0831106 Rev.0

Calibration procedure

TFS

INSTRUMENT CALIBRATION PROCEDURES

1 GENERAL GUIDELINES FOR CALIBRATION

For an accurate calibration it is necessary to proceed as follows:
a) - The instrument under calibration should be mounted in its case in order to keep the internal temperature stable.
b) - The ambient temperature should be stable. Avoid any drift due to air-conditioning or others.
c) - The relative humidity should not exceed 70%.
d) - The instrument must be in ON condition from 20 minutes at least.
e) - Operate, possibly, in an environment with no electromagnetic disturbances.
f) - During calibration, connect to the instrument one input at a time.
g) - Before to execute each calibration, be sure that the specific hardware setting has been made (see "Preliminary hardware setting" paragraph).

For this calibration procedure it is necessary to use calibrators with the following accuracy and resolution:

ACCURACY
1) For current input: ± 0.025% output ± 0.0025% range ± 0.01 µA
2) For voltage input : + 0.005% output + 0.001% range + 5 µV
3) For TC input: + 0.005% output + 0.001% range + 5 µV
4) For RTD input: ± 0.02 % ± 0.0025 Ω/decade.
5) For cold junction compensation: better than 0.1 °C

RESOLUTION
1) For current input: 0.5 µA
2) For voltage input: 100 µV
3) For TC input: 1 µV
4) For RTD input: 10 mΩ
5) For cold junction compensation: better than 0.1 °C

2 PRELIMINARY HARDWARE SETTINGS

INPUT TYPE SELECTION
1) Remove the instrument from its case.
2) Set J1according to the desired input type.
3) Set the dip switch V1to the open condition (see fig. 1).
4) Re-insert the instrument in its case.

Input	J1				
Type	1-2	3-4	5-6	7-8	9-10
TC-RTD	open	close	open	open	open
60 mV	open	close	open	open	open
5 V	close	open	close	open	open
10 V	open	open	close	open	open
20 mA	open	open	open	close	close

NOTE: the not used jumper can be placed on pin 7-9

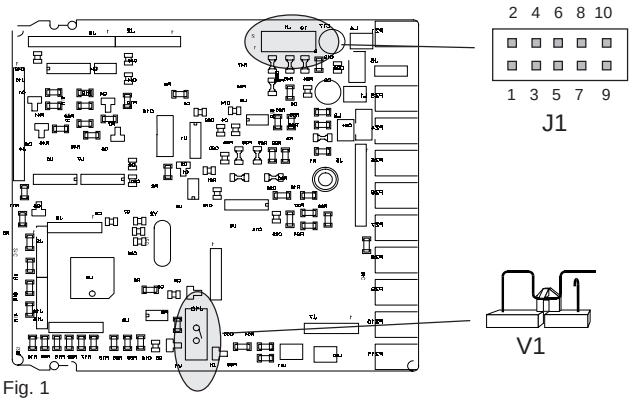


Fig. 1

3 CALIBRATION PROCEDURE

3.1 FOREWORD
Calibration parameters are divided in groups.
Each group is comprised of two parameters (initial and full scale values) plus a specific calibration check.
Follows a complete list of the "calibration groups" is reported.
A) TC input
B) Cold junction
C) RTD input
D) Linear mA input
E) Linear 5 V input
F) Linear 10 V input
G) Current transformer input calibration
H) Default calibration data loading

3.2 HOW TO PROCEED
1) Switch on the instrument the display will show "CONF".
2) Push the ▲ pushbutton, the upper display will show "CAL" while the lower display is blank.
3) Push the FUNC pushbutton to display the first calibration group on the lower display. Depress FUNC pushbutton more times until the desired calibration group is reached.

GENERAL NOTES ABOUT CALIBRATION PROCEDURE:
1) During calibration procedure, when the initial or full scale value of a group is selected and the upper display shows "OFF", pushing the FUNC pushbutton the instrument will jump to the next parameter for checking **without to modify** the previous calibration setting.
In this way it is possible to recalibrate only the desired input or output.
It is also possibe to make a check of one or more calibration group without to remake the specific calibration.
Pushing the MAN pushbutton it is possible to scroll back through the calibration parameters without to memorize the setting.

2) During calibration procedure the serial communication interface and the time out will be disabled.

A) TC INPUT CALIBRATION

A.1) "tL" - INITIAL SCALE VALUE
The lower display will show "tL" while the upper display will show "OFF"
1) Make the specific hardware setting as described at paragraph 2.
2) Connect the instrument under test to the calibrator as shown in Fig. 2.

