GE Power Management


# Digital Voltage & Frequency Protection

# MIV

## Instructions

GEK-106247B

ISO 9000 Registered ISO 9000

# *Anything you can't find?*

# *Anything not clear enough?*

IF YOU HAVE ANY COMMENT ON THE CONTENTS OF THE PRESENT MANUAL, KINDLY FAX US A COPY OF THIS PAGE TOGETHER WITH A COPY OF THE PAGE WHERE YOU HAVE FOUND THE PROBLEM, TO THE FAX NUMBER +34 94 485 88 45 FILLING IN THE QUESTIONAIRE BELOW. WE WILL BE HAPPY TO SOLVE YOUR DOUBTS, AND WE THANK YOU FOR HELPING US IMPROVE THIS MANUAL.

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***Description of your question or suggestion:***

Manual GEK code: _____

_____

_____

_____

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## Local HMI menu map MIV1000 models:

DEFAULT SCROLLING MENU: Va, Vb, Vc, Vn, Vab, Vbc, Vca — MENU

ENTER

| INFORMATION | MAIN SETTINGS | | ADV. SETTINGS | | OPERATIONS | DATE/TIME |
|---|---|---|---|---|---|---|
| Va | GENERAL | STATUS | GENERAL | TAB | RESET | |
| Vb | | FRQ | | TRIP MIN TIME | ACT TABLE 1 | |
| Vc | | APP | | | ACT TABLE 2 | |
| Vn | | PWD | | | OPEN BREAKER | |
| Vab | | ADD | | | CLOSE BREAKER | |
| Vbc | | BAUD | | | | |
| Vca | F27P1 | TRIP 27P1 | F27P1 T2 | TRIP 27P1 T2 | | |
| DATE / TIME | | TAP 27P1 | | TAP 27P1 T2 | | |
| LTU | | TIME 27P1 | | TIME 27P1 T2 | | |
| LT PHASE | | SUP 27P1 | | SUP 27P1 T2 | | |
| LTU V | F27P2 | TRIP 27P2 | F27P2 T2 | TRIP 27P2 T2 | | |
| LT DATE/TIME | | TAP 27P2 | | TAP 27P2 T2 | | |
| RESET | | TIME 27P2 | | TIME 27P2 T2 | | |
| | | SUP 27P2 | | SUP 27P2 T2 | | |
| | F 59P1 | TRIP 59P1 | F59P1 T2 | TRIP 59P1 T2 | | |
| | | TAP 59P1 | | TAP 59P1 T2 | | |
| | | TIME 59P1 | | TIME 59P1 T2 | | |
| | F 59P2 | TRIP 59P2 | F59P2 T2 | TRIP 59P2 T2 | | |
| | | TAP 59P2 | | TAP 59P2 T2 | | |
| | | TIME 59P2 | | TIME 59P2 T2 | | |
| | F 59N1 | TRIP 59N1 | F59N1 T2 | TRIP 59N1 T2 | | |
| | | TAP 59N1 | | TAP 59N1 T2 | | |
| | | TIME 59N1 | | TIME 59N1 T2 | | |
| | F 59N2 | TRIP 59N2 | F59N2 T2 | TRIP 59N2 T2 | | |
| | | TAP 59N2 | | TAP 59N2 T2 | | |
| | | TIME 59N2 | | TIME 59N2 T2 | | |

| INFORMATION | |
|---|---|
| MOD | |
| VER | |
| D T | |
| IDEN | |
| Va | |
| Vb | |
| Vc | |
| Vn | |
| Vab | |
| Vbc | |
| Vca | |
| INP1 | |
| INP2 | |
| OUT1 | |
| OUT2 | |
| OUT3 | |
| OUT4 | |
| B52A | |
| B52B | |

**NOTE:**
The map lines are crossed as follows:

Enter
Escape

\+
\-

The RESET operation can be performed by pressing the ENTER key during 3 seconds.

## Local HMI menu map MIV2000 models:

DEFAULT SCROLLING MENU: F — MENU

ENTER

| INFORMATION | MAIN SETTINGS | | ADV. SETTINGS | | OPERATIONS | DATE/TIME |
|---|---|---|---|---|---|---|
| F | GENERAL | STATUS | GENERAL | TAB | RESET | |
| DATE / TIME | | FRQ | | TRIP MIN TIME | ACT TABLE 1 | |
| LTU | | APP | | | ACT TABLE 2 | |
| LT PHASE | | PWD | | | OPEN BREAKER | |
| LTU F | | ADD | | | CLOSE BREAKER | |
| LT DATE/TIME | | BAUD | | | | |
| RESET | F81_1 | TRIP 81_1 | F81_1 T2 | TRIP 81_1 T2 | | |
| | | TYPE 81_1 | | TYPE 81_1 T2 | | |
| | | PICK 81_1 | | PICK 81_1 T2 | | |
| | | TIME 81_1 | | TIME 81_1 T2 | | |
| | | SUP 81_1 | | SUP 81_1 T2 | | |
| | F81_2 | TRIP 81_2 | F81_2 T2 | TRIP 81_2 T2 | | |
| | | TYPE 81_2 | | TYPE 81_2 T2 | | |
| | | PICK 81_2 | | PICK 81_2 T2 | | |
| | | TIME 81_2 | | TIME 81_2 T2 | | |
| | | SUP 81_2 | | SUP 81_2 T2 | | |
| | F 81_3 | TRIP 81_3 | F81_3 T2 | TRIP 81_3 T2 | | |
| | | TYPE 81_3 | | TYPE 81_3 T2 | | |
| | | PICK 81_3 | | PICK 81_3 T2 | | |
| | | TIME 81_3 | | TIME 81_3 T2 | | |
| | | SUP 81_3 | | SUP 81_3 T2 | | |
| | F 81_4 | TRIP 81_4 | F 81_4 T2 | TRIP 81_4 T2 | | |
| | | TYPE 81_4 | | TYPE 81_4 T2 | | |
| | | PICK 81_4 | | PICK 81_4 T2 | | |
| | | TIME 81_4 | | TIME 81_4 T2 | | |
| | | SUP 81_4 | | SUP 81_4 T2 | | |

| INFORMATION |
|---|
| MOD |
| VER |
| D T |
| IDEN |
| F |
| INP1 |
| INP2 |
| OUT1 |
| OUT2 |
| OUT3 |
| OUT4 |
| B52A |
| B52B |

## Input configuration signals:

NO DEFINITION
BREAKER 52 A
BREAKER 52 B
TRIP CONTACT CLOSE (P)
TABLE CHANGE
SETT CHANGE DISABLE
RESET (P)
OSCILLO. TRIGGER (P)
GENERAL INPUT
**MIV1000**
VOLTAGE DISABLED (by DI)
27P1 DISABLED (by DI)
27P2 DISABLED (by DI)
59P1 DISABLED (by DI)
59P2 DISABLED (by DI)
59N1 DISABLED (by DI)
59N2 DISABLED (by DI)
TRIP DISABLED (by DI)
PHASE VOLT FUNCT
DISABLED (by DI)
GROUND VOLT FUNCT
DISABLED (by DI)
**MIV2000**
FREQUENCY DISABLED
81_1 DISABLED (by DI)
81_2 DISABLED (by DI)
81_3 DISABLED (by DI)
81_4 DISABLED (by DI)
TRIP DISABLED (by DI)
**MIV3000**
VOLTAGE DISABLED (by DI)
27P1 DISABLED (by DI)
27P2 DISABLED (by DI)
59P1 DISABLED (by DI)
59P2 DISABLED (by DI)
59N1 DISABLED (by DI)
59N2 DISABLED (by DI)
47 DISABLED (by DI)
FREQUENCY DISABLED
81_1 DISABLED (by DI)
81_2 DISABLED (by DI)
TRIP DISABLED (by DI)
PHASE VOLT FUNCT
DISABLED (by DI)
GROUND VOLT FUNCT
DISABLED (by DI)

***NOTE:*** *(P) stands for Pulse activation*

## Output configuration signals:

NO DEFINITION
LOGIC 1
LOGIC 2
LOGIC 3
LOGIC 4
INPUT 1
INPUT 2
E2PROM FAILURE
USER SETTINGS
READY
CLOSE BREAKER
ACTIVE TABLE
LOCAL
**MIV1000**
PHASE A TRIP
PHASE B TRIP
PHASE C TRIP
PHASE TRIP
GROUND TRIP
59P TRIP
50N TRIP
27 TRIP
27_1a TRIP
27_1b TRIP
27_1c TRIP
27_2a TRIP
27_2b TRIP
27_2c TRIP
59_1a TRIP
59_1b TRIP
59_1c TRIP
59_2a TRIP
59_2b TRIP
59_2c TRIP
27P1 TRIP
27P2 TRIP
59P1 TRIP
59P2 TRIP
59N1 TRIP
59N2 TRIP
GENERAL TRIP
27_1a PICKUP
27_1b PICKUP
27_1c PICKUP
27_2a PICKUP
27_2b PICKUP
27_2c PICKUP
59_1a PICKUP
59_1b PICKUP
59_1c PICKUP
59_2a PICKUP
59_2b PICKUP
59_2c PICKUP
27P1 PICKUP
27P2 PICKUP
59P1 PICKUP
59P2 PICKUP
59N1 PICKUP
59N2 PICKUP
GENERAL PICKUP
27_1a VIRTUAL TRIP
27_1b VIRTUAL TRIP
27_1c VIRTUAL TRIP
27_2a VIRTUAL TRIP
27_2b VIRTUAL TRIP
27_2c VIRTUAL TRIP
59_1a VIRTUAL TRIP
59_1b VIRTUAL TRIP
59_1c VIRTUAL TRIP
59_2a VIRTUAL TRIP
59_2b VIRTUAL TRIP
59_2c VIRTUAL TRIP
27P1 VIRTUAL TRIP
27P2 VIRTUAL TRIP
59P1 VIRTUAL TRIP
59P2 VIRTUAL TRIP
59N1 VIRTUAL TRIP
59N2 VIRTUAL TRIP
GENERAL VIRTUAL TRIP
**MIV 2000**
81_1 TRIP
81_2 TRIP
81_3 TRIP
81_4 TRIP
GENERAL TRIP
81_1 PICKUP
81_2 PICKUP
81_3 PICKUP
81_4 PICKUP
GENERAL PICKUP
81_1 VIRTUAL TRIP
81_2 VIRTUAL TRIP
81_3 VIRTUAL TRIP
81_4 VIRTUAL TRIP
GENERAL VIRTUAL TRIP
**MIV 3000**
PHASE A TRIP
PHASE B TRIP
PHASE C TRIP
PHASE TRIP
GROUND TRIP
FREQUENCY TRIP
81_1 TRIP
81_2 TRIP
GENERAL TRIP
59P TRIP
59N TRIP
27 TRIP
27_1a TRIP
27_1b TRIP
27_1c TRIP
27_2a TRIP
27_2b TRIP
27_2c TRIP
59_1a TRIP
59_1b TRIP
59_1c TRIP
59_2a TRIP
59_2b TRIP
59_2c TRIP
27P1 PICKUP
27P2 PICKUP
59P1 PICKUP
59P2 PICKUP
59N1 PICKUP
59N2 PICKUP
47 PICKUP
81_1 PICKUP
81_2 PICKUP
PICKUP
27_1a VIRTUAL TRIP
27_1b VIRTUAL TRIP
27_1c VIRTUAL TRIP
27_2a VIRTUAL TRIP
27_2b VIRTUAL TRIP
27_2c VIRTUAL TRIP
59_1a VIRTUAL TRIP
59_1b VIRTUAL TRIP
59_1c VIRTUAL TRIP
59_2a VIRTUAL TRIP
59_2b VIRTUAL TRIP
59_2c VIRTUAL TRIP
27P1 VIRTUAL TRIP
27P2 VIRTUAL TRIP
59P1 VIRTUAL TRIP
59P2 VIRTUAL TRIP
59N1 VIRTUAL TRIP
59N2 VIRTUAL TRIP
47 VIRTUAL TRIP
81_1 VIRTUAL TRIP
81_2 VIRTUAL TRIP
GENERAL VIRTUAL TRIP

GE Power Management

# MIV

## Digital Voltage/Frequency Protection Quick Reference Guide

## Getting Started:

- Power the device at its rated voltage shown on the faceplate. The READY LED will remain switched off, showing that the unit is not yet in service.
- Connect the unit to a computer using a direct wire (without crossing transmission-reception).
- Install M+PC software.
- Once installed, run the software. The default password for entering M+PC is **7169**. Leave the UserName field blank.
- In case of using a communications port different from COM1 in the computer, click on the OPTIONS menu and enter the port that is being used.
- Click on RELAY CONNECTION. Enter **1** as address (unit number) and **1** as password.
- Set the MIV with the desired settings of the different protection units.
- Finally, put the unit in service, by setting the RELAY STATUS setting in GENERAL SETTINGS as RDY (ready).

After completing these steps, the READY LED will turn on showing that the unit is in service.

For complete information about the MIV, please refer to instruction manual GEK-106247 (English) or GEK-106272 (Spanish).

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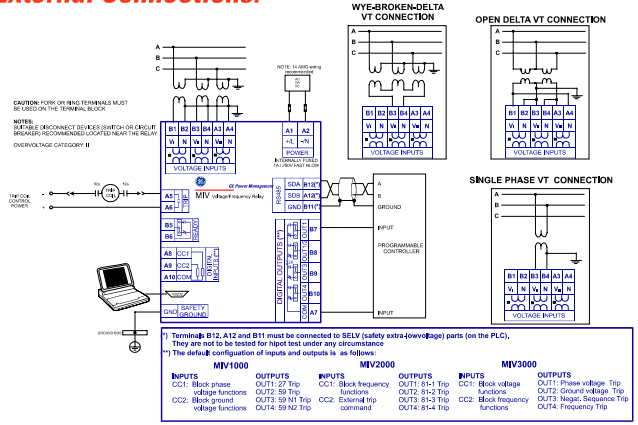
## Local HMI menu map MIV3000 models:

DEFAULT SCROLLING MENU: Va, Vb, Vc, Vn, Vab, Vbc, Vca, V2, F — MENU

ENTER

| INFORMATION | MAIN SETTINGS | | ADV. SETTINGS | | OPERATIONS | DATE/TIME |
|---|---|---|---|---|---|---|
| Va | MOD | GENERAL: STATUS | GENERAL: TAB | | RESET | |
| Vb | VER | GENERAL: FRQ | GENERAL: TRIP MIN TIME | | ACT TABLE 1 | |
| Vc | D T | GENERAL: APP | | | ACT TABLE 2 | |
| Vn | IDEN | GENERAL: PWD | | | OPEN BREAKER | |
| Vab | Va | GENERAL: ADD | | | CLOSE BREAKER | |
| Vbc | Vb | GENERAL: BAUD | | | | |
| Vca | Vc | F27P1: TRIP 27P1 | F27P1 T2: TRIP 27P1 T2 | | | |
| V2 | Vn | F27P1: TAP 27P1 | F27P1 T2: TAP 27P1 T2 | | | |
| F | Vab | F27P1: TIME 27P1 | F27P1 T2: TIME 27P1 T2 | | | |
| DATE / TIME | Vbc | F27P1: SUP 27P1 | F27P1 T2: SUP 27P1 T2 | | | |
| LTU | Vca | F27P2: TRIP 27P2 | F27P2 T2: TRIP 27P2 T2 | | | |
| LT PHASE | V2 | F27P2: TAP 27P2 | F27P2 T2: TAP 27P2 T2 | | | |
| LTU V/F | F | F27P2: TIME 27P2 | F27P2 T2: TIME 27P2 T2 | | | |
| LT DATE/TIME | INP1 | F27P2: SUP 27P2 | F27P2 T2: SUP 27P2 T2 | | | |
| RESET | INP2 | F 59P1: TRIP 59P1 | F59P1 T2: TRIP 59P1 T2 | | | |
| | OUT1 | F 59P1: TAP 59P1 | F59P1 T2: TAP 59P1 T2 | | | |
| | OUT2 | F 59P1: TIME 59P1 | F59P1 T2: TIME 59P1 T2 | | | |
| | OUT3 | F 59P2: TRIP 59P2 | F59P2 T2: TRIP 59P2 T2 | | | |
| | OUT4 | F 59P2: TAP 59P2 | F59P2 T2: TAP 59P2 T2 | | | |
| | B52A | F 59P2: TIME 59P2 | F59P2 T2: TIME 59P2 T2 | | | |
| | B52B | F 59N1: TRIP 59N1 | F59N1 T2: TRIP 59N1 T2 | | | |
| | | F 59N1: TAP 59N1 | F59N1 T2: TAP 59N1 T2 | | | |
| | | F 59N1: TIME 59N1 | F59N1 T2: TIME 59N1 T2 | | | |
| | | F 59N2: TRIP 59N2 | F59N2 T2: TRIP 59N2 T2 | | | |
| | | F 59N2: TAP 59N2 | F59N2 T2: TAP 59N2 T2 | | | |
| | | F 59N2: TIME 59N2 | F59N2 T2: TIME 59N2 T2 | | | |
| | | F 47: TRIP 47 | F 47 T2: TRIP 47 T2 | | | |
| | | F 47: TAP 47 | F 47 T2: TAP 47 T2 | | | |
| | | F 47: TIME 47 | F 47 T2: TIME 47 T2 | | | |
| | | F 81_1: TRIP 81_1 | F 81_1 T2: TRIP 81_1 T2 | | | |
| | | F 81_1: TYPE 81_1 | F 81_1 T2: TYPE 81_1 T1 | | | |
| | | F 81_1: PICK 81_1 | F 81_1 T2: PICK 81_1 T2 | | | |
| | | F 81_1: TIME 81_1 | F 81_1 T2: TIME 81_1 T2 | | | |
| | | F 81_1: SUP 81_1 | F 81_1 T2: SUP 81_1 T2 | | | |
| | | F 81_2: TRIP 81_1 | F 81_2 T2: TRIP 81_1 T2 | | | |
| | | F 81_2: TYPE 81_1 | F 81_2 T2: TYPE 81_1 T1 | | | |
| | | F 81_2: PICK 81_1 | F 81_2 T2: PICK 81_1 T2 | | | |
| | | F 81_2: TIME 81_1 | F 81_2 T2: TIME 81_1 T2 | | | |
| | | F 81_2: SUP 81_1 | F 81_2 T2: SUP 81_1 T2 | | | |

## External Connections:




## SETTINGS:

### MAIN SETTINGS

| DESCRIPTION | HMI | DEFAULT | RANGE |
|---|---|---|---|
| GENERAL SETTINGS | GENERAL | | |
| RELAY STATUS | STA | DIS | RDY-DIS |
| FREQUENCY | FRQ | 50 | 50 - 60 Hz |
| APPLICATION | APP | 3P+N WYE | 3P+N WYE, 3P DELTA, SINGLE PHASE, GROUND |
| PASSWORD | PWD | 1 | 1 - 255 |
| ADDRESS | ADD | 1 | 1 - 255 |
| BAUDRATE | BAUD | 9.6 | 0.3 - 19.2 |
| FUNCTION 27P (2 units) | F27P | | |
| 27P TRIP | TRIP 27P | NO | YES - NO |
| 27P PICKUP | TAP 27P | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 27P TIME DELAY | TIME 27P | 1.00 s | 0-600.00 s |
| 27P 52 SUPERVISION | SUP 27P | NO | YES - NO |
| FUNCTION 59P (2 units) | F59P | | |
| 59P TRIP | TRIP 59P | NO | YES - NO |
| 59P PICKUP | TAP 59P | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 59P TIME DELAY | TIME 59P | 1.00 s | 0-600.00 s |
| FUNCTION 59N (2 units) | F59N | | |
| 59N TRIP | TRIP 59N | NO | YES - NO |
| 59N PICKUP | TAP 59N | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 59N TIME DELAY | TIME 59N | 1.00 s | 0-600.00 s |
| FUNCTION 47 | F47 | | |
| 47 TRIP | TRIP 47 | NO | YES - NO |
| 47 PICKUP | TAP 47 | 60 V | 2.0-60.0 V |
| 47 TIME DELAY | TIME 47 | 1 s | 0 - 600.00 s. |
| FUNCTION 81 (2 or 4 units) | F81 | | |
| 81 TRIP | TRIP 81 | NO | YES - NO |
| 81 TYPE | TYPE 81 | UND | UND - OVE |
| 81 PICKUP | PICK 81 | 42 Hz | 42 -67.5 Hz |
| 81 TIME DELAY | TIME 81 | 1 s | 0-600.00 s |
| 81 SUPERVISION | SUP 81 | 30 V<br>10 V | 30-250 V<br>10-60 V |

### ADVANCED SETTINGS

| DESCRIPTION | | HMI | DEFAULT | RANGE |
|---|---|---|---|---|
| GENERAL ADVANCED SETTINGS | | GENERAL ADV. | | |
| IDENTIFICATION | | | MIV | |
| ACTIVE TABLE | | TAB | 1 | 1 - 2 |
| TRIP MIN TIME | | TRIP MIN TIME | 100 | 50 - 300 ms. |
| FUNCTION 27P (2 units) | TABLE 2 | F27P T2 | | |
| 27P TRIP | TABLE 2 | TRIP 27P T2 | NO | YES - NO |
| 27P PICKUP | TABLE 2 | TAP 27P T2 | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 27P TIME DELAY | TABLE 2 | TIME 27P T2 | 1.00 s | 0-600.00 s |
| 27P 52 SUPERVISION | TABLE 2 | SUP 27P T2 | NO | YES - NO |
| FUNCTION 59P (2 units) | TABLE 2 | F59P T2 | | |
| 59P TRIP | TABLE 2 | TRIP 59P T2 | NO | YES - NO |
| 59P PICKUP | TABLE 2 | TAP 59P T2 | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 59P TIME DELAY | TABLE 2 | TIME 59P T2 | 1.00 s | 0-600.00 s |
| FUNCTION 59N (2 units) | TABLE 2 | F59N T2 | | |
| 59N TRIP | TABLE 2 | TRIP 59N T2 | NO | YES - NO |
| 59N PICKUP | TABLE 2 | TAP 59N T2 | 110.0 V<br>60.0 V | 10.0-250.0 V<br>2.0-60.0 V |
| 59N TIME DELAY | TABLE 2 | TIME 59N T2 | 1.00 s | 0-600.00 s |
| FUNCTION 47 | TABLE 2 | F47 T2 | | |
| 47 TRIP | TABLE 2 | TRIP 47 T2 | NO | YES - NO |
| 47 PICKUP | TABLE 2 | TAP 47 T2 | 60 V | 2.0-60.0 V |
| 47 TIME DELAY | TABLE 2 | TIME 47 T2 | 1 s | 0 - 600.00 s. |

### ADVANCED SETTINGS

| DESCRIPTION | HMI | DEFAULT | RANGE |
|---|---|---|---|
| FUNCTION 81 (2 or 4 units) TABLE 2 | F81 T2 | | |
| 81 TRIP TABLE 2 | TRIP 81 T2 | NO | YES - NO |
| 81 TYPE TABLE 2 | TYPE 81 T2 | UND | UND - OVE |
| 81 PICKUP TABLE 2 | PICK 81 T2 | 42 Hz | 42 -67.5 Hz |
| 81 TIME DELAY TABLE 2 | TIME 81 T2 | 1 s | 0-600.00 s |
| 81 SUPERVISION VOLTAGE TABLE 2 | SUP 81 T2 | 30 V<br>10 V | 30-250 V<br>10-60 V |
| EVENT MASKS | | | |
| 27P1 PICKUP | | YES | YES- NO |
| 27P2 PICKUP | | YES | YES- NO |
| 59P1 PICKUP | | YES | YES- NO |
| 59P2 PICKUP | | YES | YES- NO |
| 59N1 PICKUP | | YES | YES- NO |
| 59N2 PICKUP | | YES | YES - NO |
| 47 PICKUP | | YES | YES - NO |
| 81_1 PICKUP | | YES | YES- NO |
| 81_2 PICKUP | | YES | YES- NO |
| 81_3 PICKUP | | YES | YES - NO |
| 81_4 PICKUP | | YES | YES - NO |
| 27P1 DISABLED (by d.i.) | | YES | YES - NO |
| 27P2 DISABLED (by d.i.) | | YES | YES - NO |
| 59P1 DISABLED (by d.i.) | | YES | YES - NO |
| 59P2 DISABLED (by d.i.) | | YES | YES - NO |
| 59N1 DISABLED (by d.i.) | | YES | YES - NO |
| 59N2 DISABLED (by d.i.) | | YES | YES - NO |
| 47 DISABLED (by d.i.) | | YES | YES - NO |
| 81_1 DISABLED (by d.i.) | | YES | YES - NO |
| 81_2 DISABLED (by d.i.) | | YES | YES - NO |
| 81_3 DISABLED (by d.i.) | | YES | YES - NO |
| 81_4 DISABLED (by d.i.) | | YES | YES - NO |
| TRIP DISABLED (by d.i.) | | YES | YES - NO |
| 27P1 TRIP | | YES | YES - NO |
| 27P2 TRIP | | YES | YES - NO |
| 59P1 TRIP | | YES | YES - NO |
| 59P2 TRIP | | YES | YES - NO |
| 59N1 TRIP | | YES | YES - NO |
| 59N2 TRIP | | YES | YES - NO |
| 47 TRIP | | YES | YES - NO |
| 81_1 TRIP | | YES | YES - NO |
| 81_2 TRIP | | YES | YES - NO |
| 81_3 TRIP | | YES | YES - NO |
| 81_4 TRIP | | YES | YES - NO |
| GENERAL TRIP | | YES | YES - NO |
| PROTECTION STATUS | | YES | YES - NO |
| OUTPUT 1 | | YES | YES - NO |
| OUTPUT 2 | | YES | YES - NO |
| OUTPUT 3 | | YES | YES - NO |
| OUTPUT 4 | | YES | YES - NO |
| DIGITAL INPUT 1 | | YES | YES - NO |
| DIGITAL INPUT 2 | | YES | YES - NO |
| SETT CHANGE DISABLED | | YES | YES - NO |
| TRIP BY INPUT | | YES | YES - NO |
| TRIP BY COMM | | YES | YES - NO |
| RESET LATCH AUX | | YES | YES - NO |
| BREAKER 52A | | YES | YES - NO |
| BREAKER 52B | | YES | YES - NO |
| BREAKER CLOSED | | YES | YES - NO |
| ACTIVE TABLE CHANGE | | YES | YES - NO |
| OSCILLO TRIGGER BY D.I. | | YES | YES - NO |
| OSCILLO TRIGGER BY COMM. | | YES | YES - NO |
| SETTINGS CHANGE | | YES | YES - NO |
| E2PROM FAILURE | | YES | YES - NO |
| USER SETTINGS | | YES | YES - NO |
| OSCILLOGRAPHY MASKS | | | |
| OSCILLO BY COMMUNICATIONS | | NO | YES - NO |
| OSCILLO BY DIGITAL INPUT | | NO | YES - NO |
| OSCILLO BY TRIPPING | | NO | YES - NO |
| OSCILLO BY PICKUP | | NO | YES - NO |

# CONTENTS

# 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**

## 1.1. INSPECTION CHECKLIST

- Open the relay packaging and inspect the relay for physical damage.
- View the faceplate relay model number and verify that the relay is the correct model ordered.
- 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 GE Power Management Home Page (www.geindustrial.com/pm).

**Note: If there is any physical damage noticed on the relay, or any of the contents listed are missing, please contact GE Power Management immediately.**

**GE Power Management contact information:**

**GENERAL ELECTRIC POWER MANAGEMENT S.A**
**Avda. Pinoa, 10**
**48170 Zamudio, Vizcaya (Spain)**
**Phone: +34 94-485 88 00, Fax: +34 94-485 88 45**
**E-mail:** gepm.help@indsys.ge.com

**GENERAL ELECTRIC POWER MANAGEMENT**
**215, Anderson Avenue**
**L6E 1B3 Markham, ON (CANADA)**
**Phone: +1 905 294 6222, Fax: +1 905 201 2098**
**E-mail:** info.pm@indsys.ge.com

**The information provided herein does not intend to cover all details of variations of the described 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 POWER MANAGEMENT.**

## 1.2. M+PC SOFTWARE

### 1.2.1. HARDWARE AND SOFTWARE REQUIREMENTS FOR COMMUNICATIONS

The faceplate keypad + display or the M+PC software interface can be used to communicate with the relay. The M+PC 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 M+PC software to properly operate on a PC:

| | |
|---|---|
| Processor: | Intel® Pentium recommended |
| Memory: | 16 Mb minimum |
| Hard Drive: | 10 Mb free space required before installation of M+PC software |
| O/S: | Windows 95, Windows 98 or Windows NT 4.0, SP 3 or higher. |
| Hardware: | CD-ROM drive or 3,5” Floppy disk drive. |
| | Unused communications port (i.e. COM1) |

The M+PC help system has been developed using Microsoft's HTMLHelp technology. In order to view this powerful file format it is necessary to have a help file viewer, which is included with M+PC. This viewer needs Microsoft® Internet Explorer (version 3.02 or higher) to be installed in the computer. However, Internet explorer does not need to be the default system browser.

Internet Explorer 3.02 is included with M+PC under the “ie” folder.

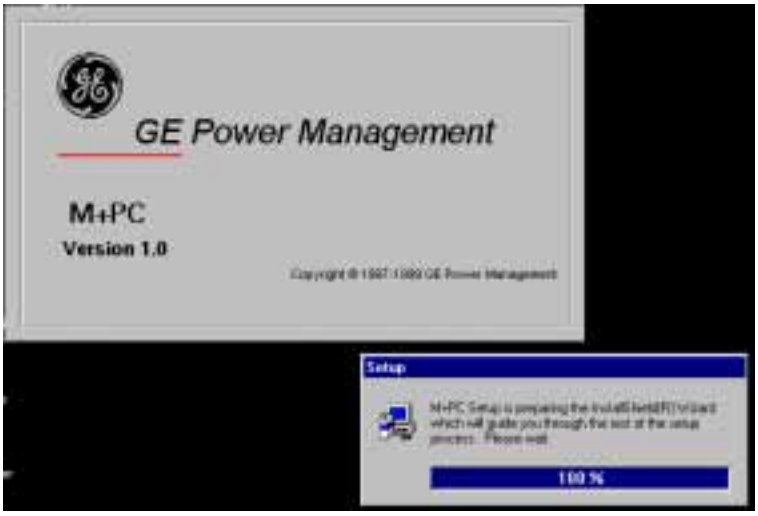
**Contextual help can be accessed from any program screen by pressing F1.**

### 1.2.2. SOFTWARE INSTALLATION

Refer to the following instructions to install the M+PC software:

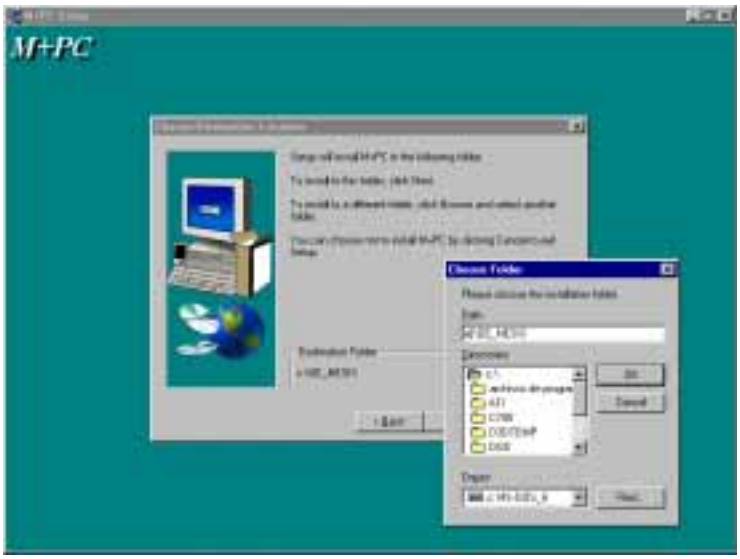
1. Start the **Windows**® program.
2. Insert the M+PC software CD (or Floppy disk) into the CD ROM drive (or Floppy disk drive).
3. If the installation program does not start automatically, from the **Windows**® **Start** menu, choose **Run**, type d:\SETUP.EXE (assuming your CD ROM driver is configured as the 'D:' unit) or a:\SETUP.EXE if you are using the floppy disk drive (assuming your Floppy disk drive is configured as the 'A:' unit) and press **Enter.**

You will see the following screen:



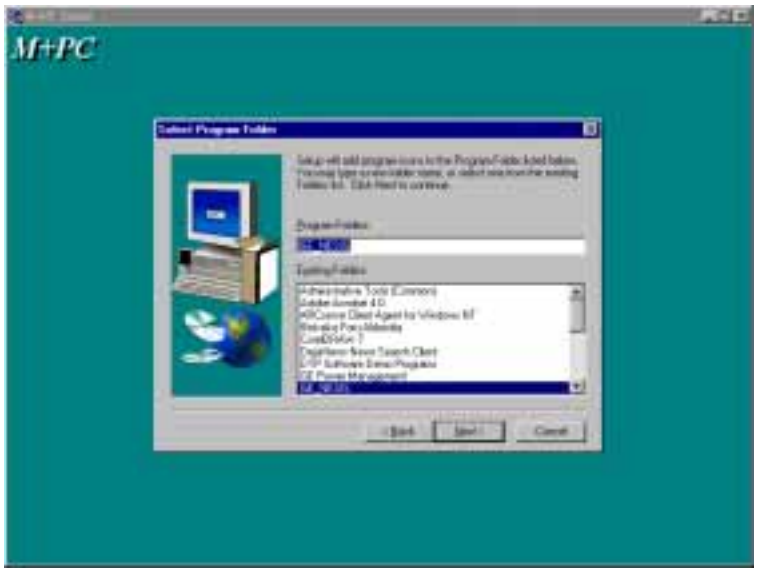

4. Follow the on-screen instructions to install the M+PC software. When the **Welcome** window appears, click on **Next** to continues with the installation procedure.

5. When the **Choose Destination Location** window appears and if the software is not to be located in the default directory, click **Browse** and type in the complete path name including the new directory name.

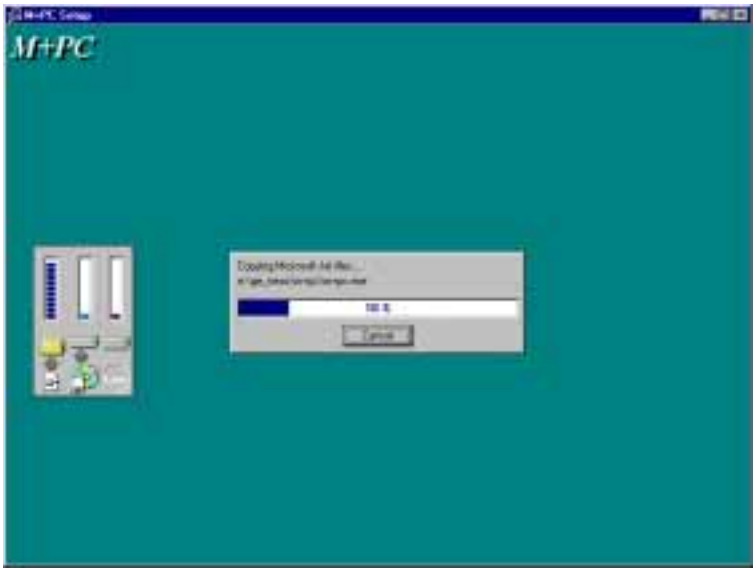



6. Click **Next** to continue with the installation procedure.

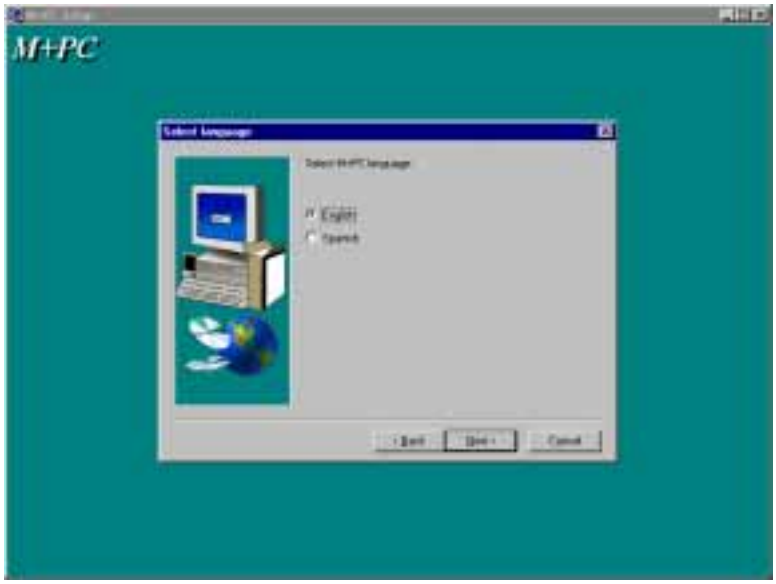
7. The default program group where the application will be added to is shown in the **Selected Program Folder** window. If it is desired that the application be added to an already existing program group, choose the group name from the list shown.



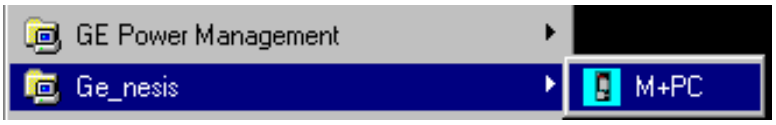
8. Click Next to begin the installation process, and all the necessary program files will be copied into the chosen directory.




9. To finish with the installation process, using your mouse select the language by clicking on **English** or **Spanish**.



10. Subsequently, double click on the M+PC software icon to activate the application.




**Refer to the HUMAN INTERFACES chapter in this manual and the M+PC software Help program for more information about the M+PC software interface**

## 1.3. HARDWARE INSTALLATION

### 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 M+PC software can communicate to the relay via the faceplate RS232 port, or the rear panel RS485. To communicate with the relay via the faceplate 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 rear RS485 port from a computer RS232 port, an RS232/RS485 converter box is needed. We recommend to use the F485 converter, manufactured by GE. This converter box is connected to the computer using a “straight through” serial cable. A shielded twisted pair (20, 22 or 24 AWG according to the American standards; 0.25, 0.34 or 0.5 $mm^2$ according to the European standards) cable is used to connect the converter box to the relay rear communications terminals. The converter box (+, -, GND) terminals are connected to the relay (SDA, SDB, GND) terminals respectively. For long communications 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. KEYPAD & DISPLAY

Display messages are organized into menus under the main headings: Information, Main Settings, Advanced Settings, Operations and Date/Time. A 3-key keypad and a 3.5-character display (shown below) are used as elementary local HMI.

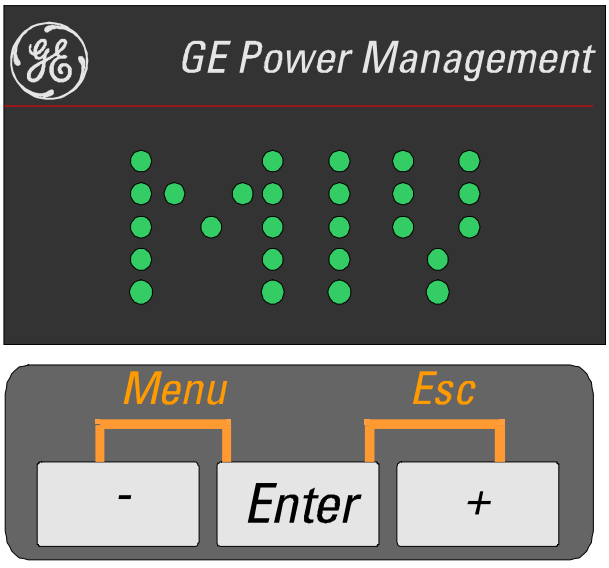



**Figure 1.1 MIV KEYPAD AND DISPLAY**

## 1.4. USING THE KEYPAD AND DISPLAY

### 1.4.1. HIERARCHICAL MENU

Browsing and hierarchical menu:

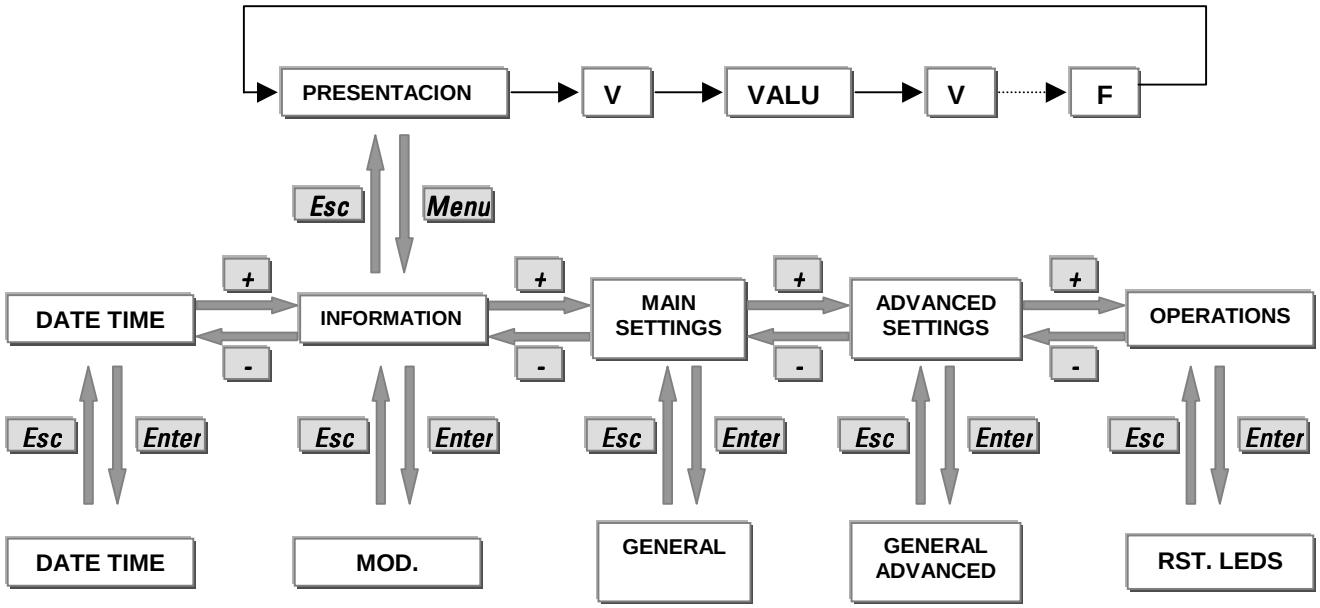



**FIGURE 1.2. MOVING THROUGH THE HIERARCHICAL MENU**

As shown in figure 1.2, there are 3 hierarchical levels to access the information in the relay. The first level is an automatic scrolling menu that shows the measured values.

Pushing simultaneously "**-**" and "**Enter**" keys the second level is accessed (this is indicated by the "**Menu**" text labelled over the "-" and "Enter" keys). To access information within the same hierarchical level (horizontal movement) push "**+**" or "**-**". To access the third level push the "**Enter**" key 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 "**+**" and "**Enter**" keys simultaneously. This is indicated by the "**Esc**" text labelled over the "**+**" and "**Enter**" keys.

Refer to the section "Keypad and Display", for more information on the use of the local keypad and display to access information and change settings.

# 2. PRODUCT DESCRIPTION

## 2.1. INTRODUCTION

### 2.1.1. GENERAL OVERVIEW

The MIV relay is a microprocessor-based relay designed for the following applications:

- Undervoltage and overvoltage protection and supervision for substations.
- Overvoltage protection for Generators.
- Undervoltage detection in MV busbar automatic transfer schemes
- Undervoltage, overvoltage and voltage unbalance protection for Motors
- Presence/lack of voltage condition monitoring in lines and busbars
- Ground fault protection for Generators through ground voltage supervision
- Ground fault monitoring for Lines with isolated ground.
- Load shedding schemes and load restoration through voltage/frequency
- Under/overvoltage protection for Generators

Negligible over-travel and a high drop out to pick up ratio (>97%), along with the possibility of adjust a time delay for the instantaneous units, allow optimal co-ordination without compromising selectivity.

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 M+PC communication software is the Windows® based program used to communicate with the relay.

The MIV uses flash memory technology, which allows field upgrading (through M+PC software) as new features are added. This upgrade can be performed only through the communications port on the front of the unit.

The following single line diagrams illustrate the functionality of the different models, using ANSI (American National Standards Institute) device numbers.

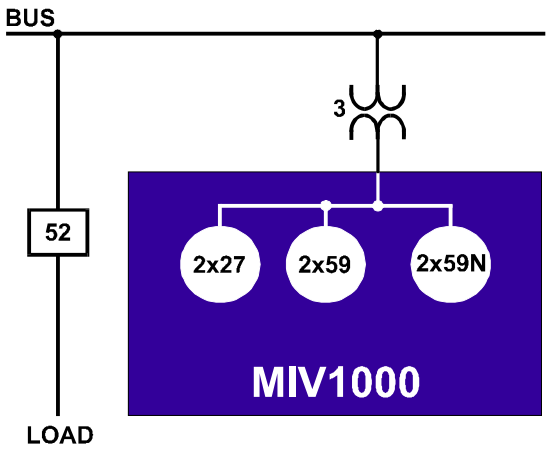



**FIGURE 2.1. MIV1000 FUNCTIONAL BLOCK DIAGRAM**

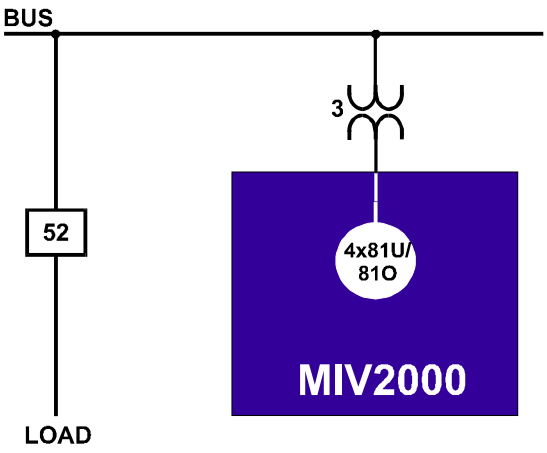



FIGURE 2.2. MIV2000 FUNCTIONAL BLOCK DIAGRAM

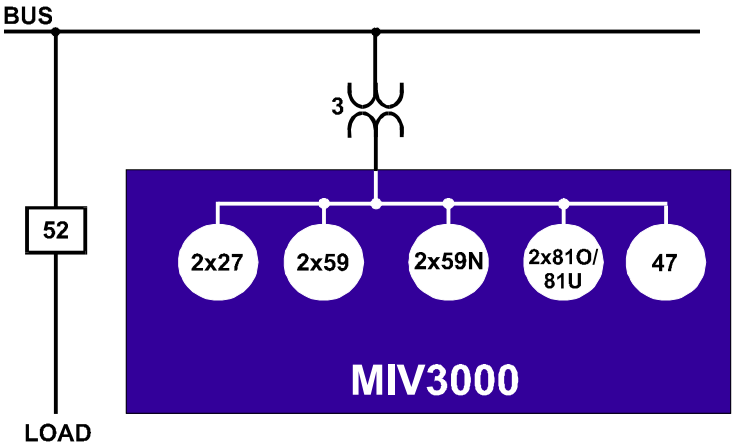



FIGURE 2.3. MIV3000 FUNCTIONAL BLOCK DIAGRAM

## 2.2. VOLTAGE UNITS

The MIV incorporates three independent voltage inputs; each input can be connected between phases or phase-to-ground. Additionally, the relay can be used both as three-phase protection or as one-phase protection. In this last case only the input associated to VII must be activated (please refer to the wiring diagram on figure 3-4).

In order to adequate the relay operation to the desired type of connection, it is requested to set the APPLICATION value in the GENERAL SETTINGS (please refer to section 5-2-1).

### 2.2.1. OVERVOLTAGE UNIT (59)

The MIV incorporates, in models MIV1000 and MIV3000, two independent time delayed overvoltage units. Each of them can be enabled and set independently, both for pickup voltage and timing.

