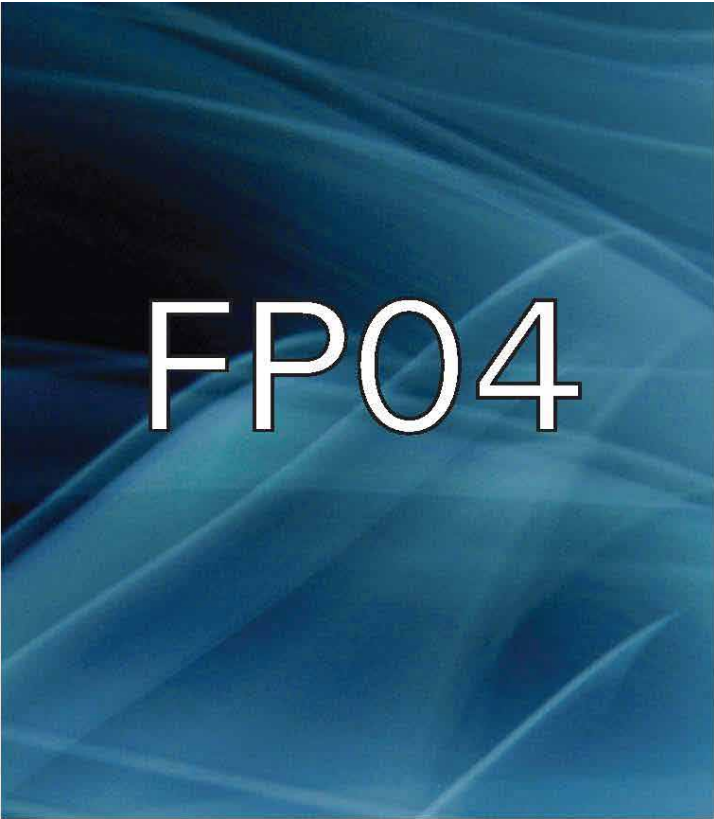


FP04-AR

Operating & Instruction Manual



Electrical Distributors



OPERATING & INSTRUCTION MANUAL

FP04 - AR FEEDER PROTECTION RELAY

Document version: 01v02

Combined Over-current, Earth Fault, and Sensitive Earth Fault
Protection & Auto-Reclose Relay

Document History

Revision	Date	Description	Revisions
FP04-B-1.0 FW Vers 3.xx	16 July 2007	FP04-B User Manual	Updated photos, logo, text boxes, headers, & footers.
FP04-AR FW Vers 4.xx	07 March 2011	FP04-AR Operating Instruction Manual	Additional Auto Re-close function.

About this manual

This manual is designed to cater for known applications during installation, operation, and maintenance of the equipment.

Safety Symbol Legends



Draws attention to operating procedure, practice, condition, or statement, which, if not strictly observed, could result in injury or death.



Draws attention to an essential operating procedure, practice, or statement, which, if not observed, could result in damage to, or destruction of, equipment.



Draws attention to an essential operating or maintenance procedure, or statement that must be observed.



PLEASE READ INSTALLATION PRACTICE

- *Keep these instructions available for personnel responsible for proper installation.*
- *These instructions are a guide to the installation of the protection relay.*
- *NOTE: BEFORE the meter protection relay is energised, make a final check that the voltage to be connected to the protection relay is within the rated voltage of the protection relay; at the same time also inspect for any physical damage that may have been caused during transportation or installation handling.*
- *ELECTRICAL CONNECTION diagrams are for a guide only and not meant as specific wiring diagrams for the user's installation.*
- *The information in this document does not supplant or take the place of any applicable NATIONAL and or LOCAL SAFETY CODES, or requirements of insurance underwriters.*
- *Apparatus covered by this instruction literature should be operated and serviced only by competent personnel familiar with good safety practice.*
- *These instructions are written for such personnel and are not intended as a substitute for proper training and experience in safety procedures for this type of equipment.*
- *All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions.*
- *If further information is desired by purchaser regarding his particular installation, operation, or maintenance of his equipment, Strike Technologies should be contacted.*
- *This document details the necessary information for the installation, functions, default parameters of the Enermax+ meter and meter specifications.*
- *Should the customer have requested a special configuration, the details of this will be listed in a separate document supplied with the meter.*

Operating and instruction manual

Combined Over -current, Earth Fault, Sensitive Earth Fault

Relay, and Auto Re -close





Electrical Distributors

TABLE OF CONTENTS

PLEASE READ INSTALLATION PRACTICE	3
INTRODUCTION	10
Product Evolution Information.....	10
MAIN PRODUCT FEATURES	10
AUTO RE-CLOSE: Manual Breaker Activation Menu:	10
Protection Functions.....	10
Breaker Fail Detection	10
Measuring input applications.....	11
Protection Curves (selectable)	11
Multifunction Function Outputs/inputs	11
Digital input applications	11
Digital Inputs logic settings	11
Relay Outputs	11
FP04-AR Enclosure	12
User Interface	12
Test Functions.....	12
Data Communications	12
Application Software.....	13
FPO4-AR Features.....	14
Updating of the FP04-B	14
PRODUCT OVERVIEW	16
Application.....	16
Application Auto Reclose Sequence Scenario	16
INSTALLATION & COMMISSIONING	18
Unpacking, Storage and Handling.....	18
Enclosure and Draw-Out Unit.....	18
Configuring the Hardware Prior to Installation	19
Output Relay Rating	19
Auto Reclose and Output Relay Cautions	19
Output Relay Contact Form	19
Re-inserting the FP04-AR in the Case.....	19
Terminals	19
Mounting	19
Wiring	20
Earth Connection.....	20
Auxiliary power supply	20
Current transformer circuits	20
Output Relay Circuits	21
Digital Inputs	21
Serial Communication Port	21
Noise Isolation	21
FP04 - AR FRONT PANEL FUNCTIONS	23
OPERATING FP04 - AR PROTECTION RELAY	24
FP04-AR Start-up.....	24
The Running Displays.....	26
Annunciator Symbols On Running Displays.....	26
Factory Default Display	26
Changing Factory Default Display	26
Input Active Display.....	26
AUTO -RECLOSE APPLICATION CONSIDERATIONS	28
Auto-Reclose Installation Reminders.....	28



Electrical Distributors

Auto-Reclose Timing Scenarios	28
The Basic Auto-Reclose Scenario	28
Block Auto-Reclose Input - Function	28
Auto-Reclose Second Set of Settings - Function	28
Block Trip Input - Function	28
Breaker Re-wound Input - Function	28
Multi shot auto-reclose	28
Auto-Reclose output relay functionality:	30
Auto-Reclose time setting problems or features	30
SOFTWARE	30
Programming Software	30
Accessing The Information From Displays.	30
Remote Communications Via Modem.	32
MAIN MENU & DISPLAYS: NAVIGATING	32
Accessing The Main Menus	32
Button Operation – Enter/Exit Menus	32
MENU ACCESS	33
Scrolling Through Sub-menus	35
Changing or Selecting Parameters	35
Some Exceptions	35
Scrolling	35
The Exit Process	35
MAIN MENU FUNCTIONS & DISPLAYS : [VIEW INFORMATION][Trip History]	37
Trip History menu	37
Reclose Successful and More Shots – Trip History	37
Trip display features when auto-reclose is enabled:	37
The Post-trip Displays	39
TRIP HISTORY MENU	39
Trips listed	39
Elements and parameters exceeded	39
Elements & levels of current that caused the trip	40
Date/time stamp trip occurred	40
Relay outputs activated by the trip	40
MAIN MENU FUNCTIONS & DISPLAYS : [VIEW INFORMATION][Status]	40
The Status information menu:	40
User Defined FP04-AR screen message	40
View: Input Status	40
View: Output Relay Status	42
View: Communications Monitoring	42
View: Setup Saved Count	42
View: Breaker Trip Count	42
View: Breaker Failed Count	43
View: Event Trip Count	43
View: Total Reclose Shot Count	43
View: Auto Re-Close Success count	43
View: Reclose Lockout Count	43
View: Breaker Rewind Failed Count	43
View: Maximum Rewind Time	43
View: Breaker I ² t Accumulation	45
View: Event Trip	45
View: Event Trip Pre-Set Auto/Man	45
MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Elements]	45



Electrical Distributors

Element Settings	45
Element Protection Settings: Over-current and Earth Fault	45
Element Protection Settings: E1 to E4 settings menu	46
Element Protection Settings: E1 to E4 Element Name – [Ia], [Ib], [Ic], [Io]	46
Element Protection Settings: Fault Levels	46
Element Protection Settings: E1 to E4 – [>][>>][xt][SI][VI][EI][LTI][DTL]	47
Element curves	47
Element Protection Settings: Programmable Reset Time	47
Element Protection Settings: Re-set Time Graph	48
Element Protection Settings: E1 to E4 Threshold Exceeded Reset Time	50
Element Protection Settings: E1 to E4 – CT [1] or [5A]	50
Event Time Settings: Current Failed To Clear On Breaker trip	51
Event Time Settings: Breaker failed to trip On Event Input	51
Clear FP04-AR memory: Clear Trip History	51
MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Output Relays]	52
The Output relay setup menu:	52
Output Relays Settings: K1 to K5 - Menu	53
Output Relays Settings: K1 to K5 - Function Description	53
Output Relays Settings: K6 Self-Supervisory Function Description	53
Output Relays Settings: K1 to K5 – Allocate To Protection Start condition	53
Output Relays Settings: K1 to K5 – Pre-allocated To Input application	53
Output Relays Settings: K1 to K5 – Allocate Output To A Protection Trip Condition	54
Output Relays Settings: K1 to K5 – Allocate To Event Trip	54
Output Relays Settings: K1 to K5 – Allocate To Auto Reclose Status	54
Output Relays Settings: K1 to K5 – Allocate To Breaker Status	56
Output Relays Settings: K1 to K5 – Relay Checksum Application	56
Output Relays Settings: K1 to K5 – Checksum setting	56
View Output Relay: K1 to K5 – Checksum values	56
Output Relays Settings: K1 to K5 – Relay Hold Times	56
Breaker Trip Monitoring – Accumulator Maintenance I ² t Time	57
Breaker Trip –Use MODBUS Communications To Trip Breaker	57
MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Digital Inputs]	57
The Input setup menu:	57
Disabled	57
Breaker on/off state	57
Block auto-reclose	58
Block trip	58
Breaker rewind input	58
Event Tripping	58
Remote Reset	58
Digital Inputs Menu	58
Digital Inputs 1 to 3 Settings – Allocate Function To Input	60
Digital Inputs 1 to 3 Settings – Active High Or Low	60
MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Auto Re -Close]	61
The Auto-reclose setup menu:	61
Elements 1 to 4 Settings – Allocate [>] [>>] Thresholds To Allow Auto Re-Close	61
Auto Re-close – Select Max Number Of Shots allowed	61
Manual Re-close – Select to Use Auto Re-close Trip Settings	61
Manual Re-close – Select to Time before Auto Re-close Trip Settings Cancelled	61
Re-close Shot – Select Dead time for each repeat shot	62
Re-close Shot – Select Output Relay Energised Period	62
Auto Re-close active period – Select When To Switch Back To Normal Protection Settings	62
Auto Re-close Reset Time – Select period When Auto Re-close is deemed Successful	62
Breaker Rewind Time – Select Period To Allow Breaker To Rewind After First Auto Re-close	62



Adjust Re-close Shots – Select Excess Threshold Current to limit Re-close shots.....	63
Auto Re-close Protection Settings – Set Curve, [>] [>>] [xt].	63
MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY][Function Resets]	64
Function Resets Settings.....	64
Power Up Function – Restore To State At Auxiliary Power Fail	64
Disable Operator Resetting Trip Condition – Select Auto, 1 To Ten Times Or Disable	64
MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY][Line Frequency]	65
Line Frequency Setting	65
Supply – Set Line Frequency	65
MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY][Hardware Choices]	65
The Hardware setup menu:	65
Configure Firmware - Read Terminal 17 & 19 As Digital Input.	65
MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY][Serial Ports]	66
Serial Port Settings.....	66
Communication Front Port – Set Baud rate, Parity	66
Communication Rear Port – Set Baud rate, Parity	66
Communications Protocol – MODBUS.....	68
MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY][Real Time Clock]	69
Real Time Clock Setting	69
Set the Time & Date	69
MAIN MENU FUNCTIONS & DISPLAYS : [EXECUTE TESTS][Simulation Tests]	70
FP04-AR Self Current Injecting.....	70
Simulate Current Injecting	70
Self-Injection Procedure	70
FP04-AR Testing functions	72
Manual off-line diagnostic test	72
MAIN MENU FUNCTIONS & DISPLAYS : [EXECUTE TESTS][Diagnostics]	73
Online diagnostic features	73
Error Messages.....	73
Interactive Diagnostic Tests.....	73
Procedure.....	73
MAIN MENU FUNCTIONS & DISPLAYS : [SET SECURITY][Change Password]	75
Setting the Password.....	75
MAIN MENU FUNCTIONS & DISPLAYS : [SYSTEM CONTROL][Close Breaker]	75
Manually Close Breaker	75
Appendix 1	76
Fig 1: Timing diagram for auto reclose function:	76
Table 1: General Characteristics	78
Table 2: Technical Specifications	79
Tables 3 & 4: Output Relay Checksum Structure	80
Table 5: Element Protection Parameters	80
Table 6: Step by Step Installation and Commissioning Instructions.....	81
Factory default settings & computer SW	82
New software	82
FP04-AR factory default element settings	84
FP04-AR factory auto-reclose default settings.....	86
FP04-AR default I/O settings	88
Default factory history (new relay - empty)	88
FP04-AR testing and managing the relay.....	90
Appendix 2	91
Diagram 1: Relay Case and Panel Cut-out Dimensions.....	91
Diagrams 2: Schematics with internal electrical detail and case terminal layout.....	93
Appendix 3	94
Graph 1: Standard Inverse Characteristic Curves.....	94



Electrical Distributors

Graph 2: Very Inverse Characteristic Curves	96
Graph 3: Extreme Inverse Characteristic Curves.....	98
Graph 4: Long Time Inverse Characteristic Curves	100
Graph 5: Definite Time Delay Characteristic Curves	101

INTRODUCTION

Product Evolution Information

FP04-B was released in late 2004, and replaced the earlier FP2001 model, now the FP04-AR replaces the FP04-B.

One relay fits all

- All of the features from the FP04-B still exist in the FP04-AR with the addition of the auto re-close function all programmable via the FP04-AR keypad or the PC SW.
- This reduces the user's stockholding and offers the greatest flexibility should operational requirements change.
- The new application software addresses these new features.

MAIN PRODUCT FEATURES

AUTO RE -CLOSE: Manual Breaker Activation Menu:

The manual breaker activation menu, allows the user to manually close the breaker, according to the auto-reclose setup. During this process the breaker shot relay will be closed for the time set in the shot impulse time.

If the auto reclose setup must be used, the auto-reclose settings will be copied to the protection function at the start of the process. These settings will be active until the "manual reclose use auto reclose settings" time passed. The normal trip settings will then be transferred to the protection function.

If a trip occurred during normal reclose procedure, the FP04-AR will continue with a normal auto-reclose procedure, as the setup require. To prevent this activate the [auto-reclose block] input.

If the breaker on/off input is not set in the input setup, the menu function will just display [NO BREAKER INPUT SELECTED] and return to the main menu.

Protection Functions

Breaker Fail Detection

The breaker fail function must be selected in [SET PROTECTION] [ELEMENTS] & [SET PROTECTION] [DIGITAL INPUTS] for the breaker fail to be detected.

The breaker fail function can be disabled.

This function will check for:

- The measured current after any trip is initiated. When the measured current does not drop below 10% of the nominal current in the breaker failed settable time, the breaker-failed relay will be activated and if auto reclose was busy, it will be stopped and locked out.
- It must also see the breaker input status as open.

The breaker failed counter is incremented to indicate another breaker failed count. The trip history will indicate the breaker fail condition in the third history information display.

If the measured current of all the measured elements drops below before the breaker-failed time, and the breaker input status indicated as open, the function will stop the timeout. The alarm LED is not used for this function.

It must be remembered that this function will be activated by any trip function even if the trip function was not routed to a trip output relay.

Measuring input applications

MEASURING INPUT: [Elements 1 to 4]	Individually programmable for 1A or 5A. Can be configured either of following functions, in any combination:
MEASURING INPUT: [Element 3]	Individually programmable for 1A or 5A.
Protection Curves (selectable)	- Over-current & Earth Fault.
MEASURING INPUT:	- Sensitive Earth Fault, as an alternative to OC/EF.
- SI (Standard Inverse).	
- VI (Very Inverse).	
- EI (Extreme Inverse).	
- LTI (Long Term Inverse).	
- DTL (Definite Time Delay).	

Multi function Function Outputs/inputs

- The FP04-AR is supplied with factory jumper settings for K4 & K5 as relay outputs.
- When the FP04-AR is applied to auto-reclose the breaker, more digital inputs are required to interface to the breaker system.
 - Hard wired inputs are needed to read status such as [block auto re-close], [breaker closed/open], [trip spring wound].
 - To accommodate the functions the standard digital input plus the K4 & K5 will require the PC board links to be relocated to use the outputs as inputs, not forgetting the firmware also needs to be configured by the user to allocate the new inputs.

Digital input applications

DIGITAL INPUT: [Breaker Fail detection]	Using the standard digital input or input sacrificed from output. Programmable time delay.
DIGITAL INPUT: [Trip blocking function]	Using the standard digital input or input sacrificed from output.
DIGITAL INPUT: [Auto re-close Blocking function]	Using the standard digital input or input sacrificed from output.
DIGITAL INPUT: [Breaker closed state]	Using the standard digital input or input sacrificed from output.
DIGITAL INPUT: [Breaker re-wound state]	Using the standard digital input or input sacrificed from output.
DIGITAL INPUT: [Event tripping]	Using the standard digital input or input sacrificed from output.

Digital Inputs logic settings

- DIGITAL INPUT: The optically isolated digital input - User configurable for active low/active high.
- Setting to Active High indicates the input is powered (30 – 250V AC/DC) and on, i.e. status = ON.
 - Setting to Active Low indicates the input is not powered and is off, i.e. status = OFF.

Relay Outputs

There are a total of 6 relay outputs...
Also refer to....

- Diagram 2 – Schematic Diagram and Terminal Numbering.
- [Output relay contact form].
- [Digital input applications].

Terminal 10 & 12 (Relay 1):

- User can be matrix to react to any of the protection features available for tripping, alarming and status.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board.

Terminal 14 & 16 (Relay 2):

- User can matrix to react to any of the protection features available for tripping, alarming and status.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board.

Terminal 18 & 20 (Relay 3):

- User can matrix to react to any of the protection features available for tripping, alarming and status.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board.

Terminal 13 & 15 (Relay 4) or sacrifice to be (Input 3):

- User can matrix to react to any of the protection features available for tripping, alarming and status.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board. Ref:
- By changing the link on the PC board it can be configured for (Input 3) operation and functions selected as per [DIGITAL INPUT] applications.

Terminal 17 & 19 (Relay 5) or sacrifice to be (Input 2):

- User can matrix to react to any of the protection features available for tripping, alarming and status.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board.
- By changing the link on the PC board it can be configured for (Input 3) operation and functions selected in menu [SET PROTECTION] [DIGITAL INPUTS].

Terminal 2 & 4 (Relay 6):

- This output cannot be user can matrix to react to any of the protection features available, and is dedicated to be the self-supervision output relay. This relay can be used to determine when power fails or there is fault with the relay.
- Two output connections can be set for relay contacts to be normally open or normally closed by setting the link on the PC board.

FP04 -AR Enclosure

The FP04-B & FP40-AR enclosures are identical, flush mount and 19" rack compatible.
Draw-out facility, with automatic shorting of the measuring elements CT input connections.
Refer to Diagram 1 for dimensions.

User Interface

3 LED Status Indications: Power On (Healthy); Alarm; Trip
Alpha-numeric, backlit, Liquid Crystal Display (2 lines x 16 characters)
Menu driven user interface with 5 button interactive keypad, for interactive set-up and display of operational parameters as well as status, post-trip information and a trip history log showing details of the last 40 trips

Test Functions

Both on-line and user activated hardware diagnostic testing.
Integrated simulated injection facility to verify set-up.

Data Communications

Two serial interfaces for programming and interrogation.
Remote communication via external fixed line or GSM modem.
Both Strike protocol and Modbus RTU protocol co-reside in the product.



Application Software

Windows 95/98/2000/NT/XP Software Package, for local programming/data uploading, as well as remote communication via modem.

FPO4 - AR Features

As followings:

- Multi shot breaker auto re-close.
- RS232 connection on the front panel & firmware configurable RS232 OR RS485 to standard rear terminals. Both serial ports are separately programmable to baud rates of 2400 to 115200.
- Strike Technologies protocol & MODBUS co-reside in the relay.
- 1A/5A CT selection programmable – no removing of relay to configure CT wire connections.
- Greater accuracy of time and current measurements.
- Improved response time.
- Time stamping of the trip history records and other status registers.
- Reset after a trip can be either automatic after a pre-set delay, or requiring user acknowledgement.
- A pre-set number of user acknowledged resets can occur before a password is required.
- The digital inputs can be configured as one of the alternative functions; trip blocking, an event input, breaker status, trip spring wound, block auto re-close, or for remote reset.
- Four running displays, any one which can be programmed to be the default.
- Lost password recovery procedure to ease this without compromising system security.

Updating of the FP04 -B

The FP04-B is now replaced by the FP04-AR combined over-current, earth fault, and sensitive earth-fault protection relay with additional auto-reclose function when required. The FP04-AR has more components fitted for the additional output/input hardware functionality and other minor hardware changes. For this reason an existing FP04-B is readily usable to upgrade to work as a FP04-AR.

As the FP04-AR has the same basic functionality as its predecessor the FP04-B and has no radical changes in the protection setup but can now have outputs re-designated as inputs to accommodate the additional status feedback required when the auto reclose function is applied.

Strike Technologies progressive R & D in protection relays has been built on the foundation of years of continued development through previous successful models. The FP04-AR has quality embedded into every stage of its design and it has been manufactured to the strictest quality standards. Combining state of the art hardware technology and software techniques it provides the most convenient functionality in its sphere.

This manual contains an overview, functional description, and specification of the FP04-AR, as well as detailed instructions on installation, commissioning, setting up, operation, and maintenance.

Whilst it provides a wealth of information, the manual does not replace the need for anyone installing, operating, or maintaining the equipment to be suitably qualified and/or trained. Such a person should have a prior knowledge of power system protection, power system measurements, and power system safety procedures. Before installing, setting up or operating the FP04-AR relay, the user should study the applicable sections of this manual, taking particular note of WARNINGS, CAUTIONS and NOTES included for the safety and protection of both personnel and equipment.

Before attempting to trouble-shoot the equipment, the user should thoroughly understand the entire manual. For trouble-shooting and commissioning the following equipment is required:

Digital multi-meter with clip-on current tong for measuring 1A or 5A current transformer secondary.

A single-phase primary or secondary injection test set, which is included in the product range offered by Strike Technologies.

Due to the nature of the FP04-AR relay, it is not recommended that the user should attempt repairs other than the removal and replacement of the draw-out unit that houses all electrical and electronic parts. Any faulty FP04-AR relays should be returned to STRIKE Technologies (Pty) Ltd. for testing, and if necessary, for repair or replacement of faulty parts, re-calibration, and re-testing.

Thank you for purchasing the FP04-AR PROTECTION RELAY, please contact Strike Technologies (Pty) LTD for further details if not covered within this manual.



This equipment is potentially hazardous in respect of electrical shock or burn. Only qualified personnel, who are thoroughly familiar with the FP04-AR relay and these instructions, should install operate or



maintain this equipment. To minimize the hazard of shock or burn, the user should adhere to approved protection and safety procedures.

PRODUCT OVERVIEW

Application

The FP04-AR Auto Reclose Protection Relay is a digital, integrated, multi-function, combined over-current, earth fault, and sensitive earth fault protection relay, for application on medium and high voltage incoming and outgoing feeder circuits.

FP04-AR can be used as a standard protection relay or enable and use the Auto Reclose function.

Its purpose is to continually monitor a circuit and upon detecting a dangerous condition, use its outputs to open breakers in the circuit, followed by a one shot auto reclose. On Reclose and the fault still exists the relay will, lockout, bringing it to safe levels until the fault can be rectified.

The user will programme the FP04-AR with regard to...

- Each input's protection function.
- The fault levels associated with it.
- Enable and set Auto Reclose parameters.
- Select which outputs are switched accordingly.

The product is completely configurable, to cater for the widest range of relay settings, doing away with the need for different models to cope with different functionalities.

Application Auto Reclose Sequence Scenario

1. First manually close breaker, breaker will re-charge spring on closure.
 - a. The breakers own internal trip spring re-wound status will protect the breaker from closing before it can be established that it is charged and can trip on a fault.
2. With breaker on load activate FP04-AR auto reclose input.
3. FP04-AR will now be ready to Auto re-close.
4. Fault occurs.
5. FP04-AR will trip breaker.
6. Start trip pulse energised time.
7. FP04-AR will start dead time.
 - a. Trip coil energised for period.
 - b. Breaker opens.
 - c. Allow for arc to extinguish.
8. Breaker open.
 - a. Start breaker rewind time.
 - b. Check for breaker rewind input signal status.
9. FP04-AR will run its pre-set spring rewind time cycle.
10. Before the first shot.
 - a. The breaker has its own internal trip spring interlock and will disable closing till its internal trip spring re-wind status indicates the trip spring is re-wound and breaker ready to re-close.
 - b. As the trip spring actual rewind time required should be shorter than the FP04-AR re-wind time window setting, the FP04-AR will cut short its time cycle and close on activation from the trip spring wound input signal to FP04-AR.
 - c. When the trip spring actual rewind time is longer than the FP04-AR time setting, wait for FP04-AR trip spring time cycle to elapse then lock-out.

Other important considerations:

1. BREAKER CLOSING – FP04-AR relay output time: Once the FP04-AR has started the breaker closing sequence, it must not break the closing coil circuit before it has time to magnetically close.
I.e. breaking the breaker "close coil" circuit to soon will burn-out the FP04-AR output relay contacts due to arcing.
2. BREAKER CLOSED – FP04-AR relay output time: The FP04-AR must only hold in power to the closing coil circuit for a brief period.
I.e. breaking the breaker "close coil" circuit will burn-out coil when powered too long.



Note

Refer to Fig 1 for timing sequence.



Electrical Distributors

INSTALLATION & COMMISSIONING

Unpacking, Storage and Handling

Upon receipt:

- FP04-AR Relay should be examined to ensure no obvious damage occurred during transit.
- Care must be taken when unpacking so that none of the parts are damaged.
- Check that the product delivered corresponds with that ordered.
- When the relay is not to be installed immediately upon receipt, it should be stored in a location free of dust and moisture in its original packaging.
- The allowable storage temperature range is -20°C to +70°C.
- When handling the draw-out module outside the fixed metal case, care should be taken to avoid contact with the electronic components and electrical connections.
- Electronic circuits are well protected by the fixed metal case.



Removing FP04 - AR from case.

The FP04-AR Relay incorporates static sensitive devices, if removed from the case for storage and/or transport; the draw-out module should be placed in an anti-static bag. Therefore do not withdraw the draw-out chassis unnecessarily.

When it is necessary to withdraw the FP04-AR module from its housing, the following precautions should be taken:

- o Before removing the draw-out module, ensure that you are at the same electrostatic potential as the equipment, by touching the fixed metal case.
- o Handle the draw-out module by the metal fascia plate, frame, or edges of the printed circuit boards.
- o Avoid touching the electronic components, printed circuit board tracks, or connectors.
- o If the equipment is to be passed to another person, first ensure you are both at the same electrostatic potential, by touching.
- o Place the draw-out module on an anti-static surface, or on a conducting surface, which is at the same potential as you.
- o Further information on safe working procedures for electronic equipment can be found in the relevant national and international standards.

Enclosure and Draw - Out Unit

The FP04-AR Relay is mounted on a draw-out chassis which slides into a fixed case. This housing is particularly suitable for either flush mounting or 19 inch rack mounting. The case is designed for use in tropical climates, and is designed to withstand shock, vibration and the ingress of dust and moisture.

Two phosphor bronze earth continuity strips are riveted to the draw-out chassis and make contact with the earthing strips in the fixed case.

In order to remove the draw-out chassis, unscrew by a quarter turn the bottom catch of the removable front cover and remove by pulling it's the bottom edge.



Then firmly and slowly pull the draw-out handle on the front fascia plate to remove the draw-out chassis of the FP04-AR Relay.

