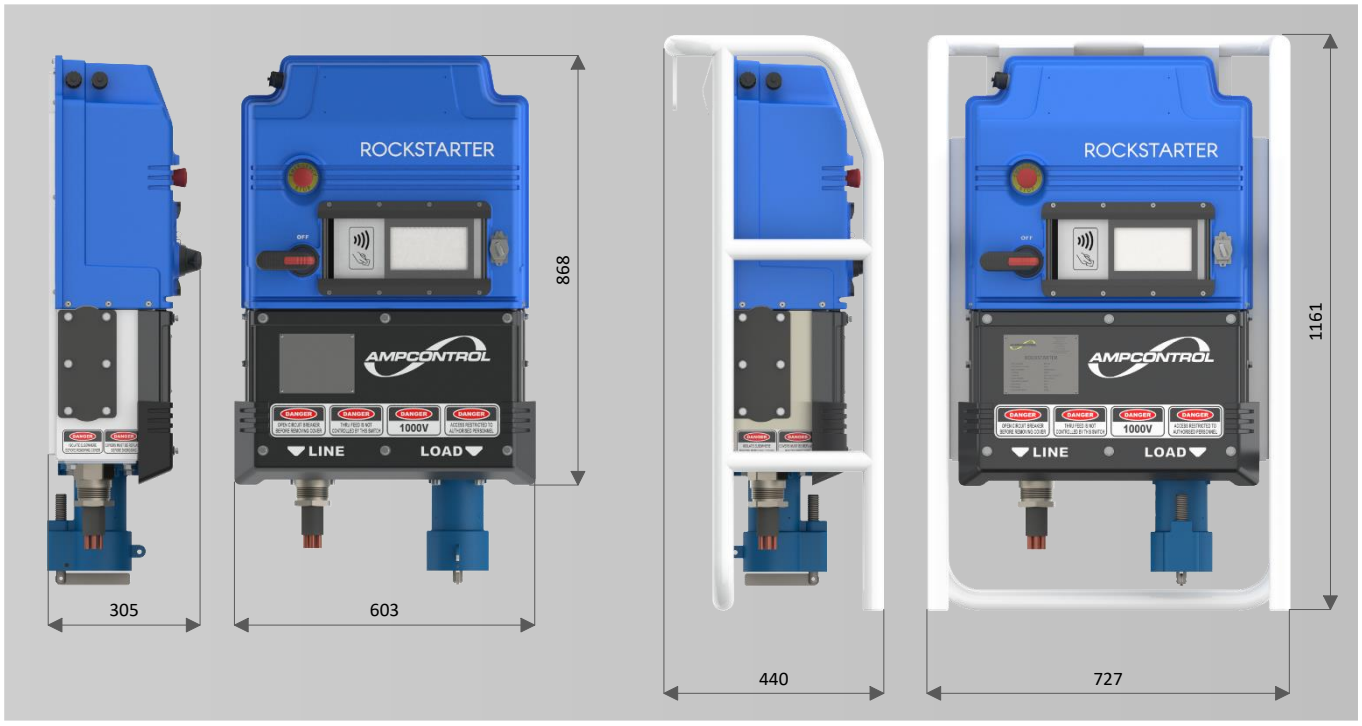


Figure 6: Rockstarter Dimensions (mm)

Table 1: Rockstarter Dimensions

Configuration	Dimensions (W x H x D)
Single Rockstarter (no frame)	603 x 868 x 305 mm
Single Rockstarter mounted with lifting adaptor	603 x 930 x 326 mm
Single Rockstarter in mounting frame	727 x 1161 x 440 mm
Single Rockstarter in mounting frame with lifting adapter	727 x 1182 x 440 mm
1 or 2 Rockstarters mounted to wall mount	2055 x 1194 x 442 mm
3 or 4 Rockstarters mounted to wall mount	4055 x 1194 x 442 mm

4.3.2 Mounting Arrangement

There are three optional mounting solutions available for the Rockstarter, the Lifting Adaptor, Mounting Frame and Mounting Frame with Wall Mount. These are detailed in the following subsections.

4.3.2.1 Lifting Adaptor

The lifting adaptor consists of a bracket with two VRS-M6 lifting lugs which is secured at the top of the Rockstarter. The lifting adaptor is secured to the back of the Rockstarter using 4 M8x25 mm bolts. Provisions have also been made for securing the adaptor to the bottom of the Rockstarter. It is recommended that the lifting adaptor is used for transporting the Rockstarter.

The lifting adaptor is rated for securing the Rockstarter with a sling or chain with an internal angle (α) of no more than 90°, refer to Figure 7. An internal sling angle of 60 or 90° will result in a sling height approximately 290 mm or 170 mm respectively. This additional height, along with any additional mounting hardware, must be taken into account when selecting a suitable mounting location.

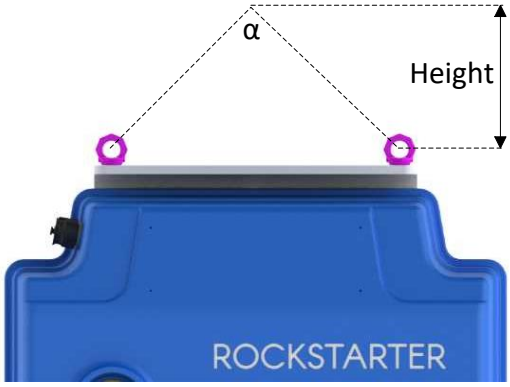


Figure 7: Rockstarter Lifting Adaptor

4.3.2.2 Mounting Frame

The mounting frame (refer to Figure 3) provides additional protection, allows for easier handling, and provides a means to attach the Rockstarter to the wall mount. The frame is secured to the rear of the Rockstarter using 9 M8x16 mm bolts. The mounting frame may be secured to the Rockstarter without removing the lifting adaptor/s.

CAUTION!

It is recommended that additional mechanical protection be implemented where there is an elevated risk of damage to the Rockstarter.

4.3.2.3 **Wall Mount**

The wall mount kit enables multiple Rockstarters to be mounted together and ensures the correct spacing for the optional through feed kit; enabling multiple Rockstarters to be connected together with a single Incoming feed. The maximum number of Rockstarters which may be connected using the through supply kit is limited by the system protection system and buss ratings. These must be taken into account when using the through supply kit.

Each wall mount kit supports two Rockstarters, refer to Figure 3. Wall mounts may be connected together for applications requiring additional Rockstarters, refer to Figure 4. Wall mounts are bolted together and are keyed to ensure correct alignment.

The process for securing the Rockstarter to the wall mount is as follows:

1. If multiple wall mounts are required, connect the wall mounts together using the supplied hardware.
2. Mount to wall mounts in the desired location in your operation.
3. Fit Mounting frames to Rockstarter if not already fitted. This is required for alignment and securing to the wall mount.
4. Lift the Rockstarter over the wall mount, aligning the slot at the back of the mounting frame with the tab on the wall mount, refer to Figure 8. The mounting frame and wall mount are keyed and will self-align provided the Rockstarter is placed near the final position. This ensures correct spacing for the optional through supply kit.

Figure 8: Rockstarter Wall Bracket Mount

5. Once the Rockstarter is fitted to the wall mount, the unit must be secured using the supplied clamps, refer to Figure 9.

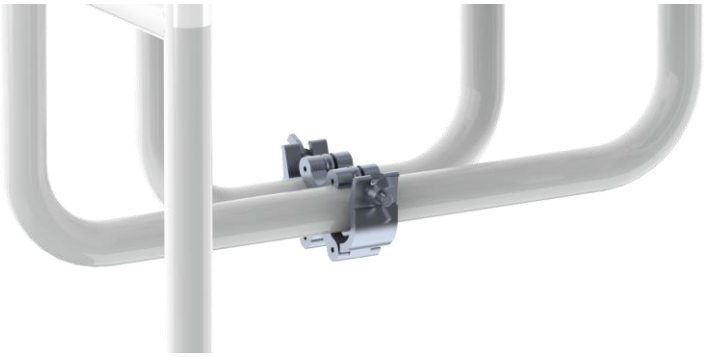


Figure 9: Mounting Bracket Clamps

6. Install the necessary through feed terminations. For details on the through feed electrical connections, refer to Section 0.

4.3.3 Terminal Compartment Cover

The terminal compartment cover provides access to the incoming, outgoing, through feed and Pilot termination points. The user replaceable fuses and control supply termination block is also located behind this cover. The terminal compartment cover can be seen in Figure 10. The terminal compartment cover is secured with 6 M8x60 mm bolts. The cover must not be removed unless the Rockstarter's circuit breaker is isolated.

Three secondary terminal covers provide additional protection to the incoming and through feed cable terminations. These secondary terminal covers must not be removed unless the Rockstarter has been isolated upstream. The covers must be replaced before the upstream isolation is removed to ensure the safety of the next operator entering the compartment. Each through feed secondary cover is secured with two slot head M5x20 mm screws while the secondary cover on the incoming feed is secured with 2 M5x10 mm Phillips-head screws.

The phase connections for the incoming, outgoing and through feed connections are labelled/engraved next to the termination points. Torque specifications for these connections are also labelled within the terminal compartment. The recommended torque for these terminations is 20 Nm.

For more information, refer to the following sections:

- Incoming and outgoing terminations – refer to Section 4.3.4
- Through feed terminations – refer to Section 0
- Pilot termination options – refer to Section 4.4.1 and Section 4.4.2
- Control supply termination options – refer to Section 4.4.3

WARNING!

The terminal compartment cover must not be removed unless the Rockstarter's circuit breaker is isolated.

The secondary terminal covers must not be removed unless the Rockstarter has been isolated upstream.

The secondary terminal covers must be replaced before upstream isolation is removed.

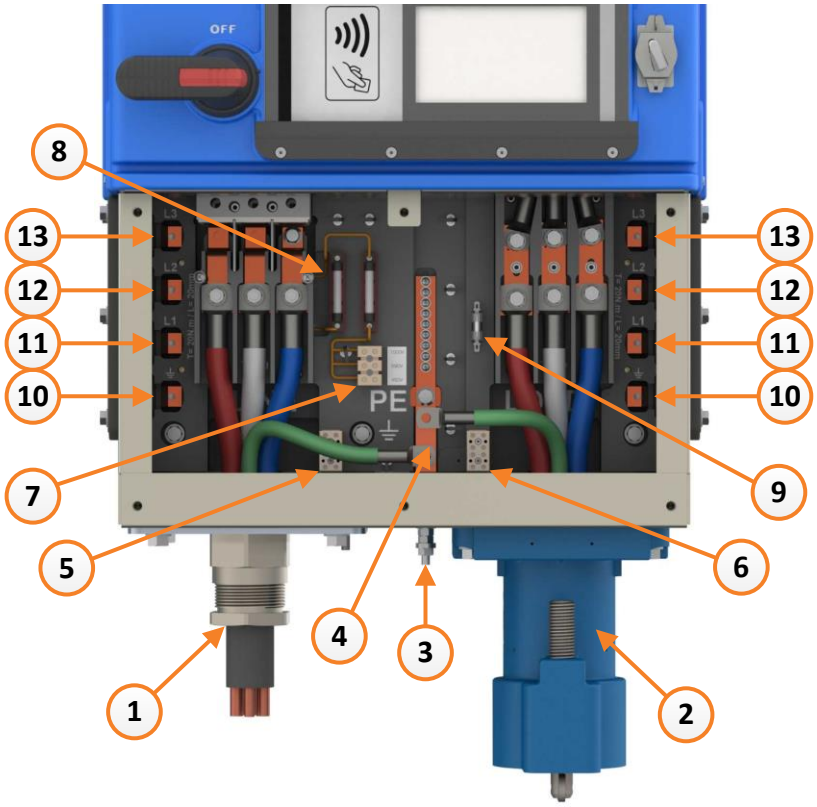


Figure 10: Rockstarter Terminal Compartment Cover Overview

1. Incoming feed (glanded shown)
2. Outgoing Feed (receptacle shown)
3. Chassis earth
4. Earth busbar
5. Incoming pilot termination block
6. Outgoing pilot termination block
7. Control supply termination block
8. Control supply fuses
9. Auxiliary I/O fuse
10. Through feed – earth
11. Through feed – L1
12. Through feed – L2
13. Through feed – L3

4.3.4 **Incoming & Outgoing Cable Terminations**

The Rockstarter's incoming and outgoing connections may be configured to suit either a glanded cable entry or a restrained receptacle. The incoming and outgoing feeds natively support a 300 A receptacle footprint while the blanking plate may be drilled to accommodate glanded cables up to 120 mm^2. The incoming and outgoing gland/blanking plates, 300 A restrained receptacles and adapter plates are secured using 4x M12x45 mm bolts.

Support for 60 A and 150 A receptacles is provided via two optional adaptor plates, refer to Figure 11. The 60 A adaptor plate contains 4 countersunk M8x40 mm hex head bolts spaced appropriately for the two receptacles. The 150 A adaptor plate contains 4 countersunk M12x45 mm hex head bolts spaced appropriately for the two receptacles.

All gland/blanking plates, receptacles and adaptor plates are bolted through the Rockstarter enclosure and secured to a threaded backing plate. All unused entries must be sealed using Ampcontrol supplied gland plates to maintain the IP rating of the starter.

WARNING!

All unused entries must be sealed using Ampcontrol supplied gland plates.

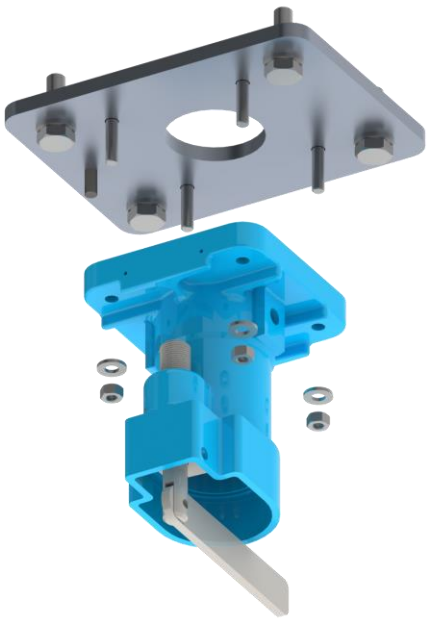


Figure 11: Rockstarter Adaptor Plate (60A pictured)

4.3.4.1 **Termination Extension Housing Kit**

The optional termination extension kit provides a 230 mm extension for incoming glanded cables. When combined with the optional dual incomer termination, the termination extension kit allows the incoming feed of the Rockstarter to branch off to supply another load.

The incoming termination extension kit is secured to the incoming feed of the Rockstarter using 4 M12x45 mm bolts while the gland plate is secured to the base of the extension housing with 8 M8x35 mm bolts. The gland plate is supplied as a solid piece and must be drilled to accommodate glanded cables.

Figure 12: Dual Gland J-Box

4.3.4.2 **Dual Incomer Termination**

There are two options for connecting dual incomers to the Rockstarter. The first option is the Flexible busbar, suited to installations using smaller diameter cables of 70 mm^2 and lower. The second option is a side entry box that allows larger cables to be terminated with extra room, this box is has two options available, a 95 mm^2 and 120 mm^2 option.

These kits allow the Rockstarter's incoming feed to branch off to supply another load or additional Rockstarters.

The process for installing the Rockstarter's dual incomer termination is as follows, It is important to note that when installing supply cables or supply extensions to the Rockstarter the upstream supply should be isolated and tagged out to prevent energisation of the cables and dangerous voltages being present.

WARNING!

Isolate upstream supplies before installing Incomer or Extension cables to the Rockstarter. Not doing so may allow exposed conductors to be energised with dangerous voltage.

Option 1: Flexible Busbar

1. Remove the terminal compartment cover and secondary cover to the incoming feed. Ensure correct isolation procedures are followed.
2. The flexible buses allow the second termination point to move out of the way while securing the incoming feed/first termination point to the original incomer termination point of the Rockstarter as per normal.
3. Thread the supplied insulation sleeve over the second incoming cable and away from termination point. Leave loose.
4. Secure the second incoming cables to the second termination point on the flexible busbar. The recommended torque for the dual incomer terminations is 20 Nm. Alternatively, this can be done before securing the first termination point, order will depend on installer.
5. Re-install the incomer terminal cover under the secondary termination points.
6. Finally slide the loose insulation sleeve back over the second termination point and around the flexible busbar until it contacts the circuit breaker (approximately 60-80 mm past the termination fastener). Secure in place using a cable tie on both sides.

WARNING!

The insulation sleeve must maintain a minimum 50 mm overlap over the insulation of the flexible busbar and second incoming cable to maintain safety IP2X protection.

Figure 13: Dual Incomer Termination

Option 2: Side Entry box

1. Remove the terminal compartment cover and secondary cover to the incoming feed. Ensure correct isolation procedures are followed.
2. Install one incomer as normal on the Rockstarter's incomer / line connection point.
3. Remove the desired through feed internal cover and the external side entry gland plate.
4. Install the side entry box onto the Rockstarter using the supplied hex head screws and ensuring the seal is not damaged.
5. With the side entry box mounted the incoming cable and gland and be installed in the supplied 50 mm hole in the bottom of the box.
6. Cut the cable to the required length and terminate with the provided CB lugs.
7. Secure the second incoming cables to the through feed connection points. The recommended torque for these connections is 20 Nm.
8. Re-install the internal covers, and side entry box side plates. The side plates are universal and can be installed either side, however labelling will indicate the correct side to install.

Figure 14: Dual Connection Side Entry Box

4.3.5 Through Connection

The through supply kit enables multiple Rockstarters to be connected together with a single incoming supply. The through supply kit must only be used with all connected Rockstarters mounted to the wall mount assembly. Ensure through connections are only performed with Ampcontrol supplied accessories.

To fit the through supply kit, ensure correct isolation procedures are followed to isolate upstream supply:

1. Ensure all Rockstarters are mounted to the same wall mount assembly as detailed in Section 0.
2. Remove the terminal compartment cover and secondary cover to the appropriate through feed connection/s on both Rockstarters to be joined.
3. Remove the blanking plates from the appropriate through feed connections.
4. Through feed connections are supplied assembled. Position the assembly between the two Rockstarters and position all cable lugs in the appropriate position. Ensure the O-ring is undamaged and in position.
5. Firmly secure all hardware.
    a. Secure the through feed cables on both Rockstarters. The pre-terminated through feed cables are secured to the appropriate phase bus termination points via M8 bolts with a recommended torque of 20 Nm.
    b. Secure gland plates to the Rockstarter via 6 M8x25 mm bolts.
    c. Tighten the nylon gland in the gland plates to secure the cables and obtain the IP rating.
6. If required, remove the appropriate pilot blanking plugs are replace with glands. Feed the pilot wire through the glands and connect as detailed in Section 4.4.1.2.
7. Install through feed cable cover. The cover clips over the cables.
8. Secure all internal IP2X terminal covers.
9. Install terminal compartment cover.

When the through supply functionality is not required, all cable entries and exits must be sealed using Ampcontrol supplied blanking plates. Ensure unused pilot entries are sealed using nylon blanking plugs.

WARNING!

The through supply kit must only be used with all connected Rockstarters mounted to the wall mount assembly.

Ensure through connections are only performed with Ampcontrol supplied accessories.

Figure 15: Through Feed – with (left) & without (right) cover

4.3.6 **Auxiliary I/O & Ethernet Connectors**

The Rockstarter is equipped with an Ethernet and auxiliary I/O connector at the top of the unit, refer to Figure 16 item 1 and 2. Ethernet connectivity is provided by way of an RJ45. The auxiliary I/O connector utilises a Bulgin PXP6012/16S/CR connector, refer to Table 2 for the auxiliary I/O connector pinout. An optional I/O J-Box and connecting cables are available for easy connection to the Rockstarter's auxiliary I/O connector. The connecting cable is available in 1, 2 and 5 metre lengths. For applications which only require dual fan sequencing, an optional, pre-terminated fan sequencing cable is available. For any application requiring multiple Rockstarters to be sequenced a "Tee" cable can be utilised. Refer to Section 7.2.3 for an overview of fan sequenced starts.

Figure 16: Ethernet & Terminal I/O Connector

Table 2: Terminal I/O Connector Pinout

Auxiliary I/O Connector			
Pin	***Label (I/O)***	***Pin***	***Label (I/O)***
1,2,3,4,5	Factory Use	11,12	Reset (I)
6,7	Run (O)	13,14	Stop (I)
8	Spare	15,16	Start (I)
9,10	Delay Start (I)		

4.3.7 **Sequencing Cables**

There are two specific cables provided for sequencing Rockstarters, Cable Fan Sequencing Rockstarter and Cable Rockstarter Sequencing Tee.

The Fan Sequencing cable (Part Number 181876), this cable connects the “Run” output of one RKS to the “Delayed Start Input” of the second RKS. This cable can be connect in any direction. The master RKS will depend on the configuration of the Rockstarter’s.

The Sequencing Tee cable(Part Number 195515), this cable has three plugs (Master/Slave/This). The Master-Slave connection connects the “Run” output of the Master to the “Delayed Start Input” of the This RKS plug. While the “Run” of the This RKS plug is connected to the “Delayed Start Input” of the plug labelled Slave. This allows the Tee cable to be cascaded to perform a multiple sequence start. The configuration / orientation of this cable is directional with each plug appropriately labelled.

Part Number	Description	Plug Connections
181876	CABLE FAN SEQUENCING ROCKSTARTER	P1 “Run” to P2 “Delayed Start Input” P2 “Run” to P1 “Delayed Start Input”
195515	CABLE ROCKSTARTER SEQUENCING TEE	P1 (Master, “Run”) to P2 (This RKS, “Delayed Start Input”) P2 (This RKS, “Run”) to P3 (Slave, “Delayed Start Input”)

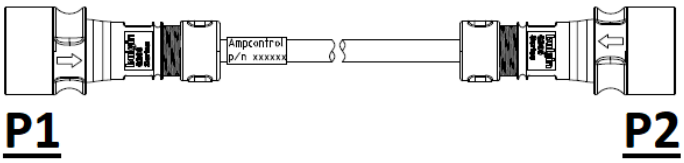


Figure 17 The Fan Sequencing Cable (181876)

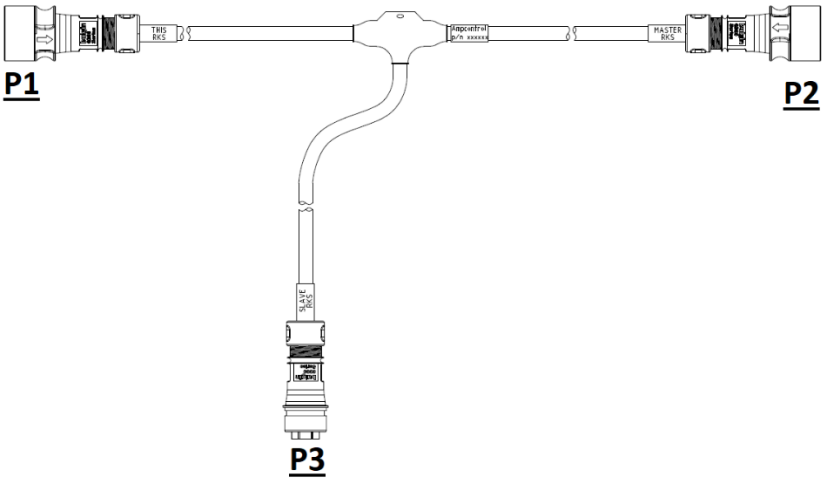


Figure 18 The Sequencing Tee Cable (195515)

4.3.8 **Load Connection Module (LCM)**

The LCM is a microprocessor-based module that can be utilised to replace the diode at the end of the trailing cable pilot conductor. It is powered by and communicates via the pilot line. Its non-volatile memory stores the Rockstarters configuration and protection settings, allowing load identification and protections settings to be utilised whenever the load is used.

All LCM terminals are fully shrouded, with the pilot and earth terminals being segregated from the other control and monitoring terminals.

The LCM provides remote start and stop input facilities. The circuitry involved in these functions is self-diagnostic and will cause the outlet to turn off if the circuits are earthed or interconnected. This reduces the chance of the outlet operating when not required to do so due to wiring faults. It should be noted that these functions are operational only, and that any emergency stops should be wired directly into the pilot circuit.

WARNING!

Any emergency stops should be wired directly into the pilot circuit.

PTC terminals are provided for a semiconductor ‘switching’ thermistor. These terminals are protected in a similar manner to the stop and start circuits. The resistance threshold is as follows, trip when resistance exceeds 1960 Ω and reset when value drops back below 1847 Ω.

Five RTD inputs are provided for PT100 RTDs. The Rockstarter can be programmed to trip on RTD over-temperature.

A parameter dongle allows an LCM to be replaced without needing to re-program the parameters. When installed, this dongle should be firmly secured to the machine/equipment. The relevant settings changes made on the connected Rockstarter are automatically pushed to the LCM parameter dongle.

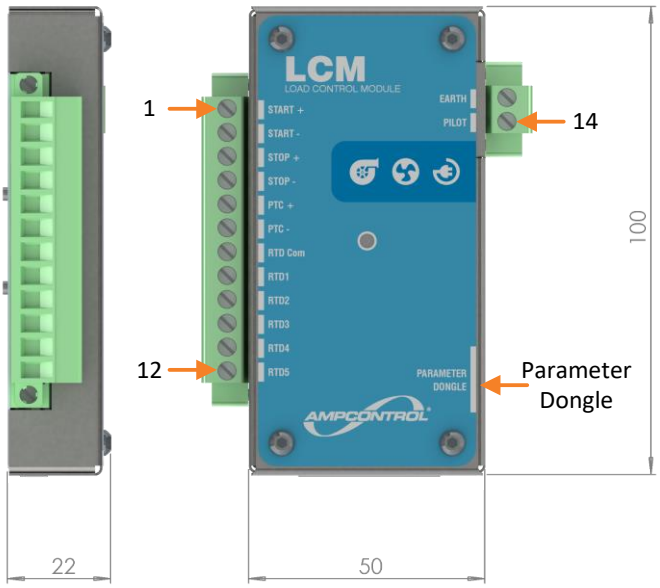


Figure 19: Load Connection Module (LCM) (mm)

Table 3: LCM Pinout

LCM			
Left Side		**Right Side**	
Terminal	**Description**	**Terminal**	**Description**
1	Start +	13	Earth
2	Start -	14	Pilot
3	Stop +	Parameter Dongle	
4	Stop -		
5	PTC +		
6	PTC -		
7	RTD Com		
8	RTD1		
9	RTD2		
10	RTD3		
11	RTD4		
12	RTD5		

4.3.9 Float Junction Box (196069)

The float junction box provides a remote Start and Stop input through the Rockstarters I/O Connector. The module is a IP66 plug and play extension and utilises 2x M25 glanded entries to the junction box for each of the start and stop (High and low float level) inputs. To use this with the Rockstarter, you cannot have the Rockstarter configured for Remote start. The Float Junction Box inputs are connected directly to the Auxiliary Start and Stop inputs, meaning this module can be used for start and stop inputs for any mode.

When used on pumps, it is recommended that you operate the Rockstarter in Pump Mode with Sleep disabled. This will allow the Rockstarter's Pump controller to act as a failsafe if a float input gets stuck or becomes faulty. Provided that the inputs do not fail the Rockstarter will never enter sleep mode and will function with the float inputs only as desired.

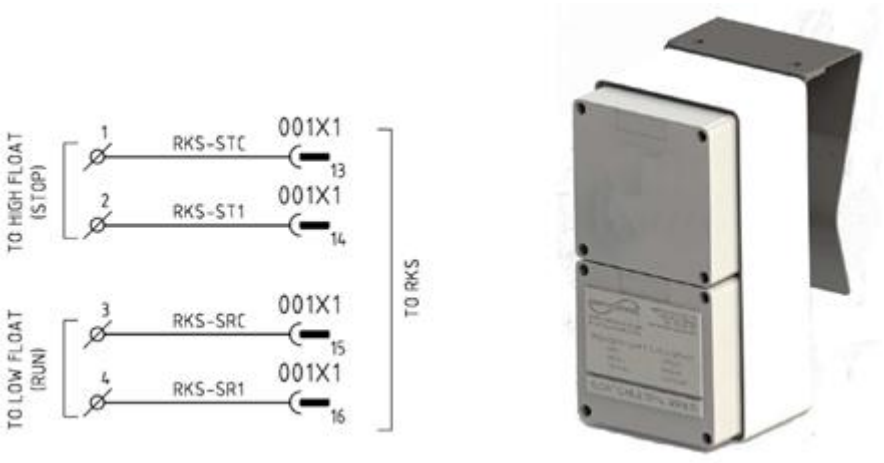


Figure 20: Float Junction Box (196069)

4.3.10 H3RO Fibre Communications Junction Box Complete with Terminals (192139)

The H3RO fibre communications junction box provides an interface between local copper Ethernet/IP connections to Rockstarter panels and a site fibre network, significantly increasing the distance at which data can be exchanged with Rockstarters remotely. The equipment is powered from a connected RKS through the IO cable.

The enclosure is IP66 rated with IP67 connectors (connection requires appropriate external cable termination to maintain rating). Standard the enclosure allows for 3 Copper connections, however this can be increased to 5 if desired (identify when ordering).

The junction box also provides a full break out of connected RKS IO terminals that are connected. The junction box comes prewired for fan sequencing between a Master fan and up to two Slave fans.

Figure 21: H3RO Fibre Communications Junction Box Complete with Terminals (192139)

4.4 Electrical Installation Information

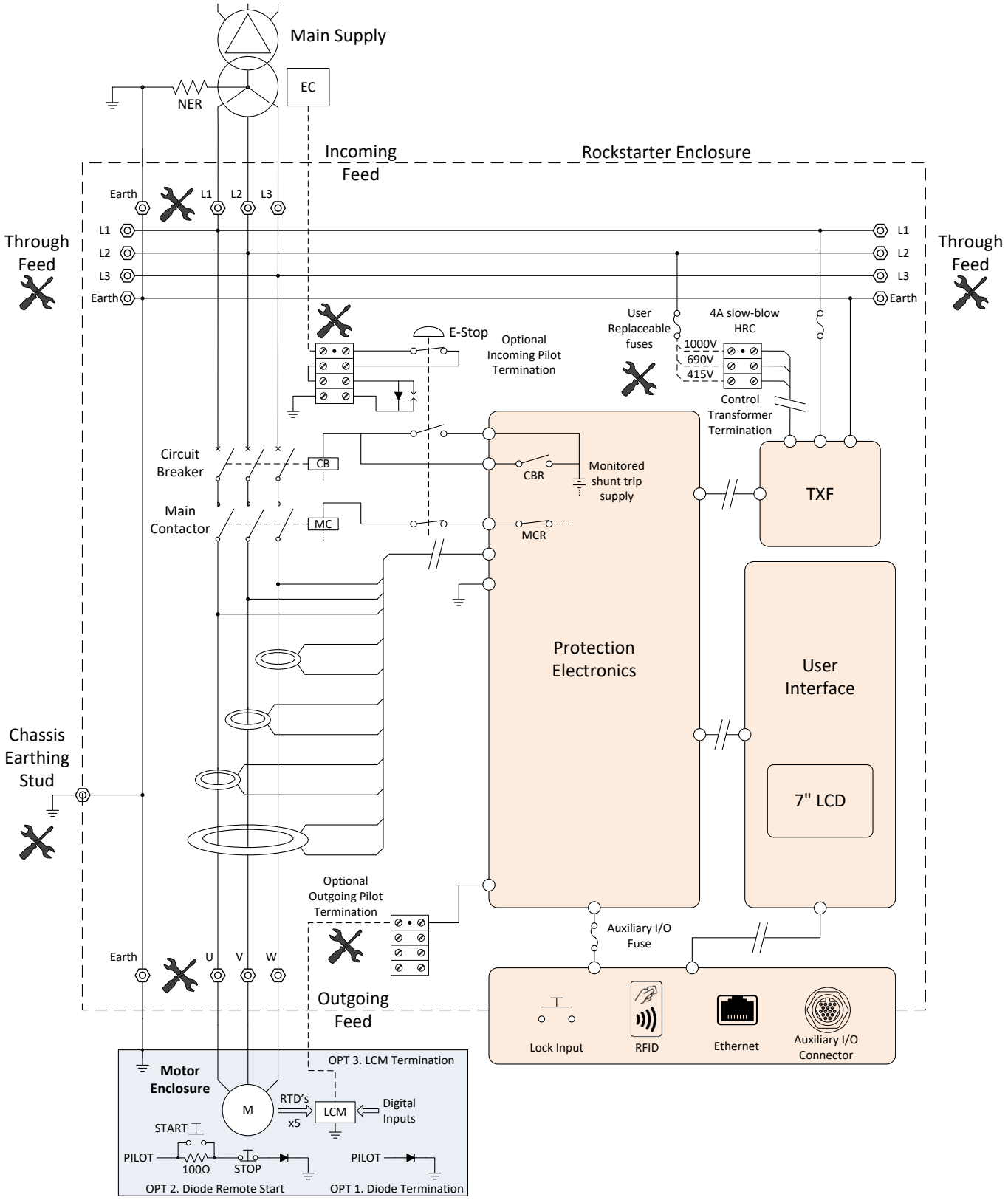


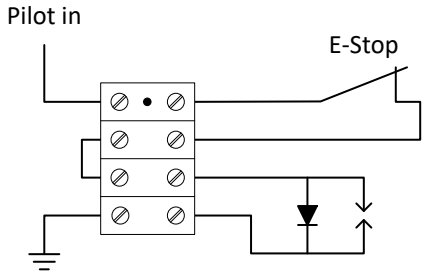
Figure 22: Electrical Connection Diagram

WARNING!

