## GE Power Management



# Digital Multifunctional Protection, Control and Supervision Relay <br> <br> MOV 2000 

 <br> <br> MOV 2000}

Instructions
GEK 106271

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## TABLE OF CONTENTS

1. GENERAL DESCRIPTION AND APPLICATION ..... 5
1.1. General Description ..... 5
2. OPERATION PRINCIPLES .....  7
2.1. Protection Functions ..... 7
2.1.1. A FUNCTION ..... 7
2.1.2. FUNCTION - A' ..... 7
2.1.3. FUNCTION - B ..... 8
2.1.4. FUNCTION - C ..... 8
2.1.5. FUNCTION - D ..... 8
2.1.6. FUNCTION - E ..... 8
2.1.7. FUNCTION - F ..... 8
2.1.8. FUNCTION - J. ..... 9
2.1.9. FUNCTION - G ..... 9
2.1.10. FUNCTION - H ..... 9
2.1.11. FUNCTION - I ..... 9
2.1.12. Function 25 for the side 52 (521) ..... 9
2.1.13. FUNCTION 25 for Central 52 (520) ..... 9
2.2. Monitoring and Registering Functions ..... 10
2.2.1. Measuring. ..... 10
2.2.2. Status of the Associated Line Selector Switch ..... 10
2.2.3. Visual Signalling (LEDs). ..... 10
2.2.4. SELF TEST OF THE UNIT. ..... 11
2.3. ANALYSIS FUNCTIONS ..... 11
2.3.1. EVENT RECORDER. ..... 11
2.3.2. OSCILLOGRAPHY RECORDING ..... 13
2.4. Control ..... 14
2.4.1. SETTINGS TABLES ..... 14
2.4.2. TIME SYNCHRONIZATION ..... 14
2.4.3. CONFIGURABLE INPUTS AND OUTPUTS ..... 15
2.4.3.1. Digital Inputs ..... 15
2.4.7.2. Outputs ..... 15
2.5. HUMAN-MACHINE INTERFACE (HMI) ..... 15
2.6. REMOTE COMMUNICATIONS. ..... 16
3. SETTINGS ..... 21
4. TECHNICAL CHARACTERISTICS ..... 31
4.1. MODEL LIST ..... 31
4.2. TECHNICAL CHARACTERISTICS ..... 31
5. HARDWARE DESCRIPTION ..... 35
5.1. PHYSICAL DESCRIPTION ..... 35
5.1.1. CASE. ..... 35
5.1.2. ELECTRICAL CONNECTIONS ..... 35
5.1.3. INTERNAL CONSTRUCTION ..... 35
5.2. OPERATION THEORY ..... 36
5.2.1. MAGNETIC MODULE ..... 36
5.2.2. CPU BOARD. ..... 36
5.2.3. POWER SUPPLY ..... 37
5.2.4. KEYPAD AND DISPLAY ..... 37
6. ACCEPTANCE TESTS ..... 39
6.1. CONNECTIONS AND NECESSARY EQUIPMENT ..... 39
6.2. VISUAL INSPECTION ..... 39
6.3. INSULATION TESTS ..... 39
6.4. INDICATORS ..... 40
6.5. POWER SUPPLY ..... 40
6.6. COMMUNICATIONS ..... 41
6.7. MEASUREs ..... 41
6.8. CHECKING THE INPUTS ..... 41
6.9. CHECKING THE OUTPUTS ..... 41
6.10. KEYPAD, DISPLAY AND LEDS ..... 43
6.11. FUNCTIONS A \& A' (TIMED OVERVOLTAGE UNITS) ..... 43
6.12. FUNCTIONS B, C \& D (VOLTAGE ABSENCE FUNCTIONS) ..... 45
6.13. FUNCTIONS E, F, \& J (VOLTAGE PRESENCE UNITS) ..... 48
6.14. FUNCTIONS G, H \& I (WEAK INFEED UNITS) ..... 49
6.15. FUNCTIONS 25 (SIDE AND CENTRAL SYNCHRONISM) ..... 50
6.16. IRIG-B ..... 53
7. INSTALLATION AND MAINTENANCE ..... 55
7.1. INSTALLATION ..... 55
7.2. SAFETY GROUND CONNECTION AND SUPPRESSION OF DISTURBANCES ..... 55
7.3. MAINTENANCE ..... 55
8. KEYPAD AND DISPLAY ..... 57
8.1. MENU TREE. ..... 59
8.2. SETTINGS GROUP ..... 60
8.3. INFORMATION GROUP ..... 64
8.4. OPERATIONS GROUP ..... 65
8.5. SINGLE KEY OPERATION ..... 66
8.6. CONFIGURATION MENU. ..... 66
FIGURES ..... 69

## LIST OF DRAWINGS

Figure 1. Panel mounting diagram (226B6086H10) ..... 70
Figure 2. Front view (226B7412H9) ..... 71
Figure 3. External Connections (189C4129 H1) ..... 72
Figure 4. RS232 connection (MOV with PC) ..... 73
Figure 5. RS232 connection (MOV with MODEM) ..... 73
Figure 6. Rear view (226B7412H10) ..... 74
Figure 7. Dimensions diagram (226B6086H10) ..... 75
LIST OF TABLES
TABLE 1. Default LED configuration ..... 11
TABLE 2. List of events. ..... 11
TABLE 3. Internal protection status. ..... 17
TABLE 4. Settings common to all tables. ..... 22
TABLE 5. Independent settings for each table. ..... 23
TABLE 6. HMI menu. Description. ..... 59
TABLE 7. HMI menu. Settings \& Ranges ..... 60
TABLE 8. Settings change procedure. ..... 63
TABLE 9. Relay status information. ..... 64

### 1.1. GENERAL DESCRIPTION

The MOV system is a digital multifunction unit for protection, control, and measure, using a group or algorithms that allow the implementation of different voltage functions, described on section 2 of the present instruction manual.

The MOV system is housed in a 19 " 2 units high rack. Figure 1 shows the panel drilling dimensions.
The information and functions management can be performed with a PC connected to the serial port (RS232 or fibre optic), or using the man-machine interface (MMI), that includes a 20 key keypad and an LCD with two rows of 16 characters each, on the front of the unit.

The functions included in this system are as follows:

## a) Protection:

- Undervoltage functions $\left(A, A^{\prime}\right)$.
- Voltage absence functions (B, C, D).
- Voltage presence functions (E, F, J).
- Weak infeed functions (G, H, I).
- Closing and reclosing permission functions for two breakers.


## b) Monitoring and Registering:

- Three-phase line voltage, busbars $1 \& 2$ voltage measurement
- Associated line selector switch status.
- Optical signalling with 17 LED indicators (16 configurable).
- Self-check.


## c) Analysis:

- Event recording.
- Oscillography recording.


## d) Control:

- 3 settings tables.
- Time synchronization using communications, or IRIG-B.
- Configurable inputs and outputs.
- User configurable internal logic.
e) Communications Interfaces:
- Local and remote communications using three connectors, one on the front and two on the rear of the unit.
- Manual interface (MMI) with keypad and alphanumeric display.
- GE-INTRO configuration software and GE-LOCAL communications software, Windows ${ }^{\text {TM }}$ based. Both software packages are part of the GE-NESIS (GE NEtwork Substation Integration System).


### 2.1. PROTECTION FUNCTIONS

The MOV general connections diagram, and the external voltage commuting required is shown on the following diagram:

where: $\sqrt{1=}$ Undervoltage on bus 1 .
$\overline{\mathrm{V2}}=$ Undervoltage on bus 2 (or line 2$)$
$\overline{\mathrm{V} 3}=$ Undervoltage on line phase A.
$\overline{\mathrm{V} 4}=$ Undervoltage on line phase B.
$\overline{\mathrm{V5}}=$ Undervoltage on line phase C.
$\frac{89}{89}=$ Line Selector switch closed.
${ }^{*}=$ Line Selector switch open.
$+=$ logic OR.
$\mathrm{TMP}=$ time setting for function A.

This function consists on detecting undervoltage (1.1. setting) on both sides of the side breaker (in case of breaker and a half schemes), during a certain period of time (setting 2.1.). It monitors the Busbar voltage (V1) and the line voltage values ( $\mathrm{V} 3, \mathrm{~V} 4, \mathrm{~V} 5$ ) or V 2 , depending on the status of the line disconnection switch. The operation of this function allows the side breaker to trip and signal undervoltage to the control system.

$$
=(\overline{\mathrm{V} 1} * 89+(\mathrm{V} 3 * \mathrm{~V} 4 * \mathrm{~V} 5) * 89) * \text { TMP }
$$

This function detects undervoltage (setting 1.1.) on the line side associated to the central breaker. In order to monitor undervoltage on both sides of the central breaker, this function needs to be ANDed with function A' of the MOV relay protecting the other two breakers (contacts in series).

$$
=V 3 * V 4 * V 5
$$

This function detects voltage absence (setting 1.2.) on the line in order to allow a line grounding operation.
2.1.4. FUNCTION - C

$$
=V 1+(V 2 * 89)+(V 3 * V 4 * V 5) * 89
$$

This function detects the voltage absence (setting 1.2.) on any or both sides of the side breaker, in order to allow the side breaker closing, when the remote connection cannot operate due to the lack of voltage. This function can be used also for emergency closing.
2.1.5. FUNCTION - D

$$
=(\overline{\mathrm{V} 1} * 8 \overline{9})+(\sqrt{3 *} \mathrm{~V} 4 * \mathrm{~V} 5) * \overline{89}
$$

This function detects the voltage absence on the line side of the central breaker. Voltage absence on any side of the central breaker can be detected by parallel connecting the operation of both MOVs protecting the breaker. The use of this function is the same as function C , but for the central breaker.
2.1.6. FUNCTION - E

$$
=\mathrm{V} 1 *(\mathrm{~V} 2 * 89+(\mathrm{V} 3+\mathrm{V} 4+\mathrm{V} 5) * 89)
$$

This function detects the voltage presence (setting 1.3.) on both sides of the side breaker.

### 2.1.7. FUNCTION - F

$$
=(\mathrm{V} 1 * 89+(\mathrm{V} 3+\mathrm{V} 4+\mathrm{V} 5) * 89)
$$

This function detects voltage presence on both sides of the central breaker, by series connecting the operations of both MOVs protecting the breaker and a half scheme. It is used for sending a signal to the control system and the remote connection.

$$
=\mathrm{V} 1+\mathrm{V} 2 * 89+(\mathrm{V} 3+\mathrm{V} 4+\mathrm{V} 5) * 89
$$

This function detects voltage presence (setting 1.3.) in one or both sides of the side breaker. It can be used for conditioning the undervoltage trip to voltage presence. This allows the breaker to close when there is no voltage (voltage absence) avoiding an undervoltage trip afterwards.
$=\mathrm{V} 3$
This function detects weak infeed condition (setting 1.4) on line phase $A(V 3)$.

$$
=\overline{\mathrm{V} 4}
$$

This function detects weak infeed condition (setting 1.4) on line phase B (V4).
2.1.11. FUNCTION - I

$$
=\overline{\mathrm{V} 5}
$$

This function detects weak infeed condition (setting 1.4) on line phase C (V5).

### 2.1.12. FUNCTION 25 FOR THE SIDE 52 (521)

The MOV2 includes different settings for closing and reclosing permissions. It also includes different masks for permissions in the case of DL-DB, LL-DB. DL-LB and/or Synchronism during a selectable period of time (settings 3.4, and 3.5). In order to verify the synchronism between both sides of the side breaker, the unit checks that the difference in module, phase, and frequency of voltage values V 1 , and V 2 (when the line selector switch is open), or V 1 , and V 4 (when the line selector switch is closed) are smaller than settings 3.1, 3.2, and 3.3.

The synchronism check function only operates for LL-LB conditions, that is, when voltage on both sides of the breaker is equal or higher than the voltage presence setting (setting 1.3). Once this condition is present, voltage must fall below the voltage absence setting (setting 1.4) in order to become a Dead Line or Dead Bus situation.

For this breaker, the BUS side refers to the voltage value independent from the line 89, that is, V1. The LINE side refers to voltage values V 4 or V 2 , depending on the status of 89 .

### 2.1.13. FUNCTION 25 FOR CENTRAL 52 (520)

The MOV2 includes different settings for closing and reclosing permission. It also includes different masks for permissions in the case of DL-DB, LL-DB. DL-LB and/or Synchronism during a selectable period of time (settings 3.4, and 3.5). In order to verify the synchronism between both sides of the central breaker, the unit checks that the difference in module, phase, and frequency of voltage values V1, and V2 (when the line selector switch is open), or V 1 , and V 4 (when the line selector switch is closed) are smaller than settings 4.1, 4.2, and 4.3.

The synchronism check function only operates for LL-LB conditions, that is, when voltage on both sides of the breaker is equal or higher than the voltage presence setting (setting 1.3). Once this condition is present, voltage must fall below the voltage absence setting (setting 1.4) in order to become a Dead Line or Dead Bus situation.

For this breaker, the BUS side refers to the voltage value independent from the line 89 , that is, V 2 . The LINE side refers to voltage values V 4 or V 1 , depending on the status of 89 .

### 2.2. MONITORING AND REGISTERING FUNCTIONS.

2.2.1. MEASURING

The MOV system can measure the following magnitudes:

- Line voltage values (three phases), for busbar 1 and 2, in module, phase, and frequency.

These measures can be accessed locally on the unit's LCD, or using the communications software GELOCAL.