Configuring the Hardware Prior to Installation

Output Relay Rating



Caution

Not all the output relays have the same rating.

K1 has a higher DC voltage rating to take trip coil conditions.

K 2 – K6 have slightly lower ratings and that must be considered when using in any trip or closing circuits.

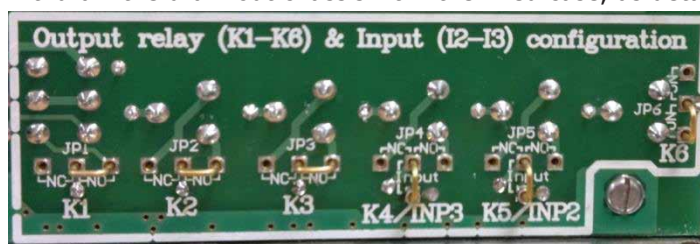
Auto Reclose and Output Relay Cautions

Check the output relay ratings when auto reclose requires an output to operate the closing coil.

Refer to technical specification. An interposing relay may be required to take the DC voltage/load.

Output Relay Contact Form

Output relays 1 to 6 each have one changeover (form C) contact. As default, output relays 1 to 6 are supplied with the normally open (relay de-energized) contacts wired to the terminal block. However, the user may easily change any or all of the contacts of output relays 1 to 6 wired to the terminal block to be normally closed, as required by the application. To do this, withdraw the draw-out chassis from the fixed case, as detailed taking note of the handling requirements.



Then, referring to figure above, identify the relay N/O and N/C selection links, on the Analogue / Power supply printed circuit board. Move the link to the desired position for each relay, to select the appropriate contact form.

Re -inserting the FP04 -AR in the Case .

In order to insert the draw-out chassis into the fixed case carefully align the guide rails on the draw-out chassis with the corners of the fixed case. Then firmly and slowly push the handle on the front fascia plate to insert the draw-out chassis into the fixed case. When the chassis is almost fully inserted, an extra resistance will be felt as the moving contacts on the draw-out chassis mate with the contacts of the fixed case. At this point, press the handle very firmly to fully insert the draw-out chassis. Then place the front cover by hooking the top catch over the clip on the fixed case. Align the front cover and refasten the bottom catch by a quarter turn.

Terminals

A terminal block, with 28 recessed terminals, is provided on the fixed case. Standard M4 screw terminals (cable lugs with M4 and lug outer diameter ≤ 8 mm), or fast-on connectors (4.8 mm width and 0.8 mm thickness), can be used on the terminal block for connections to the protection relay.

Removing the draw-out chassis from the fixed case automatically short circuits the current transformer field terminals, before breaking contact with the draw-out chassis, and ensures that the current transformer circuits are not open circuited during and after removal.

Refer Appendix 2 diagram 2 for details of the terminal layout and terminal connection diagram.

Mounting

The FP04-AR Relay can be mounted anywhere that meets the environmental specifications as detailed in appendix 1 table 1, and in particular it should be mounted indoors, in a clean, dry atmosphere, out of direct sunlight, and free from excessive dust and vibration.

Refer appendix 2 diagram one for details of outline dimensions, cut-out details, and mounting holes.



Caution

Heat producing devices must be located at sufficient distances to ensure that the maximum operating temperature of the FP04-AR Relay is not exceeded.

The FP04-AR Relay is normally used as a flush mounted or 19 inch rack mounted instrument, for fitting on or within switchgear or relay panels. The relay should be mounted at a convenient height above floor level to facilitate optimum visibility and operator interaction.

The mounting holes of the fixed metal casing of the FP04-AR Relay are accessible without removing the front cover and/or the draw-out module. Therefore it is strongly recommended that the draw-out module should remain protected by the fixed metal case during mounting and assembly of a FP04-AR Relay into a panel or 19 inch rack.

Wiring

All current transformer, auxiliary voltage, and output relay wiring connects to the terminal block with 28 recessed terminals on the rear of the fixed casing.

Refer appendix 2 diagram 2 for a terminal diagram showing terminal numbers.

Earth Connection

It is recommended that a 4mm² earth conductor to be installed from the FP04-AR Relay earth terminal to the panel earth bar. In addition, ensure that the panel is properly earthed in accordance with local regulations.



Warning

For personnel safety as well as not to adversely affect the FP04-AR Relay by surges, transients and other electrical and electro-magnetic disturbances, it is essential that the relay is properly earthed as detailed above.

Auxiliary power supply

The product is powered by a high efficiency, switch-mode power supply, with separate rear connection terminals. Any auxiliary voltage supply from 30V – 250V ac or dc may be used. The connection terminals are not polarity sensitive and therefore it is not necessary to establish the polarity when connecting a dc supply voltage.

The maximum burden on the auxiliary supply is 10VA.

Wire the auxiliary power supply to terminals 5 and 7.

Refer appendix 2 diagram 2 for connections.



Caution

Check carefully, before energizing, that the auxiliary voltage is correct, and falls within the range indicated on the FP04-AR Relay faceplate and ensure that the auxiliary supply is adequately protected by means of fuses or miniature circuit breakers to suit the fault level and wire size used as well as the inrush current. High rupturing capacity fuses (2A) are recommended.

Current transformer circuits

Connect the current transformer connections for elements 1, 2, 3, and 4 to terminals 21 & 22, 23 & 24, 25 & 26, and 27 & 28 respectively.



Caution

Refer also to the connection Diagram 2.

One side of each CT circuit should be earthed, and multiple earth connections and earth loops should be avoided.

Check carefully, before applying current transformer inputs, that the current transformer rated currents are correct and correspond with the nominal rated currents of the relevant measuring elements

Refer appendix table 2 for the acceptable current range, the short-time Over-current, and the VA burden of the measuring elements.



Warning

Extremely hazardous voltages can appear across the CT secondaries when the CT secondary current is open circuited. Do not attempt to connect, disconnect, service or insert other devices in the CT secondary current loops without positively switching off the primary circuit, and thus ensuring that the secondary current is zero.

Output Relay Circuits

Connect the output relay circuits to the terminals of output relays K1, K2, K3, K4, K5, and K6 to terminals 10 & 12, 14 & 16, 18 & 20, 13 & 15, 17 & 19 and 2 & 4, respectively.

Refer : Refer appendix 2 diagram 2 connection diagram.



Caution

Check carefully before applying voltage to the output relay contacts that the loads and voltages to be applied are within the ratings of the relay contacts. Refer to Appendix 1 for the continuous thermal rating, the short time current rating, the making/breaking capacity, the maximum switching voltage and the maximum switching current of the output relays.

Ensure that the voltages applied to the output relay contacts are adequately protected by means of fuses or miniature circuit breakers to suit the fault-level, wire size, and contact rating.

Digital Inputs

There is one dedicated digital input and two multifunctional outputs that can be sacrificed and configured to be digital inputs. Total of three digital inputs can then be used to interface with the Auto-re-close function.

Refer appendix 2 diagram 2.

The digital input terminals can accept ac or dc input voltages and are not polarity sensitive.



Caution

Check carefully before applying voltage to the digital input terminals to ensure...

- Voltage applied to the digital input is adequately protected by means of fuses (High rupturing capacity fuses (2A) are recommended) or miniature circuit breakers to suit the fault level and wire size used.
- Voltage applied for digital inputs is correct and falls within the range detailed in Appendix 1.
- The FP04-AR relay is not still configured for relay outputs on when using the terminals for input function, resulting in a possible short across output relay contacts.

Serial Communication Port

When required, wire the Rx, Tx, and common terminals (6, 8, & 3 respectively). Note that for RS232 a "crossover connection" is required:

- I.E. the RX of the FP04-AR must be wired to the TX of the host device and vice versa.
- For RS485 models, the multi-drop wiring between FP04-AR's and the wiring from the first FP04-AR to the host RS485 port is Rx to Rx and Tx to Tx, i.e. not "crossed over".
- For RS485 applications, to obtain the best results in environments with high electrical noise, it is recommended that the last device in the line be terminated with a 120Ω resistor connected between terminal 6 (Rx-) and terminal 8 (Tx+) on the rear terminal block of the relay.

Noise Isolation

When properly connected and earthed, FP04-AR Relays are highly tolerant of electrical and electro-magnetic noise. Refer to Table 1 in Appendix 1 for the withstand ability. However, as with other microprocessor based measurement and protection equipment, the FP04-AR Relay must be installed, wired, and located with some degree of concern for excessive EMC out of specification for feeder protection relays for electrical and electro-magnetic noise which could cause erratic operation. The relay should be wired, mounted, and isolated from sources of potential noise and disturbances in excess of those prescribed in Appendix 1.

In extreme cases this may require that filters or surge suppressors be applied to electro-magnetic devices operating in close proximity to the FP04-AR Relay.

To avoid possible problems from electrical and electro-magnetic noise and disturbances, or if specific problems are experienced in this regard, obtain specialist advice regarding counter measures and solutions.



Caution

READ THE MANUAL

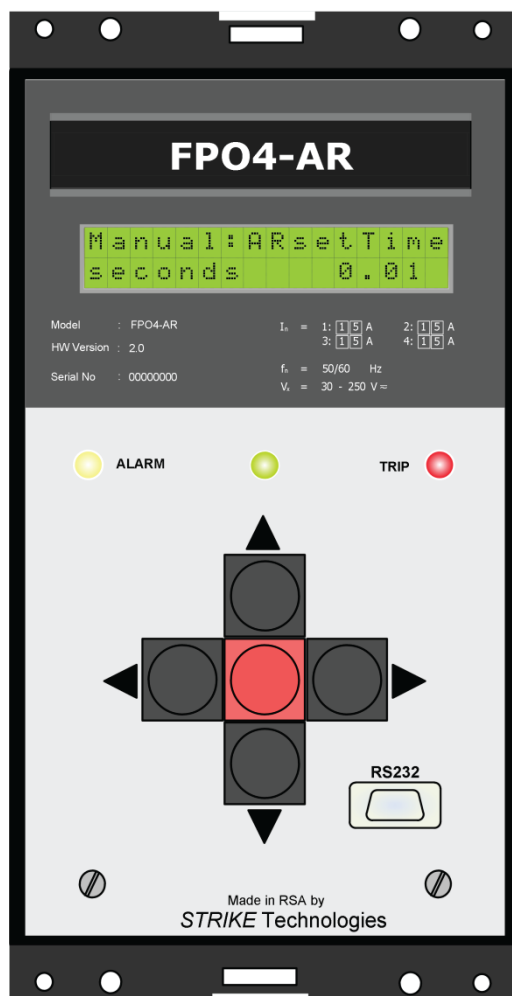
Performing any changes to element variable or other settings, changes to output relay configurations, or running the diagnostic test sequence to test the output relays, or running the simulated injection test, may cause the associated circuit breaker to trip. This could cause serious system disruption. Therefore

the greatest care should be exercised when performing these functions on-line, and the user should have a thorough knowledge of this entire manual as well as the particular application and system.


To fully commission the relay it is necessary to programme it to the required configuration. It is necessary to read and fully understand the following two sections with regard to this. Thereafter the complete step by step installation and commissioning table in appendix 1 can be referred to as a quick guide.

FP04 -AR FRONT PANEL FUNCTIONS

A menu driven user interface is provided on the front panel. This allows convenient viewing of operational information as well as programming facilities for relay set-up, and access to certain test aids for verification purposes.



Five button keypad.

The four black buttons are for scrolling left, and right, up or down, and the red  button is an "Accept", or "Enter" button, for confirming an entry or value, during set-up, for navigating backward or forward in the menu structure, or for accepting a trip annunciation condition, to allow the display to resume its normal running status.

LED Status Indication

There are three status indicators:

Power On (Healthy)

The green LED indicates...

- With power applied it will be on steady.
- Diagnostic test is performed automatically by the software at intervals of approximately 10 minutes; the function is performed in the background and does not compromise the protection in any way.
- During the self-tests, all possible hardware and microprocessor functions are tested, and the green LED will flash for a short duration.
- Flashing continuously indicates that the relay has failed to complete its on-line diagnostic test successfully.

Alarm/Start . This Yellow LED is illuminated whenever there is a software start signal active, i.e. any parameter which is above its set threshold.

Trip . This red LED is illuminated when a trip condition occurs and remains on until the trip condition, with its post-trip display, is cancelled by pressing the red "accept" button on the keypad. If multiple trip conditions were present at the time of trip, each condition must be sequentially accepted before the red LED will go off.

Alpha - numeric, backlit, LCD (2 lines x 16 characters)

This display panel provides most of the information feedback to the operator. It has a backlight which extinguishes after a 2 minutes of keypad inactivity. Pressing any button after this will light the display once more. The function of that button is ignored for this purpose.

The display has the following running displays functionality:

- Simultaneous display of current on all 4 elements on one screen.
- Display of all four primary currents in amps.
- Values are either in per cent or per unit of rated current (depending on the value prevailing).
- Scroll and , Digital Input status, Date & time.

There a four possible running displays to view.

Alternatively, by scrolling right or left, the, or the can be selected.

Status displays

Display of various operating parameters

Trip History display

Details of up to the last 40 trip events and any clearing of information. These are time stamped.

Password entry display

Allows entry of an optional password, to restrict access to certain interactive menus. This provides a measure of security against casual or unauthorized interference to the relay operation.

Programming displays


Used interactively with the keypad, when accessing the menu during the set-up of:

Elements	Output Relays
Digital Input	Function Resets
Line Frequency	Serial Ports
Real-time clock	Password

OPERATING FP04 - AR PROTECTION RELAY

FP04 -AR Start -up

The following is the possible screen messages that will be briefly displayed at FP04-AR power-up.

J U M P E R O F F R e s e t m a y f a i l	 Warning	When this message ever shows on relay power-up, contact Strike Technologies as there is possible tampering with the relay.
--	---	--

F P O 4 - A R V e r s i o n 4 . 0 0 5 0 H z	This is the standard start-up screen when powered up.
--	---



Note

This section assumes that the relay has been correctly installed and wired as detailed in the previous section, and that power is applied to the auxiliary supply terminals.

Once the FP04-AR has been set up as required it is ready to carry out its protective functions. During normal operation various displays come into play:



Electrical Distributors

The Running Displays

The displays available on the relay following powered up in a healthy state, when the relay is not in the menu mode. Post-trip Information displays (displayed automatically following a trip)

Annunciator Symbols On Running Displays

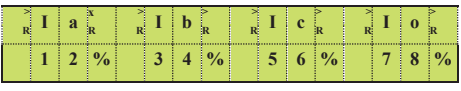

Included in this display format are various annunciator symbols, indicating which trip functions have been set on each element and their status. Refer to the [Factory default Display].

For each element as follows...



- Steady state [$>$], or [$>>$] symbol, to the left and right of the respective element current display, indicates that the low-set and/or high-set thresholds, respectively have been set for that element.
- When one, or both these symbols are not shown, the related threshold settings have been disabled.
- When either, or both symbols for a particular element are flashing, the associated threshold(s) have been exceeded and the relay can be expected to trip in due time. Note that while the yellow alarm/start LED will be on at this time, the annunciator symbols provide the extra information as to which threshold(s) on which element(s) are exceeded.
- [x] symbol displayed relates to the blocking function.
- An [x] symbol next to an element label indicates that a blocking input signal is active for that element.
- A flashing [x] indicates that the associated current threshold is exceeded, but that the relay will not trip, because of an active blocking input.
- [R] Indicates auto reclose has been applied to the protection parameter.

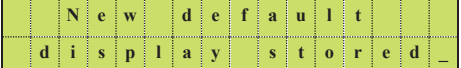


Factory Default Display

There are four displays which can be viewed.

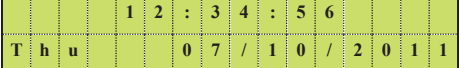


	<p>The default running display on shipment is that of the four element currents shown in p.u., or % of nominal rated CT current. Switching between the per cent or per unit display happens automatically and is dependent upon the magnitude of the currents. Included in this display format are various annunciator symbols, providing information as to the status of the element currents, as described above. Press  to scroll to next screen.</p>
---	---

Changing Factory Default Display


The user can select the FP04-AR to display any of the running displays to be the default as shown here. To select the user required default display, scroll  to the display required and press and hold button  till this screen shows, then release. The default is then set. It can be changed at any time to suit the user.

	<p>Press and hold button  till this screen shows [New default display stored]. Or press  to scroll to next screen.</p>
---	--

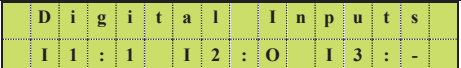


This default running display will be reverted to if there is no keypad activity for 2 minutes.

	<p>Press and hold button  till this screen shows [New default display stored]. Or press  to scroll to next screen.</p>
---	--

Input Active Display

 The display shows the standard input 1 and the configurable inputs 2 & 3. All three I1, I2, & I3 have been allocated to be permanently on the screen with dynamic indication of input state... [1] condition = on, [0] condition = off, [-] condition = not configured for input.

The active High or low will influence whether the display shows on or off when power is applied.

	<p>Press and hold button  till this screen shows [New default display stored]. Or press  to scroll to next screen.</p>
---	--

	<p>Press and hold button  till this screen shows [New default display stored].</p>
---	---



Electrical Distributors

3	:	6	7	.	8	A	4	:	1	2	.	3	A	Or press	to scroll to next screen. Wrap back to first screen.
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----------	--

AUTO - RECLOSE APPLICATION CONSIDERATIONS

Auto - Reclose Installation Reminders

The FP04-AR impulse output relay can in some cases reclose directly due to the settings (Impulse relay hold time of 60ms and an instantaneous trip of 10ms). This cannot be prevented in the firmware and needs to be corrected outside the relay with an anti-pumping circuit.

Auto - Reclose Timing Scenarios

The auto-reclose function of the FP04-AR cannot operate separate from the trip functions.

The auto-reclose functions of the FP04-AR protection relay illustrated in appendix 1, Fig 1. The breaker response time is expanded to show the different stages of the breaker during open and reclose activity. For the feeder line the dead time is from the time the arc is extinguished until the closing circuit is energised. For FP04-AR the dead time can only be measured from the time a trip is issued, until the closing circuit is energised.

The Basic Auto - Reclose Scenario

Single shot, no breaker rewind checking, and disabled auto-reclose trip setup. The Breaker on/off input selected as input, one trip relay and one reclose relay. In this scenario, the trip output relay will open the breaker. The dead time timer will start to run. When this timer timed out, the reclose relay will fire a shot to reclose the breaker. The reset timer will time-out to reset (reclaim) the auto-reclose for a next reclose procedure.

Block Auto - Reclose Input - Function

The auto-reclose input will lock out the reclose process any time the input becomes active for more than 50ms during the auto-reclose process. If the auto-reclose block input stays on for 3 seconds and then off for three seconds the auto-reclose process will reset (reclaim).

Auto - Reclose Second Set of Settings - Function

Setting the time that the auto-reclose settings must be active during auto-reclose can activate or disable the auto-reclose settings. These settings are a full second set of trip settings and are as flexible as the normal trip settings. After the FP04-AR has tripped the breaker and the relay hold time timed out, the auto-reclose settings are copied to the protection unit, ready for the reclose. When the reclose shot is fired, the time to use auto-reclose settings start to time out. This time is re-loaded if a trip becomes active. If no trip is busy the normal trip settings will be copied to the protection unit after the time to use auto-reclose settings timed out.

It is preferred that the time to use auto-reclose settings must be shorter than the reset (reclaim) time. This will make sure that the FP04-AR is back to the normal condition before it will reset (reclaim) the auto-reclose fully.

Block Trip Input - Function

The block trip input will inhibit the trip functions during normal trip busy or auto-reclose trip busy. During the time that the input is active, the trip time out registers will be reloaded, to start the time-out again, after the block signal is released.

Breaker Re-wound Input - Function

The breaker re-wound input is checked after the breaker opened (trip output relay hold time). It must be active before the breaker rewind time timed out. If this happens, the breaker rewind time is compared to the stored time to store the maximum breaker rewind time. If the input does not become active before the set time, the FP04-AR will lock out the auto-reclose procedure.

Multi shot auto - reclose

The FP04-AR can be set for 4 shots to be fired. The timing diagram will be the same for each re-close shot.

Refer appendix 1, Fig 1 for timing diagram.

Auto - Reclose output relay functionality:

The auto-reclose relay setting has the following functions:

- Auto-reclose enabled – this output relay will be active (coil energised) when the auto-reclose function of the FP04-AR is enabled. The relay will reset if the auto-reclose function is disabled in the menu.
- Auto-reclose busy – this output relay will be active (coil energised) during the time that the auto-reclose function is busy. The relay will reset when the auto-reclose reset time timed out or if the auto-reclose function locked out.
- Auto-reclose lockout – this output relay will be active (coil energised) when the auto-reclose function locked out. The relay will reset when the trip function is acknowledged on the relay front panel.
- Breaker fail relay – this output relay will be active (coil energised) when the breaker did not open after a trip was issued. The relay will reset after the breaker fail trip reset time timed out.
- Breaker rewind failed – this output relay will be active (coil energised) when the breaker rewind input failed to become active before the breaker rewind timer timed out. The relay will be cleared when the trip is acknowledged.
- Auto-reclose shot – this output relay will be active when a reclose shot is fired, and for the reclose impulse time. After the reclose impulse time timed out the relay will reset.

Auto - Reclose time setting problems or features

The FP04-AR can be set up in such a way that problems can occur during the auto-reclose procedure. The following scenarios state the possible errors that must be prevented while setting up the FP04-AR relay from the front panel: (If the FP04-AR PC software is used these problems will automatically be verified and the users will be notified.)

- Relay hold times longer than auto-reclose dead time –if the auto-reclose dead time timed out before the trip function's output relay hold time elapsed, the FP04-AR will lockout the auto reclose. The trip functions, will continue until the hold times elapsed.
- Breaker rewind lockout time longer than the dead time – the FP04-AR will directly go to lockout after the dead time timer timed out. In this case the dead time needs to be set for a longer time setting.
- Auto-reclose settings active time longer than auto reclose reset time: In this case the auto-reclose settings will stay active after a successful reclose procedure. This will not affect the FP04-AR protection operation, except that the settings is not back to normal before the auto-reclose function is reset (reclaimed). The trip may still be active if the normal settings become active; therefore the auto-reclose may reset (reclaim) and start the auto-reclose again in a continuous loop.



Note

Only the first trip is stored in history: if the trip was not assigned to an output relay the FP04-AR record the wrong trip function to the trip history.

SOFTWARE

A Windows 95/98/2000/NT/XP/W7 Software Package is available for use with the FP04-AR relay. This package is easy to use, intuitive in fashion, and provides the following functionality.

Programming Software

While the set-up of the FP04-AR may be entirely programmed directly on the relay using the menus provided and the user interface, it is often more convenient to do this from a laptop or other PC, connected to the relay via the data port. The advantages of this are mainly where multiple relays are to be programmed with the same or similar set-ups. The set-up(s) can be created and saved beforehand, and downloaded to the relay(s) on site. Additionally, the set-up can be retrieved and printed out, to verify the correct programming of the relay(s) for record purposes.

Accessing The Information From Displays.

Running displays, as well as trip history information can be uploaded from the relay(s) at any time, for viewing purposes.




Electrical Distributors

Remote Communications Via Modem.

Packaged together with the Application Software package is a Dialler module which facilitates use of the package over a modem link, for remote communication.

Various modems have been evaluated for use with this facility, including fixed line and GSM types and their set-ups are included in the Dialler module, for convenient selection by the user. Other modems may well be usable, but these are not supported by Strike Technologies.

MAIN MENU & DISPLAYS : NAVIGATING



In order to set up the FP04-AR, to operate it in anything more than it's most basic use, or to test the unit, it is necessary enter the menu. Despite the number of programmable parameters, and the amount of information that can be extracted from the relay, it is a simple and intuitive process. Manual programming is achieved by using just the five buttons on the front panel, the horizontal scrolling buttons and , the vertical scrolling buttons and , and the red button .

Accessing The Main Menus

Button Operation – Enter/Exit Menus

To enter the menu press both horizontal scroll buttons and simultaneously for five seconds.

To exit without entering a menu press both horizontal scroll buttons and simultaneously.



To exit while in a sub menu press  then select [Cancel] then press  to exit back to main menu, then press and simultaneously to exit main menu back to running display.



Note


When in menu mode, whether merely viewing information, or changing parameters, the protection remains in operation and is not compromised in any way. The previous parameters remain in force, until the [Save] action is activated, whereupon the changed parameters come into force.

When a password has never been set, no password will be requested and the display will switch straight to the [VIEW INFORMATION][Trip History] display in the main menu list.

<table border="1"> <tr> <td>T</td><td>y</td><td>p</td><td>e</td><td>P</td><td>a</td><td>s</td><td>s</td><td>w</td><td>o</td><td>r</td><td>d</td> </tr> <tr> <td></td><td></td><td></td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td></td> </tr> </table>	T	y	p	e	P	a	s	s	w	o	r	d					0	0	0	0	0	0			<p>If a password has been set, you will be requested to enter it. This is a 6 digit numeric code.</p> <p>For the number use or to scroll through the six numbers, then for each digit use the or buttons, only one digit will be accepted as a password, the user can set any digit between 0 - 9.</p> <p>The digit being addressed will be indicated by a cursor - a line beneath the digit.</p> <p>Once you have set all digits, press the red button  to enter.</p> <p>You may be asked to confirm.</p>
T	y	p	e	P	a	s	s	w	o	r	d														
				0	0	0	0	0	0																
																									




Note

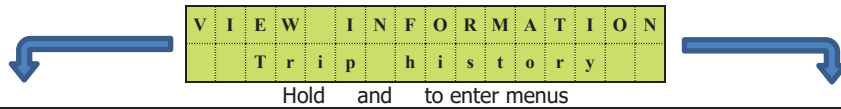
When shipped, the default password is all zeros, which allows unrestricted access to all menu functions. By setting a new password the valid password must be entered to access to any interactive menu. This provides a measure of security against inadvertent or unauthorized alterations to the relay settings. Unrestricted access is still provided to all information displays, by pressing  instead of entering the password.

MENU ACCESS


The FP04-AR can be accessed to be programmed via the communications port or via the push-button keypad. There are 15 main menus available which can be scrolled through using **▲** and **▼**. The main menus cover programming the FP04-AR, viewing history and status, and testing.

MAIN FP04 -AR MENU


Note:  Press to enter the sub menus.




From the menu above

Press **▼** to move down through menus below or  to enter sub menus.


S	Y	S	T	E	M	C	O	N	T	R	O	L
C	L	O	S	E	B	R	E	A	K	E	R	

Press **▲** to move up through menus above or  to enter sub menus.


S	E	T	S	E	C	U	R	I	T	Y		
C	H	A	N	G	E	P	A	S	S	W	O	R

Press **▲** to move up through menus above or  to enter sub menus.


E	X	E	C	U	T	E	T	E	S	T	S	
D	I	A	G	N	O	S	T	I	C	S		

Press **▲** to move up through menus above or  to enter sub menus.


E	X	E	C	U	T	E	T	E	S	T	S	
S	I	M	U	L	A	T	I	O	N	T	E	S

Press **▲** to move up through menus above or  to enter sub menus.


C	U	S	T	O	M	I	S	E	R	E	L	A	Y
R	E	A	L	T	I	M	E	C	L	O	C	K	

Press **▲** to move up through menus above or  to enter sub menus.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y
S	E	R	I	A	L	P	O	R	T	S			


Press **▲** to move up through menus above or  to enter sub menus.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y
H	A	R	D	W	A	R	E	C	H	O	I	C	E


Press **▲** to move up through menus above or  to enter sub menus.

Note can only be activated when the relay is in trip state with the breaker open and the trip spring wound.


From the menu above

Press **▼** to move down through menus below or  to enter sub menus.


V	I	E	W	I	N	F	O	R	M	A	T	I	O	N
				S	T	A	T	U	S					

Press **▼** to move down through menus below or  to enter sub menus.


S	E	T	P	R	O	T	E	C	T	I	O	N		
		E	L	E	M	E	N	T	S					

Press **▼** to move down through menus below or  to enter sub menus.


S	E	T	P	R	O	T	E	C	T	I	O	N		
O	U	T	P	U	T	R	E	L	A	Y	S			

Press **▼** to move down through menus below or  to enter sub menus.


S	E	T	P	R	O	T	E	C	T	I	O	N		
D	I	G	I	T	A	L	I	N	P	U	T	S		

Press **▼** to move down through menus below or  to enter sub menus.


S	E	T	P	R	O	T	E	C	T	I	O	N		
A	U	T	O	R	E	C	L	O	S	E				

Press **▼** to move down through menus below or  to enter sub menus.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y	
F	U	N	C	I	O	N	R	E	S	E	T	S		

Press **▼** to move down through menus below or  to enter sub menus.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y	
L	I	N	E	F	R	E	Q	U	E	N	C	Y		




Press **▲** to move across through menus to left or  to enter sub menus.