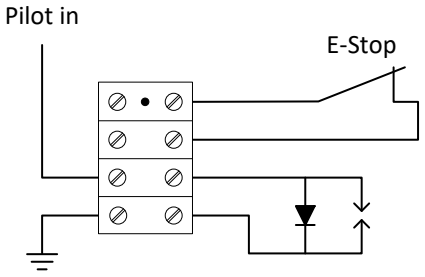
Pilot terminations must be continuous.

4.4.1 Incoming Pilot

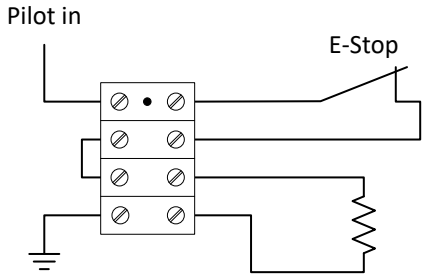
4.4.1.1 Incoming Terminations



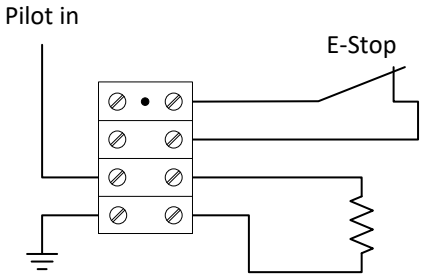
Diode + E-Stop Termination
[Default]



Diode termination



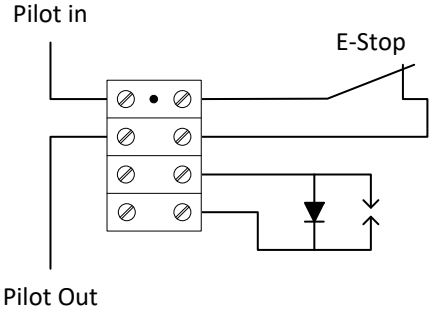
Resistor + E-Stop Termination



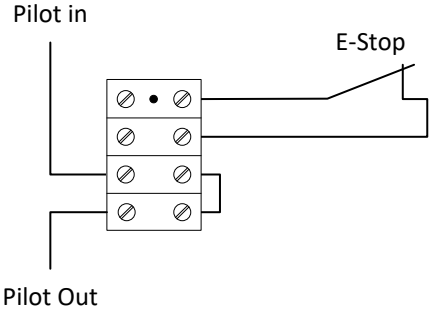
Resistor Termination

Figure 23: Incoming Pilot – Terminations

4.4.1.2 Through Terminations



Pilot Pass Through + E-Stop



Pilot Pass Through

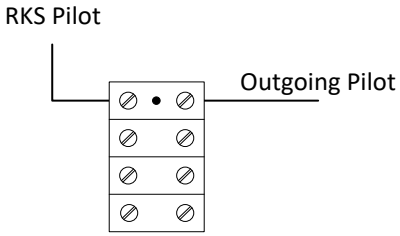
Figure 24: Incoming Pilot – Through Terminations

4.4.2 Outgoing Pilot

Earth continuity protection can be disabled in the UI when not required. For applications requiring EC protection, the outgoing pilot can be connected to the outgoing pilot terminal block (See Figure 10 for location) in the terminal compartment.

NOTE

Remote starts will not be possible when earth continuity protection is disabled, regardless of the pilot termination mode.



Outgoing Pilot Connection

Figure 25: Outgoing Pilot – Terminations

4.4.2.1 Diode Termination

If enabled, the Rockstarter's earth continuity protection monitors the presence of a termination diode that is installed in the motor enclosure to ensure that there is a continuous earth connection between the supply enclosure and the motor enclosure via the outlet cable. Ampcontrol recommends our pilot termination module (PN 115119), alternatively a 1N5404 diode can be utilised.

4.4.2.2 Diode Remote Start Termination

A remote start button can be implemented in the motor enclosure provided that the Rockstarter's earth continuity protection is enabled and the remote start function is enabled within the UI.

In order to install a remote start push button, wire a 100 Ω, 1 %, 5 W resistor in series with the pilot conductor, refer to Figure 26. With the resistor installed, wire a push button with a normally open contact in parallel with this 100 Ω resistor so that it will short out the resistor when the button is pressed.

For more information on the operation of the Rockstarter's Remote Start Function, refer to Section 8.2.3.

4.4.2.3 Diode Remote Stop Termination

A remote stop button can be implemented in the motor enclosure provided that the Rockstarter's earth continuity protection is enabled.

In order to install a remote stop push button, wire a normally closed contact in series with the pilot conductor, refer to Figure 26. When the push button is pressed the pilot will open circuit, initiating an earth continuity trip, which will open the outlet's contactor.

For more information on the operation of the Rockstarter's Remote Stop Function, refer to Section 8.2.4.

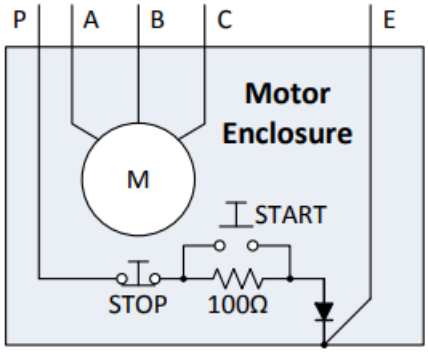


Figure 26: Remote Stop/Start

4.4.2.4 **Load Connection Module (LCM)**

A remote Start / Stop button can be implemented in the motor enclosure provided that the Rockstarter's earth continuity protection is enabled. If the remote start, stop, and PTC functions are not required, each set of terminals must be bridged to prevent incorrect data and control inputs being detected.

WARNING!

Any emergency stops should be wired directly into the pilot circuit.

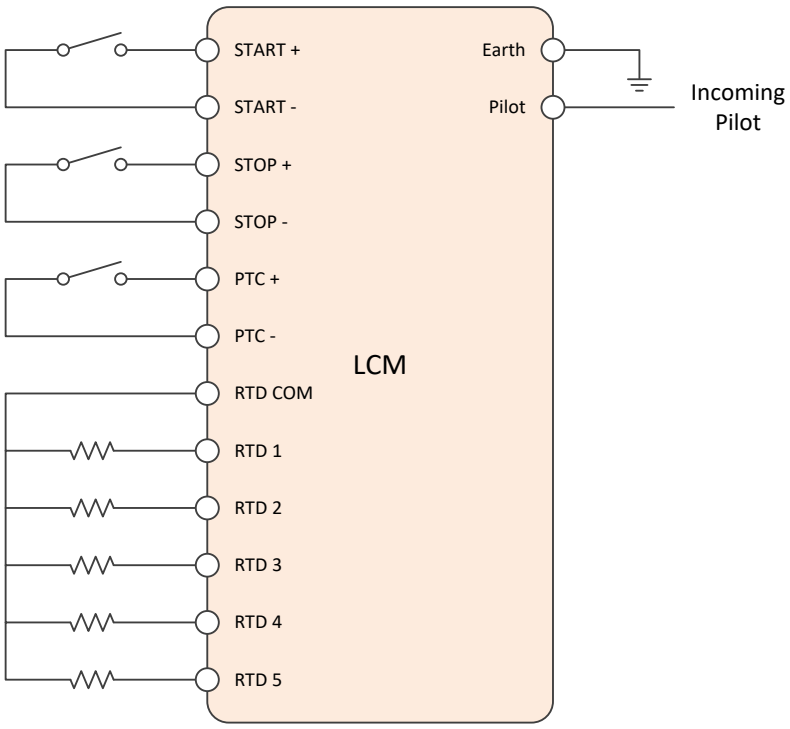


Figure 27: Load Connection Module (LCM) – Connection Diagram

4.4.3 Fuses & Control Supply Termination

The Rockstarter contains two user-replaceable fuses protecting the control supply transformer. The B-phase (L1) fuse connects to the transformer via a terminal block which allows for configuration of the transformer's primary tap, refer to Figure 28. This must be correctly connected for the appropriate line voltage in conjunction with the appropriate voltage setting within the HMI. The termination block is labelled within the terminal compartment. The factory default configuration has supply connected to the 1000 VAC terminal.

A third auxiliary I/O fuse is also located in the termination compartment. This supply is fed through to the AUX connector at the top of the Rockstarter and is for Ampcontrol diagnostic use only.

WARNING!

The system voltage must be set in conjunction with the appropriate control supply termination, ensuring the outlet is correctly configured for the system line voltage

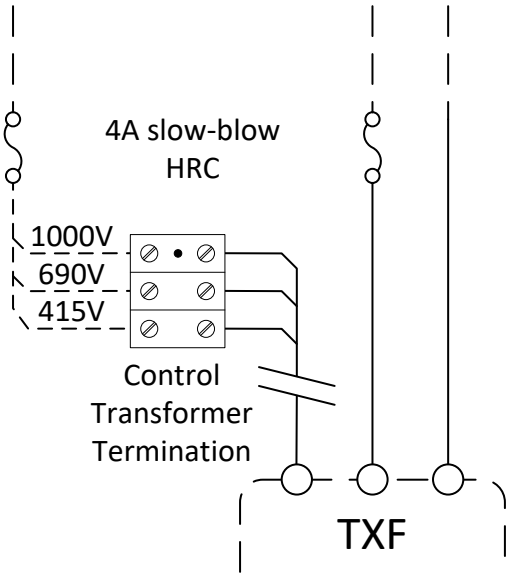


Figure 28: Control Supply Termination

5 COMMISSIONING

Prior to being put into service, the electrical protection system must be correctly commissioned. This manual does not cover system commissioning; the full scope of commissioning tests should be determined during the risk assessment or FMEA covering the design of the electrical protection system.

The following tests can provide guidance on checking the correct operation of the Rockstarter during commissioning. This is not intended to provide an exhaustive commissioning checklist but should be considered to be a minimum set of tests.

All tests and trips can be monitored through the Log menu on the Rockstarter HMI. When testing is undertaken, the logs should be monitored to ensure all events are captured and logged correctly.

NOTE

Running a full OTS test sequence gives coverage of all touch potential protection items outlined in sections 5.1, 5.2, 5.3 and 5.5.

5.1 Earth Leakage

Test the correct operation of earth leakage circuits by injecting a fault current through the Earth Leakage CT. This can be undertaken via the HMI (refer to Section 6.1). Ensure that the MC successfully trips and requires an authorised reset. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (detailed in Section 6.1.5) and the HMI should display the relevant trip messages. The correct operation of the earth leakage protection may be verified by running an OTS test.

5.2 Earth Continuity

Required if: Earth Continuity Protection is enabled.

In order to test that the earth continuity protection is functioning correctly, series and shunt resistance tests must be performed. These tests will verify that the earth continuity protection is functioning. The correct operation of the earth continuity protection may be verified by running an OTS test.

5.2.1 Earth Continuity – Series

The EC series resistance trip can be verified by creating an open circuit in the pilot line. This can be achieved through the HMI (refer to Section 6.1). Ensure that the contactor successfully trips and either requires a general reset (if EC latching selected) or automatically resets (if non-latching mode is selected). The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (detailed in Section 6.1.5) and the HMI should display the relevant trip messages.

5.2.2 Earth Continuity – Shunt

The EC shunt resistance trip can be verified by creating a short circuit between the pilot line and earth. This can be achieved through the HMI (refer to Section 6.1). Ensure that the contactor successfully trips and either requires a general reset (if EC latching selected) or automatically resets (if non-latching mode is selected). The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (detailed in Section 6.1.5) and the HMI should display the relevant trip messages.

5.3 Earth Fault Lockout

The earth fault lockout protection can be tested by connecting a suitably rated test resistor to a single outgoing power conductor. Attempt to energise the outlet and confirm that the protection module trips on earth fault lockout and fails to close the MC. This test should be repeated for all phases. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (as detailed in Section 6.1.5) and the HMI should display the relevant trip messages. The correct operation of the earth fault lockout protection can be verified by running a full OTS test sequence.

WARNING!

If the earth fault lockout protection fails, **full system voltage and power may be subsequently applied to the test resistors**.

5.4 Insulation Test (High Voltage)

The Rockstarter Cable Connection Module (CCM) will present a resistance to earth on each phase when performing a HV insulation test on the outgoing connections. It is recommended that HV insulation tests not be carried out on the outgoing terminals of the Rockstarter to prevent damage to the CCM.

When performing HV insulation tests on the incoming and subsequent through feed connections, it is recommended that the CB's be opened and the control transformer fuses be removed.

5.5 Main Contactor Fail

While the Rockstarter is stopped (MC open), apply a voltage on the load side of the contactor. The voltage must be greater than the selected trip level to initiate a Loss of Vacuum (LOV) trip. Ensure that a CB trip is initiated by the Rockstarter. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (as detailed in Section 6.1.5) and the HMI should display the relevant trip messages.

Alternatively, a Frozen Contact (FC) trip can be initiated through the OTS. The OTS does not apply a voltage to the outlet; instead, it performs a logical FC trip as outlined in the OTS user manual.

A MCF trip will require the CB to be reset before an HMI authorised reset is possible.

5.6 Voltage Measurement

Validate the voltage measurement function of the Rockstarter by checking the HMI data status page readout (alternatively through the communications port) with the contactor closed.

5.7 Load Connection Module (LCM)

Required if: LCM pilot termination selected.

Validate the correct operation of the LCM by making changes to parameters and ensuring these changes take effect. Perform the Remote Stop and Remote Start tests with the LCM installed.

5.8 Pump Protection Test

Required if: Pump Protection is enabled.

Using the user interface, configure the operational settings of the pump outlet.

Entering Sleep mode: With the pump removed from the water, initiate a start and ensure the pump goes to sleep after 5 seconds and starts the sleep countdown timer.

Exiting Sleep mode: (This may require the sleep time to be lowered to prevent long waits, alternatively a forced start can be initiated from the HMI) With the pump inserted into the water, wait for the countdown timer to end and ensure the pump restarts and continues to run while pumping water.

5.9 Fan Protection Test

Required if: Fan Protection is enabled.

Using the user interface, configure the operational settings of the fan control.

Burp sequence: Initiate a burp sequence and ensure the outlet follows the programmed starting sequence. Ensure that fan continues to run once the burp sequence has finished.

5.10 Remote Stop Test

Required if: Earth Continuity Protection is activated & a remote stop button is installed.

The remote stop function requires a N/C pushbutton/switch be installed in series with the pilot circuit.

1. Energise the outlet and confirm that it is running.
2. Operate the remote stop operator and confirm an EC Series trip stops the outlet.
3. Release the remote stop button.
    a. If the EC trip is set to latching, a reset should be required to restart the outlet.
    b. If the EC trip is set to non-latching, the outlet can be restarted.

5.11 Remote Start Test

Required if: Earth Continuity Protection is activated, Remote Start is enabled & a remote start button is installed.

With the outlet healthy, operate the remote start pushbutton/switch and confirm that the outlet energises.

Stop the outlet and restart using the remote start pushbutton/switch, continue to hold the start active once the outlet energises for greater than 5 seconds to initiate a Held/Stuck Start Input trip. Ensure that the contactor successfully trips and required a general reset. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (as detailed in Section 6.1.5) and the HMI should display the relevant trip messages.

5.12 Emergency Stop

No Upstream Pilot:

Operate the E/Stop and ensure that the Rockstarter's circuit breaker successfully trips. Since the upstream supply has not been tripped the HMI will indicate the relevant trip messages. A CB reset will be required before all trips can be reset. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (as detailed in Section 6.1.5).

Upstream Pilot:

Operate the E/Stop and ensure that the supply to the Rockstarter trips and the Rockstarter's circuit breaker successfully trips. When power is restored to the Rockstarter the HMI will indicate the relevant trip messages. A CB reset will be required before all trips can be reset. The indication LEDs on the fascia of the Rockstarter should illuminate yellow to indicate a trip (as detailed in Section 6.1.5).

6 PRODUCT OPERATION

6.1 Interfacing Elements

The Rockstarter is controlled via the HMI. The system is menu driven and navigated via the 7.0 inch capacitive-touch LCD display. The touchscreen provides an intuitive interface for viewing and modifying the outlet's configuration. All outlet control and protection settings are made through this interface. The touchscreen can be operated while wearing gloves or using a stylus and will function (within reasonable limits) with dirt and other contaminants on the screen.

The following sub-sections provide a brief overview of each of the interface elements. The HOME screen is displayed in Figure 29 below.

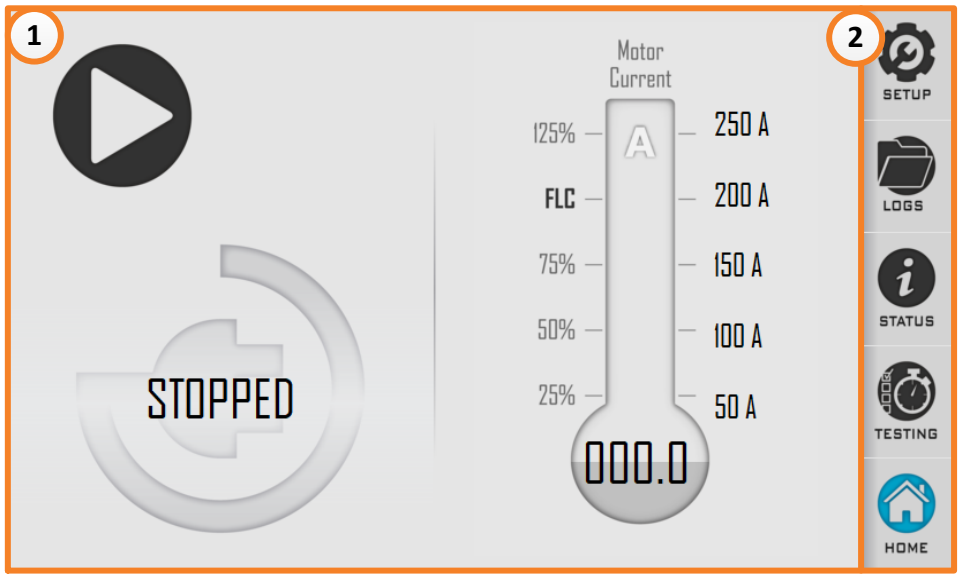


Figure 29: Rockstarter UI Interface

There are a number of features identified in this image by numbered circles and detailed below.

- Item 1 – Displays information that is relevant to the selected menu option/operating state
- Item 2 – Common to all views and displays the available menu options. The blue icon represents the active menu option. Menu options include:
    a. Home – For an overview of the HOME screen, refer to Section 6.1.1.
    b. Testing – For an overview of the TESTING screen, refer to Section 6.1.2.
    c. Status – For an overview of the STATUS screen, refer to Section 6.1.3.
    d. Logs – For an overview of the Log screen, Refer to Section 6.5.
    e. Setup – For an overview of the SETUP screen, refer to Section 6.1.4.

NOTE

After 15 minutes of inactivity on any menu option the display will revert to the HOME screen. Any unsaved changes to the Rockstarter's configuration will be lost.

6.1.1 **Home Interface**

The HOME screen of the Rockstarter will appear similar to that of Figure 30 below. The interface has a number of features which are identified in this image by numbered circles. Items identified in this figure are detailed in the following subsections.

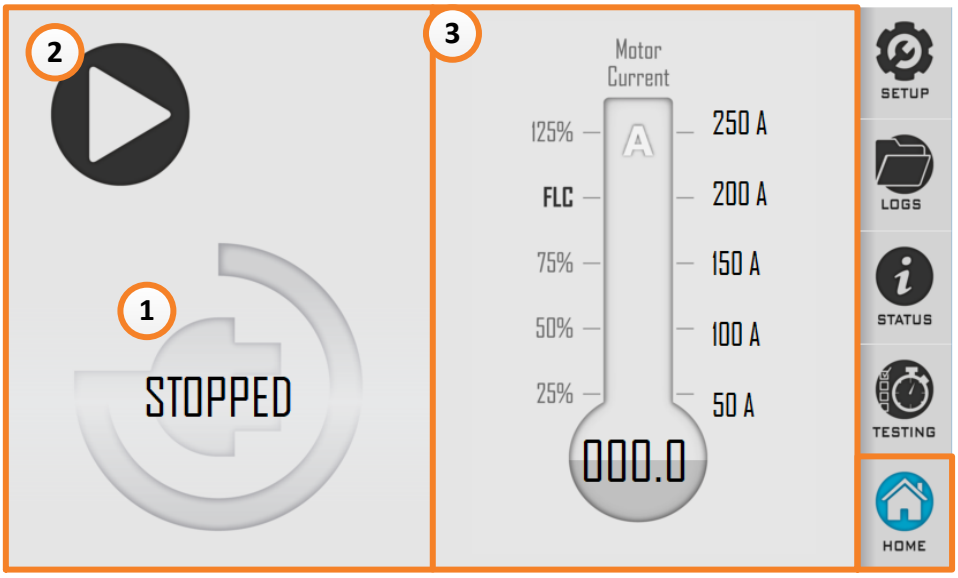


Figure 30: Rockstarter UI – Home Screen

6.1.1.1 **Item 1: Outlet State**

This will display an icon representing the current operating mode of the Rockstarter, as well as text indicating the current operating state. The area underneath this section will display additional information as required e.g. the trip type, pump sleep detect is disabled etc. Table 4 provides an overview of the icons used to indicate the Rockstarter's operating modes.

Table 4: Outlet State

Mode of Operation		
Outlet	***Fan***	***Pump***
		

6.1.1.2 **Item 2: Outlet Control**

The buttons displayed here are action buttons and allow for control of the Rockstarter. Refer to Table 5 for an overview of the buttons/icons.

Table 5: Outlet Control

Description	***Icon***	***Description***	***Icon***
Start		Manual Start Override	
Stop		System Undertaking Check	
Required Authorised Input		Disable Sleep	
Remote Start		Enable Sleep	
Reset		Disable Blast Detect	
Delay Start		Enable Blast Detect	
Slave Mode, Auxiliary Delayed Start Input Only			

NOTE

If the Rockstarter is configured for remote start mode then the local start button within the UI will be unavailable.

NOTE

The current version of the Rockstarter does not have the Blast Detection Enabled. This is not available to current models.

6.1.1.3 **Item 3: Outlet Status and Trip Indication**

The outlet status portion of the user interface will display the outlet current and the full load current set point. This section will also indicate whether the outlet is configured for remote start, if auto resume is active or if operating in LCM mode. Should a protection trip occur, this area of the display will indicate the type of trip/s that are active. A more detailed description of the trip can be revealed by selecting the trip message.

Table 6: Outlet Status Icons

Description	***Icon***
Auto Resume	

Description	***Icon***
Earth Continuity Protection Turned OFF	

NOTE

The protection system constantly injects a test signal into outlets core balance CT. The earth leakage on the outlet will read a small non-zero value, even when the outlet is open. This confirms that the earth leakage detection system is operational.

Table 7: Trip Messages

Category	***Description***	***Message***
Personnel Protection	Earth Leakage	Fault current detected above trip level, **xx**mA. Measured value = **xx**mA
	Earth Continuity Shunt	Pilot shunt resistance below trip level, 1.5 kΩ. Measured value = **xx**Ω
	Earth Continuity Series	Pilot series resistance above trip level, **xx**Ω. Measured value = **xx**Ω
	Earth Fault Lockout	An Earth Fault has been detected on the load side of the contactor.
	Insulation Fault	An insulation fault has been detected on the load side of the contactor.
	Uncommanded Open	The contactor opened unexpectedly. Service recommended.
	Fail to Close	Contactor is reporting open while commanding it closed. Service recommended.
	Loss of Vacuum	Detected **xx**V on the line while commanding the contactor to open. Service Recommended
	Frozen Contactor	Contactor is reporting closed while commanding it open. Service recommended
	Fast EC Trip	Shunt trip power supply failed. Service required. Measured value = **xx**Ω
	Fast EC Trip	Pilot series resistance above trip level
	Remote Termination	Remote Termination Initialising
	Remote Termination	Remote Termination device not detected
	Remote Termination	Corrupt parameter settings detected
	Remote Termination	Input 1 or 2 above trip setting **xxx**°C, Measured value **xxx**°C

Category	Description	Message
	Remote Termination	Input 3, 4 or 5 above trip setting **xxx**°C, Measured value **xxx**°C
	Remote Termination	Stop Input Circuit input detected as open circuit
	Remote Termination	Remote Termination device PTC Input detected as open Circuit
	Remote Termination	Remote Termination device communications fault
Load Protection	Start Block	If restart time is available: "Motor too hot, thermal capacity **xxx**%. **xx** minutes before restart allowed" If not: "Motor too hot. Thermal capacity **xxx**%. Restart available at **xx**%"
	Motor Overload	Motor too hot. Thermal capacity exceeded.
	Short Circuit	Load current exceeded **xx**A for **xx**ms.
	Current Imbalance	Current imbalance detected above trip level, **xx**%. Measured value **xx**%
	Short Circuit	"Load current exceeded **xx**A for xxms, but did not reach **yy**A" (where **yy** is the INST trip level)
	Undervoltage	**xx**V detected on the line. Trip level < **xx**V.
	Undercurrent	Current detected below trip level, **xx**A. Measured value **xx**A
Outlet Control	Remote Start	There is a fault in the pilot circuit preventing the 100 Ω start resistor being detected
	Remote Start	Remote start button detected for more than 5 seconds after contactor closed.
General Fault	RFID Comms Failure	RFID Communications Fail, Please use external lock button, cycle power/replace screen electronics to resolve.
	I2C connection failed	RKS Setting Dongle Fail, cycle power or replace dongle to resolve
	Shunt Trip Supply Fault	Shunt trip power supply failed. Service required.
	System Error	Protection Setting Memory Fault
		The Earth Leakage CT cannot be detected
		Internal Electronics Fault, Internal Logic Error. Please cycle power to clear
		Failed to detect coil supply voltage
		Failed to maintain communications to protection electronics
		Protection Electronics CCM Fault
		Protection Electronics Battery Fault
		Volt charge failed. Service required
		OTS mode ended
		Circuit Breaker has opened
		Internal Electronics Fault TM32
		Internal Electronics Fault TM33
		Internal Electronics Fault TM34
		Internal Electronics Fault TM35
		Internal Electronics Fault TM36
		Internal Electronics Fault TM37

6.1.2 **Testing Interface**

The TESTING screen of the Rockstarter UI is shown in Figure 31 below. Authorised access is required to operate the Rockstarter's testing functions, refer to Section 6.1.6 for details on gaining authorised access. This interface allows the user to select from the following tests:

- Item 1 – Earth Leakage
- Item 2 – Earth Continuity Series
- Item 3 – Earth Continuity Shunt
- Item 4 – Outlet Test System Tester (OTS)

Selecting an earth leakage or earth continuity test will return the user to the HOME page, the test function will operate and should initiate an outlet trip with the appropriate trip message being displayed. For details on resetting earth leakage and earth continuity trips, refer to Section 0. Refer to the following section for details on the Outlet Test System. All test actions are logged.

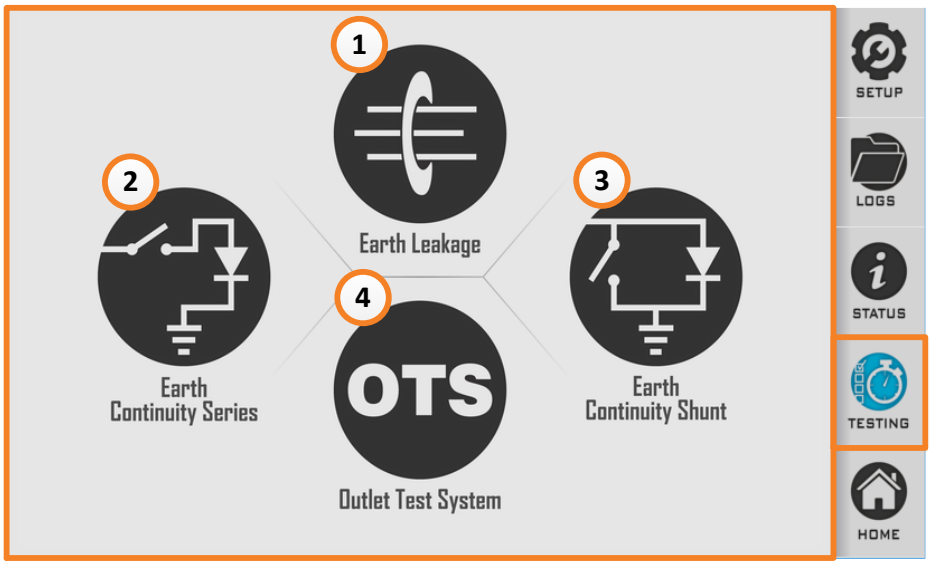


Figure 31: Rockstarter UI – Testing Screen

NOTE

If Earth Continuity Protection is disabled, the earth Continuity Series and Earth Continuity Shunt tests will not be available.

The Earth Leakage test button will energise until an earth leakage trip is detected and then turn off. If no trip occurs for up to 1 second, the button will turn off and a trip will occur. Text in the bottom left of the HOME screen will indicate if an EC test is active. Alternatively, if you enter the test page, the active button will be blue.

The Earth Continuity test buttons will activate an open circuit (series test) or short circuit (shunt test) fault indefinitely until the test button is manually turned off. This allows the pilot core to be isolated during maintenance when the pilot detection voltage is needed to be removed.

The EC series test button has been linked to the circuit breaker operation such that opening the circuit breaker also turn on the EC series test button. Closing the circuit breaker will turn off the EC series test button. The EC series test button can be toggled when the circuit breaker is open to allow testing of the EC circuit as desired.

6.1.2.1 **Outlet Test System (OTS)**

Selecting the Outlet Test System will present the user with the interface similar to that shown in Figure 32. The “OTS Enable” button, item 2, allows the user to enable/disable the OTS testing mode. When the Outlet Test System is enabled, the button will change to blue and the menu options on the right will disappear (item 3), preventing the user from navigating away from the OTS page during testing. Operation of the ‘OTS Enable’ button is logged. During testing, the OTS enable button will be locked out (as shown in this image) and an “OTS STOP TEST” button (item 1) will appear, allowing the user to abort the initiated OTS testing sequence.

The OTS testing interface can be entered in any system operating mode and does not require the Rockstarter’s settings to be modified. The OTS Enable button is disabled during the following operating conditions:

- Fan delayed starts
- Fan auto-restarts
- Fan post-blast starts
- Normal mode auto-restarts
- Pump sleeps
- Pump auto-restarts

OTS test mode will time out after 15 minutes of inactivity (no Bluetooth connection). A power cycle will disable OTS test mode. At the conclusion of an OTS test sweep, the user will be presented with a message prompting them to “Disable Testing & Exit”. This must be done before proceeding to normal Rockstarter functionality. The lower portion of Figure 32 consists of three status indicators. The functionality of these indicators is detailed in Table 8 below. When the Rockstarter’s earth continuity protection is disabled the EC test should be unchecked within the OTS application. Otherwise the Rockstarter will not trip on EC and the application will report a fault.

