GE
Grid Solutions

MIB High Impedance Bus Differential Relay

Instruction Manual

GE publication code: GEK-106426G

WORLDWIDE 10 YEAR WARRANTY

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REGISTERED ISO 9001 GE MULTILIN

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GE Multilin MIB High Impedance Bus Differential Relay instruction manual for revision G.

Part number: GEK-106426 -G (April 2016)

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1 GETTING STARTED

To help ensure years of trouble free operation, please read through the following chapter for information to help guide you through the initial installation procedures of your new relay.

CAUTION: THE OPERATOR OF THIS INSTRUMENT IS ADVISED THAT IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED IN THIS MANUAL, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED

INSTALLATION MUST BE ACCORDING TO THE NATIONAL ELECTRIC CODE OF THE APPROPRIATE COUNTRY

IMPORTANT WARNING: For upgrading the relay firmware to version 4.00 or later, it is mandatory that the EnerVista MII Setup version is 1.10 or higher. For firmware version 5.00 or later, the EnerVista MII Setup version must be 2.10 or later. Otherwise it may result in damage to the relay

It will take a few seconds for the relay to restart after the completion of the update process. Therefore, before unplugging the relay, please make sure that the relay main screen shows the analog inputs values.

1

Open the relay packaging and inspect the relay for physical damage.

Check the label at the side of the relay and check that the relay model is the same model ordered.

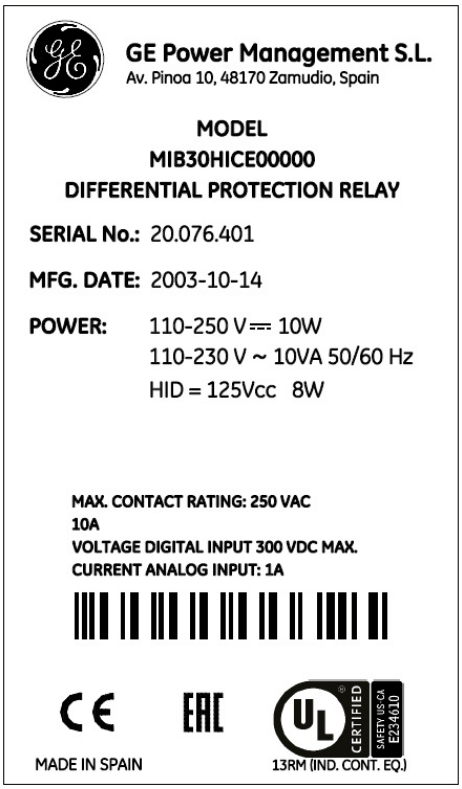

Figure 1–1: RELAY IDENTIFICATION LABEL

Ensure that the mounting screws have been included with the relay.

For product information, instruction manual updates, and the latest software updates, please visit the Grid Solutions Home Page (http://www.gegridsolutions.com/index.htm)

Note: If there is any physical damage detected on the relay, or any of the contents listed are missing, please contact GE Multilin immediately at:

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The information provided herein does not intend to cover all details of variations of the equipment nor does it take into account the circumstances that may be present in your installation, operating or maintenance activities.

Should you wish to receive additional information, or for any particular problem that cannot be solved by referring to the information contained herein, please contact GENERAL ELECTRIC MULTILIN.

1.2.1 SYSTEM REQUIREMENTS

The EnerVista MII SETUP software interface is the preferred method to edit settings and view actual values because the PC monitor can display more information in a simple comprehensible format.

The following minimum requirements must be met for the EnerVista MII SETUP software to properly operate on a PC:

- Pentium® class or higher processor (Pentium® II 300 MHz or higher recommended)
- Windows® NT 4.0 (Service Pack 3 or higher), Windows® 2000, Windows® XP
- Internet Explorer® 5.0 or higher
- 64 MB of RAM (128 MB recommended)
- 40 MB of available space on system drive and 40 MB of available space on installation drive
- RS232C serial and Ethernet port for communications to the relay

1.2.2 SAFETY INSTRUCTIONS

The ground screw shown in the following figure must be correctly grounded.

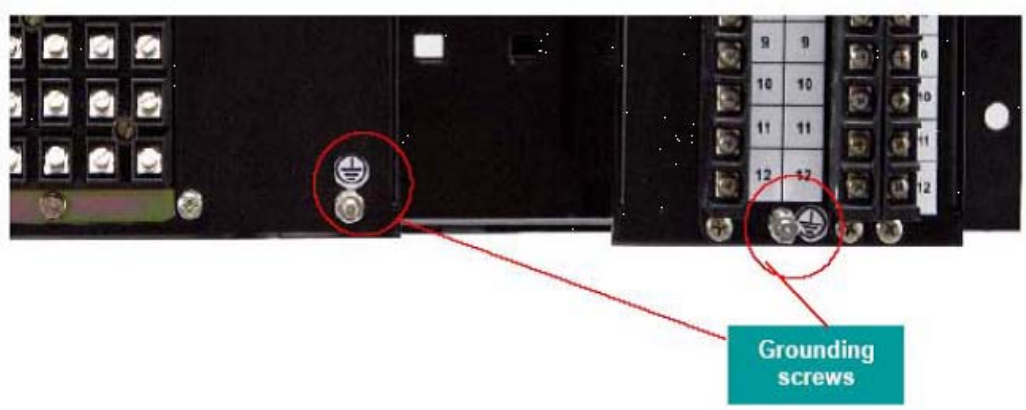


Figure 1–2: GROUNDING SCREWS LOCATION

If you want to communicate with the relay using a computer through the front serial port, please ensure that the computer is **grounded to the same ground as the relay**.

In case of using a portable computer, it is recommended to have it disconnected to its power supply, as in many cases they are not correctly grounded either due to the power supply itself or to the connector cables used. Powering the portable PC with its internal battery drastically decreases the possibility of producing permanent damage to the computer or the relay. Beware of the possibility of losing communication in firmware change processes

This is required not only for personal protection, but also for avoiding a voltage difference between the relay serial port and the computer port, which could produce permanent damage to the computer or the relay.

GE Multilin will not be responsible for any damage in the relay or connected equipment whenever this elemental safety rule is not followed.

In case of a firmware flashing process, due to the risk of losing communication, GE Multilin will not be responsible in case of a communication failure if the relay and PC are not grounded to the same point.

1.2.3 INSTALLATION

After ensuring the minimum requirements for using ENERVISTA MII Setup are met (see previous section), use the following procedure to install the ENERVISTA MII Setup from the enclosed GE ENERVISTA CD.

1. Insert the GE ENERVISTA CD into your CD-ROM drive.
2. Click the **Install Now** button and follow the installation instructions to install the no-charge ENERVISTA software.
3. When installation is complete, start the ENERVISTA Launchpad application.
4. Click the **IED Setup** section of the **Launch Pad** window.

Figure 1–3: ENERVISTA LAUNCH PAD WINDOW

5. In the ENERVISTA Launch Pad window, click the **Add Product** button and select the relay from the Install Software window as shown below. Select the “Web” option to ensure the most recent software release, or select “CD” if you do not have a web connection, then click the **Add Now** button to list software items for the corresponding relay model.

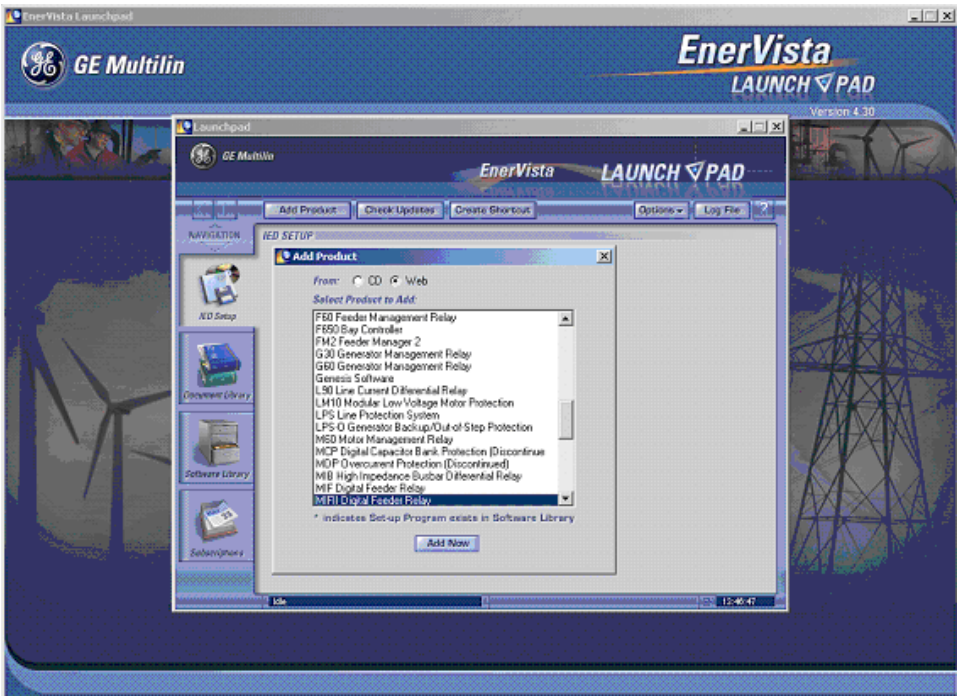


Figure 1–4: ADD PRODUCT

6. If “Web” option is selected, choose from the list the software program related to the specific model and click the **Download Now** button to obtain the installation program.
7. When ENERVISTA detects that there is already a version of the program in the Software Library, you can choose whether to install it directly or to check for more versions.

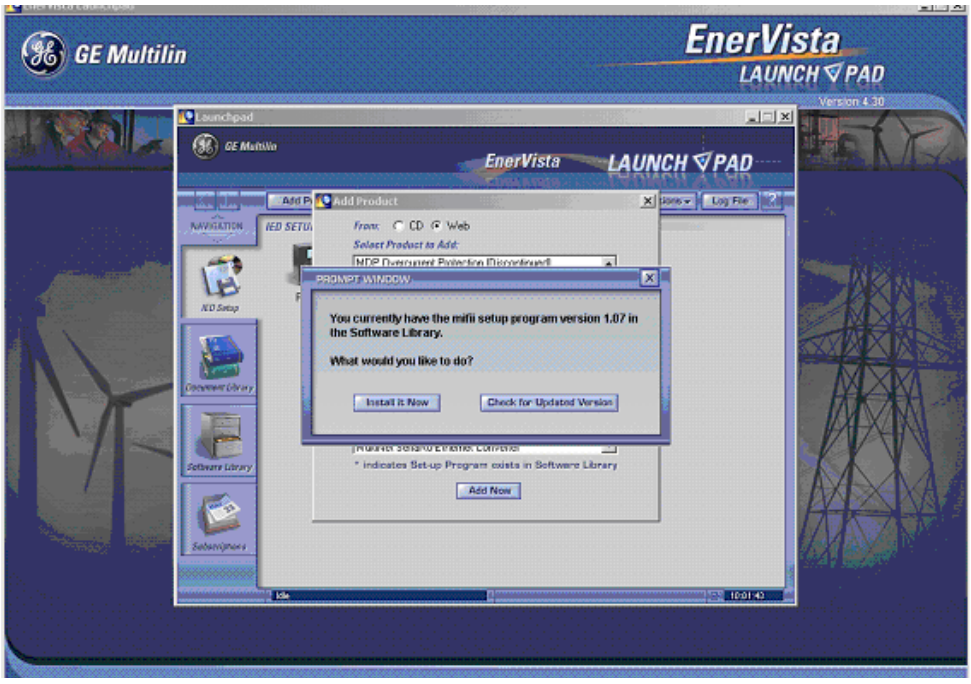
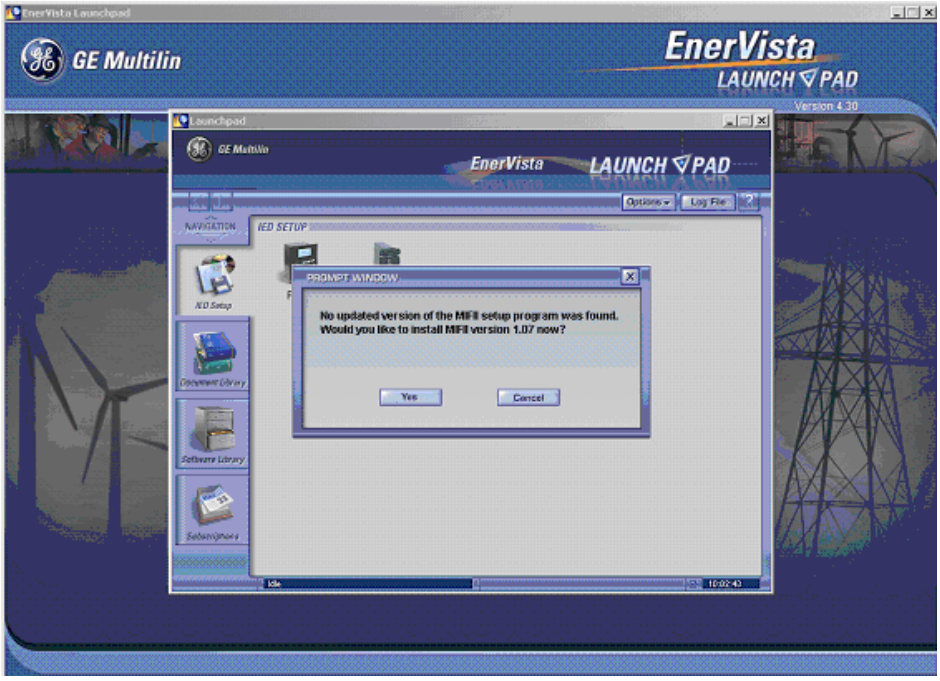
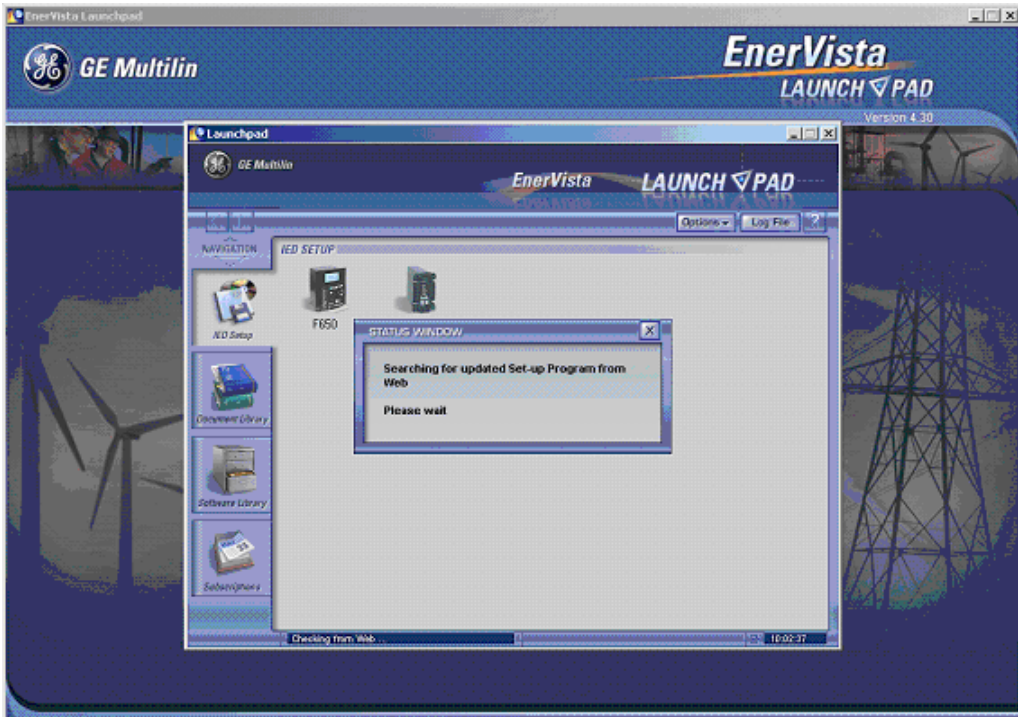


Figure 1–5: CHECK FOR UPDATED VERSIONS?

8. If we click the “Check for Updated Versions” button, the program will proceed to search for the different versions of set-up program from the Web.



9. ENERVISTA Launchpad will obtain the installation program from the Web. If the version you already have is the last one on the Web, the following screen will appear



10. If there were more versions on the Web, ENERVISTA will then show the user the different setup programs available for upgrade, with their version, size and release date.
11. Double-click the installation program once its download is complete, to install the EnerVista MII SETUP software.
12. Select the complete path, including the new directory name, where the EnerVista MII SETUP will be installed.

13. Click on **Next** to begin the installation. The files will be installed in the directory indicated and the installation program will automatically create icons and add EnerVista MII SETUP to the Windows start menu.
14. Follow the on-screen instructions to install the EnerVista MII SETUP software. When the **Welcome** window appears, click on **Next** to continue with the installation procedure.

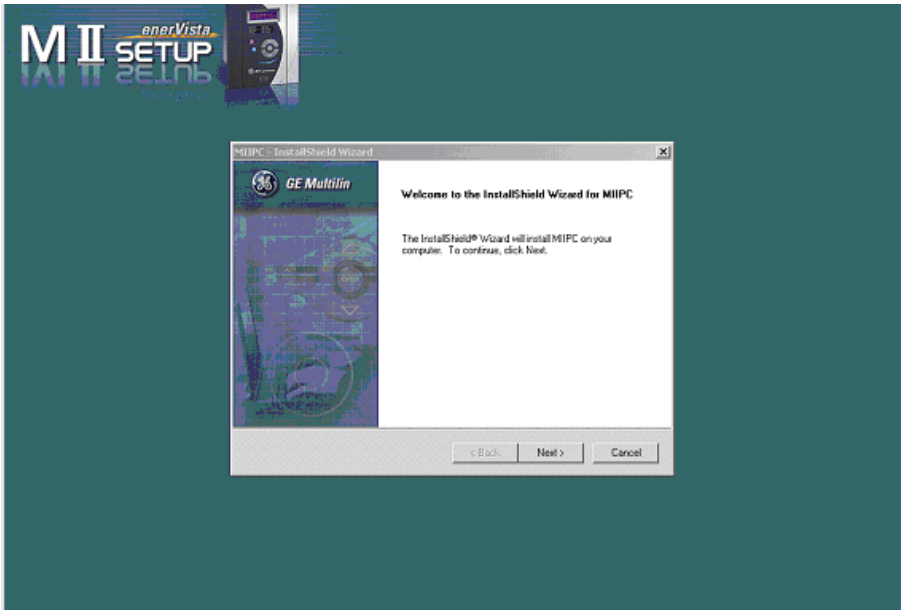


Figure 1–6: WELCOME TO INSTALLATION WINDOW

15. When the **Choose Destination Location** window appears, and if the software is not to be located in the default directory, click **Change…** and type in the complete path name including the new directory name and click **Next** to continue with the installation procedure.

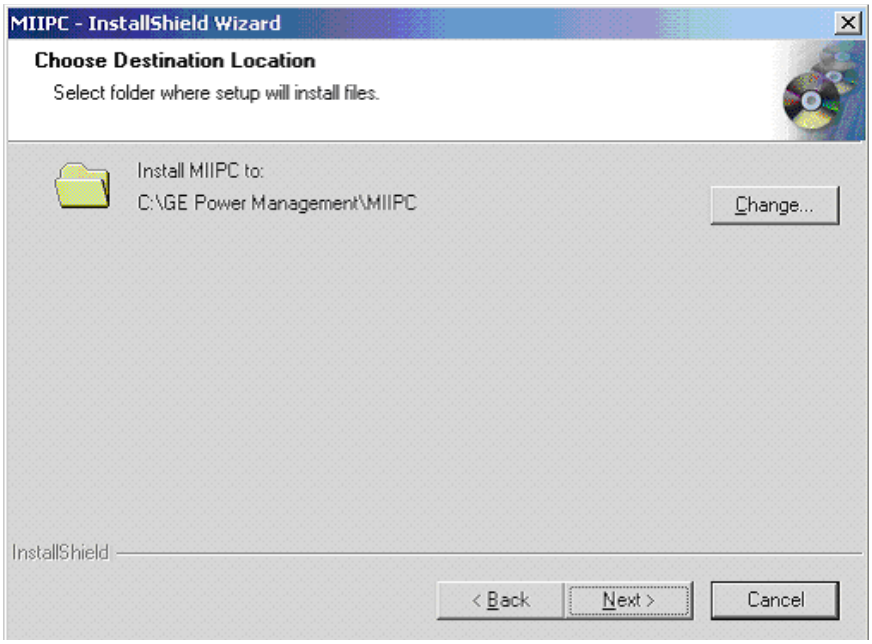


Figure 1–7: CHOOSE DESTINATION LOCATION WINDOW

16. The default program group where the application will be added to is shown in the **Selected Program Folder** window. Click **Next** to begin the installation process, and all the necessary program files will be copied into the chosen directory.

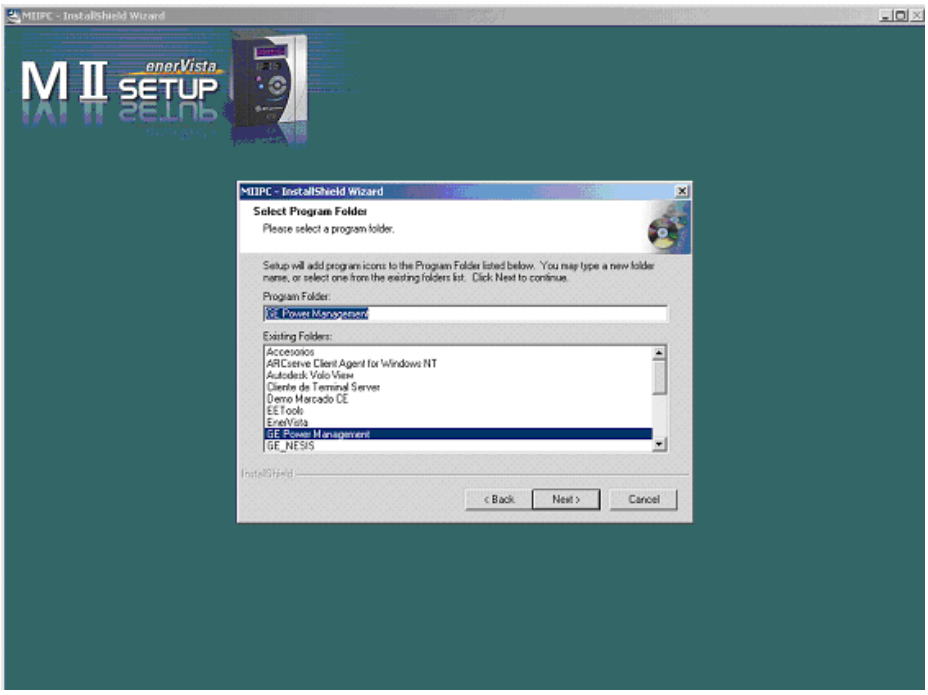


Figure 1–8: PROGRAM FOLDER

17. To finish with the installation process, select the desired language for startup

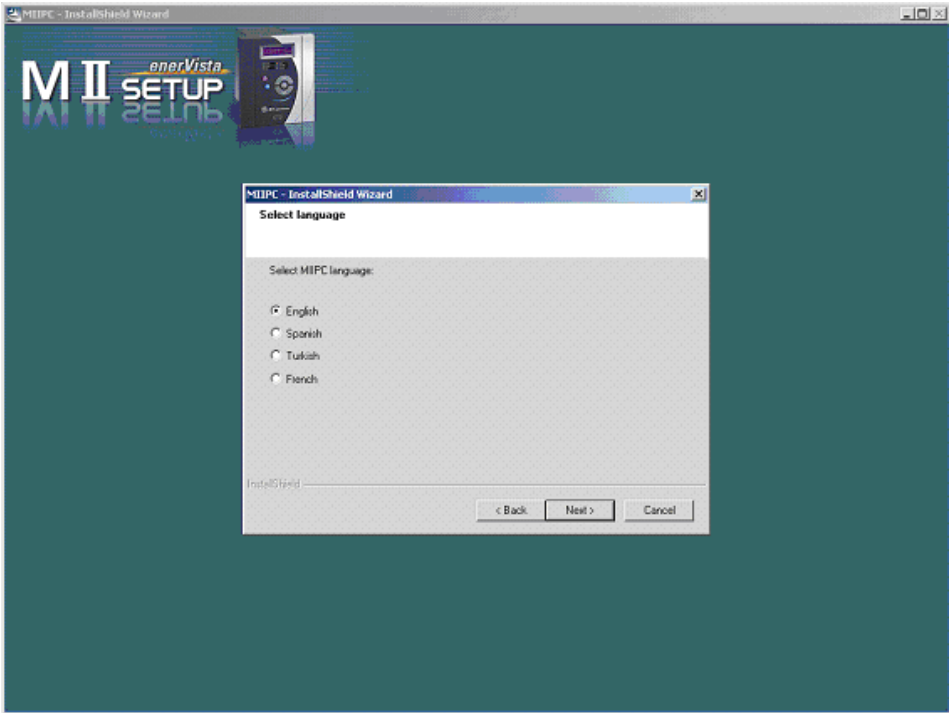


Figure 1–9: LANGUAGE SELECTION

18. Click **Finish** to end the installation. The MII device will be added to the list of installed IEDs in the ENERVISTA Launchpad window, as shown below.


EnerVista Launchpad
GE Multilin
EnerVista
LAUNCH PAD
Launchpad
Add Product
Check Updates
Create Shortcut
Options
Log File
NAVIGATION
IED SETUP
F650
M Family
MII Family

1.3.1 MOUNTING & WIRING

Please refer to the HARDWARE chapter for detailed relay mounting and wiring instructions. Review all **WARNINGS and CAUTIONS.**

1.3.2 COMMUNICATIONS

The EnerVista MII SETUP software can communicate to the relay via the faceplate RS232 port, or the rear panel RS485 port. To communicate with the relay via the RS232 port, a standard “straight through” serial cable is used. The DB9 male end is connected to the relay and the DB9 or DB25 female end is connected to the PC COM1 or COM2 port as described in the HARDWARE chapter.

To communicate with the relay’s RS485 port from a computer’s RS232 port, a RS232/RS485 converter box is required. GE Multilin offers F485, DAC300 and RS232/485 converters. This converter box is connected to the computer using a “straight through” serial cable. A shielded twisted pair (20, 22 or 24 AWG; 0.25, 0.34 or 0.5 mm^2) cable is used to connect the converter box to the relay rear communication terminals. The converter box (-, +, GND) terminals are connected to the relay (SDA, SDB, GND) terminals respectively. For long communication cables (longer than 1 Km), the RS485 circuit must be terminated in a RC network (i.e. 120 ohm, 1 nF) as described in the HARDWARE chapter.

1.3.3 FACEPLATE KEYPAD & DISPLAY

Display messages are organized into menus under the main headings: Actual Values, Main Settings, Advanced Settings, Operations and Change Date&Time. A 5-key keypad and a 16x2 character LCD display (shown below) are used as elementary local HMI.

1

Figure 1–10: RELAY KEYPAD AND DISPLAY

Using this keypad it is possible to access all the different menus in the relay and to view and change settings.

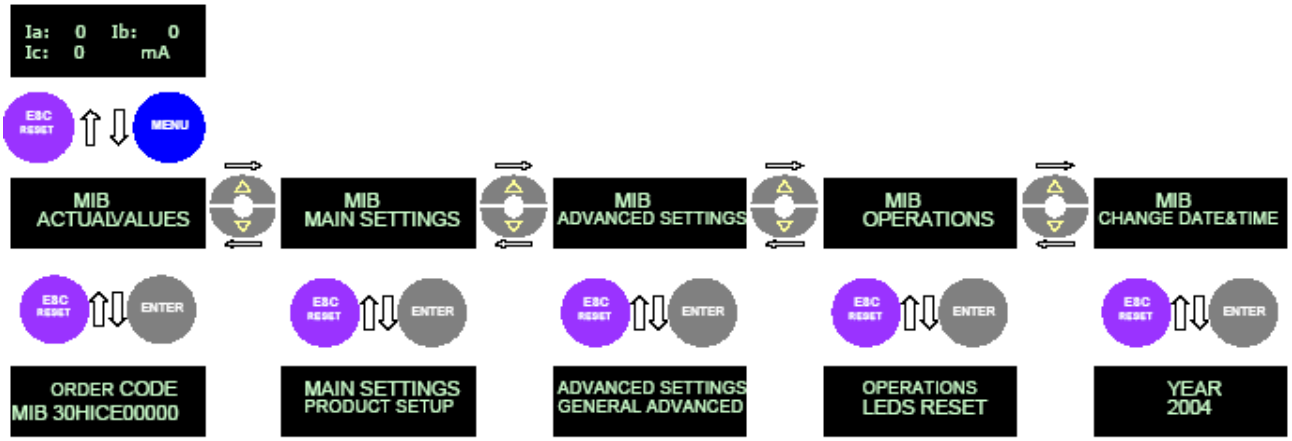


Figure 1–11: MOVING THROUGH THE HIERARCHICAL MENU (

As shown in Figure 1–11:, there are 3 hierarchical levels to access the information in the relay. The first level (Main screen) shows the current value for each phase ($Idiff_1$, $Idiff_2$, $Idiff_3$)

Pressing the Menu button accesses the second level. To access information within the same hierarchical level (horizontal movement), push the up/down arrow buttons. To access the third level push the "**Enter**" button when the desired heading is shown in the display.

To return back to the previous level (from the third to the second level, or from the second to the first one), push the "ESC/ RESET" button.

Refer to chapter 7, for more information on the use of the local keypad and display to access information and change settings.

2.1.1 GENERAL OVERVIEW

PROTECTION

- Two Differential Protection Units (87-1 and 87-2)

CONTROL

- Reset 86
- Close

METERING

- Differential currents

INPUTS/OUTPUTS

- Programmable digital inputs and outputs Up to 3 Differential current inputs

COMMUNICATIONS

- Front RS232 port
- Rear RS485 port

USER INTERFACE

- 2x16 LCD Display
- 6 LEDs (4 programmable)

SECURITY

- Access password for setting changes
- Local access priority

OTHERS

- 1 Oscillography record
- 24 Event recorder

- MIB is a microprocessor-based protection relay designed for the following applications:High-Impedance differential protection for Bus bars
- Restricted Ground Fault (RGF) protection on electrical machines with grounded-wye windings
- Differential protection for generators
- Differential protection for reactances

In applications where all the CTs have the same ratio.The CTs could be 1A or 5A, as the input current for the relay is the differential one, physically obtained wiring the CTs.

The protection combines a well-proven principle, as the high-impedance one, with the advantages of microprocessor technology. The criteria used in high impedance differential protection are very simple. The high impedance path using a stabilizing resistor R (2000 Ohm resistors), produces a voltage and current during an internal fault. Measuring the value, the unit can determine if there is an internal or external fault. If the voltage or current value is above the set pickup value, the fault is internal. If the value is under the pickup value, then the fault is external. The pickup value becomes the critical point. This setting must contemplate the possibility of a complete CT saturation. Selecting an adequate pickup value, the stability of the scheme is ensured including operation under extreme conditions.

To cover the mentioned application, MIB is comprised of the following modules:

- ***High Impedance Module: Stabilising Resistors and voltage limiters.*** The High-Speed over current module connected in series with the stabilizing resistors provide high speed operation for bus faults involving high-magnitude currents. A voltage limiting element (MOV) is connected in parallel to avoid excessively high CT secondary voltages that can damage the current inputs when the relay fault occurred.
- ***High-Speed overcurrent module: Differential protection for up to 3 differential currents.***
- ***Lockout Relay & Push Button: Mechanical lockout after relay operation and Reset Button.***

The procedure for determining the necessary settings and the resulting sensitivity to low-current bus faults is very simple and straightforward, requiring only knowledge of the CT secondary excitation characteristics and their secondary impedance.

For the best possible results, all CTs should have the same rating, and should have a characteristic similar to a bushing CT with a distributed secondary winding, that has little or no secondary leakage reactance.

The overcurrent-relay unit connected in series with the stabilizing resistor voltage limiter provides high-speed operation for bus faults involving high-magnitude currents. Since the overcurrent module unit is relied on only for high magnitude currents, its pickup can easily be made high enough to avoid operation for external faults.

Additionally, a latching relay is incorporated, whose contacts are aimed to short circuit the resistors once the associated relay has tripped. This way, the fault current is prevented from circulating through the resistors after the relay has tripped.

The MIB relay provides two configurable digital inputs and three configurable contact outputs. Additionally, it provides two fixed outputs, one associated to the TRIP command and the other one to the SYSTEM ALARM.

Also it provides communications with a computer by means of two communication ports, one located in the front (RS232 type) and one located in the rear (RS485 type). Both faceplate RS232 port and rear RS485 port may be used to connect a PC for programming settings, monitoring actual values and for retrieving stored information (list of events, oscillography, etc.). All serial ports use the Modbus® RTU protocol and may be connected to system computers with baud rates from 300, 600, 1200, 4800, 9600 and 19200 bps. The rear RS485 port can be converted into an RS232 port or into a fibre optic (plastic or glass) serial port by using the GE **DAC300** module. The EnerVista MII Setup communication software is the Windows® based program used to communicate with the relay.

The following one line (single line) diagram (Figure 2–1:) illustrates the relay functionality using ANSI (American National Standards Institute) device numbers.

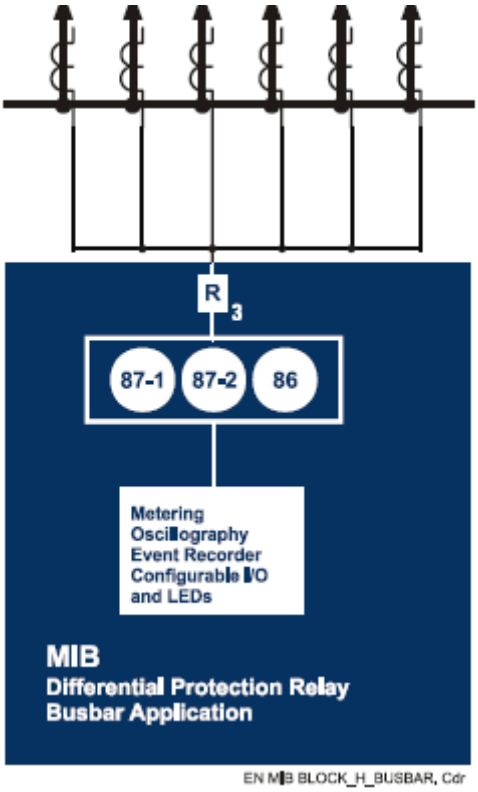


Figure 2–1: SINGLE LINE DIAGRAM. BUS-BAR APPLICATION. MIB 30

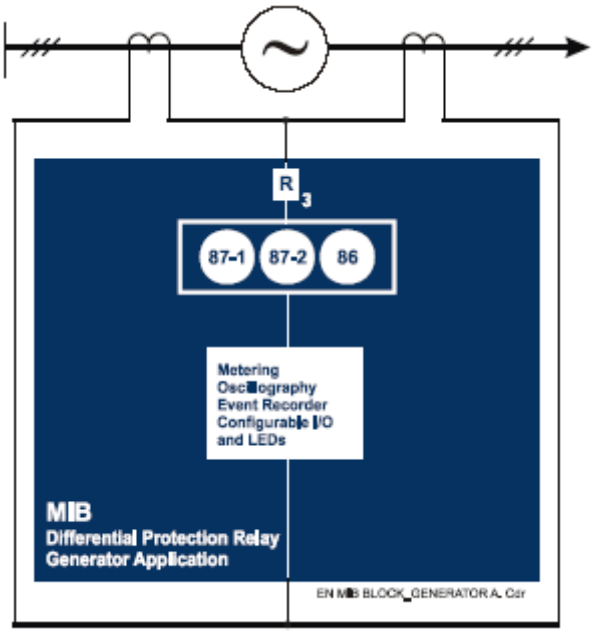


Figure 2–2: SINGLE LINE DIAGRAM. GENERATOR APPLICATION. MIB 30

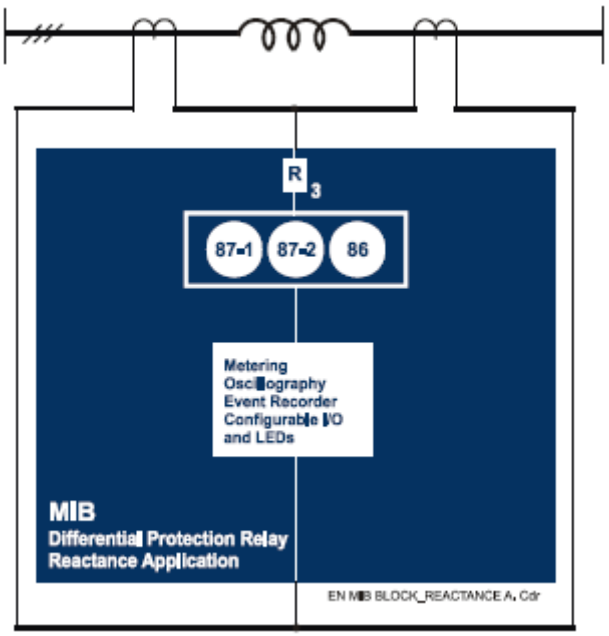


Figure 2–3: SINGLE LINE DIAGRAM. REACTANCE APPLICATION. MIB 30

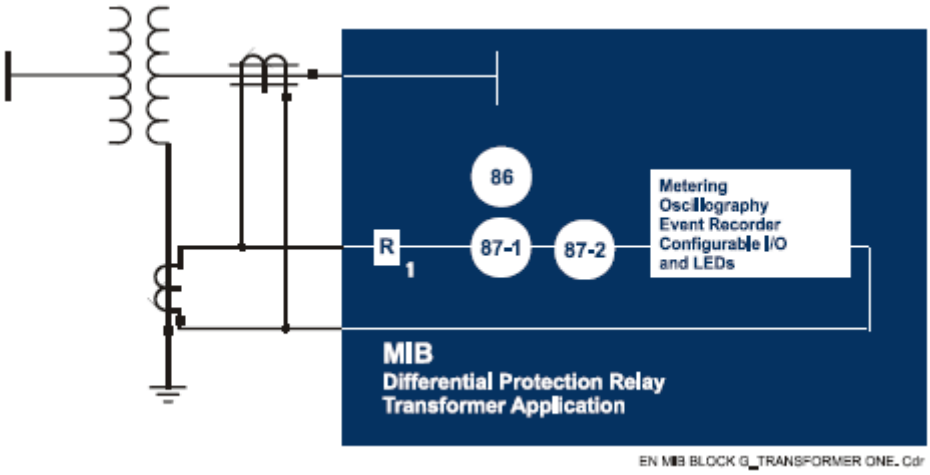


Figure 2–4: SINGLE LINE DIAGRAM. ONE WINDING-RGF APPLICATION. MIB 10

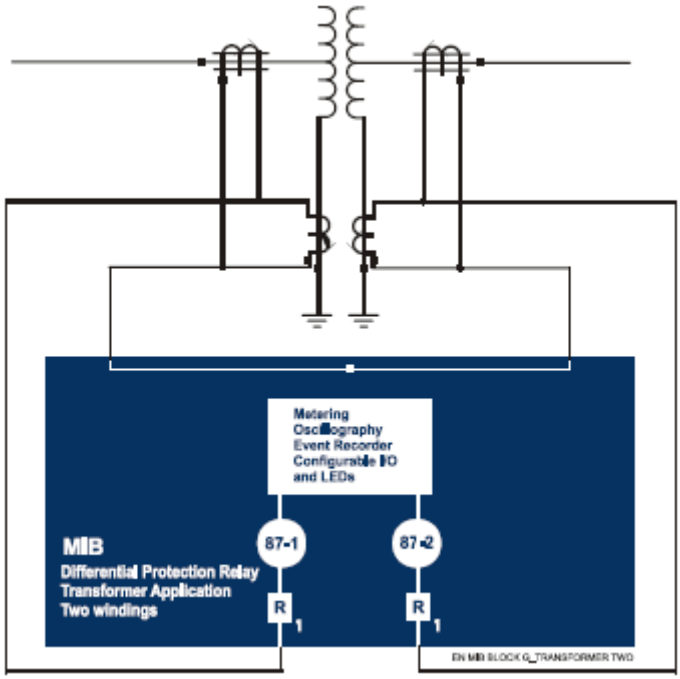


Figure 2–5: SINGLE LINE DIAGRAM. TWO WINDING-RGF APPLICATION. MIB 20

MII family relays have several security features to restrict rear port operation when an operator is making changes by the local port or relay keypad, and/or to block access to setting changes for non-authorized users.