Electrical Distributors

Scrolling Through Sub - menus

Once you have accessed one of the 15 menus, you would scroll through its sub-menus by first pressing  then using  and  to scroll forward or reverse through the sub menus.

Changing or Selecting Parameters





Within the sub-menus, parameters are adjusted or choices normally made by using  and .

Some Exceptions

Some sub-menus do not follow the general rules described above.

- Trip History Scroll vertically to select a particular trip.
 Scroll horizontally for supplementary information on a particular trip.
- Diagnostics Press the red button to step to each item.
- Simulation Scroll vertically to select an element.
 Scroll horizontally to select element current adjustment.
 Then scroll vertically to adjust the current to be injected.

Scrolling

All displays and parameters can be scrolled in either direction and values can be incremented or decremented, by using the appropriate buttons. Generally  scrolls in the normal (forward) direction and  in the reverse direction;  increments and  decrements a value. Holding a scroll button in scrolls continuously. All scrollable sub-menus and parameters are of the "wraparound" type i.e. last wraps around to first. When held down, the scroll speed gradually increases the longer the button is held.


Usually (with some exceptions), once a parameter has been set to a value, or choice, the operator simply scrolls to the next item. All items on a submenu are saved together in one operation. This occurs when exiting the sub-menu.





Note

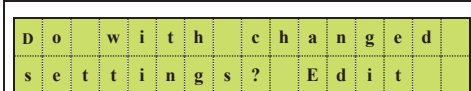

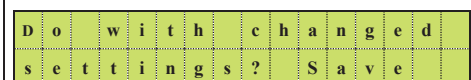

When programming the FP04-AR, it is important that any function not required must be disabled, to prevent confusion and possible spurious operation. Disable is an available option when scrolling a value, or selecting from possible choices.

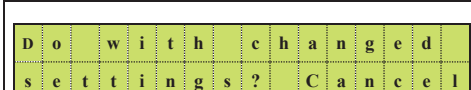

The Exit Process

To revert to the main menu without changing/saving any parameters press  then use  and  to [Cancel].

If the sub-menu being exited is an information display only, the display will revert to the main menu immediately.

If the sub-menu is a setting menu, use  and  to choose between the following options which are presented to you:

	Selecting [Edit] will re-enter the menu to make further changes. Press  to have your choice accepted, and revert to the main menu.
	Selecting [Save] will save the changes made and exit the menu. Press  to have your choice accepted, and revert to the main menu.






	Selecting [Cancel] will exit the menu without making any changes since the last save. Press  to have your choice accepted, and revert to the main menu.
---	---

To revert to the running displays from the main menu, press both  and  simultaneously.



Note

If the relay is inadvertently left in menu mode, it will automatically perform a [cancel] operation and exit to the running displays after approximately 2 minutes without saving any changes made since last changed saved.

In the three sections of this manual that follow, the symbols , , , , or  appearing at the beginning of a line of text indicate that the relevant button should be pressed to change to the display to that which will be described.



Electrical Distributors

Trip History menu

Trip setup menu : For all the trip settings, Nominal current, CT ratios, and the trip reset time. An additional feature is to clear the trip history. This function added here when password protected. The trip setup menu cannot be entered when a password has been set.

Trip history menu : Up to 40 trips history information loggings. No password is needed to enter this menu. The menu normally has only viewing capability. If the red button is pressed directly after the menu entering the menu, and the password was correct, the history can be cleared by choice.

Reclose Successful and More Shots – Trip History

The auto-reclose is taken as successful when the auto-reclose reset-time timed out after a reclose. The history is grouped in group numbers. The group number of trips related to one successful reclose is the same, therefore it can be taken that all the trips that occurred during a 4 shot reclose process will have the same group number.

The trip history menu displays up to the last 40 trips. On the first display is shown the number of trips in the history list. If there are trips logged in the history, the will scroll between the trips in the history.

The third display shows the auto reclose information. This display is only finalised once the relay finished the auto reclose shot. If the history log is viewed while an auto-reclose dead time wait is busy, the display will show [Waiting:-AR busy]. The display can show one of the following configurations:

- If auto-reclose was disabled in the setup during the history log, the display will show [Areclose:Disable].
- For successful reclose – Group number, shot number and [Reclose Success]. The group number is an indication of the combined trip and recloses sessions if more than one reclose shot was fired. The shot number is the number of the shot to fire next after the trip.
- For recloses before the successful reclose the trip history display will indicate [Reclose Normal] to indicate that the reclose process for that shot completed as normal (No lockout).
- If the breaker failed to close with a reclose (No trip occurred but the breaker failed to close) the trip history display will show [Bkr fail closing].
- For any lockout condition – Group number, shot number and type of lockout. The different lockout types can be:
 - o [Lockout: Rewind] Breaker rewind failed.
 - o [Lockout: AllShot] All the reclose shot of the according to the setup was fired.
 - o [Lockout: ARBlock] The auto-reclose block input was activated.
 - o [Lockout: TripBusy] The trip function was still busy when an auto-reclose shot should be fired.
 - o [Lockout: TripHold] The trip relay hold time was still active when the auto-reclose dead time timed out.
 - o [Current Superv.1] Current supervision level 1 decreased the shot count by one.
 - o [Current Superv.2] Current supervision level 2 decreased the shot count by two.
 - o [Current Superv.3] Current supervision level 3 decreased the shot count by three.
 - o [Current Superv.D] Current supervision level 4 to directly lockout.
- For breaker fail – the breaker-failed function can be active even if auto-reclose is disabled. There can be two different display combinations:
 - o If auto-reclose disabled [Areclose:Disable] [Lockout:-Bfailed].
 - o If auto-reclose enabled [ARgrp= Shot=] [Lockout:-Bfailed].

Trip display features when auto -reclos e is enabled:

When the auto reclose function is enabled, the time to reclose will be shown after a trip condition. When the reclose shot is fired, the display will oscillate between showing the running display and the time to reclose successful (reset time passed). After this time the trip display will show as mentioned in the previous section.



Electrical Distributors

The Post -trip Displays


Once a fault or other condition has caused the FP04-AR to trip, the red "trip" LED will illuminate and the running displays automatically change to show post-trip information.

The post-trip operational display is constituted as follows:

3	:	I	a	>	>	t	r	i	p	D	T	L					
1)					1	9	5	%			5	.	8	7	5	s

The top line of the LCD display shows the element number, together with the element label and the parameter that caused the trip as well as the active time curve.

The second line indicates the trip reference number, together with the value of current for that element at the time of trip, as well as the elapsed time from activation of starter to trip event.

Pressing  the red "accept" button will remove the post-trip information and if no password was required, the LCD display reverts to the normal running displays.

However, should a password be required and is correctly entered, the Allowed Resets sub-menu under the CUSTOMISE RELAY - Function Resets menu is activated. This allows an alteration of this parameter if necessary.

If multiple conditions were present at the time of trip i.e. more than one starter was active at the time of trip, these will be presented as additional post-trip screens. In this case, pressing the "accept" button will cause the next post-trip display to appear. In the case of multiple conditions, each post-trip display must be accepted separately, until all are accepted, whereupon the normal running display is restored.

The trip information is also stored in the non-volatile Trip History register. Up to 40 such sets of information are stored, where after the earliest information is over-written with data by subsequent trips. Viewing and clearing the Trip History registers is described under the section on [VIEW INFORMATION][TRIP HISTORY].

TRIP HISTORY MENU


This is accessed from the main menu.



Note

The protective functions are not compromised when in the menu mode. The relay continues to provide full protection.

V	I	E	W	I	N	F	O	R	M	A	T	I	O	N			
				T	r	i	p	h	i	s	t	o	r	y			

Press  to access the VIEW INFORMATION – Trip History sub-menus.

Trip s listed


T	r	i	p	h	i	s	t	o	r	y							
T	r	i	p	s	l	i	s	t	e	d	=	1	2				

The display will initially show the total number of trips currently listed. Scrolling right or left will display the time stamp of the last time the trip history was cleared.

Scrolling down once displays trip number 1. Note that the trip list is constructed on a Last-in, First-out basis; i.e. trip number 1 is the latest trip stored. For each initial trip screen there are a further 3 screens giving further detail, by scrolling right.



Element s and parameter s exceeded

I	:	I	a	>	>	t	r	i	p	D	T	L					
1)					1	9	5	%			5	.	8	7	5	s

Press  for this first screen to be displayed is identical to the Post-trip information display, described above.

Display top line on extreme left "1:" = element number.

Display bottom line on extreme left "1)" = trip count number.

Use  and  to scroll to other trip count number.

Elements & Levels of current that caused the trip

1 : 70 %	2 : 45 %	3 : >> 195 %	4 : 67 %
----------	----------	--------------	----------

Press **▶** for second display shows the value of the current flowing in each element at the moment of trip.

Date/time stamp trip occurred

1 2 : 3 4 : 5 6	
T h u 0 7 / 1 0 / 2 0 1 1	The third display shows the time stamp of the trip, together with a Breaker Failed flag if applicable.

Relay outputs activated by the trip

R e l a y (s) t r i p p e d	
- - - 4 5	The fourth display shows which relays were activated by the trip.

Should it be required to clear the Trip History registers, this function is accessed in the SET PROTECTION – Elements menu, thus providing password protection against inadvertent clearing of the Trip History.

MAIN MENU FUNCTIONS & DISPLAYS : [VIEW INFORMATION] [Status]

The Status information menu:

Status information menu : For all the status information of the relay. This menu can be accessed at any time without the password. Some of the counters and timers can be cleared. For this functionality, the password must be entered.

To verify that the digital input circuit is responding to a valid input, proceed as follows:

V I E W I N F O R M A T I O N	
S t a t u s	Press ▶ to access the VIEW INFORMATION – Status sub-menus.

User Defined FP04 - AR screen message

I n s t a l l I n f o .	This screen will auto scroll installation information.
T h i s d i p l a y i s	A 100-character user defined string can be typed in the PC program and transferred to the FP04-AR, which can then be used to identify the FP04-AR when used in long distance communications.

View : Input Status

Digital inputs : This display will show the status of the inputs of the FP04-AR (on the terminals). [ON] is when there is a voltage supplied to the connector that is above the minimum operating range of the digital input. [OFF] is when there is no voltage or a voltage lower than the digital input operating range supplied.

D I G I T A L I N P U T # 1 I n p u t s i g n a l : O N	Scroll horizontally to the [DIGITAL INPUT #1] screen. This is an active display and will change when the input signal is high or low, i.e. noting that high can represent [ON] or [OFF] in the relay logic settings. E.G. When set for active = [ON], then disconnected = [Input signal:OFF]. When set for active = ON then connected = [Input signal:ON].
D I G I T A L I N P U T # 2 I n p u t s i g n a l : O F F	Apply a valid input signal and note that the display changes to [Input signal:ON] Remove the valid input signal and note that the display reverts to [Input signal:OFF].
D I G I T A L I N P U T # 3 I n p u t s i g n a l : O F F	Scroll horizontally to view input #2 & #3 status. Exit the menu mode in the normal way.



Electrical Distributors



Note

The digital input circuit can be set to respond to Active High (On = voltage on digital input), or Active Low (On = no voltage applied to digital input). The ON/OFF displays observed in the above tests must be interpreted accordingly.

This should be borne in mind when interpreting this status display. Correct operation of the digital input circuit can be verified by applying the active input condition, according to the Active High/Active Low setting, while observing this status display.

View : Output Relay Status

Relay coil status – this status display shows the state of the firmware output to the output relay coils. [1] Shows the output relay coil is energised. [0] show the output relay coil is not energised.

R	e	l	a	y	:		#	1	2	3	4	5			
0	=	O	f	f		1	=	O	n		1	1	0	1	0

The instantaneous status of each of the relays K1-K5 is shown as On or Off. When a [i] is displayed in place of [0] or [1] then it indicates the output has been configured to be an input.



Note

The hardware links on the PC board must also be configured to inputs and not outputs.

View : Communication s Monitoring

Communication activity : This status show if characters was received on the serial port. [ON] shows that the serial communications port is busy handling characters. [Rx] stands for received characters, and [TX] stands for transmitted characters.



Note

The [ON] status is delayed to show short duration communications. If communications errors occur, the display will still show [ON], because it only shows activity, NOT integrity.

	F	r	o	n	t	C	o	m	m	s	.		
T	x	=	O	F	F	R	x	=	O	F	F		

The next two displays show the status of the Transmit and Receive lines of the front and rear communication ports. This is useful when implementing and testing a comms link. [ON] shows that the serial communications port is busy handling characters. [Rx] stands for received characters, and [Tx] stands for transmitted characters.



Note

The [ON] status is delayed to show short duration communications. If communications errors occur, the display will still show [ON], it only shows activity, NOT integrity.

View : Setup Saved Count

Setup saved count – this counter shows the times the setup was changed during the FP04-AR lifetime.

S	e	t	u	p	S	a	v	e	d				
C	o	u	n	t	e	r	=		0	0	0	1	2

Accumulated number of different set-ups saved in the relay.

View : Breaker Trip Count

Breaker trip count – this counter shows the times that the connected breaker was tripped by this FP04-AR. This counter is connected to the trip functions only. Even if the function that tripped was not programmed to an output relay, this count will still increase. Pressing the red button can clear this counter. The clear function is only available if the password was correctly supplied (or no password required).

B	r	e	a	k	e	r	t	r	i	p			
C	o	u	n	t	e	r	=		0	0	0	0	2

Accumulated number of breaker trips activated by the relay.

View : Breaker Failed Count

Breaker failed count : This counter shows the times that the breaker failed to open. Pressing the red button can clear this counter. The clear function is only available if the password was correctly supplied (or no password required).

B	r	e	a	k	e	r	F	a	i	l	e	d			Accumulated number of breaker fail events logged.
C	o	u	n	t	e	r	=			0	0	0	0	0	

View : Event Trip Count

E	v	e	n	t	T	r	i	p	p	e	d			Accumulated number of event trips.
C	o	u	n	t	e	r	=			0	0	0	0	

View : Total Reclose Shot Count

Total reclose shot count : Count of the FP04-AR recloses, and is increased every time a reclose shot is fired. Pressing the red button can clear this counter. The clear function is only available if the password was entered (or no password required).

T	o	t	a	l	R	e	c	l	o	s	e			Accumulated number of FP04-R recloses actions.
C	o	u	n	t	e	r	=			0	0	0	0	

View : Auto Re -Close Success count

Reclose shot successful count : Count that the breaker reclosed successfully, and is increased every time the "Auto-reclose reset time" timed out. Pressing the red button can clear this counter. The clear function is only available if the password is entered (or no password required).

R	e	c	l	o	s	e	S	u	c	c	e	s	s			Accumulated number of FP04-R reclose successful actions.
C	o	u	n	t	e	r	=			0	0	0	0	0	0	

View : Reclose Lockout Count

Total reclose lockout count : Count of auto-reclose function locked outs. Pressing the red button can clear this counter. The clear function is only available if the password is entered (or no password required).

R	e	c	l	o	s	e	L	o	c	k	o	u	t			Accumulated number of FP04-R actions failed or status feedback failed, causing a lockout.
C	o	u	n	t	e	r	=			0	0	0	0	0	0	

View : Breaker Rewind Failed Count

Breaker rewind failed count: Count of the breaker rewind procedure that failed to finish. Pressing the red button can clear this counter. The clear function is only available if the password was correctly supplied (or no password required).

B	r		R	e	w	i	n	d	F	a	i	l	e	d			Accumulated number of FP04-R rewind status feedback failed, as the FP04-AR rewind timer elapsed before FP04-AR input rewind status occurred. This would also cause a lockout.
C	o	u	n	t	e	r	=			0	0	0	0	0	0	0	

For each of the above counters, or will display the time and date that the counter was last cleared.

View : Maximum Rewind Time

Maximum rewind time : Timer shows the maximum time that the breaker took to rewind. This time starts at 0 and is updated every time a rewind check is done. The rewind check is only done if the breaker rewind option is programmed to one of the inputs. The rewind time is taken from the moment of trip until the time the breaker rewind input is active. Pressing the red button can clear this timer. The clear function is only available if the password was entered (or no password required).

M	a	x	i	m	u	m	R	e	w	i	n	d			Monitors the rewind time following a trip and updates when greater that the



Electrical Distributors

T	i	m	e	=					0	.	0	0	0	s	current maximum time. Can be used to check out-of-bounds changes in time.
---	---	---	---	---	--	--	--	--	---	---	---	---	---	---	---

View : Breaker I²t Accumulation

Breaker I²t accumulation : Display shows the accumulated I²t register for an element. The register is generated from the I² of the measured currents of an element at time of trip. This current is then multiplied by the breaker I²t time setting in the output relay setup. Pressing the red button can clear this counter. The clear function is only available if the password was entered (or no password required)

B r e a k e r I ² t										
E 1	>	t	r	i	p	:	A	u	t	o
							0	.	0	0

The next four displays show the integrated breaker I²t value for the breakers associated with each of the elements E1 to E4. This is the sum of the product of the square of the value of current interrupted at each trip, and a time constant, according to the manufacturers' recommendation for the particular breaker. This value is useful for preventative maintenance purposes.

View : Event Trip

E v e n t										
E 1	>	t	r	i	p	:	A	u	t	o
E v e n t										
E 1	>	t	r	i	p	:	A	u	t	o

The next nine displays (low-set and high-set trips for each of the elements 1 – 4, and Event trip) show the allowed operator trip resets applicable for each trip condition.



Note

To remotely programme and interrogate the FP04-AR a new version of the application software is available. Note that because of the added features of the FP04-AR the previous software for the FP04-B is not suitable.

View : Event Trip Pre-Set Auto/ Man

E v e n t										
E v e n t	T r i p	:	A u t o							

Will indicate

There are no further operational displays. All other menus and displays pertain to the interactive set-up and testing of the FP04-AR relay.

MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION] [Elements]

Element Settings

Element Protection Settings: Over-current and Earth Fault

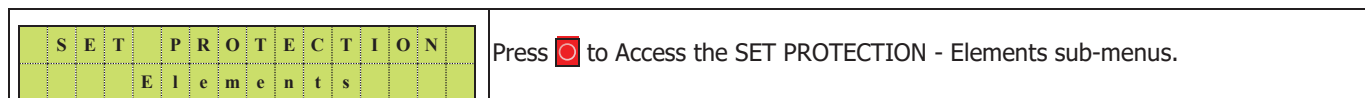
Current inputs on all four elements are converted to low-level ac signals by means of isolation transformers and anti-aliasing filters. These are then continuously measured by means of digital sampling and the RMS values calculated. Digital band pass filters ensure that only fundamental frequency currents are measured, thus allowing more precise thresholds to be set without "nuisance tripping". A digital signal processor takes care of these measuring, filtering and calculation tasks, ensuring fast and accurate results. When initially shipped, the default running display shows the RMS values continuously from left to right, in % or p.u., depending on the magnitude. An alternative display shows each element's primary current in amps. Either of these displays, or the Time & Date or Digital Input Status displays can be set as the default.



Note

When certain parameters are changed in the element set-up, sometimes the message following value changed will be displayed. This occurs when a change is made, which makes a related setting no longer applicable e.g. Selecting [Is] on Element 3, when it was previously [Ic] ([Is] has a different setting range to [Ic] and the user must set a new value). The message is followed by a display of the affected parameter (Is in the above case). In most cases the affected parameter is shown as disabled as a fail-safe measure. The operator can now choose an appropriate value.

Element Protection Settings : E1 to E4 settings menu



These elements provide over-current and earth fault protection as follows...

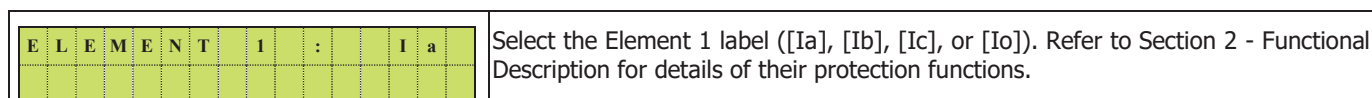
Any element may be programmed as an over-current element, with an overall range of [0.25 to 32] p.u. Of I_n , by identifying it as either [Ia], [Ib], or [Ic] during set up.

Similarly any element may be programmed as an Earth fault detector, with an overall range of [0.1 to 32] p.u. of I_n , by identifying it as [Io] during set up.

When the element setup is entered, all the existing settings can be viewed by pressing the left or right button. The up and down button will change the active display setting. After a setting is changed, and the left or right button pushed, the relevant settings are checked for boundaries. If the relevant setting is out of bounds, the display will show "The following value changed: -" and the value that changed will appear on the display. The trip setup menu contains the following items:

- Element Name – this is a description of the element that will be used to identify any function related to this trip, and can be one of the following:
[Ia], [Ib], [Ic] or [Io] (earth fault)
For element 3 there is an additional name [Is]. If this name is selected and saved, the firmware will activate the sensitive earth fault measurement hardware.

Element Protection Settings : E1 to E4 Element Name – [Ia], [Ib], [Ic], [Io]



Note

Any function not required must be set to Disable.

In the case of the [I>>] high-set thresholds, the time function is fixed as [DTL]. In this case the [I>>:xt] is the definite time lag in seconds.

Element Protection Settings : Fault Levels

Each element can be programmed to detect two levels of fault...

- High set [I>>] – a major violation of circuit integrity which would typically trigger a fast trip after a very short time.
- Low set [I>] – a lesser violation of circuit integrity which would typically trigger a trip after a longer period.
- Over-current and Earth fault elements each have a choice of time functions, for low-set only: [SI], [VI], [EI], [LTI], [DTL].
- Sensitive Earth fault low-set and all high-set ranges are fixed to [DTL].
- Each of the [SI], [VI], and [EI] functions (curves) has an associated time multiplier [xt], which scales the basic curve according to a particular requirement.

In the case of the [DTL] time function, [xt] sets the definite time delay in seconds.

Refer : appendix 3 graphs 1 to 7 for the relevant curves.

Element Protection Settings : E1 to E4 – [I>][I>>][Ia>xt][SI][VI][EI][LTI][DTL]

Element curves

The type of trip function for [I>] and can be one of the following:

Curve settings [SI], [VI], [EI] and [LTI].

Definite time lag [DTL].

ELEMENT 1 : I a Trip curve : S I	Scroll right and select the required curve type for element 1 Next set the [Ia>/In] low-set threshold to the required value.
ELEMENT 1 : I a I a > / I n : 1 . 1 0	[I>/In]– this is the threshold at which the function will activate the start relay and dynamically (according to each 5ms measurement) count the trip time down. The settable range of the threshold change according to the selected element name. The following settable ranges apply:
ELEMENT 1 : I a I a > x t : 0 . 0 2 5	<ul style="list-style-type: none"> - [Ia], [Ib] and [Ic] – [0.25In – 2.35In] or [disabled]. - [Io] – [0.10In – 1.05In] or [disabled]. - [Is] – [0.02In – 0.50In] or [disabled].
ELEMENT 1 : I a I a > > / I n : 0 . 5	Scroll right and set the [Ia>:xt] time multiplier as required. [I>: xt] – the time multiplier is used to adjust the curve trip time. If [DTL] is selected, this setting is a multiplier of 1 second. For these two cases the settable range is as follows:
ELEMENT 1 : I a I a > > : x t : 0 . 1 0 0	<ul style="list-style-type: none"> - Curves – [0.0 – 4.0 x]. - [DTL] – [0.0 – 50.0 x] 1 second. Scroll right and set the [Ia>>]:set as required. [I>>/In] – this function is fixed to [DTL]. The settable range is according to the element name:
	<ul style="list-style-type: none"> - [Ia], [Ib], [Ic] and [Io] – [0.5 – 32.0In] or [disabled]. - [Is] – [0.1 – 1.0In] or [disabled]. Scroll right and set the Ia>>:xt time multiplier as required. [I>>: xt] – this is the [I>>] time multiplier. Because the function is fixed to [DTL], the settable range for all is – [0.0 – 50.0] x 1 second.



Note

Repeat the above for Element 2 [Ib], Element 3 [Ic], and Element 4 [Io]. Each trip function works separate from another, therefore any of the [I>] or [I>>] trip functions can be set individually as only trip or combined with others.

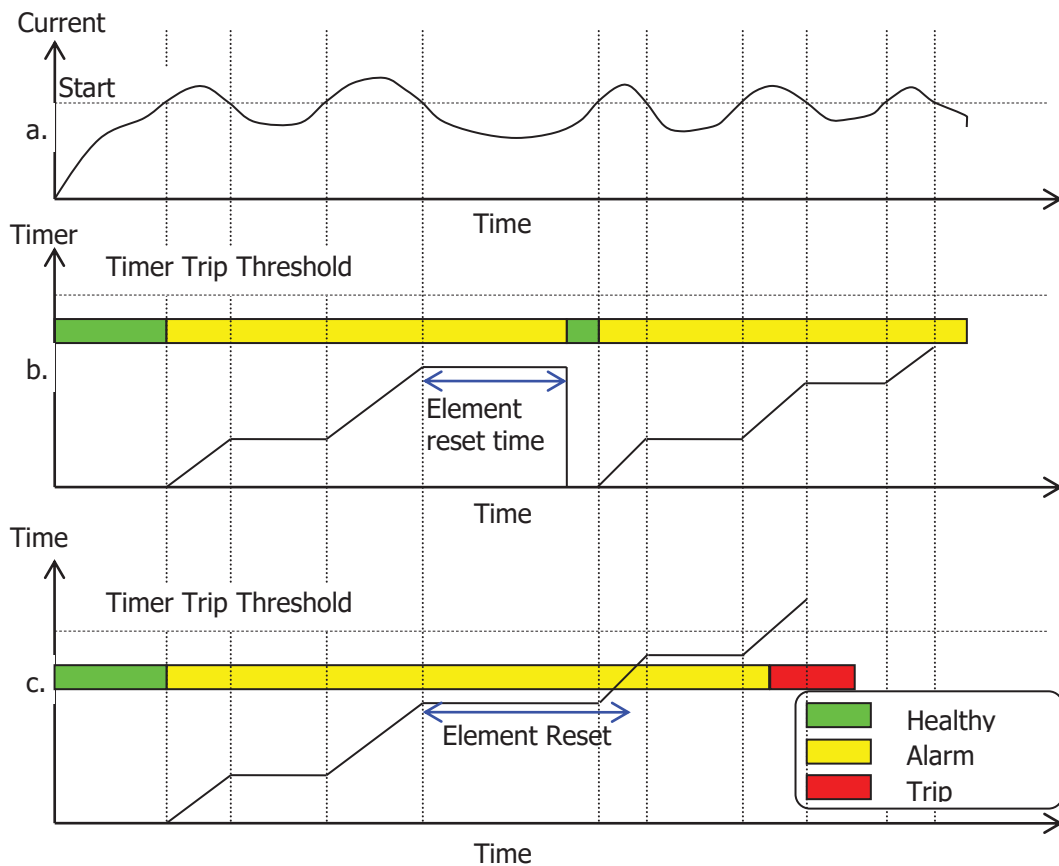
The label Is (Sensitive Earth fault) is also available, with its own [Is>/In] setting range. Note that Is only has the [DTL] time function available.

When Element 3 is identified as [Is] during set up, it assumes the function of a Sensitive Earth Fault detector and is automatically configured with a more sensitive measuring range of [0,02 to 0.50] p.u. of [In].

Element Protection Settings : Programmable Reset Time

As detailed above, whenever a threshold is exceeded, a timer is started, and if the condition is sustained the relay will enter a trip condition in due time. However, should the input current recover below the set threshold before the time-out, the timer count is not immediately cleared, but rather is held for a programmable Element Reset Time before resetting. Should the threshold be exceeded again before expiry of this reset time, the timer count starts incrementing from its previous value. This means that a trip could occur in a shorter time because of the prior accumulated count value.

Element Protection Settings : Re -set Time Graph.



The graphs show a sequence of varying current in a monitored circuit, with two different consequences for the relay condition dependent upon the Element Reset Time:

The current measured, occasionally exceeding the trip threshold value.

The accumulating timer value with a shorter element reset time, allowing an intermediate timer reset.

The accumulating timer value with a longer element reset time, thus allowing no intermediate reset of the timer, and eventually creating a trip condition.

This function is intended to provide detection of a recurring marginal condition, typically where a measured current hovers around the set threshold, eventually causing the relay to trip, which otherwise could continue indefinitely, without detection. Should this function not be required, simply set the Element Reset Time to zero.

