MR-EF
(EARTH FAULT PROTECTION RELAY)

Technical Manual

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1. GENERAL DESCRIPTION

P+B Engineering, design and manufacture a range of Drawout Protection Relays and Intelligent Protection and Control Systems. These Microprocessor based range of relays are mounted in 50, 100, 150 and 200mm wide Drawout cases. In general terms, Auxiliary and Tripping relays are supplied in 50mm cases. The majority of MR-EF, Feeder, Transformer, Generator and Motor protection relays are fitted into 100mm wide cases and the more complex Multifunction relays command wider 150 and 200mm cases.

The Vision range of Protection Relays and Controllers, are sub-divided into two categories:

1. **MR** Range – Cost effective General Protection Drawout Relays with a 2 line LCD display.

2. **Vision Drawout** – Multifunction Protection and Control devices with a large, fully graphical LCD display.

**MR-EF** This manual describes the MR-EF Drawout cased

- Microprocessor based Earth/Ground Fault Relay

### 1.1 Protection Functions

- Earth Fault (IEC Curves)
- Serial Timeout protection
- Internal Error Protection

### 1.2 Displayable Data

- Earth Fault Current
- Trip Status
- Alarm Status
- Digital I/O Status
- Active Fault Status

### 1.3 Displayable MR-EF Status

- Healthy / Trip / Alarm
- Alarm Description
- Trip Description

### 1.4 Control Output Relays

- 1 Relay Output Fixed for trip Pulse
- 3 Programmable Output Trip Relays

### 1.5 Control Inputs.

- 2 Programmable Inputs
2. Technical Specification

Power Supply

<table>
<thead>
<tr>
<th>Auxiliary Power Supply &amp; Low Voltage Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Nominal</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Maximum Power Consumption</td>
</tr>
</tbody>
</table>

Measurement

<table>
<thead>
<tr>
<th>Earth Fault Current Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
</tr>
<tr>
<td>Range</td>
</tr>
<tr>
<td>Display Accuracy</td>
</tr>
<tr>
<td>Pick Up accuracy</td>
</tr>
<tr>
<td>CT Burden</td>
</tr>
</tbody>
</table>

Protection Functions

<table>
<thead>
<tr>
<th>Earth Fault Time Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous Earth Fault Trip</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time Delays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Fault Trip</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Relay Contacts Ratings

<table>
<thead>
<tr>
<th>Output Relays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Load</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Maximum Operating Voltage</td>
</tr>
<tr>
<td>Max Making Current</td>
</tr>
<tr>
<td>Max Breaking Current</td>
</tr>
</tbody>
</table>

P+B Protection Relays and Controllers are all type tested over a range of climatic, mechanical, electrical and electromagnetic compatibility IEC tests. Please refer to Type Test information to be found on www.pbeng.co.uk

4. MR-EF Terminations.

External connections are made using crimp or screw terminals to the MIDOS connection block. This then allows pre-wiring to be carried out prior to fitting into the switchgear. These are suitable for accepting 2.5 sq. mm wire. See SECTION 14.2 for terminal assignment.

5. MR-EF Analogue Inputs.

5.1. Power Supply Live

The MR-EF requires an AC or DC Voltage to supply the unit. The digital inputs are connected to this supply too. The MR-EF can also be fitted with a Low Voltage Power Supply (PSU) and / or Low Voltage digital inputs.

5.2 Conventional Current Transformers

Normally, the MR-EF has provision to allow connection of standard 1 amp or 5 amp secondary current transformer.

6. MR-EF Serial Port

6.1. RS485

The Serial Port supplied with MR-EF as standard utilises a half duplex RS485 protocol allowing up to 32 units to be daisy-chained together, or to be multi-drop connected with a single shielded twisted pair cable.

The MR-EF in addition to its very comprehensive protection and control features has been equipped with a very powerful data communications system. It provides high-speed data acquisition to supervisory computers to form a complete protection monitoring.