### 2.2.2. STATUS OF THE ASSOCIATED LINE SELECTOR SWITCH

The MOV system monitors the status of an associated line selector switch through digital inputs 89/a, and 89/b when the selector switch is set to have two contacts, and through input 89/a when it is set to have only one contact. The selector switch status is accessible using the local MMI, or the communications program. This last will display the status in real time on a bay mimic, visible in the GE-LOCAL program. (This screen, as well as the measures screen, can be configured by the user with GE-INTRO configuration software).

### 2.2.3. VISUAL SIGNALLING (LEDS).

The status represents the digital information from all the equipment units (inputs, pickups, alarms, etc.). Those signals included in the status are grouped in groups of 16; there are 10 different groups in the status; the last group corresponds to the 16 AND gates that can be defined using the programmable logic through GE-INTRO software. Therefore, the desired signals, or the result of an AND gate from a group can be taken to this last group AND1....AND16.

The MOV unit front panel has a total of 17 LED indicators. One of them is a two-color LED with a fixed function, system alarm (RED), or system ready (GREEN). The rest are red color LEDs, and can be configured by the user with the GE-INTRO software; they can be assigned either to an event (selectable between the 32 protection and 16 communications events), or to an AND gate of up to 16 events. Events are defined using the protection or communications status, assigning one of them to the activation of a status, or an OR gate of up to 16 status included in the same group.

Besides, each LED can be configured to incorporate a memory in case of lack of power supply (the status of those LEDs with memory is stored in EEPROM memory, so that when the power supply is restored, those LEDs that were lit before the power breakdown will continue to be lit), and to be blinking or not.

A LED testing option is included. All indicators will light up when pressing the TARGET RESET pushbutton. This button allows to reset the LED signals when it is kept pressed.

MOV units are supplied with the following default LED configuration:

Table 1. Default LED configuration

| COLUMN |  |  |  |
| :---: | :--- | :---: | :--- |
| LED No | LEFT | LED № | RIGHT |
| 1 | Function A (with memory) | 9 | Function H |
| 2 | Function A’ (with memory) | 10 | Function I |
| 3 | Function B | 11 | Function J |
| 4 | Function C | 12 | 521 Instantaneous synchronism |
| 5 | Function D | 13 | 520 Instantaneous synchronism |
| 6 | Function E | 14 |  |
| 7 | Function F | 15 |  |
| 8 | Function G | 16 | Local communication mode (blinking) |

### 2.2.4. SELF TEST OF THE UNIT.

The MOV system incorporates, thanks to its digital technology, self-test functions that guarantee its correct operation, and will disable the unit in case of internal orders.

These self-tests are performed both during start-up and normal operation. Tests are carried out on the internal power supply, program memory (ROM), working memory (RAM), oscillography memory (RAM) and the settings and calibration memory (EEPROM).

Additionally, a hardware test is included for the signalling LEDs. All of them will light up when pressing the TARGET RESET button. If this button is pressed for more than one second, the memorised indicators will be deleted.

### 2.3. ANALYSIS FUNCTIONS

The MOV system includes event recording and oscillography with time resolution of 1 millisecond. In order to maintain the integrity of date and time, as well as the oscillography record, there is a capacitor backup for the internal high-resolution clock and the oscillography memory, with capacity for storing the information during at least 24 hours after a power supply breakdown.

### 2.3.1. EVENT RECORDER

The MOV keeps a record of the last 165 events, including date and time (with 1 ms resolution), event type, current and voltage values when the event occurred, and unit status information.

This record is stored in a non volatile memory and is maintained event without power supply.

The following table shows the possible causes for an event:
Table 2. Causes for events

| Index | Status |
| :--- | :--- |
|  |  |
| 0.0 | Program start-up |
| 0.1 | Settings change |
| 0.2 | Counters writing |
| 0.5 | W/o timers |
| 0.6 | Out of service |


| Index | Status |
| :---: | :---: |
| 1.0 | Parallel EEPROM alarm |
| 1.1 | Serial EEPROM alarm |
| 1.4 | Default general settings ALARM |
| 1.5 | Default Table 1 settings ALARM |
| 1.6 | Default Table 2 settings ALARM |
| 1.7 | Default Table 3 settings ALARM |
| 2.0 | EXTERNAL TRIGGER |
| 2.1 | ACTIVE TABLE-1 |
| 2.2 | ACTIVE TABLE -2 |
| 2.3 | ACTIVE TABLE -3 |
| 2.4 | COMMUNICATIONS TRIGGER |
| 4.0 | UNDERVOLTAGE (mT-VaL1) |
| 4.1 | UNDERVOLTAGE (mT-VbL1) |
| 4.2 | UNDERVOLTAGE (mT-VcL1) |
| 4.3 | UNDERVOLTAGE (mT-V1) |
| 4.7 | UNDERVOLTAGE (mT-V2) |
| 5.0 | VOLTAGE ABSENCE (aT-VaL1) |
| 5.1 | VOLTAGE ABSENCE (aT-VbL1) |
| 5.2 | VOLTAGE ABSENCE (aT-VcL1) |
| 5.3 | VOLTAGE ABSENCE (aT-V1) |
| 5.7 | VOLTAGE ABSENCE (aT-V2) |
| 6.0 | VOLTAGE PRESENCE (pT-VaL1) |
| 6.1 | VOLTAGE PRESENCE (pT-VbL1) |
| 6.2 | VOLTAGE PRESENCE (pT-VcL1) |
| 6.3 | VOLTAGE PRESENCE (pT-V1) |
| 6.7 | VOLTAGE PRESENCE ( pT -V2) |
| 7.0 | WEAK INFEED (ad-VaL1) |
| 7.1 | VOLTAGE PRESENCE (ad-VbL1) |
| 7.2 | WEAK INFEED (ad-VcL1) |
| 8.0 | 89L1 Status |
| 8.1 | Undefined (error) 89L1 |
| 8.2 | 89L1Opening failure ALARM |
| 8.3 | 89L1Closing failure ALARM |
| 12.0 | DL-DB |
| 12.1 | LL-DB |
| 12.2 | DL-LB |
| 12.3 | LL-LB |
| 12.4 |  |
| 12.5 | SYNCH-Reclose (TMP1) |
| 12.6 |  |
| 12.7 | SYNCH-Close (TMP2) |
| 13.0 | DL-DB |
| 13.1 | LL-DB |
| 13.2 | DL-LB |
| 13.3 | LL-LB |
| 13.4 |  |
| 13.5 | SYNCH-Reclose (TMP1) |
| 13.6 |  |
| 13.7 | SYNCH-Close (TMP2) |
| 14.0 | FUNCTION-A (TMP) |
| 14.1 | FUNCTION-A' (TMP) |
| 14.2 | FUNCTION-B |
| 14.3 | FUNCTION-C |
| 14.4 | FUNCTION-D |


| Index | Status |
| :--- | :--- |
| 14.5 | FUNCTION-E |
| 14.6 | FUNCTION-F |
| 14.7 | FUNCTION-G |
| 15.0 | FUNCTION-H |
| 15.1 | FUNCTION-I |
| 15.2 | FUNCTION-J |
| 15.3 | PERMISSION 79 521 |
| 15.4 | CLOSING PERMISSION 521 |
| 15.5 | PERMISSION 79 520 |
| 15.6 | CLOSING PERMISSION 520 |

2.3.2. OSCILLOGRAPHY RECORDING

The MOV can store up to 4 oscillography records, with a resolution of 16 samples per cycle. Each record has a maximum capacity of 62 cycles, and the number of pre-fault cycles is selectable between 1 and 8 . Each record includes the following information:

- Instantaneous values of voltage and current inputs $\left(\mathrm{V}_{3}=\mathrm{V}_{\mathrm{A}}, \mathrm{V}_{4}=\mathrm{V}_{\mathrm{B}}, \mathrm{V}_{5}=\mathrm{V}_{\mathrm{C}}, \mathrm{V}_{1}, \mathrm{~V}_{2}\right)$ :
- Digital information:
- Protection units status.
- Digital inputs status.
- Date and time.
- Causes that triggered the oscillography.

| EXTERNAL TRIGGER |
| :--- |
| COMMUNICATION TRIGGER |
| FUNCTION-A (TMP) |
| FUNCTION-A' (TMP) |
| FUNCTION-B |
| FUNCTION-C |
| FUNCTION-D |
| FUNCTION-E |
| FUNCTION-F |
| FUNCTION-G |
| FUNCTION-H |
| FUNCTION-I |
| FUNCTION-J |

- Active settings table in the moment of the record.

There is a configurable mask that determines which functions or internal status will trigger the oscillography. This can be done either by a configurable digital inputs, by communications or from the HMI.

Oscillography records are retrieved and converted to COMTRADE (Standard IEEE C37.111-1991) format file, using the GE-LOCAL communications software, and they can be viewed using the GE-OSC software, or any other software package accepting COMTRADE or ASCII format (e.g. EXCEL ${ }^{\text {TM }}$ ).

### 2.4. CONTROL

The MOV incorporates three independent settings tables, stored in a non volatile memory, so that they are maintained event without power supply. Only one table is active at each time, and it is the one used by the system to operate.

MOV settings are divided in generic groups (General settings, Switchgear settings, Oscillography masks and Function Permissions). These are common to all setting tables. Other settings are separate for each table.

There is a setting called "ACTIVE TABLE" that allows choosing the settings table that will be active each time.

There is a way to switch the settings table using up to 2 digital inputs, named "TABLE SELECTION 0" and "TABLE SELECTION 1". These allow up to 4 combinations, from 0 to 3 . For applications requiring a lower number of tables (up to 2), we can use only one digital input.

The selected combination is obtain from the binary codification of the above referred inputs (please refer to the following table). 0 means selecting the table shown on the "ACTIVE TABLE" setting. Numbers 1 to 3 select tables 1 to 3 (we must keep in mind that table 3 is always associated with cold load pickup, and has maximum priority. Please refer to section 2.4.5.).

| Number | Table Selection 1 | Table Selection 2 | Active Table |
| :---: | :---: | :---: | :---: |
| 0 | 0 | 0 | Selected by setting |
| 1 | 0 | 1 | 1 |
| 2 | 1 | 0 | 2 |
| 3 | 1 | 1 | 3 |

NOTE: If the active table is controlled using these inputs, this selection will have priority over the "ACTIVE TABLE" setting, and the table used will be determined by the status of the digital inputs.
2.4.2. TIME SYNCHRONIZATION

The MOV system includes an input for time synchronization. This input requires the connection of a device to supply a demodulated IRIG-B output. In this way co-ordinated universal time is measured to a high degree of precision and this makes it possible to tag the events generated by the unit with a resolution of one millisecond.

The use of this input makes it possible to correlate data obtained from different units thanks to synchronization with GPS satellites. In this way it is possible to obtain very useful information for analysis, crossreferencing the information provided by different units for a given incident.

Alternatively, it is possible to synchronise units by means of communications, using the GE-LOCAL communications software, or manually by means of the MMI. If the IRIG-B input is used it has priority over time setting by communications, since the time read by IRIG-B is much more accurate.

### 2.4.3.1. Digital Inputs

The MOV system has 6 digital inputs (two groups of 3 inputs with one common in each group). The inputs can be configured by the user by means of the GE-INTRO configuration program.

The inputs are configured using GE-INTRO configuration software. One of the following meanings can be assigned to any input: (For more detail about the configuration of the inputs, see GE-INTRO Instruction Book).

- Table Selection 0 (L)
- Table Selection 1 (L)
- External trigger (P)
- 89/a (L)
- 89/b (L)
(L) Indicates a level input.
(P) Indicates a pulse input

There is also the IRIG-B synchronization input already mentioned.
The diagram of external connections, in figure 3, shows the default input configuration.

### 2.4.7.2. Outputs

The MOV system has 22 configurable outputs.
The outputs are configured using the GE-INTRO configuration software.
The technical characteristics of the outputs are shown in section 4.
The configurable outputs can be programmed using logic based on the internal protection states (pick-ups, trips, alarms, etc.) The MOV has 160 different internal states, and these can be used to carry out logical operations NOT, AND and OR, which gives to the unit a great flexibility.

The output configuration logic is done by using different levels. At the first level it is possible to use AND gates of up to 16 signals (see section 2.2.3). The output is incorporated into the states matrix so that it can in turn be used in next AND gates of up to 16 inputs. This process can continue until the 16 Ands are used.

Once the AND gates have been configured it is possible to create a second level with OR gates of 16 inputs limited to the established groups of bytes, and whose logical outputs are assigned to physical outputs of the unit.

The default output configuration is included in the diagram of external connections in figure 3.

### 2.5. HUMAN-MACHINE INTERFACE (HMI)

The MOV system includes as standard a 20 key keyboard and a 2 line liquid crystal display (LCD) with 16 characters per line. This display has highly reliable LED diode back lighting (the screen brightness can be adjusted on the rear of the front board).

By means of this interface the user can change the settings, view measurements, carry out operations and access information stored in the unit. The functions of this local interface and how to use it are described in the section KEYBOARD AND DISPLAY.

### 2.6. REMOTE COMMUNICATIONS

The relay has 2 serial gates and three connectors. Gate 1 can be reached from the front of the relay in connector 1 (PORT 1 connector) or from the back (PORT 2 connector). The second gate can be reached from connector 3 (PORT 3 connector) which is located on the rear.

There are different models each with a different physical connection for the PORT 3 connector (RS-232 or fibreoptic). In the "RS232" models the three connectors are RS232. In the "RS232 and fibre-optic" models the PORT1 and PORT2 connectors are RS232 while the PORT3 connector is replaced by a fibre-optic connector.

The PORT 1 connector has priority over the PORT 2 connector and is selected when the DCD (Data Carrier Detect) signal is activated. Figure 8 shows how to make the connections to a personal computer.

