



Instruction Manual

EX-CAL 3000



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1. Safety information

This instruction manual contains information and warnings that must be observed for safe operation under the conditions described.

2. Faults and damage

If there are any grounds for believing the unit is no longer safe to use, it must be taken out of service and measures taken to prevent its further unintentional use.

The safety of the unit may be impaired if, for example:

- external damage to the housing is visible
- the unit has not been stored correctly
- the unit has suffered transport damage.

3. Safety regulations

When using the Ex-CAL 3000 intrinsically-safe multi-calibrator, the appropriate safety regulations must be observed to avoid incorrect operation of the unit.

The Ex-CAL 3000 multi-calibrator is suitable for carrying out brief measurements and simulations in intrinsically-safe circuits of categories "ia" or "ib".

"Brief" means that the instrument must not be in permanent operation.

In the "measurement" mode, the ex-CAL 3000 behaves as a passive component without energy storage, i.e. without inductive and capacitive properties.

The limit values of the particular intrinsically-safe circuits must be taken into account.

4. Battery

Only 1.5 volt NiCd accumulators or 1.5 volt primary batteries in accordance with IEC LR 14 may be used. The use of batteries other than these is strictly forbidden.

In addition, the Ex data must be observed in all circumstances.

Note!

The battery must only be changed outside the hazardous area.

5. Ex data

Certificate of Conformance: PTB Nr. Ex-95.D.2106

Input circuit: U_{max} = 65 Volt
I_{max} = 500 mA
P_{max} = 1000 mW

Output circuit: U_o = 22,45 Volt
I_o = 78,7 mA

	EEx ia IIC	EEx ib IIC
Co	68 nF	135 nF
Lo	0,5 mH	5 mH

Interface circuit: U_o = 9 Volt
I_o = 153 mA

	EEx ia IIC	EEx ib IIC
Co	720 nF	7 µF
Lo	0,5 mH	1 mH

6. Technical data

Operating temperature: - 10° to + 40°C

Storage temperature: - 20° to + 50°C

Warm-up time: 2 minutes maximum at constant ambient temperature

Relative humidity 0 to 90% without condensation

Power supply: 6 x 1.5 Volt NiCd accumulators or
6 x 1.5 Volt primary batteries in accordance with IEC LR14

LoBat indication: Advance warning

Protection class: IP 53

Housing: rugged metal housing

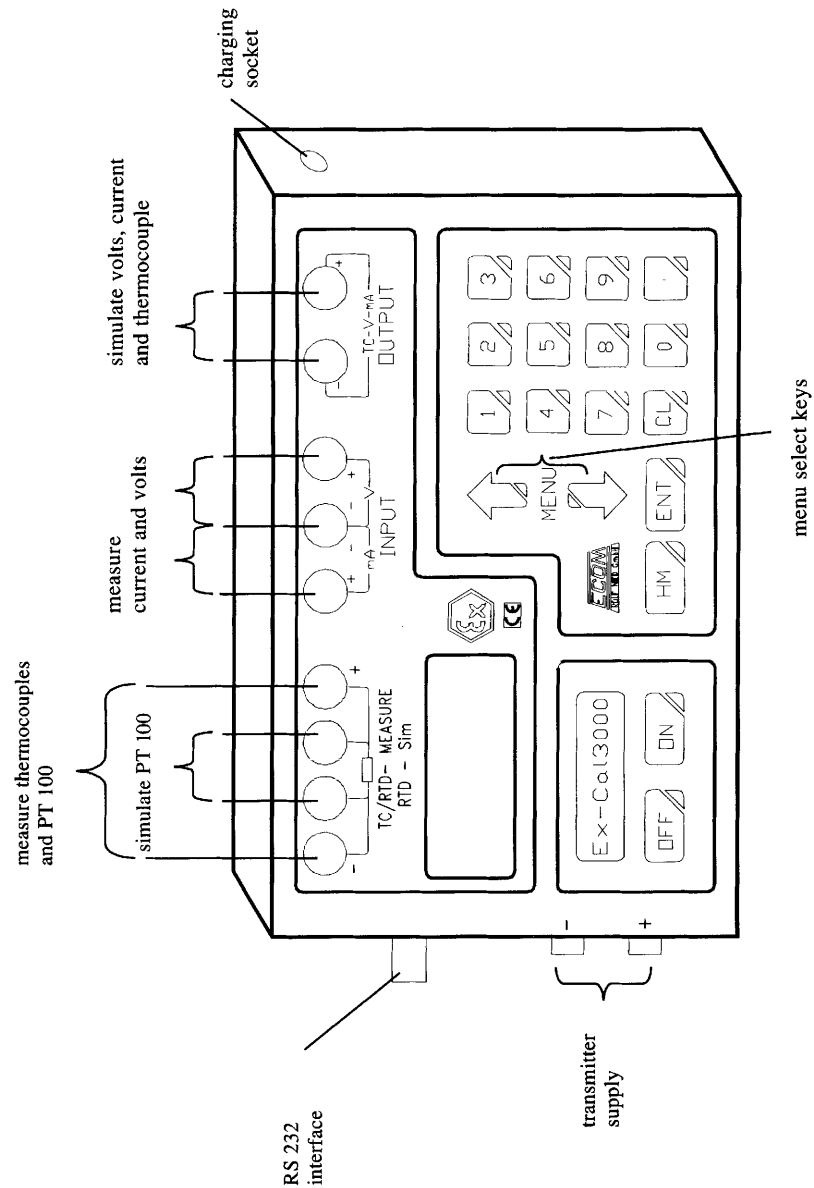
Dimensions: 220 x 135 x 50 mm

Weight: approx. 1.5 kg (without batteries)

6.1 Specifications

Function	Range	Resolution	Accuracy
Current simulation			
mA	0...25.00 mA	0.01 mA	0.02%
Voltage simulation			
mV	0...125.00 mV	0.01 mV	0.02%
V	0... 1.2500 V	0.1 mV	0.02%
V	0... 12.500 V	1 mV	0.02%
Temperatur simulation			
Pt100	-199°C...800°C	1°C	0.15°C
Typ J	0°C...760°C	1°C	0.25°C
Typ K	0°C...1000°C	1°C	0.75°C
Typ T	-100°C...400°C	1°C	0.45°C
Typ E	0°C...1000°C	1°C	0.35°C
Typ R	500°C...1750°C	1°C	1.75°C
Typ S	500°C...1750°C	1°C	2.05°C
Typ B	500°C...1800°C	1°C	2.15°C
Typ L	-100°C...900°C	1°C	0.75°C
Current measurement			
mA	0..300.00 mA	0.01 mA	0.03%
Voltage measurement			
Range 1	-50.00 mV...50.000 mV	1 µV	0.02%
Range 2	-500.0 mV...500.00 mV	10 µV	0.02%
Range 3	-2.0000 V...2,0000 V	100 µV	0.02%
Range 4	-20.000 V...20,000 V	1 mV	0.02%
Range 5	-65.00 V...65,00V	10 mV	0.03%
Signal feedback measurement			
mA	0..30.000 mA	1 µA	0.03%
V	0...30.00 V	10 mV	0.03%
Temperature measurement			
Pt100	-199°C...800°C	0.1°C	0.20°C
Typ J	0°C...760°C	0.1°C	0.25°C
Typ K	0°C...1000°C	0.1°C	0.75°C
Typ T	-100°C...400°C	0.1°C	0.45°C
Typ E	0°C...1000°C	0.1°C	0.35°C
Typ R	500°C...1750°C	0.1°C	1.75°C
Typ S	500°C...1750°C	0.1°C	2.05°C
Typ 6	500°C...1800°C	0.1°C	2.15°C
Typ L	-100°C...900°C	0.1°C	0.75°C

6.2 General view of Ex-CAL 3000



7. Introduction

The Ex-CAL instrument you have purchased enables you to select all the signals you need to check your plant easily and quickly.

The Ex-CAL 3000 has two main operating modes:

- **SIMULATION** of voltages, currents and temperature signals
- **MEASUREMENT** of voltages, currents and temperature signals

Explanation of terms:

All messages displayed by the Ex-CAL 3000 are shown as "**Display messages**" in inverted commas when referred to in the text.

If the user has to press a key, the name of the key is shown in angle brackets. If, for instance, the user should press the ENT key, the text simply shows <ENT>.

Functions of the Ex-CAL 3000

The Ex-CAL 3000 provides extensive guidance to the user. The following convention is used for user guidance:

- 1. **The 3rd line of the display shows the limit values that must be observed for the entries.**
- 2. **The 4th line of the display tells you which function key the Ex-CAL expects you to press.**
- 3. **Special messages and error messages (see Section 12).**

7.0 Switching on the Ex-CAL 3000

Press the "ON" key.

