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MR-METI31 Directional Relay
Technical Manual

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2. MR-METI Principles

2.1. Area Of Application

The relay type MR-METI is designed specifically for directional control of the overcurrent and earth fault relay type MCGG Retrofit relays. Each relay is provided with adjustable characteristic angle settings, thus making the relay suitable for both phase and earth fault applications.

The combination, of relays types MR-METI and MCGG RETROFIT, are used to ensure discrimination when overcurrent protection is applied to parallel feeders, ring mains, parallel transformers and transformer feeders.
The voltage polarised version, when applied as a phase fault relay is generally used in the quadrature connection with a relay characteristic angle setting of 30° or 45° (current lead) which will result in system characteristic angles of 60° or 45° respectively, where the line current lags the phase-neutral voltage. When used for earth fault applications, the

polarising voltage is supplied by a 3-phase voltage transformer tertiary winding and a relay characteristic angle of 45° or 60° (current lag) is used for solidly earthed systems and 0° for resistive earthed systems.

The dual polarised relay is used for earth fault applications where there is a power transformer available with an earthed neutral and the polarising current is supplied by a current transformer in the neutral connection. The dual polarised relay can work satisfactorily with either or both voltage polarising and current polarising inputs connected to the relay.

2.2. Description

The type METI relay comprises a plug- in relay with a case and cover, see Appendix 1 for dimensions. To ensure that current transformer connections cannot be open circuited when the module is being withdrawn from case, short-circuiting contacts are mounted on the case terminal block. These are actuated by a barrier on the module terminal block.

When used with the type MCGG retrofit relay, the output contacts of the METI relay close for faults in restrain direction and inhibit the operation of the overcurrent relay

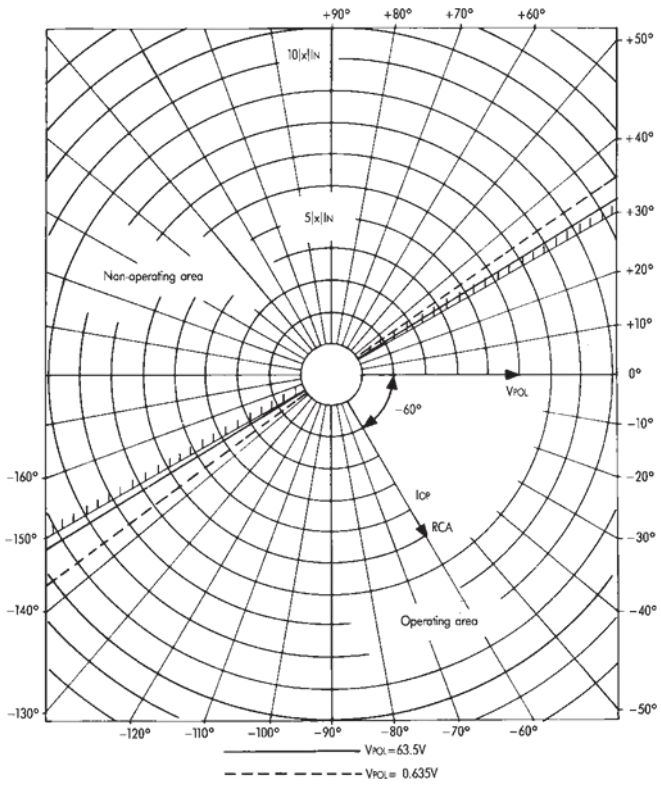
The MR-METI 31 is made up of 3 units combined into 1 chassis as shown below, the left-hand unit monitors the red phase, middle unit monitors the yellow phase and the right-hand unit monitors the blue phase.

Each of the 3 units have their own individual LCD and programming buttons, which allows the user to program each individual unit's settings, the unit's also have their own Front USB port and status LEDs

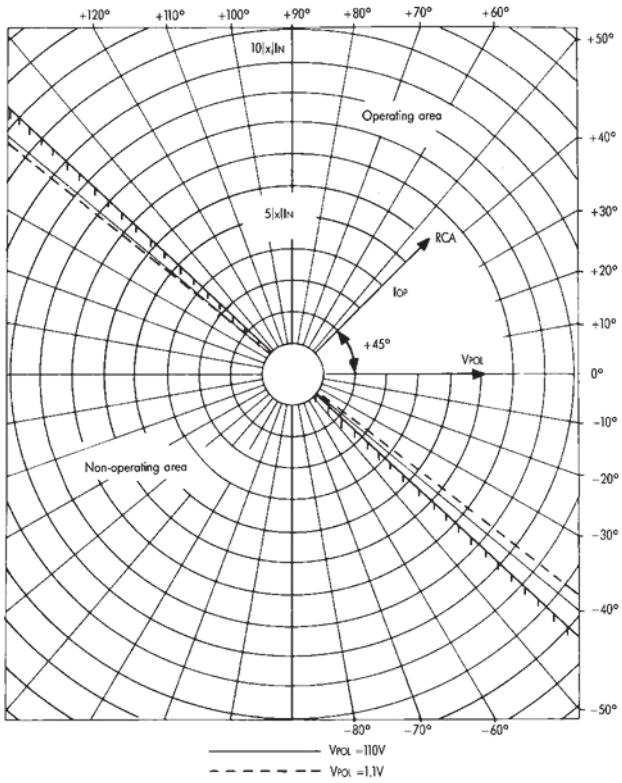
Red Phase Yellow Phase Blue Phase

2.3. Principle of operation

Examples



Typical characteristics of earth fault voltage polarised unit relay characteristic angle = -60’



Typical characteristic of phase fault voltage polarised unit. Relay Characteristic angle = +45’

3. Technical Specification.

Power Supply.

AUXILIARY POWER SUPPLY & LOW VOLTAGE POWER SUPPLY	
AC Nominal	Range 80 – 265V AC / DC Range 24V AC / 24-48V DC (Low Voltage Power Supply Optional Extra)
Frequency	45 - 65 Hz
Maximum Power Consumption	10VA, 15VA Nominal

Measurement.

PHASE CURRENT MEASUREMENT	
Method	True RMS, Sample time <1ms
Range	0.1 to 20x Phase CT Primary Amps
Full Scale	20 x Phase CT Primary Amps Setting
Accuracy	± 3% at Phase CT Primary amps
VOLTAGE MEASUREMENT	
Method	True RMS, Sample time <1ms
Range	1V – 130V AC
Minimum Reading	1% of VT primary
Display Accuracy	± 3%
VT Burden	0.01 VA

Protection Functions.

TIME DELAYS	
Accuracy	± 25ms
Total Run Time	0.1 to +0.2 sec. for less than 1 second or ± 2%

Relay Contacts Ratings.

OUTPUT RELAYS	
Rated Load	10A @ 250 AC 10A @ 30V DC
Maximum Breaking Voltage	250V AC
Max Making Current (max. 4s at duty cycle 10%)	35A
Max Breaking Capacity AC	2500VA
Max Breaking Capacity DC	600mA @ 110V DC 100mA @ 220V DC

4. Environmental Tests.

CLIMATIC	TEST STANDARD	SEVERITY LEVEL
Temperature Dry Cold Operational	IEC 60068-2-1	-20 deg C,96 hrs
Temperature Dry Cold Transportation & Storage	IEC 60068-2-1	-40 deg C, 96hrs
Temperature Dry Heat Operational	IEC 60068-2-2	+60 deg C, 96 hrs
Temperature Dry Heat Transportation & Storage	IEC 60068-2-2	+85 deg C, 96 hrs
Damp Heat Steady State	IEC 60068-2-30	95% Non-condensing, Cyclic Test Db
Enclosure	IEC 60529	front IP52, rear IP00
MECHANICAL		
Vibration	IEC 60255-21-1	Class I
Shock & Bump	IEC 60255-21-2	Class I
Seismic	IEC 60255-21-3	Class I
ELECTRICAL		
Insulation resistance	IEC 60255-5	500 Vdc, 5 secs
Dielectric Test	IEC 60255-5	Series C of table 1 2.5 kV CT Inputs 50Hz, 1 min 2.0 kV all other inputs, 1 min 1.5 kV open contacts, 1 min
High Voltage Impulse	IEC 60255-5	5 kV peak 1.2/50uS,0.5J 3 pos, 3 neg
Voltage Dips, Short Interruptions & Voltage variations immunity	IEC 60255-11 IEC 61000-4-11	3 dips & 3 interruptions at 10 sec intervals of duration between 10mS and 500mS at zero crossings. Variations 40% &70%
Ripple in dc supply	IEC 60255-11	12% ac ripple
VT input Thermal Withstand		120% Vn, continuous
CT input Thermal Withstand		250xIn half wave,100xIn for 1 second 30 x In for 10 second, 4 x In cont.
ELECTROMAGNETIC COMPATIBILITY		
Electrical fast Transient/Burst	IEC 60255-22-4 IEC 61000-4-4	Class IV -4.0kv Power supply Class IV -4.0 kV Other inputs 1 min each polarity
Oscillatory Waves 1 Mhz Burst	IEC 60255-22-1	Class III Longitudinal 2.5 kV, 2sec Transverse 1.0 kV, 2 sec
Electrostatic Discharge	IEC 60255-22-2	Class IV 8 kV contact 15kV air discharge, 10 discharges at 1 sec intervals
Conducted Disturbance RF fields	IEC 61000-4-6	0.15 to 80 Mhz Severity Level 10Vrms +sweeps 0.05-0.15MHz & 80-100MHz
Radiated e-m field from digital portable telephones	ENV 50204	900 & 1890mhz at 10V/m
Radiated RF e-m field immunity test	IEC 60255-22-3	Class III test method A +sweep 500-1000mhz or IEC 1000-4-3 80-1000mhz severity 10V/m 80% modulated 1 kHz
Surge Immunity	IEC 61000-4-5	4kV common mode 4kV differential mode, 1.2/50uS
Power Frequency Magnetic Field	IEC 61000-4-8	1000A/m for 1 sec 100A/m for 1 minute
Pulse Magnetic Field	IEC 61000-4-9	6.4/16uS, 1000A/m
Damped Oscillatory Magnetic Field Immunity	IEC 61000-4-10	0.1 & 1.0 Mhz, 100A/m
Conducted & Radiated RF Interference Emission	EN55022 or EN55011or EN50081-2	Class A interference limits
Power frequency conducted immunity, common mode	IEC 61000-4-16 IEC 60255-22-7	DC to 150kHz sweep test level 4 300V at 16 2/3 & 50/60Hz

5. Inputs and Outputs.

5.1. Power Supply Live.

The MR-METI 31 requires a permanent AC or DC Voltage to supply the unit as specified by the relay rating label, terminal 13 being positive and terminal 14 being negative. This auxiliary live is also used as the source voltage to power the digital inputs.