Gate 1 (PORT 1 and PORT 2 connectors) and 2 (PORT 3 connector) are independent and the unit can serve them simultaneously.

The communications protocol is the same as that used for the rest of the GE digital protection systems and requires the use of the GE-LOCAL software. The instruction book for this program, which facilitates dialogue with the relay, is supplied with the unit. The protocol is reliable and allows communication with different protection systems. It guarantees very efficient data transfer (especially for the oscillography and other large files) along with error detection and automatic communication recovery.

The status of the local/remote communication is indicated on the front of the unit by LED indicator 16 (the last LED in the right-hand column.) Local communication refers to communication via the keyboard/display (local display showing any information except for the initial MOV GENERAL ELECTRIC screen), or via communications gate 1 (PORT 1, PORT2 connectors), and remote communication refers to connection via gate 2 (PORT 3 rear connector).

Local and remote communications can exist at the same time, although there is only one possibility for changing settings and carrying out operations, since this can only be done with the communication which has priority (local communication) while the other is limited only to accessing information. When the local communication is interrupted, either by the disconnection of PORT 1 connector or because the HMI is on the initial screen (a situation which can be caused intentionally, or automatically if no key has been pressed for 15 minutes), the remote communication recovers the ability to modify settings and carry out operations.

TABLE 3. Internal Protection Status

| Index | Status |
| :---: | :---: |
| 0.0 | Program start-up |
| 0.1 | Settings Change |
| 0.2 | Counters writing |
| 0.3 |  |
| 0.4 |  |
| 0.5 | WITHOUT TIME |
| 0.6 | OUT OF SERVICE |
| 0.7 |  |
| 1.0 | Parallel EEPROM ALARM |
| 1.1 | Serial EEPROM ALARM |
| 1.2 |  |
| 1.3 |  |
| 1.4 | Default General Settings ALARM |
| 1.5 | Default Table 1 Settings ALARM |
| 1.6 | Default Table 2 Settings ALARM |
| 1.7 | Default Table 3 Settings ALARM |
| 2.0 | EXTERNAL TRIGGER |
| 2.1 | ACTIVE TABLE - 1 |
| 2.2 | ACTIVE TABLE - 2 |
| 2.3 | ACTIVE TABLE - 3 |
| 2.4 | COMMUNICATIONS TRIGGER |
| 2.5 |  |
| 2.6 |  |
| 2.7 |  |
| 3.0 | Pl1 |
| 3.1 | PI2 |
| 3.2 | PI3 |
| 3.3 | PI4 |
| 3.4 | PI5 |
| 3.5 | PI6 |
| 3.6 |  |
| 3.7 |  |
| 4.0 | UNDERVOLTAGE (mT-VaL1) |
| 4.1 | UNDERVOLTAGE (mT-VbL1) |
| 4.2 | UNDERVOLTAGE (mT-VcL1) |
| 4.3 | UNDERVOLTAGE (mT-V1) |
| 4.4 |  |
| 4.5 |  |
| 4.6 |  |
| 4.7 | UNDERVOLTAGE (mT-V2) |
| 5.0 | VOLTAGE ABSENCE (aT-VaL1) |
| 5.1 | VOLTAGE ABSENCE (aT-VbL1) |
| 5.2 | VOLTAGE ABSENCE (aT-VcL1) |
| 5.3 | VOLTAGE ABSENCE (aT-V1) |
| 5.4 |  |
| 5.5 |  |
| 5.6 |  |
| 5.7 | VOLTAGE ABSENCE (aT-V2) |
| 6.0 | VOLTAGE PRESENCE (pT-VaL1) |


| Index | Status |
| :---: | :---: |
| 6.1 | VOLTAGE PRESENCE (pT-VbL1) |
| 6.2 | VOLTAGE PRESENCE (pT-VcL1) |
| 6.3 | VOLTAGE PRESENCE (pT-V1) |
| 6.4 |  |
| 6.5 |  |
| 6.6 |  |
| 6.7 | VOLTAGE PRESENCE (pT-V2) |
| 7.0 | WEAK INFEED (ad-VaL1) |
| 7.1 | WEAK INFEED (ad-VbL1) |
| 7.2 | WEAK INFEED (ad-VcL1) |
| 7.3 |  |
| 7.4 |  |
| 7.5 |  |
| 7.6 |  |
| 7.7 |  |
| 8.0 | 89L1 Status |
| 8.1 | Undefined (error) 89L1 |
| 8.2 | 89L1 Opening failure ALARM |
| 8.3 | 89L1 Closing failure ALARM |
| 8.4 |  |
| 8.5 |  |
| 8.6 |  |
| 8.7 |  |
| 9.0 |  |
| 9.1 |  |
| 9.2 |  |
| 9.3 |  |
| 9.4 |  |
| 9.5 |  |
| 9.6 |  |
| 9.7 |  |
| 10.0 |  |
| 10.1 |  |
| 10.2 |  |
| 10.3 |  |
| 10.4 |  |
| 10.5 |  |
| 10.6 |  |
| 10.7 |  |
| 11.0 |  |
| 11.1 |  |
| 11.2 |  |
| 11.3 |  |
| 11.4 |  |
| 11.5 |  |
| 11.6 |  |
| 11.7 |  |
| 12.0 | DL-DB (only MOV2) |
| 12.1 | LL-DB (only MOV2) |
| 12.2 | DL-LB (only MOV2) |
| 12.3 | LL-LB (only MOV2) |
| 12.4 |  |


| Index | Status |
| :---: | :---: |
| 12.5 | SYNCH-Reclose (TMP1) (only MOV2) |
| 12.6 |  |
| 12.7 | SYNCH-Close (TMP2) (only MOV2) |
| 13.0 | DL-DB (only MOV2) |
| 13.1 | LL-DB (only MOV2) |
| 13.2 | DL-LB (only MOV2) |
| 13.3 | LL-LB (only MOV2) |
| 13.4 |  |
| 13.5 | SYNCH-Reclose (TMP1) (only MOV2) |
| 13.6 |  |
| 13.7 | SYNCH-Close (TMP2) (only MOV2) |
| 14.0 | FUNCTION-A (TMP) |
| 14.1 | FUNCTION-A' (TMP) |
| 14.2 | FUNCTION-B |
| 14.3 | FUNCTION-C |
| 14.4 | FUNCTION-D |
| 14.5 | FUNCTION-E |
| 14.6 | FUNCTION-F |
| 14.7 | FUNCTION-G |
| 15.0 | FUNCTION-H |
| 15.1 | FUNCTION-I |
| 15.2 | FUNCTION-J |
| 15.3 | 79521 permission (only MOV2) |
| 15.4 | 521 CLOSE PERMISSION (only MOV2) |
| 15.5 | 79520 PERMISSION (only MOV2) |
| 15.6 | 520 CLOSE PERMISSION (only MOV2) |
| 15.7 | LACK OF SYNCHRONISM |
| 16.0 |  |
| 16.1 |  |
| 16.2 |  |
| 16.3 |  |
| 16.4 |  |
| 16.5 |  |
| 16.6 |  |
| 16.7 |  |
| 17.0 |  |
| 17.1 |  |
| 17.2 |  |
| 17.3 |  |
| 17.4 |  |
| 17.5 |  |
| 17.6 |  |
| 17.7 |  |
| 18.0 | AND 1 |
| 18.1 | AND 2 |
| 18.2 | AND 3 |
| 18.3 | AND 4 |
| 18.4 | AND 5 |
| 18.5 | AND 6 |
| 18.6 | AND 7 |
| 18.7 | AND 8 |
| 19.0 | AND 9 |


| Index | Status |
| :--- | :--- |
| 19.1 | AND 10 |
| 19.2 | AND 11 |
| 19.3 | AND 12 |
| 19.4 | AND 13 |
| 19.5 | AND 14 |
| 19.6 | AND 15 |
| 19.7 | AND 16 |

This section describes the settings incorporated in the MOV unit, and the procedure for changing them. First a complete list of the MOV settings is shown, together with their limits, units and corresponding steps (the column marked DEFAULT indicates that this is the setting on the relay when it leaves the factory). This is followed by individual comments for those settings which require more detailed explanation.

It is possible to see the settings or to modify them manually, using the keyboard and display, or by means of a computer connected to any of the serial ports. To modify the settings by means of the keyboard, go to section 8 "KEYBOARD AND DISPLAY". To modify the settings by computer follow these instructions:

- Make sure that the available connection cable coincides with the diagrams in figures 4 and 5 , depending on whether the serial port of your computer is DB9 or DB25.
- Connect the cable between the relay (or modem) and the serial port of your computer.
- Run the GE-LOCAL software. For more details on the installation and use of the GE-LOCAL software see the GE-LOCAL instruction book.
- Make sure that the program configuration communication parameters coincide with those of the MOV unit. More specifically, these parameters for the communication configuration of the local HMI are as follows:
- COMMUNICATION BAUD RATE (for the relay depending on which port is being used (local or remote))
- STOP BIT (for the relay depending on which port is being used (local or remote))

To modify or view the unit's configuration parameters go to the configuration menu, corresponding to section 8 "KEYBOARD AND DISPLAY".

When connecting to the unit, check that the relay number and password coincide with those which appear on the unit's configuration menu.

The MOV system has 3 settings tables stored in non-volatile memory, and these can be selected by settings or configurable inputs. There is also a set of independent settings, common to all the tables. The following categories contain the settings common to the 3 tables:

```
GENERAL
PERMISSIONS FOR EACH FUNCTION
OSCILLOGRAPHY MASKS
SWITCHGEAR
```

The remaining categories, shown below, contain the settings which can be selected independently for each of the 3 tables:

- Voltage levels
- Timers
- Side Synchronism
- Central Synchronism

It should be noted that in order to simplify setting the unit and for safety reasons, all settings related to the configuration of the unit (configurable inputs and outputs, alarms configuration and LEDs) have been removed from the keyboard/display and communications software. To carry out these configurations the GE-INTRO configuration software must be run.

The following settings are common to all tables:

TABLE 4. Settings common to all tables

| COMMON TO ALL TABLES | LIMITS | DEFAULT |
| :---: | :---: | :---: |
| GENERAL SETTINGS |  |  |
| RELAY STATUS | 0=Out of S. / 1=In Service | In Service |
| IDENTIFICATION | 20 ASCII characters | W/O Ident. MOV |
| FREQUENCY | $0=50 \mathrm{~Hz} / 1=60 \mathrm{~Hz}$ | 60 Hz |
| LINE VT RATIO | 1-4000 | 100 |
| V1 VT RATIO | 1-4000 | 100 |
| V2 VT RATIO | 1-4000 | 100 |
| ACTIVE TABLE | 1-3 | 1 |
| PERMISSIONS $x$ FUNCTIONS |  |  |
| FUNCTION A |  | permitted |
| FUNCTION A' |  | permitted |
| FUNCTION B |  | permitted |
| FUNCTION C |  | permitted |
| FUNCTION D |  | permitted |
| FUNCTION E |  | permitted |
| FUNCTION F |  | permitted |
| FUNCTION G |  | permitted |
| FUNCTION H |  | permitted |
| FUNCTION I |  | permitted |
| FUNCTION J |  | permitted |
| OSCILLOGRAPHY SETTINGS |  |  |
| No. OF PRE-FAULT CYCLES | 1-8 | 8 |
| FUNCTION A |  | permitted |
| FUNCTION A' |  | Not permitted |
| FUNCTION B |  | Not permitted |
| FUNCTION C |  | Not permitted |
| FUNCTION D |  | Not permitted |
| FUNCTION E |  | Not permitted |
| FUNCTION F |  | Not permitted |
| FUNCTION G |  | permitted |
| FUNCTION H |  | Not permitted |
| FUNCTION I |  | Not permitted |
| FUNCTION J |  | Not permitted |
| EXTERNAL TRIGGER |  | Not permitted |
| COMMUNICATIONS TRIGGER |  | permitted |
| SWITCHGEAR SETTINGS |  |  |
| OPENING TIMER | 0,10-20,00 s | 0,50 s |
| CLOSING TIMER | 0,10-20,00 s | 0,50 s |
| No. OF CONTACTS | 1-2 | 1 (-A) |

The next chart shows the settings that are independent for each table:

TABLE 5. Independent Settings for Each Table

| No. | Independent for each table | Limits | Default |
| :---: | :---: | :---: | :---: |
| 1. | VOLTAGE SETTINGS (V) |  |  |
| 1.1 | UNDERVOLTAGE | 5-150 V | 40 V |
| 1.2 | VOLTAGE ABSENCE | 5-150 V | 10 V |
| 1.3 | VOLTAGE PRESENCE | 5-150 V | 50 V |
| 1.4 | WEAK INFEED | 5-150 V | 6 V |
| 2. | TIMER SETTINGS |  |  |
| 2.1 | UNDERVOLTAGE TIMER | 0,10-20,00 s | 1,00 s |
| 2.2 | UNDERVOLTAGE' TIMER | 0,10-20,00 s | 1,00 s |
| 3. | 25 SETTINGS FOR 521 |  |  |
| 3.1 | DIFF. IN MODULE | 1-30 V | 10 V |
| 3.2 | DIFF. IN ANGLE | 10-60응 | 10 - |
| 3.3 | DIFF. IN FREQUENCY | 0,01-2,00 Hz | $0,10 \mathrm{~Hz}$ |
| 3.4 | 25/ 79 TIMER | 0,10-20,00 s | 0,50 s |
| 3.5 | 25/ CLOSE TIMER | 0,10-20,00 s | 0,50 s |
| 3.6 | 79/ DL-DB | Dead line - Dead bus | Not permitted |
| 3.7 | 79/ LL-DB | Live line - Dead bus | Not permitted |
| 3.8 | 79/ DL-LB | Dead line - Live bus | Not permitted |
| 3.9 | 79/ SYNCHECK | SYNCHRO CHECK | Permitted |
| 3.10 | CLOSE/ DL-DB | Dead line - Dead bus | Not permitted |
| 3.11 | CLOSE/ LL-DB | Live line - Dead bus | Not permitted |
| 3.12 | CLOSE/ DL-LB | Dead line - Live bus | Not permitted |
| 3.13 | CLOSE/ SYNCHECK | SYNCHRO CHECK | permitted |
| 4. | 25 SETTINGS FOR 520 |  |  |
| 4.1 | DIFF. IN MODULE | 1-30 V | 10 V |
| 4.2 | DIFF. IN ANGLE | 10-60응 | 10 - |
| 4.3 | DIFF. IN FREQUENCY | 0,01-2,00 Hz | 0,10 Hz |
| 4.4 | TEMP. 25/ 79 | 0,10-20,00 s | 0,50s |
| 4.5 | TEMP.25/ CLOSE | 0,10-20,00 s | 0,50 s |
| 4.6 | 79/ DL-DB | permitted / Not permitted | Not permitted |
| 4.7 | 79/ LL-DB | permitted / Not permitted | Not permitted |
| 4.8 | 79/ DL-LB | permitted / Not permitted | Not permitted |
| 4.9 | 79/ SYNCHECK | permitted / Not permitted | permitted |
| 4.10 | CLOSE/ DL-DB | permitted / Not permitted | Not permitted |
| 4.11 | CLOSE/ LL-DB | permitted / Not permitted | Not permitted |
| 4.12 | CLOSE/ DL-LB | permitted / Not permitted | Not permitted |
| 4.13 | CLOSE/ SYNCHECK | permitted / Not permitted | permitted |

## COMMENTS ON THE SETTINGS:

## GENERAL SETTINGS

## 1. GENERAL SETTINGS

### 1.1 RELAY STATUS:

This setting allows to put the unit out of service, so that it will not activate any output in any case, except for the System Ready alarm, that will be active. The Ready LED on the front of the unit will remain red while the relay is out of service.

### 1.2 IDENTIFICATION:

This setting allows to rename ( 20 characters) the unit in order to customize and identify it.

### 1.3 FREQUENCY:

This setting is the electrical system frequency: 50 or 60 Hz .

### 1.4 LINE VT RATIO:

This setting allows the user to view the line voltage measures (V3, V4 and V5) in primary. This setting does not apply for the event record measures or the oscillography record, as these are shown in secondary.

### 1.5 V1 VT RATIO:

This setting allows the user to view the busbar voltage measure (V1) in primary. This setting does not apply for the event record measures or the oscillography record, as these are shown in secondary.

### 1.6 V2 VT RATIO:

This setting allows the user to view the V2 voltage measure in primary. This setting does not apply for the event record measures or the oscillography record, as these are shown in secondary.

### 1.7 ACTIVE TABLE:

This setting determines which particular settings are active, whether those of table 1, 2 or 3 . When the "ACTIVE TABLE" inputs are operative, they have priority over this setting, and therefore the setting can show a different table than the one that is actually active, which will be determined by the corresponding inputs.

## 2. PERMISSIONSxFUNCTIONS

### 2.1 FUNCTION PERMISSION MASK:

With this Mask it is possible to enable or disable the operation of each function:
FUNCTION A, FUNCTION A', FUNCTION B, FUNCTION C, FUNCTION D, FUNCTION E, FUNCTION F, FUNCTION G, FUNCTION H, FUNCTION I and FUNCTION J.

## 3. OSCILLOGRAPHY SETTINGS

### 3.1 NUMBER OF PRE-FAULT CYCLES

This setting allows to choose the number of pre-fault cycles that the user wishes to store with each oscillography record. Pre-fault means what has occurred just before the cause that triggered the oscillography.

### 3.2 Oscillography Trigger Mask

This setting allows to choose the causes that will trigger an oscillography record

## 4. SWITCHGEAR SETTINGS

## 4. 1 OPENING TIMER:

When in the general setting 4.3 it is set that the line switch status will be determined by two input contacts (normally open -A and normally closed -B), the unit verifies that the transition from closed to open does not exceed the set time.

### 4.2 CLOSING TIMER

When in the general setting 4.3 it is set that the line switch status will be determined by two input contacts (normally open -A and normally closed -B), the unit verifies that the transition from open to closed does not exceed the set time.

### 4.3 NUMBER OF CONTACTS:

Using this setting we specify the number of input contacts used for establishing the line switch status. In case of setting a 1 , the contact must be normally open (-A). When setting a 2 , contact -A (normally open) and contact - B (normally closed), the unit itself will solve the undetermined status (both contacts energised) and the opening and closing failure statuses (both contacts deenergized during a time longer than the opening and closing times).

We must take into account that when this setting is 2 and the switch status is undetermined (not open nor closed), those functions where the line switch status is necessary will not operate.

## PARTICULAR SETTINGS

## 1. VOLTAGE LEVEL SETTINGS

### 1.1 UNDERVOLTAGE:

This setting determines the voltage value under which undervoltage is detected.

### 1.2 VOLTAGE ABSENCE:

This setting determines the voltage value under which voltage absence is determined.

### 1.3 VOLTAGE PRESENCE:

This setting determines the voltage value over which voltage presence is detected.

### 1.4 WEAK INFEED:

This setting determines the voltage value under which weak infeed is determined.

## 2. TIMER SETTINGS

### 2.1 UNDERVOLTAGE TIMER:

This setting determines the timer for function - A.

### 2.2 UNDERVOLTAGE' TIMER:

This setting determines the timer for function - $\mathrm{A}^{\prime}$.

## 3. 25 SETTINGS FOR 521 (only for MOV2)

### 3.1 DIFF. IN MODULE:

This setting determines the maximum difference in module admissible between voltage values at both sides of the side breaker for a synchronism situation.

### 3.2 DIFF. IN ANGLE:

This setting determines the maximum difference in phase admissible between voltage values at both sides of the side breaker for a synchronism situation.

### 3.3 DIFF. IN FREQUENCY:

This setting determines the maximum difference in frequency admissible between voltage values at both sides of the side breaker for a synchronism situation.

### 3.4 TEMP. 25/ 79:

This setting determines the minimum time during which the difference in module, phase and frequency between voltage values at both sides of the side breaker must remain under the values set in 3.1, 3.2 and 3.3. for a synchronism for reclose condition.

### 3.5 TEMP. 25/ CLOSE:

This setting determines the minimum time during which the difference in module, phase and frequency between voltage values at both sides of the side breaker must remain under the values set in 3.1, 3.2 and 3.3. for a synchronism for close condition.

### 3.6 RECLOSE PERMISSIONS:

This mask allows to set the situations that must converge for a side breaker reclose permission: 79/ DL-DB, 79/ LL-DB, 79/ DL-LB and/or 79/ SYNCHECK.
3.7 CLOSE PERMISSIONS:

This mask allows to set the situations that must converge for a side breaker close permission: CLOSE/ DLDB, CLOSE/ LL-DB, CLOSE/ DL-LB and/or CLOSE/ SYNCHECK.

## 4. 25 SETTINGS FOR 520 (only for MOV2)

### 4.1 DIFF. IN MODULE:

This setting determines the maximum difference in module admissible between voltage values at both sides of the central breaker for a synchronism situation.

### 4.2 DIFF. IN ANGLE:

This setting determines the maximum difference in angle admissible between voltage values at both sides of the central breaker for a synchronism situation.

### 4.3 DIFF. IN FREQUENCY:

This setting determines the maximum difference in frequency admissible between voltage values at both sides of the central breaker for a synchronism situation.

### 4.4 TEMP. 25/79:

This setting determines the minimum time during which the difference in module, phase and frequency between voltage values at both sides of the central breaker must remain under the values set in 4.1, 4.2 and 4.3. for a synchronism for reclose condition.

### 4.5 TEMP. 25/ CLOSE:

This setting determines the minimum time during which the difference in module, phase and frequency between voltage values at both sides of the central breaker must remain under the values set in 4.1, 4.2 and 4.3. for a synchronism for close condition.

### 4.6 RECLOSE PERMISSIONS:

This mask allows to set the situations that must converge for a central breaker reclose permission: 79/ DLDB, 79/ LL-DB, 79/ DL-LB and/or 79/ SYNCHECK.

### 4.7 CLOSE PERMISSIONS:

This mask allows to set the situations that must converge for a central breaker close permission: CLOSE/ DL-DB, CLOSE/ LL-DB, CLOSE/ DL-LB and/or CLOSE/ SYNCHECK.

The names used to describe the settings both for the local MMI and the communications program is limited by the space available for the identifying texts. For reference, the following is a table of the names used for each setting in the local display and the GE-LOCAL software.

## General Settings Group

Relay in service
Relay identification
Frequency
LINE VT Ratio
BUSBAR VT Ratio (V1)
BUSBAR VT Ratio (V2)
No. Of active table
Permissions Settings Group
Function enabling

## GENERAL SETTINGS

RELAY STATUS
IDENTIFICATION
FREQUENCY
LINE VT RATIO
V1 VT RATIO
V2 VT RATIO
ACTIVE TABLE

## PERMISSIONSxFUNCTION

FUNCTION A FUNCTION A' FUNCTION B FUNCTION C FUNCTION D FUNCTION E FUNCTION F FUNCTION G FUNCTION H FUNCTION I FUNCTION J

## Oscillography Record Settings Group

Pre-fault cycles
Oscillo trigger Mask

## Switchgear Group

Maximum 89 opening time
Maximum 89 closing time
Number of 89 contacts
Voltage Levels Settings Group
Undervoltage initiate (fun A y A')
Voltage absence initiate (fun B, C y D)
Voltage presence initiate (fun E, F y J)
Weak infeed initiate (fun $\mathrm{G}, \mathrm{Hel}$ )
Functions timer Settings Group
Side Undervoltage timer
Central Undervoltage timer
Side Synchronism Settings Group
Difference in Module
Difference in Phase
Difference in Frequency
Timer for reclose
Timer for close
Reclose Permissions
Dead line - Dead Bus
Live line - Dead Bus
Dead line - Live Bus
SYNCHRO CHECK
Close Permissions
Dead line - Dead Bus
Live line - Dead Bus
Dead line - Live Bus
SYNCHRO CHECK

## OSCILLO SETTINGS

No. PRE-FAULT CYCLES
FUNCTION A
FUNCTION A'
FUNCTION B
FUNCTION C
FUNCTION D
FUNCTION E
FUNCTION F
FUNCTION G
FUNCTION H
FUNCTION I
FUNCTION J
COMMUNICATION TRIGGER
EXTERNAL TRIGGER

## SWITCHGEAR SETTINGS

OPENING TIME
CLOSING TIME
№ CONTACTS
VOLTAGE SETTINGS(V)
UNDERVOLTAGE
voltage absence
VOLTAGE PRESENCE
WEAK INFEED
TIMER SETTINGS
UNDERVOLTAGE TEMP.
UNDERVOLTAGE' TEMP.
25 SETTINGS FOR 521
DIF. MODULE
DIF. ANGLE
DIF. FREQUENCY
TEMP. 25/ 79
TEMP. 25/ CLOSE
79/ DL-DB
79/ LL-DB
79/ DL-LB
79/ SYNCHECK
CLOSE/ DL-DB
CLOSE / LL-DB
CLOSE / DL-LB
CLOSE / SYNCHECK

## Central Synchronism Settings Group

Difference in Module
Difference in Phase
Difference in Frequency
Timer for reclose
Timer for close
Reclose Permissions
Dead line - Dead Bus
Live line - Dead Bus
Dead line - Live Bus
SYNCH CHECK
Close Permissions
Dead line - Dead Bus
Live line - Dead Bus
Dead line - Live Bus
SYNCH CHECK

## 25 SETTINGS FOR 520

DIF. MODULE
DIF. ANGLE
DIF. FREQUENCY
TEMP. 25/ 79
TEMP. 25/ CLOSE
79/ DL-DB
79/ LL-DB
79/ DL-LB
79/ SYNCHECK
CLOSE/ DL-DB
CLOSE / LL-DB
CLOSE / DL-LB
CLOSE / SYNCHECK

### 4.1. MODEL LIST



### 4.2. TECHNICAL CHARACTERISTICS

## MECHANICAL

- Metallic package in a 19 " rack 2 units high
- Protection degree IP51 (according to IEC 529).
- Local HMI with LCD display ( $2 \times 16$ characters) and 20 -key keypad
- Rear connection through 6 boards of 12 terminals each
- Dimensions: $437 \times 164 \times 88 \mathrm{~mm}$.
- Weight: Net 6 kg . Packed 7 kg


## ELECTRICAL

- Frequency:
- Rated voltage:
- Auxiliary Voltage:
- Operative range:
- Digital inputs voltage:
- Thermal capacity: Voltage circuits