The following messages appear one after another in the Ex-CAL 3000 display:

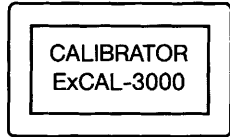


Figure 7.0

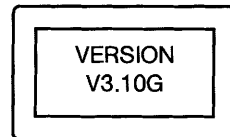


Figure 7.1

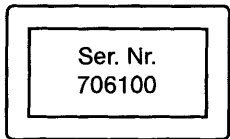


Figure 7.2

Note:

Always state the version number and serial number in the case of queries.

The last information is the calibration date as follows:

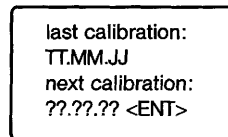


Figure 7.3

TT= day MM = month JJ = year

Note:

In the case of a new Ex-CAL, the date under "Calibrated on" is the date of the final test or the date of adjustment at the factory. You decide on the next calibration date! This depends on operational requirements. The date you enter is stored in non-volatile memory in the Ex-CAL.

To access the main menu (referred to as **HM** in the following text), simply accept the output by pressing the <ENT> key. You are now in the HM and you will see the screen shown below. You can select all the Ex-CAL functions from here. You can always recognise the main menu as the string "==== *HM* ===== " always

appears in the first line of the display.

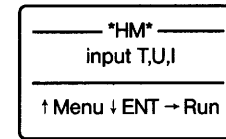


Figure 7.4 Main menu

Currently, the main menu contains 6 items as shown in Table 1 below:

Table 1

- | | |
|-----------------------|---|
| 1. " input T, U, I " | if you want to measure temperature signals from thermocouples or Pt 100 sensors or measure voltages or currents |
| 2. " output T, U, I " | if you want to simulate temperature signals from thermocouples or Pt 100 sensors or measure voltages or current |
| 3. "test 2-wire Tx" | for a simple and rapid test of 2-wire transmitters |
| 4. "read data" | to download jobs created with the PC software. |
| 5. "transmit data" | to transmit your results to the PC for subsequent evaluation and documentation |
| 6. "job select" | this allows you to search for and select your stored jobs |

Note:

items 4-6 can only be selected in conjunction with the software package.

Selection of the individual menus is carried out using the arrow keys.

The selected menu item is accessed by pressing the <ENT> key.

Note:

All the functions of the EX-CAL 3000 are controlled from the main menu. To simplify operation, a key (HM) is provided on the keypad to call up the main menu. This key always returns you to the main menu. If this key is pressed while a menu is active, the action already selected is cancelled. The Ex-CAL 3000 switches off the output sockets and displays the last selected function in the main menu. If you select the function again using <ENT>, you will see that the Ex-CAL 3000 has "marked" all the parameter entries. This allows you to quickly repeat the last measurement.

8. Measurement functions of the EX-CAL 3000

To activate the measurement functions of the Ex-CAL 3000, use the arrow keys in the main menu to find the following display:

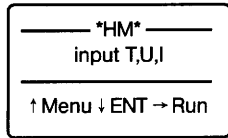


Figure 8.0 Select measurement functions

<ENT> opens the measurement function selection menu. From here, you can take highly accurate measurements of

- temperatures using type J, K, T, E, R, S, B thermocouples or from two Pt 100 sensors
- voltages from 50.000 mV to 65.00 V in 5 measuring ranges
- currents up to 300 mA in one measuring range.

Note:

Pressing the <HM> key always returns you to the main menu: (as shown in Figure 8.0).

8.1 Measuring temperatures with the Ex-CAL 3000

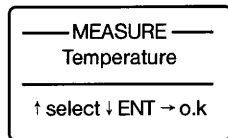
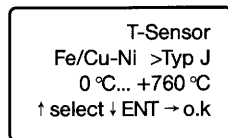


Figure 8.1 Selecting temperature measurement functions

To measure temperatures, choose the "Temperature" menu item in the selection menu using the arrow keys as shown in Figure 8.1. <ENT> opens a further selection menu, in which you are prompted to select a temperature sensor (Figure 8.1.2).

8.1.1 Measuring temperatures using thermocouples

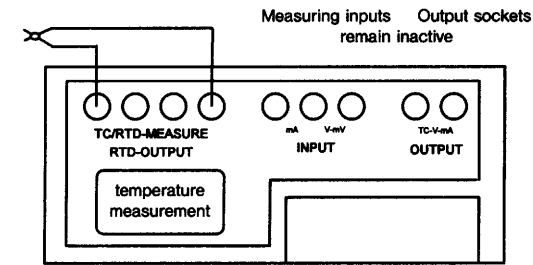


- ← Sensor type
- ← Valid measuring range

Figure 8.1.2 Finding temperature sensors

Select the desired temperature sensor using the <ARROW KEYS>.

The schematic connection of your thermocouple to your Ex-CAL is shown in the diagrams below.



You confirm your selection using <ENT>.

You then select one of the two types of cold junction compensation by pressing key "1" or "2".

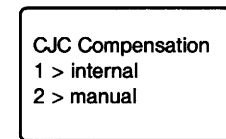


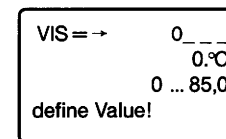
Figure 8.1.4

Selecting the cold junction compensation

Note

By pressing <1> you allow the Ex-CAL to set and display the measured thermal EMFs in relation to the internally specified cold junction temperature. This mode is useful if you want to use the Ex-CAL as a thermometer.

If <2> is pressed, the Ex-CAL opens a screen editor as shown in Figure 8.1.5. This allows you to define the value for the cold junction compensation temperature.



← Valid range

Figure 8.1.5 Manual cold junction compensation

Note:

Manual cold junction compensation is useful if you want to check the temperature at a heated reference junction.

The arrows in the display indicate the terminals to which the thermocouple must be connected.

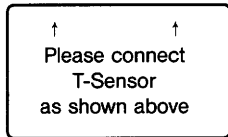


Figure 8.1.6 Connection information

Please ensure that the "+" side is inserted into the red (right) socket and the "-" side is inserted into the black (left) socket. The polarity must be observed, otherwise you will obtain erroneous values. The connection information is displayed for 3 seconds. The Ex-CAL displays the temperature output screen as shown in Figure 8.1.7 below.

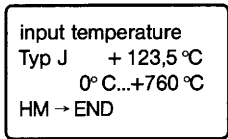


Figure 8.1.7 Temperature measurement with type J thermocouple

If the thermocouple is correctly connected, the Ex-CAL 3000 will now display the temperatures it has calculated on the basis of your cold junction definition.

8.1.2 Measuring temperatures using Pt 100 sensors

The Ex-CAL can carry out temperature measurements with 2 different temperature sensors. Temperature sensors with alpha coefficient 385 and sensors to JIS with a coefficient of 392 are supported. To carry out a temperature measurement using a Pt 100 sensor, you must select one of the two sensors in the sensor selection menu shown in Figure 8.1.8.

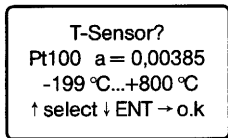


Figure 8.1.8 Select Pt 100

After confirming using <ENT>, you must choose one of 3 measuring modes. The Ex-CAL allows you to measure temperatures using 2, 3 or 4 wire connection.

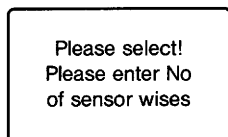


Figure 8.1.9 Measuring mode selection menu

Note:

The cable resistance is included in full in the measurement if 2-wire connection is used.

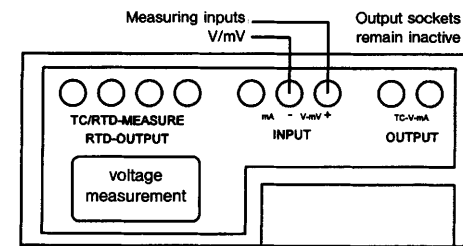
With 3 wire connection, the Ex-CAL can largely compensate for cable resistance. The best results are obtained using 4 wire connection. In this mode, the Ex-CAL 3000 can largely exclude cable resistances of up to 20 ohms from the measurement.

Once you have chosen a method of measurement, the Ex-CAL 3000 gives you connection information that shows the appropriate sockets for RTD measurement according to the mode of measurement chosen.

When the Pt 100 sensor is connected correctly, the Ex-CAL 3000 shows the corresponding temperature.

