GE Power Management

# MRC Series 1000

## DIGITAL PROTECTION RELAY FOR THERMAL IMAGING OVERLOADS

GENERAL ELECTRIC

DIGITAL PROTECTION RELAY FOR
THERMAL IMAGING OVERLOADS

GENERAL ELECTRIC
U.S.A.

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**FIGURE LIST**

## 1. DESCRIPTION

The MRC is a digital microprocessor based relay that provides nondirectional overcurrent thermal protection functions and is used to protect against line overloads.

The functions performed by the MRC are:

Thermal protection, through thermal image of the line currents (49).

Two phase overcurrent protections at fixed times of 5 and 30 minutes (51).

Instantaneous overcurrent protection (50).

Phase current measuring.

Recording of the phase currents of the last trip.

The relay has been implemented using digital technology and is enclosed in a 1/3 standard rack case of 19" wide by 4 units high.

The MRC has three tripping relays, two of which have one contact normally open and the other contact normally closed, and the other relay with a contact that is normally open. It is provided with two contacts (NA + NC) for a temperature pre-alarm, both are electrically insulated, and feature the same characteristics as the tripping contacts. It also contains an NC contact as a device alarm.

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

**Should you wish to receive additional information, or for any particular problem which cannot be solved by referring to the information contained herein, please write to:**

**GENERAL ELECTRIC (USA) PROTECTION AND CONTROL EQUIPMENT S.A.**

## 2. TYPE LIST

Data required for completely defining a model are indicated in the framed table. Please state clearly your characteristics together with the precise type identification.

| Indicate | CT Phase |
|---|---|
| 0 | 5 |
| 1 | 1 |

MRC10 ___ 1A000 ___ 00

| Indicate | Auxiliary voltage |
|---|---|
| G | 48/125 VAC/VDC |
| H | 110/240 VDC<br>110/220 VAC |

## 3. CHARACTERISTICS

### 3.1. General characteristics

- Accuracy, reliability, and low consumption

- Flush mounting

- LED's for indicating pick-up, trip, and system ready

- Highly legible 7 segment display

- Sealed anti-shock, fire resistant plastic cover which allows resetting of the indicators from the exterior.

- Highly reliable solid state components

- Digital microprocessor based system

### 3.2. Technical Specifications

Rated frequency: 50 Hz to 60 Hz

Rated Current: In = 1 A or 5 A

Auxiliary Voltage: 48 to 125 VDC / AC, 110 to 250 VDC / AC (two models)

Consumption: Less than 1.5 W at all voltages

Temperature:
Effective range: 23 ° F to 105 ° F (-5 ° C to 40 ° C)
Operating range: 14 °F to 131 °F (-10 °C to 55 °C)
Storage range: -40 °F to 149 °F (-40 °C to 65 °C)

Thermal capacity:
Continuous: 2 x In
During 3 sec: 50 x In
During 1 sec: 100 x In

Ambient Humidity: Up to 95% without dew condensation

Trip contacts:
Make and carry: 3000 W resistive, for 0.2 s with a maximum of 30 A and 300 VDC.
Break: 50 W resistive, with a maximum of 2 A and 300 V DC.
Carry continuously: 5 A.

Alarm contacts:
Make and carry: 5 A DC during 30 s and a maximum of 250 VDC.
Break: 25 W inductive, and a maximum of 250 VDC.
Carry continuously: 3 A.

Type tests

Insulation test:

2 kV 50 / 60 Hz for 1 minute (IEC 255-5).

Impulse test:

5 kV peak , 1.2 / 50 μs, 0.5 J (IEC 255-5).

Interference test:

2.5 kV common mode , 1 kV differential mode, class III (IEC 255-22-1).

Electrostatic discharge:

Class III (IEC 255-22-2).

Radiointerference:

Class III (IEC 255-22-3).

Fast transient:

Class III (IEC 255-22-4).

| | | |
|---|---|---|
| Accuracy: | Operating value: | 5% |
| | Operating time: | 5% or 25 ms (whichever is greater). |
| Repeatability: | Operating value: | 1% |
| | Operating time: | 2% or 25 ms (whichever is greater). |
| Approximate weights: | - Net: | 8.8 lbs (4 kg) |
| | - Packaged: | 11 lbs (5 kg) |

### 3.3. Settings ranges

*Tap currents (Is)*

From 0.55 to 1.30 x In in steps of 0.05 x In.

*Thermal image unit*

Time constant ($\tau 1$): From 1 to 20 minutes in 3 minute steps.

Cooling time constant ($\tau 2$): 1 - 6 times the time constant ($\tau 1$).

*Unit timed at 5 minutes*

From 2 to 4 times the tap (Is) in steps of 0.05 x Is.
Disabled by setting to zero.

*Unit timed at 30 minutes*

From 2 to 4 times the tap (Is) in steps of 0.05 x Is.
Disabled by setting to zero.

*Instantaneous unit*

From 3 to 6 times the tap (Is) in steps of 0.05 x Is.
Disabled by setting to zero.

# 4. OPERATING PRINCIPLES

## 4.1. Inputs

The current transformers of the protected circuit produce a secondary current which is applied the relay input and reduced by internal current transformers. The secondary currents of the internal transformers are connected to input resistances which provide a voltage that represents the input current to the relay.

This voltage is filtered before arriving at the multiplexer and the micrcontroller internal analog to digital converter where the measurement is performed.

## 4.2. Measurement

The microcontroller internal timer generates an interrupt every 0.625 milliseconds so that 32 interrupts are generated for each cycle.

Measurement of the phases is performed during each of these interrupts. The measurements may be positive or negative. The average maximum of the positive and the negative is calculated, eliminating any possible offset of the measuring circuits. Using this value, we refer to a table to obtain the phase current in a value times the set tap.

Two consecutive measurements are performed to improve the accuracy in obtaining this value. The first is performed using a determined voltage reference from the internal converter and depending on the value that is obtained the reference is changed and the second measurement is performed. This second measurement is the one that is actually used by the system. In this manner we take better advantage of the dynamic range of the analog to digital converter and therefore the accuracy is greater.

## 4.3. Thermal Protection

The MRC protection system, as mentioned earlier, provides thermal protection by means of the thermal image obtained from the line current.

The value of the efficient current of the three phases is continually calculated (see equation below) and the greatest of these values is used to calculate the thermal image. The maximum current of the three phases is processed by a thermal image algorithm to find the equivalent temperature in each instant. When the temperature reaches a limit value a trip is produced and the trip LED on the front panel of the relay illuminates.

$$t = \tau 1 \ \ln \left( I^2 / I^2 - 1 \right)$$

The MRC F1 reading shows the percentage ratio between the temperature at a given moment and the limit value. This limit is the temperature at which the system would be stabilized applying a symmetrical three-phase current system of the same modulus as the tap current. Please see section KEYPAD AND DISPLAY for the description of the reading details.