\author{

- Permanent: <br> - During 1 min:
}

50 or 60 Hz (selectable by setting)
100/ $\sqrt{ } 3$ to $220 / \sqrt{ } 3$ Vac
$48-125 \mathrm{Vdc}$ or $110 / 250 \mathrm{Vcc}$ (different models)
$80 \%$ to $120 \%$ of rated values
$48-125,110-250 \mathrm{Vdc}$ (different models)

$$
\begin{array}{r}
2 \times V n \\
3.5 \times V n
\end{array}
$$

- Temperature ranges:
- Operation
- Storage
- Humidity :
- Tripping contacts:
- Rated voltage, maximum opening voltage:
- Rated current, closing current
- Operation power
- Mechanical life:
- Auxiliary and alarm contacts
- Operation power (non-inductive loads)
- Operation voltage.
- Operation continuous current
- Mechanical life
- Electrical life at full load
- Circuit burden:
- Voltage circuits:
- Consumption:
- Auxiliary voltage:
- Digital inputs:
- Accuracy:
- Voltage and current:
- Times:
- Error index:
- Repetitivity:
- Operation value: $1 \%$
- Operation time:

$$
\begin{aligned}
& -20^{\circ} \mathrm{C} \text { to }+55^{\circ} \mathrm{C} \\
& -40^{\circ} \mathrm{C} \text { to }+65^{\circ} \mathrm{C}
\end{aligned}
$$

Up to $95 \%$ without condensing

> 250/440 Vac

16/25 A
4000 VA
$30 \times 10^{6}$ ops

## 1760 VA

380/250 Vac/Vdc.
8 A
$10^{7}$ ops
$10^{5}$ ops
0.2 VA at $\mathrm{Vn}=63.5 \mathrm{~V}$

12 W stand-by
16 W with all relays active
8 mA ( 1 W for Vaux $=125 \mathrm{Vdc}$ )
5\%
$5 \%$ or 30 ms (whichever is greater)
Class E-5 according to IEC 255-4
$2 \%$ or 30 ms (whichever is greater)

## COMMUNICATIONS

- RS232 using DB9 female connector (2 or 3 connectors depending on model)
- Mode : Half duplex.
- 1 mm plastic fibre-optic (depending on model)

| Typical power output : | -8 dBm |
| :--- | :--- |
| Receiver sensitivity | -39 dBm |
| Numeric aperture N.A. | 0.5 |
| Wave length | 660 nm (visible red) |
| HFBR-4516 type connector |  |

- Glass fibre-optic 62.5/125 (depending on model):

| Typical power output: | -17.5 dBm |
| :--- | :--- |
| Receiver sensitivity | -25.4 dBm |
| Numeric aperture N.A. | 0.2 |
| Wave length | 820 nm (near infrared) |
| SMA type connector |  |

## STANDARDS

The MOV system complies with the following standards, which include the GE insulation and electromagnetic compatibility standard and the standards required by Community Directive 89/336 for the EC market, 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 255-5 | $\begin{aligned} & 600 \mathrm{~V}, 2 \mathrm{kV} \\ & 50 / 60 \mathrm{~Hz} 1 \mathrm{~min} . \end{aligned}$ |
| -Impulse Voltage Withstand | IEC 255-5 | 5kV, 0.5 J |
| -1 MHz interference | IEC 255-22-1 | III |
| -Electrostatic discharge | $\begin{aligned} & \text { IEC 255-22-2 } \\ & \text { EN 61000-4-2 } \end{aligned}$ | $\begin{aligned} & \text { IV } \\ & \text { 8kV } \end{aligned}$ |
| -Immunity to radio interference | IEC 255-22-3 | III |
| -Electromagnetic fields radiated with amplitude modulation | ENV 50140 | $10 \mathrm{~V} / \mathrm{m}$ |
| -Electromagnetic fields radiated with amplitude modulation. Common mode | ENV 50141 | $10 \mathrm{~V} / \mathrm{m}$ |
| -Electromagnetic fields radiated with frequency modulation | ENV 50204 | $10 \mathrm{~V} / \mathrm{m}$ |
| -Fast transients | $\begin{aligned} & \text { IEC 255-22-4 } \\ & \text { EN 61000-4-4 } \end{aligned}$ | IV |
| - Magnetic fields at industrial frequency | EN 61000-4-8 | $30 \mathrm{Av} / \mathrm{m}$ |
| -RF emission | EN 55011 | B |

## CAUTION


#### Abstract

The MOV contains electronic components that could be damaged by electrostatic discharge if those currents flow through certain terminals of the components. The main source of electrostatic discharge currents is the human body, especially in conditions of low humidity, carpeted floors and isolating shoes. Where these conditions exist, care should be exercised when removing and handling the modules. The persons handling the modules should make sure that their body charge has been discharged, by touching some surface at ground potential before touching any of the components on the modules.


### 5.1. PHYSICAL DESCRIPTION

### 5.1.1. CASE

The MOV case is made from stainless steel and consists of the main body and a covering lid. The main body of the case contains the blocks of terminals necessary to carry out the external connections and guides to support the trays which contain the internal parts of the relay. The trays can be pulled out in order to facilitate the maintenance and servicing of the relay.
5.1.2. ELECTRICAL CONNECTIONS

All the electrical connections for voltage, current, digital input and output relays are made using the blocks of terminals fixed to the rear part of the case. The connections required for the unit's communications are made using three DB-9 type connectors, one on the front and two on the rear when using communication option RS-232. One of these connectors is replaced by the corresponding fibre-optic connector in the models which include this option.

### 5.1.3. INTERNAL CONSTRUCTION

Internally the MOV unit is divided into 2 trays and a case. The case consists of the case with the blocks of terminals described above. Inside the lower tray are located the CT and VT which are connected to the CPU by a frontal bus.

The lower tray carries the magnetic module and a printed circuit board which contains the power supply, the digital inputs and also the trip outputs and auxiliary outputs.

The upper tray carries the board with the protection system CPU and the board with the communications. This tray can also carry as an option the output expansion board.

The front panel consists of a covered keyboard and a board which carries the alphanumeric display, the LEDs and the Reset button. The model number (see list of models in Chapter 4) and the technical characteristics of the unit are situated on the front panel of the relay.

The 16 indicator LEDs can be identified using labels which can be placed beside them.
A frontal bus is responsible for the connections between the boards described above. Both trays can be pulled out. To do so you first have to release the front panel which is fixed to the case with two screws and pull it out, removing the flat cable which connects it to the CPU. It is then possible to remove the frontal bus.

The terminal blocks situated on the rear of the case are identified with the letters $A, B, C$ and $D$, and optionally $E$ and $F$, as shown in figure 6 . In addition, each terminal is identified with a number.

The communications connectors are situated on left-hand side of the front and on the right-hand side of the rear of the case. The front port is labelled as PORT 1 and the rear ports as PORT 2 and PORT3. The IRIG-B connection is made using a block of two additional terminals.

### 5.2. OPERATION THEORY

The MOV unit measures voltage signals, carries out complex calculations using internal data, stores relevant events, activates trip relays and generates information which can be used to determine the status of the power system to which it is connected. The functionality of the MOV can be divided into the following sections :

- Magnetic module
- CPU board
- Power supply
- Keyboard and display

The magnetic module carries out two essential functions: galvanic insulation and scaling analog input signals. In the case of voltage transformers it scales the input voltage so that internally the unit works with voltages which are greatly below the input voltages. In the case of current transformers the input current for the primary winding is converted into a scaled voltage in the secondary winding of the transformer. Each voltage and current transformer must be linear in the whole measurement range of the relay. The voltages supplied by the input transformers are applied directly to the CPU signal processing board.

### 5.2.2. CPU BOARD

The MOV uses two 16-bit microprocessors operating at a clock frequency of 20 MHz . One of these microprocessors is used to carry out relay communications and the other to carry out the calculations which are necessary for the protection functions. The microprocessor chosen is designed to carry out input and output calculations and operations at very high speed. The use of two microprocessors is especially recommendable so as to make the protection and communication functions totally independent of each other inside the unit itself, and thereby increase the reliability of the system.

The analogue-digital converter converts the voltage inputs into their digital equivalent with a resolution of 10 bits.
The unit's code is stored in non-volatile EPROM memory while the settings and events are stored in non-volatile EEPROM memory. The data related to the oscillography is stored in RAM memory which is maintained using a capacitor, thus avoiding the loss of information when the unit is disconnected.

A high resolution real time clock is used to time-tag the events and ensure an appropriate post-fault analysis can be done, with a resolution of one millisecond. This clock can be synchronised externally using an IRIG-B type input.

The input and output functions are divided between the two microprocessors. The serial ports, the keyboard and the display are controlled by the communications microprocessor. External communications are processed by a serial communications controller circuit which contains a universal asynchronous transceiver (DUART). The digital inputs and outputs are processed by the protection microprocessor.

The MOV contains 6 independent circuits to process digital inputs. These circuits check the presence or absence of input voltage and are designed to insulate them electrically from the microprocessor, thus increasing the reliability of the system.

On the front of the relay there is a set of 17 LEDs, one of which is fixed and indicates the operating status of the unit, and the rest are user-configurable by means of GE-INTRO software.

The button situated on the front can be used to check the status of the LEDs and to reset the trip indicators. In order to reset the indicators, simply press the button for 3 seconds.
5.2.3. POWER SUPPLY

The MOV power supply can be of two types, depending on the model: 48-125 Vdc or 110/250 Vdc. The operating margin of the power supply is $\pm 20 \%$ and it is galvanically insulated from the rest of the relay's circuits. The power supply provides $\pm 12 \mathrm{Vdc}$ to supply the analog part and the output relays and +5 Vdc for the digital circuits.

### 5.2.4. KEYPAD AND DISPLAY

The MOV display is an LCD display (liquid crystal) and consists of two rows of 16 characters each and can be seen in the window situated on the front of the unit. The intensity of the display can be adjusted by using an adjustable resistance situated on the rear of the front board. The keyboard consists of a set of twenty covered keys.

There follows a list of tests which 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: 6.2, 6.5, 6.6, 6.7 and 6.9.

### 6.1. CONNECTIONS AND NECESSARY EQUIPMENT

Necessary equipment:

- Up to 5 AC voltage power supplies
- One DC voltage power supply
- One chronometer
- One multimeter

Connect the relay as indicated in the external connections diagram, Figure 3 (189C4129F1).
Depending on each test, VAC power supplies shall be connected according to the wiring diagram.
For safety reasons, the relay shall be grounded.
Apply power always through terminals A10 and B10 at the rated voltage indicated on the front plate.
For simulating the external contacts closing (inputs to MOV unit) we will use jumpers and switches.

### 6.2. VISUAL INSPECTION

Check that the relay has not suffered any kind of damage due to transportation and handling.
Check that all the screws are sufficiently tight and that the terminal strips have not been damaged in any way.
Check that the information on the characteristics plate coincide with those of the ordered model.

### 6.3. INSULATION TESTS

- Progressively apply 2000 RMS volts between each group of terminals indicated below and the case during one second.


## DURING ALL TESTS, TERMINALS A9 AND B9 SHALL BE

 DISCONNECTED- The independent relay groups are as follows:

| Group 1: | A10, B10 | Power supply |
| :--- | :--- | :--- |
| Group 2: | A1 to A6, B1 to B4 | Voltage transformers |
| Group 3: | C9 to C12, D9 to D12 | Digital inputs |
| Group 4: | C9, C10, D9, D10 | Inputs group 1 |
| Group 5: | A11, B11 | Trip 1 |
| Group 6: | A12, B12 | Trip 2 |
| Group 7: | C1, D1 | Trip 3 |
| Group 8: | C2, D2 | Trip 4 |
| Group $9:$ | C4, D4 | Trip 5 |


| Group 10: | C5, D5 | Trip 6 |
| :--- | :--- | :--- |
| Group 11: | C6, D6 | Trip 7 |
| Group 12: | C7, D7 | Trip 8 |
| Group 13: | C8, D8 | Trip 9 |
| Group 14: | E1, F1 | Trip 10 |
| Group 15: | E2, F2 | Trip 11 |
| Group 16: | E3, F3 | Trip 12 |
| Group 17: | E4, F4 | Trip 13 |
| Group 18: | E5, F5 | Trip 14 |
| Group 19: | E6, F6 | Trip 15 |
| Group 20: | E7, F7 | Trip 16 |
| Group 21: | E8, F8 | Trip 17 |
| Group 22: | E9, F9 | Trip 18 |
| Group 23: | E10, F10 | Trip 19 |
| Group 24: | E11, F11 | Trip 20 |
| Group 25: | E12, F12 | Trip 21 |
| Group 26: | C3, D3 | System ready |

### 6.4. INDICATORS

Check that pressing the TARGET RESET button with the relay connected to a power supply, all the indicators light up.

### 6.5. POWER SUPPLY

During functional tests, terminals A9 and B9 must be connected to ground for safety reasons

- Configure all outputs as function - G.
- Check that with the relay turned off, all the output contacts, except the SYSTEM READY remain open.
- Power the relay at the minimum voltage and check that all the output contacts, except the SYSTEM READY are closed, that the relay communicates properly (asking for the model), and that consumption is within the limits shown in Table 1.
- Repeat the test at the rated and maximum voltage.

| Table-1: | Model "H" |
| :---: | :---: |
| Voltage (Vdc) | Consumption <br> $(\mathrm{mA})$ |
| 88 | $550 \pm 25 \%$ |
| 250 | $225 \pm 25 \%$ |
| 300 | $205 \pm 25 \%$ |

### 6.6. COMMUNICATIONS

The test is to check that the 3 connectors in the relay allow communication with the relay. To do this it is necessary to use a computer and a connector suitable to establish the connections between PC and relay which are shown in figure 4.

The communication parameters which have to be set for the computer are the relay's default settings, as follows:

Relay number:
Remote port baud rate:
Local port baud rate: 19200

Remote stop bits:
Local stop bits:

19200
1
1

This test is carried out at the minimum and maximum voltage that the relay will allow ( $\pm 20 \%$ of the rated voltage).

