PF1

PUMP & FAN RELAY

User Manual

Version: 7, August 2020

Created in Australia by Ampcontrol Pty Ltd

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 PF1.

WARNING!

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

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1 SAFETY AND OTHER WARNINGS

For safety reasons, the PF1 must be installed, operated and serviced only by competent electrical personnel. Please read and understand this instruction manual completely before installing, operating or servicing this equipment. Failure to install or operate this instrument 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 PF1 and associated equipment being installed 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 PF1 functioning correctly it is highly recommended that all safety functions of the PF1 be periodically tested to ensure correct operation.

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1.2 Summary of Essential Cautions and Warnings

This sub-section provides a summary of all of the essential caution and warning statements throughout this document. A reference is also provided to the location within the document.

Section 4.1.3	**WARNING!** 	The PF1 has been design to provide the user with the maximum flexibility, with regards to configuration. The user is able to configure the PF1 such that the Earth Leakage and Earth Continuity protection functions are disabled. **Ampcontrol accepts no responsibility or liability in cases where the user has incorrectly configured the PF1.** The user remains ultimately responsible for the configuration of the PF1 and their greater system.
Section 4.4.8	**CAUTION!** 	**Overloading any of the output relay contacts can damage the PF1, potentially resulting in unsafe operation**. The installer is to ensure that the limitations detailed in the Specifications Table (Section 13) are respected.
Section 4.4.9	**NOTE** 	Although the EC Pilot terminal (20) is only required to be wired in if the PF1 relay's earth continuity protection is to be enabled, **the EC Earth terminal (21) must always be connected**. Failure to connect the EC Earth terminal to earth will result in non-compliance.
Section 5.5	**WARNING!** 	In Earth Continuity Only Mode, if **remote start is not enabled**, when the pilot resistance returns to a healthy range (remote stop button released) the **K1 output relay will energise**.
Section 6.1.3	**NOTE** 	When the Pump configuration is changed, the **iSet parameter stored in the PF1 will be reset to infinity**. The user will be required to perform the iSet procedure.
Section 6.3	**WARNING!** 	If the PF1 is set to resume after a power failure, the pump can and will energise after a power outage. All operators should be aware of this. **This setting should be used with caution.**
Section 11.2	**NOTE** 	The Facia Stop button will only open the K1 output relay if the PF1 is set to Pump Mode or Fan Mode. If the PF1 is not set to either Pump Mode or Fan Mode, the **Fascia Stop button will not perform a function**.

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2 RECEIVING AND STORAGE

2.1 Receiving

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

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 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 and 50˚C, preferably on shelves and protected from moisture and sunlight.

2.4 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**.

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.

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3 PRODUCT OVERVIEW

3.1 Description

The Ampcontrol PF1 is a multi-functional Relay designed for hard rock mining applications. It has the ability to perform two standard protection functions which are compliant to AS/NZS2081:2011 for Earth Leakage and Earth Continuity. In addition to these protection functions, the PF1 also provides selectable control functionality for Pump or Fan motor installations.

The Pump Protection function manages the no-load/under-current condition of a pump by monitoring the load current. When the load on the pump motor decreases due to the intake pipe not being fully submerged (known as snoring), the speed of the pump motor will rise to its maximum, which can burn out the pump motor in as little as 30 seconds. The under-current condition is detected by the PF1 which can apply a configurable sleep/run cycle to help prevent pump burnout due to a lack of water.

The Fan Protection function manages the gradual pre-inflation of flexible ventilation conduit, by applying a pulsed (burp) start-up sequence to the fan motor. This can prevent damage to the material of the ventilation tube during the initial stages of inflation.

The four protection/control functions of the PF1 can be independently enabled or disabled as required.

3.2 Features

The PF1 has the following key features:

- Fully configurable using Smart Tools PC software, via USB (external power not required)
- Pump Protection (Anti-Snore Mode)
- Fan Protection (Burp Mode)
- Earth leakage protection (AS/NZS 2081:2011 compliant)
- Earth continuity protection (AS/NZS 2081:2011 compliant)
- Remote start/stop functionality
- Event data logging (10,000 records)
- 24Vac or 24Vdc operation (one model)
- DIN rail mounted
- LED status indication to aid in diagnostics
- Pluggable screw terminal blocks

3.3 Application

The PF1 is intended for use in the hard rock mining industry on electrical outlets supplying Pump or Fan motors. When applied correctly, the specialised pump and fan protection functions can significantly reduce the risk of damage to equipment and thus can also considerably reduce maintenance requirements.

The PF1's Pump and Fan operating functions can both be disabled, allowing the PF1 to also operate as a combined Earth Leakage and Earth Continuity relay on non-pump and non-fan outlets. This has the added advantage of reducing Relay variants used across a given site (reduced stock, spares, maintenance and operator training costs).

The following sub-sections provide some typical applications of the PF1.

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3.3.1 PF1 Pump (Only) Application

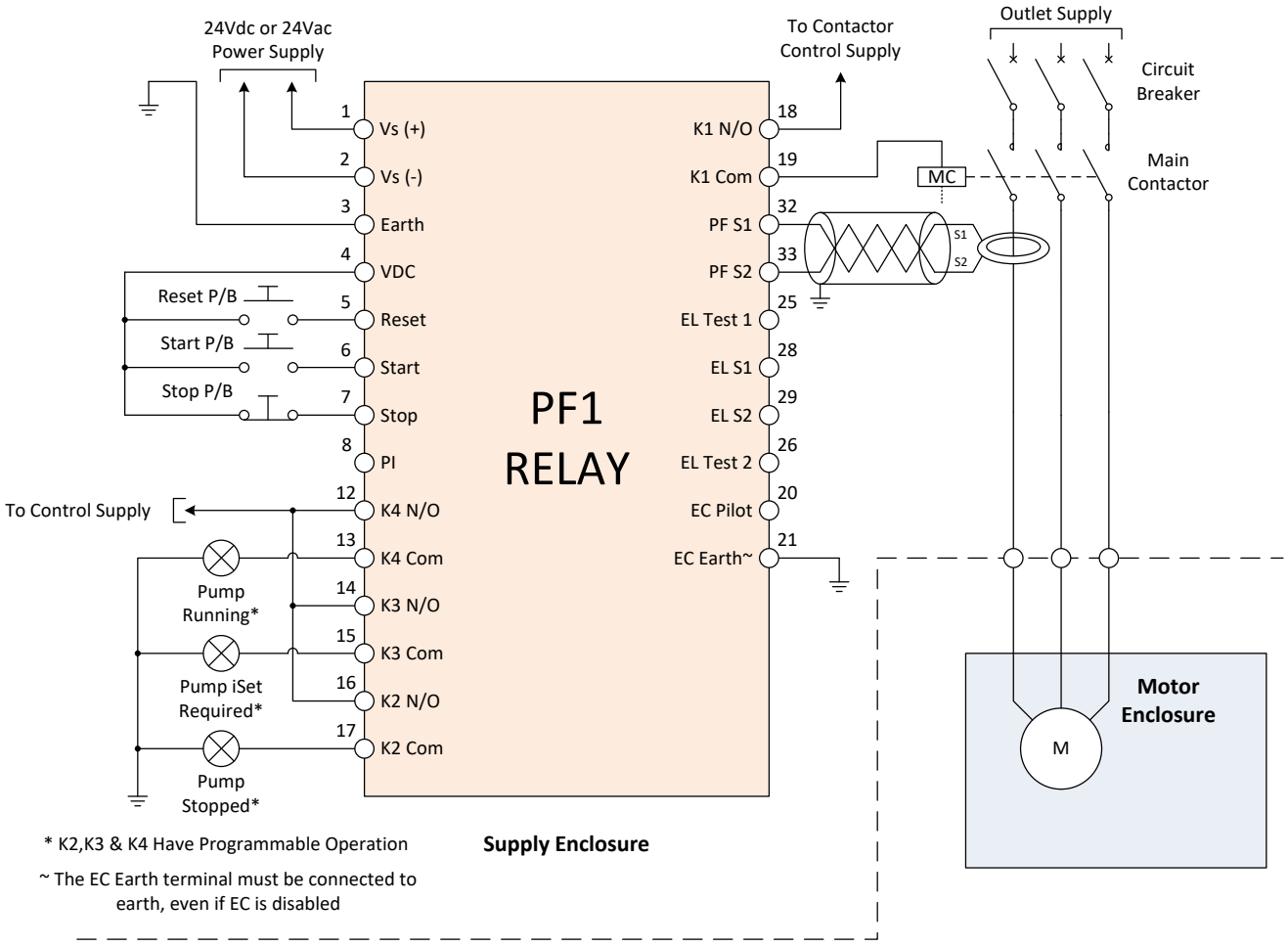

Figure 3.1: Typical Application - Pump Protection (Only)

Table 1: PF1 Configuration for a Typical Application of Pump Protection (Only)

PF1 Typical Configuration – Pump Mode (Only)		
Setting Category	**Setting Type**	**Setting**
Pump Protection	*Enabled*	Yes
	Sleep Mode	Incremental
	iSet Offset (Hysteresis)	5%
	iSet Source	Local and Remote Start
	iSet Current (Minimum)	1.5A
	iSet Start-Up Lockout Period	10 seconds
	Runtime: After start (Minimum)	30 seconds
	Runtime : Between sleeping (Minimum)	20 seconds
	Sleep Time (Initial Delay)	5.0 minutes
	Pump Resume After Power Failure	Yes
Fan Protection	*Enabled*	No
Earth Leakage Protection	*Enabled*	No
Earth Continuity Protection	*Enabled*	No
Output Relays (K2)	*Enabled*	Yes
	Default State	Open (de-energised)
	Pump Stopped	Checked
Output Relays (K3)	*Enabled*	Yes
	Default State	Open (de-energised)
	Pump iSet Required	Checked
Output Relays (K4)	*Enabled*	Yes
	Default State	Open (de-energised)
	Pump Running	Checked

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3.3.2 PF1 Fan (Only) Application

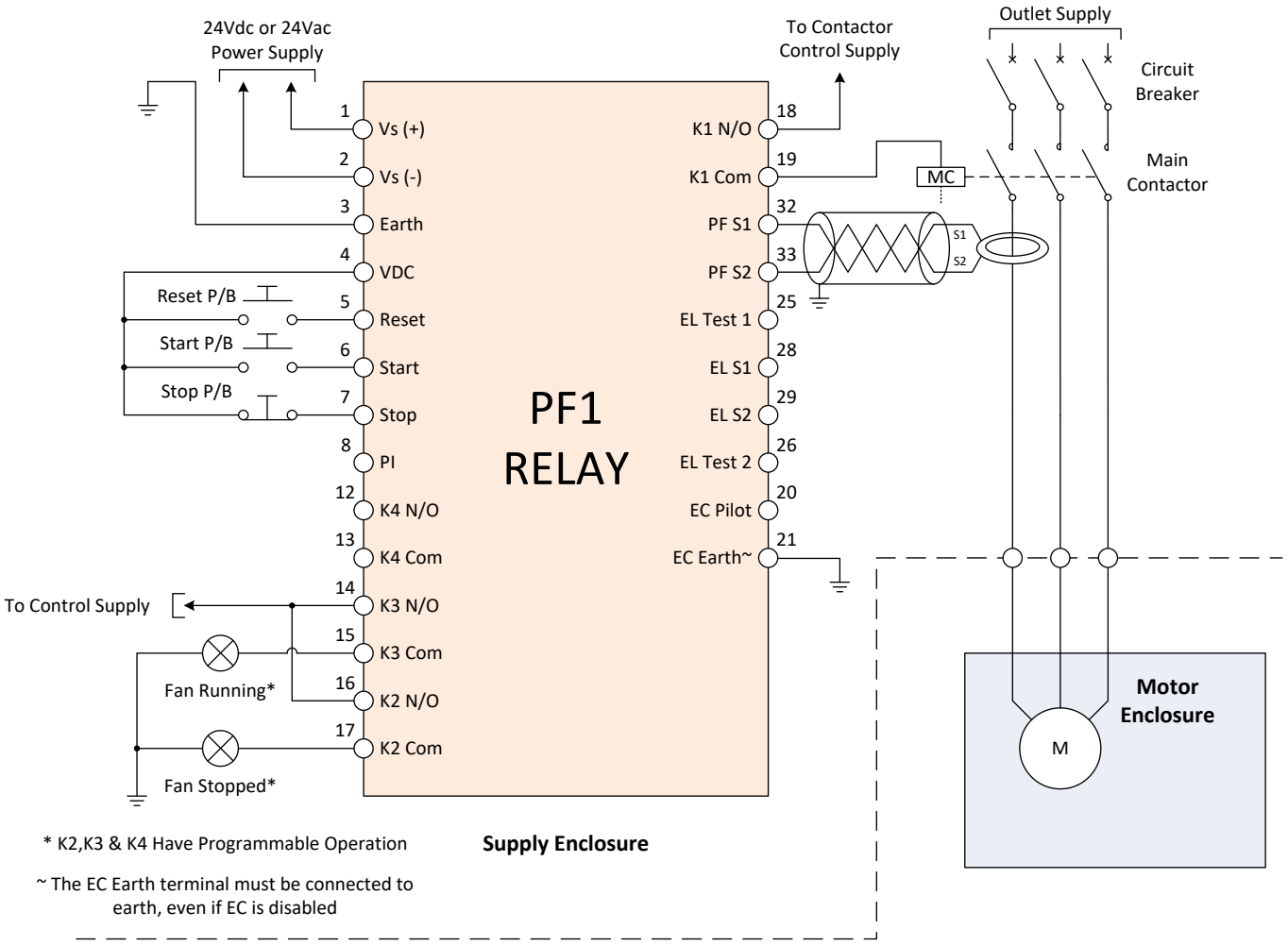

Figure 3.2: Typical Application - Fan Protection (Only)

Table 2: PF1 Configuration for a Typical Application of Fan Protection (Only)

PF1 Typical Configuration – Fan Mode (Only)		
Setting Category	**Setting Type**	**Setting**
Pump Protection	*Enabled*	No
Fan Protection	*Enabled*	Yes
	Burp Cycles	4
	Burp 1 On Period	1 Seconds
	Burp 1 Off Period	2 Seconds
	Burp 2 On Period	1 Seconds
	Burp 2 Off Period	1 Seconds
	Burp 3 On Period	1 Seconds
	Burp 3 Off Period	2 Seconds
	Burp 4 On Period	3 Seconds
	Burp 4 Off Period	1 Seconds
Earth Leakage Protection	*Enabled*	No
Earth Continuity Protection	*Enabled*	No
Output Relays (K2)	*Enabled*	Yes
	Default State	Open (de-energised)
	Fan Stopped	Checked
Output Relays (K3)	*Enabled*	Yes
	Default State	Open (de-energised)
	Fan Running	Checked
Output Relays (K4)	*Enabled*	No

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3.3.3 PF1 Pump (EL, EC, Remote Start & Remote Stop) Application

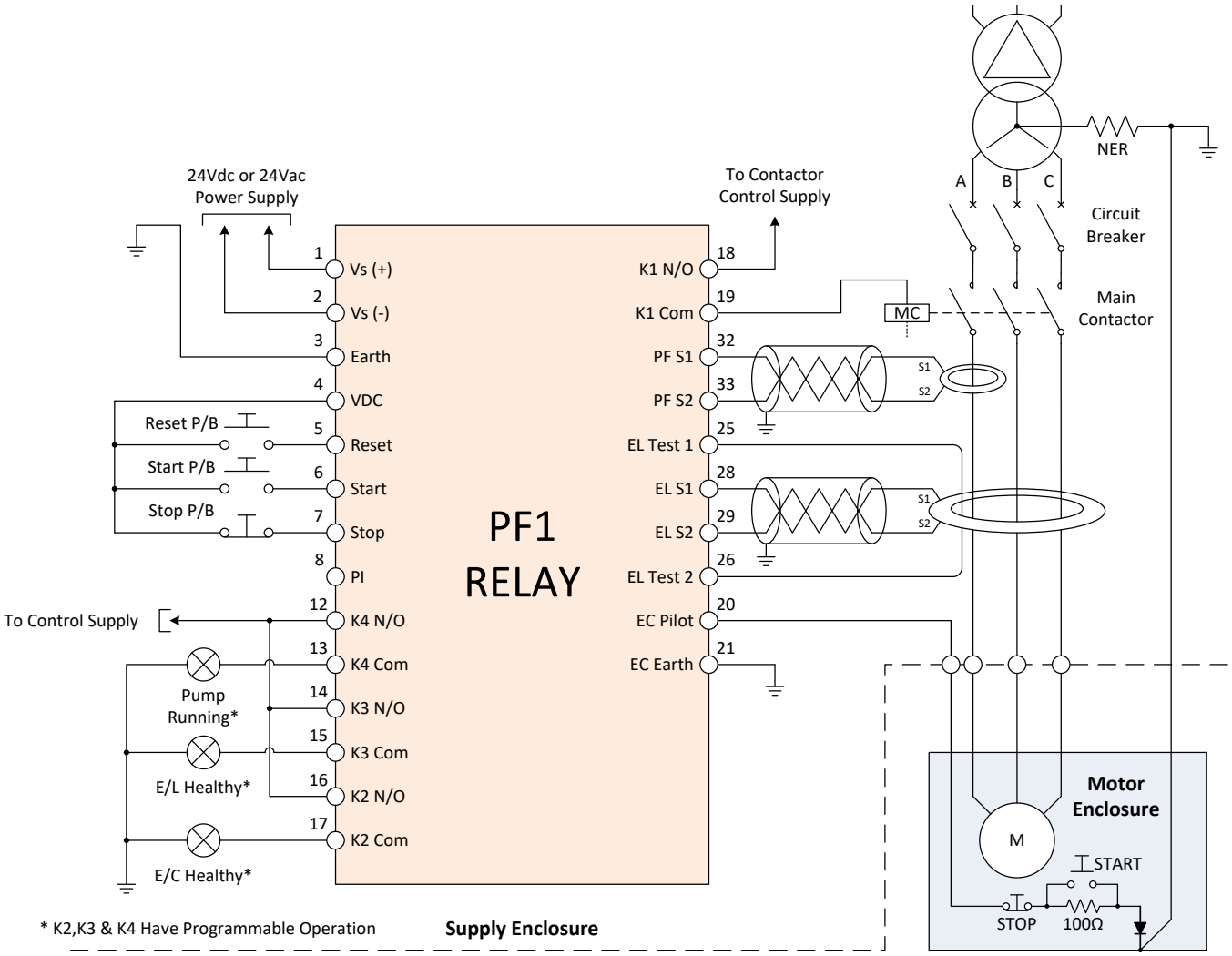

Figure 3.3: Typical Application - Pump Protection (EL, EC, Remote Start & Remote Stop)

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Table 3: PF1 Configuration for a Typical Application of Pump Protection (EL, EC, R.Start & R.Stop)

PF1 Typical Configuration – Pump Mode with EL, EC, R.Start & R.Stop		
Setting Category	**Setting Type**	**Setting**
Pump Protection	*Enabled*	Yes
	Sleep Mode	Incremental
	iSet Offset (Hysteresis)	5%
	iSet Source	Local and Remote Start
	iSet Current (Minimum)	1.5A
	iSet Start-Up Lockout Period	10 seconds
	Runtime: After start (Minimum)	30 seconds
	Runtime : Between sleeping (Minimum)	20 seconds
	Sleep Time (Initial Delay)	5.0 minutes
	Pump Resume After Power Failure	Yes
Fan Protection	*Enabled*	No
Earth Leakage Protection	*Enabled*	Yes
	Bandwidth Mode	Wide
	Trip Current	300 mA
	Trip Time	50 ms
Earth Continuity Protection	*Enabled*	Yes
	Trip Latching	No
	Remote Start (+100 Ω)	Yes
	Trip Resistance : Series (Maximum)	45 Ω
	Healthy Hysteresis : Series	3 Ω
	Trip Resistance : Shunt (Minimum)	1250 Ω
	Healthy Hysteresis : Shunt	100 Ω
	Trip Time	100 ms
Output Relays (K2)	*Enabled*	Yes
	Default State	Open (de-energised)
	Pump Running	Checked
Output Relays (K3)	*Enabled*	Yes
	Default State	Open (de-energised)
	E/L Healthy	Checked
Output Relays (K4)	*Enabled*	Yes
	Default State	Open (de-energised)
	E/C Healthy	Checked

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4 INSTALLATION

4.1 General Warnings

These instructions have been designed to assist users of the PF1 with installation.

