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For a good 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 constant.
- 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) - Minimum warm-up time must be 20 minutes.
- e) - Operate possibly in a noise free environment.
- f) - During calibration, connect one input at a time and supply the input signal when the group is enabled only.

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

### ACCURACY

- 1) For TC, mV or V input:  $\pm 0.005\%$  output  $\pm 0.001\%$  range  $\pm 5 \mu\text{V}$
- 2) For current input:  $\pm 0.025\%$  output  $\pm 0.0025\%$  range  $\pm 0.01 \mu\text{A}$
- 3) For RTD input:  $\pm 0.02\%$   $\pm 0.0025 \Omega/\text{decade}$ .
- 4) For Cold junction compensation: better than  $0.1 \text{ }^\circ\text{C}$

### RESOLUTION

- 1) For TC, mV input:  $1 \mu\text{V}$
- 2) For current input:  $0.2 \mu\text{A}$
- 3) For RTD input:  $10 \text{ m}\Omega$
- 4) For cold junction compensation: better than  $0.1 \text{ }^\circ\text{C}$
- 5) For V input :  $100 \mu\text{V}$

## 5.3 CALIBRATION PROCEDURE

### 5.3.1 FOREWORD

During calibration procedure the instrument will show CL and CH parameters if analog retransmission is selected only.

For frequency input type, no calibration procedures are provided.

**NOTE:** Calibration parameters are logically divided in groups of two parameters each (initial and final scale value).

After each group the calibration check is provided but it is also possible to do it without a new calibration is made.

When calibration check is required only, press twice the F pushbutton when "OFF" is shown on the display. The instrument goes directly to the specific group check.

The alphanumeric display will show the parameter code (C - ) while the numerical display will show "ON" or "OFF".

Using ▲ and ▼ pushbuttons it is possible to select between "ON" or "OFF".

To go to the next parameter without modify the calibration, push F pushbutton when the display is showing "OFF" .

To set parameter calibration, push F pushbutton when the display show "ON".

**NOTE:** Pushing R pushbutton it is possible to go back to the previous parameter without modify the calibration.

### 5.3.2 CALIBRATION PROCEDURE

All the instruments are originally calibrated by means of calibrators with high accuracy and resolution (see para. 5.2).

The instrument are calibrated for inputs and output specifies in ordering code only (see para. 1.4).

When the display shows "CAL" it is possible to load the default parameter as detailed in section 6

Follows a list of calibration symbols:

Code	Parameter
C 0	- Current input minimum range value (0 mA)
C 1	- Current input maximum range value (20 mA)
C 2	- Voltage input minimum range value ( 0 V)
C 3	- Voltage input maximum range value ( 5 V)
C 4	- Voltage input minimum range value ( 0 V)
C 5	- Voltage input maximum range value (10 V)
C 6	- TC, mV input minimum range value ( 0 mV)
C 7	- TC, mV input maximum range value ( 60 mV)
C 8	- RTD input minimum range value ( 0 $\Omega$ )
C 9	- RTD input maximum range value ( 500 $\Omega$ )
C J	- Cold junction compensation
C L	- Analog retransmission minimum range value
C H	- Analog retransmission maximum range value

**NOTE:** apply only appropriate input signal when calibration or checking code are displayed .

## HOW TO PROCEED

Push the F pushbutton to visualize the first calibration symbol on the display. Depress, in sequence, F pushbutton until the desired calibration symbol is reached.

### C 0 - CURRENT INPUT MINIMUM RANGE VALUE

- Connect the instrument to the calibrator as shown in Fig. 5.2.
- Set 0.000 mA DC on the calibrator (even if the minimum range value is 4 mA).  
The display will show "OFF".  
Depress ▲ pushbutton to enable the calibration; then the display will switch to "ON".
- Wait few seconds, until the measurement has stabilized.
- Push the F pushbutton; the numerical displays will blank and only the decimal point of the right hand figure of the numerical display will be lit. When the calibration is completed the instrument will go automatically to the next parameter.

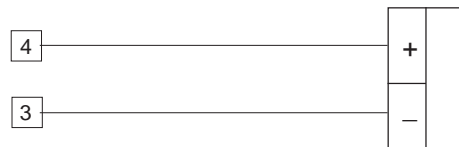


Fig. 5.2

### C 1 - CURRENT INPUT MAXIMUM RANGE VALUE.

- Set 20,000 mA on the calibrator (see Fig. 5.2).
- Push ▲ pushbutton, the display will show "ON" and "C 1" will remain on the alphanumerical display.
- Wait few seconds then push F pushbutton.
- The numerical displays will blank temporarily to show that the instrument is performing the calibration routine.