Besides, these units can be used as one-phase protection. For this purpose it is necessary to apply voltage only to input VII. For use as three-phase protection, voltage must be applied to the three inputs (VI, VII and VIII).

The operation mode, one-phase or three-phase is selected by a setting in the General Settings group.

The associated settings to each of the overvoltage units are the following:

**Tripping Permission**

This setting allows enabling or disabling the 59 trip.

Disabling the tripping of a certain unit involves disabling the general pickup due to the same unit; however, it does not disable the unit's pickup. This means that if the unit pickup has been used for any output configuration, or programmable logic, these will be operational.

**Pickup Level**

This setting determines the voltage threshold from which the voltage unit picks up starting the timer that will cause the trip.

The range of this setting depends on the model, and the limits are as follows:

10,00 - 250,00 V in steps of 0,1 V for high range models.

2,00 - 60,00 V in steps of 0,1 V for low range models.

**Timing**

This setting determines the time that must pass between the unit pickup and the trip.

If once the unit has picked up and the timer has been started, voltage falls below the pickup level before the trip occurs, the timer will return to the stand-by status. If a new pickup occurs, the timer will restart from zero.

The timing range is as follows:

0 - 600 sec in steps of 0,01 sec.

If this setting is adjusted to 0 sec., the relay will operate in less than 0,030 sec. The tripping time for higher values of the setting will be the set value plus less than 30 ms.

The accuracy in the measure of the overvoltage unit is +/- 3% of the pickup level in the complete range.

The timing accuracy is 3% of the set value or 25 ms (whichever is greater).

### 2.2.2. UNDERVOLTAGE UNIT (27)

The MIV incorporates, in models MIV1000 and MIV3000, two independent time delayed undervoltage units. Each of them can be enabled and set independently, both for pickup voltage and timing.

Besides, these units can be used as one-phase protection. For this purpose it is necessary to apply voltage only to input VII. For use as three-phase protection, voltage must be applied to the three inputs (VI, VII and VIII).

In order to avoid undesired operation in the case where the breaker is open, and the measuring transformer is located on the line side, the MIV includes a breaker supervision feature that enables or disables the undervoltage unit operation by means of a setting when the breaker is open.

For the breaker supervision feature to operate, three conditions must be present:

1. The supervision feature must be enabled, by the corresponding setting
2. One of the relay digital inputs must be assigned the breaker status (52A or 52B)
3. The breaker status must be physically wired to the corresponding input

The associated settings to each of the undervoltage units are the following:

**27 Tripping Permission**

This setting allows enabling or disabling the 27 trip.

Disabling the tripping of a certain unit involves disabling the general pickup caused by this unit; however, it does not disable the unit's pickup. This means that if the unit pickup has been used for any output configuration, or programmable logic, these will be operational.

**Pickup Level**

This setting determines the voltage threshold under which the voltage unit picks up starting the timer that will cause the trip.

The range of this setting depends on the model, and the limits are as follows:

10,00 - 250,00 V in steps of 0,1 V for high range models.

2,00 - 60,00 V in steps of 0,1 V for low range models.

**Timing**

This setting determines the time that must pass between the unit pickup and the trip.

If once the unit has picked up and the timer has been started, voltage raises above the pickup level before the trip occurs, the timer will return to the stand-by status. If a new pickup occurs, the timer will restart from zero.

The timing range is as follows:

0 - 600 sec in steps of 0,01 sec.

If this setting is adjusted to 0 sec., the relay will operate in less than 0,030 sec. The tripping time for higher values of the setting will be the set value plus less than 30 ms.

The accuracy in the measure of the overvoltage unit is +/- 3% of the pickup level in the complete range.

The timing accuracy is 3% of the set value or 25 ms (whichever is greater).

### 2.2.3. GROUND OVERVOLTAGE UNIT (59N)

The MIV incorporates, in models MIV1000 and MIV3000, two independent fixed time ground overvoltage units. Each of them can be enabled and set independently, both for pickup voltage and timing.

Depending on the operation mode (application) selected in the general settings, and on the type of connection, the ground overvoltage unit will measure in different ways:

- If the selected operation mode is three-phase + ground, the relay will internally calculate the ground voltage from the voltage value in the three phases
- If the ground one-phase mode has been selected, the relay will measure the ground voltage on input VII.

The associated settings to each of the ground overvoltage units are the following:

**59N Tripping Permission**

This setting allows enabling or disabling the 59 trip.

Disabling the tripping of a certain unit involves disabling the general pickup due to the same unit; however, it does not disable the unit's pickup. This means that if the unit pickup has been used for any output configuration, or programmable logic, these will be operational.

**Pickup Level**

This setting determines the voltage threshold from which the voltage unit picks up starting the timer that will cause the trip.

The range of this setting depends on the model, and the limits are as follows:

10,00 - 250,00 V in steps of 0,1 V for high range models.

2,00 - 60,00 V in steps of 0,1 V for low range models.

**Timing**

This setting determines the time that must pass between the unit pickup and the trip.

If once the unit has picked up and the timer has been started, voltage falls below the pickup level before the trip occurs, the timer will return to the stand-by status. If a new pickup occurs, the timer will restart from zero.

The timing range is as follows:

0 - 600 sec in steps of 0,01 sec.

If this setting is adjusted to 0 sec., the relay will operate in less than 0,030 sec. The tripping time for higher values of the setting will be the set value plus less than 30 ms.

The accuracy in the measure of the overvoltage unit is +/- 3% of the pickup level in the complete range.

The timing accuracy is 3% of the set value or 25 ms (whichever is greater).

### 2.2.4. VOLTAGE UNBALANCE UNIT (47)

The MIV 3000 incorporates a voltage unbalance unit. This unit is based on the negative sequence of the phase-to-ground voltage values, and therefore it is disabled in the cases where the selected operation mode (application) is different from 3P+G wye connected.

The associated settings to the voltage unbalance unit are the following:

**47 Tripping Permission**

This setting allows enabling or disabling the 47 trip.

Disabling the tripping of a certain unit involves disabling the general pickup due to the same unit; however, it does not disable the unit's pickup. This means that if the unit pickup has been used for any output configuration, or programmable logic, these will be operational.

**Pickup Level.**

This setting determines the voltage threshold that must be overpassed for the voltage unit to pickup, starting the timer that will cause the trip.

This setting has the following limits:

2,00 - 60,00 V in steps of 0,1 V.

**Timing.**

This setting determines the time that must pass between the unbalance unit pickup and the trip.

If once the unit has picked up and the timer has been started, voltage falls below the pickup level before the trip occurs, the timer will return to the stand-by status. If a new pickup occurs, the timer will restart from zero.

The timing range is as follows:

0 - 600 sec in steps of 0,01 sec.

If this setting is adjusted to 0 sec., the relay will operate in less than 0,030 sec. The tripping time for higher values of the setting will be the set value plus less than 30 ms.

The accuracy in the measure of the overvoltage unit is +/- 3% of the pickup level in the complete range.

The timing accuracy is 3% of the set value or 25 ms (whichever is greater).

## 2.3. FREQUENCY UNITS

The MIV incorporates different optional frequency units depending on the model.

### 2.3.1. FREQUENCY UNIT (81)

The MIV2000 incorporates four definite time frequency units, and the MIV3000 includes two.

Each of these units can be independently configured as under or overfrequency.

In all cases, frequency is measured at input VII, so if this input is not connected, the measured frequency will be 0 Hz.

Each frequency unit is supervised by an undervoltage unit, that can be set independently. This means that if voltage at input VII falls below the value adjusted in this setting, the frequency unit will be immediately blocked.

The associated settings are as follows:

**81 Tripping Permission**

This setting allows enabling or disabling the frequency unit.

Disabling the tripping of a certain unit involves disabling the general pickup due to the same unit; however, it does not disable the unit's pickup. This means that if the unit pickup has been used for any output configuration, or programmable logic, these will be operational.

**Pickup Level.**

This setting determines the frequency threshold that must be overpassed (above or below, depending on whether it is an over or underfrequency unit) for the voltage unit to pickup, starting the timer that will cause the trip.

This setting has the following limits:

42,00 – 67,50 Hz in steps of 0,01 Hz for all models.

**Type of Unit**

With this setting we can select the unit to operate as overfrequency or underfrequency.

**Timing.**

This setting determines the time that must pass between the frequency unit pickup and the trip.

If once the unit has picked up and the timer has been started, frequency varies and goes out of the tripping range, before the trip occurs, the timer will return to the stand-by status. If a new pickup occurs, the timer will restart from zero.

The timing range is as follows:

0 - 600 sec in steps of 0,01 sec.

If this setting is adjusted to 0 sec., the relay will operate in less than 0,030 sec. The tripping time for higher values of the setting will be the set value plus less than 30 ms.

The accuracy in the measure of the overvoltage unit is +/- 3% of the pickup level in the complete range.

The timing accuracy is 3% of the set value or 25 ms (whichever is greater).

**Voltage Supervision:**

This value determines the voltage value at input VII, under which the frequency unit is blocked.

The ranges for this setting are as follows:

For low range:
Voltage supervision 10.0 – 60.0 V in steps of 0.1 V

For high range:
Voltage supervision 30.0 – 250.0 V in steps of 0.1 V

**Accuracy:**

The metering accuracy for frequency is +/- 10 mHz.

## 2.4. EVENTS

The MIV stores a historical record with the last 24 events. Each event contains the event description, date and time (4 ms accuracy), the voltage (VI, VII, VIII) and frequency (Vn, V2) values (the appearing values will vary depending on the model), and a summary of the status signals that can produce events, and whether they were activated or not in that moment.

In the M+PC there is a field called “EVENTS”, where the user can check how many events have been produced since the last time that Events where deleted. If this number is higher than 24 (maximum number of events stored), this means that from all the produced events, only the last 24 are stored.

This event record is stored in a capacitor backed up RAM memory.

The whole MIV functionality related to events is performed from the M+PC 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 SETTINGS section.

The following table shows a list of all possible events for each model:

| DESCRIPTION | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|
| Pickup/reset 27P1 | ♦ | | ♦ |
| Pickup/reset 27P2 | ♦ | | ♦ |
| Pickup/reset 59P1 | ♦ | | ♦ |
| Pickup/reset 59P2 | ♦ | | ♦ |
| Pickup/reset 59N1 | ♦ | | ♦ |
| Pickup/reset 59N2 | ♦ | | ♦ |
| Pickup/reset 47 | | | ♦ |
| Pickup/reset 81_1 | | ♦ | ♦ |
| Pickup/reset 81_2 | | ♦ | ♦ |
| Pickup/reset 81_3 | | ♦ | |
| Pickup/reset 81_4 | | ♦ | |
| 27P1 trip enable/disable by digital input | ♦ | | ♦ |
| 27P2 trip enable/disable by digital input | ♦ | | ♦ |
| 59P1 trip enable/disable by digital input | ♦ | | ♦ |
| 59P2 trip enable/disable by digital input | ♦ | | ♦ |
| 59N1 trip enable/disable by digital input | ♦ | | ♦ |
| 59N2 trip enable/disable by digital input | ♦ | | ♦ |
| 47 trip enable/disable by digital input | | | ♦ |
| 81_1 trip enable/disable by digital input | | ♦ | ♦ |
| 81_2 trip enable/disable by digital input | | ♦ | ♦ |
| 81_3 trip enable/disable by digital input | | ♦ | |
| 81_4 trip enable/disable by digital input | | ♦ | |
| General trip enable/disable by digital input | ♦ | ♦ | ♦ |
| 27P1 trip | ♦ | | ♦ |
| 27P2 trip | ♦ | | ♦ |
| 59P1 trip | ♦ | | ♦ |
| 59P2 trip | ♦ | | ♦ |
| 59N1 trip | ♦ | | ♦ |
| 59N2 trip | ♦ | | ♦ |
| 47 trip | | | ♦ |
| 81_1 trip | | ♦ | ♦ |
| 81_2 trip | | ♦ | ♦ |
| 81_3 trip | | ♦ | |
| 81_4 trip | | ♦ | |

| DESCRIPTION | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|
| General trip | ♦ | ♦ | ♦ |
| Protection status in service/out of service | ♦ | ♦ | ♦ |
| Digital output 1 active/non active | ♦ | ♦ | ♦ |
| Digital output 2 active/non active | ♦ | ♦ | ♦ |
| Digital output 3 active/non active | ♦ | ♦ | ♦ |
| Digital output 4 active/non active | ♦ | ♦ | ♦ |
| Digital input 1 active/non active | ♦ | ♦ | ♦ |
| Digital input 2 active/non active | ♦ | ♦ | ♦ |
| Settings change disabled by digital input active/non active | ♦ | ♦ | ♦ |
| Trip operation by digital input | ♦ | ♦ | ♦ |
| Trip operation by command | ♦ | ♦ | ♦ |
| Auxiliary digital output latch reset | ♦ | ♦ | ♦ |
| 52 B open/closed | ♦ | ♦ | ♦ |
| 52 A open/closed | ♦ | ♦ | ♦ |
| 52 Open/closed | ♦ | ♦ | ♦ |
| Settings Table 2 selection by digital input | ♦ | ♦ | ♦ |
| Oscillo trigger by digital input | ♦ | ♦ | ♦ |
| Oscillo trigger by command | ♦ | ♦ | ♦ |
| Settings Change | ♦ | ♦ | ♦ |
| E2PROM failure | ♦ | ♦ | ♦ |
| User settings/default settings | ♦ | ♦ | ♦ |

**1000** : MIV1000/MIV1010 models
**2000** : MIV2000 models
**3000** : MIV3000/MIV3010 models

## 2.5. OSCILLOGRAPHY

### 2.5.1. OSCILLOGRAPHY DESCRIPTION MIV1000/3000

The MIV stores an oscillography record, with a resolution of 8 samples per cycle, and a length of 24 cycles (the 2 first being pre-fault cycles), including the following information:

- Instantaneous values of phase voltages (VI, VII, VII) and frequency (f). The 2 first cycles are pre-fault cycles.
- Digital information:

- Pickups (protection functions*)
- Trip inhibition by digital input (protection functions*)
- Trips (protection functions*)
- Ready (protection in service)
- Auxiliary digital outputs
- Digital inputs
- Breaker 52A, Breaker 52B, Status 52
- Table 2 selection by digital input
- E2prom failure
- Default settings/User's settings

*protection functions: 27P1, 27P2, 59P1, 59P2, 59N1, 59N2, (MIV1000)
27P1, 27P2, 59P1, 59P2, 59N1, 59N2, 47, 81_1, 81_2, (MIV3000)

- Date and time
- Model
- Number of oscillo
- VI, VII, VIII voltages and frequency f (f only in MIV3000 models) in the moment of the oscillography trigger
- Active table in the moment of the oscillography trigger
- Unit's settings when retrieving the oscillography record.

### 2.5.2. OSCILLOGRAPHY DESCRIPTION MIV2000

The MIV stores an oscillography record, with a resolution of 2 samples per cycle, and a length of 432 cycles (the 36 first being pre-fault cycles), including the following information:

- Instantaneous value of frequency (f). The 36 first cycles are pre-fault cycles.
- Digital information:

- Pickups (81 functions)
- Trips (81 functions)

- Date and time
- Model
- Number of oscillo

- VI, VII, VIII voltages and frequency f (f only in MIV3000 models) in the moment of the oscillography trigger
- Active table in the moment of the oscillography trigger
- Unit's settings when retrieving the oscillography record.

The number of oscillo is a circular counter, that increases with each generated oscillo. 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.

The whole MIV functionality related to oscillography is performed from the M+PC 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:

- Pickup of one of the protection functions
- Trip of one of the protection functions
- Oscillography trigger by communications
- 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 SETTINGS section.

## 2.6. MULTIPLE SETTINGS GROUPS

Two independent Settings Groups are available in the permanent (non-volatile) memory of the MIV relay. Only one of the two is active at a given time. User can select which settings 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 MIV relay. For those users who need to use the full functionality of the relay, the Advanced Settings must be used.

## 2.7. MEASUREMENT AND SELF-TEST

### 2.7.1. MEASUREMENT

The MIV provides actual values for phase and ground voltages, negative sequence voltage and frequency, depending on the model. The accuracy is 1% of the rated value, and 3% for the complete range.

#### *2.7.1.1. MIV1000 measures*

Va
Vb
Vc
Vn
Vab
Vbc
Vac
f

#### *2.7.1.2. MIV2000 measures*

Vb
f

#### *2.7.1.3. MIV3000 measures*

Va
Vb
Vc
Vn
Vab
Vbc
Vac
V2
f

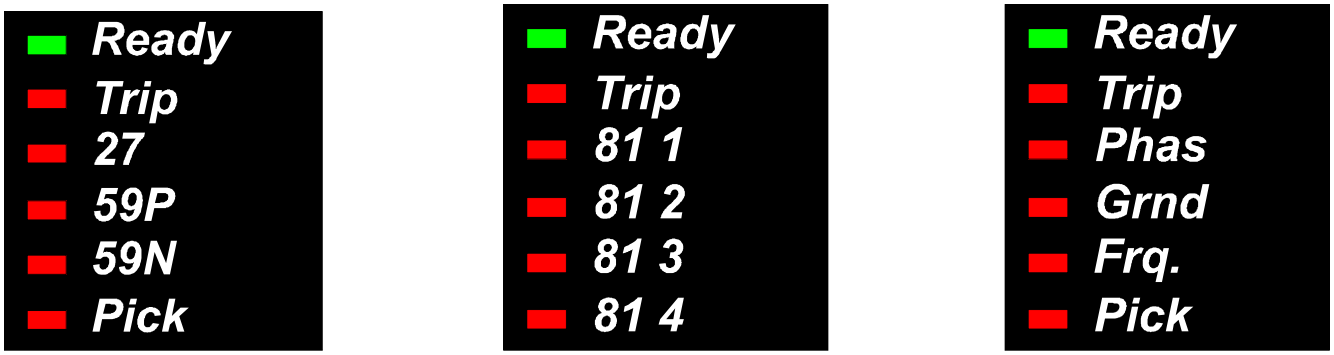
### 2.7.2. SELF-TEST

The 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 CRITICAL FAILURE ALARM output contact will be activated.

## 2.8. USER INTERFACE

**LED targets**

There are 6 LED Targets in all MIV models. The first one is green and has the 'READY' (relay in service) fixed meaning (cannot be configured), the second one is red and fixed for TRIP; the last four are red and can be configured by the user. The default configuration of the LEDs is shown in figure 2.2




**MIV1000** **MIV2000** **MIV3000**

**FIGURE 2.2 DEFAULT CONFIGURATION OF MIV LED TARGETS**

The meaning 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. This LED not being lit in the previous mentioned conditions indicates lack 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.
- **PHAS:** Points out that the trip has been issued by one of the Phase Protection Units.
- **GRND:** Points out that the trip has been issued by one of the Ground Fault Protection Units.
- **INST:** Points out that the trip has been issued by one of the Instantaneous Units, either phase or ground units.
- **PICK:** Points out that at least one of the protective units has picked up.
- **FRQ:** Indicates that the trip has been issued by one of the Frequency Protection Units
- **81_1:** Trip issued by the 81_1 unit.
- **81_2**: Trip issued by the 81_2 unit.
- **81_3**: Trip issued by the 81_3 unit.
- **81_4**: Trip issued by the 81_4 unit.
- **27**: Trip issued by the 27P1 and/or 27P2 unit.
- **59P**: Trip issued by the 59P1 and/or 59P2 unit.
- **59N**: Trip issued by the 59N1 and/or 59N2 unit.

LEDs associated to tripping functions are latched and once they have been lit up, they remain lit up until the **ENTER** key is pressed for more than 3 seconds (RESET) provided that the trip condition has disappeared. The LED associated to *function pickup* is auto-reset type, and lights up while the pickup condition (current above setting) exists.

***Keypad and Display***

A three-key keypad allows access to the MIV relay information and allows settings change. Measurement data (actual values), last trip information (fault report) and settings are shown on the 3.5 characters dots-display. Only by using a PC, the M+PC program and a communications cable the user can access to all the internal information in the relay, as the list of events and oscillography data cannot be shown on the small faceplate display. Access to I/O configuration and logic configuration is also possible only via PC.

***Communication Ports***

The faceplate RS232 and the rear RS485 port provides an easy to use human interface. 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 MIV 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.

***Software***

MIV units are supply together with M+PC software, a Windows® based software allowing communication with the relay for data view and retrieval, as well as oscillography, I/O configuration and logic.

## 2.9. MODEL LIST. ORDERING CODE

The MIV has a draw-out construction, 4U high and 1/8 of a 19" rack wide. The MIV relays can be mounted in 1/8 rack cases, one relay per case, or as an alternative they can be supplied in half or full 19'' rack cases, including several M family units (in an M+ System). Each M product is built as a stand alone draw-out module containing all functionally required elements such as CT/VTs, I/O, power supply, CPU etc. MIF, MIM, MIG and MIW products are built in 4'' wide modules, while MIV and MIR products are built in 2'' wide modules. These modules can be plugged into an M050 half 19'' rack case or an M100 full 19'' rack case. M050 cases can hold a maximum of 8'' in total module length (i.e. 2 MIV modules or 1 MIV and 2 MIV modules), while the M100 case can hold a maximum of 16'' in total module length (i.e. 4 MIFs, 2 MIV and 4 MIVs, or 8 MIV modules). A system comprised of several M family relays in the same case is called an M+ System.

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

**Table 2.1: - Ordering Guide**

| MIV | - | 0 | - | 0 | E | 0 | 0 | 0 | - | 0 | 0 | - | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | | | | | | | | | | | | Voltage functions |
| | **2** | | | | | | | | | | | | Frequency functions |
| | **3** | | | | | | | | | | | | Voltage and frequency functions |
| | | | | | | | | | | | | | **Voltage Range** |
| | | | **0** | | | | | | | | | | 10-250 V (all models) |
| | | | **1** | | | | | | | | | | 2-60 V (only MIV1000) |
| | | | | | | | | | | | | | **Auxiliary Voltage** |
| | | | | | | | | | **F** | | | | 24-48 Vdc |
| | | | | | | | | | **H** | | | | 110-250 Vdc 110-220 Vac |
| | | | | | | | | | | | | | **Mounting options** |
| | | | | | | | | | | | | **C** | Individual case |
| | | | | | | | | | | | | **S** | Mounted in an M+ system ** |

** If relays are to be mounted in an M+ system, then either an M050 half 19'' rack or M100 full 19'' must be ordered. The M050 and M100 racks are provided at no additional cost.

A depth reducing collar can be ordered to reduce the mounting depth of the unit in 2.48''.

## 2.10. TECHNICAL SPECIFICATIONS

**THE FOLLOWING TECHNICAL SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE**

### 2.10.1. PROTECTION UNITS

**PHASE OVERVOLTAGE (59P1, 59P2)**

| | |
|---|---|
| Voltage | Fundamental |
| Unit status | Active/inactive |
| Pickup level (range 0) | 10.00 - 250.00 V in steps of 0.1 V |
| Pickup level (range 1) | 2.00 - 60.00 V in steps of 0.1 V |
| Reset level | 97% to 98% of the pickup value |
| Accuracy | 1% at the rated value y 3% in the complete range |
| Timer | 0 - 600 s in steps of 0.01 s |
| Reset type | Instantaneous |
| Timers accuracy | ±3% of operation time or ±25 ms. (whichever is greater) |

**PHASE UNDERVOLTAGE (27P1, 27P2)**

| | |
|---|---|
| Voltage | Fundamental |
| Unit status | Active/inactive |
| Pickup level (range 0) | 10.00 - 250.00 V in steps of 0.1 V |
| Pickup level (range 1) | 2.00 - 60.00 V in steps of 0.1 V |
| Supervision by breaker position | YES/NO |
| Reset level | 97% to 98% of the pickup value |
| Accuracy | 1% at the rated value y 3% in the complete range |
| Timer | 0 - 600 s in steps of 0.01 s |
| Reset type | Instantaneous |
| Timers accuracy | ±3% of operation time or ±25 ms. (whichever is greater) |

**GROUND OVERVOLTAGE UNIT (59N1, 59N2)**

| | |
|---|---|
| Voltage | Fundamental |
| Unit status | Active/inactive |
| Pickup level (range 0) | 10.00 - 250.00 V in steps of 0.1 V |
| Pickup level (range 1) | 2.00 - 60.00 V in steps of 0.1 V |
| Reset level | 97% to 98% of the pickup value |
| Accuracy | 1% at the rated value y 3% in the complete range |
| Timer | 0 - 600 s in steps of 0.01 s |
| Reset type | Instantaneous |
| Timers accuracy | ±3% of operation time or ±25 ms. (whichever is greater) |

**VOLTAGE UNBALANCE UNIT (47)**

| | |
|---|---|
| Voltage | Fundamental |
| Unit status | Active/inactive |
| Pickup level | 2.00 - 60.00 V in steps of 0.1 V |
| Reset level | 97% to 98% of the pickup value |
| Accuracy | 1% at the rated value y 3% in the complete range |
| Timer | 0 - 600 s in steps of 0.01 s |
| Reset type | Instantaneous |
| Timers accuracy | ±3% of operation time or ±25 ms. (whichever is greater) |

**FREQUENCY UNITS (81_1, 81_2, 81_3, 81_4)**

| | |
|---|---|
| Unit type | Underfrequency/overfrequency |
| Frequency pickup level | 42.0 - 67.5 Hz in steps of 0.01 Hz. |
| Accuracy | ±10mHz |
| Timer | 0 - 600 s in steps of 0.01 s |
| Reset type | Instantaneous |
| Reset level | 40 mHz |
| Timers accuracy | ±3% of operation time or ±25 ms. (whichever is greater) |
| Supervision voltage | 30 - 250 V in steps of 0.1 V (range 10 - 250 V) |

## 2.10.2. MEASURING UNITS

**FUNDAMENTAL VOLTAGE**

| | |
|---|---|
| Accuracy | ±1% at the rated value y ±3% in the complete range |

**FREQUENCY**

| | |
|---|---|
| Accuracy | ±10 mHz |

## 2.10.3. INPUTS

**AC VOLTAGE**

| | |
|---|---|
| Secondary rated voltage: | 110/120 V ac |
| Frequency | 50/60 Hz |
| Consumption | < 0.2 VA @ Vn secondary |
| Maximum permissible voltage: | 440 Vac continuous |

**DIGITAL INPUTS**

| | |
|---|---|
| Voltage contacts | 300 Vdc maximum |
| Recognition time | <4 ms |

### 2.10.4. POWER SUPPLY

**LOW RANGE**

| | |
|---|---|
| DC Rated Voltage | 24 to 48 Vdc |
| Maximum/minimum DC Voltage | 19/60 Vdc |

**HIGH RANGE**

| | |
|---|---|
| Rated DC voltage | 110 to 250 Vdc |
| Maximum/minimum DC voltage | 88/300 Vdc |
| Rated AC voltage | 110 to 220 Vac @ 48-62 Hz |
| Maximum/minimum AC voltage | 88/264 Vac @ 48-62 Hz |
| Consumption | máx. 10W |
| Backup maintenance time (date, time, and events historic) without power supply | > 1 week |

### 2.10.5. OUTPUTS

**TRIP CONTACTS**

| | |
|---|---|
| Contact capacity | |
| Maximum operation voltage | 400 Vac |
| Continuous current: | 16 A |
| Make and Carry: | 30 A |
| Breaking capacity: | 4000 VA |

**OUTPUT RELAYS**

| | |
|---|---|
| Configuration: | 6 Electro-Mechanical Form C |
| Contact Material: | Silver alloy suited for inductive loads |

**Max. Ratings for 100.000 operations:**

| VOLTAGE | MAKE&CARRY CONTINUOUS | MAKE&CARRY 0.2 sec | BREAK | MAX LOAD |
|---|---|---|---|---|
| **DC Resistive** | | | | |
| 24 Vdc | 16 A | 48 A | 16 A | 384W |
| 48 Vdc | 16 A | 48 A | 2.6 A | 125W |
| 125 Vdc | 16 A | 48 A | 0.6 A | 75 W |
| 250 Vdc | 16 A | 48 A | 0.5 A | 125 W |
| **DC Inductive (L/R=40ms)** | | | | |
| 24 Vdc | 16 A | 48 A | 8 A | 192 W |
| 48 Vdc | 16 A | 48 A | 1.3 A | 62 W |
| 125 Vdc | 16 A | 48 A | 0.3 A | 37.5 W |
| 250 Vdc | 16 A | 48 A | 0.25 A | 62.5 W |
| **AC Resistive** | | | | |
| 120 Vac | 16 A | 48 A | 16 A | 1920 VA |
| 250 Vac | 16 A | 48 A | 16 A | 4000 VA |
| **AC Inductive PF = 0.4** | | | | |
| 120 Vac | 16 A | 48 A | 11.2 A | 1344 VA |
| 250 Vac | 16 A | 48 A | 11.2 A | 2800 VA |

### 2.10.6. COMMUNICATIONS

| | | |
|---|---|---|
| **FACEPLATE 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 |

### 2.10.7. ENVIRONMENTAL CONDITIONS

**Operating Temperatures:** -20º C to +60º C
**Ambient Storage Temperatures:** -40º C to +80º C

### 2.10.8. STANDARDS

The **MIV** 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.

| 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 | II |
| **Shock:** | IEC 60255-21-2 | I |

### 2.10.9. PRODUCTION TESTS

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

### 2.10.10. APPROVALS

- Manufactured under an ISO9001Registered system.
- CE Marking.

# 3. HARDWARE

## 3.1. DESCRIPTION

### 3.1.1. RELAY IDENTIFICATION

The complete model number of the relay is shown on the faceplate. Figure 3.1 shows the faceplate of the relay.


**FIGURE 3.1. FACEPLATE AND IDENTIFICATION OF MIV RELAY**

### 3.1.2. PANEL CUTOUT

The MIV case is made from **corrosion resistant stainless steel**. Case dimensions, along with panel cutout details for panel mounting are shown in figure 3.2.

The modular design allows the relay to be easily upgraded or repaired by a qualified person.

The relay is provided with a plastic lid that fits over the faceplate, sealing the relay hermetically, avoiding dust coming into the relay.

The relay must be mounted such that the faceplate sits semi-flush with the panel or switchgear door, allowing the operator access to the keypad and the RS232 communications port. The relay is secured to the panel with the use of four screws supplied with the relay.

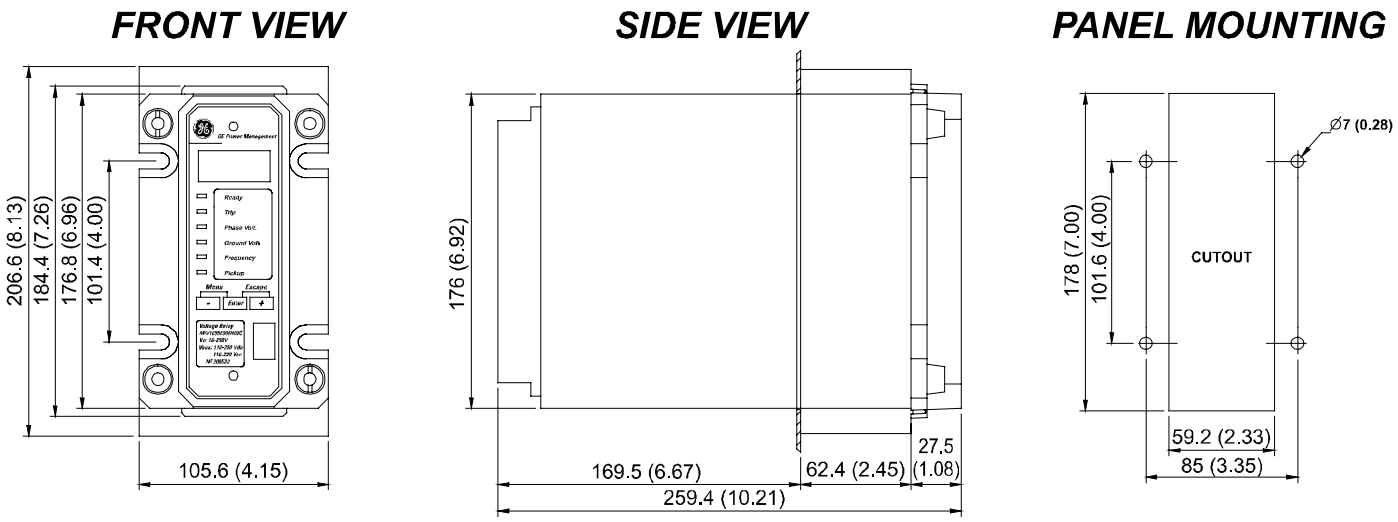



**FIGURE 3-2A. MOUNTING AND DIMENSIONS DRAWING FOR MIV MODELS WITH DEPTH REDUCING COLLAR**

***Note**: Dimensions are shown in mm, and in inches between parenthesis.*

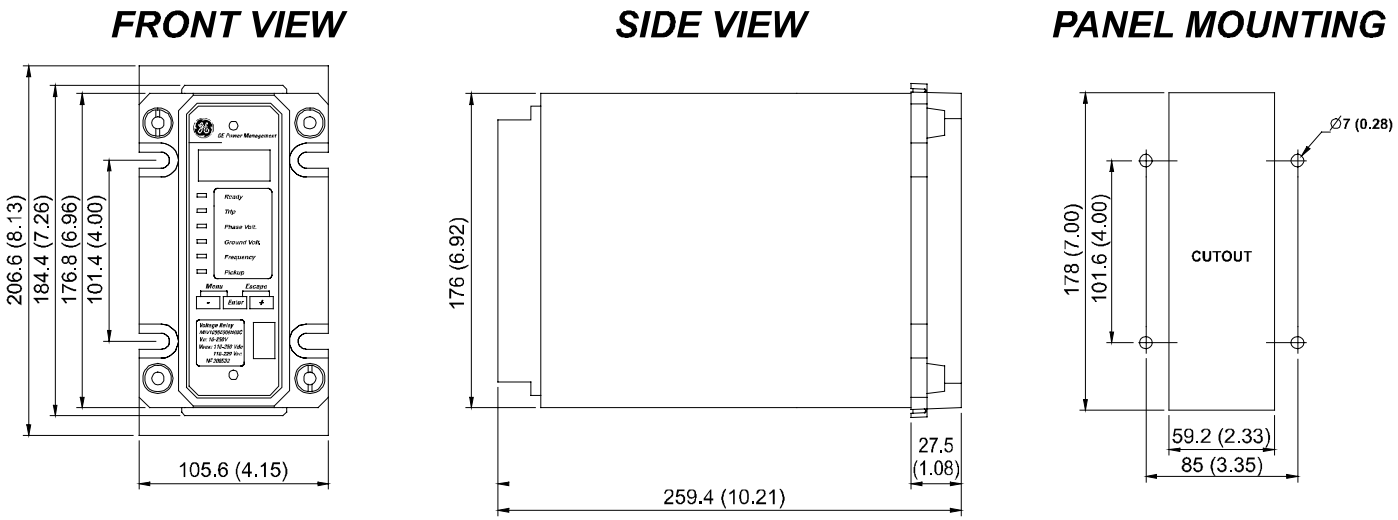



**FIGURE 3-2B. MOUNTING AND DIMENSIONS DRAWING FOR MIV MODELS WITHOUT DEPTH REDUCING COLLAR**

### 3.1.3. MODULE WITHDRAWAL / INSERTION

**WARNING: MODULE WITHDRAWAL AND INSERTION MAY ONLY BE PERFORMED WHEN CONTROL POWER HAS BEEN REMOVED FROM THE UNIT.**

The modular design of the relay allows for the withdrawal and insertion of the module.

**WITHDRAWAL**: Remove the methacrylate cover on the faceplate, loosing the four screws located on the four corners of the cover. Then loose the small screws that keep the faceplate in place and pull from the knobs located on the upper and lower side of the faceplate. Before performing this action **control power must be removed from the relay**. Current inputs are automatically shorted back in the terminal block when the module is withdrawn.

**INSERTION:** Proceed inversely to the withdrawal procedure. Press the module firmly in the case, using the knobs, until it is completely inserted. Once this is done, bolt the screws of the faceplate and replace the control power. Check if the relay is fully operative. Finally, replace the methacrylate cover.

### 3.1.4. WIRING AND INTERNAL CONNECTIONS

The electrical connection with the substation AC/DC wires is done on both terminal blocks, at the rear part of the relay case. Each terminal block has 12 terminals (M3, 3 mm diameter).

### 3.1.5. REAR TERMINAL ASSIGNMENTS

The terminal blocks are identified by a letter located in the upper part, beside the terminal block. There are two terminal blocks, and have been assigned the letters A and B respectively, in order to avoid confusions while wiring external cables.

For each terminal block, the wiring screws (1 to 12) have been labelled with their corresponding number.

Figure 3-3 shows the location and identification of the terminals blocks at the rear of the MIV relay.

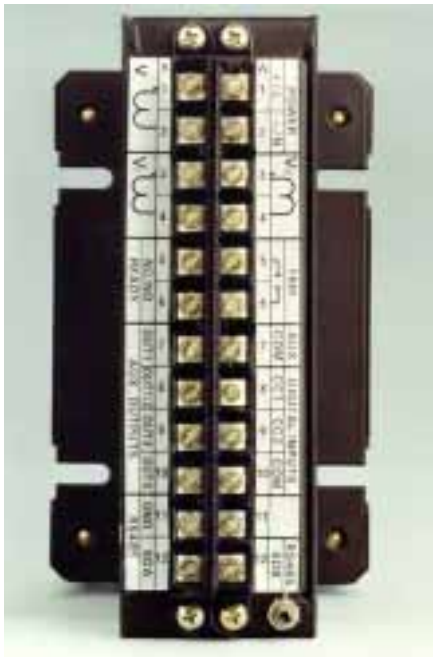


**FIGURE 3-3 MIV RELAY REAR VIEW**

## 3.2. WIRING AND EXTERNAL CONNECTIONS

### 3.2.1. TYPICAL WIRING DIAGRAM

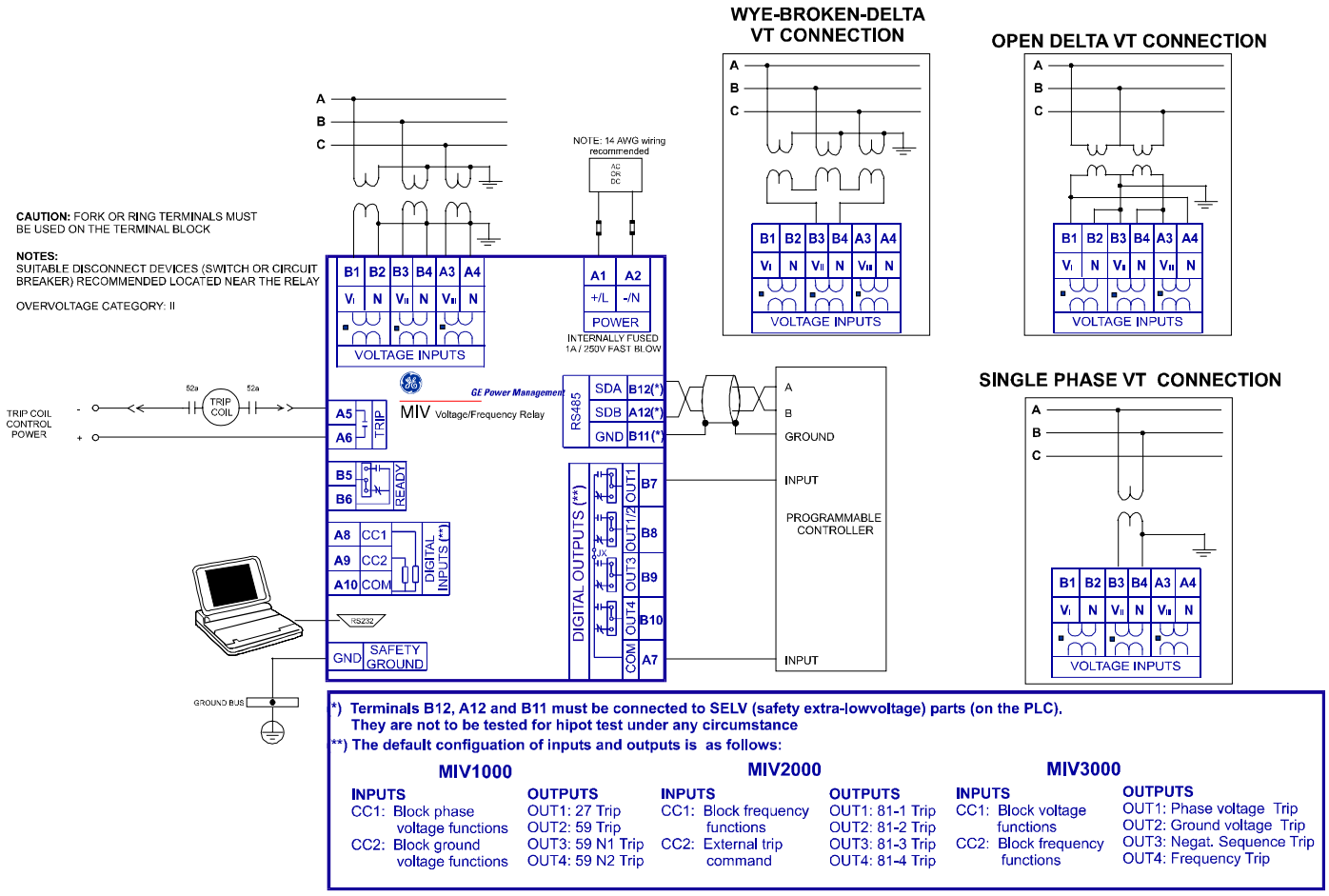



**FIGURE 3-4 TYPICAL WIRING DIAGRAM FOR MIV RELAY**

**Table 3-1: Input values according to the type of connection**

| VOLTAGE INPUT | $V_I$ | $V_{II}$ | $V_{III}$ |
|---|---|---|---|
| 3PG WYE | $V_A$ | $V_B$ | $V_C$ |
| 3P DELTA | $V_{AB}$ | $V_{BC}$ | $V_{CA}$ |
| SINGLE PHASE | | $V_{AB}$ (e.g.) | |
| GROUND | | $V_N$ | |

### 3.2.2. POWER SUPPLY

**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 | Rated Voltage |
|---|---|
| F | 24/48 Vdc |
| H | 110/250 Vdc<br>110/220 Vac |

### 3.2.3. VOLTAGE TRANSFORMER INPUTS

Each AC voltage input has an isolation transformer. Voltage inputs have no internal grounding connections. 110/120 rated Vac secondary voltage transformers can be used.

The VT wye connections are identical independently from the phase sequence rotation ABC or ACB. The same happens in the case of a delta connection. In this last case, Ground Overvoltage (59N) and Voltage Unbalance (47) units will be disabled.

### 3.2.4. DIGITAL INPUTS AND OUTPUTS

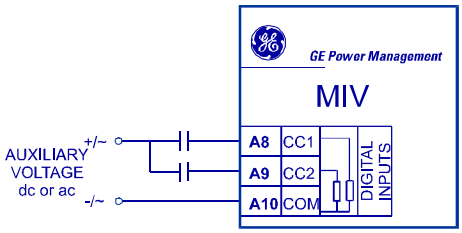
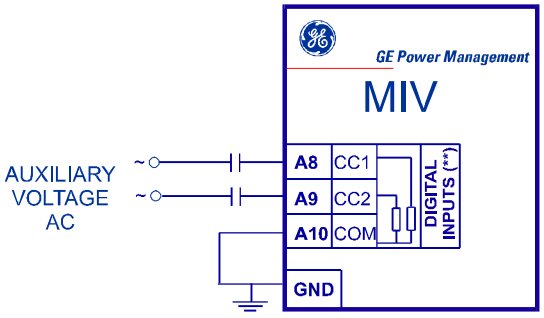



**FIGURE 3-6 CONTACT INPUTS CONNECTIONS**

The MIV relay works with 'wet contacts'. 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.

In case of using AC voltage, it must be ensured that there is no appreciable 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.



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

### 3.2.5. OUTPUT CONTACTS CONFIGURATION

All output relays are form C relays. For each output relay it is possible to select which state is preferred to have at the MIV terminals, NC (normally closed) or NO (normally open).

Figure 3-7 shows the PCB of a MIV relay, and the location of the jumpers used to select the configuration of each output contact (NO or NC).

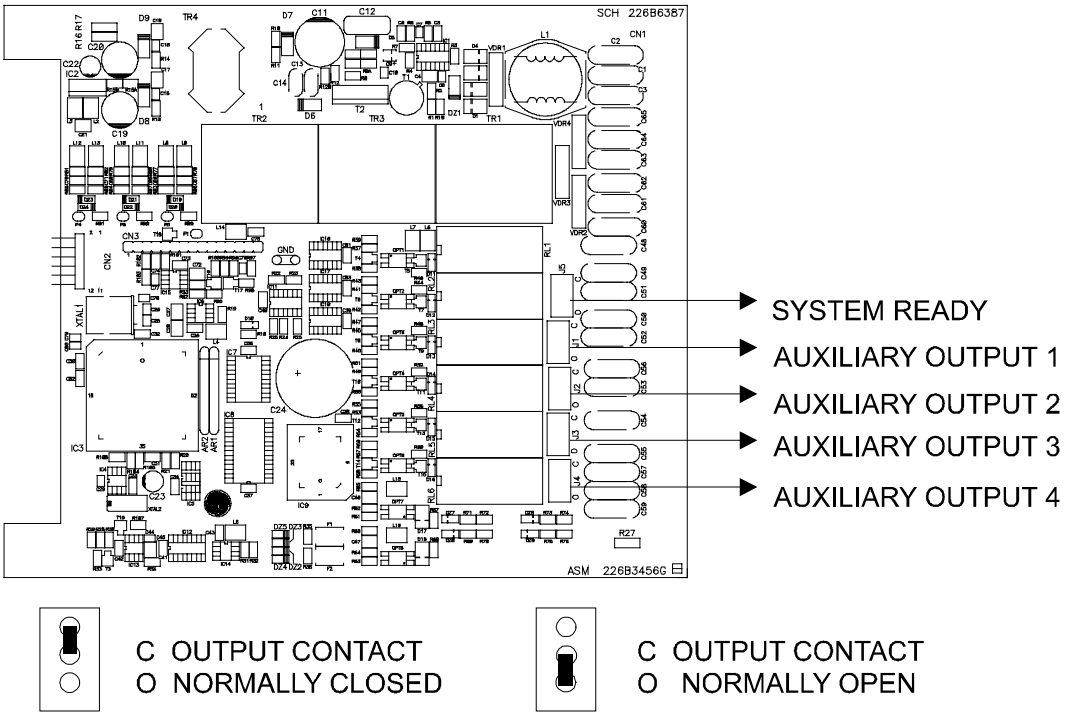
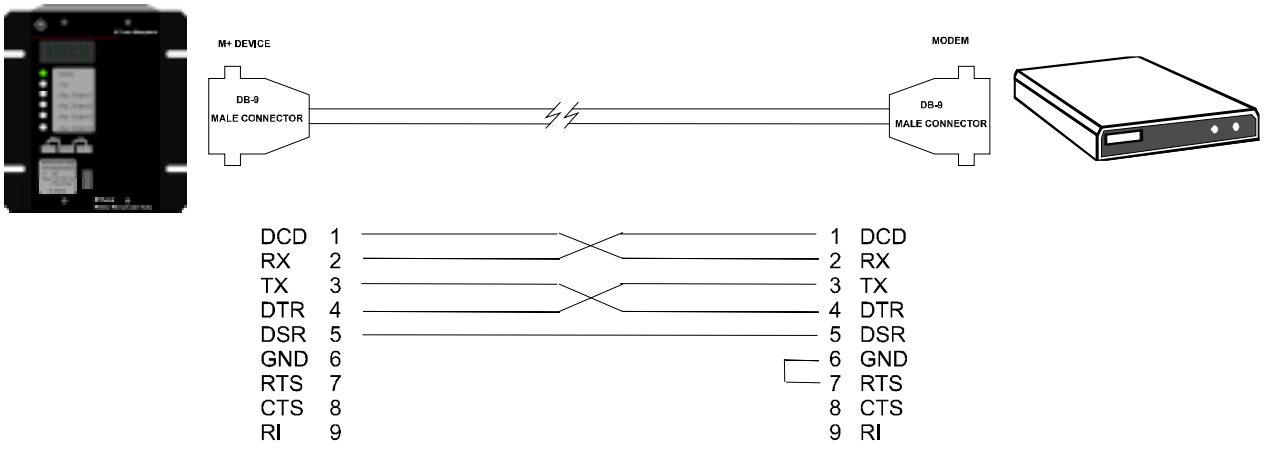


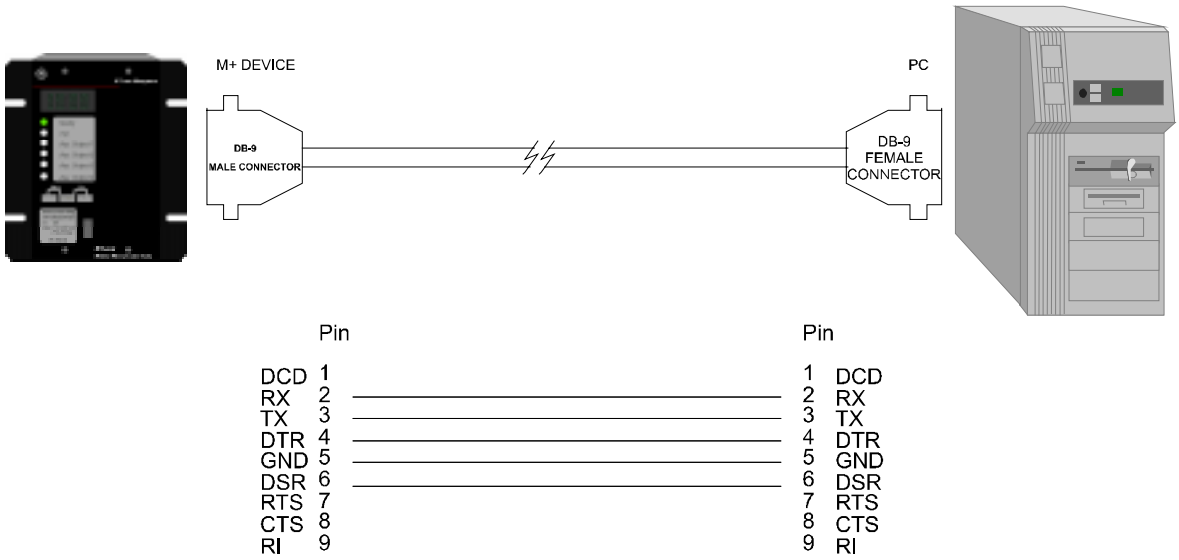

**FIGURE 3-7 PCB SCHEME SHOWING THE JUMPERS TO CONFIGURE THE OUTPUT CONTACTS (NC / NO)**

### 3.2.6. RS232 FACEPLATE COMMUNICATIONS PORT

A 9-pin RS232C serial port is located on the relay's faceplate for programming with a portable (personal) computer. All that is required to use this interface is a personal computer running the M+PC software. Figure 3-8 shows the communications cable configuration.