### 6.7. MEASURES

| TABLE-1 | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{4}$ | $\mathbf{5}$ | $\mathbf{6}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| V1 | 5 V | 10 V | 50 V | 100 V | 150 V | 200 V |
| $\mathbf{V} 2$ | 5 V | 10 V | 50 V | 100 V | 150 V | 200 V |
| $\mathbf{V} 3$ | 5 V | 10 V | 50 V | 100 V | 150 V | 200 V |
| $\mathbf{V 4}$ | 5 V | 10 V | 50 V | 100 V | 150 V | 200 V |
| $\mathbf{V 5}$ | 5 V | 10 V | 50 V | 100 V | 150 V | 200 V |

- Apply voltages shown in table 1 , at a frequency of 60 Hz with a phase of $0^{\circ}$.
- Check that the relay measures V1, V2, V3, V4, and V5 with an accuracy better than $\pm 5 \%$
- Apply voltages shown in table 1 , at a frequency of 50 Hz with a phase of $0^{\circ}$.
- Check that the relay measures V1, V2, V3, V4, and V5 with an accuracy better than $\pm 5 \%$


### 6.8. CHECKING THE INPUTS

- Apply to each input $20 \%$ less than the minimum admissible voltage.
- Check that the unit recognises that all inputs are activated.
- Apply to each input $20 \%$ more than the maximum admissible voltage
- Check that the unit recognises that all inputs are activated.


### 6.9. CHECKING THE OUTPUTS

Set the relay according to the following table:

| GENERAL SETTINGS |  |
| :--- | :--- |
| ACTIVE TABLE | 1 |
| PERMISSIONSxFUNCTIONS |  |
| FUNCTION A | not permitted |
| FUNCTION A' | not permitted |
| FUNCTION B | not permitted |
| FUNCTION C | not permitted |
| FUNCTION D | not permitted |


| FUNCTION E | not permitted |
| :---: | :---: |
| FUNCTION F | not permitted |
| FUNCTION G | not permitted |
| FUNCTION H | not permitted |
| FUNCTION I | not permitted |
| FUNCTION J | not permitted |
| SWITCHGEAR SETTINGS |  |
| NUMBER OF CONTACTS | 1 |
| Table -1 |  |
| VOLTAGE SETTINGS (V) |  |
| UNDERVOLTAGE | 40 V |
| VOLTAGE ABSENCE | 10 V |
| VOLTAGE PRESENCE | 50 V |
| WEAK INFEED | 6 V |
| PROTECTION INPUTS |  |
| PROTECTION INPUT 1 | Input_89L_A |
| PROTECTION OUTPUTS |  |
| Protection output 1 | FUNCTION A |
| Protection output 2 | FUNCTION A' |
| Protection output 3 | FUNCTION A |
| Protection output 4 | FUNCTION A' |
| Protection output 5 | Program Start-up |
| Protection output 6 | FUNCTION C |
| Protection output 7 | FUNCTION D |
| Protection output 8 | FUNCTION E |
| Protection output 9 | FUNCTION F |
| Protection output 10 | FUNCTION G |
| Protection output 11 | FUNCTION A |
| Protection output 12 | FUNCTION A' |
| Protection output 13 | FUNCTION B |
| Protection output 14 | FUNCTION C |
| Protection output 15 | FUNCTION D |
| Protection output 16 | FUNCTION E |
| Protection output 17 | FUNCTION F |
| Protection output 18 | FUNCTION G |
| Protection output 19 | FUNCTION H |
| Protection output 20 | FUNCTION I |
| Protection output 21 | FUNCTION J |
| Protection output 22 | 89L STATUS |

- Check that all output contacts are open
- Permit only function A and check that only SP1, SP3 and SP11 contacts close.
- Permit only function A' and check that only SP2, SP4 and SP12 contacts close.
- Permit only function B and check that only SP13 contact closes.
- Permit only function C and check that only SP6 and SP14 contacts close.
- Permit only function D and check that only SP7 and SP15 contacts close.
- Apply 60 Vac to V1 and V2.
- Permit only function E and check that only SP8 and SP16 contacts close.
- Permit only function F and check that only SP9 and SP17 contacts close.
- Permit only function G and check that only SP10 and SP18 contacts close.
- Permit only function H and check that only SP19 contact closes.
- Permit only function I and check that only SP20 contact closes.
- Permit only function $J$ and check that only SP21 contact closes.
- Apply auxiliary voltage to P11 input (89 closed) and check that only SP22 contact closes.


### 6.10. KEYPAD, DISPLAY AND LEDS

- Press the TARGET RESET button and check that all LEDs light up.
- Press the following keys in the below stated order, and check that the display shows the following messages:

| KEY | MESSAGE |
| :---: | :---: |
| SET | SEE PROTECTION SETTINGS |
| CLR | MOV |
|  | GENERAL ELECTRIC |
| INF | STATUS |
| ENT | MODEL |
| CLR | STATUS |
| CLR | MOV |
|  | GENERAL ELECTRIC |
| ACT | SET |
|  | DATE/TIME |
| CLR | MOV |
|  |  |
|  |  |

### 6.11. FUNCTIONS A \& A' (TIMED OVERVOLTAGE UNITS)

## FUNCTIONS CHECK

Set the relay according to the following table:

| GENERAL SETTINGS | 1 |
| :--- | :--- |
| ACTIVE TABLE |  |
| PERMISSIONS XUNCTION | permitted |
| FUNCTION A | permitted |
| FUNCTION A |  |
| SWITCHGEAR SETTINGS | $0,5 \mathrm{~s}$ |
| OPENING TIME | $0,5 \mathrm{~s}$ |
| CLOSING TIME | 2 |
| CONTACTS |  |
| Table -1 | 50 V |
| VOLTAGE SETTINGS $(\mathrm{V})$ |  |
| UNDERVOLTAGE |  |
| TIMER SETTINGS |  |


| UNDERVOLTAGE TIMER | $0,2 \mathrm{~s}$ |
| :--- | :--- |
| UNDERVOLTAGE' TIMER | $0,2 \mathrm{~s}$ |
| PROTECTION INPUTS |  |
| Protection input 1 | Input_89L_A |
| Protection input 2 | Input_89L_B |
| PROTECTION OUTPUTS |  |
| Protection output 1 | FUNCTION A |
| Protection output 2 | FUNCTION A' |

## FUNCTION A':

## 89 OPEN

- Apply auxiliary voltage through terminal PI2 (89 OPEN)
- Apply Vac voltage corresponding to half the undervoltage setting in V3, V4 and V5.
- Apply Vac voltage corresponding to twice the undervoltage setting in V1.
- Decrease V1 and check that terminal SP2 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.


## 89 CLOSED

- Apply auxiliary voltage only through the input terminal PI1 (89 closed).
- Apply Vac voltage corresponding to half the undervoltage setting in V1.
- Apply Vac voltage corresponding to twice the undervoltage setting in V3, V4 and V5.
- Decrease V3, V4 and V5, and check that terminal SP2 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.


## FUNCTION A:

## 89 OPEN

- Apply auxiliary voltage through terminal PI2 (89 OPEN)
- Apply Vac voltage corresponding to half the undervoltage setting in V1.
- Apply Vac voltage corresponding to twice the undervoltage setting in V2.
- Decrease V2 and check that terminal SP1 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.
- Apply auxiliary voltage through terminal PI2 (89 OPEN)
- Apply Vac voltage corresponding to half the undervoltage setting in V2.
- Apply Vac voltage corresponding to twice the undervoltage setting in V1.
- Decrease V1 and check that terminal SP1 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.


## 89 CLOSED

- Apply auxiliary voltage only through the input terminal PI1 (89 closed).
- Apply Vac voltage corresponding to half the undervoltage setting in V1.
- Apply Vac voltage corresponding to twice the undervoltage setting in V3, V4 and V5.
- Decrease V3, V4 and V5 simultaneously, and check that terminal SP1 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.
- Apply Vac voltage corresponding to half the undervoltage setting in V3, V4 and V5.
- Apply Vac voltage corresponding to twice the undervoltage setting in V1.
- Decrease V1, and check that terminal SP1 is activated for $100 \%$, and deactivated for $104 \%$ of the undervoltage setting.


## CHECKING THE TIMER

Set the relay according to the following table:

| GENERAL SETTINGS |  |
| :--- | :--- |
| ACTIVE TABLE | 1 |
| PERMISSIONSxFUNCTIONS |  |
| FUNCTION A | permitted |
| FUNCTION A' | permitted |
| SWITCHGEAR SETTINGS | $0,5 \mathrm{~s}$ |
| OPENING TIME | $0,5 \mathrm{~s}$ |
| CLOSING TIME | 2 |
| CONTACTS |  |
| Table -1 | 50 V |
| VOLTAGE SETTINGS (V) |  |
| UNDERVOLTAGE | $0,1 \mathrm{~s}$ |
| TIMER SETTINGS | $0,1 \mathrm{~s}$ |
| UNDERVOLTAGE TIMER |  |
| UNDERVOLTAGE' TIMER | input_89L_A |
| PROTECTION INPUTS | input_89L_B |
| Protection input 1 |  |
| Protection input 2 | FUNCTION A |
| PROTECTION OUTPUTS | FUNCTION A' |
| Protection output 1 |  |
| Protection output 2 |  |

- Apply auxiliary voltage to input terminal PI2 (89 OPEN).
- Apply Vac corresponding to twice the undervoltage setting to V1.
- Eliminate V1 voltage and check that the time until SP1 and SP2 are activated is less than the time set for undervoltage V and $\mathrm{V}^{\prime}$ (+20ms).
- Repeat the three previous steps changing the timer settings to $0.5 \mathrm{~s}, 1 \mathrm{~s}, 10 \mathrm{~s}$ and 20 s .


### 6.12. FUNCTIONS B, C \& D (VOLTAGE ABSENCE FUNCTIONS)

## CHECKING THE FUNCTIONS

Set the relay according to the following functions:

| GENERAL SETTINGS |  |
| :--- | :--- |
| ACTIVE TABLE | 1 |
| PERMISSIONSxFUNCTIONS | permitted |
| FUNCTION B | permitted |
| FUNCTION C | permitted |
| FUNCTION D |  |
| SWITCHGEAR SETTINGS | $0,5 \mathrm{~s}$ |
| OPENING TIME | $2,5 \mathrm{~s}$ |
| CLOSING TIME |  |
| CONTACTS | 5 V |
| Table -1 |  |
| VOLTAGE SETTINGS (V) | input_89L_A |
| VOLTAGE ABSENCE | input_89L_B |
| PROTECTION INPUTS |  |
| Protection input 1 |  |
| Protection input 2 |  |
| PROTECTION OUTPUTS |  |


| Protection output 13 | FUNCTION B |
| :--- | :--- |
| Protection output 14 | FUNCTION C |
| Protection output 15 | FUNCTION D |

## FUNCTION B:

- Apply Vac voltage corresponding to twice the voltage absence setting to V3, V4 and V5.
- Decrease V3, V4 and V5 simultaneously and check that terminal SP13 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


## FUNCTION C:

## 89 CLOSED:

- Apply Vac voltage corresponding to twice the voltage absence setting to V1.
- Apply auxiliary voltage only to Pl1 (89 closed)
- Apply Vac voltage corresponding to twice the voltage absence setting to V3, V4 and V5.
- Decrease V3, V4 and V5 simultaneously and check that terminal SP14 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


## 89 OPEN:

- Apply auxiliary voltage only to PI2 (89 open)
- Apply Vac voltage corresponding to twice the voltage absence setting to V2.
- Decrease V2 and check that terminal SP14 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


## 89 UNDETERMINED:

- Apply auxiliary voltage PI1 and PI2 (89 undetermined)
- Apply Vac voltage corresponding to twice the voltage absence setting to V1.
- Decrease V1 and check that terminal SP14 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


## FUNCTION D:

## 89 CLOSED:

- Apply auxiliary voltage only to PI1 (89 closed)
- Apply Vac voltage corresponding to twice the voltage absence setting to V3, V4 and V5.
- Decrease V3, V4 and V5 simultaneously and check that terminal SP15 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


## 89 OPEN:

- Apply auxiliary voltage only to PI2 (89 open)
- Apply Vac voltage corresponding to twice the voltage absence setting to V1.
- Decrease V1 and check that terminal SP15 is activated for $100 \%$ and deactivated for $104 \%$ of the voltage absence setting.