Each MR-EF can be connected to an isolated data highway using RS485 communications. Up to 32 units can be connected to each data highway. The host system can interrogate the unit to monitor status, historical data and fault data as well as control functions such as reset fault / alarm conditions.

The MR-EF 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.

6.2. Profibus - Optional

Please contact P&B Engineering for further details of this optional protocol.
6.3. RS232

This RS232 port allows access to historical and dynamic data without disturbing the rear RS485 network.

Full details of the protocols, device mapping, gsd files and other support documents are available on request.

Information on the Xcell Data Concentrator is contained in the P&B Integrated Protection & Control System Integrators Manual, available on request.

7.0 Protection Functions.

7.1 MR-EF Settings

7.2 EF CT Primary

This setting allows the user to program the primary current rating of the protection class current transformers on the supply phases. It is assumed that all phase current transformers are of the same rating.

7.3. Protection Settings.

The protection functions are configurable independently of the others settings.

The MR-EF provides the following settings to choose from:

<table>
<thead>
<tr>
<th>ANSI No.</th>
<th>Protective Function</th>
<th>Available Action</th>
<th>Available Reset</th>
<th>Variable</th>
<th>Range</th>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>50/51N</td>
<td>Earth Fault</td>
<td>★ ★ ★ ★ ★ ★ ★</td>
<td>★</td>
<td>Trip Level</td>
<td>1% - 1500%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Trip Time (DEFT ONLY)</td>
<td>50mS - 60S</td>
<td>0.01s</td>
</tr>
<tr>
<td>94</td>
<td>Serial Timeout</td>
<td>★ ★ ★ ★ ★ ★ ★</td>
<td>★</td>
<td>Timeout In</td>
<td>1-120s</td>
<td>1s</td>
</tr>
<tr>
<td>94</td>
<td>Profibus DP Fault</td>
<td>★ ★ ★ ★ ★ ★ ★</td>
<td>★</td>
<td>Trip Time</td>
<td>1-60s</td>
<td>1s</td>
</tr>
<tr>
<td>94</td>
<td>Internal Error</td>
<td>★ ★ ★ ★ ★ ★ ★</td>
<td>★</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ Only available on PROFIBUS model only
7.3.1 Earth Fault

There are two independent stages of Earth Fault Protection.

- Low Set Earth Fault Overcurrent
- High Set Earth Fault Overcurrent (Definite Time Characteristic Only)

The MR-EF may be configured to trip, alarm and/or indicate as a result of an Earth Fault condition.

The following options are available for the Earth Low Set protection characteristic. Normal Inverse (NINV), Very Inverse (VINV), Extremely Inverse (EINV) or Definite Time (DT). Refer to section 13 for further details on these characteristics.

7.3.2 Serial Timeout.

For a set period of inactivity on the rear or front communication port the unit can be configured to take some action in the event.

It is worth noting that the MR-EF device is slave to any host system, the unit will not send information via the serial port unless it has been requested by a master device.

7.3.3 Internal Error

The MR-EF 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-EF will generate an error.

7.3.4 Alarm.

An Alarm is considered as a high level function. If the function activates it cause the MR-EF to enter an alarm state; the fault will be displayed on the screen and the right hand LED will turn ORANGE.

If an output relay is set as Alarm it will change state with the fault.

7.3.5 Trip.

A Trip is considered as a high level function. If the function activates it will cause the MR-EF to enter a trip state; the fault will be on the screen and the right hand LED will turn RED.

7.3.6 Reset.

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

7.3.7 Auto Reset.

This option, when enabled, automatically resets the Fault when the situation that caused the trip has been removed.

7.3.8 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 on the screen just above the top right button. This will only occur if the fault has been removed and the MR-EF is enabled for a panel reset.
7.3.9 Blocking Input.

A digital input configured as a "Blocking input" will provide the facility to block any MR-EF protection function configured to be "Blockable". Most of the MR-EF protection features may have blocking logic assigned. In the event this digital input changes to a blocking status then all those protection features configured as "Blockable" will be disabled for the duration of time the blocking input is energised. This feature may be beneficial in blocking the likes of Undervoltage protection during the starting of large machines connected to the feeder/transformer being protected.