### CURRENT INPUT CHECK

- The instrument will show "A" preceded by a number showing the measured value in counts.  
Set 20.000 mA on the calibrator, if C 1 calibration is correct the indication will be "25000A"  $\pm 10$  counts.
- Check the zero calibration by resetting the calibrator to 0.000 mA.  
The resulting indication should give "00000A"  $\pm 10$  counts.  
Check the linearity by setting the calibrator to 10.000 mA; the readout must be "12500A"  $\pm 10$  counts.
- Push F for the next calibration

### C 2 - 0 - 5 V INPUT MINIMUM RANGE VALUE

- a) Connect the instrument to the calibrator as shown in Fig. 5.3.
- b) Set 0.000 V DC on the calibrator (even if the minimum range value is 1 V).  
The display will show "OFF".  
Depress ▲ pushbutton to enable the calibration; then the display will switch to "ON".
- c) Wait few seconds, until the measurement has stabilized.
- d) Push the F pushbutton; the numerical displays will blank and only the decimal point of the right hand figure of the numerical display will be lit. When the calibration is completed the instrument will go automatically to the next parameter.

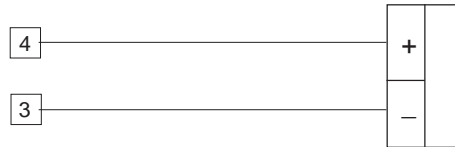


Fig. 5.3

### C 3 - 0 - 5 V INPUT MAXIMUM RANGE VALUE.

- a) Set 5,000 V on the calibrator (see Fig. 5.3).
- b) Push ▲ pushbutton, the display will show "ON" and "C 3" will remain on the alphanumerical display.
- c) Wait few seconds then push F pushbutton.
- d) The numerical displays will blank temporarily to show that the instrument is performing the calibration routine.

### 0 - 5 V INPUT CHECK

- a) The instrument will show "B" preceded by a number showing the measured value in counts.  
Set 5.000 V on the calibrator, if C 3 calibration is correct the indication will be "25000B"  $\pm 10$  counts.
- b) Check the zero calibration by resetting the calibrator to 0.000 V.  
The resulting indication should give "00000B"  $\pm 10$  counts.  
Check the linearity by setting the calibrator to 2.500 V; the readout must be "12500B"  $\pm 10$  counts.
- c) Push F for the next calibration

#### C 4 - 0 - 10 V INPUT MINIMUM RANGE VALUE

- a) Connect the instrument to the calibrator as shown in Fig. 5.4.
- b) Set 0.000 V DC on the calibrator (even if the minimum range value is 2 V).  
The display will show "OFF".  
Depress **▲** pushbutton to enable the calibration; then the display will switch to "ON".
- c) Wait few seconds, until the measurement has stabilized.
- d) Push the F pushbutton; the numerical displays will blank and only the decimal point of the right hand figure of the numerical display will be lit. When the calibration is completed the instrument will go automatically to the next parameter.

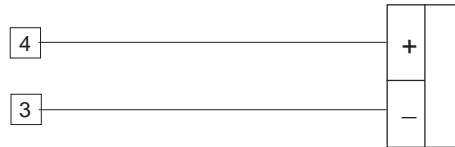


Fig. 5.4

#### C 5 - 0 - 10 V INPUT MAXIMUM RANGE VALUE.

- a) Set 10,000 V on the calibrator (see Fig. 5.4).
- b) Push **▲** pushbutton, the display will show "ON" and "C 3" will remain on the alphanumerical display.
- c) Wait few seconds then push F pushbutton.
- d) The numerical displays will blank temporarily to show that the instrument is performing the calibration routine.

#### 0 - 10 V INPUT CHECK

- a) The instrument will show "C" preceded by a number showing the measured value in counts.  
Set 10.000 V on the calibrator, if C 5 calibration is correct the indication will be "25000C"  $\pm 10$  counts.
- b) Check the zero calibration by resetting the calibrator to 0.000 V.  
The resulting indication should give "00000C"  $\pm 10$  counts.  
Check the linearity by setting the calibrator to 5.000 V; the readout must be "12500C"  $\pm 10$  counts.
- c) Push F for the next calibration

### C 6 - TC, mV INPUT MINIMUM RANGE VALUE

- a) Provide connections between calibrator and instrument under test as shown in Fig. 5.5.
- b) The numerical display will show "OFF", while "C 6" will appear on the alphanumerical display.
- c) Set calibrator to 0.000 mV. Push ▲ pushbutton, the display will change to "ON".
- d) After few seconds, start calibration by pushing F pushbutton, the display will blank and only the decimal point will appear on the display.