The time constants can be set between 3 and 60 minutes, in 3 minute steps. Operating times for time constants greater than 3 minutes are obtained by multiplying $\tau$ by the corresponding factor. Thus, for example, the times for $\tau = 6$ will be 2 times those corresponding to $\tau = 3$.

When the current disappears the temperature starts to drop in accordance with the cooling constant which is equivalent to the heating constant multiplied by a set value between 1 and 6.

Figure 1 shows the operation time as a function of the equivalent thermal current of the thermal image curve for a time constant of 30 minutes.

This unit may not be disabled.

Once a trip has been produced, the trip output remains active until the temperature falls below 80% of the trip limit.

### 4.4. Timing Units

The MRC has two fixed time timing units, one at 5 minutes and the other at 30 minutes.

The times the tap reading is measurement is compared with the tap set by the user, and if it is exceeded the red PICK-UP LED on the front panel of the relay will illuminate. Once the corresponding time has passed (5 or 30 minutes depending on the unit) the TRIP LED illuminates.

The minimum current to activate the timing unit will never be less than the set value (Is) nor greater than this value by 10%.

$$1.0 \text{ Is} \leq \text{Imin} \leq 1.1 \text{ Is}$$

The return percentage is not less than 95% of the value that produced the operation.

These units can be disabled by setting a zero in the corresponding settings (please see section KEYPAD AND DISPLAY).

### 4.5. Instantaneous Unit

The instantaneous unit follows two actuation criteria:

- The unit operates if the measured instantaneous current is greater than two times the efficient current set by the user.

- The unit operates if the measured efficient current is greater than the efficient current set by the user.

The PICK-UP and TRIP LED's will illuminate in either of these two cases.

The trip level can be set by the user to a value between 3 and 6 times the tap.

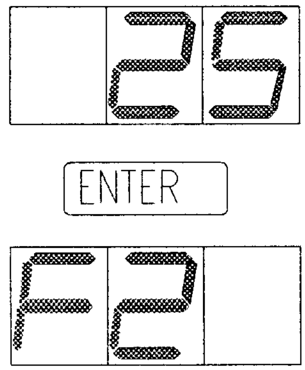
This unit can be disabled by setting a zero in the corresponding setting (please see section KEYPAD AND DISPLAY).

### 4.6. Keypad and Display

#### 4.6.1. Readings Sequence

This is the MRC fundamental sequence and the MRC automatically sets itself to this sequence when starting. It is divided into a series of "Functions", each corresponding to different information. These functions are numbered from 0 to 8 and are identified by the letter "F" followed by a function number.

In normal operation, the MRC generally displays the value of the thermal image expressed as a percentage of the tripping limit; if, for example, we assume that the thermal image unit value is 25% of the tripping limit value, the number 25 will be shown on the display. If at this moment we press **ENTER** and maintain the push-button pressed in, the letter "F" will appear followed by a number, in this case 2.

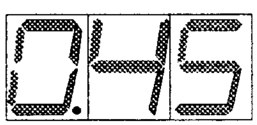



As long as the push-button is pressed in, this code will remain on the display.

This indicates that we are in the readings sequence, and upon releasing the **ENTER** key the value for function 2 (Phase A current) will be displayed.

This is the general guideline for the Readings Sequence: the code that is shown while we press and hold **ENTER** corresponds to what appears on the display when it is released. Let us assume that we already have released **ENTER**. Then we will see value of the Pase A current expressed in times the tap current, constantly updated. So, if a current 0.45 times the tap current flows, the following is displayed:

If **ENTER** is pressed again, F3 will be shown, which is the code of the next reading, and upon releasing it the value of F3 corresponding to the Phase B current; if we keep pressing and releasing the **ENTER** key, all readings up to 8 will be successively shown. After this reading, it will cycle to 0.

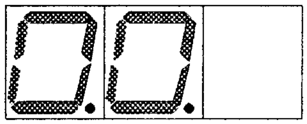



The MRC readings are:

F0 : Relay status.
F1 : Thermal image expressed as a percentage of the tripping value.
F2 : Phase A current.
F3 : Phase B current.
F4 : Phase C current.
F5 : Code of the unit that has tripped.
F6 : Phase A current that flowed when the trip occurred.
F7 : Phase B current that flowed when the trip occurred.
F8 : Phase C current that flowed when the trip occurred.

A detailed description of the readings follows:

**F0: Relay status**




The MRC status is given by a two-digit code which is shown on the left of the display. For distinguishing this code from other readings, the two corresponding decimal points are lit. So, a 00 (everything O.K.) status will be shown as:

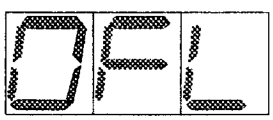
The MRC status codes are as follows:

00 : Everything O.K.
01 : Settings failure. The stored settings are incorrect.
80 : ROM failure. The program memory has failed.
81 : EEPROM write failure.

Errors with a zero as the first digit can be corrected by the user. Errors with an eight as the first digit indicate relay electronic system failures and require the MRC unit to be repaired. The error resetting procedures will be discussed when explaining the **RESET** operation.

**F1: Thermal image**

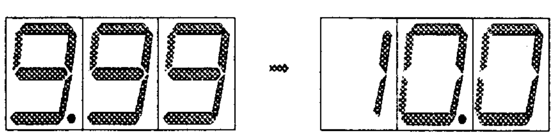
This reading will provide us the calculated value of the thermal image as a percentage relative to the trip value. When this value reaches 100 the relay will trip. As the display is capable of displaying three digits, it can display any value up to 999. If the thermal image calculation reaches 1000%, thus exceeding the display capacity, the message OFL (Overflow) will be displayed:




This message does not mean that the thermal image internal value does not keep increasing, it only means that the display is not longer able to show it. When current stops flowing across the line, the value will have to decrease again to 999 before the "OFL" message disappears.

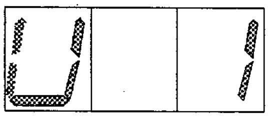
When the thermal image internal representation is greater than the space for storing it, its value no longer increases, but it remains blocked until the normal current stops flowing and cooling begins. For every Time Constant of the thermal curve, this point represents a different percentage of the tripping limit, because each Time Constant has a different limit. In all cases, this value lies well over 100%, so that this blocking will not have any effect on normal operating conditions. Only when tests are carried out, where the tripping relay action does not interrupt the current, the Thermal Image may reach it's internal limit. For a Time Constant of 600 minutes, the value at which the Thermal Image will block is 182%. For the rest of the Time Constants the percentage is proportionally greater.

**F2: Phase A current**




This reading shows the Phase A current expressed in times the tap current (xIs). The representation is made with a variable accuracy, where the number of decimal figures that are shown depends on the reading value. For example, see the change from 9.99 to 10.00 times the tap current.