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




RELAY - PC CONNECTION WIRE FOR RS-232 FRONT PORT

**FIGURE 3-8 RS232 FACEPLATE PORT CONNECTION**

In addition to the RS232 port on the faceplate, the relay provides the user with an additional RS485 communication port. RS485 data transmission and reception are accomplished over a single twisted pair with 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. Correct polarity must also be observed. For instance, the relays must be connected with all RS485 SDA terminals connected together, and all SDB terminals connected together. The COM terminal should be connected to the common wire inside the shield, when provided. 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 configuration 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 internally provided. To ensure maximum reliability, all equipment should have similar transient protection devices installed.

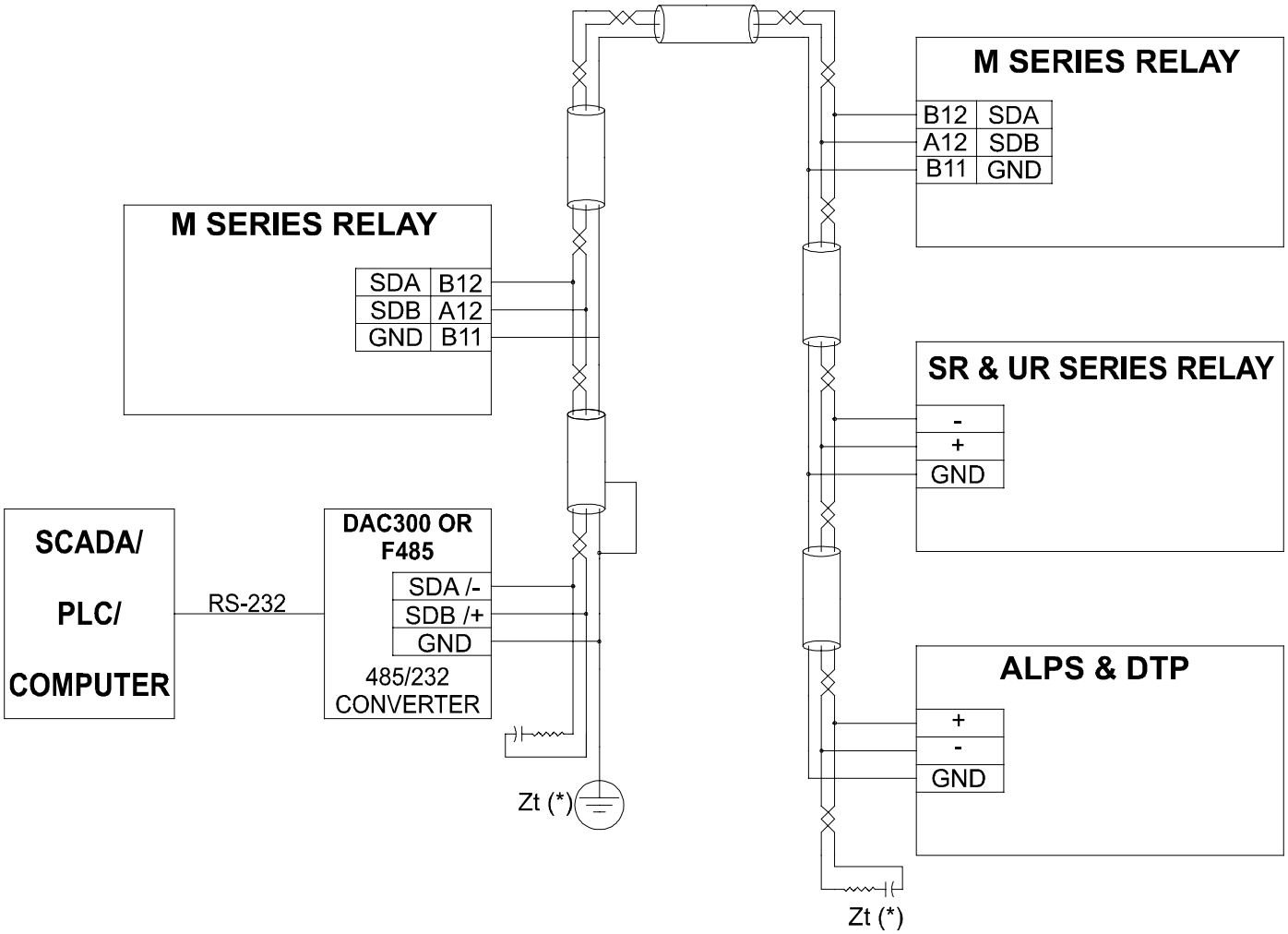



**FIGURE 3-9 RS485 SERIAL CONNECTION**

# 4. HUMAN-MACHINE INTERFACE

## 4.1. M+PC SOFTWARE INTERFACE

The M+PC software provides a graphical user interface (GUI) as one of two human interfaces to a M Family relay. The alternate human interface is implemented via the device's faceplate keypad and display. The M+PC software interface can be used while disconnected (i.e. off-line or simulation mode) or connected (i.e. on-line) to a MIV relay, locally or remotely, using a modem and the telephone line. In off-line mode, you can prepare a file of the device's parameter settings for eventual downloading to the device. Another application of the off-line mode is personal training on the relay. In on-line mode, you can communicate with the device in real-time, access to all the information in the device, modify settings, retrieve registered data and perform commands.

The M+PC software can be run from any computer supporting Microsoft® Windows 95®, 98® or NT® (Service Pack 3.0 or higher) and the latest version can be downloaded from the GE Power Management Internet site http://www.GEindustrial.com/pm. This chapter provides a brief description of the M+PC software interface use. The M+PC Help menu provides this same information on-line.

### 4.1.1. STARTING THE PROGRAM

To start the M+PC software program double click on the program icon (if a direct access has been created) or select the program from the **Start** Windows® menu. Once started, the following **Login** window will appear:

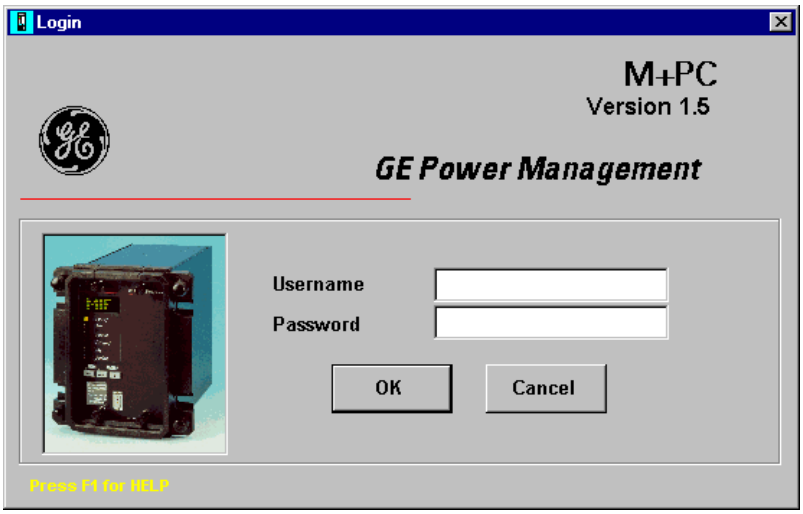



**FIGURE 4.1: STARTING THE PROGRAM**

The User Name and Password must be entered in this window. This data must be properly entered to access the program functions, both for the off-line and on-line operation modes. The factory default values for this fields are: **Username**: none (leave the box empty); **Password**: **7169** (it corresponds with the ASCII codes for 'G' 'E'). Users management (add, modify or eliminate users) must be done by a user with a Management access level (user type: 1). This is done using the **Users** option within the Main Menu.

### 4.1.2. START WINDOW

Once the correct Username and Password have been entered and the **OK** button clicked, the Start Window will appear. In this window, the desired operation mode must be selected: 'on-line', this is relay connection, or 'off-line', for simulation mode.

M+PC software uses the same structure for all its windows. This structure is shown in the following figure. There are three different ways to access the M+PC functions: clicking on the desired item on the upper menu bar (pop-up windows); clicking on the icons located on the tool-bar, just below the menu bar (a small help window appears when the mouse pointer is on any icon); clicking on different function buttons that appear on the central part of the window.

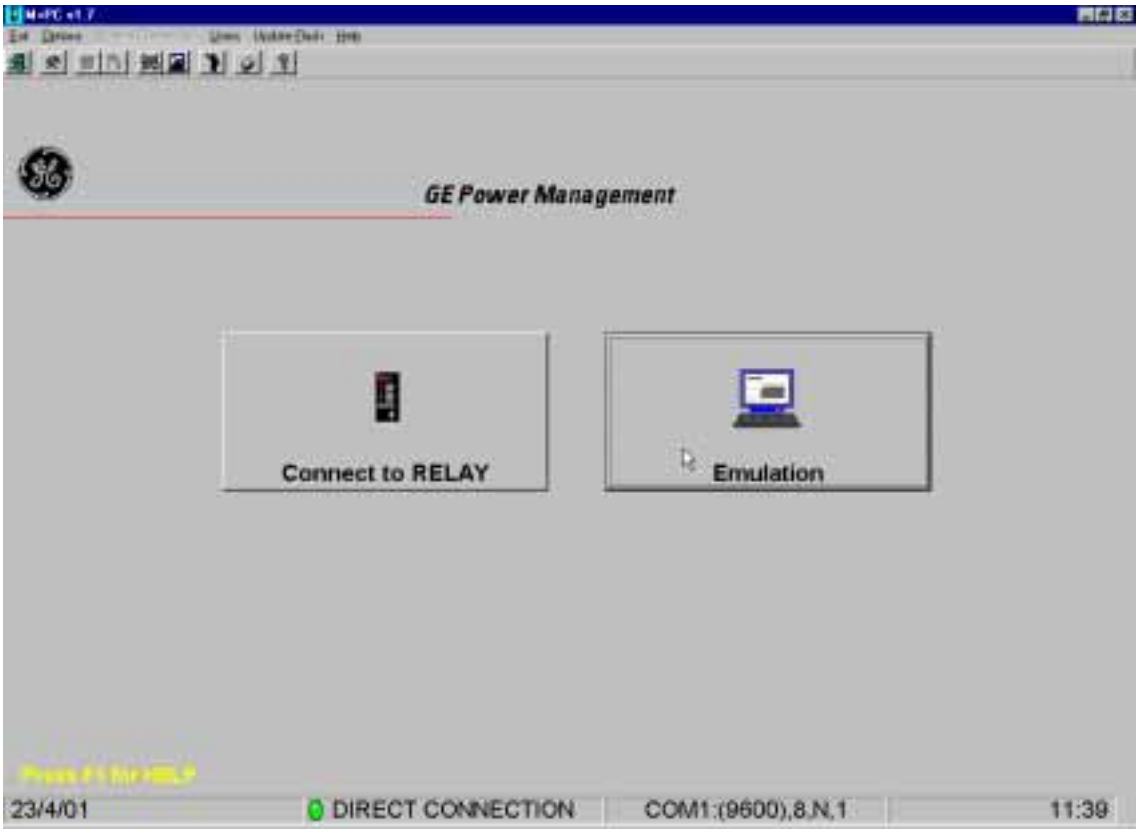



**FIGURE 4.2: START WINDOW**

Clicking on the function buttons "**Relay Connection**" and "**Emulation**", the corresponding operation mode is selected, "on-line" and "off-line" respectively. For the "**Emulation"** operation mode, the access is immediate, whilst for the "**Relay Connection**", the communications parameters must be properly set. These parameters are shown in the lower bar of the window.

For example, COM 1: (9600), 8, N, 1 stands for:

| | | |
|---|---|---|
| **COM 1** | **:** | PC Communications port number 1. |
| **9600** | **:** | Communications speed = 9600 bauds. |
| **8** | **:** | Number of Data bits = 8 |
| **N** | **:** | No Parity. |
| **1** | **:** | Number of Stop Bits = 1. |

These parameters can be modified in the **Options** menu (or clicking on the corresponding icon on the tool bar).

The EMULATION mode allows to simulate the connection to a particular relay even if the physical relay is not available. This mode allows the user to:

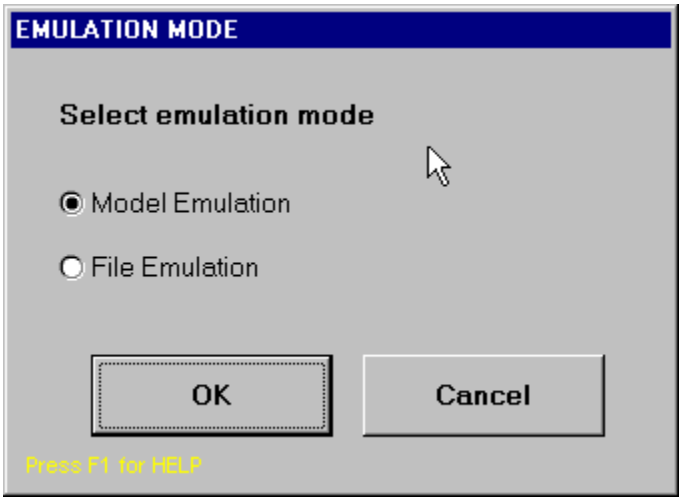
* View status, settings, and protection units incorporated in the selected relay unit.
* Create settings files for a quick configuration of the relay once it is connected to the PC.
* Besides, it can be used to program a relay with options retrieved from another unit.

The emulation mode is selected from the M+PC Start window:

There are two kinds of emulation available:

Model Emulation.

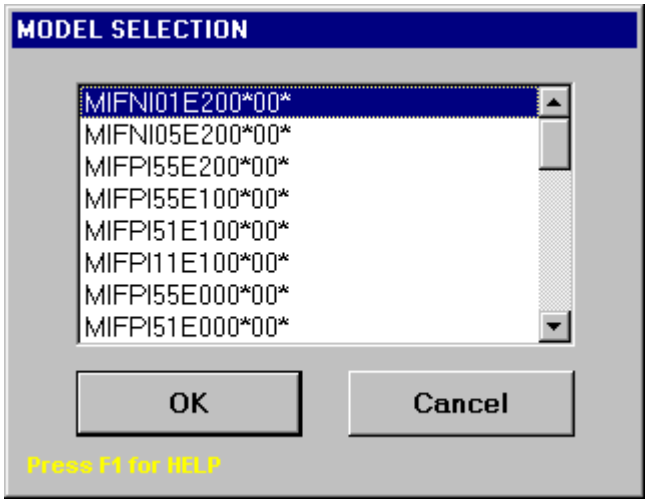
File Emulation.



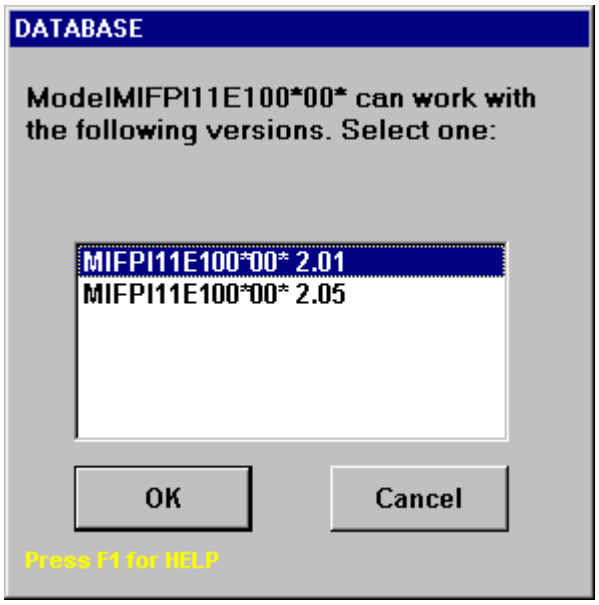

The following sections detail the operation of each model:

#### *4.1.3.1. MODEL EMULATION.*

If the Model Emulation is selected, the program will display a menu with all M Family models available for emulation. The required information for emulating a model is contained in the file M+PC.MOD. If you cannot find the desired relay model, please contact GE Power Management.



If there is more than one firmware version for the same model, the system will display a list of options, so that the user can select the desired version




#### *4.1.3.2. FILE EMULATION.*

M+PC offers also the option to emulate a file. The available files can be selected among the different files created in the M+PC while connected to a relay, as follows:

**Settings Files**: These files are saved from the FILE option in the M+PC main window. The file will include information about the model, as well as all the settings stored in the relay, that is, the memory map.

**Oscillography Files**: These files are created when retrieving oscillography. The file will include the relay model, the relay settings, and the oscillography information.

**Event Files**: These files can be saved while connected to a relay. The file includes the relay model, the relay settings (memory map) and the events present in the relay.

### 4.1.4. OPTIONS MENU

The Options Menu opens a window with four tabs, each of which contains forms that allow modifying the communications parameters, modem configuration, language selection for M+PC and enabling the “debug” option.

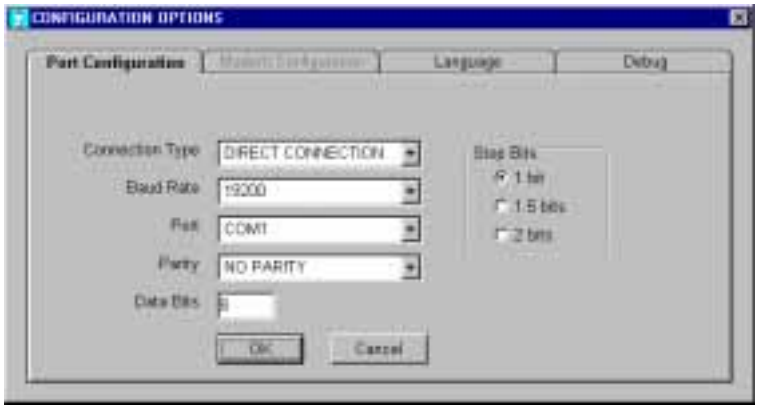



**Figure 4.3: OPTIONS MENU – PORT CONFIGURATION TAB.**

- “**Port Configuration**” tab allows modifying the communications parameters. These parameters, as mentioned before, are: connection type (direct connection or modem), baudrate, computer port to be used, parity, number of data bits and number of stop bits.


**Figure 4.4: OPTIONS MENU - MODEM CONFIGURATION TAB**

- “**Modem Configuration**” is accessible if the connection type selected in the “**Port Configuration**” is ‘**Modem’**. If the connection type is ‘**Direct Connection**’, this tab is inactive and cannot be accessed. The parameters to be configured in this tab are: Modem Type: Hayes compatible or V.25; Telephone number to dial; Modem Initialization String; Waiting Time; Dialling Mode: Pulse or Tones.


**Figure 4.5: OPTIONS MENU - LANGUAGE TAB**

- This window allows to choose the language that will be used by M+PC. This choice is recorder in the configuration file of the M+PC program, so your language selection will be used next times you run the program.

- Finally, the **Debug** Tab allows to monitor all the communication messages being sent between the MIV and the computer, to analyze the communications network.

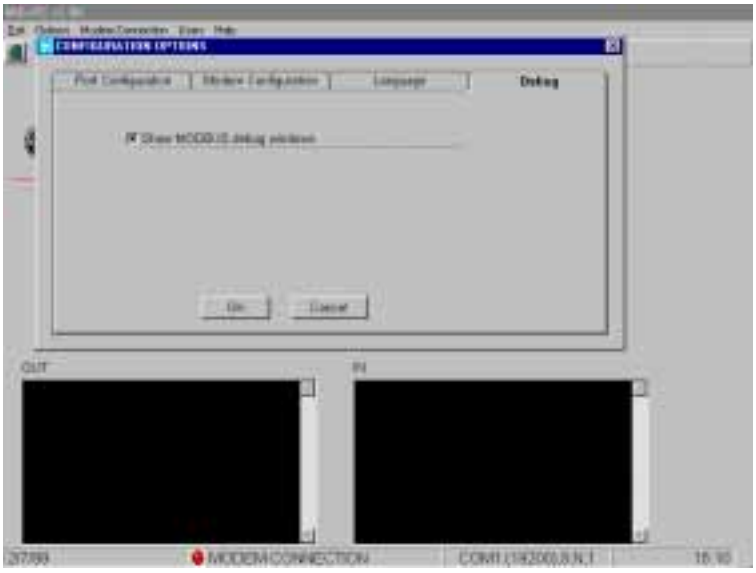



**Figure 4.6: OPTIONS MENU - DEBUG TAB**

Once the Options Menu has been checked, you can proceed to “Relay Connection”, directly or through a modem.

In general, the off-line (Emulation) mode and the on-line (Relay Connection) mode are almost identical, so the most complete one (Relay Connection) will be described. The only differences for the Emulation mode are that the access is immediate, without checking the relay model identification, and that the operation in this mode is obviously limited to file management. In the Emulation mode it is not possible to perform operations that require data retrieving from a relay.

### 4.1.5. USERS MANAGEMENT MENU

This menu allows adding new users to the M+PC program, with the corresponding passwords and accessing levels.

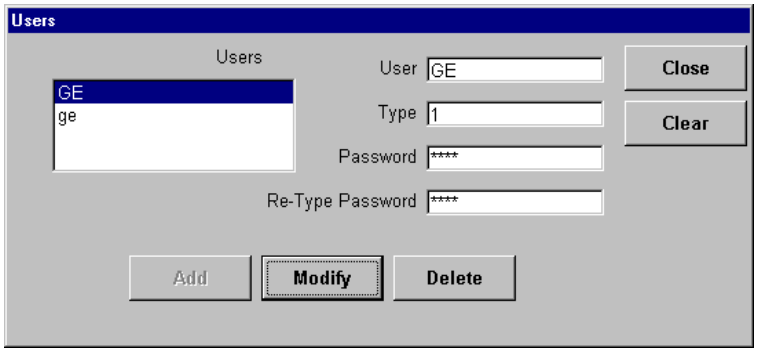



**Figure 4.7: USERS MANAGEMENT.**

In this Users Management window, the program manager can add, eliminate or modify user names, passwords and access levels:

**MODIFY:** To modify a user's properties, first it must be selected from the users list and then the information associated to that user can be changed. Clicking on the MODIFY PROPERTIES button, all the changes will be stored. If the password is being changed, it must be entered twice, to ensure it has been properly entered.

**ADD:** To empty the properties in a window click on the clear button, or enter in the user box the name of the new user. The first property is User Type. This must be entered as a number as follows:

1. **Program/Users Manager. Allows modifying Users properties.**
2. **Normal/Regular User. For this type of user, the access levels are defined by the Program/Users Manager.**

The password must be entered twice, to avoid misspelling. While the password is being entered, the password characters are not displayed in the screen and are substituted by the "*" character. The password can be left blank (empty box), in this case it is not necessary to repeat it. When the Add button is clicked, the new user properties are stored.

**DELETE:** To Delete a User it is necessary to select it from the users list and then click on Eliminate. The User identified by the Username GE or Users Manager, cannot be eliminated, though it is possible to modify its password.

### 4.1.6. FLASH MEMORY UPDATE

In the START WINDOW (figure 4.2), we click on the “Flash Update” option to start the Flash Memory Update program.

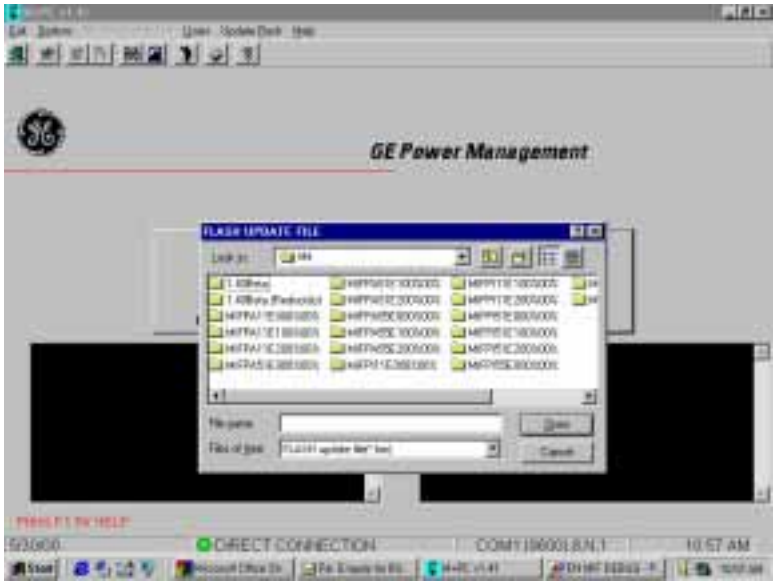



**Figure 4.8. FLASH MEMORY UPDATE**

Here, we select the name of the file we will use to update the FLASH memory, and the following screen will be displayed, showing details of the old model and the new model:


If we are trying to update to a model option with higher functionality, the program will request a password. This password can be obtained by placing an order to GE Power Management. In the order, the following three parameters must be clearly indicated:

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

In case there are several units to be updated, all the serial numbers shall be indicated, and a different password will be assigned for each unit.

If the update does not intend to change the functionality of the relay, but only the firmware revision, the program will not request a password.

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

Finally, when the process has been completed, we will see the following screen:

We must take into account that the Flash memory update may involve a change in the MODBUS memory map, although this does not necessarily involve an update to a higher functionality model. This may result a critical issue when the relay is integrated in a system, and the user must take into account the modifications that are to be performed in the memory map access programs for MIV relays.

**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.

### 4.1.7. DEVICE IDENTIFICATION WINDOW

Once the “Relay Connection” button has been clicked, a Device Identification window appears, needed to identify the relay the computer must access to communicate with:

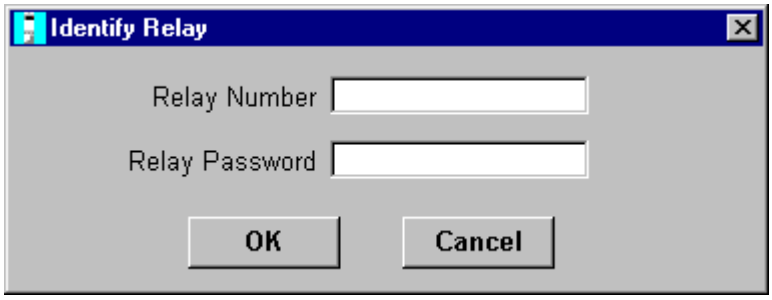



**Figure 4.9: DEVICE IDENTIFICATION WINDOW**

The parameters in this window are: **Relay Number** and **Relay Password**. The **Relay Number** is a device number in between 1 and 255. This number (like an address) must match the Relay Number entered in the relay itself (which can only be modified using the relay keypad). The **Relay Password** must match the password entered in the relay itself, (which can only e modified using the relay keypad) to have access to operations and settings change. If the user does not know the relay password, or enters a wrong password, the connection between the computer and the relay will be established, but the access level will be ‘*monitoring*’; this means that the user will not be able to perform any settings change or operation. The relay password can only be changed on the relay itself, using the relay keypad. **The factory default parameters are Relay Number = 1; Relay Password = 1.**

Once these parameters have been entered and the **OK** button clicked, the computer will try to establish communication with the relay.

### 4.1.8. M+PC MAIN WINDOW

Once the communication has been established between computer and relay, the Main Window of the M+PC program appears. The structure of the window, from which all functions of an M-family relay can be accessed, is maintained through the entire program.

The main window comprises the following three working zones:

- Pop-up windows and icons, as explained for the Start window.
- Graphic Information windows. There are two windows/tabs available, called FRONT VIEW and REAR VIEW, containing graphical information on the device. By default, the program will display the FRONT VIEW tab, showing a front view of the device and the most important information (refreshed on-line) of the relay. In the example, for a MIV Voltage and Frequency protection relay, the device information shown is:

- Voltage-frequency measures, negative sequence voltage (depending on relay model).
- LED status.
- Digital inputs/outputs status (active status shown in red, inactive shown in green)
- Relay date and time.

Clicking on the REAR VIEW tab you access to the second graphic information window. The default information in REAR VIEW displays the rear terminals of the relay properly labelled, which can be useful for wiring the device. Once this tab has been selected, its information will be shown until you click on the FRONT VIEW tab.

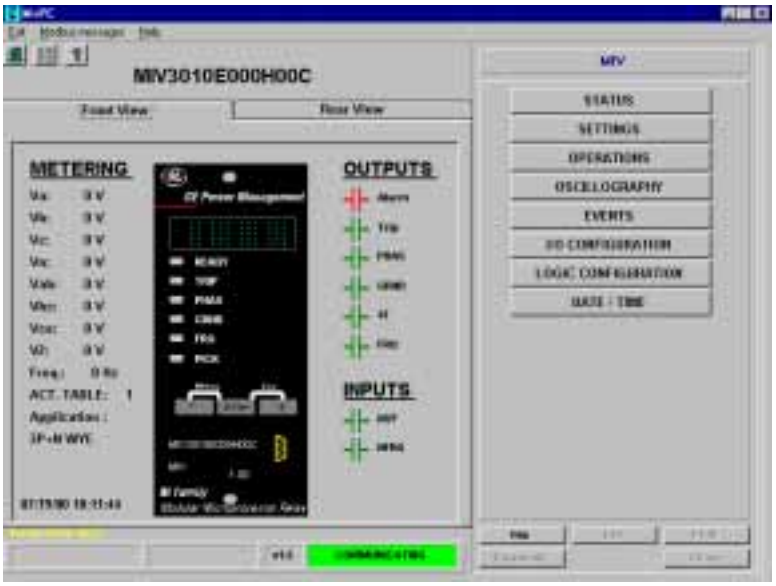



**FIGURE 4.10 MAIN MENU (FRONT VIEW)**

The Status bar, on the lower part of the window shows the operation mode (Relay Connection or Emulation). It also shows the name of the settings file open (if any) and the software version. For those processes that require retrieving big pieces of information from the relay and take long communication time, a percentage bar is shown to let the user follow it up.

On the right hand side of the window there is a set of buttons that allow access to all the information in the relay. Clicking on any of these buttons, a new sub-set of buttons, associated to the button clicked, will be shown. A complete description of all these set and sub-set of buttons is given in following sections in this instruction manual.

In the lower right hand side, there is a different set of buttons. Depending on the set of buttons shown above, some or all buttons in the lower part will be available. Only the ones that can be accessed at a given time are active. The buttons available in the lower right part are:

- **File**: Allows the use of files, for those functions (i.e. settings management) that may need them.
- **Send**: To send a group of settings or all the relay settings to the device.
- **Edit**: To edit individual settings.
- **Print**: Allows to print the settings values associated to a menu.
- **Close**: Closes the active menu and returns to the previous one.


**FIGURE 4.11: MAIN MENU (REAR VIEW)**

### 4.1.9. RELAY STATUS MENU

Clicking on the Status button you access the Relay Status Menu. In this menu a table showing internal relay information, as functions status and measurements is shown. There is a vertical scrolling bar to move this table up and down, to reach the information needed:

- Relay model number and firmware version.
- Relay Date and Time.
- Measured values
- Protection functions status (Pickup / Trip for each function).
- Active Settings table number.
- Contact Inputs and Outputs status, and Target LEDs status.
- Information from the self-testing functions of the device.

| | |
|---|---|
| Model | MIV3010E000H00C |
| Version | 1.00 |
| Date/Time | 07/19/00 17:32:51 |
| Identification | MIV |
| Va | 0 V |
| Vb | 0 V |
| Vc | 0 V |
| Vn | 0 V |
| Vab | 0 V |
| Vbc | 0 V |
| Vca | 0 V |
| V2 | 0 V |
| Frequency | 0 Hz |
| OSC. NUMBER | 2 |
| All events | 45 |
| ACTIVE TABLE | 1 |
| Frequency | 50 Hz |
| 27_1A Pickup | |
| 27_1B Pickup | |
| 27_1C Pickup | |
| 27_2A Pickup | |
| 27_2B Pickup | |
| 27_2C Pickup | |
| 59_1A Pickup | |
| 59_1B Pickup | |
| 59_1C Pickup | |
| 59N1 Pickup | |

**FIGURE 4.12: STATUS SCREEN**

### 4.1.10. SETTINGS MENU

Clicking on the **Settings** button, you access the **Settings Menu**. At a first step, you access the same sub-menu for all M family relays, that shows all relay settings divided in two groups: **Main Settings** and **Advanced Setting**. The first group comprises the basic settings (main protection functions) needed to use the relay, whilst the second group includes more advanced settings (double settings table, customized curves, etc.), only needed if more complex protection schemes are required.

The objective of this division is to make as easy as possible the use of the relay for those users that just require the basic functionality of the M family relay.

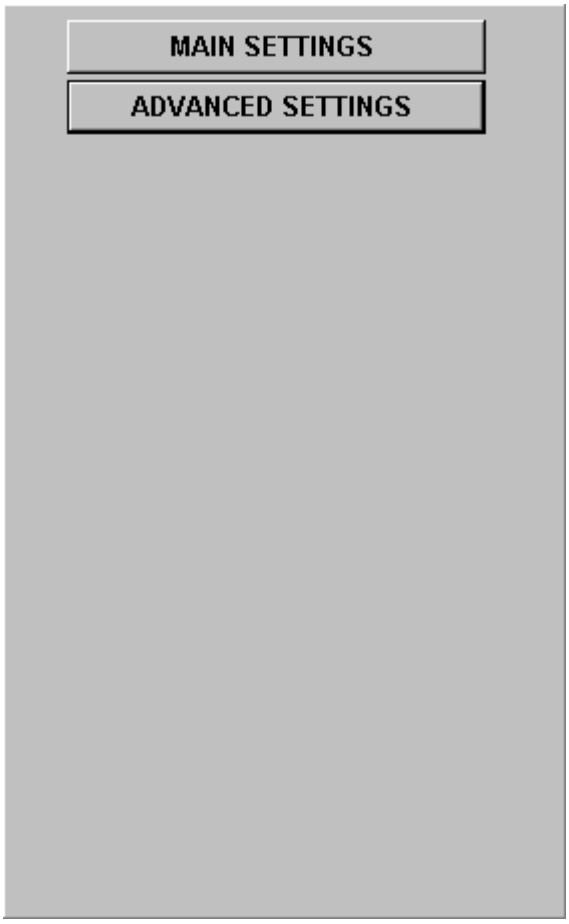



**FIGURE 4.13: SETTINGS MENU**

Clicking on any of these buttons, **Main Settings** or **Advanced Settings**, you access the corresponding sub-menu:

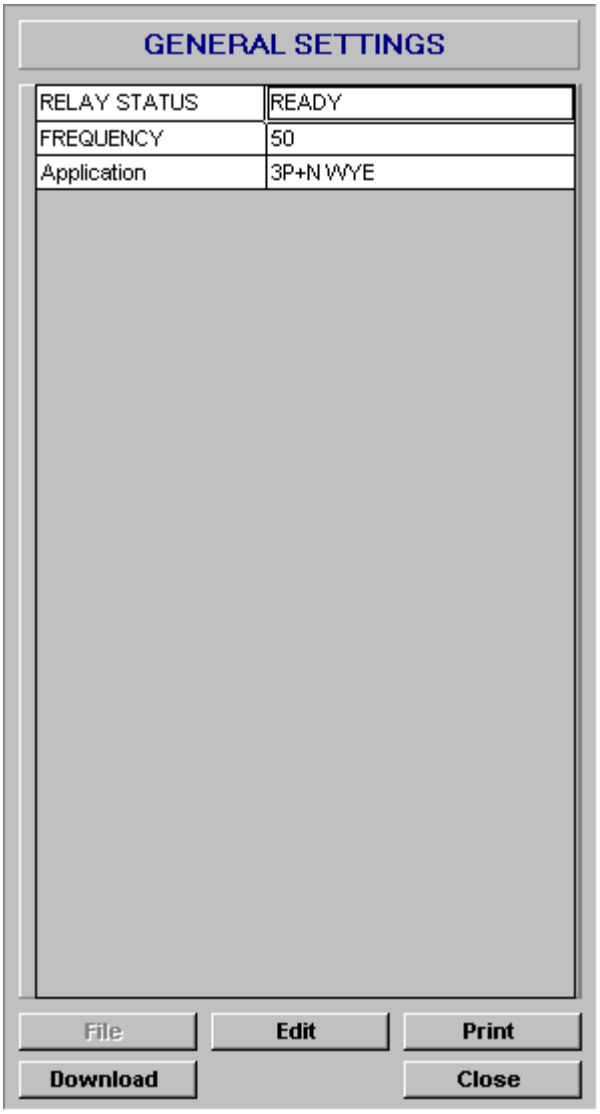



**FIGURE 4.14: GENERAL SETTINGS.**

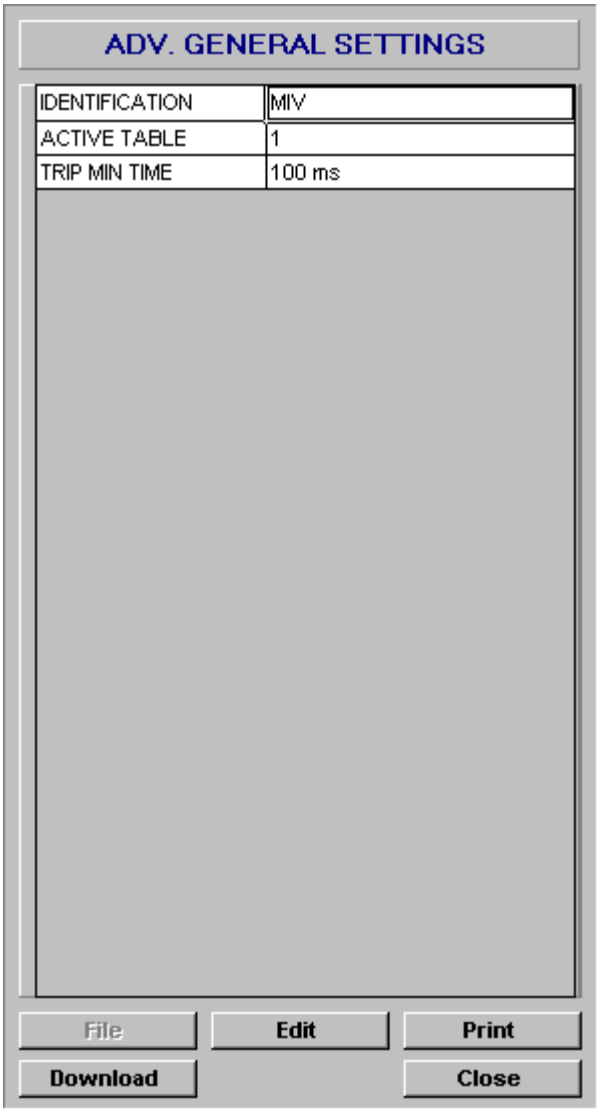



**FIGURE 4.15: ADVANCED SETTINGS.**

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 (in the example, the 59P Function in a MIV Voltage/Frequency Protection relay has been selected)
- Edit the setting double-clicking on it.
- Modify the value of the setting (see figure 4.16 to 4.18).
- Confirm/Accept the modified value.
- Send the settings to the relay (or save them on a file, if working in Emulation mode, to send the settings later on).

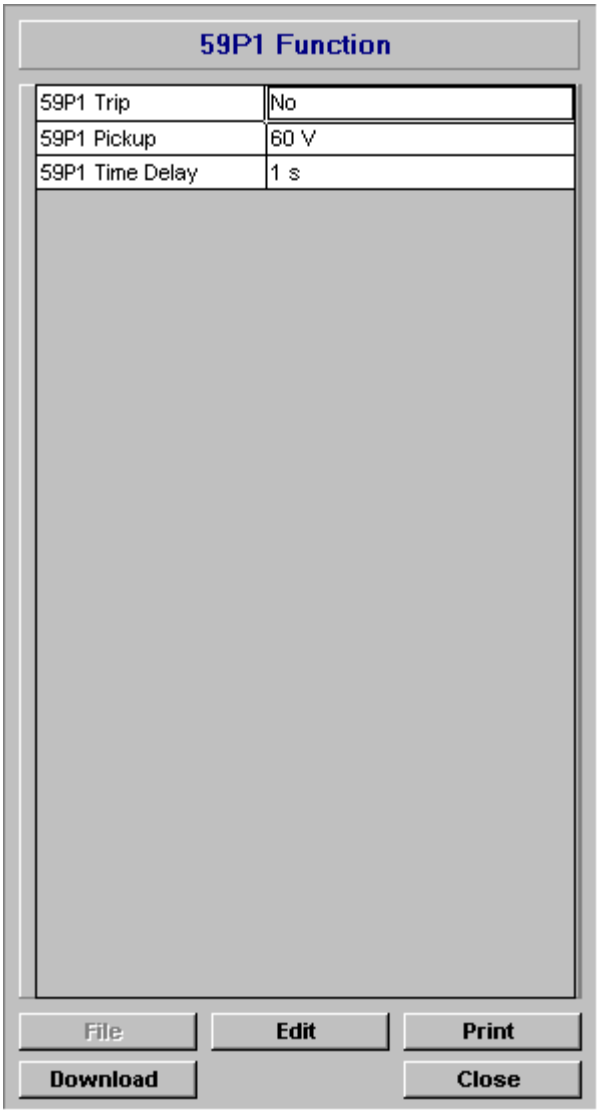



**FIGURE 4.16: 59P UNIT SETTINGS**

Mainly, there are four different setting formats:

- **Boolean/Logic Settings (only two choices)**. For this type of setting, the two possible options are shown for the user to select which one is the appropriate, clicking with the mouse on the option desired.

- **Numerical Settings**. For this type of setting, a number must be entered. The program shows the minimum and maximum value for each setting, and any value out of the corresponding range will not be accepted by the program.

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

- **Text Setting:** A text box is shown.

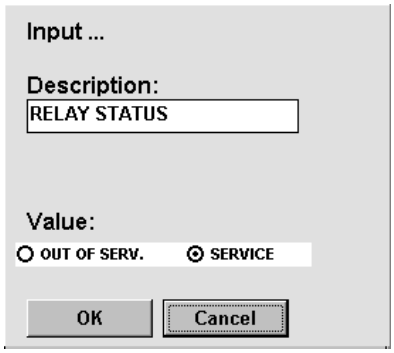



FIGURE 4.17: LOGIC SETTING

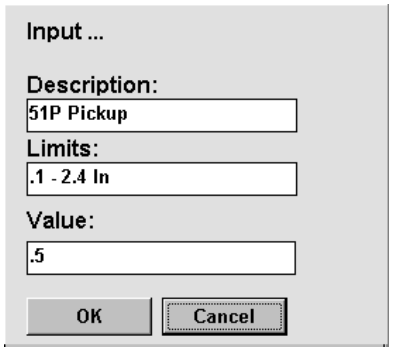



FIGURE 4.18: NUMERICAL SETTING


FIGURE 4.19: SETTING WITH OPTIONS

## 4.1.11. ADVANCED SETTINGS MENU

The different possibilities of the Advanced Settings Menu are similar to those of the Main Settings, with the exception of the fact that the Advanced Settings Menu includes Events Mask and Oscillography Mask. These settings can only be set from the PC.

### *4.1.11.1. Oscillography Mask*

Oscillography masks are as follows:

| Oscillography Mask | Option |
|---|---|
| Communications trigger | (YES/NO) |
| Osc. Trigger by digital input | (YES/NO) |
| Osc. Trigger by trip | (YES/NO) |
| Osc. Trigger by pickup | (YES/NO) |

### *4.1.11.2. Events Mask*

The list of events that are subject to be masked is shown in section 2.4.

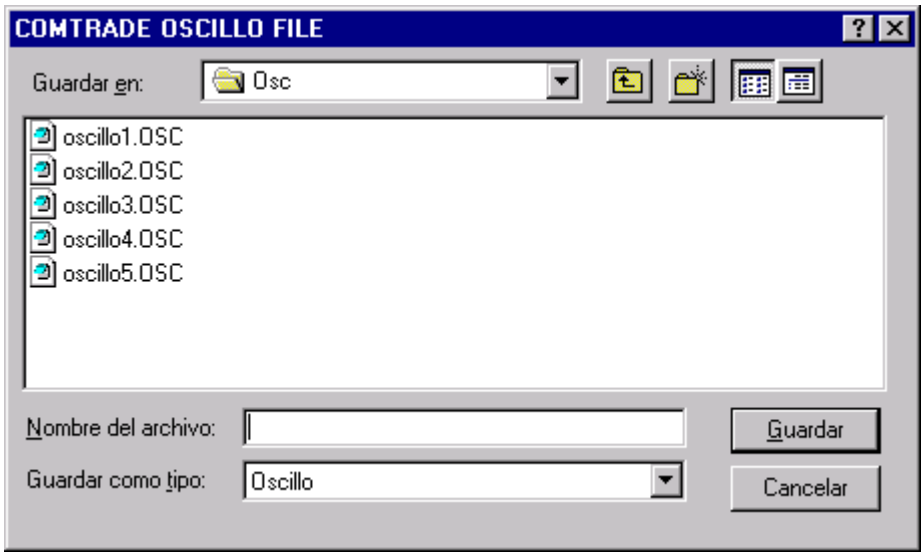
### 4.1.12. OPERATIONS MENU

Clicking on the **Operations** button, the Operations Menu is accessed. A sub-menu listing all possible operation commands is shown. Clicking on the desired button, the command is initiated. To perform an operation, depending on the command type, two steps will be followed. First, the command is selected; and second, after asking the user for confirmation, it is sent to the relay.