7.3.10 Remote Reset

Allows remote reset of a protection Trip/alarm on energising of Digital Input. Needs to be configured in protection settings. Reset = Remote 'R'
8. System Settings.

8.1 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 to something else the new password must be used.

**Engineer Password** – This is generally only used during commissioning/setup of the relay. The option allows a global password to be used to access the relay's data and settings menus. When 'Engineer Password' is enabled the following passwords will work for all menus:-

ABAAA, PBACS, xxxxx (User Set Password, Factory Default at P&B is 6363)

When ‘engineer Password’ is disabled only the User Set Password will work. Please note if this user set password is lost, no other password will override it. The only way to retrieve a lost password is to read back through the comms or default the relay at power up, back to the factory defaults.

8.2 Change Password.

The MR-EF default password is '6363'. It is recommended for security purposes this password can be changed. The password may be up to 6 characters long and alphanumeric if desired.

If the User Password is lost the only options 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.

8.3 LCD Contrast and LCD Backlight.

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

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Data = 000030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y 30 N</td>
<td>Save Next</td>
</tr>
</tbody>
</table>

Selecting ‘Y’ displays the input screen

For Contrast

<table>
<thead>
<tr>
<th>Light</th>
<th>Dark</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>128</td>
</tr>
</tbody>
</table>

For Backlight

<table>
<thead>
<tr>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>156</td>
</tr>
</tbody>
</table>

8.4 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 one using the display scroll button, then enter the system settings and select 'set default page'.

8.5 Default Return Time.

If the MR-EF is not being accessed using the buttons on the front of the relay after a predetermined time the relay will default to the Pre-set Page. In this setting you can control that feature. You are able to switch off the return feature or specify a time for the delay before the return to the Pre-set Page.

8.6 Time Sync Delay. (Only for use with Chronovision)

Chronovision is a GPS based device which connects on the RS485 network and synchronises the time and date of each connected unit. This delay prevents immediate updating of the RTC.
8.7 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.

8.8 Unit ID. / Unit Type.
Displays the Serial number and device type.

8.9 Software Activation Keys
In order for some functions to operate a unique activation code is required to access hidden menu screens.

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

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

8.12 Screen Saver
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-EF 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.

8.13 Screen Saver Time
Sets period of inactivity before activating screen saver function.


9.1 Serial Enabled / Disabled.
This setting allows the user to enable the MR-EF serial communications port. This setting must be set to ‘Enable’ if communication with the relay through any serial link is required.

9.2 Feeder Number.
This setting range 1 to 32 (125 Profibus), with a default setting of 1, identifies the MR-EF unit to the Xcell unit (or any Master device connected to the Data highway) to which the RS485 or Profibus port is connected. When updating firmware the auto program mode requires the feeder number to be 1.

9.3 RS485 Baud Rate.
This setting allows the user to configure the appropriate communications baud rate such that the MR-EF can communicate correctly on the Data Highway to which it is connected.

9.4 RS232 Baud Rate.
This setting allows the user to configure the baud rate for the front mounted RS232 port.
9.5 Serial Delay.

The MR-EF 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-EF without enduring data collisions on the network.

9.7 Fast Scan 1 to 3.

Each FastScan number can be programmed to export important data when requested. This number references an internal address in MR-EF and allows configurable data mapping between units. Typical data could be Average Phase Current, Voltage and so on. A table of the FastScan reference numbers can be found in SECTION 15.

9.8 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-EF to limit the number of updates it makes to its Fast Scan values.

9.9 Protocol. (RS232 & RS485)

The RS232/RS485 serial communications ports, may be configured to operate using a slave implementation of Modbus RTU® or P&B Engineering’s own protocol “P&B Standard” designed to remove some of the speed issues associated with a function based protocol like Modbus.

9.10 Parity. (RS232 & RS485)

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”. Not required if Profibus.