The relay has an access priority system, giving priority to local access over remote access. The access mode is **Local** either when the relay display is inside MAIN SETTINGS, ADVANCED SETTINGS or OPERATIONS menu, or when the front port (RS232) communication is established. When the access is local by the RS232 port, the back port is disabled and the relay will not serve any petition or command sent by the rear port. When the access is local by keypad, the back port is not disabled, and actual values can be read, but setting changes and operations will not be allowed by the back port.

Setting changes, either by keypad and display or by communications, are **password protected**: the user has to enter a password to change any setting. When the password is entered, the password protection is disabled and the user can change any setting freely. Thirty minutes after the last setting change performed, or when the ESC/RESET key is pressed for three seconds or more, the relay returns automatically to the password protected status and will ask for the password again if a new attempt to change settings is made.

2.3.1 DIFFERENTIAL UNITS (87-1) (87-2)

MIB provides 2 Differential Units, 87 1 and 87 2. Each one can be enable/disable and set independently.

These elements consist on overcurrent detectors that measure the current flowing in the High-impedance differential circuits. The pick up value can be set between 5 mA and 400 mA, and the time delay from 0 to 600 seconds.

For a Bus-bar differential application, these elements will receive the differential currents corresponding to phase A, B and C. The elements will measure the three differential currents, and operate if any of them surpass the pickup setting during the specified time delay.

For a one-grounded-winding transformer RGF application, these elements will receive the differential current corresponding to the ground connection in one winding and operate if it surpass the pickup setting during the specified time delay.

For a two-grounded-windings transformer RGF application, this element will receive the differential currents corresponding to the ground connection in each of the two windings and operate if any of the two ground differential currents surpass the pickup setting during the specified time delay.

The formulas and procedures described in the following paragraphs for determining relay settings assume that the relay is connected to the full winding of the differentially connected CTs. It is further assumed that the secondary winding of each CT has negligible leakage reactance and that all the CTs have the same ratio. If all of these conditions do not exist, please refer the application to the nearest GE Multilin Sales Office.

2.4.1 SETTING OF THE DIFFERENTIAL ELEMENT

It is assumed that an external fault causes complete saturation of the CT in the faulted circuit. The current forced through this secondary by the CTs in the in feeding circuits will be impeded only by the resistance of the windings and leads. The resulting IR drop will be the maximum possible voltage that can appear across the MIB relay for an external fault. The setting of the high impedance differential unit is expressed as follows:

$$Vs = \frac{I_F}{N}(R_S + P * R_L) \qquad (1)$$

$$I_R = 1.6\frac{Vs}{\mathrm{Re}} \qquad (2)$$

Where:

I_R = pickup setting of the 87 unit

R_S = DC resistance of fault CT secondary windings and leads to housing terminal

R_L = single conductor DC resistance of CT cable for one way run from CT housing terminal to junction point (at highest expected operating temperature.

P = 1 for three phase faults; 2 for single phase to ground faults

I_F = external fault current – primary RMS value

N = CT ratio

1.6 = margin factor

R_E = stabilizing resistance (2000)

Calculations need only be made with the maximum value of I_F for single phase and three phase faults. If the relay is applicable for these conditions, it will perform satisfactorily for all faults.

The pessimistic value of voltage determined by the equation, for any of the methods outlined, is never realized in practice. The CT in the faulted circuit will not saturate to the point where it produces no assisting voltage. Furthermore, the condition that caused the fault CT core to saturate also tends to saturate the cores of the CTs in the in-feeding circuits, which results in a further decrease in voltage across the MIB. These effects are not readily calculated.

The value of the 87 setting established by the equation is the minimum safe setting. Higher settings will provide more safety margin, but will result in somewhat reduced sensitivity.

The method of utilizing the above equation is outlined below:

- Determine the maximum three phase and single phase to ground fault currents for faults just beyond each of the breakers.
- The value of R_L is the one-way cable DC resistance from the junction point to the fault CT being considered.
- For each breaker in turn calculate I_R separately utilizing the associated maximum external three phase fault current with P=1 and the maximum external single phase to ground fault current with P=2.
- Use the highest of the values of I_R so obtained in c) above.

It is desirable for the pickup current of the 87 unit multiplied by 2000 ohm. to plot below the knee of the excitation curve (i.e. point on the excitation curve where the slope is 45°) of all the CTs in use.

2.4.2 MINIMUM FAULT TO TRIP 87

After the pickup setting of 87 has been established for an application, a check should be made to determine the minimum internal fault current that just cause the unit to operate. If this value is less than the minimum internal fault current expected, the pickup setting is suitable for the application. The following expression can be used to determine the minimum internal fault current required for the particular 87 pickup setting.

$$I_{MIN} = \left[\sum_{1}^{n} I_X + I_R + I_1 \right] * N \qquad (3)$$

Where:

I_{MIN} = Minimum internal fault current to trip 87

n = Number of breakers connected to the bus (i.e. number of CTs per phase)

I = Secondary excitation current of individual CT at a voltage equal to pickup level of 87

I_R = Pickup level in 87 unit

I_1 = Current in the MOV unit at 87 pickup level

N = CT ratio.

The values of $(I)_1$, $(I)_2$, etc. are obtained from the secondary excitation characteristics of the respective CTs. The first term in equation (2) reduces to N*Ix if it is assumed that all CTs have the same excitation characteristics.

The current drawn by the MOV unit can be obtained from that curve in **2-6** that applies to the relay being used.

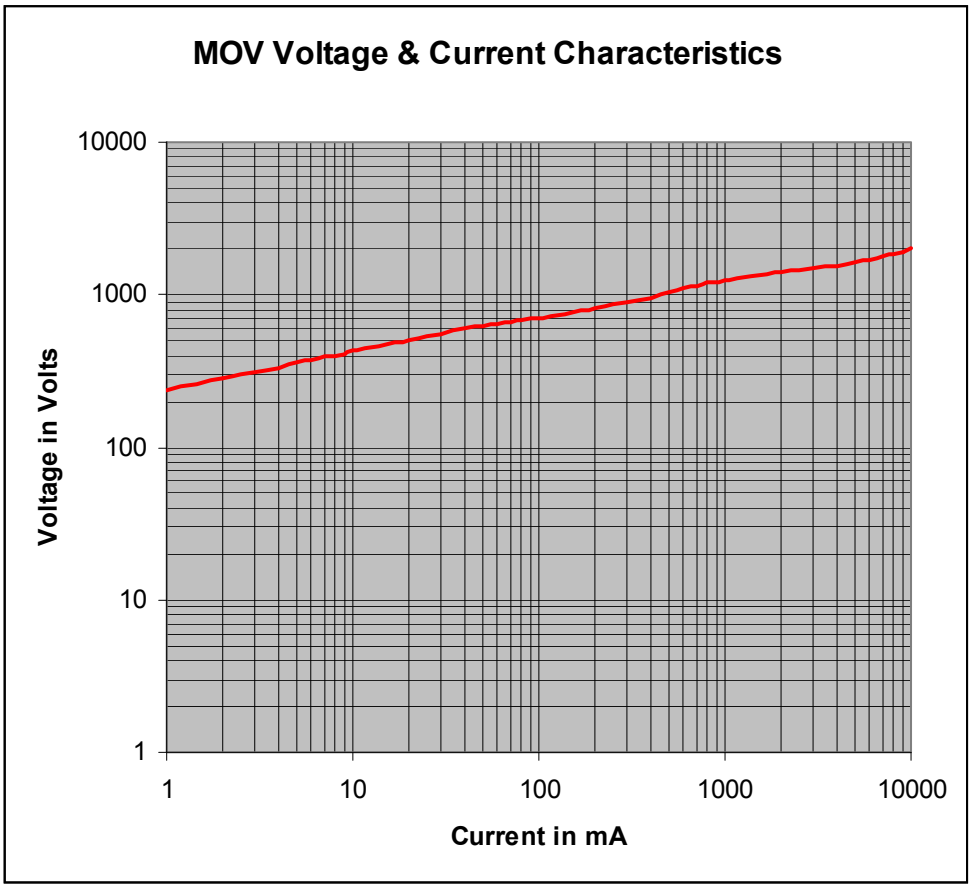


Figure 2–6: MOV VOLTAGE & CURRENT CHARACTERISTICS

MIB stores an historical record with the last 24 events. Each event contains the event description, date and time (4 ms accuracy), the current values in phases and ground at that moment, and a summary of the status signals that can produce events, and whether they were active or not in that moment.

In EnerVista MII SETUP there is an "**EVENTS**" menu, where the user can check how many events have been produced since the last time the Events were deleted. If the number of events produced is higher than 24 (maximum number of events stored), this means that only the last 24 will be stored.

This event record is stored in a capacitor backed up RAM memory. Events functionality in MIB is performed via the EnerVista MII SETUP software.

Inside the ADVANCED SETTINGS group, there is a sub-group called EVENT MASKS, from where the different causes that can produce events can be masked. They are detailed in the SETPOINT – SETPOINT – ADVANCED SETTINGS – EVENT MASK section. The following table shows a list of all possible events.

Table 2–1: LIST OF EVENTS

NAME	VALUE
87 1 Pickup/Drop out	Yes
87 2 Pickup/Drop out	Yes
General PIckup	Yes
87 1 Trip	Yes
87 2 Trip	Yes
General trip	Yes
87 1 Disable by input	Yes
87 2 Disable by input	Yes
Trip disabled (by DI)	Yes
Protection status	Yes
Output 1	Yes
Output 2	Yes
Output 3	Yes
Output 4	Yes
Digital Input 1	Yes
Digital Input 2	Yes
Sett. change disable	Yes
Trip operation by input	Yes
Trip operation by command	Yes
Reset latch aux	Yes
Settings group change	Yes
Oscillo trigg by DI	Yes
86 Status	Yes
Reset 86	Yes
Oscillo trigg by comm	Yes
Settings change	Yes
EEPROM Failure	Yes
User settings	Yes

MIB1000/3000 stores an oscillography record, with a resolution of 8 samples per cycle with a length of 24 cycles (including 2 pre-fault cycles), with the following information:

Instantaneous values of currents. The 2 first cycles are pre-fault cycles.

- Digital information:
  - •Pickups (protection functions)
  - •Trip inhibition by digital input (protection functions)
  - •Trips (protection functions)
  - •Auxiliary digital outputs
  - •Digital inputs
- Date and time
- Model
- Number of oscillo
- Value of the differential currents at the moment of the oscillography trigger
- Active group at the moment of the oscillography trigger
- Element settings when retrieving the oscillography record.

The number of oscillo is a circular counter that increases with each generated oscillography. This value appears on the relay status and is used only for informative purposes.

The oscillography record is stored in a capacitor backed up RAM memory.

MIB functionality related to oscillography is performed from the ENERVISTA MII SETUP program. The oscillography record obtained is stored on the PC in a COMTRADE-IEEE C37.111-1991 format.

There are four possible causes that can produce an oscillography trigger:

1. Pickup of one of the protection functions
2. Trip of one of the protection functions
3. Oscillography trigger by communications
4. Oscillography trigger by digital input

In the ADVANCED SETTINGS group, there is a sub-group called OSCILLOGRAPHY MASKS, from where the above-mentioned causes can be masked. They are detailed in the SETPOINT – SETPOINT – ADVANCED SETTINGS – OSCILOGRAPHY MASK section.

Two independent Setting Groups are available in the permanent (non-volatile) memory of the MIB relay. Only one of the two is active at a given time. Users can select which setting group is active using a setting, sending a command to the relay from the communications program, or by a digital input.

Settings are divided in two different categories: Main Settings and Advanced Settings. This makes setting the relay extremely simple for those users who want to use just the Main functions of the MIB relay. Users who require the full functionality of the relay can use the Advanced Settings.

2.8.1 MEASUREMENT

MIB provides actual values for differential currents Accuracy is 1% at nominal current, and 3% in the complete range.

2.8.2 SELF-TEST

Self-monitoring tests are carried out both when the unit is started up and during normal operation. Any internal problem detected by the self-monitoring function will issue an alarm and the READY output contact will be released, indicating an out of service condition.

There are 6 LED Targets in the front of the relay. The first one is green ('READY' -relay in service-) and cannot be configured; the second one is red and fixed for trip, while the other 4 can be configured by the user. The default configuration of the LEDs is shown in the following figure.

Figure 2–7: MIB LEDS DEFAULT CONFIGURATION

It is possible to configure the color of the 4 configurable LEDs between red and green using the keypad of the front panel of the relay (for details, refer to Chapter 7).

The indication of each LED is as follows:

READY: The relay is powered up, its power supply is receiving VDC or Vac, and all the internal circuits are working properly. The relay status setting is set as "RDY" (ready) and at least one of the protection functions is enabled. If the LED is off with the above-mentioned conditions, this indicates a loss of auxiliary supply voltage or an internal HW/SW critical failure condition.

TRIP: The relay has issued a trip, activating the corresponding tripping output contact.

MIB 10 and MIB 20

87-1 Trip: Indicates that the trip has been issued by 87-1

87-2 Trip: Indicates that the trip has been issued by 87-2

87-1 Pickup: Indicates that element 87-1has picked up

87- 2 Pickup: Indicates that element 87-2 has picked up

MIB 30

87- A Trip: Indicates that the trip has been issued by 87-1 or 87-2 for phase A

87- B Trip: Indicates that the trip has been issued by the 87-1 or 87-2 for phase B

87- C Trip: Indicates that the trip has been issued by the 87-1 or 87-2 for phase C

PICKUP: Indicates that at least one of the protective elements has picked up.

LEDs associated to tripping functions are latched and once they have been turned on, they remain on until the ESC/RESET button is pressed for more than 3 seconds (RESET) providing that the trip condition has disappeared. The LED associated to *function pickup* is self-reset type, and stays on while the pickup condition (current above setting) exists.

2.9.2 KEYPAD AND DISPLAY

A five-button keypad allows access to MIB relay information and settings changes. Measurement data (actual values), five last trip information (fault reports) and settings are shown on the 16x2 character LCD display.

The keypad includes the functionality to modify the contrast of the display (refer to Chapter 8 for details).

The event list, oscillography, I/O and logic configuration can be accessed only from the EnerVista MII SETUP program.

2.9.3 COMMUNICATION PORTS

The front RS232 and the rear RS485 port provide interface with the relay. All serial ports use the Modbus® RTU protocol and may be connected to system computers with baud rates from 300 to 19200 bps. Up to 32 MIB relays can be connected (daisy-chained) on the same communication circuit. Each relay must be assigned a different Modbus Address (using a setting) if multiple relays are connected on the same circuit.

2.9.4 SOFTWARE

MIB units are supplied together with EnerVista MII SETUP software, a Windows® based software that allows communication with the relay for data viewing and retrieval, as well as oscillography, I/O configuration and logical configuration (in models where these features are available).

MIB Units are made up of two different modules, such as:

- High Speed overcurrent protection module: MIB, supplied as 4U high and ¼ of a 19'' rack wide.
- High impedance module: HID, supplied in a metallic case of ½ rack and 4U high.

Both modules can be mounted independently or they can be mounted together in a standard 19" rack 6 units high.

The information required to completely specify the relay is provided in the following table:

MIB	-	0	-	-	C	E	0	0	0	0	0	DESCRIPTION
												Number of High Impedance Differential Elements
	1											1 winding transformer Restricted Ground Fault application
	2											2 winding transformer Restricted Ground Fault application
	3											Bus / machine application
												Power Supply
			L	O								48 VDC (range: 39~57 VDC)
			H	I								125 VDC (range: 100~150 VDC)
			H	H								220 VDC (range: 176~264 VDC)

ACCESSORIES

A depth-reducing (B1315P7) collar can be ordered separately. This collar reduces the mounting depth in 63 mm (2.48 inches).

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

2.11.1 PROTECTION ELEMENTS

2.11.1.1 DIFFERENTIAL ELEMENTS (87 1, 87 2)

Current Input:	Fundamental
Rated Current	1 A
Pickup Level:	0.005 to 0.400 A in steps of 0.01 A
Reset Level:	97% to 98% typical
Level Accuracy:	±3% in the complete range ±1mA
Operate Time:	< 15 ms at 4 x pickup
Time Delay:	0.00 to 600.00 sec. in steps of 0.01 s
Timing Accuracy:	± 3% of operate time or ±20ms (whichever is greater) at 1.03 x pickup
Reset Type:	Instantaneous

2.11.2 METERING FUNCTIONS

2.11.2.1 CURRENT

Accuracy:	±3% ±1mA in the complete range

2.11.3 INPUTS

2.11.3.1 AC CURRENT

Secondary Rated Current	In = 1 A
Frequency	50/60 Hz +-3 Hz (The unit can be set to 50 or 60 Hz)
Relay CT Burden	<0.08 VA @ In=1A secondary
Current Withsband	4 x In continuously
	100 x In for 1 sec

NOTE: The values shown in this point refer to the current inputs of the relay. The relay can use CTs of rated currents of 1 or 5A, if they are connected as shown in the 2.2 point, since the current input will be the differential one.

2.11.3.2 DIGITAL INPUTS

Voltage Level:	300 VDC maximum for HI Power Supply 75 VDC maximum for LO power supply
Recognition Time:	< 4 ms

2.11.4 POWER SUPPLY

2.11.4.1 LOW RANGE

Rated DC Voltage:	24 to 48 VDC
Min./Max. DC Voltage:	19 / 58 VDC

2.11.4.2 HIGH RANGE

Rated DC Voltage:	110 to 250 VDC
Min./Max. DC Voltage:	88 / 300 VDC
Rated AC Voltage:	110 to 230 Vac @ 50 – 60 Hz
Min./Max. AV Voltage:	88 / 264 Vac @ 50 – 60 Hz
Power Consumption:	Max. = 10 W
Proper backup time (date, time and log memory) without power supply voltage	> 1 week

2.11.4.3 LOW RANGE (HID MODULE)

Rated DC Voltage:	48 VDC
Min./Max. DC Voltage:	38 / 57 VDC
Consumption:	8W at rated voltage

2.11.4.4 HIGH RANGE 125 VDC (HID MODULE)

Rated DC Voltage:	125 VDC
Min./Max. DC Voltage:	100 / 150 VDC
Consumption:	8W at rated voltage

2.11.4.5 HIGH RANGE 220 VDC (HID MODULE)

Rated DC Voltage:	220 VDC
Min./Max. DC Voltage:	176/264 VDC
Consumption:	8W at rated voltage

2.11.5 OUTPUTS

2.11.5.1 OUTPUT RELAYS

Configuration:	6 Electro-Mechanical Form C
Contact Material:	Silver alloy suited for inductive loads
Maximum Operating Voltage:	400 Vac
Single Contact Carry Continous:	10 A at 250 Vac. general purpose
	¾ HP, 124 Vac
	1-1/2 HP, 250 Vac
	10A, 250 Vac, 0.4 PF,
	B300 pilot duty
Make and Carry:	30 A
Breaking:	4000 VA

Max. Ratings for 100.000 operations:

VOLTAGE	MAKE&CARRY CONTINUOUS	MAKE&CARRY 0.2 SEC	BREAK	MAX LOAD
DC Resistive				
24 VDC	10 A	48 A	10 A	384W
48 VDC	10 A	48 A	2.6 A	125W
125 VDC	10 A	48 A	0.6 A	75 W
250 VDC	10 A	48 A	0.5 A	125 W
AC Resistive				
120 Vac	10 A	48 A	10 A	1920 VA
250 Vac	10 A	48 A	10 A	4000 VA
AC Inductive PF = 0.4				
250 Vac	10 A	30 A	10 A	1000 VA

2.11.6 COMMUNICATIONS

FRONT PORT	RS232	300, 600, 1200, 2400, 4800, 9600 or 19200 bps, Modbus® RTU
REAR PORT	RS485	300, 600, 1200, 2400, 4800, 9600 or 19200 bps, Modbus® RTU

2.11.7 ENVIRONMENTAL

Operating Temperatures:	-20º C to +60º C
Ambient Storage Temperatures:	-40º C to +80º C
Maximum relative humidity	95%
Altitude	2000 m. Max
Pollution Degree	2

2.11.8 TYPE TESTS AND CERTIFICATIONS

The MIB system complies with the following standards, which include the standards required by Community Directive 89/336 for the CE marking, in line with European standards. It also complies with the European directive requirements for low voltage, and the environmental and operating requirements established in ANSI standards C37.90, IEC 255-5, IEC 255-6 and IEC 68.PRODUCTION TESTS

Test	Standard	Class
Insulation Test Voltage:	IEC 60255-5	2kV, 50/60 Hz 1 min
Surge Test Voltage:	IEC 60255-5	5 kV, 0.5 J. (3 positive pulses and 3 negative.)
1 MHz Interference:	IEC 60255-22-1	III
Electrostatic Discharge:	IEC 60255-22-2	IV
	EN 61000-4-2	8 kV in contact, 15 kV through air.
Radiointerference:	IEC 60255-22-3: 40 MHz, 151 MHz, 450 MHz and cellular phone.	III

Radiated Electromagnetic fields with amplitude modulation.	ENV 50140	10 V/m
Radiated Electromagnetic fields with amplitude modulation. Common mode.	ENV 50141	10 V/m
Radiated Electromagnetic fields with frequency modulation.	ENV 50204	10 V/m
Fast Transients:	ANSI/IEEE C37.90.1	IV
	IEC 60255-22-4	IV
	BS EN 61000-4-4	IV
Magnetic fields at industrial frequency:	EN 61000-4-8	30 AV/m
Power Supply interruptions:	IEC 60255-11	
Temperature:	IEC 57 (CO) 22	
RF Emission:	EN 55011	B
Sinusoidal Vibration:	IEC 60255-21-1	I
Shock:	IEC 60255-21-2	I

2.11.9 PRODUCTION TESTS

Insulation Test:	IEC255-5 (Tested on CTs, Power Supply terminals, Contact Inputs and Contact Outputs)

2.11.10 APPROVALS

Manufactured under an ISO9001 Registered system

Conforms to CE Marking

UL listed (File E234610)

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

2.12.1 VOLTAGE LIMITERS

TECNOLOGY: MOV (METAL OXYDE VARISTOR)

Nominal Voltage (VDC):	970 V
Nominal Voltage (VAC):	750 V
Nominal Current (DC):	4.7 mA ± 50%
Pick Voltage:	1880 V
Pick Current:	200 A
Power Dissipation:	8 W
Nominal Power Absorption:	2600 J

STABILIZING RESISTORS

Resistance with latching relay	20 x 100 SAC 2k 75W

2.12.2 LATCHING RELAY

NOMINAL VOLTAGE	
Latching relay LO	48 VDC
Latching relay HI	125 VDC
Latching relay HH	220 VDC
Operation range	80 % to 150 % of nominal voltage
Consumption	8 W at nominal voltage
Pickup value	60% of nominal voltage
OPERATING TIME (at nominal voltage)	
Close time (N.O. contact)	< 25 ms.
Open time (N.C. contact)	< 20 ms.
CONTACTS	
Continuous current	10 A continuous
	20 A during 1 minute
	200 A during 1 second
Breaking	5000 VA non inductive at 250 Vac
	375 W inductive at 125 VDC.
	250 W inductive at 250 VDC.
DIELECTRIC WITHSTAND	
Between independent circuits	2500 Vac one minute
Between circuits and ground	2500 Vac one minute
Between open contact terminals	1800 Vac one minute
Mechanical life	More than 10 million operations

2.12.3 ENVIRONMENTAL

Operating temperatures	-20ºC to +60ºC
Ambient storage temperatures	-40ºC to +80ºC
Maximum relative humidity	95%
Altitude	2000 m. max
Pollution degree	2

WARNING

The system incorporates electronic components that might be affected by electrostatic discharge currents flowing through certain component terminals. The main source of electrostatic discharges is human body, especially under low humidity conditions, with carpet floors or isolating shoes. If such conditions are present special care should be taken while manipulating MIB modules. Operators, before even touching any components, must make sure that their bodies are not charged by either touching a grounded surface or by using an antistatic grounded wrist bracelet.

Units are made up of different modules, such as:

High Speed overcurrent protection module

High impedance module

Both modules can be mounted independently or they can be mounted together in a standard 19" rack 6 units high

Figure 3–1: MIB FRONT VIEW

High impedance modules incorporate the following parts:

1. Latching relay
2. Resistors
3. MOV (Metal Oxide Varistors)
4. Reset button

   Metallic Case

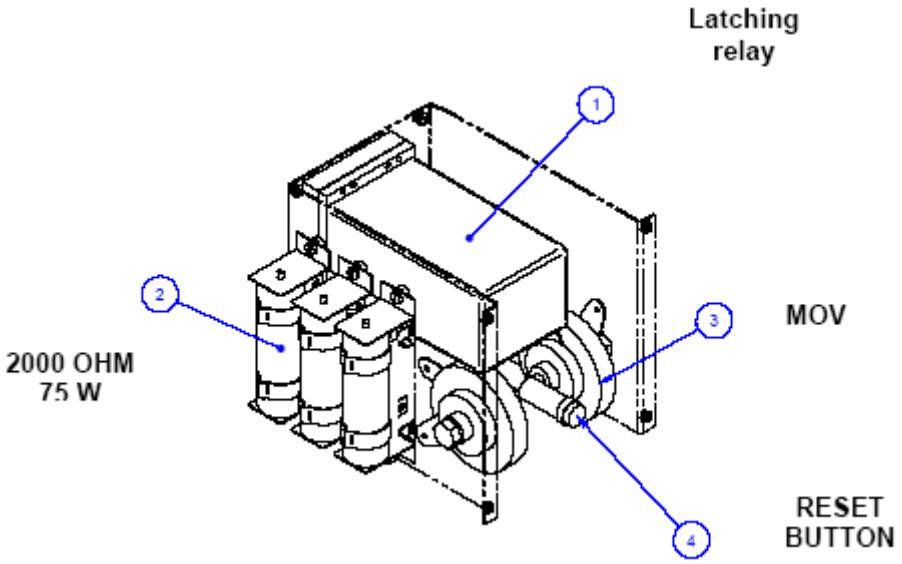


Figure 3–2: INTERNAL MOUNTING VIEW

3.2.1 MOUNTING

The HID module is composed of a black metallic stainless steel case. The case contains a metallic panel to which the MOV (Metal Oxide Varistors) and the stabilizing resistors are hooked, as well as the connections base for the latching relay and internal connections among the stabilizing resistors, MOV, and latching relay contacts.

Components are mounted on a base screwed to the rear side of the case. The module is closed with the frontal plate where the latching relay reset button is located. This allows the user access to the front reset button. The HID module is secured to the panel with the 4 M6 screws provided with the unit.

Wiring is made in the rear side of the module. Drilling dimensions are shown on the drilling dimension diagram.

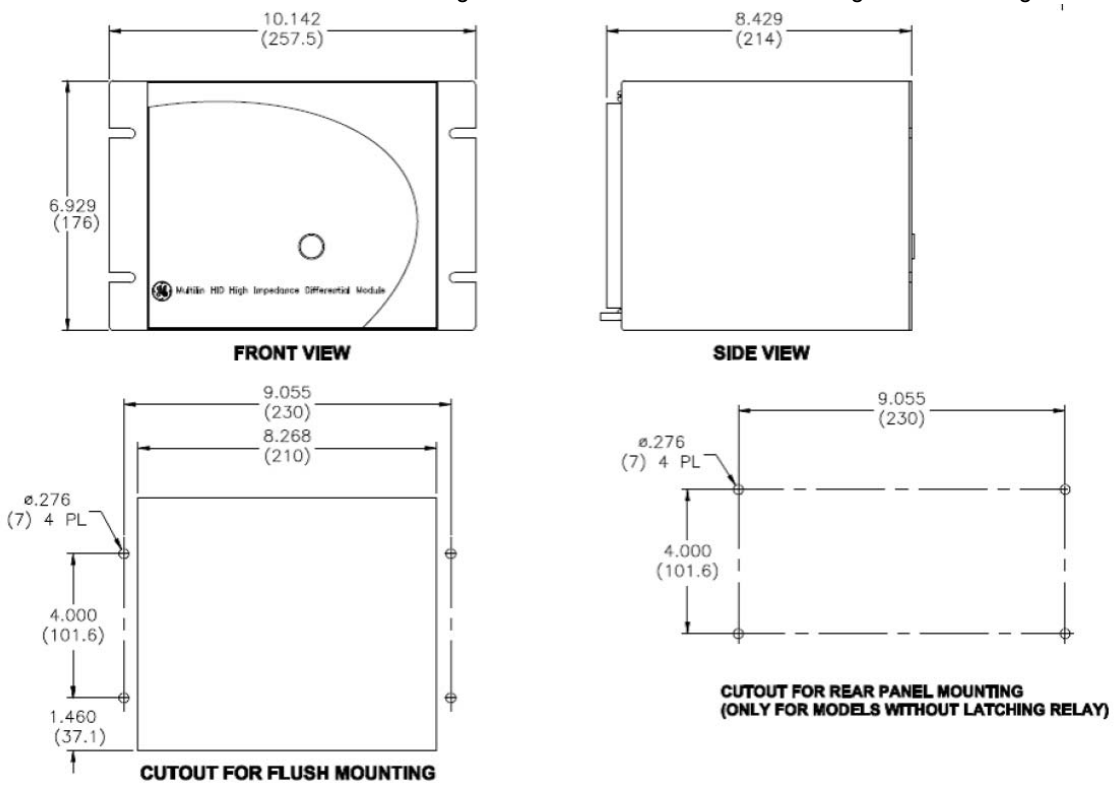


Figure 3–3: DIMENSIONS AND DRILLING FOR HID MODULE WHEN MOUNTED ALONE

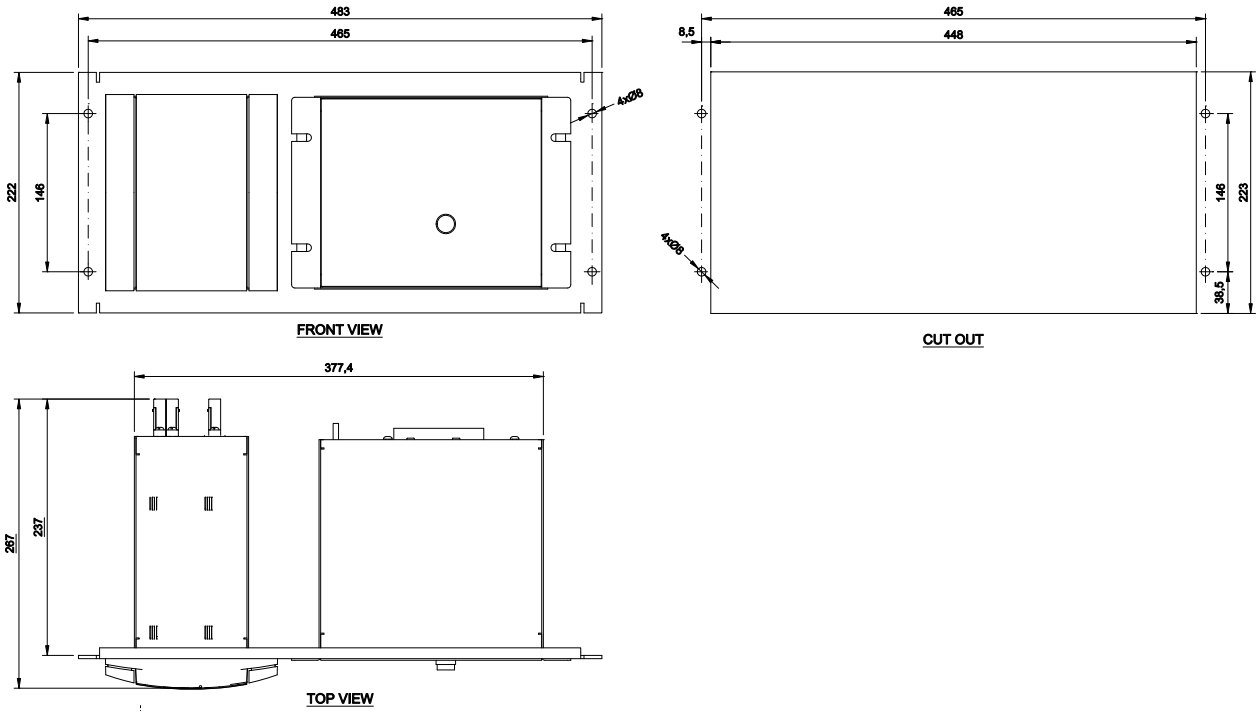


Figure 3–4: DIMENSIONS AND DRILLING FOR HID MODULE WHEN MOUNTED TOGETHER WITH MIB MODULE IN A 19" RACK

3.2.2 MECHANICAL DESCRIPTION

The HID module is available in a metallic case of ½ rack four units high, highly resistant to corrosion. It is made of stainless steel (AISI 304), coated with an epoxy layer, and the rest of the metallic pieces are covered with a high quality resistive coating that has successfully passed at least 96 hours in the salt spray chamber (S/N ASTM B-117).

As well, an IP52 (IEC 529) protection degree against dust and water through the front and with the relay mounted in the panel .

3.2.3 REAR DESCRIPTION

The relay is wired through the terminal blocks located at the rear of the unit. The maximum recommended cable section for this terminal board, with the appropriate terminal, is 6 mm^2 (AWG 10).

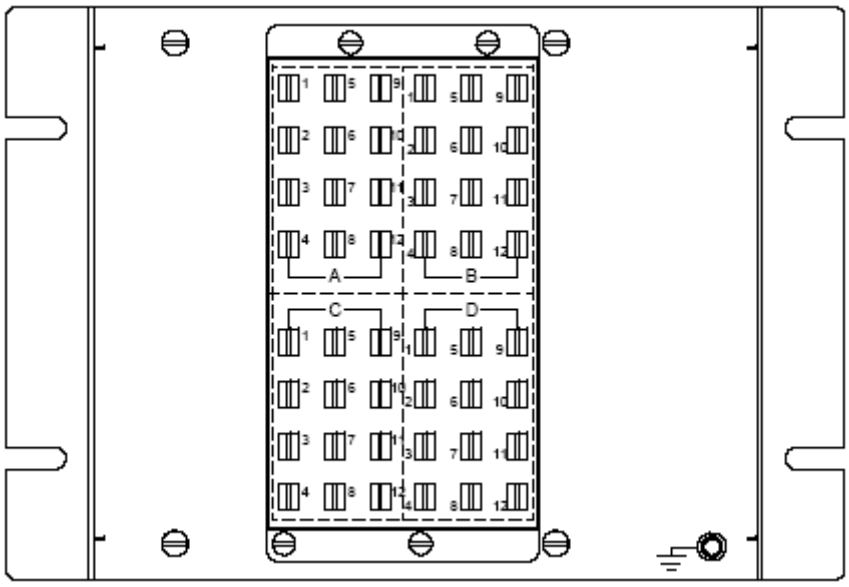


Figure 3–5: REAR VIEW TERMINALS DIAGRAM

Recommended cable section: 12/16 AWG.

Copper conductor only.

