

Betriebsanleitung
Operating instructions
Guide de l'utilisateur
Manuale di istruzioni

Millimar S 1840

Mahr

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Dear valued customer,

Congratulations on choosing a product by Mahr GmbH. We kindly request that you follow the instructions below in order to ensure the long-term precision of your measuring instrument.

We operate a policy of continuous improvement and are constantly developing our products, especially with regard to renaming of type designations. It is possible therefore that there may be slight differences between the text and illustrations in this document and the measuring instrument in your possession. We reserve the right to make changes to the design and scope of supply, the right to undertake further technical developments, and all rights relating to translation of this documentation.

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The following symbols are used in these operating instructions:

General information.

Important information.
Failure to follow instructions marked with this symbol can cause inaccurate results and lead to equipment damage.

Permitted Uses

The Millimar S 1840 measuring instrument is easy to operate and designed for use in production. Two versions are available:

S 1840:
For connecting one or two inductive probes.

S 1840 PE:
For connecting pneumatic measuring equipment (measuring mandrel, measuring ring or nozzle, measuring mandrel, nozzle measuring ring).

The operating, maintenance and repair information specified in these operating instructions must be observed.

Disposal



Electronic devices, including accessories and used batteries (rechargeable and disposable), must not be disposed of as regular garbage, since they contain high-value materials that can be recycled and reused. European Directive 2002/96/EG (WEEE) requires that electrical and electronic devices must be collected separately to unsorted municipal waste so that they may be subsequently reprocessed. The crossed-out garbage can symbol indicates that separate collection is necessary.
Mahr GmbH carries out the redemption and disposal of its electrical and electronic products in accordance with legal requirements. Please contact your local service representative.

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Mahr GmbH is registered in Germany with the Elektro-Altgeräte-Register (EAR, 'national register for used electrical appliances') under WEEE Reg. No. DE 56624193.

Voided warranty

Service that is due to viruses that were introduced via a network connection or other data carrier, are generally excluded from the warranty services.

Storage temperatures below –10 °C or above +50 °C and relative humidity levels above 85 % will invalidate the warranty for the instrument.



Safety Instructions

This instrument complies with the relevant safety regulations. It was dispatched from our production facility in good condition and perfect working order. However, failure to follow the instructions given below can cause personal injury or death.

1. Before you connect up and use the equipment for the first time, read the accompanying documentation. Follow the safety precautions detailed in the operating instructions.
2. Keep the documentation close to the equipment ready for quick reference.
3. Follow safety precautions, accident prevention regulations and internal company instructions. You should request further information from your company safety officer.
4. Before you connect up the equipment, check the local supply voltage to make sure that it is within the working range of the AC adapter (100 V - 240 V, 50 Hz - 60 Hz). If they do not match, the instrument may not be connected under any circumstances!
5. The instrument may only be connected to a grounded power socket which complies with the regulations of the local power supply company. This also applies to any extension cables used.
6. Only use original, intact AC adapters.
7. When connecting inductive probes make sure that the plug are firmly screwed onto the connection sockets.
8. When connecting pneumatic probes make sure that the compressed air is connected properly.
9. Do not drop the instrument and make sure it is positioned securely.
10. Do not operate the instrument in areas where there is a risk of explosion and do not expose the instrument to direct sunlight!
11. Do not clean the membrane keypad with cleaners that contain solvents.
12. Before opening the housing, disconnect the power supply.
13. The gages with which the Millimar is used are subject to gage monitoring. For this reason, gage monitoring performed by the user or Mahr Service must ensure adherence to the specified error limits.

Order No.	Last Modification	Version
3760807	15.04.2011	Valid as of version V3.38 Original operating instructions

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The following symbols are used in these operating instructions:



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Caution. Non-observance of this information can result in incorrect measurements or even damage to the instruments!

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0 Commissioning

1. Carefully unpack the Millimar, the probe and the AC adapter.

   Do **not** dispose of the original packaging. In case of a complaint or repair, the relevant components must be returned to the manufacturer in the original packaging. Damage that occurs due to shipping in unsuitable packaging is not part of the Mahr GmbH warranty obligation!

2. Use the AC adapter included in the scope of delivery to connect the Millimar to the power supply.

   Using a different AC adapter is not permitted. Damage that occurs due to using a different AC adapter is not part of the Mahr GmbH warranty obligation!

3. Connect the probe(s) to C1 and/or C2.

   The S 1840 PE units have only one probe input.
   In contrast, the S 1840 units have two probe inputs. An inductive probe can be connected to each input of the S 1840.

4. Switch on the instrument using the ON/OFF switch.
   A self-test is performed automatically. When the self-test is complete, the flashing entry "DEUTSCH" appears on the display.

5. Use the **DATA** and **MASTER** keys to select the required display language (German, English, French, Spanish, Italian, Portuguese or Swedish).
   The selected setting can be changed later at any time.

6. Press **START** as soon as the required language is displayed.
   The flashing entry "MM" appears on the display.

7. Use the **DATA** and **MASTER** keys to select the unit of measurement (mm, µm or inch) with which the measuring values are to be displayed.
   The selected setting can be changed later at any time.

8. Press **START** as soon as the required unit of measurement is displayed.
   The size of the current indication area of the light bar is shown on the display. The measuring value of the connected probe is shown on the display and on the light bar.

9. Upon delivery, the linking formula "+C1 + C2" is set for instruments with inductive module and "+C1" for instruments with PE module. These settings can be changed at any time in the catalog of functions and parameters (see point 12).

10. Set the light bar indication range. To do this:
    - Press these keys: 1 × **MENU** key, 2 × **MASTER** key, 2 × **MENU** and 3 × **MASTER** key until "RANGE1" is shown on the display.
    - Press the **MENU** key again. The indication range currently valid for the selected unit of measurement flashes (e.g. "*1" for ± 1 mm).
    - Use the **DATA** and **MASTER** keys to set the indication range to be used.
    - Accept the indication range set by pressing **START** once.

11. Set the value displayed for the probe(s) to zero. To do this, press the **MASTER** and **START** keys in sequence.

12. Change the instrument settings as required. To do so, use the **MENU** key to open the Millimar catalog of functions and parameters. The following is shown on the display:

    ```
    FEATURE
    1.
    ```

    The designation shown in the upper line (here "`Feature`") indicates the function currently in use; the numerical value in the lower line (here "1.") indicates the internal numbering of the respective function or setting. This means that the number of places in the lower line indicates the user's exact current position in the catalog of functions and parameters.

Navigating in the catalog of functions and parameters

While navigating in the catalog of functions and parameters, the red arrows on the instrument's keys show the direction in which the uses moves through the catalog by pressing the respective key.

Use the **DATA** and **MASTER** keys to select other functions/settings on the same level.

Use the **MENU** key to indicate the sub-functions/ settings available for the currently displayed function/sub-function.

Use the **ESC** key to return to the higher function level.

Use the **START** key to accept the parameter settings. This automatically returns the user to the higher function level.

Changing numerical values for parameter settings

– Select the parameter to which the numerical value belongs and press the **MENU** key.
  The numerical value is then displayed with the preceding sign flashing.

– Use the **DATA** and **MASTER** keys to set the preceding sign ("+" or "-").

– Use the **MENU** key to move to the first digit of the numerical value (this place then flashes) and then use the **DATA** and **MASTER** keys to set it to the required number.

– Use the **MENU** key to move to the next digit of the numerical value and set it to the required number as well.

If a digit does not need to be changed, press the **MENU** key repeatedly until the next digit to be changed starts flashing. If a digit is skipped unintentionally, use the **ESC** key at any time to return to this digit and change it as described. Pressing the **ESC** key while the preceding sign is flashing moves the user to the last digit of the numerical value.

– Set the other digits of the numerical value as described.

– When the numerical value is set as required, press the **START** key.
  The numerical value input terminates and the set numerical value starts flashing. Finally, accept the flashing value with the **START** or **ESC** key. Accepting the value returns the user to the higher function level as well. Pressing any of the other keys returns the user to numerical value input.

Further information regarding the keys on the keypad can be found in section "Operating elements and connections" in these operating instructions.

To make configuration easier, the Windows software "Millimar D 1000 S" is available on the Mahr GmbH website ("www.mahr.de") (web code #6776).

The most important settings can be made using this tool via a Windows user interface.

1 General

The Millimar S 1840 measuring instrument is easy to operate and designed for use in production. Two versions are available:

S 1840:
For connecting one or two inductive probes.

S 1840 PE:
For connecting pneumatic measuring equipment (an air plug gage or ring gage, or a nozzle plug or ring gage).

Both versions can be used to carry out both dynamic and static measurements.

The current measuring value is shown as an illuminated point in the light bar and as a numerical value on the display. The measuring values of two probes can be displayed at the same time.

The resolution can be set at a variety of stages. The lowest possible resolution is 0.1 µm.

In addition to the current measuring value, the sum or the difference of the measuring values of two probes can be displayed as well.

Internal measuring value memories enable the recording of maximum, minimum and mean values over a specific period of time (measurement period). At the end of the measurement period, the features are calculated and displayed based on these values.

The measurement period can be specified using the Millimar keypad, an external control signal or an internal timer (internal clock).

Depending on the interface protocol selected, the RS-232 interface enables the transfer/ query of measuring results to/from an external computer and the query/adjustment of the instrument parameters from/by a computer and the connection of a printer..

Other instruments in the Millimar series or a PLC can be connected at the (I/O) interface for additional instruments.

The Millimar S 1840:

- For performing static or dynamic measurements
- Analog results display
- Digital results display
- All functions are easy to set with 6 function keys
- MarTalk for convenient programming using a connected Windows computer
- RS-232 interface for sequence control or for integration into a quality assurance system
- Parallel interface for additional instruments with three optocoupler -controlled inputs and outputs controlled plus one analog output
- The 400 most recent measuring values are saved in the Millimar and read out using the RS-232 interface
- Customer calibration

2 Operating elements and connections

2.1 Front panel of the Millimar

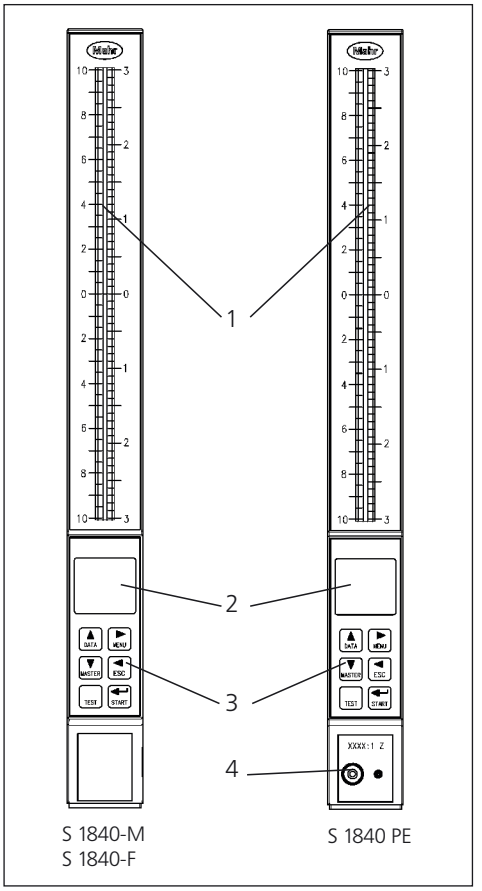


Fig. 1
Front panel of the Millimar S 1840

1 Light bar
2 Display
3 Keypad
4 Connection for pneumatic measuring equipment

Light bars (1)

The light bar serves as an analog results display. Tolerance and warning limits are shown as illuminated points.