At the end of this calibration routine, the instrument will go to the next parameter.

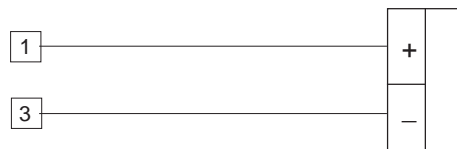


Fig. 5.5

### C 7 -TC, mV INPUT - MAXIMUM RANGE VALUE

- a) Set the calibrator to 60.000 mV (see Fig. 5.5).
- b) Push ▲ pushbutton, the displays will show "ON" and "C 7".
- c) Wait few seconds then push F pushbutton.
- d) The numerical displays will blank temporarily to show that the instrument is performing the calibration routine.

### TC INPUT CHECK

Then the display will show "D" preceded by a number showing the measured value in counts.

C7 calibration is correct if the indication is "25000 D"  $\pm$  10 counts.

- a) Check the zero calibration, by setting the calibrator to 0.000 mV, the readout must be "00000D"  $\pm$ 10 counts.
- b) Check linearity at half scale by setting 30 mV on the calibrator. The readout must be "12500D"  $\pm$ 10 counts.
- c) Push F pushbutton, and go to the next calibration.

### C 8 - RTD INPUT MINIMUM RANGE VALUE

- Connect a resistor box as shown in Fig. 5.6.
- Set 0.00  $\Omega$  on the resistor box.
- Push  $\blacktriangle$  pushbutton, then the instrument will show "ON" and "C 8".
- After few seconds, start calibration routine by pushing F pushbutton. The decimal point of least significant digit on the numerical display will light to indicate that the instrument is performing calibration. Then the displays will show "OFF" and "C 9".

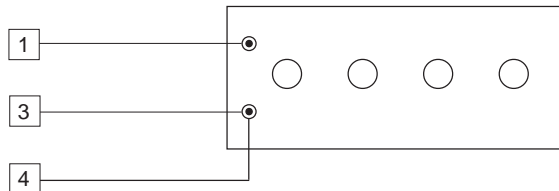


Fig. 5.6

### C 9 - RTD INPUT MAXIMUM RANGE VALUE

- Set the resistance box to 500.00  $\Omega$  (see Fig. 5.6).
- Push  $\blacktriangle$  pushbutton, the displays will show "ON" and "C 9".
- Wait few seconds then push F pushbutton.
- The numerical displays will blank temporarily to show that the instrument is performing the calibration routine.

### RTD INPUT CHECK

- The display will show "25000  $\Omega$ "  $\pm 10$  counts otherwise set the resistance box to 500.00  $\Omega$  (see Fig. 5.6)  
The C9 calibration is correct if the indication is "25000 $\Omega$ "  $\pm 10$  counts.
- Check the zero calibration by setting 0.00  $\Omega$  on the resistance box; the readout must be "00000  $\Omega$ "  $\pm 10$  counts.  
To check the half scale linearity, set the resistance box to 250.00 $\Omega$  and the readout should be "12500  $\Omega$ "  $\pm 10$  counts.
- Push F pushbutton to proceed to next calibration step.

### C J COLD JUNCTION COMPENSATION

**NOTE:** make sure that C6 and C7 parameters are correctly calibrated before CJ calibration.

- a) Measure the temperature close to terminals 1 and 3 using an appropriate instrument, for instance, a MEMOCAL.
- b) Wait a few minutes to allow the temperature stabilization of entire the system (compensation cable, sensor, calibrator and instrument).
- c) The displays will show "C J" and "25.0".

**NOTE:** This value is only a default value and it not represents the real measurement.

Using ▲ or ▼ pushbuttons, make the readout value equal to the temperature measured by the measuring device in tenth of °C. The display will show an half zero at the most significant digit to indicate the ON calibration condition.

- d) Initiate the calibration routine by pushing F pushbutton.