NOTE

If OTS test mode is disabled either due to user selection, time out or power cycle all parameters will revert to their previous settings.

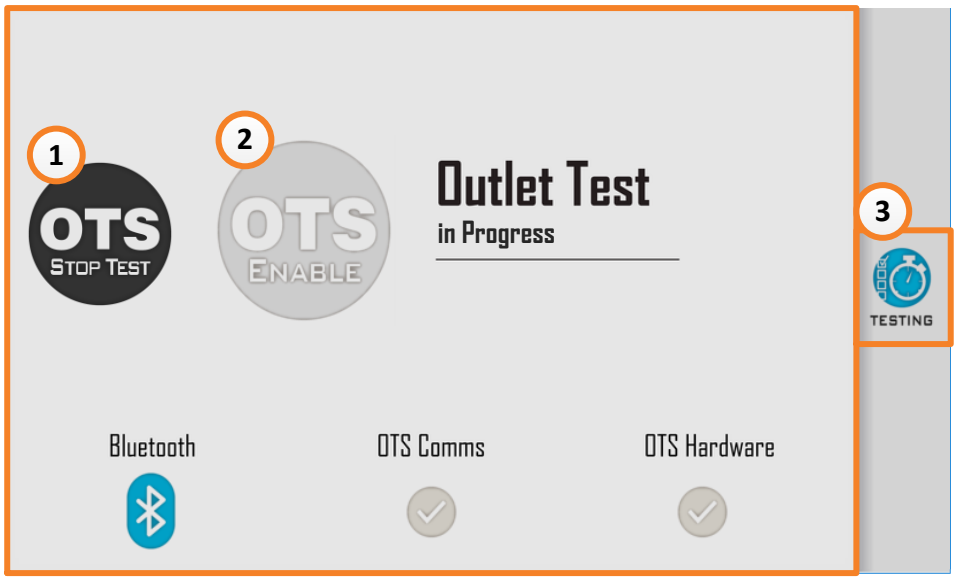


Figure 32: Rockstarter UI – Outlet Test System

Table 8: OTS Status Symbols

	Symbol	Description	
Bluetooth		Solid Blue	Connected
		Blue Flash	Advertising
		Grey	Off
		Red	Error
OTS Comms		Grey Tick	Healthy
		Red Cross	Fault
OTS Hardware		Grey Tick	Healthy
		Red Cross	Fault

An OTS test sweep may be performed as detailed in the OTS documentation with the following exceptions:

- OTS testing will not be allowed to proceed unless the Rockstarter's OTS enable button has been selected
- There is no 'CONFIG' option within the OTS application as it is automatically configured for use with the Rockstarter

NOTE

The Rockstarter is identified within the OTS application by the asset number (if the OTS has been correctly configured) or serial number. The Rockstarter's serial number can be found on the name plate on the front of the Rockstarter or on status page 4.

NOTE

The Rockstarter is only Compatible with version 3 or greater of the OTS application.

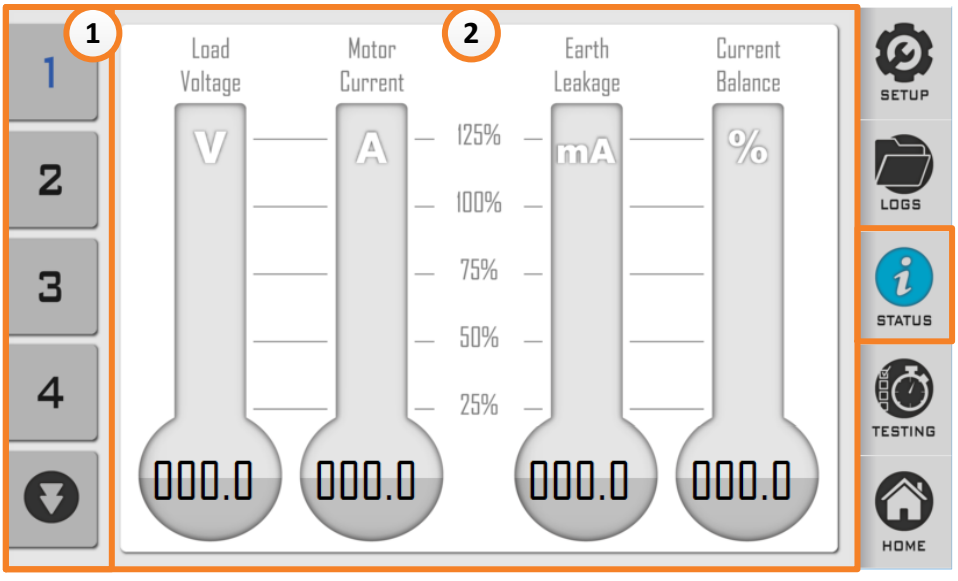


Figure 33: Rockstarter UI – Status Screen

6.1.3 Status Interface

The STATUS interface (Figure 33) displays an overview of the status of the outlet as well as system information including serial numbers, hardware, software and firmware versions. The buttons located on the left of the image (item 1) allow the user to navigate through the status pages. Refer to Table 9 for an overview of the information contained within this menu. All pages from 7 onwards present raw data and is anticipated for Ampcontrol diagnostic use.

Table 9: Status Page Overview

Page	Overview	Page	Overview
1	Average Load Voltage Average Load Current Earth Leakage Current Current Imbalance	5	E-stop (from Protection [In] CB status [In] Reset Lock Input [In] Shunt Voltage Status [In] EL Routine Test [Out] GPIO Connector – Start [In] GPIO Connector – Stop [In] GPIO Connector – Reset [In] Delayed Start [In] GPIO Connector – Run [Out] OTS Tester Start [In] OTS Tester Reset [In] OTS Test Enable [Out]
2	Earth Continuity Shunt Resistance Earth Continuity Series Resistance Thermal Accumulator Internal Temperature	6	Protection Outlet Parameter Status Protection/LCM Load Parameter Status UI System Parameter Status UI Pump Parameter Status UI Fan Parameter Status LCM Name Parameter Status UI Asset Parameter Status
3	Average Load Voltage Average Load Current Earth Leakage Current Current Imbalance Earth Continuity Series Resistance Earth Continuity Shunt Resistance Thermal Accumulator Internal Temperature CB Openings MC Closures	7-17	Ampcontrol diagnostic use
4	Time Rockstarter Serial Number Protection Firmware Version Display Firmware Version Supervisor Firmware Version OTS Firmware Version Processor Image Version Rockstarter HMI IP Address Free Memory		

6.1.4 **Setup Interface**

The SETUP interface allows the user to configure all control and protection settings, refer to Figure 34. This interface has a number of features identified in this image by numbered circles and detailed below. The SETUP menu is navigated via the five options down the left hand side of the display with the blue icon representing the active menu selection, refer to item 1. The outlet must be stopped before parameters can be modified. If the outlet is running then only the current parameters may be viewed. The following provides an overview of each of Setup menu options from top to bottom.

- **Outlet Control**, refer to Section 7
  - Mode of Operation (MO)
    - Outlet Control Mode
    - System Voltage
  - Starting Options (SO)
    - Remote start at Machine
    - Restart After Power Cycle
    - Pilot Mode
    - (Fan Mode) Delayed Fan Start
    - (Fan Mode) Post-Blast Start (currently NA)
  - (If in Pump or Fan Mode) Fan/Pump Mode Control (MC)
    - (Fan Mode) Burp Timing Mode
    - (Fan Mode) Burp Cycles
    - (Fan Mode) On Time
    - (Fan Mode) Off Time
    - (Fan Mode) Blast Pressure Level (currently NA)
    - (Pump Mode) Sleep Timing Mode
    - (Pump Mode) Snore Current
    - (Pump Mode) Sleep Time
  - (If LCM Selected) LCM Parameters (LP)
    - LCM Name
    - RTD 1-2 Trip Level
    - RTD 3-5 Trip Level
    - RTD 1-2 Reset Level
    - RTD 3-5 Reset Level
- **Personnel Protection**, refer to Section 8
  - Earth Continuity (EC)
    - Trip Time
    - Trip Level
    - Latching
  - Earth Leakage (EL)
    - Trip Time
    - Trip Level
  - Frozen Contact / Loss of Vacuum (FC)
    - Back EMF Time
    - Loss of Vacuum Level

- **Load Protection**, refer to Section 9
  - Overload (OL)
    - Overload Model
    - Time Multiplier
    - Full Load Current (FLC)
    - Thermal Accumulator Start Block
    - (FAN MODE) Fan Sequence Thermal Start Block
    - Thermal Model Cooling Multiplier (MOL)
  - Short Circuit (SC)
    - Current Multiplier
    - Trip Time
  - Under Voltage (UV)
    - Trip Level
  - Current Imbalance (CI)
    - Trip Level
  - Under Current (UC) (Not available in Pump Mode)
    - Trip Level
- **General**
  - Asset Name (AN)
    - Asset Name
  - Network Parameters (NP)
    - IP Address
    - Subnet Mask
    - Default Mask
    - Default Gateway
  - Time (T)
    - Hour
    - Minute
  - Date (D)
    - Day
    - Month
    - Year
- **Save Changes** – changes must be saved before taking effect. Refer to Section 6.1.4.1.

NOTE

Parameters cannot be changed while the outlet is running. If the outlet is running, then only the current parameters may be viewed.

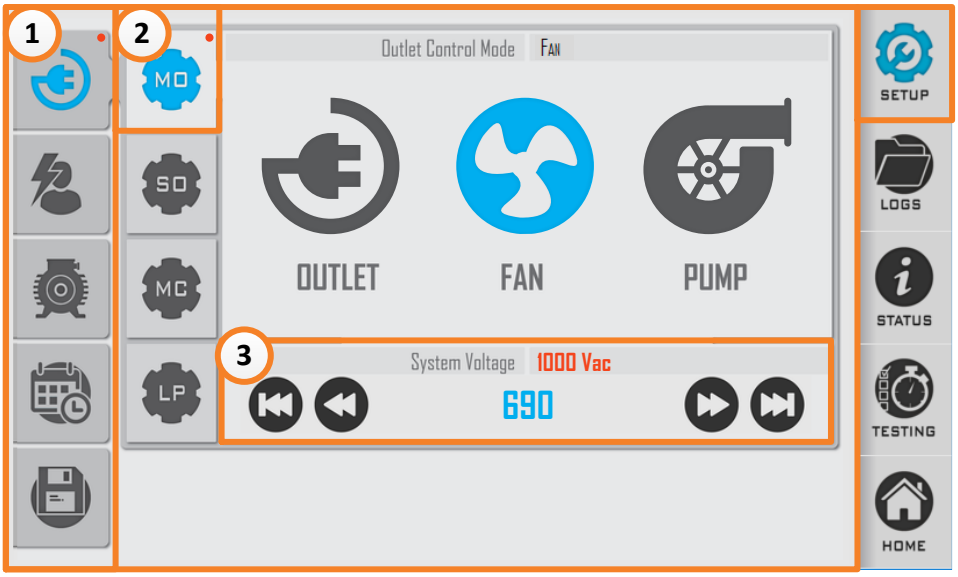


Figure 34: Rockstarter UI – SETUP Page

Selecting the menu options on the left (item 1) reveals a secondary menu (item 2). The current outlet settings are shown next to the heading for each setting option. Black text indicates that this is the current setting stored on the Rockstarter while red text (item 3) indicates a parameter modification that has not been saved. Parameter modifications are also indicated by a red dot in the top left-hand corner of the corresponding upper menu levels, refer to items 1 and 2.

Certain parameters are linked and changing one will modify another. For instance, the UC trip point is used as the snore current level when the Rockstarter is operating in Pump Mode. When this occurs the modified parameters are indicated by "****" appearing in place of the red dot in the corresponding upper menu levels.

NOTE

After 15 minutes of inactivity on any menu option the display will revert to the HOME screen. Any unsaved changes to the Rockstarter's configuration will be lost.

6.1.4.1 **Parameter Saving**

Parameter saving requires authorisation to continue. All parameter changes are logged. Once authorised, the parameter change acceptance time will vary depending on whether the Rockstarter is operating in Diode of LCM Mode. When in Diode Mode the process is quicker that when operating in LCM Mode. If the change occurred successfully, a message appears, then the UI changes to the Home screen after 2 seconds.

If the Pilot Mode is being changed, no other parameters are permitted to be changed. Likewise, if any other parameters are being modified, then the Pilot Mode cannot be changed.

For a Pilot Mode change, once the change has been verified, then the parameter sets for the new Pilot Mode are loaded (e.g. if the Pilot Mode is changing from Diode to LCM mode, then all the LCM parameters will need to be loaded into the Rockstarter).

When a parameter set is loaded, the parameter Invalid Masks are checked. If any UI parameter is invalid, it will be added to a list (shown on status page 6), and a trip will be flagged. To make a parameter 'valid' again, it can either be explicitly modified, or it will be set to its default value implicitly the next time any other parameter value is changed (i.e. when the Save button is pressed).

Parameter sets will be reloaded at the following times:

- At startup
- When they have their values changed
- After an internal Comms Fault is cleared
- If the LCM is detached, and reattached (or a new one is attached)

Anytime that parameters are being changed or loaded/reloaded, then a “Parameter Syncing” message will display on the Home screen. During this time no outlet starts will be allowed. After a power cycle, if the UI detects that the protection parameters have changed, then any auto-restart is disabled. A log message will appear to that effect.

6.1.5 Lighting and Indication

The Rockstarter incorporates LED lighting in the LCD surround to indicate the location and operating state. The LEDs are very bright but dim upon touchscreen interaction. After 15 minutes of UI inactivity, the lighting will revert to full brightness and the LCD will enter a sleep state. Should the LCD/LED panel be damaged it may be replaced in-situ. For details on replacing the LCD/LED panel, refer to APPENDIX C: HMI REPLACEMENT.

The Rockstarter’s LED lighting will flash red/white under the following conditions:

- Pre Starting System Check
- During Pump Sleeping
- In-between Fan Burps
- During Fan Delayed Start Count Down
- Auto-Restart Delay Count Down
- Fan Post-Blast Delay Count Down

The remaining LED operation is detailed in Table 10.

Figure 35: Rockstarter Lighting

Table 10: Rockstarter Lighting Overview

Screen Lighting	***Single Flash***	***Solid***
White	–	Running
Yellow	Failed NFC Action	Tripped
Red	–	Stopped
Blue	Successful NFC Action	–

NOTE

A failed NFC read while the unit is tripped will cause a temporary dimming of the yellow LEDs.

6.1.6 RFID Authorisation & Lock Input

Certain functions of the Rockstarter may be accessed by general users while other functions require authorisation. Authorisation on the Rockstarter is achievable from three inputs; a user trackable RFID tag, the lock input switch, or over Modbus TCP.

To unlock the Rockstarter:

- RFID Tag: Hold the RFID tag over the RFID reader
- Lock Input: Activate the switch on the front of the unit, refer to Figure 2
- Modbus TCP: Send the appropriate control bit through communications.

A successful RFID read will be indicated by a blue flash while a failed tag read will be indicated by a yellow flash. If there are trips present in the Rockstarter then the LEDs will be solid yellow. In this situation a failed tag read will be indicated by the yellow LEDs will dimming momentarily. RFID authorisation will time out after 30 seconds.

All authorisation events will be logged along with a time stamp, RFID authorisations will also log the user's ID.

6.2 Outlet Starting

To energise an outlet, the following start sequence will be followed:

- If there are any active trips, the Rockstarter will ignore any start command received
- If all trips are cleared, the Rockstarter will initiate a start sequence
- An earth fault lockout test is conducted. This test checks for a cable fault to earth. If the test fails, the start sequence will be cancelled and the Rockstarter will report and earth fault lockout trip
- Attempt to close the Main Contactor. If the Main Contactor close was successful the Rockstarter will be in a running state. If the close is not successful (Does not close within 5 seconds), a 'close fail' trip will occur and the start sequence will be cancelled
- The Rockstarter will continue in the running state with the outlet closed until a stop command is received or a protection function trips
- The Rockstarter now waits for the main contactor feedback to confirm that the main contactor has closed. If this feedback is not detected within 5 seconds of close request, a 'close fail' trip will occur and the start sequence will be cancelled
- If at any point during the start sequence a stop command is received or a protection function trips, the start sequence is immediately cancelled and the Main Contactor (or Circuit Breaker) will be opened
- In the event of any trip condition, the Rockstarter will trip the Main Contactor (or Circuit Breaker as appropriate) and prevent the MC from closing until the fault condition has cleared and the trip has been reset

6.3 Outlet Resets

All resets in the Rockstarter are handled through the HMI. Most trips are reset with a general reset, not requiring authorised access. Some trips require an authorised reset to provide a level of competency associated with resetting faults. Authorisation is provided by way of a user trackable RFID tag (Section 6.1.6), the lock input on the front of the Rockstarter (Figure 2) or over the Modbus TCP communications input.

The following latched trips may be cleared (once the fault has cleared) with a general reset:

- Earth Continuity (EC)
- Overload (OL)
- Current Imbalance (CI)
- Under Voltage (UV)
- Under Current (UC)
- Earth Fault Lockout (EFLO)
- Remote start stuck

The following latched trips may be cleared only after authorised confirmation:

- Earth Leakage (EL)
- Earth Leakage CT detect (EL CT)
- Main Contactor Faults
    - Frozen Contact (FC)
    - Loss of Vacuum (LOV)
    - Fail to Close (FTC)
    - Fail to Open (FTO)
- Short Circuit (SC)

In the event of a MCF trip, Ampcontrol recommends the user performs an OTS test sweep to verify the operation of the protection functions and contactor. If the contactor is faulty, remove the Rockstarter from service and return the Rockstarter to Ampcontrol for inspection.

The following trip types will always latch (and require reset to continue): EL, ELCT, FC, SC, OL, UV, EFLO, Circuit Breaker and E-stop. The Circuit Breaker and E-Stop trips will require a mechanical reset of the operator. Thermal Block trips will never latch. UC trips will latch only when the operating mode is configured to Normal or Fan. In Pump Mode, UC faults are used for the pump run-dry detection. EC trips will only latch when configured to do so.

A Circuit Breaker trip will also result in an EC Series trip on the pilot (when EC protection is enabled), this aspect has been designed into the operation of the Rockstarter. As a result of the Circuit Breaker / Pilot circuit interaction, as EC Series trip cannot be reset at the same time as the CB trip and will require a second reset input.

NOTE

When resetting a Circuit Breaker trip the reset button must be pressed twice.

6.4 Internal Trips

The Rockstarter has a number of trip functions that are not directly associated with the protection of the outlet, but signal that an internal fault has been detected. If an internal trip is detected, contact Ampcontrol for assistance.

In particular the following faults would require the Rockstarter to be returned for and inspection and service:

- Cable Connection Module Identification
- MCF Battery Trip
    - The Rockstarter has an internal battery. This is used to power the real time clock as well as power the MCF latch. The health of this battery is monitored and if the battery condition is failing this trip will be set
- Internal Logic Error
    - This trip will be set in the event that an internal fault has been detected

6.5 Event Log

The recorded event logs provide a history of the Rockstarters operation. A real time clock/calendar is included, allowing each log to sequentially record the time, date and details of each event. A chronological list of the previous 50 events is stored and is viewable from the HMI or over the communications interface.

The following events are logged:

Table 11: Event Log Entry Types

Log ID	Event Text	Description
0	"Event Code # Zero"	Reserved
1	"Feed On"	Logs the LCM Load Details when does this mean the contactor is closed
2	"Insulation Test Record"	Should not exist in RKS
3	"Earth Leakage Trip"	Trip event, See Section 8.1
4	"Series Earth Continuity Trip"	Trip event, See Section 8.2
5	"Overcurrent Trip"	Trip event, See Section 9
6	"Short Circuit INST Trip"	Trip event, See Section 9.2
7	"Close Failed"	Trip event, See Section 8.4.3.
8	"Main Contactor Relay Closed"	Main Contactor input has been detected to close
9	"Under Current Trip"	Trip event, See Section 9.5
10	"General Trip Reset"	A general reset has been actioned
11	"Power Down"	The Rockstarter has been powered down
12	"Dongle Memory Error"	Protection Electronics settings not valid – Potential corruption
13	"Unexpected Restart"	HMI or Protection Electronics has faulted causing a restart.
14	"Frozen Contactor"	Trip event, See Section 8.4.2
15	"Loss of Vacuum"	Trip event, See Section 8.4.1
16	"Current Imbalance Trip"	Trip event, See Section 9.4
17	"Thermal Memory Loss"	Thermal Accumulator has become corrupt
18	"Main Contactor Opened"	External only trip, Main contactor has been detected to open
19	"LCM Memory Error"	Invalid parameter set in LCM The LCM has corrupt Parameters
20	"Shunt Earth Continuity Trip"	Trip event, See Section 8.2
21	"Thermal Memory Reset"	Thermal Accumulator has been cleared – Currently not available in RKS

Log ID	Event Text	Description
22	"LCM Stop"	Stop has been pressed at LCM
23	"LCM Off Line"	LCM Disconnected
24	"Insulation Trip"	Not Active in RKS
25	"LCM Communications Timeout"	LCM Communications has failed
26	"Power Up"	Rockstarter has been powered up
27	"Under Voltage Trip"	Trip event, See Section 9.3
28	"Stopped"	HMI has stopped the outlet
29	"No Coil Voltage Trip"	Main contactor Coil Voltage lost
30	“CT Detection Error"	Trip event, See Section 8.1.3
31	"Remote Start Stuck"	Trip event, See Section 8.2.2
32	"HMI Comms Timeout"	HMI has lost comms to the protection electronics.
33	"Start Disabled"	HMI has prevented outlet from starting
34	"Earth Fault Lockout Trip"	Trip event, See Section 8.3
35	"Unknown Restart Status"	HMI or Protection Electronics has faulted causing a restart
36	"Short Circuit Trip Reset"	The Authorised Reset required trip has been reset
37	"Earth Leakage Trip Reset"	The Authorised Reset required trip has been reset
38	"Fatal Clock Error"	Fault in electronics
39	"MCF Battery Under Voltage"	Protection Electronics on board battery is low
40	"Control Mask Changed"	HMI has changed the Protection control Masks,
41	"Invalid CCM"	Internal Electronics Fault (detect different CCM ID)
42	"Internal Logic Error"	Protection Electronics operating Error
43	"Pos Temp Coefficient Trip"	PTC Input Trip on LCM
44	"LCM Grp1 Temperature Trip"	A LCM Group 1 Temperature input exceeded trip level
45	"LCM Grp2 Temperature Trip"	A LCM Group 2 Temperature input exceeded trip level
46	"Short Circuit LT Trip"	Trip event, See Section 9.2
47	"Charge Status Trip"	General energy storage electronics charge dropped below threshold, resettable when charge is sufficient.
48	"VShunt Status Trip"	CB Shunt Trip electronics charge storage has dropped below threshold, resettable when charge is sufficient.
49	"Circuit Breaker Trip"	CB Has Tripped, See Section 8.4 / 9.2
50	"Kill Switch Trip"	HMI putting protection into bootloader mode, HMI has stopped the protection electronics operation

6.6 Time and date

The time and date are used only to time stamp the events in the log (which are recorded sequentially regardless or the time and date). The time and data are not used for any control functions.

6.7 Modbus TCP

The implementation of Modbus TCP allows all Rockstarter data to be extracted but has also implemented inputs allowing for remote control over the outlet. This includes Starts, Stops, Resets and Authorise inputs. See APPENDIX B: ROCKSTARTER MODBUS TCP for Modbus tables.

6.8 Remote Desktop Access

The Rockstarter has implemented Virtual Network Computing (VNC), this can be used to monitor control and configure the Rockstarter remotely. The VNC will need to be used in conjunction with MODBUS TCP to provide the Authorisation input. Any VNC software can be used by accessing the unit directly through the configured IP address. To ensure there are no network conflicts each Rockstarter will need to have the Network Settings manually configured initially.

NOTE

VNC Access Password: letmein

7 OUTLET CONTROL

7.1 Outlet Configuration

The Outlet Control setup is accessed through the Mode of Operation (MO) menu, which allows for configuration of the Rockstarters three modes (Normal, Fan and Pump) and system voltage. This must be set in conjunction with the appropriate control supply termination, ensuring the outlet is correctly configured for the system line voltage. Refer to Section 4.3.3 for details on the control supply termination block.

- Mode of Operation (MO)
  - Outlet Control Mode
  - System Voltage

> **NOTE** If earth continuity protection was disabled prior to changing the Rockstarters mode of operation (Outlet, Pump, Fan), it will automatically re-enable (with a trip time of 500 ms) when the mode of operation is changed.

In addition, the Outlet Control menu allows for configuration of the following:

- Starting Options (SO) Three of the five options are available regardless of the outlet control mode
  - Remote Start at Machine (For information, refer to Section 8.2.3)
  - Restart after power cycle
  - Pilot Mode – Diode or LCM
  - (If in Fan Mode) Delayed Fan Start
  - (If in Fan Mode) Post-Blast Start (currently NA)

- Mode Control (MC) – If the outlet is configured in Fan Mode or Pump Mode, a third menu option will allow for configuration of the burp and sleep functions, refer to Section 7.2 and Section 7.3, respectively
  - (Fan Mode) Burp Timing Mode
  - (Fan Mode) Burp Cycles
  - (Fan Mode) On Time
  - (Fan Mode) Off Time
  - (Fan Mode) Blast Pressure Level (currently NA)
  - (Pump Mode) Sleep Timing Mode
  - (Pump Mode) Snore Current
  - (Pump Mode) Sleep Time

- LCM Parameters (LP) – If the pilot is configured for LCM termination, a fourth menu option will allow for configuration of the LCM, refer to Section 0
  - LCM Name
  - RTD 1-2 Trip Level
  - RTD 3-5 Trip Level
  - RTD 1-2 Reset Level
  - RTD 3-5 Reset Level

WARNING!

The system voltage must be set in conjunction with the appropriate control supply termination, ensuring the outlet is correctly configured for the system line voltage

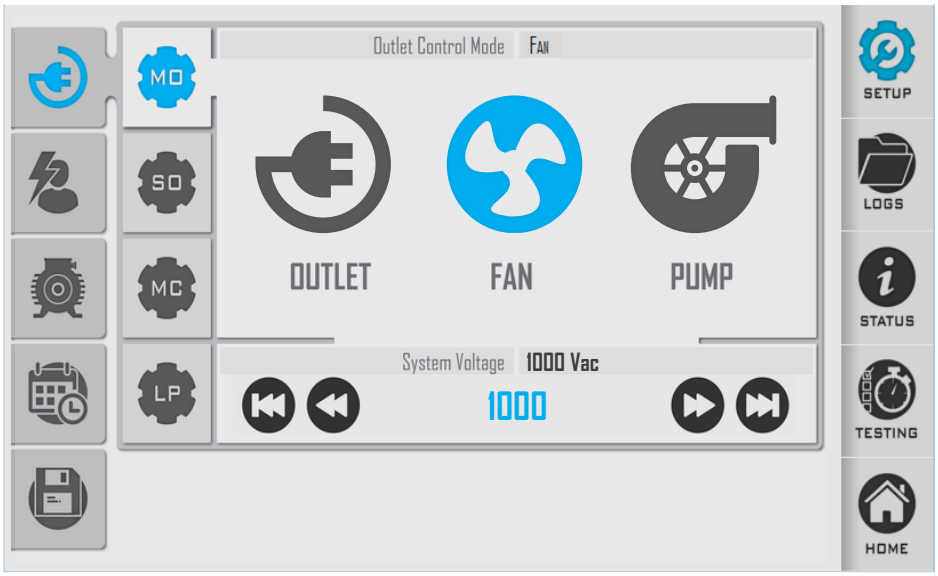


Figure 36: Rockstarter UI – Mode Control

7.1.1 **Restart after Power Cycle**

It is possible to re-close the outlet after system power is restored from an outage. This function is called “Restart after Power Cycle”, it is independent of the Pump or Fan Modes. If power is lost to the system while the outlet is ‘Running’, the Rockstarter will restart the outlet when the power supply is restored, allowing the operation to resume after the specified delay. This restart will only occur if all Rockstarter prestart checks pass and the protection functions are healthy.

The Rockstarter is said to be ‘Running’ under the following conditions:

- Main Contactor Closed in Normal Mode
- Main Contactor Closed or during sleep cycle in Pump Mode
- Main Contactor Closed or during burping when in Fan Mode
- If the outlet has already been auto restarted but is in the restart delay period, and another power cycle occurs

The Rockstarter will not auto-restart if a power cycle occurs while in the “Delayed Fan Start” or “Post-Blast Start” delays.

WARNING!

If the Rockstarter is set to resume after a power failure, the outlet can and will energise after a power outage if the system if healthy. All operators should be aware of this.

This setting should be used with caution.

7.1.2 LCM Input Configurations

When operating in LCM mode, it is possible to connect RTD input that can be monitored at the Rockstarter. The LCM can be programmed with a name to allow it to be identified easier by the user. This identifier can be up to 15 characters.

The RTD inputs are all individually monitored however there are only two trip levels that can be configured with corresponding reset levels. RTD inputs 1 & 2 are grouped to one trip / reset setting, with the remaining RTD inputs 3, 4 & 5 being grouped to the second trip / reset setting.

The trip levels can be set to any value 0-200 °C with the corresponding reset value also being set to any value 0-200 °C.

For a reset to occur, all RTD inputs of that group need to be below the reset level.

7.2 Fan Control Mode

Due to the sudden and continuous pressure differential along the length of the airbag during initial inflation, the walls of the bags can blow off or potentially rip, requiring downtime or costly repairs. The Rockstarter's Burp Mode manages this by pulsing the fan motor during start-up. This allows the pressure in the bag to ramp in a controlled manner and inflate over a longer period of time.

Burp Control occurs on every start in fan mode. Burp Mode can be set from 0 to 4 cycles. If 0 cycles are selected, then the Burp Mode will be disabled and the Rockstarter will not perform any pulsing of the fan motor during start up, acting like a Direct Online (DOL) start. Both the ON and OFF periods are configurable. After the Rockstarter completes the prescribed number of burp cycles, the fan motor will run normally.

Fan Mode is a selectable operating mode of the Rockstarter that provides additional protection and control functionality when the outlet is supplying fan motors. The Additional settings can be seen in Table 12. The setting is found in the Starting Options (SO) menu (Delay Fan Start, Post-Blast Start) and the Fan/Pump Mode Control (MC) menu (Burp Timing Mode, Burp Cycles, Burp On Time, Burp Off Time, Blast Pressure Level).

Table 12: Fan Protection – Configuration Settings

Burp Timing Mode
Incremental
Fixed

Burp Cycles
0
1
2
3
4

Burp On Time
1 second
2 seconds
3 seconds
4 seconds
5 seconds
10 seconds
15 seconds
20 seconds

Burp Off Time
1 second
2 seconds
3 seconds
4 seconds
5 seconds
10 seconds
15 seconds
20 seconds

Delayed Fan Start
Off
0 minutes
1 minute
2 minutes
3 minutes
4 minutes
5 minutes
10 minutes
15 minutes
20 minutes
25 minutes
30 minutes
45 minutes
60 minutes
75 minutes
90 minutes
105 minutes
120 minutes

Delayed Fan Start Cont.
0 minutes Slave
0.5 minutes Slave
1 minute Slave
2 minutes Slave
3 minutes Slave
4 minutes Slave
5 minutes Slave
10 minutes Slave
15 minutes Slave
20 minutes Slave
30 minutes Slave
60 minutes Slave
75 minutes Slave
90 minutes Slave
105 minutes Slave
120 minutes Slave

Post Blast Start
0 minutes
0.5 minutes
1 minute
2 minutes
3 minutes
4 minutes
5 minutes
10 minutes
15 minutes
20 minutes
30 minutes
60 minutes

Blast Pressure Level
2 kPa
4 kPa
6 kPa
8 kPa
10 kPa

7.2.1 **Burp Timing Modes**

The Rockstarter can be configured to two burp timing modes, fixed and incremental. These modes refer to the length of time that the Rockstarter remains in the ON and OFF state each time that a burp event occurs.