Tightening torque for M3 screw connections (HID unit): 0.3 Nm

Tightening torque for M4 screw connections (MIB unit): 1.2 Nm

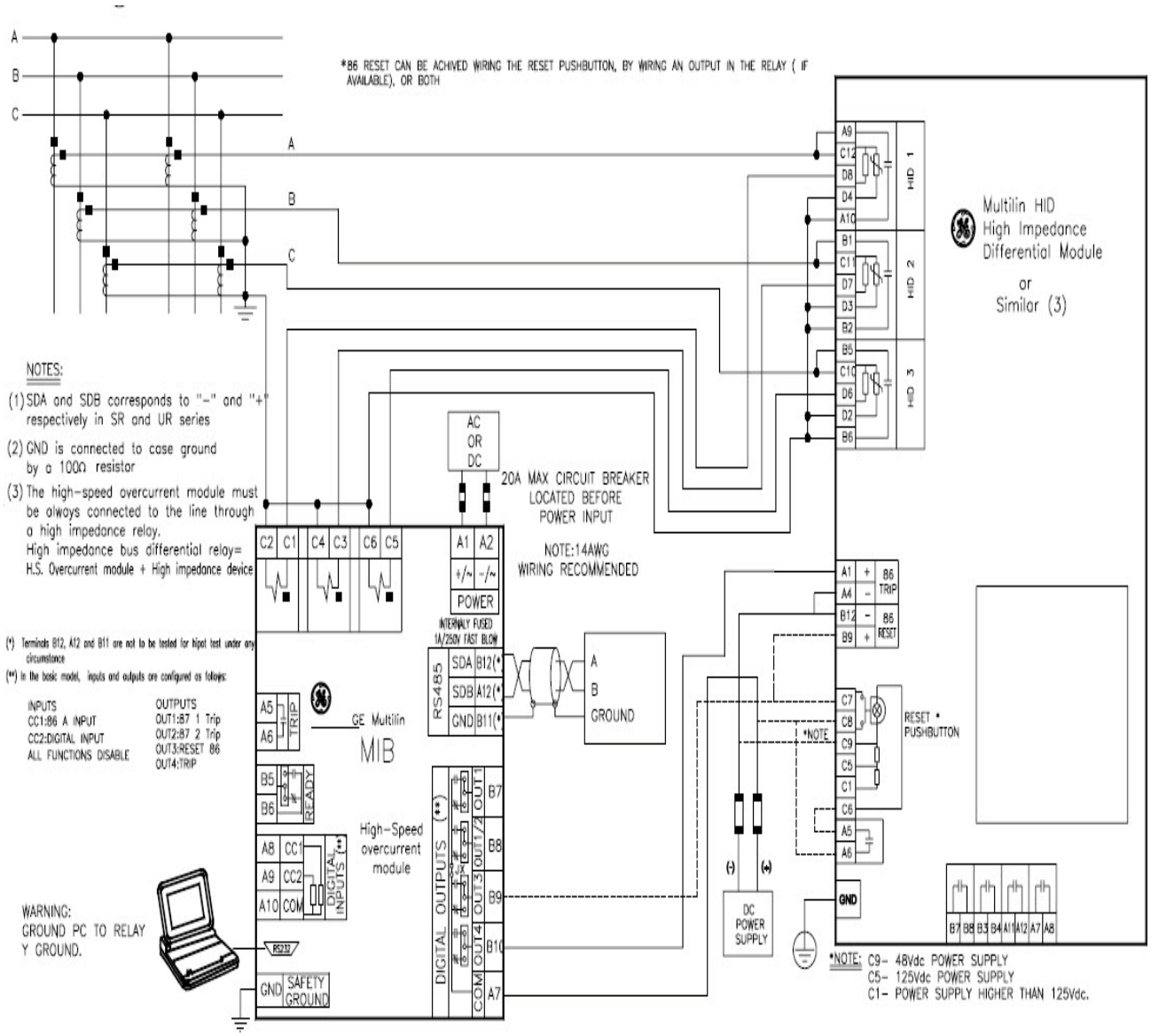


Figure 3–6: TYPICAL WIRING DIAGRAM FOR MIB RELAY

3.2.5 CONTROL POWER

CAUTION: CONTROL POWER SUPPLIED TO THE RELAY MUST MATCH THE RATED VOLTAGE OF THE RELAY. IF THE VOLTAGE IS APPLIED TO THE WRONG TERMINALS, DAMAGE MAY OCCUR.

Table 3–2: CONTROL POWER VOLTAGE RANGE

RANGE	OPERATION RANGE
LO	38.4-57.6 VDC
HI	100-150 VDC
HH	176-264 VDC

MIB current inputs are composed of four elements:

1. Stabilizing resistor (inside HID).
2. Varistor (inside HID)
3. Contact from latching relay (inside HID)
4. Current input in the high-speed overcurrent module.

Depending on selected MIB model, the inputs configuration of High Impedance Device may change. If the Number of High Impedance Differential Elements is 1, the HID will have only one input, If the Number of High Impedance Differential Elements is 2, the HID will have two inputs, and If it is Bus / machine application it will have three inputs.

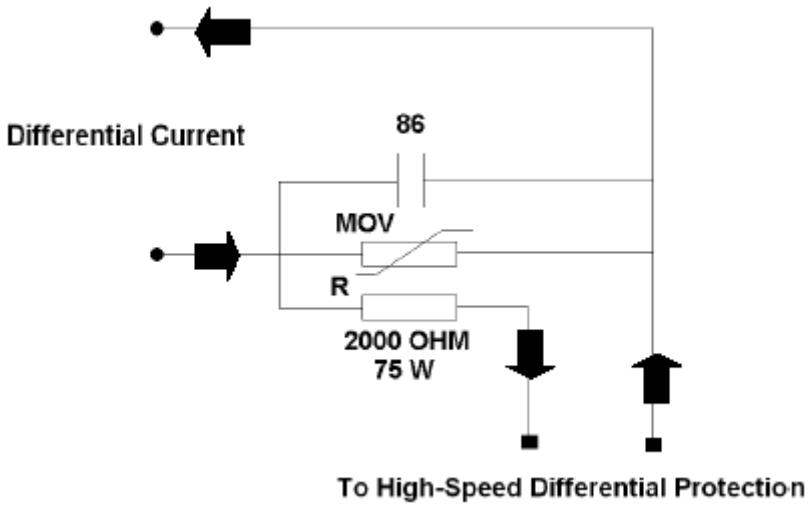


Figure 3–7: MIB CURRENT INPUTS

Current flows through stabilizing resistor into current input of the overcurrent module. Once high-speed overcurrent module trips, latching relay contacts short-circuit stabilizing resistor plus current input. In this way, excessive heating causing damage to resistors is avoided. MOV is used to avoid overvoltages damaging current input, limiting voltage to 1880V.

3.3.1 MECHANICAL DESCRIPTION

The high-speed overcurrent module is available in a box of a quarter of 19” rack four units high. The metallic case of the unit is highly resistant to corrosion. It is made of stainless steel (AISI 304), coated with an epoxy layer, and the rest of the metallic pieces are covered with a high quality resistive coating that has successfully passed at least 96 hours in the salt spray chamber (S/N ASTM B-117).

The front of the relay is made of a shielded high quality thermoplastic, flame retardant (V0), highly resistive material, which guarantees the unit’s immunity to all types of EMI/RFI/ESD interference. As well, an IP52 (IEC 529) protection degree against dust and water through the front and with the relay mounted in the panel.

The modular design of the relay simplifies repair or replacement of its components, without the need to manipulate the wiring. These types of operations must be performed exclusively by qualified personnel and only after removing auxiliary voltage from the unit.

3.3.2 MOUNTING

The high-speed overcurrent module is secured to the panel with the 4 M6 screws provided with the unit. This allows the user access to the front keypad, display and communication port. The wiring is at the rear of the unit. The drilling dimensions are shown on the drilling dimension diagram.

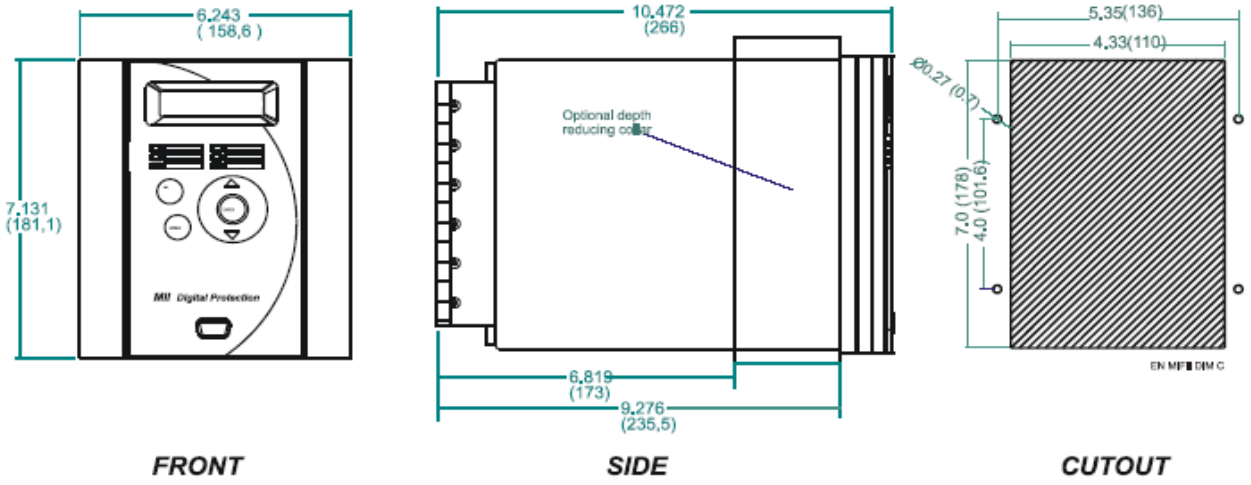


Figure 3–8: HIGH-SPEED OVERCURRENT PROTECTION MODULE MOUNTING DIAGRAM

3.3.3 REAR DESCRIPTION

The module is wired through the terminal blocks located at the rear of the unit. In these terminal blocks, current terminals are shorted two-by-two when the module is extracted, so that the CT secondary never remains open. The maximum recommended cable section for this terminal board, with the appropriate terminal, is 6 mm2 (AWG 10).

High-speed overcurrent modules have two contact inputs named CC1 and CC2. Default configuration for both inputs is:

- CC1: 86a contact
- CC2: All functions disable

CC1 is intended to be used with an auxiliary contact from the latching relay (A7-A8) is shown in external wiring diagram). In this way, high-speed overcurrent module is able to know the latching relay status.

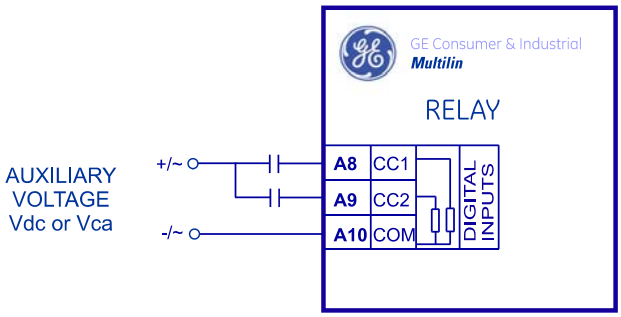


Figure 3–9: CONTACT INPUTS CONNECTIONS

Wet contacts must be connected to the inputs of the relay. A wet contact has one side connected to the positive terminal of an external DC power supply. The other side of this contact is connected to the required contact input terminal (A8 or A9). In addition, the negative side of the external source must be connected to the relay common (negative) terminal (A10). The maximum external voltage source voltage for this arrangement is 300 VDC for HI models and 57.6 for LO models.

The voltage threshold at which an input will detect a closed contact input depends on the relay model. For low voltage range relays (LO model), the threshold is set to 12 VDC. For high voltage range relays (HI model), the voltage threshold is 75 VDC.

In case of using AC voltage, it must be ensured that there is no voltage (less than 10 Vac) between the input common terminal, A10, and the ground terminal. The AC system must be line/neutral type, and not line/line, ensuring that the neutral and ground do not differ in more than 10 Vac. The reason for this is that there might be enough current circulating through the EMC filtering capacitors on these inputs to cause undesired activation.

If it is not possible to ensure the previous conditions, the connection shown below can be used, where lines are wired only to inputs (A8 and A9), and the common (A10) is connected to the unit ground terminal.

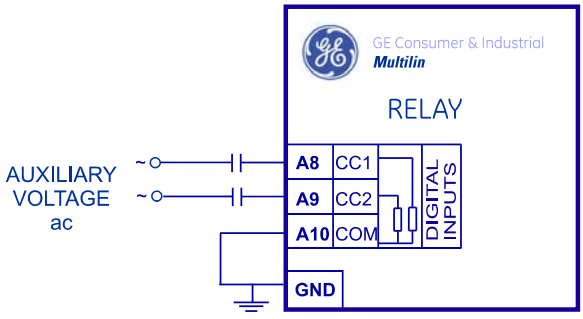


Figure 3–10: CONTACT INPUTS CONNECTIONS (AC ACTIVATION)

3.3.5 OUTPUT CONTACTS CONFIGURATION

MIB relays provide one trip contact, one alarm (system ready) contact and four auxiliary contacts sharing one common located in the high-speed overcurrent module. All output relays are form C relays.All output relays are form C relays. Only one of the two states of the form C relay is connected to the output terminal. For each output relay it is possible to select which state is preferred to have at the MIFII terminals, NC (normally closed) or NO (normally open).

Next figure shows the PCB of a relay, and the location of the jumpers used to select the configuration of each output contact (NO or NC).

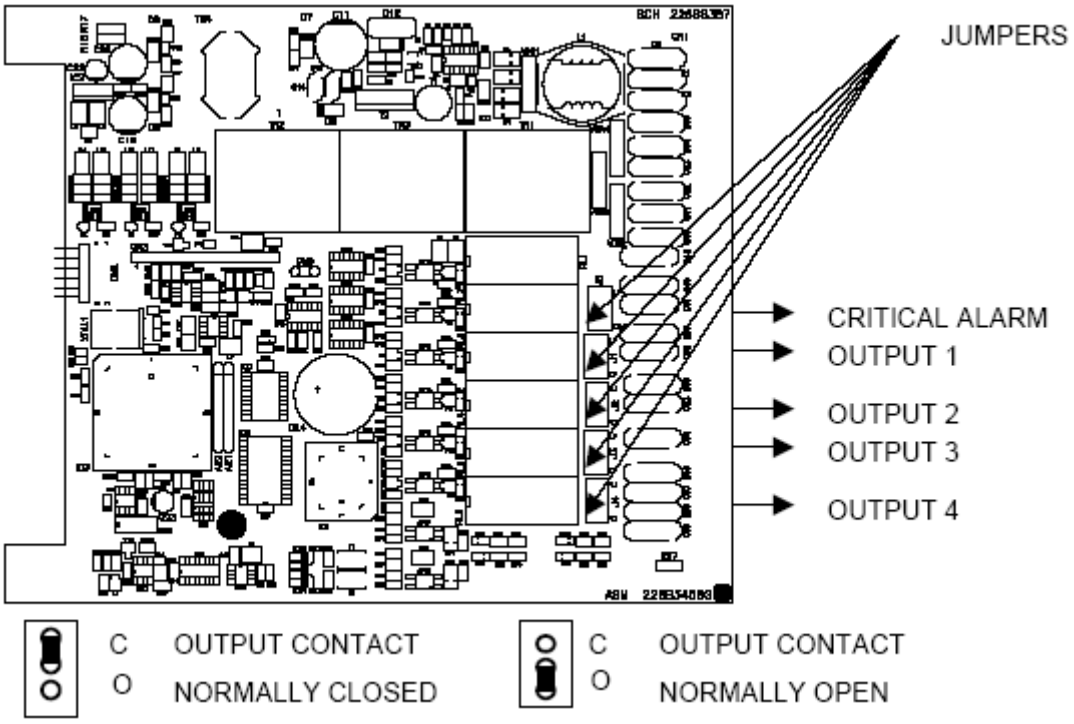


Figure 3–11: PCB SCHEME SHOWING THE JUMPERS TO CONFIGURE THE OUTPUT CONTACTS (NC / NO)

MII relays provide one trip contact, one alarm contact and four configurable contacts (option 1 and 2) sharing one common.

An internal jumper, called Jx jumper, has been provided to allow splitting the four configurable outputs into two isolated groups. In this case, the number of outputs is reduced to three.

Jx jumper is closed in the factory default configuration. (It is possible to order relays with Jx removed).

The figure shows the factory default configuration with Jx Jumper closed. It is located on the soldering part of the PCB containing the inputs and outputs.

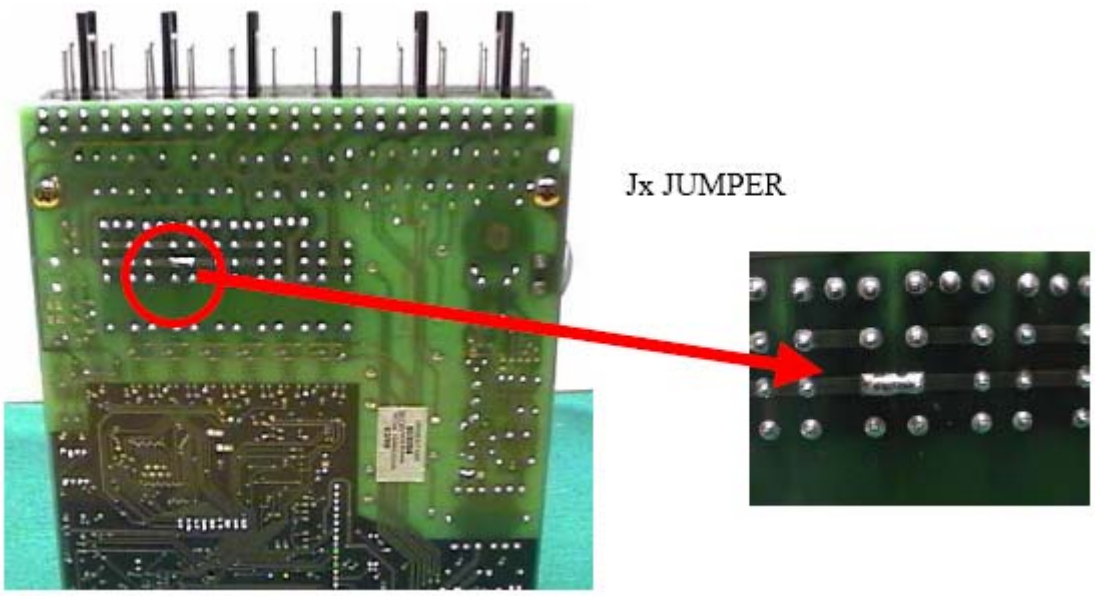
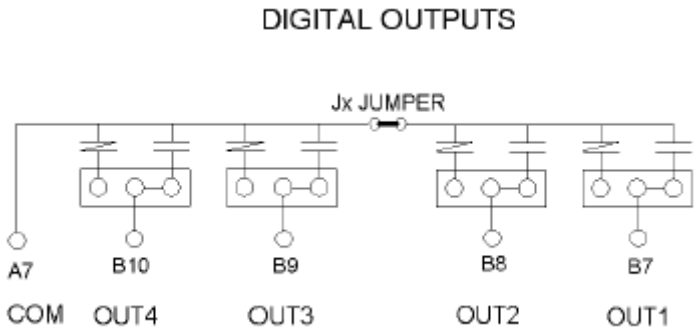


Figure 3–12: JX JUMPER

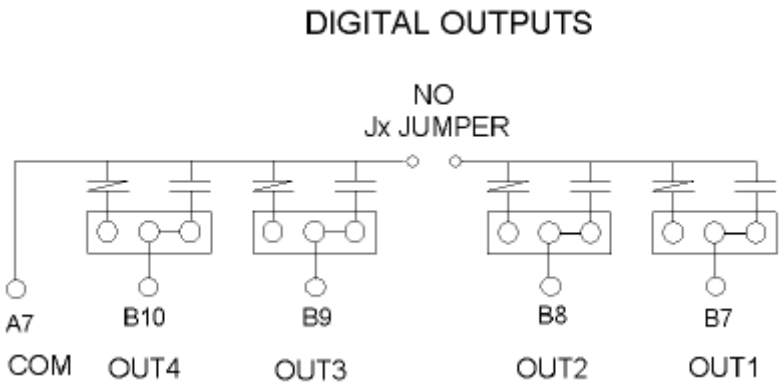
The Jx jumper is a tin-solder jumper easy to remove using a de-soldering tool.

The standard factory default output contact configuration consists of one group of four outputs, with the same common. The figure below shows the configuration:



Each output has a different configuration, and it is able to operate independently to the others.

If Jx jumper is removed, the output contact configuration change as shown in the following figure:



After removing the Jx Jumper, the outputs are divided in two groups: Independent and isolated.

Group1: Terminals B8-B7: Provide one output contact combining OUT1 and OUT2

Group 2: Terminals B9-A7: OUT3 Standard output contact

Terminals B10-A7: OUT4 Standard output contact

3.3.6.1 OUTPUT CONFIGURATION AT TERMINALS B8-B7:

To have a **normally open** contact across terminals B7-B8, configure OUT1 and OUT2 as shown bellow:

- Remove JX internal jumper
- Keep OUT1 and OUT2 as normally open contacts (factory default conf.)
- Using the PC software, configure the two outputs to operate using the same internal signal. The internal signal used in the example is "XX TRIP"

OUT1 and OUT2 must operate together to operate like a single output.The configuration of OUT1 and OUT2 must be the same so both outputs close.

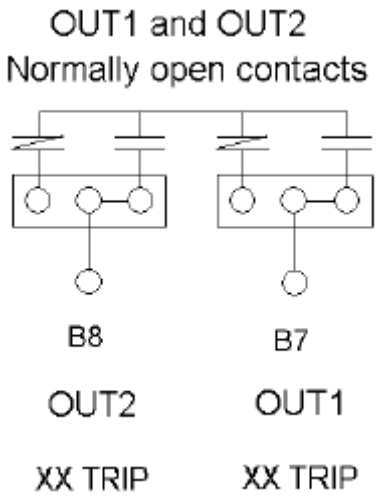
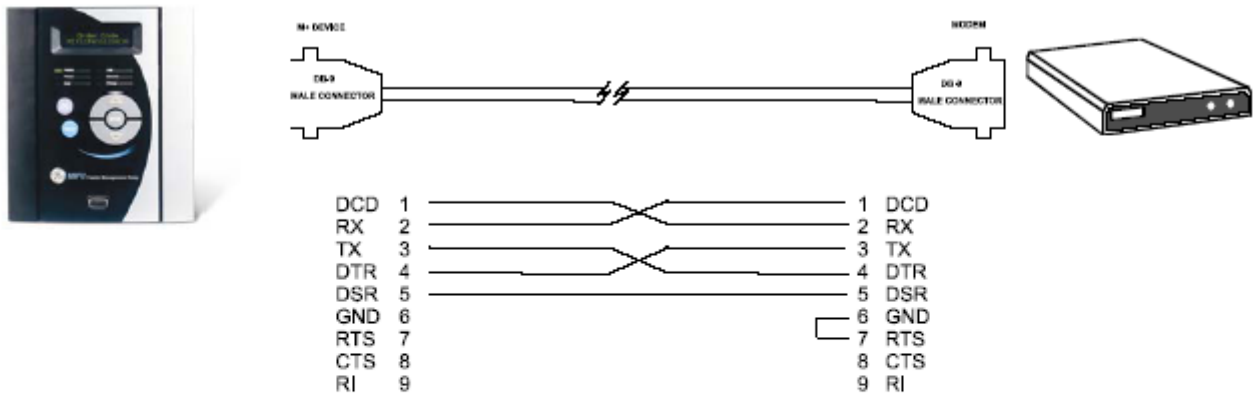


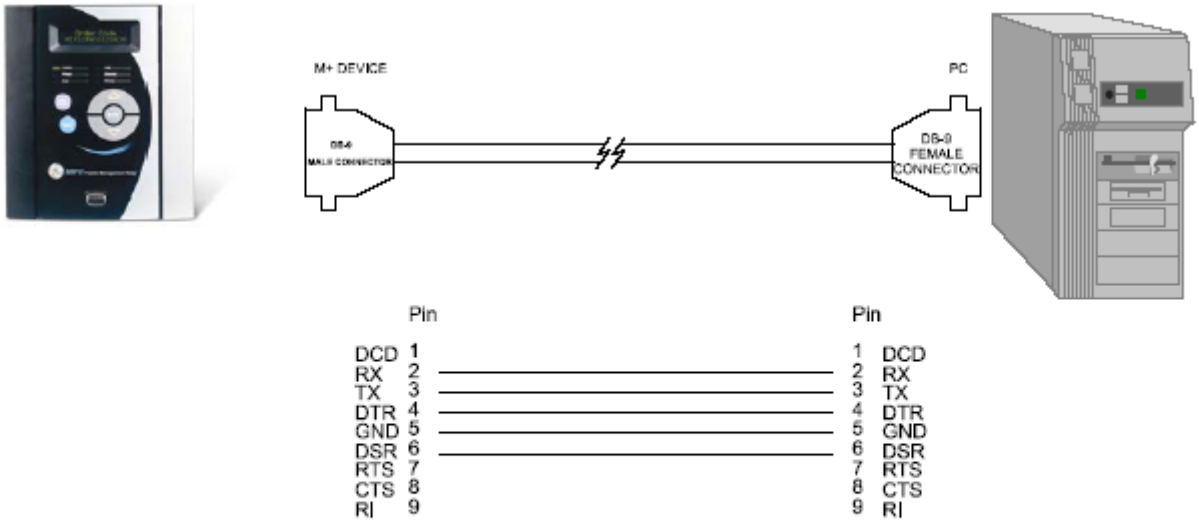
Figure 3–13: OUT1 AND OUT2 CONFIGURATION TO ACT AS A NORMALLY OPEN CONTACT

3.3.7 RS232 FRONT COMMUNICATIONS PORT

A 9-pin RS232C serial port is located on the front of the relay for programming with a portable (personal) computer. All that is required to use this interface is a personal computer running the EnerVista MII SETUP software. Next figure shows the communications cable configuration.



RELAY-MODEM CONNECTION WIRE, FOR RS-232 FRONT PORT



RELAY - PC CONNECTION WIRE FOR RS-232 FRONT PORT

Figure 3–14: RS232 FRONT PORT CONNECTION

WARNING: IN ORDER TO PREVENT DAMAGE BOTH TO THE PC SERIAL COMMUNICATIONS PORT AND THE RELAY FRONT RS232 PORT, IT IS COMPULSORY TO CONNECT THE RELAY GROUND TO THE SAME GROUND AS THE PC. OTHERWISE, USE AN UNGROUNDED COMPUTER.

FOR THIS PURPOSE, PLEASE FOLLOW THE SAFETY INSTRUCTIONS IN CHAPTER 1

In addition to the front RS232 port, the relay provides the user with an additional RS485 communication port. RS485 data transmission and reception are accomplished over a single twisted pair that transmit and receive data alternating over the same two wires. Through the use of these port, continuous monitoring and control from a remote computer, SCADA system or PLC is possible.

To minimize errors from noise, the use of shielded twisted pair wire is recommended. For a correct operation, polarity must be respected, although if it is not, there is no danger to damage the unit. For instance, the relays must be connected with all RS485 SDA terminals connected together, and all SDB terminals connected together. The RS485 standard refers only to terminals named “A” and “B”, although many devices use terminals named “+” and “-“. As a general rule, terminals “A” should be connected to terminals “-“, and terminals “B” to “+”. There are exceptions to this rule, such as the GE ALPS and DDS family of relays. The GND terminal should be connected to the common wire inside the shield, when provided. Otherwise, it should be connected to the shield. To avoid loop currents, the shield should be grounded at one point only. Each relay should also be daisy chained to the next one in the link. A maximum of 32 relays can be connected in this manner without exceeding driver capability. For larger systems, additional serial channels must be added. It is also possible to use commercially available repeaters to increase the number of relays on a single channel to more than 32. Do not use other connection configurations different than the recommended.

Lightning strikes and ground surge currents can cause large momentary voltage differences between remote ends of the communication link. For this reason, surge protection devices are provided internally. To ensure maximum reliability, all equipment should have similar transient protection devices installed.

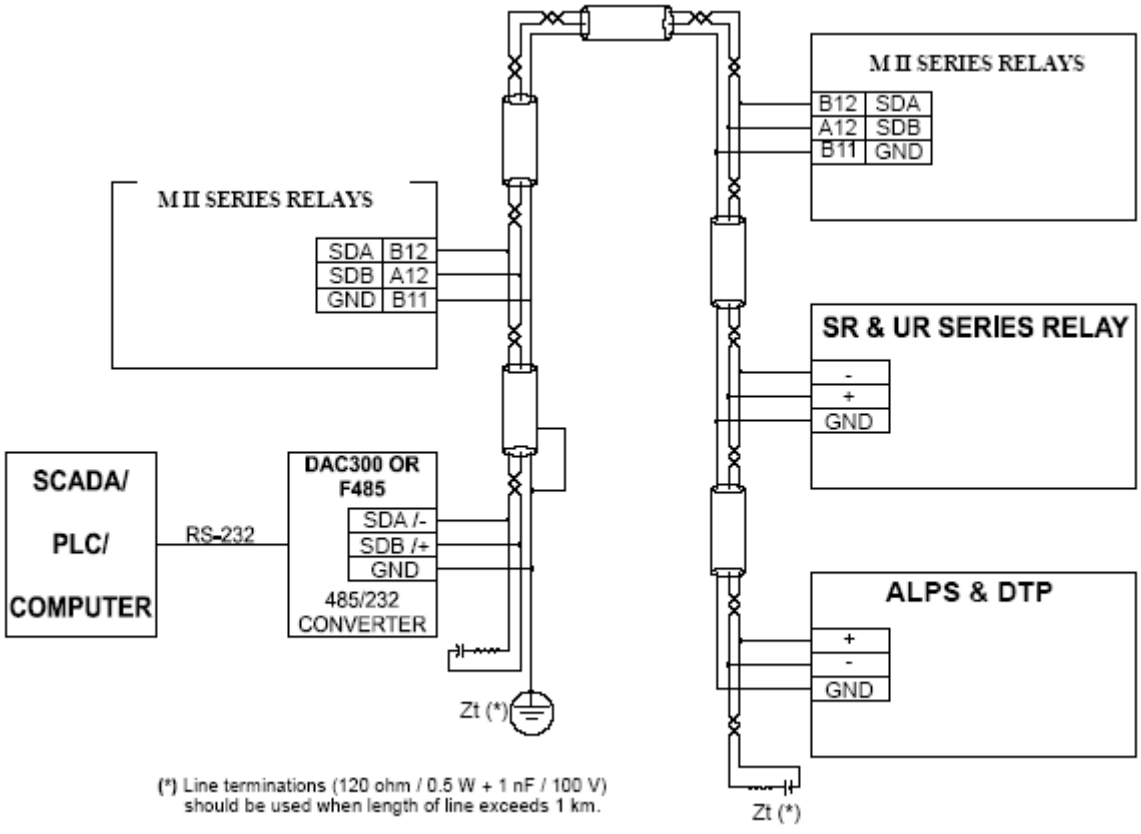


Figure 3–15: RS485 SERIAL CONNECTION (B6366H5)

4.1.1 OVERVIEW

IMPORTANT NOTE: MII FAMILY RELAYS CAN BE USED ONLY WITH ENERVISTA MII SETUP SOFTWARE.

The EnerVista MII SETUP software package uses only ModBus protocols, and is designed to communicate with a single relay at a time. GE Multilin offers different communication software packages, such as GE-POWER and ENERVISTA, which can be used to communicate simultaneously with several relays.

EnerVista MII SETUP software provides an easy way to configure, monitor and manage all MIFII features.

a) Setting files

EnerVista MII SETUP software provides two ways of working with setting files:

1.In off-line mode, disconnected from the relay, creating or editing setting files for a future download to the relay.

2.Modifying directly the relay settings while connected to the relay.

b) Configuration

The configuration of inputs, outputs and LEDs can be modified, and internal logics with the different relay elements can be created. For MIFII, it depends on the selected option (OPTION 0, 1 or 2)

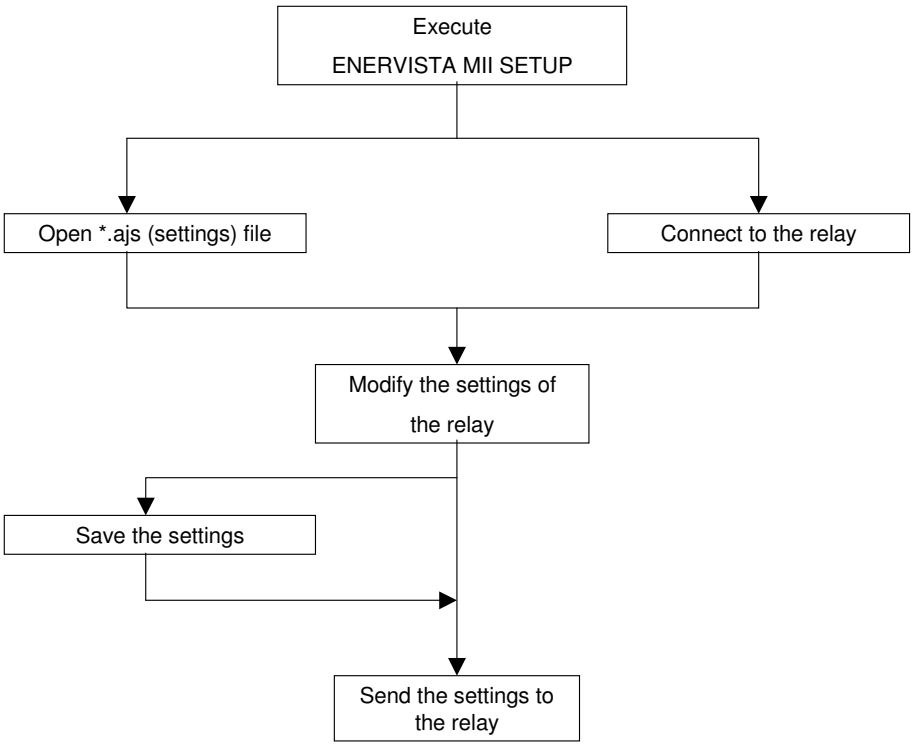
c) All metering values used by the unit can be monitored, as well as the internal states, inputs and outputs status.

d) Performing the different available operations.

e) Firmware updates.

f) Viewing the different records stored in the relay, as events, oscillography, etc.

The simplified use of the EnerVista MII SETUP software is as follows:



4.1.2 STARTING COMMUNICATION

Before the physical connection to the relay, it is important that the user reviews the safety instructions detailed in section 1. This section explains the importance of connecting both relay ground terminal and computer to a good grounding. Otherwise, communication may not be possible, or the relay and/or the computer could be damaged.

To work online, the relay communication parameters (e.g. baud rate, relay address and password) must match the parameters in the computer.

The computer parameters can be modified, in the Communication – Computer menu. Refer to the appropriate section in this same chapter for more details.

4.1.3 MAIN SCREEN

The main screen of EnerVista MII SETUP software includes the following components:

- Title
- Main menu bar
- Main icon bar
- Working area
- Status bar

Figure 4–1: ENERVISTA MII SETUP MAIN SCREEN

4.2.1 NEW

From the **File – New** option, the user can create a new file that will contain all the protection unit settings, as well as the relay configuration (inputs, outputs, events, oscillography, etc.).

When the option is selected, the following screen will be shown. The user must select here a specific relay model matching exactly the relay model to which the settings and configuration will later be downloaded. The mentioned settings and configuration are related to the default factory settings of the relay

The Model Selection window will show only some basic models and those for which the MIIPC software has ever been connected. In case the relay has been connected to different firmware version of the same model, a version selection window will appear to choose the correct one.

.

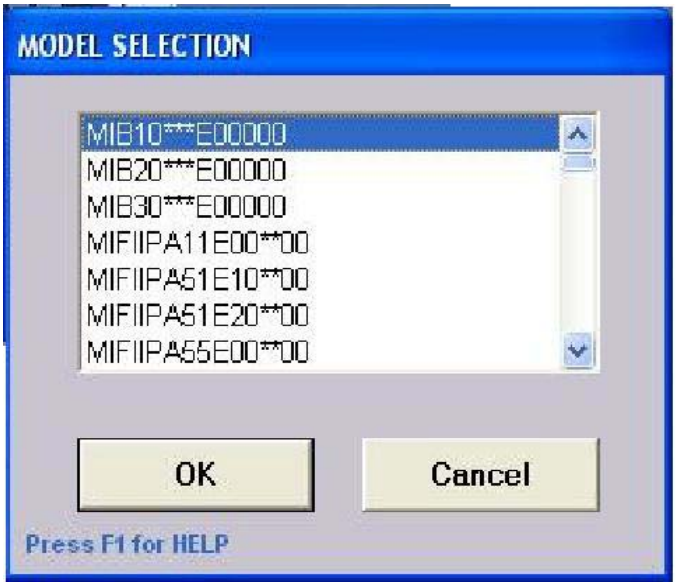


Figure 4–2: MODEL SELECTION

Once the relay model is selected, the software will load the relay structure and will enable the ***Setpoint***, ***Actual***, ***Communication***, ***View*** and ***Help*** menus for configuration.

4.2.2 OPEN

Option that allows to open previously created setting files for their modification.

Once the relay model is selected, the program will enable ***Setpoint***, ***Actual***, ***Communication***, ***View*** and ***Help*** sub-menus.

4.2.3 SETTINGS FILE CONVERTER

The Settings File converter allows the user to convert former versions setting files to another one.

When the option is selected, a .ajs file chooser will be shown, to select the settings source file. After selecting it, a model selection window will appear for choosing the version of the new file. Please, note that the Relay I/O configuration an the Logic configuration won't be converted.

Figure 4–3: WARNING POP-UP

Finally, the settings will be charged on the Enervista MII Setup on offline mode, so it must be saved in order to get the new .ajs file.

4.2.4 PROPERTIES

From the **File – Properties** option, the program will show a screen including the relay model information, firmware version, etc., as shown on Figure 4–4:

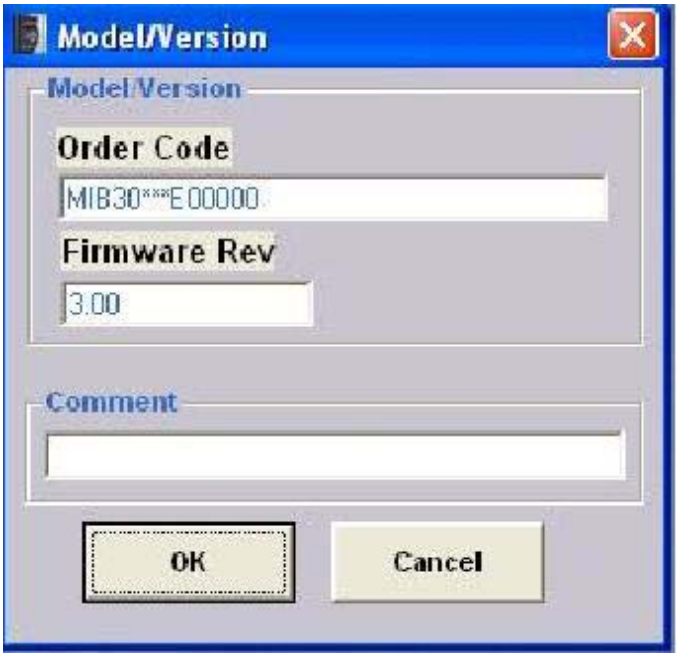


Figure 4–4: MODEL/VERSION

4.2.5 GET INFO FROM RELAY

The **File – Get info from relay** option enables the user to save the relay settings in a file on the hard disk of the computer. This file can later be opened offline to review and modify settings, and send them again to the relay after the modifications.