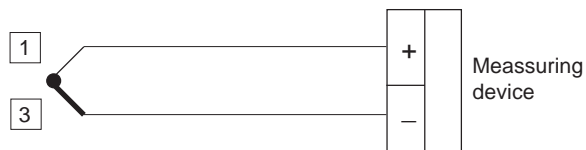


Fig. 5.7

### COLD JUNCTION COMPENSATION CHECK

The display will show "RJ" and the cold junction temperature in tenths of °C.

Make sure that the display readout is equal to the value read on the measuring device (MEMOCAL).

Push F pushbutton to proceed to next calibration step.

### C L - ANALOG RETRANSMISSION MINIMUM RANGE VALUE

- a) Connect the instrument as shown in Fig. 5.8.

- b) Set J104, J105 and J107 on the option card as follow:

Retransmission type	Jumpers		
	J104	J105	J107
Current	OPEN	CLOSED	2 - 3
Voltage	CLOSED	OPEN	1 - 2

- b) The alphanumerical display shows "C L" and the numerical display shows a number of counts.

- c) Using ▲ or ▼ pushbuttons, adjust the instrument output until 0.000mA  $\pm$  0.015 mA or 00.00V  $\pm$  0.0073 V is shown by the measuring device.

- d) Depress F pushbutton. The instrument memorizes the above value as zero.  
The display will show now "C H" which means that the instrument is ready for next calibration step.

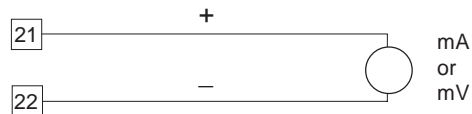


Fig. 5.8

- NOTE:** 1) The minimum value must be calibrated at 0 mA even if the output is 4 - 20 mA.  
2) For current output only, the D/A converter of the instrument is not able to generate a negative signal; therefore, during the calibration of this parameter, make the instrument to generate a positive signal (by the ▲ pushbutton), then decrease slowly the output signal (by ▼ pushbutton) until the lower value appears on the display.

#### C H - ANALOG RETRANSMISSION MAXIMUM RANGE VALUE

- a) Push ▲ and ▼ pushbuttons until the output of the instrument is  $20.000 \text{ mA} \pm 0.015 \text{ mA}$  or  $10 \text{ V} \pm 0.0075 \text{ V}$ .  
b) Memorize this calibration by pushing F pushbutton.

With this last operation the instrument returns at the beginning of the calibration routine.  
Switch off the instrument and set the dip switches according to para. 4.1.



## SECTION 6 DEFAULT PARAMETERS SETTING

### 6.1 PRELIMINARY

The instrument is delivered with a default parameters sets stored and usable, in every moment, for clear all the memories. Different parameters sets are provided for configuration, calibration and operative modes but the memorization follows the same procedure. During every particular working mode it is possible to load only the parameters of the specific mode.

### 6.2 DEFAULT PARAMETERS SETTING

Push ▲ pushbutton and, maintaining the pressure, push ▼ pushbutton. The display will show "OFF" and "dF". Pushing ▲ pushbutton, on the display will appear "ON". Push F pushbutton to start default parameters loading. During this routine the display will show "LOAD" and "dF". After loading routine the instrument will return to the initial status.

### 6.3 DEFAULT CONFIGURATION PARAMETERS

1	Power supply frequency	50 Hz
2	Input type	TC
3	TC type	K
3.a	RTD type	Pt 100 Ω
3.b	Engineering unit	°C
3.c	Burn-out	Over range
4	Linear input type	4-20 mA
4.a	Square root extraction	Disabled
4.b	Decimal point position	None
4.c	Initial scale readout	-1999
4.d	Final scale readout	9999
4.e	Engineering unit	°C
4.f	Break points number	0
4.g	Break points inputs	with 10% step
4.h	Break points readouts	with 10% step
5	Readout digital filter	0.4 s
6	NOT USED	
7	External contact function	HOLD
7.a	Contact status	Closed
8	Options	None
9	Analog retransmission type	4-20 mA

9.a	Retransmission minimum scale value	-1999
9.b	Retransmission maximum scale value	9999
9.c	Digital filter on the analog retransmission	None
10	Serial interface address	00
10.a	Baud rate	19200
10.b	Byte format	7bit + even parity
11	Alarm 1 type	High alarm with automatic reset
11.a	Alarm 1 hysteresis	0.1 %
12	Alarm 2 type	low alarm with automatic reset
12.a	Alarm 2 hysteresis	0.1 %
13	Digital filter on the alarm threshold	None
14	Safety lock	0

#### 6.4 DEFAULT CALIBRATION PARAMETERS

The default calibration parameters allow to verify the correct working of the instrument but they are not calibration parameters.