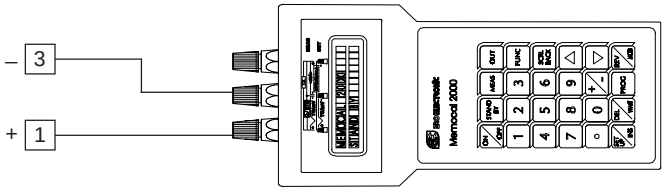
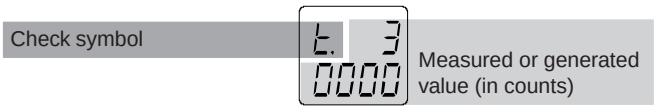


Fig.2

3) Set calibrator to 0.000 mV.
4) Push ▲ or ▼ pushbutton, the upper display will change to "On".
5) After few seconds, start the calibration by pushing the FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

A.2) "tH" - FINAL SCALE VALUE
The lower display will show "tH" while "OFF" is shown on the upper display.
1) Set the calibrator to 60.000 mV (see Fig. 2).
2) Push ▲ or ▼ pushbutton, the upper display will change to "On".
3) After few seconds, start calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

A.3) "t." - TC INPUT CHECK
The upper display show "t." followed by the measured value in counts as shown in the following figure:



The "tH" calibration is correct if the indication is equal to "t. 3 0000" ± 10 counts.
1) Check the zero calibration, by setting the calibrator to 0.000 mV, the read-out must be equal to "t. 0 0000" ± 10 counts.
2) Check the half scale linearity by setting the calibrator to 30.000 mV. The read-out must be "t. 1 5000" ± 10 counts.
NOTE: when it is desired to use a different check point, the following formula describes the ratio between the signal input and the instrument read-out (in counts).

$$\text{Instrument readout (in counts)} = \frac{\text{input value}}{60\ (\text{mV})} \bullet 30000$$

3) Push FUNC pushbutton, the instrument will go to the next calibration group.

B) COLD JUNCTION CALIBRATION
NOTE: make sure that "tL" and "tH" parameters are correctly calibrated before to calibrate "rJ" parameter.

B.1) rJ - ACTUAL VALUE
The lower display will show "rJ" while the upper display will show "OFF"
1) Measure the temperature close to terminals 1 and 3 using a calibrator, for instance, the MEMOCAL (see Fig. 3).

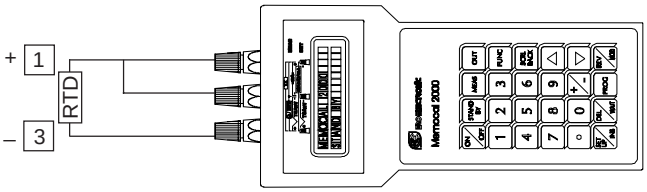


Fig. 3

2) Wait for a few minutes to allow the temperature stabilisation of the entire system (sensor, calibrator and instrument).
The first pressure of ▲ or ▼ push-button allows to show on the upper display a read-out value.
3) Using ▲ or ▼ push-button, set a read-out value equal to the temperature measured by the measuring device (in C° and tenths of °C).
4) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

B.2) "rJ" - COLD JUNCTION COMPENSATION CHECK
The upper display will show "rJ." while the lower display will show the measured cold junction temperature (in C° and tenths of °C).
1) Make sure that the cold junction temperature measured by the instrument is equal to the value measured by the measuring device (MEMOCAL).
2) Push FUNC pushbutton, the instrument will go to the next calibration group.

C) RTD INPUT CALIBRATION
NOTE: make sure that "tL", "tH" and "rJ" parameters are correctly calibrated before to calibrate this parameter group.

C.1) "PL" - INITIAL SCALE VALUE
The lower display will show "PL" while the upper display will show "OFF"
1) Make the specific hardware setting as described at paragraph 2.
2) Make a short circuit among the 1, 3 and 4 terminals as shown in Fig. 4.

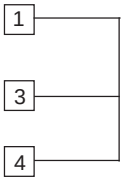


Fig.4

3) Push ▲ or ▼ pushbutton, the upper display will change to "On".
4) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.
5) Remove the short circuit from the 1, 3 and 4 terminals.

C.2) "PH" - FINAL SCALE VALUE
The lower display will show "PH" while the upper display will show "OFF"
1) Connect the instrument under test to the calibrator as shown in Fig. 5.

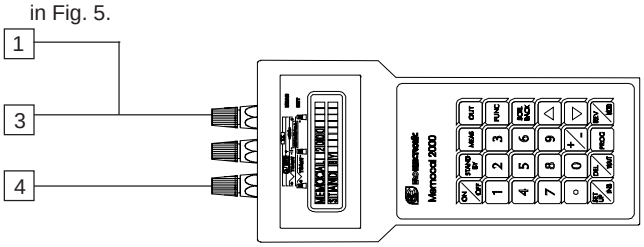


Fig.5

2) Set the calibrator to 375.00 Ω.
3) Push ▲or ▼ pushbutton, the upper display will change to "On".
4) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

C.3) "P." - RTD INPUT CHECK
The upper and lower display show "P." followed by the measured value in counts.