4.2.6 SEND INFO TO RELAY

The **File – Send info to relay** option enables to send to the relay a settings file stored on the hard disk of the computer.

Please, note that only files matching the version of the relay's firmware will be acceptable for being sent to the relay. In other case, an error message will be shown, asking the user to convert the file using the Setting File Converter application included in this software.

4.2.7 PRINT SETUP

The **File – Print Setup** option enables the user to configure the print setup for the settings file as shown in Figure 4–5:

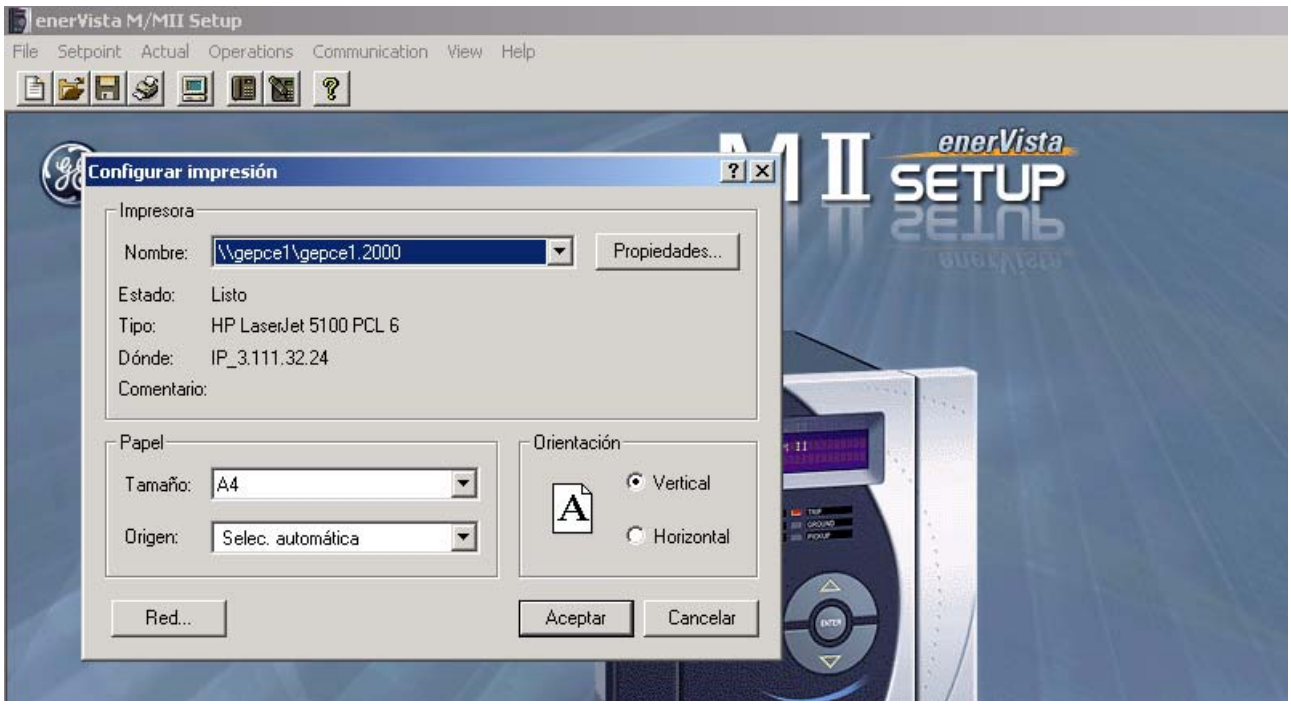


Figure 4–5: PRINTER SETUP

4.2.8 PRINT PREVIEW

The **File – Print Preview** option displays a preview of the settings print-out. It is also provides a quick view of all the relay settings at a glance, without having to navigate through the different menu trees. From this screen it is also possible to configure the printer that will be used, or to directly print the document. Double clicking on the document with the left mouse button will enlarge the document view, and double clicking with the right button will reduce the size.

The available actions in this screen are shown in Figure 4–6:

Figure 4–6: PRINT PREVIEW CONTROLS

4.2.9 PRINT

The **File – Print** option prints the relay settings using Windows default (active) printer.

4.2.10 CLOSE

The **File – Close** option exits the program. It does not prompt for confirmation or save the open file.

Clicking on the Setpoint menu entry gives access to Settings, Configuration, Logic Configuration and Clock.

4.3.1 SETTINGS

The **Settings** sub-menu is the same for all MII family relays, and shows all relay settings divided in two groups: **Main Settings** and **Advanced Settings**. The first settings group has basic settings (main protection functions). The second settings group includes more advanced settings (double settings group, customized curves, etc.), needed only if more complex protection schemes are required

The purpose of this division is to simplify the use of the relay for those users only requiring the basic functionality of the relay.

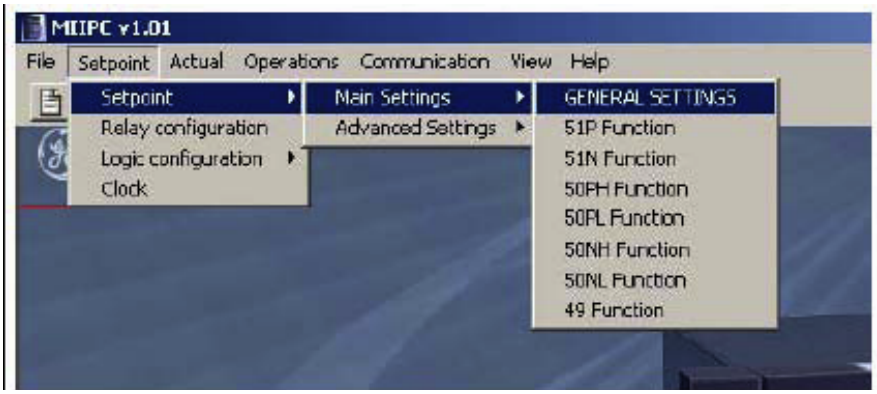


Figure 4–7: SETTINGS MENU

Once in the corresponding sub-menu, either Main Settings or Advanced Settings, the procedure to enter and modify any setting value is the same:

Select the settings group (the function selected in the example is the51P function in a MIFII).

Edit the setting double-clicking on the value (for example, 51P enable).

Modify the value of the setting (see Figure 4–9: to Figure 4–11:).

Confirm/Accept the modified value.

Store the settings in the relay (if working in Emulation mode, this option stores them on a temporay file that must be savedwith the File->Save option in order to preserve them the corresponding file) with the **Store** button. If the **OK** button is pressed without having pressed Store (a window asking confirmation will appear), the settings of this group will be discarded.

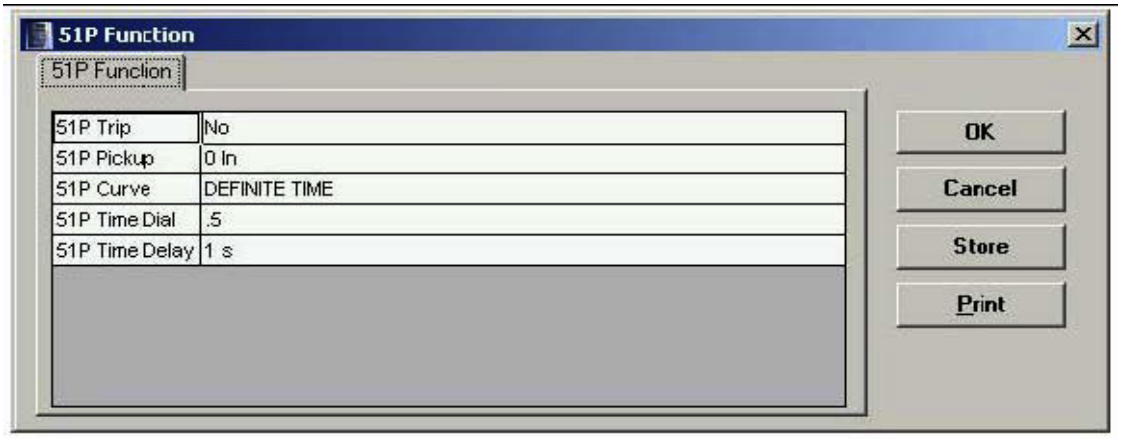


Figure 4–8: FUNCTION MENU

Primarily there are four different setting formats:

Boolean/Logic Settings (only two choices). For Boolean settings, the two possible options are shown so as the user can select which one is the appropriate, clicking with the mouse on the option desired.

Numerical Settings For Numerical settings, a number must be entered. The program shows the minimum and maximum value for each setting, and it will not accept any value out of the corresponding range.

Settings with a set of options For set of options settings, a pop-up window is shown, containing all possible values. Select the appropriate one clicking on it.

Text Setting A text box is shown.

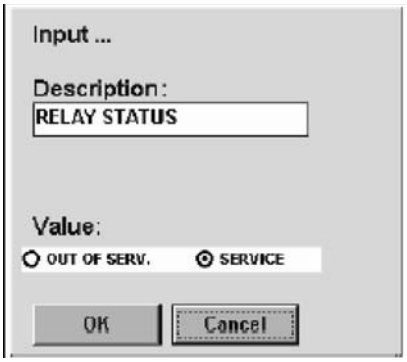


Figure 4–9: LOGIC SETTING.

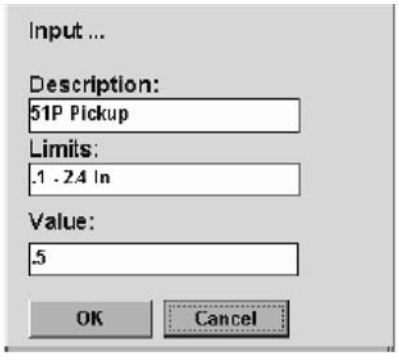


Figure 4–10: NUMERIC SETTING.

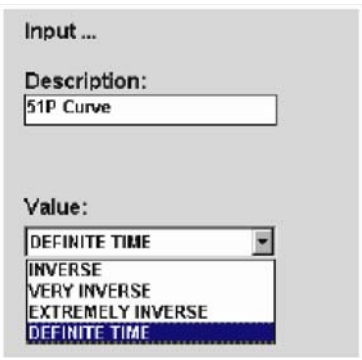


Figure 4–11: SET OF OPTIONS.

4.3.2 MAIN SETTINGS

4.3.2.1 GENERAL SETTINGS

General settings describe and activate the electric system settings where the relay is going to operate. Some of these settings will be used with measure values presentation purposes; however, some of them are directly applied during the sampling and analogical-numerical conversion process (nominal frequency setting). Therefore, these settings need to be altered so they fit with the system settings.

4.3.2.2 GROUP 1- GROUP 2 FUNCTION SETTINGS

The M family relays provide two independent setting groups. **Group 1** is available in the Main Settings group, while **Group 2** can be accessed in the Advanced Settings group. The setting groups can be selected by digital input, through a communications command or from the EnerVista MII SETUP, or simply selecting it with the relay keypad. The setting that shows the active group can be found in General Advanced Settings.

4.3.3 ADVANCED SETTINGS

4.3.3.1 ADVANCED GENERAL SETTINGS

Advanced General Settings enables configuration of the active setting group as well as the minimum time the trip contact will remain closed, to let the circuit breaker open the circuit so as the contact does not get burnt.

4.3.3.2 OTHER ADVANCED SETTINGS

Besides the Flex Curve values, the user may configure the mask of events that will generate an event report and the events that will generate an oscillography.

Setpoint – Relay Configuration shows a dialog box to configure digital inputs, contact outputs and front panel LEDs, as shown in Figure 4–12:

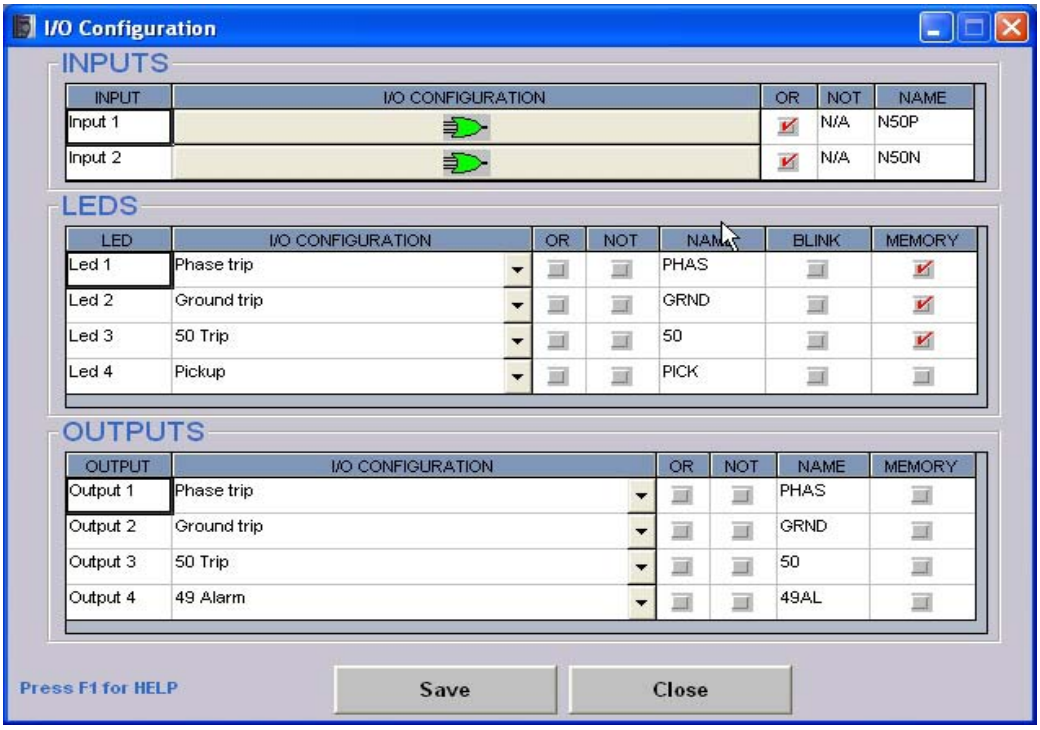


Figure 4–12: RELAY CONFIGURATION SETTINGS

Each input, output and LED can be assigned an individual function (status bit) or an OR of a group of functions. Functions can also be assigned to virtual inputs and outputs, in order to allow greater flexibility when creating complex logics.

The meaning of the different columns is explained below:

- **INPUT/LED/OUTPUT**: Designates the respective element
- **I/O configuration**: the appearance and function of this column can be, depending on the state of the respective OR checkbox column:

  - **OR checkbox** is not checked: the element consists of a drop down list in which the user can select the function that will activate the output or LED, or that will be activated by the input

  - **OR checkbox** is checked: the element consists of a button that will activate a new window (see Figure 4–13:) where the user can choose a sum of several functions that will activate the output or LED, or be activated by the input. These functions are distributed in groups, and only functions in the same group can be chosen for the same OR gate.

- **OR**: activates the **OR button** for the I/O configuration column (see previous point). The window that appears when the OR button is pressed can be seen in Figure 4–13:

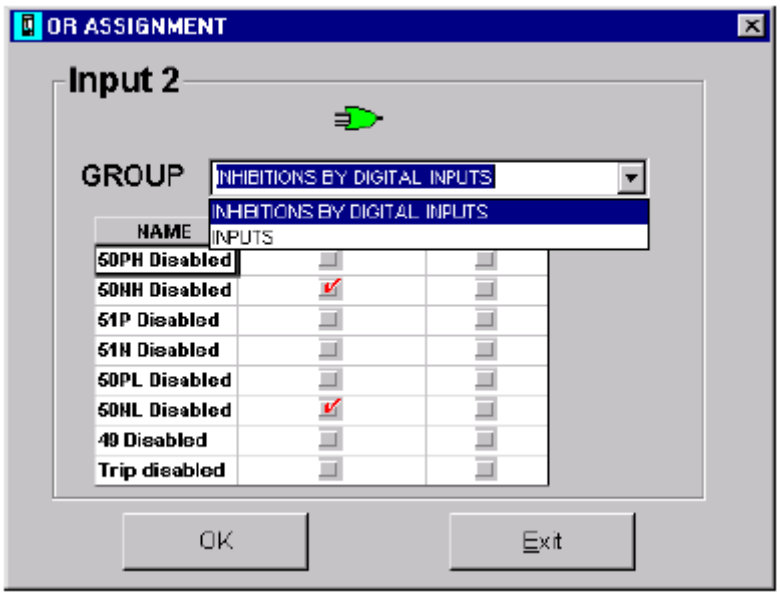


Figure 4–13: OR ASSIGNMENT

- **NOT**: when **NOT** checkbox is enabled, the logic is inverted. The element (input, output, LED) will actuate when the conditions are NOT fulfilled.
- **NAME**: the user can write an identifying label of up to 4 characters that will get stored to be displayed later on.
- **BLINK** (only for LEDs): the selection of **BLINK** checkbox makes the LED blink (alternatively switch ON and OFF) instead of being fixed when it is activated.
- **MEMORY** (only for outputs and LEDs): when **MEMORY** checkbox is enabled, the respective element will be latched. If the cause that generated the activation of the output or LED does no longer exist, the element will remain active until a RESET command is performed.

4.3.5 DATE /TIME

The **change date/time** option opens a window with two choices:

- Sending the PC date and time to the unit, this is, synchronizing the PC and the unit.
- Selecting a date and a time and sending it to the relay.

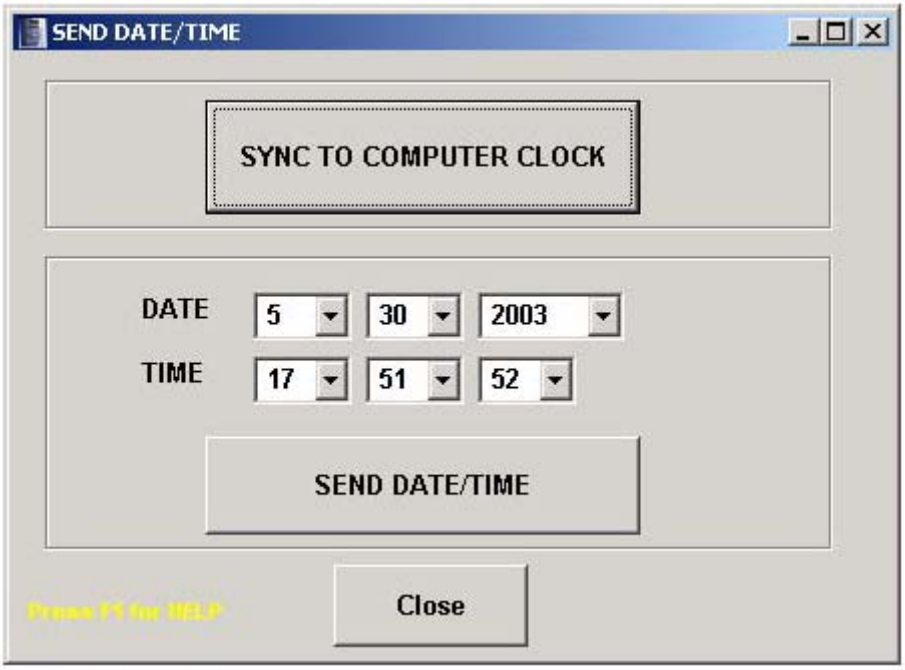


Figure 4–14: CHANGE DATE/TIME

Once the new date and time have been sent, the user can check in the status graph, or even in the relay itself, that the new date/time has been correctly entered.

Actual - Actual values menu displays the **Status Window** shown in Figure 4–15:. This window shows internal relay information, measures, function status as well as additional information. There is a vertical scroll bar to navigate up and down the table to reach the desired information:

- Relay model number and firmware version.
- Relay internal date and time.
- Values of currents, voltages and powers (phase and ground).
- Protection function status (pickup / trip for each function).
- Active settings group number.
- Contact inputs and outputs status, and LEDs status.
- Information from the self-test functions of the device.

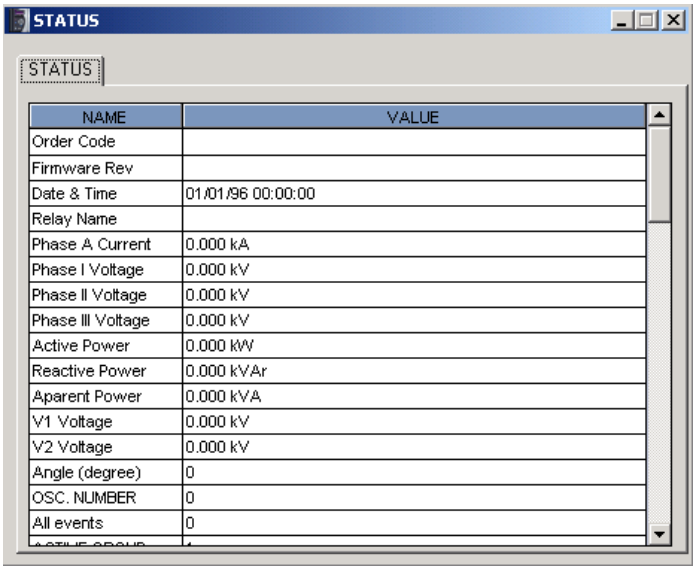


Figure 4–15: STATUS WINDOW

Actual – Event Recorder option makes the last 24 relay events to be retrieved (up to 32 for MIFII) and displayed in the window appearing in Figure 4–16:. Each event record is labeled with date, time (with 1msec. resolution), the cause of the event (pickup, trip of a certain function, etc.), and a list of the status of all inputs, outputs and functions during the event. Additionally, the program also shows current and voltage values for all phases and ground, frequency and single line sequence voltage during the event.

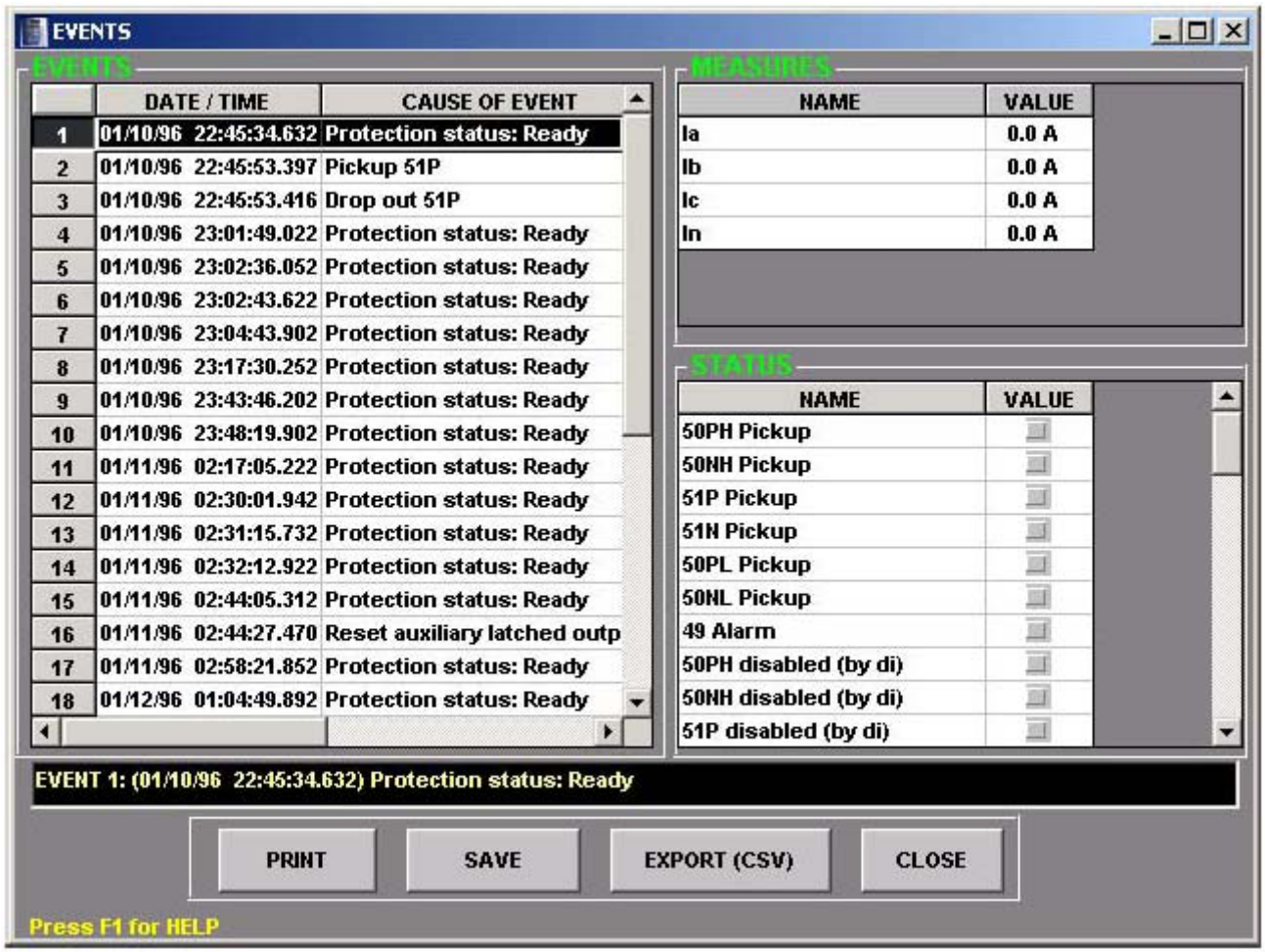


Figure 4–16: EVENTS WINDOW

The retrieved events can be reviewed in this window or also saved to disk (to be opened with EnerVista MII SETUP program) or exported to CSV (Comma Separated Values) format. This is a standard text table format that can be opened with most commercially available database or spreadsheet programs such as MS Access or Excel.

In the **Actual - WAVEFORM CAPTURE** option, the user can start the process to retrieve the Oscillography record stored in the relay. The program will request the path and filename where the file is to be stored, by means of the following form:

Figure 4–17: OSCILLOGRAPHY RECORD

This file can be viewed using GE_OSC software (the use of this software is described in manual GEK-105596).

From **Operations** menu the user can perform all possible operation commands.

Figure 4–18: OPERATIONS MENU

The **COMMUNICATION** menu provides configuration options to communicate with the relay, as well as to perform a ModBus communication troubleshooting, or to update the relay with a new firmware.

After making any change, pressing ***Store*** button saves the changes without exiting the window. Pressing ***OK*** saves and exits and pressing ***Cancel*** exits without saving changes.

4.6.1 COMPUTER

In **COMPUTER** dialog the user can configure the necessary adjustments to communicate with the relay from a PC.

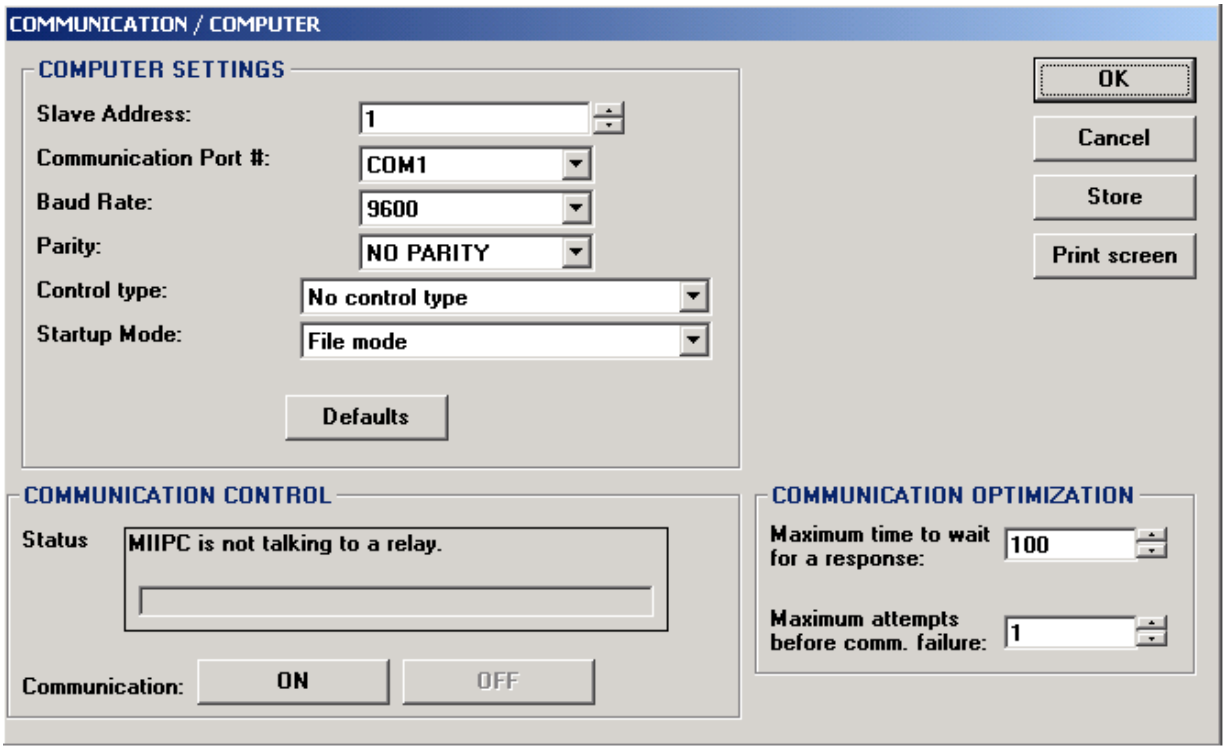


Figure 4–19: COMMUNICATIONS DIALOG

4.6.1.1 COMPUTER SETTINGS

In **COMPUTER SETTINGS** box the user can configure computer communication settings, besides the connection (Control Type) and Startup Mode.

Control Type defines the connection type that is going to be used:

- **No control type** for serial connection (front RS232 or rear RS485),
- **ModBus/TCP** for Ethernet connection (by means of a serial/TCP converter). When this option is chosen, the serial configuration data disappears and a new box appears at the right to configure the IP address, the port number and the unit id.

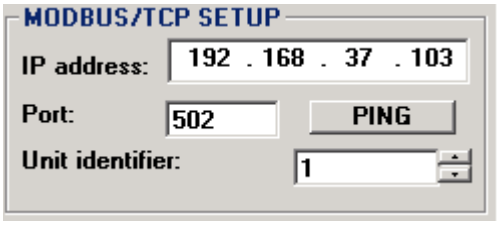


Figure 4–20: MODBUS/TCP SETUP

- **MODEM CONNECTION** for modem serial connection. The modem configuration options appear at the right when this option is chosen.

Defaults button returns the values to the factory default ones.

4.6.1.2 COMMUNICATION CONTROL

In **COMMUNICATIONS CONTROL** box the user can view the communication status (communicating to a relay or not), connect to a relay when the right parameters are entered in the Computer Settings box (**ON** button), or disconnect from the relay when desired (**OFF** button).

Once the connection is established, when the user accesses any Setpoint or Operations, or Actual – Event Recorder[i] menu entries for the first time, the program will ask the relay password. The following window will appear:

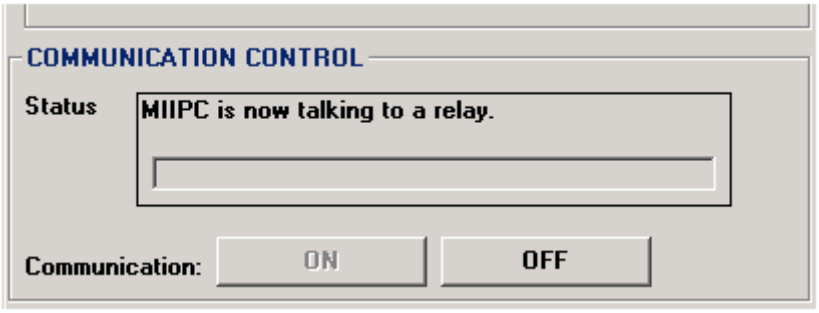


Figure 4–21: COMMUNICATION CONTROL – COMMUNICATING

i. i.e., the first time a writing operation is performed against the relay during the current communication

4.6.1.3 COMMUNICATION OPTIMIZATION

COMMUNICATIONS OPTIMIZATION box allows the user to enter values to control device response to communication attempts. Changing these parameters can improve communication, although it is recommended not to make changes to the default values if it is not required.

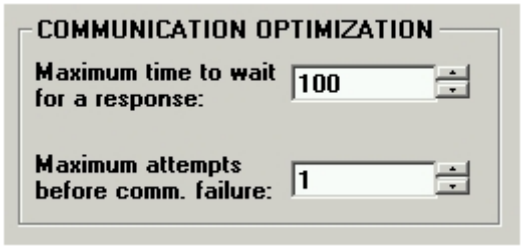


Figure 4–22: COMMUNICATION OPTIMIZATION

4.6.1.4 PRINT SCREEN

When the ***Print Screen*** button is pressed, a new window appears asking if the user wants to capture the entire screen or only the active window (the one with all the communication parameters). *Yes* means capturing the whole screen and *No* means capturing only the communications window.

Then a new window appears allowing to view the captured screen, to save the captured file in BMP or JPG format, or to print it (the print dialog window will appear so as the user can select which printer to use and enter the appropriate printer settings).

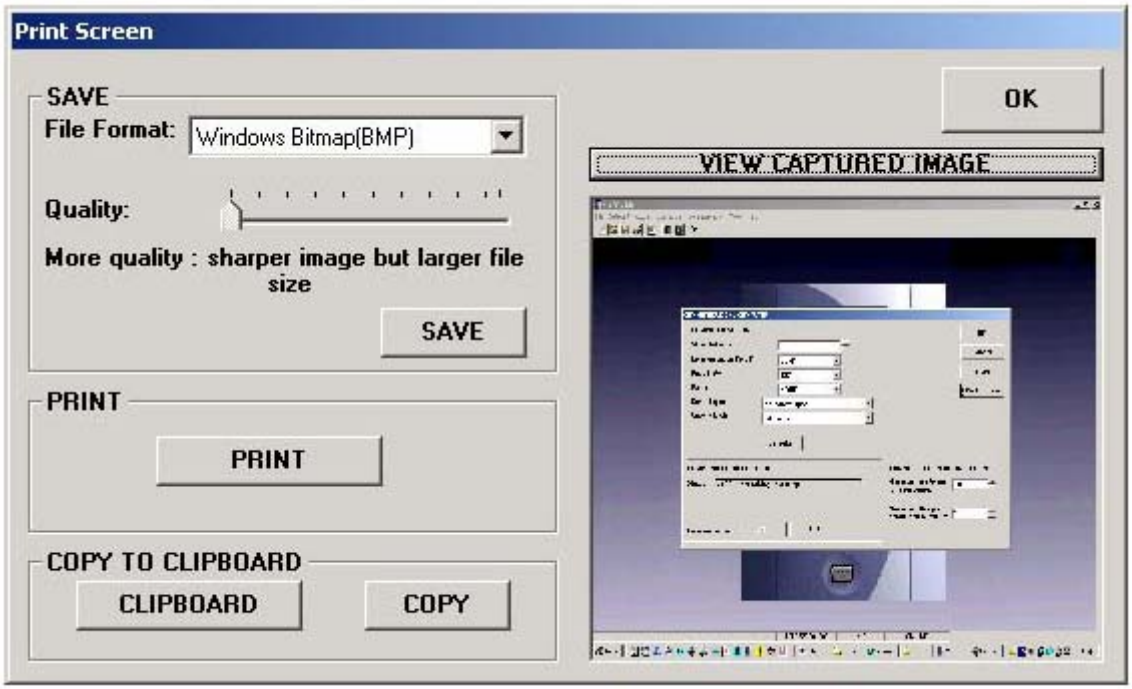


Figure 4–23: PRINT SCREEN

The **TROUBLESHOOTING** option is available only when the PC is communicating with a relay. It is intended to check the ModBus communication frames between the PC and the relay. In the upper part, the user can read any readable value from the relay (setpoints, actual values) by entering the desired hexadecimal address[i], the type of data to read (Setpoints, Actual Values), the number of registers (the length of each register is of 2 bytes) and the format of the data (integer, long, float...), checking the checkbox at the left to make the PC start polling that address or unchecking it to stop.

In the lower part, data can be sent to writable addresses of the relay. The working is similar to reading but, to send the data, the user must press the ***SEND*** button.

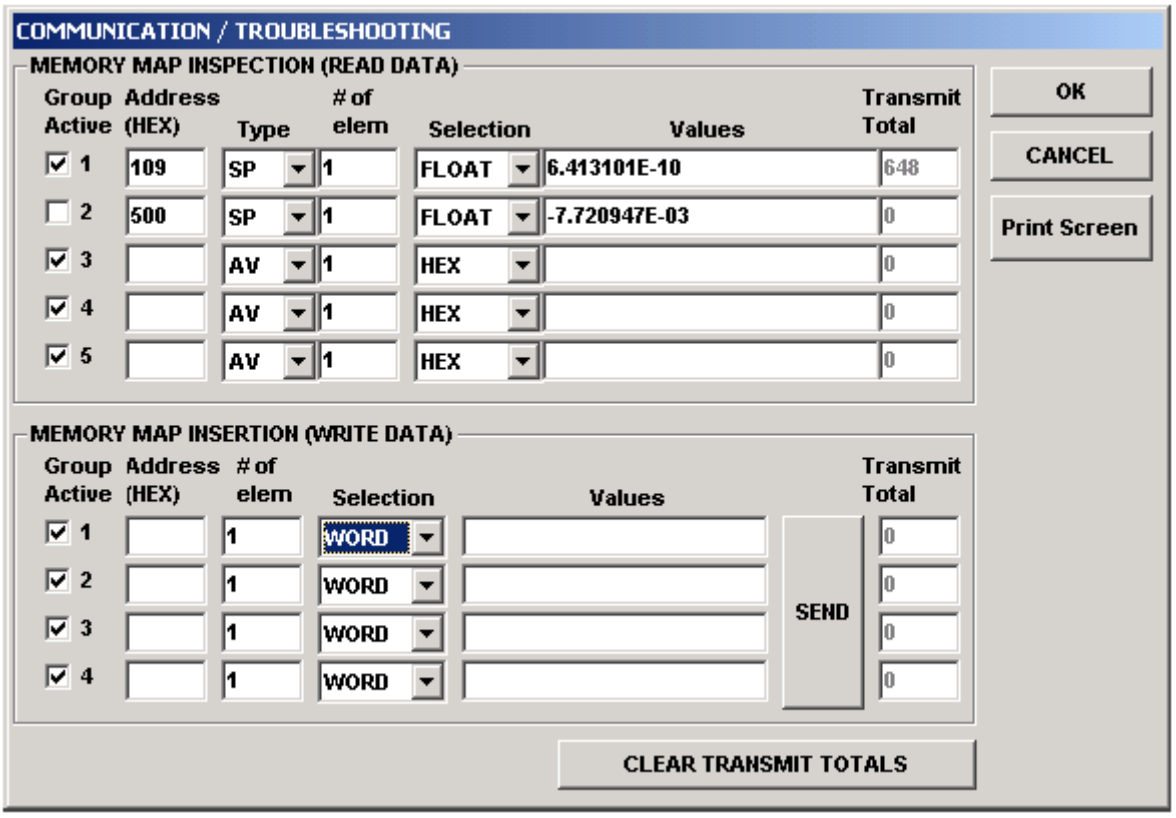


Figure 4–24: TROUBLESHOOTING

Refer to preceding section to learn about ***Print Screen*** button.

i. To check how to read memory map addresses from the relay refer to the corresponding section further in this chapter

4.6.3 UPGRADE FIRMWARE VERSION

IMPORTANT WARNING: For upgrading the relay firmware to version 4.00 or later, it is mandatory that the ENERVISTA MII Setup version is 1.10 or higher. For firmware version 5.00 or later, the ENERVISTA MII Setup version must be 2.10 or later. Otherwise it may result in damage to the relay

The **UPGRADE FIRMWARE VERSION** option is active only when there is no active communication with the relay. If the PC is communicating with the relay, the user must switch communication off in ***Communication > Computer*** menu to activate this option.