The color of the light bar depends on the relationship of the results to the tolerance limits. The colors with which the tolerances (compliance, marginal or exceeded) are displayed can be selected in the catalog of functions and parameters under "FEATURE" --> "TOLRNCE"-->"COLOR (1.4.1)".

Display (2)

The display shows the numerical results and the parameters of the catalog of functions and parameters.

Keypad (3)

The keypad has 6 keys. Four of the keys (**DATA**, **MENU**, **MASTER** and **ESC**) are used to navigate in the Millimar's catalog of functions and parameters.

MENU ►

Displays the Millimar's catalog of functions and parameters.
In the catalog of functions and parameters itself, this key is used to move into the sub-functions or to input numerical values.
When inputting numerical values, this key is used to move from one digit to the next digit to the right. The digit that is currently being set flashes.

DATA ▲

For navigating in the catalog of functions and parameters and for starting data transfer.
This key is used to page up within a function level of the catalog of functions and parameters so that further functions/settings can be displayed.

When numerical values are set, pressing this key increases the value of the flashing (currently selected) digit by 1.
When the number 9 is currently displayed and the **DATA** key is pressed, the number 0 will then be displayed.

Press the **START** key to complete the entry of numerical values. The numerical value entered flashes. Press **START** again to accept the numerical value.

If the **DATA** key is pressed after a measurement is completed, data are sent to a connected PC if the interface is set accordingly (see section 14).

MASTER ▼

In measuring mode, this key is used to start a master measurement.
In the catalog of functions and parameters, this key is used to page down within the current function level so that further functions/settings can be displayed.

When numerical values are set in the catalog of functions and parameters, pressing this key decreases the value of the flashing (currently selected) digit by 1. When the number 0 is currently displayed and the **MASTER** key is pressed, the number 9 will then be displayed.

Press the **START** key to complete the entry of numerical values. The numerical value entered flashes. Press **START** again to accept the numerical value.

ESC ◄

This key is used in the catalog of functions and parameters to move from subordinate function levels into the respective higher level.

When inputting numerical values, this key is used to move from one digit to the next digit to the left. The digit that is currently being set flashes.

Pressing **ESC** in setup mode ends the setup.

Restoring factory settings

Pressing the **ESC** key directly after switching on the instrument initializes the instrument, i.e. restores the basic settings present at delivery. This is indicated by the message "INITALL", which is shown on the display during the initialization.

— Press the **ESC** key when switching on the Millimar. The message "INITALL" is displayed. Then the flashing message "DEUTSCH (4.3.1)" is displayed.

— Use the **DATA** and **MASTER** keys to set the display language and accept it by pressing **START** twice. The flashing message "MM (4.4.1)" is displayed.

— Use the **DATA** and **MASTER** keys to set the unit of measurement and accept it by pressing the **START** key twice. The message "MAHR" is displayed and then the current probe value.

TEST (probe raw value display)

This function is required for moving and correctly positioning (setting up) the probe(s) in the measuring device because it displays the current position of the probe(s) without a factor and without a master correction.

The measuring value of the probe at C1 is displayed in the upper half of the light bar and in the top line of the display. The measuring value of the probe at C2 is displayed in the lower half of the light bar and in the bottom line of the display.

If the **DATA** or **MASTER** key is pressed, the message "SETTING" and the display range currently set are shown. Press either key again to increase or decrease the size of the display range according to the programmed gradations.

Use either the **ESC** or **START** key to close the setup mode.

START

This key is used to conclude the setting selection or numerical value setting in the catalog of functions and parameters. The most recently selected settings and numerical values are flashing on the display.

Press the **START** key again to accept the flashing settings and move to the next higher level of the catalog of functions and parameters. The changed settings are immediately used in the following measurement.

When **START** is pressed in the first function level (1., ..., 4.) or second function level (1.1, ..., 4.9) of the catalog of functions and parameters, the catalog of functions and parameters is left.

Press **START** in setup mode (**TEST**) to close setup mode.

Depending on the settings selected under PROCESS (of measurement), pressing **START** either starts individual measurements or measuring cycles. If the approproate settings have been set, **START** is used not only to start measurements, but also to end them (see section 10.2).

2.2 Rear panel of the Millimar

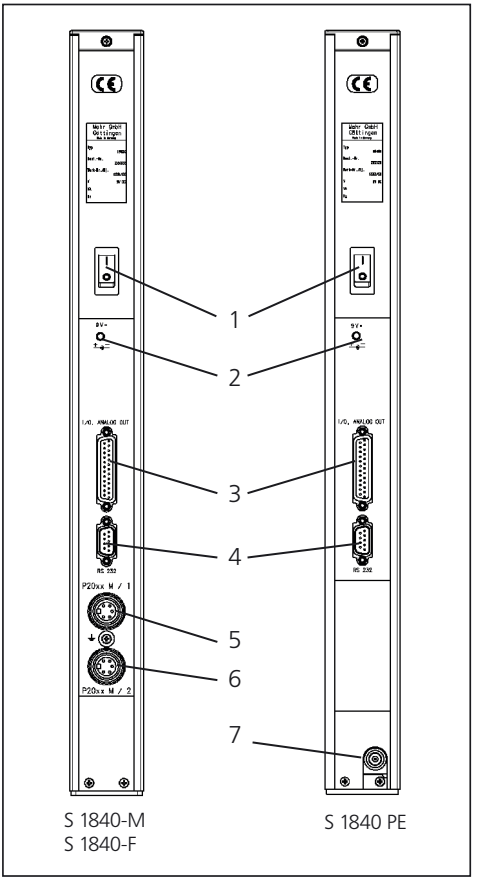


Fig. 2
Rear panel of the Millimar S 1840

1 ON/OFF switch
2 Connection for AC adapter
3 Interface for additional instruments (25-pin D-Sub)
4 Serial RS-232 interface (9-pin D-Sub)
5 Connection for inductive probe (channel C1)
6 Connection for inductive probe (channel C2)
7 Air supply connection, 2 bar (S 1840 PE) Air supply connection, 2.1 bar (S 1840 PE Fed)

ON/OFF switch (1)

The Millimar is switched on and off with the ON/OFF switch.
After the instrument is switched on, the software is booted and the following are displayed sequentially: the instrument type, the software version number, compatibility of the probe inputs, and finally, the current measuring or result value.

Connection for the AC adapter (2)

The AC adapter is connected to the connection point marked "9 V ⎓". This AC adapter covers the voltage range from 100 V to 240 V and the frequency range between 47 Hz and 63 Hz.

Using other power supply units is not permitted.

The AC adapter has a replaceable plug adapter to adapt it to the respective national plug standard. To replace the plug adapter, the existing adapter type must simply be pulled out of the adapter housing and the required adapter type inserted into the corresponding contact rails.

Parallel interface (3)

The 25-pin interface designated "I/O" enables data to be transferred from and to other instruments in the Millimar series (e.g. foot switch) or a PLC for automatic sorting procedures (see section 15, "Working with the parallel ("I/O") interface.

Serial RS-232 interface (4)

A printer or computer can be connected to this 9-pin interface. If necessary (e.g. if the measuring value memory is full and there is a risk that the oldest entries could be overwritten by the most recent entries), existing data can be printed out using the connected printer and then deleted.

If a computer is connected, depending on the Millimar interface setting, the following can be done:

- Measuring values can be sent to the computer or retrieved from it
- Parameter settings can be changed by the computer or retrieved from it
- Measurements can be started/ended by the computer

The data saved in the computer can be processed further using the corresponding programs (statistics programs, QS programs, ...) (see section 14, "Working with the serial (RS-232) interface").

Connections for inductive probes (5 + 6)

The probe connection sockets are marked with colored rings for the different probe compatibilities. The label is designed for original Mahr probes in the P20xx series.

Depending on the Millimar type, other probes can be connected as well. The following list is not exhaustive:

Probe	Ring color	/
Mahr	Red	M1 and M2
Tesa	Gray	T1 and T2
Federal	White	F1 and F2

Pneumatic connection (7)

The Millimar is also available with an integrated P/E converter. A pneumatic measuring element can be connected to this converter on the front panel. Depending on the converter design, (Mahr or Mahr /Federal), the following magnifications can be used: 2500:1, 5000:1 or 10000:1 (in accordance with the label).

Air is supplied at the compressed air supply connection on the instrument's rear panel (pressure regulator required). There are no connections for inductive probes on this instrument type.



Use a suitable fine pressure regulator to set the supply pressure to 2 bar. The compressed air used must be free of oil and dust.

3 Making basic settings

3.1 Selecting the display language

The settings for the catalog of functions and parameters are available in the following languages:

German	English	French
Spanish	Italian	Portuguese
Swedish		

The language can be selected during the initial commissioning of the instrument (see the section "Commissioning"). The language settings selected there can be changed at any time, however. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Use the **DATA** and **MASTER** keys to select the "LANGUAG (4.3)" setting.
5. Press **MENU** again. The currently valid language setting flashes.
6. Use the **DATA** and **MASTER** keys to select the new display language (Deutsch, English, Franç., Ital., Español, Portug. or Svenska).
7. Press **START**. The designation of the selected language flashes.
8. Press **START** again to accept the flashing display language. The catalog item "LANGUAG (4.3)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 6). A different display language can be selected.

9. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.2 Setting light bar brightness

Light bar brightness can be adjusted for the lighting conditions of the installation site. Upon delivery, a medium brightness is set. However, the user can change this setting at any time. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Press **MENU** again.
   The "FEATURE (4.1.1)" setting is displayed.
5. Use the **DATA** and **MASTER** keys to select the "LUMINCE (4.1.3)" setting.
6. Press **MENU** again. The currently set brightness level flashes.
7. Use the **DATA** and **MASTER** keys to select the new brightness level: (HIGH, MIDDLE, LOW).
8. Press **START**. The designation of the selected brightness level flashes.
9. Press **START** again to accept the flashing brightness level. The catalog item "LUMINCE (4.1.3)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 7). The brightness level can be changed again.

10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.3 Setting the unit of measurement

Workpiece dimensions and deviations are usually toleranced with a specific unit of measurement. To simplify checking, it is recommended that this specific unit of measurement is also used to display the measuring values. Workpiece dimensions and deviations can be displayed on the Millimar with the following units of measurement: millimeters, micrometers or inches.

The unit of measurement can be selected during the initial commissioning of the instrument (see the section "Commissioning"). The unit selected there can be changed at any time, however. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Use the **DATA** and **MASTER** keys to select the "UNIT (4.4)" setting.
5. Press **MENU** again. The currently set unit of measurement flashes.
6. Use the **DATA** and **MASTER** keys to select the new unit of measurement (MM, INCH or MICRON).
7. Press **START**. The designation of the selected unit of measurement flashes.
8. Press **START** again to accept the flashing unit of measurement. The catalog item "UNIT (4.4)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 6). The unit of measurement can be changed again.

9. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   The selected unit of measurement is shown at the lower edge of the display: mm, µm or inch.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.4 Setting the resolution/display format of the measuring value

The resolution of the numerical display can be selected based on the type and magnitude of the expected display value. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Press **MENU** again.
   The "FEATURE (4.1.1)" setting is displayed.
5. Use the **DATA** and **MASTER** keys to select the "RESOL. (4.1.2)" setting.
6. Press **MENU** again. The currently set display format (as schematized number of places preceding and following the decimal point in the display) flashes.
7. Use the **DATA** and **MASTER** keys to select the new display format. The following can be selected:

mm	**µm**	**inch**
000.00	00000	000.0000
000.000	00000.0	0.00000
000.0000	00000.00*	0.000005
0.00000		0.000000

8. Press **START**. The selected display format flashes.
9. Press **START** again to accept the flashing display format. The catalog item "RESOL. (4.1.2)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 7). The display format can be changed again.

10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again. The value is shown on the display with the selected resolution.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.5 Selecting the number of features/ test results to be displayed

Up to two features can be displayed simultaneously with the Millimar. However, this is only possible for static measurements. For this reason, before starting measurements, the number of features (1 or 2) to be displayed must be specified. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Press **MENU** again.
   The "FEATURE (4.1.1)" setting is displayed.
5. Press **MENU** again.
   The currently valid setting flashes.
6. Use the **DATA** and **MASTER** keys to select the feature display mode. The mode options are:

   `1 FEAT` One feature of either a static or dynamic measurement will be shown in the bottom line of the display.

   `2 FEAT` Two features of a static measurement are displayed.
   The value of the first feature is displayed in the upper half of the light bar and in the top line of the display.
   The value of the second feature is displayed in the lower half of the light bar and in the bottom line of the display.

   However, this is only possible within certain limits. The Millimar switches from channel to channel four times a second and digitalizes the values assessed there. Can only be used with static measurements!

   `AUTODET` One of the two values of a static or dynamic measurement is shown in the bottom line of the display. The display switches from one feature to the other when the specified section limits are exceeded or when a control signal is transmitted via the I/O interface.

7. Press **START**. The selected feature display mode flashes.

8. Press **START** again to accept the flashing setting. The catalog item "FEATURE (4.1.1)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 6). The type of feature display can be changed again.

9. If no other settings are to be made in the catalog of functions and parameters, press **START**. Depending on the selection, one or two measuring or result values are displayed.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

If the "2 FEAT" or "AUTODET" mode was selected, after the catalog of functions and parameters is closed, the entailed changes are put into effect in the display and/or in the structure of the catalog of functions and parameters.

AUTODET
If this mode was selected, menu item FEAT. 2 is shown in addition to the FEAT. 1 item in the catalog of functions and parameters. In addition, the function DET LIM is offered both for FEAT. 1 (1) and FEAT. 2 (2). This function enables limits to be set for automatic feature recognition.

2 FEAT
If this mode was selected, the function FEAT. 2 is shown in addition to FEAT. 1 in the catalog of functions and parameters. In the top line of the display, instead of the currently valid display range, the numerical value of the first feature is shown; the value of the second feature is shown in the bottom line.

3.6 Setting the light bar display range

The size of the light bar display range (RANGE) can be changed. In this case, the scaling for the light bar is adjusted accordingly. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Press **MENU** again.
   The "FEATURE (4.1.1)" setting is displayed.
5. Use the **DATA** and **MASTER** keys to select the "RANGE 1 (4.1.4)" setting.
6. Press **MENU** again. The currently set size gradation for the display range(s) flashes.
7. Use the **DATA** and **MASTER** keys to select the new gradation. The following can be selected:

mm	**µm**	**inch**
10	10 000	0.3
3	3 000	0.1
1	1 000	0.03
0.3	300	0.01
0.1	100	0.003
0.03	30	0.001
0.01	10	0.0003
0.003	3	0.0001
0.001*	1*	0.00003*
0.0003*	0.3*	0.00001*
I– – – – –I	I– – – – –I	I– – – – –I
AUTO R	AUTO R	AUTO R

The entry "I– – – – –I" stands for "tolerance limited". In this case, the display range represents the area between the lower and upper tolerance limit. This allows the user to quickly read where the current measuring value lies in the tolerance range. Trends (e.g. dimensions that are constantly increasing) can be recognized quickly and corresponding corrective measures can be taken.

In the "AUTO R" (= Autorange) setting the display range used is the smallest in which the measuring values can still be displayed.

* These display ranges are only available if the maximum resolution was set under SETTING->DISPLAY->RESOL.". In this case, the measuring ranges is limited to ± 0.2 mm.

8. Press **START**. The selected size gradation flashes.

9. Press **START** again to accept the flashing setting for the size gradation. The catalog item "RANGE 1 (4.1.4)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 7). The display range can be changed again.

   If the two feature display mode is set ("SETTING" -> "DISPLAY" -> "FEATURE" -> "2 FEAT" (4.1.1.2)), the **DATA** and **MASTER** keys can be used to select the setting "RANGE 2 (4.1.6)" in order to set the display ranges for the second feature as described above.

10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again. The value is displayed in the light bar in the selected display range.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.7 Setting the origin of the display range

The origin of the light bar display range can be set for each of the two display ranges. To do so:

1. Press the **MENU** key while the current measuring value or result is displayed.
   The catalog of functions and parameters opens and the "FEATURE (1)" setting is displayed.
2. Use the **DATA** and **MASTER** keys to select "SETTING (4)".
3. Press **MENU** again.
   The "DISPLAY (4.1)" setting is displayed.
4. Press **MENU** again.
   The "FEATURE (4.1.1)" setting is displayed.
5. Use the **DATA** and **MASTER** keys to select the "ORIGIN (4.1.5)" setting.
6. Press **MENU** again. The currently set origin for the light bar display range flashes.
7. Use the **DATA** and **MASTER** keys to select the new origin. The following can be selected: CENTER, BOTTOM and TOP.
8. Press **START**. The selected origin flashes.
9. Press **START** again to accept the flashing origin setting. The catalog item "ORIGIN (4.1.5)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 7). The origin can be changed again.

   If the two feature display mode is set ("SETTING" -> "DISPLAY" -> "FEATURE" -> "2 FEAT"(4.1.1.2)), the **DATA** and **MASTER** keys can be used to select the setting "ORIGIN2 (4.1.7)" in order to set the display range origin for the second feature as described above.
10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again. The light bar is displayed with the selected origin.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

3.8 Assigning frequently used functions onto the MENU key

The **MENU** key is freely programmable. Up to six required functions or sub-functions can be assigned to this key. To do so:

1. Select the required function in the catalog of functions and parameters.
2. When the function is shown on the display, press and hold down the **MENU** key for about three seconds.
3. When the **MENU** key is released, a number between one and six appears briefly, which stands for one of the key's six storage locations.
   The selected function is now saved to the briefly indicated storage location of the **MENU** key.

   It is not possible to save parameter values (e.g. the factor "0.3") or settings (e.g. the unit of measurement "MM") to the **MENU** key.
4. The selected item of the catalog of functions and parameters is displayed again.
5. If no other functions of the catalog of functions and parameters are to be selected and saved to the **MENU** key, press the **START** key. The current measuring value or result is displayed again.

Calling up a function in measuring mode using the **MENU** key:

1. Briefly press the **MENU** key.
   The function saved to storage location 1 is displayed.
   Use the **DATA** and **MASTER** keys to select other functions that have been assigned to the **MENU** key.
2. Press **MENU** again to select or enter the parameter settings or numerical entries for the respective, selected function.
   The settings are selected, changed, set and accepted just like in the catalog of functions and parameters.
   Depending on the selected function, select the sub-entries of the function with the **DATA** and **MASTER** keys.

In case the **MENU** key has functions assigned to it, the **MENU** key must be held down for approx. three seconds to display the "FEATURE (1)" setting of the catalog of functions and parameters.

To delete the frequently used functions assigned to the **MENU** key, select "SETTING" -> "CLR-SEL (4.8)" in the catalog of functions and parameters and then press the **MENU** key. Confirm the prompt with **START**.

The deletion of the **MENU** key assignments can be canceled with **ESC**.

4 Positioning the probe in the measuring device (Setup)

In order to perform measurements with a probe in the entire available measuring range, it must be positioned correctly in the measuring device. If not, the measuring range may be exceeded in either direction.

1. Insert the probe into the measuring device.
2. Place a setting master or a workpiece with known dimensions into the measuring device.
3. Press the **TEST** key.
   The measuring value provided by the probe at C1 is displayed in the upper half of the light bar and in the top line of the display.

   If applicable, the measuring value provided by the probe at C2 is output in the lower half of the light bar and in the bottom line of the display.
4. If the probe cannot be positioned correctly because the Millimar's display range is too small or too large, the range can be changed with **DATA** or **MASTER**. The next smaller or larger display range will then be employed. Press either of the keys again in order to increase or decrease the size of the display range according to the programmed gradations.
5. Set the probe precisely to 0 either by hand or with an existing setting device.
6. Clamp the probe in this position.
7. Use either the **ESC** or **START** key to exit setup mode.