8.2 Measuring voltages with the Ex-CAL 3000

Connection diagram for voltage measurement



Once you have selected measuring functions in the main menu, you can select the voltage measurement function from the measurement selection menu by using the arrow keys as shown in Figure 8.2.0.

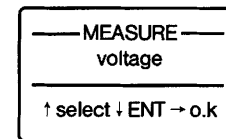


Figure 8.2.0 Voltage measurement functions

You access the measuring range selection menu (Figure 8.2.1) by pressing the <ENT> key.

You can then select the desired measuring range using the arrow keys, and confirm the selection using <ENT>.

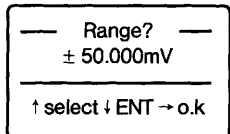
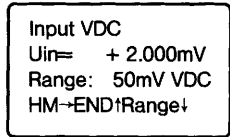


Figure 8.2.1 Selecting the measuring range



<- Current measured value
<- Measuring range

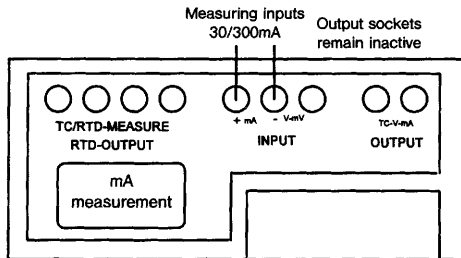
Figure 8.2.2 Voltage measurement display

Note:

If the voltage violates either the upper or lower limit values, an "overflow" message appears. You can change the measuring range at any time by using the arrow keys.

8.3 Measuring currents with the Ex-CAL 3000

Connection diagram for current measurement



The Ex-CAL displays the direction of the applied current based on the polarity shown. The Ex-CAL can measure currents in two ranges. The table below shows the measuring ranges and their resolution.

Table 8.3.0

Range 1	0.000 mA	...	30.000mA
Range 2	0.00 mA	...	300.00mA

Note:

The current ranges are permanently assigned to the EX-CAL functions. If the mA measurement function 8.3 is selected, the measuring range is 300.00mA. For the measurement of current feedback in active mode, the measuring range is specified as 30.000mA.

Once the measuring functions have been selected in the main menu, you can select the current measurement function from the measurement selection menu by using the arrow keys as shown in Figure 8.3.0.

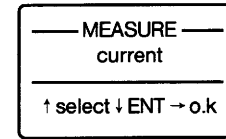


Figure 8.3.0 Current measurement

Pressing the <ENT> key takes you straight to the measurement output (Figure 8.3.1).

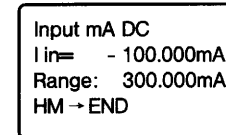


Figure 8.3.1 Current measurement display

9. Active functions of the Ex-CAL 3000

In this mode, you can use your Ex-CAL to output voltages, currents or temperature signals. The following display is selected from the main menu to put the Ex-CAL 3000 into active mode.

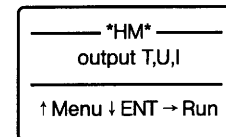


Figure 9.0 Selecting active functions

- <ENT> opens the active functions selection menu. From here, you can output
- Voltages for thermocouples of types J, K, T, E, R, S, B, L and resistance values for two Pt 100 sensors,
 - voltages from 0.00 mV to 12.500 V with 3 degrees of resolution,
 - or currents up to 25.00 mA with a high degree of accuracy.

Each of these output signals can be output in the output mode as fixed values, as a graphical array consisting of up to 12 data points or as a variable signal in the form of wave forms.

Note: Pressing the <HM> key always returns you to the main menu (as shown in Figure 9.0).

9.1 Simulating TC temperatures with the Ex-CAL 3000

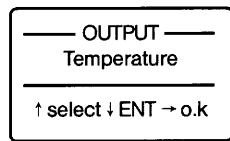
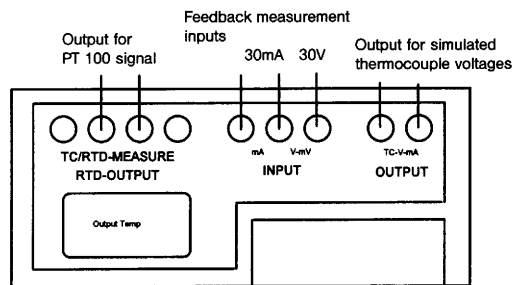


Figure 9.1 Selecting temperature outputs

The "Temperature" menu item in the <Output> selection menu must be selected to enable temperature signals to be output, see Figure 9.1. <ENT> opens a further selection menu, in which you are asked to select one of the temperature sensors (Figure 9.1.0). The simulated thermal EMFs are on the sockets shown in the diagram below. The Pt 100 resistances will be on the RTD output sockets.



Selection of temperature sensor

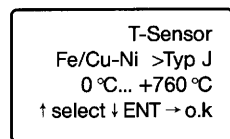


Figure 9.1.0 Selecting temperature sensor

You select the desired sensor using the arrow keys.

The output mode is started by pressing the <ENT> key. The procedure is then as described in Section 9.5.

9.2 The Ex-CAL as mA source

The Ex-CAL allows you to output currents in two ways.

1. **ACTIVE**, i.e. the Ex-CAL is both source and current-determining element. This output mode has the highest energy requirement in the mA OUTPUT mode. In this case, the load for a current of 20 mA can be as much as 750Ω.

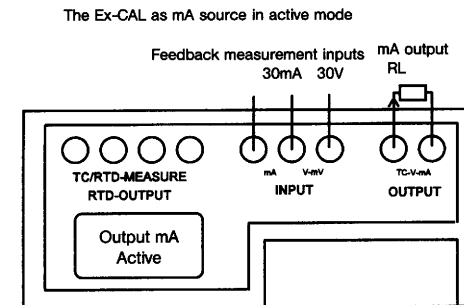


Figure 9.2.0 Ex-Cal as mA source in active mode

2. **PASSIVE**, i.e. the Ex-CAL is looped into a signal line and then acts as the current determining element. The energy requirement is at its lowest in this mode. The load that can be driven by the Ex-CAL in this mode depends on the applied voltage.

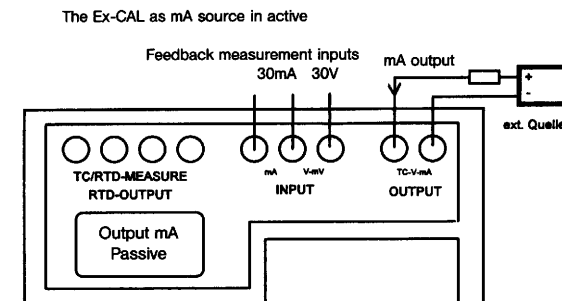


Figure 9.2.1 Ex-Cal as mA source in passive mode

9.2.1 Outputting currents with the Ex-CAL 3000

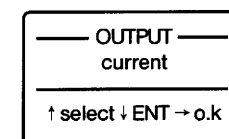


Figure 9.2.2 Selecting current output

Current output is accessed from the main menu by acknowledging the display shown in Figure 9.2.2 using <ENT>. Before outputting current, you must choose one of the two output modes.

The Ex-CAL provides a selection menu as shown in Figure 9.2.3 for this purpose.

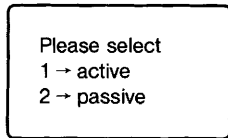


Figure 9.2.3 Selecting the output mode

Note:

The sockets labelled "O U T P U T " must always be used for current output.

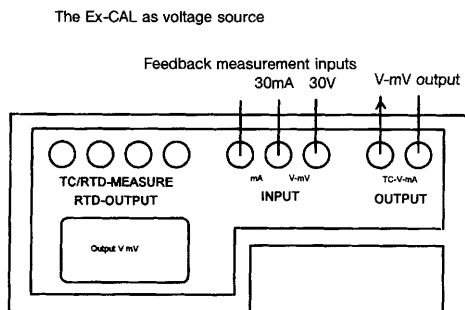
Output starts as soon as the output mode is selected. The procedure is then as described in Section 9.5.

9.3 The Ex-CAL as voltage reference source

The Ex-CAL 3000 provides three ranges for the output of voltages:

- I: 0... 125.00mV
- II: 0.0 ... 1.2500V
- III: 0.0 ... 12.500V

These allow the optimal resolution to be achieved for each range. As can be seen from the diagram, the Ex-CAL 3000 outputs the voltages on the sockets marked OUTPUT-TC-V-mA.