When this option is selected, a window appears asking for the new firmware version file to be uploaded to the relay:

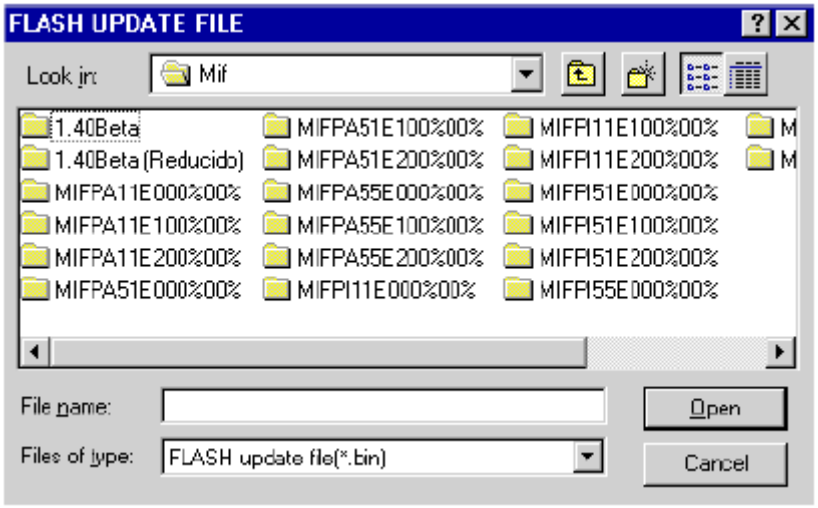


Figure 4–25: FLASH UPDATE FILE

After selecting the file that will be used to update the FLASH memory, the following screen will be displayed:

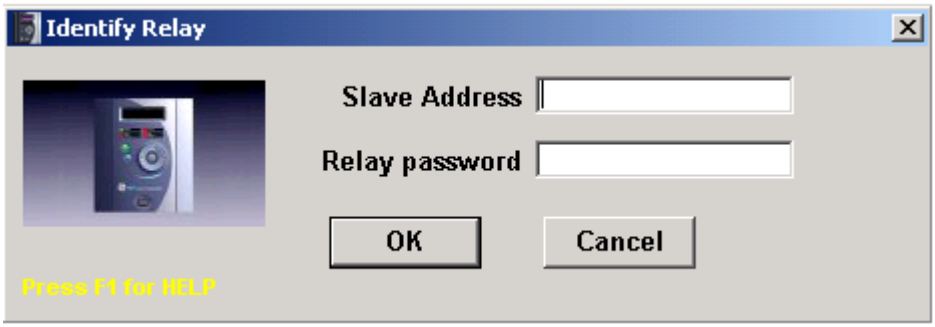


Figure 4–26: RELAY IDENTIFICATION

After introducing the Slave Address and Relay password (1 and 1 by default), the following screen will be displayed, showing details of the old model and the new model:

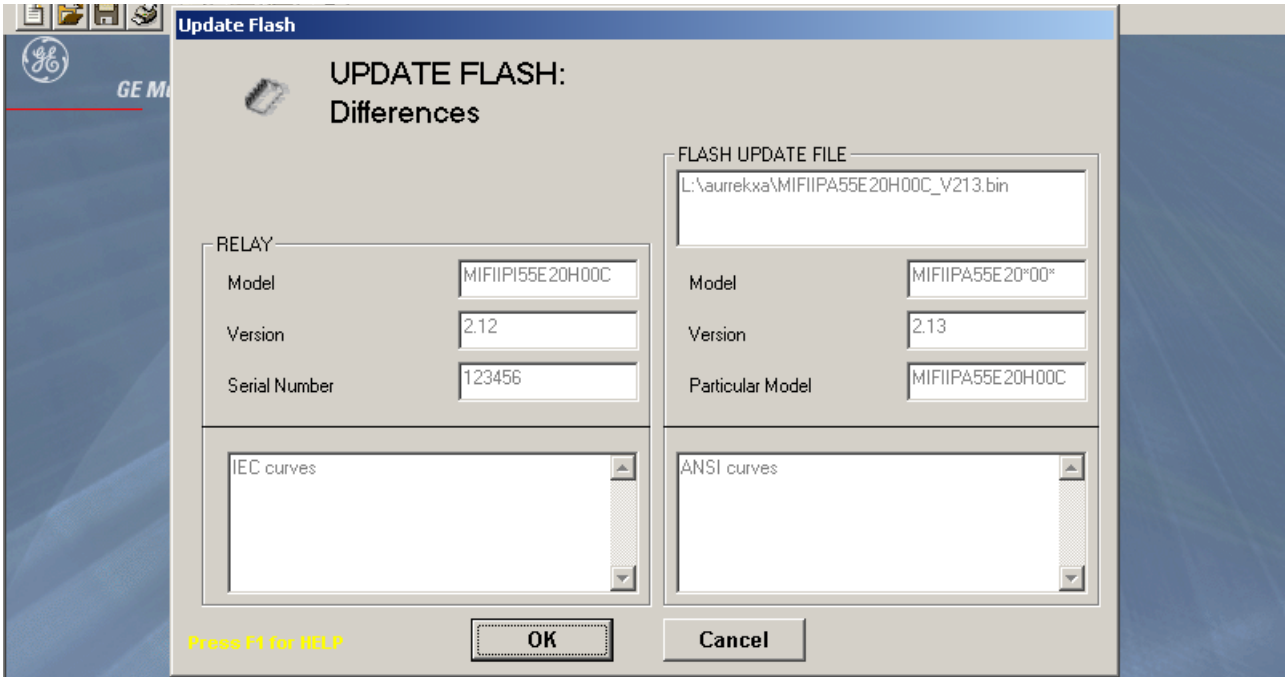


Figure 4–27: UPDATE FLASH DIFFERENCES

If the update is to a model option with higher functionality (see OPTION 1, OPTION 2 and OPTION R in the model list), the program will request a password. This password can be obtained placing an order with GE Multilin. The following three parameters must be clearly indicated in the order:

- Serial number of the unit.
- Current model option (before memory update).
- Desired model option (after memory update).

In a case where more than one unit needs to be updated, all the serial numbers must be detailed, and a different password will be assigned for each unit.

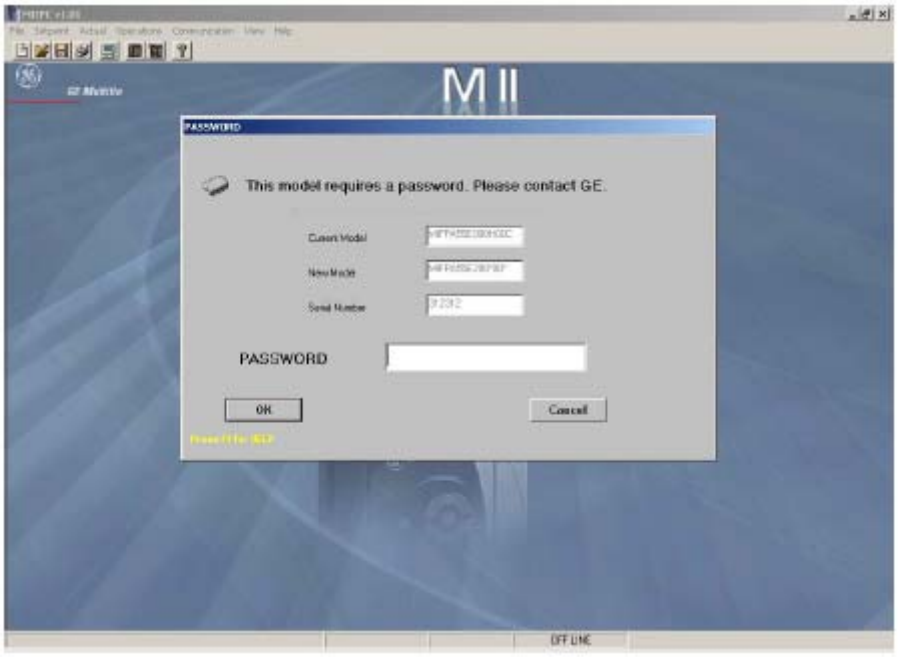


Figure 4–28: PASSWORD

If the update does not require changes to the functionality of the relay, the program will not request a password.

After completing the previous screen, and during the loading process, the following screen will be displayed, showing the update process status:

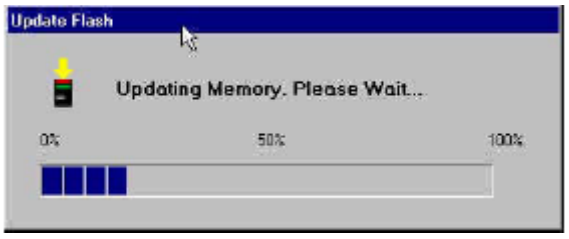


Figure 4–29: UPDATE PROCESS

During the update, the display and LEDs will blink until the total completion of the process. Then the following screen will appear:

Figure 4–30: UPDATE COMPLETED

It will take a few seconds for the relay to restart after the completion of the update process. Therefore, before unplugging the relay, please make sure that the relay main screen shows the analog inputs values.

IMPORTANT NOTICE:

The MODBUS® memory map may change for different firmware versions. As a result, the Flash memory update, when upgrading to a higher model (OPTION 1 or 2), may involve a MODBUS® memory map change. This may result a critical issue when the relay is integrated in a system, and the user should take into account the modifications that will have to be performed in the programs that access the MIFII relay memory maps.

Additionally, when a Flash memory update is performed, the loading program will enter the default settings. This means that the user will need to adapt the settings to the real situation of the protected device. If the user wants to keep the same settings after the memory update, a copy of the settings should be stored in a file before starting the update process.

4.7.1 TRACES

TRACES option is only active when the PC is communicating with the relay. If the communication is not established, to activate this option the user must switch communication on in ***Communication > Computer*** menu.

When **TRACES** are active, the ModBus communication traces will be displayed in the lower part of the screen, as shown in Figure 4–31:

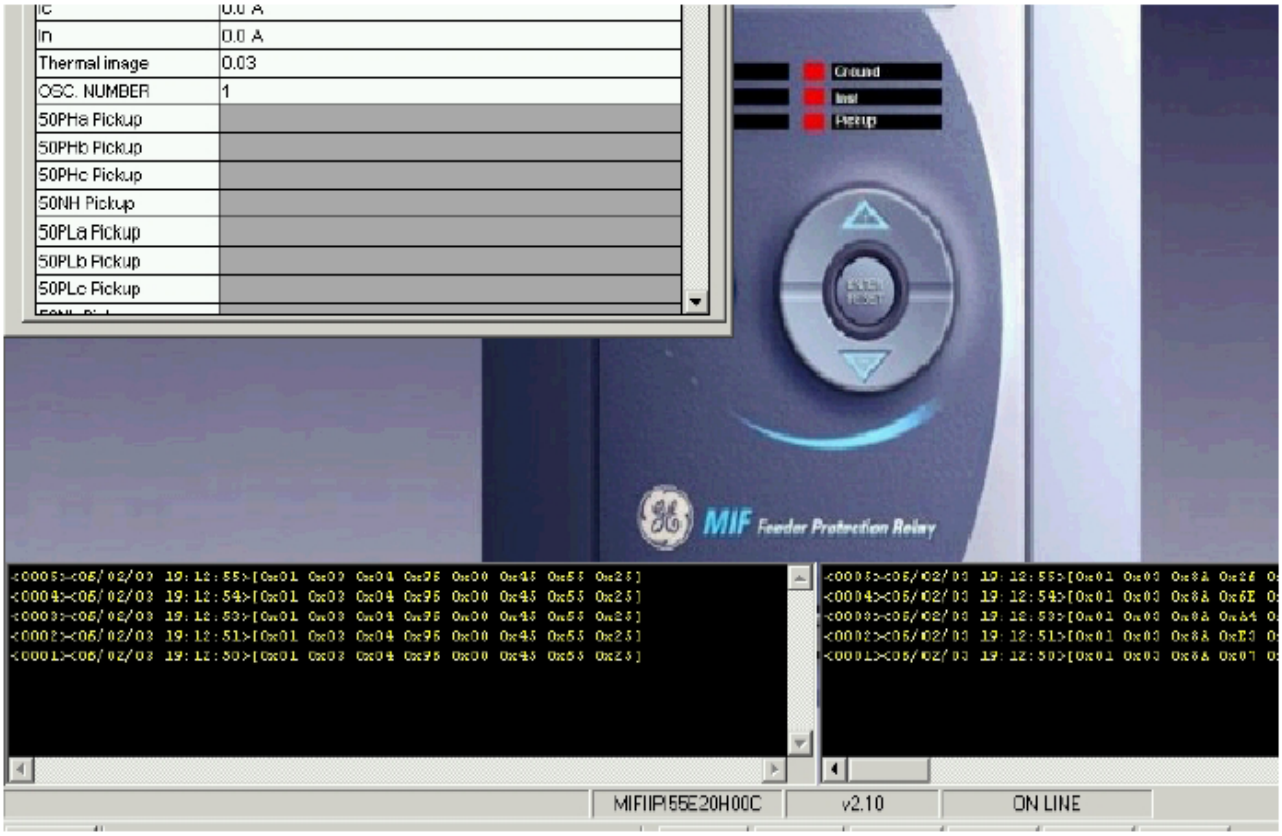
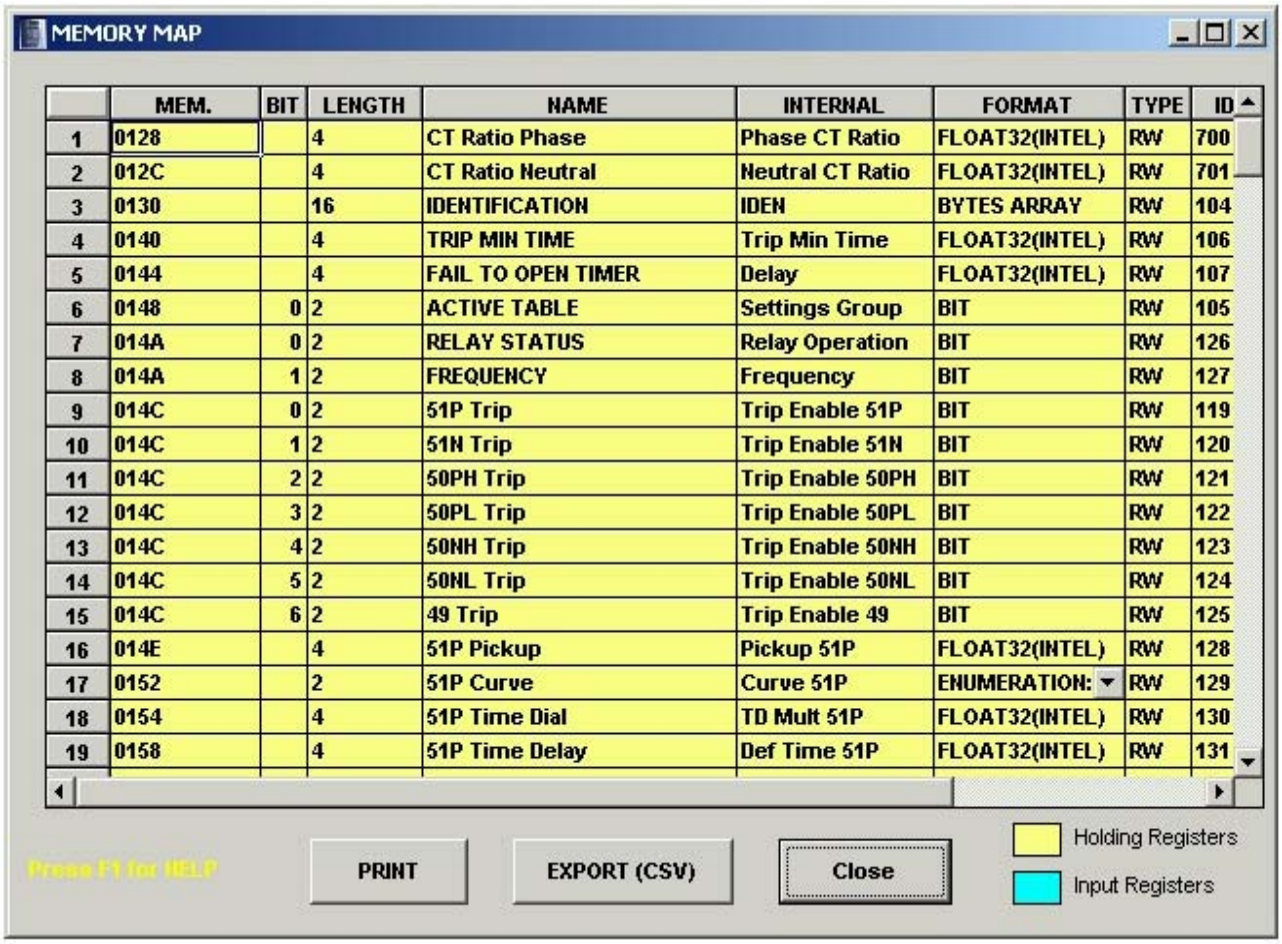


Figure 4–31: MODBUS TRACES

MODBUS MEMORY MAP option is only active when the PC is communicating with the relay. If the communication is not established, to activate this option the user must switch communication on in ***Communication > Computer*** menu.

With **MODBUS MEMORY MAP** option the user can extract the complete memory map from the relay and print or save it in CSV format (to be later opened with any database or spreadsheet program as MS Excel). It is recommended to use this feature as memory map changes with relay model and firmware version so this is the safest way of obtaining the appropriate memory map for every single relay.



	MEM.	BIT	LENGTH	NAME	INTERNAL	FORMAT	TYPE	ID
1	0128		4	CT Ratio Phase	Phase CT Ratio	FLOAT32(INTEL)	RW	700
2	012C		4	CT Ratio Neutral	Neutral CT Ratio	FLOAT32(INTEL)	RW	701
3	0130		16	IDENTIFICATION	IDEN	BYTES ARRAY	RW	104
4	0140		4	TRIP MIN TIME	Trip Min Time	FLOAT32(INTEL)	RW	106
5	0144		4	FAIL TO OPEN TIMER	Delay	FLOAT32(INTEL)	RW	107
6	0148	0	2	ACTIVE TABLE	Settings Group	BIT	RW	105
7	014A	0	2	RELAY STATUS	Relay Operation	BIT	RW	126
8	014A	1	2	FREQUENCY	Frequency	BIT	RW	127
9	014C	0	2	51P Trip	Trip Enable 51P	BIT	RW	119
10	014C	1	2	51N Trip	Trip Enable 51N	BIT	RW	120
11	014C	2	2	50PH Trip	Trip Enable 50PH	BIT	RW	121
12	014C	3	2	50PL Trip	Trip Enable 50PL	BIT	RW	122
13	014C	4	2	50NH Trip	Trip Enable 50NH	BIT	RW	123
14	014C	5	2	50NL Trip	Trip Enable 50NL	BIT	RW	124
15	014C	6	2	49 Trip	Trip Enable 49	BIT	RW	125
16	014E		4	51P Pickup	Pickup 51P	FLOAT32(INTEL)	RW	128
17	0152		2	51P Curve	Curve 51P	ENUMERATION:	RW	129
18	0154		4	51P Time Dial	TD Mult 51P	FLOAT32(INTEL)	RW	130
19	0158		4	51P Time Delay	Def Time 51P	FLOAT32(INTEL)	RW	131

Figure 4–32: MODBUS MEMORY MAP

4.7.3 LANGUAGES

LANGUAGES option is only active when there is no active communication with the relay. If the PC is communicating with the relay, to activate this option the user must switch communication off in ***Communication – Computer*** menu.

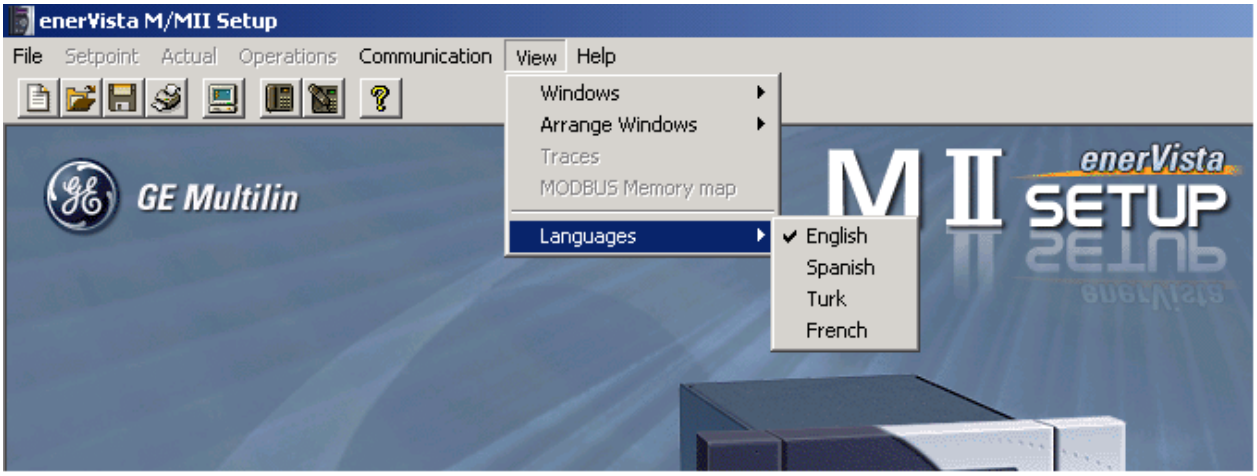


Figure 4–33: LANGUAGES

All the settings of the MIB relay, together with the procedures to change their value, are described in this chapter. First of all, a complete list of settings is shown; including ranges, units, step and factory default value. Then, the settings requiring more detailed comments are individually explained. In the EnerVista MII SETUP program, the settings are grouped under the Setpoint menu, Setpoint sub-menu entry.

The MIB relay provides two settings groups (group 2 is accessible in the ADVANCED SETTINGS group), stored in EEPROM memory (permanent memory). Using a setting or through a communications command, it is possible to select which group is active, and then used by the relay protection algorithms.

Settings can be accessed and modified either using the relay faceplate keypad, or using a computer connected to the relay through any of the relay communications ports, and the EnerVista MII SETUP program. The use of the keypad to modify settings is described in Chapter 8. If the computer is used to handle the settings, the following steps must be considered:

Make sure your communication cable matches the scheme shown in Figure 3–14:

Connect the communications cable between the relay (or modem) and the computer serial port.

Run the EnerVista MII SETUP program. The procedure to install and use the EnerVista MII SETUP program is described in section 1.2.2 and in section 4.

Make sure that the communications parameters in the relay match the EnerVista MII SETUP configuration settings (*Communication - Computer* Menu). The communications parameters shown in the relay faceplate display, within the configuration menu are:

Comm Password

Comm Baud Rate

Slave Address

For instructions on how to check and modify EnerVista MII SETUP program communications parameters please refer to chapter 4.

Check that the relay number and password in the MIB display match the numbers entered in the dialog window of the EnerVista MII SETUP, after clicking on Relay Connection.

5.2.1 PRODUCT SETUP

PATH: MENU KEY	UP ARROW BUTTON	MAIN SETTINGS	PRODUCT SETUP
MAIN SETTINGS PRODUCT SETUP	ENTER	**PRODUCT SETUP Relay operation**	Range: Ready/Disable Default: Disable
MESSAGE		**PRODUCT SETUP Frequency**	Range: 50/60 Default: 60 Hz
MESSAGE		**PRODUCT SETUP HMI Password**	Range: 0 - 9999 Default: 0 Step: 1
MESSAGE		**PRODUCT SETUP Comm Password**	Range: 0 - 255 Default: 1 Step: 1
MESSAGE		**PRODUCT SETUP Slave Address**	Range: 0 - 255 Default: 1 Step: 1
MESSAGE		**PRODUCT SETUP Comm Baud Rate**	Range: 0.3/0.6/1.2/2.4/4.8/9.6/19.2 Default: 9.6

5

5.3.1 (DIFFERENTIAL ELEMENT 87 1

PATH: MENU ⬆ MAIN SETTINGS ↵⬆ DIF ELEMENT 87 1

MAIN SETTINGS DIF ELEMENT 87 1	ENTER	DIF ELEMENT 87 1 Enable 87 1	Range: NO/YES Default: NO
		DIF ELEMENT 87 1 Trip Enable 87 1	Range: NO/YES Default: NO
		DIF ELEMENT 87 1 Pickup 87 1	Range: 0.005/0.400 A Default: 0.010 A
		DIF ELEMENT 87 1 Delay 87 1	Range: 0.00/600.00 s Default: 0.00 s

5.3.2 DIFFERENTIAL ELEMENT 87 2

PATH: MENU ⬆ MAIN SETTINGS ↵⬆⬆ DIF ELEMENT 87 2

MAIN SETTINGS DIF ELEMENT 87 2	ENTER	DIF ELEMENT 87 2 Enable 87 2	Range: NO/YES Default: NO
MESSAGE		DIF ELEMENT 87 2 Trip Enable 87 2	Range: NO/YES Default: NO
MESSAGE		DIF ELEMENT 87 2 Pickup 87 2	Range: 0.005/0.400 A Default: 0.010 A
MESSAGE		DIF ELEMENT 87 2 Delay 87 2	Range: 0.00/600.00 s Default: 0.00 s

5.3.3 GENERAL ADVANCED

PATH: MENU ⬆⬆ ADVANCED SETTINGS ↵ GENERAL ADVANCED

ADVANCED SETTINGS GENERAL ADVANCED	ENTER	ADVANCED SETTINGS Setting Group	Range: 1/2 Default: 1
		ADVANCED SETTINGS Trip Min Time	Range: 50-300 ms Default: 200 ms

5.3.4 DIFFERENTIAL ELEMENT 87 1 GROUP 2

PATH: MENU ⬆⬆ ADVANCED SETTINGS ↵ ⬆DIF ELEMENT 87 1

ADVANCED SETTINGS DIF ELEMENT 87 1	ENTER	DIF ELEMENT 87 1 Enable 87 1	Range: NO/YES Default: NO
		DIF ELEMENT 87 1 Trip Enable 87 1	Range: NO/YES Default: YES
		DIF ELEMENT 87 1 Pickup 87 1	Range: 0.005/0.400 A Default: 0.010 A
		DIF ELEMENT 87 1 Delay 87 1	Range: 0.00/600.00 s Default: 0.00 s

5.3.5 DIFFERENTIAL ELEMENT 87 2 GROUP 2

PATH: MENU ⬆⬆ ADVANCED SETTINGS ↵ ⬆⬆ DIF ELEMENT 87 2

ADVANCED SETTINGS DIF ELEMENT 87 1	ENTER	DIF ELEMENT 87 2 Enable 87 2	Range: NO/YES Default: NO
		DIF ELEMENT 87 2 Trip Enable 87 2	Range: NO/YES Default: YES
		DIF ELEMENT 87 2 Pickup 87 2	Range: 0.005/0.400 A Default: 0.010 A
		DIF ELEMENT 87 2 Delay 87 2	Range: 0.00/600.00 s Default: 0.00 s

5.3.6 EVENTS AND OSCILLOGRAPHY MASKS (ONLY ENERVISTA MII SETUP)

Event masks have two possible settings, YES or NO. If an action (e.g. the trip of a protection function) is set as YES, when the trip takes place an event will be generated. If it is set as NO, no event will be generated.

EVENT	ENERVISTA MII SETUP	DEFAULT	RANGE	STEP
Phase A 87 1 Pickup	Phase A 87 1 Pickup	YES	Y/N	NA
Phase B 87 1 Pickup	Phase B 87 1 Pickup	YES	Y/N	NA
Phase C 87 1 Pickup	Phase C 87 1 Pickup	YES	Y/N	NA
87 1 Pickup	87 1 Pickup	YES	Y/N	NA
Phase A 87 2 Pickup	Phase A 87 2 Pickup	YES	Y/N	NA
Phase B 87 2 Pickup	Phase B 87 2 Pickup	YES	Y/N	NA
Phase C 87 2 Pickup	Phase C 87 2 Pickup	YES	Y/N	NA
87 2 Pickup	87 2 Pickup	YES	Y/N	NA
General Pickup	General Pickup	YES	Y/N	NA
Phase A 87 1 Trip	Phase A 87 1 Trip	YES	Y/N	NA
Phase B 87 1 Trip	Phase B 87 1 Trip	YES	Y/N	NA
Phase C 87 1 Trip	Phase C 87 1 Trip	YES	Y/N	NA
87 1 Trip	87 1 Trip	YES	Y/N	NA
Phase A 87 2 Trip	Phase A 87 2 Trip	YES	Y/N	NA
Phase B 87 2 Trip	Phase B 87 2 Trip	YES	Y/N	NA
Phase C 87 2 Trip	Phase C 87 2 Trip	YES	Y/N	NA
87 2 Trip	87 2 Trip	YES	Y/N	NA
General trip	General trip	YES	Y/N	NA
87 1 Disable by input	87 1 Disable by input	YES	Y/N	NA
87 2 Disable by input	87 2 Disable by input	YES	Y/N	NA
General Trip enable/disable by digital input	Trip disabled(by DI)	YES	Y/N	NA
Protection status: in service/out of service	Protection status	YES	Y/N	NA
Digital output1 active/non active	Output 1	YES	Y/N	NA
Digital output 2 active/non active	Output 2	YES	Y/N	NA
Digital output 3 active/non active	Output 3	YES	Y/N	NA
Digital output 4 active/non active	Output 4	YES	Y/N	NA
Digital input 1 active/non active	Digital input 1	YES	Y/N	NA
Digital input 2 active/non active	Digital input 2	YES	Y/N	NA
Settings change disabled by digital input	Sett. change disable	YES	Y/N	NA
Trip operation by digital input	Trip operation by input	YES	Y/N	NA
Trip operation by command	Trip operation by command	YES	Y/N	NA
Auxiliary digital output latch reset	Reset latch aux	YES	Y/N	NA
Group 2 selection by digital input	Settings group change	YES	Y/N	NA
Oscillo trigger by digital input	Oscillo trigg by DI	YES	Y/N	NA
86 Status	86 Status	YES	Y/N	NA
Reset 86	Reset 86	YES	Y/N	NA
Oscillography trigger by command	Oscillo trigg by comm	YES	Y/N	NA
Settings change	Settings change	YES	Y/N	NA
EEPROM Failure	EEPROM Failure	YES	Y/N	NA
User settings/Factory settings	User settings	YES	Y/N	NA

5.3.7 OSCILLOGRAPHY MASKS

OSCILLOGRAPHY MASK	ENERVISTA MII SETUP	DEFAULT	RANGE	STEP
Oscillography Trigger by communications	Oscillo by communic.	NO	Y/N	NA
Oscillography Trigger by digital input	Oscillo by digital input	NO	Y/N	NA
Oscillography Trigger by tripping	Oscillo by tripping	NO	Y/N	NA
Oscillography Trigger by pickup	Oscillo by pickup	NO	Y/N	NA

MIB includes an internal clock to time tag events. This clock can be either synchronized with the computer clock or set manually using the EnerVista MII SETUP software program (see Setpoints – Clock). It can also be set to a given Date and Time using the faceplate keypad (DATE & TIME menu entry).

incorporates 2 digital inputs, which can be configured using the EnerVista MII SETUP software (***Setpoint > Relay Configuration***). The default input configuration is as follows:

	MIB
CC1	86 A
CC 2	All functions disable

All elements not defined as PULSE are LEVEL inputs.

In LEVEL inputs, while the voltage level is enough to activate the input, the input performs the function stated in its configuration.

PULSE inputs are different. In the configuration menu for each input there are several states already defined as Pulse inputs. When the input recognizes their activation, it performs the function stated in its configuration, independently from the time it remains activated. For the input to perform again the required function, it is required that the input voltage level is reset and reactivated.

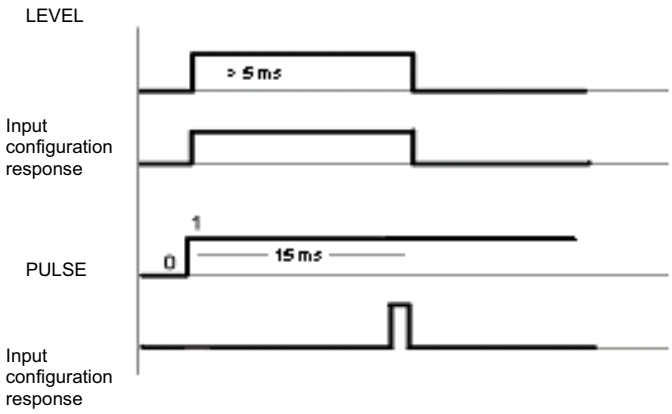


Figure 6–1: INPUT RESPONSE FOR LEVEL AND PULSE OPTIONS

The minimum operation time for a valid PULSE input is over 0.015 seconds.

Input elements are divided into three tthree groups, besides the *No definition* one. Up to eight elements can be configured to be activated by the same input, providing that they are all in the same group. Elements belonging to different groups need to be assigned to different inputs.

In order to configure an input with more than one element from the same group, we must first activate the **OR** button, click on the **I/O CONFIGURATION** option and select the desired group, then select the desired elements. For inverting an element, select the **NOT** button. Finally, click the **OK** button.

INPUT CONFIGURATION WITH MORE THAN ONE FUNCTION (OR). EXAMPLE

As shown on the figure below, input 1 is assigned to an OR. Clicking on that OR checkbox, a second screen named "OR ASSIGNMENT" is displayed, where the user can select the group that contains the desired elements (in this example, "INHIBITIONS BY DIGITAL INPUT 1"). This group includes 8 elements, from which we can select the ones we want to operate in the input, and invert them by clicking on the NOT checkbox. In the example below, all functions have been assigned to the input, and all of them have been inverted. Finally, to validate the selected configuration, the user must click on the OK button both in the "OR ASSIGNMENT" and the "I/O CONFIGURATION" screens.

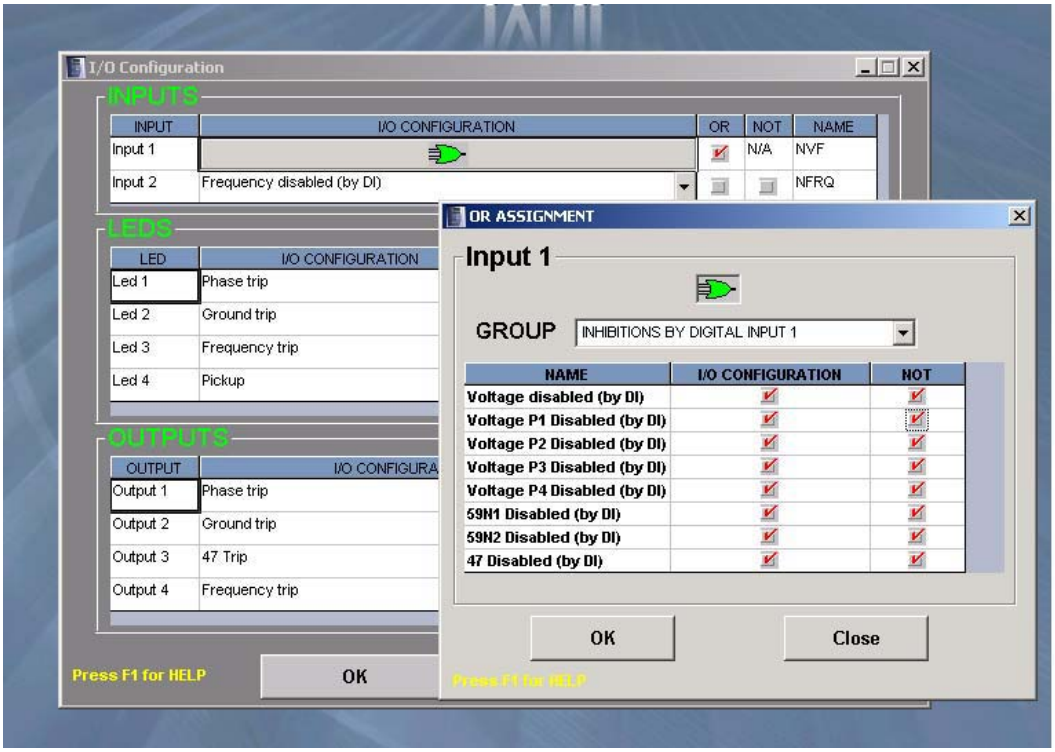


Figure 6–2: INPUT CONFIGURATION WITH MORE THAN ONE FUNCTION (OR)

SIMPLE ACTION INPUT CONFIGURATION (ONE ELEMENT ASSIGNMENT)

To assign breaker status input 52A to a digital input, select Breaker 52a from the I/O configuration selection list. The OR checkbox must not be selected.

The simplest way of programming an input is to assign it to a single element. For this purpose, the user must simply open the I/O configuration selection list of the desired input. Once opened, all possible configuration functions will be shown, and the user will then be able to select one of them.