Table 13: Rockstarter Burp Timing Mode

Fan Burp Timing Mode	Description of Operation
Fixed	In Fixed Burp Timing Mode, the burping ON and OFF time will be a fixed value for each burp cycle.
Incremental	In Incremental Burp Timing Mode each time that the Rockstarter enters a consecutive burping cycle, the ON time will increase by 50% of the previous time. The OFF time remains constant.

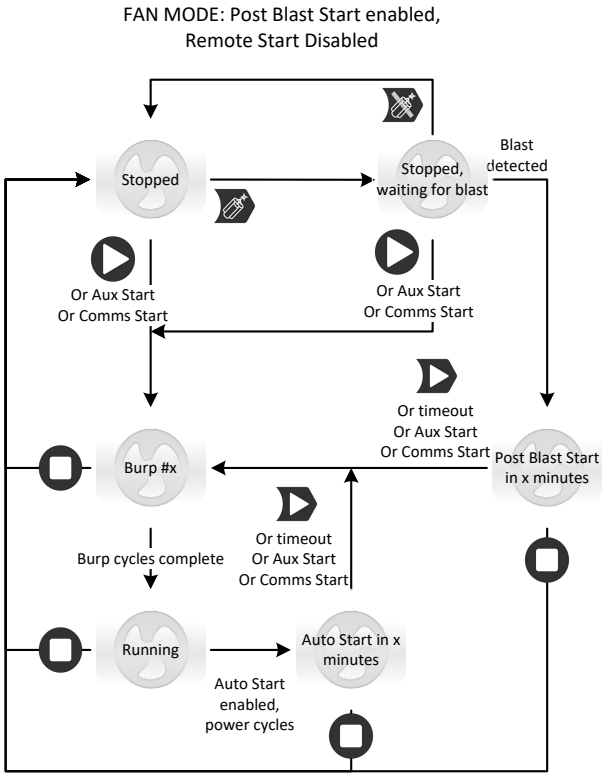


Figure 37: Starting Options - Post Blast Start Enabled, Remote Start Disabled

In the Incremental Timing Mode, the burp ON time increases as per the values shown in Table 14.

Table 14: Fan Incremental Timing Mode

Burp Cycle 1	***Burp Cycle 2***	***Burp Cycle 3***	***Burp Cycle 4***
T_{on} x 1	T_{on} x 1.5	T_{on} x 2.25	T_{on} x 3.375

7.2.2 Post-Blast Start – Not Available in Current Models

Post-Blast Start enables the Rockstarter to automatically start after detection of a blast event. Both the time delay and blast pressure level are configurable. Post-Blast Start must be enabled within the UI and enabled via the 'Enable Blast Detect' (refer to Section 0 for icon details) button on the Home screen.

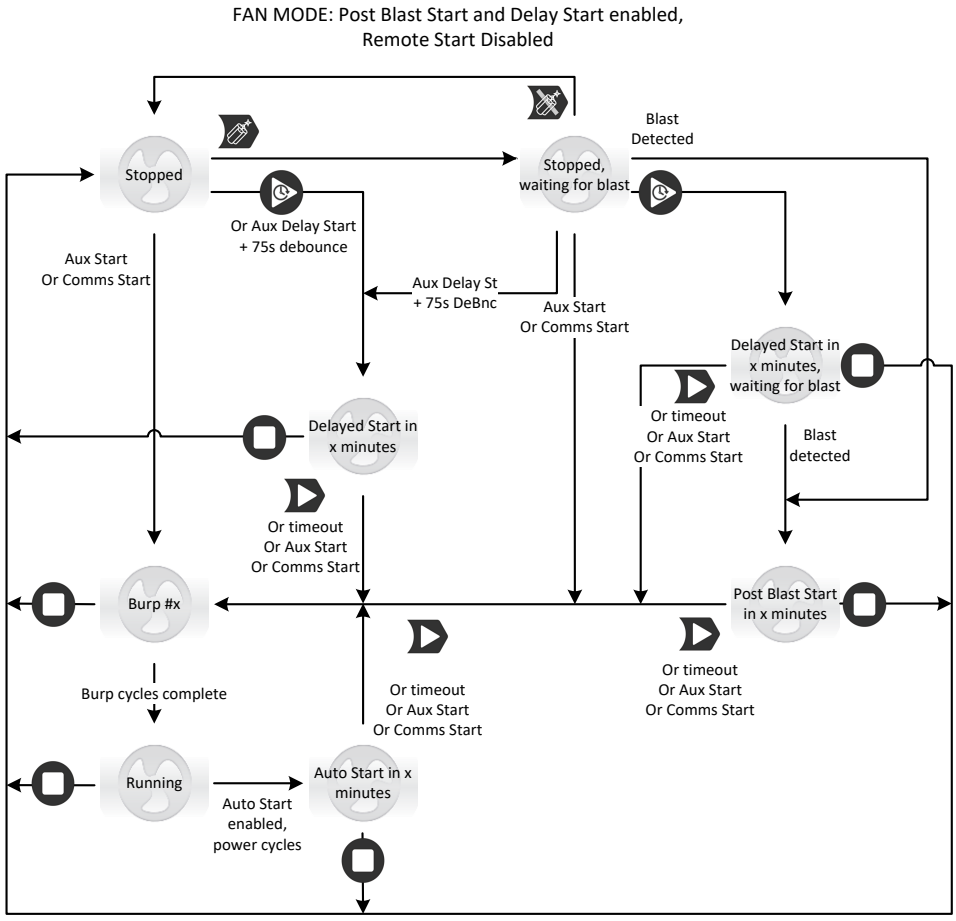


Figure 38: Starting Options - Post Blast Start and Delayed Start Enabled, Remote Start Disabled

7.2.3 Delayed Start Input

In order to perform dual fan sequence starts with the Rockstarter, the 'Run' output of the first Fan stage Rockstarter (accessed through the Auxiliary I/O connector) must be connected to the 'Delayed Start' input of the second stage Rockstarter Fan. The 'Delayed Fan Start' function of the Rockstarter must be enabled. This connection may be via the optional pre-terminated Fan Sequencing cable or, alternatively through the I/O junction box and connecting cables, refer to the equipment list.

When the Rockstarter is configured for delayed starts, should the upstream Rockstarter stop/trip while the downstream Rockstarter is in its delayed start countdown, the downstream Rockstarter will also stop.

When operating with a delayed start time, the second or following stages of the sequence can be manually started from the HMI or auxiliary IO inputs. To ensure sequenced fans are only ever started from the Master Rockstarter, additional settings with "Slave" operation are provided. When these settings are made the HMI indicates the Slave mode on the home page and it will only ever be able to start from the Auxiliary Delayed Start input of the Rockstarter.

There is a 75 second debounce on the auxiliary I/O delay start input. This is to accommodate for the situation where the upstream Rockstarter may be burping, hence the run output will be on for a maximum of 67.5 seconds plus a 7 second margin (achievable when in incremental Burp Timing Mode Burp cycles is 4 and Burp on time is set to 20 seconds, 20 x 3.375).

7.3 Pump Control Mode – (Anti Snore Mode)

When the water being pumped, drops below the level of the pump's intake pipe, a mixture of air and water is sucked into the pump. The sound that is produced when this occurs is known as snoring. As the ratio of air to water increases, the load on the pump motor decreases. An insufficiently loaded pump will run at the maximum rotor speed, potentially burning out the pump motor in as little as 30 seconds.

The Rockstarter's Pump Sleep Mode provides protection against damage by initiating a sleep state when the outlet current falls below a set level (Snore Current). After a user defined time period (Sleep Time), the Rockstarter will 'wake' the outlet to check if the intake pipe has been fully submerged again. If the pump is still under-loaded, another sleep cycle will begin.

Pump Mode is a selectable operating mode of the Rockstarter that provides addition protection and control functionality when the outlet is supplying pump motors. The additional setting can be seen in Table 15. The additional settings are found in the Fan/Pump Mode Control (MC) menu (Sleep Timing Mode, Snore Current and Sleep Time).

Table 15: Pump Protection – Configuration Settings

Sleep Timing Mode
Incremental
Fixed

Sleep Time
0.5 minutes
1 minute
2 minutes
3 minutes
4 minutes
5 minutes
10 minutes
15 minutes
20 minutes
30 minutes
60 minutes

Snore Current
30 % FLC
35 % FLC
40 % FLC
45 % FLC
50 % FLC
55 % FLC
60 % FLC
65 % FLC
70 % FLC
75 % FLC
80% FLC
85 % FLC
90 % FLC
95 % FLC

7.3.1 Sleep Modes

The Rockstarter can be configured to two timing modes, fixed and incremental. These modes refer to the length of time that the Rockstarter remains in the sleep state each time that an undercurrent event occurs.

Table 16: Rockstarter Pump Sleep Timing Mode

Pump Sleep Timing Mode	***Description of Operation***
Fixed	In Fixed Sleep Mode each time the Rockstarter enters a sleep cycle, the sleep time will be a fixed value.
Incremental	In Incremental Sleep Mode each time that the Rockstarter enters a consecutive sleep cycle, the sleep time will increase by 50%. If water is present (current is above the Snore Current set-point) when the pump wakes up, the sleep time will reset back to its initial value.

In the Incremental Sleep Timing Mode, the consecutive sleep time increase as per the values shown in Table 17.

After the Rockstarter has entered sleep mode four consecutive times, the sleep mode will no longer increase and will remain constant at that duration.

Table 17: Pump Incremental Timing Mode

Sleep Cycle 1	***Sleep Cycle 2***	***Sleep Cycle 3***	***Sleep Cycle 4***	***Sleep Cycle 4***
T_{sleep} x 1	T_{sleep} x 1.5	T_{sleep} x 2.25	T_{sleep} x 3.375	T_{sleep} x 5.06

The Rockstarter is considered to have entered sleep mode consecutively if, after waking up from a sleep state, the pump operates 5 seconds and does not exceed the specified Snore Current and therefore returns to sleep. The Rockstarter will then initiate another sleep cycle and the consecutive sleep count will increase.

This sleep count will reset under any of the following conditions:

- The Snore Current level is exceeded
- The pump is stopped/tripped
- The pump is started with the start button
- The Rockstarter loses power

If the operator requires a single one-shot style pump operation, they can simply activate the pump sleep option. This disables the waking up of a pump once it goes to sleep and waits for the user to restart the outlet. The Sleep Disabled function can be activated from the home page of the HMI, no limitation is placed on when this can be activated or disabled.

NOTE

Undercurrent settings will not be visible when operating in Pump Mode as the undercurrent trip point is used for the snore set-point.

NOTE

When the Rockstarter enters a snore cycle in Pump Mode, it will log as an undercurrent trip in the log list.

NOTE

If the pump is running with sleep disabled, the pump will run until it goes to sleep and will not start back up.

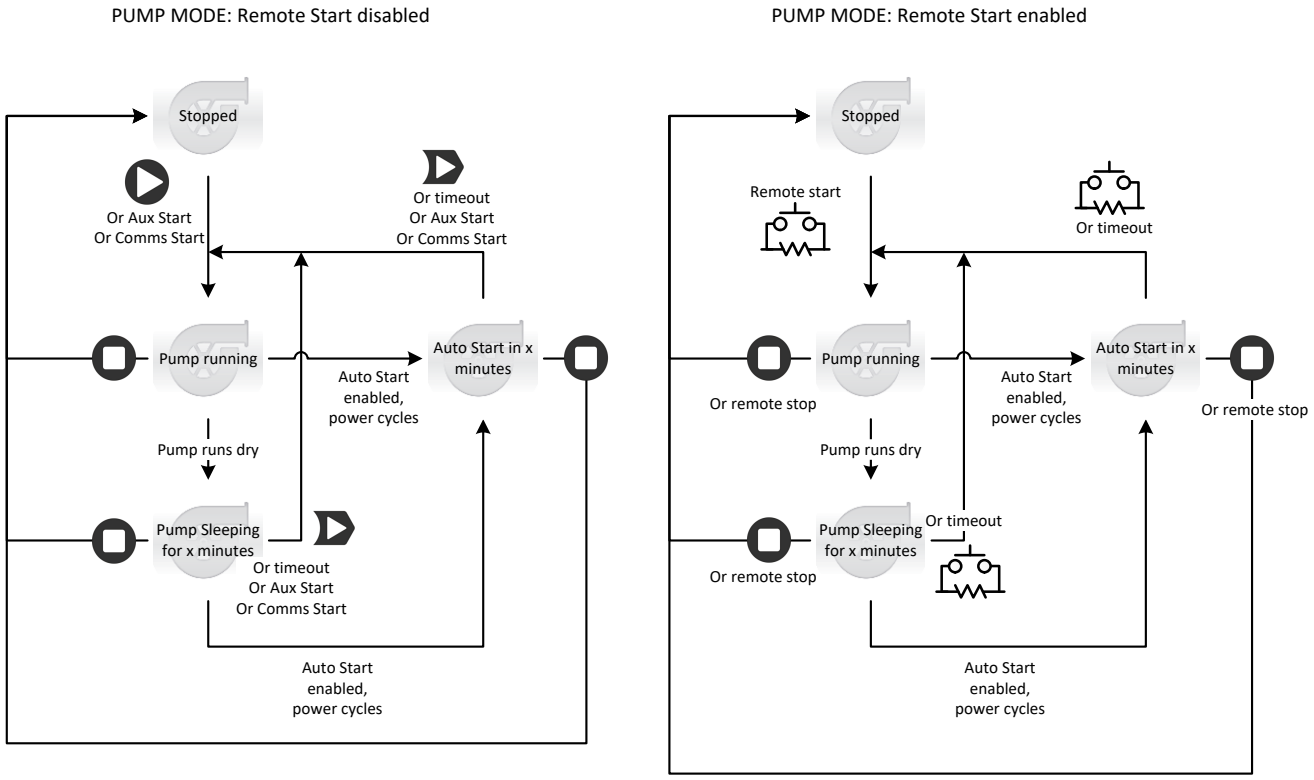


Figure 39: Starting Options – Pump Mode

8 TOUCH POTENTIAL PROTECTION FUNCTIONS

The Rockstarter provides a number of protection functions that meet the requirements of the AS/NZS 2081 standard. These protection functions are:

- Earth Leakage
- Earth Continuity
- Earth Fault Lockout
- Main Contactor Fail

8.1 Earth Leakage

8.1.1 Trip Characteristics

Table 18: Earth Leakage Trip Characteristics

Parameter	***Action***
Frequency Range	Weighted Wideband, 5 Hz - 10 kHz
Power Cycle	Trip status maintained
Reset	Requires an authorised reset after the trip condition has cleared
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	Always active
Logging	Always logged
Monitoring	Earth Leakage current displayed as 0-125 % of selected trip level
Trip Level (mA)	30, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500
Trip Time (ms)	Instant, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500

8.1.2 Operation Summary

The earth leakage protection function utilises a core balance toroid to measure the earth fault current. This function is tested to AS/NZS 2081:2011. The Rockstarter implements Ampcontrol's weighted wideband earth leakage protection function, which provides a scaled earth leakage response. This takes into account the reduced sensitivity of the human body to touch potentials at higher frequencies. This improved frequency discrimination also reduces the occurrence of nuisance trips.

When a fault occurs such that the trip level and time delays are exceeded a trip occurs. This trip opens / prevents a close on the Main Contactor and is latched. An earth leakage trip is considered a special fault and requires an authorised reset.

The status page Earth Leakage current (EL) is displayed the actual current value with the bar graph visually showing the percentage compared to the trip level.

8.1.3 Earth Leakage CT Failure Protection

Table 19: Earth Leakage CT Failure Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires a general reset after the trip condition has cleared
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	Always active
Logging	Always logged
Monitoring	CT Detect trip status bit
Trip Time	500 ms

The Rockstarter continuously monitors the integrity of the earth leakage detection circuit, as required by AS/NZS 2081:2011, by passing a 15 mA, 200 Hz test signal through the primary of the earth leakage CT. If the test signal is not detected by the Rockstarter a 'CT Detection Error' trip will occur. As the test signal is always present, the display will constantly indicate an earth leakage level of approximately 15 mA, even when no actual earth leakage current is present. The test signal will also interact with earth leakage currents and, depending on the frequency of the earth leakage current, create minor fluctuation in the earth leakage value shown in the display.

The Earth Leakage CT Failure trip time is fixed at 500 ms.

NOTE

The CT detection signal registers as a leakage current for the outlet which is displayed on the main status even when the outlet is open.

8.2 Earth Continuity

This function monitors the continuity of the earth between the outlet and the machine, via the pilot core. This is designed in accordance with AS/NZS 2081:2011. The Rockstarter measures the resistance of the pilot-earth loop (Series) and the leakage between the pilot and earth conductors (Shunt). The series detection is used to monitor the cables length and in turn touch potentials while the shunt measurement ensures that a pilot to earth fault is detected.

If the pilot-earth loop is not healthy (series resistance greater or shunt resistance lower than their respective trip settings) a trip occurs opening the main contactor. The trip can be configured as latching or non-latching. This allows the user to determine if the trip is manually or automatically reset once the pilot-earth loop is healthy.

The Rockstarter can be configured to operate in either Diode or LCM mode. This determines what terminating device the Rockstarter is expecting on the pilot. When the Load Connection Module (LCM) is terminated the pilot can also be used to transfer data for machine communications.

NOTE

The LCM will only be recognised by the Rockstarter and will not be seen as a suitable pilot termination by other earth continuity devices.

NOTE

If earth continuity protection was disabled prior to changing the Rockstarters mode of operation (Outlet, Pump, Fan), it will automatically re-enabled (with a trip time of 500 ms) when the mode of operation is changed.

CAUTION!

Cable parameters are important to the correct operation of the Pilot E/C function. Ampcontrol recommends the use of symmetrical cables to eliminate induced voltage on the pilot conductor from the power conductor.

8.2.1 Pilot Series Trip Characteristics

Table 20: Earth Continuity Series Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires a general reset (latched mode) or Automatically resets (non-latching mode) after the trip condition has cleared.
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	Can be disabled through the HMI for installations no requiring EC protection
Logging	Logged only if outlet is running
Monitoring	Available as the raw ohms measurement, resolution of 1 Ω.
Trip Time (ms)	100, 150, 200, 300, 400, 500, Off
Trip Level (Ω)	10, 15, 20, 25, 30, 35, 40, 45
Latch	On, Off
Remote Start	On, Off

8.2.2 Pilot Shunt Trip Characteristics

Table 21: Earth Continuity Shunt Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires a general reset (latched mode) or Automatically resets (non-latching mode) after the trip condition has cleared.
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	Can be disabled through the HMI for installations no requiring EC protection
Logging	Always logged
Parameters	Trip time Trip latch enable
Monitoring	Available as the raw ohms measurement, resolution of 100 Ω.

8.2.3 Remote Start

Remote start mode can be used to allow the start sequence to be initiated from the load via a pilot core. In remote start mode, comms sources cannot force the start of the outlet. They can however prevent the outlet from starting.

- In Diode mode: Remote start is implemented with a 100 Ω resistor (1 % 5 W) connected in series with the pilot circuit and a normally open pushbutton connected in a parallel to this resistor. The loop resistance of the circuit will then be 100 Ω plus the resistance of the pilot-earth loop
- In LCM mode: Remote start is implemented through a normally open pushbutton connected to the “Start Input” of the LCM

NOTE

Remote starts will not be possible when earth continuity protection is disabled, regardless of the pilot termination mode.

NOTE

If the Rockstarter is configured for remote start then the local start button within the UI will be unavailable.

The remote start setting requires the following sequence for a start to be triggered:

Diode Mode:

1. The Rockstarter must be healthy and ready to start, all trips must be clear.
2. The Rockstarter’s earth continuity protection and remote start function must be enabled.
3. The pilot resistance must be detected above 90 Ω to ensure that a start resistor is in place.
4. As soon as the 100 Ω resistance is shorted a start is triggered.
   (Note that the EC series protection function will still be operating, and the start will not be triggered if the EC measurement is above the EC trip level).
5. If the EC resistance falls below 90 Ω but remains above the EC series threshold it will result in a remote start error trip after 1 second.
6. The start sequence (EFLO, MC closing) starts immediately after the trigger.
7. The start resistor must remain shorted out by the start button for the duration of the pre-start tests and until the outlet is energised (greater than ~3 sec).
8. If the EC resistance does not return to above 90 Ω within 5 seconds after the outlet energises, the Rockstarter will trip on ‘Remote Start Stuck’.
9. The Remote Start Fault is automatically reset once the EC resistance return to above 90 Ω. (An external reset is not required)

If the earth continuity trip is set to non-latching, the “Start Timed Out” fault will automatically reset once the start resistor is detected (a manual reset is not required).

LCM Mode:

1. The Rockstarter must be healthy and ready to start, all trips must be clear.
2. The Rockstarter’s earth continuity protection and remote start function must be enabled.
3. The communications between the Rockstarter and LCM must be healthy.
4. As soon as the start input is shorted a start is triggered.
5. The start sequence (EFLO, MC closing) starts immediately after the trigger.

6. The start resistor does not need to remain shorted out by the start button for the duration of the pre-start tests. This input is edge triggered, it can be held closed or released.
7. There is no ‘Remote Start Stuck” trip in LCM Mode as the start is initiated through the LCM and does not affect the pilot circuit.

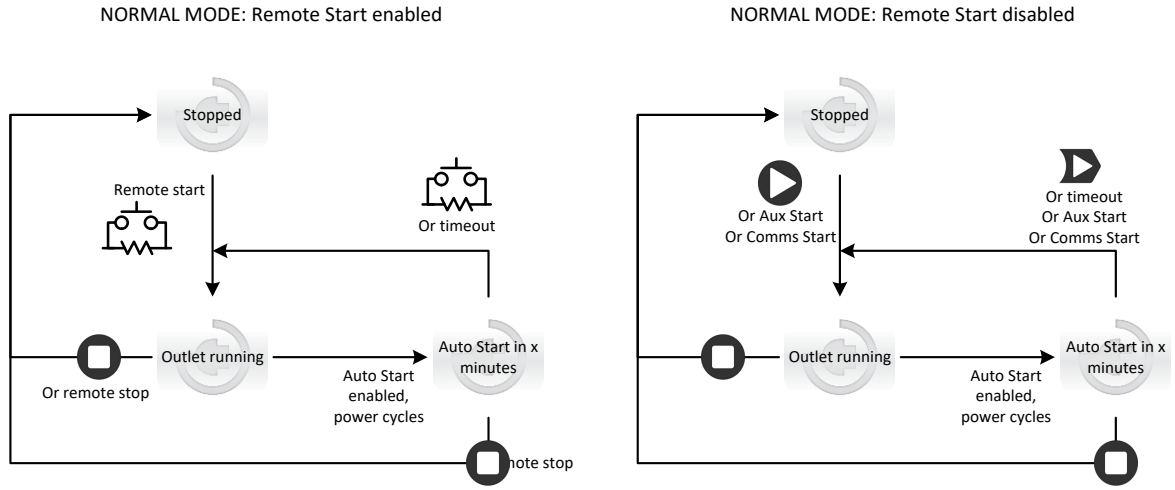


Figure 40: Starting Options - Normal Mode

8.2.4 **Remote Stop**

Remote stops can be utilised in any mode of operation, it does not require Remote Start Mode to be active. This allows for outlet stops to be initiated from the load via a pilot core. Regardless of the mode of operation, a stop can be initiated from any source (HMI, Remote, AUX, Modbus TCP, and Remote Desktop) and will prevent the outlet from starting.

In Diode mode: Remote stop button can be implemented by installing a normally closed pushbutton in series with the pilot conductor. When the pushbutton is pressed it will create an open circuit on the pilot line causing an earth continuity trip.

If earth continuity is not set to latch, the Rockstarter can be started and stopped at the motor enclosure. If earth continuity is set to latch, a reset must be performed before the outlet can be started again.

In LCM mode: Remote stop is implemented through a normally closed push button connected to the “Stop Input” of the LCM. If not being used this input need to be shorted out to prevent a stop being initiated.

8.3 Earth Fault Lockout

Table 22: Earth Fault Lockout Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires a general reset
Trip Actions	Prevent Main Contactor from closing
Active Period	Single test performed during the start sequence
Logging	Logged when test fails
Monitoring	Last test value stored, for each phase. Value stored is from 0-150 %, where 100 % is 3 MΩ
Trip Level	3PH Load Disconnected – Trip by 3 MΩ 3PH Load Connected – Trip by 1 MΩ
Test Time	2 seconds

The earth fault lockout function tests the resistance of the three phase lines to earth. The Rockstarter applies an extra low voltage signal prior to the closure of the main contactor in accordance with AS/NZS 2081:2011. The test is automatically initiated by a starting sequence once all starting conditions are met. This test takes 2 seconds. When the impedance of any of the phase conductors falls below the tripping threshold a trip occurs.

The EFLO trip point has been chosen to ensure compliance to the worst-case scenario as defined in AS/NZS 2081:2011 Section 7.2.

"Earth fault lockout protection devices shall be designed to prevent energization of the circuit interrupting device when the insulation resistance of any active conductor to earth is below 1 MΩ. This requirement shall apply to any combination of active conductors to earth".

To ensure compliance with AS/NZS 2081:2011, the EFLO set point is influenced by the configuration that reduces the impedance to earth the greatest. This being all three phases shorted together through a load or connected motor, essentially causing all three-phase leakage impedance's to be paralleled. An electric motor or load can be treated as a short circuit for the applied DC test voltage. Under this circumstance the Rockstarter needs to trip before it detects 1 MΩ to ensure compliance.

The individual leakage impedances for each phase, if the load is an un-shorted configuration, then it is required to be greater than 3 MΩ to ensure the minimum level of safety is maintained.

Table 23: EFLO Trip Threshold

EFLO Trip Threshold	***Outlet Configuration***	***Example***
1 Meg	Load on Outlet	Outlet cable terminated by Motor
3 Meg	Open Circuit	Outlet Shuttle car with incomer contactor

8.4 Main Contactor Protection

There are four main contactor protection functions. Each of the functions monitors the states of the outlets main contactor. If a fault is detected, the circuit breaker is opened in order to remove power from the potentially faulty contactor.

8.4.1 Load Side Voltage Detection (Loss of Vacuum)

Table 24: Voltage Detection Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires an authorised reset. Note: The condition of the contactor is required to be investigated and documented. Ampcontrol recommends performing a controlled start and stop prior to returning to service. A detailed statutory test record in generated by the OTS application.
Trip Actions	Open Circuit Breaker Prevent Main Contactor from closing
Active Period	When outlet is not energised and the Back EMF timer has expired.
Logging	Logged when a trip occurs
Monitoring	Phase voltages are continuously updated.
Back EMF Time (sec)	2, 5, 10, 15, 20
Loss of Vacuum Level (VAC or VDC)	25, 50, 100, 150
Trip Time	< 1 Second

The Loss of Vacuum trip in the Rockstarter acts like a Main Contactor Fail Electrical trip. Loss of Vacuum detection provides protection against a faulty contactor that has failed due to ionisation between the contacts (or welded contacts) causing voltage to be detected on the output when the contactor is open.

The voltage level at which the main contactor failure protection should be initiated is outlined in AS/NZS 2081:2011 Clause 9.2.1, being 25 VAC or 60 VDC or up to 10 % of the system voltage.

If the LOV setting is set about the voltage level defined by AS/NZS 2081:2011, the protection scheme will no longer be compliant to the standard. Users are required to be diligent in the configuration of the settings to ensure the Rockstarter remains compliant to the relevant standards. The voltage setting is for both AC and DC voltages, a setting of 25 V will trip from 25 VAC to 25 VDC.

The loss of vacuum protection cannot be enabled immediately after the outlet is stopped as there is the potential for back EMF from the load to cause a nuisance trip. Subsequently, a back EMF timer is provided and allowed to elapse after the outlet has stopped, before the Loss of Vacuum protection can be operated.

8.4.2 **Frozen Contactor**

Table 25: Frozen Contactor Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires an authorised reset. Note: The condition of the contactor is required to be investigated and documented. Ampcontrol recommends performing a controlled start and stop prior to returning to service. A detailed statutory test record in generated by the OTS application.
Trip Actions	Open Circuit Breaker Prevent Main Contactor from closing
Active Period	When outlet is not running
Logging	Always
Monitoring	None
Trip Time	100 ms

The Frozen Contactor trip in the Rockstarter acts like a main contactor fail logical trip. If the Rockstarter detects that the main contactor has closed when requested to be open, or remains closed after requested to open, it will result in a frozen contactor trip, tripping the circuit breaker.

The frozen contactor protection activates in approximately 100 ms.

8.4.3 Close Fail

Table 26: Contactor Close Fail Trip Characteristics

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires an authorised reset. Note: The condition of the contactor is required to be investigated and documented. Ampcontrol recommends performing a controlled start and stop prior to returning to service. A detailed statutory test record in generated by the OTS application.
Trip Actions	Open Circuit Breaker Prevent Main Contactor from closing
Active Period	After closing MCR, prior to receiving confirmation from the MCI
Logging	Always
Monitoring	None
Trip Time	1 second

Close fail detects the event when the Rockstarter attempts to close the main contactor but receives no confirmation of the close via the contactor feedback. As a result, the Rockstarter will trip the circuit breaker.

Close fail protection activates in approximately 1 second.

8.4.4 External Open

Table 27: External Open Trip Characteristic

Parameter	***Action***
Power Cycle	Trip status maintained
Reset	Requires an authorised reset. Note: The condition of the contactor is required to be investigated and documented. Ampcontrol recommends performing a controlled start and stop prior to returning to service. A detailed statutory test record in generated by the OTS application.
Trip Actions	Open Circuit Breaker Prevent Main Contactor from closing
Active Period	While running
Logging	Always
Monitoring	None
Trip Time	1 second

An external open trip occurs if the main contactor is detected as having been opened while the system is in run mode.

External open protection activates in approximately 1 second.

8.4.5 Coil Voltage Detection

Table 28: Coil Voltage Detection Trip Characteristics

Parameter	Action
Power Cycle	–
Reset	Automatic
Trip Actions	Open Circuit Breaker Prevent Main Contactor from closing
Active Period	Always
Logging	Only logged if it results in the protection module stopping a running outlet
Monitoring	Coil voltage status bit

The coil voltage is internally detected by the Rockstarter. This additional functionality is provided so in the event of the contactor coil voltage being lost while the outlet is running a nuisance main contactor Failure trip does not occur, as the changing of state for the main contactor can be explained by the loss of coil voltage.

8.4.6 MCF Latch

Contactor related trips must be reset only by an authorised person. Operation of the contactor should be checked by performing an OTS test sweep. All trip bits that feed into the main contactor failure flag are individually logged in the Rockstarter for event analysis in the instance of a circuit breaker trip.

For any MCF fault, the condition of the contactor is required to be investigated and documented. Ampcontrol recommends performing a controlled start and stop, prior to returning to service. A detailed statutory test record in generated by the OTS application.

9 LOAD RELATED PROTECTION FUNCTIONS

The Rockstarter individually measures all three of the outlets phase currents. The measured currents are used to implement the following protection functions:

- Inverse time protection – Overcurrent or Motor Overload
- Short Circuit
- Under Current
- Phase Current Imbalance

The ‘Full Load Current’ setting determines the base current for all of the phase current related functions: the measured currents are normalized based on the selected value. The range is selectable form 2A to 250A.

9.1 Inverse Time Protection

The 'Overload Model' setting is used to select one of three Inverse Time-Current characteristics:

- Very Inverse Overcurrent
- Extremely Inverse Overcurrent
- Motor Overload

> **NOTE**
> When the Motor Overload parameter is set, the Short Circuit functionality is also modified to better suit motor starting transients. See Section 9.2 for further information.