**FIGURE 4.20: OPERATIONS MENU**

### 4.1.13. OSCILLOGRAPHY MENU

By clicking on the **OSCILLOGRAPHY** button in the MAIN MENU, the user can start the process to retrieve the Oscillography record stored in the MIV. The program will request the path and filename where the file is to be stored, by means of the following form:




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

### 4.1.14. EVENTS MENU

By clicking on the **EVENTS** button in the MAIN MENU, all the stored events will be retrieved (up to 24). Each event record is labelled 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 voltage values for all phases and ground, frequency and negative sequence voltage during the event are also shown.


Now, we can print the event list, or save it to a file.

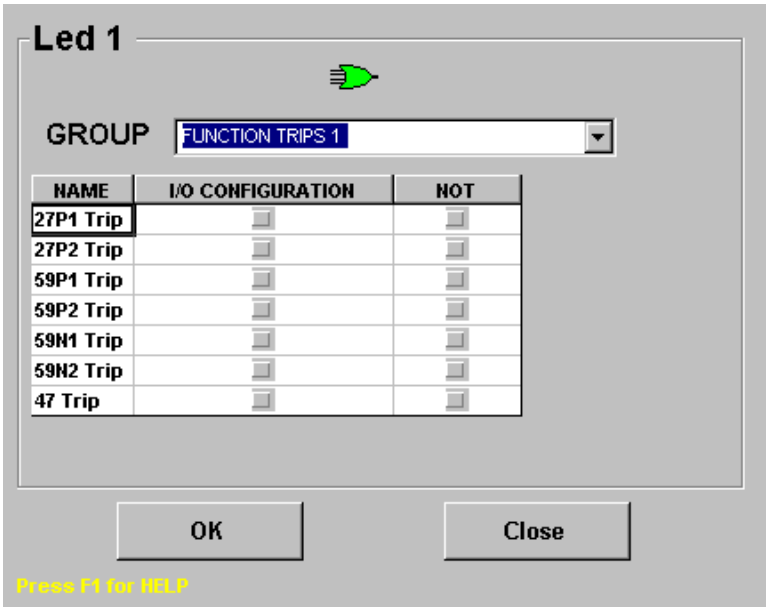
### 4.1.15. INPUT/OUTPUT CONFIGURATION

In this menu, the user can configure inputs, outputs and LEDs.

When clicking on the **I/O CONFIGURATION** button in the MAIN MENU, the following form will be displayed. Here, we can start assigning meanings to the different inputs, outputs and LEDs.


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 great flexibility when creating complex logics.

When selecting an OR action, the following screen will be displayed:

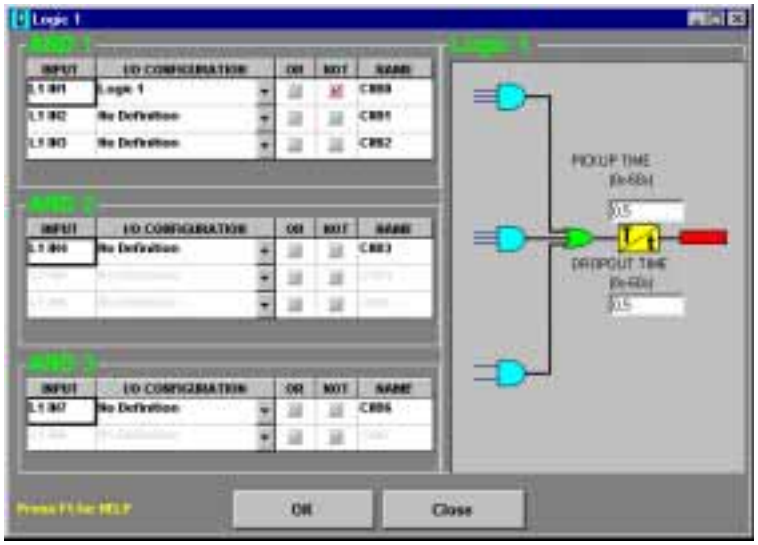



In this screen we can assign those functions that will be part of the OR.

### 4.1.16. LOGIC CONFIGURATION

The logic to be followed by the relay can be programmed using M+PC. To access the programming of this logic, from the main menu we must choose the **CONFIGURATION** option, and then select the concrete logic to be programmed.

When selecting one of the logics, we will see a new window where we can assign up to 8 inputs to the logic circuit. Each of these inputs can be a single function or status, as well as a logical union of several statuses.




In the previous window, we can assign the statuses that will be part of the logic OR.

Additionally, it is possible to assign a mnemotechnical name to each of these assignments.

On the other hand, it is also possible to define the activation and deactivation times, that is, the time during which the logic result must remain in the same value for considering a change of status.

### 4.1.17. SEND DATE/TIME

When selecting the SEND DATE/TIME operation, we will see a screen where there are two choices:

Sending the PC date and time to the unit, that is synchronizing the PC and the unit

Selecting a date and a time and sending it to the relay.

Once the new date and time have been sent, we can close this window and check in the status graph, or even in the same relay, how the new date/time has been entered.

# 5. SETTINGS

## 5.1. GENERAL SETTING STRUCTURE

All the settings of the MIV relay, together with the procedure 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.

The MIV relay provides two settings tables (table 2 is accessible in the ADVANCED SETTINGS group), stored in E2PROM memory (permanent memory). Using a setting or through a communications command *(or through a digital input in models with OPTION 1 or 2*), it is possible to select which table 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 M+PC 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:

1. Make sure your communication wire matches the scheme shown in figure 3.8.
2. Connect the communications cable between the relay (or modem) and the computer serial port.
3. Run the M+PC program. The procedure to install and use the M+PC program is described in section 1.2.2. SOFTWARE INSTALLATION and in section 4. HUMAN INTERFACE.
4. Make sure that the communications parameters in the relay match the M+PC configuration settings. The communications parameters shown in the relay faceplate display, within the configuration menu are:
    - **COMMUNICATION BAUDRATE**
    - **PASSWORD (please refer to section 4.1.6.)**
    - **RELAY NUMBER**

For instructions on how to check and modify M+PC program communications parameters please refer to chapter 4. HUMAN INTERFACE.

Check that the relay number and password in the MIV display match the numbers entered in the dialog window of the M+PC, after clicking on Relay Connection.

## 5.2. MAIN SETTINGS

### 5.2.1. GENERA SETTINGS GROUP

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| | GENERAL SETTINGS | GENERAL | | | |
| Relay status | RELAY STATUS | STA | DIS | RDY / DIS | NA |
| Frequency | FREQUENCY | FRQ | 50 Hz | 50/60 Hz | NA |
| Application | APPLICATION | APP | 3P G WYE | 3F – N PHASE-TO-GROUND, 3F PHASE-TO-PHASE, ONE-PHASE, GROUND | NA |
| Password | --- | PWD | 1 | 1 - 255 | |
| Address | --- | ADD | 1 | 1 - 255 | 1 |
| Baudrate | --- | BAUD | 9600 | 300, 600, 1200, 2400, 4800, 9600, 19200 | NA |

### 5.2.2. UNIT 27 SETTINGS (MIV1000/3000)

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 27P1** | **Unit 27P1** | **F27P1** | | | |
| Trip permission 27P1 | Trip 27P1 | TRIP 27P1 | NO | Y/N | NA |
| Pickup 27P1 | Pickup 27P1 | TAP 27P1 | 110.0 V (*) | 10.0-250.0 V | 0.1 V |
| | | | 60 V (**) | 2.0-60.0 V | |
| Timer 27P1 | Time 27P1 | TIME 27P1 | 1s | 0-600.00 s | 0.01 s |
| Supervision 27P1 by 52 | Supervision 27P1 by 52 | SUP 27P1 | NO | Y/N | NA |
| **Unit 27P2** | **Unit 27P2** | **F27P2** | | | |
| Trip permission 27P2 | Trip 27P2 | TRIP 27P2 | NO | Y/N | NA |
| Pickup 27P2 | Pickup 27P2 | TAP 27P2 | 110.0 V (*) | 10.0-250.0 V | 0.1 V |
| | | | 60 V (**) | 2.0-60.0 V | |
| Timer 27P2 | Time 27P2 | TIME 27P2 | 1s | 0-600.00 s | 0.01 s |
| Supervision 27P2 by 52 | Supervision 27P2 by 52 | SUP 27P2 | NO | Y/N | NA |

**(*)** High voltage range models (MIV*00)

**(**)** Low voltage range models (MIV*01)

### 5.2.3. UNIT 59 SETTINGS (MIV1000/3000)

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| Unit 59P1 | Unit 59P1 | F59P1 | | | |
| Trip permission 59P1 | Trip 59P1 | TRIP 59P1 | NO | Y/N | NA |
| Pickup 59P1 | Pickup 59P1 | TAP 59P1 | 110.0 V | 10.0-250.0 V | 0.1 V |
| | | | 60 V | 2.0-60.0 V | |
| Timer 59P1 | Time 59P1 | TIME 59P1 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59P2** | **Unit 59P2** | **F59P2** | | | |
| Trip permission 59P2 | Trip 59P2 | TRIP 59P2 | NO | Y/N | NA |
| Pickup 59P2 | Pickup 59P2 | TAP 59P2 | 110.0 V | 10.0-250.0 V | 0.1 V |
| | | | 60 V | 2.0-60.0 V | |
| Timer 59P2 | Time 59P2 | TIME 59P2 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59N1** | **Unit 59N1** | **F59N1** | | | |
| Trip permission 59N1 | Trip 59N1 | TRIP 59N1 | NO | Y/N | NA |
| Pickup 59N1 | Pickup 59N1 | TAP 59N1 | 110.0 V | 10.0-250.0 V | 0.1 V |
| | | | 60 V | 2.0-60.0 V | |
| Timer 59N1 | Time 59N1 | TIME 59N1 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59N2** | **Unit 59N2** | **F59N2** | | | |
| Trip permission 59N2 | Trip 59N2 | TRIP 59N2 | NO | Y/N | NA |
| Pickup 59N2 | Pickup 59N2 | TAP 59N2 | 110.0 V | 10.0-250.0 V | 0.1 V |
| | | | 60 V | 2.0-60.0 V | |
| Timer 59N2 | Time 59N2 | TIME 59N2 | 1s | 0-600.00 s | 0.01 s |

### 5.2.4. UNIT 47 (MIV3000)

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 47** | **Unit 47** | **F47** | | | |
| Trip permission 47 | Trip 47 | TRIP 47 | NO | Y/N | NA |
| Pickup 47 | Pickup 47 | TAP 47 | 60 V | 2.0-60.0 V | 0.1 V |
| Timer 47 | Time 47 | TIME 47 | 1s | 0-600.00 s | 0.01 s |

### 5.2.5. UNIT 81 (MIV2000/3000)

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 81_1** | **Unit 81_1** | **F81_1** | | | |
| Trip permission 81_1 | Trip 81_1 | TRIP 81_1 | NO | Y/N | NA |
| Type 81_1 | Type 81_1 | TYPE 81_1 | UND | UND/OVE | NA |
| Pickup 81_1 | Pickup 81_1 | TAP 81_1 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_1 | Time 81_1 | TIME 81_1 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_1 | Supervision 81_1 | SUP 81_1 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |
| **Unit 81_2** | **Unit 81_2** | **F81_2** | | | |
| Trip permission 81_2 | Trip 81_2 | TRIP 81_2 | NO | Y/N | NA |
| Type 81_2 | Type 81_2 | TYPE 81_2 | UND | UND/OVE | NA |
| Pickup 81_2 | Pickup 81_2 | TAP 81_2 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_2 | Time 81_2 | TIME 81_2 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_2 | Supervision 81_2 | SUP 81_2 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |
| **Unit 81_3** | **Unit 81_3** | **F81_3** | | | |
| Trip permission 81_3 | Trip 81_3 | TRIP 81_3 | NO | Y/N | NA |
| Type 81_3 | Type 81_3 | TYPE 81_3 | UND | UND/OVE | NA |
| Pickup 81_3 | Pickup 81_3 | TAP 81_3 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_3 | Time 81_3 | TIME 81_3 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_3 | Supervision 81_3 | SUP 81_3 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |
| **Unit 81_4** | **Unit 81_4** | **F81_4** | | | |
| Trip permission 81_4 | Trip 81_4 | TRIP 81_4 | NO | Y/N | NA |
| Type 81_4 | Type 81_4 | TYPE 81_4 | UND | UND/OVE | NA |
| Pickup 81_4 | Pickup 81_4 | TAP 81_4 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_4 | Time 81_4 | TIME 81_4 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_4 | Supervision 81_4 | SUP 81_4 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |

## 5.3. ADVANCED SETTINGS

### 5.3.1. GENERAL SETTINGS

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| | **ADVANCED GENERAL SETTINGS** | **GENERAL ADVANCED** | | | |
| Identification | IDENTIFICATION | ---- | MIV | Text | NA |
| Active table | ACTIVE TABLE | TAB | 1 | 1-2 | NA |
| Minimum trip time | T. MANT. TRIP | TRIP MIN TIME | 100 ms | 50-300 ms | 1 ms |

### 5.3.2. UNIT 27 SETTINGS (TABLE 2)

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 27P1 (TABLE 2)** | **Unit 27P1 (TABLE 2)** | **F27P1 T2** | | | |
| Trip permission 27P1 | Trip 27P1 T2 | TRIP 27P1 T2 | NO | Y/N | NA |
| Pickup 27P1 | Pickup 27P1 T2 | TAP 27P1 T2 | 110.0 V (*)<br>60 V (**) | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P1 | Time 27P1 T2 | TIME 27P1 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision 27P1 by 52 | Supervision 27P1 by 52 T2 | SUP 27P1 T2 | NO | Y/N | NA |
| **Unit 27P2 (TABLE 2)** | **Unit 27P2 (TABLE 2)** | **F27P2 T2** | | | |
| Trip permission 27P2 | Trip 27P2 T2 | TRIP 27P2 T2 | NO | Y/N | NA |
| Pickup 27P2 | Pickup 27P2 T2 | TAP 27P2 T2 | 110.0 V<br>60 V | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P2 | Time 27P2 T2 | TIME 27P2 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision 27P2 by 52 | Supervision 27P2 by 52 T2 | SUP 27P2 T2 | NO | Y/N | NA |

**(*)** High voltage range models (MIV*00)

**(**)** Low voltage range models (MIV*01)

### 5.3.3. UNIT 59

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 59P1 (TABLE 2)** | **Unit 59P1 (TABLE 2)** | **F59P1 T2** | | | |
| Trip permission 59P1 | Trip 59P1 T2 | TRIP 59P1 T2 | NO | Y/N | NA |
| Pickup 59P1 | Pickup 59P1 T2 | TAP 59P1 T2 | 110.0 V<br>60 V | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P1 | Time 59P1 T2 | TIME 59P1 T2 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59P2 (TABLE 2)** | **Unit 59P2 (TABLE 2)** | **F59P2 T2** | | | |
| Trip permission 59P2 | Trip 59P2 T2 | TRIP 59P2 T2 | NO | Y/N | NA |
| Pickup 59P2 | Pickup 59P2 T2 | TAP 59P2 T2 | 110.0 V<br>60 V | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P2 | Time 59P2 T2 | TIME 59P2 T2 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59N1 (TABLE 2)** | **Unit 59N1 (TABLE 2)** | **F59N1 T2** | | | |
| Trip permission 59N1 | Trip 59N1 T2 | TRIP 59N1 T2 | NO | Y/N | NA |
| Pickup 59N1 | Pickup 59N1 T2 | TAP 59N1 T2 | 110.0 V<br>60 V | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N1 | Time 59N1 T2 | TIME 59N1 T2 | 1s | 0-600.00 s | 0.01 s |
| **Unit 59N2 (TABLE 2)** | **Unit 59N2 (TABLE 2)** | **F59N2 T2** | | | |
| Trip permission 59N2 | Trip 59N2 T2 | TRIP 59N2 T2 | NO | Y/N | NA |
| Pickup 59N2 | Pickup 59N2 T2 | TAP 59N2 T2 | 110.0 V<br>60 V | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N2 | Time 59N2 T2 | TIME 59N2 T2 | 1s | 0-600.00 s | 0.01 s |

### 5.3.4. UNIT 47

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 47 (TABLE 2)** | **Unit 47 (TABLE 2)** | **F47 T2** | | | |
| Trip permission 47 | Trip 47 T2 | TRIP 47 T2 | NO | Y/N | NA |
| Pickup 47 | Pickup 47 T2 | TAP 47 T2 | 60 V | 2.0-60.0 V | 0.1 V |
| Timer 47 | Time 47 T2 | TIME 47 T2 | 1s | 0-600.00 s | 0.01 s |

### 5.3.5. UNIT 81

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 81_1 (TABLE 2)** | **Unit 81_1 (TABLE 2)** | **F81_1 T2** | | | |
| Trip permission 81_1 | Trip 81_1 T2 | TRIP 81_1 T2 | NO | Y/N | NA |
| Type 81_1 | Type 81_1 T2 | TYPE 81_1 T2 | UND | UND/OVE | NA |
| Pickup 81_1 | Pickup 81_1 T2 | TAP 81_1 T2 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_1 | Time 81_1 T2 | TIME 81_1 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_1 | Supervision 81_1 T2 | SUP 81_1 T2 | 30V<br>10V | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_2 (TABLE 2)** | **Unit 81_2 (TABLE 2)** | **F81_2 T2** | | | |
| Trip permission 81_2 | Trip 81_2 T2 | TRIP 81_2 T2 | NO | Y/N | NA |
| Type 81_2 | Type 81_2 T2 | TYPE 81_2 T2 | UND | UND/OVE | NA |

| | M+PC | MMI | DEFAULT | RANGE | STEP |
|---|---|---|---|---|---|
| Pickup 81_2 | Pickup 81_2 T2 | TAP 81_2 T2 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_2 | Time 81_2 T2 | TIME 81_2 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_2 T2 | Supervision 81_2 T2 | SUP 81_2 T2 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |
| **Unit 81_3 (TABLE 2)** | **Unit 81_3 (TABLE 2)** | **F81_3 T2** | | | |
| Trip permission 81_3 | Trip 81_3 T2 | TRIP 81_3 T2 | NO | Y/N | NA |
| Type 81_3 | Type 81_3 T2 | TYPE 81_3 T2 | UND | UND/OVE | NA |
| Pickup 81_3 | Pickup 81_3 T2 | TAP 81_3 T2 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_3 | Time 81_3 T2 | TIME 81_3 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_3 T2 | Supervision 81_3 T2 | SUP 81_3 T2 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |
| **Unit 81_4 (TABLE 2)** | **Unit 81_4 (TABLE 2)** | **F81_4 T2** | | | |
| Trip permission 81_4 | Trip 81_4 T2 | TRIP 81_4 T2 | NO | Y/N | NA |
| Type 81_4 | Type 81_4 T2 | TYPE 81_4 T2 | UND | UND/OVE | NA |
| Pickup 81_4 | Pickup 81_4 T2 | TAP 81_4 T2 | 42 Hz | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_4 | Time 81_4 T2 | TIME 81_4 T2 | 1s | 0-600.00 s | 0.01 s |
| Supervision voltage 81_4 T2 | Supervision 81_4 T2 | SUP 81_4 T2 | 30V | 30-250 V | 0.1 V |
| | | | 10V | 10-60 V | 0.2 V |

### 5.3.6. EVENTS AND OSCILLOGRAPHY MASKS

**Event masks have two possible settings, YES and NO. If an action (for example the trip of a protection unit) is set as YES, when this unit trips an event will be generated. If it is set as NO, the relay will show no event.**

| | M+PC | DEFAULT | RANGE | STEP |
|---|---|---|---|---|
| **Event Masks** | **Event Masks** | | | |
| Pickup/reset 27P1 | Pickup 27P1 | YES | Y/N | NA |
| Pickup/reset 27P2 | Pickup 27P2 | YES | Y/N | NA |
| Pickup/reset 59P1 | Pickup 59P1 | YES | Y/N | NA |
| Pickup/reset 59P2 | Pickup 59P2 | YES | Y/N | NA |
| Pickup/reset 59N1 | Pickup 59N1 | YES | Y/N | NA |
| Pickup/reset 59N2 | Pickup 59N2 | YES | Y/N | NA |
| Pickup/reset 47 | Pickup 47 | YES | Y/N | NA |
| Pickup/reset 81_1 | Pickup 81_1 | YES | Y/N | NA |
| Pickup/reset 81_2 | Pickup 81_2 | YES | Y/N | NA |
| Pickup/reset 81_3 | Pickup 81_3 | YES | Y/N | NA |
| Pickup/reset 81_4 | Pickup 81_4 | YES | Y/N | NA |
| 27P1 trip inhibit. Activation / deactivation by digital input | 27P1 inhibit (by D.I.) | YES | Y/N | NA |
| 27P2 trip inhibit. Activation / deactivation by digital input | 27P2 inhibit (by D.I.) | YES | Y/N | NA |
| 59P1 trip inhibit. Activation / deactivation by digital input | 59P1 inhibit (by D.I.) | YES | Y/N | NA |
| 59P2 trip inhibit. Activation / deactivation by digital input | 59P2 inhibit (by D.I.) | YES | Y/N | NA |
| 59N1 trip inhibit. Activation / deactivation by digital input | 59N1 inhibit (by D.I.) | YES | Y/N | NA |
| 59N2 trip inhibit. Activation / deactivation by digital input | 59N2 inhibit (by D.I.) | YES | Y/N | NA |
| 47 trip inhibit. Activation / deactivation by digital input | 47 inhibit (by D.I.) | YES | Y/N | NA |
| 81_1 trip inhibit. Activation / deactivation by digital input | 81_1 inhibit (by D.I.) | YES | Y/N | NA |

| | M+PC | DEFAULT | RANGE | STEP |
|---|---|---|---|---|
| 81_2 trip inhibit. Activation / deactivation by digital input | 81_2 inhibit (by D.I.) | YES | Y/N | NA |
| 81_3 trip inhibit. Activation / deactivation by digital input | 81_3 inhibit (by D.I.) | YES | Y/N | NA |
| 81_4 trip inhibit. Activation / deactivation by digital input | 81_4 inhibit (by D.I.) | YES | Y/N | NA |
| General trip inhibit. Activation / deactivation by digital input | Trip inhibit (by D.I.) | YES | Y/N | NA |
| Trip 27P1 | Trip 27P1 | YES | Y/N | NA |
| Trip 27P2 | Trip 27P2 | YES | Y/N | NA |
| Trip 59P1 | Trip 59P1 | YES | Y/N | NA |
| Trip 59P2 | Trip 59P2 | YES | Y/N | NA |
| Trip 59N1 | Trip 59N1 | YES | Y/N | NA |
| Trip 59N2 | Trip 59N2 | YES | Y/N | NA |
| Trip 47 | Trip 47 | YES | Y/N | NA |
| Trip 81_1 | Trip 81_1 | YES | Y/N | NA |
| Trip 81_2 | Trip 81_2 | YES | Y/N | NA |
| Trip 81_3 | Trip 81_3 | YES | Y/N | NA |
| Trip 81_4 | Trip 81_4 | YES | Y/N | NA |
| General trip | General Trip | YES | Y/N | NA |
| Protection activation /deactivation | Protection Status | YES | Y/N | NA |
| Auxiliary output 1 activation / deactivation | Output 1 | YES | Y/N | NA |
| Auxiliary output 2 activation / deactivation | Output 2 | YES | Y/N | NA |
| Auxiliary output 3 activation / deactivation | Output 3 | YES | Y/N | NA |
| Auxiliary output 4 activation / deactivation | Output 4 | YES | Y/N | NA |
| Digital input 1 activation / deactivation | Digital input 1 | YES | Y/N | NA |
| Digital input 2 activation / deactivation | Digital input 2 | YES | Y/N | NA |
| Settings change through input inhibition activation/deactivation | Settings change inhib. | YES | Y/N | NA |
| Trip command activation through digital input | Trip command through input | YES | Y/N | NA |
| Trip command activation through command | Trip command through command | YES | Y/N | NA |
| Auxiliary contacts latching reset | Aux. contact latch | YES | Y/N | NA |
| 52 B open/closed | Breaker 52 B | YES | Y/N | NA |
| 52 A open/closed | Breaker 52 A | YES | Y/N | NA |
| 52 open/closed | Breaker status | YES | Y/N | NA |
| TABLE 2 selection through digital input | TABLE CHANGE | YES | Y/N | NA |
| Oscillography trigger by digital input | Osc. Trigger through D.I. | YES | Y/N | NA |
| Oscillography trigger by command | Osc. Trigger through command | YES | Y/N | NA |
| Settings change executed | Settings Change | YES | Y/N | NA |
| E2prom failure | E2prom failure | YES | Y/N | NA |
| User settings / Default settings | User settings | YES | Y/N | NA |
| **Oscillography Masks** | **Oscillography masks** | | | |
| Oscillo by communications | Oscillo by comm. | NO | Y/N | NA |
| Oscillo by digital input | Oscillo by digital | NO | Y/N | NA |

| | M+PC | DEFAULT | RANGE | STEP |
|---|---|---|---|---|
| | input | | | |
| Oscillo by trip | Oscillo by trip | NO | Y/N | NA |
| Oscillo by pickup | Oscillo by pickup | NO | Y/N | NA |

**COMMENTS ON THE SETTINGS:**

The ACTIVE TABLE setting, in the Advanced General Settings, selects which of the two settings tables is active at a given time. Its default value is 1 (TABLE 1).

## 5.4. TIME SYNCHRONIZATION

MIV relay includes an internal clock to time tag events. This clock can be synchronized with the computer clock using the M+PC software program. It can also be set to a given Date and Time using the faceplate keypad.

# 6. INPUTS/OUTPUTS CONFIGURATION

## 6.1. INPUT CONFIGURATION

### 6.1.1. INPUT DESCRIPTION

The MIV incorporates 2 digital inputs, which can be configured using the M+PC software. The default input configurations are as follows:

**MIV1000**

Input 1: Phase voltage units trip inhibition.

Input 2: Ground voltage units trip inhibition

**MIV2000**

Input 1: Frequency units trip inhibition

Input 2: Trip contact close

**MIV3000**

Input 1: Voltage units trip inhibition.

Input 2: Frequency units trip inhibition

All functions not defined as PULSE are LEVEL inputs.

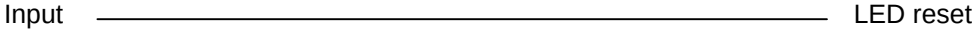
The minimum operation time for a valid PULSE input is over 0.015 seconds.

Inputs functions are divided in groups with eight functions per group, besides the *No definition* function. Up to eight functions can be configured for the same input, provided that they are all in the same group. Functions belonging to different groups need to be assigned to different inputs.

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

For example, we can inhibit the trip of all 59 units using only one input.


If we want to reset LEDs using a digital input, we must assign the LED reset function to one digital input



### 6.1.2. INPUT FUNCTIONS

The following table shows the list of functions that can be assigned to each input. The table is divided into groups. The first group is common to all models.

| | |
|---|---|
| No definition | Input not assigned |

| | |
|---|---|
| Status 52 a | Active with breaker closed |
| Status 52 b | Active with breaker open |
| Close trip contact<br>(PULSE) | This functions allows to close the trip contact |
| Table change (TABLE 2 activation) | Activating this function means that TABLE 2 will be the active table. When this function is deactivated, the active table is the table selected for the ACTIVE TABLE setting. |
| Settings change inhibit | When this function is active, settings and tables cannot be modified. It is only possible to activate TABLE 2 using the Table Change digital input |
| Reset (PULSE) | This function allows resetting the LEDs and the output LATCHes. |
| Oscillography trigger (PULSE) | Oscillography activation |
| Generic input | Generic function used in the logic configuration |

**MIV1000 model**

| | |
|---|---|
| Voltage inhib. (by DI) | Voltage units trip inhibition function |
| Inhib. 27P1 (by DI) | 27P1 unit trip inhibition function |
| Inhib. 27P2 (by DI) | 27P2 unit trip inhibition function |
| Inhib. 59P1 (by DI) | 59P1 unit trip inhibition function |
| Inhib. 59P2 (by DI) | 59P2 unit trip inhibition function |
| Inhib. 59N1 (by DI) | 59N1 unit trip inhibition function |
| Inhib. 59N2 (by DI) | 59N2 unit trip inhibition function |

| | |
|---|---|
| Inhib. Trip (by DI) | All trip inhibition. |

| | |
|---|---|
| Phase voltage units inhib. (by DI) | Phase voltage units trip inhibition function |
| Ground voltage units inhib. (by DI) | Ground voltage units trip inhibition function |

**MIV2000 model**

| | |
|---|---|
| Inhib. Frequency (by DI) | Frequency units trip inhibition function |
| Inhib. 81_1 (by DI) | 81_1 unit trip inhibition function |
| Inhib. 81_2 (by DI) | 81_2 unit trip inhibition function |
| Inhib. 81_3 (by DI) | 81_3 unit trip inhibition function |

| | |
|---|---|
| Inhib. 81_4 (by DI) | 81_4 unit trip inhibition function |
| Inhib. Trip (by DI) | All trip inhibition |

**MIV3000 model**

| | |
|---|---|
| Inhib. Voltage (by DI) | Voltage units trip inhibition function |
| Inhib. 27P1 (by DI) | 27P1 unit trip inhibition function |
| Inhib. 27P2 (by DI) | 27P2 unit trip inhibition function |
| Inhib. 59P1 (by DI) | 59P1 unit trip inhibition function |
| Inhib. 59P2 (by DI) | 59P2 unit trip inhibition function |
| Inhib. 59N1 (by DI) | 59N1 unit trip inhibition function |
| Inhib. 59N2 (by DI) | 59N2 unit trip inhibition function |
| Inhib. 47 (by DI) | 47 unit trip inhibition function |

| | |
|---|---|
| Inhib. Frequency (by DI) | Frequency units trip inhibition function |
| Inhib. 81_1 (by DI) | 81_1 unit trip inhibition function |
| Inhib. 81_2 (by DI) | 81_2 unit trip inhibition function |
| Inhib. Trip (by DI) | All trip inhibition |

| | |
|---|---|
| Phase voltage units inhib. (by DI) | Phase voltage units trip inhibition function |
| Ground voltage units inhib. (by DI) | Ground voltage units trip inhibition function |

## 6.2. OUTPUT AND LED CONFIGURATION

### 6.2.1. OUTPUT AND LED DESCRIPTION

The MIV incorporates 4 configurable outputs y 4 LED indicators, which can only be configured by M+PC software.

The default configuration for outputs is as follows:

**MIV1000**

| OUTPUT | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Trip 27 | No |
| 2 | Trip 59P | No |
| 3 | Trip 59N1 | No |
| 4 | Trip 59N2 | No |

**MIV 2000**

| OUTPUT | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Trip 81_1 | No |
| 2 | Trip 81_2 | No |
| 3 | Trip 81_3 | No |
| 4 | Trip 81_4 | No |

**MIV 3000**

| OUTPUT | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Phase voltage trip | No |
| 2 | Ground voltage trip | No |
| 3 | Trip 47 | No |
| 4 | Trip frequency | No |

The default LED configuration is as follows:

**MIV 1000**

| LED | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Trip 27 | Yes |
| 2 | Trip 59 | Yes |
| 3 | Trip 59N | Yes |
| 4 | Pickup | No |

**MIV 2000**

| LED | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Trip 81_1 | Yes |
| 2 | Trip 81_2 | Yes |
| 3 | Trip 81_3 | Yes |
| 4 | Trip 81_4 | Yes |

**MIV 3000**

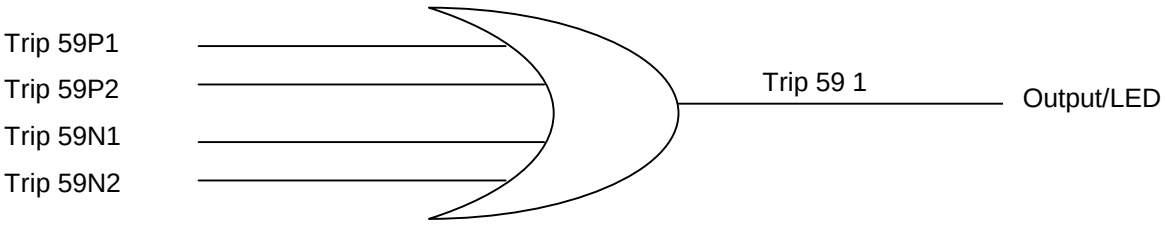
| LED | CONFIGURATION | MEMORY |
|---|---|---|
| 1 | Phase voltage trip | Yes |
| 2 | Ground voltage trip | Yes |
| 3 | Trip frequency | Yes |
| 4 | Pickup | No |

Functions that can be assigned to Outputs/LEDs are divided in eight groups, besides the *No definition* function. Functions belonging to the same group can be assigned to the same output/LED. Functions of different groups need to be assigned to different outputs/LEDs.

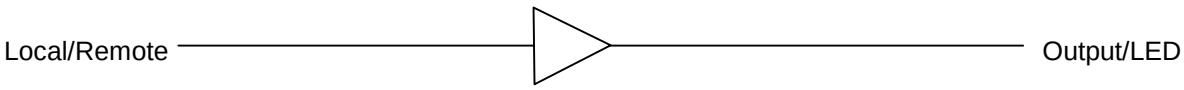
In order to assign several functions to an output/LED, first we must activate the **OR** button, click on the **I/O CONFIGURATION** frame and select the desired group, then select the desired functions. In order to negate a function, select the **NOT** button. Finally, click on the **OK** button.

Now you can invert all the logic by selecting the general **NOT** button. Outputs can be memorized, and LEDs can be set to be fixed or blinking.

If we want to assign a phase or ground 59 trip to an output or LED:




If we want an output or LED to be active when function is Remote, we must program the output or LED with the Local/Remote function inverted with NOT.




**We must keep in mind that functions from different groups can not be included in an OR logic.**

### 6.2.2. OUTPUT AND LED FUNCTIONS

The list of functions that can be assigned to the different outputs and LEDs is divided in the following groups. The first list is common to all MIV models:

| | |
|---|---|
| No definition | Output or LED not configured |

| | |
|---|---|
| Logic 1 | Output signal from the logic block 1 |
| Logic 2 | Output signal from the logic block 2 |
| Logic 3 | Output signal from the logic block 3 |
| Logic 4 | Output signal from the logic block 4 |

| | |
|---|---|
| Input 1 | Digital Input 1 |
| Input 2 | Digital Input 2 |

| | |
|---|---|
| E2prom failure | Activated when a failure is detected in the E2prom management |
| User settings | This function is inactive when the unit is using the DEFAULT settings. When settings are modified by the user, this function is activated. |

| | |
|---|---|
| Ready | Active when the relay is in service and at least one protection unit has trip enabled. |

| | |
|---|---|
| Close Breaker | It activates and creates a pulse when the CLOSE BREAKER operation is performed. |

| | |
|---|---|
| Active Table | T1 or T2 |
| Local/Remote | This is LOCAL when the HMI is on the MAIN SETTINGS, ADVANCED SETTINGS or OPERATIONS menu. |

**MIV1000**

| | |
|---|---|
| Trip phase a | Any phase a unit has tripped |
| Trip phase b | Any phase b unit has tripped |
| Trip phase c | Any phase c unit has tripped |
| Trip phase | One of the 27P1, 27P2, 59P1, 59P2 units has tripped |
| Trip ground | One of the 59N1 and/or 59N2 units has tripped |

| | |
|---|---|
| Trip 59P | 59P1 and/or 59P2 unit trip |
| Trip 59N | 59N1 and/or 59N2 unit trip |
| Trip 27 | 27P1 and/or 27P2 unit trip |

| | |
|---|---|
| Trip 27_1 a | 27P1 phase a unit trip |
| Trip 27_1 b | 27P1 phase b unit trip |
| Trip 27_1 c | 27P1 phase c unit trip |
| Trip 27_2 a | 27P2 phase a unit trip |
| Trip 27_2 b | 27P2 phase b unit trip |
| Trip 27_2 c | 27P2 phase c unit trip |

| | |
|---|---|
| Trip 59_1 a | 59P1 phase a unit trip |
| Trip 59_1 b | 59P1 phase b unit trip |
| Trip 59_1 c | 59P1 phase c unit trip |
| Trip 59_2 a | 59P2 phase a unit trip |
| Trip 59_2 b | 59P2 phase b unit trip |
| Trip 59_2 c | 59P2 phase c unit trip |

| | |
|---|---|
| Trip 27P1 | 27P1 unit trip |
| Trip 27P2 | 27P2 unit trip |
| Trip 59P1 | 59P1 unit trip |
| Trip 59P2 | 59P2 unit trip |
| Trip 59N1 | 59N1 unit trip |
| Trip 59N2 | 59N2 unit trip |

| | |
|---|---|
| General trip | Trip of any unit |

| | |
|---|---|
| Pickup 27_1 a | 27P1 phase a unit pickup |
| Pickup 27_1 b | 27P1 phase b unit pickup |
| Pickup 27_1 c | 27P1 phase c unit pickup |

| | |
|---|---|
| Pickup 27_2 a | 27P2 phase a unit pickup |
| Pickup 27_2 b | 27P2 phase b unit pickup |
| Pickup 27_2 c | 27P2 phase c unit pickup |

| | |
|---|---|
| Pickup 59_1 a | 59P1 phase a unit pickup |
| Pickup 59_1 b | 59P1 phase b unit pickup |
| Pickup 59_1 c | 59P1 phase c unit pickup |
| Pickup 59_2 a | 59P2 phase a unit pickup |
| Pickup 59_2 b | 59P2 phase b unit pickup |
| Pickup 59_2 c | 59P2 phase c unit pickup |

| | |
|---|---|
| Pickup 27P1 | 27P1 unit pickup |
| Pickup 27P2 | 27P2 unit pickup |
| Pickup 59P1 | 59P1 unit pickup |
| Pickup 59P2 | 59P2 unit pickup |
| Pickup 59N1 | 59N1 unit pickup |
| Pickup 59N2 | 59N2 unit pickup |

| | |
|---|---|
| General pickup | Pickup of any unit |

| | |
|---|---|
| Virtual trip 27_1 a | Virtual trip of unit 27P1 phase a |
| Virtual trip 27_1 b | Virtual trip of unit 27P1 phase b |
| Virtual trip 27_1 c | Virtual trip of unit 27P1 phase c |
| Virtual trip 27_2 a | Virtual trip of unit 27P2 phase a |
| Virtual trip 27_2 b | Virtual trip of unit 27P2 phase b |
| Virtual trip 27_2 c | Virtual trip of unit 27P2 phase c |

| | |
|---|---|
| Virtual trip 59_1 a | Virtual trip of unit 59P1 phase a |
| Virtual trip 59_1 b | Virtual trip of unit 59P1 phase b |
| Virtual trip 59_1 c | Virtual trip of unit 59P1 phase c |
| Virtual trip 59_2 a | Virtual trip of unit 59P2 phase a |
| Virtual trip 59_2 b | Virtual trip of unit 59P2 phase b |
| Virtual trip 59_2 c | Virtual trip of unit 59P2 phase c |

| | |
|---|---|
| Virtual trip 27P1 | Virtual trip of unit 27P1 |
| Virtual trip 27P2 | Virtual trip of unit 27P2 |
| Virtual trip 59P1 | Virtual trip of unit 59P1 |
| Virtual trip 59P2 | Virtual trip of unit 59P2 |
| Virtual trip 59N1 | Virtual trip of unit 59N1 |
| Virtual trip 59N2 | Virtual trip of unit 59N2 |

| | |
|---|---|
| General Virtual Trip | Virtual trip of any unit |

**MIV 2000**

| | |
|---|---|
| Trip 81_1 | 81_1 unit trip |
| Trip 81_2 | 81_2 unit trip |
| Trip 81_3 | 81_3 unit trip |
| Trip 81_4 | 81_4 unit trip |
| General trip | Trip of any unit |

| | |
|---|---|
| Pickup 81_1 | Pickup of unit 81_1 |
| Pickup 81_2 | Pickup of unit 81_2 |
| Pickup 81_3 | Pickup of unit 81_3 |
| Pickup 81_4 | Pickup of unit 81_4 |
| General pickup | Pickup of any unit |

| | |
|---|---|
| Virtual trip 81_1 | Virtual trip of unit 81_1 |
| Virtual trip 81_2 | Virtual trip of unit 81_2 |
| Virtual trip 81_3 | Virtual trip of unit 81_3 |
| Virtual trip 81_4 | Virtual trip of unit 81_4 |
| Virtual trip general | Virtual trip of any unit |

**MIV 3000**

| | |
|---|---|
| Trip phase a | Trip of any phase a unit |
| Trip phase b | Trip of any phase b unit |
| Trip phase c | Trip of any phase c unit |
| Phase Trip | Trip of any of 27P1, 27P2, 59P1, 59P2 or 47 units |
| Ground Trip | Trip of unit 59N1 and/or 59N2 |

| | |
|---|---|
| Frequency Trip | Trip of unit 81_1 and/or 81_2 |
| Trip 81_1 | Trip of unit 81_1 |
| Trip 81_2 | Trip of unit 81_2 |
| General trip | Trip of any unit |

| | |
|---|---|
| Trip 59P | Trip of unit 59P1 and/or 59P2 |
| Trip 59N | Trip of unit 59N1 and/or 59N2 |
| Trip 27 | Trip of unit 27P1 and/or 27P2 |

| | |
|---|---|
| Trip 27_1 a | Trip of unit 27P1 phase a |
| Trip 27_1 b | Trip of unit 27P1 phase b |
| Trip 27_1 c | Trip of unit 27P1 phase c |
| Trip 27_2 a | Trip of unit 27P2 phase a |
| Trip 27_2 b | Trip of unit 27P2 phase b |
| Trip 27_2 c | Trip of unit 27P2 phase c |

| | |
|---|---|
| Trip 59_1 a | Trip of unit 59P1 phase a |
| Trip 59_1 b | Trip of unit 59P1 phase b |
| Trip 59_1 c | Trip of unit 59P1 phase c |
| Trip 59_2 a | Trip of unit 59P2 phase a |
| Trip 59_2 b | Trip of unit 59P2 phase b |
| Trip 59_2 c | Trip of unit 59P2 phase c |

| | |
|---|---|
| Trip 27P1 | Trip of unit 27P1 |
| Trip 27P2 | Trip of unit 27P2 |
| Trip 59P1 | Trip of unit 59P1 |
| Trip 59P2 | Trip of unit 59P2 |
| Trip 59N1 | Trip of unit 59N1 |
| Trip 59N2 | Trip of unit 59N2 |
| Trip 47 | Trip of unit 47 |

| | |
|---|---|
| Pickup 27_1 a | Pickup of unit 27P1 phase a |
| Pickup 27_1 b | Pickup of unit 27P1 phase b |
| Pickup 27_1 c | Pickup of unit 27P1 phase c |
| Pickup 27_2 a | Pickup of unit 27P2 phase a |
| Pickup 27_2 b | Pickup of unit 27P2 phase b |
| Pickup 27_2 c | Pickup of unit 27P2 phase c |

| | |
|---|---|
| Pickup 59_1 a | Pickup of unit 59P1 phase a |
| Pickup 59_1 b | Pickup of unit 59P1 phase b |
| Pickup 59_1 c | Pickup of unit 59P1 phase c |

| | |
|---|---|
| Pickup 59_2 a | Pickup of unit 59P2 phase a |
| Pickup 59_2 b | Pickup of unit 59P2 phase b |
| Pickup 59_2 c | Pickup of unit 59P2 phase c |

| | |
|---|---|
| Pickup 27P1 | Pickup of unit 27P1 |
| Pickup 27P2 | Pickup of unit 27P2 |
| Pickup 59P1 | Pickup of unit 59P1 |
| Pickup 59P2 | Pickup of unit 59P2 |
| Pickup 59N1 | Pickup of unit 59N1 |
| Pickup 59N2 | Pickup of unit 59N2 |
| Pickup 47 | Pickup of unit 47 |

| | |
|---|---|
| Pickup 81_1 | Pickup of unit 81_1 |
| Pickup 81_2 | Pickup of unit 81_2 |
| General pickup | Pickup of any unit |

| | |
|---|---|
| Virtual trip 27_1 a | Virtual trip of unit 27P1 phase a |
| Virtual trip 27_1 b | Virtual trip of unit 27P1 phase b |
| Virtual trip 27_1 c | Virtual trip of unit 27P1 phase c |
| Virtual trip 27_2 a | Virtual trip of unit 27P2 phase a |
| Virtual trip 27_2 b | Virtual trip of unit 27P2 phase b |
| Virtual trip 27_2 c | Virtual trip of unit 27P2 phase c |

| | |
|---|---|
| Virtual trip 59_1 a | Virtual trip of unit 59P1 phase a |
| Virtual trip 59_1 b | Virtual trip of unit 59P1 phase b |
| Virtual trip 59_1 c | Virtual trip of unit 59P1 phase c |
| Virtual trip 59_2 a | Virtual trip of unit 59P2 phase a |
| Virtual trip 59_2 b | Virtual trip of unit 59P2 phase b |
| Virtual trip 59_2 c | Virtual trip of unit 59P2 phase c |

| | |
|---|---|
| Virtual trip 27P1 | Virtual trip of unit 27P1 |
| Virtual trip 27P2 | Virtual trip of unit 27P2 |
| Virtual trip 59P1 | Virtual trip of unit 59P1 |
| Virtual trip 59P2 | Virtual trip of unit 59P2 |
| Virtual trip 59N1 | Virtual trip of unit 59N1 |
| Virtual trip 59N2 | Virtual trip of unit 59N2 |
| Virtual trip 47 | Virtual trip of unit 47 |

| | |
|---|---|
| Virtual trip 81_1 | Virtual trip of unit 81_1 |
| Virtual trip 81_2 | Virtual trip of unit 81_2 |
| General Virtual trip | Virtual trip of any unit |

When trip conditions exist for a protection unit, the relay operates a virtual trip of this unit. If it is not disabled by setting or Digital Input, the trip occurs.

# 7. LOGIC CONFIGURATION

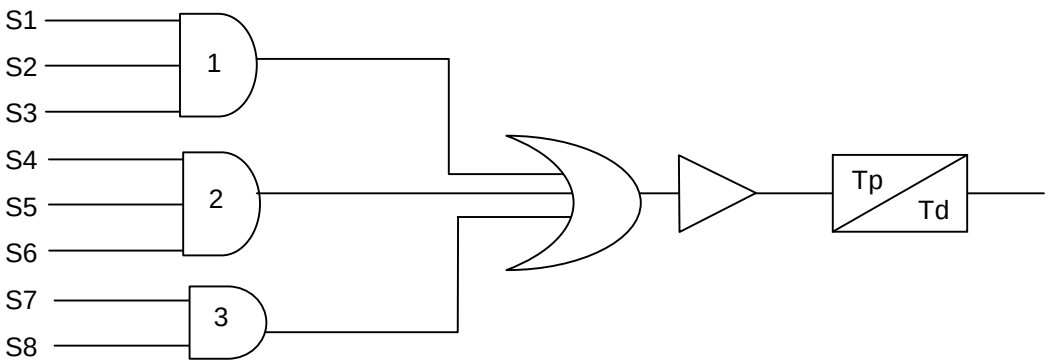
## 7.1.1. LOGIC DESCRIPTION

Using the M+PC software, we can configure 4 different logics.