The MR-METI 31 can also be fitted with a Low Voltage Power Supply (PSU) and Low Voltage digital inputs

Note: If the primary system frequency is 60Hz, then this should be stated when placing the order otherwise the unit will only be calibrated for 50Hz.

5.2. Voltage

The MR-METI 31 has provision to allow connection of standard single-phase voltage transformers with typical secondary voltage of 100V or 110V ac.

5.3. Current Transformer Inputs.

The MR-METI 31 has provision to allow connection of standard protection class 1 amp or 5 amp secondary rated current transformers with 1-2.5VA.

5.4. Output Relays.

The MR-METI 31 is provided with 3 Fixed output relays set to IArd Trip see section 7.5.2

5.5. RS485 Rear Port.

The RS485 port utilises a half-duplex RS485 protocol allowing up to 32 units to be daisy-chained together with a single shielded twisted pair cable.
The MR-METI 31 provides high-speed data acquisition to supervisory computers to form a complete Feeder management system.

The host system can interrogate the unit to monitor Feeder status, historical data and fault data as well as control functions, such as reset of fault / alarm conditions. Setting parameters may also be changed or read.

The MR-METI 31 is available with P&B network gold (P&B protocol) installed for use with the Xcell Data Concentrator for fully Integrated Protection, Control & Monitoring Systems with full dual redundancy or with a Slave implementation of Modbus RTU protocol for small systems and direct Modbus access to devices where data concentration is not required.

5.6. RS232/USB Front Port.

The front mounted RS232/USB port allows access to historical and running data without disturbing the rear RS485 network. This port can be used for direct programming.

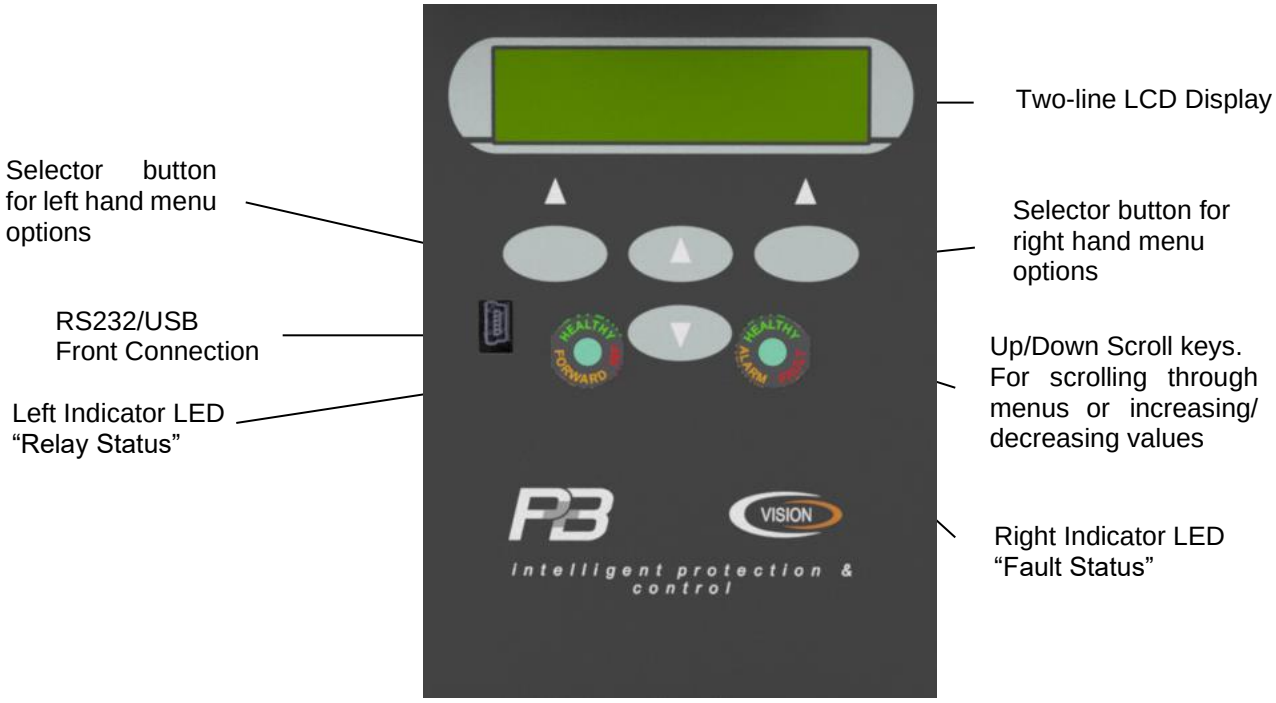
6. Faceplate Functions.

The MR-METI 31 faceplate has been designed to provide an intuitive easy to use display allowing access to all the required information an operator would require.

This is achieved by using tri colour LED indications and an LCD display driven by 4 function keys.

The concept eliminates the need for additional indication devices on the front of the motor starter panel such as Lamps, Ammeter, Voltmeter, Hours Run Indicator, Operations Counter, etc. Helping to reduce the overall cost of the feeder panel and giving improved reliability by the reduction of separate components.

6.1. LED Status.



The LED's operate as below*:

LED Colour	Left Hand LED – Relay Status	Right Hand LED – Fault Status
GREEN	Healthy	Healthy
AMBER	Forward	Alarm
RED	Internal Relay Fault	Fault

7. LCD Display.

The MR-METI 31's interface is fundamental to the philosophy of the Vision relay family of devices. The screen provides access to all dynamic and historical data and protection parameters.

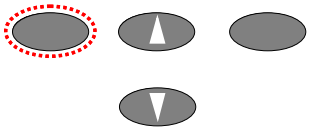
7.1. Menu Screens.

SV100-MR-METI11 SW Version **x.xxx**	Id 0.0A Hlth MENU

Upon powering up the MR-METI 31 the self-supervision feature is active, to check for errors during the start-up sequence See Section 10, then the software version screen appears for a few seconds. The screen shows the software version and the unit type, which should be noted in all correspondence regarding the relay.

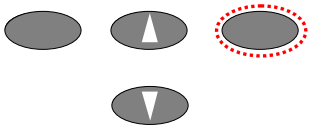
After the Introduction screen disappears then the initial display scroll page appears.

The four push buttons are used to navigate to areas of the menu structure.
Using these soft-keys provides for a very easy to use environment to effectively navigate the entire menu system.

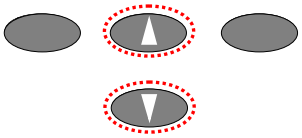


Any description in the LCD window appearing to the LEFT in CAPITALS can be selected using the left-hand push button.

Any description in the LCD window appearing to the RIGHT in CAPITALS can be selected using the right hand push button.



The centre push buttons are used to scroll the LCD window to display different menu prompts or data.



Whilst the MENU prompt remains to the bottom left portion of the LCD, the up and down push buttons can be used to select different pages of measured or status data, this is referred to as display scroll.

Any one of those display scroll pages can be selected as the default page, meaning if the unit is left in a sub menu – it would automatically return to the pre-selected page within the display scroll after an adjustable period of time

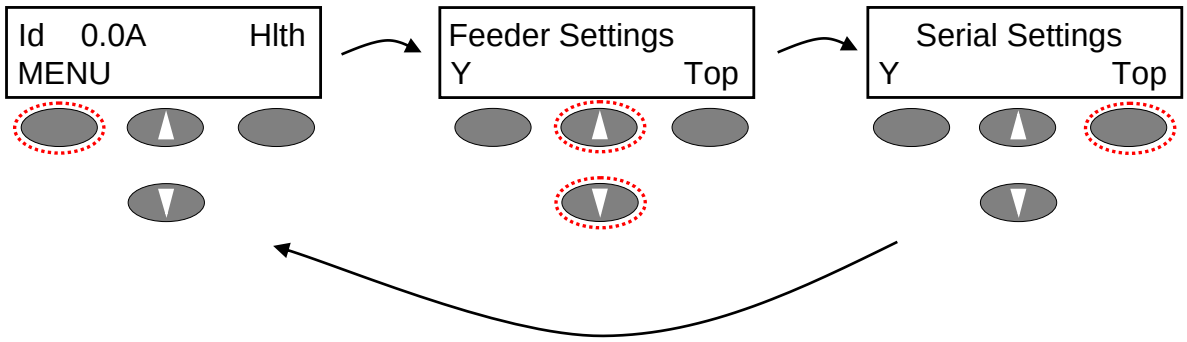
7.2. Display Scroll.

Examples of the Display Scroll screens.

Id 0.0A Hlth MENU	Vd 0V Hlth MENU	AFd 0.0% Hlth MENU	DI1 OFF MENU
DI2 OFF MENU	Tr Normal MENU	AI Normal MENU	IRF 0 Hlth MENU

Selecting the <MENU> button allows access into the sub menu and settings structure. The <UP> and <DOWN> buttons scroll through each sub menu heading.

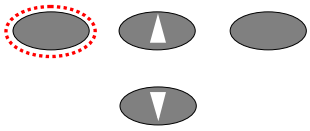
The left button selects entry to each level. The right button <TOP> restores the screen to the display scroll and menu prompt.



7.3. Feeder Settings.

```
Feeder Settings
Y                Top
```

```
CT Primary
Y      100A      N
```



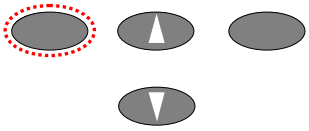
This screen allows access to the Feeder Settings of the relay. The CT Primary can be viewed and set.

The list of values that are available to be changed can be scrolled through by pressing the UP and DOWN buttons.

A value can be selected to have its value changed by pressing the Y button when the value is highlighted. This then brings up the VALUE CHANGE SCREEN

```
CT Primary
Y      100V      N
```

```
Data =     00010
Save            Next
```



The Value Change pop-up allows you to alter settings in specified steps within the minimum and maximum values of the particular setting range. The UP and DOWN arrow buttons are used to alter the value. The Next function is used to skip along to the next character. Save is pressed to store the new value and exit.

If an undesired value is inserted incorrectly use the Next button to skip past the last character to the left. The Save option button now operates as a Discard to dump the new value without saving – reverting back to the original value on initial selection.

CT Primary.

This setting allows the user to program the primary current rating of the protection class current transformer used to measure the phase fault current

VT Primary.

This setting allows the user to program the primary voltage rating of the voltage transformer.

VT Secondary.

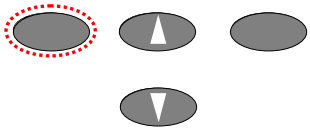
This setting allows the user to program the secondary voltage rating of the voltage transformer.
The VT Primary and Secondary should be set to the same value if directly connecting the voltage input without a step-down transformer.

7.4. Serial Settings.

```
Serial Settings
Y                Top
```

```
Serial
Y      Enabled    N
```

This screen allows the configuration of the communication ports.



Serial Enabled / Disabled.