The "PH" calibration is correct if the indication is equal to "P. 3 0000" ± 10 counts.

1) Check the zero calibration, by making the short circuit as described at point C.1, the read-out must be equal to "P. 0 0000" ± 10 counts.
2) Remove the short circuit.
3) Connect the calibrator as shown in Fig. 7.
4) Check the linearity by setting the calibrator to 125.00 Ω. The read-out must be "P. 1 0190" ± 10 counts.
5) Set the calibrator to 250.00 Ω. The read-out must be "P. 2 0189" ± 10 counts.
6) Push FUNC pushbutton, the instrument will go to the next calibration group.

D) mA INPUT CALIBRATION

D.1) "nAL" - INITIAL SCALE VALUE

The lower display will show "nAL" while the upper display will show "OFF"

1) Make the specific hardware setting as described at paragraph 2.
2) Connect the instrument under test to the calibrator as shown in Fig. 6.

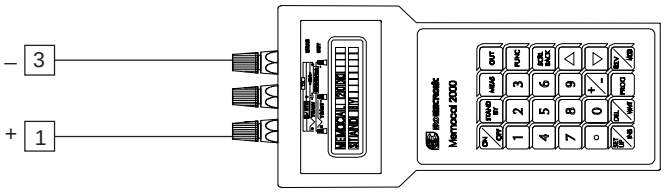


Fig. 6

3) Set calibrator to 0.000 mA.
4) Push ▲or ▼ pushbutton, the upper display will change to "On".
5) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

D.2) "nAH" - FINAL SCALE VALUE

The lower display will show "nAH" while the upper display will show "OFF"

1) Set the calibrator to 20.000 mA.
2) Push ▲ or ▼ pushbutton, the upper display will change to "On".
3) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

D.3) "nA." - mA INPUT CHECK

The upper and lower show "nA." followed by the measured value in counts.

The "nAH" calibration is correct if the indication is equal to "nA. 3 0000" ± 10 counts.

1) Check the zero calibration, by setting the calibrator to 0.000 mA, the read-out must be equal to "nA. 0 0000" ± 10 counts.
2) Check the linearity by setting the calibrator to 10.000 mA , the read-out must be "nA. 1 5000" ± 10 counts.
   NOTE: when it is desired to use a different check point, the following formula describes the ratio between the signal input and the instrument read-out (in counts).

$$\text{Instrument readout (in counts)} = \frac{\text{input value}}{20\ (\text{mA})} \bullet 30000$$

3) Push FUNC pushbutton, the instrument will go to the next calibration group.

E) 5 V INPUT CALIBRATION

E.1) "5UL" - INITIAL SCALE VALUE

The lower display will show "5UL" while the upper display will show "OFF"

1) Make the specific hardware setting as described at paragraph 2.
2) Connect the instrument under test to the calibrator as shown in Fig. 7.

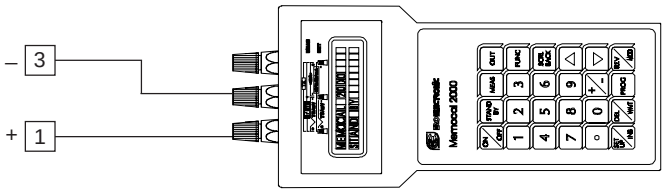


Fig.7

3) Set calibrator to 0.000 V.
4) Push ▲ or ▼ pushbutton, the upper display will change to "On".
5) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

E.2) "5UH" - FINAL SCALE VALUE

The lower display will show "5UH" while the upper display will show "OFF"

1) Set the calibrator to 5.000 V.
2) Push ▲ or ▼ pushbutton, the upper display will change to "On".
3) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

E.3) "5U." - 5 V INPUT CHECK

The upper and the lower displays show "5U." followed by the measured value in counts.

The "5UH" calibration is correct if the indication is equal to "5U. 3 0000" ± 10 counts.

1) Check the zero calibration, by setting the calibrator to 0.0000 V, the read-out must be equal to "5U. 0 0000" ± 10 counts.
2) Check the linearity by setting the calibrator to 2.500 V The read-out must be "5U. 1 5000" ± 10 counts.
   NOTE: when it is desired to use a different check point, the following formula describes the ratio between the signal input and the instrument read-out (in counts).

$$\text{Instrument readout (in counts)} = \frac{\text{input value}}{5\ (\text{V})} \bullet 30000$$

3) Push FUNC pushbutton, the instrument will go to the next calibration group.

F) 10 V INPUT CALIBRATION

F.1) "10UL" - INITIAL SCALE VALUE

The lower display will show "10UL" while the upper display will show "OFF"

1) Make the specific hardware setting as described at paragraph 2.
2) Connect the instrument under test to the calibrator as shown in Fig. 8.