Before the PF1 can be installed, there are a number of things that need to be considered and understood to prevent incorrect or unsafe operation of the PF1 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 functionality and any limitations of the PF1 are understood to prevent incorrect installation or usage creating a potentially dangerous hazard.

4.1.2 Ensure that the application into which the PF1 is being installed has been properly specified, 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 PF1 will properly perform the required functions within the system design.

It is important to understand how the PF1 is intended to interact with other equipment within a system. For safe and reliable use, it is crucial that neither the PF1 relay's logical operation nor its signalling be compromised by incompatibilities with connected equipment.

WARNING!

The PF1 has been designed to provide the user with the maximum flexibility, with regards to configuration. The user is able to configure the PF1 such that the Earth Leakage and Earth Continuity protection functions are disabled.

Ampcontrol accepts no responsibility or liability in cases where the user has incorrectly configured the PF1. The user remains ultimately responsible for the configuration of the PF1 and their greater system.

4.1.4 Modifications of any form to the PF1 are prohibited.

The PF1 as supplied has been designed and manufactured to comply with the requirements of protection standards. If modifications of any form are made to the PF1, the equipment may no longer be fit for use. If any modifications or damage to the PF1 is evident, do not use the equipment.

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4.2 Mandatory Installation Practices

The following information must be adhered to when installing the PF1. Failure to adhere to this information may give rise to unsafe operation and void product warranty.

Using the PF1 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 PF1 must be powered by a regulated supply within the specified voltage range.
- The installation of the PF1 must be carried out by suitably trained and qualified personnel.
- Identification labels fixed to the PF1 must not be damaged, removed or covered.
- The installation is to be in accordance with the relevant installation Standards/Codes of Practice. Modifications must not be made to any part of the PF1. As supplied, the unit is built to, and complies with the relevant standards. Any modifications will render the unit non-compliant.
- Complete and accurate records of the installation must be kept as part of the site installation.
- The PF1 may only be used together with Ampcontrol approved/supplied accessories e.g. CTs and toroids.

4.3 Mechanical Installation

4.3.1 PF1 Enclosure Dimensions (mm)

Figure 4.1: PF1 Enclosure Dimensions (Terminal Plugs Removed)

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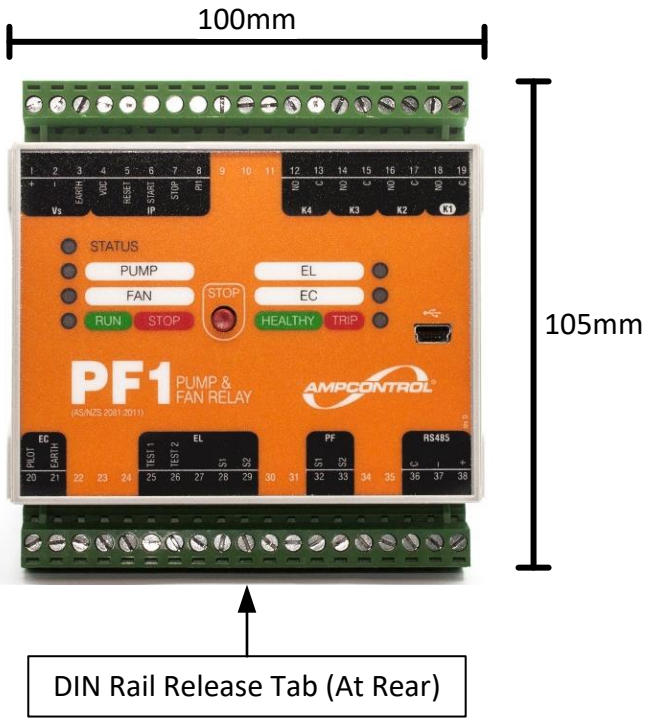

Figure 4.2: PF1 Enclosure Dimensions (Terminal Plugs Inserted)

4.3.2 PF1 Mounting Arrangements

The PF1 is DIN Rail mounted and can be mounted in any orientation; however, it should ideally be oriented as shown. The DIN rail release tab is located on the bottom of the relay at the rear of the unit.

4.3.3 PF1 Terminal Layout

#	Terminal Name	I/O
1	Vs Supply (+)	
2	Vs Supply (-)	
3	Earth	
4	VDC Out	O
5	Reset Input	I
6	Start Input	I
7	Stop Input	I
8	Programmable Input	I
9	Not Connected	
10	Not Connected	
11	Not Connected	
12	Output Relay K4 N/O Contact	O
13	Output Relay K4 Common	O
14	Output Relay K3 N/O Contact	O
15	Output Relay K3 Common	O
16	Output Relay K2 N/O Contact	O
17	Output Relay K2 Common	O
18	Output Relay K1 N/O Contact	O
19	Output Relay K1 Common	O

#	Terminal Name	I/O
20	EC Pilot Connection	I/O
21	EC Earth Connection	I
22	Not Connected	
23	Not Connected	
24	Not Connected	
25	EL Test 1 Connection	O
26	EL Test 2 Connection	O
27	Not Connected	
28	EL S1 Toroid Connection	I
29	EL S2 Toroid Connection	I
30	Not Connected	
31	Not Connected	
32	Phase CT S1 Connection	I
33	Phase CT S2 Connection	I
34	Not Connected	
35	Not Connected	
36	Not Connected	
37	Not Connected	
38	Not Connected	

Figure 4.3: PF1 Terminal Layout

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4.3.4 Accessories

The PF1 requires an earth leakage toroid and a current transformer (both included in the PF1 kit) for full functionality. The dimensions and mounting arrangements for these accessories can be found in APPENDIX B:

4.4 Electrical Installation

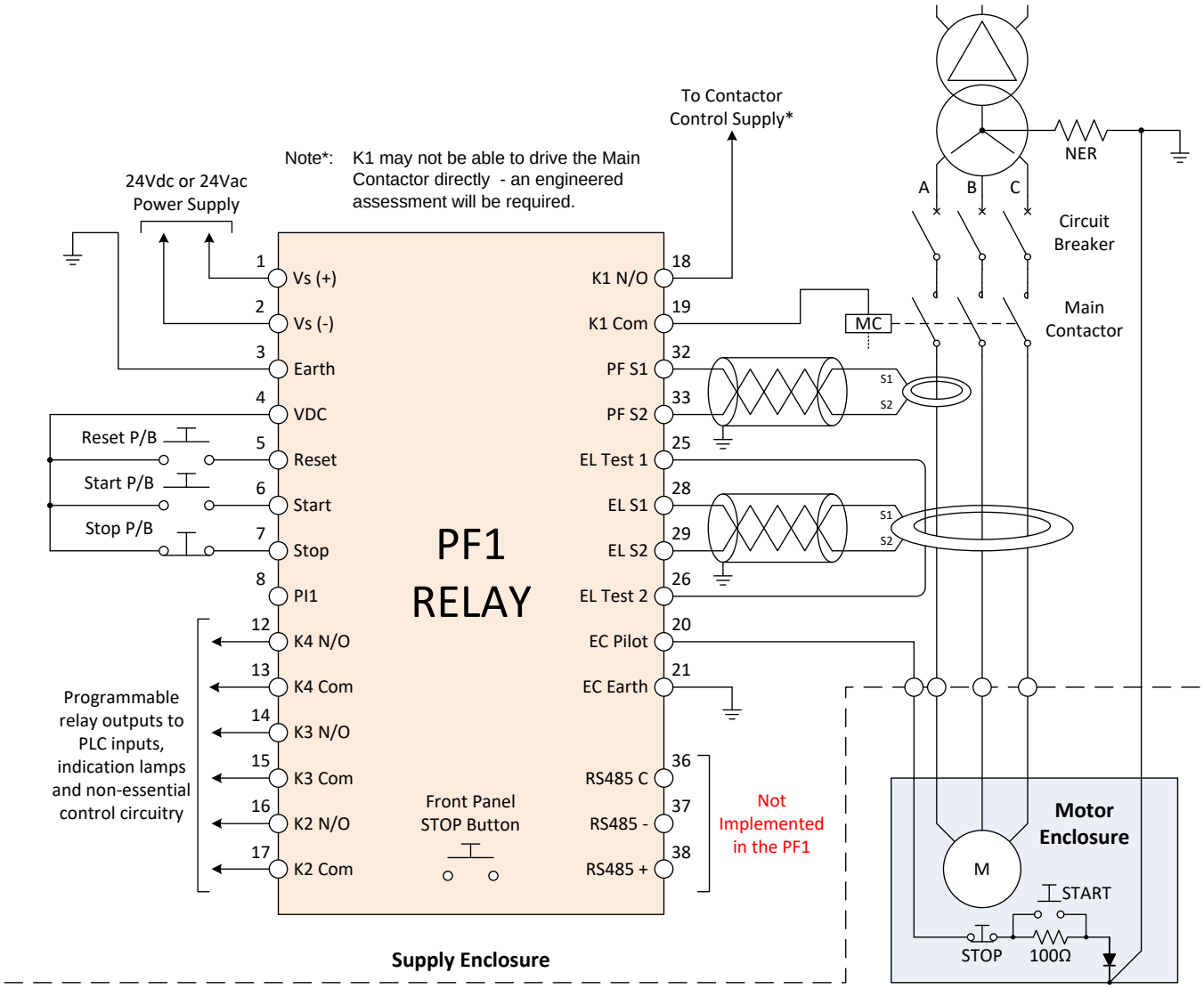

Figure 4.4: Typical Electrical Application

4.4.1 Vs Supply (Terminals 1 & 2)

The acceptable regulated supply voltage range for the PF1 is from 18 to 28.8Vac (50 to 60Hz), or 18 to 28.8Vdc. It is recommended that a suitable form of surge protection is included, for installations, where the supply input can be subjected to surges outside of the limits defined by AS/NZS2081.

Table 4: Recommended Surge Protection

Manufacturer	EPCOS
P/N	B72220S0250K101
Description	TVS Varistor, B722 Series, 25 V, 31 V, 77 V, Radial Leaded, Metal Oxide Varistor

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4.4.2 Vs Earth (Terminal 3)

The Vs Supply Earth must be connected to a frame or common earth via a minimum 1.5mm^2 conductor.

4.4.3 VDC Out (Terminals 4)

Output voltage source, used in conjunction with the digital inputs.

4.4.4 Digital Inputs (Terminals 5, 6, & 7)

The PF1 has three (fixed) digital input terminals: Reset (N/O), Start (N/O) & Stop (N/C), respectively.

To wire in a digital input, the contact of the actuator must be wired between the VDC terminal (4) and the input's terminal. When the contact closes, the VDC voltage will be applied to the input terminal, thereby "closing" the input.

The PF1 relay's digital inputs are intended to be wired to the output contacts of a PLC and/or to external pushbuttons.

NOTE

The maximum allowable loop impedance for each of the digital inputs is 1kΩ. Ensure that the impedance at the time of installation is sufficiently under this, such that any circuit degradation over time – due to contact deterioration, oxidisation etc. – will not increase the impedance above this limit.

4.4.5 PI1 Input (Terminal 8)

Programmable input 1.

This input is able to be programmed to different uses from within the PF1's Smart Tools software. See Section 11.4 for further details.

NOTE

The maximum allowable loop impedance for the PI input is 1kΩ. Ensure that the impedance at the time of installation is sufficiently under this, such that any circuit degradation over time – due to contact deterioration, oxidisation etc. – will not increase the impedance above this limit.

4.4.6 Terminals 9, 10 & 11

Future use, do not connect anything to these terminals.

4.4.7 K2, K3, K4 Output Relays (Terminals 12, 13, 14, 15, 16 & 17)

The functionality of the K2, K3 & K4 Output Relays can be customised to the user's requirements using the Smart Tools software. These relays are normally open, but can be individually programmed to operate as normally closed relays if desired (all relays will revert to normally open on Vs power loss).

These output relays are primarily intended to be used to switch indication circuits into PLCs and Lamps. Depending on the application, they can also be used to add a level of redundancy to the operation of K1.

Refer to Section 11.5 for further details.

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4.4.8 K1 Output Relay (Terminals 18 & 19)

This is the primary control and tripping output relay.

The K1 relay has a normally open contact that is to be wired into the tripping circuit of the outlet's main contactor. When the PF1 initiates a power interruption cycle as part of its control function, or when a trip occurs, the K1 relay will de-energise (open), opening the main contactor.

Unlike the other output relays, the functionality of the K1 output relay cannot be directly configured. Rather, its operation is dependent upon the protection and control configuration of the PF1 as a whole.

CAUTION!

Overloading any of the output relay contacts can damage the PF1, potentially resulting in unsafe operation. The installer is to ensure that the limitations detailed in the Specifications Table (Section13) are respected.

4.4.9 Earth Continuity (Terminals 20 & 21)

The EC Pilot terminal (20) is to be wired to the pilot core of the outlet's cable. The PF1 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. The magnitude of the pilot/earth return loop impedance is also monitored via this terminal.

The EC Earth terminal (21) is to be wired to the common earth point, together with the earth core of the outlet's cable, using at minimum a 1.5mm^2 conductor.

NOTE

Although the EC Pilot terminal (20) is only required to be wired in if the PF1 relay's earth continuity protection is to be enabled **the EC Earth terminal (21) must always be connected**. Failure to connect the EC Earth terminal to earth will result in non-compliance.

4.4.10 Terminals 22, 23 & 24

Future use, do not connect anything to these terminals.

4.4.11 Earth Leakage Toroid Test (Terminals 25 & 26)

The EL Test terminals (25 & 26) are used to output a test signal that is monitored by the PF1 via the outlet's earth leakage toroid. This signal is used to prove that the wiring between the PF1 and the earth leakage toroid is undamaged, and that the toroid itself is still functioning.

One continuous conductor should be wired from the EL Test 1 terminal (25), through the centre of the earth leakage toroid and back to the EL Test 2 terminal (26).

NOTE

The EL Test 1 terminal (25) and the EL Test 2 terminal (26) are only required to be wired in if the PF1 relay's earth leakage protection function is to be enabled.

The CT detection wiring must have a loop resistance below 2Ω.

4.4.12 Terminal 27

Not used, do not connect anything to this terminal.

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4.4.13 Earth Leakage Terminals (Terminals 28 & 29)

The EL S1 terminal (28) is to be wired to the S1 terminal of the outlet's earth leakage toroid.

The EL S2 terminal (29) is to be wired to the S2 terminal of the outlet's earth leakage toroid.

The earth leakage function of the PF1 is designed for use with the supplied toroid. All three of the outlet's phase conductors must pass through the centre of this toroid.

NOTE

The EL S1 terminal (28) and the EL S2 terminal (29) are only required to be wired in if the PF1 relay's earth leakage protection is to be enabled.

S1 and S2 can be interchanged without affecting the PF1 relay's operation.

The loop impedance of the cables used to connect the EL toroid to the PF1 relay must be less than 0.1Ω. It is required that this is wired as a twisted pair + shield to Earth (on PF1 end only).

4.4.14 Terminals 30 & 31

Future use, do not connect anything to these terminals.

4.4.15 Phase CT Terminals (Terminals 32 & 33)

The PF S1 terminal (32) is to be wired to the S1 terminal of the installed phase current transformer.

The PF S2 terminal (33) is to be wired to the S2 terminal of the installed phase current transformer.

The supplied current transformer should be installed on one phase conductor to allow the PF1 to monitor the (pump / fan) current that is being used by the outlet.

NOTE

The loop impedance of the cables used to connect the Phase CT to the PF1 relay must be less than 0.1Ω. It is required that this is wired as a twisted pair + shield to Earth (on PF1 end only).

4.4.16 Terminals 34 & 35

Future use, do not connect anything to these terminals.

4.4.17 RS485 (Terminals 36, 37 & 38)

RS485 has **not been implemented in the PF1**. If you desire to have RS485 (with the accompanying Modbus RTU protocol) implemented in future PF relay family, please contact Ampcontrol to register your interest.

4.4.18 Front Panel STOP Button (PF1 Fascia)

The Front Panel STOP button is located on the fascia of the PF1 relay. This button can be used to stop the PF1 relay, provided that the PF1 relay is operating in either its Pump or Fan protection function. If the PF1 does not have either of these functions enabled then the STOP button will not perform a function. In this case, the state of the K1 relay will depend solely upon the heath of the enabled protection functions.

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4.4.19 Remote Stop Button (Motor Enclosure)

A remote stop button can be implemented in the motor enclosure provided that the PF1 relay'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. When the push button is pressed the pilot will open circuit, initiating an earth continuity trip, which will open the outlet's contactor.

For information on the operation of the Remote Stop Function, refer to Section 9.5.2.

4.4.20 Remote Start Button (Motor Enclosure)

A remote start button can be implemented in the motor enclosure provided that the PF1 relay's earth continuity protection is enabled **and** the PF1 relay's remote start function has been enabled.

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

For information on the operation of the Remote Start Function, refer to Section 9.5.1.

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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 PF1 during commissioning. This is not intended to provide an exhaustive commissioning checklist, but should be considered to be a minimum set of tests.

Each test need only be completed if that particular function of the PF1 is being utilised in the installation.

5.1 Pump Protection Test

Required if: Pump Protection is enabled.

Using the Smart Tools software, configure the operational settings of the pump outlet.

Required if: Pump Sleep Mode is enabled.

Prior to commencement of general operation, the iSet procedure must be completed.

This procedure is required for each PF1 (+pump), which has been configured with a fixed or incremental pump sleep mode.

For instructions on performing the iSet procedure, refer to Section 6.1.3.

5.2 Fan Protection Test

Required if: Fan Protection is enabled.

Using the Smart Tools software, configure the operational settings of the fan outlet.

5.3 Earth Leakage Test

Required if: Earth Leakage Protection is enabled.

In order to test that the earth leakage protection is functioning correctly, with the outlet running, inject a test current at 120% of the trip level setting through the centre of the toroid.

Confirm that the PF1 trips on an earth leakage fault and the outlet's main contactor is opened. The red "Trip" LED on the fascia of the PF1 should be illuminated.

This test will verify that the earth leakage toroid is functioning and is wired in correctly, as well as proving that the K1 output relay trips the main contactor when an earth leakage fault is detected.

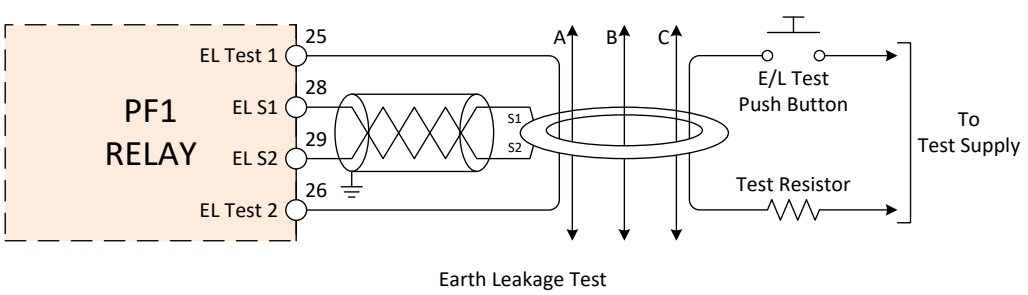

Figure 5.1: Earth Leakage Test Wiring

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5.4 Earth Continuity Test

Required if: Earth Continuity Protection is enabled.