The default logic configuration is the following:

| LOGIC | CONFIGURATION | PICKUP TIMER | DROPOUT TIMER |
|---|---|---|---|
| 1 | S1 = Not defined | 0 | 0 |
| 2 | S1 = Not defined | 0 | 0 |
| 3 | S1 = Not defined | 0 | 0 |
| 4 | S1 = Not defined | 0 | 0 |

Logic functions are divided in several groups, besides *Not defined* function. We can configure up to eight signals in the same Logic box with the following structure:



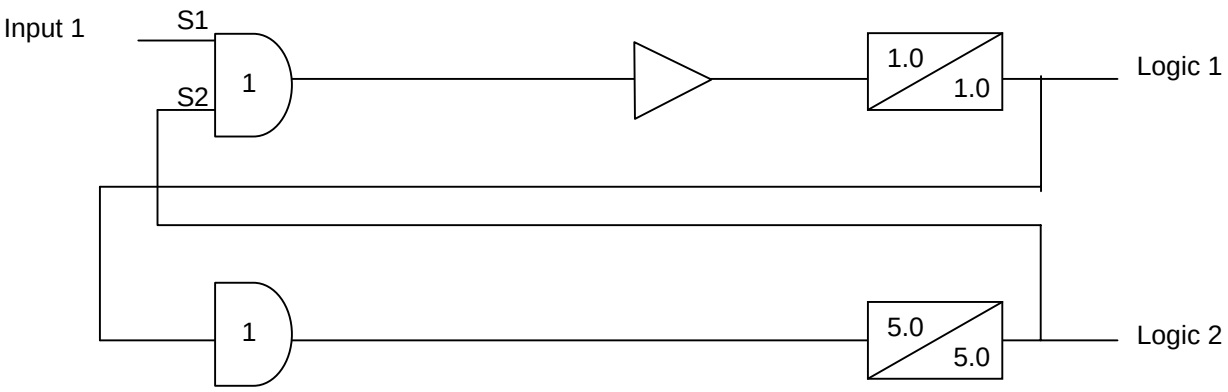

Each signal (S1...S8) has the same structure as the outputs/LEDs.

To configure a logic box, we can proceed in the same way as for the outputs/LEDs configuration per signal. If we want to assign more than one function to each signal, they must be all in the same group. We must click on the OR button, then on the I/O CONFIGURATION, and then select the desired group, etc.

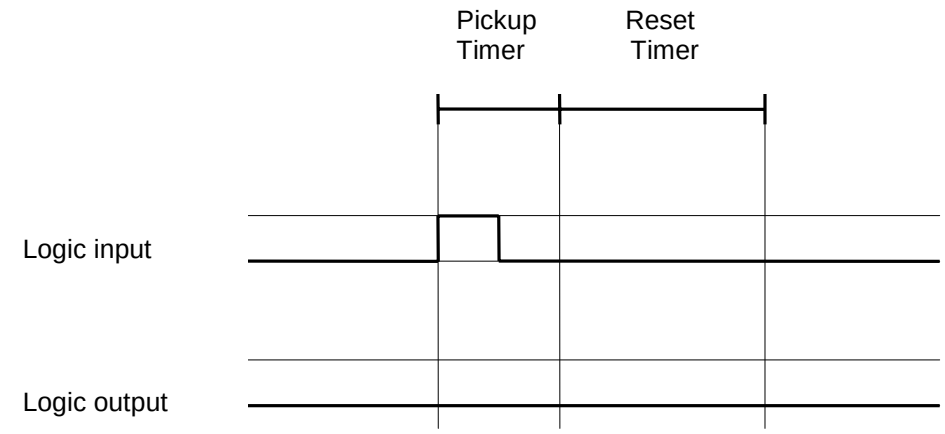
There are two timers, pickup and dropout timers, that can be assigned to each logic box.

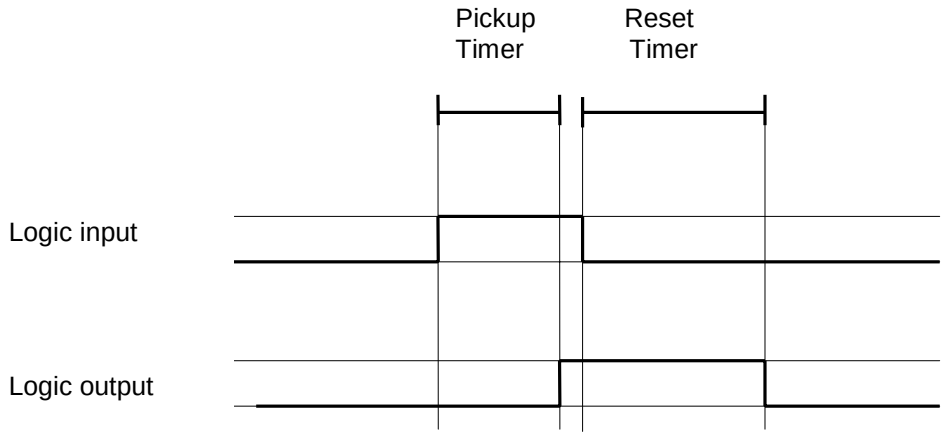
***IMPORTANT NOTE***
***Signals must be used in order, starting with S1. If we wish to use more than one signal in the same AND, use S2 first and then S3. If we wish to use another AND use AND 2 first, and then AND 3.***

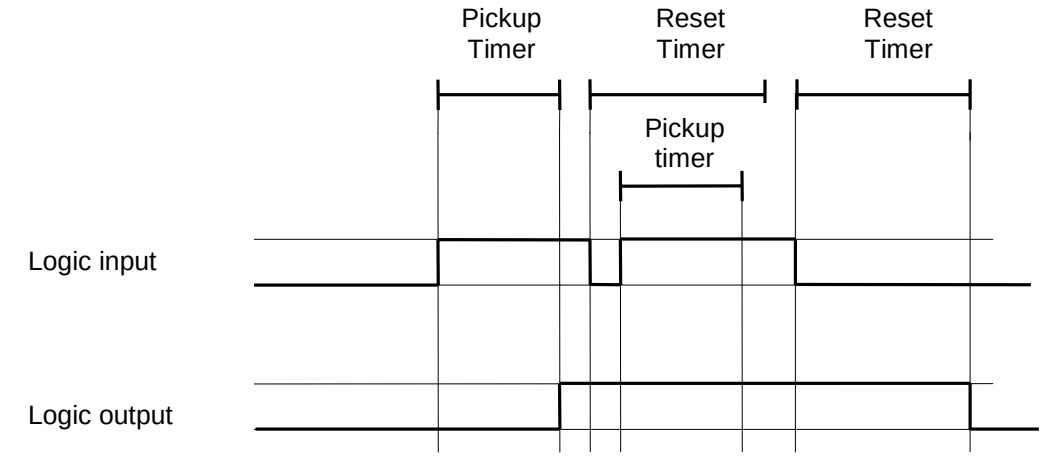
For example, we can configure the following logic, where Input 1 is the RESET signal:



Time diagram for the logic configuration:



### 7.1.2. LOGICAL FUNCTIONS

The list of functions that can be assigned in the configurable logic is divided in the following groups. The first groups are common to all MIV models:

| | |
|---|---|
| Not assigned | Output or LED not configured |

| | |
|---|---|
| Logic 1 | Output signal of logic 1 |
| Logic 2 | Output signal of logic 2 |
| Logic 3 | Output signal of logic 3 |
| Logic 4 | Output signal of logic 4 |

| | |
|---|---|
| Output 1 | Digital Output 1 |
| Output 2 | Digital Output 2 |
| Output 3 | Digital Output 3 |
| Output 4 | Digital Output 4 |
| Input 1 | Digital Input 1 |
| Input 2 | Digital Input 2 |

| | |
|---|---|
| Status 52 a | Active with breaker closed |
| Status 52 b | Active with breaker open |
| Table change (TABLE 2 activation) | The activation of this function means that the active table is T2. If it is inactive, the active table will be defined by the ACTIVE TABLE setting |
| Settings change inhibition | When this function is active, settings and tables cannot be modified. Only the active table can be changed to T2 using the Table Change digital input. |
| Generic input | Generic use function used for logic configuration |

| | |
|---|---|
| E2prom failure | Activated when a failure is detected in the E2prom management |
| User settings | This function is inactive when the unit is using the DEFAULT settings. When settings are modified by the user, this function is activated. |

| | |
|---|---|
| Ready | Active when the relay is in service and at least one protection unit has trip enabled. |

| | |
|---|---|
| Active Table | T1 or T2 |
| Local/Remote | This is LOCAL when the HMI is on the MAIN SETTINGS, ADVANCED SETTINGS or OPERATIONS menu. |

**MIV1000**

| | |
|---|---|
| Trip phase a | Any phase a unit has tripped |
| Trip phase b | Any phase b unit has tripped |
| Trip phase c | Any phase c unit has tripped |
| Trip phase | One of the 27P1, 27P2, 59P1, 59P2 units has tripped |
| Trip ground | One of the 59N1 and/or 59N2 units has tripped |

| | |
|---|---|
| Trip 59P | 59P1 and/or 59P2 unit trip |
| Trip 59N | 59N1 and/or 59N2 unit trip |
| Trip 27 | 27P1 and/or 27P2 unit trip |

| | |
|---|---|
| Phase voltage units inhibit (by DI) | Inhibition of 27P1, 27P2, 59P1 and 59P2 units trip |
| Ground voltage units inhibit (by DI) | Inhibition of 59N1 and 59N2 units trip |

| | |
|---|---|
| Trip 27_1 a | Trip of unit 27P1 phase a |
| Trip 27_1 b | Trip of unit 27P1 phase b |
| Trip 27_1 c | Trip of unit 27P1 phase c |
| Trip 27_2 a | Trip of unit 27P2 phase a |
| Trip 27_2 b | Trip of unit 27P2 phase b |
| Trip 27_2 c | Trip of unit 27P2 phase c |

| | |
|---|---|
| Trip 59_1 a | Trip of unit 59P1 phase a |
| Trip 59_1 b | Trip of unit 59P1 phase b |
| Trip 59_1 c | Trip of unit 59P1 phase c |
| Trip 59_2 a | Trip of unit 59P2 phase a |
| Trip 59_2 b | Trip of unit 59P2 phase b |
| Trip 59_2 c | Trip of unit 59P2 phase c |

| | |
|---|---|
| Trip 27P1 | Trip of unit 27P1 |
| Trip 27P2 | Trip of unit 27P2 |
| Trip 59P1 | Trip of unit 59P1 |
| Trip 59P2 | Trip of unit 59P2 |
| Trip 59N1 | Trip of unit 59N1 |
| Trip 59N2 | Trip of unit 59N2 |

| | |
|---|---|
| General Trip | Trip of any unit |

| | |
|---|---|
| Pickup 27_1 a | Pickup of unit 27P1 phase a |
| Pickup 27_1 b | Pickup of unit 27P1 phase b |
| Pickup 27_1 c | Pickup of unit 27P1 phase c |
| Pickup 27_2 a | Pickup of unit 27P2 phase a |
| Pickup 27_2 b | Pickup of unit 27P2 phase b |
| Pickup 27_2 c | Pickup of unit 27P2 phase c |

| | |
|---|---|
| Pickup 59_1 a | Pickup of unit 59P1 phase a |
| Pickup 59_1 b | Pickup of unit 59P1 phase b |
| Pickup 59_1 c | Pickup of unit 59P1 phase c |
| Pickup 59_2 a | Pickup of unit 59P2 phase a |
| Pickup 59_2 b | Pickup of unit 59P2 phase b |
| Pickup 59_2 c | Pickup of unit 59P2 phase c |

| | |
|---|---|
| Pickup 27P1 | Pickup of unit 27P1 |
| Pickup 27P2 | Pickup of unit 27P2 |
| Pickup 59P1 | Pickup of unit 59P1 |
| Pickup 59P2 | Pickup of unit 59P2 |
| Pickup 59N1 | Pickup of unit 59N1 |
| Pickup 59N2 | Pickup of unit 59N2 |

| | |
|---|---|
| General pickup | Pickup of any unit |

| | |
|---|---|
| Virtual trip 27_1 a | Virtual trip of unit 27P1 phase a |
| Virtual trip 27_1 b | Virtual trip of unit 27P1 phase b |
| Virtual trip 27_1 c | Virtual trip of unit 27P1 phase c |
| Virtual trip 27_2 a | Virtual trip of unit 27P2 phase a |
| Virtual trip 27_2 b | Virtual trip of unit 27P2 phase b |

| | |
|---|---|
| Virtual trip 27_2 c | Virtual trip of unit 27P2 phase c |

| | |
|---|---|
| Virtual trip 59_1 a | Virtual trip of unit 59P1 phase a |
| Virtual trip 59_1 b | Virtual trip of unit 59P1 phase b |
| Virtual trip 59_1 c | Virtual trip of unit 59P1 phase c |
| Virtual trip 59_2 a | Virtual trip of unit 59P2 phase a |
| Virtual trip 59_2 b | Virtual trip of unit 59P2 phase b |
| Virtual trip 59_2 c | Virtual trip of unit 59P2 phase c |

| | |
|---|---|
| Virtual trip 27P1 | Virtual trip of unit 27P1 |
| Virtual trip 27P2 | Virtual trip of unit 27P2 |
| Virtual trip 59P1 | Virtual trip of unit 59P1 |
| Virtual trip 59P2 | Virtual trip of unit 59P2 |
| Virtual trip 59N1 | Virtual trip of unit 59N1 |
| Virtual trip 59N2 | Virtual trip of unit 59N2 |

| | |
|---|---|
| General virtual trip | Virtual trip of any unit |

| | |
|---|---|
| Inhib 27P1 (by DI) | Unit 27P1 trip inhibition |
| Inhib 27P2 (by DI) | Unit 27P2 trip inhibition |
| Inhib 59P1 (by DI) | Unit 59P1 trip inhibition |
| Inhib 59P2 (by DI) | Unit 59P2 trip inhibition |
| Inhib 59N1 (by DI) | Unit 59N1 trip inhibition |
| Inhib 59N2 (by DI) | Unit 59N2 trip inhibition |

| | |
|---|---|
| Trip inhib. (by DI) | Trip inhibition |

| | |
|---|---|
| General trip | General trip |

**MIV 2000**

| | |
|---|---|
| Trip 81_1 | Trip of unit 81_1 |
| Trip 81_2 | Trip of unit 81_2 |
| Trip 81_3 | Trip of unit 81_3 |
| Trip 81_4 | Trip of unit 81_4 |
| General trip | Trip of any unit |

| | |
|---|---|
| Pickup 81_1 | Pickup of unit 81_1 |
| Pickup 81_2 | Pickup of unit 81_2 |
| Pickup 81_3 | Pickup of unit 81_3 |
| Pickup 81_4 | Pickup of unit 81_4 |
| General pickup | Pickup of any unit |

| | |
|---|---|
| Virtual trip 81_1 | Virtual trip of unit 81_1 |
| Virtual trip 81_2 | Virtual trip of unit 81_2 |
| Virtual trip 81_3 | Virtual trip of unit 81_3 |
| Virtual trip 81_4 | Virtual trip of unit 81_4 |
| General virtual trip | Virtual trip of any unit |

| | |
|---|---|
| Inhib 81_1 (by DI) | Unit 81_1 trip inhibition |
| Inhib 81_2 (by DI) | Unit 81_2 trip inhibition |
| Inhib 81_3 (by DI) | Unit 81_3 trip inhibition |
| Inhib 81_4 (by DI) | Unit 81_4 trip inhibition |
| Trip inhib. (by DI) | General trip inhibition |

**MIV 3000**

| | |
|---|---|
| Trip phase a | Trip of any phase a unit |
| Trip phase b | Trip of any phase b unit |
| Trip phase c | Trip of any phase c unit |
| Phase trip | Trip of 27P1, 27P2, 59P1, 59P2 or 47 unit |
| Ground trip | Trip of 59N1 and/or 59N2 unit |

| | |
|---|---|
| Frequency trip | Trip of unit 81_1 and/or 81_2 |
| Trip 81_1 | Trip of unit 81_1 |
| Trip 81_2 | Trip of unit 81_2 |
| General trip | Trip of any unit |

| | |
|---|---|
| Trip 59P | 59P1 and/or 59P2 unit trip |
| Trip 59N | 59N1 and/or 59N2 unit trip |
| Trip 27 | 27P1 and/or 27P2 unit trip |
| Phase voltage units inhibition (by DI) | 27P1, 27P2, 59P1 and 59P2 unit trip |
| Ground voltage units inhibition (by DI) | 59N1 and 59N2 unit trip |

| | |
|---|---|
| Trip 27_1 a | Trip of unit 27P1 phase a |
| Trip 27_1 b | Trip of unit 27P1 phase b |
| Trip 27_1 c | Trip of unit 27P1 phase c |
| Trip 27_2 a | Trip of unit 27P2 phase a |
| Trip 27_2 b | Trip of unit 27P2 phase b |
| Trip 27_2 c | Trip of unit 27P2 phase c |

| | |
|---|---|
| Trip 59_1 a | Trip of unit 59P1 phase a |
| Trip 59_1 b | Trip of unit 59P1 phase b |
| Trip 59_1 c | Trip of unit 59P1 phase c |
| Trip 59_2 a | Trip of unit 59P2 phase a |
| Trip 59_2 b | Trip of unit 59P2 phase b |
| Trip 59_2 c | Trip of unit 59P2 phase c |

| | |
|---|---|
| Trip 27P1 | Trip of unit 27P1 |
| Trip 27P2 | Trip of unit 27P2 |
| Trip 59P1 | Trip of unit 59P1 |
| Trip 59P2 | Trip of unit 59P2 |
| Trip 59N1 | Trip of unit 59N1 |
| Trip 59N2 | Trip of unit 59N2 |
| Trip 47 | Trip of unit 47 |

| | |
|---|---|
| Pickup 27_1 a | Pickup of unit 27P1 phase a |
| Pickup 27_1 b | Pickup of unit 27P1 phase b |
| Pickup 27_1 c | Pickup of unit 27P1 phase c |
| Pickup 27_2 a | Pickup of unit 27P2 phase a |
| Pickup 27_2 b | Pickup of unit 27P2 phase b |
| Pickup 27_2 c | Pickup of unit 27P2 phase c |

| | |
|---|---|
| Pickup 59_1 a | Pickup of unit 59P1 phase a |
| Pickup 59_1 b | Pickup of unit 59P1 phase b |
| Pickup 59_1 c | Pickup of unit 59P1 phase c |
| Pickup 59_2 a | Pickup of unit 59P2 phase a |
| Pickup 59_2 b | Pickup of unit 59P2 phase b |
| Pickup 59_2 c | Pickup of unit 59P2 phase c |

| | |
|---|---|
| Pickup 27P1 | Pickup of unit 27P1 |

| | |
|---|---|
| Pickup 27P2 | Pickup of unit 27P2 |
| Pickup 59P1 | Pickup of unit 59P1 |
| Pickup 59P2 | Pickup of unit 59P2 |
| Pickup 59N1 | Pickup of unit 59N1 |
| Pickup 59N2 | Pickup of unit 59N2 |
| Pickup 47 | Pickup of unit 47 |

| | |
|---|---|
| Pickup 81_1 | Pickup of unit 81_1 |
| Pickup 81_2 | Pickup of unit 81_2 |
| General pickup | Pickup of any unit |

| | |
|---|---|
| Trip virtual 27_1 a | Trip virtual de la unit 27P1 phase a |
| Trip virtual 27_1 b | Trip virtual de la unit 27P1 phase b |
| Trip virtual 27_1 c | Trip virtual de la unit 27P1 phase c |
| Trip virtual 27_2 a | Trip virtual de la unit 27P2 phase a |
| Trip virtual 27_2 b | Trip virtual de la unit 27P2 phase b |
| Trip virtual 27_2 c | Trip virtual de la unit 27P2 phase c |

| | |
|---|---|
| Virtual trip 59_1 a | Virtual trip of unit 59P1 phase a |
| Virtual trip 59_1 b | Virtual trip of unit 59P1 phase b |
| Virtual trip 59_1 c | Virtual trip of unit 59P1 phase c |
| Virtual trip 59_2 a | Virtual trip of unit 59P2 phase a |
| Virtual trip 59_2 b | Virtual trip of unit 59P2 phase b |
| Virtual trip 59_2 c | Virtual trip of unit 59P2 phase c |

| | |
|---|---|
| Virtual trip 27P1 | Virtual trip of unit 27P1 |
| Virtual trip 27P2 | Virtual trip of unit 27P2 |
| Virtual trip 59P1 | Virtual trip of unit 59P1 |
| Virtual trip 59P2 | Virtual trip of unit 59P2 |
| Virtual trip 59N1 | Virtual trip of unit 59N1 |
| Virtual trip 59N2 | Virtual trip of unit 59N2 |
| Virtual trip 47 | Virtual trip of unit 47 |

| | |
|---|---|
| Virtual trip 81_1 | Virtual trip of unit 81_1 |
| Virtual trip 81_2 | Virtual trip of unit 81_2 |
| General virtual trip | Virtual trip of any unit |

| | |
|---|---|
| Voltage inhib (by DI) | Trip inhibition of units 27P1, 27P2, 59P1, 59P2, 59N1, 59N2 and 47 |
| Inhib 27P1 (by DI) | Unit 27P1 trip inhibition |
| Inhib 27P2 (by DI) | unit 27P2 trip inhibition |
| Inhib 59P1 (by DI) | unit 59P1 trip inhibition |
| Inhib 59P2 (by DI) | unit 59P2 trip inhibition |
| Inhib 59N1 (by DI) | unit 59N1 trip inhibition |
| Inhib 59N2 (by DI) | unit 59N2 trip inhibition |
| Inhib 47 (by DI) | unit 47 trip inhibition |

| | |
|---|---|
| Frequency Inhib (by DI) | 81_1, 81_2, 81_3 and 81_4 units inhibition |
| Inhib 81_1 (by DI) | 81_1 unit trip inhibition |
| Inhib 81_2 (by DI) | 81_2 unit trip inhibition |
| Trip inhib (by DI) | All trips inhibited |

# 8. KEYPAD AND DISPLAY

## 8.1. FACEPLATE KEYPAD

**MIV** faceplate keypad comprises three keys, as shown in figure 8.1.

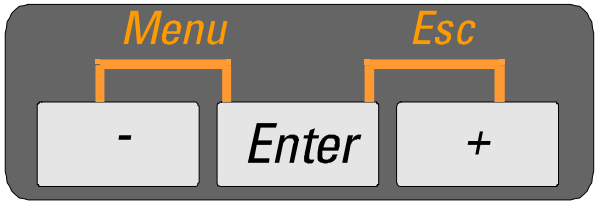



**FIGURE 8.1. KEYPAD**

As described in section 1.4.1 Hierarchical Menu, "**Menu**" function is activated when the "**-**" and "**Enter**" keys are pressed simultaneously. The Menu function takes us to the second level within the hierarchical structure of the device settings. To access the third level press the **Enter** key when the desired menu is shown in the display. To return to the previous level (from the third level to the second one, or from the second level to the first one) you must activate the **Esc** function. This is done by pressing the "**Enter**" and "**+**" keys simultaneously.

## 8.2. ALPHANUMERICAL DISPLAY

The faceplate display of the MIV relay is a 3.5 characters alphanumeric (can display letters and numbers) display. It is a LEDs matrix type display. Using the display you can view different types of data, as settings, trip information, alarms, etc.

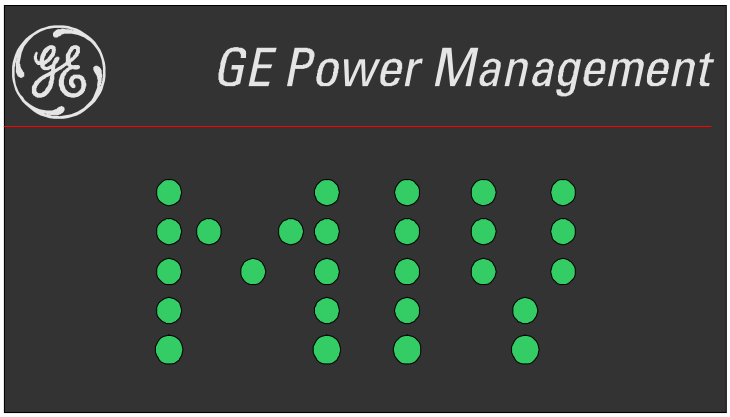



**FIGURE 8.2. ALPHANUMERICAL DISPLAY**

Messages in the display are shown in English language. If the keypad is not in use during 15 minutes, the relay will automatically perform an scrolling through the most relevant measures.

## 8.3. MAIN STRUCTURE

If the keypad is not in use, during steady state, the faceplate display shows the relay model identification **(MIV)** and a series of actual values.

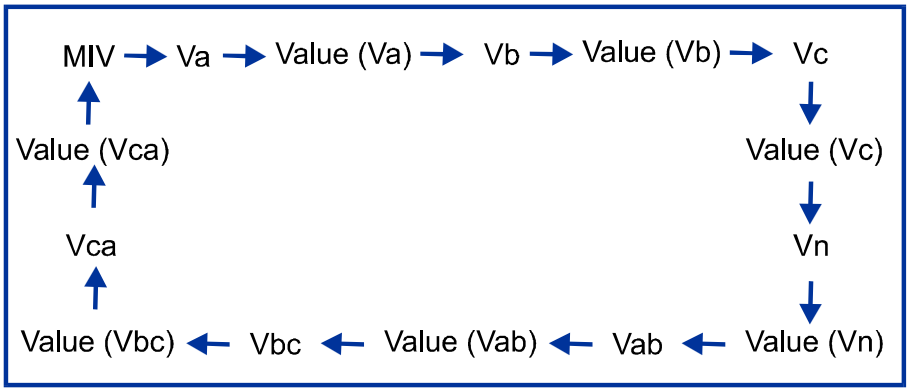



**FIGURE 8-3. GENERAL PRESENTATION SCHEME "SCROLLING" FOR MIV1000 MODELS**

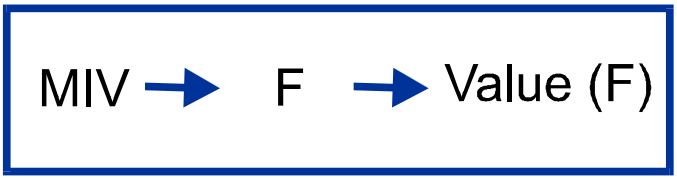



**FIGURE 8-4. GENERAL PRESENTATION SCHEME "SCROLLING" FOR MIV2000 MODELS**

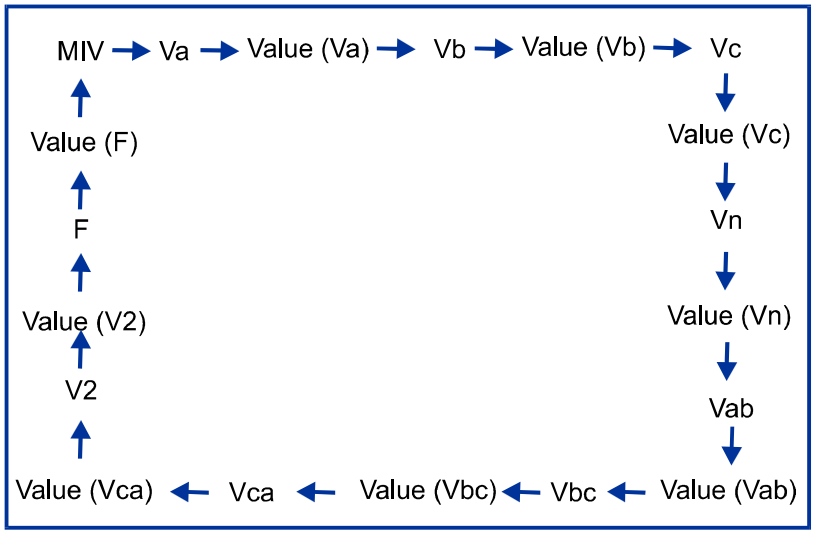
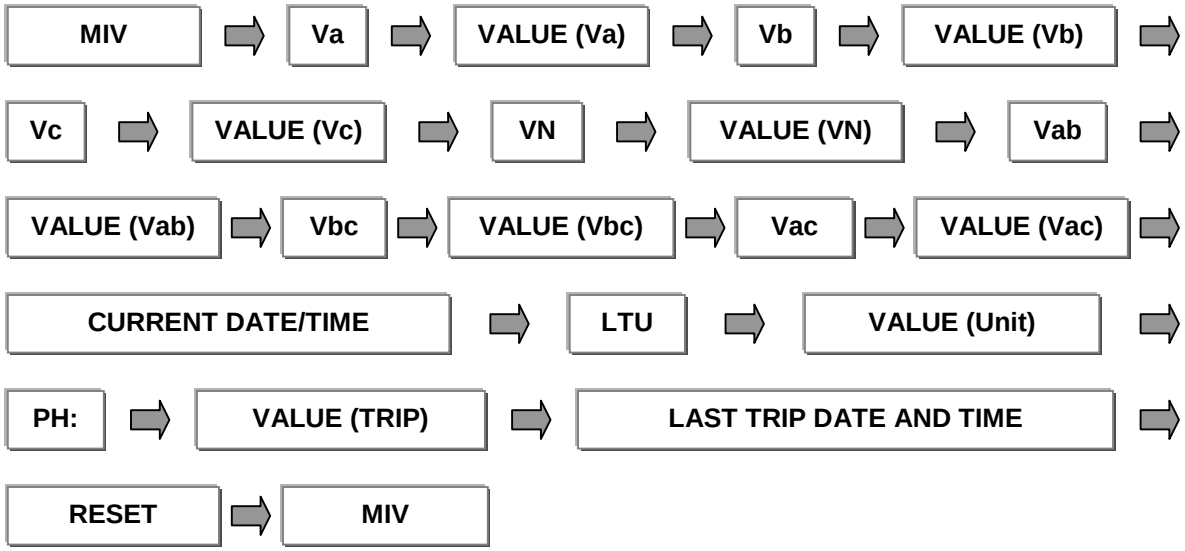



**FIGURE 8-5. GENERAL PRESENTATION SCHEME "SCROLLING" FOR MIV3000 MODELS**

**There are two ways of exiting the stand-by status:**

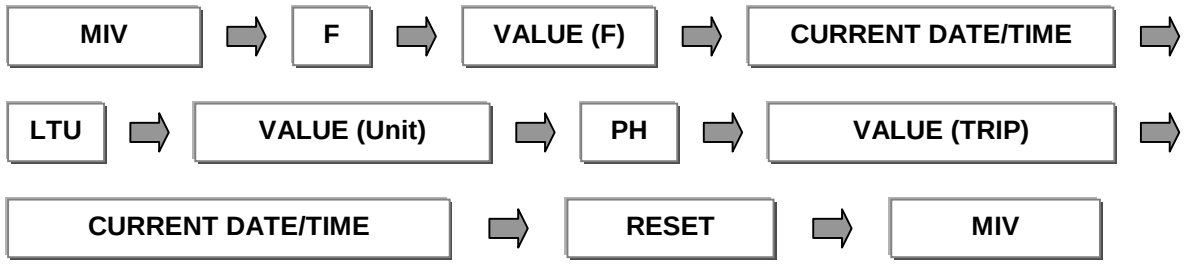
### 8.3.1. MODE 1: ENTERING THE SINGLE-KEY MODE BY PRESSING THE ENTER KEY:

The **SINGLE-KEY OPERATION** menu allows the user to access the same information shown by the automatic scrolling during steady state plus Date and Time and Last Trip Information (Function that tripped (LTU = Last Trip Unit), Phases involved).



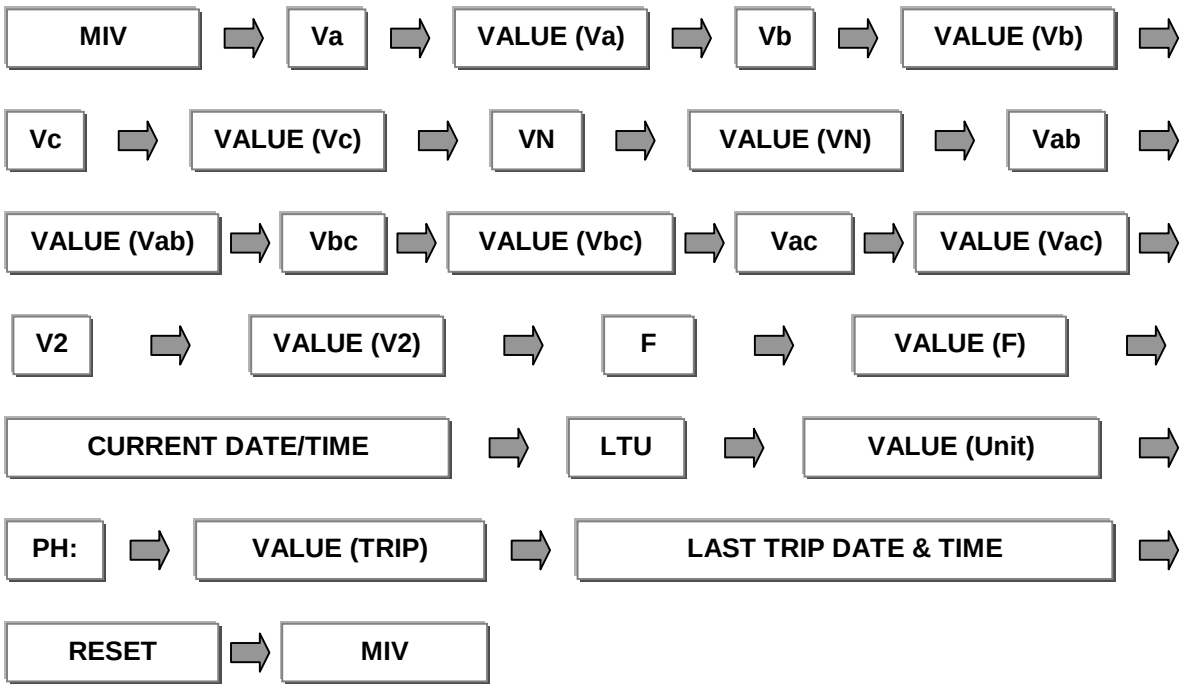

**We can always return to the stand-by status by pressing ESC**

**FIGURE 8-6. SINGLE-KEY OPERATION MENU FOR MIV1000 MODELS**




**We can always return to the stand-by status by pressing ESC**

**FIGURE 8-7. SINGLE-KEY OPERATION MENU FOR MIV2000 MODELS**




**We can always return to the stand-by status by pressing ESC**

**FIGURE 8-8. SINGLE-KEY OPERATION MENU FOR MIV3000 MODELS**

The mnemonics used in the figure have the following meanings:

**Va :** Phase A voltage
**Vb :** Phase B voltage
**Vc :** Phase C voltage
**VN :** Ground voltage
**Vab :** AB phase-to-phase voltage
**Vbc :** BC phase-to-phase voltage
**Vac :** CA phase-to-phase voltage
**V2 :** Negative sequence voltage
**F :** Frequency
**VALUE(Va)** : Measure in volts of phase A voltage
**VALUE(Vb) :** Measure in volts of phase B voltage
**VALUE(Vc) :** Measure in volts of phase C voltage
**VALUE(VN) :** Measure in volts of ground voltage
**VALUE(Vab) :** Measure in volts of phase-to-phase voltage for phases AB
**VALUE(Vbc) :** Measure in volts of phase-to-phase voltage for phases BC
**VALUE(Vac) :** Measure in volts of phase-to-phase voltage for phases CA
**VALUE(V2) :** Measure in volts of the negative sequence voltage
**VALUE(F) :** Frequency measure in Hz.

**LTU :** Last trip unit

**VALUE(unit) :** Shows which protection unit has caused the last trip

**PH:** Shows which phase has caused the last trip

**VALUE(trip) :** Shows the value of the magnitude that has caused the trip.

In case of a voltage unit, this value will be measured in volts, and in case of a frequency unit, in Hertzs.

### 8.3.2. MODE 2: ENTERING A MENU USING THE MENU & ESC KEYS:

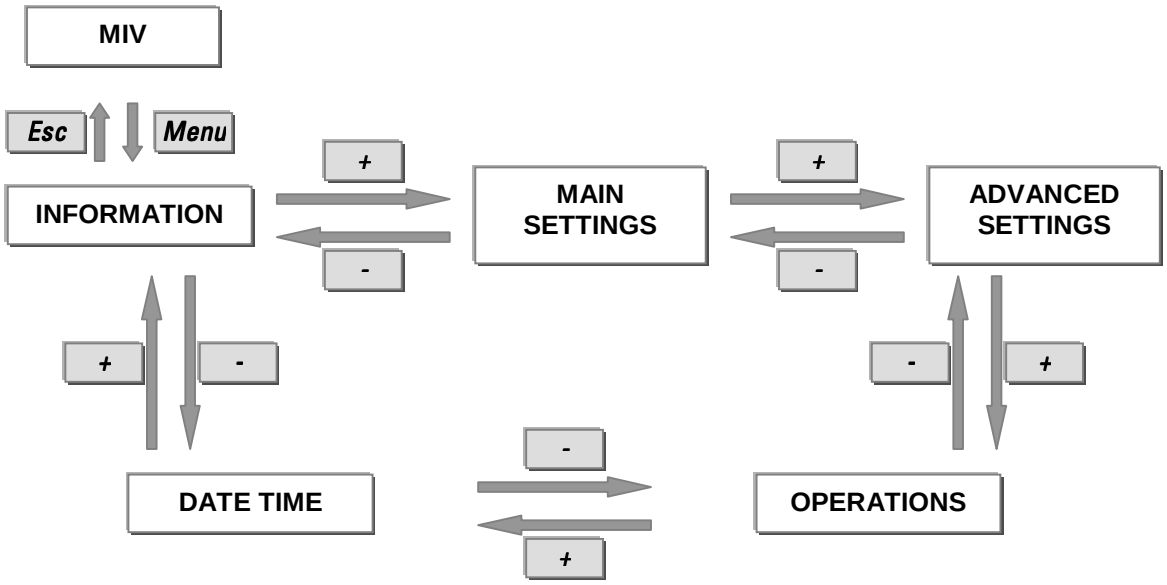



**FIGURE 8.9. MENU MODE DISPLAY SEQUENCE**

The mnemonics used in the previous figure refer to the different sub-menus in the relay, and have the following meaning:

**INFORMATION** Shows information about the internal status of the device.

**MAIN SETTINGS** Access to the Main Settings of the relay.

**ADVANCED SETTINGS** Access to the Advanced Settings of the relay.

**OPERATIONS** Access to the Commands menu of the device.

**DATE TIME** Access to the relay Date and Time.

## 8.4. INFORMATION MENU

The information menu accesses internal data in the relay, as the status of the contact inputs, contact outputs, AC inputs, firmware version and relay date and time.

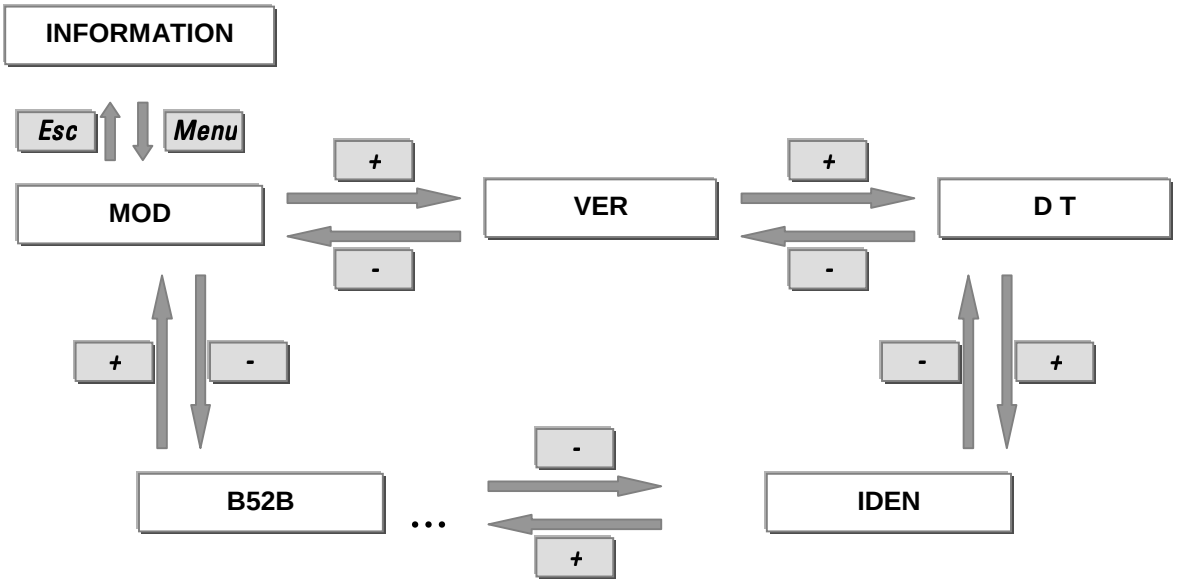



**FIGURE 8.10. DISPLAY SEQUENCE IN THE INFORMATION MENU**

To access the Information menu it is necessary to select **Menu** (pressing "**Enter**" and "**-**" simultaneously), and then press **Enter** when the display shows **INFORMATION**. Movement through the different options in this menu is done with the **"+"** and **"-"** keys.

Once on the desired item of the menu, pressing **Enter** the corresponding value is shown in the faceplate display.

The mnemonics used in the previous figure have the following meaning:

| | |
|---|---|
| **MOD** | Relay Model number |
| **VER** | Firmware version installed in the relay. |
| **D T** | Relay Date and Time. |
| **IDEN** | Identification. |
| **Va,Vb,Vc,Vab,Vbc,Vac,V2,F** : | Already defined |
| **INP1** | Contact Input # 1 status. |
| **INP2** | Contact Input # 2 status. |
| **OUT1** | Contact Output #1 status. |
| **OUT2** | Contact Output #2 status. |
| **OUT3** | Contact Output #3 status. |
| **OUT4** | Contact Output #4 status. |
| **B 52A** | Terminal 52 A |
| **B 52B** | Terminal 52 B |

## 8.5. MAIN SETTINGS MENU

Keypad and Display handling to access the Main Settings menu:

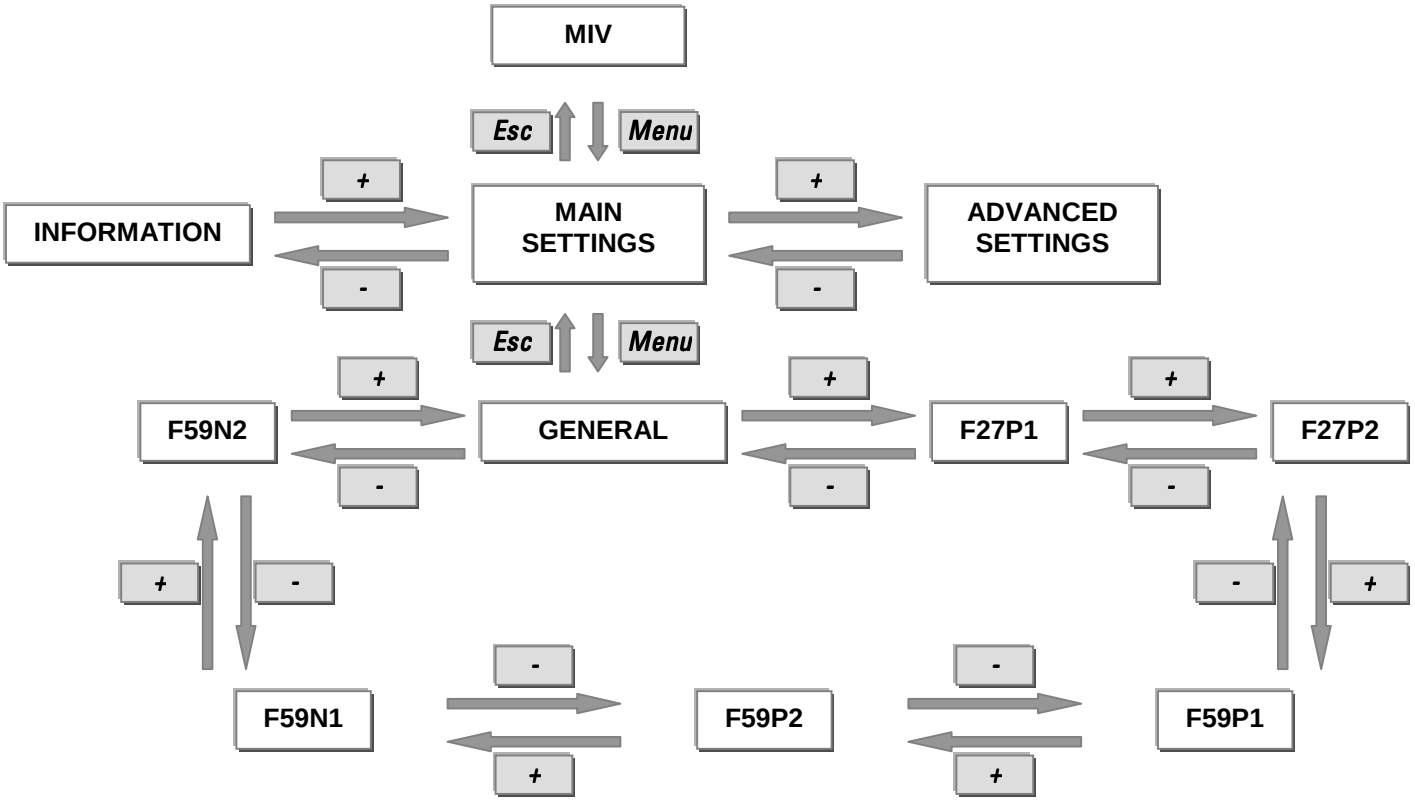



**FIGURE 8.11. SAMPLE OF MAIN SETTINGS SCREEN SEQUENCE FOR MIV1000**

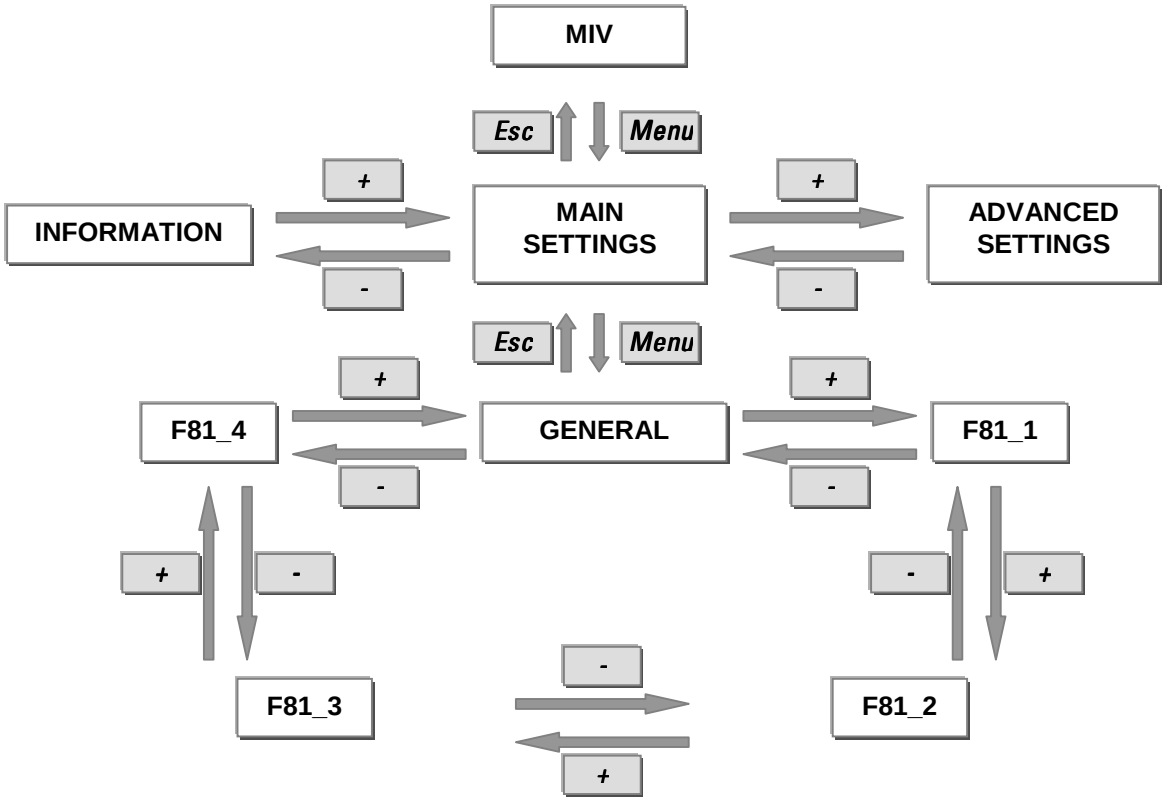



**FIGURE 8.12. SAMPLE OF MAIN SETTINGS SCREEN SEQUENCE FOR MIV2000**

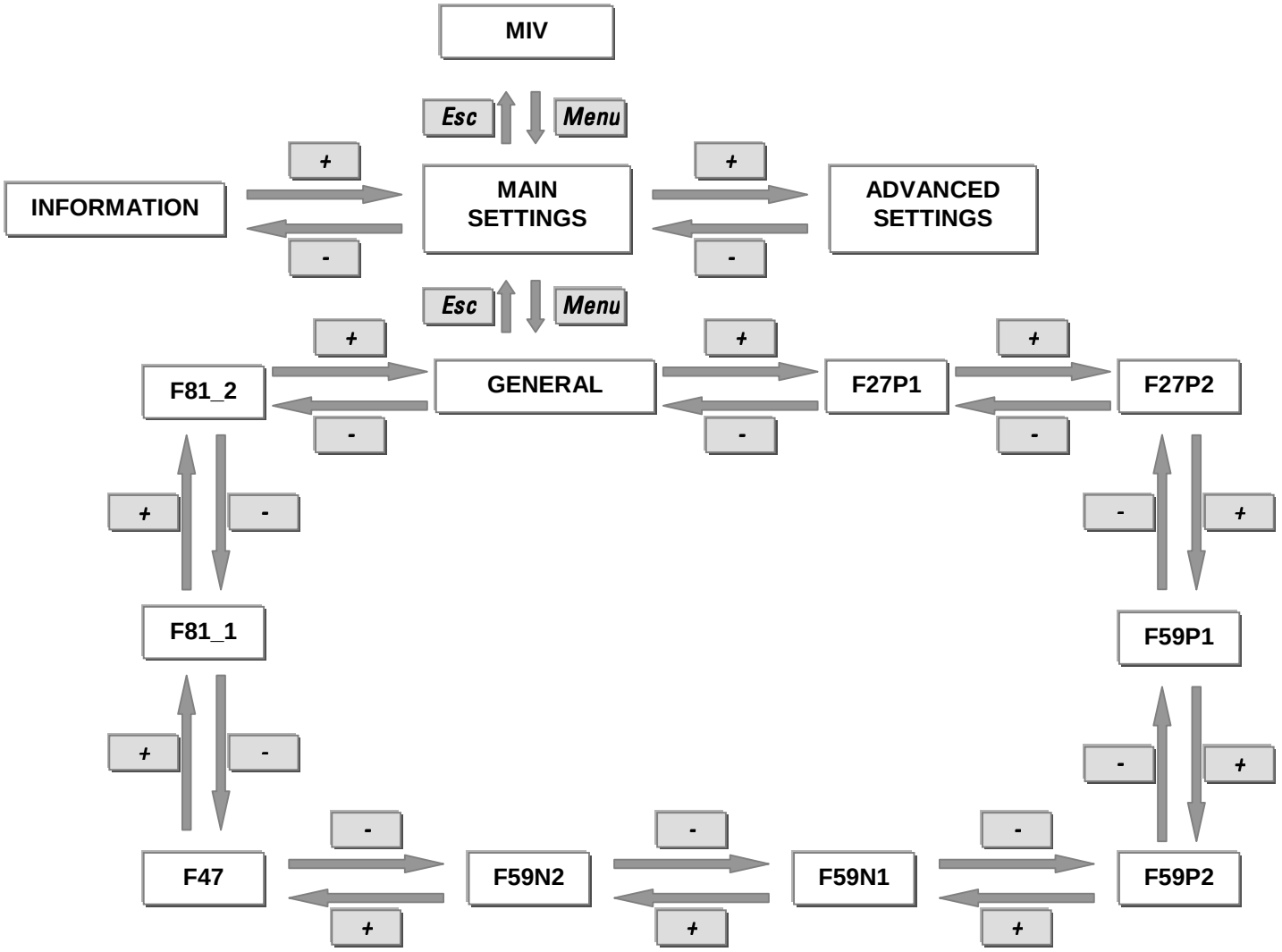



**FIGURE 8.13. SAMPLE OF MAIN SETTINGS SCREEN SEQUENCE FOR MIV3000**

From the Main Settings heading, the General Settings heading is reached pressing **Enter**. From this point, movement through all the different headings in the same level is done pressing "**+**" and "**-**" keys.