### 6.13. FUNCTIONS E, F, \& J (VOLTAGE PRESENCE UNITS)

## CHECKING THE FUNCTIONS

Set the relay according to the following table:

| GENERAL SETTINGS |  |
| :--- | :--- |
| ACTIVE TABLE | 1 |
| PERMISIONSxFUNCTIONS |  |
| FUNCTION E | permitted |
| FUNCTION F | permitted |
| FUNCTION J | permitted |
| SWITCHGEAR SETTINGS | $0,5 \mathrm{~s}$ |
| OPENING TIME | $0,5 \mathrm{~s}$ |
| CLOSING TIME | 2 |
| CONTACTS |  |
| Table -1 | 100 V |
| VOLTAGE SETTINGS (V) |  |
| VOLTAGE PRESENCE | Input_89L_A |
| PROTECTION INPUTS | Input_89L_B |
| Protection input 1 | FUNCTION E |
| Protection input 2 | FUNCTION F |
| PROTECTION OUTPUTS | FUNCTION J |
| Protection output 8 |  |
| Protection output 9 |  |
| Protection output 21 |  |

## FUNCTION E:

## 89 OPEN

- Apply auxiliary voltage only to PI2 (89 open)
- Apply Vac voltage corresponding to half the voltage presence setting to V1 and V2.
- Increase V1 and V2 and check that terminal SP8 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## 89 CLOSED, VOLTAGE IN PHASE A:

- Apply auxiliary voltage only to PI1 (89 closed)
- Apply Vac voltage corresponding to half the voltage presence setting to V1 and V3.
- Increase V1 and V3 and check that terminal SP8 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE B:

- Apply Vac voltage corresponding to half the voltage presence setting to V1 and V4.
- Increase V1 and V4 and check that terminal SP8 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE C:

- Apply Vac voltage corresponding to half the voltage presence setting to V1 and V5.
- Increase V1 and V5 and check that terminal SP8 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## FUNCTION F:

## 89 OPEN:

- Apply auxiliary voltage only to PI2 (89 open)
- Apply Vac voltage corresponding to half the voltage presence setting to V1.
- Increase V1 and check that terminal SP9 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## 89 CLOSED, VOLTAGE IN PHASE A:

- Apply auxiliary voltage only to PI1 (89 closed)
- Apply Vac voltage corresponding to half the voltage presence setting to V3.
- Increase V3 and check that terminal SP9 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE B:

- Apply Vac voltage corresponding to half the voltage presence setting to V 4 .
- Increase V4 and check that terminal SP9 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE C:

- Apply Vac voltage corresponding to half the voltage presence setting to V 5 .
- Increase V5 and check that terminal SP9 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## FUNCTION J:

## 89 UNDETERMINED:

- Apply auxiliary voltage to PI1 and PI2 (89 undetermined)
- Apply Vac voltage corresponding to half the voltage presence setting to V 1 .
- Increase V1 and check that terminal SP21 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## 89 OPEN:

- Apply auxiliary voltage only to PI2 (89 open)
- Apply Vac voltage corresponding to half the voltage presence setting to V 2 .
- Increase V2 and check that terminal SP21 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## 89 CLOSED, VOLTAGE IN PHASE A:

- Apply auxiliary voltage only to PI1 (89 closed)
- Apply Vac voltage corresponding to half the voltage presence setting to V3.
- Increase V3 and check that terminal SP21 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE B:

- Apply Vac voltage corresponding to half the voltage presence setting to V 4 .
- Increase V4 and check that terminal SP21 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


## VOLTAGE IN PHASE C:

- Apply Vac voltage corresponding to half the voltage presence setting to V 5 .
- Increase V5 and check that terminal SP21 is activated for $100 \%$ and deactivated for $96 \%$ of the voltage presence setting.


### 6.14. FUNCTIONS G, H \& I (WEAK INFEED UNITS)

## CHECKING THE FUNCTIONS

Set the relay according to the following table:

| GENERAL SETTINGS |  |
| :--- | :--- |
| ACTIVE TABLE | 1 |
| PERMISSIONSxFUNCTIONS | permitted |
| FUNCTION G | permitted |
| FUNCTION H | permitted |
| FUNCTION I | $0,5 \mathrm{~s}$ |
| SWITCHGEAR SETTINGS | $0,5 \mathrm{~s}$ |
| OPENING TIME | 2 |
| CLOSING TIME |  |
| CONTACTS | 5 V |
| Table -1 |  |
| VOLTAGE SETTINGS (V) | Input_89L_A |
| WEAK INFEED | Input_89L_B |
| PROTECTION INPUTS |  |
| Protection input 1 | FUNCTION G |
| Protection input 2 | FUNCTION H |
| PROTECTION OUTPUTS | FUNCTION I |
| Protection output 18 |  |
| Protection output 19 |  |

## FUNCTION G:

- Apply Vac voltage corresponding to twice the weak infeed setting toV3.
- Decrease V3 and check that terminal SP18 activates for $100 \%$ and deactivates for $104 \%$ of the weak infeed setting.


## FUNCTION H:

- Apply Vac voltage corresponding to twice the weak infeed setting toV4.
- Decrease V4 and check that terminal SP19 activates for $100 \%$ and deactivates for $104 \%$ of the weak infeed setting.


## FUNCTION I:

- Apply Vac voltage corresponding to twice the weak infeed setting toV5.
- Decrease V5 and check that terminal SP20 activates for $100 \%$ and deactivates for $104 \%$ of the weak infeed setting.


### 6.15. FUNCTIONS 25 (SIDE AND CENTRAL SYNCHRONISM)

Set the relay according to the following table:

| GENERAL SETTINGS |  |
| :---: | :---: |
| ACTIVE TABLE | 1 |
| SWITCHGEAR SETTINGS |  |
| No. OF CONTACTS | 1 |
| Table -1 |  |
| VOLTAGE SETTINGS (V) |  |
| VOLTAGE PRESENCE | 50 V |
| 25 SETTINGS FOR 521 |  |
| DIF. MODULE | 10 V |
| DIF. ANGLE | 10 - |
| DIF. FREQUENCY | $0,10 \mathrm{~Hz}$ |
| TEMP. 25/ 79 | 0,50 s |
| TEMP. 25/ CLOSE | 0,50 s |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE / DL-DB | Not permitted |
| CLOSE / LL-DB | Not permitted |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| DIF. MODULE | 10 vol |
| DIF. ANGLE | $10 \bigcirc$ |
| DIF. FREQUENCY | $0,10 \mathrm{~Hz}$ |
| TEMP. 25/ 79 | 0,50s |
| TEMP. 25/ CLOSE | 0,50 s |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE / DL-DB | Not permitted |
| CLOSE / LL-DB | Not permitted |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |
| PROTECTION INPUTS |  |
| Protection input 1 | Input_89L_A |
| PROTECTION OUTPUTS |  |
| Protection output 1 | PERMISSION 79521 |
| Protection output 2 | CLOSE PERMISSION 521 |
| Protection output 3 | PERMISSION 79520 |
| Protection output 4 | CLOSE PERMISSION 520 |

Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| 25 SETTINGS FOR 521 |  |
| :--- | :--- |
| 79/ DL-DB | permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | permitted |


| CLOSE / LL-DB | Not permitted |
| :--- | :--- |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | permitted |
| CLOSE / LL-DB | Not permitted |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |

- Apply 60 Vac only to V1.
- Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| 25 SETTINGS FOR 521 |  |
| :--- | :--- |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE / DL-DB | Not permitted |
| CLOSE / LL-DB | permitted |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/L-DB | permitted |
| CLOSE / DL-LB | Not permitted |
| CLOSE / SYNCHECK | Not permitted |

- Apply 60 Vac only to V 2 .
- Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| 25 SETTINGS FOR 521 |  |
| :--- | :--- |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE / LL-DB | Not permitted |
| CLOSE / DL-LB | permitted |
| CLOSE / SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | Not permitted |
| CLOSE/ DL-LB | permitted |
| CLOSE/ SYNCHECK | Not permitted |

- Apply auxiliary voltage only to terminal PI1 (89 closed).
- Apply 60 Vac only to V1 and V2.
- Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| 25 SETTINGS FOR 521 |  |
| :--- | :--- |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | Not permitted |
| CLOSE/ DL-LB | permitted |
| CLOSE/ SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | Not permitted |
| CLOSE/ DL-LB | permitted |
| CLOSE/ SYNCHECK | Not permitted |

- Apply 60 Vac only to V4.
- Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| 25 SETTINGS FOR 521 |  |
| :--- | :--- |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | permitted |
| CLOSE/ DL-LB | Not permitted |
| CLOSE/ SYNCHECK | Not permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | Not permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | permitted |
| CLOSE/ DL-LB | Not permitted |
| CLOSE/ SYNCHECK | Not permitted |

## SYNCHRONISM CHECK UNIT:

## 89 OPEN, Compare V1 with V2:

- Remove auxiliary voltage from terminal PI1 (89 open).
- Apply 60 Vac at 60 Hz to V 1 and V 2 with an angle difference of 00 between both voltages.
- Change the following settings and check that contacts SP1, SP2, SP3 and SP4 close.

| GENERAL SETTINGS |  |
| :--- | :--- |
| FREQUENCY | 60 Hz |
| 25 SETTINGS FOR 521 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | Not permitted |
| CLOSE/ DL-LB | Not permitted |
| CLOSE/ SYNCHECK | permitted |
| 25 SETTINGS FOR 520 |  |
| 79/ DL-DB | Not permitted |
| 79/ LL-DB | Not permitted |
| 79/ DL-LB | Not permitted |
| 79/ SYNCHECK | permitted |
| CLOSE/ DL-DB | Not permitted |
| CLOSE/ LL-DB | Not permitted |
| CLOSE/ DL-LB | Not permitted |
| CLOSE/ SYNCHECK | permitted |

- Increase voltage V1 and check that for 70 Vac, contacts SP1, SP2, SP3 and SP4 open.
- Decrease V1 voltage to 60 Vac.
- Change V1 angle with respect to V2, and check that when reaching $10^{\circ}$, contacts SP1, SP2, SP3 and SP4 open.


## 89 CLOSED, Compare V1 with V4:

- Apply auxiliary voltage only to PI1 (89 closed).
- Apply 60 Vac at 60 Hz to $\mathrm{V} 1, \mathrm{~V} 2$ and V 4 with an angle difference of 00 between $\mathrm{V} 1-\mathrm{V} 4$ and $\mathrm{V} 2-\mathrm{V} 4$, and check that contacts SP1, SP2, SP3 and SP4 close.
- Increase V4 and check that when reaching 70 Vac, contacts SP1, SP2, SP3 and SP4 open.
- Decrease V4 to 60 Vac.
- Change V4 angle with respect to V 1 and V 2 , and check that when reaching $10^{\circ}$, contacts SP1, SP2, SP3 and SP4 open.


### 6.16. IRIG-B

- Synchronise the relay with the date and time of the PC that is being used to communicate with the unit.
- Check that the relay and the PC show the same time.
- Place in the IRIG-B receiver a date/time completely different from the current time, which is on the PC.
- Connect the IRIG-B receiver to the relay.
- Check that the relay and the IRIG-B receiver show the same date/time.


### 7.1. 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.

The relay should be mounted on a vertical surface. Figure 1 shows the diagram for panel drilling for panel mounting.

Given that the design of the MOV 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.

### 7.2. SAFETY GROUND CONNECTION AND SUPPRESSION OF DISTURBANCES

A9 and B9 terminals (see figure 3) 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.

### 7.3. 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 which permit immediate identification with only the aid of the keyboard 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 fault.

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

Since most of the protection and communications functions are integrated in two separate programs, it is unlikely that faults will occur due to problems of wear or ageing which are typical in electromechanical, analog or hybrid protection systems. Moreover, a failure in the communications processor does not affect the protection functions, which are implemented by a dedicated processor.

The MOV has a 20 key keyboard and a liquid crystal DISPLAY with 32 characters, divided into two rows of 16 each. The following diagram shows the appearance of the MOV Keyboard:


The keyboard program uses menus to access the different relay functions. These functions are divided into five large groups, each of which is accessed using a different key. These groups are the following:

Information: Provides data about the status of the relay, alarms, breaker status, record of currents, events record, etc. This menu is accessed using the INF key.

Operations: Allows to synchronise the relay date and time, and to trigger the oscillography. This menu is accessed by pressing the ACT key.

Settings: Allows to view and change all the relay settings. This menu is accessed by pressing the SET key.
Configuration menu: Permits access to the system configuration and the modification of the passwords, access, communication speeds, etc. This menu is accessed by keying in the code "7169" In order to access this mode the relay should be on the main screen.

Single key menu: By pressing the ENT key the MOV can be operated in a simplified mode. It is not necessary to remove the methacrylate cover on the front of the relay to access this mode.

In stand-by mode, the MOV shows the following message on the DISPLAY:

## MOV

GENERAL ELECTRIC

This is the point from which the five groups mentioned above can be selected. In order to select a different group you must return to this screen by pressing CLR, and then press the key which corresponds to that group.

Once inside a group it is not possible to select a different one. Movement inside a group is carried out using the following keys : ENT, CLR, and the up, down, left, right arrows. Their function is as follows :

ENT: Accepts the option that is shown on the screen at that moment. The equivalent of going down one level in the menu tree.

CLR: Abandons the option that is shown on the screen at that moment. The equivalent of going up one level in the menu tree.
8. KEYPAD AND DISPLAY

UP / DOWN ARROW: Change options. The equivalent of a horizontal movement within a menu. When the required option appears on the screen it can be selected with the ENT key.

LEFT / RIGHT ARROWS: Show the different possibilities of a given setting. It is not used for all settings. When the required option appears on the screen it can be selected with the ENT key.

### 8.1. MENU TREE.

The MOV has different menus, divided into levels. Level 0 is the initial screen. Level 1 of the menus is accessed by pressing the corresponding group key (SET, INF, etc). Moving within a given level is done by using the UP and DOWN arrows. It is possible to go down to levels 2 and 3 by pressing the ENT key. Press CLR to go up a level within the menu tree. Level 1 for each of the five groups is shown in the following table :

TABLE 6. HMI Menu. Description

| Group | Level 1 | Description |
| :--- | :--- | :--- |
| SET | VIEW PROTECTION <br> SOTTINGS <br>  <br>  <br>  <br> SODIFY PROTECTION | • View settings |
|  | - STATUS | Modify settings |

### 8.2. SETTINGS GROUP

This group allows to view and modify the MOV settings. It is accessed by pressing the SET key when the MOV is in stand-by status. The display will then show the following message:

## VIEW PROTECTION

SETTINGS

Pressing keys $\uparrow \downarrow$ we can see this message :

## MODIFY PROTECTION <br> SETTINGS

The menu tree for the MOV settings is shown in the following table. Note that to go down a level in the tree you have to press the ENT key and that to go up you have to press the CLR key.