9.11 Serial Timeout Protection.

DETAILED IN SECTION 7.3
10. MR-EF Faceplate Functions

The MR-EF Faceplate has been designed to provide display and access to all the required information an operator may require.

This is achieved by using 2 tri-colour LED's, a LCD display and 4 software driven function keys.

This eliminates the need for additional indication devices on the front of the feeder panel such as Lamps, Ammeter, Voltmeter, Hours Run Indicator, Operations Counter, etc. which helps reduce the cost of the switchgear panel and gives improved reliability by the reduction of separate components.

The following section details the function of the Front plate devices.

10.1. LED Status.

The LED's on the front of the MR-EF operates as follows:

<table>
<thead>
<tr>
<th>LED Colour</th>
<th>Left LED [MR-EF Status]</th>
<th>Right LED [Fault Status]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Healthy</td>
<td>Healthy</td>
</tr>
<tr>
<td>Yellow</td>
<td>Inhibit</td>
<td>Alarm</td>
</tr>
<tr>
<td>Red</td>
<td>Internal Fault</td>
<td>Fault</td>
</tr>
</tbody>
</table>
12. Menu Tree Structure.

**INITIAL MENU**
- Earth Fault Current, Alarm Status, Trip Status, Digital I/P1 Status, Digital I/P2 Status, Profibus Status (if option fitted)

**DISPLAY SCROLL**
- Card Inserted
  - Card Type: Data or Settings
  - Device Type
  - Card Options
  - Transfer to Card or Device
  - Lock
  - Auto Lock
  - Format Card

**MENU**
- Password
  - Engineer Password
  - Change Password
- Contrast/Backlight Set
- Set Default Page
- Default Return Time
- Time Sync Delay
- S/W Ver & Serial No
- Enable Smart Card
  - Time & Date
  - Chronovision
  - Screen Saver & Time

**CALIBRATION MENU**
- Io Low Gain
- Io Low Offset
- Io High Gain
- Io High Offset
- Auto I Cal
- Reset Cal
- Offset Cal
- Digital Inputs
  - Output Relay Tests
  - Noise Check

**TRIP HISTORY**
- Trip Cause 1 – 32 events
  - Time/Date
- Trip Cause 1 – 32 events
  - Time/Date

**ALARM HISTORY**
- Alarm
  - Trip information
  - Time & Date
- Alarm
  - Trip information
  - Time & Date

**LAST FAULT**
- EF CT Primary
  - No of Trips
  - Acc. Trip Current

**STATS INFO**
- FEEDER SETTINGS
  - Engineer Password
  - Change Password
- Contrast/Backlight Set
- Set Default Page
- Default Return Time
- Time Sync Delay
- S/W Ver & Serial No
- Enable Smart Card
  - Time & Date
  - Chronovision
  - Screen Saver & Time

**SYSTEM SETTINGS**
- SMART CARD MENU (OPTIONAL)
  - Card Inserted
  - Card Type: Data or Settings
  - Device Type
  - Card Options
  - Transfer to Card or Device
  - Lock
  - Auto Lock
  - Format Card

**PROTECT SETTING**
- EF> Action Trip
- EF> Reset Panel
- EF> Trip Level
- EF> Trip Time
- EF> Characteristic
- EF> Times Multiplier
- EF>> Action Trip
- EF>> Reset Panel
- EF>> Trip Level
- EF>> Trip Time
- Ser Timeout Action
- Ser Timeout Reset
- Serial Timeout
- Internal Error
- Internal Error Reset

**SERIAL SETTINGS**
- Serial Enable/Disable
  - Feeder No.
  - RS485 Baud Rate
  - RS232 Baud Rate
  - Serial Delay
  - Fastscan 1-3
  - Max Scan Time
  - RS485 Protocol
  - RS485 Parity
  - RS232 Protocol
  - RS232 Parity

**I/O OPTIONS**
- Digital Input 1
  - (Not used/Reset fault/Block Input)
  - Digital Input 2
  - (Not used/Reset fault/Block Input)
- Output 1 – TRIP
  - Output 2, 3 & 4
  - (Not used/Alarm/Trip)
  - Trips Fail Safe/Healthy/Healthy Fail Safe/Internal Fail
12. Graphical Display.