9.3.1 Outputting voltages with the Ex-CAL 3000

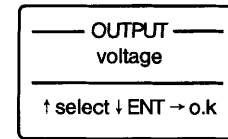


Figure 9.3.1 Selecting voltage output

You select the voltage range you want after pressing the <ENT> key.

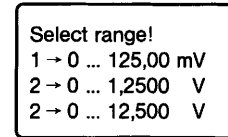


Figure 9.3.2 Voltage ranges

Output starts as soon as the output mode is selected. The procedure is then as described in Section 9.5.

9.4 Checking 2-wire transmitters with the Ex-CAL 3000

This function provides an extremely powerful test program for the simple and rapid checking of your 2-wire transmitter. The Ex-CAL provides the supply for the 2-wire transmitter to be tested. A special scaling menu allows you to enter the transmission parameters of your 2-wire transmitter directly into the Ex-CAL. The Ex-CAL then converts the transmitter current directly into the appropriate engineering unit. This makes the test function particularly easy to use because the conversion calculation is done for you by the Ex-CAL. The connection diagram below shows how easy it is to connect your 2-wire transmitter to the Ex-CAL.

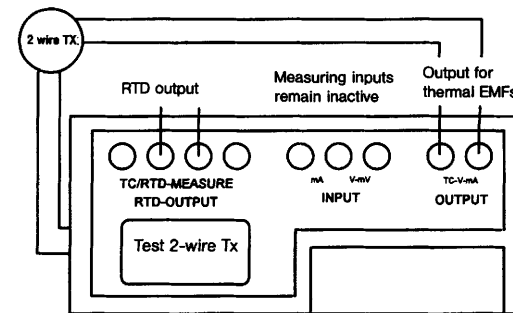


Figure 9.4.0 Connecting a 2-wire transmitter

The 2-wire transmitter is fed from the side output sockets of the Ex-CAL. Depending on the type of sensor, the temperature signal is taken either from the RTD sockets for Pt 100 sensors or from the OUTPUT sockets for thermocouples and fed to the 2-wire transmitter.

To put the Ex-CAL into active mode, select the item "Test 2-wire Tx" from the main menu.

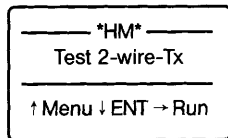


Figure 9.4.1 Entering the 2-wire test function

<ENT> opens the selection menu, where you must specify the type of transmitter.

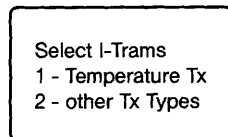


Figure 9.4.2 Selection menu

Different types of 2-wire transmitter

- <1> allows you to check 2-wire temperature transmitters. These transmitters are connected as shown in Figure 9.4.0.
- <2> allows you to test any other type of transmitter. In this case, the command variable comes from an external source, e.g. pressure. The connection to the Ex-CAL provides only the power supply and evaluation of the transmitter current.

After pressing <1>, the Ex-CAL asks you to select the temperature sensor appropriate to your transmitter (see Figure 9.4.3).

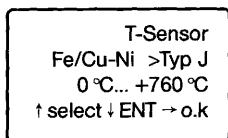


Figure 9.4.3 Sensor selection menu

Use the arrow keys to select the temperature signal appropriate to your sensor.

Note:

The remaining considerations are the same whether you select a transmitter with a thermocouple or one with a Pt 100. It is important that you take the temperature signals from the correct sockets as indicated by their inscriptions. It then remains to specify the cold junction compensation.

Assuming that you want to output thermal EMFs for temperatures appropriate to type J thermocouples, you must scroll through the menu using the arrow keys until you see the output as shown in Figure 9.1.0. Pressing the <ENT> key causes the Ex-CAL to make all the calculations for the output of thermal EMFs based on this element and you enter the output mode. The procedure is then as described in Section 9.5.

9.5 The output mode of the Ex-CAL 3000

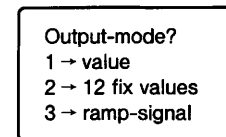


Figure 9.5.0 Overview of output modes

9.5.1 Outputting a fixed value

The fixed value allows you to output the particular units (U, I, T) and change them by a defined amount.

If you press the <1> key with the output screen displayed (Figure 9.5.0), the Ex-CAL opens a dialog window in which you can specify the output value.

Example:

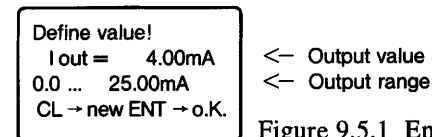


Figure 9.5.1 Entry menu

The output value is confirmed using <ENT>.

The output value can be redefined by pressing <CL>.

Example; <CL> pressed:

```
Define value!
I out = 4.00mA
0.0 ... 25.00mA
Enter value
```

Figure 9.5.2 Entering the output value

After redefining the output value and pressing the <ENT> key, you will see:

```
Define value!
I step = 1.00mA    <- Step value
0.0 ... 10.00mA   <- Step range
CL → new ENT o.K.
```

Figure 9.5.3 Entering the step range

After pressing the <ENT> key you will see:

Note! Only for thermocouples, otherwise continue with Section 9.5.1.2.

9.5.1.1 Cold junction compensation

```
CJC-Compensation
1 → internal
2 → manual
```

Figure 9.5.4 Cold junction compensation

<1> causes the Ex-CAL to determine the cold junction temperature using its internal sensor and include it in the calculation.

```
CJC - Temperature
CJC = 25 °C
```

Figure 9.5.5 Internal cold junction compensation

Note:

In the case of internal cold junction compensation, the Ex-CAL checks the cold junction temperature continuously at fixed time intervals. If the ambient temperature or the temperature of the cold junction changes, the Ex-CAL corrects the output signal according to the temperature detected at the cold junction.

<2> allows you to compensate the cold junction with a fixed value, a user-definable temperature in the specified range.

```
Define value!
T comp = +25 °C
-10 °C ... +59 °C
CL new ENT → o.K.
```

Figure 9.5.6 Manual cold junction compensation

9.5.1.2 Specifying signal feedback measurement

```
Feedback?
1 → Iin 0..30mA
2 → Uin 0..30V
3 → no feedback.
```

Figure 9.5.7 Specifying signal feedback measurement

Note:

Signal feedback measurement always takes place with electrical isolation from the output signals produced by the Ex-CAL, i.e. you can connect the signal you want to measure directly to the measurement sockets of the Ex-CAL without needing to take account of any potentials.

If you select current, the Ex-CAL provides the additional option of scaling. Information about scaling can be found in Section 10 of this manual. After defining the feedback measurement, all necessary entries are made and the Ex-CAL then returns immediately to the output menu (Figure 9.5.8).

Example

```
Output mA DC
out = 4.00mA    <- Output value display
step = 1.00mA   <- Instantaneous output value
I meas = 4.11mA <- Step value
               <- Signal feedback
```

Figure 9.5.8 Signal output

You can now increase or decrease the output value by the step value using the arrow keys.

Note:

You can specify a new output value at any time using the keypad.

Example: 4.44 <ENT> specifies an output of 4.44 mA.

9.5.2 Output of up to 12 fixed values

In this output mode, you can store up to 12 fixed values that you need frequently in the Ex-CAL. The values are stored in non-volatile memory.

If you press the <2> key with the output screen displayed (Figure 9.5.0), the Ex-CAL opens a dialog window in which you can specify the output values.

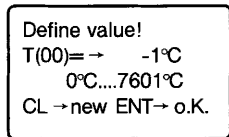


Figure 9.5.9 Entering fixed values

The Ex-CAL always refers to the values stored in memory and offers these as suggested values. You can accept the suggested value using <ENT>, while <CL> takes you to the input screen in which you can enter the desired fixed values.

<ENT> confirms the first value. The display then immediately presents the next curve point to be defined.

Note

When you have defined all the points on the curve, you can terminate the input procedure using ↑. If you make a mistake while entering the curve definition, you can go back to the beginning of the table by pressing ↓. You confirm correct entries by pressing <ENT>, incorrect entries can easily be deleted using <CL> and then overwritten.

When simulating thermal EMFs, you must enter the type of cold junction compensation as described in Section 9.5.1.1.

You can then step through all 12 values in the output mode using ↑ and ↓

9.5.3 Output a wave form

In this output mode, the Ex-CAL can be used to output a continuously rising and falling value.

To achieve this, you must enter the appropriate start value, the end value and the step value.

The Ex-CAL then asks you for the time intervals, i.e. the dwell times, between each point.