This setting allows the user to enable the MR-METI 31 serial communications port. This setting must be set to 'Enable' if communication with the relay through any serial link is required.

Drive Number.

This setting range 1 to 32, with a default setting of 1, identifies the MR-METI 31 unit to the Xcell unit (or any Master device connected to the Data highway) to which the RS485 port is connected.

RS485 Baud Rate.

This setting allows the user to configure the appropriate communications baud rate such that the MR-METI 31 can communicate effectively on the Data Highway to which it is connected.

RS485 Protocol.

The RS485 serial communications port may be configured to operate using a slave implementation of Modbus RTU® or P&B Engineering's own protocol "P&B Standard"

RS485 Parity.

This setting allows the user to set the parity to match that of the host system on the serial link. The options are "Odd", "Even" and "None".

RS232/USB Baud Rate.

This setting allows the user to configure the baud rate for the front mounted RS232/USB port.

RS232/USB Protocol.

The RS232/USB serial communications port may be configured to operate using Modbus RTU® or P&B Engineering's own protocol "P&B Standard".

RS232/USB Parity.

This setting allows the user to set the parity to match that of the host system on the serial link. The options are "Odd", "Even" and "None".

Serial Delay.

The MR-METI 31 may be configured to respond to a request for information from the serial port instantly or after a designated delay.

A communications delay may be beneficial to ensure the Master device on the Data Highway receives all information sent back by the MR-METI 31 without enduring data collisions on the network.

Fast Scan 1 to 3.

A Fast Scan is a system used when operating in conjunction with the XCell Data Concentrator. As the XCell polls relays attached on its network, the Fast Scan settings allows the user to select important data to be read at a quicker rate.

The data on the communications link is broken into Fast Scan Data (or Process Critical Data) and Slow Scan or Full Read Data (Electrical Engineering Data).

The configuration of Fast Scan is not necessary unless the MR-METI 31 in used in conjunction with the XCell unit.

Each Fast Scan number can be programmed to export important data when requested. This number references an internal address in MR-METI 31 and allows configurable data mapping between units.

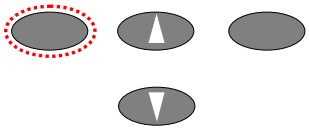
Max Scan Time.

This setting need only be used in order to limit the amount of data traffic on a RS485 network. Dynamic data can change rapidly, this setting allows the MR-METI 31 to limit the number of updates it makes to its Fast Scan values.

7.5. I/O Settings (Input / Output Settings).

```
I / O Settings
Y                Top
```

```
Digital 1
Y     Reset FaultN
```



The I/O settings are where the 2 digital inputs are shown but are not programmable on the MR-METI and 3 relay outputs that are fixed.

7.5.2 Relay Outputs

The MR-METI 31 provides 3 relay outputs which are fixed to IArd Trip

RLY Red Ph Terminals 1 & 2 will energise once the protection setting IArd is set to trip and the trip requirements have been met on the red phase.

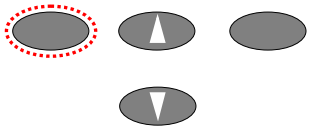
RLY Yellow Ph Terminals 3 & 4 will energise once the protection setting IArd is set to trip and the trip requirements have been met on the Yellow phase.

RLY Blue Ph Terminals 5 & 6 will energise once the protection setting IArd is set to trip and the trip requirements have been met on the Blue phase.

7.6. System Settings.

```
System Settings
Y              Top
```

```
Password
Y    ENABLED   N
```



This screen allows access to relay specific settings. Such as, password functionality, screen contrast settings etc. and non-categorised relay settings.

These settings and their functions are explained in detail below

Password.

If the password is set to enabled the default password (6363) may be used to change setting and reset statistical data. If the password has been changed then the new password must be used.

Engineering Password

If enabled the Engineer Password will allow access using the standard password. Generally, if a password is requested a prompt will offer ‘AAAAA’, changing the second A to a B ‘ABAAA’ allows access.

Change Password.

The MR-METI 31 default password is '6363'. It is recommended for security purposes this password be changed. The password may be up to 6 characters long and alphanumeric if desired.
If the User Password is lost and the Engineers Password has been disabled the only options to retrieve the password are to either read the information via the serial link or execute a Configuration Reset on the relay to restore all of the factory defaults see appendix 5.

Contrast and LCD Backlight.

These functions allow the user to change the display contrast and backlight levels.

Set Default Page / Default Return Time.

Any of the display scroll data pages can be nominated as the default page and returned to after a set period of key press inactivity.
To set the page; select the required page in the main display scroll menu then enter the system settings menu and select ‘set default page’.

Time Sync Delay.

The MR-METI 31 can be time synchronised by either Chronovision which is a GPS based device which sits on the RS485 network and synchronises the time and date of each connected unit, or via broadcast command on the daisy chained RS485 Modbus network. This delay prevents immediate updating of the Relay real time clock (RTC).

Software Version.

Displays the operating firmware loaded on to the unit. This should be noted along with the serial number when corresponding about this equipment

Serial Number.

Displays the Serial number of the Relay.

Enable Disturbance

In order for some functions to operate a unique activation code is required to access hidden menu screens, The Disturbance Recording facility requires unique activation codes to operate.

Time and Date.

These functions allow the user to set the date and the time on the relay.

Chronovision

When enabled allows the real time clock to be updated via the broadcast GPS sync signal from Chronovision.

Screen Saver and Screen Saver Time

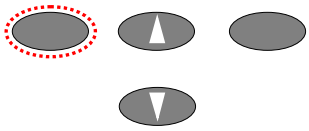
To help extend the life of the LCD we can power the display down if the application suits. The screen will power down after the set time from the last key press. The MR-METI 31 will still operate and can be remotely controlled via digital inputs or the serial interface.
On any key press or active fault, the display will re-activate the backlight.

7.7. Protect Settings.

```
Protect Settings
Y                Top
```

```
>IAd      Action
Y     DISABLED   N
```

This sub menu allows the user to configure all of the current based protective functions:



DISPLAYED:	FULL DETAIL:
>IAd.	Directional Overcurrent
SerTmout	Serial Timeout
Intnl Err	Internal Error

Each function can be set to Alarm and / or Trip and / or Block or left as an unused function, disabled. The reset for the protective function is configurable as are the trip levels and trip times.

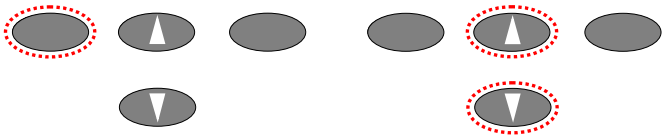
The protective function actions are as follows:

Disabled	Protection Disabled
Alarm	Alarm Enabled
Trip	Trip Enabled
Alarm & Trip	Alarm & Trip Enabled

```
>IAd      Reset
Y     DISABLED   N
```

```
DATA=DISABLED
Save        Discard
```

The reset options are as follows;
Using the UP and DOWN keys the data can be changed to one of the following;



Panel	Panel reset only
Serial	Serial reset only
S P	Serial or Panel reset
AUTO	Auto reset

Each protection function is configurable independently of the others. The available action, the type of reset, the various threshold levels and trip timers for each and every protection function can be found in section 7.7.
This section describes in detail what each function does and how it operates.

Function.

If a particular function is required for a protective use it should be selected and set to the required action.
If a particular function is not required it should be left disabled. The display will show DISABLED next to the function name. If a function is disabled then the threshold level and trip times will not impact the activity of the relay.

Alarm.

An Alarm is considered as a high-level function. If the function activates it will be recorded as part of the alarm history and cause MR-METI 31 to enter an alarm state; the alarm fault will be displayed in the main display scroll page and the right-hand LED will give an alarm indication (amber colour).
If an output relay is set as Alarm it will change state with the fault.

Trip.

A Trip is considered as a high-level function. If the function activates it will be recorded as part of the trip history and cause the MR-METI 31 to enter a trip state; the fault will be displayed in the active faults page and the unit will automatically display that page, the right-hand LED will give a Trip indication (red colour).
If an output relay is set as Trip it will change state with the fault.

Reset.

The configuration of the reset allows that particular protection function to be cleared or reset to a healthy condition providing the condition that caused the fault, alarm or inhibit has been removed.

Auto Reset.

This option, when enabled, automatically resets the fault when the situation that caused the trip has been removed. If Auto Reset is selected the other reset options are not required.

Panel-Reset.

This option, when Enabled, allows a reset of a fault to be carried out from the front panel of the relay. A reset button will be displayed in the top right-hand corner of the main display scroll page, if any fault has been removed and is enabled for a panel reset.

Serial-Reset.

This option, when Enabled, allows a reset of a fault to be carried out through the serial communication port of the relay.

7.7.1. Reverse-Directional Overcurrent Fault (IArd)

The MR-METI 31 can be configured to trip for Reverse-directional overcurrent, the determination of the direction is based on measuring the angular displacement between the phase current and an auxiliary voltage quantity, formed from the opposite phase to phase voltage by rotating it see section 2.3 for more information.

IArd Trip Level

The MR-METI 31 may be configured to trip and alarm as a result of a reverse-directional Overcurrent condition. The Directional Overcurrent action will occur when the current surpasses the programmed Charact. Angle level and the voltage and current is within the area of operation see section 2.3.

7.7.2. Serial Timeout (Ser Tmout)

The MR-METI 31 can be used to trip or alarm upon a loss of communication. The Serial Timeout function is only applicable to the RS485 communication port. The MR-METI 31 is a slave device and will respond to serial requests. If a serial request from the master communication device is not received within the serial time out trip time period, then the serial timeout function will be activated.

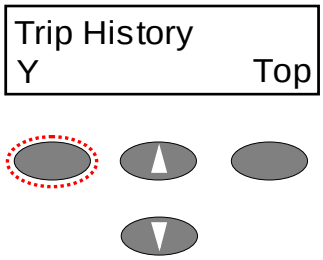
Serial Timeout

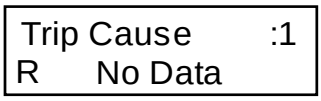
This setting is the amount of time that needs to pass with no communication before the unit actions.

7.7.3. Internal Error (Intnl Err)

The MR-METI 31 incorporates an internal software and hardware watchdog feature to monitor the integrity of both on board hardware and software systems. This feature may be configured to indicate as a result of any registered problems. If a problem with the hardware or software is located during the error check routines the MR-METI 31 will generate an error code (or diagnostic status). Further information related to the internal error monitoring can be found in section 10.

7.8. Trip History.



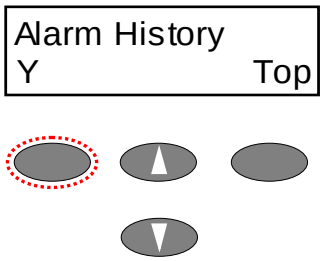


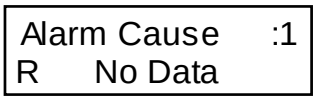
This screen allows access to the relays Trip History data. Up to 32 Trip events can be registered in this menu screen, starting with the most recent to last available (32nd most recent trip).
Each event record contains the Trip Cause, the Trip Time and Trip Date.