In order to test that the earth continuity protection is functioning correctly, two tests must be performed: the series resistance test and the shunt resistance test.

These tests will verify that the earth continuity protection is functioning and is wired correctly, as well as proving that the K1 output relay trips the main contactor when an earth continuity fault is detected.

5.4.1 EC Series Resistance Test

The EC series resistance trip can be verified by creating an open circuit in the pilot line, or by temporarily installing a resistor in series with the pilot conductor. If a resistor is used, the value should be a minimum of 3Ω above the selected trip level to account for the tripping hysteresis level.

Confirm that the PF1 initiates an earth continuity trip and that the main contactor is opened. The red "Trip" LED on the fascia of the PF1 should be illuminated.

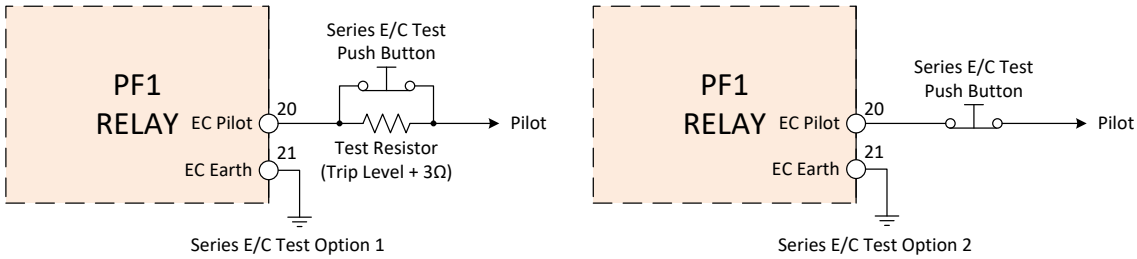

Figure 5.2: Earth Continuity Series Test Wiring Options

5.4.2 EC Shunt Resistance Test

The EC shunt resistance trip can be verified by creating a short circuit between the pilot line and earth, or by temporarily installing a resistor between the pilot line and earth. If a resistor is used, the recommended value is 820Ω (2W 1%).

Confirm that the PF1 initiates an earth continuity trip and that the main contactor is opened. The red "Trip" LED on the fascia of the PF1 should be illuminated.

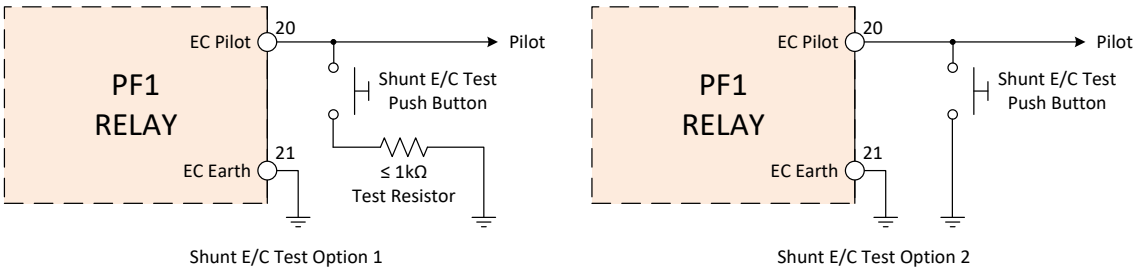

Figure 5.3: Earth Continuity Shunt Test Wiring Options

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5.5 Remote Stop Test

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

The PF1 can be configured as a standalone earth continuity relay (with or without earth leakage protection) or as a pump/fan protection relay with the added functionality of earth continuity protection.

If the PF1 is being used as a standalone earth continuity relay, the remote start function must be enabled or the earth continuity trip must be set to latching.

WARNING!

In Earth Continuity Only Mode, if **remote start is not enabled**, when the pilot resistance returns to a healthy range (remote stop button released) the **K1 output relay will energise**.

5.5.1 Remote Stop Test (Pump or Fan Mode Activated)

1. Energise the outlet and confirm that it is running.
2. Press the remote stop pushbutton that has been installed in the pilot line and confirm that the PF1 trips on earth continuity.
3. Release the remote stop button and confirm that the outlet does not re-energise.

5.5.2 Remote Stop Test (Pump & Fan Mode Disabled)

1. Energise the outlet and confirm that it is running.
2. Press the remote stop pushbutton that has been installed in the pilot line and confirm that the PF1 trips on earth continuity.
3. Release the remote stop button
    a. If a remote start button is installed, or the trip is set to latching the outlet should not re-energise.
    b. If a remote start button is not installed and the earth continuity trip is not set to non-latching, the outlet will re-energise. This is **not a recommended operating mode** for the PF1.

5.6 Remote Start Test

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

The remote start function requires that a 100Ω resistor be installed in series with the pilot line. If the remote start function is enabled, the 100Ω resistor must be sensed by the PF1 or an earth continuity trip will occur.

Perform the earth continuity tests described in Section 5.4 with the 100Ω installed.

Energise the outlet using the remote start pushbutton and confirm that it is running.

Stop the outlet then start it again using the remote start pushbutton and hold the pushbutton in. Confirm that an earth continuity trip occurs after a period of 15 seconds.

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6 PUMP PROTECTION

Pump Protection is a selectable operating function of the PF1 that provides additional protection and control functionality for outlets that are supplying pump motors.

Enabling Pump Protection provides two additional control functions that are individually configurable from within the Smart Tools software: Pump Sleep (Anti-Snore Mode) and Pump Resume after Power Failure.

NOTE

Enabling Pump Protection or Fan Protection provides additional control functions. **Pump Protection and Fan Protection cannot be simultaneously activated**.

Table 5: Pump Protection - Configuration - via Smart Tools PC Software

Enabled
Yes
No

Sleep Mode
None
Incremental
Fixed

Pump Resume After Power Failure
Yes
No

iSet Current (Minimum)
1.5A

iSet Startup Lookout Period
10s

iSet Source
Local and remote start

iSet Offset (Hysteresis)
5% - 20% (1% Increments)

Runtime: After Start (Minimum)
30s

Runtime: Between Sleeping
5s – 60s (1s Increments)

Sleep: Initial Delay (Incremental Only)	Sleep: Fixed Delay (Fixed Only)
0.5 minutes	0.5 minutes
1.0 minutes	1.0 minutes
2.0 minutes	2.0 minutes
3.0 minutes	3.0 minutes
4.0 minutes	4.0 minutes
5.0 minutes	5.0 minutes
10.0 minutes	10.0 minutes
15.0 minutes	15.0 minutes
20.0 minutes	20.0 minutes
30.0 minutes	30.0 minutes
60.0 minutes	60.0 minutes

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6.1 Pump Sleep 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. This 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 PF1 relay's Pump Sleep Mode (Anti-Snore Mode) provides protection against damage by initiating a sleep state when the outlet current falls below a set level (iSet value). After a user defined time period (determined by the sleep cycle settings), the PF1 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.

The PF1 monitors the outlet current via the supplied current transformer that is installed on one of the outlet phase conductors, and connected to the PF1 via the PF S1 terminal (32) and PF S2 terminal (33).

NOTE

The S1 and S2 terminals of the current transformer are interchangeable without affecting the operation of the PF1.

6.1.1 Sleep Modes

Pump Sleep mode can be configured to three states: "Off", "Incremental" and "Fixed". The Pump Sleep Mode can be selected using the Smart Tools software.

Table 6: Pump Sleep Mode Selection

Pump Sleep Mode	Description of Operation
Off	Deactivates Sleep Mode. Pump control will now be strictly manual, via the local or remote pushbuttons and/or via a float switch setup.
Incremental	In Incremental Sleep Mode each time that the PF1 enters a consecutive sleep cycle, the sleep time will increase. If water is present when the pump wakes up, the sleep time will reset back to its initial value.
Fixed	In Fixed Sleep Mode each time that the PF1 enters a sleep cycle, the sleep time will be a fixed value.

Setting the Pump Sleep Mode to either "Incremental" or "Fixed" mode will enable the PF1 Relay's sleep function. The terms "incremental" and "fixed" refer to the length of time that the relay remains in the sleep state each time that an undercurrent event occurs.

In Fixed Mode the length of time that the PF1 will operate in sleep mode remains constant regardless of the number of times that it consecutively enters a sleep state.

In Incremental Mode the length of time that the pump will remain in the sleep state will increase each time the PF1 initiates consecutive sleep states.

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The Incremental Mode time increase follows the formula of:

$$Incremental\ Sleep\ Time = Initial\ Delay\ \times 1.5^{x}$$

Where x is the number of times the PF1 has consecutively entered a sleep state. The x count is capped at 4 which represents a time period of roughly 5 times the initial delay. After the PF1 has entered sleep mode four consecutive times, the sleep time will no longer increase and will remain constant at that duration.

The PF1 is considered to have entered sleep mode consecutively if, after waking up from a sleep state, the pump operates for the defined period and does not exceed the specified undercurrent level. After an adjustable initial time period has passed, the PF1 will then initiate another sleep cycle and the consecutive sleep count will increase.

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

a) The under-current level is exceeded
b) The pump is stopped / tripped
c) The pump is started with the start button
d) The PF1 loses auxiliary power

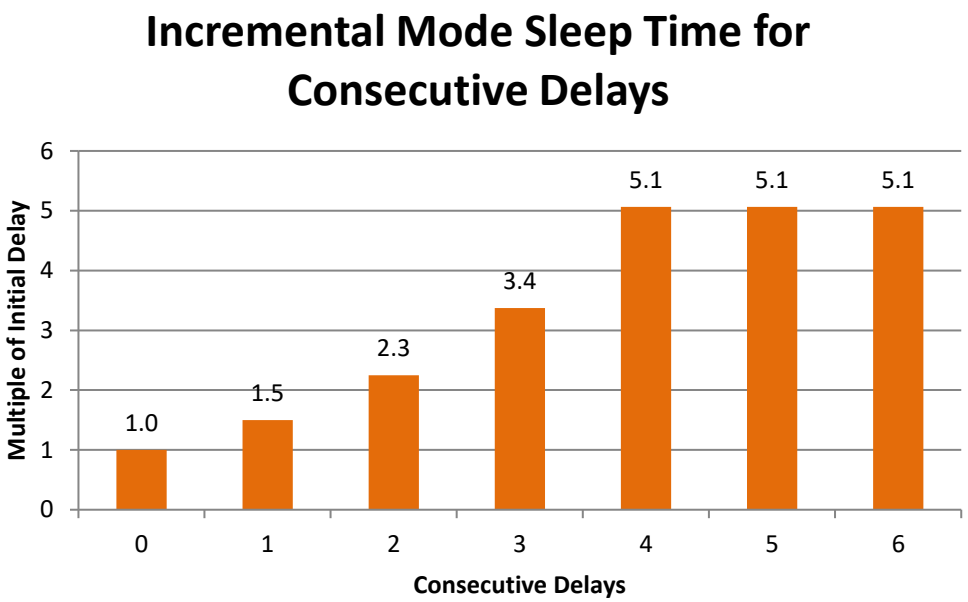

Figure 6.1: Sleep Mode: Incremental Time Multiples for Consecutive Sleeps

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6.1.2 Sleep Cycle Settings

The sleep cycle settings affect the operation of the PF1 relay's sleep function.

Table 7: Sleep Cycle Setting Definitions

Pump Mode Parameter	Set by	Options	Setting Description
iSet Current Level	Local or Remote Start	-	The current that the outlet draws when the pump intake pipe is withdrawn from the water. (under-current / no-load current)
iSet Offset (Hysteresis)	PC Software	5%,10%,15%, 20%	A percentage of the *iSet Current Level*. The PF1 will initiate its sleep mode sequence when the load current falls below the *iSet Current Level* + the *iSet Offset (Hysteresis)*.
iSet Current (Minimum)	PC Software	1.5A (fixed value in this version)	The minimum current value that the outlet must be drawing before the iSet current value can be set.
iSet Start-Up Lockout Period	PC Software	10 seconds (fixed value in this version)	The minimum amount of time that must elapse after the outlet is started before the *iSet Current Level* can be set.
Runtime: After start (Minimum)	PC Software	30 seconds (fixed value in this version)	The minimum period of time that the PF1 will run the outlet before it will enter sleep mode. It will only enter sleep mode if the outlet current is less than the undercurrent level.
Runtime : Between sleeping (Minimum)	PC Software	5 to 60 seconds (1s increments)	The minimum time that the outlet will run after it exits sleep mode if the current is still below the undercurrent level.
Sleep Time (Initial Delay)	PC Software	0.5, 1, 2, 3, 4, 5, 10, 15, 20, 30, 60 (minutes)	Only used if the Incremental Sleep Mode has been selected. This value will be the initial delay time when the PF1 enters sleep mode. After the initial sleep, the length of each subsequent sleep will increase as described in Section 6.1.1. If the outlet current sensed by the PF1 exceeds the undercurrent level during any of the periods when it awakens, then the delay length will reset back to the base level initial delay.
Sleep Time (Fixed Delay)	PC Software	0.5, 1, 2, 3, 4, 5, 10, 15, 20, 30, 60 (minutes)	Only used if the Fixed Sleep Mode has been selected. This value will be the time duration of the PF1 sleep. This sleep duration is fixed and will not increase for consecutive sleeps.

NOTE

If the minimum operating current of the connected pump is below 3A, it is recommended that multiple turns of the phase conductor be wound through the Phase Current Transformer (CT) to increase the sensitivity of the circuit.

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6.1.3 iSet Procedure

In order for the PF1 to register the under-current level of the pump that the outlet is supplying, the iSet value of the pump motor must be set.

> **NOTE**
>
> When the Pump configuration is changed, the **iSet parameter stored in the PF1 will be reset to infinity**. The user will be required to perform the iSet procedure.

If set correctly, the iSet level is the current that the pump motor draws when the water intake pipe is sucking air.

> **NOTE**
>
> The current at which the PF1 will initiate a sleep cycle is determined as:
>
> $$iSet\ Current + (iSet\ Offset\ (Hysteresis)\ Percentage\ \times iSet\ Current)$$

In order to set the iSet Current (aka iSet level) in the PF1, the PF1 relay must be powered and power must be available at the outlet that is to be energised. Follow the procedure below to set the iSet level:

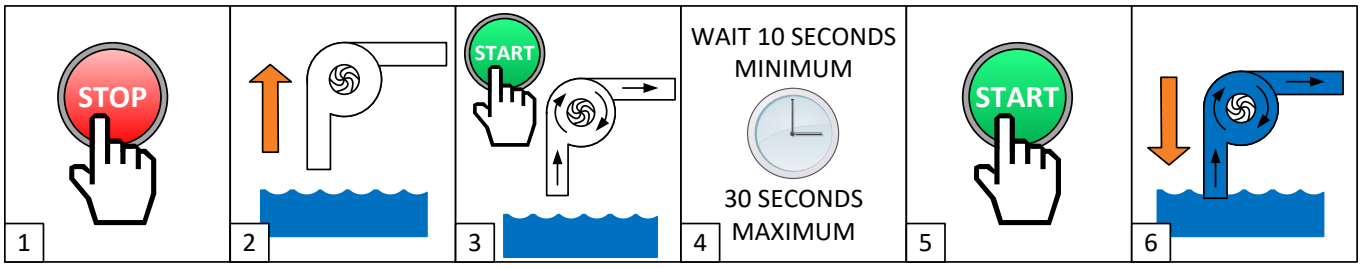

Figure 6.2: Sleep Mode iSet Procedure

1. Ensure that the outlet is stopped and that no faults are present.
2. Remove the pump's intake pipe from the body of water.
3. Press either the local start button or the remote start button to start the outlet.
4. After the outlet has started there is a 10 second period (*iSet Start-Up Lockout Period*) in which the iSet parameter cannot be set. This is to prevent inadvertent setting of the iSet level during the start-up sequence.
   The window in which the iSet level can be set is after the 10 second lockout period has ended and before the *Runtime: After start (Minimum)* period has expired (factory set to 30 seconds). The total window in which the iSet level can be set is 20 seconds.
5. Whilst in the permissible period, while the outlet is already running, press either the local start button or the remote start button to set the iSet level.
   If iSet was successfully set, the PF1 will immediately go into a sleep state, confirming that a successful iSet has taken place. To bring the PF1 out of the sleep state, simply press the start button again.
6. After setting the iSet level, replace the pump's intake pipe into the body of water.
   Once the *Runtime: After start (Minimum)* time period has expired, the PF1 will measure the current draw on the outlet. If this value is less than the undercurrent level, then it will enter a sleep cycle. If it is not, it will continue to pump.

The iSet value of the PF1 is intended to be set each time a new/different pump is powered from the same outlet.

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6.1.4 Pump Sleep Mode Operating Logic

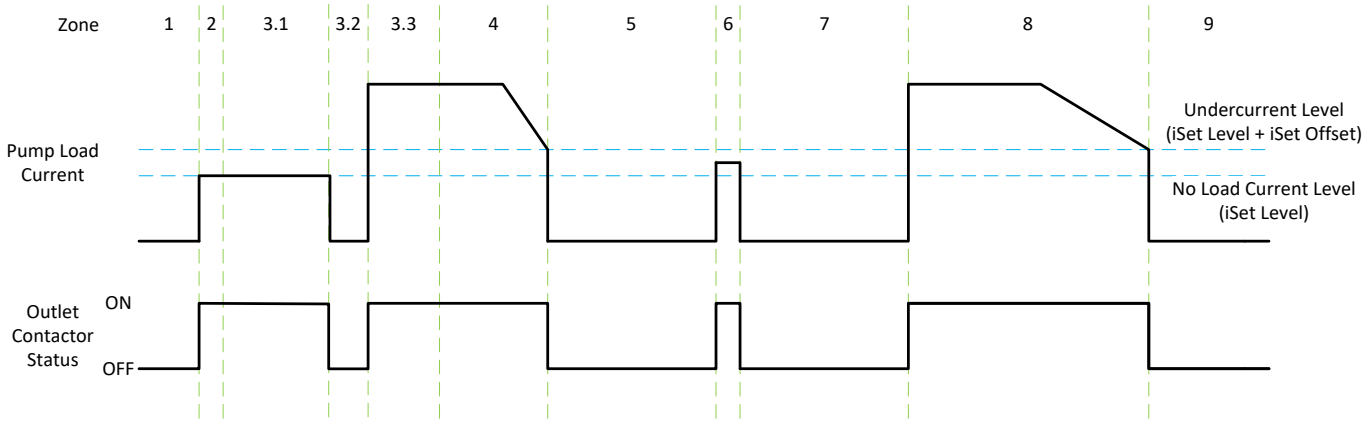

Figure 6.3: Pump Sleep Mode Operating Logic Diagram (See Table 8)

Table 8: Pump Sleep Mode Operating Logic Zone Descriptions

Zone	Description
1	PF1 is powered and the outlet is stopped
2	The user starts the outlet by pressing the local start or remote start pushbutton, which closes the outlet contactor. Zone 2 is known as the *iSet Lockout Period*. Setting of the *iSet* level is disabled for this period, in order to prevent an accidental setting of the *iSet* level by double pressing the start button. The *iSet Lockout Period* for this version of the PF1 is fixed at 10 seconds.
3	During the Zone 3 period the user is able to set the iSet level. The length of this window is determined by the *Runtime: After start (minimum)* setting minus the *iSet Lockout Period*. The *Runtime: After start (minimum)* setting and the *iSet Lockout Period* for this version of the PF1 are fixed at 30 seconds, and 10 seconds respectively. This results in a permissible iSet window of 20 seconds. In order to set the iSet value: 1. Remove the intake pipe from the water to remove the load from the pump. 2. Set the iSet level by pressing the local start or remote start pushbutton. The setting of the iSet level will be confirmed by the PF1 immediately entering a sleep state. (shown in Zone 3.2) 3. Place the intake pipe back into the water. 4. It is possible to bring the PF1 out of the sleep state (caused by setting the iSet level) by pressing the start button again. This is shown in Zone 3.3 of the above example.