5 Calibrating to compensate for probe sensitivity

Probe sensitivity is subject to variations caused during production, which generally remain at levels less than 0.5 %. These variations can be tolerated for many measuring tasks. In these cases, the Millimar can be operated without calibration for sensitivity compensation. However, in difference measurements (C1-C2) these variations can distort the measuring result to an unacceptable extent.

The sensitivity of the dispay is also subject to variations caused during production. To calibrate just the Millimar, a setpoint generator (e.g. the 1283 WN) can be connected to the S 1840 instead of the probe. However, for exact measurements calibrating the entire measuring chain is to be preferred.

For correcting these variations, the S 1840 offers two options for correcting these deviations – firstly, the signals of both probes/channels can be multiplied with a common factor, or secondly, the sensitivity of the probe connected to C1 can be determined (calibrated) then the sensitivity of the probe connected to C2 adjusted to that of the first probe.

When calibrating the sensitivity of the probe at C1, the respective probe is used to record measuring values at two measuring points which are at a known distance from each other. Most suitable for this procedure are the gage blocks and setting pieces of various sizes with which the entire measuring chain can be calibrated. That means that the deviations in sensitivity induced by production in both the display and the probe can be recorded and corrected.

The size difference of the setting pieces or gage blocks in a measuring range of ± 2000 µm should be at least 500 µm. For measurements in a measuring range of ± 200 µm, the size difference should be at least 100 µm.

5.1 Calibrating a measuring channel

Three standards are required: one for the zero point, one for the positive indication value and one for the negative indication value. A nonimal value adjuster (e.g. Millimar 1283 WN) may be used instead of the standards.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **DATA** key. The catalog item "SETTING (4)" is displayed.
3. Press the **MENU** key again. The catalog item "DISPLAY (4.1)" is displayed.
4. Press the **DATA** key again. The entry "CALIBR (4.9)" is displayed.
5. Press the **MENU** key. The entry "PASSWRD" is displayed along with seven zeroes below it. The first zero is flashing.
6. Enter the password (1 000 000) and confirm with **START**. "CHAN 1 (4.9.1)" is displayed.
7. Press the **MENU** key. "ZERO LO" is displayed.
8. Adjust the value 0 on the nominal value adjuster and confirm with **START**. „OFFSET" will be displayed for about 2 seconds and then menu item „NEG VAL (4.9.1.1.1) together with a numerical value.
9. Use the **MENU**, **DATA** and **MASTER** keys to set the numerical value displayed to the negative value of the nominal value adjuster and accept it with **START**.
10. Set the nominal value adjuster to the negative calibration value and confirm with **START**. „POS VAL (4.9.1.1.1.1) is displayed.
11. Adjust the positive calibration value as detailed for the negative one (see points 9 and 10 of this description). „CHAN 1 (4.9.1) is displayed then.
12. A correction factor is calculated from the measuring values and the nominal values entered. In subsequent measurements, all of the measuring values of the probe at C1 will be multiplied by this factor.

    Correction factors may lie in a range between 0.3 and 3.0. If the calculated factor exceeds this range in either direction, the previously set factor remains in effect and the error message "OUT LIM" is displayed.

13. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    To make further settings, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

5.2 Adjusting the sensitivity of the probe at C2 with respect to that of the probe at C1 (instruments with inductive probes only)

If two probes are used and if the measuring values of both probes are linked to each other, the sensitivity of the probe at C2 must be adjusted with respect to that of the probe at C1.

However, such an adjustment is only possible if the differences in sensitivity are not greater than ± 1.3 %.

In addition, before adjusting one probe sensitivity with respect to the other, the probe at C1 must already be calibrated (see section 5.1).

Two gage blocks of different sizes are required for this adjustment.

1. Clamp the probe at C2 into a suitable holder (measuring stand) and let it contact the smaller gage block.
2. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
3. Press the **DATA** key. The catalog item "SETTING (4)" is displayed.
4. Press the **MENU** key again. The catalog item "DISPLAY (4.1)" is displayed.
5. Press the **DATA** key. The entry "CALIBR (4.9)" is displayed.
6. Press the **MENU** key. The entry "PASSWRD" is displayed along with seven zeroes below it. The first zero is flashing.
7. Enter the password (1 000 000) and confirm with **START**. "CHAN 1 (4.9.1) is displayed.
8. Use **MASTER** to set "CHAN 2 (4.9.2)".
9. Use the **MENU** key to select the setting "OFFS LO".
10. Press **START**. The value displayed changes to 0.000. In addition, ADJ LO is displayed.
11. Remove the smaller gage block and insert the larger one.
12. Use the **DATA** and **MASTER** keys to set the size difference between the two gage blocks **as precisely as possible**.
13. Press **START**.
    The sensitivity of the probe at C2 is adjusted with respect to that of the probe at C1.
14. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    To make further settings, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

6 Making settings for calculating and displaying features

Depending on the device version, either one pneumatic or up to two inductive probes can be connected to the Millimar S 1840. One or two features are calculated from the raw value(s) (see the section "Selecting the number of features/ test results to be displayed") and then displayed. A linking formula is required for calculating the feature (M). This formula consists of a freely selectable factor and the probe raw value(s).

S 1840 PE, S 1840 M, F, T

M = Factor × (± C1)

S 1840 M, F, T

M = Factor × (± C2)
M = Factor × (± C1 ± C2)

If the size of the deviation of a workpiece from a nominal value (nominal size) is to be displayed instead of its absolute value, the nominal size must also be entered.

6.1 Setting the factor for correcting the displayed value of the feature

Certain measuring tasks may require the entry of a factor other than 1 for the linking formula. Such tasks include e.g. measuring the eccentricity of a rotating workpiece or the indirect measurement of a workpiece via contacting with a lever that has a lever ratio other than 1:1.

Entering a factor is also required for probes that do not have standard sensitivity.
The sensitivity of the inductive probe P 2010 M for example is only 1/10 of the standard sensitivity and requires the entry of a factor of 10.

To determine the **eccentricity**, select the function (MAX-MIN). The difference between the greatest and smallest measuring values is determined. Because the measurement is taken over 360°, using a factor of 1 doubles the eccentricity value in the result. A factor of 0.5 can be entered so that the user can read the actual eccentricity directly without having to recalculate the values displayed. Using this factor, the calculated value is halved, so the eccentricity is correctly displayed.

If the workpiece is contacted indirectly by a lever with a lever ratio other than 1:1, the value displayed is distorted in proportion to the lever ratio. With a lever ratio of 1:5 (contact point on the workpiece - center of rotation of the lever - contact point on the lever), the value displayed is 5 times greater than the actual deviation. In order to read the deviation directly for a lever ratio of 1:5, a factor of (1 : 5 =) 0.2 must be entered.

In addition, the preceding sign of the factor can change the algebraic sign of the value displayed.
Example:

A feature is calculated using the factor: -0.5 and the formula: -C1. The directly measuring value (the raw value) is 1000 µm.
Feature = Factor × Formula
= -0.5 × (-(1000 µm))
= +500 µm

Setting the factor for correcting the value displayed

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Press the **MENU** key a third time. The currently valid numerical value of the factor is shown below the "FACTOR" entry with a flashing preceding sign.
4. Change the preceding sign and numerical value as required (see the section "Changing numerical values for parameter settings" in section 0.)
5. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.
6. Press **START** again to accept the flashing value as the current setting. The catalog item "FACTOR (1.1)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to setting the numerical value (see point 4). The numerical value displayed can be changed again.
7. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

   If the factor of a linking formula is often changed, this catalog function can be assigned to the **MENU** key to enable rapid access.

6.2 Selecting a channel or channel linking (formula)

A linking formula is required for calculating a feature. This formula consists of a factor that specifies the magnitude of the values displayed (see section 6.1) and a channel link, the so-called "linking formula".

Setting the linking formula

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to select the "FORMULA (1.3)" setting.
4. Press the **MENU** key. The currently set linking formula flashes.
5. Use the **MASTER** and **DATA** keys to set the linking formula to be used. The following can be selected:

+C1	Raw value of the probe at C1
−C1	Inverted raw value of the probe at C1
+C2	Raw value of the probe at C2
−C2	Inverted raw value of the probe at C2
C1 + C2	Sum of the raw values of the probes at C1 and C2
C1 − C2	Difference of the raw values of the probes at C1 and C2. If C2<C1, the difference is positive; if C2 > C1, it is negative
C2 − C1	Difference of the raw values of the probes at C1 and C2 If C2>C1, the difference is positive; if C2 < C1, it is negative
−C1 −C2	Difference between the two inverted raw values of the probes at C1 and C2

6. Press **START** as soon as the required formula is displayed. The formula starts to flash.

7. Press **START** again to accept the flashing formula as the current setting. The catalog item "FORMULA (1.3)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 5). If necessary, another formula than the one displayed can be selected now.

8. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.



If the linking formula (channel linking) is often changed, this function can be assigned to the **MENU** key to enable rapid access.

7 Selecting features

One or two features can be calculated and displayed simultaneously with the Millimar.
If one or two features are to be displayed is set in the catalog of functions and parameters under "SETTING"-> "DISPLAY"--> "FEATURE (4.1.1)" (see the section "Selecting the number of features/test results to be displayed").

1. Press the **MENU** key. One of the following catalog of functions and parameters entries is displayed: "FEATURE (1)" (if one feature is to be displayed) or "FEAT. 1 (1)" (if two features are to be displayed).
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to set "FNCTION (1.2)".
4. Press the **MENU** key. The currently set function flashes.
5. Use the **DATA** and **MASTER** keys to select the function for the feature to be calculated. The following can be selected:

NORMAL	The current measuring value that is calculated from the selected linking formula is always displayed.
MAXIMUM	The greatest measuring value (maximum value) is always shown. The value displayed only changes if the currently valid maximum value is exceeded.
MINIMUM	The lowest measuring value (minimum value) is always shown. The value displayed only changes if a value falls below the currently valid minimum value.
MAX – MIN	The difference between the lowest previously measured value (minimum value) and the greatest previously measured value (maximum value) is always shown. The value displayed only changes if a value less than currently valid minimum value is recorded or if the currently valid maximum value is exceeded.
MAX + MIN	The sum of the lowest previously measured value (minimum value) and the greatest previously measured value (maximum value) is always shown. The value displayed only changes if a value less than currently valid minimum value is recorded or if the currently valid maximum value is exceeded.
AVERAGE	The average of all of the previously measured single values is always shown. The average value is calculated using the following formula: (Measuring value 1 + Measuring value 2 + ... + Measuring value x) ÷ Number x of single measuring values

6. Press **START** as soon as the required function (required feature) is displayed. The just set function flashes.

7. Press **START** again to accept the flashing setting (feature). The catalog item "FNCTION (1.2)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 5 of this description). Another function (another feature) can be selected.