**F3: Phase B current**



This reading shows the Phase B Current expressed in times the tap current (xIs). The representation is made with a variable accuracy, where the number of decimal figures that are shown depends on the reading value.

**F4: Phase C current**

This reading shows the Phase C Current expressed in times the tap current (xIs). The representation is made with a variable accuracy, where the number of decimal figures that are shown depends on the reading value.

**F5: Unit code of the last trip**

This reading shows the code of the unit that has caused the last trip. When more than one unit has caused the trip the first one that caused it will be recorded.

For example, let us see how this reading will be shown by the tripping caused by unit 1 (Thermal Image):

As shown in the figure on the left, the U (unit) character is shown, the center digit is blank and the right one shows the code of the unit that has caused the trip. Should there be no recorded unit, this code will be a zero. This information is preserved even if the relay auxiliary voltage is removed, and it can be deleted by the user.

The trip unit codes correspond to the settings codes (please see KEYPAD AND DISPLAY).

**F6: Phase A current of the last trip**

This reading shows the Phase A Current when the last trip occurred, expressed in times the tap current (xIs). The representation is the same as F2. This information is preserved, even if the relay auxiliary voltage is removed, and it can be deleted by the user.

**F7: Phase B current of the last trip**

This reading shows the Phase B Current when the last trip occurred, expressed in times the tap current (xIs). The representation is the same as F3. This information is preserved, even if the relay auxiliary voltage is removed, and it can be deleted by the user.

**F8: Phase C current of the last trip**

This reading shows the Phase C Current when the last trip occurred, expressed in times the tap current (xIs). The representation is the same as F4. This information is preserved, even if the relay auxiliary voltage is removed, and it can be deleted by the user.

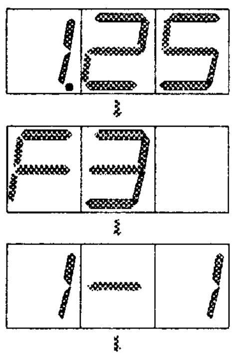
The default reading is the one that the MRC normally shows on the display. This reading is F1 (Thermal image). When voltage is applied to the relay, the default reading is shown on the display and the display returns automatically to this reading from any point in the Readings or Settings Sequences if two minutes elapse without pressing any key.

<u>4.6.2. Settings Sequence</u>

The Settings Sequence is the relay state in which the settings of the different MRC units can be changed, as well as enable or disable those units which permit enabling and disabling. The

If, at any point in the Settings Sequence, two minutes elapse without pressing any key, the MRC will return to the Readings Sequence and within it to the default reading.

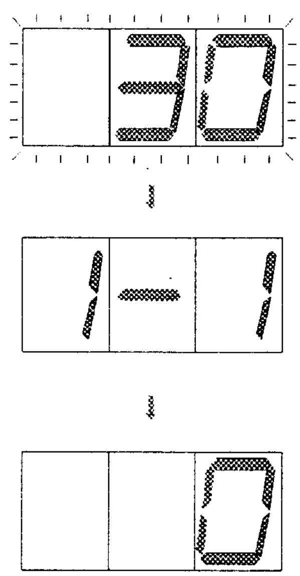
In order to enter the Settings Sequence, we must be in the Readings Sequence; it makes no difference at which point in the sequence we are. The input is carried out by **pressing the "-" key while holding down the ENTER key**. Let us see this operation in detail, assuming we are in F2 and the Phase A current value, which is 1.25 times the tap current is being shown.



The display shows the Phase A current value, 1.25 times the tap current. Now we press and hold **ENTER**. Then the code for the next function, F3, will appear. The Settings sequence can be entered from any other function in exactly the same way.

While pressing and holding down **ENTER** we press the "-" key. The display changes and the reading (1-1) appears. This is what we always see whenever we enter the Settings Sequence. The number to the left shows the unit and the number to the right the setting. Thus, (1-1) means Unit 1 - Setting 1; unit 1 is the Thermal Image and the setting 1 is the time constant.

If we want to view or change this setting value, we press **ENTER** without holding it down) and we see the current setting value, which we will assume to be 30. The setting value will blink. Whenever a setting value is shown on the display it will blink.



Before we go on, it is useful to give a complete list of MRC units and settings. So let us exit the Settings Sequence.

For this purpose, first we press again (and release) **ENTER**. This causes the setting code (1-1) to be shown again on the display. **To return to the Reading Sequences the "+" and "-" are pressed simultaneously**; the sequence order in which they are pressed does not matter, as long as both are pressed at the same time. This takes us again to the Readings Sequence, but not to the same point where we entered. Whenever we exit the Setting Sequence we will return to the normal relay status, that is, the default reading. We have assumed that the Thermal image has a value of zero.

The MRC consists of four protection units, namely:

*Unit 1: Thermal Image*

| | |
|---|---|
| 1-1 τ1 | Minutes |
| 1-2 τ2 | Times τ1 |

*Unit 2: 5 minute fixed time unit*

| | |
|---|---|
| 2-1 Pick-up value | Times tap value (xIs) |

*Unit 3: 30 minute fixed time unit*

| | |
|---|---|
| 3-1 Pick-up value | Times tap value (xIs) |

*Unit 4: Instantaneous*

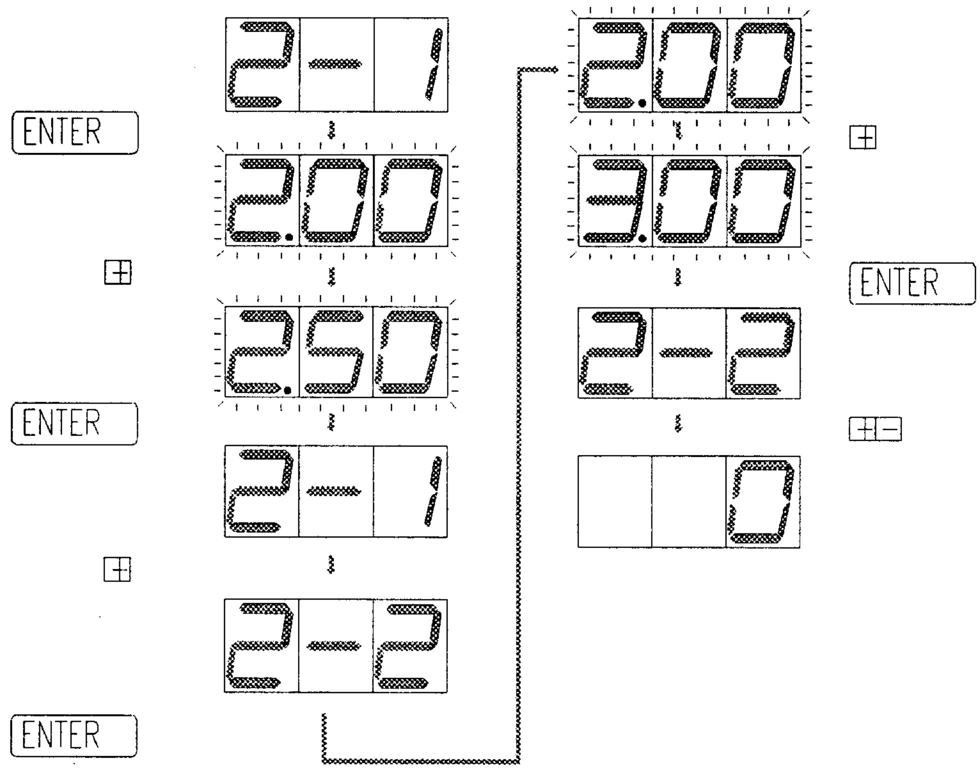
| | |
|---|---|
| 4-1 Pick-up value | Times tap value (xIs) |