**NOTE:** After default calibration parameters loading, it is necessary to recalibrate the instrument.

#### 6.5 DEFAULT OPERATIVE PARAMETERS

Alarm 1 threshold	initial scale readout
Alarm 2 threshold	initial scale readout

## SECTION 7 ERROR MESSAGES

### 7.1 OUT OF RANGE

The instrument shows the UNDER RANGE and the OVER RANGE with the following messages on the numerical display:



OVER RANGE



UNDER RANGE

During out of range indications, alarm status, peak detection and analog retransmission operate as in presence of the range limits.

- NOTE:**
- 1) The out of range indications follow the readout scaling so that when a reverse scaling is set, over range and under range are reversed also.
  - 2) The out of range indication is shown when the input signal is 2% higher or 2% lower of the max. and min. scale values respectively.

To eliminate the OUT OF RANGE condition, proceed as follows:

- 1) Check the input signal source and the connecting line.
- 2) Make sure that the input signal is in accordance with instrument configuration. Otherwise, modify the input configuration (see chapter 3.2).
- 3) Send back the instrument to your supplier for a check.

### 7.2 OPEN INPUT CIRCUIT

This instrument is able to identify the open circuit for 4-20 mA, 1-5 V, 2-10 V, TC and RTD inputs.

The open input circuit condition is shown by "OPeN" on the numerical display.

If TC or RTD input is selected, it is possible to set, in configuration procedure, the outputs status associated to the open input condition. (see para. 3.c)

For mA and V input the instrument associates this status to under range condition .

**NOTE:** For 4 - 20 mA, 1-5 V and 2-10 V inputs, the open input circuit condition is shown when the input signal is lower than the minimum range value minus 4 % of the input span.

### 7.3 ERRORS

Diagnostics are made at instrument switch-on and during normal mode of operation.

If a fault condition (error) is detected, the display will show the message "E" followed by the relative error code.

The following is a list of possible errors in numerical order.

Also causes, instrument output conditions and possible remedies are briefly described.

Same errors reset the instrument; if the error persist, send back the instrument to your supplier

## 7.4 ERROR DESCRIPTIONS

### **E001**

The alarm threshold value are incompatible with the actual readout range or their values in memory are incorrect.  
It may appear at instrument switching on in operative mode.  
The instrument does not start to operate.  
Push contemporarily ▲ and ▼ pushbutton and force the threshold values at the initial scale value.  
Set the desired threshold values.

### **E038**

EAROM memory reading error.  
It may appear at instrument switching on in operative mode.  
The instrument does not start to operate.  
The instrument remakes this check every 2 seconds.  
If this error persists, send back the instrument to your supplier.

### **E039**

EAROM memory writing error during operative mode.  
It may appear during operative mode.  
This error message will be deleted automatically after 13 seconds.  
The new values will be enabled but they will be lost at instrument switch-off.  
Send back the instrument to your supplier.

### **E101**

Incorrect configuration data in EAROM memory.  
It may appear at instrument switching on in operative mode.  
The instrument does not start to operate.  
It remakes this check every 2 seconds.  
If this error persists, remake the configuration procedure.

### **E102**

Inconsistent configuration parameters.  
It may appear at instrument switching on in operative mode.  
The instrument does not start to operate.  
It remakes this check every 2 seconds.  
If this error persists, remake the configuration procedure.

### **E138**

EAROM reading error during configuration procedure.  
It may appear during configuration procedure.  
Push F pushbutton and restart the configuration procedure.  
If this error persists, send back the instrument to your supplier.

### **E139**

EAROM writing error during configuration procedure.  
It may appear during configuration procedure.  
Push F pushbutton and restart the configuration procedure.  
If this error persists, send back the instrument to your supplier.

**E201**

Incorrect calibration data in EARAM memory.  
It may appear at instrument switching on in operative mode.  
The instrument does not start to operate.  
It remakes this check every 2 seconds.  
If this error persists, remake the calibration procedure.