8. If only one feature is to be displayed, use **START** to close the catalog of functions and parameters. However, if two features are to be displayed, points 9 through 17 of these instructions must still be carried out.

9. Press the **ESC** key. The "FEAT. 1" setting is displayed.

10. Press the **MASTER** key. The "FEAT. 2" setting is displayed ("2 FEAT (4.1.1.2)" must be set under "SETTING" --> "DISPLAY" --> "FEATURE".

11. Press the **MENU** key again. The entry "FACTOR (2.1)" is displayed.

12. Use the **DATA** and **MASTER** keys to set "FNCTION (2.2)".

13. Press the **MENU** key. The currently set feature flashes.

14. Use the **DATA** and **MASTER** keys to select the function to be calculated (see point 5).

15. Press **START** as soon as the required function (required feature) is displayed. This function flashes.

16. Press **START** again to accept the flashing setting. The catalog item "FNCTION (2.2)" is displayed again.

17. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.



If the function (feature) is often changed, this function can be assigned to the **MENU** key to enable rapid access.

8 Master measurement

Measurements made with just one probe are generally comparative measurements, i.e. the deviations from a nominal value are measured and displayed. These nominal values are determined using measurements on gage blocks, setting gages or special workpieces with known dimensions i.e. so-called master workpieces ("masters" for short). These master measurements are performed before beginning the actual measurement.

There one point and two point master measurements.

In a **one point master measurement** only one master (gage block) is contacted and the value displayed is compared with the nominal value entered. This determines if the actual value just measured deviates from the nominal value and if so, by how much. It is assumed that the deviation determined here is constant over the entire measuring range. So the raw values of the subsequent workpiece measurements are corrected by the amount determined here before the measuring results are displayed: e.g. if the actual value displayed is + 10 µm greater than the nominal value of the master, the raw values of all of the subsequent workpiece measurements are reduced by 10 µm before the measuring results are displayed. In contrast, if an actual value of just 495 µm is determined instead of the nominal value of 500 µm, 5 µm are automatically added to each raw value of a workpiece measurement before the measuring result is displayed.

The characteristic curve of the probe thus undergoes a parallel shift in the display range (see Fig. 3).

In a **two point master measurement** two masters (gage blocks) of different sizes are contacted in sequence and the actual values displayed are compared with the nominal values indicated on the masters.

First, as for the one point master measurement, the deviation from the nominal value is calculated from the measurement on the first (smaller) gage block and then corrected. The characteristic curve of the probe is also shifted accordingly in the display range (in parallel) in the first step here (see Fig. 4A).

In a second step, a correction factor is calculated from the difference between the two nominal values (`MSTR.MAX` minus `MSTR.MIN`). This factor is used to change the pitch of the characteristic curve of the probe in a linear fashion (see Fig. 4B).

For this reason, before starting a measurement series, decide whether a one point or a two point master measurement is to be performed. The respective method must then be set in the catalog of functions and parameters (see section 8.1).



The two point master measurement is only permitted with the linking formulas "C1","-C1", "C2" and "-C2". For other linking formulas, the error message "FRM FEH" appears.

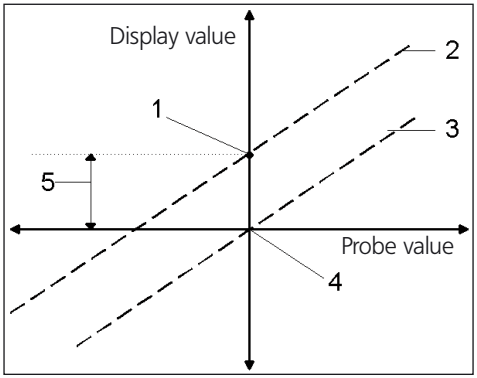


Fig. 3
Shifting the characteristic curve of the probe in the display range

1 *Measured master actual value*
2 *Calculated position of the characteristic curve of the probe*
3 *Corrected position of the characteristic curve of the probe after a one point master measurement*
4 *Master nominal value*
5 *Deviation between the nominal value and the actual value of the master measurement*

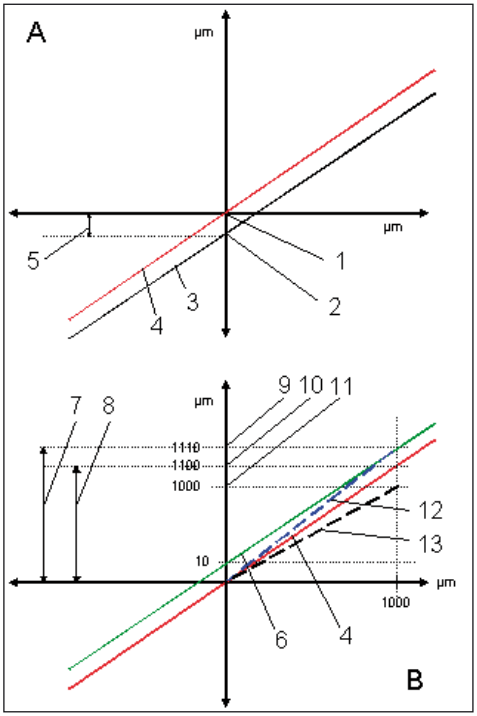


Fig. 4
Shifting the characteristic curve of the probe (A) and changing the pitch of the characteristic curve of the probe (B)

1 *Nominal value of MSTR.MIN*
2 *Actual measuring value of MSTR.MIN*
3 *Calculated position of the characteristic curve of the probe*
4 *Corrected position of the characteristic curve of the probe after a MSTR.MIN measurement*
5 *Deviation between the nominal value and the actual value of the MSTR.MIN measurement*
6 *Path of the characteristic curve of the probe based on the actual value of the MSTR.MAX*
7 *MSTR.MAX - MSTR.MIN absolute value*
8 *MSTR.MAX - MSTR.MIN taking the linear error into consideration (relative value)*
9 *Actual measuring value of MSTR.MAX*
10 *Actual value of MSTR.MAX taking the linear error into consideration*
11 *Nominal value of MSTR.MAX*
12 *Actual pitch of the characteristic curve of the probe*
13 *Required pitch of the characteristic curve of the probe to display correct values*

8.1 Selecting the type of master measurement

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MASTER** key until "PROCESS (3)" is displayed.
3. Press the **MENU** key again. The entry "MEASURE (3.1)" is displayed.
4. Press the **MASTER** key. The entry "MASTER (3.2)" is displayed.
5. Press the **MENU** key and use the **DATA** and **MASTER** keys to select either the MAST 1P setting (3.2.1, one point master measurement) or the MAST 2P setting (3.2.2, two point master measurement).

   The "MAST 2P" setting can only be selected if one of the following linking formula, "C1", "C2", "-C1" or "-C2", was selected under "FEATURE -> FORMULA".

6. Use **START** to conclude the selection of the measuring method and press **START** again to accept the selected measuring method.
7. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

8.2 Entering the nominal value of the master for a one point master measurement

The dimension of the master workpiece usually deviates slightly from the required nominal value. The actual dimension of the master workpiece, the so-called master actual value, must be entered in the catalog of functions and parameters before starting the master measurement.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press **MENU** again to move into the subordinate functions.
3. Use the **DATA** and **MASTER** keys to select the "MASTER (1.8)" setting and press the **MENU** key again. "MASTER" and a numerical value are displayed. The size of the value depends on the unit of measurement selected for the display: 0.3 mm or 300 µm or 0.011811 inches.
4. Change the numerical value displayed to the nominal value of the master (see the section "Changing numerical values for parameter settings" in section 0).
5. When the nominal value is set as required, press the **START** key. The numerical input closes and the nominal value set is flashing.

6. Press **START** again to accept the flashing nominal value as the current setting. The catalog item "MASTER (1.8)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical entry (see point 4). The nominal value displayed can be changed again, if necessary.

7. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

8.3 Performing a one point master measurement

1. If necessary, switch into the measuring value or result display.
2. Insert the master into the measuring device.
3. Press the **MASTER** key. The current probe value is displayed.
4. Press **START**. The master measurement is performed.
5. Remove the master and insert the workpiece to be measured.
6. The deviation of the workpiece from the specified nominal value is displayed.

8.4 Entering the nominal value for a two point master measurement

The dimensions of the master workpieces usually deviate slightly from the required nominal values. The actual dimensions of the master workpieces must be entered in the catalog of functions and parameters before starting the master measurement.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press **MENU** again to move into the subordinate functions.
3. Use the **DATA** and **MASTER** keys to select the MSTR.MAX (1.8) setting.
4. Press the **MENU** key. A numerical value is displayed. The size of the value depends on the unit of measurement selected for the display: 0.3 mm or 300 µm or 0.011811 inches.
5. Change the numerical value displayed to the nominal value for the larger of the two masters (see the section "Changing numerical values for parameter settings" in section 0).
6. When the nominal value is set as required, press the **START** key. The numerical input closes and the nominal value set is flashing.
7. Press **START** again to accept the flashing nominal value of the larger master as the current setting.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 4). The nominal value displayed can be changed again, if necessary.
8. If the nominal value of the larger master is entered correctly and if "MSTR.MAX" is displayed, press the **MASTER** key. "MSTR.MIN (1.9)" is displayed.
9. Press **MENU** again.
10. Set the nominal value of the smaller master as described in the section "Changing numerical values for parameter settings" in section 0.
11. Press **START** again to accept the flashing nominal value of the smaller master as the current setting.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 4). The nominal value displayed can be changed again, if necessary.
12. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

8.5 Performing a two point master measurement

1. If necessary, switch into the measuring value or result display.
2. Insert the smaller master into the measuring device.
3. Press the **MASTER** key. The current probe value is displayed.
4. Press **START**.
5. Remove the smaller master and insert the larger master. The current probe value is displayed.
6. Press **START** again to conclude the master measurement.
7. Remove the master and insert the workpiece to be measured.
8. The deviation of the workpiece from the specified nominal value is displayed.

8.6 Original master measurement

The original master measurement makes it possible to check the validity of the subsequent master measurements.

The first master measurement is performed as an original master measurement. For all of the subsequent measurements, the Millimar checks if the deviation from the original master measurement is greater than the tolerance value entered (ACTUAL).

If a deviation is too great, "MST. NOK" appears on the display. In this case, the master measurement is not performed and must be canceled with ESC. A deviation can be caused by measuring the wrong workpiece or a workpiece that has not properly been inserted or by a temperature drift.