This mode also allows you to measure a feedback current of up to 30.000 mA or voltage of up to 30.00 V at the same time. The sockets marked "INPUT-mA or V mV" are used for the feedback measurement. The Ex-CAL provides the thermal EMFs on the sockets marked "OUTPUT-TC-V-mA". The Pt 100 resistance values will be on the sockets marked RD-OUTPUT.

If you press the <3> key with the output screen (Figure 9.5.0) displayed, the Ex-CAL opens a dialog window as shown in Figure 9.5.11 in which you can specify the output temperatures.

9.5.3.1 Enter start value

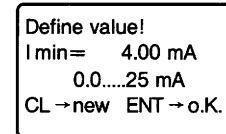


Figure 9.5.10 Entering the start value

The Ex-CAL first refers to the values stored in memory and offers these as suggested values. You can accept the predetermined value using <ENT>, while <CL> takes you to the input screen in which you can enter the desired output values. <CL> pressed:

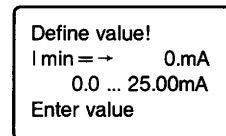


Figure 9.5.11 Entering the output value

9.5.3.2 Entering the step value

After redefining the output value and pressing the <ENT> key, you will see:

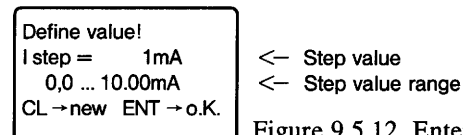


Figure 9.5.12 Entering the step value

After entering the step value and confirming using <ENT>, you will see:

```
Define value!
I max =    0mA      <- Maximum value
0.0 =   25.00mA    <- Step value range
Enter value
```

Figure 9.5.13 Defining the maximum value

9.5.3.3 Specifying the time interval

After entering the maximum value you must enter the time intervals.

```
define timesteps
t_steps =    2.0s
          2.0 ... 25.0s
CL → new ENT → o.K.
```

Figure 9.5.14 Defining the time interval

<CL> allows you to overwrite the current value and the following screen appears:

```
Define timesteps
t_step =    2.0s
          2.0 ... 25.0s
Enter value
```

Figure 9.5.15 Entering the time interval

9.5.3.4 Specifying the shape of the wave form

The Ex-CAL now has all the parameters it needs to output the wave form. You can now select one of the four types of wave form available.

```
Select ramp type
┌───┴───┐ ┌───┴───┐ ┌───┴───┐ ┌───┴───┐
 1     2     3     4
→1 →2 →3 →4
1,2,3, or 4
```

Figure 9.5.16 Wave forms

Wave forms:

Wave form 1

In this case the output signals rise in a sawtooth shape. For this wave form, the

Ex-CAL first outputs the minimum value for the time specified in t_{int} . The output value is then incremented by the step value and this in turn appears on the output sockets for t_{int} seconds.

This process continues until the maximum value is reached or violated. The output signal then returns to the start value, i.e. the minimum value, and the process starts again.

Wave form 2

In this case the output signals fall in a sawtooth shape. For this wave form, the Ex-CAL first outputs the maximum value for the time specified in t_{int} . The output value is then reduced by the step value and this in turn appears on the OUTPUT sockets for t_{int} seconds. This process continues until the minimum value is reached or violated. The output signal then returns to the start value, i.e. the maximum value, and the process starts again.

Wave form 3

In this case, the output signals have a triangular shape. For this wave form, the Ex-CAL first outputs the minimum value for the time specified in t_{int} . The output value is then increased by the step value and this in turn appears on the output sockets for t_{int} seconds. The increase continues until the maximum value is reached or violated. The Ex-CAL then reduces the output value by the step value. This process continues until the minimum value is reached again or violated. The cycle is then complete and the process starts again.

Wave form 4

As can be seen from the symbol, the output signal steps to and fro between the maximum and minimum values. The dwell times are specified by t_{int} .

After selecting the wave form and cold junction compensation (thermal EMFs only, see Section 9.5.1.1), you specify the desired signal feedback measurement.

9.5.3.5 Specifying signal feedback measurement

```
Feedback?
1 → lin 0..30mA
2 → Uin 0..30V
3 → no feedback
```

Figure 9.5.17

Specifying signal feedback measurement

Note:

Signal feedback measurement takes place with electrical isolation from the output signals produced by the Ex-CAL, i.e. you can connect the signal you want to check directly to the measurement sockets of the Ex-CAL without needing to take account of any potentials.

If you select current, the Ex-CAL provides the additional option of scaling. Information about scaling can be found in Section 10. After defining the feedback measurement, all necessary entries are made and the Ex-CAL then returns immediately to the output menu (Figure 9.5.18).

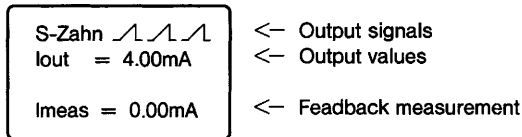


Figure 9.5.18 Signal output

The values continue to be output until you interrupt the output by pressing <HM>.

10. Scaling functions of the EX-CAL 3000

With effect from Version V3.06, the Ex-CAL 3000 provides the option of displaying feedback measurements in the transmitter test function and all current feedback measurements in active menus directly in engineering units. The scaling function is accessed via one of the active modes. If you acknowledge the query in Figure 10.0 with <1> for "mA",

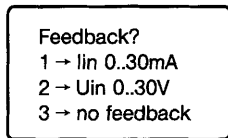


Figure 10.0 Specifying signal feedback measurement

the Ex-CAL displays the scaling option via the screen shown in Figure 10.1 below.

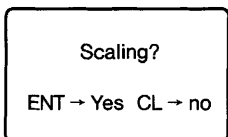


Figure 10.1 Scaling option for feedback measurement

You can quit the scaling option by pressing <CL>, while <ENT> opens the next sub-menu, which allows you to specify the desired engineering unit. You could, for instance, see the following information on the screen:

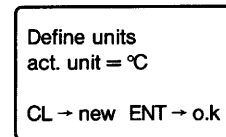


Figure 10.2 Display of engineering unit information

Note:

If you have selected "Temperature transmitter" in the transmitter test menu, the Ex-CAL automatically enters °C in the unit memory, independent of the last unit stored. If you have selected the scaling function from an active mode (OUTPUT T,U,I), or if you have specified "other" transmitters to be tested by pressing <2> in the transmitter test menu, the Ex-CAL accesses the parameter memory and shows you the value currently stored. This could be just blank spaces, which the EX-CAL 3000 always displays if there is no entry defined in the memory.

<ENT> causes the Ex-CAL to continue to use the unit currently stored, while <CL> opens the unit editor to allow you to specify any other engineering unit. The engineering unit is specified using 4 ASCII characters, which may be in either upper or lower case.

Note:

If you invoke the unit editor using <CL>, the Ex-CAL first fills the unit memory with blank spaces and places the cursor at the 1st position. If you quit the unit editor at this point using <HM>, no engineering unit will be displayed the next time you invoke the editor, as the Ex-CAL will find the 4 spaces in memory. Exception: You call up the scaling option from the temperature transmitter test menu. In this case the EX-CAL automatically enters the °C unit in the parameter memory.

Unit editor

The active editor, as shown in Figure 10.3, can be recognised by the flashing cursor positioned in the 3rd line below the character to be edited. The bottom line tells you that you can select the required character from the alphabetical

character set by using the arrow keys. As an example, we will program "mbar" as the unit using the screen display shown below.

```
define units
act. unit = ?

↑ select ↓ ENT → o.k
```

Figure 10.3 Unit editor

Note:

All the upper and lower case letters appear in one row in the Ex-CAL. Upper case "A" is obtained by pressing ↑ after "x", "y", "z" and lower case "z" is obtained by pressing ↓ after "C", "B", "A". The letters toggle between upper and lower case every time the <DP> key is pressed.

Layout of the ASCII characters

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz

↑ → ← ↓

Example: programming the unit as "mbar"

The first time ↓ is pressed, the cursor appears below the lower case "z". Hold the key down until you see the lower case "m". Pressing <ENT> transfers this to memory and the cursor moves one place to the right to the next position. Press ↑ twice, then press <ENT>. Press ↑, <DP>, <ENT> to get lower case "a". To get lower case "r", hold ↓ down until "r" appears.

```
define units
act. unit = mBar

↑ select ↓ ENT → o.k
```

Figure 10.4 Unit editor

Pressing <ENT> finishes the entry. The unit "mbar" is now stored until you overwrite it in the editor or you test a temperature transmitter. You must then specify the relationship between the scaling and your feedback measurement. The Ex-CAL 3000 reminds you to do this by displaying the screen shown in Figure 10.5 for approximately 2 sec.

```
relationship
```

Figure 10.5

Specifying the relationship between the feedback measurement and the scaling.