**E211/E212**

Autozero errors during calibration procedure.  
The instrument measure an internal autozero value too negative (E211) or too positive (E212).  
It may appear during calibration procedure.  
The instrument will not operate and after 6 seconds it will return to the beginning of the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E213**

Too small input span.  
It may appear during calibration procedure when the instrument checks the input calibration and detects an input span less than 450  $\mu$ A for current input or 110 mV for 5 V or 220 mV for 10 V or 1300  $\mu$ V for TC and mV input or 13  $\Omega$  for RTD input  
Push F pushbutton and remake the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E214/E215**

Could junction calibration errors.  
The instrument measures a compensation temperature less than -20 °C (E214) or higher than +70 °C (E215).  
It may appear during calibration procedure.  
Push F pushbutton and remake the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E216**

Out of range during calibration.  
The instrument detects an out of range signal or an open circuit condition during input calibration.  
The instrument shows the error message for 6 seconds then it will return to the calibration point where the error was found.  
The new calibration of this parameter will be lost, verify the input signal and redo the calibration procedure correctly.

**E217**

The instrument detects a too big difference between could junction measurement and calibration set during could junction calibration.  
The instrument shows the error message for 6 seconds then it will return to the calibration point where the error was found.  
The new calibration of this parameter will be lost.  
Verify the input signal and redo the calibration procedure correctly.

**E218**

Too big initial scale value or negative full scale value.  
It may appear during input calibration when the instrument check the input calibration and detects an initial scale value higher than 14,5 mA for current input or 3.6 V for 5 V input or 7.2 V for 10 V input or 44 mV for TC and mV input or 440  $\Omega$  for RTD input or a negative full scale value.

The instrument shows the error message for 6 seconds then it will return at the calibration point where the error was found.  
The new calibration of this parameter will be lost, verify the input signal and redo the calibration procedure correctly.

**E238**

EAROM reading error during calibration procedure.  
Push F pushbutton and restart the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E239**

EAROM writing error during calibration procedure.  
Push F pushbutton and restart the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E311/E312**

Autozero errors.  
The instrument measures an internal autozero value too negative (E311) or too positive (E312).  
It may appear during the operative mode.  
The instrument will not operate and will repeat this check 13 seconds.  
If this error persists, send back the instrument to your supplier.

**E313**

Too small input span.  
It may appear during operative mode when the instrument detect an input span less than 450  $\mu$ A for current input or 110 mV for 5 V or 220 mV for 10 V or 1300  $\mu$ V for TC input or 13  $\Omega$  for RTD input.  
Remake the calibration procedure.  
If this error persists, send back the instrument to your supplier.

**E314/E315**

Could junction measurement errors.  
The instrument measure a compensation temperature less than -20 °C (E314) or higher than +70 °C (E315).  
It may appear during the operative mode.  
Check the temperature and, if necessary, remake the calibration procedure.  
If this error persists, send back the instrument to your supplier.

#### **E401**

The instrument detects the incorrect access to a protected memory area (this error may be generated by a big noise only).  
After 2 seconds the instrument restarts automatically.  
Verify configuration and calibration parameters.

#### **E402**

This error may appear switch-on the instrument only.  
The calibration and configuration parameters are not protected.  
Go to configuration mode, select a parameter and push F pushbutton.  
Return in operative mode.  
If this error persists, send back the instrument to your supplier.

#### **E403**

The instrument detects a dip switch position changement or an incorrect access to the program memory area (this error may be generated by a big noise only).  
After 2 seconds the instrument restarts automatically.  
Verify configuration and calibration parameters.