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Zone	Description
4	The beginning of Zone 4 marks the end of the minimum runtime after starting period. If the load current is not above the specified undercurrent level at this point, then the pump will enter a sleep cycle. Otherwise, if the pump is running above this level, it will continue to run.
5	At Zone 5, the load current has fallen below the specified undercurrent level. This undercurrent level is calculated as the iSet value plus the iSet Offset percentage (set using the software). This signifies that the pump is sucking air (snoring) and that a sleep cycle should begin. The length of this sleep is determined by the programmed settings.
6	The PF1 has woken up from its sleep cycle to check the outlet current level. This current is found to still be below the undercurrent level. The pump will run for a set period of time (user adjustable using the *Runtime: Between sleeping (minimum)* setting) before the PF1 will re-enter the sleep state.
7	The PF1 re-enters a sleep state. In this instance the PF1 can be seen to be in Fixed Sleep Mode as the length of the sleep cycle is the same as in Zone 5. If the PF1 was in Incremental Mode, this subsequent sleep cycle would have been longer.
8	The pump function has awoken and found that the load current has risen above the undercurrent level. It will now run until the current level falls below the undercurrent level again. If the PF1 was in incremental mode, the sleep count would be reset and the length of the next sleep cycle would revert back to the value depicted in the *Sleep: Initial Delay* setting.
9	The PF1 has sensed that the load current has fallen below the undercurrent level and has entered a sleep state.

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6.2 Auto/Manual Mode

Auto/Manual Mode allows the operators to switch between Auto and Manual pump control in the field, without needing to change the PF1 configuration each time. Typically, a Double Pole Double Throw Relay (DPDT) is installed as shown in the diagram below.

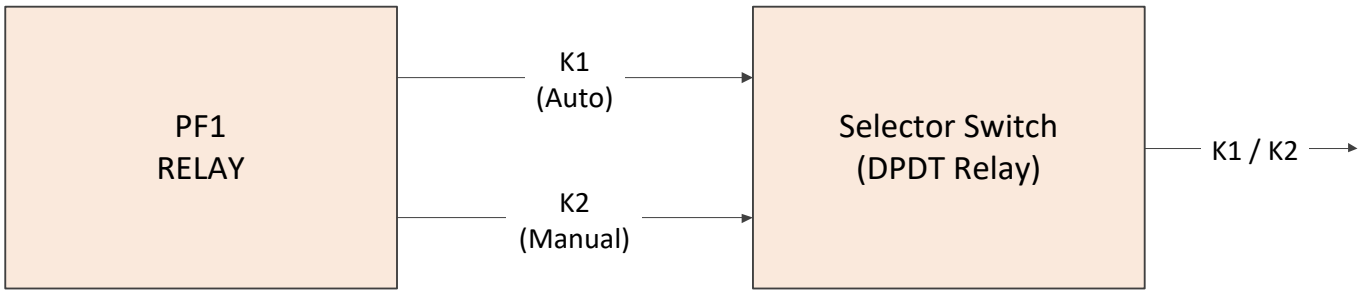

Figure 6.4: Auto/Manual Mode

Table 9: PF1 Configuration for Auto/Manual Mode

PF1 Typical Configuration – Pump Mode (Only) – With Auto / Manual option		
Setting Category	**Setting Type**	**Setting**
Pump Protection	*Enabled*	Yes
	Sleep Mode	None
	Pump Resume After Power Failure	Yes
Fan Protection	*Enabled*	No
Output Relays (K2)	*Enabled*	Yes
	Default State	Closed (energised)
	Pump Stopped	Checked
	EL tripped	Checked
	EC tripped	Checked

NOTE

Manual mode will not work properly unless there is a valid iSet value, as it relies on correct operation of the pump algorithm.

Without a valid iSet value, Auto / Manual mode will only run for 30 seconds, before stopping – failsafe.

6.3 Pump Float Switch

If Pump Protection is enabled and the Sleep period set to “Off”, it is possible to control the PF1 pump function by means of a float switch. The float system is simply a high and low water level float switch, which is interfaced with the local Start and Stop inputs of the PF1. An external stop button, on the face of the starter panel, would be included.

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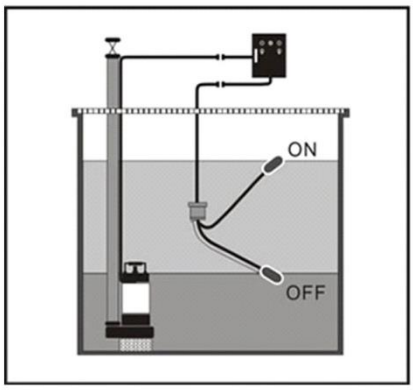

Figure 6.5: Pump Float Switch

Table 10: Pump Float Switch Logic

	Start	Stop
Water level is above limit	Closed	Closed
Water level is below limit	Open	Open

NOTE

The following points must be considered when the float arrangement is used. The PF1 Start input must be cycled for each start; it is an edge sensitive input. The PF1 Stop input is level sensitive. So long as the Stop input is open, the pump will remain in the stopped state, regardless of the Start input state.

6.4 Pump Resume after Power Failure

If Pump Protection is enabled, it is possible to configure the PF1 to re-close the outlet after system power is restored from an outage. This is called the “Resume after Power Failure” function and it is independent of the Pump Sleep Mode.

If auxiliary power is lost to the system while the pump outlet is running, when the power supply is restored, the PF1 will close the outlet and allow pumping to resume. This function will only operate if all PF1 enabled tripping functions are healthy (e.g. EL and EC).

In order to enable this feature of the PF1, ensure that the relay is in Pump Control Mode and use the Smart Tools software to toggle the *“Pump Resume after Power Failure”* setting to “Yes”.

WARNING!

If the PF1 is set to resume after a power failure, the pump can and will energise after a power outage. All operators should be aware of this.

This setting should be used with caution.

6.5 Pump Remote Start and Stop

In order to use the remote start and stop feature of the PF1, the Earth Continuity (EC) protection setting must be enabled using the supplied Smart Tools software. Once the EC protection has been enabled, then the remote start feature can be enabled.

For information on the setup and operation of the PF1’s remote start and stop features, refer to Section 9.5.

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7 FAN PROTECTION

Fan Protection is a selectable operating function of the PF1 that provides additional protection and control functionality for outlets that are supplying fan motors.

Enabling Fan Protection provides a burp mode that allows ventilation tubes to be gradually inflated, preventing tearing due to sudden pressure increases.

NOTE

Enabling Fan Protection or Pump Protection provides additional control functions. **Fan Protection and Pump Protection cannot be simultaneously activated**.

Table 11: Fan Protection - Configuration - via Smart Tools PC Software

Enabled
Yes
No

Burp Cycles
None
1
2
3
4

Burp X On Period
1s
2s
3s
4s
5s
10s
15s
20s

Burp X Off Period
1s
2s
3s
4s
5s
10s
15s
20s

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7.1 Fan Burp Mode

The PF1 provides an additional control method that is specifically for use on outlets supplying fan motors. The Burp Mode provides protection against the ripping of ventilation tubes caused by rapid inflation.

Due to the sudden and continuous pressure differential along the length of the airbag during initial inflation, the walls of the bags can rip, requiring costly repair. The PF1 relay'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.

Burp Mode can be set from 0 to 4 cycles. If "None" is selected, then the Burp Mode will be disabled and the PF1 will not perform any pulsing of the fan motor during start up. If a number of Burp cycles are selected, then it is possible to individually alter the duration of each burp. After the PF1 completes the prescribed number of Burp cycles, the fan motor will run normally.

The Burp Mode functionality is configured using the Smart Tools software.

Table 12: Burp Mode Setting Definitions

Fan Mode Setting	Set by	Options	Setting Description
Enabled	PC Software	Yes, No	This setting enables and disables the Fan mode. Fan Mode cannot be enabled whilst Pump Mode is enabled (and vice versa).
Burp cycles	PC Software	0, 1,2,3,4	Sets the number of Burp cycles. Setting the number to "0" is the will disable the Burp function.
Burp 1 On period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be energised in the first pulse.
Burp 1 Off period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be de-energised after the first pulse.
Burp 2 On period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be energised in the second pulse (if enabled).
Burp 2 Off period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be de-energised after the second pulse (if enabled).
Burp 3 On period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be energised in the third pulse (if enabled).
Burp 3 Off period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be de-energised after the third pulse (if enabled).
Burp 4 On period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be energised in the fourth pulse (if enabled).
Burp 4 Off period	PC Software	1, 2, 3, 4, 5, 10, 15, 20 (seconds)	Sets the duration that the fan will be de-energised after the fourth pulse (if enabled).

7.2 Fan Remote Start and Stop

In order to use the remote start and stop feature of the PF1, the Earth Continuity (EC) protection setting must be enabled using the supplied Smart Tools software. Once the EC protection has been enabled, then the remote start feature can be enabled.

For information on the setup and operation of the PF1 relay's remote start and stop features, refer to Section 9.5.

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8 EARTH LEAKAGE: AS/NZS 2081 PROTECTION FUNCTION

The PF1 has a selectable Earth Leakage (EL) protection function, which has been designed in accordance with AS/NZS 2081: 2011. This function monitors the earth fault current on the protected outlet via a summation toroid and trips the outlet's main contactor when the measured current exceeds the trip limit.

The earth leakage protection function uses a definite time operating characteristic with adjustable trip sensitivity and an adjustable time delay. When a fault occurs that exceeds the set trip level and time delay, an earth leakage trip occurs.

When an earth leakage trip occurs, the PF1 will de-energise the K1 output relay to trip the outlet's main contactor. All earth leakage trips are latching and are required to be reset before the outlet can be restarted again. Before a reset is performed the source of the earth leakage trip should be found and rectified.

The PF1 relay's earth leakage protection settings can be configured using the Smart Tools software. Adjustable settings are: Enabled, Bandwidth Mode, Trip Current, and Trip Time.

Table 13: Earth Leakage Protection - Configuration - via Smart Tools PC Software

Enabled	Bandwidth Mode	Trip Time	Trip Current
Yes	Wide	50 ms	30 mA
No	50Hz	100 ms	100 mA
		150 ms	150 mA
		200 ms	200 mA
		300 ms	250 mA
		400 ms	300 mA
		500 ms	350 mA
			400 mA
			450 mA
			500 mA
			1000 mA

8.1 Earth Leakage Bandwidth Mode

The PF1 has two modes of operation for its earth leakage protection function; 50Hz and Wide mode.

8.1.1 50Hz Mode

When 50Hz mode is selected, the PF1 uses a band pass filter to prevent tripping on earth leakage currents outside of the 50Hz power frequency range. This is not the preferred mode of operation, as in this mode the PF1 could filter out potentially harmful "noise" on the mains frequency.

NOTE

The PF1 has been designed with a safety function within the 50Hz mode that initiates an earth leakage trip if the measured earth leakage current exceeds 1.1A, even if that current is outside the 50Hz envelope.

8.1.2 Wide Mode

When Wide mode is selected, the PF1 will sense earth leakage currents in the 30 to 500Hz frequency range. ***This is the preferred mode of operation***, as in this mode the PF1 will provide protection against earth leakage faults across a much wider frequency range.

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8.2 EL Toroid Monitoring

The PF1 generates a CT detection signal continuously to test the integrity of the Earth Leakage circuit. The CT detection signal tests the toroidal current transformer, the wiring loop to the toroid and the input to the protection relay as required by AS/NZS 2081:2011.

If the PF1 fails to detect the CT detection signal via the earth leakage toroid, an earth leakage trip will be initiated, opening the main contactor. This fault must be present for at least 5 seconds to cause a trip.

NOTE

The CT detection wiring must have a **loop resistance below 2Ω**.

8.3 EL Reset Procedure

To use the reset function the user must connect a switch (normally open momentary pushbutton) between the Reset input terminal (5) and the VDC digital input supply terminal (4) (refer to Figure 4.4).

The user must manually reset an earth leakage trip after a fault has occurred. The procedure is as follows:

1. Investigate and rectify the fault as per site procedures.
2. Press the reset button for a minimum of 300ms.

NOTE

Performing a reset operation will reset all of the PF1 relay's latched trips, provided any fault conditions are no longer present.

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9 EARTH CONTINUITY: AS/NZS 2081 PROTECTION FUNCTION

The PF1 has a selectable earth continuity (EC) protection function, which has been designed in accordance with AS/NZS 2081: 2011. This protection function checks the integrity of the earth connection between an outlet and a load via the pilot conductor in the cable.

In a typical installation the PF1 relay's EC Pilot terminal (20) will be connected to the pilot conductor of a trailing or reeling cable. The load end of the pilot conductor is terminated with a diode to earth, creating a return path through the earth conductors of the cable to the main earth point of the outlet and then to the PF1 relay's EC Earth terminal (21).

CAUTION!

The 1N5404 type diode must be used in the pilot termination for AS/NZS 2081 compliant operation.

The PF1 measures the resistance of the pilot-earth loop (series resistance) and the resistance between the pilot and earth (shunt / insulation resistance). If the pilot-earth loop resistance rises above the set trip level for a period of time that exceeds the set trip time, an earth continuity trip will occur. If the pilot to earth resistance falls below the shunt resistance trip level of 1.25kΩ, for longer than the set trip time, an earth continuity trip will occur.

In the event of an earth continuity trip, the PF1 will de-energise the K1 output relay, tripping the outlet's main contactor.

An earth continuity trip can be configured as latching or non-latching. This allows the user to choose if the trip is manually or automatically reset once the pilot-earth loop is healthy.

NOTE

Cable parameters are important to the correct operation of the Pilot EC function. Resistance & capacitance values limit the length of cable that the relay can drive (refer to Section 13).

The PF1 relay's earth continuity protection settings can be configured using the Smart Tools software. Adjustable settings are: Enabled, Trip Latching, Remote Start, Trip Resistance: Series (Maximum), and Trip Time.

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Table 14: Earth Continuity Protection - Configuration - via Smart Tools PC Software

Enabled
Yes
No

Trip Latching
Yes
No

Remote Start
Yes
No

Trip Resistance: Series (Maximum)
10 Ω
15 Ω
20 Ω
30 Ω
45 Ω

Healthy Hysteresis: Series
-3 Ω

Trip Resistance: Shunt (Minimum)
1250 Ω

Healthy Hysteresis: Shunt
+100 Ω

Trip Time
50 ms
100 ms
200 ms
300 ms
400 ms
500 ms

9.1 EC Series Resistance Monitoring

The PF1 measures the series resistance of the pilot-earth loop by applying a positive voltage to the pilot conductor and measuring the pilot current. If the measured series resistance is above the trip setting for a period of time that exceeds the set trip time, the PF1 de-energises the K1 output relay to trip the outlet's main contactor.

The fault must be cleared before the PF1 will allow the outlet to be restarted.

In non-latching mode, the PF1 will automatically reset after the fault has been cleared.

In latching mode, the PF1 must be reset after the fault has been cleared, before the outlet can be started.

The EC series resistance monitoring function has a built in hysteresis that prevents an earth continuity trip from being reset if the measured resistance is hovering around the trip level. The resistance must fall below the trip level minus the hysteresis amount before an earth continuity fault can be reset. The earth continuity series hysteresis has a default setting of 3Ω. This value is fixed in this version of the PF1.

9.2 EC Shunt Resistance Monitoring

The PF1 measures the shunt resistance (pilot to earth) by applying a negative voltage to the pilot conductor and measuring the pilot current. If the shunt resistance is detected to be below 1.25kΩ for a period of time that exceeds the set trip time, the PF1 de-energises the K1 output relay to trip the outlet's main contactor.

The fault must be cleared before the PF1 will allow the outlet to be restarted.

In non-latching mode, the PF1 will automatically reset after the fault has been cleared.

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In latching mode, the PF1 must be reset after the fault has been cleared, before the outlet can be started.

The EC shunt resistance monitoring function has a built in hysteresis function that prevents an earth continuity trip from being reset if the measured resistance is hovering around the trip level. The resistance must increase above the trip level plus the hysteresis amount before an earth continuity fault can be reset. The earth continuity shunt hysteresis has a default setting of 100Ω. This value is fixed in this version of the PF1.

9.3 EC Latching Mode (Selectable)

When the PF1 is set to latching mode, all earth continuity faults need to be reset manually. A latched earth continuity trip will prevent the outlet from starting, even if the earth continuity fault has been rectified.

9.4 EC Reset Procedure

To use the reset function, the user must connect a switch (normally open momentary pushbutton) between the Reset input terminal (5) and the VDC digital input supply terminal (4) (see Figure 4.4).

The user must manually reset an earth leakage trip after a fault has occurred. The procedure is as follows:

1. Investigate and rectify the fault as per site procedures.
2. Press the reset button for a minimum of 300ms.

NOTE

Performing a reset operation will reset all of the PF1 relay's latched trips, provided any fault conditions are no longer present.

9.5 Remote Operation Functionality

Provided that the PF1 relay's earth continuity protection function is enabled, the PF1 allows a remote start and a remote stop pushbutton to be installed in the motor enclosure. This allows the outlet to be energised and de-energised remotely at the motor, eliminating the need for the operator to return to the power supply enclosure for general operations.

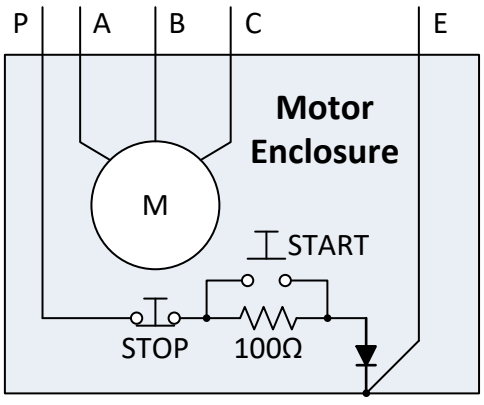

Figure 9.1: Remote Start & Remote Stop Implementation

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9.5.1 Remote Start

In remote start mode, a 100Ω resistor (1%, 5W) must be connected in series with the pilot circuit and a normally open pushbutton connected in parallel to this resistor. The loop resistance of the circuit will then be 100Ω plus the resistance of the pilot-earth loop.

To start the PF1 in remote start mode the following sequence must be followed:

1. All trips must be clear.
2. The start resistor must be detected in the pilot circuit.
3. The start button must be pressed for a minimum of 300ms.
4. The start button must be released within 15s or “Start Button timed out / stuck” trip will occur.

If the Earth Continuity trip is set to non-latching, the start timed out fault will automatically be reset once the start resistor is detected (a manual reset is not required).

NOTE

Remote Start mode must be enabled using the Smart Tools software before a remote start function can be implemented.

Remote start is typically used in conjunction with non-latching mode.

9.5.2 Remote Stop

A 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 upstream earth continuity trip.

If the earth continuity is not set to latch, the relay can be both started and stopped at the motor enclosure.

If the earth continuity trip is set to latching mode, a reset must be performed before the outlet can be started again.