To activate the original master measurement:

- In the "PROCESS -> M.ORIGIN" menu enter a tolerance value that does not equal 0.

To deactivate the original master measurement:

- In the "PROCESS -> M.ORIGIN" menu enter the value 0.
  The master measurements will not be monitored.



For one point and two point master measurements, the change in offset between one master measurement and the next is monitored.
For the two point measurement, the change in sensitivity (= change in pitch) is not monitored. .

The original master measurement is deleted by selecting the "PROCESS -> PR CLR" menu. The next master measurement then automatically becomes the original master measurement.

9 Setting tolerances and limit values

The warning and tolerance limits are highlighted in color in the light bar to show the position of a measuring value relative to the warning and tolerance limits. The limits can be set according to requirements as well as the color of the light bar on reaching a limit value.

9.1 Setting tolerance limits

Tolerance limits describe the maximum dimensions that a workpiece may have or the minimum that it must have in order to perform its function with no problems. If these limits are exceeded in either direction, the workpiece must either be rejected or reworked.

The tolerance limits that must be set on the Millimar can be found in the production or testing documentation.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to set "TOLRNCE (1.4)".
4. Press the **MENU** key. The entry "COLOR (1.4.1)" is displayed.
5. Press the **MASTER** key. The entry "TOLER. + (1.4.2)" is displayed.
6. Press the **MENU** key. The current value of the upper tolerance limit is displayed below the "TOLER. +" entry with a flashing preceding sign.
7. Change the preceding sign and numerical value of the upper tolerance limit as required (see the section "Changing numerical values for parameter settings" in section 0.)

   The upper tolerance limit can also be set with a negative value! However, when setting the lower tolerance limit, please note that it must be lower, i.e. greater in the negative direction, than the upper limit.

8. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.
9. Press **START** again to accept the flashing value as the current setting. The catalog item "TOLER. + (1.4.2)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to setting the numerical value (see point 7). The numerical value displayed can be changed again.

10. Press the **MASTER** key. The entry "TOLER. – (1.4.3)" is displayed.

11. Press the **MENU** key. The current value of the lower tolerance limit is displayed below the "TOLER. –" entry with a flashing preceding sign.

12. Change the preceding sign and numerical value of the lower tolerance limit as required (see the section "Changing numerical values for parameter settings" in section 0.)

    If a negative value was set for the upper tolerance limit, when setting the lower tolerance limit, please note that it must be lower, i.e. greater in the negative direction, than the upper limit!

13. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.

14. Press **START** again to accept the flashing value as the current setting. The catalog item "TOLER. – (1.4.3)" is displayed again.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 12). The numerical value displayed can be changed again.

15. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

9.2 Setting warning limits

If tolerance limits are exceeded in either direction, the workpiece must either be reworked or it must be disposed of because it cannot be used. To avoid this and to be able to recognize trends in a timely manner, so-called warning limits can be set before the tolerance limits are reached. If these warning limits are exceeded by several workpieces in succession, the workpieces are still fully functional, but intervention needs to be made in the production process in order to prevent the tolerance levels from being exceeded as workpieces continue to be produced.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to set "TOLRNCE (1.4)".
4. Press the **MENU** key. The entry "COLOR (1.4.1)" is displayed.
5. Use **MASTER** and **DATA** to set the entry "ALARM + (1.4.4)".
6. Press the **MENU** key. The current value of the upper warning limit is displayed below the "ALARM+" entry with a flashing preceding sign.
7. Change the preceding sign and numerical value of the upper warning limit as required (see the section "Changing numerical values for parameter settings" in section 0.)
8. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.
9. Press **START** again to accept the flashing value as the current setting. The catalog item "ALARM+ (1.4.4)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 7). The numerical value displayed can be changed again.
10. Press the **MASTER** key. The entry "ALARM– (1.4.5)" is displayed.
11. Press the **MENU** key. The current value of the lower warning limit is displayed below the "ALARM–" entry with a flashing preceding sign.

12. Change the preceding sign and numerical value of the lower warning limit as required (see the section "Changing numerical values for parameter settings" in section 0.)

13. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.

14. Press **START** again to accept the flashing value as the current setting. The catalog item "ALARM– (1.4.5)" is displayed again.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to setting the numerical value (see point 11). The numerical value displayed can be changed again.

15. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

9.3 Setting the color of the warning and tolerance limits

The position of a measuring value relative to the tolerance limits is displayed in the light bar with corresponding illuminated points for the warning and tolerance limits and with the light bar color.

To indicate compliance with the warning or tolerance limits, a green light bar is displayed. The color of the light bar when the warning and/or tolerance limits are exceeded in either direction can be selected as required.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to set "TOLRNCE (1.4)".
4. Press the **MENU** key. The entry "COLOR (1.4.1)" is displayed.
5. Press the **MENU** key again. The entry "TOLER. + (1.4.1.1)" is displayed.
6. Press the **MENU** key again. The entry ">T RED. + (1.4.1.1.1)" flashes.
7. If necessary, use **MASTER** to select the "> T YELW + (1.4.1.1.2)" setting.
8. Use **START** to accept the selected setting. The entry "TOLER. + (1.1.4.1)" is displayed again.
9. Press the **MASTER** key. The entry "TOLER. – (1.4.1.2)" is displayed.
10. Set the color of the light bar (<T RED or <T YELW) for values that fall below the lower tolerance limit and accept with **START**.
11. Press the **MASTER** key. The entry "ALARM (1.4.1.3)" is displayed.
12. Press the **MENU** key. The entry "W YELW (1.4.1.3.2)" flashes.

13. Use **MASTER** to set the color of the light bar (`W GREEN` or `W YELW`) for values that fall below the lower warning limit and for values that exceed the upper warning limit and accept with **START**.

    The colors selected here apply for both warning limits. It is not possible to select different colors for the upper and lower warning limit!

14. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    The selected colors are immediately used for values that fall below the lower warning and tolerance limits and for values that exceed the upper warning and tolerance limits.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

9.4 Setting plausibility limits

Plausibility limits restrict the validity range of the measuring values within the measuring range. When instruments are delivered, the plausibility limits are set at+ 2.5 mm and - 2.5 mm. However, if a probe with a measuring range of just ± 1 mm is connected, it is recommended that the plausibility limits also be set to ± 1 mm.

If the plausibility limits are exceeded in either direction, the message OVERFLW appears on the display. This message informs the user that the measuring result is beyond the measuring or plausibility range.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **MENU** key again. The entry "FACTOR (1.1)" is displayed.
3. Use the **DATA** and **MASTER** keys to set "PLAUS. (1.6)".
4. Press the **MENU** key. The entry "PLAUS. + (1.6.1)" is displayed.
5. Press the **MENU** key again. The current plausibility value is displayed below the "PLAUS. + (1.6.1)" entry with a flashing preceding sign.
6. Change the preceding sign and numerical value of the upper plausibility limit as required (see the section "Changing numerical values for parameter settings" in section 0.)

   The upper plausibility limit can also be set with a negative value! However, when setting the lower plausibility limit, please note that it must be lower, i.e. greater in the negative direction, than the upper limit.

7. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.

8. Press **START** again to accept the flashing value as the current setting. The catalog item "PLAUS. + (1.6.1)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 6). The numerical value displayed can be changed again.

9. Press the **MASTER** key. The entry "PLAUS. – (1.6.2)" is displayed.

10. Press the **MENU** key. The current value of the lower plausibility limit is displayed below the "PLAUS. –" entry with a flashing preceding sign.

11. Change the preceding sign and numerical value of the lower plausibility limit as required (see the section "Changing numerical values for parameter settings" in section 0.)

    If a negative value was set for the upper plausibility limit, when setting the lower plausibility limit, please note that it must be lower, i.e. greater in the negative direction, than the upper limit!

12. When the preceding sign and the numerical value have been set as required, press the **START** key. The numerical input closes and the value set is flashing.

13. Press **START** again to accept the flashing value as the current setting. The catalog item "PLAUS. – (1.6.2)" is displayed again.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to setting the numerical value (see point 11). The numerical value displayed can be changed again.

14. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

10 Setting parameters for recording measuring values

10.1 Setting filter parameters

The signals of the probes can be filtered in order to avoid disturbances caused by grooves or dirt on the workpiece. The filter cutoff frequency can be set in preset steps. In this case, the greater the value set, the less influence the filter has.

For dynamic measurements, signal filtering depends not only on the cutoff frequency, but also on the workpiece rotational speed.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Press the **DATA** key to display "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use **MASTER** to set "FILTER (4.2)".
5. Press the **MENU** key. The entry "SAMPL/S" (measuring values per second) is displayed along with a flashing numerical value below. The following values are available for filtering:
   150, 75, 50, 38, 21, 15, 10, 5, 2, 1.
6. Use the **DATA** and **MASTER** keys to set the required limit value.
7. Press **START** as soon as the required value is set. The selected value flashes.
8. Press **START** again to accept the flashing value as the current setting. The catalog item "FILTER (4.2)" is displayed again.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 5). Another value can be selected.
9. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

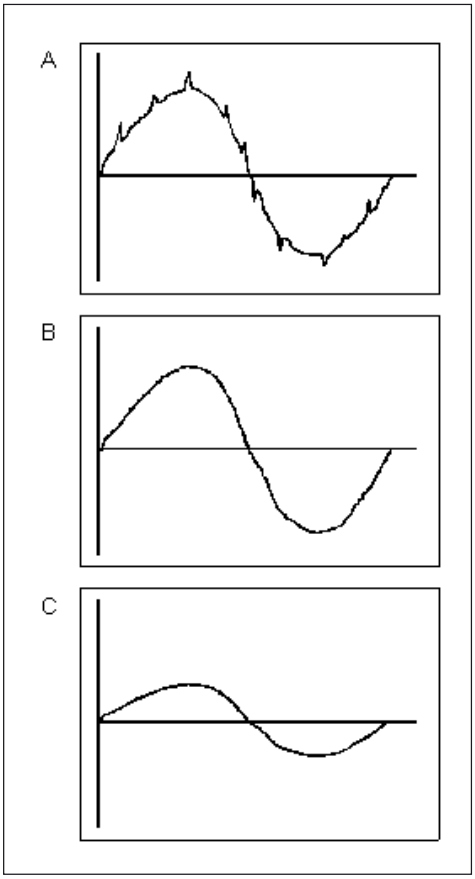


Fig. 5
Filter effect at various limit frequencies

A High limiting frequency
Disturbing signals (grooves, dirt) affect the measuring result

B Low limiting frequency
Disturbing signals are filtered out for the most part; measuring result is not affected

C Limiting frequency too low
The measured signal is distorted.