After specifying the engineering unit, you might see an output as shown below on the display.

```
mA   mBar
20.000 +100.0
4.000 +0.0
CL → new ENT → o.k
```

Figure 10.6 Relationship between feedback measurement and scaling.

Note:

The Ex-CAL automatically initialises the values given above if it finds no plausible entry in the memory.

Press <CL> to activate the editor.

```
mA minimum!
20.000 +100.0
4.000< +0.0
CL → new ENT → o.k
```

Figure 10.7 Scaling editor open

After invoking the scaling editor, it will initially point to the minimum value. This can be seen because the editor pointer, marked by the flashing cursor, points to the minimum value and the top line displays "mA min. value!". <CL> permits the value to be changed. You are then in the minimum value edit screen.

```
mA minimum!
0.
0...15.000
define value
```

Figure 10.8 Entry of minimum value

As shown in the first line, the editor prompts you to enter the minimum value. This may lie between the limits shown in the 3rd line.

Note:

If you want to enter the value 0.000 mA, it is sufficient to press <ENT>. If you want to enter a value < 1.000 mA, press <DP> and then the digit for the desired

value. Prompts appear in the 4th line of the display at each stage to facilitate input of the correct data.

After the minimum value has been entered, the Ex-CAL again displays all the parameters.

Assuming the parameters are correct, you will have to confirm them again by pressing <ENT>. The parameter editor then places the cursor on the maximum value to allow this to be changed if required.

```

mA maximum!
20.000<  +100.0
 4.000   +0.0
CL → new  ENT → o.k

```

Figure 10.9 Editing the maximum value

If you now press <CL> you will invoke the editor again, but this time for the maximum value. The 3rd line displays the range within which the value must lie.

Note:

The range in the 3rd row is always 1.000 mA above the minimum value and allows a maximum value of 22.000 mA to be entered. The Ex-CAL carries out a plausibility check before each scaling. Input errors are reported.

Editing scaling parameters

```

Maximum!   mBar
20.000 > +100.0
 4.000   +0.0
CL → new  ENT → o.k

```

Figure 10.10 Editing the scaling of the maximum value

Note:

The Ex-CAL always shows the minimum and maximum values in the same format, i.e. with the same number of decimal places. These are specified in the editor for the scaling of the maximum value. After pressing <CL> you must first specify the output format.

Specifying the output format

The editor first marks the maximum value of the entry for correction. <CL> first

opens the correction program to specify the output format.

```

Output format?
± 2000.0 mBar
↑ select ↓ ENT → o.k

```

Figure 10.11 Specifying the output format

You can move the decimal point to the right or left by pressing ↑ or ↓. A maximum of 3 decimal places can be specified. Confirm your entry by pressing <ENT>.

Note:

The Ex-CAL corrects the format following a change to the number of decimal places. The values remain unchanged at first, but the decimal point is positioned in accordance with the entry. After changing the decimal places to e.g. three places, the following screen is displayed:

```

Maximum!   mBar
20.000 > +1.000
 4.000   +0.000
CL → new  ENT → o.k

```

Figure 10.12 Editing the scaling of the maximum value

You now have the option to change the maximum value by pressing <CL> again. The change is carried out in a special editor. The range for the maximum value is from -1000 to +22000 in digits. The decimal point is inserted automatically.

The last step is to specify the minimum value. The entry is made using the value correction program as described above.

Note:

As negative values are also permissible for the maximum value, the Ex-CAL will only permit negative values for the minimum value under certain conditions, i.e. if the value entered for the maximum value was ≤ 0. In this case, it is not possible to change the sign to positive. In this case too, the Ex-CAL adapts the value range according to the maximum value.

The rule is: minimum value = maximum value -10

The entries are now complete and the Ex-CAL returns to the selected output menu, displaying the scaling of the feedback measurement in the desired unit and with the number of decimal places you specified in the editor (Figure 10.13).

```

      → +100,00Ω
Tout = → +100°C
K=      100.1°C
  
```

Figure 10.13 Temperature output with scaled feedback measurement

11. Ex CAL RS232 interface

A software package is available as an option for the Ex-CAL. This package allows you to create an extensive list of job instructions on your PC and then download them to the Ex-CAL. The job instructions you create with this Inter-Link module allow you to specify the location exactly. The Ex-CAL memory provides for a total of 6 lines of 16 characters each.

The individual job instructions define wave forms that you can create in the Ex-CAL for current, voltage or temperature. All the active functions of the Ex-CAL are available with no restrictions. This also applies to the specification of feedback measurement. The Ex-CAL is able to store up to 8 job instructions. There can be up to 25 measuring points for each job instruction. These job instructions can be found and selected in the "Select jobs" menu. A stored job instruction can be called up on the Ex-CAL as often as you like. Jobs that have been carried out are clearly marked. The Ex-CAL updates the data if you carry out a job a second time.

Note

The following menu items can only be selected if you have the PC communications software option on your Ex-CAL. The associated PC software can be requested from ECOM. It may be copied, installed and issued to others as often as you like free of charge.

To be able to use the software package, you must first connect the Ex-CAL to your PC using the interface cable available from ECOM. The EX-CAL is connected to your PC as shown in the diagram below.

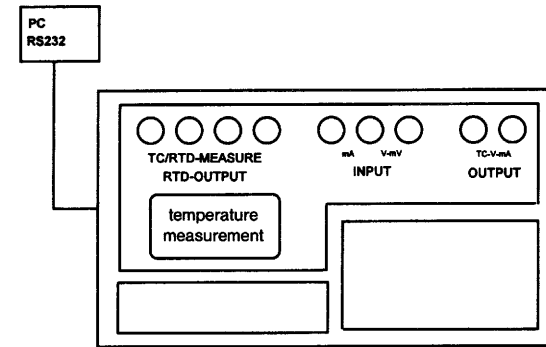


Figure 11.0 Connecting the Ex-CAL to a PC

Then start your PC and click on the Ex-CAL symbol in Program Manager. If you have not yet installed the software, place the diskette with the installation program in drive A and start the program installation with "Run" a:/install. The following menu items relating to the software are available from the EX-CAL main menu for working with the software:

- Read data
- Transmit data
- Job select

11.1 Read data

Use this Ex-CAL menu item to transfer the job instructions you created on the PC. You do this by selecting the "Read data" menu item from the main menu as shown in Figure 11.1.0.

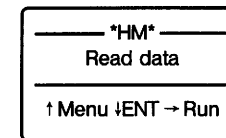


Figure 11.1.0 Requesting job instructions

<ENT> puts the Ex-CAL into a wait state (Figure 11.1.1).

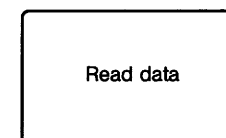


Figure 11.1.1 Wait for job instructions

All further activities are controlled from the PC. As long as the PC has not yet sent any data to the Ex-CAL, you can cancel this menu item using <HM>. Provided you have created a job instruction on the PC, you can request the PC to transfer data to the EX-CAL. This is done by invoking the Ex-CAL 3000 pulldown menu and selecting "Write". After successful transmission, the PC causes the Ex-CAL to return to the main menu.

11.2 Transmit data

Use this menu item to transfer job results to the PC. The Ex-CAL transmits all the parameters, including the location details, back to the PC. To prepare for transmission to the PC, select the "Transmit Data" menu item from the Ex-CAL main menu as shown in Figure 11.2.0.

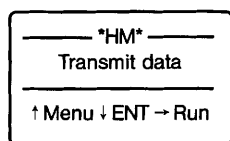


Figure 11.2.0 Initiate data transfer

<ENT> puts the Ex-CAL into a wait state. All further activities are controlled from the PC (Figure 11.2.1).

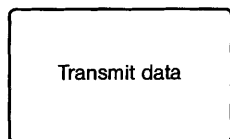


Figure 11.2.1 Wait for data request

Provided you have at least one finished job instruction on the Ex-CAL, you can request the PC to transfer data from the Ex-CAL for further evaluation. This is done by invoking the Ex-CAL 3000 pulldown menu and selecting "Read". After successful transmission, the PC causes the Ex-CAL to return to the main menu. Provided no data exchange between the PC and the Ex-CAL has taken place, you can also cancel this menu item on the Ex-CAL by pressing <HM>.

Note:

You can also request data from a blank form. The name of the original form can be reconstructed from the transmitted data. If the PC finds a form with the same name, this will be opened. After successful transmission, the PC causes the Ex-CAL to return to the main menu. Optionally, you can cause the job instruction in the Ex-CAL to be deleted to make space for new jobs.