To invert the selected function, the user must click on the NOT checkbox, to the right of the functions menu.

Figure 6–3: SIMPLE ACTION INPUT CONFIGURATION (ONE ELEMENT ASSIGNMENT)

In the example above, Input 2 has been programmed as 52a, inverted.

In case the user wants to program more than one function for each input, then an OR must be selected, as in the example regarding input configuration with more than one element (OR).

6.1.2 INPUT ELEMENTS

The following table shows the list of elements that can be assigned to each input. The table is divided into groups

GROUP	ENERVISTA MII SETUP	FUNCIONALITY
	No Definition	Input not assigned
MASK ED 1		
	87 1 Disable by Input	Disable the operation (trip) of the 87 1 function
	87 2 Disable by Input	Disable the operation (trip) of the 87 1 function
MASK ED 2		
	DI all functions disable	Disable the operation (trip) of every function
	Trip Disable (by DI)	Disable the operation of the trip contact
INPUTS		
	86B Input	'B' type contact of the latching relay
	86A Input	'A' type contact of the latching relay
	Trip Contact Close (PULSE)	Activates trip contact
	Group Change	If the input is activated the active settings group will be group 2. If it is not activated, the active settings group will be the adjusted in General Advanced Settings
	Sett. Change disable	Activated, it disables the possibility that settings and active group be changed: switching to group 2 will only be possible through digital input Group change
	Reset (PULSE)	LEDs and latched auxiliary outputs reset
	Oscillo Trigger (PULSE)	Start oscillography storage
	General Input	Generic element that may be used in logic configuration.

6.2.1 DESCRIPTION OF OUTPUTS AND LEDS

MIB incorporates 6 outputs and 6 LED indicators. 4 of the outputs and LED indicators are user configurable, and can only be programmed using EnerVista MII SETUP software (SETPOINT – RELAY CONFIGURATION). The first two LEDs are fixed for READY (System ready) and TRIP. The fixed outputs are programmed for ALARM (System alarm) and TRIP.

The TRIP LED activates when the TRIP contact closes.

The READY LED turns on when all the following conditions are fulfilled:

- The relay status is READY
- At least one of the protection functions of the active table is enabled
- The trip of at least one of the enabled functions is also enabled.

The default configuration for outputs is as follows:

OUTPUT	CONFIGURATION	MEMORY
1	87 1 Trip	No
2	87 2 Trip	No
3	Reset 86	No
4	Trip	No

The default LED configuration is as follows:

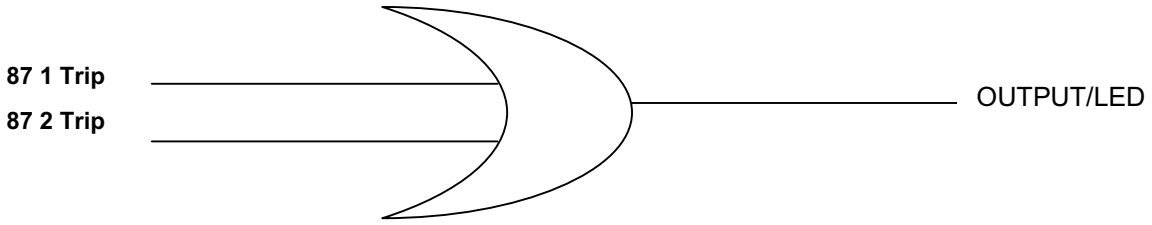
LED	CONFIGURATION		MEMORY
	3000	1000 & 2000	
1	Phase A Trip	87 1 Trip	Yes
2	Phase B Trip	87 2 Trip	Yes
3	Phase C Trip	87 1 Pickup	Yes
4	General Pickup	87 2 Pickup	No

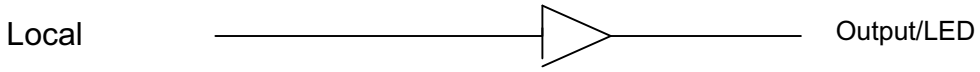
Outputs/LEDs can be configured to be activated by a single element or by a sum of several of them. These elements are divided into eight groups, besides the *No definition* element. Elements belonging to the same group can be assigned to the same output/LED. Elements of different groups need to be assigned to different outputs/LEDs.

In order to assign several elements to activate an output/LED, we first activate the **OR** button, next, click on the **I/O CONFIGURATION** frame and select the desired element group, then choose the desired elements. In order to invert an element, select the **NOT** button. Finally, click on the **OK** button.

The Output/LED logic can inverted selecting the general **NOT** button. Outputs can be latched, and LEDs can be set to be fixed or blinking.

Example:If we want to assign a phase A (High or low level) differential trip to an output or LED, the output or LED must be programmed with 87 1 function trip and 87 2 function trip. 50G1, 50G2 and DIS 51G1elements.To do this, check the OR box in the corresponding Output or LED line (for this case, Output1 and LED1). Then click on the OR button that appears in the I/O configuration column, select the desired group (*TRIP1* and click the I/O configuration box for every element that will be blocked by the input.





Elements from different groups cannot be included in an OR type logic.

6.2.2 OUTPUT AND LED ELEMENTS

The list of elements that can be assigned to the different outputs and LEDs is divided into the following groups:

Table 6–2: OUTPUTS AND LEDS ELEMENT

GROUP	FUNCTION	DESCRIPTION
	NO DEFINITION	OUTPUT OR LED NOT ASSIGNED
TRIP 1	87 1 A Trip	Trip of phase A first level differential function
	87 1 B Trip	Trip of phase B first level differential function
	87 1 C Trip	Trip of phase C first level differential function
	87 1 Trip	Trip of first level differential function (any phase)
	87 2 A Trip	Trip of phase A second level differential function
	87 2 B Trip	Trip of phase B second level differential function
	87 2 C Trip	Trip of phase C second level differential function
	87 2 Trip	Trip of second level differential function (any phase)
TRIP 2	General trip	Trip of any of the above mentioned functions
PICKUP 1	87 1 A Pickup	Pickup of phase A first level differential function
	87 1 B Pickup	Pickup of phase B first level differential function
	87 1 C Pickup	Pickup of phase C first level differential function
	87 1 Pickup	Pickup of first level differential function (any phase)
	87 2 A Pickup	Pickup of phase A second level differential function
	87 2 B Pickup	Pickup of phase B second level differential function
	87 2 C Pickup	Pickup of phase C second level differential function
	87 2 Pickup	Pickup of second level differential function (any phase)
PICKUP 2	General Pickup	Pickup of any of the above mentioned functions
TRIP READY 1	87 1 A Virtual Trip	Phase A first level differential function: there is a trip condition
	87 1 B Virtual Trip	Phase B first level differential function: there is a trip condition
	87 1 C Virtual Trip	Phase C first level differential function: there is a trip condition
	87 1 Virtual Trip	First level differential function (any phase): there is a trip condition
	87 2 A Virtual Trip	Phase A second level differential function: there is a trip condition
	87 2 B Virtual Trip	Phase B second level differential function: there is a trip condition
	87 2 C Virtual Trip	Phase C second level differential function: there is a trip condition
	87 2 Virtual Trip	High second differential function (any phase): there is a trip condition
TRIP READY 2	General Virtual Trip	Virtual trip of any of the above mentioned functions
INPUTS / OUTPUTS	Input 1	Digital input 1
	Input 2	Digital input 2
MIXED 1	86 Status	Status of latching relay 86 (1=closed, 0=open)
	EEPROM Failure	Active when a failure is detected in EEPROM management
	User settings	Active when the default settings are active, not active when the user settings are active
LEDs	Ready	Active when the relay is READY and at least one function is enabled and has trip enabled
MISCELLANEOUS 2	Close Breaker	Active when the close breaker operation is performed
MIXED 2	ACTIVE GROUP	Settings group 2 is active
	Local	Active when the relay display is inside MAIN SETTINGS, ADVANCED SETTINGS or OPERATIONS menu

Virtual trip signals are activated as soon as the protection unit trip conditions are present, independently from the enable setting. This signal can be used to activate LEDs or auxiliary outputs. If the user wants the protection unit to trip, then the trip enable setting must be activated. In this case, the relay will activate the trip contact.

has five types of display messages: actual values, main settings, advanced settings, operations and date & time. Actual values are values that are measured by the relay, such as currents; digital values of the relay, and can be digital inputs, outputs status and others; or internal information as the firmware revision. Main settings and advanced settings comprise product setup, communications and protection elements adjustments. Operations are the available commands that can be performed in the relay.

These types of messages are located within a menu structure that groups the information into categories. This chapter describes the way to navigate this menu structure and shows the complete structure so that the user can reach certain screens quickly.

The faceplate keypad is made up of five keys, as shown in Figure 7–1:

Figure 7–1: KEYPAD

The **main screen** is the one that shows the three phase and neutral currents. If the relay is not showing the main screen, you can return to it from any other screen by pressing the **Escape** key as many times as necessary until exiting the menu structure.

From the main screen, the **Menu** key enters the menu structure. From that point on, the user can navigate through the menu structure using **Up** and **Down** arrows to move horizontally, **Enter** to enter submenus and **Escape** to exit to the upper level.

7.3.1 DISPLAY

The faceplate display of the relay is a 16 column x 2-row characters alphanumeric LCD display. Messages in the display are shown in the English language.

Figure 7–2: DISPLAY

The **display contrast** can be modified simultaneously pressing **Escape** + **arrow**:

- **Escape** + **up arrow** increases the contrast
- **Escape** + **down arrow** decreases the contrast

If the keypad is not in use during 15 minutes, the display turns automatically off and returns to the main screen. Pressing ESC/RESET key, the display is automatically turned on and it shows the main screen with phase and groundcurrents.

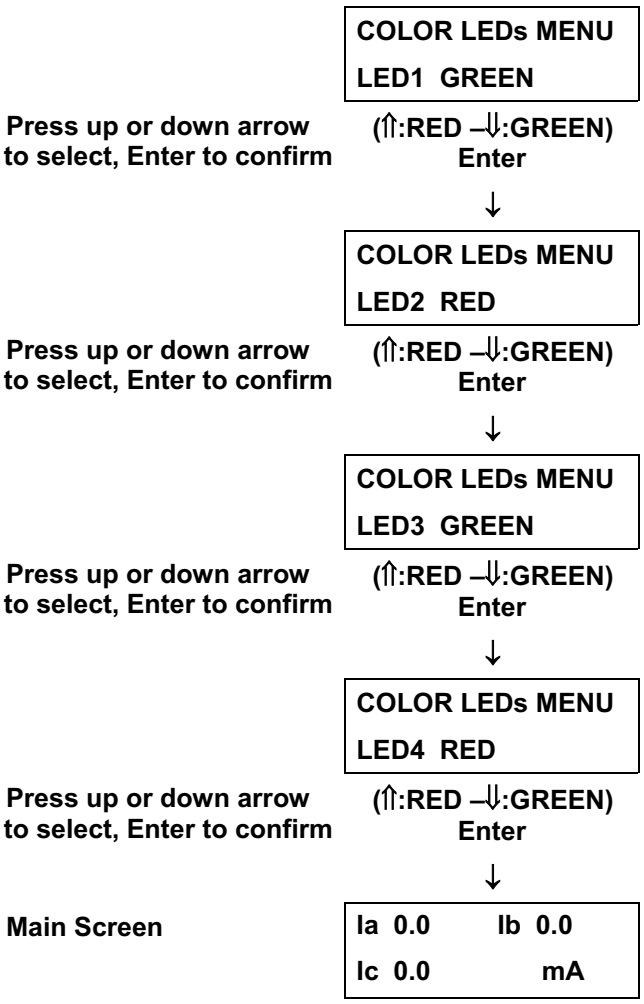
Pressing any other key, corresponding screen in the menu structure is shown. As an example, pressing ENTER key the Thermal Capacity Used screen is shown, as pressing this key the display enters in One Key Operation menu.

7.3.2 LEDS

The faceplate of the relay has six LEDs that show the relay status, as well as pickup and trip status. LEDs are grouped in two columns and three rows, as shown in the following figure:

Figure 7–3: LEDS

The two LEDs in the first row (**Ready** and **Trip**) are not configurable. ForMIB relays the other four LEDs are configurable by the user, using EnerVista MII SETUP program. See Chapter 4 for more information on how to configure LEDs.The **color** of the four **LEDs** in rows 2 and 3 can be changed between red and green in any relay model. The way to do this is to press simultaneously **up** and **down arrow** keys for more than 2 seconds. Then a new menu appears:

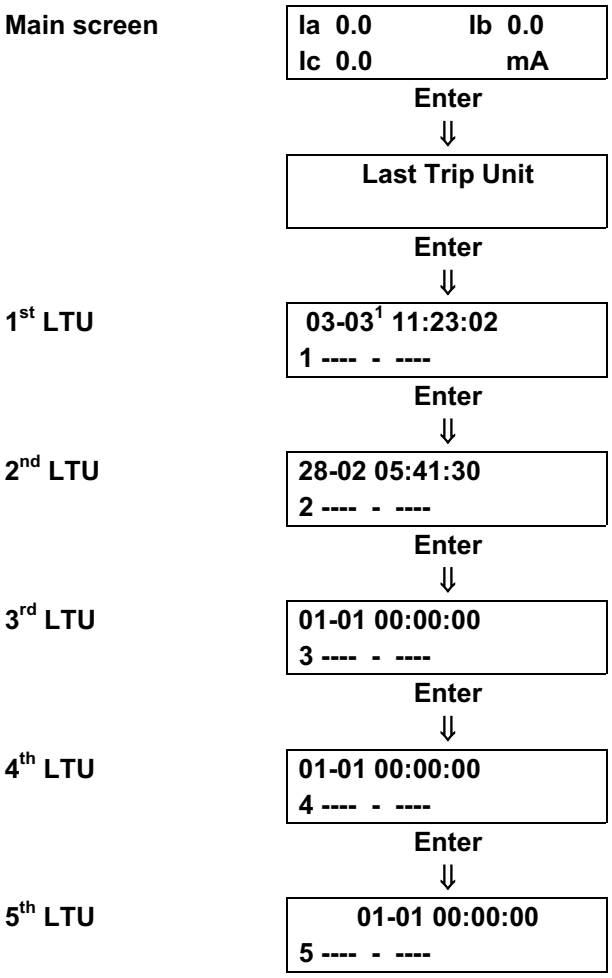

COLOR LEDs MENU
LED1 GREEN
Press up or down arrow to select, Enter to confirm
(⇑:RED –⇓:GREEN)
Enter
COLOR LEDs MENU
LED2 RED
Press up or down arrow to select, Enter to confirm
(⇑:RED –⇓:GREEN)
Enter
COLOR LEDs MENU
LED3 GREEN
Press up or down arrow to select, Enter to confirm
(⇑:RED –⇓:GREEN)
Enter
COLOR LEDs MENU
LED4 RED
Press up or down arrow to select, Enter to confirm
(⇑:RED –⇓:GREEN)
Enter
Main Screen
Ia 0.0 Ib 0.0
Ic 0.0 mA

7.4.1 ONE KEY OPERATION AND LAST TRIP DATA

From the main screen, pressing Enter key the display shows a **one-key operation menu** that presents measures, thermal image value and up to **five latest trip element** data with the element that has tripped,and the secondary current value (not affected by CT ratio), with the day, month and time of the trip.

When a fault occurs, trip information is automatically shown in the display. Pressing ENTER key, main screen will be shown again. In order to perform a RESET operation, display must be in main screen showing phase and ground currents, in this situation, pressing ESC/RESET key for more than 3 seconds a RESET operation will be performed.

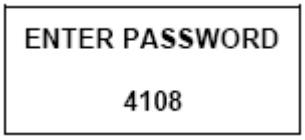
1. Day - month



7.4.2 HMI PASSWORD

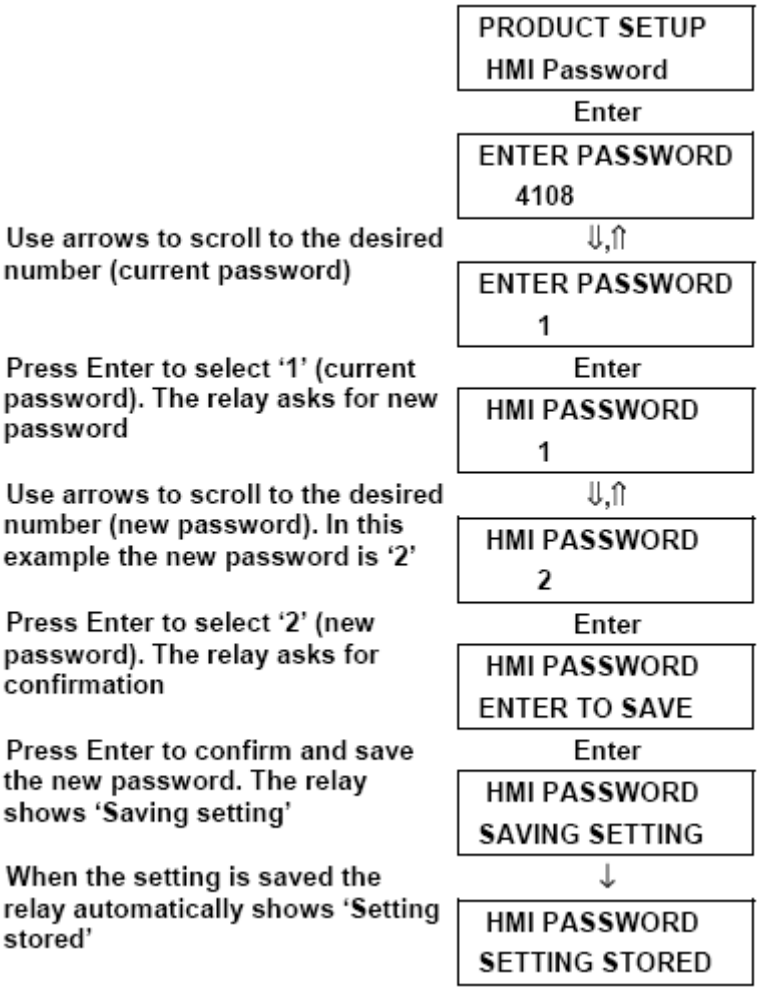
The relay allows settings protection by password. This password is called **HMI password** and it is disabled by default (value 0). If you change this value to other than 0, the HMI password will be enabled and required to change settings. **When the password is enabled, a value between 1 and 9999 is shown on the screen. This number is the password value shown in a coded format.**

When a setting is being changed, after pressing the Enter key to store the modified value the relay shows the following screen:

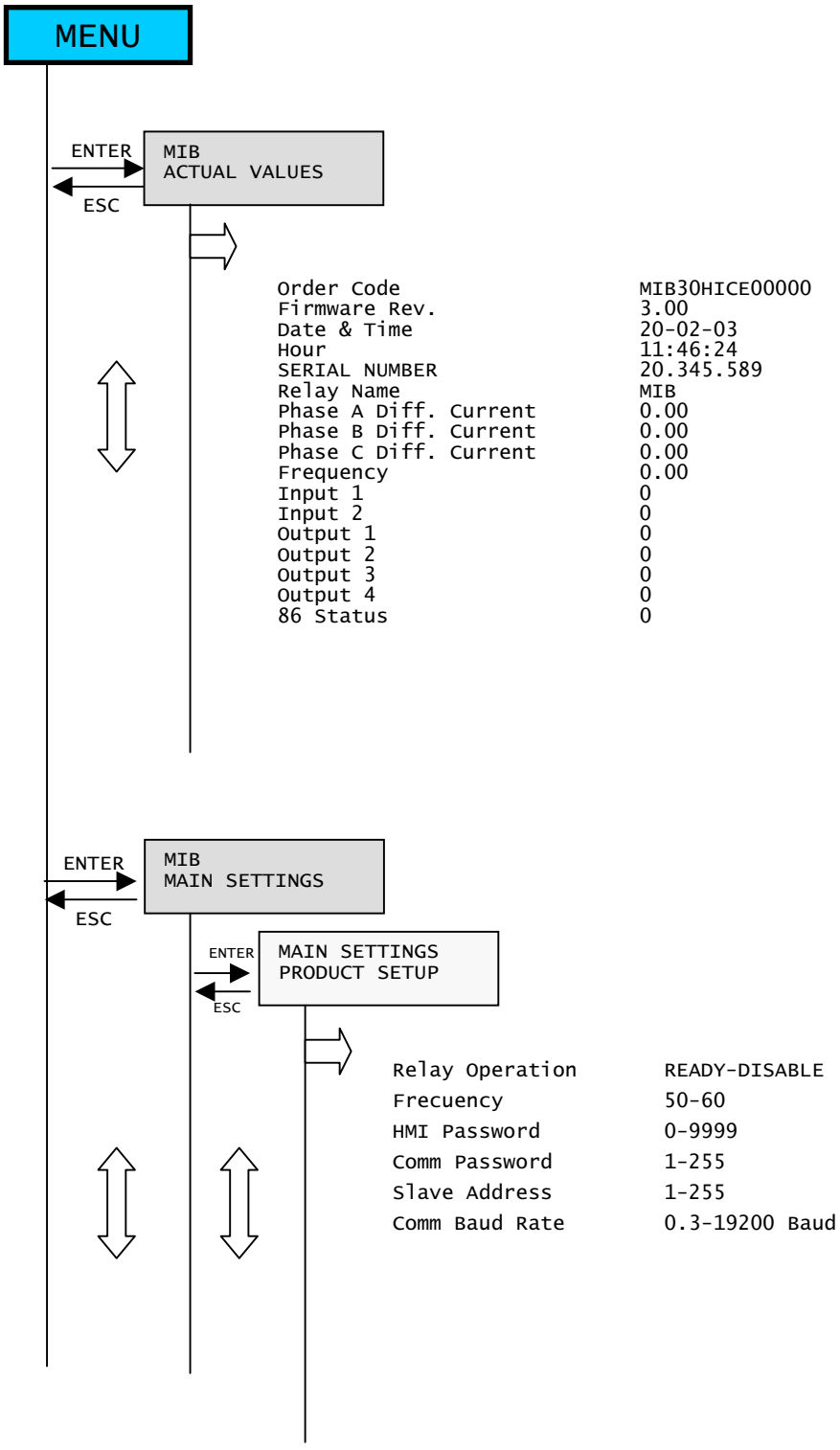


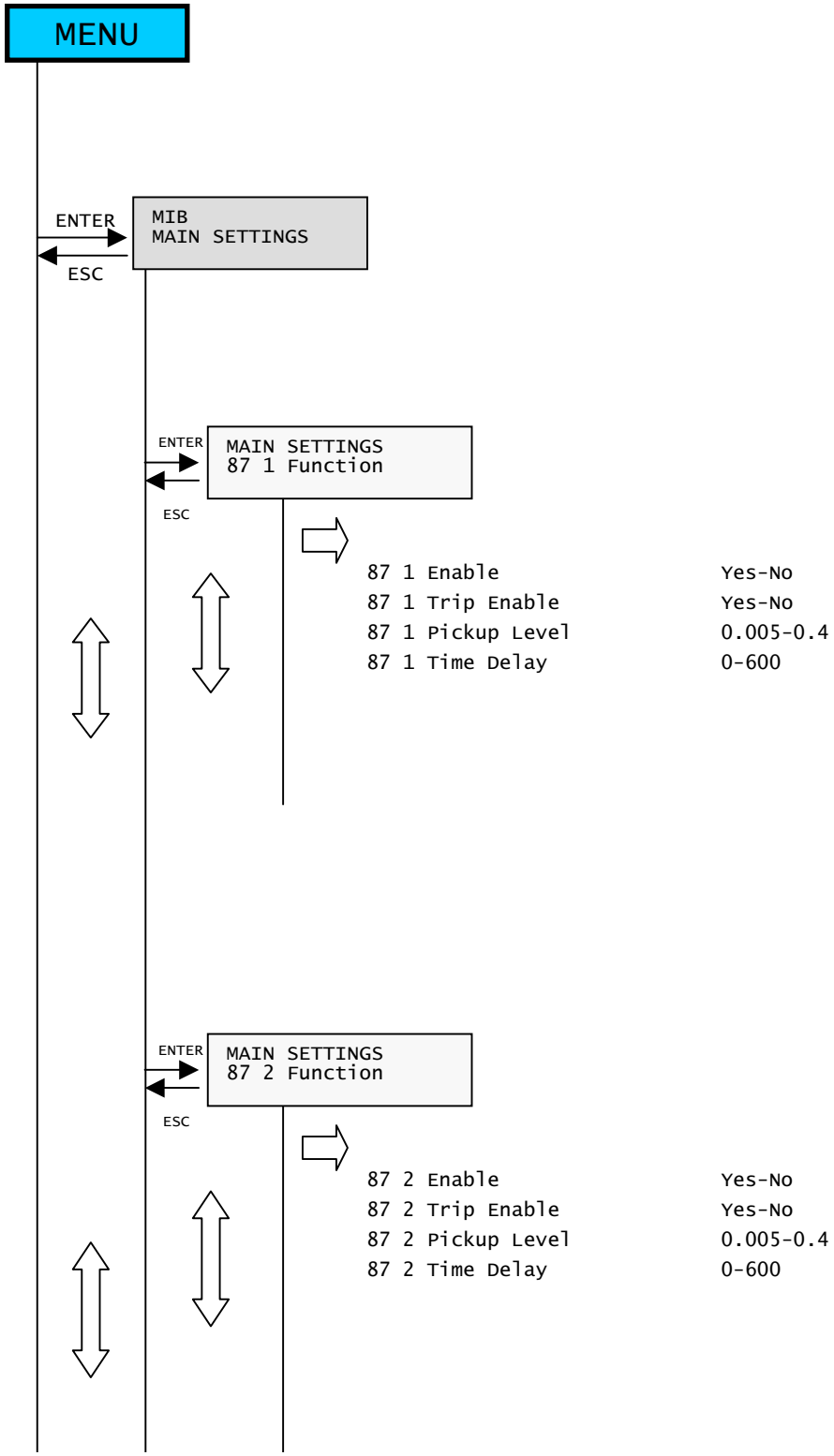
Scroll up and down with the arrow keys until the screen shows the desired password; next, press enter for confirmation and the relay will accept and store the setting change. The setting password protection will then be disabled for **15 minutes** after the last setting change is made to the relay, or until a **reset operation** (the same as to reset LEDs, pressing Esc for more than 3 seconds from the main screen) is performed.

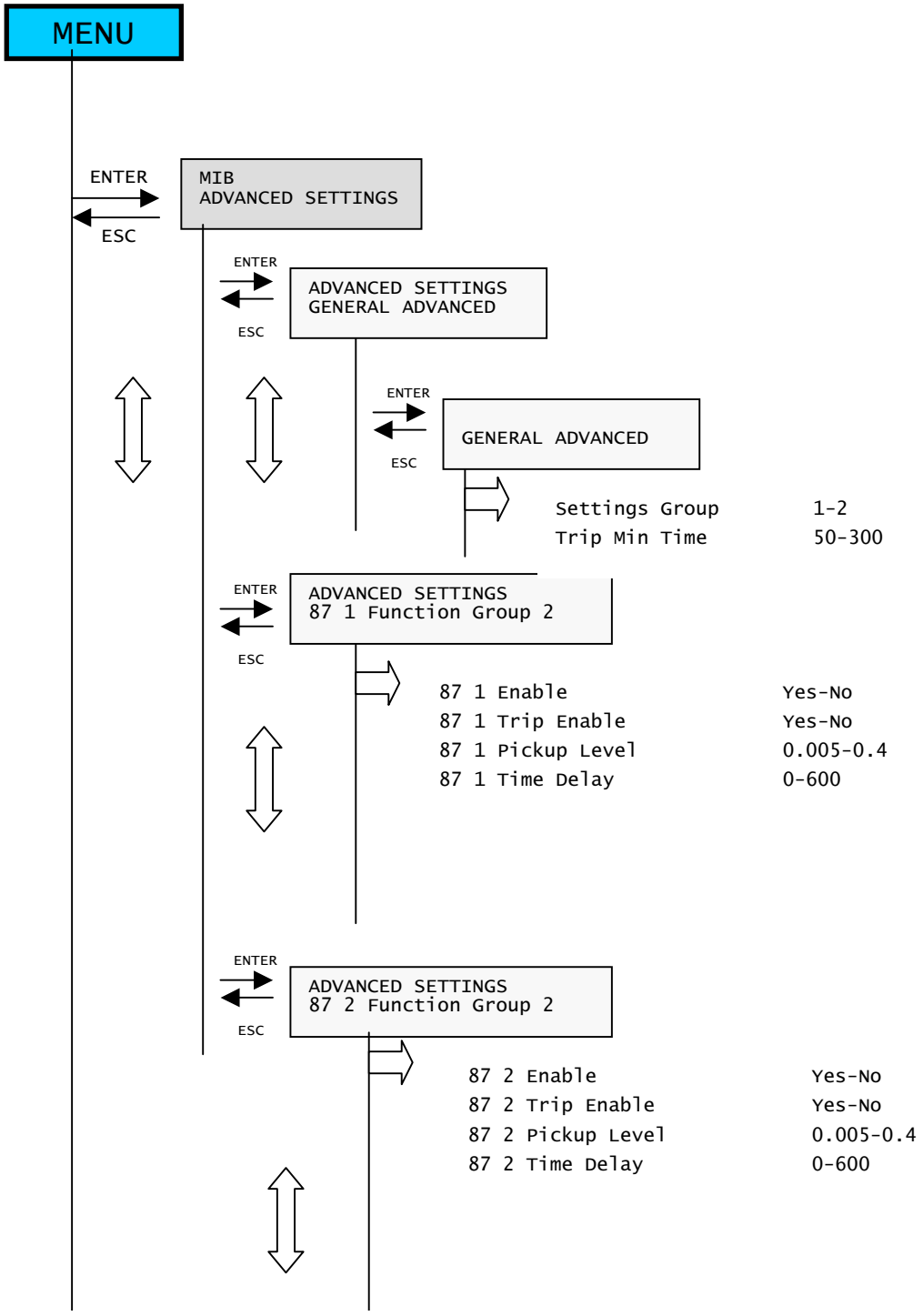
The password can be modified in the ***Main Settings > Product Setup > HMI password*** menu. The relay then asks for the current password. Once it has been entered, the relay asks for the new password. Here is an example of how to change from HMI password value 1 to 2:

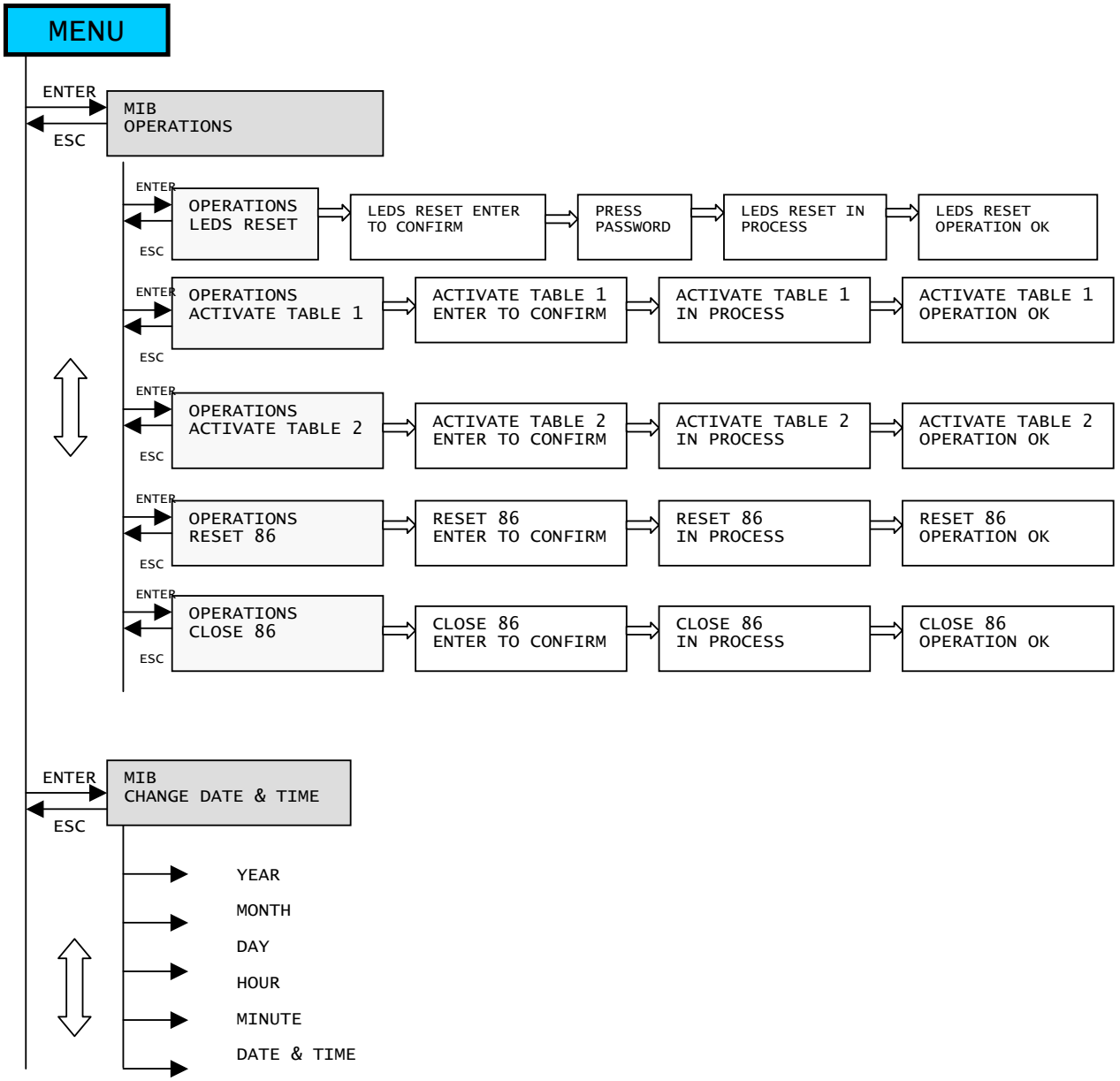


If you don't know the programmed password please contact GE Multilin Technical Service and have the encoded password value shown in ***Main Settings > Product Setup > HMI*** handy.


MENU
ENTER
ESC
MIB
ACTUAL VALUES
Order Code MIB30HICE00000
Firmware Rev. 3.00
Date & Time 20-02-03
Hour 11:46:24
SERIAL NUMBER 20.345.589
Relay Name MIB
Phase A Diff. Current 0.00
Phase B Diff. Current 0.00
Phase C Diff. Current 0.00
Frequency 0.00
Input 1 0
Input 2 0
Output 1 0
Output 2 0
Output 3 0
Output 4 0
86 Status 0
ENTER
ESC
MIB
MAIN SETTINGS
ENTER
ESC
MAIN SETTINGS
PRODUCT SETUP
Relay Operation READY-DISABLE
Frecuency 50-60
HMI Password 0-9999
Comm Password 1-255
Slave Address 1-255
Comm Baud Rate 0.3-19200 Baud


MENU
ENTER
ESC
MIB
MAIN SETTINGS
ENTER
ESC
MAIN SETTINGS
87 1 Function
87 1 Enable
Yes-No
87 1 Trip Enable
Yes-No
87 1 Pickup Level
0.005-0.4
87 1 Time Delay
0-600
ENTER
ESC
MAIN SETTINGS
87 2 Function
87 2 Enable
Yes-No
87 2 Trip Enable
Yes-No
87 2 Pickup Level
0.005-0.4
87 2 Time Delay
0-600


MENU
ENTER
ESC
MIB
ADVANCED SETTINGS
ENTER
ESC
ADVANCED SETTINGS
GENERAL ADVANCED
ENTER
ESC
GENERAL ADVANCED
Settings Group 1-2
Trip Min Time 50-300
ENTER
ESC
ADVANCED SETTINGS
87 1 Function Group 2
87 1 Enable Yes-No
87 1 Trip Enable Yes-No
87 1 Pickup Level 0.005-0.4
87 1 Time Delay 0-600
ENTER
ESC
ADVANCED SETTINGS
87 2 Function Group 2
87 2 Enable Yes-No
87 2 Trip Enable Yes-No
87 2 Pickup Level 0.005-0.4
87 2 Time Delay 0-600


MENU
ENTER
ESC
MIB
OPERATIONS
ENTER
ESC
OPERATIONS
LEDS RESET
LEDS RESET ENTER
TO CONFIRM
PRESS
PASSWORD
LEDS RESET IN
PROCESS
LEDS RESET
OPERATION OK
ENTER
ESC
OPERATIONS
ACTIVATE TABLE 1
ACTIVATE TABLE 1
ENTER TO CONFIRM
ACTIVATE TABLE 1
IN PROCESS
ACTIVATE TABLE 1
OPERATION OK
ENTER
ESC
OPERATIONS
ACTIVATE TABLE 2
ACTIVATE TABLE 2
ENTER TO CONFIRM
ACTIVATE TABLE 2
IN PROCESS
ACTIVATE TABLE 2
OPERATION OK
ENTER
ESC
OPERATIONS
RESET 86
RESET 86
ENTER TO CONFIRM
RESET 86
IN PROCESS
RESET 86
OPERATION OK
ENTER
ESC
OPERATIONS
CLOSE 86
CLOSE 86
ENTER TO CONFIRM
CLOSE 86
IN PROCESS
CLOSE 86
OPERATION OK
ENTER
ESC
MIB
CHANGE DATE & TIME
YEAR
MONTH
DAY
HOUR
MINUTE
DATE & TIME

Unpack the relay and verify that no parts are broken and that the relay has not suffered any damage during transit. Verify that the model number indicated on the faceplate corresponds to the model ordered.

All devices that work with alternating current are influenced by frequency. Since a non-sinusoidal waveform results from a fundamental frequency wave plus a series of harmonics of this fundamental wave, it can be concluded that devices working with alternating current (relays) are influenced by the applied waveform.

In order to correctly test relays that operate under alternating current, it is fundamental to use a sinusoidal current and/or voltage wave. The purity of the sinusoidal wave (the lack of harmonics) cannot be expressed in a specific form for a given relay. Each relay that is provided with tuned circuits, R-L and R-C circuits or non-linear elements (such a inverse time overcurrent relays) will be affected by non-sinusoidal waveforms.

These relays respond to the current waveform in a different way from most AC ampere-meters. If the power supply network that is used for the test contains a considerable amount of harmonics, the ampere-meter and relay responses will be different.