10.2 Specifying the measuring process

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to select the "PROCESS (3)" setting.
3. Press the **MENU** key. The entry "MEASURE (3.1)" is displayed.
4. Press the **MENU** key. The entry "MEASMOD (3.1.1)" is displayed.
5. Press the **MENU** key again. The currently applicable mode for workpiece measurement flashes
6. Use the **DATA** and **MASTER** keys to select either "NORMAL" or "AUTOMAT" mode.

   NORMAL Measurements are taken continuously. Pressing **START** deletes the MAX, MIN and average memories.

   AUTOMAT Pressing **START** starts the measurement. Pressing **START** again ends the measurement and displays the result. If a time that does not equal "0" was set under "TIMER (3.1.2)", the measurement ends automatically after this time period. If a time "T–PAUSE" was entered under "REPEAT (3.1.3)", the measurement is repeated after "T–PAUSE" expires.
   Press **START** to end the succession of single measurements and pauses in between. The letter "T" shown in the bottom line of the display during the measurement indicates an ongoing measurement.
7. Press **START** as soon as the required mode is set. This mode flashes.
8. Press **START** again to accept the flashing mode. The catalog item "MEASMOD (3.1.1)" is displayed.

   Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the selection list (see point 5). A different mode can be selected.
9. If the "NORMAL" mode was selected, continue with point 20.
   If the "AUTOMAT" mode was selected, continue with point 10.
10. Press the **MASTER** key. The entry "TIMER (3.1.2)" is displayed.
11. Press the **MENU** key. The entry "T–TIMER" and a numerical value with its first digit flashing are displayed.
12. Enter the required measurement period in seconds (see the section "Changing numerical values for parameter settings" in section 0.)
13. Press **START** as soon as the measurement period has been entered. The numerical input closes and the set measurement period is flashing.

14. Press **START** again to accept the flashing measurement period. The catalog item "TIMER (3.1.2)" is displayed again.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 12). A different measurement period can be entered.

15. Press the **MASTER** key. The entry "REPEAT (3.1.3)" is displayed.

16. Press the **MENU** key. The entry "T-PAUSE (3.1.3.1)" and a numerical value with its first digit flashing are displayed.

17. Enter the required pause period in seconds (see the section "Changing numerical values for parameter settings" in section 0.)

18. Press **START** as soon as the pause period has been entered. The numerical input closes and the set pause period is flashing.

19. Press **START** again to accept the flashing pause period. The catalog item "REPEAT (3.1.3)" is displayed again.

    Pressing either the **MASTER** or **DATA** key instead of the **START** key returns you to the numerical input (see point 17). A different pause period can be entered.

20. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    START can be used to start one measurement or a measurement series. If the "AUTOMAT" mode was selected, the message "MEASURE" is displayed during the measurement and the message "PAUSE" is displayed during the pause. If the measurement series is ended with **START**, the message "ABORT" is output briefly.
    Also note the messages in the following sections regarding the "NORMAL" and "AUTOMAT" modes.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

10.3 "NORMAL" mode



See section 10.2 for information on how to activate this mode.

The selected feature is continuously calculated based on the linking formula and the function (i.e. MAXIMUM, MINIMUM, MAX+MIN, MAX–MIN, AVE or NORMAL). Pressing **START** saves the calculated value. **START** is also used to initiate a new measurement and recalculate the selected feature.

If the "NORMAL" setting was selected under both "FEATURE-> FNCTION (1.1)" and "PROCESS-> MEASURE -> MEASMOD (3.1.1)", the current measuring value is always displayed.

If the "MAXIMUM" setting was selected under "FEATURE -> FNCTION" and the "NORMAL" setting was selected under PROCESS-> MEASURE-> MEASMOD", the calculated maximum value is displayed. However, the display only changes if a new maximum value is calculated or if the previous maximum value is saved with **START** and a new measurement starts.

If the "MINIMUM" setting was selected under "FEATURE -> FNCTION" and the "NORMAL" setting was selected under PROCESS-> MEASURE-> MEASMOD (3.1.1)", the calculated minimum value is displayed. However, the display only changes if a new minimum value is calculated or if the previous minimum value is saved with **START** and a new measurement starts.

If one of the settings "MAX+MIN", "MAX–MIN" or "AVE" was selected under FEATURE -> FNCTION (1.1)" and if the "NORMAL" setting was selected under PROCESS -> MEASURE-> MEASMOD (3.1.1)", the calculated sum or difference or the average is continuously updated. Use **START** to save the current value. A new measurement starts right away.

10.4 "AUTOMAT" mode



See section 10.2 for information on how to activate this mode.

During the set measurement period (T-Timer), the letter "T" is shown in the bottom line of the display.

During the measuring time, the selected feature (i.e. MAXIMUM, MINIMUM, MAX+ MIN, MAX–MIN or AVE) is calculated and displayed for the duration of the pause.
If the "NORMAL" setting was selected under " FEATURE -> FNCTION", when the measurement period ends, the most recently recorded measuring value is displayed and saved.

After the pause period expires, the next measurement starts. Measurement and pause continue to run in sequence until the **START** key is pressed again.

10.5 Entering a start delay

If a certain amount of time should pass between pressing **START** and starting the measurement, a time period can be entered by which the start of the measurement is to be delayed.

A start delay is particularly useful when a dynamic measurement (e.g. on a shaft) is performed and it is supposed to start automatically via a switch contact on the measuring device. When the shaft is approached, vibrations occur in the measuring device that affect the measuring result. During the waiting time (delay) while the message "WAIT" is shown on the display, the vibrations subside and no longer affect the measuring result.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to select the "PROCESS (3)" setting.
3. Press the **MENU** key. The entry "MEASURE (3.1)" is displayed.
4. Press the **MENU** key. The entry "MEASMOD (3.1.1)" is displayed.
5. Use the **DATA** and **MASTER** keys to select the "DELAY (3.1.4)" setting.
6. Press the **MENU** key. A numerical value with its first digit flashing is displayed under "DELAY".
7. Enter the required start delay in seconds (see the section "Changing numerical values for parameter settings" in section 0.)
8. Press **START** as soon as the start delay time has been entered. The numerical input closes and the set delay is flashing.
9. Press **START** again to accept the flashing delay time. The catalog item "DELAY (3.1.4)" is displayed again.
10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

11 Password protection

The catalog of functions and parameters can be protected with a password (seven digits). Password protection is active as soon as a password is entered and confirmed with **START** and the user exits the catalog of functions and parameters. From this point, every time an attempt is made to call up sub-functions to one of the main functions (FEAT. 1, FEAT. 2, PROCESS or SETTING), the password is requested. It must be entered correctly and confirmed with **START** in order to display the sub-functions.

Depending on the final digit of the password, however, certain areas of the catalog of functions and parameters can be excluded from password protection:

Final digit of the password	Main functions that can be accessed
1	Feature 1
2	Feature 2
3	Process
4	Setting
5, 6, 7, 8, 0	None
9	None In addition, the **MASTER** key on the keypad is blocked; no master measurements can be carried out.

Activating password protection

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "PASSWRD (4.5)" setting.
5. Press the **MENU** key. Seven zeroes are shown below "PASSWRD", the first of which is flashing.
6. Enter the password (see the section "Changing numerical values for parameter settings" in section 0).

   When selecting the final digit of the password, note the adjacent table that includes the main functions that will still be accessible!

7. Press **START** as soon as the password has been entered. The password is accepted.

   Password protection, however, is only activated after the user exits the catalog of functions and parameters. For as long as the user does not exit the catalog after entering the password, changes can still be made at all levels of the catalog of functions and parameters.

   If the password is forgotten, the instrument must be reset to factory settings (see section 16).

8. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

12 Performing measurements

When taking measurements and during the subsequent evaluation, the direction of travel of the probe must be noted. The direction of travel (polarity) of the inductive probe is specified as follows:

For the linking formula "C1" or "C2" and with the measuring bolt traveling inwards the numerical value increases in the positive direction and the light bar moves up the scale towards the top.

The direction of travel for the display can be changed if necessary by doing the following:

- either selecting a formula with a negative preceding sign ("−C1" or "−C2")
- or changing the preceding sign of the factor (-1.0 instead of 1.0)



However, if a formula and a factor both with negative preceding signs are selected simultaneously, the direction of travel for the display does not change because the two negative preceding signs cancel each other out.

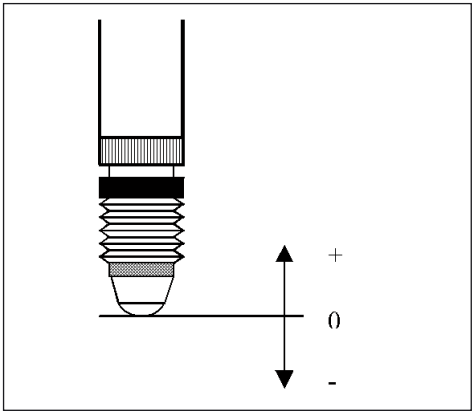
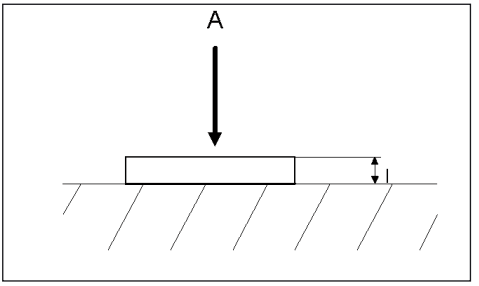


Fig. 6
Probe signals and direction of travel

12.1 Performing a compound (sum) measurement

The thickness of a workpiece is to be measured.



Preset values

Nominal size:	12 mm
Tolerance:	± 0.080 mm
(Master) Nominal value:	11.998 mm

Millimar settings

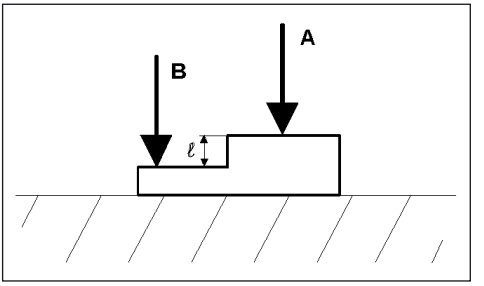
MENU –> FEATURE (1.) – ...
FNCTION (1.2.) -> NORMAL (1.2.1)
FORMULA (1.3.) –> + C1 (1.3.1)
TOLER. + (1.4.2.)–> +000.080
TOLER. – (1.4.3.)–> –000.080
NOMSIZE (1.5.)–> +012.0000
MASTER (1.8.)–> +011.9980

Measuring procedure

1. Make the settings listed above on the Millimar.
2. Place the setting master into the measuring device.
3. Press **MASTER** and **START** in succession to set the measuring instrument to the master nominal value.
4. Remove the setting master and insert the workpiece into the measuring device.
   The workpiece thickness is displayed.