The up and down pushbuttons allow each trip record to be scrolled through. In the left-hand corner of the LCD a letter 'R' is shown, this allows the reset (deleting) of individual trip events.

To reset a particular event, scroll through the available trip records until the event you require is reached, then press the left-hand pushbutton under the letter 'R' shown on the LCD. The trip event will now be reset. Only press this once otherwise multiple events could be accidentally reset with continual pressing, each trip record will take a few seconds to delete and update on the LCD.

7.9. Alarm History.



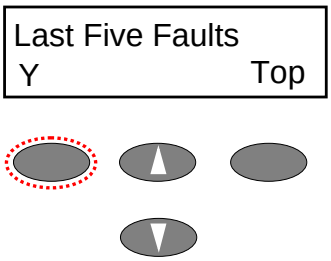


This screen allows access to the relays Alarm History data.
Up to 32 Alarm events can be registered in this menu screen, starting with the most recent to last available (32nd most recent alarm).
Each event record contains the Alarm Cause, the Alarm Time and Alarm Date.

The up and down pushbuttons allow each trip record to be scrolled through. In the left-hand corner of the LCD a letter 'R' is shown, this allows the reset (deleting) of individual alarm events.

To reset a particular event, scroll through the available alarm records until the event you require is reached, then press the left-hand pushbutton under the letter 'R' shown on the LCD. The alarm event will now be reset. Only press this once otherwise multiple events could be accidentally reset with continual pressing, each alarm record will take a few seconds to delete and update on the LCD.

7.10. Last Five Faults.



This screen allows access to the relays last five fault data information. This will be the most recent trip and alarm events. Information given in this screen is more detailed than that of the Alarm and Trip History pages. To scroll through the available data, use the up and down pushbuttons on the front plate of the relay to scroll through the last trip and alarm data, and press the left-hand pushbutton to scroll through faults 1 to 5. The information provided for both last trip and last alarm is as follows:

Trip Cause	Alarm Cause
Trip Time	Alarm Time
Trip Date	Alarm Date
Trip Current Channels:	Alarm Current Channels:
(Id, Vd, AFd)	(Id, Vd, AFd)

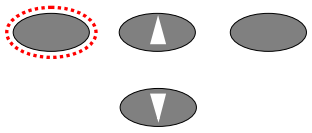
7.11. Calibration Menu.

The calibration menu should not be entered unless it is absolutely necessary to do so.
Any inadvertent settings made here may compromise the accuracy of the unit and its ability to trip.

If the Password is set to enabled, the password will be requested here to allow read only access to the majority of this menu. However, the frequency setting can be changed.

```
Calibration Menu
Y                Top
```

```
Password:■AAAAA
Save            Next
```



The gain and offset values for each of the analogue channels can be adjusted. Auto calibration routines can also be performed.

Each unit is calibrated prior to dispatch and a signed test report is issued.

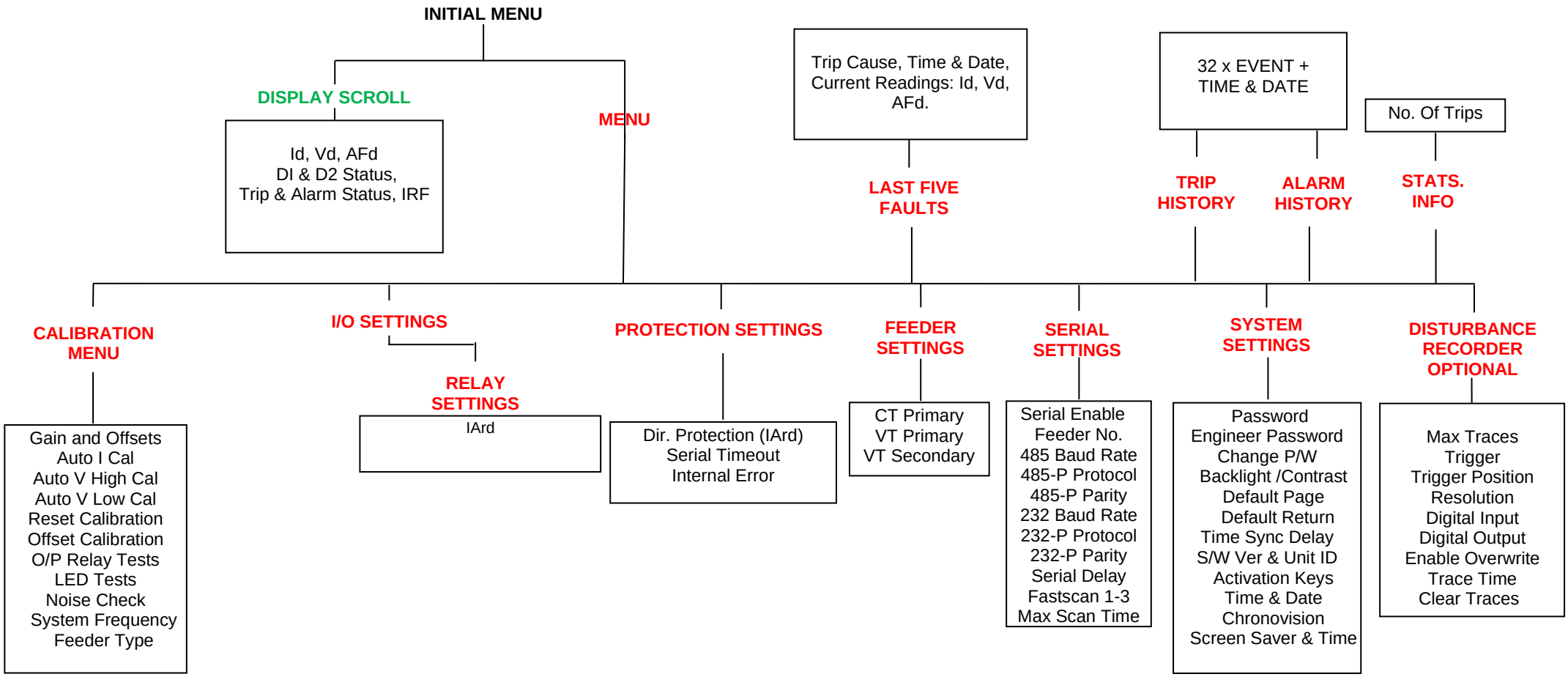
If users require access to the calibration menu to re-calibrate the device, a unique password must be obtained from P&B Protection Relays. The serial number of the unit will be required to do this.

In addition to the calibration of analogue inputs the Calibration Sub Menu provides some useful diagnostic tools. After entering the password, the Calibration Sub Menu will be displayed and allows access to the following settings:

Gain and Offsets for each analogue channel.	Typically, a gain value is between 900 to 1200
Auto I Cal*	Allows calibration of current channel, contact P&B for procedure.
Auto V High Cal*	Allows calibration of voltage channel, contact P&B for procedure.
Auto V Low Cal*	Allows calibration of voltage channel, contact P&B for procedure.
Reset Cal Factors*	Reset the calibration to default, gain=1024
Run Offset Cal *	Without any injected input, this sets all channels to 0.
Digital Inputs	Check of the binary digital input status
O/P Relay Tests*	Output relays can be forced to changed state
LED Tests	Allows Tri- colour LEDs to be checked
Noise Check	View the noise level readings per channel
System Frequency	Corresponds the relay to the frequency of the measured system.

*** Unique password required to make setting visible.**

8. Menu Tree Structure.



9 MR-METI 31 Setting Sheets

9.1. MR-METI 31 System Settings Summary.

	Range	Step	Default	User Setting
Serial Settings				
Serial	Enabled / Disabled		Enabled	
Drive Number	1-32	1	1	
RS485 Baud Rate	9600/19200/38400		9600	
RS485 Serial Protocol	Modbus / P&B Std		P&B Std.	
RS485 Parity	Even / Odd / None		Even	
RS232/USB Baud Rate	4800/9600		9600	
RS232/USB Serial Protocol	Modbus / P&B Std		P&B	
RS232/USB Parity	Even / Odd / None		Even	
Serial Delay	1ms-20ms	1ms	1ms	
Fastscan 1	0-255	2	0	
Fastscan 2	0-255	2	0	
Fastscan 3	0-255	2	0	
Max Scan Time	1-30s	1s	2s	
Feeder Settings				
CT Primary	1-5000A	1A	100A	
VT Primary	100-33000V	5V	415V	
VT Secondary	100-110V	1V	100V	
System Settings				
Password	Enabled / Disabled		Disabled	
Engineering Password	Enabled / Disabled		Enabled	
Change Password	5 Characters		6363	
LCD Contrast	0 - 128	5	64	
LCD Backlight	0 - 312	5	156	
Default Return Time	No Return (Off) 1-5min	1min	1min	
Time Sync Delay	0-2000ms	1ms	0ms	
Software Version	X.XXX			
Serial Number	XXXXXX			
Enable Disturbance	XXXXXX			
Date	XX/XX/XX			
Time	XX:XX:XX			
Chronovision	Enabled / Disabled		Disabled	
LCD Screen Saver	Enabled / Disabled		Disabled	
LCD Screen Saver Time	60-3600s	1s	3600s	

9.2. MR-METI 31 Control Setting Summary.

	Range	Step	Default	User Setting
Relay Outputs				
Relay Red Phase	Fixed		IArd	IArd
Relay Yellow Phase	Fixed		IArd	IArd
Relay Blue Phase	Fixed		IArd	IArd

9.3. MR-METI 31 Protection Setting Summary.

Selectable
! Fixed

ANSI No.	Protective Function	Trip	Alarm	Block	Auto	Panel	Serial		Variable	Range	Step
	IArd	#	#	#	#	#	#		Charact. Angle Trip Level	0° – ±60°	0°, ±30°, ±45° or ±60°
	Serial Timeout	#	#	#	#	#	#		Timeout In	1 - 120	1s
	Internal Error	#	#	#	#	#	#				

9.4. MR-METI 31 Blank Protection Setting Summary.

Selectable
! Fixed

ANSI No.	Protective Function	Available Action								Variable	User Setting
		Trip	Alarm	Block		Auto	Panel	Serial			
	IArd									IArd Trip Level	
	Serial Timeout									Timeout In	
	Internal Error										

10. MR-METI 31 Self Supervision

The MR-METI 31 protection relays are equipped with an internal self-supervision software monitoring function. The self-supervision feature is active immediately at power-up, to check for errors during the start-up sequence and during run-time, continually monitoring the relay's hardware and software whilst in service.