The LCD screen provides access to limited dynamic and historical data, protection parameter set points and control set-up.

12.1. Menu Screens.

On power up the introduction screen appears for a few seconds. The screen shows the software version and the unit type, which should be noted in all correspondence with P&B regarding the relay.

After the Introduction screen disappears then the Initial screen appears.

The bottom line shows the Key prompt for the left hand button. The right hand button prompt appears only when the right hand button is assigned a function. Otherwise this will display any active messages.

The up and down arrow keys scroll in a loop displaying various measured values and MR-EF status data shown on the top line. Any one of these pages can be selected as the ‘default’ page, so that if the unit is left whilst in a sub menu, the screen can return to a pre-selected page after a set time-out period (See ‘System Settings’)

Using the scroll keys to view
The following status of the MR-EF

IE 0A Hlth
DI 1 OFF
DI 2 OFF
Tr Normal
Al No alarm

‘*’ Shows if protection fault is still active
Tr * ‘Trip Cause’
Al * ‘Alarm Cause’

‘*’ Shows if alarm still present
12.2. Display Scroll.

Examples of the Display Scroll screens

<table>
<thead>
<tr>
<th>Feeder Settings</th>
<th>Serial Settings</th>
<th>I/O Settings</th>
<th>System Settings</th>
<th>Protect Settings</th>
<th>Trip History</th>
<th>Alarm History</th>
<th>Last fault</th>
<th>Stats Info</th>
<th>Calibration Menu</th>
<th>Smart Card Menu</th>
</tr>
</thead>
</table>

Only shows if Smart Card function has been activated

12.3. Menu.

Pressing 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 restores the screen to the display scroll and menu prompt.
The following details each menu sub level in turn:

12.4. MR-EF Settings.

<table>
<thead>
<tr>
<th>Feeder Settings</th>
<th>EFCT Primary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y Top</td>
<td>Y 1500 A N</td>
</tr>
</tbody>
</table>

This screen allows access to the MR-EF Settings of the relay. In this case the EFCT Primary.

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.

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.

12.5. Serial Settings.

<table>
<thead>
<tr>
<th>Serial Settings</th>
<th>Serial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y Top</td>
<td>Y Enabled N</td>
</tr>
</tbody>
</table>

This screen allows the configuration of the communication ports details each function.

Using the UP and DOWN arrows will switch between ‘Enabled’ and ‘Disabled’ selection.

See SECTION 9, for further details
12.6. I / O Settings.

The I / O settings are where the 2 digital inputs are programmable, 1 out of the 4 relay outputs is assigned to TRIP, the other 3 are programmable.

Relay outputs can be assigned to the same function whereas the digital inputs cannot.

Select ‘Y’ to make selection from the list, using the scroll function, choose the option required and ‘Save’.

If a digital input has previously been assigned, that particular choice is removed from the list for the other.

I/O Settings

Y  TOP

Digital 1

Y  Not Used  N

Data = Block Input

Save  Discard

Relay 1

TRIP  N

Relay 1 defaults to TRIP only

Relay 2 – 4 are programmable. By selecting ‘Y’, the Scroll Buttons can be used to select the appropriate relay setting.

Relay 2

Y  TRIP  N

Data = Alarm

Save  Discard

Not Used

Alarm

Alarm Fail Safe

Trip

Trip Fail Safe

Healthy

Healthy Fail Safe

Internal Fail

Selecting ‘Save’ will confirm setting.
12.7.1. Programmable Output.

The MR-EF has 4 outputs - Relay O/P1 is fixed to TRIP, this provides a fixed pulse output of 500mS, upon the protection function, if enabled, activating. Relay 2 – 4 can be programmed as follows

12.7.2 Not Used.

This option switches off the use of that particular output relay.