NOTE

EC Latching Mode allows an **emergency stop button** to be installed in the pilot line.

The PF1 can be set as a standalone earth continuity relay (pump and fan protection both set to off).

If set as a standalone earth continuity relay, the remote start button should be used, or the earth continuity trip should be set to latching.

WARNING!

If the PF1 is set to operate as a **standalone earth continuity relay** with a non-latching trip, and the **remote start function is disabled**, the PF1 will **energise the K1 output relay** when the pilot resistance returns to a healthy range e.g. when the remote stop button is released.

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10 SMART TOOLS SOFTWARE

The PF1 is supplied with the Smart Tools PC software. This program allows the user to configure the protection settings of the PF1, along with providing a number of diagnostic tools.

This software is provided on a USB drive that is supplied with each PF1. The latest version of the Smart Tools software can be found by visiting the Ampcontrol website and navigating to the Software folder in the Technical Resources Library.

http://www.ampcontrolgroup.com/technical-resources/

NOTE

The Smart Tools software package has an **integrated help system** that explains the use of the software tool in detail.

10.1 Operating System Requirements

Smart Tools has been tested to work with Windows 7, 8 and 10, extensive testing has only been conducted for Windows 7. A driver signature verification workaround will be required for the installation of Smart Tools on machines running 64-Bit versions of Windows 8 and 10. Refer to Appendix A or the Ampcontrol website for details on this process.

Table 15: Minimum System Requirements for Running the Smart Tools Software

Category	Requirement
Operating System (minimum)	Windows 7 (32 or 64 bit)
Display Resolution (minimum)	1024 x 768
Available USB Ports (minimum)	1

10.2 Software Version Naming Conventions

New Smart Tools software releases will periodically become available on the Ampcontrol webpage. These versions will consist of Major and subsequent Patch releases (minor).

Major versions will have the naming convention of vM.0.0 (where M is 1, 2, 3 etc.).

Patch releases will have the naming convention of vM.x.x (where M is 1, 2, 3 etc.).

As Major releases are typically quite large (>100Mb), users can download a Patch release (typically around half the size) for installation. This is provided that the M value of their current installation matches that of the available Patch release. If the M value does not match, the Major release must be downloaded and installed first.

NOTE

There will be two variations for each major and minor version of software, according to the intended version of Window's. The correct installation file will contain either x86 or x64, for 32 and 64-Bit operating systems respectively.

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10.3 Connecting the PF1 to Your PC

In order to communicate with the PF1 it is first necessary to install the Smart Tools software package. For information on this process, please refer to the Installation Guide in APPENDIX A:

To connect (USB communications) to the PF1:

1. Launch Smart Tools.
2. Connect the supplied USB Type A to USB Mini cable between your PC and the PF1.
3. The software should automatically detect the port that the PF1 has been plugged into and communication should now be established.
4. If communication is not established, it may be necessary to manually enter the USB port number into the Smart Tools software from within the “Smart Tools Settings” page. For further information and help on troubleshooting, refer to the in program help tool (Help ?).

NOTE

The PF1 does not require an external power source to communicate with Smart Tools. The PF1 will run on USB power; however, the **output relays will not close if no external power source is connected**.

10.4 Navigating the User Interface

The Smart Tools software has been presented in a manner that allows operation with minimal training.

The menu bar on the left side of the interface allows the user to switch between the different screens of the program.

10.4.1 Home Page

The home page exists primarily to allow the user to select the Relay Type being used. Once the Relay Type has been selected, an image of the Relays front panel will be displayed, allowing the user to validate their choice. At present, only the PF1 is supported in Smart Tools.

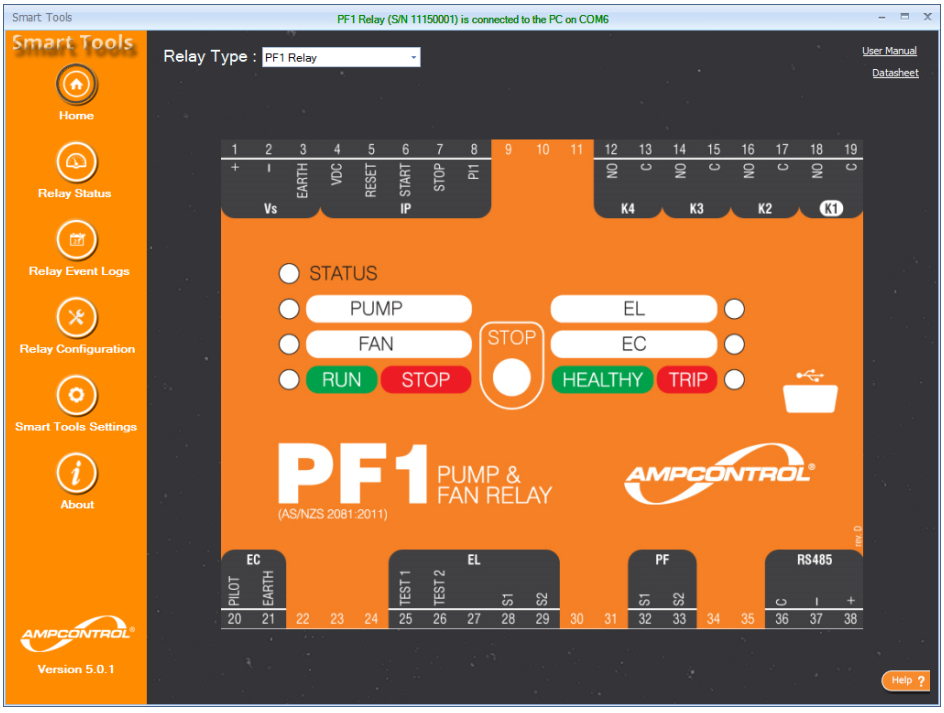

Figure 10.1: Smart Tools Software - Home Page

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10.4.2 Relay Status Page

The Relay Status page allows the user view the status of the connected PF1 in real time. This can be used as a diagnostic tool if the user is experiencing faults on the system.

NOTE

The measured values that are displayed on the Relay Status page and in the Event Logs are for indicative purposes only.

NOTE

The values displayed in the status screen do not update in real time. **In order to update the values, click on the Update button.**

From this screen it is also possible to both open and save status files.

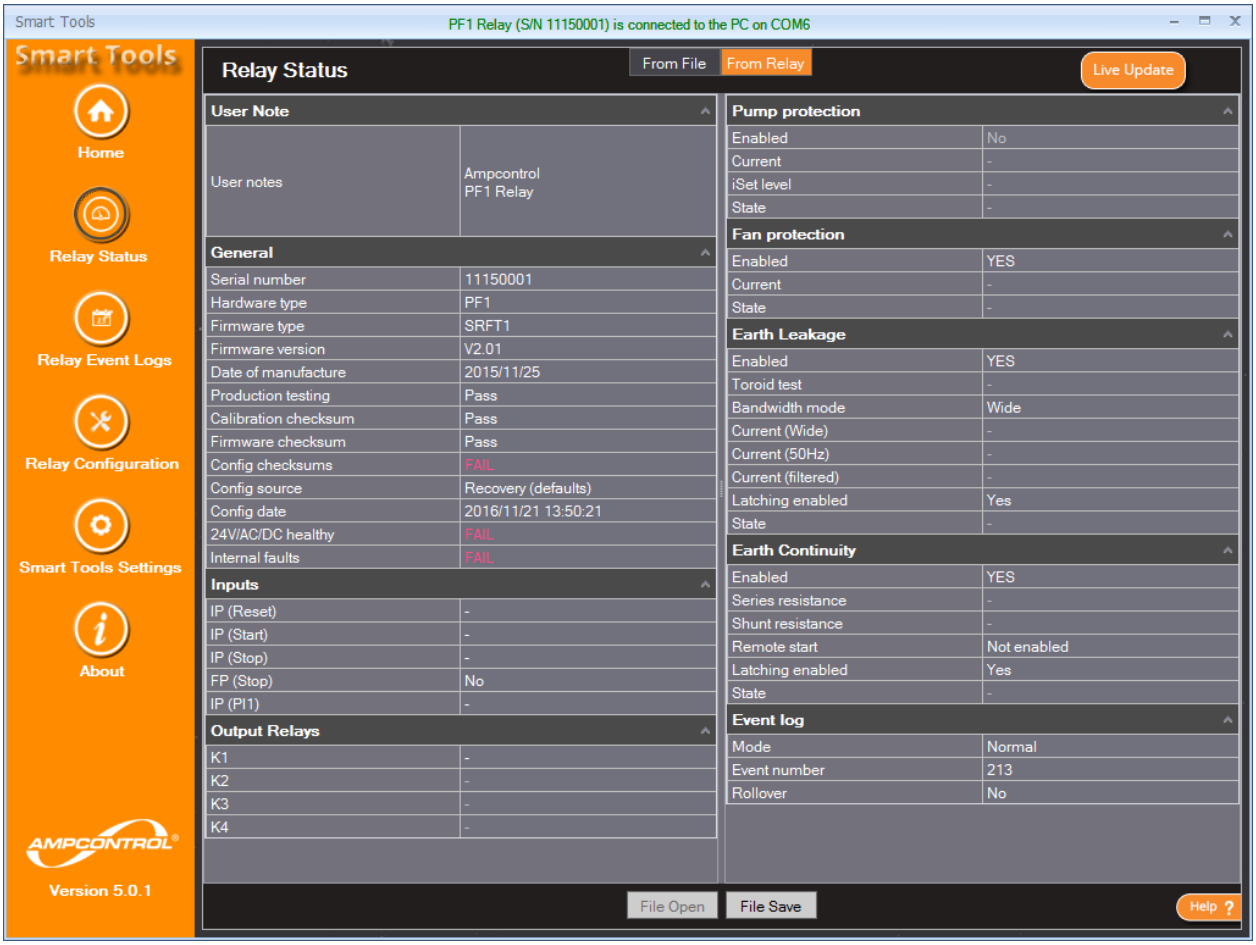

Figure 10.2: Smart Tools Software - Relay Status Page

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10.4.3 Relay Event Logs Page

The PF1 is provided with an event logging system that allows the user to diagnose system faults and review operational data. Each event is given a **relative time stamp.** Using the “Calculate Time” feature, the user can determine the elapsed time, between any 2 events.

NOTE

The PF1 relay does not have a real time clock. Using the “Calculate Time” feature, the user can determine the elapsed time, between any 2 events.

From this screen it is also possible to both open and save event log files.

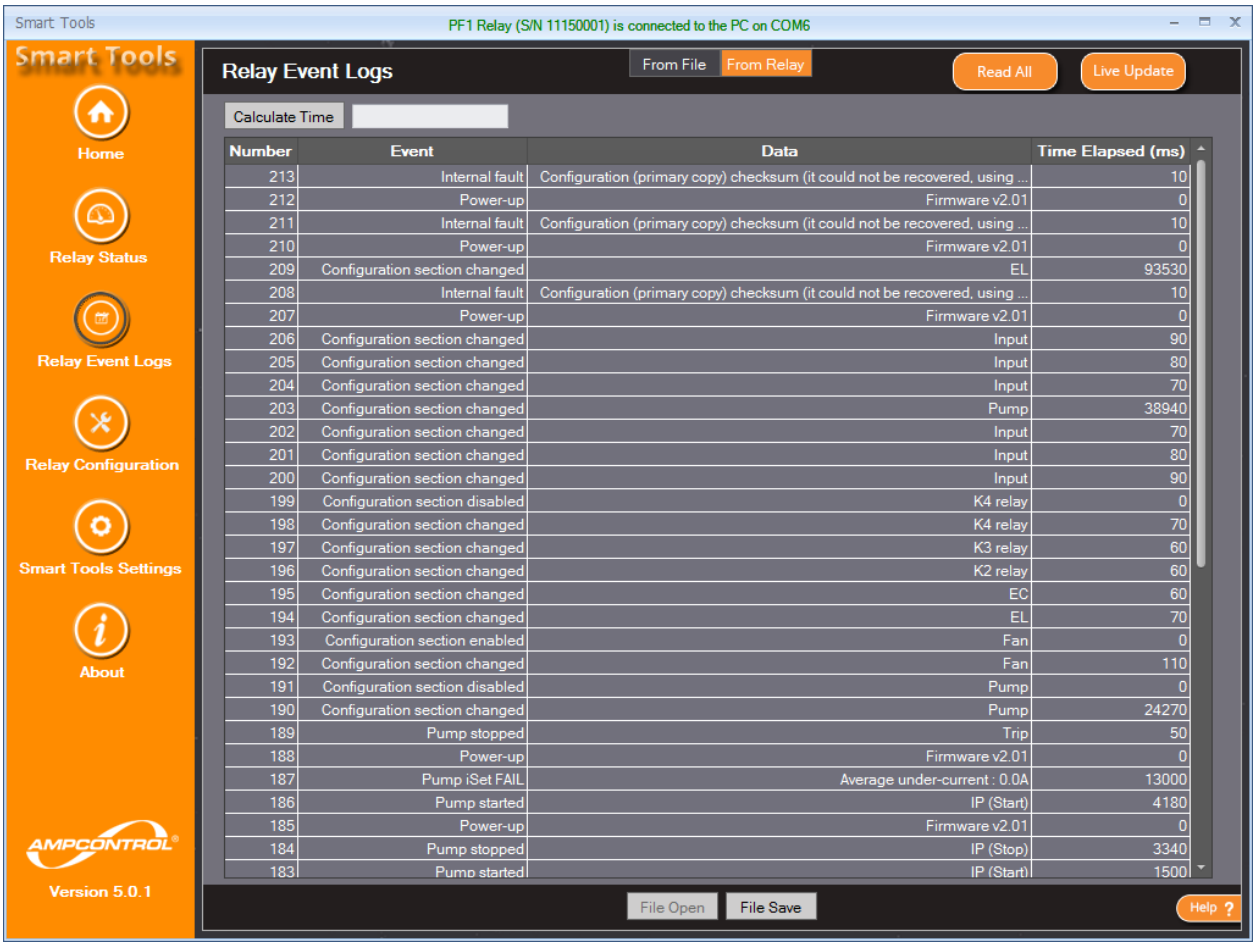

Figure 10.3: Smart Tools Software - Relay Event Logs Page

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10.4.4 Relay Configuration Page

The Relay Configuration page allows the user to manage the PF1 configuration.

The configuration page is split into 2 sections:

a) File (PC) on the left side / column, which allows creation and editing of the configuration.
b) Relay on the right side / column, which is read only.

Upon launching Smart Tools, the values that appear on the “File (PC)” side will either be the factory defaults, or the values that have been read from the connected relay.

Any differences between the “File” column and the “Relay” column, will be highlighted in light red.

NOTE

If the user desires to force the “File (PC)” column to the settings that are present in the Relay, they must **click the “Copy to File” button** at the top of the “Relay” column.

The user is able to make changes to the settings within the File (PC) column. These settings will not be loaded into the PF1 until the “Save to Relay” button (top of the File (PC) column) is pressed.

NOTE

Editing the configuration in Smart Tools **does not change** the configuration in the PF1 **until the “Save To Relay” button has been pressed.**

When the “Save to Relay” button is pressed the user will be prompted for a password.

NOTE

The **password** for altering the settings in the PF1 is the **last four digits of the serial number**. Thus the password is **different for each PF1 relay**.

New settings can be loaded into the PF1 whilst the outlet is in service. However, upon loading the new settings the PF1 will perform an automatic re-boot. At this point, all output relays (K1, K2, K3 and K4) will open, resulting in the outlet de-energising.

NOTE

It is not recommended to update the settings of the PF1 while the outlet is in service.

For detailed help on the user interface features for this page, refer to the Smart Tools Integrated Help by clicking on the “Help?” icon in the bottom right hand corner of the page.

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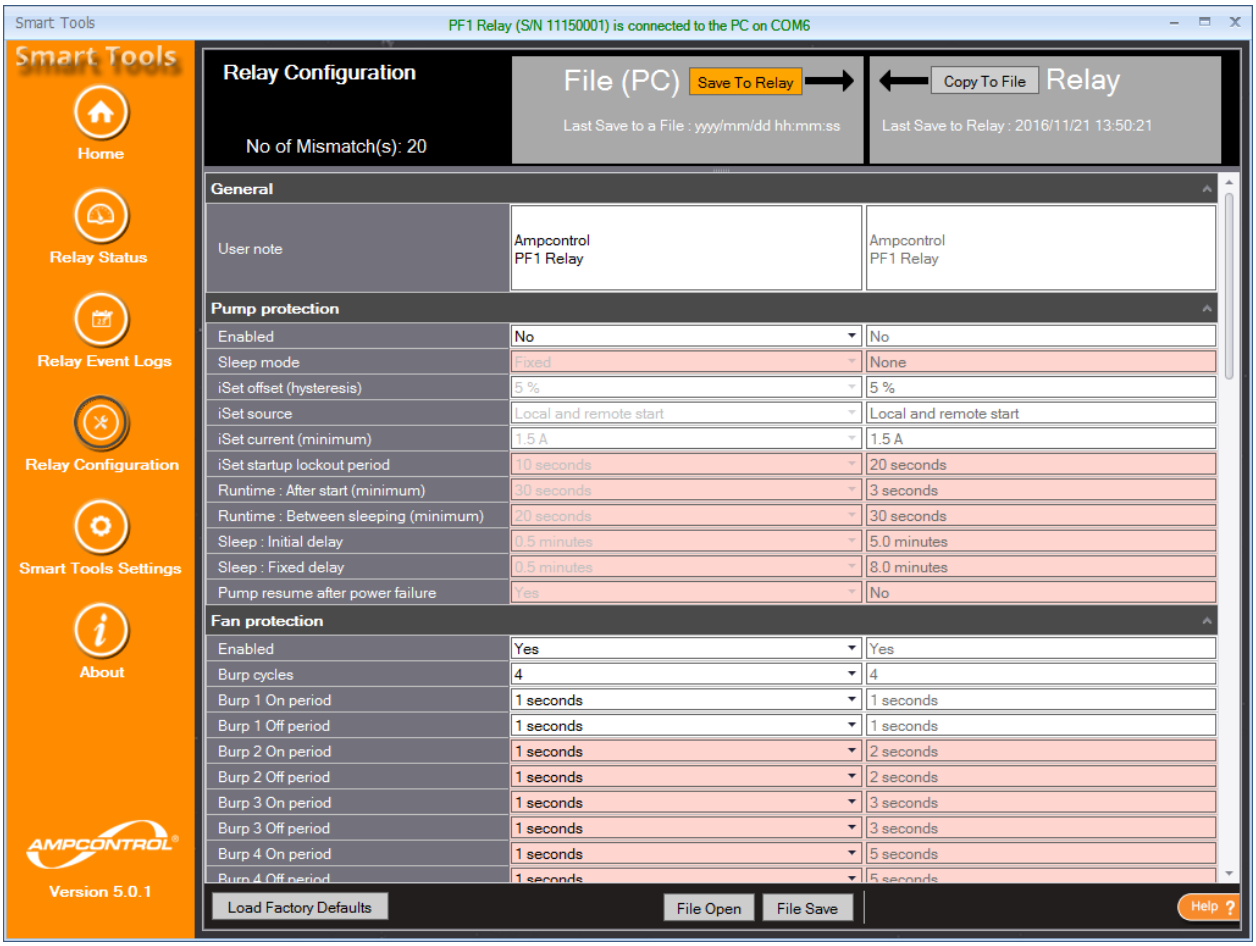

Figure 10.4: Smart Tools Software - Relay Configuration Page

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10.4.5 Smart tools Settings Page

The Smart tools Settings page allows the user to alter the USB connection settings for Smart Tools. In the majority of cases, the “Auto Detect” feature should automatically find the USB port that the PF1 has been plugged into. In rare cases, it may be necessary to force the software to communicate through a user selected USB port.