For a detailed description of the unit range and operation, please see the section on OPERATING PRINCIPLES.

Now that all of the units have been listed, it is time to carry out a real settings change. As an example we will program the 30 minute timing unit to 2.5 x Is and the instantaneous unit to 4.75 x Is.

We will enter the Settings Sequence using the procedure that has been explained, and then the code 1-1 will be shown. Our example requires that we change settings 3-1 and 4-1. To access these settings, press repeatedly the "+" and "-" keys until the desired code is shown on the display, in this case 3-1. The settings selection is cycled, so that when "+" is pressed when the last setting is currently shown on the display, it is cycled to the first setting and vice versa, if "-" is pressed when the first setting is on the display, it is cycled back to the last one.

Once the 3-1 setting is on the display, press **ENTER** and the setting value will blink. Let us assume it is 2.00 times the tap. For changing it to 2.5 press the "+" key until the desired value appears on the display. For acknowledging this data, press **ENTER** and the code 3-1 will again be shown. In this way the 3-1 setting value has changed from 2.00 to 2.50. The flow diagram of this operation is shown below.




This process is the same for any settings that is to be changed. Select the setting code that is to be changed. When the code appears on the display, press **ENTER**. Then the current setting value will be shown on the display. Using the "+" and "-" keys the setting value can be increased or decreased until the desired value appears on the display. At this moment press **ENTER** and the new setting value will be accepted.

If on the display the maximum permissible value for that setting is shown, pressing "+" will have no effect. The same will occur if the minimum permissible value for this setting is shown and the "-" key is pressed.

If the "+" or "-" key is pressed and held down, the setting value increases or decreases automatically five times per second. To avoid undesired repetitions of the pressed key, note that the first repetition occurs after half a second.

This mechanism only works when changing the setting value and not when selecting the setting code. For this operation, the "+" or "-" keys must be pressed and released for every code increase or decrease.

We have assumed that the original value for setting 4-1 was 3.30 x Is. Had it been different, it would have been sufficient to press the "+" and "-" keys until selecting the desired value and then pressing **ENTER**.

After changing a setting value, it is updated when **ENTER** is pressed for accepting the change. When a setting is changed, the corresponding unit is completely reset. The rest of the units are not affected by the change and keep working normally. However, when **ENTER** is pressed, all protections are "frozen" in the status in which they are for the time it takes to process a new setting (between 0.08 and 0.1 seconds). Once the corresponding unit has been reset, all of them are restarted.

If the setting value has not been changed, the unit is not reset, even if the "+" and "-" keys have been pressed.

The resetting of the unit where the adjustments have been changed is completed, including the deletion of a pick-up or trip should they have occurred.

### 4.6.3. Zeroing of the Thermal Image Unit

For zeroing the thermal image we must be in the Readings Sequence. At any point in this sequence, we press **ENTER**. The corresponding reading code will be shown on the display. While holding down **ENTER** we press the "+" key at the same time. The thermal image returns to 0 and the MRC goes back to the basic status, showing the default reading value on the display.

### 4.6.4. Resetting the MRC

The reset operation is carried out, from the Readings Sequence by pressing and holding **ENTER** for three seconds. The effects of these operations are different, depending on whether the MRC is operating normally or is in an error state.

MRC in normal operation:

The MRC returns to the default reading, the TRIP LED is switched off and the currents of the last trip are deleted, except if the trip output is active at that moment. In such a case, the only effect that RESET has is returning to the default reading.

MRC in error situation:

When the MRC detects a malfunction during its operation, the corresponding error code blinks on the display, the measurement is turned off, the READY LED is switched off and the DEVICE ALARM output is actuated. If a RESET occurs under these conditions, the relay will completely reinitialize the software, thus allowing the operation to be restarted if the error causes have disappeared.

A detailed description of the error codes and their meanings follows:

**01 - Setting error**

When starting the program, the MRC loads the EEPROM setting values. If the stored settings do not pass any of the controls to which they are subject, a setting error occurs. This error can be fixed by the user by reprogramming all of the relay settings.

The programming of settings after an error has occurred is identical to the procedures explained in this section, except for the fact that the settings values are random values. If one setting value is not valid, when pressing **ENTER** for accepting it, nothing will occur; the setting is not accepted until it is valid. For converting the setting to a valid value, press and hold "+" or "-" until the setting no longer changes. When this occurs, program the desired value using the normal procedure.

Once all settings have been reviewed, the MRC is restarted by pressing **RESET**.

**80 - ROM failure**

The program memory contents have deteriorated. It must be replaced.

**81 - EEPROM written error**

The non-volatile memory has deteriorated and it can no longer store the settings. It must be replaced.

# 5. CONSTRUCTION

## 5.1. Case

The MRC case is made of plated steel. The general dimensions are shown in figure 5.

The front cover is made of plastic, and can be fitted to the relay case by pressing on a rubber gasket located around the relay, which produces a dust-proof seal.

## 5.2. Electrical and Internal Connections

Connection of the external wires is carried out at the two terminal blocks mounted on the rear panel of the case. Each terminal block contains 12 screw terminals, each of 4 mm screwed diameter.

All current inputs are located on a terminal block, which is located on the back, on the same back plate. This block has the capability of supporting the current transformer's secondary currents. The internal current input wires have a greater cross-section than the rest of the internal connection wires. They have been designed so that they have the minimum possible length to minimize the resistive load supported by the current transformers. The connections are produced through snap-on terminals. The input current wires run in their own harnesses, separated from the rest of the wire harnesses so that the magnetic field coupling effects associated with the input currents on the weak current internal wires can be minimized.

## 5.3. Identification

The complete relay type data is stated on the name plate. Figure 2 shows the MRC front plate.

The terminal blocks are identified by characters located on the back plate, just over each block left edge (with the relay viewed from behind). There are three terminal blocks in each box and each has a single code (from A to C) to avoid confusion when connecting the external wires.