12.7.2 Alarm.

If an output relay is assigned as "Alarm" then this relay will change state from de-energised to energised when triggered by any protection function or external device connected to the relay that is configured to alarm. The alarm operates after the expiry of the programmed time delay assigned to the protection feature.

12.7.3 Alarm Fail-Safe.

If an output relay is assigned as "Alarm FS" then this relay will change state from energised to de-energised when triggered by any protection function or external device connected to the relay that is configured to alarm. The alarm operates after the expiry of the programmed time delay assigned to the protection feature.

12.7.4 Trip.

If an output relay is assigned as ‘Trip’ then this relay will change state from the de-energised to the energised relay contact when triggered by any protection function or external device connected to the MR-EF.

12.7.5 Trip Fail Safe.

If an output relay is assigned as ‘Trip FS’ (Trip Failsafe) then this relay will change state from energised to the de-energised relay contact when triggered by any protection function or external device connected to the MR-EF.

12.7.6 Healthy

Will energise if no alarm, Trip or Internal Error is present, i.e. System ‘Healthy’.

12.7.7 Healthy Fail Safe

As above (Healthy), but Fail Safe will de-energise

12.7.8 Internal Fail

Relay O/P will energise upon internal relay hardware or software failure.

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

These settings and their functions are explained in SECTION 9.


The calibration menu should not be entered unless it is necessary to do so. Any inadvertent settings made here may compromise the accuracy of the unit and its ability to trip. It should be noted that the Calibration should be left alone as it could result in the invalidation of the factory calibrations test certificate.

If the Password is set to enabled (SECTION 9.1 & 9.2) it will be requested here to allow access. The gain and offset values for each of the analogue channels can be adjusted. Auto calibration routines can also be performed.

12.10. Smart Card Settings. (OPTIONAL)

The Smart Card is a removable eeprom memory card which can be supplied with MR-EF on request.

An activation code is required to access this menu system in order to allow full manipulation of the card.

The activation code is programmed in the System Settings, Enable Smart Card option.

The Smart Card can be used for parameter storage and for cloning the MR-EF settings or it can be formatted as an extended data card which will log and store events.

The Smart Card is explained in more detail – PLEASE CONTACT P & B ENGINEERING FOR MORE INFORMATION.
13.1 IEC Overcurrent Inverse-Time Characteristic Equations

Characteristics according to IEC 255-4 or BS 142

Normal Inverse \[ t = \frac{0.14}{(I/Is)0.02 - 1} \] tI> [s]

Very Inverse \[ t = \frac{13.5}{(I/Is) - 1} \] tI> [s]

Extremely Inverse \[ t = \frac{80}{(I/Is)^2 - 1} \] tI> [s]

Where: t = Tripping Time
   tI> = Time Multiplier
   I = Fault Current
   Is = Starting Current
The MR-EF is supplied in a Drawout case suitable for flush mounting as detailed below.

The case can be supplied with an optional sash lockable dustproof cover.
14.2. TERMINATION DETAILS SUMMARY

<table>
<thead>
<tr>
<th>Fastscan Parameter</th>
<th>Fastscan Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Fault Current (IE)</td>
<td>0</td>
</tr>
<tr>
<td>IE Current Scale</td>
<td>2</td>
</tr>
<tr>
<td>Pre Trip IE</td>
<td>4</td>
</tr>
<tr>
<td>Trip Fault Number</td>
<td>6</td>
</tr>
<tr>
<td>Pre Alarm IE</td>
<td>8</td>
</tr>
<tr>
<td>Trip Alarm Number</td>
<td>10</td>
</tr>
<tr>
<td>Trip Time (part 1)</td>
<td>12</td>
</tr>
<tr>
<td>Trip Time (part 2)</td>
<td>14</td>
</tr>
<tr>
<td>Trip Date (part 1)</td>
<td>16</td>
</tr>
<tr>
<td>Trip Date (part 2)</td>
<td>18</td>
</tr>
<tr>
<td>Number of Trips</td>
<td>20</td>
</tr>
<tr>
<td>Accumulated Trip Current</td>
<td>22</td>
</tr>
<tr>
<td>Digital 1 (Trip Status Bits)</td>
<td>24</td>
</tr>
<tr>
<td>Digital Inputs 1 - 2</td>
<td>26</td>
</tr>
<tr>
<td>Output Relays 1 - 4</td>
<td>28</td>
</tr>
<tr>
<td>Logic Status (FS0)</td>
<td>30</td>
</tr>
</tbody>
</table>