The Overcurrent Time Multiplier setting (TMS) scales the basic trip time for the basic overcurrent characteristics to the desired response time. Values are provided from 0.05 to 30; refer to APPENDIX A: PROTECTION ELEMENT LOAD CURRENT TABLES for the full list of values. For cross reference, the nominal trip times are listed for each TMS value, for each of the curve options at 10x FLC.

9.1.1 **Overcurrent**

Table 29: Overcurrent Trip Characteristics

Parameter	***Action***
Power Cycle	–
Reset	Requires a general reset.
Trip Actions	Open Main Contactor Prevent Main Contactor from closing Block restart if the thermal accumulator is not below the selected start block level. In Fan Mode, Thermal Start block setting changes to Fan Sequence Thermal Start Block.
Active Period	When Overcurrent curve is set to Very Inverse or Extremely Inverse.
Logging	Always
Monitoring	Phase currents displayed as a percentage of selected full load current thermal accumulator (TAC)
Curve	Very Inverse as per IEC 60255-151 B Curve, or Extremely Inverse as per IEC 60255-151 C Curve
Time Multiplier Setting (TMS)	0.05 – 30x FLC
Full Load Current	See RKS Full Load Current Selection Table in Appendix A
Thermal Accumulator Start Block	20, 30, 40, 50, 60, 70, 80, 90 %
Fan Sequence Thermal Start Block (%)	0,5,10,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85,90

The three phase currents are compared and the highest current is used to determine the trip time. If the current exceeds the selected full load current, an overcurrent trip accumulator (TAC) increases. If the overcurrent condition persists so that the trip accumulator reaches 100 % then a trip occurs. If viewed during start up, the trip accumulator can help determine if the overcurrent settings are correct.

The Overcurrent curves provided are as follows:

1. **Very Inverse** as per IEC 60255-151 B Curve. The trip time and reset time in seconds for current I follows the characteristic defined by:

$$t(I) = TMS \cdot \left(\frac{13.5}{I-1}\right)$$

$$t_R(I) = TMS \cdot \left(\frac{1.69}{1-I}\right)$$

2. **Extremely Inverse** as per IEC 60255-151 C Curve. The trip time and reset time in seconds for current I follows the characteristic defined by:

$$t(I) = TMS \cdot \left(\frac{80}{I^2-1}\right)$$

$$t_R(I) = TMS \cdot \left(\frac{1.28}{1-I^2}\right)$$

Where:

t(I)	=	the idealised trip time,
I	=	the input current ratio relative to the full load current set point – i.e. per unit current,
	=	$I_{fault\ current}$ / $I_{full\ Load}$
TMS	=	the Overcurrent Time Multiplier Setting,
t_R (I)	=	the idealised reset time.

See Overcurrent Curves, drawing IPXB014 in APPENDIX D: DRAWINGS

The thermal characteristics utilised in these overload functions are restricted compared to the Motor Overload option. Thermal load is contributed to the accumulator only when the currents are above the overload set-point. The trip accumulator resets relatively quickly if the current falls below the selected full load current level.

When the protection module is not in the 'running' state, if the thermal accumulator is not below the selected start block level, a start block (trip) will occur. This will automatically clear once the thermal accumulator drops to or is below the selected level. Note this will generally happen quickly when the inverse overcurrent modes are selected.

When in Fan Mode (V17 firmware onwards), the thermal start block setting becomes "Fan Sequence thermal Start Block". The RKS will implement a start sequence thermal start block level. This will prevent a sequence start when the thermal accumulator would otherwise reach or exceed 100 % with the #Burp starts programmed into the Rockstarter. The individual starts of the sequence will be protected by a thermal start block of 90 % regardless of this setting.

To set this value correctly, it is recommended that with the thermal accumulator at 0 %, a start sequence be performed and the final thermal capacity (FTC) be recorded. The value recorded is the minimal thermal capacity required to perform a fan sequence start given the current settings. The fan sequence thermal start block can then be set to 100-FTC. This should prevent failed sequence starts due to thermal capacity being exceeded and reduce down time. Tuning of the setting may be required as equipment wears or the system characteristics and settings alter.

NOTE	1. The per-unit current is clipped to a maximum of 1250 %. Therefore the trip time for input currents above this level will not decrease any further i.e. the trip characteristic 'flat lines' beyond 1250 % of the selected full load current. 2. Independent of the selected curve and TMS setting, the minimum trip times for the overcurrent functions are nominally 100 ms. 3. The trip times calculated from the above formulae are idealised. The trip calculations are executed every 20ms, so there is an additional delay and uncertainty of 25 ms +/- 15 ms.

9.1.2 **Motor Overload**

Table 30: Motor Overload Trip Characteristics

Parameter	***Action***
Power Cycle	Trip Status maintained
Reset	Requires a general reset (and all three measured phase currents must be below the 100 %).
Trip Actions	Open Main Contactor Prevent Main Contactor from closing Block restart if the thermal accumulator is not below the selected start block level.
Active Period	When Overcurrent curve is set to Motor Overload.
Logging	Always
Parameters	Time Multiplier Full Load Current Cooling Multiplier Thermal Accumulator Start Block
Monitoring	Phase currents displayed as a percentage of selected full load current TAC.
Curve	Thermal Model as per IEC 60255-8
Time Multiplier	0.05 – 30x FLC
Full Load Current	See RKS Full Load Current Selection Table, See Appendix A
Cooling Multiplier	0.2, 0.3, 0.4, 0.5, 0.8, 1.0, 2, 5, 10, 20, 50
Thermal Accumulator Start Block (%)	20, 30, 40, 50, 60, 70, 80, 90
Fan Sequence Thermal Start Block (%)	0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90

This protection scheme uses a first order thermal model of an electric motor to determine the tripping characteristic utilised. It is fundamentally different to the overcurrent protection outlined above in that all current levels contribute to the model heating, and the effects of that heating persist in the model.

The three measured phase currents are squared and added together to provide the heating input into the thermal model. The cooling is assumed to be proportional to the model's 'temperature' at any given time. The thermal accumulator (TAC) is the model's 'temperature' (presented in a %) where 0 % represents the motor being cold, and 100 % meaning the motor has reached its maximum temperature limit (and will therefore trip).

The trip time is dependant not only on the present current level, but also the prior current history. Since motor currents typically vary widely during starting and running, the actual trip time is also variable. To facilitate co-ordination of the protection with motor capabilities (and upstream protection), the trip time in seconds for a simple (theoretical) scenario of a fixed overload current of I is given by:

$$t(I) = TMS \cdot 72.9 \cdot ln\left(\frac{I^2 - {I_p}^2}{I^2 - 1.05^2}\right)$$

Where:

t(I) = the idealised trip time,

I = the input current ratio relative to the full load current set point – i.e. per unit current,

= $I_{fault\ current}$ / $I_{full\ Load}$

I_p = The load current that was flowing (long enough to reach thermal stability) prior to the overload occurrence

TMS = the Overcurrent Time Multiplier Setting,

ln = the natural logarithm

NOTE

1. The per-unit current is clipped to a maximum of 1250 %. Therefore the trip time for input currents above this level will not decrease any further: i.e., the trip characteristic 'flat lines' beyond 1250 % of the selected full load current.
2. Independent of the selected TMS setting, the minimum trip times for the Overload function is nominally 100 ms.
3. The trip times calculated from the above formulae are idealized. The trip calculations are executed every 20 ms, so there is an additional delay and uncertainty of 25 ms +/- 15 ms.
4. The above characteristic is equivalent to IEC 60255-8 (equation below) with the substitution of $\boldsymbol{\tau}$ =TMS • 72.9. This scaling aligns the trip time at 10PU current with that of the Extremely Inverse curve above (e.g. 808 ms with a TMS of 1.0).

$$t = \tau \cdot \ln\left(\frac{I^2 - {I_p}^2}{I^2 - (k \cdot I_B)^2}\right)$$

Where in the protection module:

K = 1.05, called the 'Service Factor'

I_B = 1

The base thermal model provides a thermal time constant of 72.9 seconds. The TMS setting scales the basic thermal time constant, allowing a maximum time constant of over 36 minutes (TMS = 30).

See Motor Overload Curves drawing IPXB013 in APPENDIX D: DRAWINGS.

The TAC provides information about how much thermal capacity is left, and therefore how long it will take to trip from a given starting point and overload current. If the motor current I is constant (and below 1.05PU), the TAC will eventually settle to a value as follows:

$$TAC = \left(\frac{I}{1.05}\right)^2 \cdot 100\%$$

For example, if the long-term average load current was 0.7PU, the TAC would settle at 44 %.

The relative trip time for a constant current as a function of the initial value of the TAC is given by:

$$t(TAC) = (\ 100\% - TAC\ ) \cdot Cold\ Trip\ Time$$

Continuing the example above, with the TAC starting at 44 %, the trip time would be 56 % of the cold trip time (for the same current), that is, if the long-term average current (Ip) prior to an overload was 0.7PU, the trip time for an overload from that starting point would be 56 % of the trip time for the same overload current starting from cold. Drawing IPXB013 also shows the overload curve for various values of Ip.

The motor manufacturer's data should be consulted to select the time multiplier appropriate for the motor being protected. Typically, the capacity of a cold motor is given at six times its rated current. The characteristic equation above can be used to select the TMS to match the motors overload capacity.

While the main contactor is closed, the cooling output from the thermal model is calculated to achieve the necessary behaviour to match the characteristic above.

The overload cooling multiplier modifies the cooling output of the thermal model when the motor is stopped. This can be used to account for reduced cooling capacity of the motor when it is not running. A cooling multiplier of 1 means the cooling is independent of whether the motor is running or not – e.g. a water-cooled motor. A setting of 2.5 may be appropriate for a fan-cooled motor, however for the best protection consult the motor manufacturer. Values are provided from 1.0 to 5.0.

The thermal model continues to simulate the motor's thermal behaviour even if the power is removed from the relay. When power is restored, the thermal memory would be at the same level had there been no loss of power.

The thermal accumulator shows the state of the thermal model: 0 % = Cold, 100 % = Trip. When a trip occurs it cannot be reset until the current is below the pick-up level.

When the Rockstarter is not in the 'running' state, if the thermal accumulator is not below the selected start block level, a 'start block' (trip) will occur. This will automatically clear once the thermal accumulator drops to or is below the selected level. This functionality is used to ensure adequate thermal capacity is available before another start is allowed. If necessary, it will force sufficient cooling time to allow the restoration of sufficient thermal reserve.

If for example the application required capability to permit a locked rotor start lasting up to 60 % of the allowable 'cold' locked rotor start time (before tripping on Motor Overload), the 'Start Block Level' parameter would be set to 40 %.

When in Fan Mode (V17 firmware onwards), the thermal start block setting becomes "Fan Sequence thermal Start Block", see Section 9.1.1 for further information.

CAUTION!

Incorrect motor protection setup, **may cause or lead to motor failure or permanent motor damage**.

9.2 Short Circuit

Table 31: Short Circuit Trip Characteristics

Parameter	***Action***
Power Cycle	Trip Status maintained
Reset	Specific short circuit reset
Trip Actions	Open Circuit Breaker Open Contactor 1 second after Circuit Breaker opens
Active Period	Always
Logging	When a fault occurs
Monitoring	Phase currents displayed as a percentage of selected full load current.
Trip Level (Multiples of FLC	1.5 to 12.5 in 0.25 increments in OC mode 3.0x to 25x when in MOL mode with additional slower trip element at 1.5x to 12.5x (Multiples of Full Load Current) Trip occurs at the level determined by selected Full Load Current x SC Level of 6 kA, whichever is lesser.
Trip Time (ms)	40 ,60, 80, 100, 120, 140, 160, 180, 200
Upper Detection Limit (A)	2350

The short circuit function has a definite time characteristic. If the current exceeds the selected level for the pre-set time, then a trip occurs.

The short circuit trip level is adjustable from 1.5 to 12.5 times the Full Load Current (FLC) in 0.25 increments. Note that there is also an upper limit in the current measuring system of 2350A (RMS). This limit will effectively override selections where the combination of the selected full load current and the selected short circuit level exceeds 2350A. For example, if 250A is selected, the short circuit will trip at 9.4PU (940 %) even if the short circuit level is set to 9.5x or above. The per unit current at which the 2350A limit takes effect is listed as ‘SC max’ along with the full range current values in APPENDIX A: PROTECTION ELEMENT LOAD CURRENT TABLES.

The trip time is selectable from 40 to 200 ms.

If the over current function is set to Motor Overload, the short circuit functionality is modified as follows:

1. The primary ‘instantaneous’ short circuit trip level is double the selected value: therefore, so it covers a range from 3.0 to 25 times full load current.
2. A second ‘time delayed’ short circuit element becomes active. This element operates at the selected short circuit trip level, but the trip time is the selected (primary) trip time plus 60 ms.

There is a separate ‘SC-LT’ trip bit (LT stands for ‘long time’) & event log to differentiate each of the short circuit elements. This modified functionality allows the short circuit protection to be set just above the locked rotor current level without risking spurious trips due to initial transient offsets (which can effectively double the initial inrush peak current).

When a short circuit trip occurs, the circuit breaker is opened, and the main contactor left closed for one second to allow the circuit breaker time to clear to fault. Any other trips or control action to open the contactor during this time – except for earth leakage, will be blocked.

9.3 Under Voltage

Table 32: Under Voltage Trip Characteristics

Parameter	***Action***
Power Cycle	–
Reset	Automatic
Active Period	When outlet is running
Logging	Only if outlet is running
Monitoring	Phase voltage displayed in Volts.
Trip Level	Off, 40 %, 50 %, 60 %, 70 %, 75 %, 80 %, 85 %, 90 %, 95 %
Trip Time	800 ms

Under Voltage protection is enabled as soon as the main contactor is closed. If any of the phase voltages drop below the selected trip setting of the nominal line voltage for 800 ms then the outlet is stopped.

9.4 Current Imbalance

Table 33: Current Imbalance Trip Characteristics

Parameter	***Action***
Power Cycle	Trip Status maintained
Reset	General reset
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	Always
Logging	Always
Monitoring	Phase currents displayed in Amps.
Trip Level	5 %, 10 %, 20 %, 50 %, OFF
Trip Time	2 seconds

The current imbalance measurement is available and is calculated as:

$$i_{bal} = \frac{MAX\ \Delta\ i \times 100\%}{i_{av}}$$

Where:

i_{av} = the average of the 3 phase currents

MAX Δ i = the maximum deviation of a phase current from the average.

The phase current imbalance protection is inhibited while the average current is below 20 % of the selected full load current.

If the trip level is exceeded, a timer is triggered. If the imbalance remains above the set level for more than 2 seconds the Rockstarter trips.

9.5 Under Current

Table 34: Under Current Trip Characteristics

Parameter	***Action***
Power Cycle	–
Reset	Automatic
Trip Actions	Open Main Contactor Prevent Main Contactor from closing
Active Period	When outlet is running
Logging	When a fault occurs
Monitoring	Phase currents displayed in Amps.
Trip Level	0 % (Disabled), 30 %, 35 %, 40 %, 45 %, 50 %, 55 %, 60 %, 65 %, 70 % , 75 %, 80 %, 85 %, 90 %, 95 % FLC
Trip Level	4 seconds

Under current protection monitors all three phase currents. If any phase drops below the selected threshold, the trip timer starts counting. The under current protection will trip after any phase current is below the threshold for 4 seconds. Under current trips will latch only when the operating mode is Normal or Fan. In Pump Mode, the UC faults are used for the pump sleep detection.

10 SERVICE, MAINTENANCE & DISPOSAL

10.1 Equipment Service

A number of external system based checks should be completed on a regular basis. These 'routine inspections' must be carried out by suitably trained people with knowledge of the Rockstarter and the systems into which it is fitted. Routine inspections may take the form of either visual-only checks, or visual and 'hands-on' checks.

10.1.1 **Visual Only Inspections**

A basic visual inspection focuses on looking at the installation for signs of physical damage, water or dust ingress and the condition of cables and labels. This level of inspection may also include cleaning the HMI/LED display panel.

Observations would typically be:

- Check that the Rockstarter enclosure, frame, operators, HMI, LED display, seals, through feed assembly etc. are in good order with no physical damage
- Check that connected cables are free from cuts, abrasions and obvious signs of damage. Cable restraints are in good order and correctly fitted
- Check that labels on enclosure and covers are present and in good condition (especially warning labels)
- Check that no modifications have been carried out to installed equipment

10.1.2 **Hands-On (Detailed) Inspections**

A more detailed inspection would include all of the elements of a visual inspection, plus some checks that cover the integrity of connections, fixtures and fittings. This type of inspection may involve opening the terminal compartment cover to gain access inside the Rockstarter.

In addition to basic visual observations, more detailed integrity checks would involve:

- Check that the terminal compartment is free from water and dust ingress internally
- Verify that all internal covers are fitted
- Ensure terminal cover and gland plate seals are in good condition
- Verify that Rockstarter frame, wall mounts and other mechanical fixtures are secured in place. This includes gland plates, terminal covers and tightness of cable glands
- Verify all terminal compartment electrical connection are secure and correctly torques to required specifications

10.2 Equipment Maintenance

Repairs are limited to nominated OEM accessories, as per the items listed in the Accessories and spare part Section 11. The Rockstarter must be returned to Ampcontrol for all other repairs.

WARNING!

Repairs are limited to nominated OEM accessories and spare parts. **The Rockstarter must be returned to Ampcontrol for all other repairs**.

If, during an inspection, it is determined that there is damage to the Rockstarter's through connection, these should be replaced. Ensure through connections are only performed with Ampcontrol supplied accessories.

It is recommended that the Rockstarter be subject to regular functional tests at intervals determined by risk assessment or FMEA. These intervals typically coincide with periodic maintenance checks and will cover (but not limited to) tests such as:

- Earth Leakage protection testing
- Earth continuity protection testing
- Earth Fault Lockout (EFLO) protection testing
- Frozen Contactor (FC) protection testing

The Rockstarter contains built in support for routine tests that can be completed by authorised operators. Refer to Section 6.1.2 for an overview of the test functions. Running a full OTS sequence will provide coverage protection functions listed above.

Regular testing with the OTS is recommended.

10.3 Disposal

Please return unwanted units to the Ampcontrol for disposal/recycling.

ENVIRO

The electronic equipment discussed in this manual **must not be treated as general waste**. By ensuring that this product is disposed of correctly you will be helping to prevent potentially negative consequences for the environment which could otherwise be caused by incorrect waste handling of this product.

11 ACCESSORIES & SPARE PARTS

11.1 Accessories

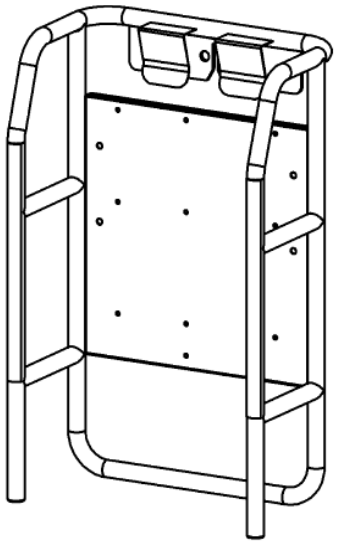


Figure 41: Rockstarter Mounting Frame C/W Bolts – PN: 177190

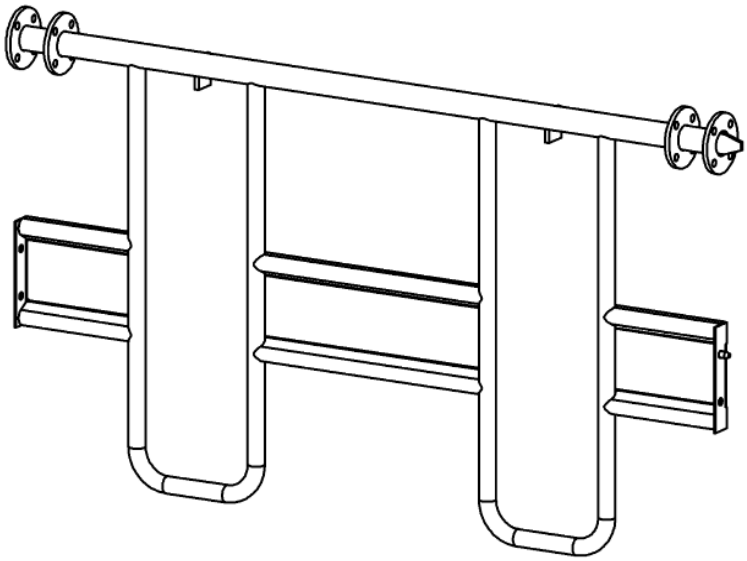


Figure 42: Rockstarter Mounting Bar Kit – PN: 177191

Accessories	
Part Number	**Description**
190491	CLAMP 48mm PIPE SWIVEL COUPLING

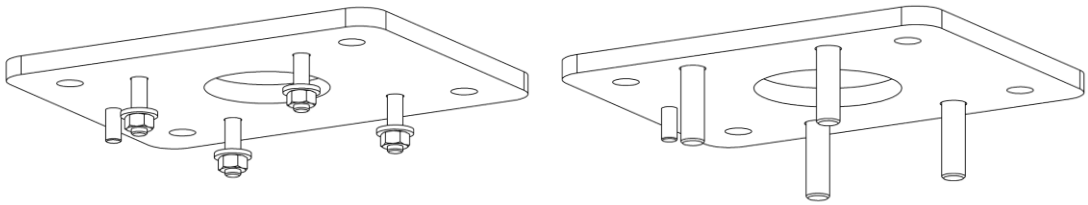


Figure 43: Rockstarter Adaptor Plates - 60A left (PN: 179292) & 150A right (PN: 181811)

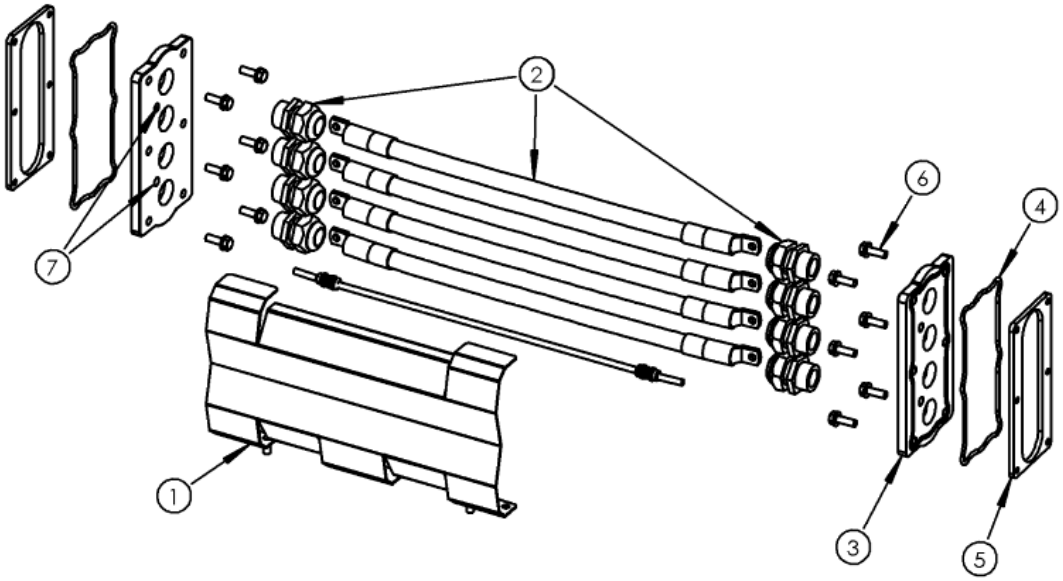


Figure 44: Through Feed Kit – 181441

PN: 181441 - KIT FEED THROUGH COMPLETE WITH GUARD ROCKSTARTER		
Part Number	**Description**	**Item Number**
181062	COVER FEED THROUGH ROCKSTARTER	1
179168	KIT CABLE FEED THROUGH ROCKSTARTER Includes all 4 through feed cables, pilot cable, and glands	2
179565	PLATE GLAND THROUGH 4 HOLES ROCKSTARTER	3
179093	O-RING GLAND PLATE THROUGH FEED ROCKSTARTER	4
180269	BACKING PLATE THROUGH ROCKSTARTER	5
181869	KIT SCREW WASHER GLAND FEED THROUGH ROCKSTARTER	6
181461	PLUG NYLON BLANKING 12mm	7
190882	KIT SCREW WASHER ELECTRICAL FEED THROUGH ROCKSTARTER (for securing cable lugs)	-

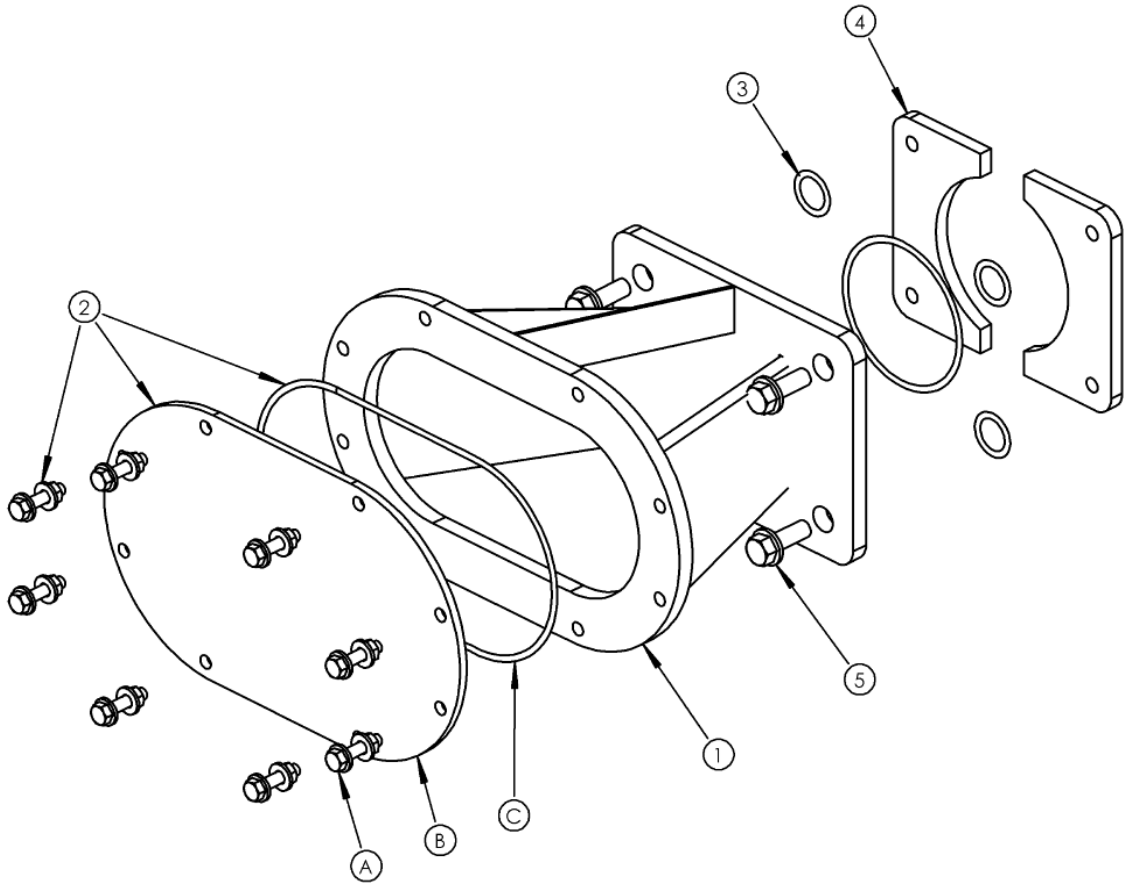


Figure 45: Dual Gland Junction Box

PN: 181903 - KIT JUNCTION BOX DUAL GLAND ROCKSTARTER		
Part Number	**Description**	**Item Number**
181905	JUNCTION BOX DUAL GLAND ROCKSTARTER	1
-	KIT PLATE GLAND EXTENSION HOUSING ROCKSTARTER (see kit below)	2
181843	KIT O-RING GLAND PLATE MAIN ENTRY ROCKSTARTER	3

Accessories (Not Included in Kit)		
Part Number	**Description**	**Item Number**
180576	BACKING PLATE MAIN ENTRY ROCKSTARTER	4
181868	KIT SCREW WASHER MAIN ENTRY ROCKSTARTER	5

KIT PLATE GLAND EXTENSION HOUSING ROCKSTARTER		
Part Number	**Description**	**Item Number**
190884	KIT SCREW WASHER GLAND PLATE EXTENSION ROCKSTARTER	A
181906	PLATE GLAND JUNCTION BOX DUAL GLAND ROCKSTARTER	B
181907	O-RING JUNCTION BOX DUAL GLAND ROCKSTARTER	C

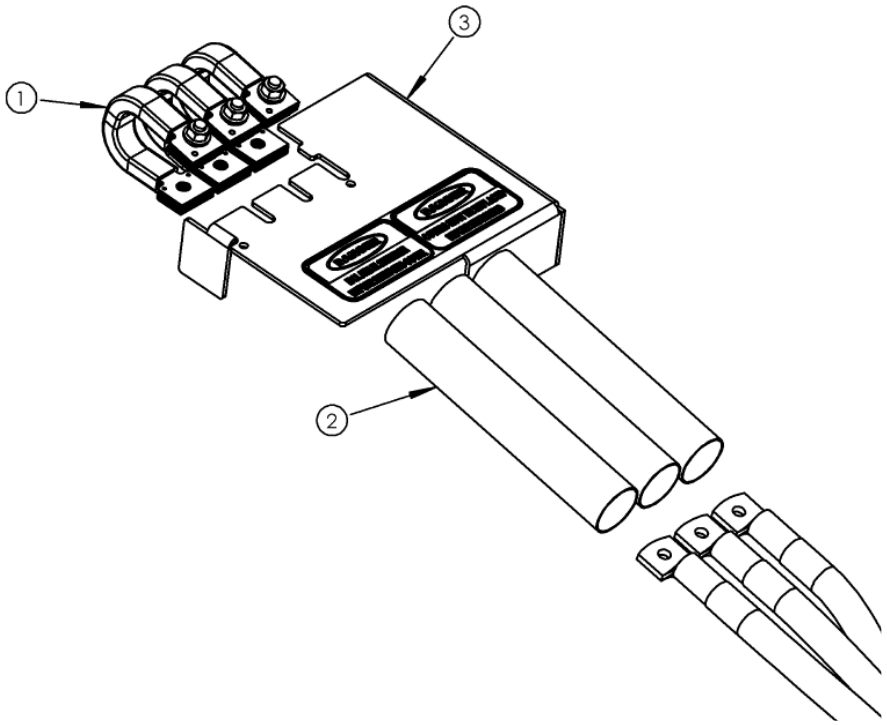


Figure 46: Dual Incomer: Option 1 Flexible Busbar

PN: 181881 - KIT TERMINATION DUAL INCOMER ROCKSTARTER		
Part Number	**Description**	**Item Number**
181904	BUSBAR FLEXIBLE ROCKSTARTER	1
190441	INSULATION TERMINATION DUAL INCOMER ROCKSTARTER	2
190501	COVER PLASTIC LINE CADDY DUAL FEED ROCKSTARTER	3
138972	CABLE TIE NYLON BLACK 300x4.8mm	-

Accessories (Not Included in Kit)		
Part Number	**Description**	**Item Number**
181872	KIT COVER INTERNAL INCOMER ROCKSTARTER	3