The self-supervision within the MR-METI 31 will attempt to report and record any detected faults. Fault status information can be viewed using the HMI operator panel located on the front of the relay or can be accessed via the USB communication maintenance port located on the front of the relay operator panel. Upon detection of a fault, a reboot, if possible, of the relay will be performed in order to try and resolve/clear the detected fault. If the reboot fails to resolve the detected fault, then the MR-METI 31 relay will default to a safe operating mode.

When the MR-METI 31 has entered its safe operating mode the output relays will be inhibited, and it shall not be possible to place the relay back into service until the detected fault has been corrected. The HMI operator panel will indicate an internal error has occurred, by switching the 'IRF' indicator to red and where possible an error message will be shown on the liquid crystal display panel.

Fault codes are stored within the non-volatile memory of the MR-METI 31. Information detailing the fault codes can be accessed via the HMI LCD panel using the trip history fault page or the analogue values page. Fault codes can be retrieved using the USB communication maintenance port located on the front of the relay operator panel.

The self-supervision feature within the MR-METI 31 is designed to check the operation of the hardware and software functions within the relay are performing as designed. The information detailed below is a description of each of the individual check routines and subsequent error codes.

10.1 Power/Start-Up

If a RAM, EEPROM or RTC error is detected during power/start-up sequence, the error message will be shown on the start screen in the following form
"SYSTEM TESTS"
"Ew Rx Cy Fz: ????"

where w="-" if the EEPROM test failed, otherwise, x="+";
x="-" if the RAM test failed, otherwise, y="+";
y="-" if the RTC test failed, otherwise, z="+";
z="-" if the Flash test failed, otherwise, z="+";
"????" is the error code, whose bit definitions are as below: -

D0 (1)	The header data for settings stored in EEPROM corrupted
D1 (2)	CRC check for settings stored in EEPROM is wrong
D2 (4)	The header data for calibration parameters stored in EEPROM corrupted
D3 (8)	CRC check for calibration parameters stored in EEPROM is wrong
D4 (16)	The relay attribute values stored in the EEPROM are wrong
D5 (32)	The block length for the settings stored in the EEPROM is out of range
D6 (64)	The boundary check for the settings failed
D7 (128)	RAM tests failed
D8 (256)	RTC check failed

If there is an error detected during the power-up checks, the testing will be halted, and an error message displayed. To continue checking the remaining functions one of the front panel pushbuttons will need to be pressed.

The internal error function will check if the CRC checksum of the program data stored in the flash matches the FLASH CRC stored in the EEPROM. If mismatch is detected, a "FLASH MEMORY CHANGED" message will be shown and the start-up process halted. To continue with the power-up checking one of the front panel pushbuttons will need to be pressed.

10.2 Online Monitoring

If an error is detected during run-time it will be displayed at the bottom of the LCD screen. The error code functions available during run-time are shown below: -

D0 (1)	Timer 2 - 10ms level not running
D1 (2)	Timer 3 - 1s level not running
D2 (4)	Timer 4 - 100ms level not running
D3 (8)	Timer 5 - 630us level not running
D4 (16)	ADC Response time overrun or no response
D5 (32)	Reserved
D6 (64)	Reserved
D7 (128)	Reserved
D8 (256)	Reserved
D9 (512)	Reserved
D10 (1024)	Reserved
D11 (2048)	EEPROM memory check failed
D12 (4096)	Idle task/Wait loop not running
D13 (8192)	Reserved
D14 (16384)	Reserved
D15 (32768)	Defensive error trapped
D16 (65536)	Watchdog timer overflow
D17 (131072)	Illegal Opcode Detected
D18 (262144)	Stack Under/Overflow detected
D19 (524288)	RAM Online Check Failed
D20 (1048576)	Online Boundary Check for settings Failed
D21 (2097152)	RTC Check Failed
D22 (4194304)	Initialisation Check Failed

If the initialisation Check Fails, the relay will be locked out until the auxiliary power is cycled.
If an online diagnostic error has been captured prior to the last watchdog reset, the relay will automatically be locked out for one minute. If no errors are detected during the one-minute lockout period, then the relay will be restored to normal healthy status once the one-minute lockout period time has elapsed.

If an internal error is detected during the online period a forced reboot of the relay could be triggered by the watchdog timer in an attempt to clear the detected fault.

Appendix 1

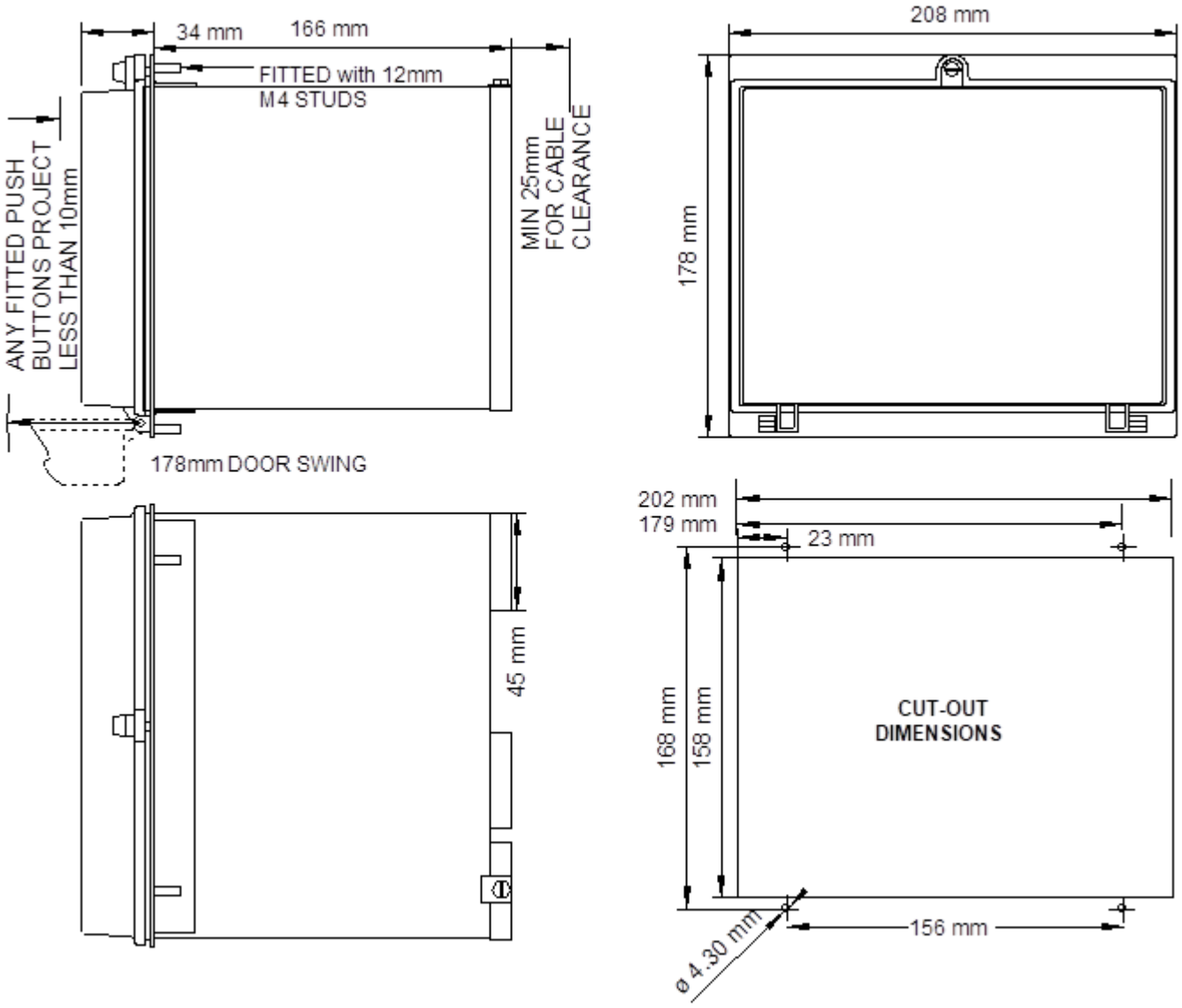
MR-METI 31 Installation.

The MR-METI 31 is supplied in a 200 series withdrawable case suitable for flush mounting as detailed below. The control and CT cable should be stranded copper core of 0.5 to 2.5mm^2.

The rear terminal block accepts both pre-insulated screw and push on blade type connectors. Each terminal having 1x M4 screw type and 2x 4.8mm blade type complying BS5057.

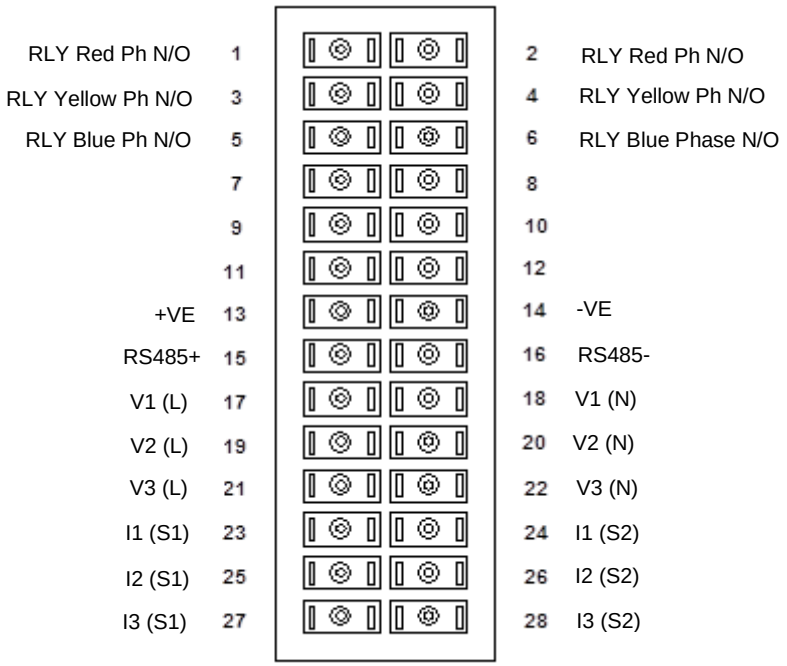
Wiring torque of M4 screw should not exceed: 0.5 – 0.6 Nm
The MR-E has been designed for installation on to open type panels, for use on the flat surface of a type 1 enclosure and for installations where the ambient temperature does not exceed 60^0 C.