At each terminal block, the coupling screws (1 to 12) are marked with engraved numbers.

## 5.4. MRC Front Panel Control

The following setting and signaling elements are situated on the front panel of the MRC (as shown in figure 2):

Current tap select switch

This element selects the minimum relay operating current. It consists of 2 banks of two switches each, each of which have a number marked on the right side. The switches are open when they are positioned to the left and closed when they are positioned to the right side. The tap current at which the relay is set (Is) will be the product of the rated phase current (In) times 0.55 plus the addition of the amounts written to the right side of each closed switch.

Example: setting a relay of In = 5 A for an Is of 4. 5A. For this purpose, and given that 5 x 0.9 = 4.5, we must close the necessary switches for obtaining an amount of 0.35, which, added to the fixed amount of 0.55, will give us 0.9; we will get this by closing the switches marked 0.2, 0.1, and 0.05 and opening the one marked 0.4.

The current range is:

Is from 0.55 to 1.3 x In in 0.05 x In steps.

Push buttons and display

The MRC is provided with three push buttons for controlling all relay operations. It is also provided with three luminous seven-segment displays for providing information to the user. A detailed description of the operation of these elements is given in the section KEYPAD AND DISPLAY.

### 5.5. External Signals

The MRC is provided with three light-emitting diodes (LED's) on the relay front plate for signaling the following conditions:

- READY. Green LED which indicates that the relay is in operation.
- PICK-UP. Red LED that indicates that a pick-up in one of the protection units has been produced.
- TRIP. Red LED that indicates that a protection unit has tripped. This LED remains lit until it is switched off by the user through a RESET (please see the KEYPAD AND DISPLAY); if the relay auxiliary voltage is switched off, when it returns, the LED will change to the status it had before the voltage was switched off.

## 6. RECEIVING, HANDLING, AND STORAGE

This relay is supplied to the customer in a special package, which adequately protects it during transportation, as long as this is performed in normal conditions.

Immediately after receiving the relay, the customer should check whether it shows any signs of transportation damage. If it is apparent that the relay has been damaged by inappropriate handling, it must be immediately advised in writing to the carrier, and the damage must be reported to the manufacturer.

For unpacking the relay, normal care should be taken in order not to lose the screws also supplied in the box.

If the relay is not to be installed immediately, it is recommended to store it in its original package, and keep it in a dry and dust-free place.

## 7. ACCEPTANCE TESTS

Upon receipt, it is recommended to carry out an immediate visual check, as well as the tests that are described below, in order to make sure that the relay has not been damaged during transportation.

These tests can be carried out as installation or acceptance tests, at the user's discretion. Since most users apply different procedures for installation and acceptance tests, this section will indicate all tests that can be performed on the MRC.

If the tests that have been carried out show that the relay does not function correctly, it must be reported to the manufacturer. Because of its digital design, the MRC does not require any calibration changes.

### 7.1. Visual Inspection

Make sure that the model indicated on the front plate matches the order data.

Unpack the relay and make sure that there are no broken parts and there are no signs that the relay has been damaged during transportation.

### 7.2. General Considerations about the Power Supply Network

All devices powered by alternating current are affected by the frequency. Because a non-sine wave is the result of a fundamental wave and a series of harmonics belonging to this fundamental wave, the devices that are powered by alternating current are affected by the form of the wave applied.

To correctly test relays that operate on alternating current it is necessary to use a voltage and / or current sine wave. The purity of a sine wave (absence of harmonics) cannot be expressed specifically for any given relay. However, in any relay that includes tuned circuits, circuits R-L and R-C or non-linear elements (such as inverse time overcurrent relays) are affected by the non-sine waves.

These relays respond to the voltage wave form differently from the majority of alternating current voltmeters. If the AC source used for the test contains many harmonics, the voltmeter and relay readings will be different.

The relays are calibrated in the factory using a network of 50 or 60 Hz containing a minimum amount of harmonics. When testing the relay, you should use an AC source whose waveform does not contain harmonics.

The voltmeters and stop watches used to perform the trip tests and operating time tests must be calibrated and their precision should be better than that of the relay. The network power used in the tests must remain stable, mainly in the levels near the pick-up voltage.

It is important to stress that the precision used in the tests depends on the network power and the instruments used. Operating tests performed with inadequate power and instruments are useful to test that the relay operates correctly and that it's characteristics are verified approximately. However, if the relay is calibrated under these conditions, it's operating characteristics may be outside the tolerance levels.

### 7.3. Thermal Image Unit

Proceed with the following steps:

Connect the relay as shown in figure 4. For supplying power to the relay, a 127 or 220 V - 50 Hz or 120 V - 60 Hz power supply with a serial variable resistor must be used.

Disable the rest of the units in order to avoid any interference when testing. To do this, zero the settings 2-1, 3-1, 4-1 following the procedure explained in the section KEYPAD AND DISPLAY.

Set the relay tap to the minimum tap. To do this, refer to figure 2 which shows the relay front panel:

Position all tap selection switches to the left.

Set the time constant $\tau 1$ to 30 minutes (setting 1-1).

Successively apply currents of 2, 5 and 10 times the minimum tap value and make sure that the operating times are within the ranges shown in Table 1. Make sure that the output relay operates and the TRIP LED lights.

**TABLE 1**

| Rated current (A) | Applied current (A) | Ieq (times Is) | Operating time (s) |
|---|---|---|---|
| 5 | 10 | 2 | 485.0 - 536 |
| | 25 | 5 | 70.6 - 78 |
| | 50 | 10 | 17.7 - 19.5 |

After each measurement you must reset the thermal image (please see "Zeroing of the Thermal Image" in the section KEYPAD AND DISPLAY).

### 7.4. Timing Units

Proceed with the following steps:

Connect the relay as shown in figure 4. For supplying power to the relay, a 127 or 220 V - 50 Hz or 120 V - 60 Hz power supply with a serial variable resistor must be used.

Disable the rest of the units in order to avoid any interference when testing. To do this, zero the settings 2-1 or 3-1 (depending on which timing you are going to test) following the procedure explained in the section KEYPAD AND DISPLAY. Set the thermal image to 600 (setting 1-1) so that it does not have time to trip before the timing units.

Set the relay tap to the minimum tap. To do this, refer to figure 2 which shows the relay front panel:

Position all tap selection switches to the left.

Set the tested timing unit to any value (setting 2-1 or 3-1).

Apply currents greater than that of the set value. Make sure that the relay picks up between 100 and 110% of the set value. Check that the actuation times are 5 or 30 minutes depending on the unit being tested. Make sure that the output relay operates and the TRIP LED lights.

### 7.5. Instantaneous Units

Connect the relay as shown in figure 4. For supplying power to the relay, a 127 or 220 V - 50 Hz or 120 V - 60 Hz power supply with a serial variable resistor must be used.