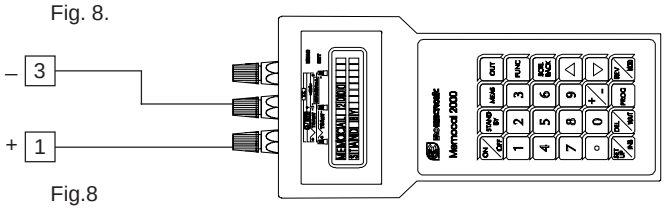
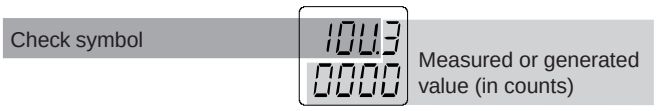


Fig.8

3) Set calibrator to 0.000 V.
4) Push ▲ or ▼ pushbutton, the upper display will change to "On".
5) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

F.2) "10UH" - FINAL SCALE VALUE
The lower display will show "10UH" while the upper display will show "OFF"
1) Set the calibrator to 10.000 V.
2) Push ▲ or ▼ pushbutton, the upper display will change to "On".
3) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

F.3) "10U." - 10 V INPUT CHECK
The upper and the lower displays show "10U." followed by the measured value in counts.



The "10U." calibration is correct if the indication is equal to "10U.3 0000" ± 10 counts.
1) Check the zero calibration, by setting the calibrator to 0.000 V, the read-out must be equal to "10U.0 0000" ± 10 counts.
2) Check the linearity by setting the calibrator to 5.000 V The read-out must be "10U.1 5000" ± 10 counts.
NOTE: when it is desired to use a different check point, the following formula describes the ratio between the signal input and the instrument read-out (in counts).

$$\text{Instrument readout (in counts)} = \frac{\text{input value}}{10\ (\text{V})} \bullet 30000$$

3) Push FUNC pushbutton, the instrument will go to the next calibration group.

G) CURRENT TRANSFORMER INPUT CALIBRATION

G.1) "ct.L" - INITIAL SCALE VALUE
The lower display will show "ct.L" while the upper display will show "OFF"
1) Made the specific hardware setting as described at paragraph 2.
2) Connect the instrument under test to the calibrator as shown in Fig. 9.

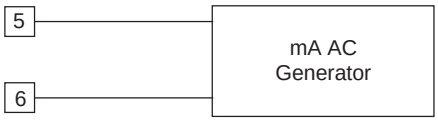


Fig.9

3) Set calibrator to 0.00 mA AC.
4) Push ▲ or ▼ pushbutton, the upper display will change to "On".
5) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

G.2) "ct.H" - FINAL SCALE VALUE
The lower display will show "ct.H" while the upper display will show "OFF"
1) Set the calibrator to 50.00 mA AC.
2) Push ▲ or ▼ pushbutton, the upper display will change to "On".
3) After a few seconds, start the calibration by pushing FUNC pushbutton. At the end of this calibration routine, the instrument will go to the next step.

G.3) "ct." - CURRENT TRANSFORMER INPUT CHECK
The upper and the lower displays show "Ct." followed by the measured value in counts.

The "ct.H" calibration is correct if the indication is equal to "ct. 0 1000" ± 10 counts.
1) Check the zero calibration, by setting the calibrator to 0.00 mA AC, the read-out must be equal to "ct. 0 0000" ± 10 counts.
2) Check the linearity by setting the calibrator to 25.00 mA AC. The read-out must be "ct. 0 0500" ± 10 counts.
NOTE: when it is desired to use a different check point, the following formula describes the ratio between the signal input and the instrument read-out (in counts).

$$\text{Instrument readout (in counts)} = \frac{\text{input value}}{50\ (\text{mA AC})} \bullet 1000$$

3) Push FUNC pushbutton, the instrument will go to the next calibration group.

H) DEFAULT CALIBRATION PARAMETER LOADING.

A complete and consistent set of calibration parameters is memorized in the instrument. These data are theoretical data and are used only to clear all calibration memory but after a default calibration data loading it is necessary to make **all** calibrations.

When is desired to clear all calibration memory proceed as follows:
a) The upper display will show "CAL" while the lower display is blank.
b) Push the▼ push-button, the lower display will show the firmware version.
c) Push and keep depressed the ▼ push-button again and push the ▲ push-button, the lower display will show "dFLt".
d) Push ▲ or ▼ pushbutton, the upper display will change to "On".
e) Push the FUNC push-button, the upper display will show:

LOAd

Then the upper display will show CAL again and the default calibration parameter loading procedure is ended.

WARNING: After default calibration data loading, it is necessary to remake **all** instrument calibrations.

Ero Electronic S.r.l.
Via E. Mattei, 21
28100 Novara
Italy
Tel. (+39) 0321 481111
Fax. (+39) 0321 481112

Specifications subjected to change without notice