200 Series Case Dimensions



Appendix 2

Termination Numbers MR-METI 31

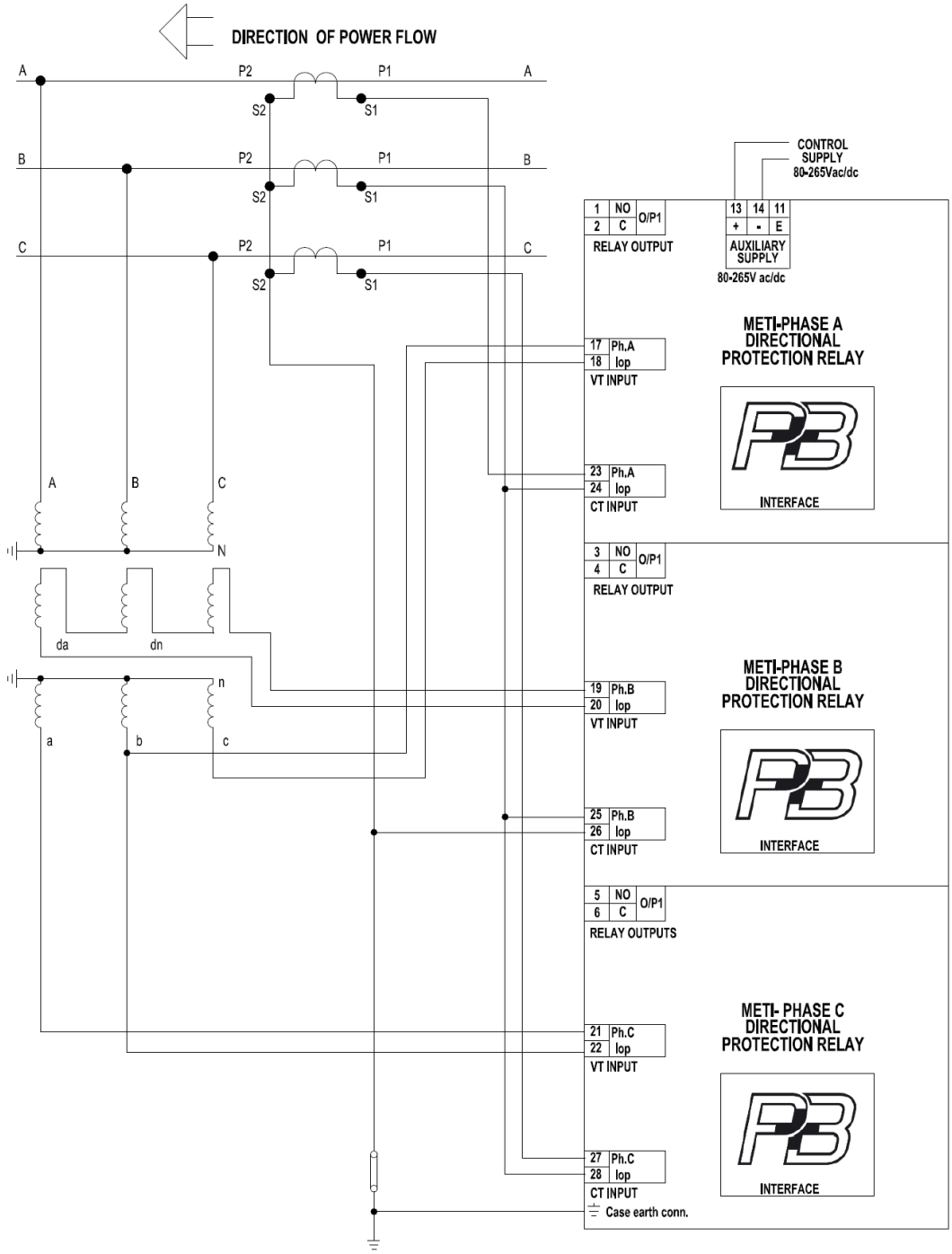


For Sample connections please see Appendix 3

Appendix 3

Connection Example

Example 1. Typical application diagram: Directional relay MR-METI31 Two phase and earth fault



Appendix 4

Abbreviation KEY

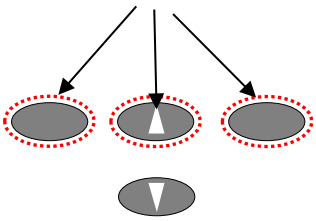
FS	=	Fail Safe
AUX	=	Auxiliary
Intrnl	=	Internal
Trpd	=	Tripped
Alrm	=	Alarm
Hlth	=	Healthy
Ser Tmout	=	Serial Timeout
Ser	=	Serial
DI1	=	Digital Input 1
DI2	=	Digital Input 2
IRF	=	Internal Relay Fault
Vin	=	Measured Voltage Input
Indic.	=	Indicator
Trp	=	Trip
Alm	=	Alarm
ACB	=	Air Circuit Breaker
Fdbk.	=	Feedback
SW	=	Software
Scrn	=	Screen
Stats	=	Statistics
Id	=	Directional Current
Vd	=	Directional Voltage
AFd	=	Directional Angle factor

Appendix 5

Factory Default Procedure

If for any reason the unit is required to be set to factory defaults the following method can be applied.

- Power down the relay unit.
- Press and hold the following three buttons



- Whilst holding the three buttons power the unit back up and the below should be shown on the display to indicate the default values have been installed.

SV100-MR-METI11 Default Values

This is useful if the engineering password has been disabled and password has been enabled and changed from the default password to an alternative which has been forgotten. By defaulting the relay this will re-enable the engineering password and disabled the password option as well as setting the password back to 6363.

All calibration information will **NOT** change during this procedure.

Note the above will have to be carried out on each of the 3 units to fully default the MR-METI relay, hence the MR-METI unit may need powering up and down 3 times to allow each unit to be defaulted.

Appendix 6

Disturbance Recording Activation

If the unit was not purchased with disturbance recording, it is still possible to activate this feature at a later date. To activate the disturbance recording feature after purchasing you must enter a unique password into Disturbance Recording Activation Key menu see section 7.6. The disturbance recording password can be obtained by contacting P&B.

If disturbance recording was purchased when placing the order of the unit this password should already be inputted into the unit prior dispatch by P&B and the password will be indicated on the test certificate for that unit.

Download Disturbance data files using Vision Control 3

Downloading the disturbance data files can be achieved by using Vision Control 3, please contact P&B to obtain a copy of the software, and the Vision Control 3 manual can be obtained via our website http://www.pbsigroup.com/protection-relays/vision-control/

Vision control 3 is a multifunction tool that can be used to download the disturbance data file and using the file downloaded interrogate the data retrieved.

Fault Disturbance Recording

Fault Disturbance Analysis Section allows downloading of Disturbance Record file (Comtrade File) from Relay and a Disturbance Viewer is new featured added as part of Vision Control 3.

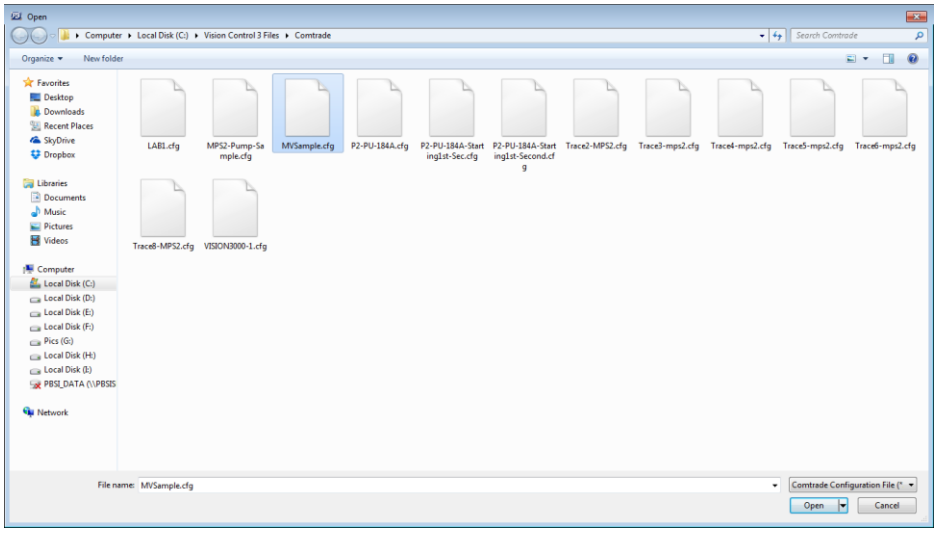
Fault Disturbance Activation is an optional feature in P&B Relays which can be ordered and enabled through a special activation code from P&B.

Disturbance Viewer

Disturbance Viewer is a comprehensive tool to View Disturbance data from P&B Relays. The Data is arranged in a simplified manner with all the analog curves displayed first and Digital signals displayed at bottom and eac trace can be scrolled up and down.

Comtrade Data comprise of 2 files with same name and extension as .cfg which stores configuration and .dat which stores data samples. Disturbance data from 3rd Party relays can also be viewed if the file supplied is in the std. IEC COMTRADE format.

Click on the **View Comtrade File** button to open dialog to select the Comtrade file with **.cfg** extension to be viewed.