The relays are calibrated by the manufacturer using a 50 or 60 Hz power supply network with minimum harmonic contents. When the reception or installation tests are carried out, a power supply network with a harmonic-free waveform must be used.

Ampere-meters and stop-watches that are used for carrying out the test must be calibrated and their accuracy must be better than that of the relay. The power supply network used for the tests must remain stable, mainly at levels close to the test pick-up current, as well as for the time for which the relay operates according to the curve under test.

It is important to stress that the test accuracy depends on the power supply network conditions as well as on the instruments used. Functional tests carried out under inappropriate power supply conditions or using inappropriate instruments can be used for ensuring that the relay works roughly correctly and, therefore, for verifying its characteristics in an **approximate** manner.

Here follows a list of tests that can be used to check that the unit is fully operational. For a more limited test for the reception of units we recommend carrying out only the tests listed in sections 9.5, 9.8, 9.10, 9.11, 9.12, 9.13, 9.14, 9.15, 9.16, 9.17, 9.18 and 9.19.

For verifying insulation, independent groups will be created, and voltage will be applied as follows:

2500 RMS volts will be applied **progressively** among all terminals in a group, short-circuited between them and the case, during one second.

2500 RMS volts will be applied **progressively** between groups, during one second.

The independent groups on the relay are as follows:

Group 1:	A1, A2	Power Supply
Group 2:	C1 to C6	Current Transformers
Group 3:	A8, A9, A10	Contact Inputs
Group 4:	A5, A6	Trip
Group 5:	B7, B8, B9, B10, A7	Contact Outputs

8

NOTE:

In case of performing this test on all terminals at the same time, have in mind that the consumption will increase, due to the impedance of the capacitors inside the relay, used to derive high frequency surges to ground. The consumption will be approximately, 3 mA at 2000 Volts for each input.

In case the Hi-Pot device used to test the relay trips due to excessive consumption, apply the test between each group and ground one at a time.

NOTE: Do not test insulation on terminals B12, A12 and B11 (RS485). These terminals must be grounded during the test.

DURING TESTS, GND TERMINAL MUST BE GROUNDED FOR SAFETY REASONS

When the relay is shipped from our factory, it has default settings, which are the starting point for the following tests.

An exhaustive list of all the settings necessary for each test will not be given here. Just the specific settings required for each test are indicated, and it can be supposed that the other settings do not affect the test being performed.

We must take into account that these tests are only valid for the default factory configuration. Different configurations involving modifications in certain elements, such as different contact configuration, will require a subsequent modification of the test procedure.

Acceptance tests are explained assuming the default settings.

Necessary equipment:

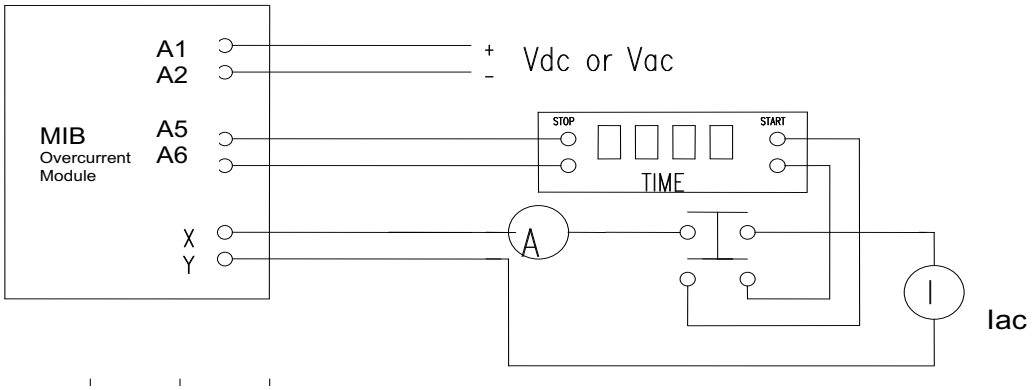
- 1 AC current source .
- 1 DC voltage power supply.
- 1 timing device.
- 1 Multi-meter.
- Optionally, it is advisable to have a PC available, with the EnerVista MII SETUP software installed.
- Relay wiring diagram.

Connect the relay as shown in

For safety reasons, the external protection earth terminal should be securely grounded.

Supply the unit through terminals A1 and A2 at the rated voltage

.



Phase	Overcurrent Module	
	X	Y
A	C1	C2
B	C3	C4
C	C5	C6

NOTE: Terminals for current injection

8

Figure 8–1: TEST CONNECTIONS FOR MIB (RELAY

NOTE: If the relay is wanted to be tested using HID Terminals, a current wave must be used. Otherwise, the metering will be affected by the accuracy of the resistor

Check that pressing the “ESC/RESET” button for more than 3 seconds, all the front target LEDs light up and reset.

Connect the relay to a power supply at rated minimum voltageindicated in the table below

A (C1-C2 terminals) a current equal to 0.1 amp.The . will trip and close trip contact and OUT1 and OUT4 outputs. Under these tripping conditions check that the READY(B5-B6 terminals) output is open, and trip contact (A5-A6 terminals) and OUT1 (A7-B7 terminals) and OUT4 (A7-B10 terminals) auxiliary contacts are closed. Also check that the relay can communicate with the PC program in case you are using the relay connected to a PC:

GENERAL SETTINGS	
Relay Status	RDY
Frequency	Line frequency
87 1 FUNCTION	
87 1 Enable	YES
87 1 Trip Enable	YES
87 1 Pickup level	0.010 A
87 1 Time Delay	1 sec

Voltage test and maximum consumption is shown below:

Model "LO" (24 - 48 VDC)	
Voltage (VDC)	Maximum Consumption (mA)
18	900
48	300
58	250

Model "HI" (110 - 250 VDC 120-230 Vac)	
Voltage (VDC)	Maximum Consumption (mA)
88	130
110	105
250	55
Voltage (Vac)	Maximum Consumption (mA)
110	200
220	140

Shown values are only illustrative, as due to the nature of the internal power supply (switched power supply), the consumption currents are high frequency currents, and the meters used measure these values with a poor accuracy.

The communication test checks that the 2 communications ports (the front RS232 and the rear RS485) work properly. To perform this test is necessary to establish the connection between the PC and the relay (refer to Figure 3–14:). If the front port is used, a straight through cable is needed. If the rear RS485 port is used, an RS485/RS232 converter is needed. GE Multilin offers DAC300, F485 or RS232/485 converters.

The communications parameters that have to be set in the computer should match the relay default communication settings.

The factory default settings for the MIB relay are:

COMMUNICATIONS			
NAME	**VALUE**	**UNITS**	**RANGE**
Slave Address	1		1 - 255
Communication Port	COM1		COM1 – COM*
Baud Rate	9.600	Bauds	300 – 19 200
Parity	NONE		NONE – ODD - EVEN
Control type	No control type		No control type, Modem connection, MODBUS/TCP
Start up mode	File Mode		Communicate with relay – File mode

Using the EnerVista MII SETUP program, communicate with the relay and in the Status window check that the communications are not lost at any time. Perform this test on both communications ports.

This test is carried up at the minimum and maximum voltage that the relay allows (+-20 of the rated voltage)

When the relay is shipped from the factory, it comes with a default set of settings, which act as the starting point for the following tests.

Since the MIB relay has a large number of settings, a list of all the settings necessary for all tests will not be given here, but rather only the specific settings required for each test indicated.

These tests are only valid for the default factory configuration. Different configurations involving modifications in certain elements, such as different contact configuration, will require a subsequent modification of the test procedure.

Sequentially apply the rated voltage to input CC1 and CC2 (A8-A10 and A9-A10).

Check that when voltage is applied to one contact input, only this input gets active, and the other one remains inactive. Use the INFORMATION menu on the faceplate or a PC and the ACTUAL VALUES menu in the EnerVista MII SETUP program (***Actual> Actual Values***) to easily check which input gets active for each test.

Repeat this test at minimum and maximum permissible voltages.

Check that all the outputs are open.

Set the relay as follows:

87 2			
NAME	**VALUE**	**UNITS**	**RANGE**
87 2 Enable	Yes		Yes/No
87 2 Trip Enable	Yes		Yes/No
87 2 Pickup level	0.01	Amps	0.005 – 0.4
87 2 Time Delay	0	Seconds	0 - 600

Inject a current through phase A terminals equal to 0.1 amp to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) and OUT4 (terminals A7-B10) close, and the **PICKUP (LED4),** and **OP 87A (LED1)** LEDs lights up.

Inject a current through phase B terminals equal to 0.1 amp to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) and OUT4 (terminals A7-B10) close, and the **PICK UP (LED4), OP 87B** (LED2) and **TRIP** LEDs light up.

Inject a current through phase C terminals equal to 0.1 amp1 x In (phase) to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) and OUT4 (terminals A7-B10) close, and the **PICK UP (LED4)**, **OP 87C (LED3)** and **TRIP** LEDs light up.

Remove the Power Supply from the relay and check that the READY contact (terminals B5-B6) closes. Power on the relay again and check that the READY (terminals B5-B6) contact opens.

Set the relay to the same frequency than the AC source used and apply the following currents:

PHASE	1	2	3
Ia (Amps)		0.2 amps (phase)	
Ib (Amps)	0.1 amps (phase)		0.3 amps (phase)
Ic (Amps)			

Check that the relay measures Ia, Ib and Ic with an accuracy better than 3%

Enable only 87 1 function.

Set its time delay and pickup to 0.1 A.

With 0.9 times the pickup current the relay should not trip.

With 1.1 times the pickup current the relay should trip in between 10 to 50 ms.

With 4 times the pickup current the relay should trip in less than 15 ms.

The test should be carried out for phases A, B and C.

Enable only 87 2 function.

Set its time delay and pickup to 0.1 A.

With 0.9 times the pickup current the relay should not trip.

With 1.1 times the pickup current the relay should trip in between 10 to 50 ms.

With 4 times the pickup current the relay should trip in less than 15 ms.

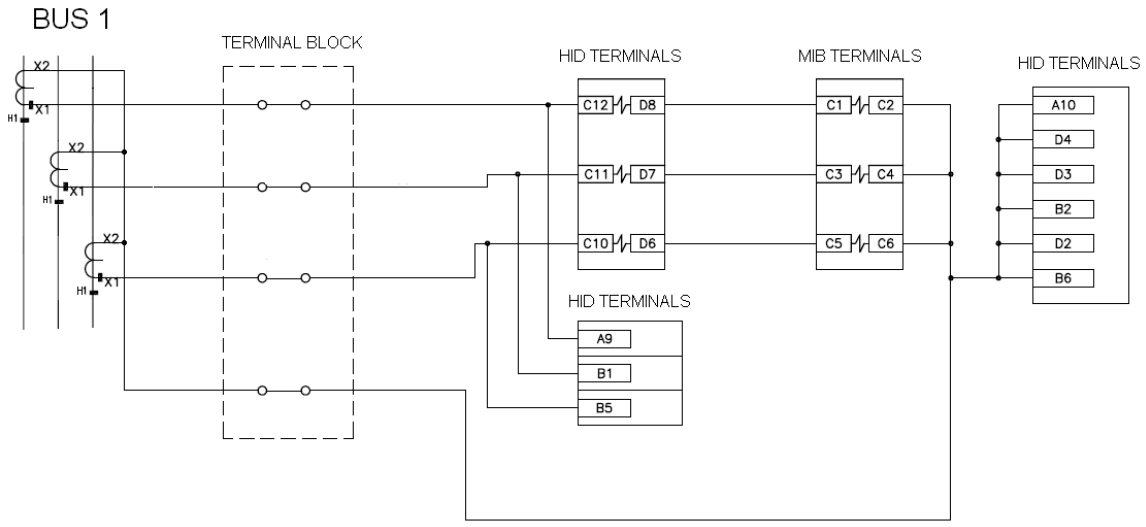
The test should be carried out for phases A, B and C.

Synchronize the relay date and time with the PC, using the EnerVista MII SETUP communications program (SETPOINT – CLOCK). Check using the keypad and display that the relay is actually in synchronism with the computer.

8.15.1 BACKGROUND

High Impedance Differential protection is a well-known principle where stabilization resistors provide immunity against CT saturation due to external faults. HID module provides resistors together with voltage limiters (MOV) to be used with high-speed overcurrent relay in order to get a high impedance differential protection scheme. External CT's are differentially connected exactly as for traditional high impedance differential protection relaying. During normal conditions there will be no voltage or very small voltage across the impedance connected across paralleled CTs. Significant voltage will develop across paralleled CTs and 2000 Ohm resistor during an internal fault. MIB relay connected in series with the 2000-Ohm resistor will measure the current flowing through the circuit. If the current is above the pick-up the MIB relay will trip. MIB relay works with current range of 10 - 400 mA.

The diagram below shows typical wiring of MIB and HID modules. Output from the CTs is wired across HID impedance in series with MIB current input.



8.15.2 WIRING AND NECESSARY EQUIPMENT

Necessary equipment:

1 AC voltage source.

1 DC voltage power supply.

1 timer.

1 Multi-meter.

Typical wiring diagram: (3000) B5177F1

(2000) B5177F2

(1000) B5177F3

8.15.3 CONTINUITY

Test equipment:

A multimeter or continuity measurer with a maximum threshold of 110 Ω.

Method:

Check for continuity between the grounded screw and any metallic point of the case that has no painting on it.

8.15.4 ISOLATION TEST

IMPORTANT:

During all tests, the screw located on the rear of the relay must be grounded.

For verifying isolation, independent groups will be created, and voltage will be applied as follows:

2500 RMS volts will be applied **progressively** among all terminals in a group, short-circuited between them and the case, during one second. In case the Hi-Pot device used to test the relay trips due to excessive consumption, apply the test between each group and ground one at a time.

2500 RMS volts will be applied **progressively** between groups, during one second.

- Group 1 (LATCHING RELAY contacts): A5 – A6 – A7 – A8– A9 – A10– A11 – A12– B1 – B2– B3 – B4– B5 – B6 – B7 – B8
- Group 2 (LATCHING RELAY coils): A1 – A4 – B9 – B12
- Group 3 (Pushbutton)*: C5 – C6 – C7 – C8
- Group 4 (Analogical Group): C10 – C11 – C12 – D6 – D7 – D8 – D2 – D3 – D4

Consumption will not be higher than 20 mA.

*NOTE:Use terminal C5 for 125 VDC power supply. For power supply from 125 Vdc to 250 VDC use C1 terminal.

8.15.5 MEASURES

Latching relay Coil Resistor (HID module)

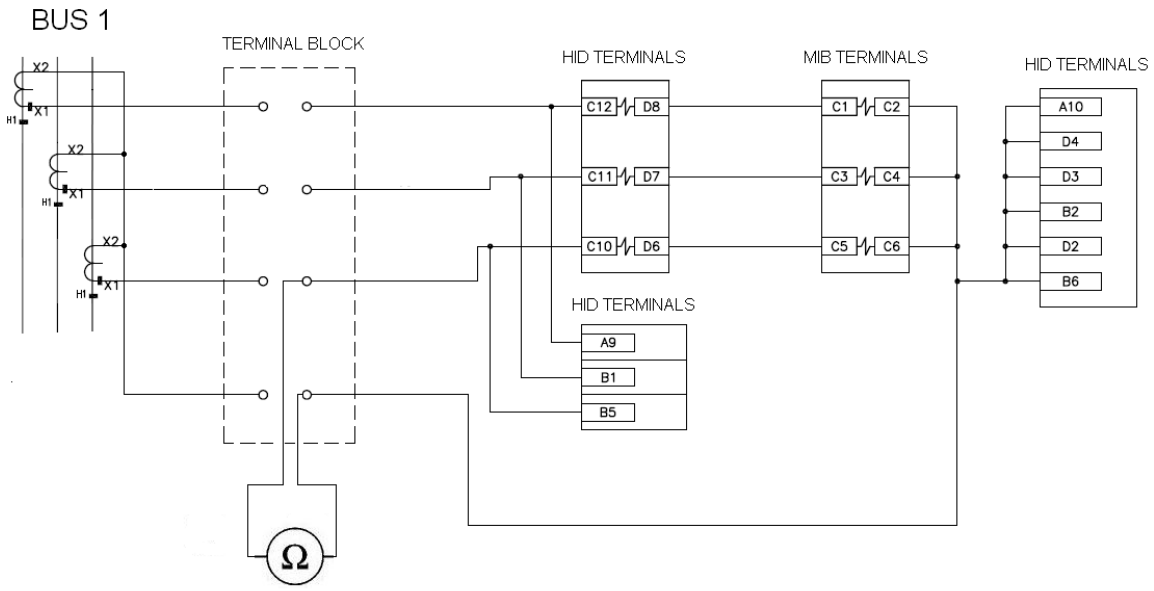
POWER SUPPLY	A1 – A3 TERMINALS	B10 – B12 TERMINALS
1 (48 VDC)	340 OHM	340 OHM
2 (125 VDC)	2K15	2K15
3 (220 VDC)	4K2	4K2

NOTE: Accuracy of 20%.

Resistance Metering

To verify operation of HID latching contacts the following test should be performed:

Connect a resistance meter across HDI impedance in series with MIB phase input.



Measure the resistance when HID is not tripped. The resistance should be 2000 Ohms.

Latching relay contacts on HID terminals: B7-B8, B3-B4, A11-A12, A7-A8 should be opened.

Trip the HID unit by applying VDC to HID terminals A1 (+) and A4 (-).

DC Voltage to be applied will depend on the model of the HID unit:

Model Number: HID-3-1 Voltage Level: 48 VDC

Model Number: HID-3-2 Voltage Level: 125 VDC

Model Number: HID-3-3 Voltage Level: 220 VDC

When HID trips latching contacts across the resistance will close, the resistance should now be 0.

Latching relay contacts on HID terminals: B7-B8, B3-B4, A11-A12, A7-A8 should be closed.

Record the test information.

HID Impedance:

SWITCHGEAR SECTION	PHASE	HID INPUT RESISTANCE WHEN HID IS NOT TRIPPED(+/- 12%)	HID INPUT RESISTANCE WHEN HID IS TRIPPED
3200	A	2000	0
3200	B	2000	0
3200	C	2000	0

8.15.6 LATCHING RELAY

Contact test:

- Check with the external wiring diagram that all the auxiliary contacts of the latching relay are open and, therefore, there is no continuity between them.
- Apply voltage to terminals +A1 y –A4 and verify that latching relay contacts operation time is below 25 ms.
- Verify that all auxiliary contacts have changed their position to closed and that there is continuity between each pair of them.
- Apply voltage to terminals +B9 and –B12 and verify that latching relay contacts opening time is below 20 ms.
- Check that all auxiliary contacts have changed to their default position (open) and, therefore, there is no continuity between each pair of them

Lamp:

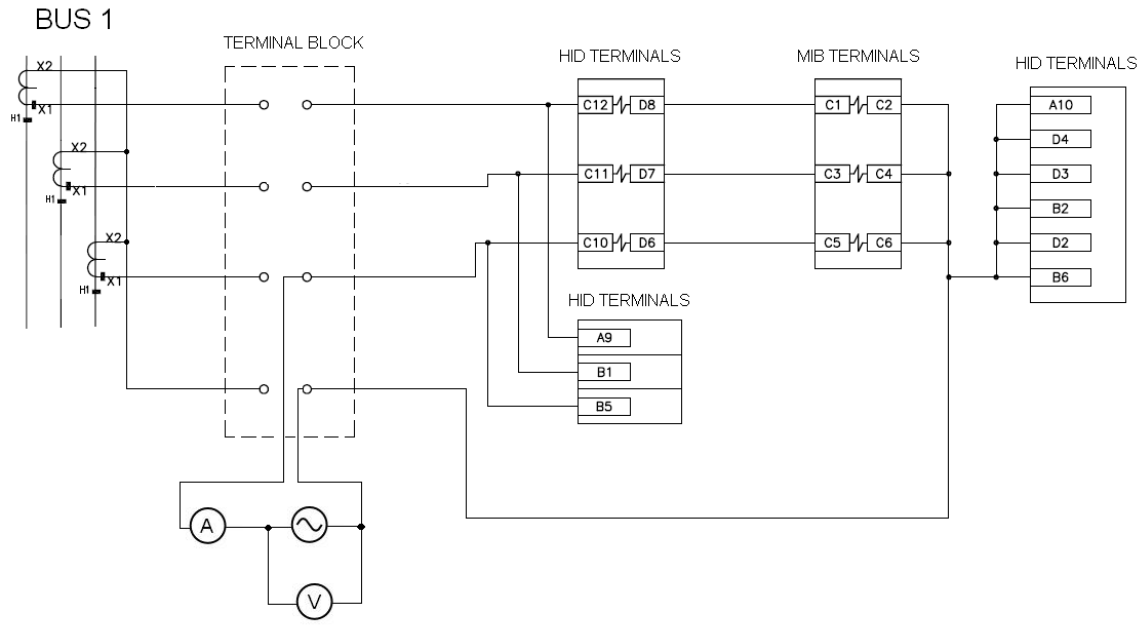
- By having the latching relay in the reset position, apply the latching relay rated voltage and check that the button lightens up. [Terminals C6(+) and C9(-) for 48 VDC; Terminals C6(+) and C5(-) for 125 VDC; Terminals C6(+) and C1(-) for more than 125 VDC].
- Switch the voltage off and check the lamp turns off.
- Without any DC supply at C7-C8 terminals, check with a Resistance test that when pressing the button there is full continuity between C7 and C8 terminals.

8.15.7 HIGH IMPEDANCE DIFFERENTIAL ELEMENT TEST

Voltage source can be used to test the MIB/HID wiring and operation.

CTs can be isolated and voltage source connected across HID impedance in series with MIB

phase input as shown in the wiring diagram below.



Each phase should be tested separately.

Monitored voltage and current values should be recorded.

SWITCHGEAR SECTION	PHASE	MIB 30 METER (mA)	EXTERNAL METER CURRENT INTO RELAY (mA)	VOLTAGE ACROSS HIGH IMPEDANCE (Volts)	MIB OPERATION
3200B	A	15	14.7	29	NO TRIP
3200B	A	20	19.5	39	NO TRIP
3200B	A	31	30	59	NO TRIP
3200B	A	40	39	78	NO TRIP
3200B	A	51	49.5	97	NO TRIP
3200B	A	72	71.2	137	NO TRIP
3200B	A	74	72.5	139	TRIP
3200B	B	15	14	28	NO TRIP
3200B	B	20	19	37	NO TRIP
3200B	B	30	29.4	58	NO TRIP
3200B	B	40	39	76	NO TRIP
3200B	B	50	48.5	95	NO TRIP
3200B	B	72	70.5	136	NO TRIP
3200B	B	74	72.4	139	TRIP
3200B	C	15	15	29	NO TRIP
3200B	C	20	19	38	NO TRIP
3200B	C	30	29	57	NO TRIP
3200B	C	40	39	77	NO TRIP
3200B	C	50	49	96	NO TRIP
3200B	C	72	71	136	NO TRIP
3200B	C	74	72.5	139	TRIP

When MIB relay trips the following should happen:

MIB relay Trip contact - terminals A5 - A6 will close. This will operate the external lock-out switch. LED on the front of the MIB relay will lit indicating phase that caused the trip.

MIB relay output contact 4 will close shorting terminals A7 and B10 on MIB relay which will apply DC voltage into terminals A1 on HID module causing the lock-out relay to operate.

When lock-out relay operates all contacts on HID module will close.

Latching contact of HID module at terminals A9-A10, B1-B2, B5-B6 will close thus bypassing all current to ground.

Contact A7 and A8 on HID module will close, this will apply voltage into MIB relay digital input CC1 at terminal A8, signaling that HID module has tripped.

Latching relay contacts : B7-B8, B3-B4, A11-A12 will also close.

The following pages intend to be useful to register the user settings. They can be used as a guide or template or to record the relay settings, in case your company does not provide a propietary form sheet.

8.16.1 MAIN SETTINGS

8.16.1.1 GENERAL SETTINGS

	ENERVISTA MII SETUP	HMI	USER VALUE	RANGE	STEP
GENERAL SETTINGS	PRODUCT SETUP	GENERAL			
Relay Status	Relay Operation	STA		RDY / DIS	NA
Frequency	Frequency	FRQ		50/60 Hz	NA
Password	---	PWD		1 – 255	
Address	---	ADD		1 – 255	1
Communications Speed	---	BAUD		300, 600, 1200, 2400, 4800, 9600, 19200	NA

8.16.1.2 DIFFERENTIAL CURRENT UNITS

	ENERVISTA MII SETUP	HMI	USER VALUE	RANGE	STEP
FIRST LEVEL DIFFERENTIAL FUNCTION	**87 1 FUNCTION**	**F 87 1**			
First Level 87 Enable	87 1 Enable	ENABLE 87 1		Y/N	NA
Permission to Trip First Level 87	87 1 Trip Enable	TRIP 87 1		Y/N	NA
First Level 87 Tap / Pickup Value	87 1 Pickup Level	TAP 87 1		0.005-0.4 A	0.01 A
First Level 87 Definite Time Delay	87 1 Time Delay	TIME 87 1		0 – 600.00 s.	0.01 s.
SECOND LEVEL DIFFERENTIAL FUNCTION	**87 2 FUNCTION**	**F 87 2**			
Second Level 87 Enable	87 2 Enable	ENABLE 87 2		Y/N	NA
Permission to Trip Second Level 87	87 2 Trip Enable	TRIP 87 2		Y/N	NA
Second Level 87 Tap / Pickup Value	87 2 Pickup Level	TAP 87 2		0.005-0.4 A	0.01 A
Second Level 87 Definite Time Delay	87 2 Time Delay	TIME 87 2		0 – 600.00 s.	0.01 s.

8.16.2.1 ADVANCED GENERAL SETTINGS

	ENERVISTA MII SETUP	HMI	USER VALUE	RANGE	STEP
General Settings (Adv.)	ADV. GENERAL SETT.	GENERAL ADVANCED			
Identification	IDENTIFICATION	---		Text	NA
Active Settings group	Settings Group	TAB		1 – 2	NA
Trip Contact - Minimum time closed.	Trip Min Time	TRIP MIN TIME		50 – 300 ms.	1 ms.

8.16.2.2 DIFFERENTIAL CURRENT UNITS GROUP 2

	ENERVISTA MII SETUP	HMI	USER VALUE	RANGE	STEP
GROUP 2 FIRST LEVEL DIFFERENTIAL FUNCTION	**87 1 FUNCTION GROUP2**	**F87 1 G2**			
First Level 87 Enable	87 1 G2 Enable	ENABLE 87 1 G2		Y/N	NA
Permission to Trip First Level 87	87 1 G2 Trip Enable	TRIP 87 1 G2		Y/N	NA
First Level 87 Tap / Pickup Value	87 1 G2 Pickup Level	TAP 87 1 G2		0.005-0.4 A	0.01 A
First Level 87 Definite Time Delay	87 1 G2 Time Delay	TIME 87 1 G2		0 – 600.00 s.	0.01 s.
GROUP 2 SECOND LEVEL DIFFERENTIAL FUNCTION	**87 2 FUNCTION GROUP2**	**F87 2 G2**			
Second Level 87 Enable	87 2 G2 Enable	ENABLE 87 2 G2		Y/N	NA
Permission to Trip Second Level 87	87 2 G2 Trip Enable	TRIP 87 2 G2		Y/N	NA
Second Level 87 Tap / Pickup Value	87 2 G2 Pickup Level	TAP 87 2 G2		0.005-0.4 A	0.01 A
Second Level 87 Definite Time Delay	87 2 G2 Time Delay	TIME 87 2 G2		0 – 600.00 s.	0.01 s.

8.16.2.3 EVENT MASKS

	ENERVISTA MII SETUP	USER VALUE	RANGE
Phase A 87 1 Pickup	Phase A 87 1 Pickup		Y/N
Phase B 87 1 Pickup	Phase B 87 1 Pickup		Y/N
Phase C 87 1 Pickup	Phase C 87 1 Pickup		Y/N
87 1 Pickup	87 1 Pickup		Y/N
Phase A 87 2 Pickup	Phase A 87 2 Pickup		Y/N
Phase B 87 2 Pickup	Phase B 87 2 Pickup		Y/N
Phase C 87 2 Pickup	Phase C 87 2 Pickup		Y/N
87 2 Pickup	87 2 Pickup		Y/N
General Pickup	General Pickup		Y/N
Phase A 87 1 Trip	Phase A 87 1 Trip		Y/N
Phase B 87 1 Trip	Phase B 87 1 Trip		Y/N
Phase C 87 1 Trip	Phase C 87 1 Trip		Y/N
87 1 Trip	87 1 Trip		Y/N
Phase A 87 2 Trip	Phase A 87 2 Trip		Y/N
Phase B 87 2 Trip	Phase B 87 2 Trip		Y/N
Phase C 87 2 Trip	Phase C 87 2 Trip		Y/N
87 2 Trip	87 2 Trip		Y/N
General trip	General trip		Y/N
87 1 Disable by input	87 1 Disable by input		Y/N
87 2 Disable by input	87 2 Disable by input		Y/N
General Trip enable/disable by digital input	Trip disabled (by DI)		Y/N
Protection status: in service/out of service	Protection status		Y/N
Digital output1 active/non active	Output 1		Y/N
Digital output 2 active/non active	Output 2		Y/N
Digital output 3 active/non active	Output 3		Y/N
Digital output 4 active/non active	Output 4		Y/N
Digital input 1 active/non active	Digital input 1		Y/N
Digital input 2 active/non active	Digital input 2		Y/N
Settings change disabled by digital input	Sett. change disable		Y/N
Trip operation by digital input	Trip operation by input		Y/N
Trip operation by command	Trip operation by command		Y/N
Auxiliary digital output latch reset	Reset latch aux		Y/N
Group 2 selection by digital input	Settings group change		Y/N
Oscillo trigger by digital input	Oscillo trigg by DI		Y/N
86 Status	86 Status		
Reset 86	Reset 86		
Oscillo trigger by command	Oscillo trigg by comm		Y/N
Settings change	Settings change		Y/N
EEPROM Failure	EEPROM Failure		Y/N
User settings/Factory settings	User settings		Y/N

8.16.2.4 OSCILLOGRAPHY MASKS

OSCILLOGRAPHY MASK	ENERVISTA MII SETUP	USER SETTING	RANGE
Oscillo by communications	Oscillo by comm.		Yes / No
Oscillo by digital input	Oscillo by digital input		Yes / No
Oscillo by trip	Oscillo by trip		Yes / No
Oscillo by pickup	Oscillo by pickup		Yes / No

The relay should be installed in a clean, dry and dust-free place, with no vibrations. It should also be well lit to facilitate inspection and testing.

Operational conditions as defined in section 3 must not be exceeded in any case.

The relay should be mounted on a vertical surface. Figure 3–4: shows the diagram for panel drilling and mounting.

Given that the design of the MIB unit is based on high performance digital technology it is not necessary to recalibrate the relay. However if the tests show that it is necessary to readjust the relay, it is recommended that the unit should be returned to the manufacturer to have this done.

Threaded plug labelled as GND (refer to 1.3) should be correctly grounded, so that the disturbance suppression circuits in the system work correctly. This connection should be as short as possible (preferably 25 cm or less) to guarantee maximum protection. In this way capacitors that are internally connected between the inputs and ground divert high frequency disturbances directly to ground without passing through the electronic circuits, with the result that the circuits are perfectly protected.

In addition this connection also guarantees the physical safety of the personnel who have to touch the relay, since the whole case is connected to ground.

ATTENTION: Every time a PC is connected to the relay, the PC must be grounded to the same ground as the relay.

Given the important role that the protection relays play in the operation of any installation, a periodical program of tests is highly recommended. The unit incorporates built-in diagnostic functions that permit immediate identification with only the aid of the keypad and display, the detection of some of the most likely circuit failures. Testing the unit is recommended at intervals of 2 years or more. Although the built-in diagnosis does not reduce the average time between failures, it does increase the availability of the protection because it allows a drastic reduction in the average interruption time involved in detecting and repairing the fail.

The set of tests that can be carried out to test that all the features of the MIB unit function properly is described in detail in the chapter entitled COMMISSIONING.

In case of detecting accumulated pollution, the unit can be cleaned with a clean cloth, either dry or slightly dampened with a cleaner containing alcohol.

Abrasive cleaners must be avoided, as these can damage the metallic surface or the electrical connection elements.

APPENDIX A

This appendix describes the fundamentals about the communication with MIB units using ModBus® protocol. References to memory addresses can vary depending on the model and firmware revision. Therefore, please make sure that the memory map is the appropriate one for the model and firmware version installed.

To make this easier for the user, the communications software supplied with MII family units, EnerVista MII Setup, includes a tool that allows to extract the memory map of any MII family module connected to the computer.

The ModBus® function used is number 3 (READ HOLDING REGISTERS). The information retrieved from the relay is in Intel format (little endian), that is to say, ordered from lower to higher weight (first the least significant byte, then the next least significant byte and so on until the most significant one, that will go last). The message request command is generated as follows:

Request:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03h)
Beginning address	1 word (High Byte – Low Byte)
Number of registers	1 word (High Byte – Low Byte)
CRC	1 word

Reply:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03h)
Nº of bytes	1 Byte
Value of the registers	n data bytes /2 words (from lowest byte to highest byte)
CRC	1 word

Example:

Reading 75 registers (150 bytes) beginning from address 04FEH(1278) (

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01H	03H	04FEH	004BH	653DH

Reply

ADDRESS	FUNCTION	BYTES	DATA0	...	DATA74	CRC
01H	03H	96H	500DH		0200H	84D5H

Commands are executed in two steps: **selection and confirmation**. First, send the command or operation selection command. When the relay response arrives, send the confirmation. It is necessary to send the relay password. The structure for both commands is the same; the only variation is the related code.

The ModBus® function used is 16 (10h), PRESET MULTIPLE SETPOINTS.There must be an address where to write the corresponding operation code. This address is 0 (0000H) for every operation. The data to be written must be in Intel format; this means that the order of the bytes must be inverted (from lower weight to higher weight). The only exceptions for this rule are texts, which are in reading order (Motorola format). In each case, the order is specified. The available commands list is as follows:

OPERATION	SELECTION (HEX)	CONFIRMATION (HEX)
LEDs RESET	09	0A
RESET 86	3D	3E
CLOSE 86	3F	40
ACTIVATE GROUP 1	0D	0E
ACTIVATE GROUP 2	0F	10
OSCILLOG. TRIGGER	17	18
SETTINGS CHANGE	01	02
OPEN/CLOSE OSCILLOGRAPHY	11	12
OPEN/CLOSE EVENTS	13	14
SET DATE & TIME	FE	N/A

SELECTION

Request:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (000H) (High byte – low byte)
Number of registers	1 word (0001H) (High byte – low byte)
Number of bytes	1 byte (02H)
Value of the registers	Register1=>Command code (Low byte – High byte)
CRC	1 word

Reply:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (000H) (High byte – low byte)
Nº of registers	1 word (0001H) (High byte – low byte)
CRC	1 word

CONFIRMATION:

Request:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (0000H) (High byte – low byte)
Number of registers	1 word (0003H) (High byte – low byte)
Number of bytes	1 byte (06H)
Value of the registers	Register1=>Command code (Low byte – High byte). Register2=>Relay password (Low byte – High byte). Register3=>Constant value 0000H[1] Register4=>Value (Low byte-High byte)[2]
CRC	1 word

1 The registers sent correspond to two data: the command code in 16-bit integer format (2 bytes) and the relay password in 32-bit integer format (4 bytes). The last one, when it is reordered from the least to the most weighted byte, produces registers 2 and 3. For example: if the relay password is 27 (decimal), changed to hexadecimal it results in 1B. In 32-bit it will be 00 00 00 1B. After reordering it, it becomes 1B 00 00 00, from where register 2 (1B 00) and 3 (00 00) are obtained.

2 Only for SET OPENINGS and Set I^2 in MIFII module. The format is Float32. In the rest of cases this 4th register is not used.

Reply:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (0000H) (High byte – low byte)
Number of registers	1 word (0003H) (High byte – low byte)
CRC	1 word

A.2.2.1 SELECTION

Request:

To activate Group 2, the selection command will be 0FH; therefore the operation to be performed is a writing of word 0F 00H at the address 00 00H.

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	#BYTES	DATA0	CRC
01H	10H	0000H	0001H	02H	0F00H	A3A0H

Reply:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01H	10H	0000H	0001H	01C9H

A.2.2.2 CONFIRMATION

The operation confirmation code for Group 2 activation is 16 (10h). In this case, it is necessary to send the relay password (in this example its value is 1)

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	#BYTES	DATA0	DATA1	DATA2	CRC
01H	10H	0000H	0003H	06H	10 00H	01 00H	00 00H	E5ECH

Reply:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01H	10H	0000H	0003H	8008H

To synchronize the date and time of a relay we use a command with the following characteristics:

1. The command is executed in broadcast mode (relay address = 00H)
2. Date and time are included in the message. The date and time format length is 6 bytes.
3. No answer is expected from the relay.

FIELD	LENGTH
Relay address	1 byte (00H – broadcast)
Function	1 byte (10H)
Beginning address	1 word (0000H) (High Byte – low byte)
Number of registers	1 word (0004H) (High Byte – low byte))
Number of bytes	1 byte (08H) (High Byte – low byte))
Value of the registers	Register 1=>Command code(FE 00) (Low byte – High byte). Register 2...4=>Date and time
CRC	1 word

Example:

The following date and time will be sent: 31st of May 1999, at 10.01:04.224, this is 107,690,464,224 milliseconds from the base date/time:

107,690,464,224 Decimal = 00 19 12 DA 13 E0 Hexadecimal.

Reordering to send the lowest weight byte first: E0 13 DA 12 19 00:

ADDRESS	FUNCTION	BEGINNING	#REGS	#BYTES	COMMAND	VALUE	CRC
00	10	00 00	00 04	08	FE 00	E0 13 DA 12 19 00	FA9C

There are three steps to write a setting:

1. Execute a selection command using the corresponding code (See command execution)
2. Change the setting
3. Execute a confirmation command using the corresponding code (See command execution)

The ModBus® function used for setting modifications is 16, PRESET MULTIPLE REGISTERS

A.4.1 FRAME STRUCTURE

A.4.1.1 SETTING CHANGE SELECTION

Request:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (High Byte – low byte)
Number of registers	1 word (High Byte – low byte)
Number of bytes	1 byte
Value of the registers	Low byte- high byte
CRC	1 word

Reply:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (0000H) (High Byte – low byte)
Number of registers	1 word (0001H) (High Byte – low byte)
CRC	1 word

A.4.2 SETTING CHANGE CONFIRMATION

Request:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (0000H) (High Byte – low byte)
Number of registers	1 word (0003H) (High Byte – low byte)
Number of bytes	1 byte (06H)
Value of the registers	Register1=>Command code (0200H) (Low byte-High byte) Register2=>Relay password (Low byte-High byte) Register3=> Constant value 0000H
CRC	1 word

Reply:

FIELD	LENGTH
Relay address	1 byte
Function	1 byte (10H)
Beginning address	1 word (0000H) (High Byte – low byte)
Number of registers	1 word (0003H) (High Byte – low byte)
CRC	1 word

A.4.3 EXAMPLE OF SETTING CHANGE

This example modifies the IDENTIFICATION setting of an MIB module that stores this information at position 0134H of its memory map. The module identification in an ASCII text of 16 characters.