TABLE 7. HMI Menu. Settings and ranges

| Level 1 | Level 2 | Level 3 | Valid Range |
| :---: | :---: | :---: | :---: |
| - VIEW <br> PROTECTION SETTINGS <br> - MODIFY PROTECTION SETTINGS | - GENERAL | - RELAY STATUS <br> IDENTIFICATION (View, do not modify) <br> - FREQUENCY <br> - LINE VT RATIO <br> - V1 VT Ratio <br> - V2 VT RATIO <br> - ACTIVE TABLE | In Service Out of Service <br> Alphanumerical chain of up to 20 characters $50 / 60 \mathrm{~Hz}$ 1-4000 in steps of 1 $1-4000$ in steps of 1 $1-4000$ in steps of 1 1-3 |
|  | - PERMISSIONS X FUNCTION | - FUNCTION A <br> - FUNCTION A' <br> - FUNCTION B <br> - FUNCTION C <br> - FUNCTION D <br> - FUNCTION E <br> - FUNCTION F <br> - FUNCTION G <br> - FUNCTION H <br> - FUNCTION I <br> - FUNCTION J | -- <br> - <br> - <br> - <br> - Permitted No Permitted 1 Permitted |


| Level 1 | Level 2 | Level 3 | Valid Range |
| :---: | :---: | :---: | :---: |
|  | - OSCILLO MASK | - No. PRE-FAULT CYCLES <br> - FUNCTION A <br> - FUNCTION A' <br> - FUNCTION B <br> - FUNCTION C <br> - FUNCTION D <br> - FUNCTIONE <br> - FUNCTION F <br> - FUNCTION G <br> - FUNCTION H <br> - FUNCTION I <br> - FUNCTION J <br> - EXTERNAL TRIGGER <br> - COMMUNICATIONS TRIGGER | - 1-8 <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled <br> - Enabled <br> - Disabled |
|  |  | - OPENING TIME <br> - CLOSING TIME <br> - No. OF CONTACTS | - 0.10-20.00s <br> - 0.10-20.00s <br> - 1-2 |
|  | $\begin{array}{ll} \hline \text { - VOLTAGE } \\ \text { SETTINGS (V) } \end{array}$ | - UNDERVOLTAGE <br> - voltage absence <br> - Voltage presence <br> - WEAK INFEED | $\begin{array}{ll} \hline & 5-150 \mathrm{~V} \\ \hline & 5-150 \mathrm{~V} \\ - & 5-150 \mathrm{~V} \\ \hline \end{array}$ |
|  | - TIMER SETTINGS | - UNDERVOLTAGE TIMER <br> - UNDERVOLTAGE' TIMER | $\begin{array}{ll} \hline- & 0.10-20.00 \mathrm{~s} \\ - & 0.10-20.00 \mathrm{~s} \\ \hline \end{array}$ |
|  | $\begin{array}{\|ll} \hline- & 25 \text { SETTINGS } \\ & \text { FOR } 521 \end{array}$ | - DIF. MODULE <br> - DIF. ANGLE <br> - DIF. FREQUENCY <br> - TEMP. 25/79 <br> - TEMP. 25/CLOSE <br> - 79 DL-DB <br> - 79 LL-DB <br> - 79 DL-LB <br> - 79 SYNCHECK <br> - CLOSE DL-DB <br> - CLOSE LL-DB | - $1-30 \mathrm{~V}$ <br> - 1-45 <br> - $0.01-2.00 \mathrm{~Hz}$ <br> - 0.1-20.00 s <br> - 0.1-20.00 s <br> - Permitted <br> - Not permitted <br> - Permitted <br> - Not permitted <br> - Permitted <br> - Not permitted <br> - Permitted <br> - Not permitted <br> - Permitted <br> - Not permitted <br> - Permitted <br> - Not permitted |
|  |  |  |  |



The MOV has a group of settings which are common to all the tables and others which are specific to each settings table. Settings in the table above refer only to T 1 .

The rest of groups is applicable to each table independently. There are different groups for each table.
The steps to be taken in order to change any setting are as follows:

1. Press the SET key.
2. Select the option MODIFY SETTINGS.
3. Select the required setting in the menu trees.
4. ENTER the value to be modified (or select the required value from the list of available settings using LEFT/RIGHT ARROW keys).
5. Press the ENT key. To repeat the setting for a setting in the same group repeat steps 3 to 5 .
6. Press the END key.
7. The relay will request confirmation of the change by means of the following message:

## CONFIRM?

$\mathrm{Y} / \mathrm{N}$
8. If you want to confirm this change press the $\mathbf{1 / Y}$ key. (If not, press $\mathbf{3 / N}$ ).
9. The relay will then show the following message on the screen:
10. Press the CLR key repeatedly in order to return to the stand-by screen.

If the setting entered is outside the limits of the range allowed for that setting, the relay will not accept the change and will show the following message:

## SETTINGS OUT OF RANGE

Some settings do not require you to key in a numeric value, but to choose an option from a series of possibilities. In this case the options can be viewed using the LEFT/RIGHT ARROW keys.

Example : Configure the V2 VT RATIO as 1000.
To make this change we will start from the stand-by screen and take the following steps:
TABLE 8. Settings Change Procedure

| Pressed Key | Display Message | Notes |
| :---: | :---: | :---: |
|  | MOV GENERAL ELECTRIC | We start from the stand-by screen |
| SET | VIEW PROTECTION SETTINGS | We enter Level 1 |
| $\downarrow$ | MODIFY PROTECTION SETTINGS | We rotate inside Level 1 |
| ENT | GENERAL SETTINGS | We enter Level 2 |
| ENT | RELAY STATUS IN SERV. | We enter Level 3. <br> The IN SERVICE assignation is the default factory configuration for RELAY STATUS. We see the current value on the left and the new value on the right. |
| $\downarrow$ | ACTIVE TABLE | We rotate inside level 3 |
| $\downarrow$ | $\begin{aligned} & \text { V2 VT RATIO } \\ & 100 \end{aligned}$ | We search the desired setting |
| 1000 | V2 VT RATIO  <br> 100 1000 | We enter the new value |
| ENT | V2 VT RATIO  <br> 100 1000 | We accept |
| END | CONFIRM? (Y/N) | The unit asks for confirmation |
| Y | SETTINGS CHANGE EXECUTED | The change is executed |
| CLR | MODIFY PROTECTION SETTINGS | We return to level 1 |
| CLR | (*) MOV GENERAL ELECTRIC | This screen is previous to the stand-by status. It does not allow the remote settings change. |
| CLR | MOV GENERAL ELECTRIC | Stand-by status |

### 8.3. INFORMATION GROUP

This group provides information about the status of the MOV. Press the INF key in the main menu to access this group. The information group consists of the following sub-groups:

## - Status

Press the INF key to access this subgroup in the same way as in the operation in the settings group. This takes us to level 1 in the menus. When this sub-group has been selected (in this case it is the only option) we press the ENT key to see the contents (down to level 2). In this level we can move through the contents by using the UP/DOWN arrows. Press the CLR key repeatedly to leave the information group and return to the reset screen.


## Status.

The MOV allows you to view the status of certain internal values of the relay. From the status menu we press the ENT key. By pressing the UP arrow key we can move through the status menu and obtain the following information:

TABLE 9. RELAY STATUS INFORMATION

| DISPLAY | POSSIBLE VALUES |
| :---: | :--- |
| MODEL |  |
| MOV2100M101H00A | Depends on model |
| DATABAEE | Depends on model |
| VERSION PROT | Depends on model |
| VERSION COM | Depends on model |
| Va-LINE | Measured values |
| Vb-LINE | Measured values |
| Vc-LINE | Measured values |
| V-SIDE1 | Measured values |
| V-SIDE2 | Measured values |
| DIF. ANGLE 521 | Measured values |
| DIF. FREQUENCY 521 | Measured values |
| DIF. ANGLE 520 | Measured values |
| DIF. FREQUENCY 520 | Measured values |
| RELAY STATUS | In/Out of Service |
| ACTIVE TABLE | 1, 2 or 3 |
| LINE 89 | Open/Closed |
| 521 LINE BUSBAR | Dead / Live |
| SYNCHRO 521 INST | Yes/No |
| SYNCHRRO 521 79 | Yes/No |
| SYNCHRO 521 CLOSE | Yes/No |
| 520 LINE BUSBAR | Dead / Live |
| SYNCHRO 520 INST | YES/NO |
| SYNCHRO 520 79 | YES/NO |


| DISPLAY | POSSIBLE VALUES |
| :---: | :--- |
| SYNCHRO 520 CLOSE | YES/NO |
| FUNCTION A | YES/NO |
| FUNCTION A | YES/NO |
| FUNCTION B | YES/NO |
| FUNCTION C | YES/NO |
| FUNCTION D | YES/NO |
| FUNCTION E | YES/NO |
| FUNCTION F | YES/NO |
| FUNCTION G | YES/NO |
| FUNCTION H | YES/NO |
| FUNCTION I | YES/NO |
| FUNCTION J | YES/NO |
| LOCAL CONNECTION | In/Out of service |
| DATE/TIME | Correct/lncorrect |
| E2PROM | Correct/lncorrect |
| COMMUNICATIONS |  |
| COMMUNICATION | USER - DEFAULT |
| SEETTINGS | PROTECTION LINK |

### 8.4. OPERATIONS GROUP

This group allows you to synchronise the time on the unit, and trigger the oscillography recorder. To access this group press the ACT key when the MOV is in the stand-by screen. This takes you to the operations menu and shows the first item on the menu :

## SET <br> DATE/TIME

This shows that the first item on the OPERATIONS menu is the function for entering the date and time for the relay. When the UP/DOWN ARROW keys are pressed the rest of the items on the actions menu appear. After locating the required operation use the ENT key to select it.

To avoid carrying out operations by mistake the keyboard program requires confirmation of the operation selected. To confirm, press the $\mathbf{1 / Y}$ key and then ENT. To abort the operation press the $\mathbf{3 / N}$ key and then ENT. Pressing CLR is the equivalent of pressing the $\mathbf{3 / N}$ key and then ENT, aborting the operation.

If the command is confirmed the result of the operation appears on the screen. With either ENT or CLR you can accept this message and return to the OPERATIONS menu.

The MOV offers the following operations:

- Set date/time
- Communications trigger


### 8.5. SINGLE KEY OPERATION.

The MOV has a simplified operation mode which can be used by pressing the ENT key. This mode allows access to certain information about the relay without the need to remove the external methacrylate cover. Operation is by pressing the ENT key repeatedly. This mode can only be accessed from the stand-by screen. The information available in this mode is shown in order in the following table:

## Magnitude

- VA- LINE
- VB- LINE
- VC- LINE
- V-Side 1
- V- Side 2
- DIF ANGLE 521
- DIF FREQUENCY 521
- DIF ANGLE 520
- DIF FREQUENCY 520
- RELAY STATUS
- ACTIVE TABLE
- LINE 89
- 521 LINE BUSBAR
- 520 LINE BUSBAR
- DATE AND TIME


### 8.6. CONFIGURATION MENU.

The MOV has a configuration menu which can only be accessed by means of the keyboard. The aim is to select the way in which the MOV interacts with the exterior.

To enter the configuration menu, start from the stand-by screen and use the keyboard to enter a four figure code. If the code is correct, entry to the configuration unit is permitted. If not it returns to the stand-by screen.

The code is unique for all the MOV relays and is not intended to be a password, but rather a simple safety measure to avoid accidental changes to the configuration. This code is 7169, chosen to coincide with the ASCII code for the initials GE. This is how to enter the configuration unit from the stand-by screen:


The value and meaning of the settings are explained below. Note that movement between the options in this group is with the right/left arrow keys.

- NET. BAUDRATE : The speed in bauds which the MOV will use for serial communications through the remote port. The possible speeds are between 1200 and 19200 bauds.
- NET. STOP BITS : The number of stop bits which are added to each byte which is transmitted on the serial line.
- LOC. BAUDRATE : as above but for local communications.
- LOC. STOP BITS : As above but for local communications.
- LOCAL SETTINGS : Settings changes by local communications (allowed/not allowed).
- REM SETTINGS : Settings changes by remote communications (allowed/not allowed).
- LOC OPERATIONS : Operations being performed by local communications (computer directly connected) (allowed/not allowed).
- REM OPERATIONS : Operations being performed by remote communications (e.g. modem) (allowed/not allowed).
- UNIT NUMBER : Each MOV is identified by a unit number which it uses to identify the messages which are sent to it on the remote communications line. This number can be between 1 and 255.
- PASSWORD : To prevent unauthorised persons from communicating with the relay via a communications program and changing the settings or performing operations, the relay has a password. This password can only be seen on the relay display and takes the form of a number between 0 and 99999.
- t TIME-OUT : Set to 0 if the relay is not working in a DDS integrated system. Set to the maximum time between two synch signals coming from the PC host, when the relay is working in a DDS integrated system. If a new synch signal is not received in this time the relay will report an error.

DIMENSIONES EN mm.
DIMENSIONS IN mm.

FIGURE 1. PANEL MOUNTING DIAGRAM (226B6086H10).


FIGURE 2. FRONT VIEW (226B7412H9)


FIGURE 3. EXTERNAL CONNECTIONS (189C4129 H1)


FIGURE 4. RS232 CONNECTION (MOV WITH PC)


FIGURE 5. RS232 CONNECTION (MOV WITH MODEM)


FIGURE 6. REAR VIEW (226B7412H10)


FIGURE 7. DIMENSIONS DIAGRAM (226B6086H10)