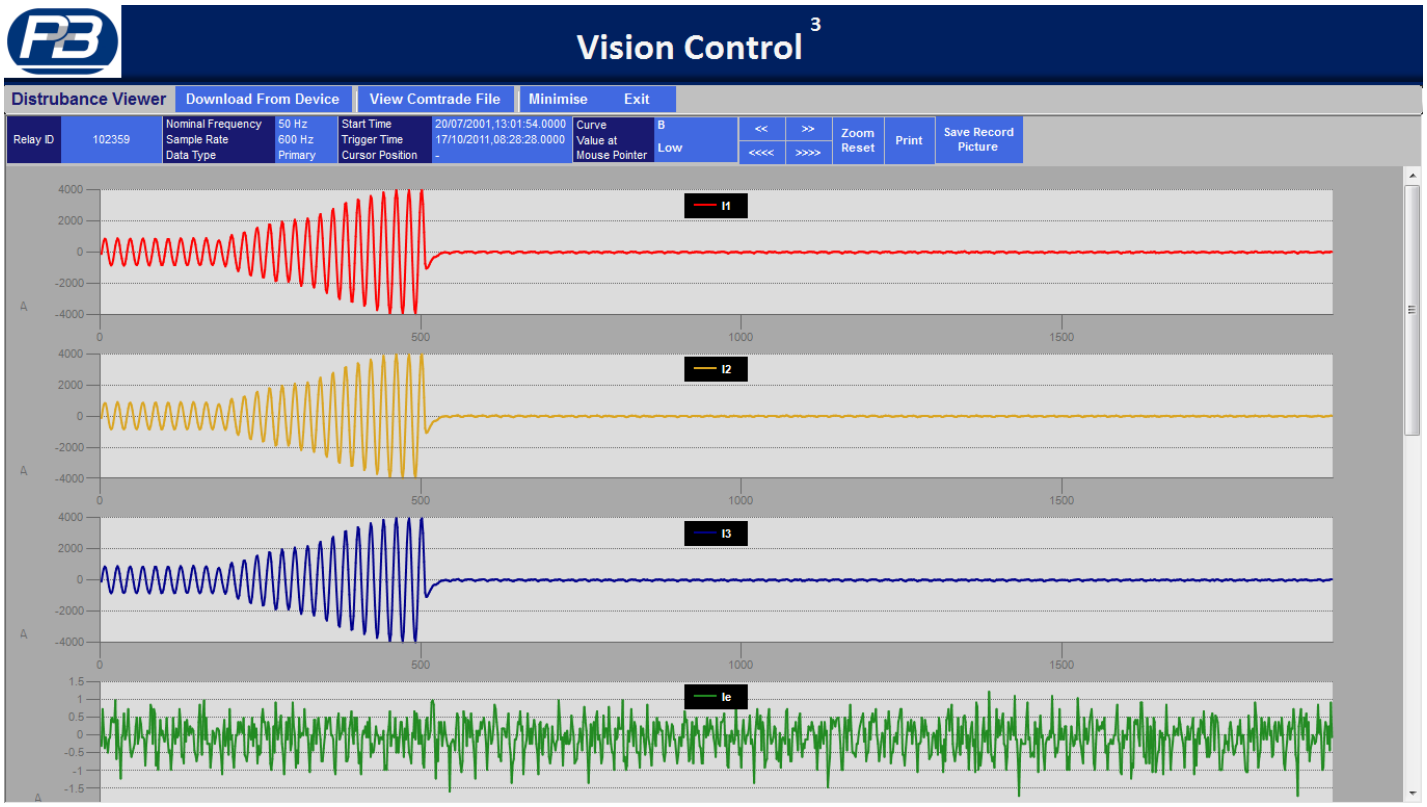


Note: With the Vision Control 3 Installation a sample file **MVSample.cfg** is also copied in **C:\Vision Control 3 Files\Comtrade** folder. This is supplied to provide a demo of the viewer facility if no disturbance files have been retrieved.

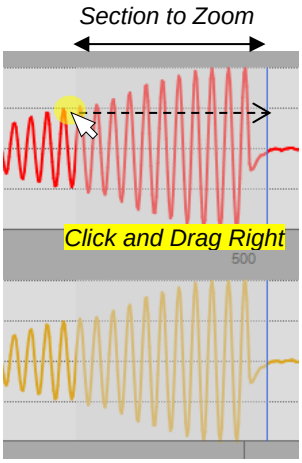
The selected Comtrade File is Loaded when **Open** is Clicked.

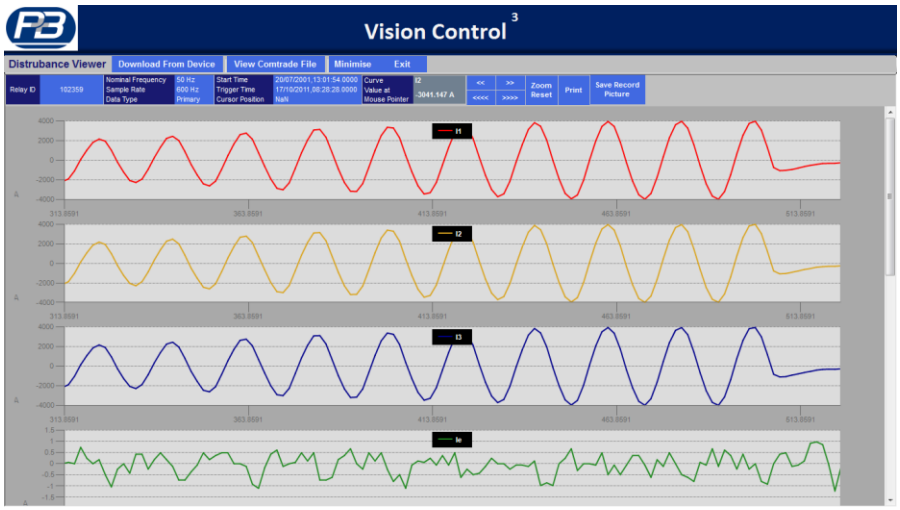
The Disturbance Records are displayed as various curves. The Curve Information is loaded on the top.

Various tools are available on the Top Tool Bar for Moving trace display ares to the Left or Right with **<<<<** or **>>>>** buttons respectively.



Zooming can be done by clicking anywhere on the curve and Dragging Mouse to the extent required as shown below.

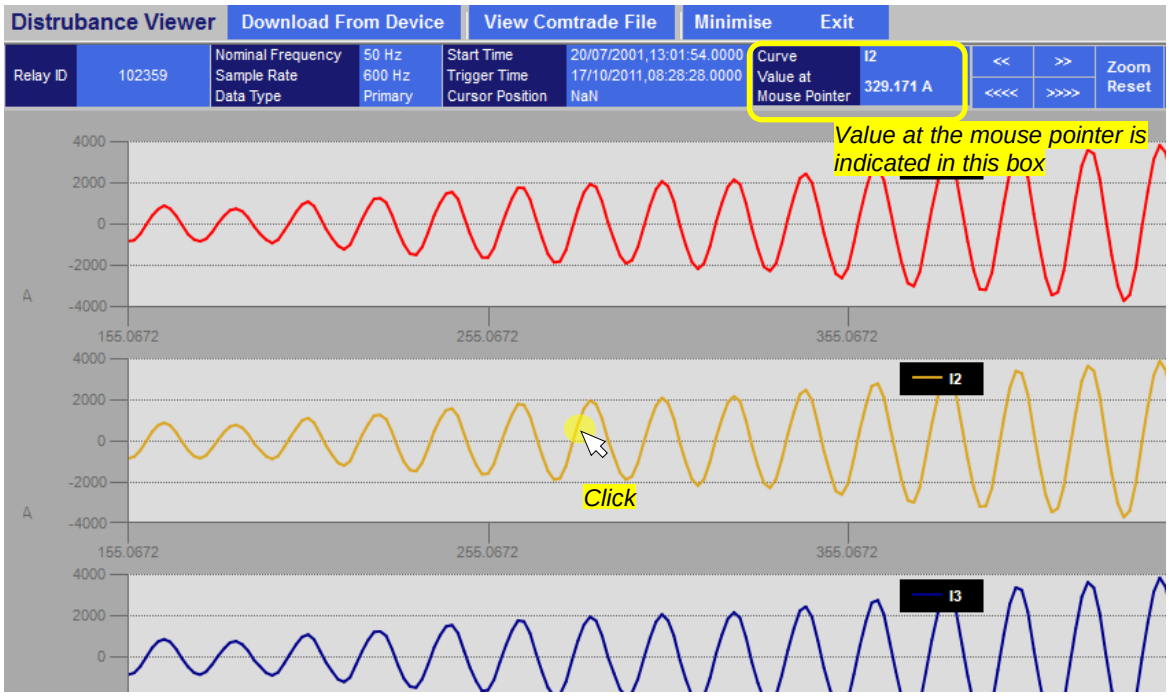




Zoomed View

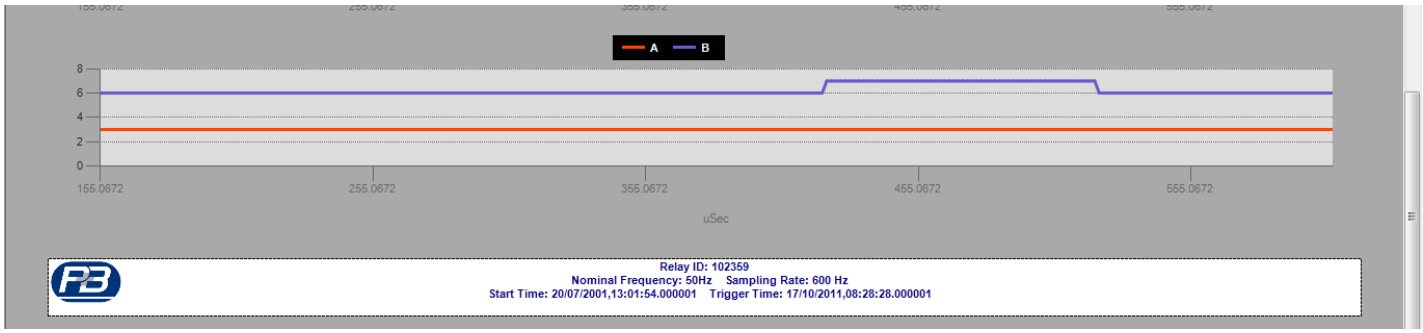
Click on **Zoom Reset** to view full Trace length.

Move the cursor over the waveform to find value and name of the trace as shown below.



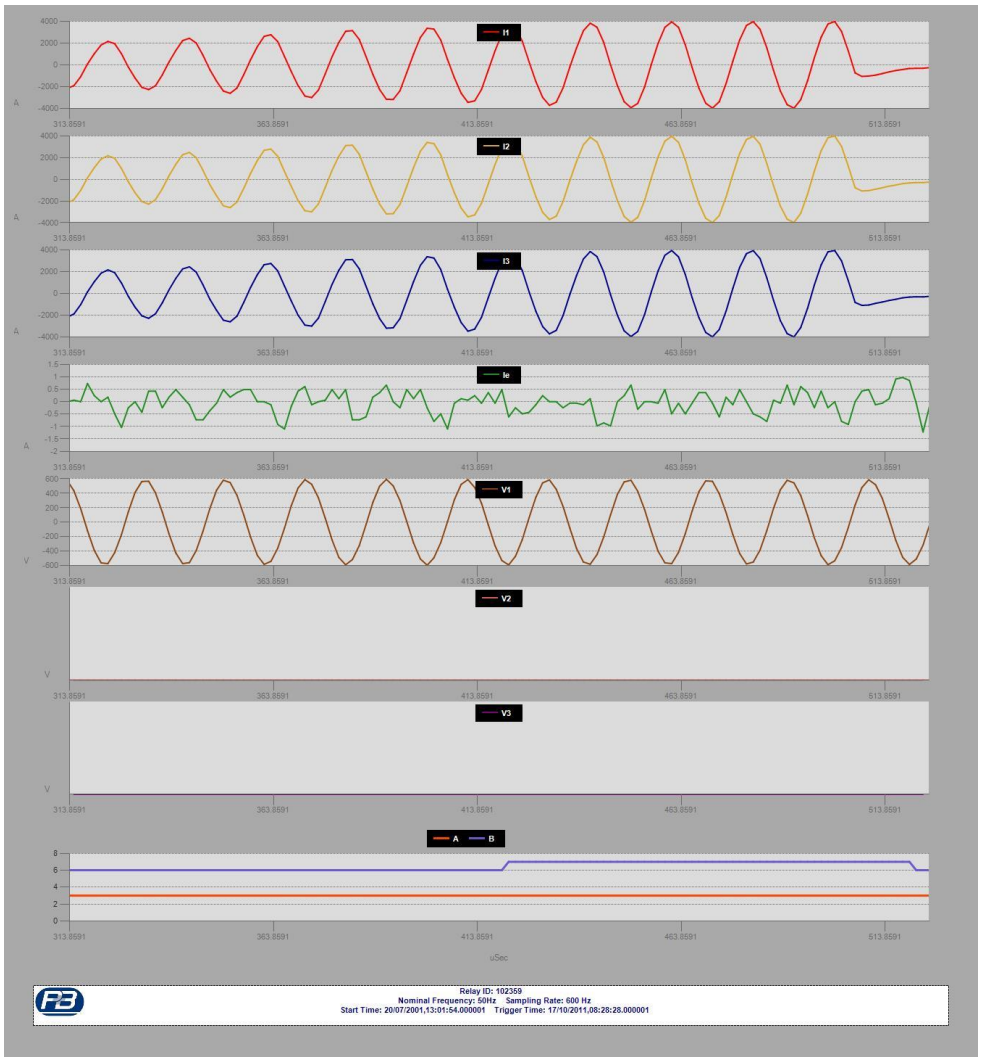
Cursor Position is also displayed when clicked on the waveform and a redline indicating the marker is displayed.