Disable the rest of the units in order to avoid any interference when testing. To do this, zero the settings 2-1 and 3-1 following the procedure explained in the section KEYPAD AND DISPLAY. Any value for the thermal image can be set.

Set the relay tap to the minimum tap. To do this, refer to figure 2 which shows the relay front panel:

Position all tap selection switches to the left.

Set the instantaneous unit to any value (setting 4-1).

Apply current. Make sure that the relay trips when the current reaches the set value. Make sure that the output relay operates and the **TRIP LED** lights.

## 8. PERIODIC TESTS AND MAINTENANCE

Given the primary role that protection relays have in any installation, it is recommended that a periodic test program be followed. Given that the intervals between these tests vary for different types of relays and installations as well as the experience of the user performing the tests, it is recommended that the points described in the section INSTALLATION are checked at intervals of 1 to 2 years.

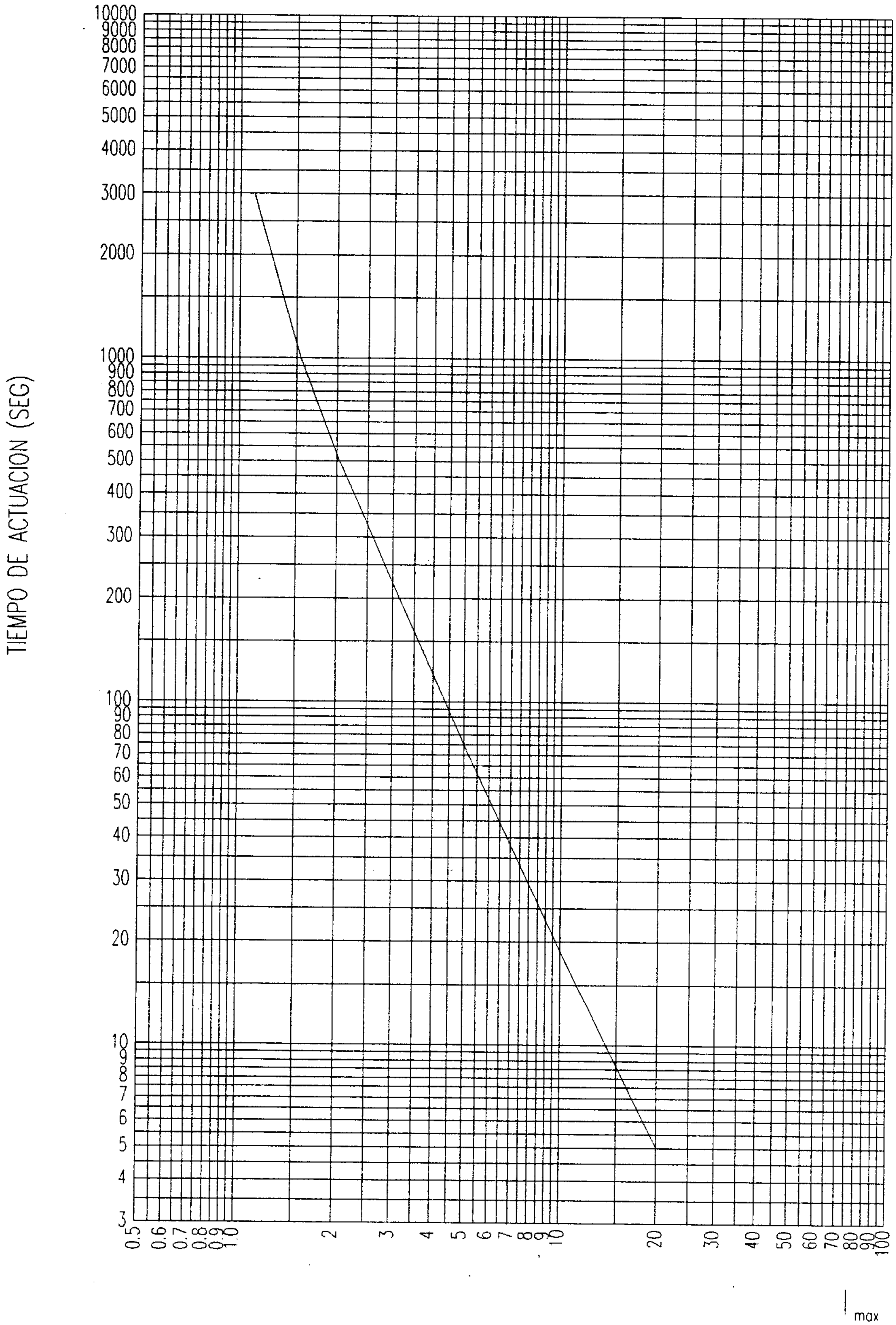



Fig. 1. MRC Thermal Curve for $\tau_1$ = 30 minutos.