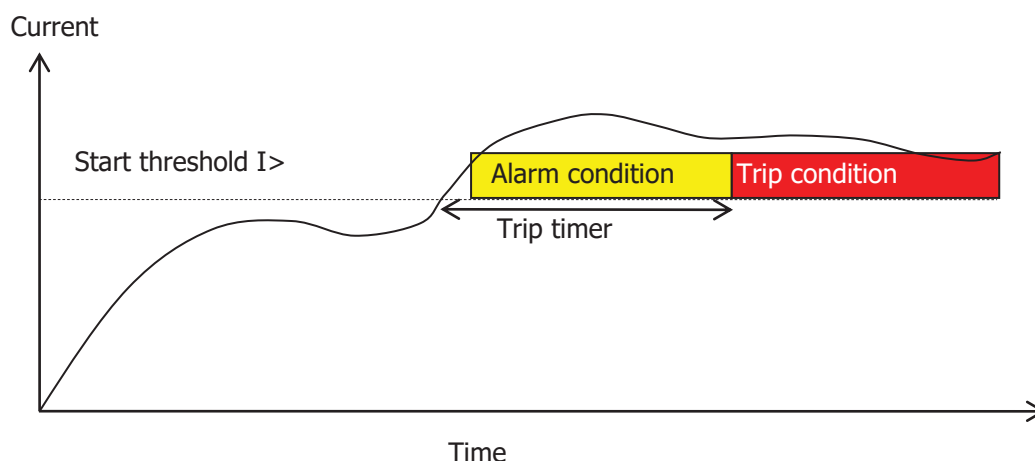
For each of the four measuring elements, whenever the measured current exceeds its associated setting threshold value $[I >]$, or $[I >>]$, a software [start] signal is initiated. This will illuminate the Yellow "Alarm" LED and activate any associated output relays (K1 to K5), according to their set-up.

By programming the output relays to Auto during set-up, they will automatically self-reset should the element current recover below the threshold setting.

Alternatively, by programming the relays to 0 – 10 during set-up, they become latching relays where they remain switched until acknowledged by the user. This user acknowledgement is governed by a password, and the figure 0 – 10 is the number of times the user can reset the output before a password is needed. A setting of 0 will always require a password. The contact form of the output (NO or NC) is hardware selectable.

Simultaneously, a timer is started, according to the timing function or curve selected for the particular threshold, and the time multiplier [xt] as set.

If the condition persists and the associated current remains above the threshold long enough for the timer to time out, a software “trip” signal will be initiated. This will illuminate the red “TRIP” LED and activate any associated output relays (K1 to K5), according to their set-up.



The display will then show details of the trip. Once the cause of the trip has been cleared, the user can then accept the trip, by pressing the red button on the front panel, in order to resume normal operation. The running display will then resume, and the red "trip" LED will extinguish. If more than one parameter is active (exceeding its threshold) at the time of trip, these will be shown in sequence and must be individually accepted, before normal operation will resume.

Element 1-4 trip reset time – all the trip functions have the same reset time setting. The reset time is used to trap trip conditions where the measured current drifts close to the trip threshold. The reset time is the time that has to pass before the accumulated trip timeout will be cleared after the measured current dropped below the trip threshold.

Element Protection Settings : E1 to E4 Threshold Exceeded Reset Time

E L E M E N T 1 t o 4 :	Set the Element 1-4 Reset time in seconds as required, referring to Section 3 – FUNCTIONAL DESCRIPTION: Programmable Element Reset Time.
R e s e t t i m e = 0 S e c	

Element Protection Settings : E1 to E4 – CT [1] or [5A]

Four measuring elements (inputs) 1 to 4 are provided.

- Each can be programmed to measure inputs from current transformers with nominal currents of either [In]=[1A], or [In]=[5A].

External CT ratio – this is the ratio of the combined external CT's with I (nominal) used in the installation. This will only be used for the primary current displays. The settable range is 1 – 60000.

C T r a t e d p r i m a r y c u r r e n t E 1 = 5 A	Adjust the CT primary rated current in amps for Element 1. This is used to scale the primary current on the running displays.

R e l a y C T n o m i n a l c u r r e n t E 1 = 5 A	Set the CT secondary current to either [1A] or [5A].



Note

Repeat the above for Element 2, Element 3, and Element 4.

MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Output Relays]

The Output relay setup menu:

Output relay setup menu : Setting the output relay functionality. This includes all the start and trip function routing, the relay hold times for each trip function, the breaker I^2t time and the force relay time for MODBUS. This menu can only be accessed when the password is entered.

The five output relays can be programmed to any of the trip, reclose, or indication functions. Move with left or right button between all the trip functions. To activate one or more output relays for a function, move the cursor under the selected output relay with the left or right button. Select a [1] to activate the specific output relay for the displayed function.

The available functions that can be directed to the output relays are:

- Element 1[> start].
- Element 1[> trip].
- Element 1[>> trip].
- Element 2[> start].
- Element 2[> trip].
- Element 2[>> trip].
- Element 3[> start].
- Element 3[> trip].
- Element 3[>> trip].
- Element 4[> start].
- Element 4[> trip].
- Element 4[>> trip].
- [Event]
- [AR Enabled].
- [AR busy].
- [AR lockout].
- [Br failed].
- [Br rewind failed]
- [Br Reclose shot].

If the relay 4 or 5 are disabled by the hardware setup (terminals wire to digital inputs), the relay setup displays will show an [i] at the disabled output relay's place. The checksum display will display [Hardware = Input] to indicate the hardware setup.

After preceding relay settings there are 5 checksums that is a bit representation of the function settings. Auto-reclose shot is in bit 0, breaker rewind failed in bit 1 and so on until element [1> start] in bit 17.


The relay hold times are settable for each trip function and will hold the relay energised for the set time. The settable range is [0.050s to 1800.000s] in steps of 0.005s for the whole range. If the button is held for longer than 3 seconds the steps will change to 0.010s to increase the setting speed.

The breaker fail output relay hold time is the time the breaker fail function will hold the output relay assigned to the breaker-failed function, before releasing it.

[Breaker I^2t time] setup is the manufacturer time setting for the [I^2t] function maintenance accumulator. This time is multiplied by the I^2 of the primary current measure at the time of trip for each element.

[MODBUS force relay time]: this time will be loaded whenever the MODBUS forced a relay to be energised. After this timeout the relay will be released for normal operation.

Output Relays Settings: K1 to K5 - Menu

S	E	T	P	R	O	T	E	C	T	I	O	N	Press  to access the Set Protection - Output Relay sub-menus.
O	u	t	p	u	t	R	e	l	a	y	s		

The FP04-AR protection relay has six relay outputs. Five outputs K1 to K5 are for normal protection use, while the sixth K6 is for the FP04-AR to check its own "health". To confirm the correct allocation of these output relays a checksum function is available in the unit.

Output Relays Settings: K1 to K5 - Function Description

Relays K1, K2, K3, K4 and K5 can be programmed to operate in reaction to any [alarm] / [start] or [trip] condition i.e. [Over-current], [Earth fault], [Sensitive earth fault] or [Breaker fail].

The functionality and contact form of these relays is user configurable as follows: -

An element [start] trigger resulting in an alarm (yellow LED) condition can be used to switch any relay output from K1 to K5.

An element [I >] or [I >>] trigger resulting in a trip (red LED) condition can be used to switch any relay output from K1 to K5.

The relay outputs can be hardwired to N/O or N/C settings by using the selecting the appropriate links on the FP04-AR's PC board. See the relevant section under Installation and Commissioning.

Output relays K1 - K5 are de-energised in the operational healthy state and will be energised during and alarm or trip condition when programmed to do so.

Relays K1 to K5 can be programmed to either self-reset automatically after a programmable [Relay Hold Time], or to do so only after user acknowledgement (i.e. [latching] or [non-latching]).

For relay contact ratings, refer to Table 2 in Appendix 1. Note that in the FP04-AR product, relay K1 has a higher dc switching capability than K2 to K5, and is intended for the direct tripping of certain switchgear. Caution should be exercised, however, not to exceed the contact ratings of any relay, as this will eventually result in contact failure.

Output Relays Settings: K6 Self -Supervisory Function Description

Relay K6 output is the FP04-AR self-supervision relay, and its functionality is not user configurable, apart from the N/O or N/C hardware option by using the relevant PC board link.

Output Relay K6 is energised in the healthy power-up normal condition, and de-energises on:

Loss of auxiliary power supply

Failure of the FP04-AR internal power supply

Failure of the microprocessor hardware, software, or memory.

Output Relays Settings: K1 to K5 - Allocate To Protection Start condition



Note

The FP04-AR now has the relay outputs K4 & K5 hardware configurable to be inputs when using the auto-reclose functionality of the protection relay. This facilitates the extra input function to monitor the breaker status requirements when re-close is to be automatic. The user must sacrifice outputs K4 & K5 for AR input functions. When the FP04-AR has been configured for outputs K4 & K5 to be inputs the display under 4 & 4 will show [i]. This has been setup in menu [CUSTOMISE RELAY] [Hardware Choices]. The user will not have access in this menu to K4 or K5 when they have been configured for [i].

R	e	l	a	y	:		#	1	2	3	4	5	The top line of the display shows the relay numbers K1 – K5. On the bottom the display opposite the relay number can be toggled between "0" and [1], the [1] indicates that relay 2 output in this case has been selected to operate on a [Ia>start] condition.	
I	:	I	a	>	s	t	a	r	t	0	1	0		i

Output Relays Settings: K1 to K5 - Pre -allocated To Input application

R	e	l	a	y	:		#	1	2	3	4	5	Relay outputs K4 & K5 can be designated to be an input and will show an [i] on the cursor line indicating it cannot be selected as an output function. In the example [i] indicates relay K4 & K5 have been selected as inputs in the	
I	:	I	a	>	s	t	a	r	t	0	1	0		i

relay setup. Note the output relay link on the PC board must also be set for K4 & K5 to work as inputs.

The Elements selected can be ([Ia], [Ib], [Ic], [Io], or [Is]), thresholds ([>] or [>>]), and function ([start] or [trip]) combination to which the relays are allocated.

Scrolling to the right steps the cursor to each relay in turn. For the parameter, the relay is allocated by toggling [1], or not allocated to the parameter [0] using and .

Once all five relays have been set up, scrolling to the right will step the display to the next allocable parameter/function for that element. Again, any combination of K1-K5 can be allocated.

Thus for each start, or trip function, any combination of K1 to K5 can be allocated.

Output Relays Settings: K1 to K5 – Allocate Output To A Protection Trip Condition

<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>I</td><td>:</td><td>I</td><td>a</td><td>></td><td>t</td><td>r</td><td>i</td><td>p</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	I	:	I	a	>	t	r	i	p	1	0	0	0	0	<p>These examples indicate that Element 1 has been labelled Ia, and its low set trip function allocated to K1 only, and.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
I	:	I	a	>	t	r	i	p	1	0	0	0	0																
<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>I</td><td>:</td><td>I</td><td>a</td><td>>></td><td>t</td><td>r</td><td>i</td><td>p</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	I	:	I	a	>>	t	r	i	p	1	0	0	0	0	<p>In the second example its high set trip function is allocated to K1 and K4, the use of output relay K4 would need to be considered if it is necessary to use K4.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
I	:	I	a	>>	t	r	i	p	1	0	0	0	0																
	<p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p>																												
	<p>Move to next screen .</p>																												



Repeat the above for [Ib], [Ic], and [Io].

Once all functions for that element have been set, scrolling further to the right will step to the next element, where the previous process is repeated for all allocable functions and so on through all four elements.

Output Relays Settings: K1 to K5 – Allocate To Event Trip



When auto reclose is in use there may only be one relay left that can be used to give a condition signal as K1 & K2 would be allocated for trip and reclose function.

<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>E</td><td>v</td><td>e</td><td>n</td><td>t</td><td></td><td></td><td></td><td>0</td><td>0</td><td>1</td><td>i</td><td>i</td><td></td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	E	v	e	n	t				0	0	1	i	i		<p>An event input activation can be copied to an output for retransmitting and confirming the event signal has been received by the FP04-AR.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
E	v	e	n	t				0	0	1	i	i																	
	<p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p>																												
	<p>Move to next screen .</p>																												

Output Relays Settings: K1 to K5 – Allocate To A uto Reclose Status

<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>A</td><td>R</td><td>E</td><td>n</td><td>a</td><td>b</td><td>l</td><td>e</td><td>d</td><td>0</td><td>0</td><td>1</td><td>i</td><td>i</td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	A	R	E	n	a	b	l	e	d	0	0	1	i	i	<p>An auto reclose activation can be copied to an output for retransmitting and confirming the auto reclose signal has been received by the FP04-AR.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
A	R	E	n	a	b	l	e	d	0	0	1	i	i																
	<p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p>																												
	<p>Move to next screen .</p>																												

<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>A</td><td>R</td><td>B</td><td>u</td><td>s</td><td>y</td><td></td><td></td><td>0</td><td>0</td><td>1</td><td>i</td><td>i</td><td></td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	A	R	B	u	s	y			0	0	1	i	i		<p>Auto reclose FP04-AR busy condition can be sent to an output for confirming auto reclose is cycling.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
A	R	B	u	s	y			0	0	1	i	i																	
	<p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p>																												
	<p>Move to next screen .</p>																												

<table border="1"> <tr><td>R</td><td>e</td><td>l</td><td>a</td><td>y</td><td>:</td><td></td><td></td><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>A</td><td>R</td><td>L</td><td>o</td><td>c</td><td>k</td><td>o</td><td>u</td><td>t</td><td>0</td><td>0</td><td>1</td><td>i</td><td>i</td></tr> </table>	R	e	l	a	y	:			#	1	2	3	4	5	A	R	L	o	c	k	o	u	t	0	0	1	i	i	<p>Auto reclose FP04-AR lockout condition can be sent to an output confirming FP04-AR is locked out.</p>
R	e	l	a	y	:			#	1	2	3	4	5																
A	R	L	o	c	k	o	u	t	0	0	1	i	i																
	<p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p>																												
	<p>Move to next screen .</p>																												



Electrical Distributors

Output Relays Settings: K1 to K5 – Allocate To Breaker Status

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R e l a y</td> <td style="padding: 2px;">:</td> <td style="padding: 2px;">#</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">4</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">B r f a i l e d</td> <td style="padding: 2px;"></td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;"></td> </tr> </table>	R e l a y	:	#	1	2	3	4	5	B r f a i l e d		0	0	1	i	i		<p>Breaker failed condition can be sent to an output confirming there is an issue with the tripped condition. This could be line current is still flowing, i.e. breaker not open or fully open.</p> <p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p> <p>Move to next screen .</p>
R e l a y	:	#	1	2	3	4	5										
B r f a i l e d		0	0	1	i	i											

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R e l a y</td> <td style="padding: 2px;">:</td> <td style="padding: 2px;">#</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">4</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">B r r e w i n d</td> <td style="padding: 2px;"></td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;"></td> </tr> </table>	R e l a y	:	#	1	2	3	4	5	B r r e w i n d		0	0	1	i	i		<p>A trip spring rewind input can be too copied to an output for retransmitting and confirming the spring rewound signal has been received by the FP04-AR.</p> <p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p> <p>Move to next screen .</p>
R e l a y	:	#	1	2	3	4	5										
B r r e w i n d		0	0	1	i	i											

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R e l a y</td> <td style="padding: 2px;">:</td> <td style="padding: 2px;">#</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">4</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">B r R e c l o s e</td> <td style="padding: 2px;"></td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;">i</td> <td style="padding: 2px;"></td> </tr> </table>	R e l a y	:	#	1	2	3	4	5	B r R e c l o s e		0	1	0	i	i		<p>Allocate auto reclose output.</p> <p>Use scrolling buttons and to move between K1 to k5, use or to select 'allocate' [1] or leave unallocated [0].</p> <p>Move to next screen .</p>
R e l a y	:	#	1	2	3	4	5										
B r R e c l o s e		0	1	0	i	i											

Output Relays Settings: K1 to K5 – Relay Checksum Application

Each relay K1 to K5 has an associated checksum which is calculated automatically according to the allocations made during set-up. This calculated checksum is displayed as part of the set-up screens. The purpose is for the user to be able to confirm the correct set-up of K1 to K5, by manually calculating the checksum representing the desired relay set-up and then comparing this with the calculated checksum, which must agree.


Output Relays Settings: K1 to K5 – Checksum setting

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R</td> <td style="padding: 2px;">E</td> <td style="padding: 2px;">L</td> <td style="padding: 2px;">A</td> <td style="padding: 2px;">Y</td> <td style="padding: 2px;">#</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">C</td> <td style="padding: 2px;">h</td> <td style="padding: 2px;">e</td> <td style="padding: 2px;">c</td> <td style="padding: 2px;">k</td> <td style="padding: 2px;">s</td> <td style="padding: 2px;">u</td> <td style="padding: 2px;">m</td> </tr> <tr> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> </tr> </table>	R	E	L	A	Y	#	1	C	h	e	c	k	s	u	m							0	0	0	0	0	0				<p>The next 5 items are each 6 digit hexadecimal checksums representing the allocations of K1 to K5.</p> <p>Each 6-digit code is automatically calculated from the allocations made to the output relays by the operator. They can be used to confirm the correct allocation of output relays, by manually calculating the appropriate checksums for the required relay allocation, and comparing these with the displayed codes. Refer to Table 3 in Appendix 1 for information on how to use the checksum codes.</p>
R	E	L	A	Y	#	1	C	h	e	c	k	s	u	m																	
						0	0	0	0	0	0																				

View Output Relay : K1 to K5 – Checksum values

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R</td> <td style="padding: 2px;">E</td> <td style="padding: 2px;">L</td> <td style="padding: 2px;">A</td> <td style="padding: 2px;">Y</td> <td style="padding: 2px;">#</td> <td style="padding: 2px;">4</td> <td style="padding: 2px;">C</td> <td style="padding: 2px;">h</td> <td style="padding: 2px;">e</td> <td style="padding: 2px;">c</td> <td style="padding: 2px;">k</td> <td style="padding: 2px;">s</td> <td style="padding: 2px;">u</td> <td style="padding: 2px;">m</td> </tr> <tr> <td style="padding: 2px;">H</td> <td style="padding: 2px;">a</td> <td style="padding: 2px;">r</td> <td style="padding: 2px;">d</td> <td style="padding: 2px;">w</td> <td style="padding: 2px;">a</td> <td style="padding: 2px;">r</td> <td style="padding: 2px;">=</td> <td style="padding: 2px;">I</td> <td style="padding: 2px;">n</td> <td style="padding: 2px;">p</td> <td style="padding: 2px;">u</td> <td style="padding: 2px;">t</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> </tr> </table>	R	E	L	A	Y	#	4	C	h	e	c	k	s	u	m	H	a	r	d	w	a	r	=	I	n	p	u	t			<p>Indicates relay output 4 has been configured for use as an input.</p>
R	E	L	A	Y	#	4	C	h	e	c	k	s	u	m																	
H	a	r	d	w	a	r	=	I	n	p	u	t																			

Output Relays Settings: K1 to K5 – Relay Hold Times

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">R</td> <td style="padding: 2px;">E</td> <td style="padding: 2px;">L</td> <td style="padding: 2px;">A</td> <td style="padding: 2px;">Y</td> <td style="padding: 2px;">H</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">L</td> <td style="padding: 2px;">D</td> <td style="padding: 2px;">T</td> <td style="padding: 2px;">I</td> <td style="padding: 2px;">M</td> <td style="padding: 2px;">E</td> </tr> <tr> <td style="padding: 2px;">E</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">.</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">6</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">s</td> <td style="padding: 2px;"></td> </tr> </table>	R	E	L	A	Y	H	O	L	D	T	I	M	E	E	1	>				0	.	0	6	0	s		<p>The [HOLD TIME] setting will hold the relay energised for the set time.</p> <div style="display: flex; align-items: flex-start;">  <p>Caution Do not use excessive [Hold Time] where it may cause trip coil heating.</p> </div> <p>The Relay Hold Times for elements 1 to 4. Hold times can be separately set for low-set [>] and high-set [>>] thresholds, for each of the four elements (eight separate displays). The settable range in each case is from [0,05 to 1800] seconds in steps of 5ms.</p>
R	E	L	A	Y	H	O	L	D	T	I	M	E															
E	1	>				0	.	0	6	0	s																



B r e a k e r F a i l H o l d T i m e	=	0 . 1 0	The equivalent settable Relay Hold Time for the Breaker Fail function, set similar fashion. The setting range here is [0,01 to 60] seconds in steps of 0,01 seconds.
---	---	---------	--

Breaker Trip Monitoring – Accumulator Maintenance I²t Time

B r e a k e r I ² t T i m e	=	0 . 1 0 0 s	Breaker I ² t Time. This value should be set according to the recommendation of the switchgear manufacturer. The set time e.g. [0.100s] is multiplied by the I ² of the primary current measured at the time of trip for each element and recorded in the status maintenance accumulator. The result can be viewed in the [VIEW INFORMATION][Status].
--	---	-------------	---

Breaker Trip – Use MODBUS Communications To Trip Breaker

M o d b u s F o r c e R e l a y T i m e	=	1 . 0	Output relay time set-up to use the Modbus Force Relay facility. This function allows the remote closure of the breaker, via the FP04-AR and is only available to be activated via a Modbus connected remote master device.
--	---	-------	---

When the user is finished with the output relay set-up, exit to the main menu using the standard  - [Edit] / [Save] / [Cancel] -  process.

MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION][Digital Inputs]

The Input setup menu:

Digital input setup menu : For setting the digital input activity and active state. This menu can only be accessed when the password (when activated) is entered correctly.
The three digital inputs can be programmed to any of six functions.

When inputs 2 or 3 is disabled in the hardware menu, the display will show [Hardware relay#4] or [Hardware relay#5] underneath the relevant input setting menu item. If this display is shown the function is disabled due to hardware routed to a relay and the input cannot be wired to the terminal block.

Each input active state could be specified as [High] or [Low]. This indicates the voltage on the connector and the range 30V - 250V ac or dc and is not polarity sensitive. If the active state is set to [High] the input will be taken as active if a voltage *between* the operating ranges of the digital input hardware is connected to the input connector. When the active state is set to [Low] the input will be taken as active if a voltage *below* the operating range of the digital input hardware is connected to the input connector.

Disabled

- When user does not want to use the digital input.

Breaker on/off state

- This input function indicates the breaker state ON or OFF.
- The breaker status ON/OFF input is used for the reset of auto reclose after external close, and to indicate the status after a reset (reclaim) function completed.

Block auto -reclose

- Input function will block the auto-reclose process at any time in the process and go directly to a lockout condition.
- This function can also be used for a manual close switch.
- To disable auto-reclose when an operator does the close procedure.
- If the manual switch is returned to auto reclose enabled, the auto-reclose function will reset if no trip in progress.
- With trip in progress the function will wait until the trip in progress has cleared, in which case it will reset (reclaim) the auto-reclose.

Block trip

- This input function will block the trip functions that are selected in the trip function block setup.
- Inhibited by applying an active signal (noting the active high or low setting) to the Digital Input.
- In the relay set-up, this input can be allocated to block any combination of the trip functions.
- This is normally used to allow a downstream relay to trip the fault, thus minimizing the extent of the resulting power outage.
- While the blocking input is active, the trip function will be blocked and the timeout timer reset.
- When the block trip input is released the function will continue the trip cycle if it is still active.
- When FP04-AR trips, the trip time will include the whole time from the first start detected until the time of trip and the blocked indication will be active for the history.
- If the [Block trip] function is selected for one of the three digital inputs, additional setting items will be shown with the left or right menu item select buttons, as follows.
 - o I> block – [Yes] will block the [I>] trip function with the blocking input active. [No] will ignore the blocking input for this function.
 - o [I>>] block – [Yes] will block the [I>>] trip function with the blocking input active. [No] will ignore the blocking input for this function.

Breaker rewind input

- This input function can be used where the breaker is supplied with a rewind state output.
- The function will indicate if the breaker rewound or not.



Event Tripping

- A digital input can be used to create a trip condition based on an active signal on its input.
- The same input conditions as described above apply, and similarly to other trip condition configurations, any combination of output relays K1 to K5 can be allocated to repeat the condition on a output./
- To create a trip, the active signal must remain valid for a pre-set length of time.
- This Event Input Trip Time is programmable under the [SET PROTECTION] [Elements] menu.
- Should the signal become inactive during this trip time, further activation will begin a new timing sequence starting from zero, even if the reactivation occurs within the original trip time.
- A suitably descriptive label, downloadable from a computer running the application software, can be programmed to appear following an event trip.

Remote Reset

- The third alternative for the digital input is to reset the FP04-AR from a remote location, e.g. a control room. This has the same effect as pressing the red button to acknowledge a trip.



Digital Inputs Menu.

<table border="1"> <tr> <td>S</td><td>E</td><td>T</td><td>P</td><td>R</td><td>O</td><td>T</td><td>E</td><td>C</td><td>T</td><td>I</td><td>O</td><td>N</td> </tr> <tr> <td>D</td><td>i</td><td>g</td><td>i</td><td>t</td><td>a</td><td>l</td><td>I</td><td>n</td><td>p</td><td>u</td><td>t</td><td>s</td> </tr> </table>	S	E	T	P	R	O	T	E	C	T	I	O	N	D	i	g	i	t	a	l	I	n	p	u	t	s	<p>Press  to access the Set Protection – Digital Inputs sub-menus.</p> <p>The digital input can be used for one of three functions, or left unused. Press or  to select the required function from the four available options for the Digital Input: Disabled, Event, Remote Reset, or Block trip.</p>
S	E	T	P	R	O	T	E	C	T	I	O	N															
D	i	g	i	t	a	l	I	n	p	u	t	s															





Electrical Distributors



Digital Inputs 1 to 3 Settings – Allocate Function To Input

<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td>B</td><td>l</td><td>o</td><td>c</td><td>k</td><td>R</td><td>e</td><td>c</td><td>l</td><td>o</td><td>s</td><td>e</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1	B	l	o	c	k	R	e	c	l	o	s	e							<p>Press  to access the DIGITAL INPUTS – Digital Inputs sub-menus. Press  to access the function allocations for the digital inputs and select as required.</p>				
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
B	l	o	c	k	R	e	c	l	o	s	e																														
<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td>B</td><td>r</td><td>e</td><td>a</td><td>k</td><td>e</td><td>r</td><td></td><td></td><td></td><td>R</td><td>e</td><td>w</td><td>i</td><td>n</td><td>d</td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1	B	r	e	a	k	e	r				R	e	w	i	n	d			<p>For input 1 select the desired input function for the relay field wiring. BLOCK RECLOSE: Input would disable auto reclose of breaker.</p>				
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
B	r	e	a	k	e	r				R	e	w	i	n	d																										
<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td>B</td><td>r</td><td>e</td><td>a</td><td>k</td><td>e</td><td>r</td><td></td><td></td><td></td><td>o</td><td>n</td><td>/</td><td>o</td><td>f</td><td>f</td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1	B	r	e	a	k	e	r				o	n	/	o	f	f			<p>BREAKER REWIND: Input when enabled will lockout the FP04-AR if re-wind fails. BREAKER ON/OFF: Input verifies status on breaker to interact with breaker fail functions.</p>				
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
B	r	e	a	k	e	r				o	n	/	o	f	f																										
<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>E</td><td>v</td><td>e</td><td>n</td><td>t</td><td></td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1											E	v	e	n	t				<p>EVENT: Input can be used to create a trip condition based on an active signal on its input. To create a trip, the active signal must remain valid for a pre-set length of time. This Event Input Trip Time is programmable under the SET PROTECTION – Elements menu. Should the signal become inactive during this trip time, further activation will begin a new timing sequence starting from zero, even if the reactivation occurs within the original trip time. A suitably descriptive label, downloadable from a computer running the application software, can be programmed to appear following an event trip.</p>				
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
										E	v	e	n	t																											
<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>R</td><td>e</td><td>m</td><td>o</td><td>t</td><td>e</td><td></td><td>R</td><td>e</td><td>s</td><td>e</td><td>t</td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1											R	e	m	o	t	e		R	e	s	e	t	<p>REMOTE RESET: Allows the FP04-AR to be reset from a remote location, e.g. a control room. This has the same effect as pressing the red button to acknowledge a trip.</p>
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
										R	e	m	o	t	e		R	e	s	e	t																				
<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>B</td><td>l</td><td>o</td><td>c</td><td>k</td><td></td><td>t</td><td>r</td><td>i</td><td>p</td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1											B	l	o	c	k		t	r	i	p			<p>BLOCK TRIP: For grading a protection system, it is possible to block the FP04-AR from tripping while another protection relay has signalled it is in the process of tripping its breaker, i.e. trip downstream first.</p>
D	I	G	I	T	A	L				I	N	P	U	T		#	1																								
										B	l	o	c	k		t	r	i	p																						

Scroll to select and set input 1 – 3 functions.