11.3 Job select

The Ex-CAL 3000 is able to store and manage up to eight job instructions that have been created on the PC. This menu enables the stored job instructions to be viewed on site and a specific one selected. If necessary, this menu allows the parameters of an existing job to be adapted to new conditions on site before carrying out the job. The changes made, e.g. increasing the scope of measurement or changing output values, are transmitted back to the PC with the measurement results.

After selecting the menu, the information on the first job transmitted to the Ex-CAL is displayed. A total of 6 lines are available for a more exact identification of the item to be tested. These are divided into 2 blocks as shown in Figure 11.3.0.

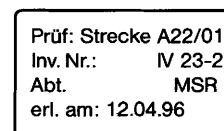


Figure 11.3.0 1st block of location details

Example of details of the location of a downloaded job. The details in the 4th line depend on whether or not the job has already been completed. If, for instance, you completed this job on 12.4.96, you will see the message:

exec at: 12.04.96

If the job is not yet done, the 4th line acts as a help; in the sample job above, the following text can be seen:

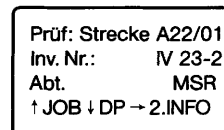


Figure 11.3.1 1st page of location details

Note

You can view all stored data in the "Job selection" menu using the arrow keys. The "first page" in each case shows you whether you have already carried out the measurement and, if so, when. The arrow keys are always available, even when the date appears in the 4th line as shown in Figure 11.3.0. To facilitate the

obtaining of further information about the location of the device to be measured, you can retrieve the second information block for the stored job by pressing the <DP> key. You get 3 more lines of the text that the PC has transmitted to the Ex-CAL (Figure 11.3.2).

```
Geb.:    Block 1
Etage:   22a
Raum:    B2
ENT selects Job
```

Figure 11.3.2 2nd block of location details

You can select the currently displayed job by pressing <ENT> or scroll onwards using the keys. You can, of course, select jobs from the 1st page by pressing <ENT>. In principle, any job can be selected, i.e. jobs previously carried out can be repeated.

We will assume for the remainder of this description that you have selected a job whose results memory is still empty. In this case, the Ex-CAL first asks you to enter the date on which the job is to be carried out (Figure 11.3.3).

Entering the date

After pressing <ENT> as shown in Figure 11.3.2, the following prompt is displayed:

```
Insert date
█ . . . . .
```

Figure 11.3.3 1st page of location details

The cursor is at the 10s position in the day field. Enter the date on which you are carrying out the measurement. If you have type the date incorrectly, you can delete the entry using <CL>, and the cursor returns to the position as shown in Figure 11.3.3. After entering the date, you are taken directly to the "Number of measuring points" sub-menu or, if the output signal is a thermocouple, you are first asked to enter details of the cold junction compensation.

Entering CJC

In this case, you will see the following message in the display:

```
Define value!
Tcomp = +22 °C
        -10 °C +59 °C
CL → new ENT → o.k
```

Figure 11.3.4 Entering CJC for thermocouples

The Ex-CAL retrieves the currently stored information from memory and displays this including the sign. If this value is OK, you can accept it directly by pressing <ENT>. You can press <CL> to define a new value. The following input screen appears:

```
Deline value!
Tcomp = → +25 °C
        -10 °C...+59 °C
CL → new ENT → o.k
```

Figure 11.3.5 Cold junction compensation

You are now requested to enter a new CJC temperature. The value must be within the limits shown in line 3. To switch to negative values, you must first press <0>. Provided no other entries have been made, <0> toggles between positive and negative. The entry menu has a full help facility. A wrong or invalid input is not possible or will not be accepted.

Note:

If you want to quit the input menu without changing the original value, you must press <HM>. In this case, you are taken directly to the next sub-menu - "Number of measuring points".

Following correct entry of the cold junction compensation, you will be presented with information about the number of parameter settings the Ex-CAL has stored for the currently selected job and what output signal will be provided for the measurement.

The possible outputs in the top line are as follows:

Tout		Thermocoupler
Rout		PT100
Output	0...125.00mV	
Output	0...1.2500 V	
Output	0...12.500 V	
activ	0...25 mA	
passive	0...25 mA	

In the following description it will be assumed that the output signal is suitable for a type J thermocouple.

```
T out = Temperature
10 step points
CL → neu ENT → o.k
```

Figure 11.3.6 Specifying the measuring points

This setting can be accepted by pressing <ENT> or corrected by pressing <CL>. We will assume that no change is required, so <ENT> is pressed. A further selection screen then appears.

```
T out = Temperature
10 step points
1 - Start measure
2 - Check Paramtr
```

Figure 11.3.7 Specifying the measuring points

At this point, you can view and check the setting again and, if necessary, change it before making the measurement. Press <2> to view the parameters. The following screen is displayed:

```
T out = Temperature
T(00)    xxx °C
no date!
↑ field ↓ CL → new
```

Figure 11.3.8 Re-specifying the measuring points
xxx is any temperature value

You now have the option to review all the parameter settings in turn and change them if necessary. For this purpose, you can move anywhere within the array using the arrow keys.

The values shown in brackets show you where you are within the array.

Assuming you are at the 3rd parameter and want to change it, you can open the entry screen using <CL>.

```
T out = Temperature
T(02)    0 °C
0 ... 760
define value!
```

Figure 11.3.9 Re-specifying the measuring points

This entry menu also has a comprehensive help facility.

Incorrect or invalid inputs will be rejected. For each output, the currently valid limits of the definition range are displayed in the 3rd line. If negative numbers are permissible and necessary, the sign can be toggled using <0> provided no other figures have yet been entered.

Input errors are corrected using <CL>.

You quit the entry menu by pressing the <ARROW UP> key. This takes you immediately to the end of the data field. The Ex-CAL finally displays the message "End of array" and returns to the editing menu "Number of measuring points". If you have decided during the review that the number of measuring points needs to be changed, you can do this now by pressing <CL>.

Otherwise, you can start the measurement immediately by pressing <ENT> and <1>.

IMPORTANT!

If you change the parameters of a job that has already been completed, this job will then be registered in the Ex-CAL as not done, i.e. the data you have recorded will no longer be accessible following modification of the parameters.

Carrying out measurements

```
T out = Temperature
T(00)    120 °C
automatic steps
meas     1.023mA
```

Figure 11.3.10 Carrying out measurements

If you press <1> in the screen shown in Figure 11.3.7, the test sequence is started. The Ex-CAL now provides the desired output signal at the defined value on the appropriate sockets. In addition, the result of the feedback measurement is displayed in the 4th line in the desired units. The index indicates the current position in the data field. In manual operation, the Ex-CAL stores the result when the <ENT> key is pressed, retrieves the next value setting and outputs this on the sockets, etc. In automatic step operation, the Ex-CAL stores the value after the expiry of the desired time and then outputs the next value. When the end of the array is reached, the following message appears:

```
Data complete!
repeat measure?
HM → no ENT → yes
```

Figure 11.3.11 Carrying out measurements

<ENT> restarts the measuring cycle.

The Ex-CAL starts again with the 1st data set. The repeat of the measurement is indicated by the following message on the display.

```
Wiederholung
T(00)      120 °C
lmess      1.023mA
```

Figure 11.3.12 Repeating measurements

Note

Both the first measurement and the repeat measurement can be cancelled at any time by pressing <HM>. If the measurement is cancelled, even at the last measurement point, the job remains registered in the Ex-CAL as not done. When the job is viewed in the job selection menu, no date is shown in the 4th line.

Special features in RS232 operation

A visual feedback measurement is available from Version V3.08. This means that you do not carry out the feedback measurement using the Ex-CAL 3000 but instead read an indication and enter the value into the Ex-CAL via the keypad.

The Interlink software provides a special selection point for this on the PC in the "PROJECT" pull-down menu in the "Assignment" menu item. This also enables you to specify any unit for the feedback measurement. Four ASCII characters are provided for the name of the engineering unit. If you use this option, the Ex-CAL outputs the following screen (Figure 11.3.13).

```
Outp      0...12,500V
U(00)     1.000V
displayed value
VIS=>     0mBar
```

Figure 11.3.13 Visual feedback measurement

The cursor on the arrow tells you that the Ex-CAL is expecting you enter something. The default value for each new measured value is zero. The Ex-CAL will continue to display the value until the necessary entry has been made.

Note:

The visual feedback measurement has a range of -32.000 digits to +32.000 digits. The output format can have up to four decimal places. An automatic step size cannot be selected for visual feedback measurement. The Ex-CAL only shows the next value after you have made a valid entry.