SELECTION:

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	BYTES	DATA0	CRC
01H	10H	0000H	0001H	02H	0100H	A7C0H

Reply:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01H	10H	0000H	0001H	01C9H

SETTING CHANGE

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	#BYTES
01H	10H	0128H	0008H	10H

ADDRESS	FUNCTION	BEGINNING	#REGS	#BYTES
01	10	0134	0008	10

DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	CRC
5445	5356H	494E	4700	0000	0000	0000	0000	5361

Data0 => 5445 ("T""E")

Data1 => 5354 ("S""T")

Data2 => 494E ("I""N")

Data3 => 4700 ("G"-00) (00 = End of string

Data4 => 00xx (00 = End of the chain. The remaining characters are not considered

Data5 => xxxx

Data6 => xxxx

Data7 => xxxx

Reply:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01	10	0118	0008	4034

CONFIRMATION (

Request:

ADDRESS	FUNCTION	BEGINNING	#REGS	BYTES	#DATA0	DATA1	DATA2	CRC
01H	10H	0000H	0003H	06H	0200H	0100H	0000H	E69EH

Reply:

ADDRESS	FUNCTION	BEGINNING	#REGS	CRC
01H	10H	0000H	0003H	8008H

A

Events reading operation consists of four steps:

1.Read the number of events recorded since the last event deletion. This number is stored in the memory position labeled "All events". See following table to find out this address for each MIB module.

2.Send an Open Events command (in a similar way as for operation selection). The code to open events is 13H.

3.Read the events. The event buffer starting address and length are defined in the memory map of each module. See attached table for a reference.

4.Close Events window. This operation is similar to command confirmation. The code to close events is 14H. In the same operation it is possible to delete some of the events. The number of events to delete must be specified in the 4th register sent in the frame (if no event has to be deleted, send this 4th register with value zero, 0000H). Deleting events is a good way to confirm that an event is not read twice.

The size of each stored event will be different depending on the module type, and the memory addresses of registers and buffers may also vary with the firmware version as detailed in the following table. The addresses shown are only orientative as they can change with module and firmware version. Check the actual memory map of every module with EnerVista MII Setup program to ensure that the addresses used are the correct ones.

A.5.1 FRAME STRUCTURE

MODULE	MIB
Firmware version	1.00
"All Events"	046E
"All Events buffer"	04A4
Length of event buffer	768
Event size (bytes)	32
Max. number of events	24

For this example a MIB module version 1.00 will be used so the memory address and event sizes will correspond to this module.

A.5.1.1 'ALL EVENTS' READING

Request:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03H)
Initiation address	1 Word (High byte – Low byte)
No of registers	1 Word (0001H) (High byte – Low byte)
CRC	1 Word

Reply:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03H)
No of bytes	1 Byte (02H)
Register value	1 Word (low byte – high byte)
CRC	1 Word

A.5.1.2 EVENTS OPENING

Request:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (10H)
Initiation address	1 Word (0000H) (High byte – Low byte)
No of registers	1 Word (0001H) (High byte – Low byte)
No of bytes	1 Byte (02H)
Value of registers	Register1=> 1300H (Low byte – High byte)
CRC	1 Word

Reply:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (10H)
Initiation address	1 Word (0000H) (High byte – Low byte)
No of registers	1 Word (0001H) (High byte – Low byte)
CRC	1 Word

A.5.1.3 EVENTS READING

Request:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03H)
Initiation address	1 Word (High byte – Low byte)
No of registers	1 Word (High byte – Low byte)
CRC	1 Word

Reply:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (03H)
No of bytes	1 Byte
Value of registers	No of bytes/2 words (High byte – Low byte)
CRC	1 Word

A

A.5.1.4 EVENTS CLOSING

Request:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (10H)
Initiation address	1 Word (0000H) (High byte – Low byte)
No of registers	1 Word (0004H) (High byte – Low byte)
No of bytes	1 Byte (08H)
Value of registers	4 Words: Register1=> Command code (1400H) (Low byte – High byte) Registers 2 & 3=> Relay password (Byte 3 – byte 2 – byte 1 – byte 0) Register4=> VALUE (Low byte – High byte).
CRC	1 Word

Reply:

FIELD	LENGTH
Relay address	1 Byte
Function	1 Byte (10H)
Initiation address	1 Word (0000H) (High byte – Low byte)
No of registers	1 Word (0004H) (High byte – Low byte)
CRC	1 Word

The following information is supplied for each event:

NAME	BIT NUMBER	RECORD INDEX	NUMBER OF BYTES	FORMAT
Event code	0	0	2	F5
Date & Time	16	1	6	F1
Idiff phase A	64	4	4	F2
Idiff phase B	96	6	4	F2
Idiff phase C	128	8	4	F2
Trip operation by communications	160	10	2	F4
LEDs and latched outputs reset	161	10	2	F4
Reset 86	170	10	2	F4
Protection status (0=out of service, 1=In service)	185	11	2	F4
Output 1	186	11	2	F4
Output 2	187	11	2	F4
Output 3	188	11	2	F4
Output 4	189	11	2	F4
Input 1	190	11	2	F4
Input 2	191	11	2	F4
Settings change inhibition by DI	193	12	2	F4
Trip operation by DI	194	12	2	F4
Settings group change by DI	198	12	2	F4
Oscillo trigger by DI	199	12	2	F4

86 Status	201	12	2	F4
Oscillo trigger by communications	202	12	2	F4
Setting change	205	12	2	F4
EEPROM error	206	12	2	F4
User settings (0 factory default, 1 when the first change is made to any setting)	207	12	2	F4
Pickup 87 1_A	208	13	2	F4
Pickup 87 1_B	209	13	2	F4
Pickup 87 1_C	210	13	2	F4
Pickup 87 1	211	13	2	F4
Pickup 87 2_A	212	13	2	F4
Pickup 87 2_B	213	13	2	F4
Pickup 87 2_C	214	13	2	F4
Pickup 87 2	215	13	2	F4
General Pickup	223	13	2	F4
87 1 inhibition by DI	227	14	2	F4
87 2 inhibition by DI	231	14	2	F4
General inhibition by DI	239	14	2	F4
Trip 87 1_A	240	15	2	F4
Trip 87 1_B	241	15	2	F4
Trip 87 1_C	242	15	2	F4
Trip 87 1	243	15	2	F4
Trip 87 2_A	244	15	2	F4
Trip 87 2_B	245	15	2	F4
Trip 87 2_C	246	15	2	F4
Trip 87 2	247	15	2	F4
General Trip	256	15	2	F4

The following tables show the codes for the different events:

EVENT CODES FOR MIB RELAY	
8192	Trip operation by command
8194	Reset auxiliary latched outputs
8254	Trip disabled by digital input
8270	General Trip
8274	Protection status: Ready
8275	Protection status: Disable
8276	Output 1 = 1
8277	Output 1 = 0
8278	Output 2 = 1
8279	Output 2 = 0
8280	Output 3 = 1
8281	Output 3 = 0
8282	Output 4 = 1
8283	Output 4 = 0
8284	Input 1 = 1
8285	Input 1 = 0
8286	Input 2 = 1
8287	Input 2 = 0
8290	Settings change disabled by digital input
8291	Settings change enabled
8292	Trip operation by digital input
8300	Active group: group 2
8301	Active group: Settings group
8302	Oscillography trigger by digital input
8308	Oscillography trigger by communications
8314	Settings change
8316	EEPROM failure
8318	User settings
8319	Factory settings
8800	Reset 86 command
8801	86 closed
8802	86 open
8803	87 1 pickup
8804	87 1 dropout
8805	87 2 pickup
8806	87 2 dropout
8807	General pickup
8808	General dropout
8809	87 1 disabled by digital input
8810	87 2 disabled by digital input
8811	87 1 Trip
8812	87 2 Trip

Oscillography reading operation consists of four steps:

1.Send an Open Oscillography command (in a similar way as for operation selection). The code to open oscillography is 11H.

2.The module will prepare the information to be sent and when it is ready it will send the ModBus response. If there is no oscillography stored, the module will respond with a Not Acknowledge code (error #7).

3.When the oscillography opening command has been executed, the registers with the information will be available to read. There are three blocks of information:

3.1. Samples buffer: analog (currents and/or voltages) and digital channels.

3.2. Trigger report: RMS values of analog channels and active table in the moment of the oscillography trigger

3.3. Configuration: additional data for the COMTRADE format files, such as: date and time, sampling rate, number of samples, line frequency, oscillo number.

The oscillography buffer starting addresses and lengths are defined in the memory map of each module. See attached table for a reference.

4.Send a Close Oscillography command (in a similar way as for operation confirmation). The code to close oscillography is 12H. The information remains in memory and it is not necessary to delete it because only one oscillography can be stored at a time and the memory will be overwritten when a new one is generated.

Same as with events, the size of each oscillography register will be different depending on the module type, and the memory addresses of oscillography buffers may also vary with the firmware version as detailed in the following table. The addresses shown are only orientative as they can change with module and firmware version. Check the actual memory map of every module with EnerVista MII Setup program to ensure that the addresses used are the correct ones.

MODULE	MIB
Firmware version	1.00
Samples buffer start	07D4
Sample record size (bytes)	18
Length of samples buffer	3456
Trigger Report start	1554
Trigger Report length	18
Configuration start	1566
Configuration length	16

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For the first block, that contains the analog and digital channels samples, the structure is as follows:

MIB					
DESCRIPTION	**BIT #**	**RECORD INDEX**	**BIT INDEX**	**# BYTES**	**FORMAT**
Id A	0	0	0	2	F2
Id B	16	1	0	2	F2
Id C	32	2	0	2	F2
87 1 A pickup	64	4	0	2	F4
87 1 B pickup	65	4	1	2	F4
87 1 C pickup	66	4	2	2	F4
87 1 pickup	67	4	3	2	F4
87 2 A pickup	68	4	4	2	F4
87 2 B pickup	69	4	5	2	F4
87 2 C pickup	70	4	6	2	F4
87 2 pickup	71	4	7	2	F4
General pickup	79	4	15	2	F4
87 1 Disable by input	83	5	3	2	F4
87 2 Disable by input	87	5	7	2	F4
Trip disable by input	95	5	15	2	F4
87 1 A trip	96	6	0	2	F4
87 1 B trip	97	6	1	2	F4
87 1 C trip	98	6	2	2	F4
87 1 trip	99	6	3	2	F4
87 2 A trip	100	6	4	2	F4
87 2 B trip	101	6	5	2	F4
87 2 C trip	102	6	6	2	F4
87 2 trip	103	6	7	2	F4
General trip	111	6	15	2	F4
Trip contact physical status (1=closed, 0=open)	120	7	8	2	F4
Alarm contact physical status (1=active=open, 0=not active=closed)	121	7	9	2	F4
Output 1	122	7	10	2	F4
Output 2	123	7	11	2	F4
Output 3	124	7	12	2	F4
Output 4	125	7	13	2	F4
Input 1	126	7	14	2	F4
Input 2	127	7	15	2	F4
86 Status	134	8	6	2	F4
Group change	137	8	9	2	F4
EEPROM failure	142	8	14	2	F4
User settings	143	8	15	2	F4

The second block of information contains the oscillo report; this includes the RMS values of analog signals when the oscillography was triggered. If the trigger is produced by a relay trip, these values will be the fault values.

This block will be written as follows:

VALUES AT THE MOMENT OF THE OSCILLOGRAPHY TRIGGER				
MIB RELAY				
MEMORY POSITION	BIT	DESCRIPTION	LENGTH (BYTES)	FORMAT
		Idiff_a when the oscillography was triggered	4	F2
		Idiff_b when the oscillography was triggered	4	F2
		Idiff_c when the oscillography was triggered	4	F2

The third and last block, that contains the rest of information for creating COMTRADE format files, has the following structure:

OSCILLOGRAPHY GENERAL DATA				
MEMORY POSITON	BIT	DESCRIPTION	LENGTH	FORMAT
16F6		Date and time	6	F1
16FC		Number of samples per second	2	F5
16FE		Number of samples	2	F5
1700		Line frequency	2	F5
1702		Oscillo index	2	F5

Once the oscillography information has been read and saved, we will close this screen in the relay. For this purpose, we send the oscillography file closing command. The information will continue to be stored in the relay, as the closing of this window does not involve a deletion of the information. However, only one oscillography window will be stored, and when a new one is created, the previous one will be deleted.

ADDRESS	FUNCTION	START	#REGS	#BYTES	COMMAND	PASSWORD	CRC
01	10	00 00	00 03	06	12 00	01 00 00 00	E4 0E

Reply from the relay:

ADDRESS	FUNCTION	START	#REGS	CRC
01	10	00 00	00 03	80 08

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When any of the previous commands produce an error in the slave the following frame is received:

ADDRESS	FUNCTION + 80 H	COD. ERROR	CRC
01H	90H	07H	0DC2H

We can receive the following values in the error code field:

01	ILLEGAL FUNCTION
02	ILLEGAL DATA ADDRESS
03	ILLEGAL DATA VALUE
04	SLAVE DEVICE FAILURE
05	ACK.
06	SLAVE BUSY
07	NEGATIVE ACKNOWLEDGE
08	MEMORY PARITY ERROR

FORMAT	DESCRIPTION	VALUE	VALUETEXT
F1	DATE/TIME		Milliseconds from 1/1/1996 at 00:00:00.000.
F2	FLOAT 32 (INTEL) IEEE (32 bits)		Please refer to the example after this table.
F3/ARRAY	TEXT		
F4/BIT	BIT		
	BIT Frequency	0	50 Hz
		1	60 Hz
	BIT Enable	0	Not permitted
		1	Permitted
	BIT States	0	Inactive
		1	Active
	BIT Active group	0	Group 1
		1	Group 2
	BIT Relay Status	0	Out of service
		1	In service
F5	INTEGER UNSIGNED 16 BIT		
F6/ NUMBERED	INTEGER UNSIGNED 16 BIT –NUMBERED – BAUDS	1	300
		2	600
		4	1200
		8	2400
		13	4800
		32	9600
		64	19200
F12	INTEGER SIGNED 16 BIT		

Format F2, FLOAT 32 (INTEL) IEEE:

ANSI/IEEE Std 754-1985 IEEE Standard for Binary Floating-Point Arithmetic as Single format.

The equation defined by the standard is as follows:

$$\textbf{Decimal value} = (-1)^{s} * 2^{e-127} * 1.m$$

In order to obtain s, e and m, we will explain an example:

If the data read in memory is: 33 F3 C7 42.

1º - Place the data with MSB first, and LSB at the end: 42 C7 F3 33

2º - Turn the number to binary:

0100 0010 1100 0111 1111 0011 0011 0011

3º - The first bit is *s*. In this case s=0

4º - The next 8 bits are *e*. In this case e=133

5º - The remaining bits are *m*. In this case m=100 0111 1111 0011 0011 0011 (In decimal, 0.565 approx)

(The weights of bits for calculating m are 0.5; 0.25; 0.125; 0.0625; 0.03125; 0.015625; 0.0078125....)

Therefore **Decimal value = (-1)0 * 2133-127 * 1.565 = 100.16 Amps**

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If we wish to connect the relay to a remote PC, it will be necessary to previously link two modems to the telephone line. The modem on the relay side will receive the call, and the modem on the PC side will make the call.

This way, both modems will be configured in different ways: the modem on the PC side will receive the commands from the PC for starting or ending communication, and therefore it will make the call. The modem connected to the relay will not receive any command from it; it will only accept communication whenever it is requested. Therefore, this last modem will be configured in “dumb” mode, which means that it does not receive commands, and is in auto-reply mode.

The EnerVista MII SETUP is a DCE device (Tx=3, Rx=2 signals), so as regards TX and RX it works as a modem (which is also a DCE device). Therefore, it is not necessary to cross the TX and RX signals in direct connection to the PC, which is a DTE device (TX=2, RX=3 signals). However, in case of a connection via modem, it will be necessary to cross the wire in the relay by means of a null modem, so that RX and TX signals are inverted, as we will be connecting two DCE devices.

In addition, we must check whether the relay is directly connected to the modem via its RS232 port, or via an RS232/RS485 converter. In this last case, we will have to verify whether the converter output is DTE or DCE, and use a null modem in the second case. For example, the DAC300 converter incorporates two ports, a DCE and a DTE. In the case of a F485 converter, an internal selector detects whether it is connected directly to a modem or relay (DCE) or to a PC (DTE).

As regards the modem-modem, PC-modem, and Relay-modem communication baud rates, in the first cases, it is recommended to set them at the same baud rate as the relay. The baud rate between relay and modem will always be the one set for the relay.

In case of communication problems between both modems, it is recommended to reduce the line baud rate.

In order to establish communication between two HAYES modems, both of them must accept HAYES commands. This is compulsory, as the PC will send specific commands for this type of modem. We must place the AT command before every command. It is possible to group several commands inside an only command line (e.g. ATB1 and ATE1 equals ATB1E1).

However, we must take into account that each manufacturer will implement only one sub-group of the HAYES commands, and therefore we cannot indicate an initiation command valid for every equipment. It is the customer's responsibility to determine which commands are accepted by a particular modem.

As a general rule, it is recommended to disable any data compression, hardware protocols, flux control or error control. Some modems allow a command, e.g. &Q0, which selects the direct asynchronous mode.

The local modem configuration, that is, the configuration of the modem that makes the call, will be performed by EnerVista MII SETUP software, by means of the provided initiation command. In order to configure the remote modem (connected to the relay), we need a communications program that allows sending HAYES commands. Any Windows® version includes a program called HYPERTERMINAL (HYPERTRM.EXE) which allows to send HAYES commands by the selected serial port. Besides, we can use any communications program allowing sending commands, such as Procomm Plus or LAPLink. Once the modem is connected to the selected port in the program, and after setting the communication parameters, we can send the required commands.

Later in this document we will detail the configuration that must be entered in some HAYES modems already tested.

EnerVista MII SETUP software allows the modem making the call to accept V.25bis commands. In this case, the modem on the relay side could be either HAYES or V.25bis, as it will not need to process any relay command.

The configuration of this kind of modem is performed by means of microswitches that set its operation. This way, the software window for entering the modem initiation commands will only be operative if a HAYES modem has been selected.

In the following sections, we will detail some communications parameters, already tested for the following modems.

B.3.1 SPORTSTER FLASH X2 MODEM (HAYES)

Initiation commands for the modem on the PC side:

We will add the following commands to the default configuration:

&AnEnable/disable the ARQ result codes	Disable the ARQ result codes	&A0
&HnSets the flux control for the data transfer (TD).	Flux control disabled	&H0
&InSets the software flux control for the data reception (RD).	Software flux control disabled.	&I0
&KnEnable/Disable data compression	Data compression disabled	&K0
&MnSets the error control (ARQ) for 1200 bps and higher.	Normal mode, error control disabled	&M0
&RnConfigures the hardware flux control for data reception (DR) and transfer request (RTS)	Modem ignores RTS.	&R1
S15Record with bit representation.	Disable ARQ/MNP for V.32/V.32bis.	S15=4
S32Record with bit representation.	Disable V.34. modulation	S32=8

Initiation commands for the modem on the RELAY side:

The following options must be added to the default configuration:

&AnEnable/disable the ARQ result codes	ARQ result codes are disabled	&A0
&DnControl the DTR operations	About DTR control.	&D0
&HnSets the flux control for the data transfer (TD).	Flux control disabled	&H0
&InSets the software flux control for the data reception (RD).	Software flux control disabled.	&I0
&KnEnable/Disable data compression	Data compression disabled	&K0
&MnSets the error control (ARQ) for 1200 bps and higher.	Normal mode, error control disabled	&M0
&RnConfigures the hardware flux control for data reception (DR) and transfer request (RTS)	Modem ignores RTS.	&R1
S0Sets the number of rings necessary for answering in automatic answering mode	The modem will answer to the first ring.	S0=1
S15Record with bit representation.	Disable ARQ/MNP for V.32/V.32bis.	S15=4
S32Record with bit representation.	Disable V.34. modulation	S32=8

Initiation commands for the PC modem:

Commands:

B0 E0 L1 M1 N1 Q0 T V0 W0 X1 Y0

&C1&D2&G0&J0&K3&Q5&R1&S0&T5&X0&Y0

S Registers:

S00:001	S01:000	S02:043	S03:013	S04:010	S05:008	S06:002	S07:050	S08:002	S09:006
S10:014	S11:095	S12:050	S18:000	S25:005	S26:001	S36:007	S37:000	S38:020	S44:020
S46:138	S48:007	S95:000							

Initiation commands for the RELAY modem:

Commands:

B1 E0 L1 M1 N1 Q0 T V0 W0 X4 Y0

&C1 &D3 &G0 &J0 &K0 &Q5 &R1 &S1 &T4 &X0 &Y0

S Registers:

S00:001	S01:000	S02:043	S03:013	S04:010	S05:008	S06:002	S07:050	S08:002	S09:006
S10:014	S11:095	S12:050	S18:000	S25:005	S26:001	S36:007	S37:000	S38:020	S44:020
S46:138	S48:007	S95:000							

In this case, the modem initial configuration is set by changing the microswitches located in three sets on the bottom of the units.

Location of modem microswitches on the PC side:

Set 1

Nº	DESCRIPTION	VALUE
1	112 ETD/OFF ON: Circuit 112 connected to ETD OFF: Circuit 112 connected to ETD	ON
2	112 ETD/ON ON: 108 circuit forced to CLOSED. OFF: 108 circuit follows ETD's 108 circuit	OFF
3	105 ETD/ON ON: Circuit 105 forced to CLOSED. OFF: Circuit 105 follows ETD's 105circuit	ON
4	TXA/TXB in a peer-to-peer line (PP) ON: In PP transfers through high channel. OFF: In PP transfers through low channel.	OFF
5&6	Baud rate selection for data transfer ON-ON1200 OFF-ON2400 ON-OFFAutomatic. OFF-OFFAutomatic.	ON-OFF
7&8	Automatic disconnection. ON-ONNo automatic disconnection. OFF-ONCircuit 105. ON-OFFCircuit 109. OFF-OFFCircuits 105 and 109.	ON-OFF

Set 2

Nº	DESCRIPTION	VALUE
1	Synchronous format of protocol V25bis in option 108.2. ON: Character oriented format (BSC). OFF: Bit oriented format (HDLC).	ON
2&3	Asynchronous character format for data transfer ON-ON8 OFF-ON9 ON-OFF10 OFF-OFF11	ON-OFF
4	Reception permission for remote loop 2 ON: Not permitted. OFF: Permitted.	OFF
5&6	Exploitation mode. ON-ONPoint-to-point line OFF-ONAutomatic call as per 108.1. ON-OFFRTC line without automatic call. OFF-OFFAutomatic call as per 108.2.	OFF-OFF
7	Number of calls for automatic answer ON: 1 call. OFF: 2 calls.	ON
8	112 ETD/OFF ON: Asynchronous operation. OFF: Synchronous operation.	ON

Set 3

Nº	DESCRIPTION	VALUE
1&2	Transmission timer selection. ON-ON114 OFF-ON113 ON-OFF114/5 OFF-OFF113	ON-ON
3	RTC Dialing system ON: Multi-frequency dialing. OFF: Loop opening pulse dialing	ON
4	Status of circuit 109, during protocol V.25bis in RTC, option 108.2. ON: Status of circuit 108 remains. OFF: Remains open.	OFF
5	Selection, when starting, of manual or automatic answering mode. ON: Automatic. OFF: Manual.	OFF
6	Protocol selection. ON: HAYES Protocol. OFF: V.25bis Protocol.	OFF
7&8	Modem transmission level. ON-ON-6 dBm OFF-ON-10 dBm ON-OFF-6 dBm OFF-OFF-15 dBm	ON-ON

Location of modem microswitches on the RELAY side:

Set 1

Nº	DESCRIPTION	VALUE
1	112 ETD/OFF ON: Circuit 112 connected to ETD OFF: Circuit 112 connected to ETD	ON
2	112 ETD/ON ON: 108 circuit forced to CLOSED. OFF: 108 circuit follows ETD's 108 circuit	ON
3	105 ETD/ON ON: Circuit 105 forced to CLOSED. OFF: Circuit 105 follows ETD's 105circuit	ON
4	TXA/TXB in a peer-to-peer line (PP) ON: In PP transfers through high channel. OFF: In PP transfers through low channel.	ON
5&6	Baud rate selection for data transfer. ON-ON1200 OFF-ON2400 ON-OFFAutomatic. OFF-OFFAutomatic.	ON-OFF
7&8	Automatic disconnection. ON-ONNo automatic disconnection. OFF-ONCircuit 105. ON-OFFCircuit 109. OFF-OFFCircuits 105 and 109.	OFF-OFF

Set 2

Nº	DESCRIPTION	VALUE
1	Synchronous format of protocol V25bis in option 108.2. ON: Character oriented format (BSC). OFF: Bit oriented format (HDLC).	ON
2&3	Asynchronous character format for data transfer ON-ON8 OFF-ON9 ON-OFF10 OFF-OFF11	ON-OFF
4	Reception permission for remote loop 2 ON: Not permitted. OFF: Permitted.	OFF
5&6	Exploitation mode. ON-ONPoint-to-point line OFF-ONAutomatic call as per 108.1. ON-OFFRTC line without automatic call. OFF-OFFAutomatic call as per 108.2.	ON-OFF
7	Number of calls for automatic answer ON: 1 call. OFF: 2 calls.	OFF
8	112 ETD/OFF ON: Asynchronous operation. OFF: Synchronous operation.	ON

Set 3

Nº	DESCRIPTION	VALUE
1&2	Transmission timer selection. ON-ON114 OFF-ON113 ON-OFF114/5 OFF-OFF113	ON-ON
3	RTC Dialling system ON: Multi-frequency dialling. OFF: Loop opening pulse dialling	OFF
4	Status of circuit 109, during protocol V.25bis in RTC, option 108.2. ON: Status of circuit 108 remains. OFF: Remains open.	OFF
5	Selection, when starting, of manual or automatic answering mode. ON: Automatic. OFF: Manual.	ON
6	Protocol selection. ON: HAYES Protocol. OFF: V.25bis Protocol.	OFF
7&8	Modem transmission level. ON-ON-6 dBm OFF-ON-10 dBm ON-OFF-6 dBm OFF-OFF-15 dBm	ON-ON

The present document intends to give an overview on how the relay deals with analog signals, in order to help determine whether the relay is appropriate for certain applications.

MIB relays, as the rest of our digital relays, are based on the following functional diagram:

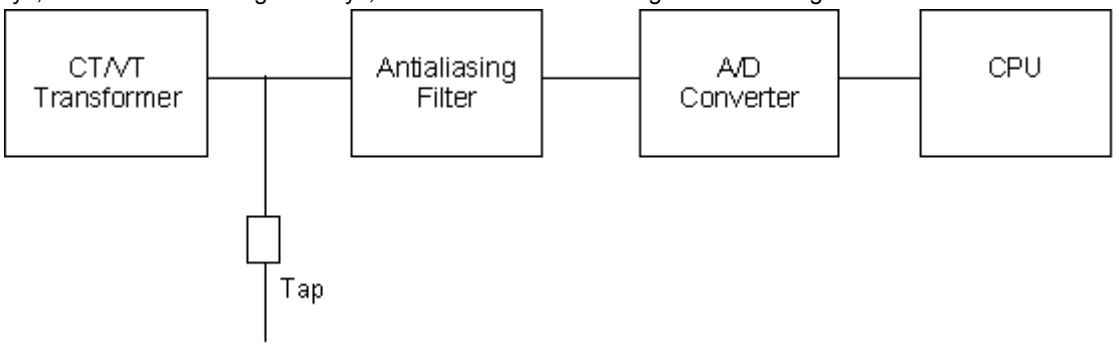

Figure C–1: FUNCTIONAL DIAGRAM

Each of these blocks has its own functionality inside the general operation of the unit, as follows:

- **Transformer (CT/VT):** It adapts the analog current and/or voltage signals to low level signals that can be used by electronic devices. Additionally, they provide isolation between the environment and the relay.
- **Tap**: It turns current signals into voltage signals, which are better managed. Do not confuse with the tap setting in the relay.
- **Antialiasing Filter**: It prevents high frequency signals (which cannot be recognized digitally) from entering the analog-digital converter. The maximum breaking frequency for this filter is determined by the Nyquist criterion, which states that the maximum frequency that can be recognized when sampling a signal is less than half the sampling frequency.

  In MIB, the sampling is 16 times per cycle, that is, 800 Hz for a frequency set to 50 Hz, and 960 Hz for a frequency set to 60 Hz.

  On the other hand, in order to obtain a reliable oscillography record, it is important to have a high breaking frequency in this filter.

  This filter does not intend to filter the harmonics, this is better done digitally.

  In MIB, the antialiasing filter has a breaking frequency of approx. 260 Hz.
- **Analog-Digital Converter**: It turns the analog signals into digital, so that they can be managed by a micro controller.
- **CPU**: It is the digital signal-processing unit; it takes tripping decisions, etc.

  The CPU performs the DFT for current and voltage signals in order to obtain the vectors representing each signal, which are used for all further calculations in the relay protection functions.

The first operation performed by the CPU with the voltage and/or current signal samples is the DFT.

The Discrete Fourier Transformation consists in decomposing a signal into a series of sinusoidal signals with frequencies that are multiples of the fundamental frequency. If after this operation, we take the fundamental frequency signal, and we disregard the rest of signals (harmonics), we will get a harmonic filter. This action is performed by the MIB relay.

MIB uses a complete cycle recursive DFT, that is, for each sample it calculates the phasor from the previous sample phasor and the difference between the current sample and the previous cycle sample. This makes the relay require a complete cycle to obtain the correct measure value.

In the following figure, we can see how the measure is established from a signal value that changes from 0 to 1.

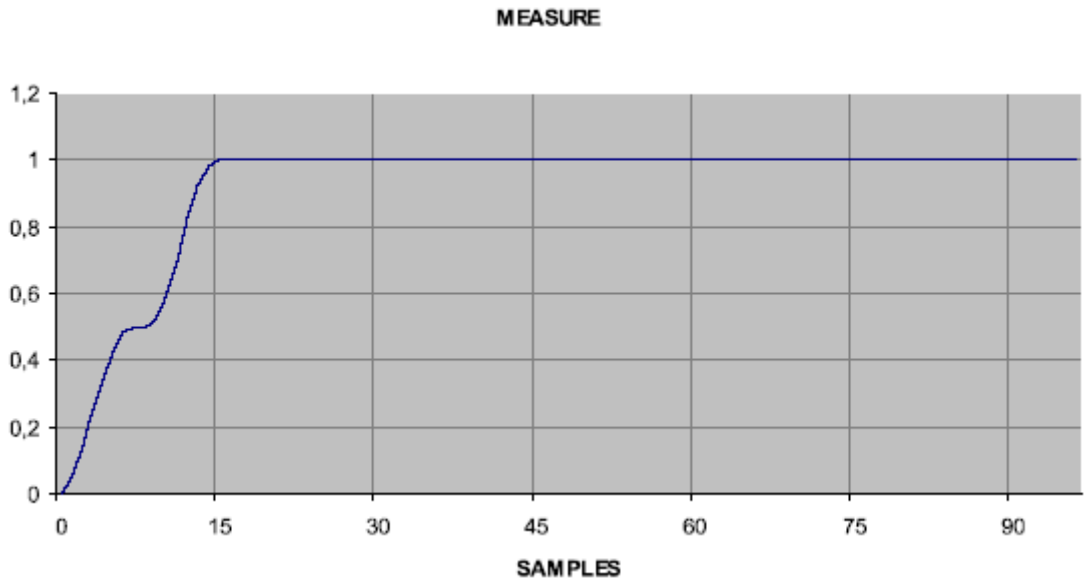

Figure C–2: ESTABLISHMENT OF THE MEASURE

Figure C–3: shows the answer from the digital filter with the frequency. The figure shows how all the high level harmonics are eliminated. This makes MIB suitable for applications where it is necessary to filter any type of harmonic, for example, the 2nd and 3rd, which are the most commonly found in electrical lines.

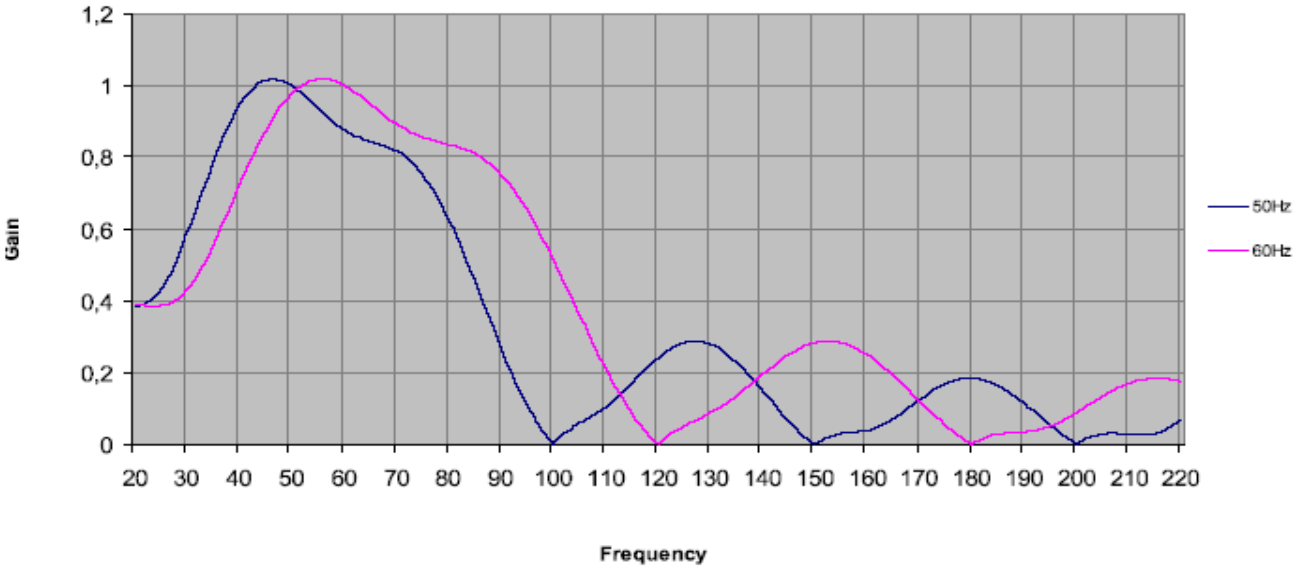

Figure C–3: FILTER RESPONSE

Figure C–4: the measurements can experience small variations for frequencies that are not the fundamental and its harmonics, as the measure varies for these frequencies. As an example, we can see in the next figure how a relay measure varies when it is set to 50 Hz, and it is being applied 60 Hz.

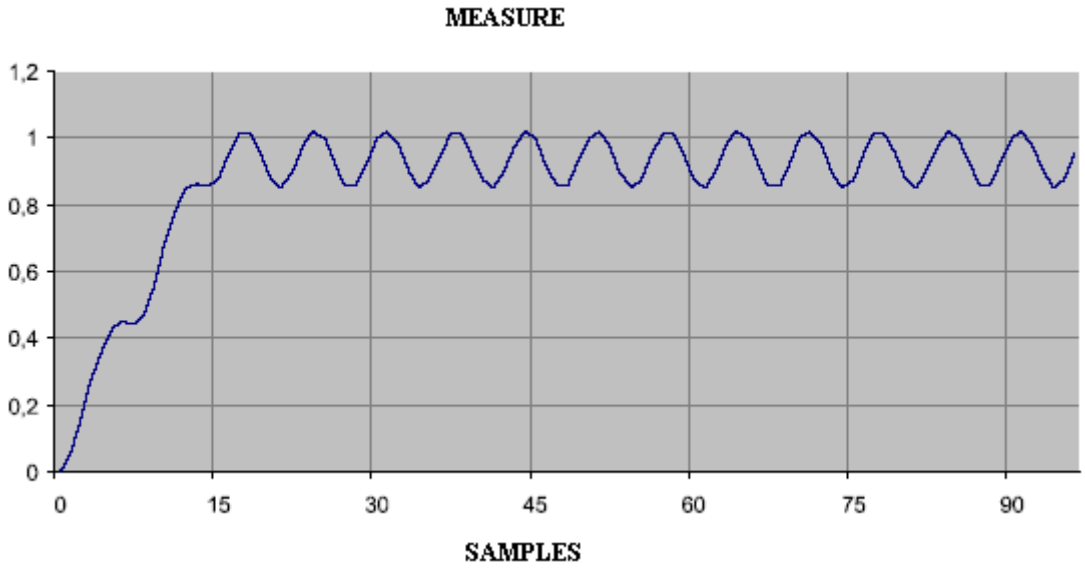

Figure C–4: MEASURE VARIATION

This case will never occur for the fundamental frequency and its harmonics, where the filter gain is always 1 and 0 respectively.

As already mentioned, the digital filter is related to the fundamental frequency, so higher multiple frequency values are annulled.

During the start-up of generators, the voltage frequency in terminals and currents that can appear in the event of a fault, will depend on the machine speed. During the start-up process, the machine will rotate at very low speed, and therefore, the obtained DFT measure will be affected, as it works on values that are related to the fundamental frequency.

In order to guarantee the correct operation of the protection units during this transitory process of acceleration, the MIB relay incorporates a metering capability for maximum values (not RMS) that is applied to the protection units not using I_1, I_2 and I_0 values only during this acceleration process. Once an admissible speed is reached (closed to the nominal speed), the system will automatically switch the metering technique to the DFT. These protection units are the overcurrent units, locked rotor and number of starts.

All protection units measure phase-by-phase and sample-by-sample using both metering techniques separately. When the obtained values are very close to each other and steady, then the system switches to DFT.