Digital Inputs 1 to 3 Settings – Active High Or Low

<table border="1"> <tr><td>D</td><td>I</td><td>G</td><td>I</td><td>T</td><td>A</td><td>L</td><td></td><td></td><td></td><td>I</td><td>N</td><td>P</td><td>U</td><td>T</td><td></td><td>#</td><td>1</td></tr> <tr><td>A</td><td>c</td><td>t</td><td>i</td><td>v</td><td>e</td><td></td><td>=</td><td></td><td></td><td>H</td><td>i</td><td>g</td><td>h</td><td></td><td></td><td></td><td></td></tr> </table>	D	I	G	I	T	A	L				I	N	P	U	T		#	1	A	c	t	i	v	e		=			H	i	g	h					<p>Should the Event function be required, scroll right to choose between [Active = High] or [Active = Low] using  or .</p>
D	I	G	I	T	A	L				I	N	P	U	T		#	1																				
A	c	t	i	v	e		=			H	i	g	h																								
<p>This is the only settable parameter for this function.</p>																																					

Scroll to select and configure input 1 – 3 voltage input high or low conditions to be read as input being ON. when the digital input is completely configured, exit using the standard  - [Edit] / [Save] / [Cancel] -  process.

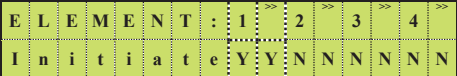
MAIN MENU FUNCTIONS & DISPLAYS : [SET PROTECTION] [Auto Re-Close]

The Auto -reclose setup menu:

Auto -reclose setup menu – for setting the auto reclose settings, including the auto-reclose set of trip settings. This menu can only be entered if the password, if activated, was entered correctly.

The auto-reclose setup menu, allows the user to set all the auto-reclose related settings. The button navigation is the same as the rest of the menus, left and right to move through the items, up and down to change the values and red to access store function.

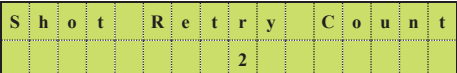
Elements 1 to 4 Settings – Allocate [>] [>>] Thresholds to Allow Auto Re -Clo se

	<p>Select elements to initiate reclose: Selects which elements to initiate auto reclose. The or setting allows the user make the decision on which trip function must the auto-reclose procedure initiate.</p> <p>For each element two protection functions can be allocated to activate the AR function.</p> <p>E.G. Element 1 has [Y] under [1] an [Y] under >> the first [Y] is the greater than protection (>) and the second [Y] is the greater-greater than protection (>>). In this example only element 1 would initiate the auto re-close on both (>) and the (>>) parameters. The user must set all elements and determine whether only (>) or (>>) or both must initiate the auto re-close in the FP04-AR.</p>
---	--



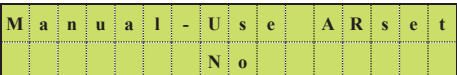
Care must be taken to ensure that all the trip functions that must initiate the auto-reclose are activated in the [SET PROTECTION][Elements] setup. To verify this check the annunciations on the running display that shows all the currents. If a trip function will initiate auto-reclose, it will show an [R] below the trip function [>] or [>>] indicator.

Auto Re -close – Select Max Number Of Shots allowed.

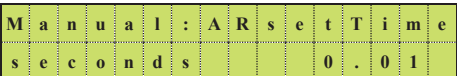
	<p>Using or determines the times that the auto-reclose will retry to close the breaker. The settable range is 1 – 4 shots.</p>
---	--

Manual Re -close – Select to Use Auto Re -close Trip Settings.

Manual use auto reclose settings – this setting determine if auto-reclose settings will be activated before a manual reclose procedure.

	<p>Using or determines whether auto-reclose trip settings will be activated before a manual reclose procedure.</p>
---	--

Manual Re -close – Select to Time before Auto Re -close Trip Settings Cancelled .

	<p>The time to stay on the auto-reclose trip settings, before changing back to the normal trip settings, after a manual reclose procedure.</p> <p>Using or set from range 0.1s to 600.0s: Below 1 step size [0.01s], above 1 step size [0.10].</p>
---	--

Re -close Shot – Select Dead time for each repeat shot.

Dead time to auto -reclose shot 1 to 3

Dead Time Shot 1 seconds 10.00	The three displays are the settings for the time from trip to reclose for the first three reclose shots. During this time the breaker will be off and no power on the feeder lines. Using or set from range 0.1s to 600.0s: Below 1 step size [0.01s], above 1 step size [0.1]
Dead Time Shot 2 seconds 10.00	
Dead Time Shot 3 seconds 10.00	

Dead time to auto -reclose shot 4

Dead Time Shot 4 seconds 10.00	Set the time from trip to reclose for shot 4. During this time the breaker will be off and no power on the feeder lines. Using or set from range 0.1s to 3600.0s Below 10 step size [0.1s], above 10 step size [1.0s].
-----------------------------------	--

Re -close Shot – Select Output Relay Energised Period.

Shot impulse time – this is the time for the output relay to stay closed (energised) for a reclose shot.

Shot min. Impulse seconds 1.00	Time for the output relay to stay closed (energised) for a reclose shot. Using or set from range 0.01s to 60.0s: Below 10 step size [0.1s], above 10 step size [1.0s].
-----------------------------------	--

Auto Re -close active period – Select When To Switch Back To Normal Protection Settings .

AR settings Time seconds 15	Determines the time that the auto-reclose settings will be used after a reclose shot. Using or set from range 1s to 1000s in steps of [1s]. This item can be disabled to prevent the auto reclose settings to be used.
--------------------------------	---

Auto Re -close Reset Time – Select period When Auto Re -close is deemed Successful.

AR reset Time seconds 15.0	Time determines the success of the auto-reclose. If no trip occurred or started for this time, after a reclose shot has been fired, the auto-reclose was successful. Using or set from range 0.1s to 1000.0s: Below 10 step size [0.1s], above 10 step size [1.0s].
-------------------------------	--

Breaker Rewind Time – Select Period To Allow Breaker To Rewind After First Auto Re -close.

Breaker rewind seconds 2.5	The maximum allowable time for the breaker rewind circuit to finish rewinding. Only used if one of the inputs is programmed as breaker rewind input. During this time the breaker rewind input is checked, as soon as it is active for 50ms, the breaker rewind is marked successful. At this time also, the maximum rewind time register is updated if the recorded time is longer than the register time. Using or set from range 0.1s to 1000.0s Below 10 step size [0.1s], above 10 step size [1.0s].
-------------------------------	---

Adjust Re -close Shots – Select Excess Threshold Current to limit Re -close shots .

Current supervision level 1

- Current threshold is checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level, the auto-reclose shot count is adjusted to 1 count less than it was. If there is not enough shots left for this action the auto-reclose will lockout.

Current supervision level 2

- Current threshold is checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level, the auto-reclose shot count is adjusted to 2 counts less than it was. If there is not enough shots left for this action the auto-reclose will lockout.

Current supervision level 3

- Current threshold is checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level, the auto-reclose shot count is adjusted to 3 counts less than it was. If there is not enough shots left for this action the auto-reclose will lockout.

<table border="1"> <tr><td>S</td><td>u</td><td>p</td><td>e</td><td>r</td><td>v</td><td>.</td><td>L</td><td>e</td><td>v</td><td>e</td><td>l</td><td>1</td></tr> <tr><td>l</td><td>e</td><td>v</td><td>e</td><td>l</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>.</td><td>5</td></tr> </table>	S	u	p	e	r	v	.	L	e	v	e	l	1	l	e	v	e	l								1	.	5	<p>Current threshold are checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level, the auto-reclose shot counts adjusted as follows... Level 1 setting in the example [1.5] indicates when the current at the time of trip is (1.5% x threshold set) above the normal set trip threshold, and the number total allowed shots set is 4, then deduct 1 and only allow total of 3 to follow.</p>
S	u	p	e	r	v	.	L	e	v	e	l	1																	
l	e	v	e	l								1	.	5															
<table border="1"> <tr><td>S</td><td>u</td><td>p</td><td>e</td><td>r</td><td>v</td><td>.</td><td>L</td><td>e</td><td>v</td><td>e</td><td>l</td><td>2</td></tr> <tr><td>l</td><td>e</td><td>v</td><td>e</td><td>l</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>.</td><td>8</td></tr> </table>	S	u	p	e	r	v	.	L	e	v	e	l	2	l	e	v	e	l								1	.	8	<p>The same principle used for level 2 & 3, E.G. level 3; when first shot exceeded (2.00% x threshold set) when the total allowed shots set is 4, then deduct 3 and only allow total of 1 shot to follow.</p>
S	u	p	e	r	v	.	L	e	v	e	l	2																	
l	e	v	e	l								1	.	8															
<table border="1"> <tr><td>S</td><td>u</td><td>p</td><td>e</td><td>r</td><td>v</td><td>.</td><td>L</td><td>e</td><td>v</td><td>e</td><td>l</td><td>3</td></tr> <tr><td>l</td><td>e</td><td>v</td><td>e</td><td>l</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>.</td><td>0</td></tr> </table>	S	u	p	e	r	v	.	L	e	v	e	l	3	l	e	v	e	l								2	.	0	<p>The three displays allow different shot adjustments to be made at different current levels, ranging from 1 count less than it was to 3 counts less than what it was. If there is not enough shots left for this action the auto-reclose will lockout. Using or set from range 1.0 to 32.0: Below 10 step size [0.1s], above 10 step size [1.0s]. This function can be disabled. To set or disable the level use or to scroll to [value] or when user gets to [disable] then [Save]or[Edit]or[Cancel].</p>
S	u	p	e	r	v	.	L	e	v	e	l	3																	
l	e	v	e	l								2	.	0															

Current supervision level 4 (Direct)

Current threshold is checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level the auto-reclose will lockout directly.

<table border="1"> <tr><td>S</td><td>u</td><td>p</td><td>e</td><td>r</td><td>v</td><td>.</td><td>D</td><td>i</td><td>r</td><td>e</td><td>c</td><td>t</td></tr> <tr><td>l</td><td>e</td><td>v</td><td>e</td><td>l</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>.</td><td>5</td></tr> </table>	S	u	p	e	r	v	.	D	i	r	e	c	t	l	e	v	e	l								2	.	5	<p>This current threshold is checked at the time of trip. If any of the element currents that initiate auto-reclose is above this level the auto-reclose will lockout directly. Using or set from range 1.0 to 32.0: Below 10 step size [0.1s], above 10 step size [1.0s]. This function can be disabled.</p>
S	u	p	e	r	v	.	D	i	r	e	c	t																	
l	e	v	e	l								2	.	5															

Auto Re -close Protection Settings – Set Curve, [>] [>>] [xt].


The following settings are in addition to the normal protection settings and are only applied when auto-reclose has occurred. There after depending on settings the FP04-AR will return to its normal settings set under [SET PROTECTION][Elements].

<table border="1"> <tr><td>E</td><td>L</td><td>E</td><td>M</td><td>E</td><td>N</td><td>T</td><td>I</td><td>:</td><td>A</td><td>R</td></tr> <tr><td>T</td><td>r</td><td>i</td><td>p</td><td>c</td><td>u</td><td>r</td><td>v</td><td>e</td><td>:</td><td>S</td><td>I</td></tr> </table>	E	L	E	M	E	N	T	I	:	A	R	T	r	i	p	c	u	r	v	e	:	S	I	<p>All settings are adjustable except for the element name that is taken directly from the normal [SET PROTECTION][Elements] protection trip settings.</p>		
E	L	E	M	E	N	T	I	:	A	R																
T	r	i	p	c	u	r	v	e	:	S	I															
<table border="1"> <tr><td>E</td><td>L</td><td>E</td><td>M</td><td>E</td><td>N</td><td>T</td><td>I</td><td>:</td><td>A</td><td>R</td></tr> <tr><td>I</td><td>a</td><td>></td><td>/</td><td>I</td><td>n</td><td>:</td><td></td><td></td><td>0</td><td>.</td><td>2</td><td>5</td></tr> </table>	E	L	E	M	E	N	T	I	:	A	R	I	a	>	/	I	n	:			0	.	2	5	<p>Press and to select protection curve. Press to scroll to next screen. Press and to select [>] protection. Press to scroll to next screen. Press and to select [>] multiplier.</p>	
E	L	E	M	E	N	T	I	:	A	R																
I	a	>	/	I	n	:			0	.	2	5														
<table border="1"> <tr><td>E</td><td>L</td><td>E</td><td>M</td><td>E</td><td>N</td><td>T</td><td>I</td><td>:</td><td>A</td><td>R</td></tr> <tr><td>I</td><td>a</td><td>></td><td>:</td><td>x</td><td>t</td><td>:</td><td></td><td></td><td>0</td><td>:</td><td>0</td><td>2</td><td>5</td></tr> </table>	E	L	E	M	E	N	T	I	:	A	R	I	a	>	:	x	t	:			0	:	0	2	5	<p>Press to scroll to next screen. Press and to select [>>] protection. Press to scroll to next screen. Press and to select [>>] multiplier.</p>
E	L	E	M	E	N	T	I	:	A	R																
I	a	>	:	x	t	:			0	:	0	2	5													



<table border="1"> <tr><td>E</td><td>L</td><td>E</td><td>M</td><td>E</td><td>N</td><td>T</td><td> </td><td>:</td><td> </td><td>A</td><td>R</td></tr> <tr><td>I</td><td>a</td><td>></td><td>></td><td>/</td><td>I</td><td>n</td><td>:</td><td> </td><td> </td><td>0</td><td>.5</td></tr> </table>	E	L	E	M	E	N	T		:		A	R	I	a	>	>	/	I	n	:			0	.5	Repeat settings for element 2, 3, & 4 where required.
E	L	E	M	E	N	T		:		A	R														
I	a	>	>	/	I	n	:			0	.5														
<table border="1"> <tr><td>E</td><td>L</td><td>E</td><td>M</td><td>E</td><td>N</td><td>T</td><td> </td><td>:</td><td> </td><td>A</td><td>R</td></tr> <tr><td>I</td><td>a</td><td>></td><td>></td><td>:</td><td>x</td><td>t</td><td>:</td><td> </td><td> </td><td>0</td><td>:035</td></tr> </table>	E	L	E	M	E	N	T		:		A	R	I	a	>	>	:	x	t	:			0	:035	
E	L	E	M	E	N	T		:		A	R														
I	a	>	>	:	x	t	:			0	:035														

MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY] [Function Resets]

Function Resets Settings






<table border="1"> <tr><td>C</td><td>U</td><td>S</td><td>T</td><td>O</td><td>M</td><td>I</td><td>S</td><td>E</td><td> </td><td>R</td><td>E</td><td>L</td><td>A</td><td>Y</td></tr> <tr><td>F</td><td>u</td><td>n</td><td>c</td><td>t</td><td>i</td><td>o</td><td>n</td><td> </td><td>R</td><td>e</td><td>s</td><td>e</td><td>t</td><td>s</td></tr> </table>	C	U	S	T	O	M	I	S	E		R	E	L	A	Y	F	u	n	c	t	i	o	n		R	e	s	e	t	s	Press  to access the Customise Relay - Function Resets sub-menus.
C	U	S	T	O	M	I	S	E		R	E	L	A	Y																	
F	u	n	c	t	i	o	n		R	e	s	e	t	s																	

Power Up Function – Restore To State At Auxiliary Power Fail






<table border="1"> <tr><td>P</td><td>o</td><td>w</td><td>e</td><td>r</td><td> </td><td>u</td><td>p</td><td> </td><td>r</td><td>e</td><td>s</td><td>t</td><td>o</td><td>r</td><td>e</td></tr> <tr><td>t</td><td>r</td><td>i</td><td>p</td><td> </td><td>s</td><td>t</td><td>a</td><td>t</td><td>e</td><td>:</td><td> </td><td>N</td><td>o</td></tr> </table>	P	o	w	e	r		u	p		r	e	s	t	o	r	e	t	r	i	p		s	t	a	t	e	:		N	o	The first display allows you to select whether or not the FP04-AR should restore a pre-existing trip state following a power outage. Use  or  to toggle between Yes or No.
P	o	w	e	r		u	p		r	e	s	t	o	r	e																
t	r	i	p		s	t	a	t	e	:		N	o																		

Disable Operator Resetting Trip Condition – Select Auto, 1 To Ten Times Or Disable

Set operator access to reset specific number of trip conditions triggered by element threshold settings.

<table border="1"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td>E</td><td>V</td><td>E</td><td>N</td><td>T</td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>E</td><td>l</td><td>></td><td>t</td><td>r</td><td>i</td><td>p</td><td>:</td><td> </td><td> </td><td>A</td><td>u</td><td>t</td><td>o</td></tr> </table>							E	V	E	N	T						E	l	>	t	r	i	p	:			A	u	t	o	<p>Press  to scroll to next screen.</p> <p>In each case use  or  to choose from: Auto, 0 – 10</p> <p>Auto: After automatic reset after a predetermined time delay, the Relay Hold Time.</p> <p>1 – 10: Allows trip resets 1 to ten times. The selected value is the number of times an operator can reset a trip condition before this would require a password. Requires user acknowledgement.</p> <p>0: A password is always required. Requires operator acknowledgement.</p> <p>Exit using the standard  [Edit] / [Save] / [Cancel]  process.</p>
						E	V	E	N	T																					
E	l	>	t	r	i	p	:			A	u	t	o																		
<table border="1"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td>E</td><td>V</td><td>E</td><td>N</td><td>T</td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>E</td><td>l</td><td>></td><td>></td><td>t</td><td>r</td><td>i</td><td>p</td><td>:</td><td> </td><td>A</td><td>u</td><td>t</td><td>o</td></tr> </table>							E	V	E	N	T						E	l	>	>	t	r	i	p	:		A	u	t	o	
						E	V	E	N	T																					
E	l	>	>	t	r	i	p	:		A	u	t	o																		
Repeat above for element 1, 2, 3 & 4																															


Set operator access to reset specific number of trip conditions triggered by hardwire FP04-AR input events.

<table border="1"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td>E</td><td>V</td><td>E</td><td>N</td><td>T</td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>E</td><td>v</td><td>e</td><td>n</td><td>t</td><td>T</td><td>r</td><td>i</td><td>p</td><td>:</td><td> </td><td>A</td><td>u</td><td>t</td><td>o</td></tr> </table>							E	V	E	N	T						E	v	e	n	t	T	r	i	p	:		A	u	t	o	<p>Press  to scroll to next screen.</p> <p>In each case use  or  to choose from: Auto, 0 – 10</p> <p>Auto: After automatic reset after a predetermined time delay, the Relay Hold Time.</p> <p>1 – 10: Allows trip resets 1 to ten times. The selected value is the number of times an operator can reset a trip condition before this would require a password. Requires user acknowledgement.</p> <p>0: A password is always required. Requires operator acknowledgement.</p> <p>Exit using the standard  [Edit] / [Save] / [Cancel]  process.</p>
						E	V	E	N	T																						
E	v	e	n	t	T	r	i	p	:		A	u	t	o																		
<table border="1"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td>E</td><td>V</td><td>E</td><td>N</td><td>T</td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>E</td><td>v</td><td>e</td><td>n</td><td>t</td><td>T</td><td>r</td><td>i</td><td>p</td><td>:</td><td> </td><td>A</td><td>u</td><td>t</td><td>o</td></tr> </table>							E	V	E	N	T						E	v	e	n	t	T	r	i	p	:		A	u	t	o	
						E	V	E	N	T																						
E	v	e	n	t	T	r	i	p	:		A	u	t	o																		



MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY] [Line Frequency]


Line Frequency Setting

Frequency setup menu – for changing the relay to 50 or 60Hz fundamental frequency. This menu can only be entered if the password, if activated, was typed correctly.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y	Press  to access the CUSTOMISE RELAY - Line Frequency sub-menu.
L	i	n	e	F	r	e	q	u	e	n	c	y		

Supply – Set Line Frequency

S	e	l	e	c	t	M	o	d	e	Toggle between 50Hz and 60Hz. using or . Exit using the standard  [Edit] / [Save] / [Cancel]  process.
5	0	H	Z							

 The default value is 50Hz and should only be changed if the FP04-AR is to be used in a 60Hz application.
Note

MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY] [Hardware Choices]


The Hardware setup menu:

Hardware setup menu : For the setup of the selection between digital inputs or output relays connected to the terminal block. This menu can only be accessed if the password, if activated, was typed correctly.




The hardware setup menu allows the user to select the hardware options configured for the FP04-AR. There are two settings:




- Terminal 17+19 – these terminals can be connected to Output relay #5 or Digital input 2.
- Terminal 13+15 – these terminals can be connected to Output relay #4 or Digital input 3.

By selecting these functions the options in the input menu and output relay menu can change. It is advisable that these setups will be checked to make sure that the related settings are correct.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y	Press  to access the CUSTOMISE RELAY – Hardware Choices sub menu.
H	a	r	d	w	a	r	e	C	h	o	i	c	e	

Configure Firmware - Read Terminal 17 & 19 As Digital Input.

T	e	r	m	i	n	a	l	1	7	+	1	9	=	Press  to scroll to next screen or configure firmware using or to choose: Relay 5 or Input 2.
D	i	g	i	t	a	l	I	n	p	u	t	2		
T	e	r	m	i	n	a	l	1	7	+	1	9	=	Alternatively, use  [Edit] / [Save] / [Cancel]  process. Cancel will bring user back to main menu.
O	u	t	p	u	t	R	e	l	a	y	#	5		

T	e	r	m	i	n	a	l	1	3	+	1	5	=	Press  to scroll to next screen or configure firmware using or to choose: Relay 4 or Input 3.
D	i	g	i	t	a	l	I	n	p	u	t	3		
T	e	r	m	i	n	a	l	1	3	+	1	5	=	Alternatively, use  [Edit] / [Save] / [Cancel]  process. Cancel will bring user back to main menu.
O	u	t	p	u	t	R	e	l	a	y	#	4		

MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY] [Serial Ports]

Serial Port Settings

Serial port menu : For all the serial port related settings. Baud rate, parity, MODBUS address, response time and receive dead time for MODBUS. This menu can only be entered if the password, if activated, was typed correctly. (For Windows interface use minimum 500ms for each timer)

Two serial ports are available on the FP04-AR for local communication purposes, one through a DB9 connector on the front panel, and one via 3 terminals on the rear terminal block.


Both ports cater for the programming and interrogation of all display registers, including set-up and running registers. This can be done using either Strike Proprietary or Modbus RTU protocols. The characteristics of these ports can be programmed in the set-up, and they can be used independently and simultaneously. However, the Modbus would have a common address, dead time and response time for both ports.

The front serial port offers only an RS232 interface, and is typically used for set-up and downloading firmware upgrades to the relay from a laptop computer.

The rear serial port can be programmed to be either an RS232 or an RS485 interface. Typically, using an RS485 interface, a centralised computer would communicate with multiple relays on a single 3 wire communication cable in a multi-drop configuration over a distance of a kilometre or more. The RS485 facility allows up to 32 relays can be connected in this fashion to a single computer.

Both Strike's proprietary protocol as well as Modbus RTU protocol co-resides in the product. The relay will automatically respond to the protocol by which it is addressed. Strike can provide an Application Software Package as detailed below, using the proprietary protocol. The Modbus RTU protocol is intended for use with commercial software, which usually has Modbus drivers included. Both the proprietary protocol and the Modbus RTU implementation details can be provided on request by entities wishing to write their own communicating software. The rear data port can also be used for remote communication via external fixed-line or GSM modem, using a separate Dialler software program module, together with Strike's Application Software package.

This function only needs to be set if either of the serial ports are to be used.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y	Access the Customise Relay – Serial Port sub-menus by pressing  .
S	e	r	i	a	l	P	o	r	t	s				

Communication Front Port – Set Baud rate , Parity

B	a	u	d	r	a	t	e	F	R	O	N	T	Front mounted DB9: The first display sets the baud-rate to be used for the front serial port. Choose from the seven rates between 2400 and 115200 using or . For a short distance connection to a laptop computer the highest setting of 115200 is normally used.
1	1	5	2	0	0								

P	a	r	i	t	y	F	R	O	N	T	Front mounted DB9: Scrolling to the right allows the setting of the parity to EVEN, ODD, or NONE, using or .
E	V	E	N								

Communication Rear Port – Set Baud rate , Parity

C	o	m	m	s	t	y	p	e	R	E	A	R	Rear standard terminals: Scroll right to set the type of serial connection for the rear port. Choose between RS232 and RS485 using or .
R	S	2	3	2									

The next two displays allow the setting of the baud rate and parity for the rear port in the same way as for the front port described above.



Note

In some applications e.g. with some modems, in high electrical noise environments, or long transmission distances, a lower rate may be required to achieve error-free communication. Data transfers will naturally take longer at the lower rates, although because the data is quite compact, this may not be



noticeable.


MAIN MENU FUNCTIONS & DISPLAYS : [CUSTOMISE RELAY] [Real Time Clock]

Real Time Clock Setting

The real time clock is a new feature of the FP04-AR, showing the time, date, and day of the week. It allows time-stamping of events such as trips and the clearance of certain status registers. This can be extremely useful when checking the trip history of a system.





The FP04-AR has enough internal reserve power to allow the clock to run for over a week, without a supply to the auxiliary input. After this it will be necessary to update the time and date.

C	U	S	T	O	M	I	S	E	R	E	L	A	Y
R	e	a	l	T	i	m	e	C	l	o	c	k	







Press  to access the CUSTOMISE RELAY – Real Time Clock sub-menu.

Set the Time & Date

			S	e	t	T	i	m	e				
			1	2	:	3	4	:	5	6			

Adjust each of the three values of hours, minutes, and seconds using  or  , and scroll between them using  and  .

			S	e	t	D	a	t	e						
			M	o	n	1	8	/	1	0	/	2	0	1	1

Scroll right to change to date. Adjust each of the four values of day of the week, day, month, and year using  or  , and scroll between them using  and  .
Alternatively, use  [Edit] / [Save] / [Cancel]  process., Cancel will bring user back to main menu.


MAIN MENU FUNCTIONS & DISPLAYS : [EXECUTE TESTS] [Simulation Tests]

FP04 - AR Self Current Injecting

Simulation test menu – for simulating an injected current into one of the measurement elements.

Simulate Current Injecting

To activate a simulated current on one of the measuring elements...

- Go to [EXECUTE TESTS] [Simulation tests]: Press  to enter this menu; you can navigate between the two settable parameters with the left or right buttons. When the cursor is next to the element name, you can select the element to use for the injected current test.



Caution

Caution should be exercised to determine that injection is permissible before proceeding with this function as the field equipment can be operated when connected to the relay outputs.

The user can determine the injection magnitude for a particular element and the trip history will log the parameters for review later.

Upon confirmation, the current magnitude is simulated as if it was externally injected and the FP04-AR reacts exactly as it would for an external injection on that element.

Any element can be selected for injection test, but will only activate an output when the FP04-AR has been pre-programmed with an output relay allocated to the protection function. To stop such an injection, press the red button. Other elements will carry on with the protection functions as normal during this time. If one of these elements tripped the relay, the simulation mode will stop.


The current self-inject simulation feature allows the user to simulate a current injection signal to test the FP04-AR as follows...

- User threshold settings.
- Protection trip settings.
- Trip times.
- FP04-AR protection settings designated to correct relay outputs.
- System field connections for integrity and operation.
- Trip history logs.


When an element with an enabled trip function is selected, the simulation current will be adjusted between the threshold + 5% and the maximum measured current 60x if it is not between these values. Move to the inject current and set it. When you activate simulation, this current will be used as a measured input to the DSP. Therefore all the functionality of the trip will be tested as if the current was actually measured.

As soon as the trip occurred, the simulation current is cleared. If the auto-reclose function is enabled the reclose shot(s) will fire as the settings require.