Relay ID and Information is derived from the Disturbance data and displayed at the end of the waveforms as shown below.



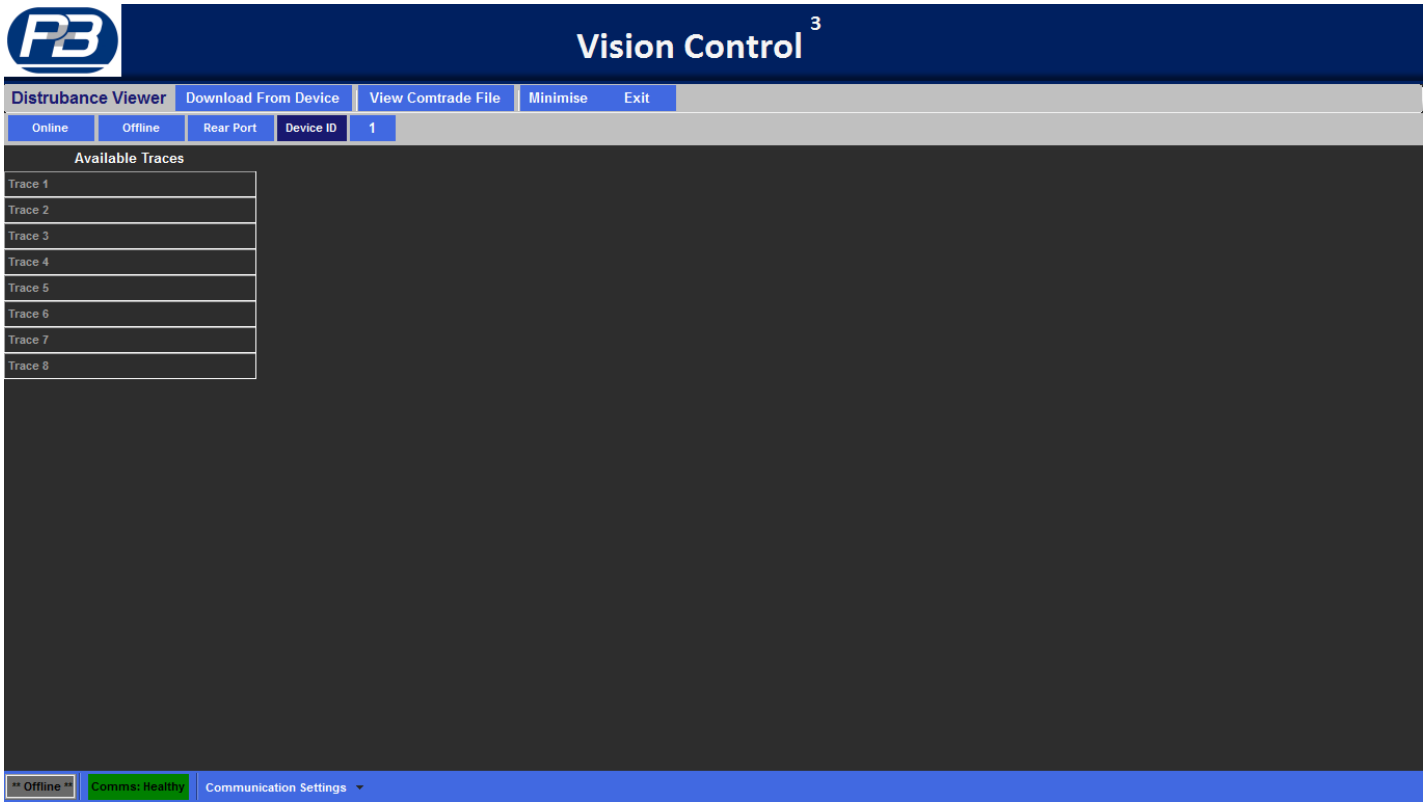
Click on **Print** to send Command to printer for trace to be printed according to paper size.

Click **Save Record as Picture** to save all the waveforms in the viewed comtrade file as a jpg file. A save dialog appears to select the location and name for the jpg file. Below is sample of jpg saved.



Disturbance Download

Click on **Download from Device** button in Fault Disturbance Analysis Section to display options related to downloading of traces.

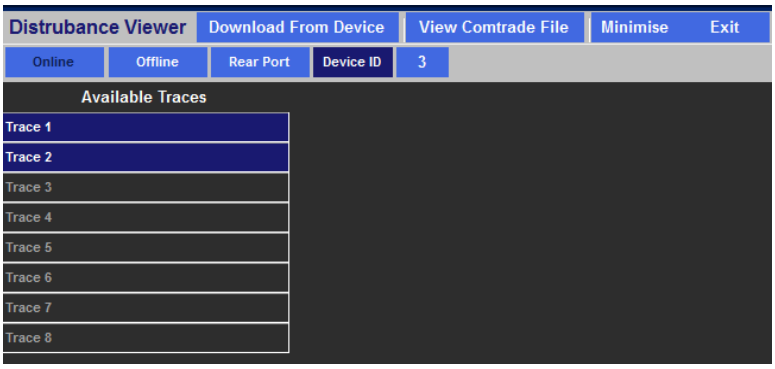


Set the required communication parameters, Device ID and selecting Rear or Front Port by clicking **Rear /Front Port** Button. It is recommended to download the disturbance trace from rear RS485 port. For shorter records upto 1 sec can also be downloaded from front port.

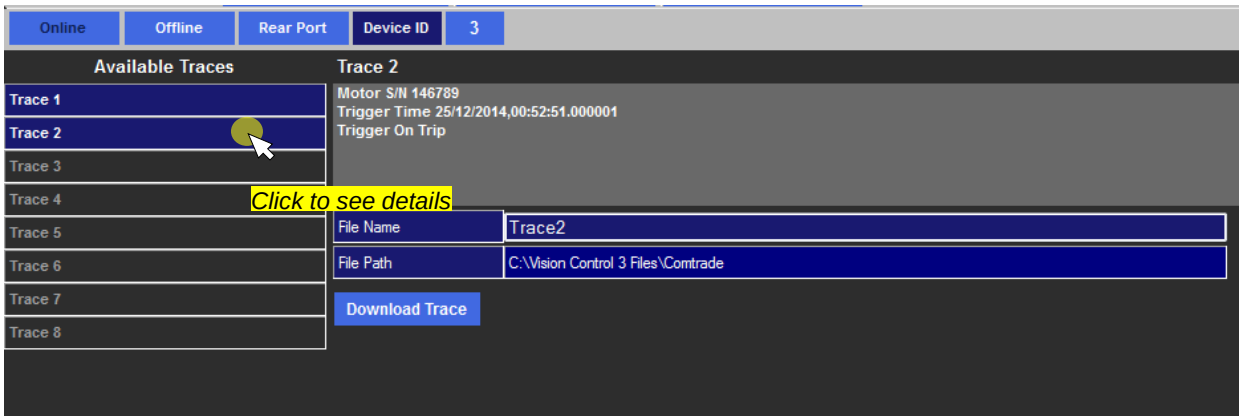
Downloading Records from Relay

Click **Online** to communicate with connected Relay.

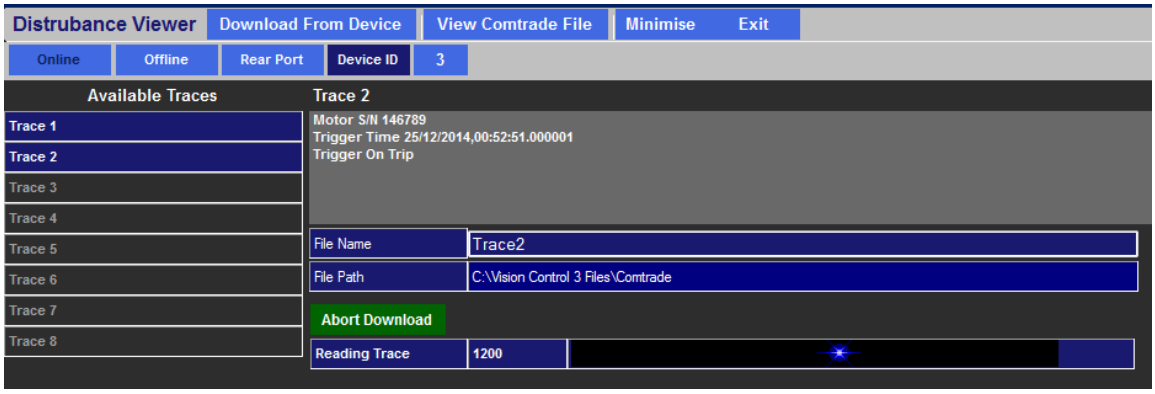
If records are available these are visible as list of Traces available in the relay for download. In the sample on right Trace 1 and Trace 2 available hence options are active for download.



Click on the Trace to view details in brief regarding the trace. Specify a file name and Press **Download Trace** Button.



Trace Download Starts and is saved at the location specified in File Path. Allow download to complete before performing any other operation.



Appendix 7

Handling Guidelines.

Installation.

Protection relaying equipment should be installed, commissioned and programmed by professional engineers familiar with such products. P&B cannot be held liable if proper handling is not observed.

The relay is programmed to the factory default settings upon shipment and must be programmed correctly to achieve safe and satisfactory protection of the equipment.

Changes to the relay hardware and or software may affect the calibration of the unit and its measurement accuracy should be checked prior to reinstating the product in service. If unsure, contact P&B for advice.

Disposal.

P&B are committed to manufacturing practices which do not result in pollution or cause damage to the environment.

As the MR-METI 31 contains a non-rechargeable battery we would recommend safe disposal of equipment at the end of its life in line with local laws.

If you wish us to dispose of equipment on your behalf, we are able to provide such services.

Caution, battery may explode if mistreated.
Do not recharge, disassemble or dispose of in fire.

Due to product development and technology changes, all information contained within this publication is subject to change without prior notice

This manual is based on firmware V0.064

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