Also on this page is the Command Timeout setting, which is the period of time (in seconds) that the Smart Tools software will allow to elapse while attempting to communicate with the PF1.

If the PF1 does not respond to a communications sequence in this time period, a timeout error will occur.

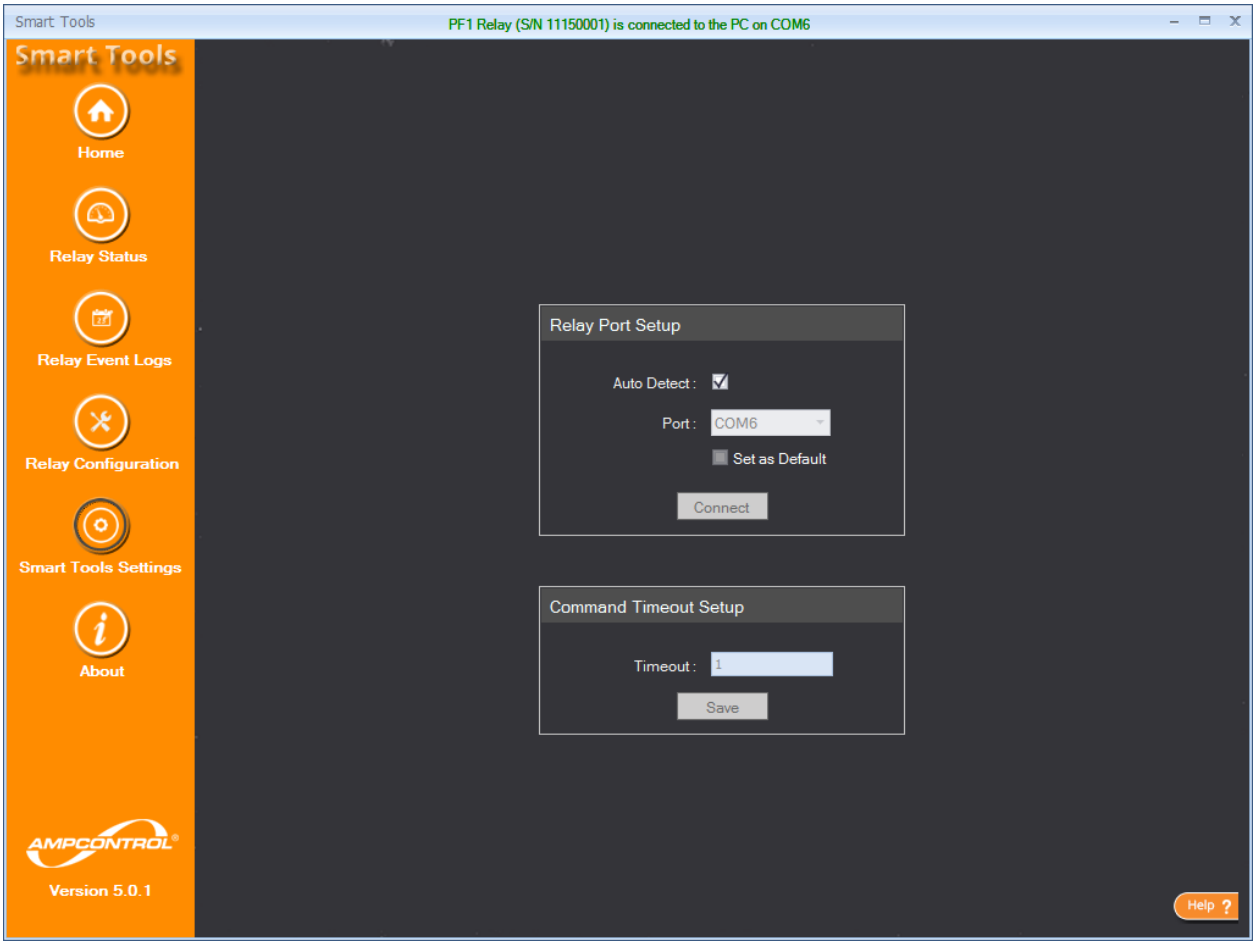

Figure 10.5: Smart Tools Software - Smart Tools Settings Page

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10.4.6 About Page

The About page provides information about the software. It is also possible to access the “Report an Issue” feature, from the About Page. This feature is explained in detail in Section 10.5.

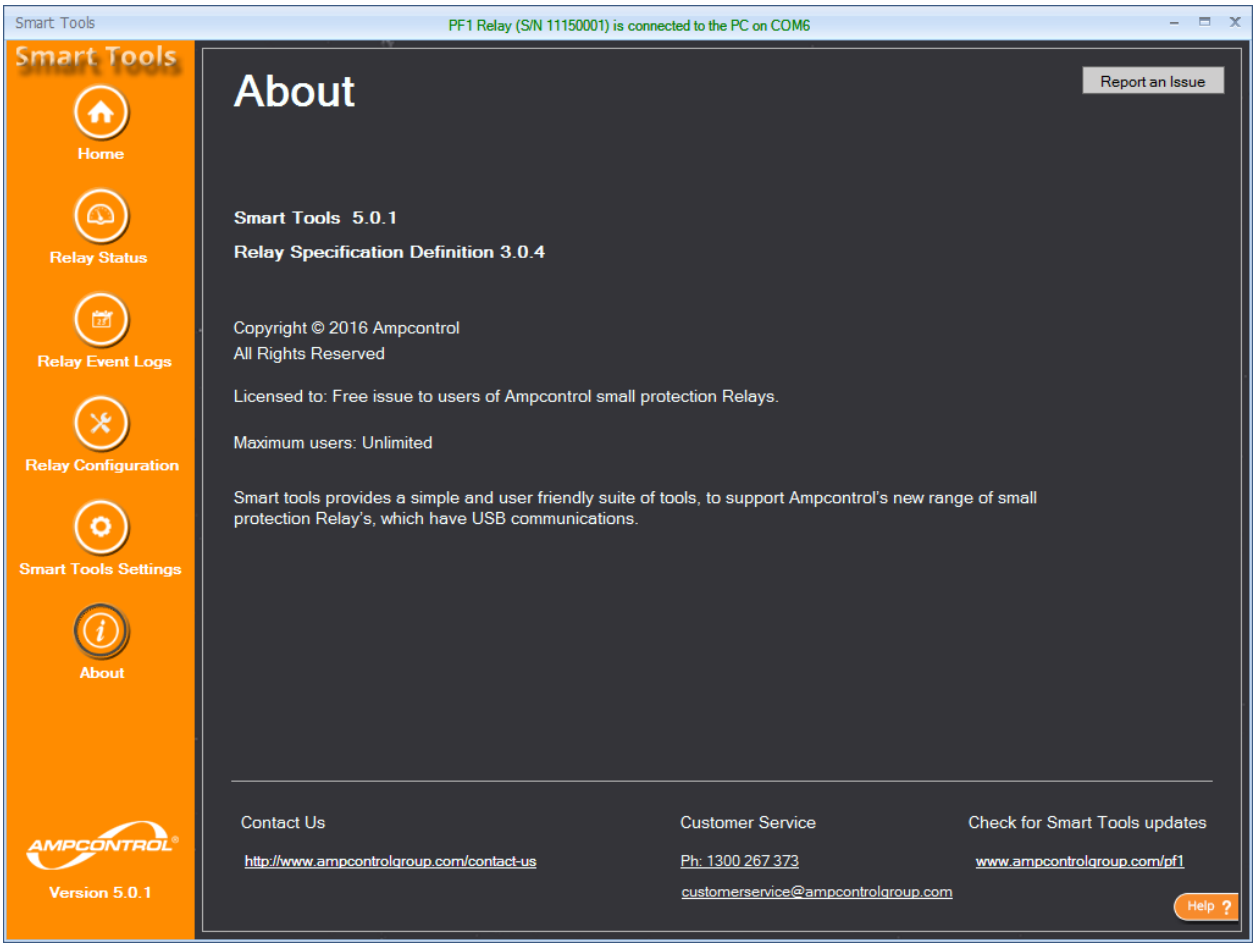

Figure 10.6: Smart Tools Software - About Page

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10.5 Issue Reporting

The Smart Tools PC software allows the user to compile an Issue Report that they can then send to the Ampcontrol Customer Service team for assistance with any PF1 / Smart Tools related issues that they may be experiencing.

The Issue Report generation tool can be launched from the About Page.

Once the user has filled in all of their contact details and description of the problem, the “Save Issue Report” button can be clicked. The software will then save a set of Smart Tools diagnostic logs into a zip file that can be emailed to customerservice@ampcontrolgroup.com.

Using this information, the customer service team will be able to better diagnose the issues that the user is experiencing in the field. Please note that service fees may apply.

NOTE

The Issue report process will not automatically include the data from the Relay (Status, Event logs and Configuration). This is because the software does not know the nature of your issue.

If relevant, please attach these files, in addition to the zip file, to the email.

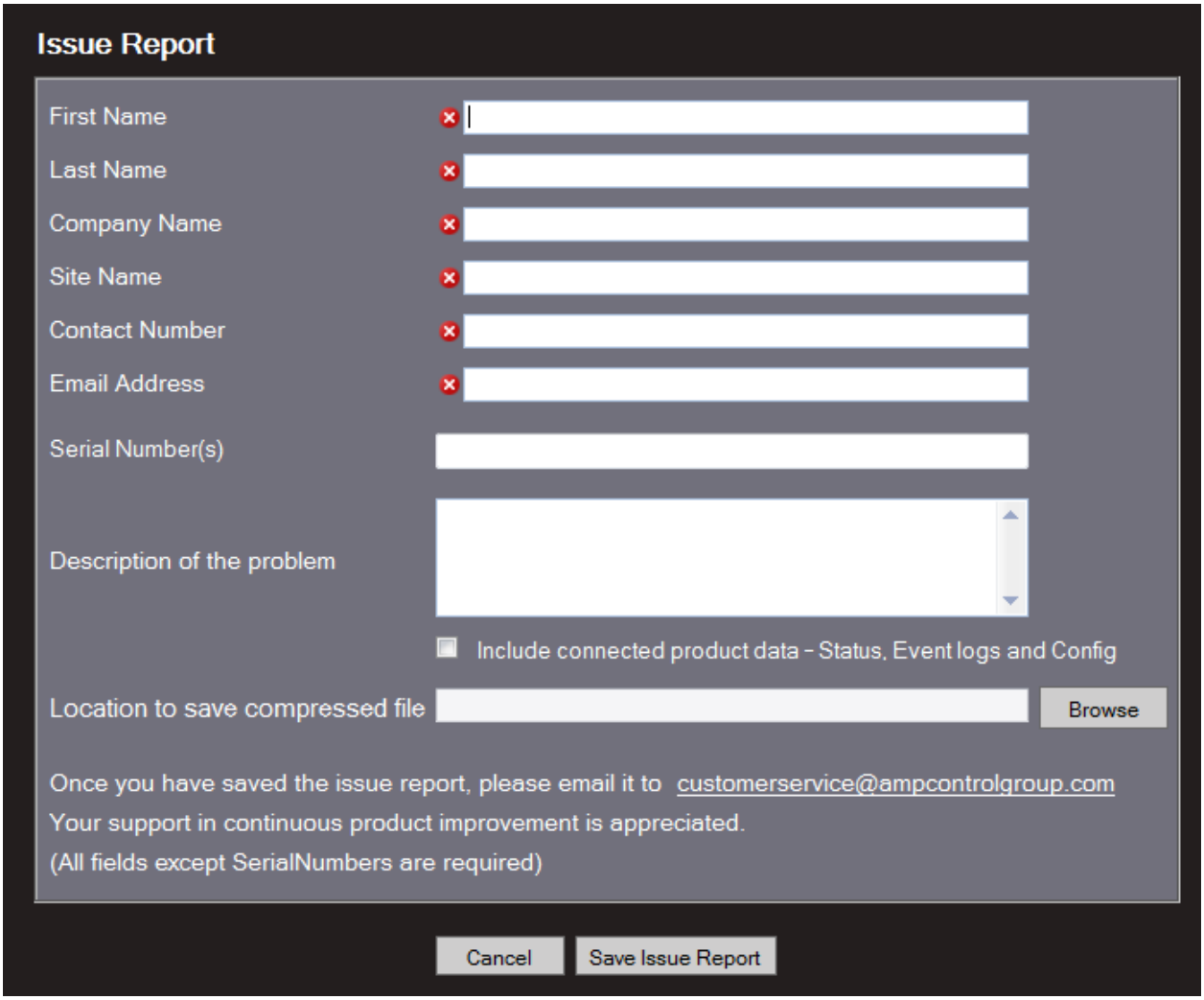

Figure 10.7: Smart Tools Software - Issue Reporting Page

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11 OPERATIONAL INTERFACE

This section will give an explanation of the physical location and the operational characteristics of the PF1 relay's interface elements. These elements include the fascia LEDs, fascia stop button, digital inputs, programmable relay outputs and the mini-USB port.

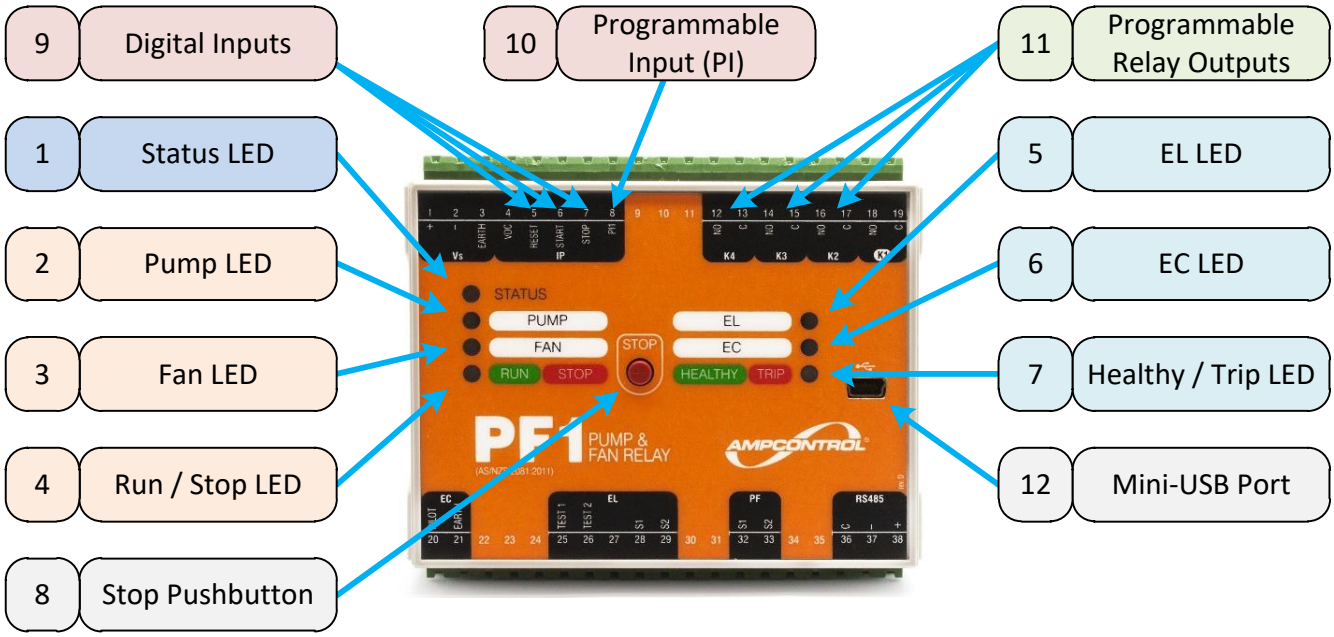

Figure 11.1: PF1 Operational Interface

11.1 Fascia LEDs

The PF1 relay's fascia has seven (7) LEDs. These LEDs give feedback on the current operating state of the PF1 and can provide diagnostic assistance in the case of system faults.

The Pump LED, Fan LED, EL LED, and EC LED employ a flash rate system to provide indication on some of their operating states. The terms 1 Flash, 2 Flash, and 3 Flash refer to a specific rate of LED illumination over a 3 second period, as depicted in Figure 11.2.

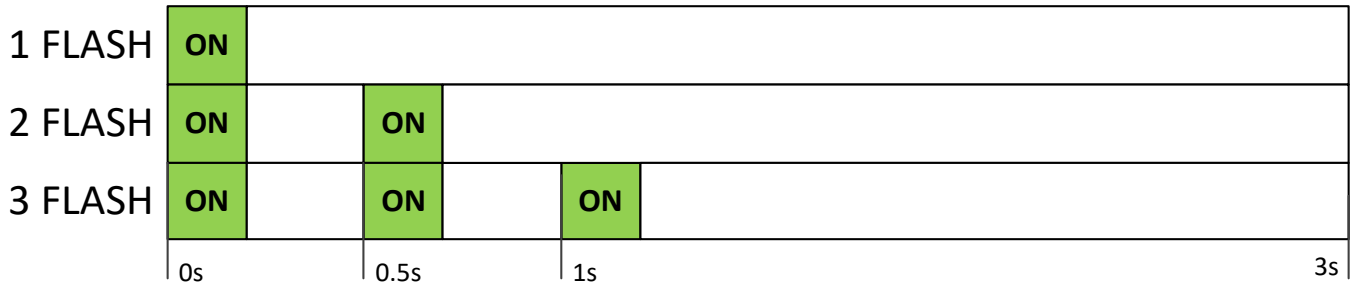

Figure 11.2: LED Flash Rate (Applicable to PUMP, FAN, EL, & EC LEDs Only)

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11.1.1 Status LED (Item 1)

The Status LED is a green and red bi-colour LED that has the following operating logic:

Table 16: Status LED Operating Logic

Status LED	Green LED	Red LED
USB Powered ONLY – Healthy	Solid On	
USB Powered ONLY – Internal Fault		Solid On
Aux Powered – Healthy	Flashing (on 10 s, off 1 s)	
Aux Powered – Internal Fault		Flashing (on 10 s, off 1 s)

11.1.2 Pump LED (Item 2)

The Pump LED is a green LED that has the following operating logic:

Table 17: Pump LED Operating Logic

Pump LED	Green LED
Pump function disabled	Off
Pump function enabled	On
Pump running but iSet is required	1 Flash
Pump sleeping	Ramp Brightness

11.1.3 Fan LED (Item 3)

The Fan LED is a green LED that has the following operating logic:

Table 18: Fan LED Operating Logic

Fan LED	Green LED
Fan function disabled	Off
Fan function enabled	On
Fan burping	Burp Flash (follows contactor operation)

11.1.4 Run / Stop LED (Item 4)

The Run / Stop LED is a green / red (dual) colour LED that has the following operating logic:

Table 19: Run / Stop LED Operating Logic

Run / Stop LED	LED Colour
Pump & Fan functions both disabled	Always Off
Pump Running	Green
Pump Sleeping	Green
Pump Stopped	Red
Fan Running	Green
Fan Burping	Green
Fan Stopped	Red
EL trip	Red
EL toroid trip	Red
EC open circuit trip (series)	Red
EC short circuit trip (shunt)	Red
EC start button trip	Red

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11.1.5 EL LED (Item 5)

The EL LED is a green LED that has the following operating logic:

Table 20: EL LED Operating Logic

EL LED	Green LED
Earth leakage protection off	Off
Earth leakage healthy	On
Earth leakage trip	1 Flash
Earth leakage toroid trip	2 Flash

11.1.6 EC LED (Item 6)

The EC LED is a green LED that has the following operating logic:

Table 21: EC LED Operating Logic

EC LED	Green LED
Earth continuity protection off	Off
Earth continuity healthy	On
Earth continuity open circuit trip	1 Flash
Earth continuity short circuit trip	2 Flash
EC start button trip	3 Flash

11.1.7 Healthy / Trip LED (Item 7)

The Healthy / Trip LED is a green / red (dual) colour LED that has the following operating logic:

Table 22: Healthy / Trip LED Operating Logic

Healthy / Trip LED	LED Colour
All protection functions are healthy	Green
EL and EC functions both disabled	Off
Earth leakage trip	Red
Earth continuity trip	Red

11.2 Fascia Stop Pushbutton (Item 8)

The PF1 has a Stop pushbutton mounted on its fascia. Pressing the Stop pushbutton will open the K1 output relay, hence opening the outlet's contactor.