Rear terminal block connections
Each terminal: 1 Screw & 2 Spade
### 16. Setting Pages Summary

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Steps</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Serial settings:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial</td>
<td>Enabled/Disabled</td>
<td></td>
<td>Enabled</td>
</tr>
<tr>
<td>Drive Number</td>
<td>1-32 (125 Profibus)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RS485 Baud Rate</td>
<td>9600/19200/38400</td>
<td></td>
<td>9600</td>
</tr>
<tr>
<td>RS232 Baud Rate</td>
<td>4800/9600</td>
<td></td>
<td>9600</td>
</tr>
<tr>
<td>Serial Delay</td>
<td>1ms-20ms</td>
<td>1ms</td>
<td>1ms</td>
</tr>
<tr>
<td>Fastscan Analogue 1</td>
<td>0-128</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Fastscan Analogue 2</td>
<td>0-128</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Fastscan Analogue 3</td>
<td>0-128</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Max Fast Scan</td>
<td>1-30s</td>
<td>1s</td>
<td>2s</td>
</tr>
<tr>
<td>Parity RS232/RS485</td>
<td>Even / Odd / None</td>
<td></td>
<td>Even</td>
</tr>
<tr>
<td><strong>MR-EF Setting:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/F 1 CT Primary</td>
<td>1-4000A</td>
<td>1A</td>
<td>100A</td>
</tr>
<tr>
<td><strong>I/O Settings:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Relays 2-4</td>
<td>Not Used, Alarm, Alarm FS, Trip, Trip FS, Healthy/Healthy FS/Internal Error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Inputs 2</td>
<td>Not Used, Blocking, Reset Fault</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Programmable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>System Settings:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Password</td>
<td>Enabled/Disabled</td>
<td></td>
<td>Disabled</td>
</tr>
<tr>
<td>Engineer Password</td>
<td>Enabled/Disabled</td>
<td></td>
<td>Enabled</td>
</tr>
<tr>
<td>Change Password</td>
<td>5 Characters</td>
<td></td>
<td>6363</td>
</tr>
<tr>
<td>Time</td>
<td>HH:MM:SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>DD:MM:YY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Sync Delay</td>
<td>0-2000ms</td>
<td>1ms</td>
<td>0ms</td>
</tr>
<tr>
<td>Smart Card Key</td>
<td>6 digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrn Saver</td>
<td>Enabled/Disabled</td>
<td></td>
<td>Disabled</td>
</tr>
<tr>
<td>Scrn Saver Time</td>
<td>60-3600s</td>
<td>1s</td>
<td>3600s</td>
</tr>
<tr>
<td>Chronovision</td>
<td>Enabled/Disabled</td>
<td></td>
<td>Disabled</td>
</tr>
<tr>
<td>Contrast</td>
<td>0 - 128</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>LCD Backlight</td>
<td>0 - 156</td>
<td>1</td>
<td>156</td>
</tr>
<tr>
<td>Default Return Time</td>
<td>No Return/1/2/3/4/5 Mins.</td>
<td></td>
<td>No Return</td>
</tr>
</tbody>
</table>
## 17. Order Form

### Earth Fault Relay (MR-EF)

<table>
<thead>
<tr>
<th>MR-EF</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Current, 1A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5A</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Housing:</td>
<td>100 Series Drawout Case</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flush Mounting</td>
<td></td>
</tr>
<tr>
<td>Frequency:</td>
<td>50Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60Hz</td>
<td></td>
</tr>
</tbody>
</table>