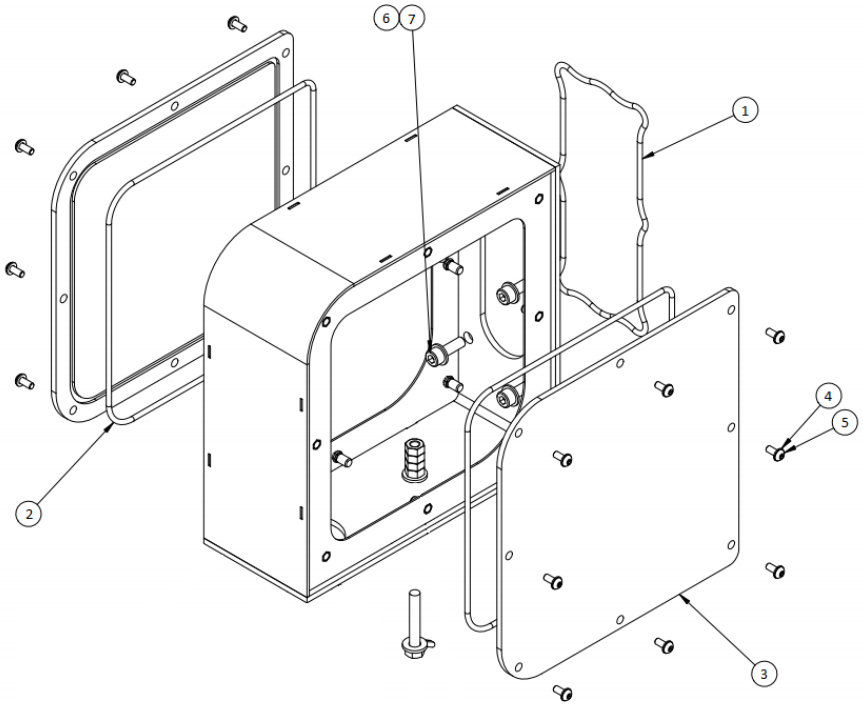


Figure 47: Dual Incomer: Option 2 Side Entry Box (192647)

PN: 193292 - KIT JUNCTION BOX ROCKSTARTER COMPLETE WITH 95mm2 LUGS
PN: 193291 - KIT JUNCTION BOX ROCKSTARTER COMPLETE WITH 120mm2 LUGS

PN: JUNCTION BOX SPARES ROCKSTARTER		
Part Number	**Description**	**Item Number**
139638	LUG 95mm2 8mm STUD CB	NA
101413	LUG 25mm2 8mm STUD	NA
139635	LUG 120mm2 8mm CB	NA
101015	LUG 35mm2 8mm STUD	NA
179093	O-RING GLND PLT THRU FEED RKS	1
192663	O-RING J-BOX SIDE ENTRY RKS	2
192648	COVER PLATE J-BOX SIDE ENTRY RKS	3
115868	WASHER M5 FLAT NYLON	4
130677	SCREW M5x12mm SS304 BTN HD SKT	5
102216	WASHER FL NYL M8	6
108019	SCREW M8x25mm CAP HD SKT	7

11.2 Spare Parts

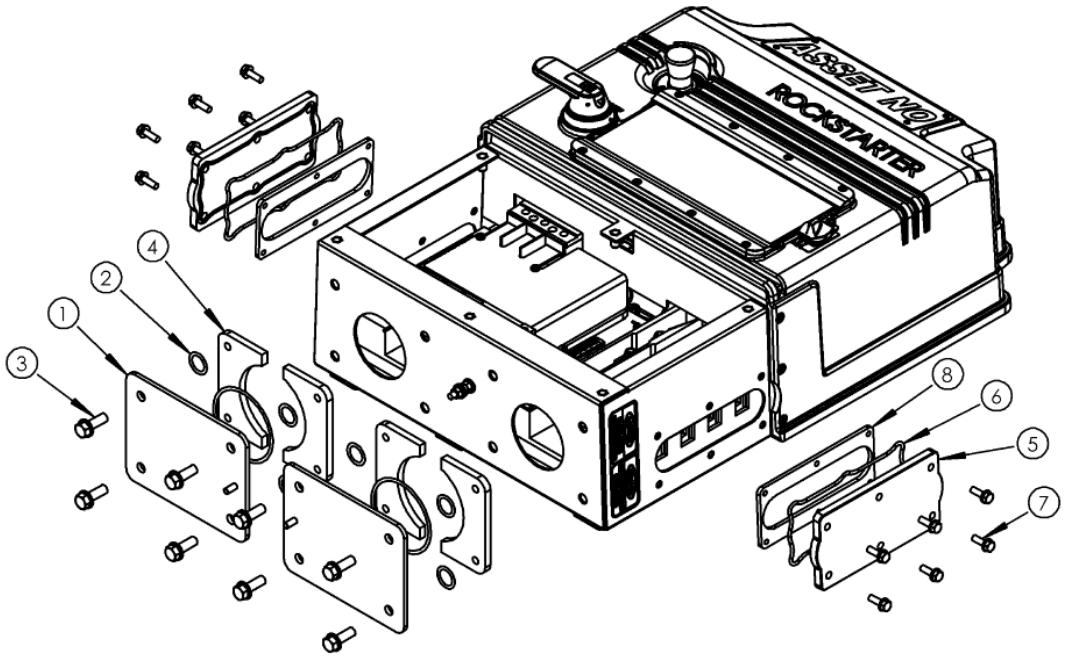


Figure 48: Rockstarter Gland Plate & Feed Through Kits

PN: 179169 - KIT GLAND PLATE LINE/LOAD ROCKSTARTER		
Part Number	**Description**	**Item Number**
179126	PLATE GLAND MAIN ROCKSTARTER	1
181843	KIT O-RING GLAND PLATE MAIN ENTRY ROCKSTARTER	2

Accessories (Not Included in Kit)		
Part Number	**Description**	**Item Number**
181868	KIT SCREW WASHER MAIN ENTRY ROCKSTARTER	3
180576	BACKING PLATE MAIN ENTRY ROCKSTARTER	4

FEED THROUGH COVER COMPONENTS		
Part Number	**Description**	**Item Number**
179128	COVER FEED THROUGH ROCKSTARTER	5
179093	O-RING GLAND PLATE THROUGH FEED ROCKSTARTER	6
181869	KIT SCREW WASHER FEED THROUGH ROCKSTARTER	7
180269	BACKING PLATE THROUGH ROCKSTARTER	8

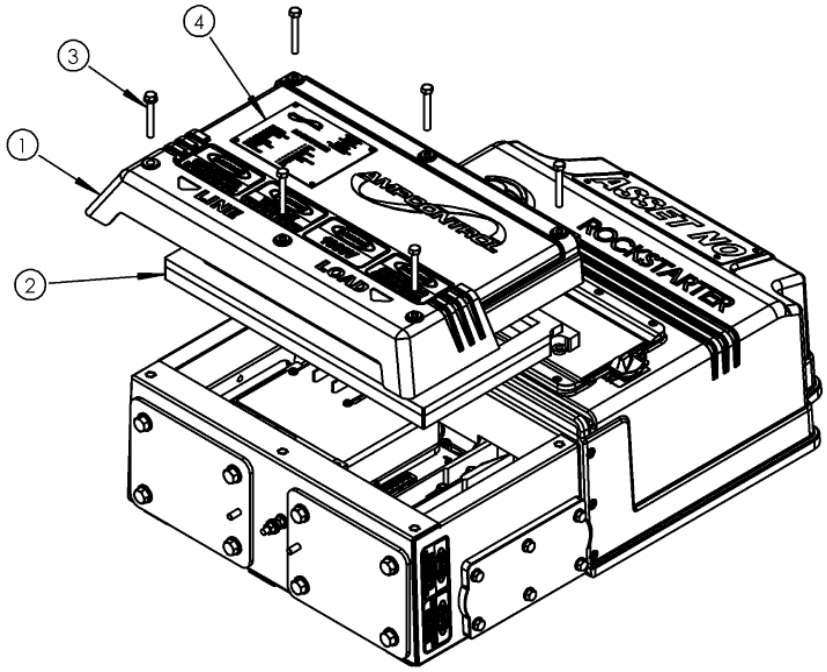


Figure 49: Rockstarter Terminal Cover Kit

PN: 179171 - KIT COVER TERMINAL CHAMBER ROCKSTARTER		
Part Number	**Description**	**Item Number**
179094	COVER TERMINAL CHAMBER ROCKSTARTER	1
180513	SEAL TERMINATION COVER ROCKSTARTER	2
181871	KIT SCREW WASHER TERMINAL CHAMBER ROCKSTARTER	3
181870	KIT LABEL MAIN ROCKSTARTER TERMINAL COVER (Requires Rockstarter serial number to be provided)	4

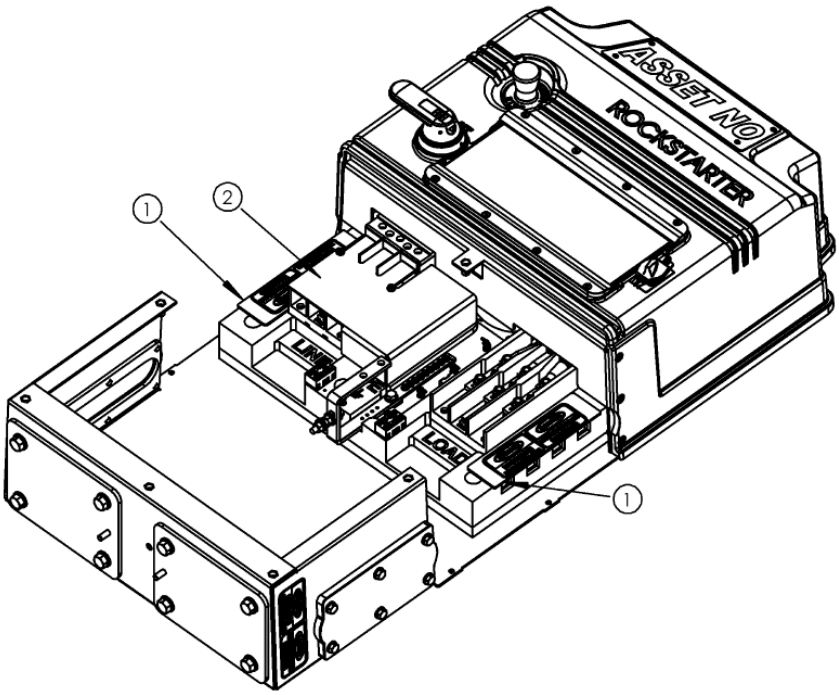


Figure 50: Rockstarter Secondary Covers

Secondary Covers		
Part Number	**Description**	**Item Number**
179173	KIT COVER FEED THROUGH INTERNAL ROCKSTARTER	1
181872	KIT COVER INTERNAL INCOMER ROCKSTARTER	2
190833	KIT NUT WASHER ELECTRICAL MAIN ROCKSTARTER	-

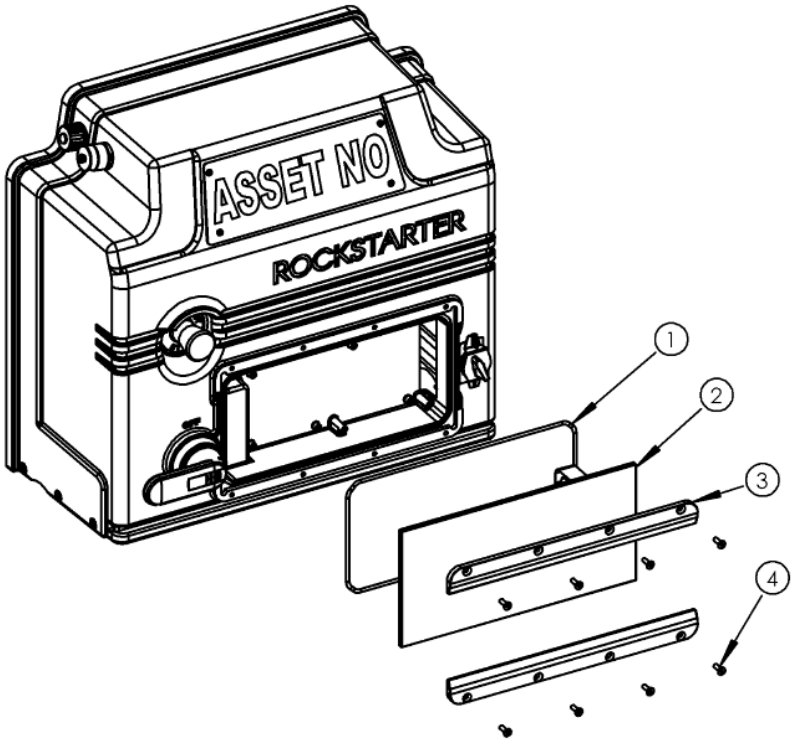


Figure 51: Rockstarter Capacitive Touch Panel Kit

TOUCH SCREEN GLASS PARTS		
Part Number	**Description**	**Item Number**
179300	O-RING SCREEN ROCKSTARTER	1
179158	PANEL CAPACITIVE TOUCH ROCKSTARTER	2
179299	FRAME SCREEN ROCKSTARTER	3
130680	SCREEN FRAME Screws SS CSK HD SKT M5x16mm	4

12 SPECIFICATIONS

NOTE

The Rockstarter's default settings are indicated below with bold font.

Specifications		
General		
System Voltage	415 V / 690 V / **1000 V**	
Fault Rating	20 kA, 0.5 s	
Incoming Max Current	250 A AC-1, 141A AC-3	
Outlet Max Current	250 A AC-1, 141A AC-3	
Through Supply Max Current	250 A AC-1, 141A AC-3	
User Interface	7-inch capacitive touchscreen	
Rockstarter Asset Name	<16 chars [**RKS-001**]	
Time	Minute [**00**], Hours [**00**]	
Date	Day [**01**], Month [**01**], Year [**2000**]	
Certification		
AS/NZS 3000, AS/NZS 2081 and AS/NZS 4871		
Mechanical & Environmental		
Dimensions (H x W x D)	With Frame: 1161 x 707 x 383 (mm) Without Frame: 840 x 575 x 230 (mm)	
Incoming & Outgoing Cable Max	A Lugged maximum of 120 mm^S will fit termination points	
Weight – Rockstarter	78 kg (excludes receptacle)	
Weight – Mounting Frame	35 kg	
Operating Temperature Range	0 °C to + 40 °C	
IP Rating	IP65	
Humidity	Between 10 % relative humidity and the dew point, non-condensing	
UV Stability	None	
Segregation	Form 4 (b,i,h)	
Incoming & Outgoing Entry Points	Glanded or Receptacle access through as AS/NZS1299 – 300 A receptacle footprint opening	
Mode of Operation		
Outlet Control Mode	**Normal**, Fan, Pump	
System Voltage	415 V / 690 V / **1000 V**	
Starting Options		
Remote Start at Machine	ON / **OFF**	
Restart After Power Cycle (Min)	**OFF**, 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0	
Pilot Termination	**Diode**, LCM	
LCM		
LCM Asset Name	<16 chars [**LCM-001**]	
RTD 1-2 Trip Level	**0**-200 [**0**]	
RTD 3-5 Trip Level	**0**-200 [**0**]	
RTD 1-2 Reset Level	**0**-200 [**0**]	
RTD 3-5 Reset level	**0**-200 [**0**]	
Network Parameters		
IP Address	nnn.nnn.nnn.nnn format (Where nnn is from 1 to 3 characters and ranges from 0 to 255)	**10.1.1.10**
Subnet Mask		**255.255.255.0**
Gateway		**1.1.1.1**

Pump / Fan Protection Functions	
Pump Protection	
Sleep Timing Mode	**Incremental** or Fixed
Snore Current (% FLC)	30, 35, 40 , 45, **50**, 55, 60, 65, 70, 75, 80, 85, 90, 95
Sleep Time (Min)	0.5, 1, 2, 3, 4, **5**, 10, 15, 20, 30, 60
Fan Protection	
Burp Timing Mode	Incremental or **Fixed**
Delayed Fan Start (Min)	**OFF**, 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 45, 60 ,75, 90, 105, 120, 0 Slave, 1 Slave, 2 Slave, 3 Slave, 4 Slave, 5 Slave, 10 Slave, 15 Slave, 20 Slave, 25 Slave, 30 Slave, 45 Slave, 60 Slave,75 Slave, 90 Slave, 105 Slave, 120 Slave
Burp Cycles	0, 1, 2, 3, **4**
Burp Cycle ON Time (Sec)	1, **2**, 3, 4, 5, 10, 15, 20
Burp Cycle OFF Time (Sec)	1, **2**, 3, 4, 5, 10, 15, 20
Post-blast Start Timer (Min)	**Currently NA**, **(OFF**, 0, 0.5, 1, 2, 3, 4, 5, 10, 15, 20, 30, 60)
*Blast Pressure Level (*kPa)	**Currently NA**, (2, 4, 6, 8, **10**)

Touch Potential Protection Functions	
Earth Leakage	
Frequency Response	Weighted Wideband, 5 Hz – 10 kHz
Trip Times (mSec)	Instant, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, **500**
Trip Levels (mA)	30, 50, 100, 150, 200, 250, 300, 350, 400, 450, **500**
Earth Continuity	
Trip Times (mSec)	100, 150, 200, 300, 400, **500**, OFF
*Trip Levels – Series (*Ω)	10, 15, 20, 25, 30, 35, 40, **45**
*Trip Levels – Shunt (*Ω)	**1500**
Latching Trip	**ON** / OFF
Frozen Contactor/Loss of Vacuum	
Back EMF Timer (Sec)	2, 5, 10, 15, **20**
*Loss of Vacuum Level (*VAC)	OFF, **25**, 50, 100, 150

Load Related Protection Functions	
Overload Protection	
OL Model	**Very Inverse**, Extreme Inverse, Motor Overload
*Time Multiplier (*x FLC)	0.05, 0.055, 0.06, 0.065, 0.07, 0.075, 0.08, 0.085, 0.09, 0.1, 0.11, 0.12, 0.13, 0.14, 0.15, 0.16, 0.17, 0.18, 0.19, 0.2, 0.22, 0.24, 0.26, 0.28, 0.3, 0.32, 0.35, 0.38, 0.42, 0.46, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, **1**, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 ,1.8, 1.9, 2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.5, 3.8, 4.2, 4.6, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 26, 28, 30
FLC (A)	2-250A [**10**]
Cooling Multiplier	1.0x, 1.5x, 2.0x, 2.5x, 3.0x, 4.0x, **5.0x**
Thermal Accumulator Start Block (%)	20, 30, 40, 50, 60, 70, 80, **90**
Fan Sequence Thermal Start Block (%)	0,5,10,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85,**90**
Short Circuit Protection	
Current Multiplier (trip level) (xFLC)	1.5, 1.75, 2, 2.25, 2.5, 2.75, 3x, 3.25, 3.5, 3.75, 4, 4.25, 4.5, 4.75, 5, 5.25, 5.5, 5.75, 6, 6.25, **6.5**, 6.75, 7, 7.25, 7.5, 7.75, 8, 8.25, 8.5, 8.75, 9, 9.25, 9.5, 9.75, 10, 10.25, 10.5, 10.75, 11, 11.25, 11.5, 11.75, 12, 12.25, 12.5
Time (mSec)	**40** ,60, 80, 100, 120, 140, 160, 180, 200

Under Voltage Protection	
Trip Level (%)	OFF, **40**, 50, 60, 70, 75, 80, 85, 90, 95
Current Imbalance Protection	
Trip Level (% FLC)	**OFF**, 5, 10, 20, 50
Under Current Protection	
Trip Level (% FLC)	**OFF**, 30, 35, 40 , 45, 50, 55, 60 , 65, 70, 75, 80, 85, 90, 95

Find Out More
For more information on this product, contact Ampcontrol Customer Service on +61 1300 267 373 or *customerservice@ampcontrolgroup.com* or visit the Ampcontrol website: www.ampcontrolgroup.com

13 EQUIPMENT LIST

13.1 Rockstarter & Accessories

Rockstarter	
Part Number	**Description**
177193	Rockstarter 1000V 250A Motor Starter
192614	Rockstarter 1000V 250A Motor Starter Complete With Frame
192615	Rockstarter 1000v 250A Complete With frame & 60A receptacle
192616	Rockstarter 1000v 250A Complete With frame & 150A receptacle
192617	Rockstarter 1000v 250A Complete With frame & 300A receptacle

Accessories – Mechanical	
Mounting	
Part Number	**Description**
177190	KIT FRAME MOUNTING COMPLETE WITH FASTENERS ROCKSTARTER
177191	KIT BAR MOUNTING 2UNIT COMPLETE WITH 2x CLAMPS ROCKSTARTER
180858	ASSEMBLY BRACKET LIFTING ROCKSTARTER
Line/Load Connections	
Part Number	**Description**
177187	KIT RECEPTACLE ROCKSTARTER – QUOTED PER ORDER
179292	PLATE ADAPTOR RECEPTACLE 60A ROCKSTARTER
181811	PLATE ADAPTOR RECEPTACLE 150A ROCKSTARTER
181903	KIT JUNCTION BOX DUAL GLAND ROCKSTARTER
Through Feed	
Part Number	**Description**
181441	KIT FEED THROUGH COMPLETE WITH GUARD ROCKSTARTER
Junction Box Side Entry	
Part Number	**Description**
193292	KIT JUNCTION BOX ROCKSTARTER COMPLETE WITH 95mm2 LUGS
193291	KIT JUNCTION BOX ROCKSTARTER COMPLETE WITH 120mm2 LUGS
General	
Part Number	**Description**
181484	LABEL ASSET NUMBER ROCKSTARTER

Accessories – Electrical	
General	
Part Number	**Description**
177194	KEY RADIO FREQUENCY IDENTIFICATION CARD ROCKSTARTER (RFID Card requires programming sheet on order)
181876	CABLE FAN SEQUENCING ROCKSTARTER
195515	CABLE ROCKSTARTER SEQUENCING TEE
115119	PTB PILOT TERMINATION
181881	KIT TERMINATION DUAL INCOMER ROCKSTARTER
192139	FIBRE COMMUNICATIONS JUNCTION BOX C/W IO TERMINALS
Load Connection Module	
Part Number	**Description**
180485	LOAD CONTROL MODULE ROCKSTARTER COMPLETE WITH DONGLE
172093	DONGLE PARAMETER LCM
Auxiliary I/O Connector	
Part Number	**Description**
179179	JUNCTION BOX INPUT/OUTPUT ROCKSTARTER
196069	JUNCTION BOX PUMP FLOAT RKS
192101	ETHERNET CABLE CAT6A C/W IP67 PLUGS 5M ROCKSTARTER
179180	CABLE INPUT/OUTPUT 1m ROCKSTARTER
179181	CABLE INPUT/OUTPUT 2m ROCKSTARTER
179182	CABLE INPUT/OUTPUT 5m ROCKSTARTER
Outlet Testing System	
Part Number	**Description**
176852	TABLET 8” LTE COMPLETE WITH CASE
177451	TABLET NON-LTE COMPLETE WITH CASE
197693	TABLET NON-LTE NFC 8IN OTS WITH CASE

13.2 Rockstarter Spares

Spare Parts – Mechanical	
Line/Load Gland Plate	
Part Number	**Description**
179169	KIT GLAND PLATE LINE/LOAD ROCKSTARTER
179126	PLATE GLAND MAIN ROCKSTARTER
181843	KIT O-RING GLAND PLATE MAIN ENTRY ROCKSTARTER
180576	BACKING PLATE MAIN ENTRY ROCKSTARTER
181868	KIT SCREW WASHER MAIN ENTRY ROCKSTARTER
Through Feed / Through Feed Gland Plate	
Part Number	**Description**
181062	GUARD THROUGH FEED ROCKSTARTER
179168	KIT CABLE FEED THROUGH ROCKSTARTER Includes all 4 through feed cables, pilot cable, and glands
179565	PLATE GLAND THROUGH 4 HOLES ROCKSTARTER
179093	O-RING GLAND PLATE THROUGH FEED ROCKSTARTER
180269	BACKING PLATE THROUGH ROCKSTARTER
181869	KIT SCREW WASHER GLAND FEED THROUGH ROCKSTARTER
181461	PLUG NYLON BLANKING 12mm
190882	KIT SCREW WASHER ELECTRICAL FEED THROUGH ROCKSTARTER
Terminal Cover	
Part Number	**Description**
179171	KIT COVER TERMINAL CHAMBER ROCKSTARTER

Spare Parts – Mechanical	
179094	COVER TERMINAL CHAMBER ROCKSTARTER
180513	SEAL TERMINATION COVER ROCKSTARTER
181870	KIT LABEL MAIN ROCKSTARTER TERMINAL COVER (Requires Rockstarter serial number to be provided)
181871	KIT SCREW WASHER TERMINAL CHAMBER ROCKSTARTER
Dual Gland Junction Box	
Part Number	**Description**
181905	JUNCTION BOX DUAL GLAND ROCKSTARTER
181906	PLATE GLAND JUNCTION BOX DUAL GLAND ROCKSTARTER
181907	O-RING JUNCTION BOX DUAL GLAND ROCKSTARTER
190884	KIT SCREW WASHER GLAND PLATE EXTENSION ROCKSTARTER
Junction Box Side Entry	
Part Number	**Description**
139638	LUG 95mm2 8mm STUD CB
101413	LUG 25mm2 8mm STUD
139635	LUG 120mm2 8mm CB
101015	LUG 35mm2 8mm STUD
179093	O-RING GLAND PLATE THROUGH FEED ROCKSTARTER
192663	O-RING JUNCTION BOX SIDE ENTRY ROCKSTARTER
192648	COVERPLATE JUNCTION BOX SIDE ENTRY ROCKSTARTER
115868	WASHER M5 FLAT NYLON
130677	SCREW M5x12mm SS304 BTN HD SKT
102216	WASHER FL NYL M8
108019	SCREW M8x25mm CAP HD SKT
Secondary Internal Covers	
Part Number	**Description**
179173	KIT COVER FEED THROUGH INTERNAL ROCKSTARTER
181872	KIT COVER INTERNAL INCOMER ROCKSTARTER
179091	COVER PLASTIC LINE CADDY ROCKSTARTER
190501	COVER PLASTIC LINE CADDY DUAL FEED ROCKSTARTER
General	
Part Number	**Description**
190491	CLAMP 48mm PIPE SWIVEL COUPLING

Spare Parts – Electrical	
User Interface	
Part Number	**Description**
179300	O-RING SCREEN ROCKSTARTER
179158	PANEL CAPACITIVE TOUCH ROCKSTARTER
179299	FRAME SCREEN ROCKSTARTER
130680	SCREEN FRAME Screws SS CSK HD SKT M5x16mm
Incomer / Outgoing Termination	
Part Number	**Description**
101086	NUT HEX SS304 M8
180132	WASHER BELLEVILLE HD GALV M8
Through Feed	
Part Number	**Description**
179168	KIT CABLE FEED THROUGH ROCKSTARTER
190882	KIT SCREW WASHER ELECTRICAL FEED THROUGH ROCKSTARTER
Dual Incomer Termination	
Part Number	**Description**
181904	BUSBAR FLEXIBLE ROCKSTARTER
190441	INSULATION TERMINATION DUAL INCOMER ROCKSTARTER
General	
Part Number	**Description**
179449	CAP DUST RJ45 BULKHEAD
181438	CAP DUST BULGIN 6012 SERIES
181878	KIT FUSE 10x 4A 1.2kV SB HRC-15kA
190558	KIT FUSE 10x 3.15A 250V SB HRC

APPENDIX A: PROTECTION ELEMENT LOAD CURRENT TABLES

A1: Protection Module Full Load Current Table

Protection Module Full Load Current Selection Table – Amps (1000:1 CT), and Max effective SC Level

Value	Amps	Value	Amps	Value	Amps	Value	Amps	Value	Amps	Value	Amps	SC max	Value	Amps	SC max
0	2.00	32	4.00	64	8.0	96	16.0	128	32.0	160	64.0	25.0x	192	128	18.4x
1	2.05	33	4.10	65	8.2	97	16.4	129	32.8	161	65.6	25.0x	193	131	17.9x
2	2.10	34	4.20	66	8.4	98	16.8	130	33.6	162	67.1	25.0x	194	134	17.5x
3	2.15	35	4.29	67	8.6	99	17.2	131	34.3	163	68.7	25.0x	195	137	17.2x
4	2.20	36	4.39	68	8.8	100	17.6	132	35.1	164	70.2	25.0x	196	140	16.8x
5	2.24	37	4.49	69	9.0	101	18.0	133	35.9	165	71.8	25.0x	197	144	16.3x
6	2.29	38	4.59	70	9.2	102	18.3	134	36.7	166	73.4	25.0x	198	147	16.0x
7	2.34	39	4.68	71	9.4	103	18.7	135	37.5	167	74.9	25.0x	199	150	15.7x
8	2.39	40	4.78	72	9.6	104	19.1	136	38.2	168	76.5	25.0x	200	153	15.4x
9	2.44	41	4.88	73	9.8	105	19.5	137	39.0	169	78.0	25.0x	201	156	15.1x
10	2.49	42	4.98	74	10.0	106	19.9	138	39.8	170	79.6	25.0x	202	159	14.8x
11	2.54	43	5.07	75	10.1	107	20.3	139	40.6	171	81.2	25.0x	203	162	14.5x
12	2.59	44	5.17	76	10.3	108	20.7	140	41.4	172	82.7	25.0x	204	165	14.2x
13	2.63	45	5.27	77	10.5	109	21.1	141	42.1	173	84.3	25.0x	205	169	13.9x
14	2.68	46	5.37	78	10.7	110	21.5	142	42.9	174	85.9	25.0x	206	172	13.7x
15	2.73	47	5.46	79	10.9	111	21.9	143	43.7	175	87.4	25.0x	207	175	13.4x
16	2.78	48	5.56	80	11.1	112	22.2	144	44.5	176	89.0	25.0x	208	178	13.2x
17	2.83	49	5.66	81	11.3	113	22.6	145	45.3	177	90.5	25.0x	209	181	13.0x
18	2.88	50	5.76	82	11.5	114	23.0	146	46.0	178	92.1	25.0x	210	184	12.8x
19	2.93	51	5.85	83	11.7	115	23.4	147	46.8	179	93.7	25.0x	211	187	12.6x
20	2.98	52	5.95	84	11.9	116	23.8	148	47.6	180	95.2	24.7x	212	190	12.4x
21	3.02	53	6.05	85	12.1	117	24.2	149	48.4	181	96.8	24.3x	213	194	12.1x
22	3.07	54	6.15	86	12.3	118	24.6	150	49.2	182	98.3	23.9x	214	197	11.9x
23	3.12	55	6.24	87	12.5	119	25.0	151	50.0	183	100	23.5x	215	200	11.8x
24	3.22	56	6.44	88	12.9	120	25.8	152	51.5	184	103	22.8x	216	206	11.4x
25	3.32	57	6.63	89	13.3	121	26.5	153	53.1	185	106	22.2x	217	212	11.1x
26	3.41	58	6.83	90	13.7	122	27.3	154	54.6	186	109	21.6x	218	219	10.7x
27	3.51	59	7.02	91	14.0	123	28.1	155	56.2	187	112	21.0x	219	225	10.4x
28	3.61	60	7.22	92	14.4	124	28.9	156	57.8	188	116	20.3x	220	231	10.2x
29	3.71	61	7.41	93	14.8	125	29.7	157	59.3	189	119	19.7x	221	237	9.9x
30	3.80	62	7.61	94	15.2	126	30.4	158	60.9	190	122	19.3x	222	244	9.6x
31	3.90	63	7.80	95	15.6	127	31.2	159	62.4	191	125	18.8x	223	250	9.4x

A2: Protection Module TMS Table

**Protection Module Overcurrent Time Multiplier Settings (TMS)
including nominal trip time in seconds at 10 PU Current**

Value	TMS	10 x trip time	
		Ext Inv. & MOL	Very Inv.
0	0.050	0.040	0.075
1	0.055	0.044	0.083
2	0.060	0.048	0.090
3	0.065	0.053	0.098
4	0.070	0.057	0.105
5	0.075	0.061	0.113
6	0.080	0.065	0.120
7	0.085	0.069	0.128
8	0.090	0.073	0.135
9	0.10	0.081	0.150
10	0.11	0.089	0.165
11	0.12	0.097	0.180
12	0.13	0.105	0.195
13	0.14	0.113	0.210
14	0.15	0.121	0.225
15	0.16	0.129	0.240
16	0.17	0.137	0.255
17	0.18	0.145	0.270
18	0.19	0.154	0.285
19	0.20	0.162	0.300
20	0.22	0.178	0.330
21	0.24	0.194	0.360
22	0.26	0.210	0.390
23	0.28	0.226	0.420
24	0.30	0.242	0.450
25	0.32	0.259	0.480
26	0.35	0.283	0.525
27	0.38	0.307	0.570
28	0.42	0.339	0.630
29	0.46	0.372	0.690

Value	TMS	10 x trip time	
		Ext Inv. & MOL	Very Inv.
30	0.50	0.404	0.750
31	0.55	0.444	0.825
32	0.60	0.485	0.900
33	0.65	0.525	0.975
34	0.70	0.566	1.050
35	0.75	0.606	1.125
36	0.80	0.646	1.200
37	0.85	0.687	1.275
38	0.90	0.727	1.350
39	1.0	0.808	1.50
40	1.1	0.889	1.65
41	1.2	0.970	1.80
42	1.3	1.05	1.95
43	1.4	1.13	2.10
44	1.5	1.21	2.25
45	1.6	1.29	2.40
46	1.7	1.37	2.55
47	1.8	1.45	2.70
48	1.9	1.54	2.85
49	2.0	1.62	3.00
50	2.2	1.78	3.30
51	2.4	1.94	3.60
52	2.6	2.10	3.90
53	2.8	2.26	4.20
54	3.0	2.42	4.50
55	3.2	2.59	4.80
56	3.5	2.83	5.25
57	3.8	3.07	5.70
58	4.2	3.39	6.30
59	4.6	3.72	6.90

Value	TMS	10 x trip time	
		Ext Inv. & MOL	Very Inv.
60	5.0	4.04	7.50
61	5.5	4.44	8.25
62	6.0	4.85	9.00
63	6.5	5.25	9.75
64	7.0	5.66	10.50
65	7.5	6.06	11.25
66	8.0	6.46	12.00
67	8.5	6.87	12.75
68	9.0	7.27	13.50
69	10.0	8.08	15.0
70	11.0	8.89	16.5
71	12.0	9.70	18.0
72	13.0	10.51	19.5
73	14.0	11.31	21.0
74	15.0	12.12	22.5
75	16.0	12.93	24.0
76	17.0	13.74	25.5
77	18.0	14.55	27.0
78	19.0	15.35	28.5
79	20.0	16.16	30.0
80	22.0	17.78	33.0
81	24.0	19.39	36.0
82	26.0	21.01	39.0
83	28.0	22.63	42.0
84	30.0	24.24	45.0

APPENDIX B: ROCKSTARTER MODBUS TCP

The following MODBUS TCP commands are supported.