The different headings in the same level than General Settings are:

| | |
|---|---|
| **GENERAL** : | General settings |
| **F27P1** : | Unit 27P1 Phase undervoltage |
| **F27P2**: | Unit 27P2 Phase undervoltage |
| **F59P1**: | Unit 59P1 Phase overvoltage |
| **F59P2**: | Unit 59P2 Phase overvoltage |
| **F59N1**: | Unit 59N1 Ground overvoltage |
| **F59N2**: | Unit 59N2 Ground overvoltage |
| **F47**: | Unit 47 Voltage Unbalance |
| **F81_1**: | Unit 81_1 Underfrequency/overfrequency |
| **F81_2:** | Unit 81_2 Underfrequency/overfrequency |
| **F81_3:** | Unit 81_3 Underfrequency/overfrequency |
| **F81_4:** | Unit 81_4 Underfrequency/overfrequency |

From the MAIN SETTINGS general screen we can access the following options by pressing ENTER:

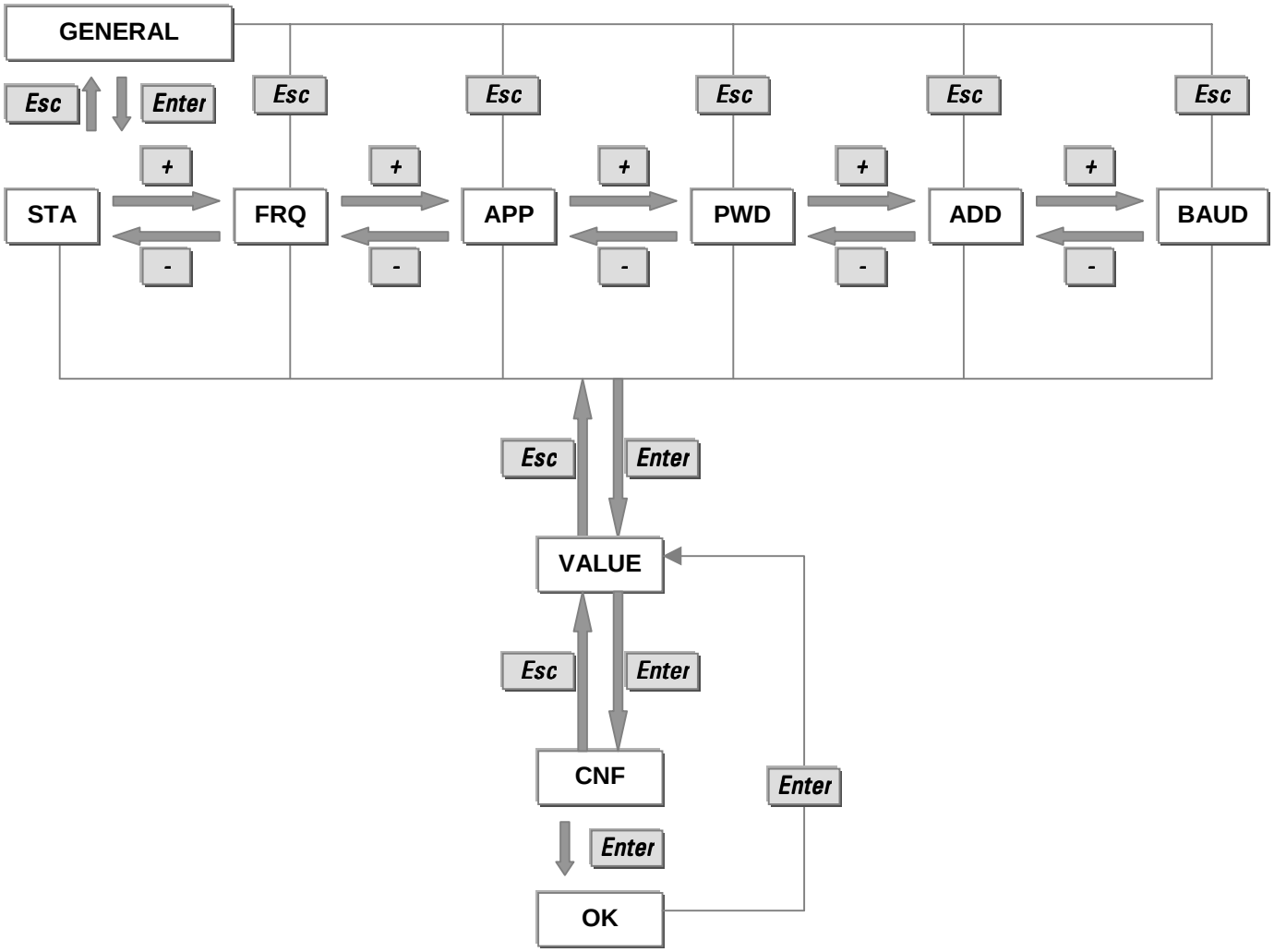



**FIGURE 8.14. GENERAL SETTINGS**

Once the desired option is displayed, pressing **Enter** the actual value of the setpoint is shown, blinking. To modify this value press "+" and "-". To accept the value modification press **Enter** again and confirm your change.

The mnemonics in the figure stand for:

| | | |
|---|---|---|
| **STA** | STATUS | Protection status. |
| | Range: | |
| | RDY | In service |
| | DIS | Out of service |

**FRQ** _ FREQUENCY _ Frequency.

Range:

| | |
|---|---|
| 50 | 50 HZ. |
| 60 | 60 HZ. |

**APP** APPLICATION Application.

Range:

| | |
|---|---|
| -3PNWYE | 3 phases + ground. Phase-to-ground voltage. |
| -3PDELTA | 3 phases. Phase-to-phase voltage. |
| -PHASE | One-phase. |
| - GROUND | Ground. |

**PWD** PASSWORD

Range:

1,2,3,... 255 (identification number).

**ADD** ADDRESS Communications address.

Range:

1,2,3,... 255 (identification number).

**BAUD** BAUD Baudrate.

Range:

| | |
|---|---|
| -0.3 | 300 bauds. |
| -0.6 | 600 bauds. |
| -1.2 | 1200 bauds. |
| -2.4 | 2400 bauds. |
| -4.8 | 4800 bauds. |
| -9.6 | 9600 bauds. |
| - 19.2 | 19200 bauds. |

**CNF** CONFIRMATION OK Validates the chosen value.

From the **F27P1** display we can access the following options:

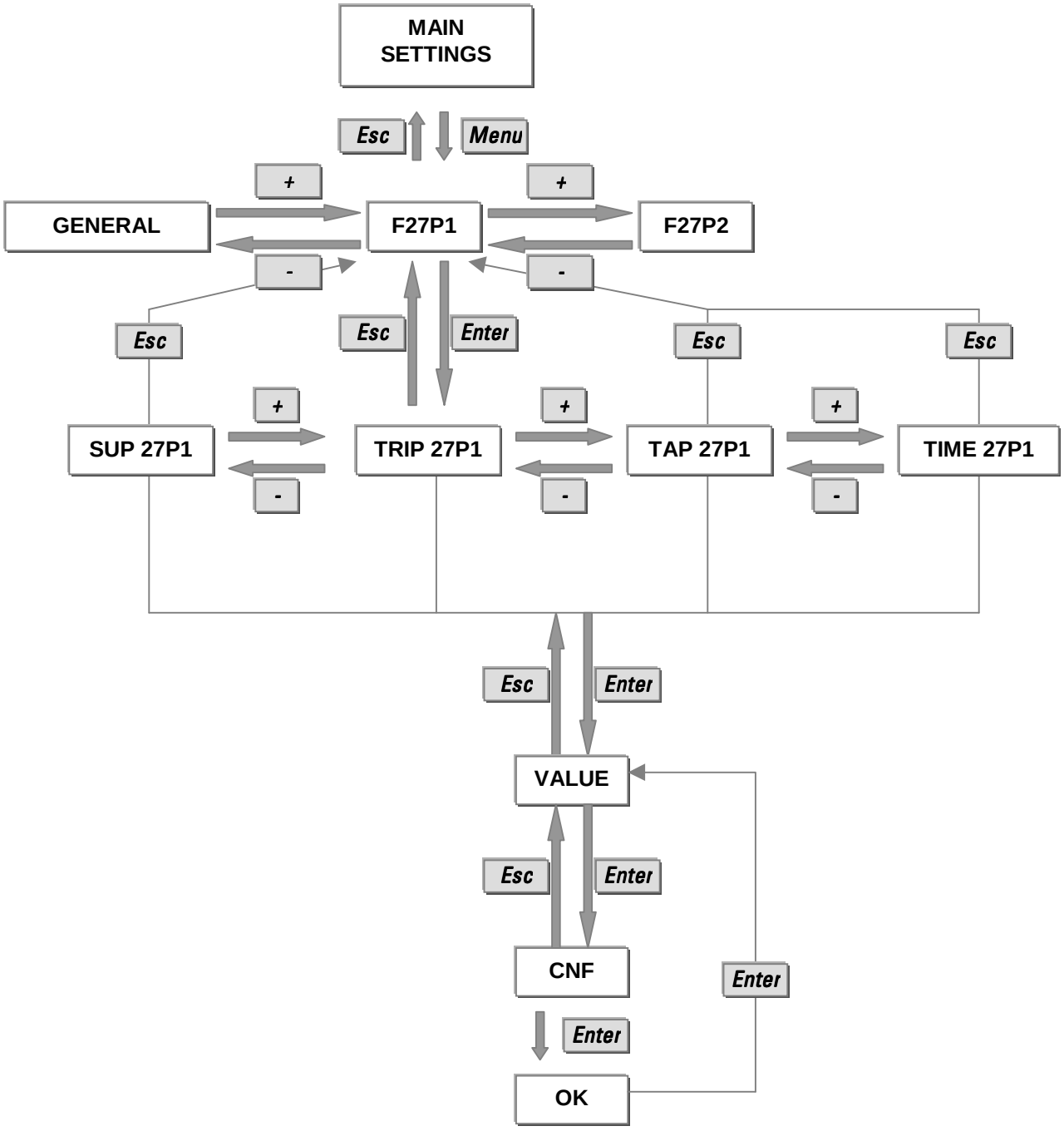



**FIGURE 8.15. DISPLAY SEQUENCE FROM F27P1**

Once we have reached an option after pressing ENTER from the function display, we press ENTER again to see the value of the chosen option. This value can be modified by pressing “+” and “-” keys.

The mnemonics appearing in the above scheme are the following:

| | | | | |
|---|---|---|---|---|
| **TRIP 27P1**: | Trip permission 27P1 | Range: | Y(YES)/N(NO) | |
| **TAP 27P1**: | Tap 27P1 | Range: | 10..250V | STEP: 0.1V |
| | | | 2..60V | |
| **TIME 27P1**: | Timer 27P1 | Range: | 0..600s | STEP: 0.01s |
| **SUP 27P1**: | Supervision 27P1 by 52 | Range: | Y(SI)/N(NO) | |
| **CNF**: | CONFIRMATION | OK | validates the selected value | |

From **F27P2**:

The display sequence is the same as for F27P1 with a 2 replacing the 1.

**From the F59P1 display, we can access the following options:**

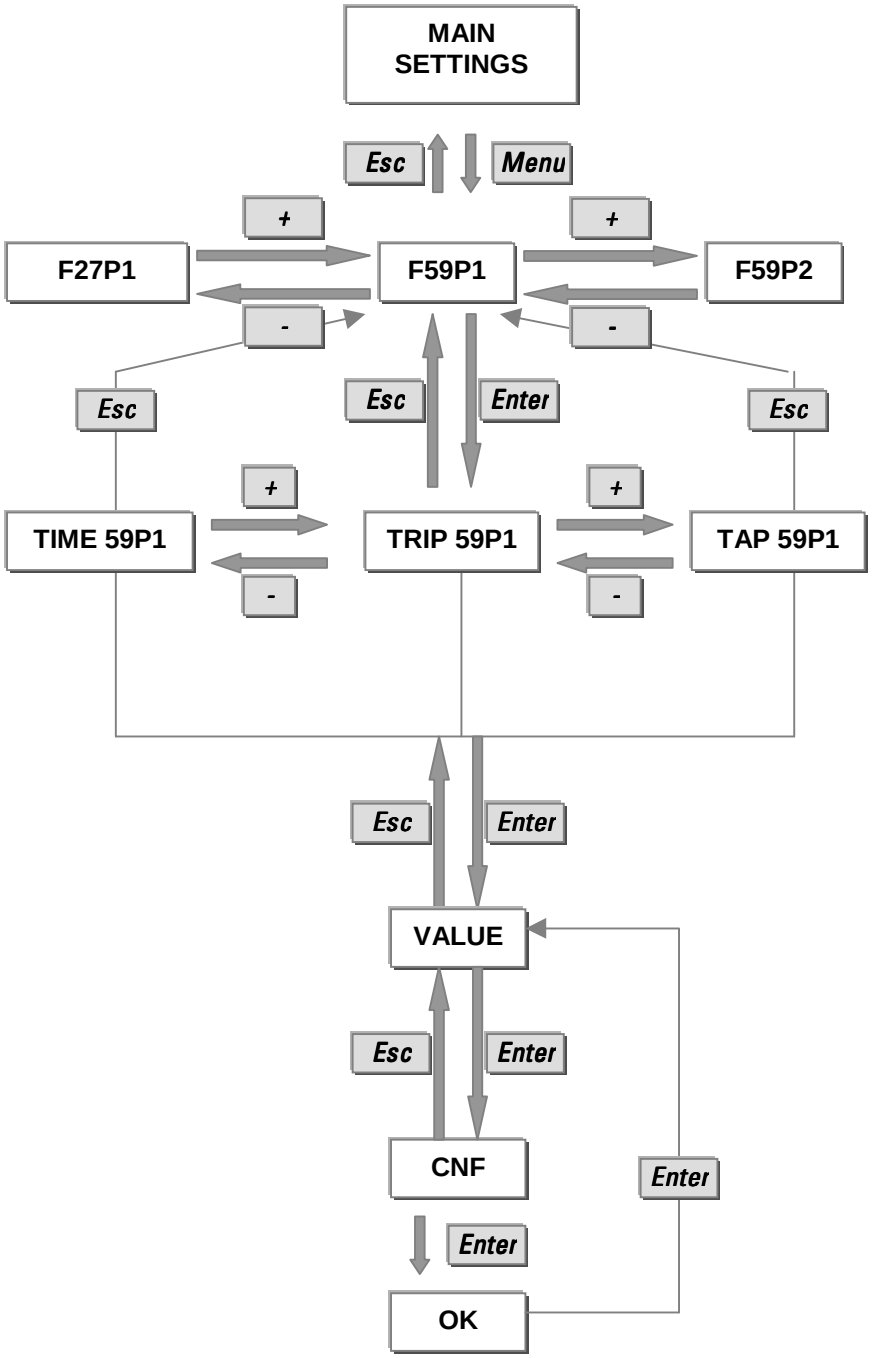



**FIGURE 8.16. DISPLAY SEQUENCE FROM F59P1**

Once we have reached an option after pressing ENTER from the function display, we press ENTER again to see the value of the chosen option. This value can be modified by pressing “+” and “-” keys.

The mnemonics appearing in the above diagram are the following:

| | | | | |
|---|---|---|---|---|
| **TRIP 59P1**: | Trip permission 59P1 | Range: | Y(YES)/N(NO) | |
| **TAP 59P1** | Tap 59P1 | Range: | 10..250V | STEP: 0.1V |
| | | | 2..60V | |
| **TIME 59P1**: | Timer 59P1 | Range: | 0..600s | STEP: 0.01s |
| **CNF**: | CONFIRMATION | OK | validates the selected value | |

From **F59P2, F59N1** and **F59N2:**

The sequence is the same as for F59P1.

**From F47, we can access the following options:**

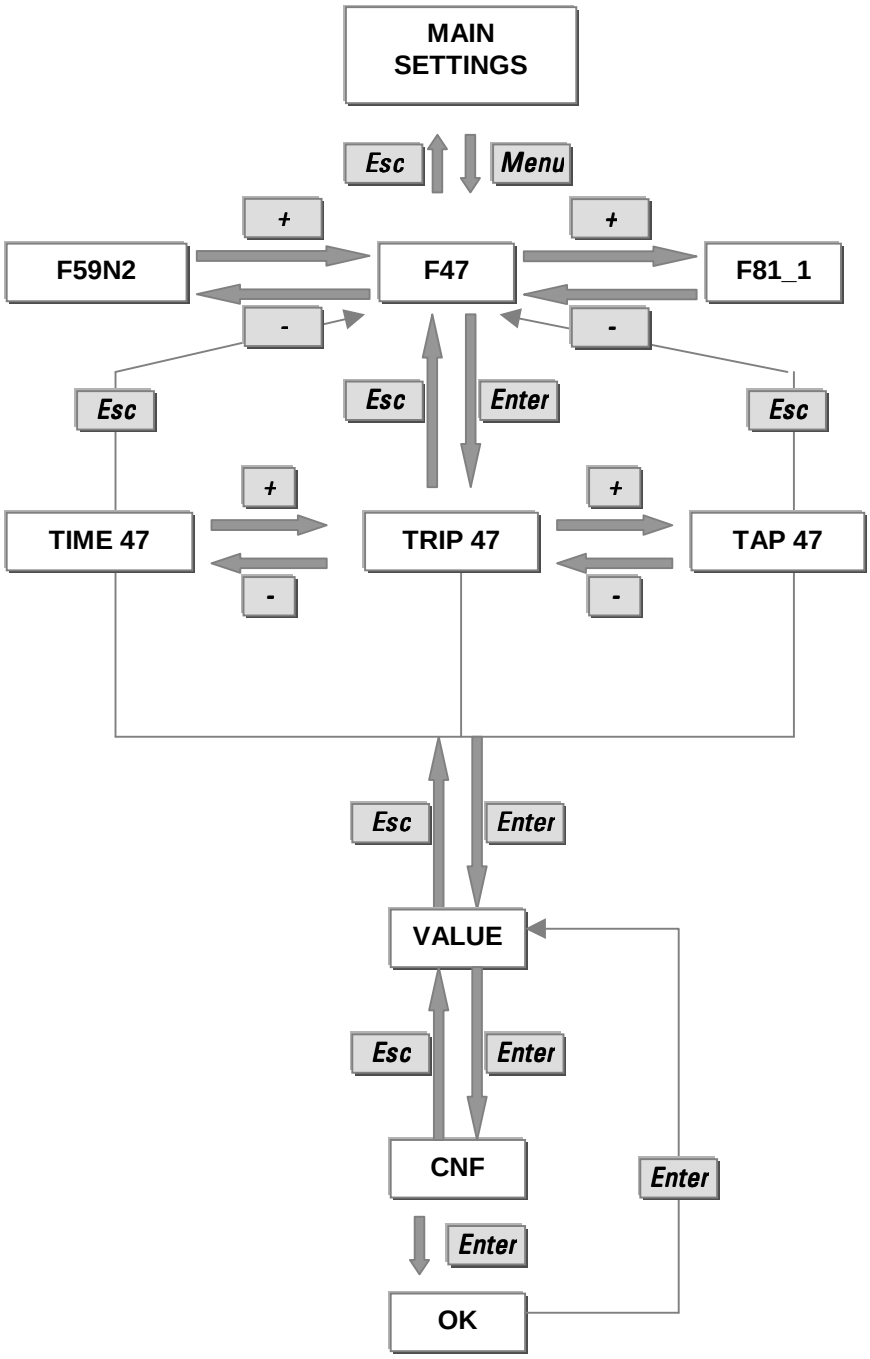



**FIGURE 8.17. DISPLAY SEQUENCE FROM F47**

Once we have reached an option after pressing ENTER from the function display, we press ENTER again to see the value of the chosen option. This value can be modified by pressing "+" and "-" keys.

The mnemonics appearing in the diagram are as follows:

| | | | |
|---|---|---|---|
| **TRIP 47** | Trip permission 47 | Range: | Y(YES)/N(NO) |
| **TAP 47** | Tap 47 | Range: | 2..60V STEP: 0.1V |
| **TIME 47** | Timer 47 | Range: | 0..600s STEP: 0.01s |
| **CNF** | CONFIRMATION | OK | validates the selected value |

**From F81_1 we can access the following options:**

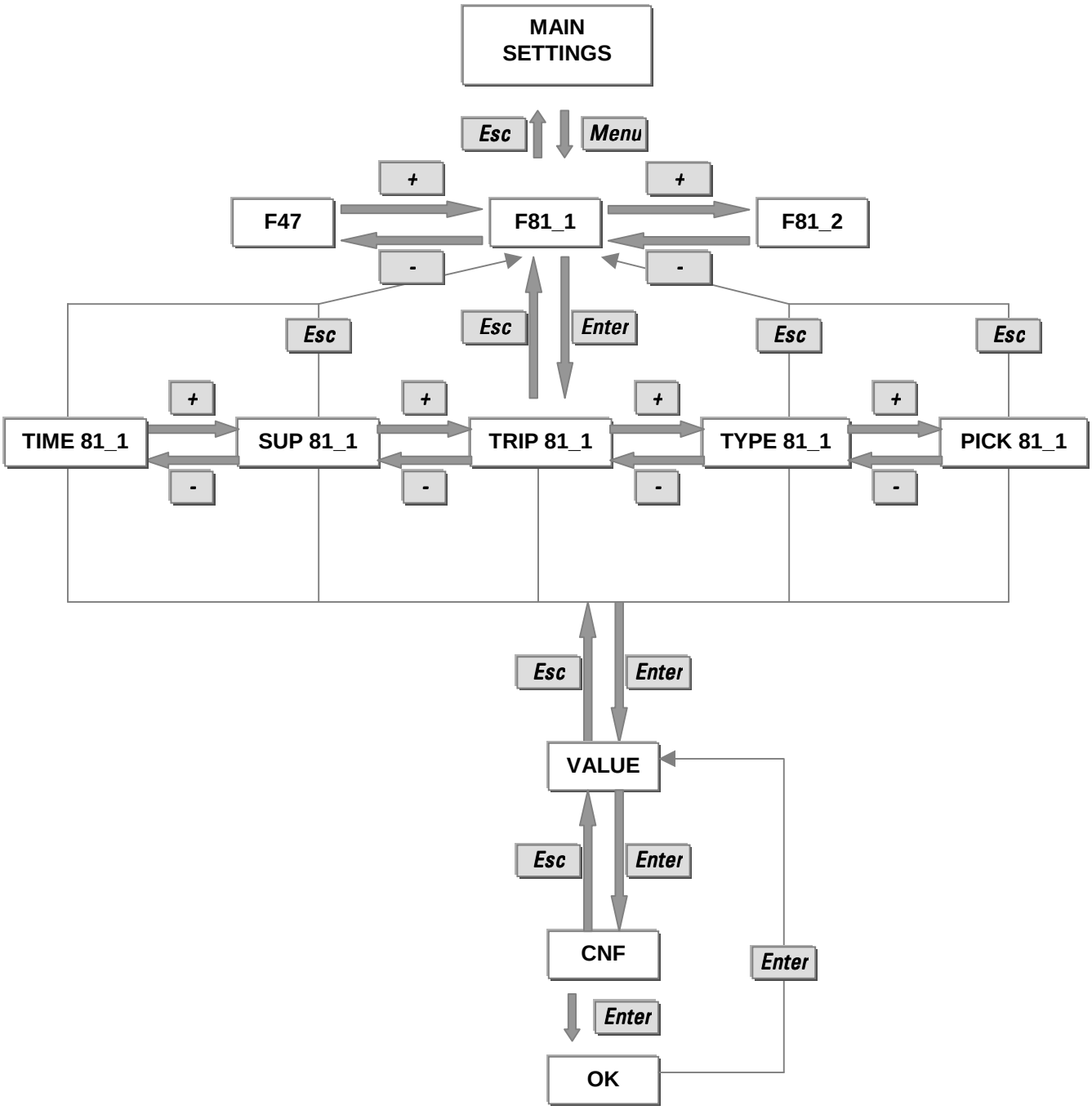



**FIGURE 8.18. DISPLAY SEQUENCE FROM F81_1**

Once we have reached an option after pressing ENTER from the function display, we press ENTER again to see the value of the chosen option. This value can be modified by pressing "+" and "-" keys.

The mnemonics used in the above diagram are as follows:

| | | | | |
|---|---|---|---|---|
| **TRIP 81_1:** | Trip permission 81_1 | Range: | Y(YES)/N(NO) | |
| **TYPE 81_1:** | Type 81_1 | Range: | UND(Underfrequency)/OVE(Overfrequency) | |
| **PICK 81_1:** | Pickup 81_1 | Range: | 42.0.. 67.5Hz | STEP: 0.01Hz |
| **TIME 81_1:** | Timer 81_1 | Range: | 0-10s | STEP: 0.01s |
| **SUP 81_1:** | 81_1voltage supervision | Range: | 10..250V | STEP: 0.1V |
| | | | 2..60V | |
| **CNF:** | CONFIRMATION | OK | validates the selected value | |

The sequence is the same for **F81_1, F81_2, F81_3** and **F81_4**

## 8.6. ADVANCED SETTINGS MENU

From the ADVANCED SETTINGS menu, we can access the following options:

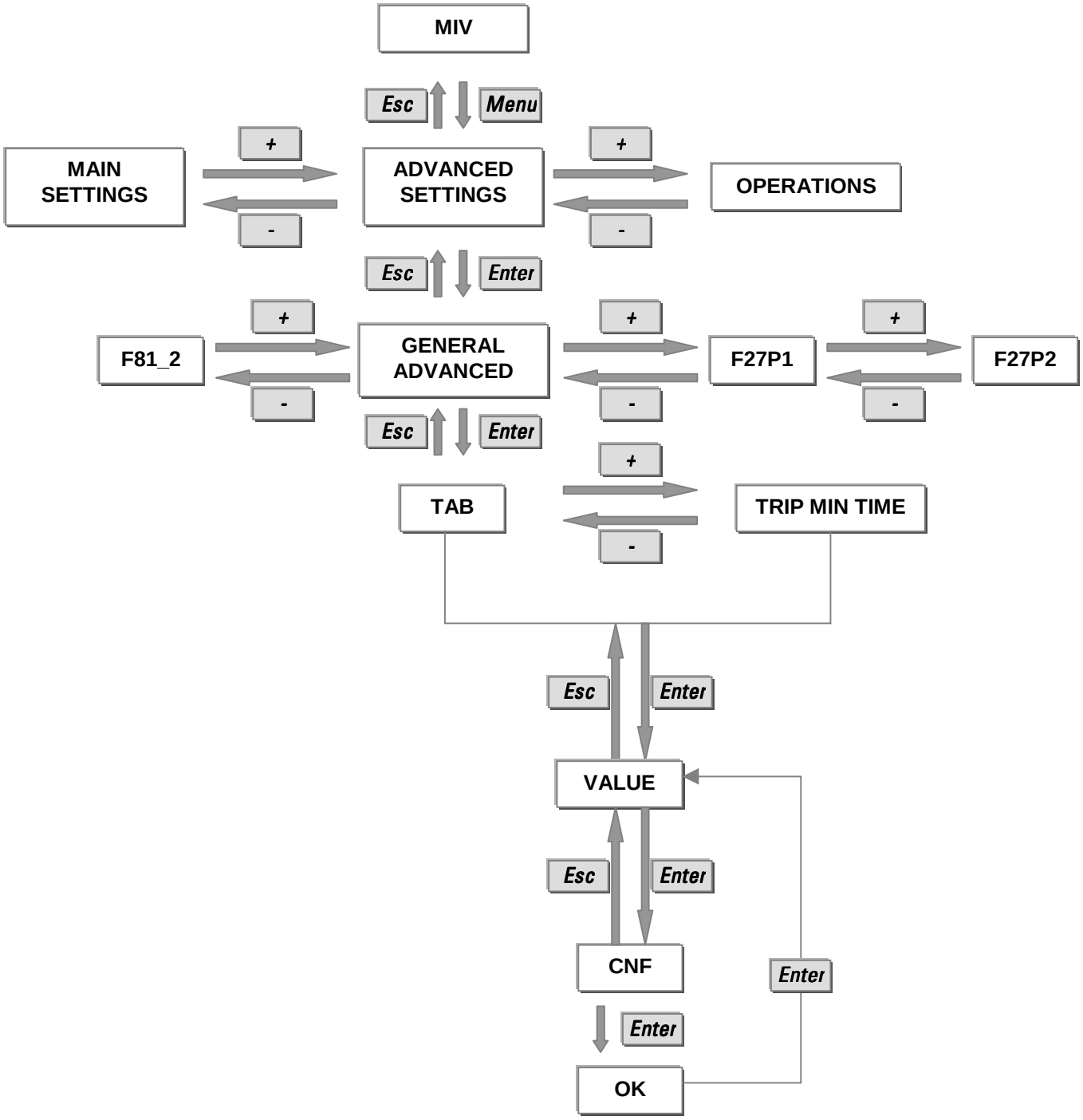



**FIGURE 8.19. ADVANCED SETTINGS SCREEN SEQUENCE**

By pressing **ESC** from any F**** screen, we return to ADVANCED SETTINGS.

The mnemonics appearing on this diagram are:

| | | | | |
|---|---|---|---|---|
| **ADVANCED SETTINGS** | | Advanced settings. | | |
| **GENERAL ADVANCED** | | General advanced settings. | | |
| **F27P1 T2:** | Unit 27P (TABLE 2) | | | |
| **F27P2 T2:** | Unit 27P2 (TABLE 2) | | | |
| **F59P1 T2:** | Unit 59P1 (TABLE 2) | | | |
| **F59P2 T2**: | Unit 59P2 (TABLE 2) | | | |
| **F59N1 T2:** | Unit 59N1 (TABLE 2) | | | |
| **F59N2 T2:** | Unit 59N2 (TABLE 2) | | | |
| **F47 T2:** | Unit 47 (TABLE 2) | | | |
| **F81_1 T2:** | Unit 81_1 (TABLE 2) | | | |
| **F81_2 T2:** | Unit 81_2 (TABLE 2) | | | |
| **F81_3 T2:** | Unit 81_3 (TABLE 2) | | | |
| **F81_4 T2:** | Unit 81_4 (TABLE 2) | | | |
| **TAB:** | Active table | - Range | 1 TABLE 1 | |
| | | | 2 TABLE 2 | |
| **TRIP MIN TIME:** | Minimum trip time | - Range: 50..300 ms | | - STEP: 1ms |
| **CNF:** | CONFIRMATION | OK | validates the selected value | |

From the ADVANCED SETTINGS screen, we can access the different TABLE 2 functions by pressing “+” and “-”. If we press ENTER from the ADVANCED SETTINGS screen, we can access TAB and TRIP MIN TIME, and from there we can press ENTER and modify their values.

**From these displays of F**** T 2 units, the display sequence and its meaning is the same as for the protection units in TABLE 1.**

## 8.7. OPERATIONS MENU

From the OPERATIONS menu, we can access the following screens:

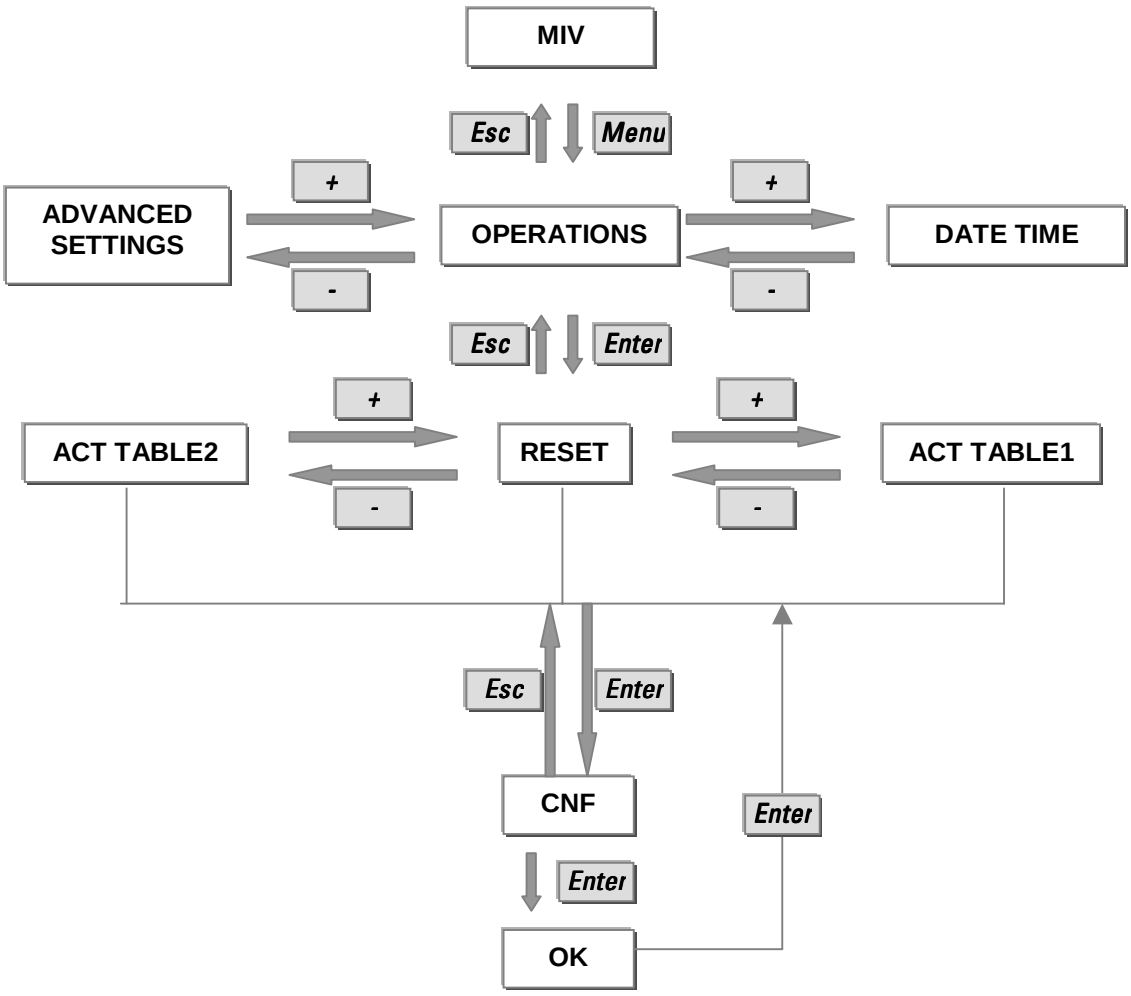



**FIGURE 8.20. OPERATIONS MENU DISPLAY SEQUENCE**

The meaning of the above display messages is the following:

| | | | |
|---|---|---|---|
| **OPERATIONS** | Operations. | | |
| **RESET** | LED and auxiliary contacts latching reset | | |
| **ACT TABLE1** | TABLE 1 activation. | | |
| **ACT TABLE2** | TABLE 2 activation. | | |
| **OPEN BREAKER** | Breaker opening | | |
| **CNF** | CONFIRMATION | OK | Validates the selected value. |

Once inside the selected option (pressing ENTER), it is possible to validate the option pressing ENTER twice until we see an OK message.

## 8.8. DATE AND TIME MENU

The following display messages allow the modification of the unit's date and time:

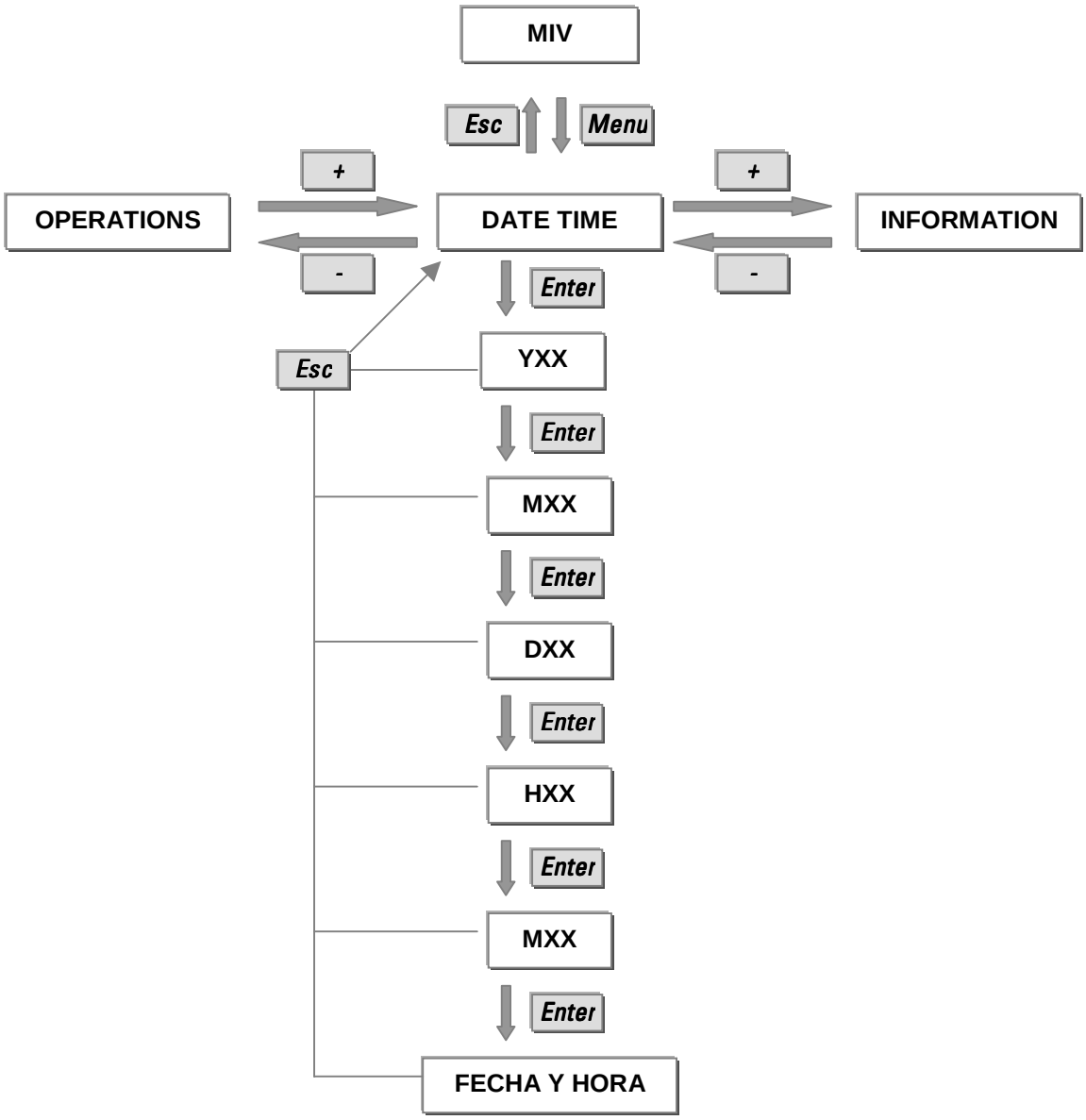



**FIGURE 8.14. DATE/TIME DISPLAY SEQUENCE**

We use the ENTER key for moving from one message to another, and once we are viewing the desired option, we press "+" or "-" keys for modifying the value. Values will appear in the following order:

**DATE TIME** Date and time.

**YXX(YEAR)** Allows to modify the year.

**MXX (MONTH)** Allows to modify the month.

**DXX (DAY)** Allows to modify the date.

**HXX (HOUR)** Allows to modify the hour.

**MXX (MINUTE)** Allows to modify the minutes.

**DATE/TIME** Displays the current date and time including the performed modifications.

## 8.9. FRONT LED RESET

The front LED indicator reset can be made in three different ways:

1. When the relay is in stand-by status, “scrolling”, we press the ”**Enter**” key and keep it pressed for more than 3 seconds. LEDs will light up and reset. This action can be interpreted as a “lamp test”, with the difference that here we also reset the indicators (LED´s).
2. Performing the operations sequence described on FIGURE 8-13, until we see the **RESET** message. Then, press “**Enter**”. The unit will ask for confirmation using the **CNF** message.

   Press “**Enter**” again and the display will show an **OK** message showing that the reset has been carried out successfully. For returning to the second menu level, press “**Enter**” again.
3. Using the LED RESET digital input.

LEDs can also be reset using the PC. For this purpose, we enter the OPERATIONS menu, and click on the corresponding icons.

# 9. RELAY COMMISSIONING

## 9.1. VISUAL INSPECTION

Unpack the relay and verify that no parts are broken and that the relay has not suffered any damage during transportation. Check that the screws are correctly tight and that the terminal blocks are in good order.

Verify that the model number indicated on the faceplate corresponds to the model ordered.

## 9.2. COMMENTS ON THE TEST EQUIPMENT

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 (e.g. the MIV) 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 making sure that the relay works roughly correctly and, therefore, for verifying its characteristics in an **approximate** manner.

The following list of tests 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 9.3, and 9.6 to 9.20 inclusive.

## 9.3. INSULATION TESTS

Progressively apply 2000 rms volts across all the terminals of a group, short-circuited, and the case for one second.

The independent groups on the relay are as follows:

| | | |
|---|---|---|
| **Group 1:** | A1, A2 | Power supply |
| **Group 2:** | B1, B2, B3, B4, A3, A4 | Voltage transformers |
| **Group 3:** | A8, A9, A10 | Inputs |
| **Group 4:** | A5, A6 | Trip |
| **Group 5:** | B7, B8, B9, B10, A7 | Auxiliary outputs |

**In case of performing this test on all terminals at the same time, we must keep 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.**

**NOTE: Do not test insulation on terminals B12, A12 and B11 (RS485)**

**DURING TESTS, GND TERMINAL MUST BE GROUNDED FOR SAFETY REASONS**

**In case of using AC voltage for the activation of digital inputs, and having connected the inputs common (A10) with the ground terminal, it is necessary to remove this connection before testing insulation on group 3.**

## 9.4. WIRING AND NECESSARY EQUIPMENT

**Necessary equipment:**

- 1 AC voltage supply.
- 1 DC voltage power supply.
- 1 Stop-watch.
- 1 Multi-meter.
- Optionally, it is advisable to have a PC available, with the M+PC software installed.
- Relay wiring diagram.

Connect the AC voltage supply to one of the phases, A (terminals B1-B2), B (terminals B3-B4) or C (terminals A3-A4), and connect the rest of the equipment as shown in figure 9.1.

**Supply the unit through terminals A1 and A2 at the rated DC voltage.**

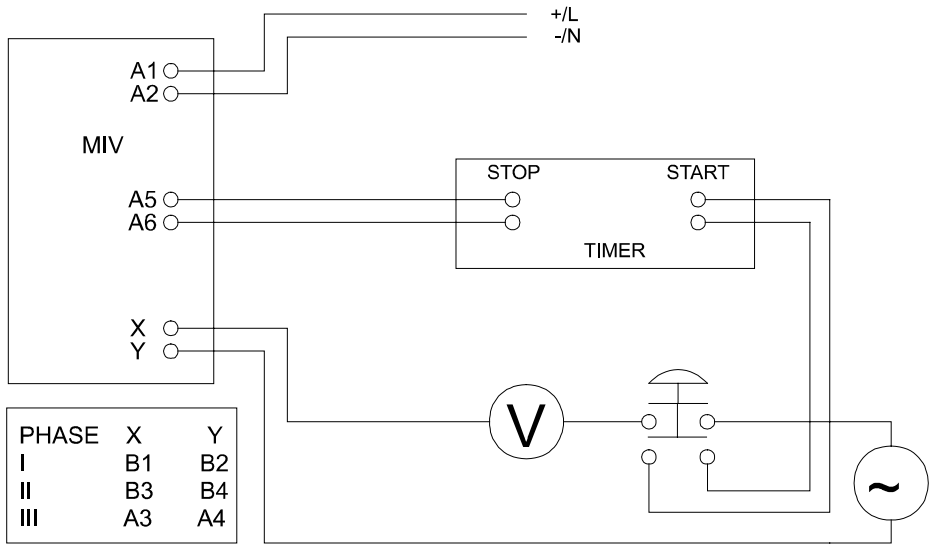



**FIGURE 9-1 MIV TESTING SCHEME**

## 9.5. TARGET LEDS

Power the relay and check that pressing the Enter key, all the faceplate target LEDs light up and reset if the key is kept pressed for more than 3 seconds.