The fascia Stop pushbutton can be used as an alternative to the "Stop" digital input.

NOTE

The Facia Stop button will only open the K1 output relay if the PF1 is set to Pump Mode or Fan Mode. If the PF1 is not set to either Pump Mode or Fan Mode, the **Fascia Stop button will not perform a function**.

11.3 Digital Inputs (Reset, Start & Stop) (Item 9)

The PF1 has three digital inputs that perform pre-programmed functions when they are shorted to the VDC terminal (for wiring details see Figure 4.4).

11.3.1 Reset Input

Closing the Reset input will clear any latched faults in the PF1, provided that fault conditions no longer exist.

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11.3.2 Start Input

If the outlet is stopped and no fault conditions exist, closing the Start input will initiate the outlet starting process.

If the outlet is in Pump mode, has just been started, and is within the allowable iSet timeframe, closing the start input (again) will save the iSet level. For a detailed explanation on the iSet procedure, refer to Section 6.1.3.

11.3.3 Stop Input

Opening the Stop input, will stop the outlet if it is running.

NOTE	
	The Start and Stop digital inputs **will not function if neither the Pump Mode nor the Fan Mode is selected**. If the PF1 is operating as an EL and/or EC relay only, the function of the K1 output relay will depend solely upon the health of those protection functions.

11.4 Programmable Digital Input (PI) (Item 10)

The PF1 relay has been implemented with an input that can be configured in the Smart Tools software to perform different functions. In the initial release of the PF1, this input can be configured as:

Table 23: Programmable Input (PI) Configuration Options

Function	Description
None	The input is disabled and the PF1 relay will not perform any actions when this input changes state.
Filtered Stop	This input acts as a filtered stop input to the PF1 relay. When this input is activated, the PF1 will activate an outlet STOP after the configurable filtering time has expired. See Section 11.4.1.

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11.4.1 Filtered Stop

If the Programmable Input (PI) is configured to operate as a Filtered Stop, the PF1 will issue a STOP command if the PI input is activated for a period of time that exceeds the configured filter time.

This function is useful for interfacing other protection devices with the PF1. In such installations it is prudent to ensure that the PF1 relay is issued a STOP command when another protection device trips the outlet.

CAUTION!

The Filtered Stop Input (along with the STOP input) are control inputs only and should not be used to actuate protection functions. Any tripping contacts wired into these inputs should also be duplicated in the outlet's tripping circuit.

It is recommended that the Filtered Stop input is used to monitor the states of the outlet's other protection devices (if present), rather than the STOP input. The reason for this is that, especially at the application of control power, race conditions may exist between protection relays. To avoid this, the "Filter Period" should be set to a time period that exceeds the expected initialisation period of these relays.

NOTE

The Filtered Stop inputs **will not function if neither the Pump Mode nor the Fan Mode is selected**. If the PF1 is operating as an EL and/or EC relay only, the function of the K1 output relay will depend solely upon the health of those protection functions.

The PF1 relay's Programmable Input (PI) can be configured to act as a "Filtered Stop" input using the Smart Tools software. Adjustable settings are: Function, Default State, and Filter Period.

Table 24: PI Filtered Stop - Configuration - via Smart Tools PC Software

Function	Default State	Filter Period
None	Normally Open	1 seconds
Filtered Stop	Normally Closed	2 seconds
		3 seconds
		4 seconds
		5 seconds
		10 seconds

The Default State can be configured as Normally Open or Normally Closed. If configured as Normally Open, the Filtered Stop function will be activated if the PI input is closed onto the VDC supply. If configured as Normally Closed, the Filtered Stop function will be activated if the PI input's connection to the VDC supply is removed (opened).

The Filter Period is the length of time that the input must be activated before the PF1 will issue a STOP command. For example, if the Filter Period is set to 5 seconds and the PI input is only active for 4 seconds, the PF1 will not issue a STOP command. In this case, the PF1 will issue a STOP command only if the PI input exceeds the 5 second filter period.

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11.5 Programmable Relay Outputs (K2, K3 & K4) (Item 11)

The PF1 has three output relays (K2, K3 & K4) with functionality that can be customised using the Smart Tools software.

The relays can be programmed to have a default state of open (de-energised) or closed (energised). This will be the state of the output relay when none of the selected parameters are true.

NOTE

Although the K2, K3 & K4 output relays can be set to a default state of closed (energised), it is important to note that **when the PF1 loses power all output relays will open (de-energise).**

Each of the three programmable outputs relays can be individually programmed to operate under any combination of the following system states:

- Pump running
- Pump iSet required
- Pump sleeping
- Pump stopped
- Fan running
- Fan stopped
- Earth leakage tripped
- Earth leakage healthy
- Earth continuity tripped
- Earth continuity healthy

As a result of enabling this level of flexibility, it is possible to select an invalid combination of states.

It is the responsibility of the user to ensure that any chosen combinations are logical.

The Programmable Relay Outputs can also allow the PF1 to be configured in an Auto/Manual Mode. This allows the operators to switch between Auto and Manual pump control in the field, without needing to change the PF1 configuration each time. For more information, refer to Section 6.2.

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12 SERVICE, MAINTENANCE & DISPOSAL

12.1 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 PF1 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.

12.1.1 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 type of inspection may involve opening cabinets to gain access to the PF1 and other equipment. This level of inspection may also include cleaning display windows that have become obscured by dirt.

Observations would typically be:

- Check that equipment enclosures, cable trays, conduits, etc. are in good order with no physical damage.
- Check that sealed wall boxes are free from water and dust ingress internally. Door seals are in good condition.
- 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 equipment, wall boxes and cables are present and in good condition (especially certification labels).
- Check that no modifications have been carried out to installed equipment.

12.1.2 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.

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

- Verify that equipment housings, wall boxes and other mechanical fixtures are secured in place. This includes terminal box lids, tightness of cable glands, integrity of wall-box mountings, security of equipment fixing to walls/DIN rails etc.
- Verify all electrical connections are secure with no loose screw terminals or DIN rail terminals not fitted to rails etc.

12.1.3 Periodic Servicing

Ampcontrol recommends that the PF1 be returned to an Ampcontrol Repair Facility for periodic servicing every 5 years.

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12.2 Equipment Maintenance

WARNING!

The PF1 Relay has no user-serviceable parts.

Any repairs must be carried out by Ampcontrol only.

If a fault develops, return the PF1 to Ampcontrol for repair. It is essential that **no attempt be made to repair the PF1** as any attempt to dismantle or repair the PF1 can **seriously compromise the safety of the unit and will thus void product warranty and compliance**.

It is recommended that the electrical protection system incorporating the PF1 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

12.3 Disposal

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.

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13 SPECIFICATIONS

General	
Compliance	(AS/NZS 2081:2011)
Supply	
Regulated Voltage	18 to 28.8Vdc or, 18 to 28.8Vac 50 to 60Hz
Impulse Voltage (max)	50V peak for 200ms
Power Consumption	10VA
Relay Contacts	
Contact Rating	110Vac / 30Vdc 1A (Resistive)
Pump & Fan	
Toroid	CT 1000/1 50mm PFCT SRS27
Toroid Ratio	1000 : 1
Primary Input Current	1 to 200A
Toroid Window Size	50mm Inner Diameter
S1/2 cable loop resistance (max)	0.1 Ω
S1/2 length (max)	10m
S1/2 cable type	Twisted pair + shield to Earth (on PF1 end only)
Earth Leakage	
Trip Times	50 to 500ms
Trip Levels	30 to 1000mA
Toroid	EL500/60 or EL500SP1 (requires firmware V6+)
Toroid Ratio	100 : 1
Toroid Window Size	60mm Inner Diameter
Passband	Wide Band Mode: 30 to 500Hz 50Hz Mode: 30 to 90Hz
S1/2 cable loop resistance (max)	0.1Ω
S1/2 length (max)	10m
S1/2 cable type	Twisted pair + shield to Earth (on PF1 end only)
TEST1/2 cable loop resistance (max)	2Ω
TEST1/2 length (max)	10m
TEST1/2 cable type	Twisted pair
Earth Continuity	
Trip Times	50 to 500ms
Trip Levels (Series)	10 to 45Ω
Trip Levels (Shunt)	1250Ω
Pilot Output Signal Voltage	<30Vdc
Pilot Cable	C_{max} = 0.25µF L_{max} = 0.70mH
Terminating Diode	1N5404 3A
Remote Start Resistor	100R 1% 5W

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Mechanical & Environment	
IP Rating	IP20
Operating Temperature Range	-10 to 60˚C
Storage Temperature Range	-20 to 70˚C
Humidity	Between 10% relative humidity and the dew point, non-condensing
Dimensions (mm)	With Plugs: 100w x 105h x 110d Without Plugs: 100w x 85h x 110d
Terminal Wire Gauge (Max)	2.5mm^2 (with bootlace ferrule)
Weight (Kit)	3kg (PF1 Relay: 500g, EL Toroid: 1500g, PF CT: 650g, Packing: 300g)
USB Interface	
Type	USB Mini
Current Consumption	75mA (when supply voltage is not energised)
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: ampcontrolgroup.com	

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14 EQUIPMENT LIST

KIT	
Part Number	***Description***
174403	Kit Relay PF1 Pump & Fan c/w Toroids Which includes: • Relay PF1 Pump & Fan (P/N 173563) • Current Transformer - 50mm Inner Diameter (P/N 175616) • Earth Leakage Toroid - 60mm Inner Diameter (P/N 115439) or (P/N 178810: requires firmware V6+) • EC Diode (P/N 117023) • EC Start Resistor (P/N 169732)
RELAY	
Part Number	***Description***
173563	Relay PF1 PUMP+FAN Which includes: • PF1 Pump & Fan Relay • 2x 19 way field pluggable screw terminal blocks • USB Drive with Smart Tools PC software, User manual and Datasheet • USB Type A to Mini-USB Cable (1m) • EC Terminating Diode - 1N5404 3A (P/N 117023) • EC Start Resistor - 100R 1% 5W (P/N 169732)
CURRENT TRANSFORMERS	
Part Number	***Description***
175616	Current Transformer - 50mm Inner Diameter (Included in Kit)
EARTH LEAKAGE TOROIDS	
Part Number	***Description***
115439 or 178810*	Earth Leakage Toroid - 60mm Inner Diameter (Included in Kit) (*178810 requires firmware V6+)
ACCESSORIES	
Part Number	***Description***
117023	EC Terminating Diode - 1N5404 3A (Included in Kit)
169732	EC Start Resistor - 100R 1% 5W (Included in Kit)

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APPENDIX A: SMART TOOLS INSTALLATION GUIDE

The following instruction set will inform the user on the process of downloading and installing the Smart Tools software for use with the PF1.

System Requirements
While Smart Tools has been tested to work with Windows 7, 8 and 10, extensive testing has only been conducted for Windows 7. A driver signature verification workaround will be required for the installation of Smart Tools on machines running 64-Bit versions of Windows 8 and 10 (for details on this process, please refer to the section below).

Category	Requirement
Operating System (minimum)	Windows 7 (32 or 64 bit)
Display Resolution (minimum)	1024 x 768
Available USB Ports (minimum)	1

Downloading

The latest version of the Smart Tools software can be found by visiting the Ampcontrol website and navigating to the Software folder in the Technical Resources Library.

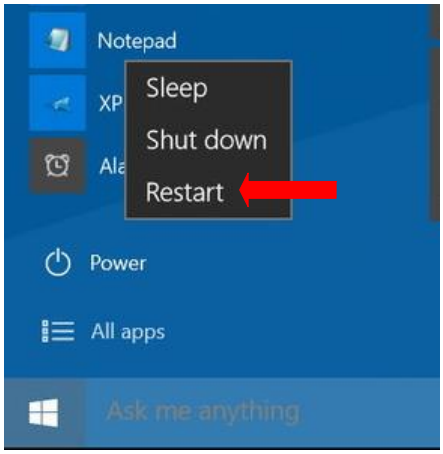
http://www.ampcontrolgroup.com/technical-resources/

The installation file will depend upon the Windows system architecture and the software version or patch. For more information on selecting the correct installation file, please refer to Section 10.2.

Disable Driver Signature Verification in Windows 8 and 10 (64-Bit)

1) Get into the boot manager

   Hold down the SHIFT key, and click on Restart in the power options menu.



   The PC will restart and enter boot manager.

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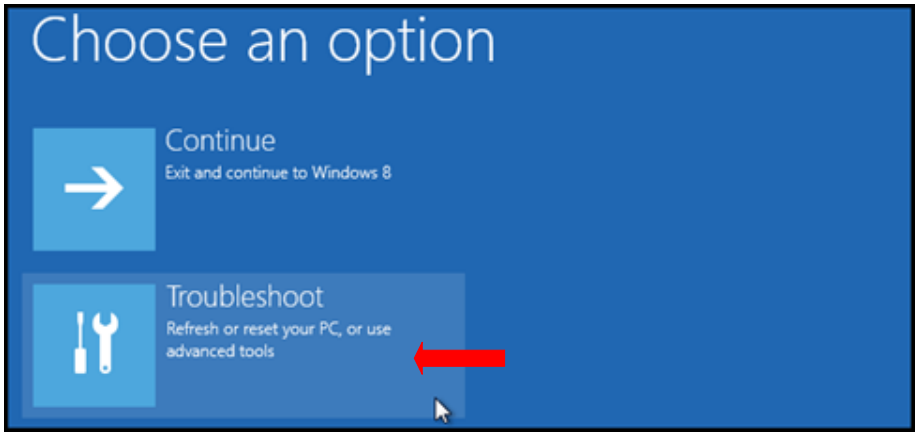
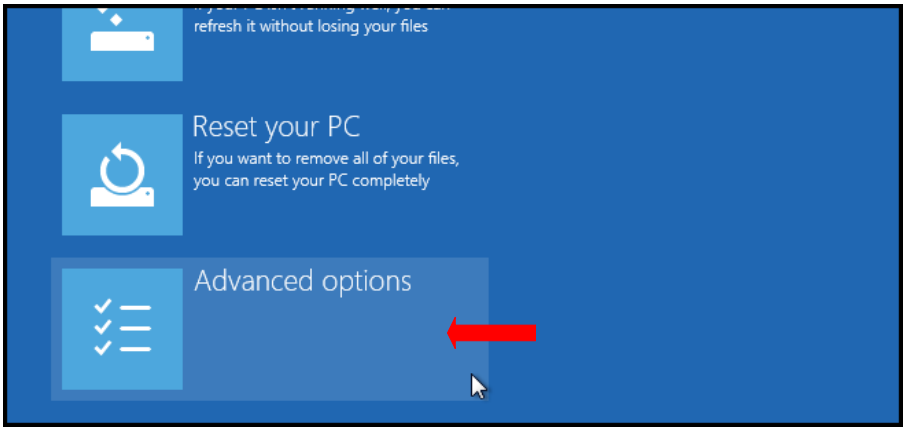
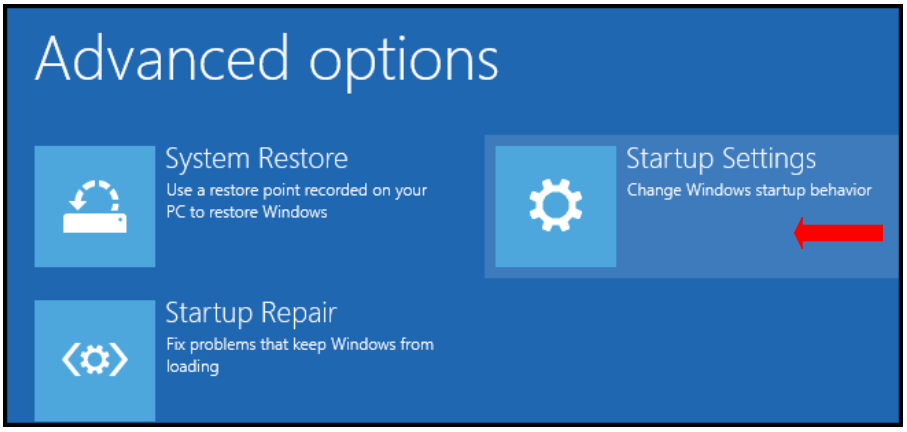
2) Select Troubleshoot



3) Select Advanced options



4) Select Start-up Settings



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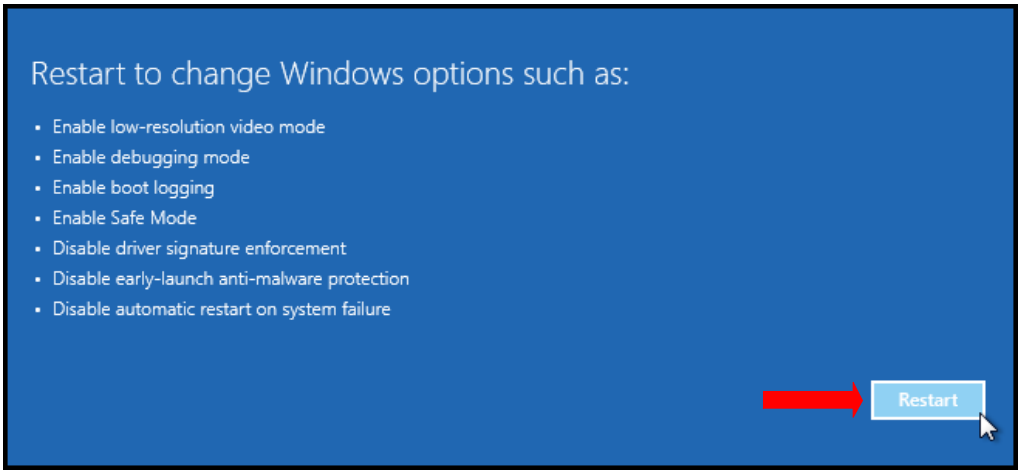
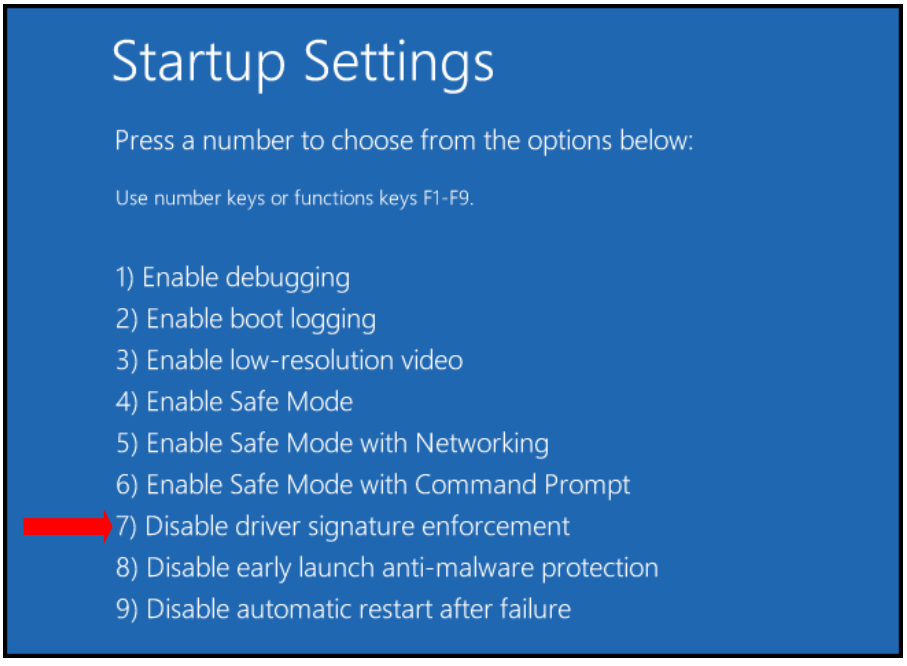
5) Click Restart to enter the mode where you can make the change



6) Wait for the PC to restart

7) Finally you will be given a list of options shown below.