Examples of format:

```
+25000
-2500.0
+250.00
+25.000
-2.5000
```

The flashing cursor disappears when you enter the first digit. You can change the sign in the usual way using the 0 key before entering the first digit. <CL> deletes the entries already made for the current measurement and also allows you to change the sign if necessary.

mA output

A further special feature from Version V3.08 is the option to distinguish between operating modes when outputting current. Basically, the Ex-CAL is able to output current actively or passively. This can now be determined by the software. The user sees the difference in the following screens.

```
active      0.25mA
I(00)=     1.00mA
Steps:     manual
lmeas=     1.002mA
```

Figure 11.3.14 Active current output

```
passive     0.25mA
I(00)=     1.00mA
lmeas=     1.002mA
```

Figure 11.3.15 Passive current output

12. EX-CAL 3000 error messages

The Ex-CAL 3000 has an extensive (self) monitoring system. This provides you, on the one hand, with precise information about the status of your Ex-CAL 3000

and, on the other, notifies you of possible operating errors when using the instrument.

Output of error messages

The Ex-CAL error messages can be divided into two groups:

1. Silent error messages
2. Acoustically supported error messages

The error messages appear as text on the display. The position of the error message depends on the current operating mode. In most cases, the error message appears in the 3rd line of the display. The 4th line usually displays additional information.

Silent error messages

These are mostly just supplementary messages with no special significance whose occurrence only needs to be noted.

Acoustic error messages

More important error messages and notice of incorrect operation are reinforced acoustically by the **"ERROR BEEP"**. This is an audible warning consisting of 3 short tones that should draw your attention to an error message.

12.1 General error messages

Battery voltage warning

The Ex-CAL checks the condition of the batteries immediately when switched on and during the whole period of operation. Notice is given in good time before the batteries become discharged.

12.1.1 Battery early warning stage

As soon as the Ex-CAL detects that the battery voltage has fallen below 6.8 volts, a message stating that the batteries should be recharged is output. A distinction is made between two situations:

12.1.2 Warning immediately after switching on

If you switch on the Ex-CAL with "empty batteries", you will immediately hear the "ERROR BEEP" and the following text appears in the top line of the display:

"LOW BATT warning"

After 2 seconds, the following message relating to the present battery voltage is

output:

```
" Please charge the "  
" batteries "  
" U batt = 6.41 V"  
" continue with CL "
```

Note:

If you now press the CL key the EX-CAL continues the switch on procedure. You should in any case change or charge the batteries as automatic shutdown will occur in a few minutes.

This is done to avoid deep discharge of the batteries and also to ensure that the voltage is sufficient for all operating modes.

12.1.3 Warning during operation

If your Ex-CAL has been in operation for some time, the early warning is output on just one line. Once again, this is accompanied by an ERROR BEEP. The battery voltage is not shown in active menus, so that, in most cases, you can continue work without interruption.

Note:

When you quit the current menu, the Ex-CAL continues to display the battery voltage until you acknowledge it by pressing CL. If you continue working in another menu, you will receive a message there as well. As far as is possible, the message will always be visible in the display. Acknowledgement in an active menu is not necessary. Provided you did not get the warning immediately after switching on, you can continue working for up to an hour before shutdown occurs, depending on operating mode.

12.2 Error message in the MEASURING mode

12.2.1 Overflow message during voltage measurement

In the voltage mode you will receive the message

```
" * OVERFLOW * ",
```

in the 2nd line as soon as you violate the measuring range.

Note:

If you have not yet reached the end of the range, you can change to the next higher range by pressing the ↑ key. Violating a range does not cause any damage

to the Ex-CAL provided the absolute limit value is not exceeded.

12.2.2 Measuring range error message during voltage measurement

The Ex-CAL 3000 has five measuring ranges, and these can be selected directly in the active menu using the arrow keys. If you are already in the highest range, you will get the ERROR BEEP if you press the ↑ key again, followed by a message in the bottom line.

" Maximum range "

After 2 seconds the normal user guide appears again.

If you are already in the lowest range, you will get the ERROR BEEP if you press the ↓ key again, followed by a message in the bottom line:

" Minimum range "

After 2 seconds the normal user guide appears again.

12.2.3 Overflow message when measuring current

In the current measurement mode, you will get the ERROR BEEP and the following message in the 2nd line:

" * OVERFLOW * "

This appears as soon as the current you are measuring exceeds the measuring range of 300 mA.

!!! Important!!!

In the Current measurement mode, the Ex-CAL can withstand a current of 5 times the rated current for a short period without damage. If, however, the connections are incorrect, this value can be quickly exceeded. Therefore, to avoid damage to the Ex-CAL, you should stop the measurement immediately if you hear the ERROR BEEP and see the above message in the display.

12.2.4 Overflow message during temperature measurement

During temperature measurement you will receive one of the messages below depending on whether the overflow is positive or negative:

a.) positive overflow

" S Type +>>.>°C "

b.) negative overflow

" S Type ->>.>°C "

Note:

A positive overflow may also indicate a sensor break. You will also receive the positive overflow message if you use the wrong sockets. With thermocouple measurement, the room temperature will be displayed in the case of a short circuit.

12.3. Error messages in ACTIVE operation

12.3.1 Error message during output of voltages or thermal EMFs

The Ex-CAL checks whether the output agrees with the desired voltage. If the deviation is too great, you will get the ERROR BEEP and, in the 3rd, line, the error message

" Load too low "

This message is displayed until the error is corrected.

Note:

As long as this message is visible, you cannot increase the value of the voltage in the fixed value output. In the 3rd operating mode, "Ramp functions", the Ex-CAL remains "stopped" at its preset output level after issuing an error message of this type if the next value would be higher than this. It is possible to reduce the value manually, and this would also be carried out by the ramp function.

Correction of operating value?

An error message of this type can also indicate that some operating values in the Ex-CAL have changed due to ageing and therefore needs to be corrected.

12.3.2 Error message during current output

The Ex-CAL checks whether the output agrees with the desired thermal EMF. If the deviation is too great, you will get the ERROR BEEP and, in the 3rd, line, the error message

```
" Load ?? "
```

This message remains visible until the error is corrected.

Note:

As long as this message is visible, you cannot increase the value of the current in the fixed value output. In the 3rd operating mode, "Ramp functions", the Ex-CAL remains "stopped" at its present output level after issuing an error message of this type if the next value would be higher than this. It is possible to reduce the current manually, and this would also be carried out by the ramp function.

This error message also appears if the wrong output sockets have been used or if the current circuit is broken.

Correction of operating value?

An error message of this type can also indicate that some operating values in the Ex-CAL have changed due to ageing and therefore need to be corrected.

12.4 Error messages resulting from input errors

12.4.1 Limit value violations

If you enter values into the Ex-CAL 3000, a check is made as to the validity of your entries. If you exceed the limits shown in line 3, you will get an ERROR BEEP followed by the message

```
" W A R N I N G "  
" Observe "  
" limit values "
```

After 2 seconds the input screen reappears.

12.4.2 Number of places before decimal point exceeded

If the Ex-CAL expects a particular number of places before the decimal point and you have already entered these, the Ex-CAL responds to the input of a further digit with an ERROR BEEP and displays one of the following messages for approximately 2 seconds in the 4th line, depending on whether places after the decimal point are permitted:

```
"ENT HM DP or CL"  
"ENT HM or CL  "
```

This means that the EX-Cal will only accept one of the above named keys. ENT to confirm the entry, HM for general cancel, DP to enter decimal places or CL to begin the entry again.

12.4.3 Number of places after decimal point exceeded

The number of decimal places has been specified. If more are entered, the Ex-CAL responds with the ERROR BEEP and displays the following error message in the 4th line for approximately 2 seconds:

```
"ENT HM or CL  "
```

This means that the EX-Cal will only accept one of the three keys named above. ENT to confirm the entry, HM for general cancel or CL to begin the entry again.

13. Repairs

The general terms and conditions of ELEX V apply to repair work. We recommend the repair is carried out by the manufacturer, since the protective circuits must be checked after repair for safety reasons.

14. Guarantee

The material and functionality of the instrument is guaranteed by us for a period of one year from the date of delivery. Claims can be made under guarantee by sending the defective unit to us. We reserve the right to repair, recalibrate or replace the unit.

15. Liability

ECOM accepts liability for the provisions of the guarantee. No responsibility is accepted for damage, costs or losses arising from the use or purchase of the instrument. ECOM will not be responsible for any special damages that occur or for consequential damages.

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