Modbus CMD	Comment	Application
04	Read Input Registers	Read
06	Write Single Register	Write

B1 Outlet Control Registers

Modbus Register	Name	Read/Write	Bit Identification
0	Start	Read/Write	Set to 0x00AA by user to initiate start. Cleared by Rockstarter
1	Stop	Read/Write	Set to non-zero by user to open outlet. Cleared by Rockstarter
2	Reset	Read/Write	Set to 0xAA00 by Rockstarter when reset is available. Set to 0xFF00 by Rockstarter if authorisation is required for reset. Set to 0x00AA by user to mimic the UI reset button. Cleared by Rockstarter
3	Authorise	Read/Write	Set to 0x00AA by user to send an authorise command. Use in conjunction with reset command to clear authorised trips, or in conjunction with VNC for full UI capability. Cleared by Rockstarter

B2 Outlet Live Data

Modbus Register	Name	Read/Write	Bit Identification
4	Heartbeat	Read Only	Internal 16-bit counter which is incremented every 20 ms. The counter cycles back around to 0 on overflow.
5	Volts A	Read Only	Phase to earth line voltage. The value is a percentage of the nominal system voltage. Range 0 % to 150 %.
6	Volts B	Read Only	
7	Volts C	Read Only	
8	Volts Average	Read Only	The average 3-phase, phase-to-phase voltage. This value is returned in Volts. Range 0 to 4946V.
9	Current A	Read Only	Line current represented as a percentage of the Full Load Current setting. The range is 0-1250 %.
10	Current B	Read Only	
11	Current C	Read Only	
12	Average Current	Read Only	The average current value as a percentage of the full load current setting. Ranges from 0 to 1000 %.
13	Current Imbalance	Read Only	The maximum deviation of a phase current from the average multiplied by 100 then divided by the average current. Range is 0 to 100 %.
14	Earth Leakage Current	Read Only	The unbalanced 3-phase current. This value is given as a percentage of the trip level. Range is 0 to 100 %.
15	Pilot Series Resistance	Read Only	Earth continuity series measurement. This value is returned in Ohms. When in diode remote start mode, the 100 Ω start resistance will be subtracted as required. Range of values is 0 Ω to 200 Ω

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>16</td><td>Pilot Shunt Resistance</td><td>Read Only</td><td>Earth continuity shunt measurement. This value is returned in Ohms x 100. Range of values is 0.9 kΩ to 10 kΩ. (9 to 100). Trip if below 1.5 kΩ (i.e. value <15).</td></tr>
<tr><td>17</td><td>Overcurrent / Motor Overload value</td><td>Read Only</td><td>Shows the state of the thermal accumulator: 0 % = Cold, 100 % = Trip. Range is 0 to 120 %.</td></tr>
<tr><td>18 - 19</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>20</td><td>Trip Mask 1</td><td>Read Only</td><td>The 16-bit mask of possible trips.
<table>
<tr><th>Bitmask</th><th>Trip Name</th></tr>
<tr><td>0x0001</td><td>Unused</td></tr>
<tr><td>0x0002</td><td>Thermal Start Blocked</td></tr>
<tr><td>0x0004</td><td>RKS Parameter Error</td></tr>
<tr><td>0x0008</td><td>Unused</td></tr>
<tr><td>0x0010</td><td>Unused</td></tr>
<tr><td>0x0020</td><td>Remote Start Error</td></tr>
<tr><td>0x0040</td><td>Shunt Earth Continuity</td></tr>
<tr><td>0x0080</td><td>Earth Leakage CT Detect</td></tr>
<tr><td>0x0100</td><td>Earth Leakage</td></tr>
<tr><td>0x0200</td><td>Series Earth Continuity</td></tr>
<tr><td>0x0400</td><td>Earth Fault Lockout</td></tr>
<tr><td>0x0800</td><td>Motor Overload</td></tr>
<tr><td>0x1000</td><td>Short Circuit-INST</td></tr>
<tr><td>0x2000</td><td>Current Imbalance</td></tr>
<tr><td>0x4000</td><td>Short Circuit – LT</td></tr>
<tr><td>0x8000</td><td>MCF Hardware Latch</td></tr>
</table></td></tr>
<tr><td>21</td><td>Trip Mask 2</td><td>Read Only</td><td>The 16-bit mask of possible trips.
<table>
<tr><th>Bitmask</th><th>Trip Name</th></tr>
<tr><td>0x0001</td><td>Under Voltage</td></tr>
<tr><td>0x0002</td><td>Internal Logic Error</td></tr>
<tr><td>0x0004</td><td>External MC Open</td></tr>
<tr><td>0x0008</td><td>Undercurrent Trip</td></tr>
<tr><td>0x0010</td><td>Remote Start Stuck</td></tr>
<tr><td>0x0020</td><td>Close Fail</td></tr>
<tr><td>0x0040</td><td>Loss of Vacuum</td></tr>
<tr><td>0x0080</td><td>Frozen Contactor</td></tr>
<tr><td>0x0100</td><td>No Coil Supply</td></tr>
<tr><td>0x0200</td><td>HMI Comm’s Timeout</td></tr>
<tr><td>0x0400</td><td>Unused</td></tr>
<tr><td>0x0800</td><td>Unused</td></tr>
<tr><td>0x1000</td><td>CCM ID Trip</td></tr>
<tr><td>0x2000</td><td>MCF Battery Trip</td></tr>
<tr><td>0x4000</td><td>Unused</td></tr>
<tr><td>0x8000</td><td>Unused</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>22</td><td>Trip Mask 3</td><td>Read Only</td><td>The 16-bit mask of possible trips.
<table>
<tr><th>Bitmask</th><th>Trip Name</th></tr>
<tr><td>0x0001</td><td>Unused</td></tr>
<tr><td>0x0002</td><td>Unused</td></tr>
<tr><td>0x0004</td><td>Unused</td></tr>
<tr><td>0x0008</td><td>Unused</td></tr>
<tr><td>0x0010</td><td>Unused</td></tr>
<tr><td>0x0020</td><td>Unused</td></tr>
<tr><td>0x0040</td><td>Unused</td></tr>
<tr><td>0x0080</td><td>Unused</td></tr>
<tr><td>0x0100</td><td>LCM Initialising</td></tr>
<tr><td>0x0200</td><td>LCM Offline</td></tr>
<tr><td>0x0400</td><td>LCM Parameter Error</td></tr>
<tr><td>0x0800</td><td>LCM RTD Group 1 Trip</td></tr>
<tr><td>0x1000</td><td>LCM RTD Group 2 Trip</td></tr>
<tr><td>0x2000</td><td>LCM Stop</td></tr>
<tr><td>0x4000</td><td>LCM PTC Trip</td></tr>
<tr><td>0x8000</td><td>LCM Comms Timeout</td></tr>
</table></td></tr>
<tr><td>23-25</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>26</td><td>RTC-Year</td><td>Read Only</td><td>The year value of the Real Time Clock, minus 2000, e.g. 2012 will be returned as 12.</td></tr>
<tr><td>27</td><td>RTC – Month of Year</td><td>Read Only</td><td>The month of the year value of the Real Time Clock.</td></tr>
<tr><td>28</td><td>RTC – Day of Month</td><td>Read Only</td><td>The day of the month of the Real Time Clock.</td></tr>
<tr><td>29</td><td>RTC – Hour</td><td>Read Only</td><td>The hour of the Real Time Clock.</td></tr>
<tr><td>30</td><td>RTC – Minute</td><td>Read Only</td><td>The minute of the Real Time Clock.</td></tr>
<tr><td>31</td><td>RTC – Second</td><td>Read Only</td><td>The second of the Real Time Clock.</td></tr>
<tr><td>32</td><td>RKS Protection Software Version</td><td>Read Only</td><td>The software version of the main RKS Protection processor. The version number has a minor and major part. The major version is in the high byte, the minor version in the low byte.</td></tr>
<tr><td>33</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>34</td><td>EFLO Test Result A</td><td>Read Only</td><td rowspan="3">Scaled as a % of leakage to earth. Nominal trip point is 1 MΩ when all three phases are short circuited, which is recorded as 100 %. Records the value of the last EFLO test performed.</td></tr>
<tr><td>35</td><td>EFLO Test Result B</td><td>Read Only</td></tr>
<tr><td>36</td><td>EFLO Test Result C</td><td>Read Only</td></tr>
<tr><td>37</td><td>Internal Temperature</td><td>Read Only</td><td>Temperature measured inside the RKS. Value is given to the nearest degree. Range of values is -20 ˚C to +100 ˚C. Should be a signed integer.</td></tr>
<tr><td>38</td><td>Shadow Trip Mask 1</td><td>Read Only</td><td>The 16-bit mask of possible trips which occurred during the last run period. The mask bit definitions match Trip Mask 1.</td></tr>
<tr><td>39</td><td>Shadow Trip Mask 2</td><td>Read Only</td><td>The 16-bit mask of possible trips which occurred during the last run period. The mask bit definitions match Trip Mask 2.</td></tr>
<tr><td>40</td><td>Shadow Trip Mask 3</td><td>Read Only</td><td>The 16-bit mask of possible trips which occurred during the last run period. The mask bit definitions match Trip Mask 3.</td></tr>
<tr><td>41</td><td>LCM RTD Temp 1</td><td>Read Only</td><td rowspan="4">Temperature measured by each of the LCM’s RTD inputs. These values are only valid while the pilot mode is set to LCM and an LCM is online. Value is signed and in degrees, from -20 ˚C to +300 ˚C. 32767 – Open Circuit</td></tr>
<tr><td>42</td><td>LCM RTD Temp 2</td><td>Read Only</td></tr>
<tr><td>43</td><td>LCM RTD Temp 3</td><td>Read Only</td></tr>
<tr><td>44</td><td>LCM RTD Temp 4</td><td>Read Only</td></tr>
</table>

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>45</td><td>LCM RTD Temp 5</td><td>Read Only</td><td>32766 – Short Circuit
32765 – Other Fault
32764 – LCM Offline</td></tr>
<tr><td rowspan="18">46</td><td>LCM Inputs</td><td>Read Only</td><td>See Section B18</td></tr>
<tr><td>Bitmask</td><td>Trip Name</td><td>Details</td></tr>
<tr><td>0x0001</td><td>RTD1</td><td rowspan="5">RTD inputs can be used as digital inputs. In this mode they are resistance based with 120 Ω representing closed and 240 Ω open. Resistance values too far outside of these nominal values will result in the corresponding error bit being set.</td></tr>
<tr><td>0x0002</td><td>RTD2</td></tr>
<tr><td>0x0004</td><td>RTD3</td></tr>
<tr><td>0x0008</td><td>RTD4</td></tr>
<tr><td>0x0010</td><td>RTD5</td></tr>
<tr><td>0x0020</td><td>Stop</td><td>Normally closed (1). Opens to cause LCM Stop.</td></tr>
<tr><td>0x0040</td><td>Start</td><td>Normally open (0). Closes to request start.</td></tr>
<tr><td>0x0080</td><td>PTC</td><td>Normally closed (1). Opens to cause PTC Trip.</td></tr>
<tr><td>0x0100</td><td>RTD1 Error</td><td rowspan="9">For each input bit, there is a corresponding error bit. If at any time the LCM detects a problem with a given digital input, it will set the error bit.</td></tr>
<tr><td>0x0200</td><td>RTD2 Error</td></tr>
<tr><td>0x0400</td><td>RTD3 Error</td></tr>
<tr><td>0x0800</td><td>RTD4 Error</td></tr>
<tr><td>0x1000</td><td>RTD5 Error</td></tr>
<tr><td>0x2000</td><td>Stop Error</td></tr>
<tr><td>0x4000</td><td>Start Error</td></tr>
<tr><td>0x8000</td><td>PTC Error</td></tr>
<tr><td>47</td><td>LCM Status</td><td>Read Only</td><td>The 16-bit mask of possible LCM status values.<table><tr><th>Bitmask</th><th>Trip Name</th></tr><tr><td>0x0001</td><td>Parameter Errors</td></tr><tr><td>0x0002</td><td>Non LCM Dongle</td></tr><tr><td>Others</td><td>Unused</td></tr></table></td></tr>
<tr><td>48</td><td>LCM Serial Number Low</td><td>Read Only</td><td rowspan="2">LCM serial number. These two 16-bit integers form the upper and lower words of the 32-bit serial number.</td></tr>
<tr><td>49</td><td>LCM Serial Number High</td><td>Read Only</td></tr>
<tr><td>50</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>51</td><td>LCM SW Version</td><td>Read Only</td><td>The software version of the attached LCM. The version number has a minor and major part. The major version is in the high byte, the minor version is in the low byte.</td></tr>
<tr><td>52</td><td>LCM Internal Temp</td><td>Read Only</td><td>Temperature measured within the LCM. Value is given to the nearest degree. Range of values is -20 ˚C to +100 ˚C.</td></tr>
<tr><td>53-103</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B3 UI Live Data – Fan Mode

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>104</td><td>Fan sequence state</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Fan Initalising</td></tr>
<tr><td>1</td><td>Fan Start Blocked</td></tr>
<tr><td>2</td><td>Fan Waiting To Start</td></tr>
<tr><td>3</td><td>Fan Post Blast Delay</td></tr>
<tr><td>4</td><td>Fan Autostart Delay</td></tr>
<tr><td>5</td><td>Fan Delayed Start</td></tr>
<tr><td>6</td><td>Fan Outlet Starting</td></tr>
<tr><td>7</td><td>Fan Running</td></tr>
<tr><td>8</td><td>Fan Outlet Stopping</td></tr>
<tr><td>9</td><td>Fan Outlet Pausing</td></tr>
<tr><td>10</td><td>Fan Off Delay</td></tr>
<tr><td>11</td><td>Fan Error</td></tr>
</table>
</td></tr>
<tr><td>105</td><td>Fan On Timer</td><td>Read Only</td><td rowspan="3">Live timer, will be 0 unless the timer is active. The value when timer is active is the number of seconds the timer has been running for. To determine the remaining time you will need to subtract this value from your timer / delay setting.</td></tr>
<tr><td>106</td><td>Fan Off Timer</td><td>Read Only</td></tr>
<tr><td>107</td><td>Fan Post Blast Start Timer</td><td>Read Only</td></tr>
<tr><td>108</td><td>Current Burp Cycle</td><td>Read Only</td><td>Live Cycle counter</td></tr>
<tr><td>109</td><td>Blast Detected</td><td>Read Only</td><td>0 = No, 1 = Yes</td></tr>
<tr><td>110</td><td>Fan Delayed Start Timer</td><td>Read Only</td><td rowspan="2">Live timer, will be 0 unless the timer is active. The value when timer is active is the number of seconds the timer has been running for. To determine the remaining time you will need to subtract this value from your timer / delay setting.</td></tr>
<tr><td>111</td><td>Fan Auto Restart after Power Cycle Timer</td><td>Read Only</td></tr>
<tr><td>112</td><td>Fan Blast Detect Enabled</td><td>Read Only</td><td>0 = No, 1 = Yes</td></tr>
<tr><td>113</td><td>Fan Sequence Burping</td><td>Read Only</td><td>0 = No, 1 = Yes</td></tr>
<tr><td>114 - 118</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B4 UI Live Data – Pump Mode

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>119</td><td>Pump sequence state</td><td>Read Only</td><td><table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Pump Initalising</td></tr><tr><td>1</td><td>Pump Start Blocked</td></tr><tr><td>2</td><td>Pump Waiting To Start</td></tr><tr><td>3</td><td>Pump Autostart Delay</td></tr><tr><td>4</td><td>Pump Outlet Starting</td></tr><tr><td>5</td><td>Pump Running</td></tr><tr><td>6</td><td>Pump Outlet Stopping</td></tr><tr><td>7</td><td>Pump Off Delay</td></tr><tr><td>8</td><td>Pump Error</td></tr></table></td></tr>
<tr><td>120</td><td>Sleep Cycle Count</td><td>Read Only</td><td>Live Cycle counter</td></tr>
<tr><td>121</td><td>Pump Sleep Timer</td><td>Read Only</td><td rowspan="2">Live timer, will be 0 unless the timer is active. The value when timer is active is the number of seconds the timer has been running for. To determine the remaining time you will need to subtract this value from your timer / delay setting.</td></tr>
<tr><td>122</td><td>Pump Auto Restart after Power Cycle Timer</td><td>Read Only</td></tr>
<tr><td>123</td><td>Pump Sleep Disabled</td><td>Read Only</td><td>0 = No, 1 = Yes</td></tr>
<tr><td>124 - 128</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B5 UI Live Data – Outlet Mode

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>129</td><td>Outlet sequence state</td><td>Read Only</td><td><table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Initalising</td></tr><tr><td>1</td><td>Start Blocked</td></tr><tr><td>2</td><td>Waiting To Start</td></tr><tr><td>3</td><td>Autostart Delay</td></tr><tr><td>4</td><td>Start Outlet</td></tr><tr><td>5</td><td>Outlet Starting</td></tr><tr><td>6</td><td>Stop Outlet</td></tr><tr><td>7</td><td>Outlet Stopping</td></tr><tr><td>8</td><td>Sequence Monitoring,</td></tr><tr><td>9</td><td>Outlet Error</td></tr></table></td></tr>
<tr><td>130</td><td>Outlet Auto Restart after Power Cycle Timer;</td><td>Read Only</td><td>Live timer will be 0 unless the timer is active. The value when timer is active is the number of seconds the timer has been running for. To determine the remaining time you will need to subtract this value from your timer / delay setting.</td></tr>
<tr><td>131 - 133</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B6 UI Live Data – Common

Modbus Register	Name	Read/Write	Bit Identification
134	Sequence Running	Read Only	0=false (not running) 1 = true
135	Sequence Delayed	Read Only	0=false (not delayed) 1 = true
136	EC Series Test On	Read Only	0=false, 1 = true
137	EC Shunt Test On	Read Only	0=false, 1 = true
138	MC Closures	Read Only	Number of times MC has been closed
139	CB Openings	Read Only	Number of times CB has been opened
140	System Fault	Read Only	A UI fault has occurred (encompasses RFID faults, + others)
141	RFID Fault	Read Only	An RFID fault has occurred
142	<Reserved>	Read Only	
143	Current Active Access Level	Read Only	0 = General Operator, 1 = Authorised Operator, 2 = System Operator, 3 = Ampcontrol Operator
144	OTS Bluetooth status	Read Only	0 = off, 1 = Unconnected, 2 = connected
145	OTS Test Progress	Read Only	0 = standby, 1 = Test in Progress, 2 = finished
146	OTS Enable	Read Only	0 = testing is disabled, 1 = testing enabled
147	OTS Comms link status	Read Only	0 = off, 1 = OK
148	OTS Serial Number High	Read Only	High word of S/N
149	OTS Serial Number Low	Read Only	Low word of S/N
150	OTS Firmware Major	Read Only	First digit of version (e.g. 3 in version 3.0)
151	OTS Firmware Minor	Read Only	2nd digit of version (e.g. 0 in version 3.0)
152	EL Test I/O	Read Only	0 = off, 1 = set for digital I/O
153	Start I/O	Read Only	0 = off, 1 = set for digital I/O
154	Stop I/O	Read Only	0 = off, 1 = set for digital I/O
155	Reset I/O	Read Only	0 = off, 1 = set for digital I/O
156	Run I/O	Read Only	0 = off, 1 = set for digital I/O
157	Reset Lock I/O	Read Only	0 = off, 1 = set for digital I/O
158	Auxilliary Delayed Start I/O	Read Only	0 = off, 1 = set for digital I/O
159	CB Status	Read Only	0 = off, 1 = set for digital I/O
160	VS Status	Read Only	0 = off, 1 = set for digital I/O
161	Estop Status	Read Only	0 = off, 1 = set for digital I/O
162	OTS Start I/O	Read Only	0 = off, 1 = set for digital I/O
163	OTS Reset I/O	Read Only	0 = off, 1 = set for digital I/O
164	OTS Test Enable	Read Only	0 = testing is disabled, 1 = testing enabled
165	OTS Healthy	Read Only	0 = off, 1 = set for digital I/O
166	Latched CB Status	Read Only	If there is a change to CB status, the change is kept for 2 secs
167	Debounced Delayed Start	Read Only	1 if aux delayed start input has been 1 for 75 secs
168	Remaining Aux Delay Debounce Time	Read Only	Counts down from 75 secs
169	Start Pressed	Read Only	0 = Off, 1 = On
170	Stop Pressed	Read Only	0 = Off, 1 = On
171	Reset Pressed	Read Only	0 = Off, 1 = On
172-179	<Reserved>	Read Only	

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>180</td><td>Protection State</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Running</td></tr>
<tr><td>1</td><td>Paused</td></tr>
<tr><td>2</td><td>Tripped - Non Latching</td></tr>
<tr><td>3</td><td>Tripped – Requires reset</td></tr>
<tr><td>4</td><td>Tripped – Restricted Reset</td></tr>
<tr><td>5</td><td>Waiting</td></tr>
<tr><td>6</td><td>Remote Start</td></tr>
<tr><td>7</td><td>Pass through Start</td></tr>
<tr><td>8</td><td>Testing – System Check</td></tr>
<tr><td>9</td><td>Updating Parameters – Syncing</td></tr>
<tr><td>10</td><td>Fan Burp - Stopped</td></tr>
</table>
</td></tr>
<tr><td>181 - 207</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B7 Outlet Parameters

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>208</td><td>Pilot Mode</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Trip Name</th></tr>
<tr><td>0</td><td>Diode</td></tr>
<tr><td>1</td><td>LCM</td></tr>
</table>
</td></tr>
<tr><td>209</td><td>Loss of Vacuum Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Trip Name</th></tr>
<tr><td>0</td><td>25 VAC</td></tr>
<tr><td>1</td><td>50 VAC</td></tr>
<tr><td>2</td><td>100 VAC</td></tr>
<tr><td>3</td><td>150 VAC</td></tr>
</table>
</td></tr>
<tr><td>210</td><td>Voltage Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Trip Name</th></tr>
<tr><td>0</td><td>415</td></tr>
<tr><td>1</td><td>690</td></tr>
<tr><td>2</td><td>1000</td></tr>
</table>
</td></tr>
<tr><td>211 – 225</td><td><Reserved></td><td>Read Only</td><td></td></tr>
</table>

B8 RKS Load Parameters – Diode Mode

<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>226 - 227</td><td><Reserved></td><td>Read Only</td><td>0</td></tr>
<tr><td>228</td><td>Full Load Current Range</td><td>Read Only</td><td>0-223 (See table in Appendix A)</td></tr>
<tr><td>229</td><td>Short Circuit Trip Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Level</th><th>Value</th><th>Level</th><th>Value</th><th>Level</th></tr>
<tr><td>0</td><td>1.50x</td><td>15</td><td>5.25x</td><td>30</td><td>9.00x</td></tr>
<tr><td>1</td><td>1.75x</td><td>16</td><td>5.50x</td><td>31</td><td>9.25x</td></tr>
<tr><td>2</td><td>2.00x</td><td>17</td><td>5.75x</td><td>32</td><td>9.50x</td></tr>
<tr><td>3</td><td>2.25x</td><td>18</td><td>6.00x</td><td>33</td><td>9.75x</td></tr>
<tr><td>4</td><td>2.50x</td><td>19</td><td>6.25x</td><td>34</td><td>10.00x</td></tr>
<tr><td>5</td><td>2.75x</td><td>20</td><td>6.50x</td><td>35</td><td>10.25x</td></tr>
<tr><td>6</td><td>3.00x</td><td>21</td><td>6.75x</td><td>36</td><td>10.50x</td></tr>
<tr><td>7</td><td>3.25x</td><td>22</td><td>7.00x</td><td>37</td><td>10.75x</td></tr>
<tr><td>8</td><td>3.50x</td><td>23</td><td>7.25x</td><td>38</td><td>11.00x</td></tr>
<tr><td>9</td><td>3.75x</td><td>24</td><td>7.50x</td><td>39</td><td>11.25x</td></tr>
<tr><td>10</td><td>4.00x</td><td>25</td><td>7.75x</td><td>40</td><td>11.50x</td></tr>
<tr><td>11</td><td>4.25x</td><td>26</td><td>8.00x</td><td>41</td><td>11.75x</td></tr>
<tr><td>12</td><td>4.50x</td><td>27</td><td>8.25x</td><td>42</td><td>12.00x</td></tr>
<tr><td>13</td><td>4.75x</td><td>28</td><td>8.50x</td><td>43</td><td>12.25x</td></tr>
<tr><td>14</td><td>5.00x</td><td>29</td><td>8.75x</td><td>44</td><td>12.50x</td></tr>
</table>
</td></tr>
<tr><td>230</td><td>Short Circuit Trip Time</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Delay Period</th></tr>
<tr><td>0</td><td>40 ms</td></tr>
<tr><td>1</td><td>60 ms</td></tr>
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<tr><td>3</td><td>100 ms</td></tr>
<tr><td>4</td><td>120 ms</td></tr>
<tr><td>5</td><td>140 ms</td></tr>
<tr><td>6</td><td>160 ms</td></tr>
<tr><td>7</td><td>180 ms</td></tr>
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<tr><td>231</td><td>Overcurrent Curve</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Very Inverse</td></tr>
<tr><td>1</td><td>Extremely Inverse</td></tr>
<tr><td>2</td><td>Motor Overload</td></tr>
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<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>232</td><td>Overcurrent Time Multiplier</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>TMS</th><th>Value</th><th>TMS</th><th>Value</th><th>TMS</th></tr>
<tr><td>0</td><td>0.050</td><td>29</td><td>0.46</td><td>58</td><td>4.2</td></tr>
<tr><td>1</td><td>0.055</td><td>30</td><td>0.50</td><td>59</td><td>4.6</td></tr>
<tr><td>2</td><td>0.060</td><td>31</td><td>0.55</td><td>60</td><td>5.0</td></tr>
<tr><td>3</td><td>0.065</td><td>32</td><td>0.60</td><td>61</td><td>5.5</td></tr>
<tr><td>4</td><td>0.070</td><td>33</td><td>0.65</td><td>62</td><td>6.0</td></tr>
<tr><td>5</td><td>0.075</td><td>34</td><td>0.70</td><td>63</td><td>6.5</td></tr>
<tr><td>6</td><td>0.080</td><td>35</td><td>0.75</td><td>64</td><td>7.0</td></tr>
<tr><td>7</td><td>0.085</td><td>36</td><td>0.80</td><td>65</td><td>7.5</td></tr>
<tr><td>8</td><td>0.090</td><td>37</td><td>0.85</td><td>66</td><td>8.0</td></tr>
<tr><td>9</td><td>0.10</td><td>38</td><td>0.90</td><td>67</td><td>8.5</td></tr>
<tr><td>10</td><td>0.11</td><td>39</td><td>1.0</td><td>68</td><td>9.0</td></tr>
<tr><td>11</td><td>0.12</td><td>40</td><td>1.1</td><td>69</td><td>10.0</td></tr>
<tr><td>12</td><td>0.13</td><td>41</td><td>1.2</td><td>70</td><td>11.0</td></tr>
<tr><td>13</td><td>0.14</td><td>42</td><td>1.3</td><td>71</td><td>12.0</td></tr>
<tr><td>14</td><td>0.15</td><td>43</td><td>1.4</td><td>72</td><td>13.0</td></tr>
<tr><td>15</td><td>0.16</td><td>44</td><td>1.5</td><td>73</td><td>14.0</td></tr>
<tr><td>16</td><td>0.17</td><td>45</td><td>1.6</td><td>74</td><td>15.0</td></tr>
<tr><td>17</td><td>0.18</td><td>46</td><td>1.7</td><td>75</td><td>16.0</td></tr>
<tr><td>18</td><td>0.19</td><td>47</td><td>1.8</td><td>76</td><td>17.0</td></tr>
<tr><td>19</td><td>0.20</td><td>48</td><td>1.9</td><td>77</td><td>18.0</td></tr>
<tr><td>20</td><td>0.22</td><td>49</td><td>2.0</td><td>78</td><td>19.0</td></tr>
<tr><td>21</td><td>0.24</td><td>50</td><td>2.2</td><td>79</td><td>20.0</td></tr>
<tr><td>22</td><td>0.26</td><td>51</td><td>2.4</td><td>80</td><td>22.0</td></tr>
<tr><td>23</td><td>0.28</td><td>52</td><td>2.6</td><td>81</td><td>24.0</td></tr>
<tr><td>24</td><td>0.30</td><td>53</td><td>2.8</td><td>82</td><td>26.0</td></tr>
<tr><td>25</td><td>0.32</td><td>54</td><td>3.0</td><td>83</td><td>28.0</td></tr>
<tr><td>26</td><td>0.35</td><td>55</td><td>3.2</td><td>84</td><td>30.0</td></tr>
<tr><td>27</td><td>0.38</td><td>56</td><td>3.5</td><td>-</td><td>-</td></tr>
<tr><td>28</td><td>0.42</td><td>57</td><td>3.8</td><td>-</td><td>-</td></tr>
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<tr><td>233</td><td>Overload Cooling Multiplier</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Cooling Multiplier</th></tr>
<tr><td>0</td><td>1.0</td></tr>
<tr><td>1</td><td>1.5</td></tr>
<tr><td>2</td><td>2.0</td></tr>
<tr><td>3</td><td>2.5</td></tr>
<tr><td>4</td><td>3.0</td></tr>
<tr><td>5</td><td>4.0</td></tr>
<tr><td>6</td><td>5.0</td></tr>
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<tr><td>234</td><td><Reserved></td><td>Read Only</td><td></td></tr>
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<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>235</td><td>Overload Start Block Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Reset Level</th></tr>
<tr><td>0</td><td>20 %</td></tr>
<tr><td>1</td><td>30 %</td></tr>
<tr><td>2</td><td>40 %</td></tr>
<tr><td>3</td><td>50 %</td></tr>
<tr><td>4</td><td>60 %</td></tr>
<tr><td>5</td><td>70%</td></tr>
<tr><td>6</td><td>80 %</td></tr>
<tr><td>7</td><td>90 %</td></tr>
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<tr><td>236</td><td>Current Imbalance Trip Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Acceptable Imbalance</th></tr>
<tr><td>0</td><td>5 %</td></tr>
<tr><td>1</td><td>10 %</td></tr>
<tr><td>2</td><td>20 %</td></tr>
<tr><td>3</td><td>50 %</td></tr>
<tr><td>4</td><td>OFF</td></tr>
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<tr><td>237</td><td>Under Current Trip Level</td><td>Read Only</td><td>
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<tr><th>Value</th><th>Level</th></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>30 %</td></tr>
<tr><td>2</td><td>35 %</td></tr>
<tr><td>3</td><td>40 %</td></tr>
<tr><td>4</td><td>45 %</td></tr>
<tr><td>5</td><td>50 %</td></tr>
<tr><td>6</td><td>55 %</td></tr>
<tr><td>7</td><td>60 %</td></tr>
<tr><td>8</td><td>65%</td></tr>
<tr><td>9</td><td>70 %</td></tr>
<tr><td>10</td><td>75 %</td></tr>
<tr><td>11</td><td>80 %</td></tr>
<tr><td>12</td><td>85 %</td></tr>
<tr><td>13</td><td>90 %</td></tr>
<tr><td>14</td><td>95 %</td></tr>
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<tr><td>238</td><td>Earth Leakage Trip Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>30 mA</td></tr>
<tr><td>1</td><td>50 mA</td></tr>
<tr><td>2</td><td>100 mA</td></tr>
<tr><td>3</td><td>150 mA</td></tr>
<tr><td>4</td><td>200 mA</td></tr>
<tr><td>5</td><td>250 mA</td></tr>
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<tr><td>7</td><td>350 mA</td></tr>
<tr><td>8</td><td>400 mA</td></tr>
<tr><td>9</td><td>450 mA</td></tr>
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<tr><td>239</td><td>Earth Leakage Trip Time</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Max. Trip Time</th></tr>
<tr><td>0</td><td>Instant</td></tr>
<tr><td>1</td><td>50 ms</td></tr>
<tr><td>2</td><td>75 ms</td></tr>
<tr><td>3</td><td>100 ms</td></tr>
<tr><td>4</td><td>150 ms</td></tr>
<tr><td>5</td><td>200 ms</td></tr>
<tr><td>6</td><td>250 ms</td></tr>
<tr><td>7</td><td>300 ms</td></tr>
<tr><td>8</td><td>350 ms</td></tr>
<tr><td>9</td><td>400 ms</td></tr>
<tr><td>10</td><td>450 ms</td></tr>
<tr><td>11</td><td>500 ms</td></tr>
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<tr><td>240</td><td>Earth Continuity Trip Level</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Ohms</th></tr>
<tr><td>0</td><td>10</td></tr>
<tr><td>1</td><td>15</td></tr>
<tr><td>2</td><td>20</td></tr>
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<tr><td>241</td><td>Earth Continuity Trip Time</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>100 ms</td></tr>
<tr><td>1</td><td>150 ms</td></tr>
<tr><td>2</td><td>200 ms</td></tr>
<tr><td>3</td><td>300 ms</td></tr>
<tr><td>4</td><td>400 ms</td></tr>
<tr><td>5</td><td>500 ms</td></tr>
<tr><td>6</td><td>OFF</td></tr>
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<tr><td>242</td><td>Earth Continuity Latch</td><td>Read Only</td><td>
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<tr><td>0</td><td>ON</td></tr>
<tr><td>1</td><td>OFF</td></tr>
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<tr><td>243</td><td>Remote Start</td><td>Read Only</td><td>
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<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Enabled</td></tr>
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<tr><td>244</td><td><Reserved></td><td>Read Only</td><td></td></tr>
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<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>245</td><td>Under Voltage Trip Level</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>40 %</td></tr><tr><td>2</td><td>50 %</td></tr><tr><td>3</td><td>60 %</td></tr><tr><td>4</td><td>70 %</td></tr><tr><td>5</td><td>75 %</td></tr><tr><td>6</td><td>80 %</td></tr><tr><td>7</td><td>85 %</td></tr><tr><td>8</td><td>90 %</td></tr><tr><td>9</td><td>95 %</td></tr></table></td></tr>
<tr><td>246-249</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>250</td><td>Back EMF Time</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>2 sec</td></tr><tr><td>1</td><td>5 sec</td></tr><tr><td>2</td><td>10 sec</td></tr><tr><td>3</td><td>15 sec</td></tr><tr><td>4</td><td>20 sec</td></tr></table></td></tr>
<tr><td>251 – 256</td><td><Reserved></td><td>Read Only</td><td></td></tr>
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B9 RKS General Parameters – Diode Mode