Self -Injection Procedure


<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">E</td><td style="text-align: center;">X</td><td style="text-align: center;">E</td><td style="text-align: center;">C</td><td style="text-align: center;">U</td><td style="text-align: center;">T</td><td style="text-align: center;">E</td><td style="text-align: center;">T</td><td style="text-align: center;">E</td><td style="text-align: center;">S</td><td style="text-align: center;">T</td><td style="text-align: center;">S</td> </tr> <tr> <td style="text-align: center;">S</td><td style="text-align: center;">i</td><td style="text-align: center;">m</td><td style="text-align: center;">u</td><td style="text-align: center;">l</td><td style="text-align: center;">a</td><td style="text-align: center;">t</td><td style="text-align: center;">i</td><td style="text-align: center;">o</td><td style="text-align: center;">n</td><td style="text-align: center;">t</td><td style="text-align: center;">e</td><td style="text-align: center;">s</td><td style="text-align: center;">t</td> </tr> </table>	E	X	E	C	U	T	E	T	E	S	T	S	S	i	m	u	l	a	t	i	o	n	t	e	s	t	Press  to access the EXECUTE TESTS – Simulation Test sub-menus.
E	X	E	C	U	T	E	T	E	S	T	S																
S	i	m	u	l	a	t	i	o	n	t	e	s	t														


<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">I</td><td style="text-align: center;">n</td><td style="text-align: center;">j</td><td style="text-align: center;">e</td><td style="text-align: center;">c</td><td style="text-align: center;">t</td><td style="text-align: center;">2</td><td style="text-align: center;">7</td><td style="text-align: center;">%</td><td style="text-align: center;">i</td><td style="text-align: center;">n</td><td style="text-align: center;">t</td><td style="text-align: center;">o</td> </tr> <tr> <td style="text-align: center;">E</td><td style="text-align: center;">L</td><td style="text-align: center;">E</td><td style="text-align: center;">M</td><td style="text-align: center;">E</td><td style="text-align: center;">N</td><td style="text-align: center;">T</td><td style="text-align: center;">1</td><td style="text-align: center;">I</td><td style="text-align: center;">a</td><td style="text-align: center;">y</td><td style="text-align: center;">I</td><td style="text-align: center;">a</td><td style="text-align: center;">y</td> </tr> </table>	I	n	j	e	c	t	2	7	%	i	n	t	o	E	L	E	M	E	N	T	1	I	a	y	I	a	y	<p>The top line of the display shows the magnitude of the current to be injected, while the bottom line shows the element to be injected.</p> <p>The flashing cursor next to the Element 1 label shows that this is being addressed. Scroll vertically to select the required element to be injected. Note that if an element's [I>/In], and [I>>/In] setting are both disabled in the set-up, then when selecting that element the label will be shown as [OFF]</p> <p>Scroll horizontally to access the current adjustment and then scroll vertically to adjust the value of the current.</p>
I	n	j	e	c	t	2	7	%	i	n	t	o																
E	L	E	M	E	N	T	1	I	a	y	I	a	y															

Once the required setting is reached press  to proceed to the next step

<table border="1"> <tr> <td>B</td><td>R</td><td>E</td><td>A</td><td>K</td><td>E</td><td>R</td> <td>C</td><td>A</td><td>N</td> <td>T</td><td>R</td><td>I</td><td>P</td> </tr> <tr> <td>E</td><td>x</td><td>e</td><td>c</td><td>u</td><td>t</td><td>e</td> <td>?</td> <td></td> <td></td> <td>S</td><td>e</td><td>t</td><td></td> </tr> </table>	B	R	E	A	K	E	R	C	A	N	T	R	I	P	E	x	e	c	u	t	e	?			S	e	t		<p>The display now requests confirmation that the output relay can be tripped on successful completion of the test, bearing in mind that this will trip the associated switchgear if the test is done on a live system.</p> <p>Scroll vertically through the available choices which are:</p> <p>Set - Returns to the previous display to allow further adjustment of the settings.</p> <p>No - Aborts the simulation test and returns to the main menu.</p> <p>Yes - Immediately proceeds to execute the simulated injection test.</p>
B	R	E	A	K	E	R	C	A	N	T	R	I	P																
E	x	e	c	u	t	e	?			S	e	t																	

Pressing  will execute the choice. Once the simulated injection is running, the relay will respond as if a live secondary or primary injection is being performed. During the test, the normal running display is shown. The injected current value will be shown for the selected element, together with an alternating reminder that the simulated injection test is active. Observe that the relay reacts as expected.

If necessary, the test can be aborted at any time by pressing .

If the test results in a trip (the usual desired situation), the post-trip display will be shown. Pressing  to accept the trip will exit the test mode and the relay will revert to normal running condition.



Note

Even if no trip function is selected for an element, the simulation injection will still work. In this case, the relay will never trip and can stay in simulation mode, however with no function on this element, nothing is different. To stop such an injection, press the red button. The other three elements will carry on with the protection functions as normal during this time. If one of these elements tripped the relay, the simulation mode will stop.

When an element with an enabled trip function is selected, the simulation current will be adjusted between the threshold + 5% and the maximum measured current 60x if it is not between these values. Move to the inject current and set it. When you activate simulation, this current will be used as a measured input to the DSP. Therefore all the functionality of the trip will be tested as if the current was actually measured.

As soon as the trip occurred, the simulation current is cleared. If the auto-reclose function is enabled the reclose shot(s) will fire as the settings require.

FP04 - AR Test ing functions

The relay has two diagnostic testing functions, also a simulated injection testing function. These are provided as testing aids which can be used at any time, but are particularly useful during installation and commissioning.

Manual off -line diagnostic test

A function is provided, whereby the user can interactively (from the front panel) conduct a step by step diagnostic test of the relay, particularly those hardware items that require manual intervention and cannot be checked by the automatic on-line diagnostic tests. These are:

- Keypad
- LED indicators
- Display
- Digital input
- Output relays (Caution must be exercised here and the display requests confirmation, before actually tripping the relays).

MAIN MENU FUNCTIONS & DISPLAYS : [EXECUTE TESTS] [Diagnostics]

Online diagnostic features

Diagnostic test menu : For the user diagnostic test + information.
This menu can only be entered if there was no active trip (red LED off).

The main program will perform an online diagnostic test. If the test is faulty, the fault will be displayed and hardware reset issued.

Every 4 minutes an online diagnostic test is performed if the following conditions are met:

- Menu not active – user not busy in menu.
- Trip LED and Alarm LED is off – no trip function pending or passed.
- LCD backlit is off – user not busy with buttons.
- No Lockout conditions.

On every 4-minute interval a next test of the three tests is performed. The different online diagnostic tests are:

- EPROM check – when the EPROM was generated an EPROM checksum was calculated and programmed with the code. During this test the whole EPROM code is used to calculate an EPROM checksum. The checksum is then compared with the checksum programmed on the EPROM.
- EEPROM check – with every EEPROM write a local and global checksum is calculated and programmed in the EEPROM. With this test all the important checksums are checked and reported if faulty.
- Refresh the display refresh the protection function settings.

Error Messages

At power up the RAM is checked – the EPROM is checked and the EEPROM is checked (if the jumper is out)

If an error occurred during a test the following error reports will be given:

- | | |
|--|---|
| - [RAM ERROR]: | Power up RAM test failed. |
| - [EPROM ERROR] and [PROGRAM CODE]: | The EPROM test failed. |
| - [EEPROM ERROR] and [Calibration]: | The calibration factor checksum is wrong. |
| - [EEPROM ERROR] and [Setup]: | The parameter setup checksum is wrong. |
| - [EEPROM ERROR] and [Relay Setup]: | The relay setup checksum is wrong. |
| - [EEPROM ERROR] and [AReclose Setting]: | The auto-reclose setting checksum is wrong. |
| - [EEPROM ERROR] and [Trip History]: | The trip history checksum is wrong. |
| - [EEPROM ERROR] and [Input Setup]: | The input setup checksum is wrong. |
| - [EEPROM ERROR] and [CT ratio]: | The CT ratio checksum is wrong. |

The DSP is continually checked for activity by a counter input on the microprocessor. If the DSP stopped working the input will not accumulate. In this case the error is displayed as “DSP stopped working” and the relay reboots.

Interactive Diagnostic Tests



Warning


Performing the following tests while the FP04-B is in service will suspend the protective functions for the duration of the tests. In addition, conducting the relay tests will cause the output relays to energise for approximately 2s. This will trip any associated switchgear. Therefore use caution before conducting this test. If in doubt, answer [NO] to the query: [Test RELAYS?], or [NO] to the query: “Trip Relay #x] for any, or all of the 5 relays.

The user may perform a number of various interactive tests, designed to confirm the integrity of the crucial hardware functions of the FP04-AR. These tests may be performed at any time during commissioning, or while the relay is in service.


Procedure

The process will proceed automatically through various display screens, each with a pre-set delay time. Each display screen enables the user to observe and confirm the correct operation of a particular aspect of the FP04-AR.

This process takes approximately 80 seconds, after which the process terminates and reverts to the normal operating mode.

The user may speed up this process by pressing  to [accept] each display screen, thus bypassing the pre-set delay for each display screen.

There is also a facility to test the output relays, by interactively actuating each relay in turn. If this option is chosen, the total time to perform the complete set of diagnostic tests extends to approximately 5 minutes.

E X E C U T E T E S T S	Press  to access the EXECUTE TESTS - Diagnostics sub-menus.
D i a g n o s t i c s	

The various tests, displayed in sequence are:

F i r m w a r e	Identification– The first screen provides the Firmware Version Number.
V e r s i o n 4 . 0 0 0 2 1 1	




H a r d w a r e	This should match the S/N on the nameplate.
S / N 0 5 2 3 0 9 0 4	

H a r d w a r e	Factory Pre-test Status – The next screen shows the result of factory tests and should always indicate, "PASSED".
F L O W : P A S S E D	

H a r d w a r e	Check Display – After a short delay, all pixels of the LCD panel are activated, enabling the user to confirm that there are no "dead" pixels
C h e c k D I S P L A Y	

ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ	Any malfunctioning displays could result in display misinterpretation.
ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ ÿ	

H a r d w a r e	Testing LEDs – After a short delay the LED's on the front panel are energized.
T e s t i n g L E D s	

H a r d w a r e	Test Relays? – If this test is required, scroll to [Yes] with  or  and press  to activate the relay in each case. If the relay test is not required, answer [No] to the request [Test Relays?]
T e s t R e l a y s ? N o	

C o n t r o l H a r d w a r e	The final display shows version control information utilised by Strike Technologies, after which the unit will automatically revert to the normal operating mode.
P : 4 . 0 3 C : 1 . 0 0	

MAIN MENU FUNCTIONS & DISPLAYS : [SET SECURITY] [Change Password]

Setting the Password









Password setup menu : For activating or changing the access password. This menu can always be entered into independent of the relay state.

A number of features of the FP04-AR can be protected by a password for added system security. One password covers all of these functions.

It provides protection against use of certain test functions and inadvertent or unauthorised changes to the element and relay settings, within the menu system. The password is requested on entering the whole menu structure. An operator without the password can still enter the menu by pressing the red button, but is restricted to viewing status and history information.

The password is also used when acknowledging a trip, if the reset function is not set to auto. A number of acknowledgements are allowed before the password is required. This number is programmable from 0 to 10. (0 means that a password is always required)

Should the password be forgotten, it is necessary to send an official e-mail or fax request to Strike Technologies quoting the User Code included in diagnostic menu. Strike will then respond with a special once-usable password generated from this code.

S E T S E C U R I T Y C h a n g e P a s s w o r d	Press  to access the [SET SECURITY][Change Password] sub-menu.
O L D P a s s w o r d 0 0 0 0 0 0	Enter the old password. Set each digit using  and  and scroll between digits using  and  . If the password has not been previously defined, the default is all zeros, otherwise enter the old password.
N E W P a s s w o r d 0 0 0 0 0 0	Press  to progress to the next step. Enter the new password by defining a 6 digit numeric code in a similar manner. Exit using the standard  [Edit] / [Save] / [Cancel]  process.



Note

Keep the password in a secure place. Losing the password will mean that access to the protected functions will be denied, causing substantial inconvenience.






MAIN MENU FUNCTIONS & DISPLAYS : [SYSTEM CONTROL] [Close Breaker]

Manually Close Breaker



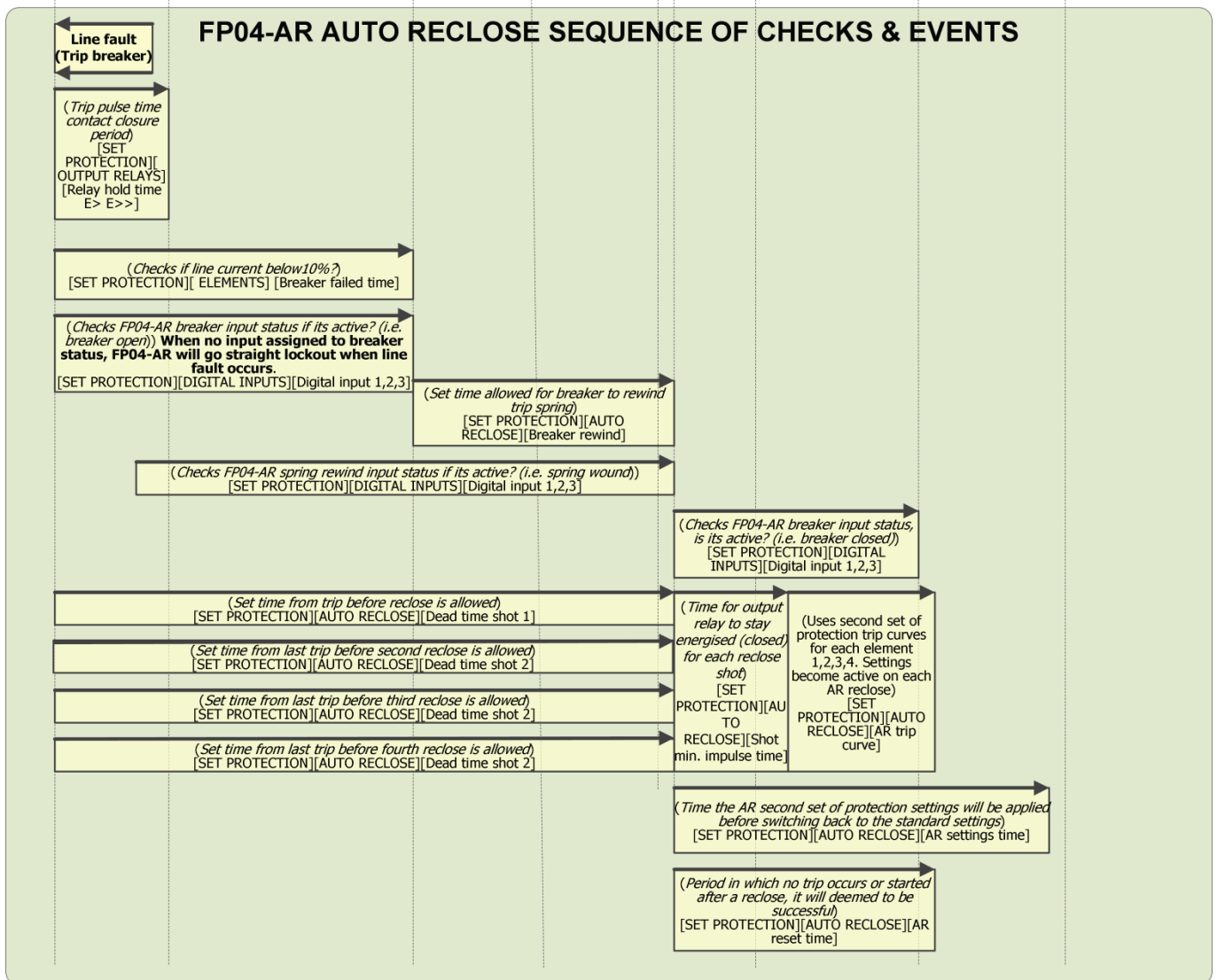
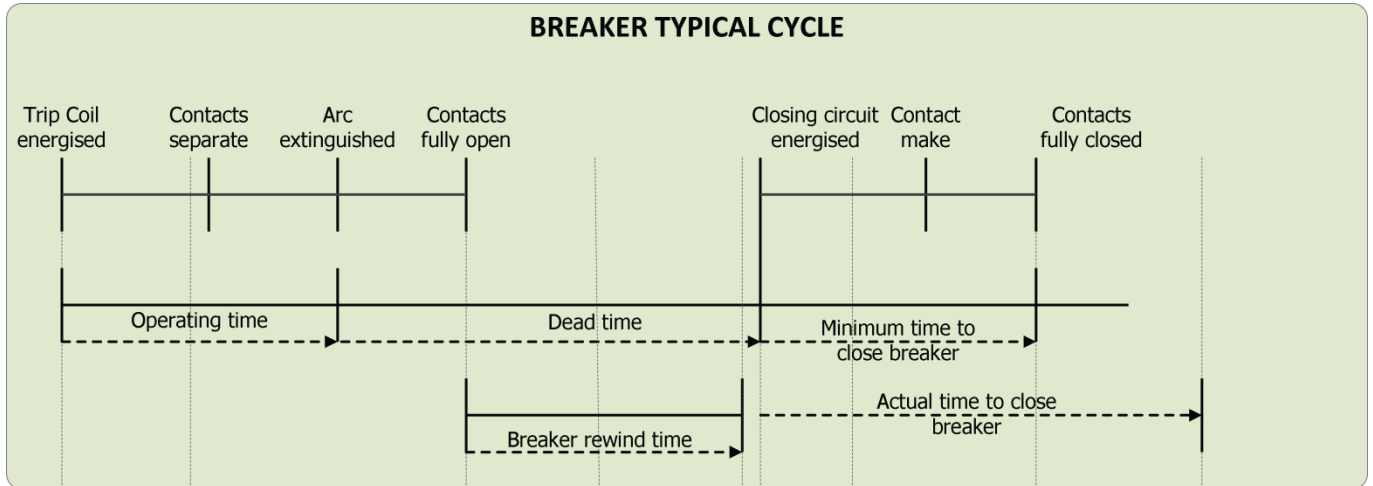
Note

This menu can only accessed when the FP04-AR is in a trip condition with the red Trip LED on. This facility will also only function when auto re-close setting allocations have been completed.

S Y S T E M C O N T R O L C l o s e B r e a k e r	Press  to access the SYSTEM CONTROL – Close Breaker sub-menu.
C l o s e B r e a k e r N o w ? N o	Please refer to note above when access is ignored. Select [No] or [Yes] using  and  then press  to [Edit] / [Save] / [Cancel]  process

Appendix 1

Fig 1: Timing diagram for auto reclose function:





Electrical Distributors

Table 1 : General Characteristics

Applicable standard	IEC 60255
Operating temperature	-10 to +55 °C to IEC 60068-2-2
Storage temperature range	-20 to +70 °C to IEC 60068-2-2
Humidity	4 days, 95% RH, at 40°C, to IEC 60068-2-78
Enclosure degree of protection	IP50 to IEC 60529
Shock and bump	Shock: 15g, 3 pulses per direction, in each of 3 axes. Bump: 10g, 1000 pulses per direction, in each of 3 axes. To IEC 60255-21-2
Vibration	1g swept frequency from 10 to 500 Hz per axis; sweep rate of 1 octave/min and a total of 20 sweeps in each of 3 axes. To IEC 60255-21-1
Power frequency voltage withstand See caution notice below	2 kV RMS 50 Hz for 1 minute, from all terminals to case (earth), and between terminals of independent circuits. 1.5 kV RMS across open contacts of output relays. To IEC 60255-5
Impulse voltage withstand See caution notice below	5 kV peak, 1,2/50 μ s wave shape, 0,5 J energy content, 5 shots in each polarity, between all terminals and case (earth), and between terminals of independent circuits. To IEC 60255-5
Insulation resistance	20 M Ω minimum at 500 V dc, to IEC 60255-5
Immunity to high frequency disturbances (1MHz burst disturbance test)	2.5 kV peak between independent circuits, and to case (earth). 1 kV peak across terminals of the same circuit. To IEC 60255-22-1
Immunity to electrostatic discharges (Electrostatic discharge test)	8 kV discharge in air with cover in place. 6 kV point contact discharge with cover removed. To EN 61000-4-2
Immunity to fast transient bursts	Class IV (4 kV). To EN 61000-4-4
Immunity to high frequency electromagnetic fields	10 V/m, 80% AM (1kHz), from 150kHz to 80MHz, to EN 61000-4-6 10 V/m, 80% AM (1kHz), from 80 to 1000MHz, to EN61000-4-3 10 V/m, 100% Pulse modulation (200Hz), 895-905MHz, to ENV 50204
Immunity to 50Hz magnetic field	100 A/m continuous, 300A/m short time EN61000-4-8
Immunity to high frequency electromagnetic field (Pulse modulated, simulation of the effect of cell phones)	To ENV 50204
Conducted emissions	To EN 55011 Class A, from 150 kHz to 30 MHz, both average and quasi-peak
Radiated emissions	To EN 55011 Class A, from 30MHz to 1000 MHz.
Nett Mass	3.1kg
Overall dimensions	103(w) x 177(h) x 248(d)

Table 2 : Technical Specifications


INPUTS				
CURRENT INPUTS	Quantity.	4.		
	Nominal rated current (In).	1A or 5A, user Programmable from keypad.		
	Continuous rating.	15A.		
	Short time rating.	300A for 1sec.		
	Burden.	40mΩ <1VA.		
	Accuracy of measurement.	± 2% of nominal current (In).		
DIGITAL INPUTS	Quantity.	1 standard, plus 2 outputs can be hardware/firmware configured to be inputs.		
	Type.	Opto-isolated level sensitive.		
	User selectable functions.	Block trip, Event input, Remote reset, AR – spring wound, AR – breaker status, AR enable Auto-reclose.		
	Active voltage range.	30 – 250V ac/dc, not polarity sensitive.		
	Response time.	Typically 30ms.		
AUXILIARY POWER SUPPLY	Nominal voltage range.	36 to 250 V ac/dc 50/60 Hz, not polarity sensitive.		
	Maximum DC burden.	<14W with all output relays energised & backlight on.		
	Maximum AC burden.	<24W with all output relays energised & backlight on.		
OUTPUTS				
RELAY OUTPUTS	Quantity.	Total of six output relays: K6 supervision relay, K1 - K3 dedicated to be output relays, K4 – K5 multifunction		
	Contact form.	Per output: 1 change-over contact (form C), user hardware configurable to be N/O or N/C.		
	K1 Trip output rated load.	Resistive (cos φ = 1)		Inductive (cos φ = 0.4: L/R = 7 ms)
		5A @ 250Vac	5A @ 250Vac	
		5A @ 48Vdc	5A @ 48Vdc	
		3A @ 110Vac	3A @ 110Vac	
		1A @ 220Vdc	1A @ 220Vdc	
	K2 – K6 rated load.	5A @ 250Vac	3.5A @ 250Vac	
		5A @ 30Vdc	2.5A @ 30Vdc	
	Rated carry current.	5A		
Maximum operating voltage.	380Vac, 250Vdc			
Minimum permissible load.	100mA @ 5Vdc			
USER INTERFACE				
KEYPAD	Type.	5 miniature spring-loaded pushbuttons		
	Function.	Scrolling buttons and , the vertical scrolling buttons and , and the red button  to enter.		
LCD	Type.	Backlit with full alpha-numeric character set.		
	Layout.	2 lines of 16 characters, 4mm high.		
DATA COMMS	RS232 F/M: Front of FP04-AR.	RS232 serial port. Select range 2400 to 115200 baud.		
	Terminals: Rear of FP04-AR.	RS232 or RS485 keypad programmable. Select range 2400 to 115200 baud.		
	Protocol.	Programmable, Strike proprietary protocol or MODBUS.		
GENERAL				
REAL TIME CLOCK	Functions.	Date, weekday, HH:MM:SS.		
	Accuracy.	± 30s per month.		
	Retention period.	In excess of 10 days without power.		
	Backup.	Super cap		
	Application.	Real time stamping of trip history and certain status registers.		

Table s 3 & 4: Output Relay Checksum Structure

Example checksum calculations

Table 3

FUNCTION	BIT ALLOCATION
Element1> start	Bit 17 MSB
Element1> trip	Bit 16
Element1>> trip	Bit 15
Element2> start	Bit 14
Element2> trip	Bit 13
Element2>> trip	Bit 12
Element3> start	Bit 11
Element3> trip	Bit 10
Element3>> trip	Bit 9
Element4> start	Bit 8
Element4> trip	Bit 7
Element4>> trip	Bit 6
Not applicable in F04-AR	Bit 5
Not applicable in F04-AR	Bit 4
Event	Bit 3
Breaker fail	Bit 2
Not applicable in F04-AR	Bit 1
Not applicable in F04-AR	Bit 0 LSB

Table 4

Output Relay K1 allocations	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0
K1 checksum	0	9	2	4	0													

Output Relay K2 allocations	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0
K2 checksum	1	2	4	8	0													

Output Relay K3 allocations	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0
K3 checksum	0	0	1	C	0													

Output Relay K4 allocations	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0
K4 checksum	2	4	9	0	0													

Output Relay K5 allocations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K5 checksum	0	0	0	0	0													

Table 5: Element Protection Parameters

Element	Element name	Trip Curve	Low -set overcurrent	Range	Setting	Parameter	Range	Setting	High -set overcurrent	Range	Parameter	Range	Setting
E1	Ia	SI	Ia>/In	0.25-2.35	0.00	Ia>:xt	0.025-4.000	0.000	Ia>>/In	0.5-32.0	Ia>>:xt	0.030-50.000	00.00
E2	Ib	SI	Ib>/In	0.25-2.35	0.00	Ib>:xt	0.025-4.000	0.000	Ib>>/In	0.5-32.0	Ib>>:xt	0.030-50.000	00.00
E3	Ic	SI	Ic>/In	0.25-2.35	0.00	Ic>:xt	0.025-4.000	0.000	Ic>>/In	0.5-32.0	Ic>>:xt	0.030-50.000	00.00
E4	Ia	Io	Io>/In	0.25-2.35	0.00	Io>:xt	0.025-4.000	0.000	Io>>/In	0.5-32.0	Io>>:xt	0.030-50.000	00.00
Element	Reset time range		Reset time	setting	CT primary range		CT primary setting		Range		Setting		
E1-E4	0-60s		05		-----		-----		-----		-----		
E1	-----		-----		1-6000A		0000A		-----		-----		
E2	-----		-----		1-6000A		0000A		-----		-----		
E3	-----		-----		1-6000A		0000A		-----		-----		
E4	-----		-----		1-6000A		0000A		-----		-----		
Breaker failed time range										0.010-30.000		00.000	
Event input trip										0.020-60.000		00.000	
Clear trip history										-----		Yes/No	

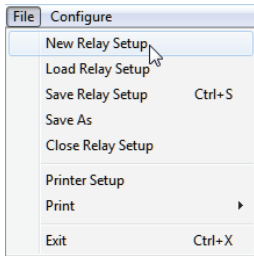
Table 6: Step by Step Installation and Commissioning Instructions

1.	Unpack the relay, and check for obvious damage.
2.	If the contact form (normally open or normally closed) of any of output relays K1, K2, K3, K4, K5 or K6 is to be changed from the default settings of normally open to normally closed, withdraw the draw-out module and reconfigure the appropriate contacts. When used with auto re-close also configure the relays to be inputs as required. The contact form configuration should be checked in any event to confirm it is correct.
3.	Insert the draw-out module back into the fixed casing and affix the front cover of the relay.
4.	Mount the FP04-AR Relay within a cut-out on the switchgear or relay panel, or within an appropriate 19 inch rack. Ensure that the fixed housing is securely screwed to the panel or 19 inch rack, using the mounting holes on the fixed housing. These are accessible from the front without removing the front cover of the relay.
5.	Wire the auxiliary power supply to the relay, (Do not apply voltage yet).
6.	Wire the current transformer circuits to the relay. (Do not apply current to the inputs yet.)
7.	Wire the appropriate output relay circuits to suit the application. (Do not apply voltage yet.)
8.	If applicable, wire the Rx, Tx, and common terminals.
9.	If applicable, wire the digital input circuit. (Do not apply voltage yet.)
10.	Measure the auxiliary power supply voltage, the voltages for the output relays and the voltage for the digital input. Confirm that these voltages are correct and within the acceptable range in accordance with the FP04-AR Relay specifications. Only then apply these voltages to the FP04-AR Relay. Measure the voltages at the terminals of the FP04-AR Relay to confirm that the voltages at the relay terminals are correct. Check that with auxiliary power applied, the self-supervision relay K6 is energized and that its contacts are in the correct state.
11.	Check that the LCD screen of the FP04-AR Relay is displaying the normal operation screen display, that the green POWER ON / HEALTHY LED is ON, and that the yellow and red LED's are off.
12.	Access the main menu.
13.	If the FP04-AR Relay is to be used in a 60Hz network (default is 50Hz), programme it accordingly via the CUSTOMISE RELAY – Line frequency sub-menu. Save the settings configured.
14.	Access the SET PROTECTION - Elements menu and configure the parameter settings for elements 1, 2, 3, & 4, including CT ratings. Save the settings configured.
15.	Access the SET PROTECTION – Output Relays menu and configure the functionality of output relays K1, K2, K3, K4, and K5
16.	Check that the output relay checksums are correct for the desired output relay configuration. Save the settings configured.
17.	Access the SET PROTECTION – Digital Inputs menu and configure (or disable) the functions as required. Save the settings configured.
18.	Access the CUSTOMISE Relay – Real Time Clock to set the time and date correctly.
19.	Access the EXECUTE TESTS – Diagnostics menu and execute the diagnostic test. Confirm that all diagnostic tests produce satisfactory results.
20.	Access the CUSTOMISE RELAY – Serial Ports menu, and select the appropriate baud rate and parity for the serial port. If using the Modbus protocol, also set the Modbus address, response time and dead time. Save the settings configured.