Press F7 or 7 to select “Disable driver signature enforcement”

8) Wait for the PC to restart

You can now install the software / drivers which were previously blocked.

NOTE

Disabling the signature verification is not permanent. It is only valid until you reboot the PC again.

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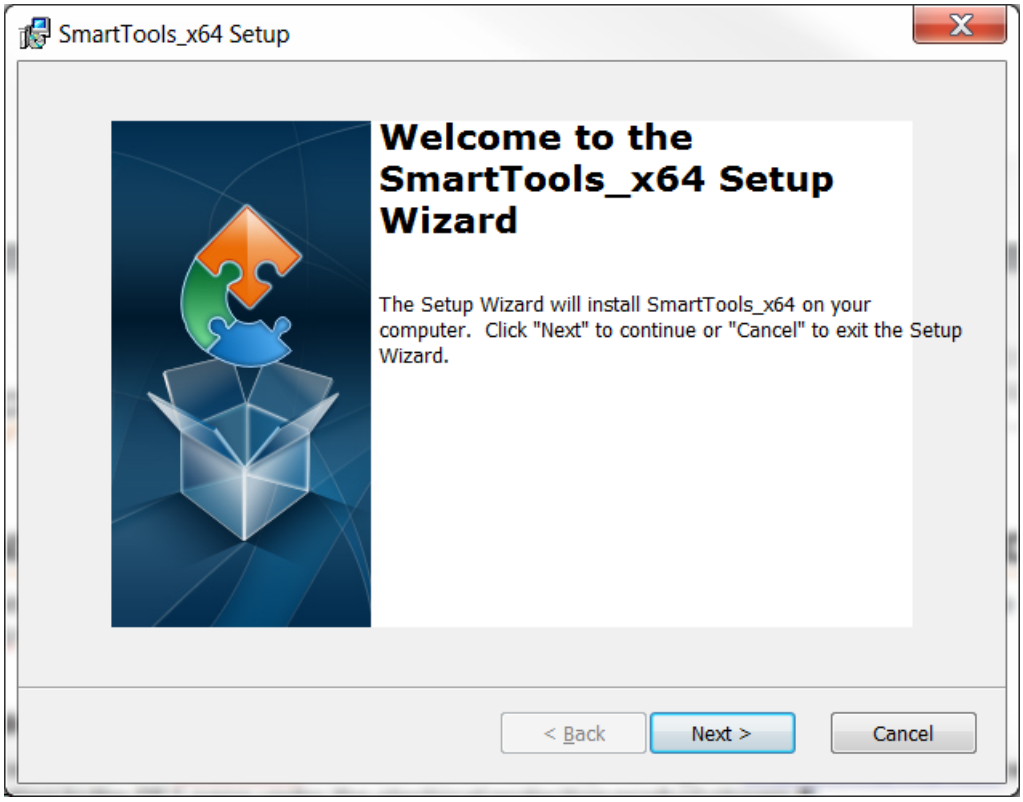
Installing

(Note, this example is for the 64bit version, but the 32bit / x86 version will install in the same manner)

1. Open the Smart Tools setup file.
2. This will bring up the installation window:



3. Click Next.

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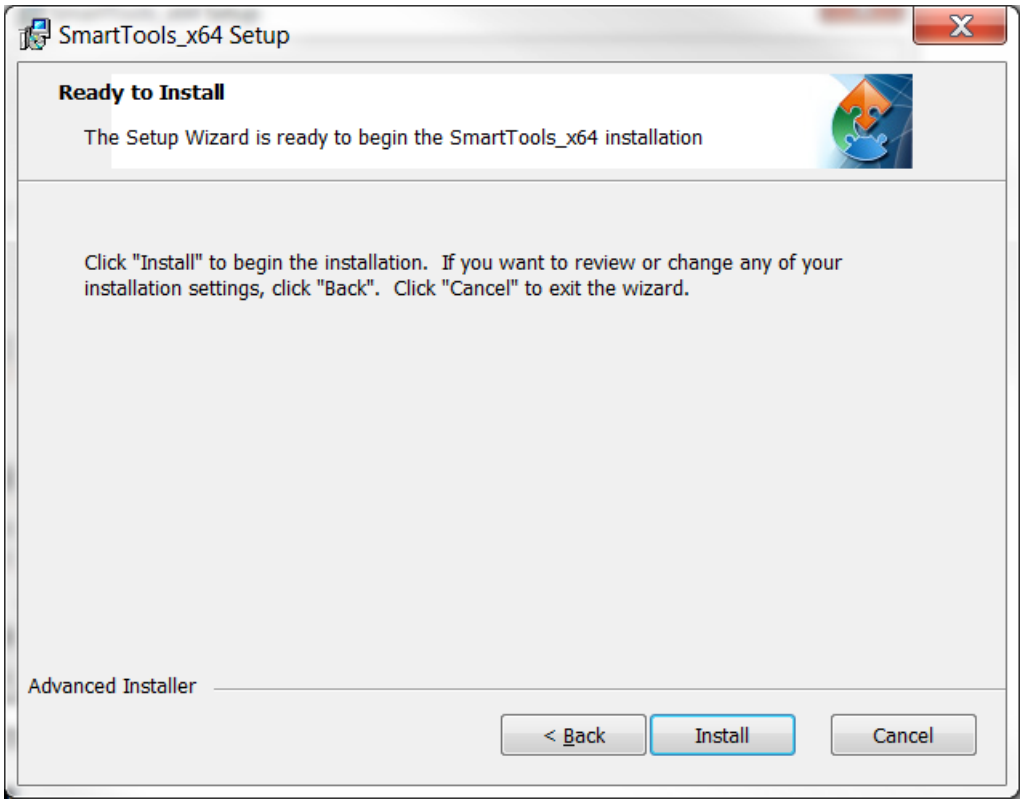
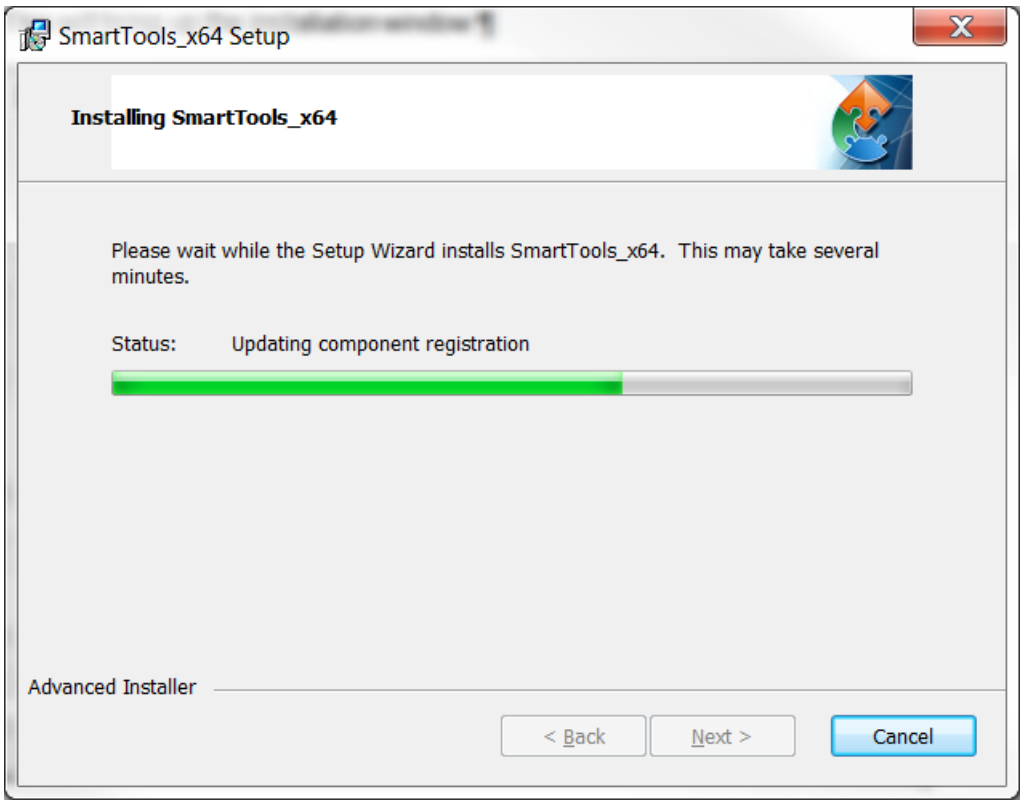
4. This will bring up the installation window:



5. Click Install.

6. This will begin the installation process:



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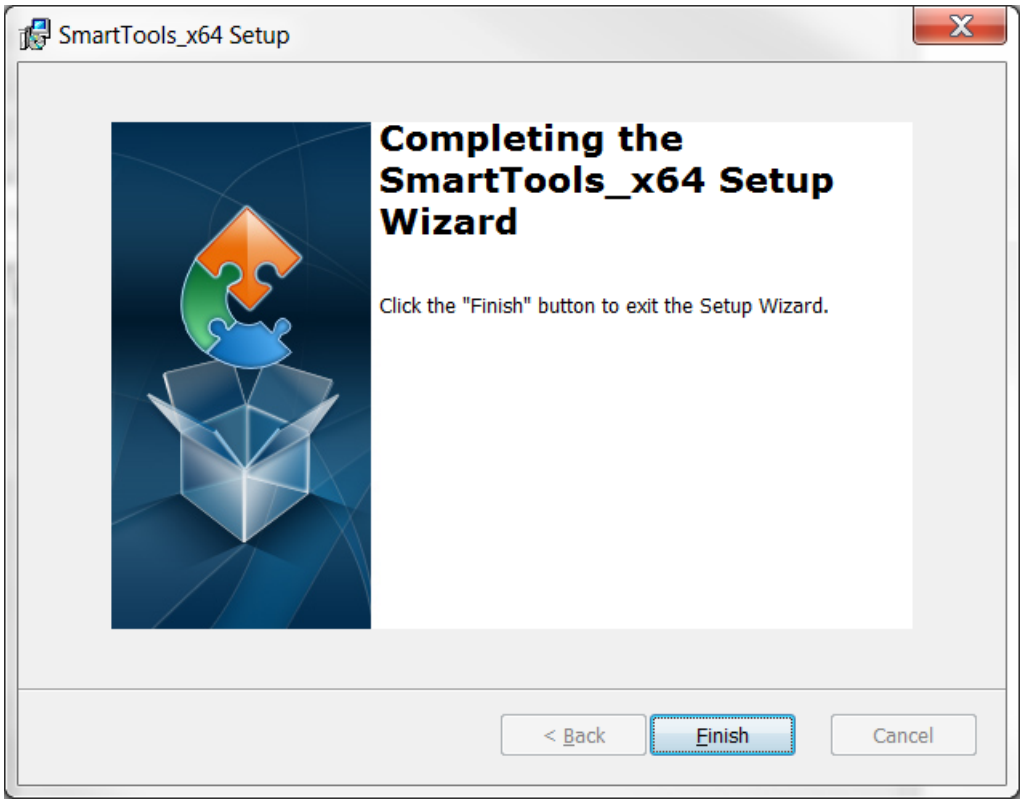
7. Once the files have been installed, this window will appear:



8. Click finish to complete the installation.
9. Navigate to the Smart Tools application, located in the Windows Start Menu.
10. Click on the Smart Tools icon to start the application.

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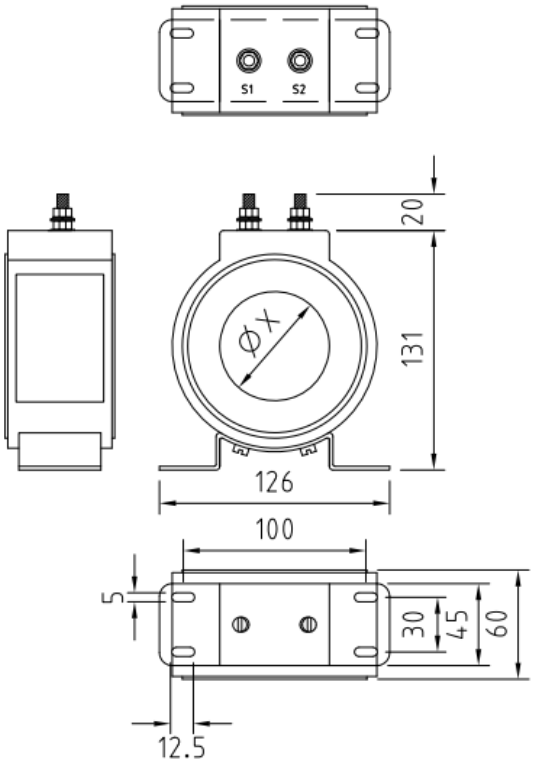
APPENDIX B: TOROID & CURRENT TXF DIMENSIONS

Earth Leakage Toroids



X = Ø 60mm

Mounting = Bracket and Screw

Figure B.1: Earth Leakage Toroid - EL500/60 - P/N 115439 - Dimensions & Mounting Details

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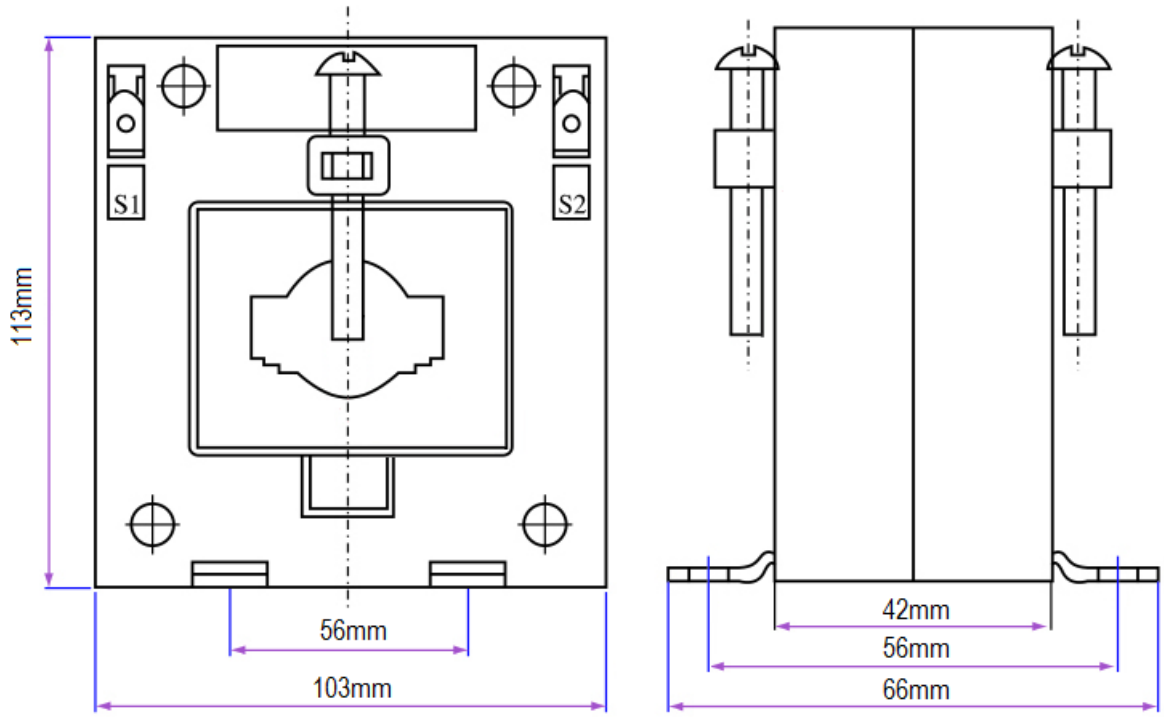

Mounting = Bracket and Screw

50mm Inner Diameter

Figure B.2: Earth Leakage Toroid – EL500SP1- P/N 178810 - Dimensions & Mounting Details (requires firmware V6+)

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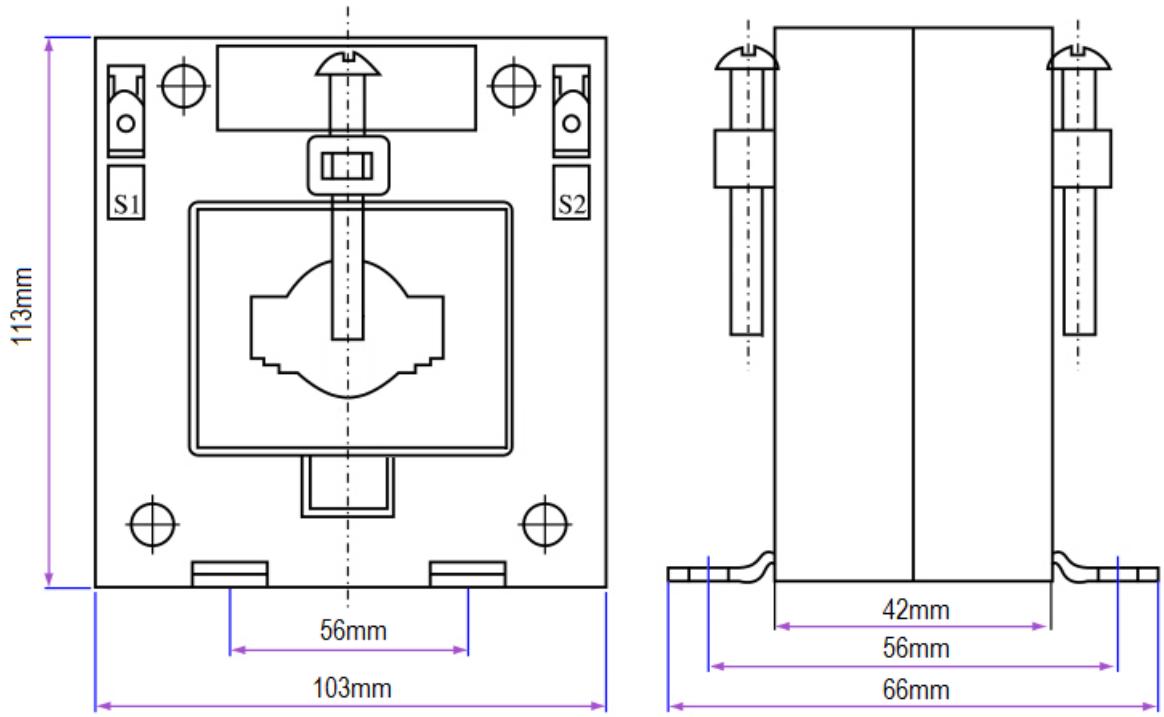
Current Transformer



Mounting = Bracket and Screw

50mm Inner Diameter

Figure B.3: Current TXF 1000:1 – PFCT SRS27 - P/N 175616 - Dimensions & Mounting Details (This is included in the PF1 Kit)

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