## 9.6. POWER SUPPLY TEST

Connect the relay to a power supply at rated minimum voltage. Enable the following functions: 27, 59, 59N, 47 and 81 (according to model) setting their pickups and trip times to the minimum possible value for units 59 and 59N, and to the maximum possible value for units 27 and 81. Inject to the relay on phase A the rated voltage and frequency, making the relay trip and close all the auxiliary outputs corresponding to the enabled functions.

Under this tripping conditions, check that the ALARM (READY) output is open, and that the relay can communicate with the PC asking for the relay model. Verify that consumption is not over the maximum indicated.

Test voltage and maximum consumption shown below:

**F MODEL (24-48 Vdc)**

| Voltage (Vdc) | Maximum consumption (mA) |
|---|---|
| 18 | 650 |
| 48 | 300 |
| 58 | 265 |

**H MODEL (110/250 Vdc 110/220 Vac)**

| Voltage (Vdc) | Maximum consumption (mA) |
|---|---|
| 88 | 130 |
| 110 | 105 |
| 250 | 55 |
| **Voltage(Vac)** | **Maximum consumption (mA)** |
| 110 | 165 |
| 220 | 95 |

## 9.7. COMMUNICATIONS

The test consists on checking that the 2 communications ports in the relay (the faceplate RS232 and the rear RS485) work properly. To perform this test is it necessary to use a computer and a suitable connector to establish the connection between the PC and the relay (refer to figure 3.8). If the faceplate port is used, a straight through cable is needed. If the rear RS485 port is used, an RS485/RS232 converter is needed.

The communications parameters that have to be set in the computer are the relay default settings, as follows:

| | |
|---|---|
| Relay Number: | 1 |
| Communication baudrate: | 9.600 |
| Number of Stop bits: | 1 |

Using the M+PC program, communicate with the relay and in the Status window check that communication is not discontinued at any time. Perform this test on both communications ports.

This test is carried out at the minimum and maximum admissible voltage (± 20% of the rated voltage).

## 9.8. RELAY SETTING

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

Since the MIV relay has a large number of settings, 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.

## 9.9. CONTACT INPUTS

- Sequentially apply the rated voltage to each 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 M+PC program to easily check which input gets active for each test.
- Repeat this test at minimum and maximum admissible voltage.

## 9.10. CONTACT OUTPUTS

**MIV1000**

- Check that all the outputs are open.
- Enable only unit 27, and set its pickup and time delay to the minimum admissible values. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT1 (terminals A7-B7) close, and the **PICKUP, TRIP, and 27** LEDs light up.
- Enable only unit 59P, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) close, and the **PICK UP**, **TRIP and 59P** LEDs light up.
- Enable only unit 59N1, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT3 (terminals A7-B9) close, and the **PICK UP**, **TRIP and 59N** LEDs light up.
- Enable only unit 59N2, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT4 (terminals A7-B10) close, and the **PICK UP**, **TRIP and 59N** LEDs light up.

**MIV2000**

- Check that all the outputs are open.
- Enable only unit 81_1, and set its pickup and time delay to the maximum admissible values. Inject rated voltage and frequency through phase B terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT1 (terminals A7-B7) close, and the **TRIP, and 81_1** LEDs light up.
- Enable only unit 81_2, and set its pickup and time delay to the maximum admissible values. Inject rated voltage and frequency through phase B terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) close, and the **TRIP, and 81_2** LEDs light up.
- Enable only unit 81_3, and set its pickup and time delay to the maximum admissible values. Inject rated voltage and frequency through phase B terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT3 (terminals A7-B9) close, and the **TRIP, and 81_3** LEDs light up.

- Enable only unit 81_4, and set its pickup and time delay to the maximum admissible values. Inject rated voltage and frequency through phase B terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT4 (terminals A7-B10) close, and the **TRIP, and 81_4** LEDs light up.

**MIV3000**

- Check that all the outputs are open.
- Enable only units 27 and 59, and set its pickup to the maximum admissible value (unit 27) and to the minimum admissible value (unit 59). Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT1 (terminals A7-B7) close, and the **PICKUP, TRIP, and PHAS** LEDs light up.
- Enable only unit 59N, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT2 (terminals A7-B8) close, and the **PICK UP**, **TRIP and GRND** LEDs light up.
- Enable only unit 47, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT3 (terminals A7-B9) close, and the **PICK UP**, **TRIP and PHAS** LEDs light up.
- Enable only unit 47, and set its pickup to the minimum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT3 (terminals A7-B9) close, and the **PICK UP**, **TRIP and PHAS** LEDs light up.
- Enable units 81_1 and 81_2, and set its pickup to the maximum admissible value. Inject rated voltage and frequency through phase A terminals to trip the relay. Check that the trip output (terminals A5-A6) and auxiliary output OUT4 (terminals A7-B10) close, and the **PICK UP**, **TRIP and FRQ** LEDs light up.
- Remove the Power Supply from the relay and check that the Alarm Output Contact (terminals B5-B6) closes. Set the power supply back to the relay terminals and check that the Alarm Output Contact opens.

## 9.11. RELAY METERING

### 9.11.1. VOLTAGE METERING

**PHASE VOLTAGE**

Set the relay to 50Hz and apply the following voltage values:

| Magnitude | Phase | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Van (V) | 0º | 2 | 64 | 70 | 120 | 150 |
| Vbn (V) | 120º | 2 | 64 | 70 | 120 | 150 |
| Vcn (V) | 240º | 2 | 64 | 70 | 120 | 150 |

Check that the relay measures the three magnitudes with an accuracy of 3%, keeping in mind that the relay gives phase-to-phase voltages while phase-to-ground voltages are entered.

Set the relay to 60Hz and repeat the test.

### 9.11.2. FREQUENCY METERING

Apply 110V at 50 Hz through Phase B voltage input.

Check that the frequency value measured by the relay is between 49,98 Hz and 50,02 Hz.

Set the relay to 60Hz and repeat the test, checking that the measured value is between 59,98 Hz and 60,02 Hz.

***NOTE: Check that the inhibition voltage for the frequency units is lower than the applied voltage. Otherwise, the unit will not measure frequency.***

## 9.12. UNDERVOLTAGE UNIT (27P1)

Enable only unit 27P1 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 27P1 undervoltage pickup tap | 10 V |
| Undervoltage operation time | 0,20 sec. |

Apply 15 V across the three phases and check that the relay does not trip.

Apply 5 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 27P1 undervoltage pickup tap | 100V |
| undervoltage operation time | 0.2 sec. |

Apply 110 V across the three phases and check that the relay does not trip.

Apply 90 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.13. UNDERVOLTAGE UNIT (27P2)

Enable only unit 27P2 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 27P2 undervoltage pickup tap | 10 V |
| Undervoltage operation time | 0,20 sec. |

Apply 15 V across the three phases and check that the relay does not trip.

Apply 5 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 27P2 undervoltage pickup tap | 100V |
| Undervoltage operation time | 0.2 sec. |

Apply 110 V across the three phases and check that the relay does not trip.

Apply 90 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.14. OVERVOLTAGE UNIT (59P1)

Enable only unit 59P1 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59P1 overvoltage pickup tap | 10 V |
| Overvoltage operation time | 0,20 sec. |

Apply 8 V across the three phases and check that the relay does not trip.

Apply 12 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59P1 overvoltage pickup tap | 100V |
| Overvoltage operation time | 0.2 sec. |

Apply 90 V across the three phases and check that the relay does not trip.

Apply 110 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.15. OVERVOLTAGE UNIT (59P2)

Enable only unit 59P2 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59P2 overvoltage pickup tap | 10 V |
| Overvoltage operation time | 0,20 sec. |

Apply 8 V across the three phases and check that the relay does not trip.

Apply 12 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59P2 overvoltage pickup tap | 100V |
| Overvoltage operation time | 0.2 sec. |

Apply 90 V across the three phases and check that the relay does not trip.

Apply 110 V across the three phases and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.16. GROUND OVERVOLTAGE UNIT (59N1)

Enable only unit 59N1 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59N1 overvoltage pickup tap | 10 V |
| Overvoltage operation time | 0,20 sec. |

Apply 8 V through phase A and check that the relay does not trip.

Apply 12 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59N1 overvoltage pickup tap | 100V |
| Overvoltage operation time | 0.2 sec. |

Apply 90 V through phase A and check that the relay does not trip.

Apply 110 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.17. GROUND OVERVOLTAGE UNIT (59N2)

Enable only unit 59N2 and its trip.

**Low Voltage Range (2-60 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59N2 overvoltage pickup tap | 10 V |
| Overvoltage operation time | 0,20 sec. |

Apply 8 V through phase A and check that the relay does not trip.

Apply 12 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

**High Voltage Range (10-250 V)**

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 59N2 overvoltage pickup tap | 100V |
| Overvoltage operation time | 0.2 sec. |

Apply 90 V through phase A and check that the relay does not trip.

Apply 110 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

## 9.18. VOLTAGE UNBALANCE UNIT (47)

Enable only unit 47 and its trip.

Set the relay as follows:

| **Voltage settings group** | |
|---|---|
| 47 voltage unbalance pickup tap | 2 V |
| Voltage unbalance operation time | 0,20 sec. |

Apply 1.96 V through phase A and check that the relay does not trip.

Apply 2.03 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 0,175 and 0,260 sec.

Repeat the test for the following settings

| **Voltage settings group** | |
|---|---|
| 47 voltage unbalance pickup tap | 60 V |
| Voltage unbalance operation time | 2.0 sec. |

Apply 58 V through phase A and check that the relay does not trip.

Apply 61.8 V through phase A and check that the relay trips.

In this last case, check that the operation time is between 1.95 and 2.15 sec.

## 9.19. FREQUENCY UNITS IN UNDERFREQUENCY MODE (81_1, 81_2, 81_3, 81_4)

Enable only unit 81_1 and its trip

Set the relay as follows:

| **81_1 Settings Group** | |
|---|---|
| Unit 81_1 type | UND |
| Pickup 81 | 47,5 Hz |
| Underfrequency voltage | 2 sec. |
| Undervoltage supervision | 38,5 V |

Apply 110 Vac through phase B, increasing frequency from 46 Hz to 54 Hz inclusive in steps of 1 Hz.

Check that the relay trips when frequency is at 46 and 47 Hz.

In the last case, check that the operation time is between 1.95 and 2.15 sec.

Apply 36 Vac through phase B, with a frequency of 46 Hz. The relay must not trip due to the undervoltage supervision.

Repeat the test enabling only unit 81_2 with the same settings defined for 81_1.

Repeat the test enabling only unit 81_3 with the same settings defined for 81_1.

Repeat the test enabling only unit 81_4 with the same settings defined for 81_1.

## 9.20. FREQUENCY UNITS IN OVERFREQUENCY MODE (81_1, 81_2, 81_3, 81_4)

Enable only unit 81_1 and its trip

Set the relay as follows:

| **81_1 Settings Group** | |
|---|---|
| 81_1 unit type | OVE |
| Pickup 81 | 52,5 Hz |
| Underfrequency timer | 2 sec. |
| Undervoltage supervision | 38,5 V |

Apply 110 Vac through phase B, changing frequency from 46 Hz to 54 Hz inclusive in steps of 1 Hz.

Check that the relay trips when frequency is at 53 and 54 Hz.

In the last case, check that the operation time is between 1.95 and 2.15 sec.

Apply 36 Vac through phase B, with a frequency of 54 Hz. The relay must not trip due to the undervoltage supervision.

Repeat the test enabling only unit 81_2 with the same settings defined for 81_1.

Repeat the test enabling only unit 81_3 with the same settings defined for 81_1.

Repeat the test enabling only unit 81_4 with the same settings defined for 81_1.

## 9.21. TIME SYNCHRONISATION

Synchronize the relay date and time with the PC, using the M+PC communications program. Check using the keypad and display that the relay is actually in synchronism with the computer.

## 9.22. USER SETTINGS

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

### 9.22.1. GENERA SETTINGS GROUP

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| | GENERAL SETTINGS | GENERAL | | | |
| Relay status | RELAY STATUS | STA | | RDY / DIS | NA |
| Frequency | FREQUENCY | FRQ | | 50/60 Hz | NA |
| Application | APPLICATION | APP | | 3F – N PHASE-TO-GROUND, 3F PHASE-TO-PHASE, ONE-PHASE, GROUND | NA |
| Password | --- | PWD | | 1 - 255 | |
| Address | --- | ADD | | 1 - 255 | 1 |
| Baudrate | --- | BAUD | | 300, 600, 1200, 2400, 4800, 9600, 19200 | NA |

### 9.22.2. UNIT 27 SETTINGS (MIV1000/3000)

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 27P1** | **Unit 27P1** | **F27P1** | | | |
| Trip permission 27P1 | Trip 27P1 | TRIP 27P1 | | Y/N | NA |
| Pickup 27P1 | Pickup 27P1 | TAP 27P1 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P1 | Time 27P1 | TIME 27P1 | | 0-600.00 s | 0.01 s |
| Supervision 27P1 by 52 | Supervision 27P1 by 52 | SUP 27P1 | | Y/N | NA |
| **Unit 27P2** | **Unit 27P2** | **F27P2** | | | |
| Trip permission 27P2 | Trip 27P2 | TRIP 27P2 | | Y/N | NA |
| Pickup 27P2 | Pickup 27P2 | TAP 27P2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P2 | Time 27P2 | TIME 27P2 | | 0-600.00 s | 0.01 s |
| Supervision 27P2 by 52 | Supervision 27P2 by 52 | SUP 27P2 | | Y/N | NA |

**(*)** High voltage range models (MIV*00)

**(**)** Low voltage range models (MIV*01)

### 9.22.3. UNIT 59 SETTINGS (MIV1000/3000)

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| Unit 59P1 | Unit 59P1 | F59P1 | | | |
| Trip permission 59P1 | Trip 59P1 | TRIP 59P1 | | Y/N | NA |
| Pickup 59P1 | Pickup 59P1 | TAP 59P1 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P1 | Time 59P1 | TIME 59P1 | | 0-600.00 s | 0.01 s |
| **Unit 59P2** | **Unit 59P2** | **F59P2** | | | |
| Trip permission 59P2 | Trip 59P2 | TRIP 59P2 | | Y/N | NA |
| Pickup 59P2 | Pickup 59P2 | TAP 59P2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P2 | Time 59P2 | TIME 59P2 | | 0-600.00 s | 0.01 s |
| **Unit 59N1** | **Unit 59N1** | **F59N1** | | | |
| Trip permission 59N1 | Trip 59N1 | TRIP 59N1 | | Y/N | NA |
| Pickup 59N1 | Pickup 59N1 | TAP 59N1 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N1 | Time 59N1 | TIME 59N1 | | 0-600.00 s | 0.01 s |
| **Unit 59N2** | **Unit 59N2** | **F59N2** | | | |
| Trip permission 59N2 | Trip 59N2 | TRIP 59N2 | | Y/N | NA |
| Pickup 59N2 | Pickup 59N2 | TAP 59N2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N2 | Time 59N2 | TIME 59N2 | | 0-600.00 s | 0.01 s |

### 9.22.4. UNIT 47 (MIV3000)

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 47** | **Unit 47** | **F47** | | | |
| Trip permission 47 | Trip 47 | TRIP 47 | | Y/N | NA |
| Pickup 47 | Pickup 47 | TAP 47 | | 2.0-60.0 V | 0.1 V |
| Timer 47 | Time 47 | TIME 47 | | 0-600.00 s | 0.01 s |

### 9.22.5. UNIT 81 (MIV2000/3000)

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 81_1** | **Unit 81_1** | **F81_1** | | | |
| Trip permission 81_1 | Trip 81_1 | TRIP 81_1 | | Y/N | NA |
| Type 81_1 | Type 81_1 | TYPE 81_1 | | UND/OVE | NA |
| Pickup 81_1 | Pickup 81_1 | TAP 81_1 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_1 | Time 81_1 | TIME 81_1 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_1 | Supervision 81_1 | SUP 81_1 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_2** | **Unit 81_2** | **F81_2** | | | |
| Trip permission 81_2 | Trip 81_2 | TRIP 81_2 | | Y/N | NA |
| Type 81_2 | Type 81_2 | TYPE 81_2 | | UND/OVE | NA |
| Pickup 81_2 | Pickup 81_2 | TAP 81_2 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_2 | Time 81_2 | TIME 81_2 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_2 | Supervision 81_2 | SUP 81_2 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_3** | **Unit 81_3** | **F81_3** | | | |
| Trip permission 81_3 | Trip 81_3 | TRIP 81_3 | | Y/N | NA |
| Type 81_3 | Type 81_3 | TYPE 81_3 | | UND/OVE | NA |
| Pickup 81_3 | Pickup 81_3 | TAP 81_3 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_3 | Time 81_3 | TIME 81_3 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_3 | Supervision 81_3 | SUP 81_3 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_4** | **Unit 81_4** | **F81_4** | | | |
| Trip permission 81_4 | Trip 81_4 | TRIP 81_4 | | Y/N | NA |
| Type 81_4 | Type 81_4 | TYPE 81_4 | | UND/OVE | NA |
| Pickup 81_4 | Pickup 81_4 | TAP 81_4 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_4 | Time 81_4 | TIME 81_4 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_4 | Supervision 81_4 | SUP 81_4 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |

## 9.23. ADVANCED SETTINGS

### 9.23.1. GENERAL SETTINGS

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| | **ADVANCED GENERAL SETTINGS** | **GENERAL ADVANCED** | | | |
| Identification | IDENTIFICATION | ---- | | Text | NA |
| Active table | ACTIVE TABLE | TAB | | 1-2 | NA |
| Minimum trip time | T. MANT. TRIP | TRIP MIN TIME | | 50-300 ms | 1 ms |

### 9.23.2. UNIT 27 SETTINGS (TABLE 2)

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 27P1 (TABLE 2)** | **Unit 27P1 (TABLE 2)** | **F27P1 T2** | | | |
| Trip permission 27P1 | Trip 27P1 T2 | TRIP 27P1 T2 | | Y/N | NA |
| Pickup 27P1 | Pickup 27P1 T2 | TAP 27P1 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P1 | Time 27P1 T2 | TIME 27P1 T2 | | 0-600.00 s | 0.01 s |
| Supervision 27P1 by 52 | Supervision 27P1 by 52 T2 | SUP 27P1 T2 | | Y/N | NA |
| **Unit 27P2 (TABLE 2)** | **Unit 27P2 (TABLE 2)** | **F27P2 T2** | | | |
| Trip permission 27P2 | Trip 27P2 T2 | TRIP 27P2 T2 | | Y/N | NA |
| Pickup 27P2 | Pickup 27P2 T2 | TAP 27P2 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 27P2 | Time 27P2 T2 | TIME 27P2 T2 | | 0-600.00 s | 0.01 s |
| Supervision 27P2 by 52 | Supervision 27P2 by 52 T2 | SUP 27P2 T2 | | Y/N | NA |

**(*)** High voltage range models (MIV*00)

**(**)** Low voltage range models (MIV*01)

### 9.23.3. UNIT 59

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 59P1 (TABLE 2)** | **Unit 59P1 (TABLE 2)** | **F59P1 T2** | | | |
| Trip permission 59P1 | Trip 59P1 T2 | TRIP 59P1 T2 | | Y/N | NA |
| Pickup 59P1 | Pickup 59P1 T2 | TAP 59P1 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P1 | Time 59P1 T2 | TIME 59P1 T2 | | 0-600.00 s | 0.01 s |
| **Unit 59P2 (TABLE 2)** | **Unit 59P2 (TABLE 2)** | **F59P2 T2** | | | |
| Trip permission 59P2 | Trip 59P2 T2 | TRIP 59P2 T2 | | Y/N | NA |
| Pickup 59P2 | Pickup 59P2 T2 | TAP 59P2 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59P2 | Time 59P2 T2 | TIME 59P2 T2 | | 0-600.00 s | 0.01 s |
| **Unit 59N1 (TABLE 2)** | **Unit 59N1 (TABLE 2)** | **F59N1 T2** | | | |
| Trip permission 59N1 | Trip 59N1 T2 | TRIP 59N1 T2 | | Y/N | NA |
| Pickup 59N1 | Pickup 59N1 T2 | TAP 59N1 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N1 | Time 59N1 T2 | TIME 59N1 T2 | | 0-600.00 s | 0.01 s |
| **Unit 59N2 (TABLE 2)** | **Unit 59N2 (TABLE 2)** | **F59N2 T2** | | | |
| Trip permission 59N2 | Trip 59N2 T2 | TRIP 59N2 T2 | | Y/N | NA |
| Pickup 59N2 | Pickup 59N2 T2 | TAP 59N2 T2 | | 10.0-250.0 V<br>2.0-60.0 V | 0.1 V |
| Timer 59N2 | Time 59N2 T2 | TIME 59N2 T2 | | 0-600.00 s | 0.01 s |

### 9.23.4. UNIT 47

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 47 (TABLE 2)** | **Unit 47 (TABLE 2)** | **F47 T2** | | | |
| Trip permission 47 | Trip 47 T2 | TRIP 47 T2 | | Y/N | NA |
| Pickup 47 | Pickup 47 T2 | TAP 47 T2 | | 2.0-60.0 V | 0.1 V |
| Timer 47 | Time 47 T2 | TIME 47 T2 | | 0-600.00 s | 0.01 s |

| | M+PC | MMI | USER SETTING | RANGE | STEP |
|---|---|---|---|---|---|
| **Unit 81_1 (TABLE 2)** | **Unit 81_1 (TABLE 2)** | **F81_1 T2** | | | |
| Trip permission 81_1 | Trip 81_1 T2 | TRIP 81_1 T2 | | Y/N | NA |
| Type 81_1 | Type 81_1 T2 | TYPE 81_1 T2 | | UND/OVE | NA |
| Pickup 81_1 | Pickup 81_1 T2 | TAP 81_1 T2 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_1 | Time 81_1 T2 | TIME 81_1 T2 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_1 | Supervision 81_1 T2 | SUP 81_1 T2 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_2 (TABLE 2)** | **Unit 81_2 (TABLE 2)** | **F81_2 T2** | | | |
| Trip permission 81_2 | Trip 81_2 T2 | TRIP 81_2 T2 | | Y/N | NA |
| Type 81_2 | Type 81_2 T2 | TYPE 81_2 T2 | | UND/OVE | NA |
| Pickup 81_2 | Pickup 81_2 T2 | TAP 81_2 T2 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_2 | Time 81_2 T2 | TIME 81_2 T2 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_2 T2 | Supervision 81_2 T2 | SUP 81_2 T2 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_3 (TABLE 2)** | **Unit 81_3 (TABLE 2)** | **F81_3 T2** | | | |
| Trip permission 81_3 | Trip 81_3 T2 | TRIP 81_3 T2 | | Y/N | NA |
| Type 81_3 | Type 81_3 T2 | TYPE 81_3 T2 | | UND/OVE | NA |
| Pickup 81_3 | Pickup 81_3 T2 | TAP 81_3 T2 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_3 | Time 81_3 T2 | TIME 81_3 T2 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_3 T2 | Supervision 81_3 T2 | SUP 81_3 T2 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |
| **Unit 81_4 (TABLE 2)** | **Unit 81_4 (TABLE 2)** | **F81_4 T2** | | | |
| Trip permission 81_4 | Trip 81_4 T2 | TRIP 81_4 T2 | | Y/N | NA |
| Type 81_4 | Type 81_4 T2 | TYPE 81_4 T2 | | UND/OVE | NA |
| Pickup 81_4 | Pickup 81_4 T2 | TAP 81_4 T2 | | 42.00-67.50 Hz | 0.01 Hz |
| Timer 81_4 | Time 81_4 T2 | TIME 81_4 T2 | | 0-600.00 s | 0.01 s |
| Supervision voltage 81_4 T2 | Supervision 81_4 T2 | SUP 81_4 T2 | | 30-250 V<br>10-60 V | 0.1 V<br>0.2 V |

### 9.23.6. EVENTS AND OSCILLOGRAPHY MASKS

**Event masks have two possible settings, YES and NO. If an action (for example the trip of a protection unit) is set as YES, when this unit trips an event will be generated. If it is set as NO, the relay will show no event.**

| | M+PC | USER SETTING | RANGE | STEP |
|---|---|---|---|---|
| **Event Masks** | **Event Masks** | | | |
| Pickup/reset 27P1 | Pickup 27P1 | | Y/N | NA |
| Pickup/reset 27P2 | Pickup 27P2 | | Y/N | NA |
| Pickup/reset 59P1 | Pickup 59P1 | | Y/N | NA |
| Pickup/reset 59P2 | Pickup 59P2 | | Y/N | NA |
| Pickup/reset 59N1 | Pickup 59N1 | | Y/N | NA |
| Pickup/reset 59N2 | Pickup 59N2 | | Y/N | NA |
| Pickup/reset 47 | Pickup 47 | | Y/N | NA |
| Pickup/reset 81_1 | Pickup 81_1 | | Y/N | NA |
| Pickup/reset 81_2 | Pickup 81_2 | | Y/N | NA |
| Pickup/reset 81_3 | Pickup 81_3 | | Y/N | NA |
| Pickup/reset 81_4 | Pickup 81_4 | | Y/N | NA |
| 27P1 trip inhibit. Activation / deactivation by digital input | 27P1 inhibit (by D.I.) | | Y/N | NA |
| 27P2 trip inhibit. Activation / deactivation by digital input | 27P2 inhibit (by D.I.) | | Y/N | NA |
| 59P1 trip inhibit. Activation / deactivation by digital input | 59P1 inhibit (by D.I.) | | Y/N | NA |
| 59P2 trip inhibit. Activation / deactivation by digital input | 59P2 inhibit (by D.I.) | | Y/N | NA |
| 59N1 trip inhibit. Activation / deactivation by digital input | 59N1 inhibit (by D.I.) | | Y/N | NA |
| 59N2 trip inhibit. Activation / deactivation by digital input | 59N2 inhibit (by D.I.) | | Y/N | NA |
| 47 trip inhibit. Activation / deactivation by digital input | 47 inhibit (by D.I.) | | Y/N | NA |
| 81_1 trip inhibit. Activation / deactivation by digital input | 81_1 inhibit (by D.I.) | | Y/N | NA |
| 81_2 trip inhibit. Activation / deactivation by digital input | 81_2 inhibit (by D.I.) | | Y/N | NA |
| 81_3 trip inhibit. Activation / deactivation by digital input | 81_3 inhibit (by D.I.) | | Y/N | NA |
| 81_4 trip inhibit. Activation / deactivation by digital input | 81_4 inhibit (by D.I.) | | Y/N | NA |
| General trip inhibit. Activation / deactivation by digital input | Trip inhibit (by D.I.) | | Y/N | NA |

| | M+PC | USER SETTING | RANGE | STEP |
|---|---|---|---|---|
| Trip 27P1 | Trip 27P1 | | Y/N | NA |
| Trip 27P2 | Trip 27P2 | | Y/N | NA |
| Trip 59P1 | Trip 59P1 | | Y/N | NA |
| Trip 59P2 | Trip 59P2 | | Y/N | NA |
| Trip 59N1 | Trip 59N1 | | Y/N | NA |
| Trip 59N2 | Trip 59N2 | | Y/N | NA |
| Trip 47 | Trip 47 | | Y/N | NA |
| Trip 81_1 | Trip 81_1 | | Y/N | NA |
| Trip 81_2 | Trip 81_2 | | Y/N | NA |
| Trip 81_3 | Trip 81_3 | | Y/N | NA |
| Trip 81_4 | Trip 81_4 | | Y/N | NA |
| General trip | General Trip | | Y/N | NA |
| Protection activation /deactivation | Protection Status | | Y/N | NA |
| Auxiliary output 1 activation / deactivation | Output 1 | | Y/N | NA |
| Auxiliary output 2 activation / deactivation | Output 2 | | Y/N | NA |
| Auxiliary output 3 activation / deactivation | Output 3 | | Y/N | NA |
| Auxiliary output 4 activation / deactivation | Output 4 | | Y/N | NA |
| Digital input 1 activation / deactivation | Digital input 1 | | Y/N | NA |
| Digital input 2 activation / deactivation | Digital input 2 | | Y/N | NA |
| Settings change through input inhibition activation/deactivation | Settings change inhib. | | Y/N | NA |
| Trip command activation through digital input | Trip command through input | | Y/N | NA |
| Trip command activation through command | Trip command through command | | Y/N | NA |
| Auxiliary contacts latching reset | Aux. contact latch | | Y/N | NA |
| 52 B open/closed | Breaker 52 B | | Y/N | NA |
| 52 A open/closed | Breaker 52 A | | Y/N | NA |
| 52 open/closed | Breaker status | | Y/N | NA |
| TABLE 2 selection through digital input | TABLE CHANGE | | Y/N | NA |
| Oscillography trigger by digital input | Osc. Trigger through D.I. | | Y/N | NA |
| Oscillography trigger by command | Osc. Trigger through | | Y/N | NA |

| | M+PC | USER SETTING | RANGE | STEP |
|---|---|---|---|---|
| | command | | | |
| Settings change executed | Settings Change | | Y/N | NA |
| E2prom failure | E2prom failure | | Y/N | NA |
| User settings / Default settings | User settings | | Y/N | NA |
| **Oscillography Masks** | **Oscillography masks** | | | |
| Oscillo by communications | Oscillo by comm. | | Y/N | NA |
| Oscillo by digital input | Oscillo by digital input | | Y/N | NA |
| Oscillo by trip | Oscillo by trip | | Y/N | NA |
| Oscillo by pickup | Oscillo by pickup | | Y/N | NA |

# *10. INSTALLATION AND MAINTENANCE*

## 10.1. INSTALLATION

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 3.2 shows the diagram for panel drilling for panel mounting.

Given that the design of the MIV 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.

## 10.2. GROUND CONNECTION AND DISTURBANCES SUPPRESSION

Terminal labelled as GND (refer to figure 3.4) should be connected to ground 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 the capacitors which 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 casing is connected to ground.

## 10.3. MAINTENANCE

Given the important role that the protection relays play in the operation of any installation, a periodic 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 MIV unit function properly is described in detail in the chapter entitled **COMMISSIONING**.

## 10.4. CLEANING INSTRUCTIONS

In case of accumulated dust, the unit can be cleaned using a dry cloth, or with a soft cleanser with alcohol content.

Abrasive cleansers must be avoided, as they can damage the metallic surfaces or the electrical connection elements.

# 11. ANNEX 1. MIV FREQUENCY UNITS USE

## 11.1. INTRODUCTION

When an Electrical System operates in a normal condition at the rated frequency, the total mechanical power of the generator turbines, equals the sum of all the connected loads, plus the power losses in the System. Any variation in load or generation, will produce a change in frequency. The enormous masses of the generation equipment are depository of all the kinetic energy, so that when there is not enough generation mechanical power, rotors rotate more slowly trying to provide the missing power; in the same way, when there is exceeding mechanical energy, rotor accelerate to absorb this energy surplus. Any variation in the generator rotors rotating speed will cause a proportional variation in frequency.

Although all these variations can be compensated by the regulation equipment installed in the generators, there are circumstances where the generation deficit or surplus cannot be compensated by these equipment due to the load variation magnitude. In these cases, there is a quick and strong frequency variation which, if maintained, may cause an Electrical System breakdown.

Therefore, in these circumstances, there is a clear need to manage appropriately and quickly the installed loads (shedding or reset), in order to maintain the integrity of the rest of the System.

### ELECTRICAL SYSTEM OPERATION LIMITS

Great part of the main equipment in the Electrical System are designed to operate at rated frequencies of 50 or 60 Hz, with a small variation range around these rated values.

Mainly, the generation groups are the most sensitive to frequency variations and their effects. They can be described as follows:

Auxiliary motors powering the refrigeration water pumps or ventilation equipment at reduced frequency, lower they speed and subsequently their output power, causing a reduction in the maximum power admissible in the generator, due to overheating. The majority of generation plants at 60 Hz can operate in these circumstances with a variation range of 56,5 to 57,5 Hz.

Some types of turbines, particularly gas and steam turbines, incorporate low pressure buckets designed to operate without resonance only at the rated power. If a 60Hz turbine is operated at 58.5 Hz or less, we find a condition where the steam excitation frequency is close to the bucket resonance frequency, causing a severe vibration and subsequently, mechanical fatigue. This situation must not be maintained form more that 10 minutes during the whole turbine life. Otherwise the turbine would be destroyed, taking into account that mechanical fatigue is accumulative. In these cases, every caution must be observed to avoid operation in the range of 58 to 58.5 Hz.

## 11.2. LOAD SHEDDING

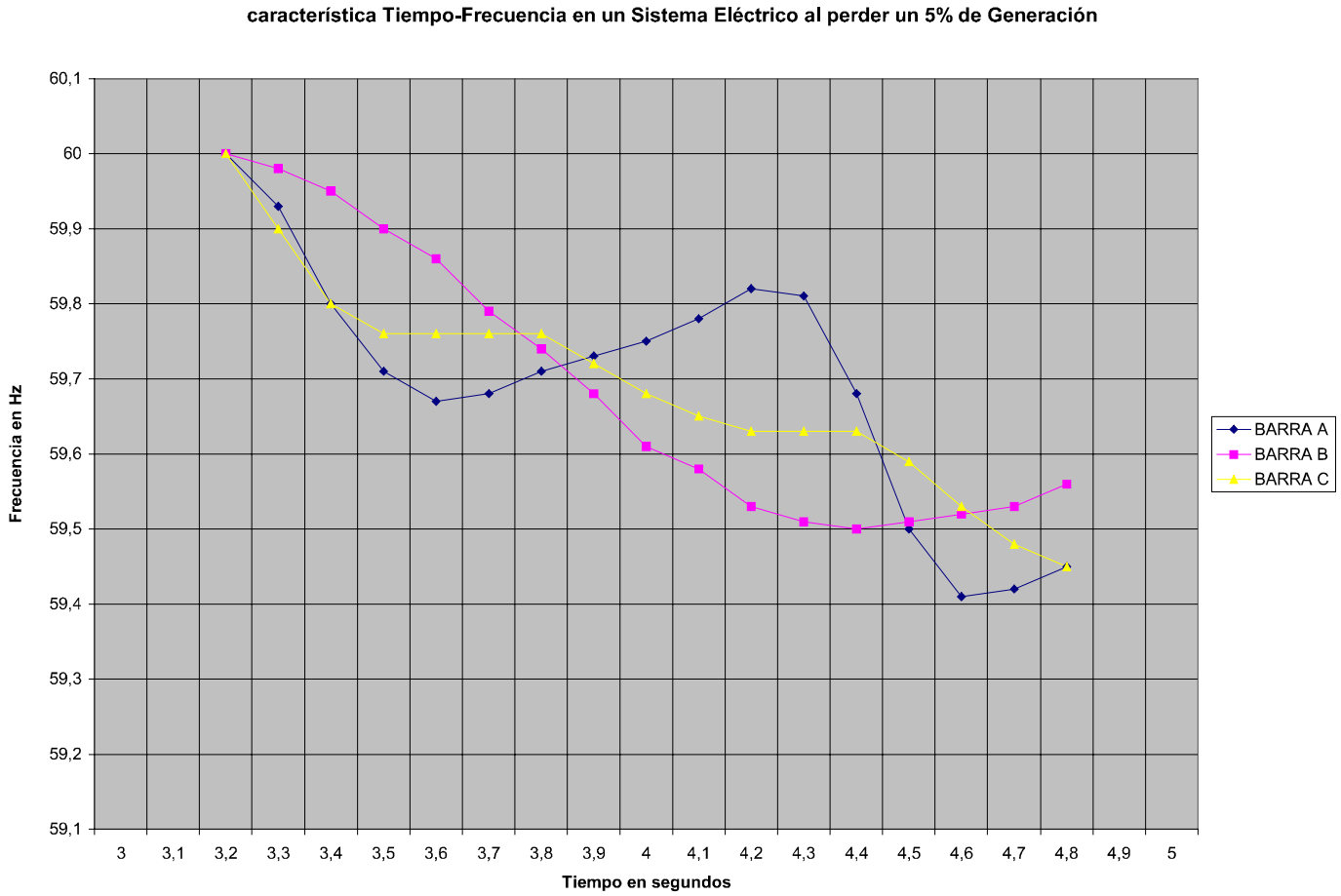
Load increases in the Electrical System, if within the generation capacity limits, are controlled by the regulation elements that produce the use of the rotative generation reserve.

When the magnitude of the load increase exceeds the System rotative reserve power, regulators have reached their limits, and in these circumstances, when the power loads exceed generation, there is a decrease of the System frequency.

In the case of a quick variation in frequency due to a strong overload, it is usually necessary to make a selective shedding of those low-priority loads for the Electrical System to recover its rated operation frequency. Once the situation has returned to normality, the following step is to connect the different loads (depending on the available generation) in order to return to normal operation conditions.

Frequency is the most reliable indicator of an overload condition. Therefore, frequency is the parameter used for detecting this situation and automatically disconnecting the programmed loads.

The purpose of load shedding is balancing the load with the generation in the balance point where all parameters are at their normal operation values. As it is not possible to measure the quantity of overload, load shedding is performed sequentially in blocks and at different frequency levels, until frequency returns at least at the minimum operation value. In the case of an Electrical System at 60 Hz, the first block will be shedded between 59.4 and 59.7 Hz. If the first block shedding is not enough and frequency continues to fall, a second block is shedded, and this way on until the System is balanced.



## 11.3. SPECIAL PROBLEMS WITH LOAD SHEDDING

### 11.3.1. HIGH SPEED RECLOSE

A possible case is a line that incorporates high-speed reclose on both ends, and a load formed by motors in the middle of the line. In case of an internal failure, the line normally trips at both ends and starts a reclose of at least one of them. It is important to disconnect all the motor loads and the plant generators during the line opening previous to the reclose, as it would be very rare for them to remain in synchronism with the rest of the network during the dead time of the reclose, due to the generation deficit in the disconnected side.

This is a typical application for a frequency relay; When shedding the low-priority loads, this fact allows to maintain at least part of the motors in service until the manual or automatic reset of the situation previous to the failure.

### 11.3.2. CRITERIA FOR A LOAD SHEDDING SCHEME

When starting a load shedding scheme, we need to determine the maximum overload level allowed by the Electrical System to maintain system balance, the maximum load level we can shed, the frequency level that will start the shedding program, and the minimum frequency we can reach.

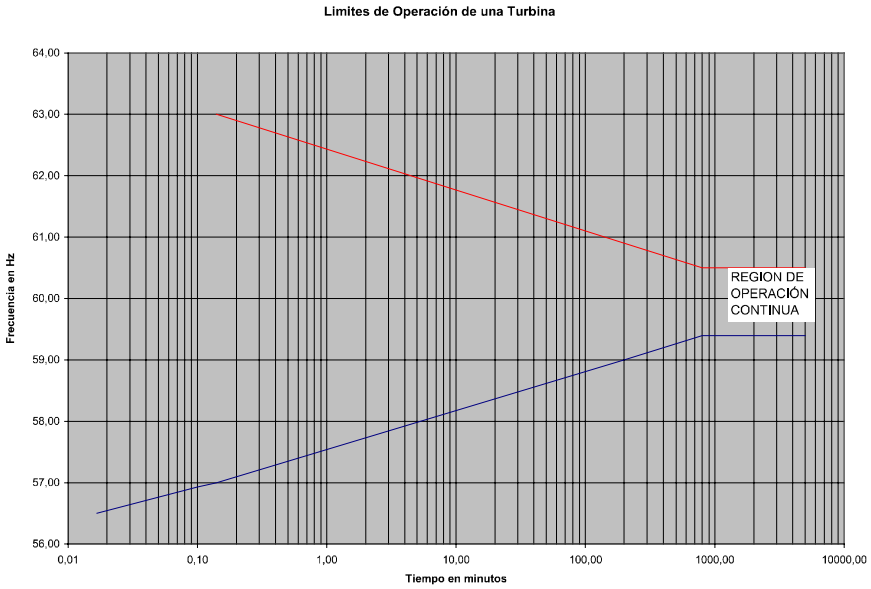
**Electrical System maximum overload**

In industrial systems including their own generation, and connected to the Electrical System through a feeder, it is quite easy to determine the overload level, but in the case of interconnections and big Electrical Systems it is more complicated, as levels and situations change during the day.

This is why, in these cases, usually stability studies are carried out for concrete events, such as the loss of big generation blocks, or the opening of critical interconnections, in order to determine the response of the System to different generation and load variations

**Maximum load level to be shedded**

The load quantity to be shedded must be enough to take the system frequency back to the rated values, or close values (around 59Hz in systems at 60 Hz). Usually the load quantity to be shedded is close to the overload value, as we can see in the following diagram:



## 11. ANNEX 1. MIV FREQUENCY UNITS USE

Frequency does not need to reach exactly 60Hz (or 50Hz) after a load shedding. If, for example frequency reaches 59Hz, the rotative generation reserve can compensate the load and leave the speed regulators adjust frequency to the rated values. If there is not enough rotative reserve, the system can operate at low frequency (taking into account the limitations for gas and steam turbines) for a period of time long enough for the operator to manually shed the required load, and bring the system back to its rated frequency value.

Usually, load shedding schemes are designed for disconnecting loads in several stages. On the other hand, as these stages are located in different points of the network, the possibility of power oscillations that can cause undesired trips in transmission lines or important interconnections is minimized.

**Start level of the load shedding scheme**

There is no pre-established criterion for fixing the starting level for load shedding, as this depends on several factors. In general, the scheme must start at values lower than the minimum operation values in emergency conditions.

The following frequency values can be established as shedding stages (for 60Hz systems):

| | |
|---|---|
| Group 1 | 59.5Hz |
| Group 2 | 59.0 Hz |
| Group 3 | 58.5 Hz |
| Group 4 | 58 Hz |

Another fact to be taken into account are the frequency deviations that can exist during power oscillations. The bigger the power oscillations are, the bigger will be the transitory frequency deviations.

**Admissible Operation Frequency Reduction**

According to the performed tests, power that can be generated in a plant decreases sensibly at 59 Hz, and reaches a limit condition at 53 to 55 Hz. In order to foresee a sufficient margin, the frequency fall is limited to 57Hz, and in extreme cases to 56 Hz. The load shedding must be always started at values higher than these limits, due to the delay caused by the operation time of associated protection equipment and breakers.