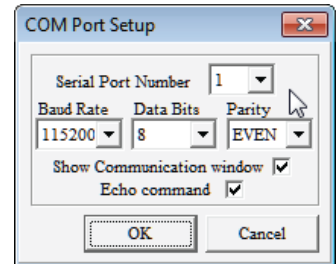
Factory default settings & computer SW

New software

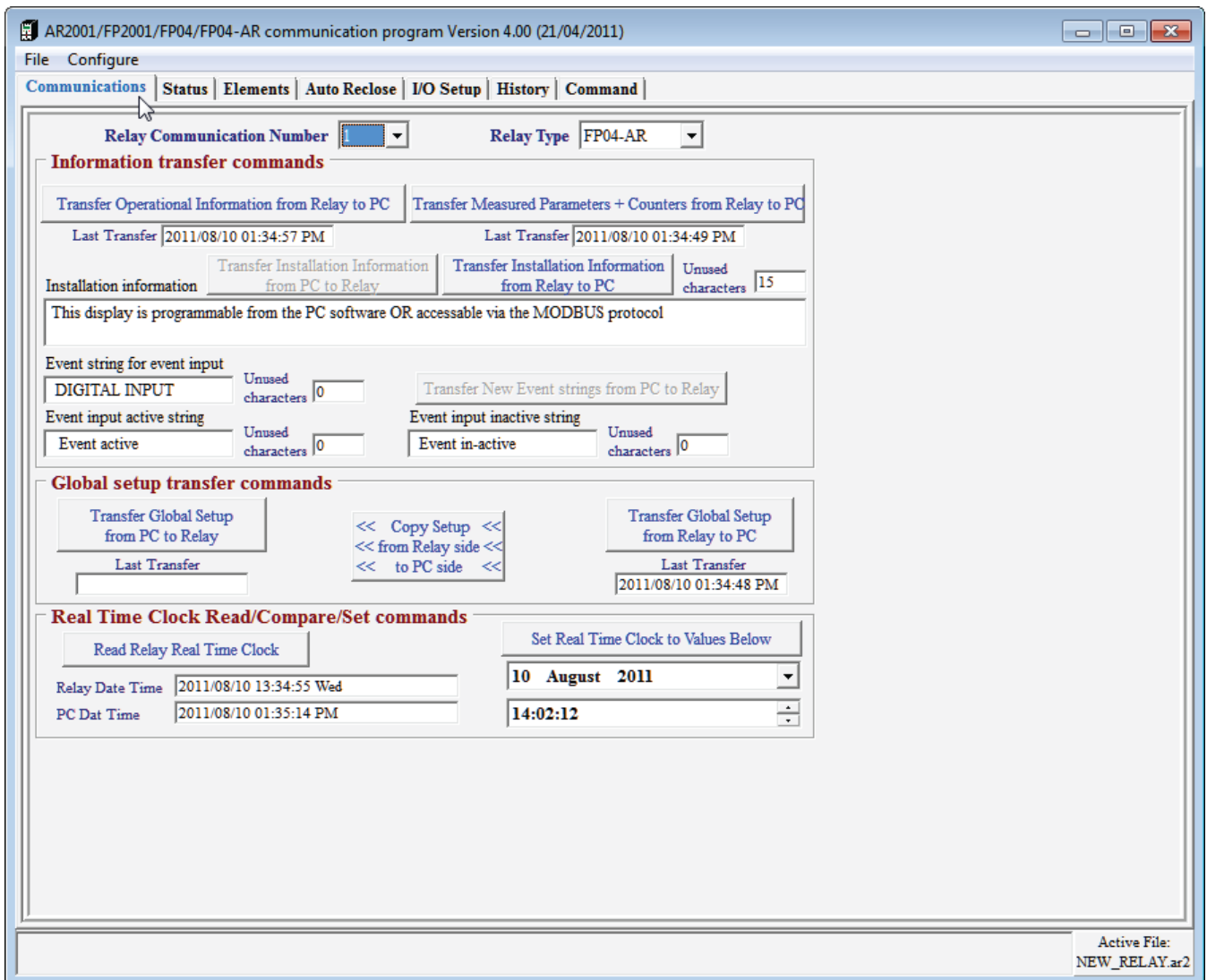
After opening the SW, first use "New Relay Setup" to access relay PC setup facilities.



Then set relay communications settings via the relay front panel as required, followed by setting the PC SW comms to match the relay settings as illustrated.



Set relay communication number and relays type





Electrical Distributors

Status after retrieving data will indicate the real time state I/O state, Amperes and other conditions.

AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications **Status** Elements Auto Reclose I/O Setup History Command

Operational Information

Status

Relay Serial Number **11310002**

Input 1	Off
Input 2	Off
Input 3	Off
Alarm LED	Off
Trip LED	Off
Operator in Setup Menu	Yes
Relay Frequency	50 Hz
Output relay #1	De-energised
coil status #2	De-energised
#3	De-energised
#4	De-energised
#5	De-energised
Relay in Simulation Mode	Off
Firmware version	4.02

Allowed resets remaining

E1>	Auto	E1>>	Auto	Event	Auto
E2>	Auto	E2>>	Auto		
E3>	Auto	E3>>	Auto		
E4>	Auto	E4>>	Auto		

Measured Parameters

	Element 1	Element 2	Element 3	Element 4
	<input type="checkbox"/> D>	<input type="checkbox"/> D>	<input type="checkbox"/> D>	<input type="checkbox"/> D>
	D>> <input type="checkbox"/>	D>> <input type="checkbox"/>	D>> <input type="checkbox"/>	D>> <input type="checkbox"/>
Current	0.00 %	0.00 %	0.00 %	0.00 %
Primary Current	0.00 A	0.00 A	0.00 A	0.00 A
I ² summation	0.00	0.00	0.00	0.00
Current				
Last Cleared	1:2011/07/26 09:11:27 Tue	2:2011/07/26 09:11:27 Tue	3:2011/07/26 09:11:27 Tue	4:2011/07/26 09:11:27 Tue
time stamps				

Counter information

	Value	Last Clear / Saved time stamp
Setup Saved Counter	000001	2011/07/26 09:11:27 Tue
Breaker Tripped	000000	2011/07/26 09:11:27 Tue
Breaker failed	000000	2011/07/26 09:11:27 Tue
Event Tripped	000000	2011/07/26 09:11:27 Tue
Reclose successful	000000	
Reclose Lockouts	000000	
Breaker Reclosed	000000	
Breaker Rewind failed	000000	
Maximum rewind time measured	0.000	s

Active File:
NEW_RELAY.ar2



Electrical Distributors

FP04 -AR factory default element settings

AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | **Elements** | Auto Reclose | I/O Setup | History | Command

Relay Description and general information
Factory default FP04-AR setup

Global Element Setup for Download
E1-E4 Trip start reset time 1 Power-up restore trip state No
Bfail time N/A K1 K2 K3 K4 K5

Global Element Setup from Last Update
E1-E4 Trip start reset time 0 Power-up restore trip state No
Bfail time N/A K1 K2 K3 K4 K5

Element 1 Setup for Download
E1>Name Ia Use blocking input for E1>
E1>Curve SI Use blocking input for E1>>
E1>start K1 K2 K3 K4 K5
E1>/In N/A K1 K2 K3 K4 K5
E1>xt 0.000 Allow resets after trip Auto
E1>>/In N/A K1 K2 K3 K4 K5
E1>>xt 0.030 Allow resets after trip Auto

Element 1 Setup from Last Upload
E1>Name Ia Use blocking input for E1>
E1>Curve SI Use blocking input for E1>>
E1>start K1 K2 K3 K4 K5
E1>/In N/A K1 K2 K3 K4 K5
E1>xt 0.025 Allow resets after trip Auto
E1>>/In N/A K1 K2 K3 K4 K5
E1>>xt 0.030 Allow resets after trip Auto

Element 2 Setup for Download
E2>Name Ib Use blocking input for E2>
E2>Curve SI Use blocking input for E2>>
E2>start K1 K2 K3 K4 K5
E2>/In N/A K1 K2 K3 K4 K5
E2>xt 0.000 Allow resets after trip Auto
E2>>/In N/A K1 K2 K3 K4 K5
E2>>xt 0.030 Allow resets after trip Auto

Element 2 Setup from Last Upload
E2>Name Ib Use blocking input for E2>
E2>Curve SI Use blocking input for E2>>
E2>start K1 K2 K3 K4 K5
E2>/In N/A K1 K2 K3 K4 K5
E2>xt 0.025 Allow resets after trip Auto
E2>>/In N/A K1 K2 K3 K4 K5
E2>>xt 0.030 Allow resets after trip Auto

Element 3 Setup for Download
E3>Name Ic Use blocking input for E3>

Element 3 Setup from Last Upload
E3>Name Ic Use blocking input for E3>

Active File: NEW_RELAY.ar2

AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | **Elements** | Auto Reclose | I/O Setup | History | Command

Element 3 Setup for Download
E3>Name Ic Use blocking input for E3>
E3>Curve SI Use blocking input for E3>>
E3>start K1 K2 K3 K4 K5
E3>/In N/A K1 K2 K3 K4 K5
E3>xt 0.000 Allow resets after trip Auto
E3>>/In N/A K1 K2 K3 K4 K5
E3>>xt 0.030 Allow resets after trip Auto

Element 3 Setup from Last Upload
E3>Name Ic Use blocking input for E3>
E3>Curve SI Use blocking input for E3>>
E3>start K1 K2 K3 K4 K5
E3>/In N/A K1 K2 K3 K4 K5
E3>xt 0.025 Allow resets after trip Auto
E3>>/In N/A K1 K2 K3 K4 K5
E3>>xt 0.030 Allow resets after trip Auto

Element 4 Setup for Download
E4>Name Io Use blocking input for E4>
E4>Curve SI Use blocking input for E4>>
E4>start K1 K2 K3 K4 K5
E4>/In N/A K1 K2 K3 K4 K5
E4>xt 0.000 Allow resets after trip Auto
E4>>/In N/A K1 K2 K3 K4 K5
E4>>xt 0.030 Allow resets after trip Auto

Element 4 Setup from Last Upload
E4>Name Io Use blocking input for E4>
E4>Curve SI Use blocking input for E4>>
E4>start K1 K2 K3 K4 K5
E4>/In N/A K1 K2 K3 K4 K5
E4>xt 0.025 Allow resets after trip Auto
E4>>/In N/A K1 K2 K3 K4 K5
E4>>xt 0.030 Allow resets after trip Auto

Event Input relay setup for Download
Name: DIGITAL INPUT Allow resets Auto
Timer 0.020 K1 K2 K3 K4 K5

Event Input relay setup from Last Upload
Name: DIGITAL INPUT Allow resets Auto
Timer 0.020 K1 K2 K3 K4 K5

Output Relay Checksum for Download

Relay K1 Checksum	000000
Relay K2 Checksum	000000
Relay K3 Checksum	000000
Relay K4 Checksum	000000
Relay K5 Checksum	000000

Output Relay Checksum from Last Upload

Relay K1 Checksum	000000
Relay K2 Checksum	000000
Relay K3 Checksum	000000
Relay K4 Checksum	000000
Relay K5 Checksum	000000

Active File: 11310002.ar2



Electrical Distributors



Electrical Distributors

FP04 - AR factory auto - reclose default settings

Note: Factory default settings are for the basic feeder protection with auto-reclose settings disabled.

AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | Elements | **Auto Reclose** | I/O Setup | History | Command

Auto-reclose functional Setup for Download

Select functions that can trigger auto-reclose

I1> I1>> I2> I2>>
 I3> I3>> I4> I4>>

AR enabled K1 K2 K3 K4 K5

AR busy K1 K2 K3 K4 K5

AR lockout K1 K2 K3 K4 K5

Reclose shot count 1

Dead time before shot 1 10.90

Dead time before shot 2 10.90

Dead time before shot 3 10.90

Dead time before shot 4 10.0

Reclose pulse time 0.10

Bkr reclose K1 K2 K3 K4 K5

Time to use auto-reclose settings after reclose N/A

Auto-reclose reset time 15.0

Breaker rewind timeout 1.0

Bkr rewind fail K1 K2 K3 K4 K5

Activation level for current supervision 1 N/A

Activation level for current supervision 2 N/A

Activation level for current supervision 3 N/A

Activation level for current supervision direct N/A

Manual reclose options

Use auto-reclose settings for manual reclose No

Time to use settings 0.10

Auto-reclose functional Setup from Upload

Selected functions that can trigger auto-reclose

I1> I1>> I2> I2>>
 I3> I3>> I4> I4>>

AR enabled K1 K2 K3 K4 K5

AR busy K1 K2 K3 K4 K5

AR lockout K1 K2 K3 K4 K5

Reclose shot count 1

Dead time before shot 1 10.00

Dead time before shot 2 10.00

Dead time before shot 3 10.00

Dead time before shot 4 10.0

Reclose pulse time 0.20

Bkr reclose K1 K2 K3 K4 K5

Time to use auto-reclose settings after reclose N/A

Auto-reclose reset time 15.0

Breaker rewind timeout 1.0

Bkr rewind fail K1 K2 K3 K4 K5

Activation level for current supervision 1 N/A

Activation level for current supervision 2 N/A

Activation level for current supervision 3 N/A

Activation level for current supervision direct N/A

Manual reclose options

Use auto-reclose settings for manual reclose No

Time to use settings 1.00

Active File: NEW_RELAY.ar2

AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | Elements | **Auto Reclose** | I/O Setup | History | Command

Manual reclose options

Use auto-reclose settings for manual reclose No

Time to use settings 0.10

Element 1 Setup for Download

E1:Curve SI

E1>/In N/A

E1>:xt 0.000

E1>>/In N/A

E1>>:xt 0.030

Element 1 Setup from Last Upload

E1:Curve SI

E1>/In N/A

E1>:xt 0.025

E1>>/In N/A

E1>>:xt 0.030

Element 2 Setup for Download

E2:Curve SI

E2>/In N/A

E2>:xt 0.000

E2>>/In N/A

E2>>:xt 0.030

Element 2 Setup from Last Upload

E2:Curve SI

E2>/In N/A

E2>:xt 0.025

E2>>/In N/A

E2>>:xt 0.030

Element 3 Setup for Download

E3:Curve SI

E3>/In N/A

E3>:xt 0.000

E3>>/In N/A

E3>>:xt 0.030

Element 3 Setup from Last Upload

E3:Curve SI

E3>/In N/A

E3>:xt 0.025

E3>>/In N/A

E3>>:xt 0.030

Element 4 Setup for Download

E4:Curve SI

E4>/In N/A

E4>:xt 0.000

E4>>/In N/A

E4>>:xt 0.030

Element 4 Setup from Last Upload

E4:Curve SI

E4>/In N/A

E4>:xt 0.025

E4>>/In N/A

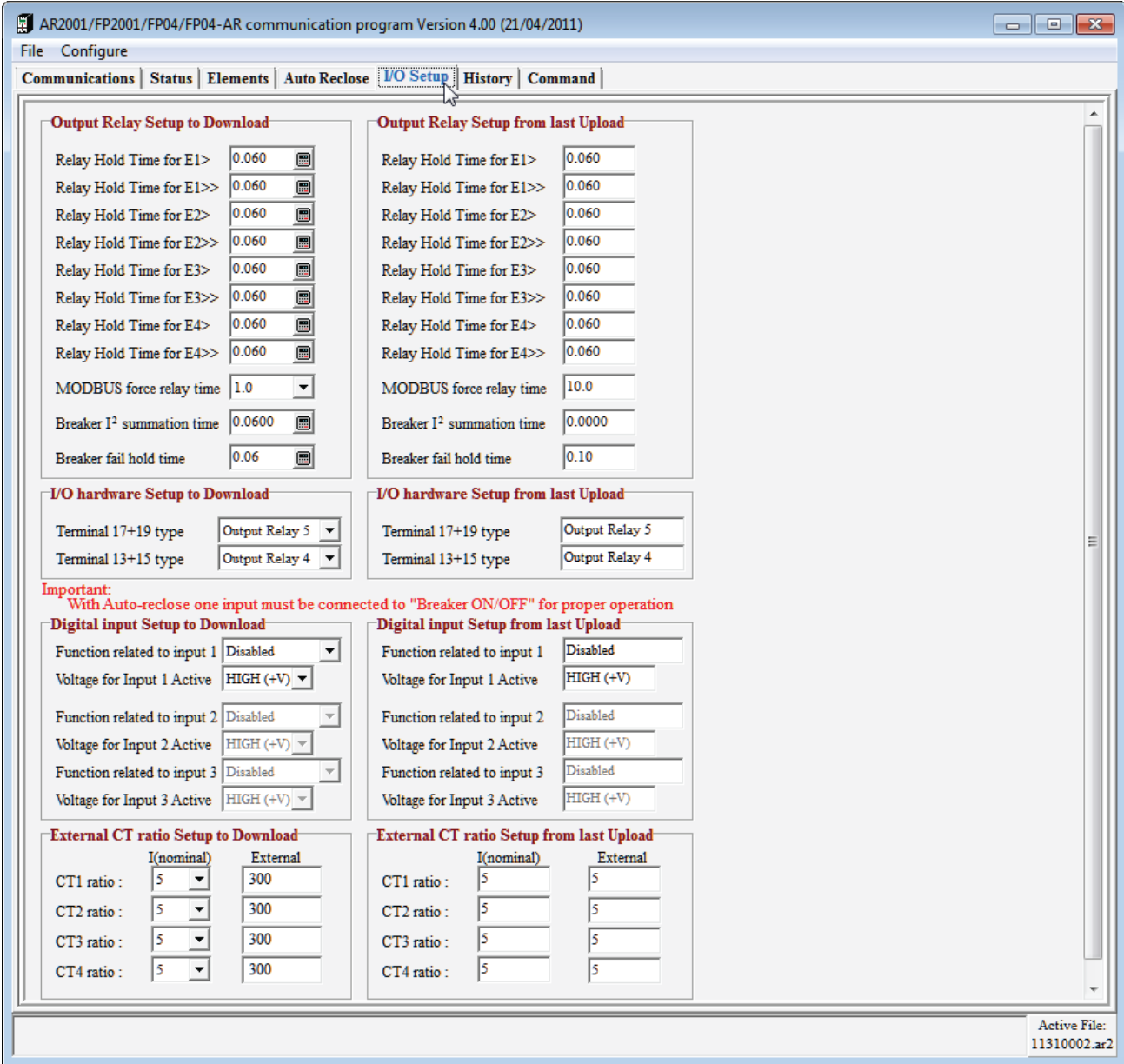
E4>>:xt 0.030

Active File: 11310002.ar2



Electrical Distributors

FP04 - AR default I/O settings



AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | Elements | Auto Reclose | **I/O Setup** | History | Command

Output Relay Setup to Download

Relay Hold Time for E1>	0.060
Relay Hold Time for E1>>	0.060
Relay Hold Time for E2>	0.060
Relay Hold Time for E2>>	0.060
Relay Hold Time for E3>	0.060
Relay Hold Time for E3>>	0.060
Relay Hold Time for E4>	0.060
Relay Hold Time for E4>>	0.060
MODBUS force relay time	1.0
Breaker I ² summation time	0.0600
Breaker fail hold time	0.06

Output Relay Setup from last Upload

Relay Hold Time for E1>	0.060
Relay Hold Time for E1>>	0.060
Relay Hold Time for E2>	0.060
Relay Hold Time for E2>>	0.060
Relay Hold Time for E3>	0.060
Relay Hold Time for E3>>	0.060
Relay Hold Time for E4>	0.060
Relay Hold Time for E4>>	0.060
MODBUS force relay time	10.0
Breaker I ² summation time	0.0000
Breaker fail hold time	0.10

I/O hardware Setup to Download

Terminal 17+19 type	Output Relay 5
Terminal 13+15 type	Output Relay 4

I/O hardware Setup from last Upload

Terminal 17+19 type	Output Relay 5
Terminal 13+15 type	Output Relay 4

Important:
With Auto-reclose one input must be connected to "Breaker ON/OFF" for proper operation

Digital input Setup to Download

Function related to input 1	Disabled
Voltage for Input 1 Active	HIGH (+V)
Function related to input 2	Disabled
Voltage for Input 2 Active	HIGH (+V)
Function related to input 3	Disabled
Voltage for Input 3 Active	HIGH (+V)

Digital input Setup from last Upload

Function related to input 1	Disabled
Voltage for Input 1 Active	HIGH (+V)
Function related to input 2	Disabled
Voltage for Input 2 Active	HIGH (+V)
Function related to input 3	Disabled
Voltage for Input 3 Active	HIGH (+V)

External CT ratio Setup to Download

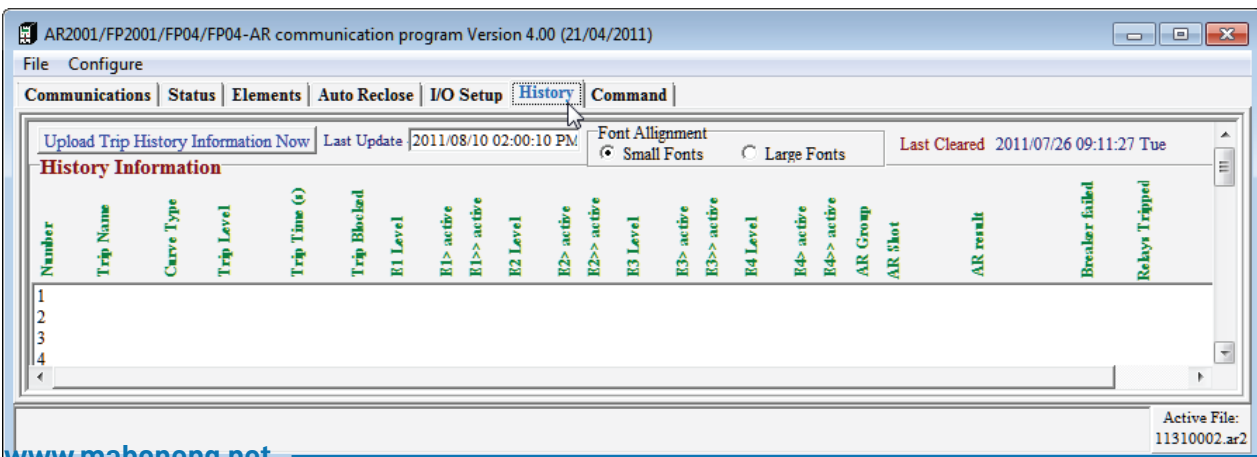
	I(nominal)	External
CT1 ratio :	5	300
CT2 ratio :	5	300
CT3 ratio :	5	300
CT4 ratio :	5	300

External CT ratio Setup from last Upload

	I(nominal)	External
CT1 ratio :	5	5
CT2 ratio :	5	5
CT3 ratio :	5	5
CT4 ratio :	5	5

Active File: 11310002.ar2

Default factory history (new relay - empty)



AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | Elements | Auto Reclose | I/O Setup | **History** | Command

Upload Trip History Information Now | Last Update | 2011/08/10 02:00:10 PM | Font Alignment | Small Fonts | Large Fonts | Last Cleared | 2011/07/26 09:11:27 Tue

History Information

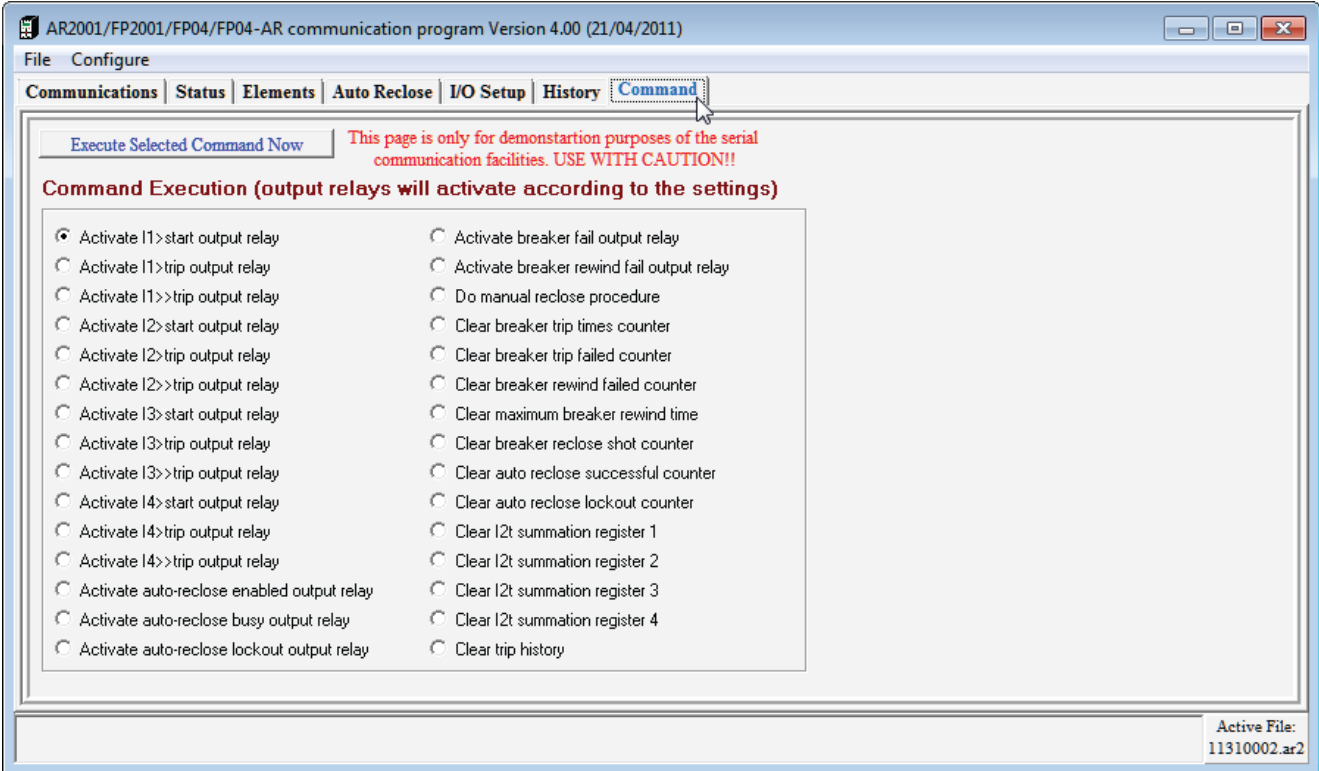
Number	Trip Name	Curve Type	Trip Level	Trip Time (s)	Trip Blocked	E1 Level	E1> active	E1>> active	E2 Level	E2> active	E2>> active	E3 Level	E3> active	E3>> active	E4 Level	E4> active	E4>> active	AR Group	AR Slot	AR result	Breaker failed	Relays Tripped	
1																							
2																							
3																							
4																							

Active File: 11310002.ar2



Electrical Distributors

FP04 - AR testing and managing the relay



AR2001/FP2001/FP04/FP04-AR communication program Version 4.00 (21/04/2011)

File Configure

Communications | Status | Elements | Auto Reclose | I/O Setup | History | **Command**

Execute Selected Command Now **This page is only for demonstration purposes of the serial communication facilities. USE WITH CAUTION!!**