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<tr><td>257</td><td>Operation mode</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Normal</td></tr><tr><td>1</td><td>Pump</td></tr><tr><td>2</td><td>Fan</td></tr></table></td></tr>
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<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>258</td><td>Restart After Power Cycle</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>0 min</td></tr>
<tr><td>2</td><td>0.5 min</td></tr>
<tr><td>3</td><td>1 min</td></tr>
<tr><td>4</td><td>1.5 min</td></tr>
<tr><td>5</td><td>2 min</td></tr>
<tr><td>6</td><td>2.5 min</td></tr>
<tr><td>7</td><td>3 min</td></tr>
<tr><td>8</td><td>3.5 min</td></tr>
<tr><td>9</td><td>4 min</td></tr>
<tr><td>10</td><td>4.5 min</td></tr>
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<tr><td>12</td><td>5.5 min</td></tr>
<tr><td>13</td><td>6 min</td></tr>
<tr><td>14</td><td>6.5 min</td></tr>
<tr><td>15</td><td>7 min</td></tr>
<tr><td>16</td><td>7.5 min</td></tr>
<tr><td>17</td><td>8 min</td></tr>
<tr><td>18</td><td>8.5 min</td></tr>
<tr><td>19</td><td>9 min</td></tr>
<tr><td>20</td><td>9.5 min</td></tr>
<tr><td>21</td><td>10 min</td></tr>
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<tr><td>259</td><td>Delayed Fan Start</td><td>Read Only</td><td>
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<tr><td>2</td><td>1 min</td></tr>
<tr><td>3</td><td>2 min</td></tr>
<tr><td>4</td><td>3 min</td></tr>
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<tr><td>15</td><td>90 min</td></tr>
<tr><td>16</td><td>105 min</td></tr>
<tr><td>17</td><td>120 min</td></tr>
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<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>260</td><td>Post-Blast Start</td><td>Read Only</td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>0 min</td></tr>
<tr><td>2</td><td>0.5 min</td></tr>
<tr><td>3</td><td>1 min</td></tr>
<tr><td>4</td><td>2 min</td></tr>
<tr><td>5</td><td>3 min</td></tr>
<tr><td>6</td><td>4 min</td></tr>
<tr><td>7</td><td>5 min</td></tr>
<tr><td>8</td><td>10 min</td></tr>
<tr><td>9</td><td>15 min</td></tr>
<tr><td>10</td><td>20 min</td></tr>
<tr><td>11</td><td>30 min</td></tr>
<tr><td>12</td><td>60 min</td></tr>
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<tr><td>261</td><td>Blast Pressure Level</td><td>Read Only</td><td>
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<tr><td>0</td><td>2 kPa</td></tr>
<tr><td>1</td><td>4 kPa</td></tr>
<tr><td>2</td><td>6 kPa</td></tr>
<tr><td>3</td><td>8 kPa</td></tr>
<tr><td>4</td><td>10 kPa</td></tr>
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<tr><td>262</td><td>Burp On Timing Mode</td><td>Read Only</td><td>
<table>
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<tr><td>0</td><td>Incremental</td></tr>
<tr><td>1</td><td>Fixed</td></tr>
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<tr><td>263</td><td>Burp Cycles</td><td>Read Only</td><td>
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<tr><td>2</td><td>2</td></tr>
<tr><td>3</td><td>3</td></tr>
<tr><td>4</td><td>4</td></tr>
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<tr><td>1</td><td>2 sec</td></tr>
<tr><td>2</td><td>3 sec</td></tr>
<tr><td>3</td><td>4 sec</td></tr>
<tr><td>4</td><td>5 sec</td></tr>
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<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
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<tr><td>266</td><td>Pump Timing Mode</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Incremental</td></tr><tr><td>1</td><td>Fixed</td></tr></table></td></tr>
<tr><td>267</td><td>Snore Current</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>30 % FLC</td></tr><tr><td>1</td><td>35 % FLC</td></tr><tr><td>2</td><td>40 % FLC</td></tr><tr><td>3</td><td>45 % FLC</td></tr><tr><td>4</td><td>50 % FLC</td></tr><tr><td>5</td><td>55 % FLC</td></tr><tr><td>6</td><td>60 % FLC</td></tr><tr><td>7</td><td>65 % FLC</td></tr><tr><td>8</td><td>70 % FLC</td></tr><tr><td>9</td><td>75 % FLC</td></tr><tr><td>10</td><td>80 % FLC</td></tr><tr><td>11</td><td>85 % FLC</td></tr><tr><td>12</td><td>90 % FLC</td></tr><tr><td>13</td><td>95 % FLC</td></tr></table></td></tr>
<tr><td>268</td><td>Sleep Time</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>0.5 min</td></tr><tr><td>1</td><td>1</td></tr><tr><td>2</td><td>2</td></tr><tr><td>3</td><td>3</td></tr><tr><td>4</td><td>4</td></tr><tr><td>5</td><td>5</td></tr><tr><td>6</td><td>10</td></tr><tr><td>7</td><td>15</td></tr><tr><td>8</td><td>20</td></tr><tr><td>9</td><td>30</td></tr><tr><td>10</td><td>60</td></tr></table></td></tr>
<tr><td>269</td><td>Asset name char 1-2</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 1 = High, Char 2 = Low</td></tr>
<tr><td>270</td><td>Asset name char 3-4</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 3 = High, Char 4 = Low</td></tr>
<tr><td>271</td><td>Asset name char 5-6</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 5 = High, Char 6 = Low</td></tr>
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<table>
<tr><th>Modbus Register</th><th>Name</th><th>Read/Write</th><th>Bit Identification</th></tr>
<tr><td>272</td><td>Asset name char 7-8</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 7 = High, Char 8 = Low</td></tr>
<tr><td>273</td><td>Asset name char 9-10</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 9 = High, Char 10 = Low</td></tr>
<tr><td>274</td><td>Asset name char 11-12</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 11 = High, Char 12 = Low</td></tr>
<tr><td>275</td><td>Asset name char 13-14</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 13 = High, Char 14 = Low</td></tr>
<tr><td>276</td><td>Asset name char 15-16</td><td>Read Only</td><td>8 Bit ASCII Characters,
Char 15 = High, Char 16 = Low</td></tr>
<tr><td>277-284</td><td><Reserved></td><td>Read Only</td><td></td></tr>
<tr><td>285</td><td>UI IP Address Byte 1</td><td>Read Only</td><td>1-255</td></tr>
<tr><td>286</td><td>UI IP Address Byte 2</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>297</td><td>UI IP Address Byte 3</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>288</td><td>UI IP Address Byte 4</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>289</td><td>UI Subnet Mask Byte 1</td><td>Read Only</td><td>1-255</td></tr>
<tr><td>290</td><td>UI Subnet Mask Byte 2</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>291</td><td>UI Subnet Mask Byte 3</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>292</td><td>UI Subnet Mask Byte 4</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>293</td><td>UI Gateway Address Byte 1</td><td>Read Only</td><td>1-255</td></tr>
<tr><td>294</td><td>UI Gateway Address Byte 2</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>295</td><td>UI Gateway Address Byte 3</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>296</td><td>UI Gateway Address Byte 4</td><td>Read Only</td><td>0-255</td></tr>
<tr><td>297</td><td>Fan Thermal Block Level</td><td>Read Only</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>0 %</td></tr><tr><td>1</td><td>5 %</td></tr><tr><td>2</td><td>10 %</td></tr><tr><td>3</td><td>15 %</td></tr><tr><td>4</td><td>20 %</td></tr><tr><td>5</td><td>25 %</td></tr><tr><td>6</td><td>30 %</td></tr><tr><td>7</td><td>35 %</td></tr><tr><td>8</td><td>40 %</td></tr><tr><td>9</td><td>45 %</td></tr><tr><td>10</td><td>50 %</td></tr><tr><td>11</td><td>55 %</td></tr><tr><td>12</td><td>60 %</td></tr><tr><td>13</td><td>65 %</td></tr><tr><td>14</td><td>70 %</td></tr><tr><td>15</td><td>75 %</td></tr><tr><td>16</td><td>80 %</td></tr><tr><td>17</td><td>85 %</td></tr><tr><td>18</td><td>90 %</td></tr></table></td></tr>
<tr><td>298 - 301</td><td><Reserved></td><td>Read Only</td><td>0</td></tr>
</table>

B10 RKS Load Parameters – LCM Mode

Modbus Register	Name	Read/Write	Bit Identification
302 – 303	<Reserved>	Read Only	0
304	Full Load Current Range	Read Only	0-223 (As Per RKS – Diode Mode)
305	Short Circuit Trip Level	Read Only	0-44 (As Per RKS – Diode Mode)
306	Short Circuit Trip Time	Read Only	0-8 (As Per RKS – Diode Mode)
307	Overcurrent Curve	Read Only	0-2 (As Per RKS – Diode Mode)
308	Overcurrent Time Multiplier	Read Only	0-84 (As Per RKS – Diode Mode)
309	Overload Cooling Multiplier	Read Only	0-6 (As Per RKS – Diode Mode)
310	<Reserved>	Read Only	0
311	Overload Start Block Level	Read Only	0-7 (As Per RKS – Diode Mode)
312	Current Imbalance Trip Level	Read Only	0-4 (As Per RKS – Diode Mode)
313	Under Current Trip Level	Read Only	0-14 (As Per RKS – Diode Mode)
314	Earth Leakage Trip Level	Read Only	0-10 (As Per RKS – Diode Mode)
315	Earth Leakage Trip Time	Read Only	0-11 (As Per RKS – Diode Mode)
316	Earth Continuity Trip Level	Read Only	0-7 (As Per RKS – Diode Mode)
317	Earth Continuity Trip Time	Read Only	0-6 (As Per RKS – Diode Mode)
318	Earth Continuity Latch	Read Only	0-1 (As Per RKS – Diode Mode)
319	Remote Start	Read Only	0-1 (As Per RKS – Diode Mode)
320	Reserved	Read Only	0
321	Under Voltage Trip Level	Read Only	0-9 (As Per RKS – Diode Mode)
322	LCM RTD 1-2 Trip Temp	Read Only	
323	LCM RTD 3-5 Trip Temp	Read Only	
324	LCM RTD 1-2 Reset Temp	Read Only	
325	LCM RTD 3-5 Reset Temp	Read Only	
326	Back EMF Time	Read Only	0-4 (As Per RKS – Diode Mode)
327 - 331	<Reserved>	Read Only	

Value	Meaning
0	RTD based tripping is switched off.
1-200	Temperature at and above which will cause the system to trip.

Value	Meaning
0	RTD based trip will reset whenever the temperature drops below the trip level.
1-200	Temperature at and below which will reset/clear the LCM RTD Temperature Trip.

B11 RKS General Parameters – LCM Mode

Modbus Register	Name	Read/Write	Bit Identification
332	Operation mode	Read Only	0-2 (As Per RKS – Diode Mode)
333	Restart After Power Cycle	Read Only	0-21 (As Per RKS – Diode Mode)
334	Delayed Fan Start	Read Only	0-17 (As Per RKS – Diode Mode)
335	Post-Blast Start	Read Only	0-12 (As Per RKS – Diode Mode)
336	Blast Pressure Level	Read Only	0-4 (As Per RKS – Diode Mode)
337	Burp On Timing Mode	Read Only	0-1 (As Per RKS – Diode Mode)
338	Burp Cycles	Read Only	0-4 (As Per RKS – Diode Mode)
339	Burp On Time	Read Only	0-7 (As Per RKS – Diode Mode)
340	Burp Off Time	Read Only	0-7 (As Per RKS – Diode Mode)
341	Pump Timing Mode	Read Only	0-1 (As Per RKS – Diode Mode)
342	Snore Current	Read Only	0-13 (As Per RKS – Diode Mode)
343	Sleep Time	Read Only	0-10 (As Per RKS – Diode Mode)
344-351	<Reserved>	Read Only	
352	Machine name char 1-2	Read Only	8 Bit ASCII Characters, Char 1 = High, Char 2 = Low
353	Machine name char 3-4	Read Only	8 Bit ASCII Characters, Char 3 = High, Char 4 = Low
354	Machine name char 5-6	Read Only	8 Bit ASCII Characters, Char 5 = High, Char 6 = Low
355	Machine name char 7-8	Read Only	8 Bit ASCII Characters, Char 7 = High, Char 8 = Low
356	Machine name char 9-10	Read Only	8 Bit ASCII Characters, Char 9 = High, Char 10 = Low
357	Machine name char 11-12	Read Only	8 Bit ASCII Characters, Char 11 = High, Char 12 = Low
358	Machine name char 13-14	Read Only	8 Bit ASCII Characters, Char 13 = High, Char 14 = Low
359	Machine name char 15-16	Read Only	8 Bit ASCII Characters, Char 15 = High, Char 16 = Low
360	Fan Thermal Block Level	Read Only	0-18 (As Per RKS – Diode Mode)
361-368	<Reserved>	Read Only	

APPENDIX C: HMI REPLACEMENT

The Rockstarter's display and digitiser is replaceable. To replace the display and digitiser:

1. Ensure the correct isolation procedures are followed.
2. Remove the 8 M5x16 mm hex head screws from the top and bottom screen holders.
3. Remove the top and bottom screen holders.
4. Remove the display glass and digitiser, taking care not to damage the ribbon cable and connector.
5. Release ribbon cable from its connector.
6. Take care during removal and installation to not damage the O-ring positioned under the screen.
7. Inspect the O-ring for damage and replace if necessary.
8. Replace screen and reverse the above steps.

For more information, contact Ampcontrol.

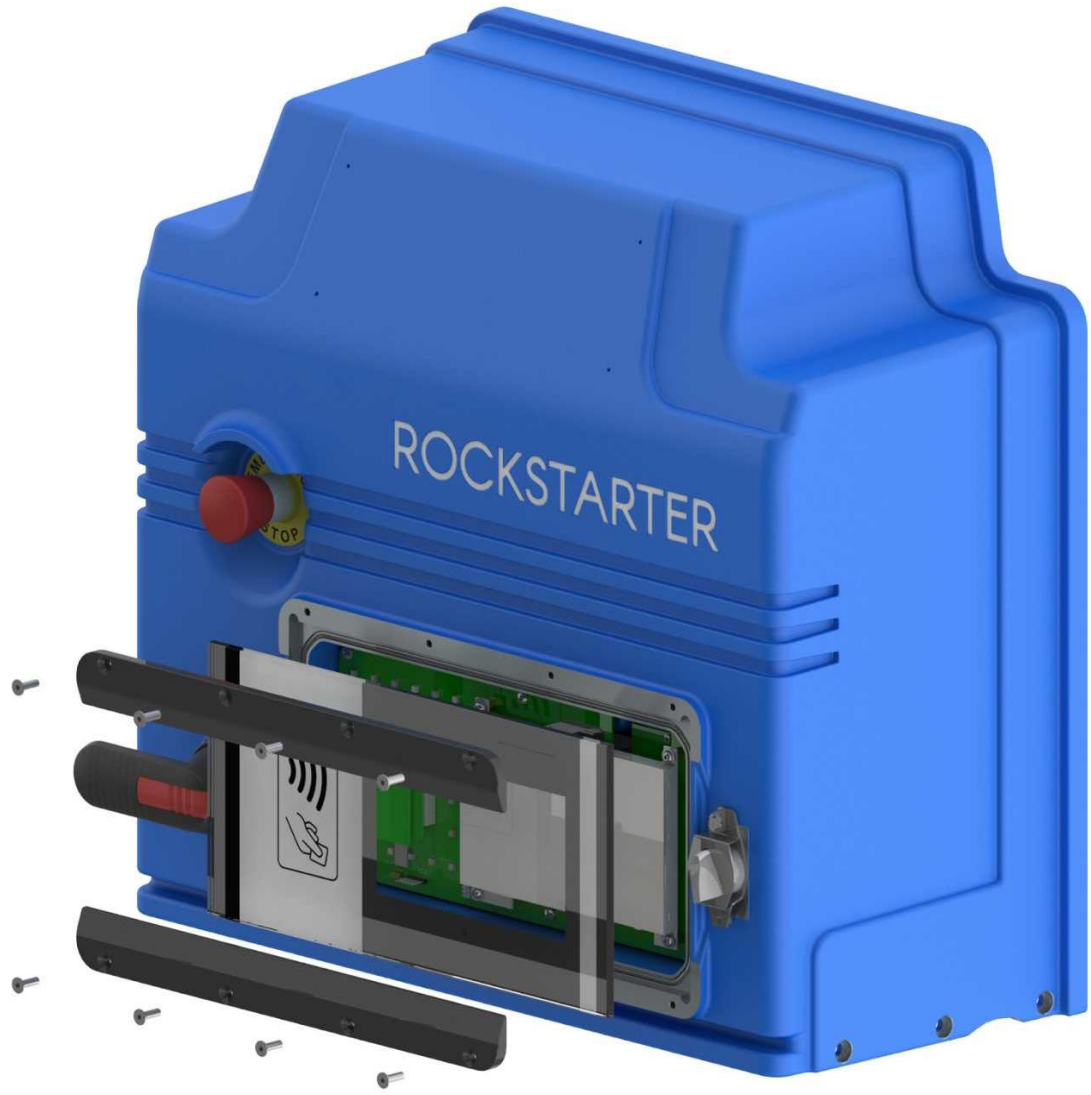

Figure 52: Replacing the Display Glass and Digitiser

APPENDIX D: DRAWINGS

The drawings in this appendix are as per the below table.

Drawing Number	Drawing Title
IPXB014	Overcurrent and Short Circuit Curves
IPXB013	Motor Overload and Short Circuit Curves

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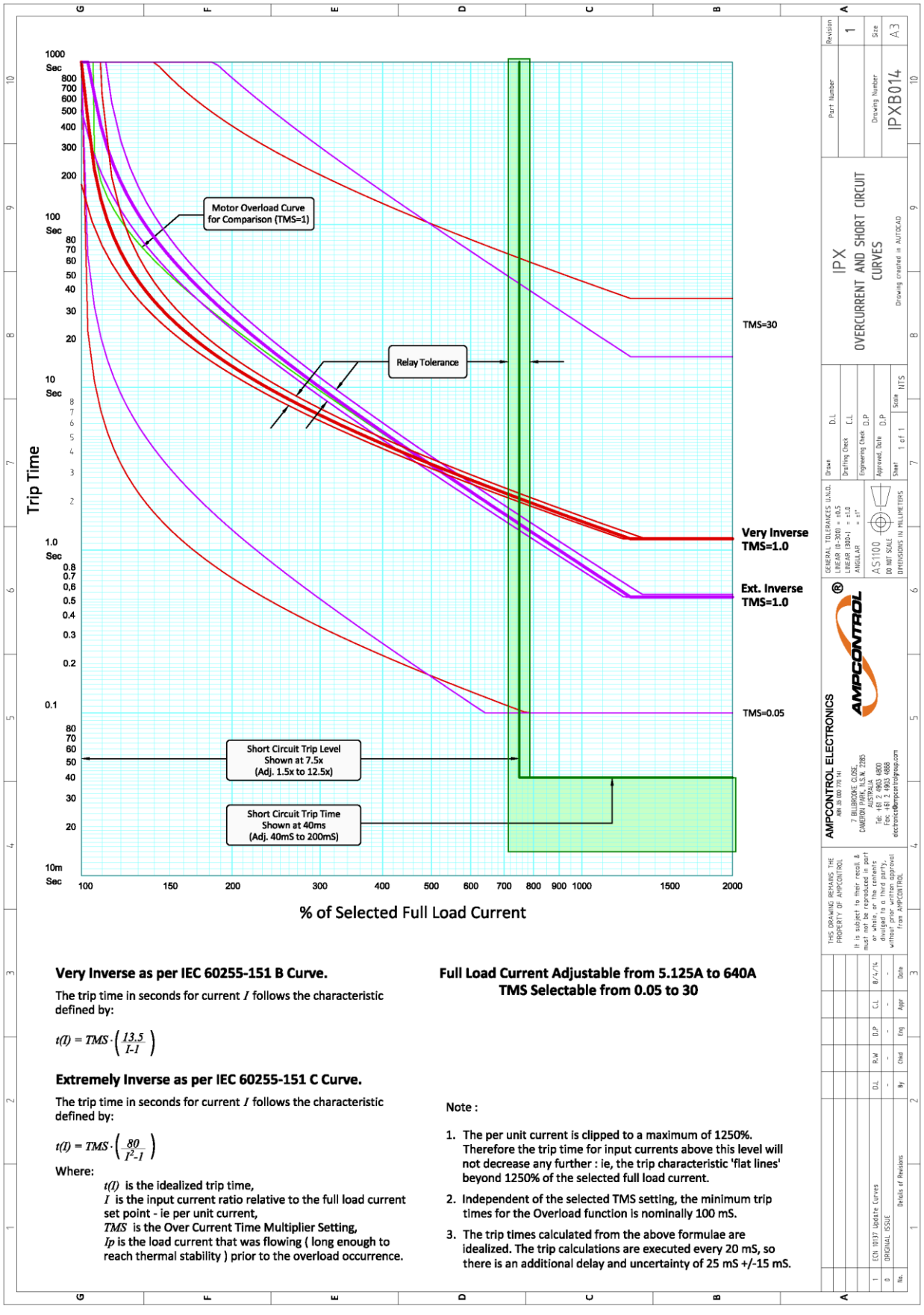

Very Inverse as per IEC 60255-151 B Curve.

The trip time in seconds for current I follows the characteristic defined by:

$$t(I) = TMS \cdot \left(\frac{13.5}{I-1} \right)$$

Extremely Inverse as per IEC 60255-151 C Curve.

The trip time in seconds for current I follows the characteristic defined by:

$$t(I) = TMS \cdot \left(\frac{80}{I^2-1} \right)$$

Where:

$t(I)$ is the idealized trip time,
I is the input current ratio relative to the full load current set point - ie per unit current,
TMS is the Over Current Time Multiplier Setting,
Ip is the load current that was flowing (long enough to reach thermal stability) prior to the overload occurrence.

Full Load Current Adjustable from 5.125A to 640A
TMS Selectable from 0.05 to 30

Note :

1. The per unit current is clipped to a maximum of 1250%. Therefore the trip time for input currents above this level will not decrease any further : ie, the trip characteristic 'flat lines' beyond 1250% of the selected full load current.
2. Independent of the selected TMS setting, the minimum trip times for the Overload function is nominally 100 mS.
3. The trip times calculated from the above formulae are idealized. The trip calculations are executed every 20 mS, so there is an additional delay and uncertainty of 25 mS +/-15 mS.

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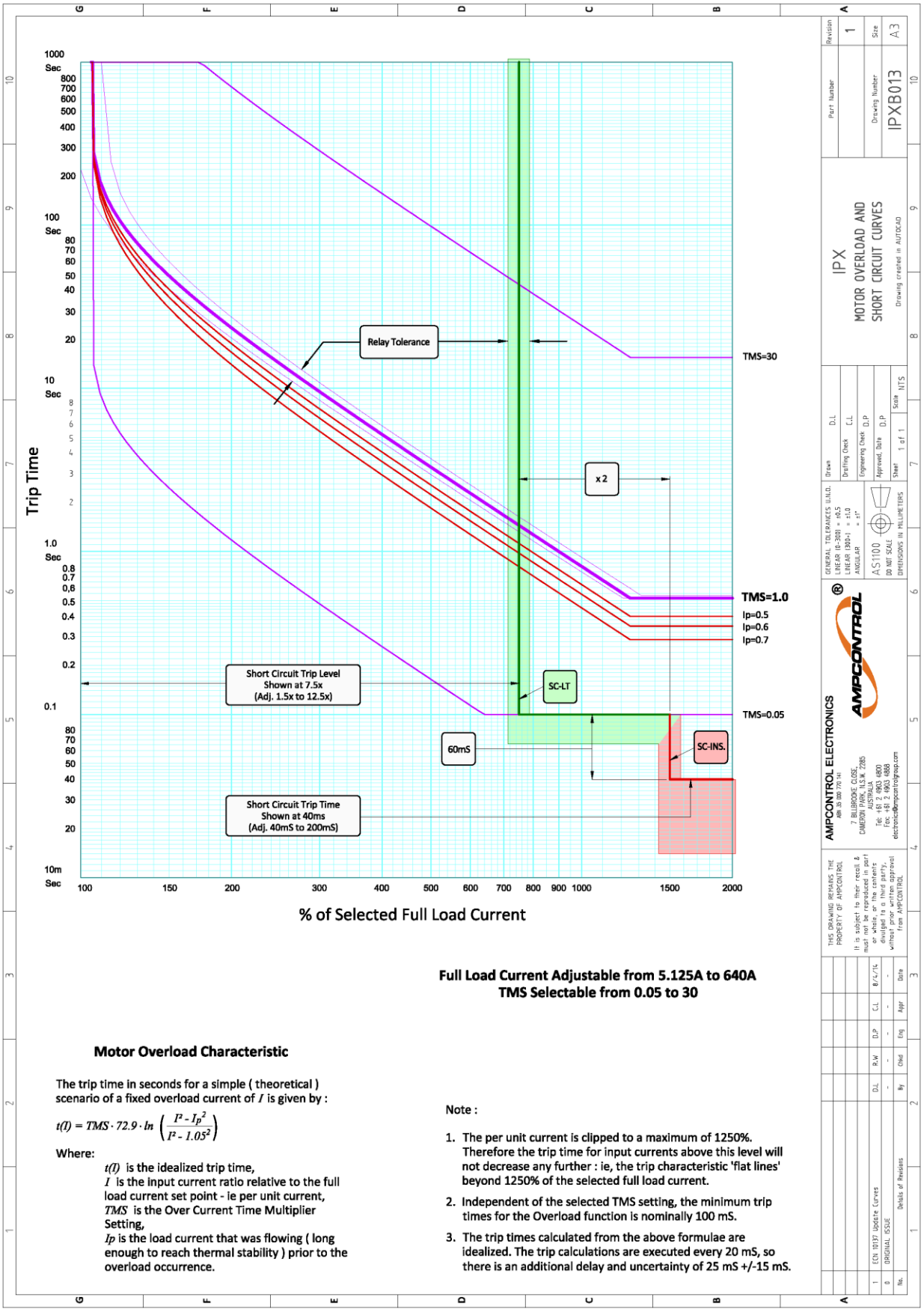

Full Load Current Adjustable from 5.125A to 640A
TMS Selectable from 0.05 to 30

Motor Overload Characteristic

The trip time in seconds for a simple (theoretical) scenario of a fixed overload current of I is given by :

$$t(I) = TMS \cdot 72.9 \cdot ln\left(\frac{I^2 - Ip^2}{I^2 - 1.05^2}\right)$$

Where:

$t(I)$ is the idealized trip time,
I is the input current ratio relative to the full load current set point - ie per unit current,
TMS is the Over Current Time Multiplier Setting,
Ip is the load current that was flowing (long enough to reach thermal stability) prior to the overload occurrence.

Note :

1. The per unit current is clipped to a maximum of 1250%. Therefore the trip time for input currents above this level will not decrease any further : ie, the trip characteristic 'flat lines' beyond 1250% of the selected full load current.
2. Independent of the selected TMS setting, the minimum trip times for the Overload function is nominally 100 mS.
3. The trip times calculated from the above formulae are idealized. The trip calculations are executed every 20 mS, so there is an additional delay and uncertainty of 25 mS +/-15 mS.