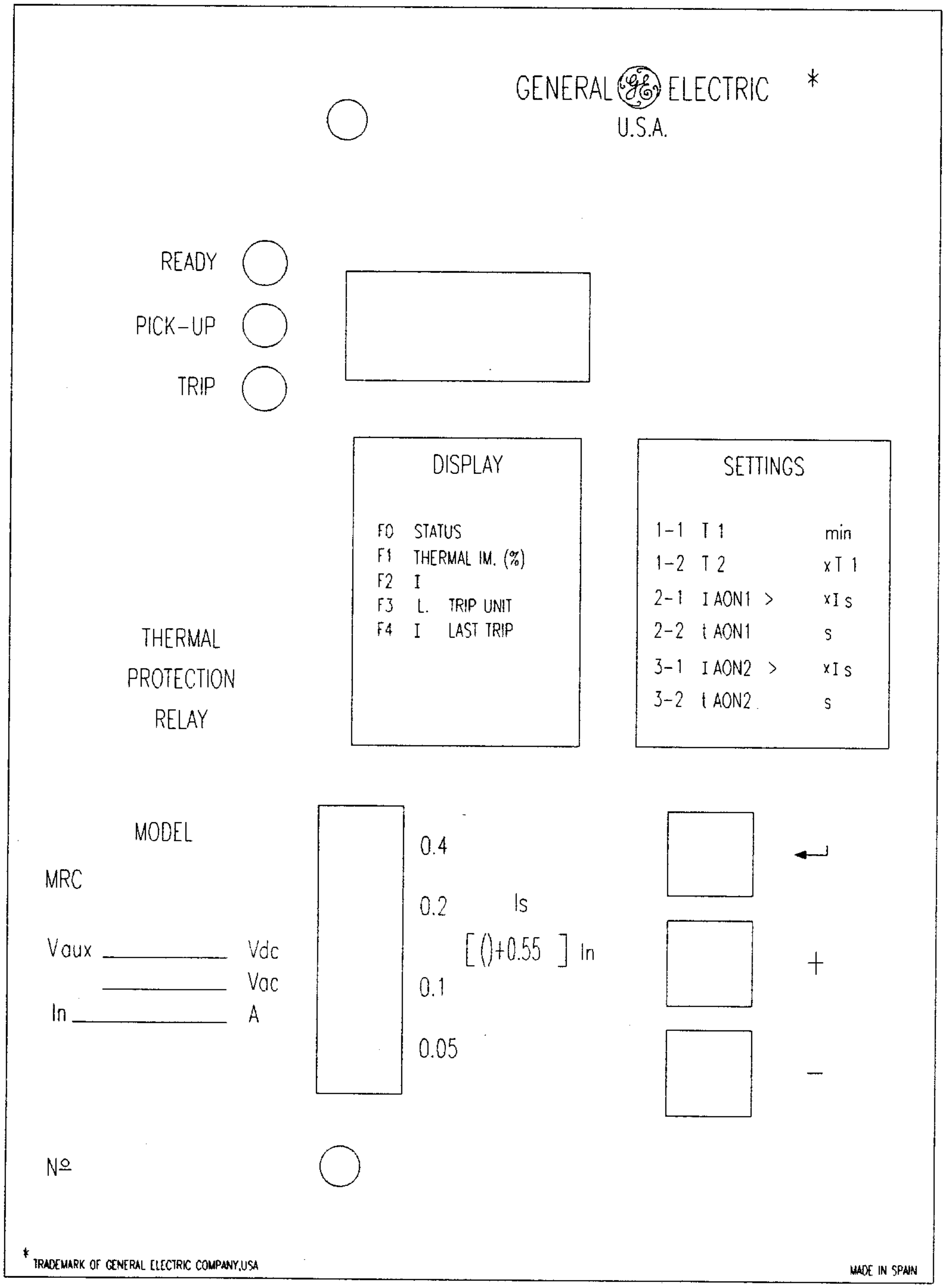



Fig. 2. MRC 2000 Front Plate.

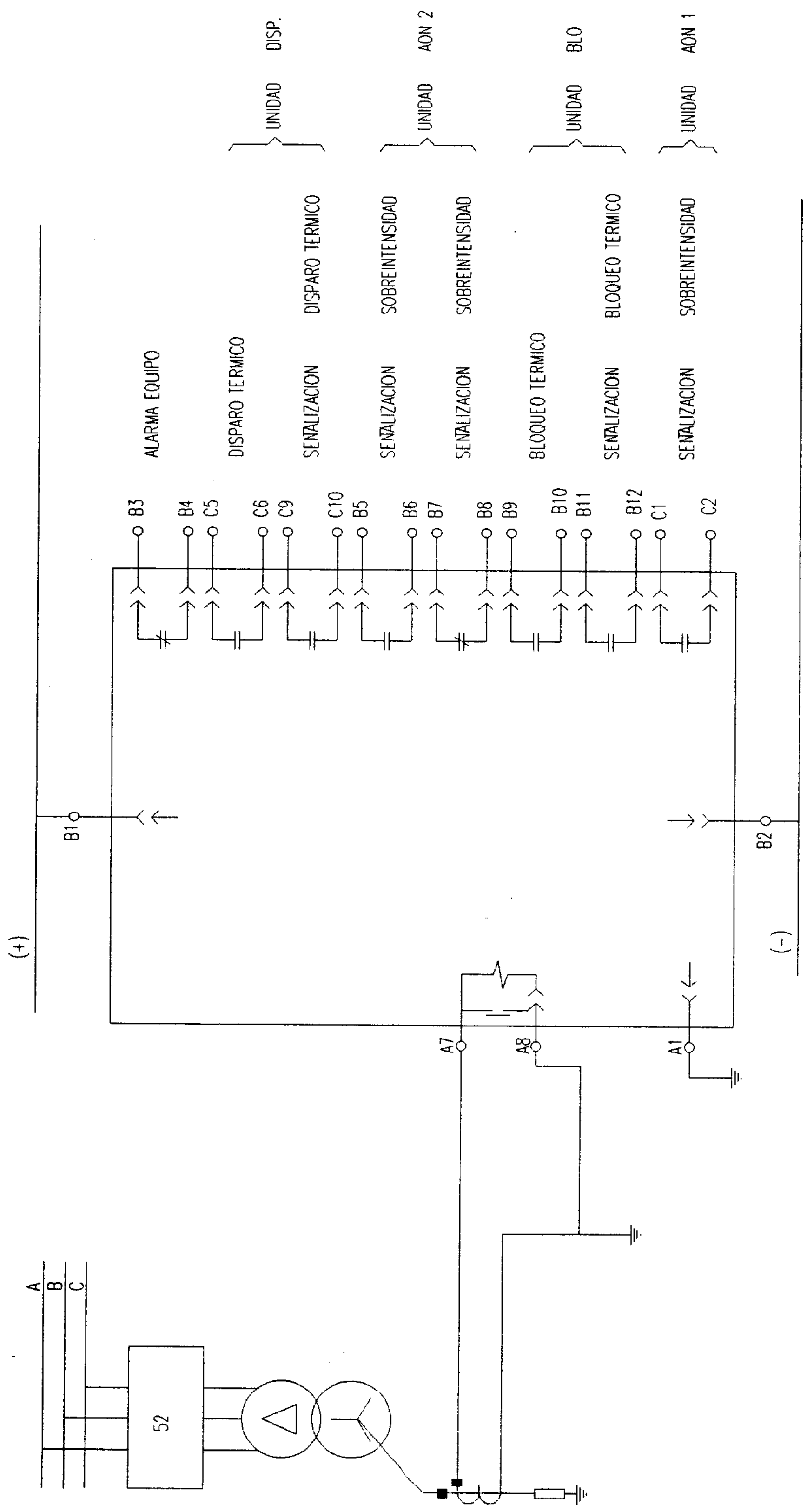
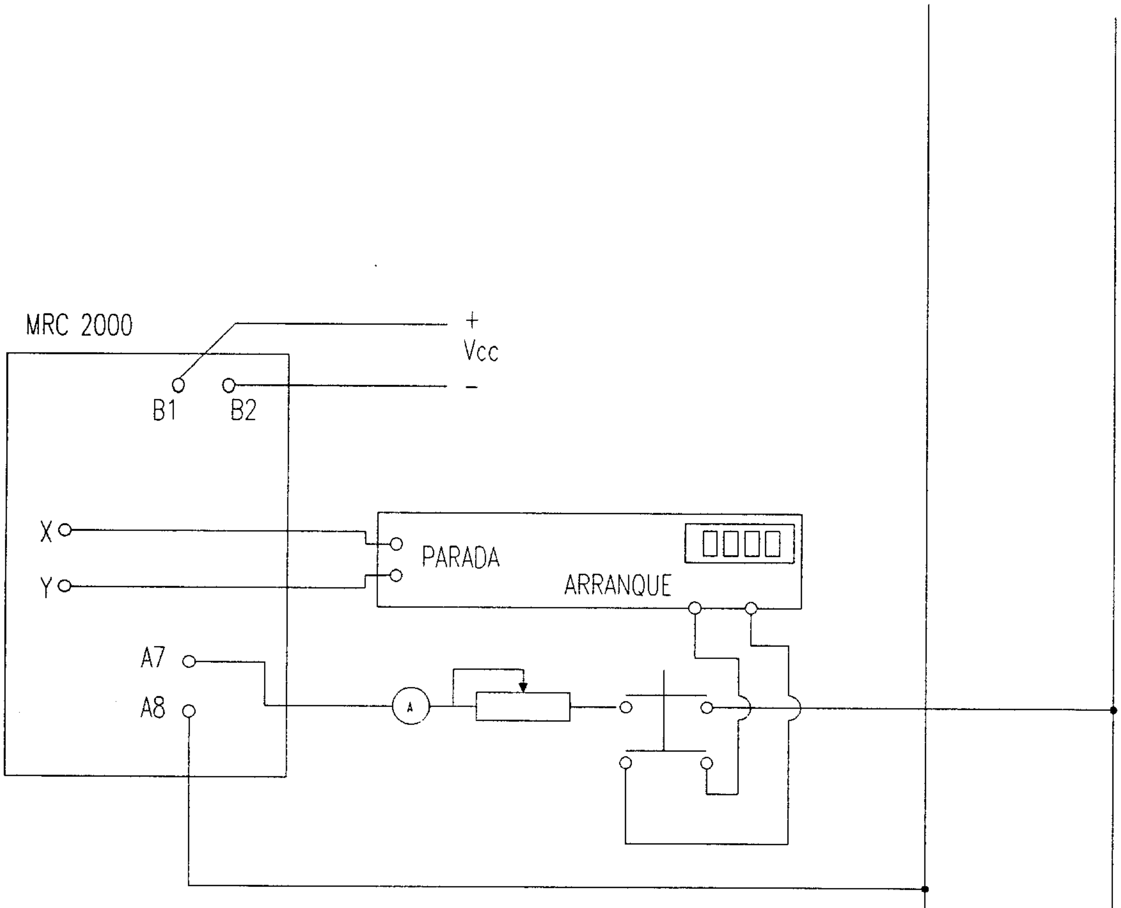