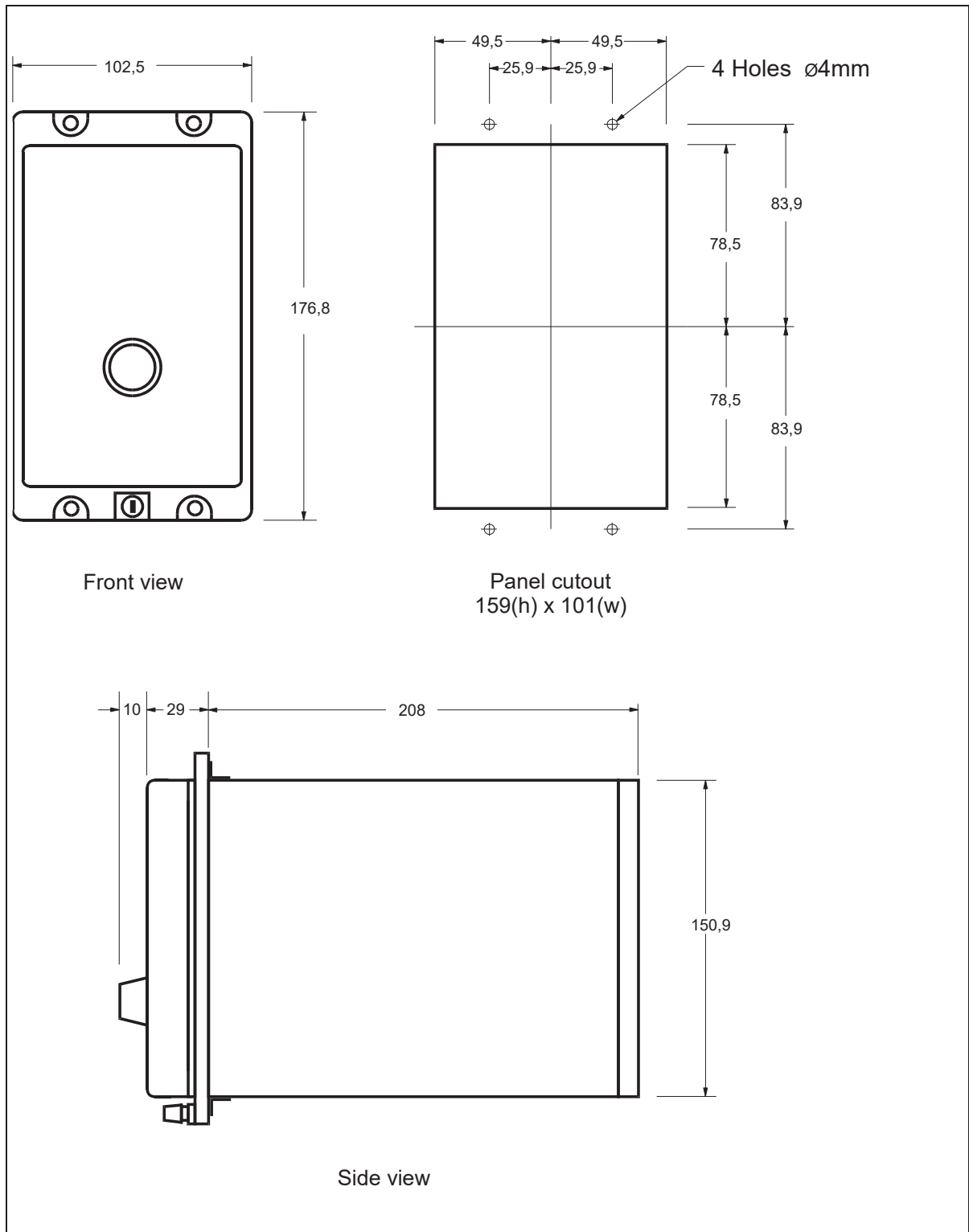
Command Execution (output relays will activate according to the settings)

- Activate I1>start output relay
- Activate I1>trip output relay
- Activate I1>>trip output relay
- Activate I2>start output relay
- Activate I2>trip output relay
- Activate I2>>trip output relay
- Activate I3>start output relay
- Activate I3>trip output relay
- Activate I3>>trip output relay
- Activate I4>start output relay
- Activate I4>trip output relay
- Activate I4>>trip output relay
- Activate auto-reclose enabled output relay
- Activate auto-reclose busy output relay
- Activate auto-reclose lockout output relay
- Activate breaker fail output relay
- Activate breaker rewind fail output relay
- Do manual reclose procedure
- Clear breaker trip times counter
- Clear breaker trip failed counter
- Clear breaker rewind failed counter
- Clear maximum breaker rewind time
- Clear breaker reclose shot counter
- Clear auto reclose successful counter
- Clear auto reclose lockout counter
- Clear I2t summation register 1
- Clear I2t summation register 2
- Clear I2t summation register 3
- Clear I2t summation register 4
- Clear trip history

Active File: 11310002.ar2

Appendix 2

Diagram 1 : Relay Case and Panel Cut -out Dimensions

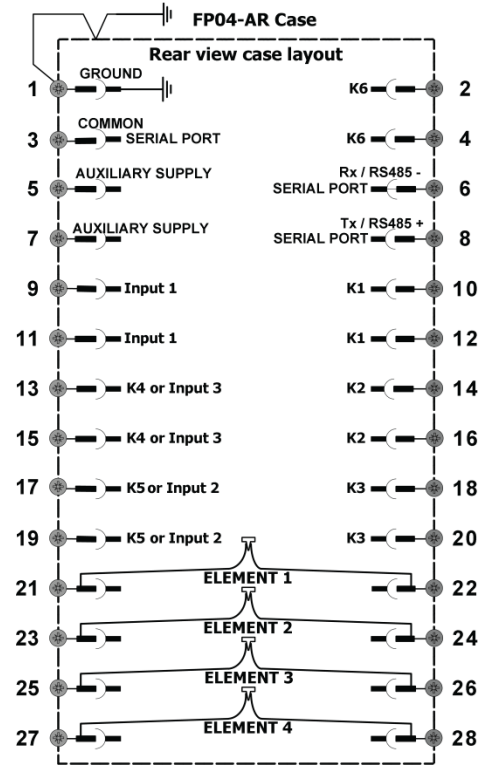
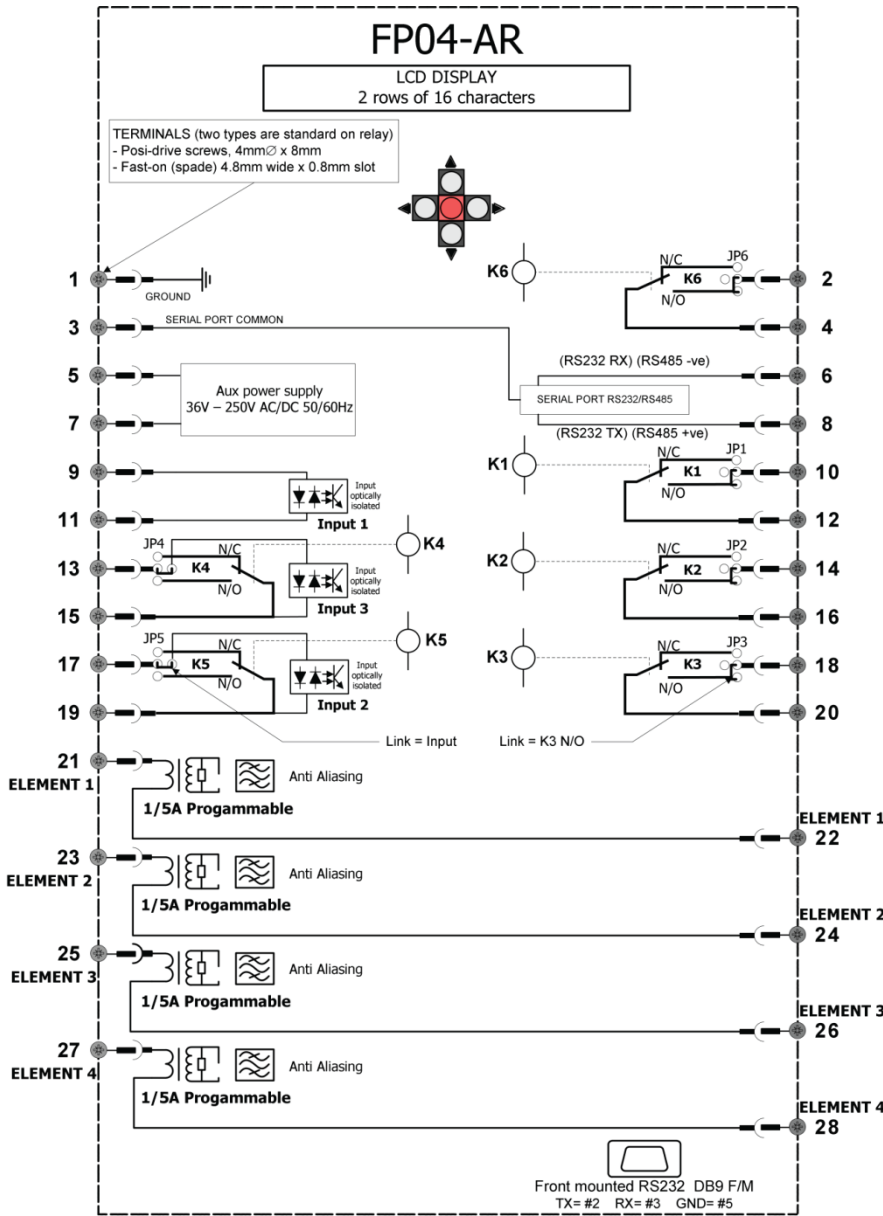




Electrical Distributors

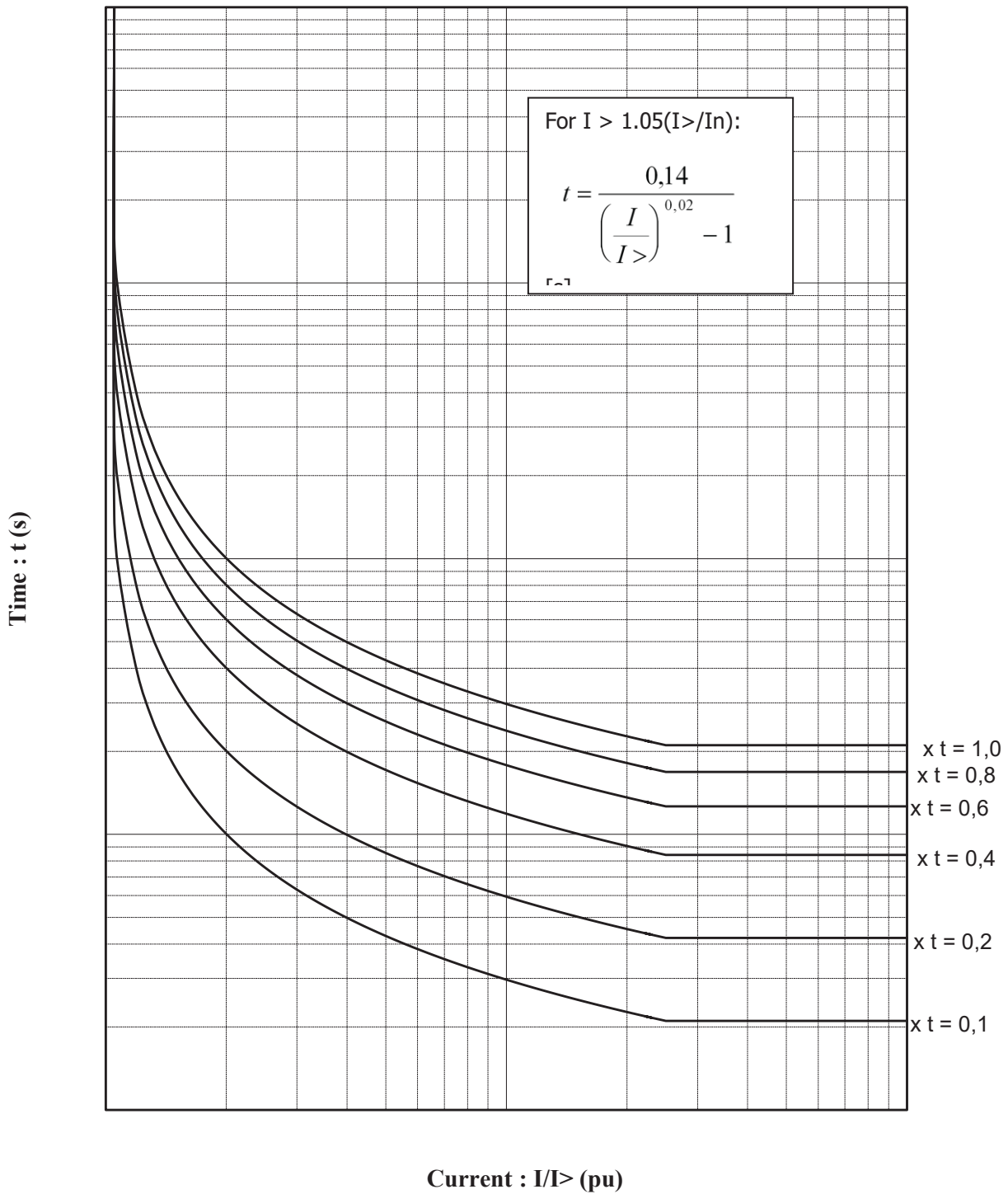
Diagram s 2: Schematics with internal electrical detail

and case terminal layout



STRIKE TECHNOLOGIES (PTY) LTD		FP04-AR TERMINAL LAYOUT & INTERNAL DETAIL			
Driven by Powertech		FP04-B CHANGES FOR FP04-AR			
FILE NAME: FP04-AR Conn & Internal circuits 2011-02-10.vsd	SIZE: A4	FS/CM NO:	DIR/CD NO: FP04-AR 01v00 2011-02-10	REV: 00v00	
Last updated: 10-Feb-11	SCALE: NTS	tornyw	ISHEET	1 OF 1	

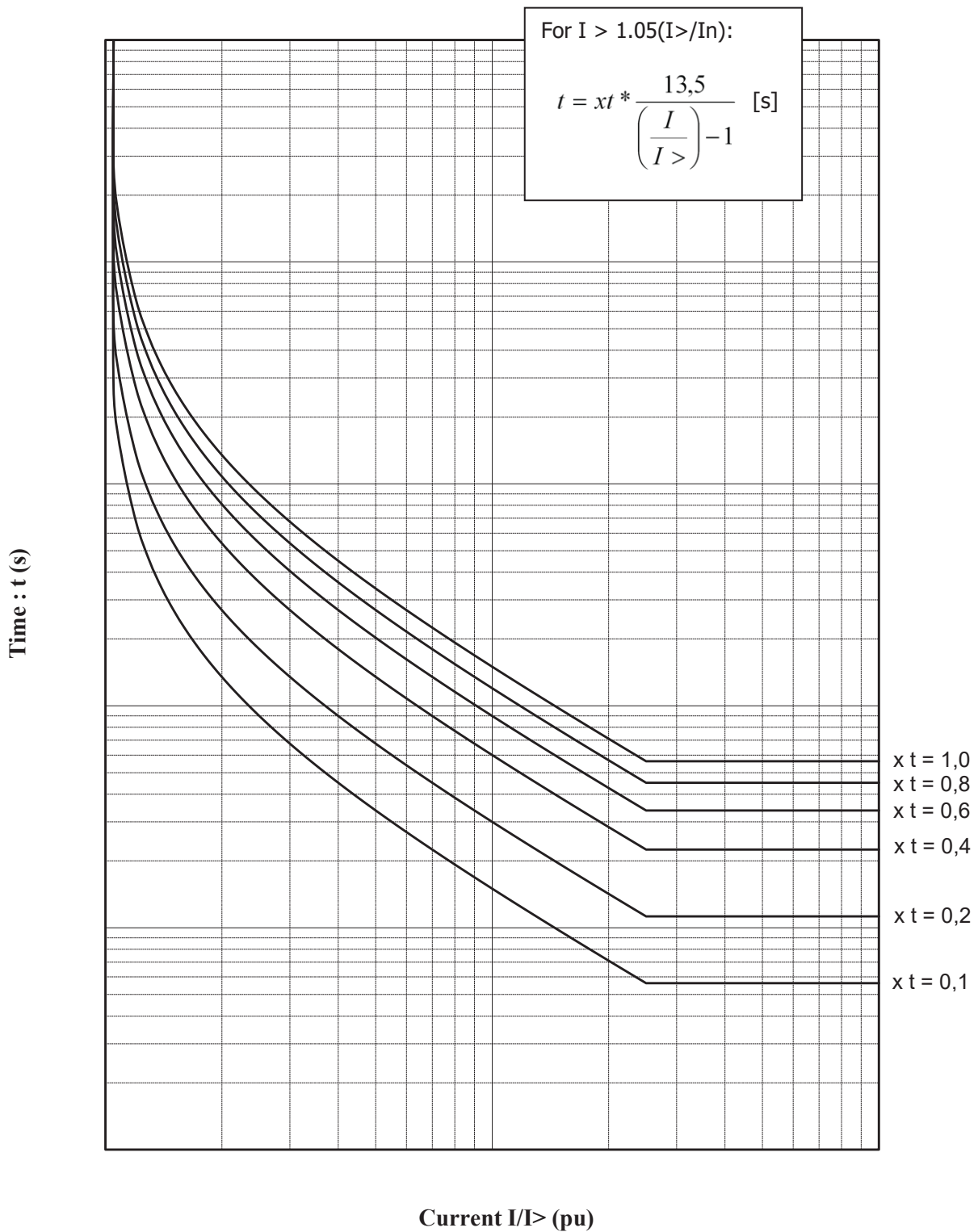
Graph 1: Standard Inverse Characteristic Curves





Electrical Distributors

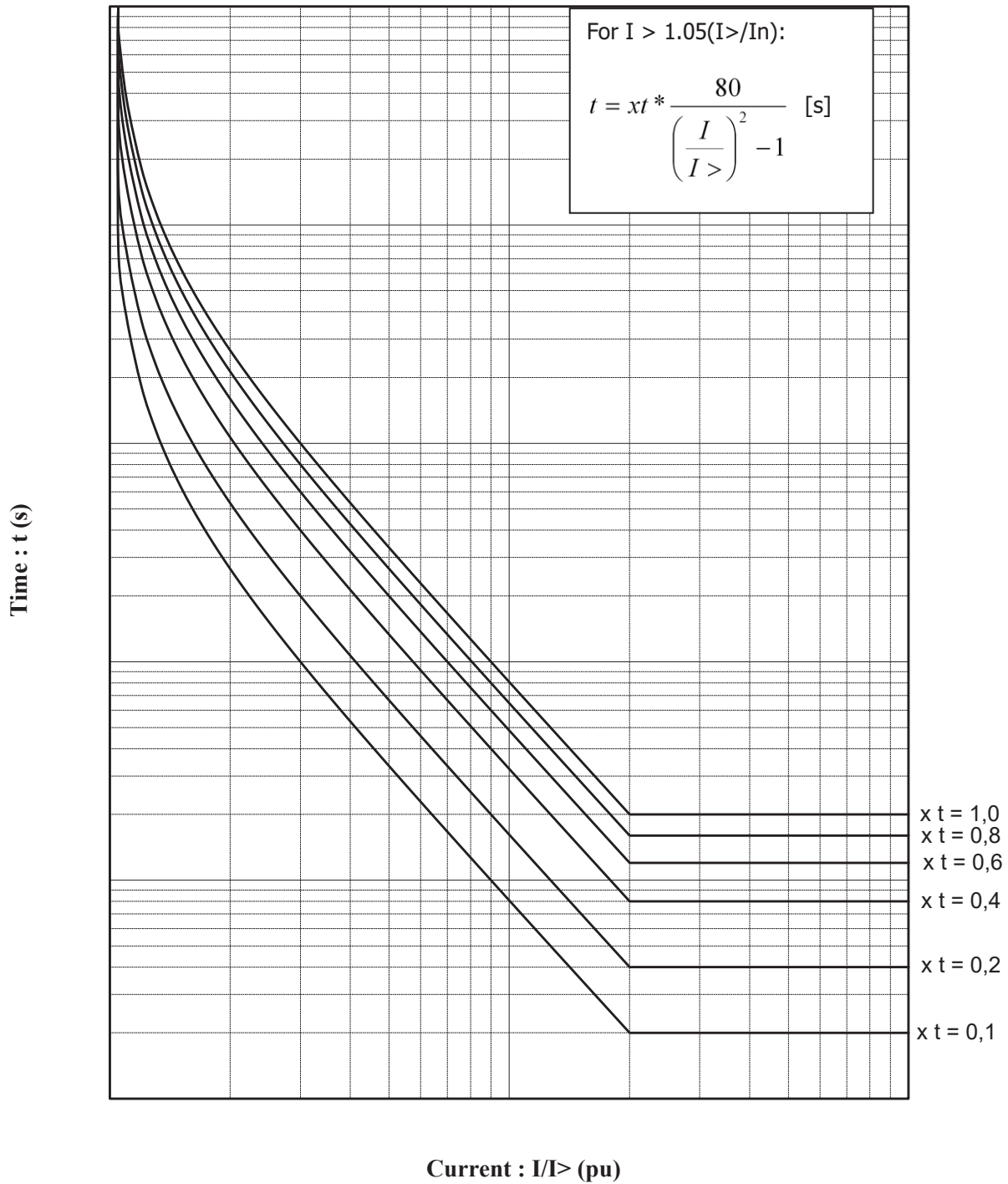
Graph 2: Very Inverse Characteristic Curves





Electrical Distributors

Graph 3 : Extreme Inverse Characteristic Curves

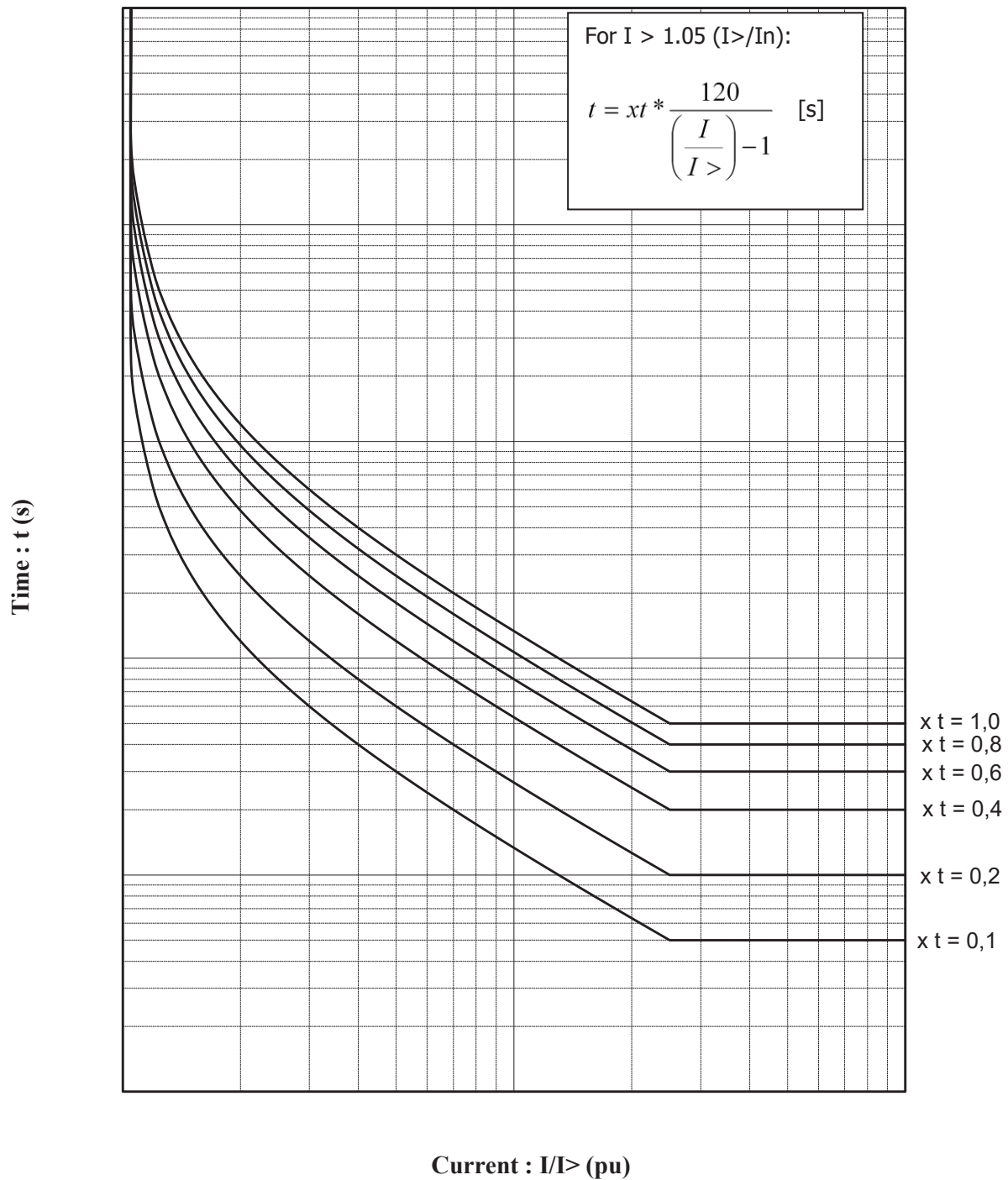




Electrical Distributors

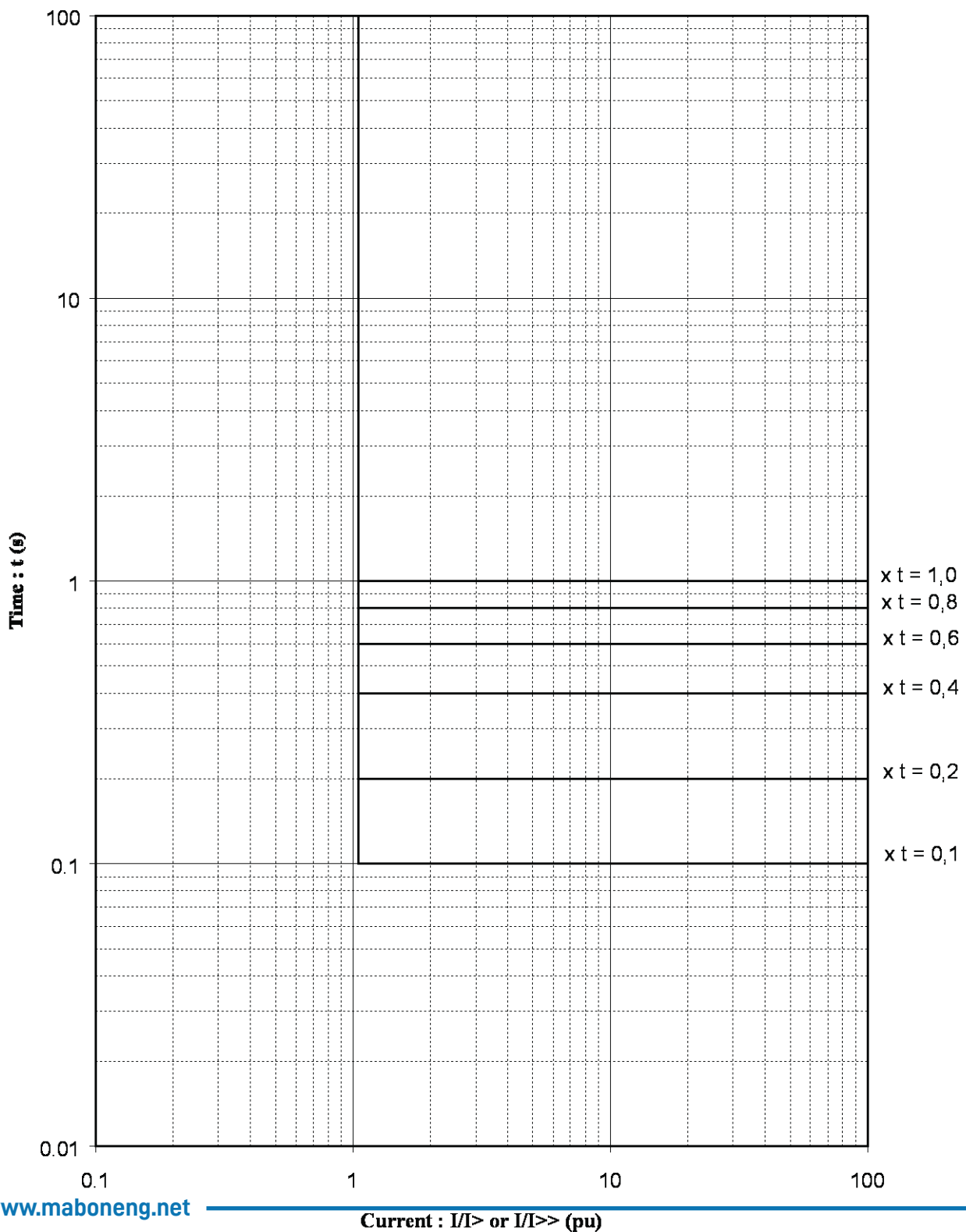
Graph 4 : Long Time Inverse Characteristic Curves

Fig 10 : Long Time Inverse (LTI) Characteristic Curves



Graph 5 : Definite Time Delay Characteristic Curves

Fig 11 : Definite Time Delay (DTL) Characteristic Curves



Strike Technologies, a division of Powertech SA (Pty) LIMITED

Co. Reg No: 2007/015049/07 VAT No: 4200116657

Gauteng Office

59A Roan Crescent, Corporate Park North, Old Pretoria Rd,
Midrand
1685

P O Box 1810
Halfway House
1685

Tel +27 (0)11 635 8000

Fax +27 (0)11 635 8180

Cape Town Branch

Unit 6B, Phumelela Park, Montague Drive,
Montague Gardens
Cape Town

Tel +27 (0)21 528 3640

Fax +27 (0)11 635 8180

www.strike.co.za