# 12. ANNEX 2. MODBUS MEMORY MAP

## 12.1. STATUS

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN. | MAX. | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04DA | | D T | Date/Time | 6 | F1 | | | | | | Yes | Yes | Yes |
| 04E0 | | ver | Version | 6 | F3 | | | | | | Yes | Yes | Yes |
| 04E6 | | mod | Model | 16 | F3 | | | | | | Yes | Yes | Yes |
| 04F6 | | iden | Identification | 16 | F3 | | | | | | Yes | Yes | Yes |
| 0506 | | LTU | Last trip function | 4 | F3 | | | | | | Yes | Yes | Yes |
| 050A | | Z2 | Last phase trip | 4 | F3 | | | | | | Yes | Yes | Yes |
| 050E | | Z3 | Last trip current | 4 | F2 | | | | | | Yes | Yes | Yes |
| 0512 | | f h | Last trip date | 6 | F1 | | | | | | Yes | Yes | Yes |
| 052C | 0 | LD | Trip LED | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 1 | LR | READY | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 2 | L1 | LED 1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 3 | L2 | LED 2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 4 | L3 | LED 3 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 5 | L4 | LED 4 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 8 | c1 | Logic 1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 9 | c2 | Logic 2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 10 | c3 | Logic 3 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052C | 11 | c4 | Logic 4 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 3 | BLOQ V N | Ground volt funct disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 052E | 4 | BLOQ V P | Phase volt funct disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 052E | 5 | DIS 59N | 59N Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 052E | 6 | DIS 59P | 59P Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 052E | 7 | DIS 27 | 27 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 052E | 8 | d | TRIP | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 9 | al | ALARM | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 10 | OUT1 | Output1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 11 | OUT2 | Output2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 12 | OUT3 | Output3 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 13 | OUT4 | Output4 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 14 | INP1 | Input1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 052E | 15 | INP2 | Input2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 0 | EDGEN | General input | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 1 | EDICAJ | Sett. change disable | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 4 | B 52B | Breaker 52b | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 5 | B 52A | Breaker 52a | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 9 | EST52 | Breaker Closed | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 14 | F1 | E2prom failure | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0530 | 15 | AU | User Settings | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0532 | 0 | prot | Protection | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0532 | 1 | bSuc | Events | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0532 | 3 | T AC | ACTIVE TABLE | 2 | F4 | | | | | | Yes | Yes | Yes |

## ANNEX 2. MODBUS MEMORY MAP

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN. | MAX. | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0532 | 4 | frec | Frequency | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0532 | 5 | LOCREM | Local | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0532 | 10 | DISP C | Phase c trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0532 | 11 | DISP B | Phase b trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0532 | 12 | DISP A | Phase a trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0532 | 13 | DISPHA | Phase trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0532 | 14 | DISNEU | Ground trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 0 | ARR 27HA | 27_1A Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 1 | ARR 27HB | 27_1B Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 2 | ARR 27HC | 27_1C Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 4 | ARR 27LA | 27_2A Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 5 | ARR 27LB | 27_2B Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 6 | ARR 27LC | 27_2C Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 8 | ARR 59HA | 59_1A Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 9 | ARR 59HB | 59_1B Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 10 | ARR 59HC | 59_1C Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 12 | ARR 59LA | 59_2A Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 13 | ARR 59LB | 59_2B Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0534 | 14 | ARR 59LC | 59_2C Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 0 | I D 27HA | 27_1A Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 1 | I D 27HB | 27_1B Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 2 | I D 27HC | 27_1C Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 4 | I D 27LA | 27_2A Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 5 | I D 27LB | 27_2B Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 6 | I D 27LC | 27_2C Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 8 | I D 59HA | 59_1A Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 9 | I D 59HB | 59_1B Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 10 | I D 59HC | 59_1C Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 12 | I D 59LA | 59_2A Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 13 | I D 59LB | 59_2B Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0536 | 14 | I D 59LC | 59_2C Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 0 | DIS 27HA | 27_1A Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 1 | DIS 27HB | 27_1B Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 2 | DIS 27HC | 27_1C Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 4 | DIS 27LA | 27_2A Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 5 | DIS 27LB | 27_2B Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 6 | DIS | 27_2C Trip | 2 | F4 | | | | | | Yes | No | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN. | MAX. | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 27LC | | | | | | | | | | | |
| 053A | 8 | DIS 59HA | 59_1A Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 9 | DIS 59HB | 59_1B Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 10 | DIS 59HC | 59_1C Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 12 | DIS 59LA | 59_2A Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 13 | DIS 59LB | 59_2B Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053A | 14 | DIS 59LC | 59_2C Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 0 | ARR 27PH | 27P1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 1 | ARR 27PL | 27P2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 2 | ARR 59PH | 59P1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 3 | ARR 59PL | 59P2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 4 | ARR 59NH | 59N1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 5 | ARR 59NL | 59N2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 053C | 6 | ARR 47 | 47 Pickup | 2 | F4 | | | | | | No | No | Yes |
| 053C | 8 | ARR 81 1 | 81_1 Pickup | 2 | F4 | | | | | | No | Yes | Yes |
| 053C | 9 | ARR 81 2 | 81_2 Pickup | 2 | F4 | | | | | | No | Yes | Yes |
| 053C | 10 | ARR 81 3 | 81_3 Pickup | 2 | F4 | | | | | | No | Yes | No |
| 053C | 11 | ARR 81 4 | 81_4 Pickup | 2 | F4 | | | | | | No | Yes | No |
| 053C | 15 | ARR V F | Pickup | 2 | F4 | | | | | | Yes | Yes | Yes |
| 053E | 0 | I D 27PH | 27P1 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 1 | I D 27PL | 27P2 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 2 | I D 59PH | 59P1 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 3 | I D 59PL | 59P2 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 4 | I D 59NH | 59N1 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 5 | I D 59NL | 59N2 Virtual trip | 2 | F4 | | | | | | Yes | No | Yes |
| 053E | 6 | I D 47 | 47 Virtual trip | 2 | F4 | | | | | | No | No | Yes |
| 053E | 8 | I D 81 1 | 81_1 Virtual trip | 2 | F4 | | | | | | No | Yes | Yes |
| 053E | 9 | I D 81 2 | 81_2 Virtual trip | 2 | F4 | | | | | | No | Yes | Yes |
| 053E | 10 | I D 81 3 | 81_3 Virtual trip | 2 | F4 | | | | | | No | Yes | No |
| 053E | 11 | I D 81 4 | 81_4 Virtual trip | 2 | F4 | | | | | | No | Yes | No |
| 053E | 15 | I D V F | General virtual trip | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0542 | 0 | MED 27PH | 27P1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 1 | MED 27PL | 27P2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 2 | MED 59PH | 59P1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 3 | MED 59PL | 59P2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 4 | MED 59NH | 59N1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 5 | MED 59NL | 59N2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0542 | 6 | MED 47 | 47 Disabled (by di) | 2 | F4 | | | | | | No | No | Yes |
| 0542 | 7 | MED V | Voltage disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |

## ANNEX 2. MODBUS MEMORY MAP

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN. | MAX. | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0542 | 8 | MED 81 1 | 81_1 Disabled (by di) | 2 | F4 | | | | | | No | Yes | Yes |
| 0542 | 9 | MED 81 2 | 81_2 Disabled (by di) | 2 | F4 | | | | | | No | Yes | Yes |
| 0542 | 10 | MED 81 3 | 81_3 Disabled (by di) | 2 | F4 | | | | | | No | Yes | No |
| 0542 | 11 | MED 81 4 | 81_4 Disabled (by di) | 2 | F4 | | | | | | No | Yes | No |
| 0542 | 14 | MED 81 | Frequency disabled (by di) | 2 | F4 | | | | | | No | Yes | Yes |
| 0542 | 15 | MED V F | Trip Disabled (by di) | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0544 | 0 | DIS 27PH | 27P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 1 | DIS 27PL | 27P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 2 | DIS 59PH | 59P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 3 | DIS 59PL | 59P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 4 | DIS 59NH | 59N1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 5 | DIS 59NL | 59N2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0544 | 6 | DIS 47 | 47 Trip | 2 | F4 | | | | | | No | No | Yes |
| 0544 | 8 | DIS 81 1 | 81_1 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 0544 | 9 | DIS 81 2 | 81_2 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 0544 | 10 | DIS 81 3 | 81_3 Trip | 2 | F4 | | | | | | No | Yes | No |
| 0544 | 11 | DIS 81 4 | 81_4 Trip | 2 | F4 | | | | | | No | Yes | No |
| 0544 | 14 | DIS 81 | Frequency trip | 2 | F4 | | | | | | No | Yes | Yes |
| 0544 | 15 | DIS V F | General trip | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0546 | | Va | Va | 4 | F2 | | | | | | Yes | No | Yes |
| 054A | | Vb | Vb | 4 | F2 | | | | | | Yes | No | Yes |
| 054E | | Vc | Vc | 4 | F2 | | | | | | Yes | No | Yes |
| 0552 | | Vn | Vn | 4 | F2 | | | | | | Yes | No | Yes |
| 0556 | | Vab | Vab | 4 | F2 | | | | | | Yes | No | Yes |
| 055A | | Vbc | Vbc | 4 | F2 | | | | | | Yes | No | Yes |
| 055E | | Vca | Vca | 4 | F2 | | | | | | Yes | No | Yes |
| 0562 | | V2 | V2 | 4 | F2 | | | | | | Yes | No | Yes |
| 0566 | | f | Frequency | 4 | F2 | | | | | | Yes | No | Yes |
| 056E | | OS | Oscillo number | 2 | F5 | | | | | | Yes | Yes | Yes |
| 0570 | | Sn | # New Events | 2 | F5 | | | | | | Yes | Yes | Yes |
| 0572 | | St | # Total Events | 2 | F5 | | | | | | Yes | Yes | Yes |

## 12.2. SETTINGS

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0134 | | IDEN | IDENTIFICATION | 16 | F3 | | | | | | Yes | Yes | Yes |
| 0144 | | TRIP MIN TIME | TRIP MIN TIME | 4 | F2 | 100 | 300 | 50 | 1 | ms | Yes | Yes | Yes |
| 0148 | 0 | TAB | ACTIVE TABLE | 2 | F4 | | | | | | Yes | Yes | Yes |
| 014A | 0 | STA | RELAY STATUS | 2 | F4 | | | | | | Yes | Yes | Yes |
| 014A | 1 | FRQ | FREQUENCY | 2 | F4 | | | | | | Yes | Yes | Yes |
| 014C | | APP | APPLICATION | 2 | F13 | | | | | | Yes | No | Yes |
| 014E | 0 | TRIP 27P1 | 27P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 1 | TRIP 27P2 | 27P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 2 | TRIP 59P1 | 59P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 3 | TRIP 59P2 | 59P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 4 | TRIP 59N1 | 59N1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 5 | TRIP 59N2 | 59N2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 014E | 6 | TRIP 47 | 47 Trip | 2 | F4 | | | | | | No | No | Yes |
| 014E | 8 | TRIP 81 1 | 81_1 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 014E | 9 | TRIP 81 2 | 81_2 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 014E | 10 | TRIP 81 3 | 81_3 Trip | 2 | F4 | | | | | | No | Yes | No |
| 014E | 11 | TRIP 81 4 | 81_4 Trip | 2 | F4 | | | | | | No | Yes | No |
| 0150 | 3 | SUP 27P1 | 27P1 52 Supervision | 2 | F4 | | | | | | Yes | No | Yes |
| 0150 | 4 | SUP 27P2 | 27P2 52 Supervision | 2 | F4 | | | | | | Yes | No | Yes |
| 0152 | | TAP 27P1 | 27P1 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 0156 | | TIME 27P1 | 27P1 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 015A | | TAP 27P2 | 27P2 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 015E | | TIME 27P2 | 27P2 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 0162 | | TAP 59P1 | 59P1 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 0166 | | TIME 59P1 | 59P1 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 016A | | TAP 59P2 | 59P2 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 016E | | TIME 59P2 | 59P2 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 0172 | | TAP 59N1 | 59N1 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 0176 | | TIME 59N1 | 59N1 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 017A | | TAP 59N2 | 59N2 Pickup | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 017E | | TIME 59N2 | 59N2 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 0182 | | TAP 47 | 47 Pickup | 4 | F2 | 60 | 60 | 2 | 10 | V | No | No | Yes |
| 0186 | | TIME 47 | 47 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | No | No | Yes |
| 018A | | TYPE 81 1 | 81_1 Type | 2 | F14 | | | | | | No | Yes | Yes |
| 018C | | PICK 81 1 | 81_1 Pickup | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | Yes |
| 0194 | | TIME 81 1 | 81_1 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | Yes |
| 0198 | | SUP 81 1 | 81_1 Supervision | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | Yes |
| 019C | | TYPE 81 2 | 81_2 Type | 2 | F14 | | | | | | No | Yes | Yes |
| 019E | | PICK 81 2 | 81_2 Pickup | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | Yes |
| 01A6 | | TIME 81 2 | 81_2 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | Yes |
| 01AA | | SUP 81 2 | 81_2 Supervision | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | Yes |
| 01AE | | TYPE 81 3 | 81_3 Type | 2 | F14 | | | | | | No | Yes | No |
| 01B0 | | PICK 81 3 | 81_3 Pickup | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | No |
| 01B8 | | TIME 81 3 | 81_3 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | No |
| 01BC | | SUP 81 3 | 81_3 Supervision | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | No |
| 01C0 | | TYPE 81 4 | 81_4 Type | 2 | F14 | | | | | | No | Yes | No |
| 01C2 | | PICK 81 4 | 81_4 Pickup | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | No |
| 01CA | | TIME 81 4 | 81_4 Time Delay | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | No |
| 01CE | | SUP 81 4 | 81_4 Supervision | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | No |
| 01D2 | 0 | TRIP 27P1 t2 | 27P1 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 1 | TRIP 27P2 t2 | 27P2 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 2 | TRIP 59P1 t2 | 59P1 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 3 | TRIP 59P2 t2 | 59P2 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 4 | TRIP 59N1 t2 | 59N1 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 5 | TRIP 59N2 t2 | 59N2 Trip T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D2 | 6 | TRIP 47 t2 | 47 Trip T2 | 2 | F4 | | | | | | No | No | Yes |
| 01D2 | 8 | TRIP 81 1 t2 | 81_1 Trip T2 | 2 | F4 | | | | | | No | Yes | Yes |
| 01D2 | 9 | TRIP 81 2 t2 | 81_2 Trip T2 | 2 | F4 | | | | | | No | Yes | Yes |
| 01D2 | 10 | TRIP 81 3 t2 | 81_3 Trip T2 | 2 | F4 | | | | | | No | Yes | No |
| 01D2 | 11 | TRIP 81 4 t2 | 81_4 Trip T2 | 2 | F4 | | | | | | No | Yes | No |
| 01D4 | 3 | SUP 27P1 t2 | 27P1 52 Supervision T2 | 2 | F4 | | | | | | Yes | No | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01D4 | 4 | SUP 27P2 t2 | 27P2 52 Supervision T2 | 2 | F4 | | | | | | Yes | No | Yes |
| 01D6 | | TAP 27P1 t2 | 27P1 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 01DA | | TIME 27P1 t2 | 27P1 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 01DE | | TAP 27P2 t2 | 27P2 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 01E2 | | TIME 27P2 t2 | 27P2 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 01E6 | | TAP 59P1 t2 | 59P1 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 01EA | | TIME 59P1 t2 | 59P1 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 01EE | | TAP 59P2 t2 | 59P2 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 01F2 | | TIME 59P2 t2 | 59P2 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 01F6 | | TAP 59N1 t2 | 59N1 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 01FA | | TIME 59N1 t2 | 59N1 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 01FE | | TAP 59N2 t2 | 59N2 Pickup T2 | 4 | F2 | 110 | 250 | 10 | 10 | V | Yes | No | Yes |
| 0202 | | TIME 59N2 t2 | 59N2 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | Yes | No | Yes |
| 0206 | | TAP 47 t2 | 47 Pickup T2 | 4 | F2 | 60 | 60 | 2 | 10 | V | No | No | Yes |
| 020A | | TIME 47 t2 | 47 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | No | No | Yes |
| 020E | | TYPE 81 1 t2 | 81_1 Type T2 | 2 | F14 | | | | | | No | Yes | Yes |
| 0210 | | PICK 81 1 t2 | 81_1 Pickup T2 | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | Yes |
| 0218 | | TIME 81 1 t2 | 81_1 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | Yes |
| 021C | | SUP 81 1 t2 | 81_1 Supervision T2 | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | Yes |
| 0220 | | TYPE 81 2 t2 | 81_2 Type T2 | 2 | F14 | | | | | | No | Yes | Yes |
| 0222 | | PICK 81 2 t2 | 81_2 Pickup T2 | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | Yes |
| 022A | | TIME 81 2 t2 | 81_2 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | Yes |
| 022E | | SUP 81 2 t2 | 81_2 Supervision T2 | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | Yes |
| 0232 | | TYPE 81 3 t2 | 81_3 Type T2 | 2 | F14 | | | | | | No | Yes | No |
| 0234 | | PICK 81 3 t2 | 81_3 Pickup T2 | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | No |
| 023C | | TIME 81 3 t2 | 81_3 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | No |
| 0240 | | SUP 81 3 t2 | 81_3 Supervision T2 | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | No |
| 0244 | | TYPE 81 4 t2 | 81_4 Type T2 | 2 | F14 | | | | | | No | Yes | No |
| 0246 | | PICK 81 4 t2 | 81_4 Pickup T2 | 4 | F2 | 42 | 68 | 42 | 100 | Hz | No | Yes | No |
| 024E | | TIME 81 4 t2 | 81_4 Time Delay T2 | 4 | F2 | 1 | 600 | 0 | 100 | s | No | Yes | No |
| 0252 | | SUP 81 4 t2 | 81_4 Supervision T2 | 4 | F2 | 30 | 250 | 30 | 10 | V | No | Yes | No |
| 0256 | 0 | O1 | Oscillo by communic. | 2 | F4 | | | | | | Yes | Yes | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0256 | 1 | O2 | Oscillo by digital input | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0256 | 2 | O3 | Oscillo by tripping | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0256 | 3 | O4 | Oscillo by pickup | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0258 | 0 | sAPCOM | Trip operation by command | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0258 | 1 | sRLATC | Reset latch aux | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 9 | E PROT | Protection status | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 10 | aux1 | Output 1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 11 | aux2 | Output 2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 12 | aux3 | Output 3 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 13 | aux4 | Output 4 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 14 | ENT1 | Digital Input 1 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025A | 15 | ENT2 | Digital Input 2 | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 1 | ihca | Sett. change disable | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 2 | ORD D | Trip operation by input | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 4 | ED 52B | Breaker 52B | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 5 | ED 52A | Breaker 52A | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 6 | C TAB | Active table change | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 7 | Gosc | Oscillo trigg by DI | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 9 | est INTE | Breaker Closed | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 10 | STOC | Oscillo trigg by comm | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 13 | C AJUS | Settings change | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 14 | SE2P | e2prom Failure | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025C | 15 | Adef | User settings | 2 | F4 | | | | | | Yes | Yes | Yes |
| 025E | 0 | sAR 27PH | 27P1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 025E | 1 | sAR 27PL | 27P2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 025E | 2 | sAR 59PH | 59P1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 025E | 3 | sAR 59PL | 59P2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 025E | 4 | sAR 59NH | 59N1 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 025E | 5 | sAR 59NL | 59N2 Pickup | 2 | F4 | | | | | | Yes | No | Yes |
| 025E | 6 | sAR 47 | 47 Pickup | 2 | F4 | | | | | | No | No | Yes |
| 025E | 8 | sAR 81 1 | 81_1 Pickup | 2 | F4 | | | | | | No | Yes | Yes |
| 025E | 9 | sAR 81 2 | 81_2 Pickup | 2 | F4 | | | | | | No | Yes | Yes |
| 025E | 10 | sAR 81 3 | 81_3 Pickup | 2 | F4 | | | | | | No | Yes | No |
| 025E | 11 | sAR 81 4 | 81_4 Pickup | 2 | F4 | | | | | | No | Yes | No |
| 0260 | 0 | sIN 27PH | 27P1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 1 | sIN 27PL | 27P2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 2 | sIN 59PH | 59P1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 3 | sIN 59PL | 59P2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 4 | sIN 59NH | 59N1 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 5 | sIN 59NL | 59N2 Disabled (by di) | 2 | F4 | | | | | | Yes | No | Yes |
| 0260 | 6 | sIN 47 | 47 Disabled (by di) | 2 | F4 | | | | | | No | No | Yes |
| 0260 | 8 | sIN 81 1 | 81_1 Disabled (by di) | 2 | F4 | | | | | | No | Yes | Yes |
| 0260 | 9 | sIN 81 2 | 81_2 Disabled (by di) | 2 | F4 | | | | | | No | Yes | Yes |
| 0260 | 10 | sIN 81 3 | 81_3 Disabled (by di) | 2 | F4 | | | | | | No | Yes | No |
| 0260 | 11 | sIN 81 4 | 81_4 Disabled (by di) | 2 | F4 | | | | | | No | Yes | No |
| 0260 | 15 | D INH | Trip disabled (by di) | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0262 | 0 | sDI 27PH | 27P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0262 | 1 | sDI 27PL | 27P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0262 | 2 | sDI 59PH | 59P1 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0262 | 3 | sDI 59PL | 59P2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0262 | 4 | sDI 59NH | 59N1 Trip | 2 | F4 | | | | | | Yes | No | Yes |

| ADDRESS | BIT | NAME | DESCRIPTION | LENGTH | TYPE | MIN | MAX | DEFAULT | SCALE | UNIT | MIV1000 | MIV2000 | MIV3000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0262 | 5 | sDI 59NL | 59N2 Trip | 2 | F4 | | | | | | Yes | No | Yes |
| 0262 | 6 | sDI 47 | 47 Trip | 2 | F4 | | | | | | No | No | Yes |
| 0262 | 8 | sDI 81 1 | 81_1 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 0262 | 9 | sDI 81 2 | 81_2 Trip | 2 | F4 | | | | | | No | Yes | Yes |
| 0262 | 10 | sDI 81 3 | 81_3 Trip | 2 | F4 | | | | | | No | Yes | No |
| 0262 | 11 | sDI 81 4 | 81_4 Trip | 2 | F4 | | | | | | No | Yes | No |
| 0262 | 15 | DISGEN | General trip | 2 | F4 | | | | | | Yes | Yes | Yes |
| 0264 | | V Cali | Calibration Voltage | 4 | F2 | 100 | 250 | 20 | 1 | | Yes | Yes | Yes |

## 12.3. FORMATS

| Format | TYPE | Value | |
|---|---|---|---|
| F1 | Date/Time | | Milliseconds since 1/1/1996 at 00:00:00.000 |
| F2 | IEEE FLOATING POINT (32 bits) | | |
| F3 | String | | |
| F4 | Logic | | |
| F5 | UNSIGNED INTEGER | | |
| F6 | UNSIGNED INTEGER - ENUMERATED | 1 | 300 |
| | | 13 | 4800 |
| | | 2 | 600 |
| | | 32 | 9600 |
| | | 4 | 1200 |
| | | 64 | 19200 |
| | | 8 | 2400 |
| F7 | UNSIGNED INTEGER – ENUMERATED | 1 | INVERSE |
| | | 16 | USER CURVE |
| | | 2 | VERY INVERSE |
| | | 4 | EXTREMELY INVERSE |
| | | 8 | DEFINITE TIME |
| F8 | UNSIGNED INTEGER – ENUMERATED | 0 | FALSE |
| | | 1 | TRUE |
| F10 | UNSIGNED INTEGER – ENUMERATED | 0 | 50 Hz |
| | | 1 | 60 Hz |
| F11 | UNSIGNED INTEGER - ENUMERATED | 8192 | Trip operation by command |
| | | 8194 | Reset auxiliary latched outputs |
| | | 8196 | 27P1 Pickup |
| | | 8197 | 27P1 Drop out |
| | | 8198 | 27P2 Pickup |
| | | 8199 | 27P2 Drop out |
| | | 8200 | 59P1 Pickup |
| | | 8201 | 59P1 Drop out |
| | | 8202 | 59P2 Pickup |
| | | 8203 | 59P2 Drop out |
| | | 8204 | 59N1 Pickup |
| | | 8205 | 59N1 Drop out |
| | | 8206 | 59N2 Pickup |
| | | 8207 | 59N2 Drop out |
| | | 8208 | 47 Pickup |
| | | 8209 | 47 Drop out |
| | | 8210 | 81_1 Pickup |
| | | 8211 | 81_1 Drop out |
| | | 8212 | 81_2 Pickup |
| | | 8213 | 81_2 Drop out |
| | | 8214 | 81_3 Pickup |
| | | 8215 | 81_3 Drop out |
| | | 8216 | 81_4 Pickup |
| | | 8217 | 81_4 Drop out |

| Format | TYPE | Value | |
|---|---|---|---|
| | | 8224 | Pickup 50PH |
| | | 8225 | Drop out 50PH |
| | | 8226 | Pickup 50NH |
| | | 8227 | Drop out 50NH |
| | | 8228 | Pickup 51P |
| | | 8229 | Drop out 51P |
| | | 8230 | Pickup 51N |
| | | 8231 | Drop out 51N |
| | | 8232 | Pickup 50PL |
| | | 8233 | Drop out 50PL |
| | | 8234 | Pickup 50NL |
| | | 8235 | Drop out 50NL |
| | | 8236 | Alarm 49 |
| | | 8237 | Drop out alarm 49 |
| | | 8240 | 50PH disabled by digital input |
| | | 8241 | 50PH enabled |
| | | 8242 | 50NH disabled by digital input |
| | | 8243 | 50NH enabled |
| | | 8244 | 51P disabled by digital input |
| | | 8245 | 51P enabled |
| | | 8246 | 51N disabled by digital input |
| | | 8247 | 51N enabled |
| | | 8248 | 50PL disabled by digital input |
| | | 8249 | 50PL enabled |
| | | 8250 | 50NL disabled by digital input |
| | | 8251 | 50NL enabled |
| | | 8252 | 49 disabled by digital input |
| | | 8253 | 49 enabled |
| | | 8254 | Trip disabled by digital input |
| | | 8255 | Trip enabled |
| | | 8256 | 50PH Trip |
| | | 8258 | 50NH Trip |
| | | 8260 | 51P Trip |
| | | 8262 | 51N Trip |
| | | 8264 | 50PL Trip |
| | | 8266 | 50NL Trip |
| | | 8268 | 49 Trip |
| | | 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 |

| Format | TYPE | Value | |
|---|---|---|---|
| | | 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 |
| | | 8296 | 52B = 1 |
| | | 8297 | 52B = 0 |
| | | 8298 | 52A = 1 |
| | | 8299 | 52A = 0 |
| | | 8300 | Active table: Table 2 |
| | | 8301 | Active table: Settings Table |
| | | 8302 | Oscillography trigger by digital input |
| | | 8304 | BF to open |
| | | 8306 | 52 Status=1 |
| | | 8307 | 52 Status=0 |
| | | 8308 | Oscillography trigger by communications |
| | | 8310 | I2 Alarm |
| | | 8312 | Cold load pickup |
| | | 8313 | Dropout cold load pickup |
| | | 8314 | Settings change |
| | | 8316 | E2prom failure |
| | | 8318 | User settings |
| | | 8319 | Factory settings |
| | | 8320 | 27P1 disabled by digital input |
| | | 8321 | 27P1 enabled |
| | | 8322 | 27P2 disabled by digital input |
| | | 8323 | 27P2 enabled |
| | | 8324 | 59P1 disabled by digital input |
| | | 8325 | 59P1 enabled |
| | | 8326 | 59P2 disabled by digital input |
| | | 8327 | 59P2 enabled |
| | | 8328 | 59N1 disabled by digital input |
| | | 8329 | 59N1 enabled |
| | | 8330 | 59N2 disabled by digital input |
| | | 8331 | 59N2 enabled |
| | | 8332 | 47 disabled by digital input |
| | | 8333 | 47 enabled |
| | | 8334 | 81_1 disabled by digital input |
| | | 8335 | 81_1 enabled |
| | | 8336 | 81_2 disabled by digital input |
| | | 8337 | 81_2 enabled |
| | | 8338 | 81_3 disabled by digital input |
| | | 8339 | 81_3 enabled |
| | | 8340 | 81_4 disabled by digital input |
| | | 8341 | 81_4 enabled |
| | | 8342 | 27P1 Trip |

| Format | TYPE | Value | |
|---|---|---|---|
| | | 8344 | 27P2 Trip |
| | | 8346 | 59P1 Trip |
| | | 8348 | 59P2 Trip |
| | | 8350 | 59N1 Trip |
| | | 8352 | 59N2 Trip |
| | | 8354 | 47 Trip |
| | | 8356 | 81_1 Trip |
| | | 8358 | 81_2 Trip |
| | | 8360 | 81_3 Trip |
| | | 8362 | 81_4 Trip |
| F12 | INTEGER 16 BIT | | |
| F13 | UNSIGNED INTEGER – ENUMERATED | 1 | 3P+N WYE |
| | | 2 | 3P DELTA |
| | | 4 | SINGLE PHASE |
| | | 8 | GROUND |
| F14 | UNSIGNED INTEGER – ENUMERATED | 2 | OVERFREQUENCY |
| | | 4 | UNDERFREQUNCY |

## 12.4. OPERATIONS

| NAME | DESCRIPTION | SELECTION | CONFIRMATION | VALUE | CURRENT | BROADCAST | MIF MODELS | MIV MODELS |
|---|---|---|---|---|---|---|---|---|
| Settings | SETTINGS | 01 | 02 | No | -- | No | 0, 1, 2 | 1000,2000,3000 |
| Rit | THERMAL IMAGE | 03 | 04 | No | -- | No | 0, 1, 2 | -- |
| APER | OPEN BREAKER | 07 | 08 | No | -- | No | 0, 1, 2 | 1000,2000,3000 |
| RL | RESET | 09 | 0A | No | -- | No | 0, 1, 2 | 1000,2000,3000 |
| AcT1 | ACTIVATE TABLE 1 | 0D | 0E | No | -- | No | 0, 1, 2 | 1000,2000,3000 |
| AcT2 | ACTIVATE TABLE 2 | 0F | 10 | No | -- | No | 0, 1, 2 | 1000,2000,3000 |
| OSC | OSCILLOGRAPHY | 11 | 12 | No | -- | No | 1, 2 | 1000,2000,3000 |
| SUCt | NUMBER OF EVENTS | 13 | 14 (+VALUE) | Yes* | No. Of events to be deleted | No | 1, 2 | 1000,2000,3000 |
| A OS | TRIGGER OSCILOOGRAPHY | 17 | 18 | No | -- | No | 1,2 | 1000,2000,3000 |
| RAPER | SET # OPENINGS | 2F | 30 (+VALUE) | Yes* | No. Of openings | No | 2 | -- |
| RCONT | SET I2 COUNTER | 31 | 32 (+VALUE) | Yes* | Counter I2 | No | 2 | -- |
| SYNC | SET DATE/TIME | FE (+VALUE) | -- | Yes* | Date/time | Yes | 0, 1, 2 | 1000,2000,3000 |
| CIER | CLOSE BREAKER | 39 | 3A | No | -- | No | -- | 1000,2000,3000 |

# 13. ANNEX 3. MODEM CONNECTION

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 M+PC 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 be set 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.

# ANNEX 3 MODEM CONNECTION

## 13.1. HAYES MODEM

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 M+PC 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.

## 13.2. V.25BIS MODEM

M+PC 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.

## 13.3. SAMPLES OF SETTINGS FOR PARTICULAR MODEMS

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

### 13.3.1. SPORTSTER FLASH X2 MODEM (HAYES)

***Initiation commands for the modem on the PC side:***

We will add the following commands to the default configuration:

| | | | |
|---|---|---|---|
| &An | Enable/disable the ARQ result codes | Disable the ARQ result codes | &A0 |
| &Hn | Sets the flux control for the data transfer (TD). | Flux control disabled | &H0 |
| &In | Sets the software flux control for the data reception (RD). | Software flux control disabled. | &I0 |
| &Kn | Enable/Disable data compression | Data compression disabled | &K0 |
| &Mn | Sets the error control (ARQ) for 1200 bps and higher. | Normal mode, error control disabled | &M0 |
| &Rn | Configures the hardware flux control for data reception (DR) and transfer request (RTS) | Modem ignores RTS. | &R1 |
| S15 | Record with bit representation. | Disable ARQ/MNP for V.32/V.32bis. | S15=4 |
| S32 | Record 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:

| | | | |
|---|---|---|---|
| &An | Enable/disable the ARQ result codes | ARQ result codes are disabled | &A0 |
| &Dn | Control the DTR operations | About DTR control. | &D0 |
| &Hn | Sets the flux control for the data transfer (TD). | Flux control disabled | &H0 |
| &In | Sets the software flux control for the data reception (RD). | Software flux control disabled. | &I0 |
| &Kn | Enable/Disable data compression | Data compression disabled | &K0 |
| &Mn | Sets the error control (ARQ) for 1200 bps and higher. | Normal mode, error control disabled | &M0 |
| &Rn | Configures the hardware flux control for data reception (DR) and transfer request (RTS) | Modem ignores RTS. | &R1 |
| S0 | Sets the number of rings necessary for answering in automatic answering mode | The modem will answer to the first ring. | S0=1 |
| S15 | Record with bit representation. | Disable ARQ/MNP for V.32/V.32bis. | S15=4 |
| S32 | Record with bit representation. | Disable V.34. modulation | S32=8 |

### 13.3.2. ZOOM PKT14.4

***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 | | | | | | | |

### 13.3.3. MODEM SATELSA MGD-2400-DHE (V.25BIS)

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**

## ANNEX 3 MODEM CONNECTION

| Nº | DESCRIPTIÓN | VALUE |
|---|---|---|
| 1 | 112 ETD/OFF<br>ON: Circuit 112 connected to ETD<br>OFF: Circuit 112 connected to ETD | ON |
| 2 | 112 ETD/ON<br>ON: 108 circuit forced to CLOSED.<br>OFF: 108 circuit follows ETD's 108 circuit | OFF |
| 3 | 105 ETD/ON<br>ON: Circuit 105 forced to CLOSED.<br>OFF: Circuit 105 follows ETD's 105circuit | ON |
| 4 | TXA/TXB in a peer-to-peer line (PP)<br>ON: In PP transfers through high channel.<br>OFF: In PP transfers through low channel. | OFF |
| 5y6 | Baud ate selection for data transfer<br>ON-ON 1200<br>OFF-ON 2400<br>ON-OFF Automatic.<br>OFF-OFF Automatic. | ON-OFF |
| 7y8 | Automatic disconnection.<br>ON-ON No automatic disconnection.<br>OFF-ON Circuit 105.<br>ON-OFF Circuit 109.<br>OFF-OFF Circuits 105 and 109. | ON-OFF |

**Set 2**

| No. | DESCRIPTION | VALUE |
|---|---|---|
| 1 | Synchronous format of protocol V25bis in option 108.2.<br>ON: Character oriented format (BSC).<br>OFF: Bit oriented format (HDLC). | ON |
| 2y3 | Asynchronous character format for data transfer<br>ON-ON 8<br>OFF-ON 9<br>ON-OFF 10<br>OFF-OFF 11 | ON-OFF |
| 4 | Reception permission for remote loop 2<br>ON: Not permitted.<br>OFF: Permitted. | OFF |
| 5y6 | Exploitation mode.<br>ON-ON Point-to-point line<br>OFF-ON Automatic call as per 108.1.<br>ON-OFF RTC line without automatic call.<br>OFF-OFF Automatic call as per 108.2. | OFF-OFF |
| 7 | Number of calls for automatic answer<br>ON: 1 call.<br>OFF: 2 calls. | ON |
| 8 | 112 ETD/OFF<br>ON: Asynchronous operation.<br>OFF: Synchronous operation. | ON |

**Set 3**

| No | DESCRIPTIONº | VALUE |
|---|---|---|
| 1y2 | Transmission timer selection.<br>ON-ON 114<br>OFF-ON 113<br>ON-OFF 114/5<br>OFF-OFF 113 | ON-ON |
| 3 | RTC Dialing system<br>ON: Multi-frequency dialing.<br>OFF: Loop opening pulse dialing | ON |
| 4 | Status of circuit 109, during protocol V.25bis in RTC, option 108.2.<br>ON: Status of circuit 108 remains.<br>OFF: Remains open. | OFF |
| 5 | Selection, when starting, of manual or automatic answering mode.<br>ON: Automatic.<br>OFF: Manual. | OFF |
| 6 | Protocol selection.<br>ON: HAYES Protocol.<br>OFF: V.25bis Protocol. | OFF |
| 7y8 | Modem transmission level.<br>ON-ON -6 dBm<br>OFF-ON -10 dBm<br>ON-OFF -6 dBm<br>OFF-OFF -15 dBm | ON-ON |

## ANNEX 3 MODEM CONNECTION

### LOCATION OF MODEM MICROSWITCHES ON THE RELAY SIDE

**Set 1**

| Nº | DESCRIPTIÓN | VALUE |
|---|---|---|
| 1 | 112 ETD/OFF<br>ON: Circuit 112 connected to ETD<br>OFF: Circuit 112 connected to ETD | ON |
| 2 | 112 ETD/ON<br>ON: 108 circuit forced to CLOSED.<br>OFF: 108 circuit follows ETD's 108 circuit | ON |
| 3 | 105 ETD/ON<br>ON: Circuit 105 forced to CLOSED.<br>OFF: Circuit 105 follows ETD's 105circuit | ON |
| 4 | TXA/TXB in a peer-to-peer line (PP)<br>ON: In PP transfers through high channel.<br>OFF: In PP transfers through low channel. | ON |
| 5y6 | Baud rate selection for data transfer.<br>ON-ON 1200<br>OFF-ON 2400<br>ON-OFF Automatic.<br>OFF-OFF Automatic. | ON-OFF |
| 7y8 | Automatic disconnection.<br>ON-ON No automatic disconnection.<br>OFF-ON Circuit 105.<br>ON-OFF Circuit 109.<br>OFF-OFF Circuits 105 and 109. | OFF-OFF |

**Set 2**

| Nº | DESCRIPTIÓN | VALUE |
|---|---|---|
| 1 | Synchronous format of protocol V25bis in option 108.2.<br>ON: Character oriented format (BSC).<br>OFF: Bit oriented format (HDLC). | ON |
| 2y3 | Asynchronous character format for data transfer<br>ON-ON 8<br>OFF-ON 9<br>ON-OFF 10<br>OFF-OFF 11 | ON-OFF |
| 4 | Reception permission for remote loop 2<br>ON: Not permitted.<br>OFF: Permitted. | OFF |
| 5y6 | Exploitation mode.<br>ON-ON Point-to-point line<br>OFF-ON Automatic call as per 108.1.<br>ON-OFF RTC line without automatic call.<br>OFF-OFF Automatic call as per 108.2. | ON-OFF |
| 7 | Number of calls for automatic answer<br>ON: 1 call.<br>OFF: 2 calls. | OFF |
| 8 | 112 ETD/OFF<br>ON: Asynchronous operation.<br>OFF: Synchronous operation. | ON |

**Set 3**

| Nº | DESCRIPCIÓN | VALOR |
|---|---|---|
| 1y2 | Transmission timer selection.<br>ON-ON 114<br>OFF-ON 113<br>ON-OFF 114/5<br>OFF-OFF 113 | ON-ON |
| 3 | RTC Dialing system<br>ON: Multi-frequency dialing.<br>OFF: Loop opening pulse dialing | OFF |
| 4 | Status of circuit 109, during protocol V.25bis in RTC, option 108.2.<br>ON: Status of circuit 108 remains.<br>OFF: Remains open. | OFF |
| 5 | Selection, when starting, of manual or automatic answering mode.<br>ON: Automatic.<br>OFF: Manual. | ON |
| 6 | Protocol selection.<br>ON: HAYES Protocol.<br>OFF: V.25bis Protocol. | OFF |
| 7y8 | Modem transmission level.<br>ON-ON -6 dBm<br>OFF-ON -10 dBm<br>ON-OFF -6 dBm<br>OFF-OFF -15 dBm | ON-ON |

## ANNEX 3 MODEM CONNECTION

# 14. ANNEX 4. STATUS LIST

| NAME | DESCRIPTION | MIV 1000 | MIV 2000 | MIV 3000 |
|---|---|---|---|---|
| Model | Relay model | ✓ | ✓ | ✓ |
| Version | Flash memory version | ✓ | ✓ | ✓ |
| Date/time | Current date and time | ✓ | ✓ | ✓ |
| Identification | Value entered in the “identification” setting (general advanced group) | ✓ | ✓ | ✓ |
| Va | Va Voltage | ✓ | | ✓ |
| Vb | Vb Voltage | ✓ | ✓ | ✓ |
| Vc | Vc Voltage | ✓ | | ✓ |
| $V_N$ | $V_N$ Voltage | ✓ | | ✓ |
| Vab | Vab phase-to-phase voltage | ✓ | | ✓ |
| Vbc | Vbc phase-to-phase voltage | ✓ | | ✓ |
| Vca | Vca phase-to-phase voltage | ✓ | | ✓ |
| V2 | Negative sequence voltage | | | ✓ |
| Frec | Frequency | | ✓ | ✓ |
| Pickup 27_1 a | Pickup of unit 27P1 phase a | ✓ | | ✓ |
| Pickup 27_1 b | Pickup of unit 27P1 phase b | ✓ | | ✓ |
| Pickup 27_1 c | Pickup of unit 27P1 phase c | ✓ | | ✓ |
| Pickup 27_2 a | Pickup of unit 27P2 phase a | ✓ | | ✓ |
| Pickup 27_2 b | Pickup of unit 27P2 phase b | ✓ | | ✓ |
| Pickup 27_2 c | Pickup of unit 27P2 phase c | ✓ | | ✓ |
| Pickup 59_1 a | Pickup of unit 59P1 phase a | ✓ | | ✓ |
| Pickup 59_1 b | Pickup of unit 59P1 phase b | ✓ | | ✓ |
| Pickup 59_1 c | Pickup of unit 59P1 phase c | ✓ | | ✓ |
| Pickup 59_2 a | Pickup of unit 59P2 phase a | ✓ | | ✓ |
| Pickup 59_2 b | Pickup of unit 59P2 phase b | ✓ | | ✓ |
| Pickup 59_2 c | Pickup of unit 59P2 phase c | ✓ | | ✓ |
| Pickup 27P1 | Pickup of unit 27P1 | ✓ | | ✓ |
| Pickup 27P2 | Pickup of unit 27P2 | ✓ | | ✓ |
| Pickup 59P1 | Pickup of unit 59P1 | ✓ | | ✓ |
| Pickup 59P2 | Pickup of unit 59P2 | ✓ | | ✓ |
| Pickup 59N1 | Pickup of unit 59N1 | ✓ | | ✓ |
| Pickup 59N2 | Pickup of unit 59N2 | ✓ | | ✓ |
| Pickup 47 | Pickup of unit 47 | | | ✓ |
| Pickup 81_1 | Pickup of unit 81_1 | | ✓ | ✓ |
| Pickup 81_2 | Pickup of unit 81_2 | | ✓ | ✓ |
| Pickup 81_3 | Pickup of unit 81_3 | | ✓ | |
| Pickup 81_4 | Pickup of unit 81_4 | | ✓ | |
| Pickup | Active when any protection function with trip enabled picks up | ✓ | ✓ | ✓ |
| Inhib. 27P1 | Trip inhibition for unit 27P1 by digital input | ✓ | | ✓ |
| Inhib. 27P2 | Trip inhibition for unit 27P2 by digital input | ✓ | | ✓ |
| Inhib. 59P1 | Trip inhibition for unit 59P1 by digital input | ✓ | | ✓ |
| Inhib. 59P2 | Trip inhibition for unit 59P2 by digital input | ✓ | | ✓ |
| Inhib. 59N1 | Trip inhibition for unit 59N1 by digital input | ✓ | | ✓ |

## ANNEX 3 MODEM CONNECTION

| NAME | DESCRIPTION | MIV 1000 | MIV 2000 | MIV 3000 |
|---|---|---|---|---|
| Inhib. 59N2 | Trip inhibition for unit 59N2 by digital input | ✓ | | ✓ |
| Inhib. 47 | Trip inhibition for unit 47 by digital input | | | ✓ |
| Inhib. 81_1 | Trip inhibition for unit 81_1 by digital input | | ✓ | ✓ |
| Inhib. 81_2 | Trip inhibition for unit 81_2 by digital input | | ✓ | ✓ |
| Inhib. 81_3 | Trip inhibition for unit 81_3 by digital input | | ✓ | |
| Inhib. 81_4 | Trip inhibition for unit 81_4 by digital input | | ✓ | |
| Voltage Inhib. | Trip inhibition for all voltage units by digital input | ✓ | | ✓ |
| Phase voltage units Inhib. | Trip inhibition for all phase voltage units by digital input | ✓ | | ✓ |
| Ground voltage units Inhib. | Trip inhibition for all ground voltage units by digital input | ✓ | | ✓ |
| Frequency units Inhib. | Trip inhibition for all frequency units by digital input | | ✓ | ✓ |
| Trip Inhib. | General trip inhibition by digital input | ✓ | ✓ | ✓ |
| Virtual trip 27_1 a* | Virtual trip for unit 27P1 phase a | ✓ | | ✓ |
| Virtual trip 27_1 b* | Virtual trip for unit 27P1 phase b | ✓ | | ✓ |
| Virtual trip 27_1 c* | Virtual trip for unit 27P1 phase c | ✓ | | ✓ |
| Virtual trip 27_2 a* | Virtual trip for unit 27P2 phase a | ✓ | | ✓ |
| Virtual trip 27_2 b* | Virtual trip for unit 27P2 phase b | ✓ | | ✓ |
| Virtual trip 27_2 c* | Virtual trip for unit 27P2 phase c | ✓ | | ✓ |
| Virtual trip 59_1 a* | Virtual trip for unit 59P1 phase a | ✓ | | ✓ |
| Virtual trip 59_1 b* | Virtual trip for unit 59P1 phase b | ✓ | | ✓ |
| Virtual trip 59_1 c* | Virtual trip for unit 59P1 phase c | ✓ | | ✓ |
| Virtual trip 59_2 a* | Virtual trip for unit 59P2 phase a | ✓ | | ✓ |
| Virtual trip 59_2 b* | Virtual trip for unit 59P2 phase b | ✓ | | ✓ |
| Virtual trip 59_2 c* | Virtual trip for unit 59p2 phase c | ✓ | | ✓ |
| Virtual trip 27P1* | Virtual trip for unit 27P1 | ✓ | | ✓ |
| Virtual trip 27P2* | Virtual trip for unit 27P2 | ✓ | | ✓ |
| Virtual trip 59P1* | Virtual trip for unit 59P1 | ✓ | | ✓ |
| Virtual trip 59P2* | Virtual trip for unit 59P2 | ✓ | | ✓ |
| Virtual trip 59N1* | Virtual trip for unit 59N1 | ✓ | | ✓ |
| Virtual trip 59N2* | Virtual trip for unit 59N2 | ✓ | | ✓ |
| Virtual trip 47* | Virtual trip for unit 47 | | | ✓ |
| Virtual trip 81_1* | Virtual trip for unit 81_1 | | ✓ | ✓ |
| Virtual trip 81_2* | Virtual trip for unit 81_2 | | ✓ | ✓ |
| Virtual trip 81_3* | Virtual trip for unit 81_3 | | ✓ | |
| Virtual trip 81_4* | Virtual trip for unit 81_4 | | ✓ | |
| General Virtual trip * | General Virtual trip | ✓ | ✓ | ✓ |
| Trip 27_1 a | Trip for unit 27P1 phase a | ✓ | | ✓ |
| Trip 27_1 b | Trip for unit 27P1 phase b | ✓ | | ✓ |
| Trip 27_1 c | Trip for unit 27P1 phase c | ✓ | | ✓ |
| Trip 27_2 a | Trip for unit 27P2 phase a | ✓ | | ✓ |
| Trip 27_2 b | Trip for unit 27P2 phase b | ✓ | | ✓ |
| Trip 27_2 c | Trip for unit 27P2 phase c | ✓ | | ✓ |
| Trip 59_1 a | Trip for unit 59P1 phase a | ✓ | | ✓ |
| Trip 59_1 b | Trip for unit 59P1 phase b | ✓ | | ✓ |
| Trip 59_1 c | Trip for unit 59P1 phase c | ✓ | | ✓ |
| Trip 59_2 a | Trip for unit 59P2 phase a | ✓ | | ✓ |

| NAME | DESCRIPTION | MIV 1000 | MIV 2000 | MIV 3000 |
|---|---|---|---|---|
| Trip 59_2 b | Trip for unit 59P2 phase b | ✓ | | ✓ |
| Trip 59_2 c | Trip for unit 59P2 phase c | ✓ | | ✓ |
| Trip 27P1 | Trip for unit 27P1 | ✓ | | ✓ |
| Trip 27P2 | Trip for unit 27P2 | ✓ | | ✓ |
| Trip 59P1 | Trip for unit 59P1 | ✓ | | ✓ |
| Trip 59P2 | Trip for unit 59P2 | ✓ | | ✓ |
| Trip 59N1 | Trip for unit 59N1 | ✓ | | ✓ |
| Trip 59N2 | Trip for unit 59N2 | ✓ | | ✓ |
| Trip 47 | Trip for unit 47 | | | ✓ |
| Trip 81_1 | Trip for unit 81_1 | | ✓ | ✓ |
| Trip 81_2 | Trip for unit 81_2 | | ✓ | ✓ |
| Trip 81_3 | Trip for unit 81_3 | | ✓ | |
| Trip 81_4 | Trip for unit 81_4 | | ✓ | |
| Trip 27 | Trip for units 27P1 and/or 27P2 | ✓ | | ✓ |
| Trip 59P | Trip for units 59P1 and/or 59P2 | ✓ | | ✓ |
| Trip 59N | Trip for units 59N1 and/or 59N2 | ✓ | | ✓ |
| Trip phase | Trip of any of units 27P1, 27P2, 59P1, 59P2, 47 | ✓ | | ✓ |
| Trip phase a | Trip on phase A | ✓ | | ✓ |
| Trip phase b | Trip on phase B | ✓ | | ✓ |
| Trip phase c | Trip on phase C | ✓ | | ✓ |
| Ground trip | Trip for units 59N1 and/or 59N2 | ✓ | | ✓ |
| Frequency trip | Trip de alguna for units de frecuencia | | | ✓ |
| Trip | General trip | ✓ | ✓ | ✓ |
| Protection | Value entered on “relay status” setting (general settings group) | ✓ | ✓ | ✓ |
| Events | Number of events since the last time events were deleted | ✓ | ✓ | ✓ |
| Active table | Shows which settings table is active (Table 1 or Table 2) | ✓ | ✓ | ✓ |
| Frequency | Value entered on the “Frequency” setting (general settings group) | ✓ | ✓ | ✓ |
| Alarm | Alarm contact status. This contact is active when “Protection” is out of service, or when trip is disabled for all units or general trip is disabled (by settings or digital input) | ✓ | ✓ | ✓ |
| Output 1 | Status of auxiliary output 1 | ✓ | ✓ | ✓ |
| Output 2 | Status of auxiliary output 2 | ✓ | ✓ | ✓ |
| Output 3 | Status of auxiliary output 3 | ✓ | ✓ | ✓ |
| Output 4 | Status of auxiliary output 4 | ✓ | ✓ | ✓ |
| Input 1 | Status of digital input 1 | ✓ | ✓ | ✓ |
| Input 2 | Status of digital input 2 | ✓ | ✓ | ✓ |
| READY | Status of the READY LED. As for the alarm contact. | ✓ | ✓ | ✓ |
| Trip LED | Status of the TRIP LED | ✓ | ✓ | ✓ |
| LED 1 | Status of LED 1 | ✓ | ✓ | ✓ |
| LED 2 | Status of LED 2 | ✓ | ✓ | ✓ |
| LED 3 | Status of LED 3 | ✓ | ✓ | ✓ |
| LED 4 | Status of LED 4 | ✓ | ✓ | ✓ |
| Logic 1 | Output status of logic 1 | ✓ | ✓ | ✓ |

## ANNEX 3 MODEM CONNECTION

| NAME | DESCRIPTION | MIV 1000 | MIV 2000 | MIV 3000 |
|---|---|---|---|---|
| Logic 2 | Output status of logic 2 | ✓ | ✓ | ✓ |
| Logic 3 | Output status of logic 3 | ✓ | ✓ | ✓ |
| Logic 4 | Output status of logic 4 | ✓ | ✓ | ✓ |
| Table change | Shows whether the Table 2 selection by digital input is active. In this case, Table 2 will be activated. Otherwise, the set table will be activated. | ✓ | ✓ | ✓ |
| Settings change inhib. | Shows whether the settings change inhibition by digital input is active. If this input is actve, no settings change or table change can be done from the PC or HMI. The table change can be done by digital input. | ✓ | ✓ | ✓ |
| Status 52A | Status of breaker terminal A. | ✓ | ✓ | ✓ |
| Status 52B | Status of breaker terminal B | ✓ | ✓ | ✓ |
| Status 52 | Breaker status | ✓ | ✓ | ✓ |
| Local/Remote | Active when the HMI is in the settings or operations menu. | ✓ | ✓ | ✓ |
| E2prom failure | Active when an e2prom failure is detected | ✓ | ✓ | ✓ |
| User settings | Active when the default settings are modified. | ✓ | ✓ | ✓ |