Fig. 3. MRC 2000 External Connections.




| | X | Y |
|---|---|---|
| IMAGEN TERMICA – DISP | C5 | C6 |
| ALARMA TERMICA – BLO | B9 | B10 |
| 50/51 – AON 1 | C1 | C2 |
| 50/51 – AON 2 | B5 | B6 |

Fig. 4. MRC Testing Connections.

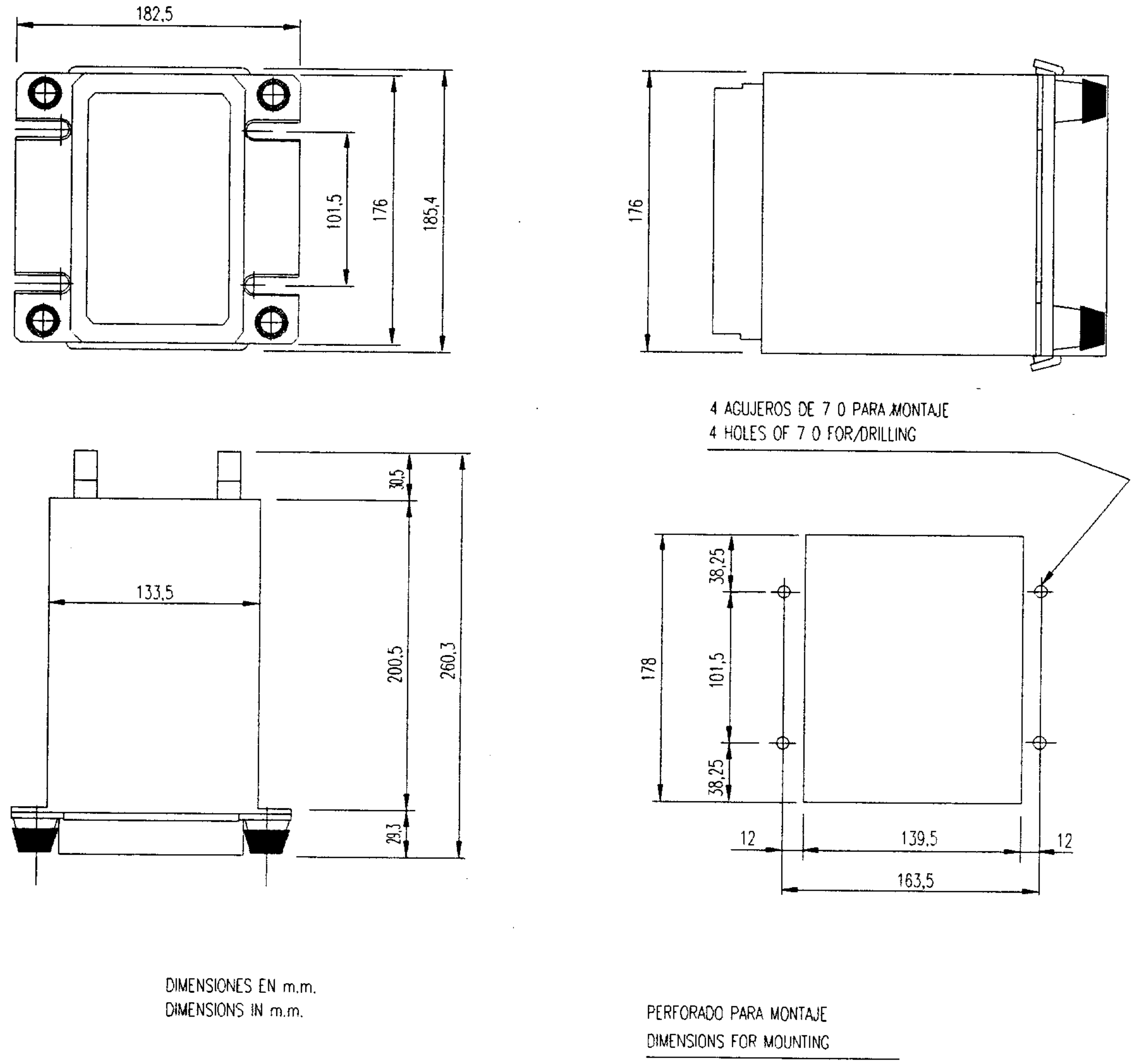



Fig. 5. MRC Dimensions.

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