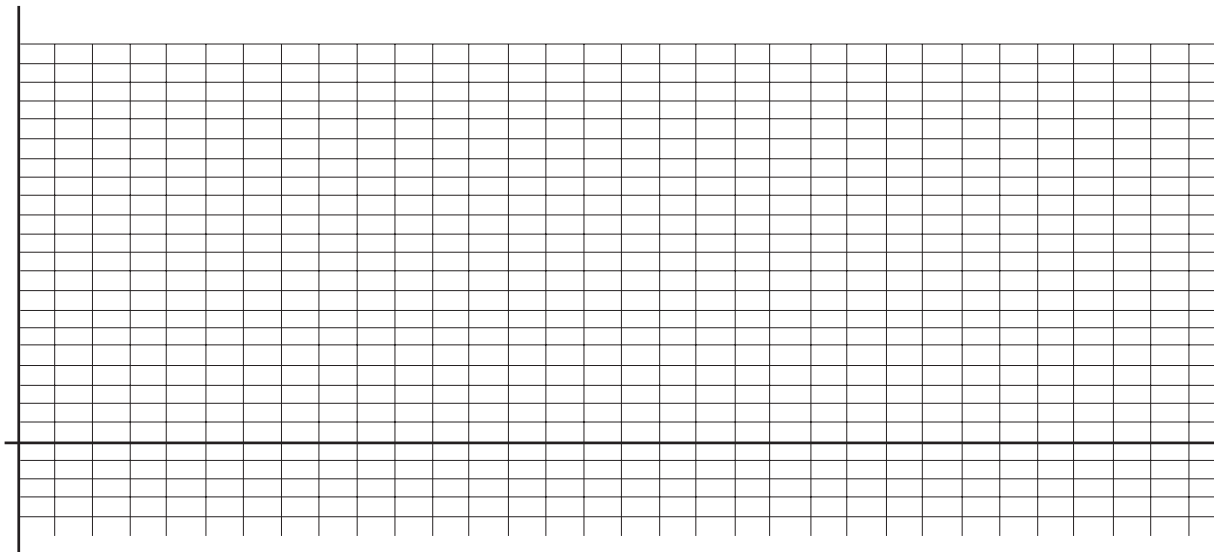


**DPS**

Serial No..... Tag No.....

**INPUT LINEARIZATION**

Measure



READOUT



**DPS**

Serial No..... Tag No.....

**INPUT LINEARIZATION BY BREAKPOINTS**

breakpoint	Input in %	Input in eng.	Readout	NOTES
0	0	units		Initial input rang value
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



**Ero Electronic S.r.l.**  
Via E. Mattei, 21  
28100 Novara  
Italy  
Tel. +39 0321481111  
Fax +39 0321481112  
eroelectronic@ero.eurotherm.co.uk

**BENELUX**  
ERO Electronic Benelux SA/NV  
Rue Val Notre Dame 384  
MOHA 4520 (WANZE)  
Tel. 085-274080  
Fax 085-274081  
ero.electronic@skynet.be

**BRASIL**  
ERO ELECTRONIC DO BRASIL Industria e  
Comercio Ltda.  
Rua Garibaldi, 659 - Conj. 202  
90035-050 PORTO ALEGRE  
Tel. 051-2214888  
Fax 051-2214734  
erobr@nutechnet.com.br

**CHINA**  
TIANJIN VEGA COMPANY Ltd  
(TAIF)  
Hebei District  
300232 TIANJIN  
Tel. 022-26273296  
Fax 022-26273297

**FRANCE**  
ERO Electronic SARL  
Zac du Chêne  
34, Rue du 35ème Régiment d'Aviation  
69673 BRON CEDEX  
Tel. 0478267979  
Fax 0478267800

**GERMANY**  
ERO Electronic GmbH  
Ottostrasse 1  
65549 LIMBURG A.D. LAHN  
Tel. 06431-95680  
Fax 06431-57493

**NETHERLAND**  
ERO Electronic Nederland  
Ganieelan 4  
2404 CH Alphen a/d Rijn  
Tel. 0172-420400  
Fax. 0172-420395  
sales@eroelectronic.nl

**SOUTH AFRICA**  
ERO Electronic S.A. Pty Ltd  
Airgro House  
1343, Spokeshave Avenue  
Stormill Ext 2 ROODEPOORT  
Tel. 011-4742278/9  
Tel. 011-4749404  
Fax 011-4749404  
P.O. Box 43112  
Industria 2042  
ero-sa@kingsley.co.za

**SPAIN**  
ERO ELECTRONIC IBERICA  
Calle La granja, 74  
Pol. Ind. Alcobendas  
MADRID  
Tel. 091-6618194  
Fax. 091-6619093

**U.K.**  
ERO U.K.  
Unit 1, Cygnet Trading Estate  
Faraday Close  
Durrington, Worthing  
WEST SUSSEX BN13 3RQ  
Tel. 01903-693322  
Fax. 01903-693377

**U.S.A.**  
AMERICAN ERO Electronic Corp  
BARRINGTON, ILL. 60010  
Tel. 0847-382-0881  
Fax 0847-382-0240  
**U.S.A.**  
BARBER COLMAN  
Industrial Instruments Div.  
P.O. BOX 2940  
Loves Park, IL - 31132 - 2940  
Tel. 0815-637-3000  
Fax 0815-637-5341  
jgsearle@ad.com