12.2 Performing a difference measurement

The height of a step on a workpiece is to be measured.



Preset values

Nominal size:	16 mm
Tolerance:	+0.012/–0.008 mm
(Master) Nominal value:	16.002 mm

Millimar settings

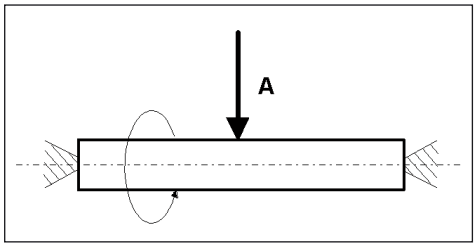
MENU –> FEATURE (1.) – ...
FNCTION (1.2.) –> NORMAL (1.2.1)
FORMULA (1.3.) –> C1 – C2 (1.3.6)
TOLER. + (1.4.2.) –> +000.0120
TOLER. – (1.4.3.) –> –000.0080
NOMSIZE (1.5.)–> +016.0000
MASTER (1.8.) –> +016.0020

Measuring procedure

1. Make the settings listed above on the Millimar.
2. Place the setting master into the measuring device.
3. Press **MASTER** and **START** in succession to set the measuring instrument to the master nominal value.
4. Remove the setting master and insert the workpiece into the measuring device.
   The height of the step is displayed.

12.3 Performing a radial runout measurement

The radial run-out deviation with respect to the centering tips is to be measured on a workpiece. This measurement consists of the sum of the runout and the eccentricity.



Preset values

Nominal size:	0 mm
Tolerance:	+0.016/–0.0 mm
(Master) Nominal value:	0.0 mm

Millimar settings

MENU –> FEATURE (1.) – ...
FNCTION (1.2.) –> MAX–MIN (1.2.4)
FORMULA (1.3.) –> + C1 (1.3.1)
TOLER.+ (1.4.2.) –> +000.0160
TOLER.– (1.4.3.) –> –000.0000
NOMINAL (1.5.) –> +000.0000
MASTER (1.8.)
MSTR.MAX –> +000.0000
MENU –> PROCESS (3.) –> MEASURE (3.1.)
-> MEASMOD -> AUTOMAT (3.1.1.2)

Measuring procedure

1. Make the settings listed above on the Millimar.
2. Insert the workpiece into the measuring device.
3. Press **START** to start the measurement and to delete the MAX/MIN memories.
   "0" is shown on the display.
4. Rotate the workpiece once around its axis.
5. Press **START** again.
   The measurement is concluded and the radial runout deviation of the workpiece is displayed.

13 Measuring value memories

The Millimar S 1840 has one memory each for the maximum value, the minimum value and the average. The stored values are calculated from the recorded measuring values over a specific measurement period. When the measurement period ends, exactly one feature is calculated from the stored data.

The calculation of exactly one feature from saved values is also called **dynamic measurement**. Dynamic measurements are often performed on rotationally symmetrical workpieces.

When measuring a rotating shaft, for example, various workpiece features can be derived from the saved values:

MAX–MIN :	Radial runout of the shaft
(MAX+MIN) /2:	Average diameter deviation (can be affected by individual outliers). Division by "2" must be set be entering a factor of "0.5" under FEATURE --> FACTOR!
AVERAGE:	Average diameter deviation

While the measurement is running (i.e. during the entire measurement period), the catalog of functions and parameters cannot be called up. First, the measurement must be concluded or canceled with **START**.

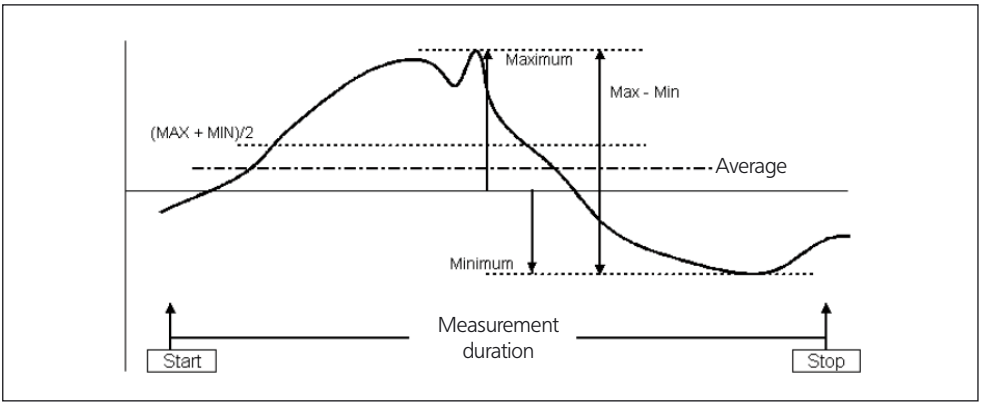


Fig. 7
Depiction of measuring value memory data and calculated features

Activating the measuring value memory function

Under "PROCESS -> MEASURE -> MEASMOD" select the "AUTOMAT (3.1.1.2)" setting. The letter "T" is shown in the bottom line of the display as soon as the measurement begins.

Controlling the measurement period of the measuring value memory function

1. Using the START key

When the **START** key is pressed for the first time, any data stored in the measuring value memory is deleted and the measurement period begins. The data stored in the measuring value memory continues to be updated until the **START** key is pressed again. The measurement period ends and the required feature is calculated from the saved data and then displayed.

2. Using a time preset

The duration of the measurement period during which the data in the measuring value memory is updated is preset in seconds. The length of the measurement period can be set under

"PROCESS -> MEASURE -> TIMER (3.1.2)"

between 0.1 seconds and 999.9 seconds.

The measurement is started either by pressing the **START** key or with a corresponding signal to a control input. After the set measurement period has expired, the measurement ends automatically, i.e. the data in the measuring value memory are no longer updated.

3. Using a control input

The measuring value memory can also be started and ended using control signals. This appoach is useful if, for example, the measuring value memory is to be activated and deactivated using contacts mounted on the measuring device.

14 Working with the serial (RS-232) interface

To transfer data using the serial (RS-232) interface, the interface must be set (configured) to meet the requirements of the user and the measuring task. For this reason, suitable settings must be selected for the following parameters:

Interface protocol (PROTOCL):

Specify whether data are to be sent in response to a request or automatically or whether external devices are allowed to change parameter settings.

Data transfer format (FORMAT)

Specify the number of data bits and stop bits with which the values are to be transferred and request a parity check is to be performed.

Data flow control (HANDSHK)

Specify how the data flow control is to be handled between devices that are not synchronized without data loss; the specification concerns whether the corresponding control signals are sent via additional lines in parallel with the data lines or if the signals (embedded in the data flow) are sent via the data lines.

Transfer rate (BAUD)

Specify the speed (given in bits per second) at which the data are to be transferred.

Start transfer (TRANSM)

Specify whether the data are to be transferred manually by pressing the **DATA** key, automatically at the end of a measurement or continuously.



The settings for data transfer format, data flow control and transfer speed must be the same for both instruments (partners)!

14.1 Selecting an interface protocol

An "interface protocol" refers to the way in which various instruments exchange data with each other. Because the Millimar S 1840 operates with different instruments (printers, computers, control units, ...) there are several interface protocols from which to choose:

`OFF` If the interface is not needed because no data are to be transferred, no interface protocol should be selected.

`ASCII` Depending on the setting, the recorded measuring values or measuring value memory data are either output after pressing the **DATA** key on the Millimar or at the end of the measurement or they are continuously output. With this interface protocol, the data transfer cannot be started by a connected PC.

`OPTORSS` The measuring values or measuring value memory data are either sent as selected under "`TRANSM`" or they can be retrieved from a connected PC. The unit of measurement is transferred as well. This record is used primarily in the area of manual measuring equipment.

`OPTORSD` The Millimar automatically transmits the measuring values or setting data requested from a connected computer and acknowledges the transfer of the data sent with <CR><LF>. This record is used primarily in the area of hand-held measuring equipment.

`M1240` The Millimar automatically transmits the measuring values or setting data requested from a connected computer and acknowledges the transfer of the data sent with <CR>.

`MarTalk` Enables both the transmission of data and settings in response to a request by a connected PC and the modification of the Millimar configuration using one of the configuration programs D1000X or D1000S.

If the Millimar is configured using the D 1000 S, the D 1000 S program automatically switches the interface protocol of the connected Millimar to MarTalk. To do this, it transmits a "break" signal via the receive line. As soon as the configuration is complete it reinstates the interface protocol selected by the user.

When switching the connected PC or PLC on or off, a "break" signal can be unintentionally triggered thus activating the "MarTalk" interface protocol. However, if the Millimar does not receive a valid MarTalk command within the next two seconds, the interface protocol set on the Millimar by the user is automatically restored.

When a terminal emulator is used (e.g. Hyperterm), a "break" signal can be triggered with the key combination **CTRL** + **PAUSE**/**BREAK**. The "DTR/DSR" line can be deactivated using the pull-down menu "Call--> Disconnect".

Setting the interface protocol on the Millimar:

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "COM (4.6)" setting.
5. Press the **MENU** key. The entry "PROTOCL (4.6.1)" is displayed.
6. Press the **MENU** key again. The interface protocol selected most recently flashes.
7. Use the **DATA** and **MASTER** keys to select the required interface protocol (see above). The following interface protocols are available: OFF, ASCII, M1240, OPTORSS, OPTORSD, MARTALK.
8. Press **START** as soon as the required interface protocol is displayed. The setting is accepted and the entry "PROTOCL (4.6.1)" is displayed again.
9. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

   If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

14.2 Selecting the data transfer format

The data transfer format specifies the number of data bits and stop bits with which the values are to be transferred and whether a parity check is to be performed.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "COM (4.6)" setting.
5. Press the **MENU** key. The entry "PROTOCL (4.6.1)" is displayed.
6. Use the **MASTER** key to select the "FORMAT (4.6.2)" entry.
7. Press the **MENU** key. The data transfer format selected most recently flashes.
8. Use the **DATA** and **MASTER** keys to select the required data transfer format. The following data transfer formats are available:

8-N-1	Eight data bits and one stop bit are transferred. No parity check is carried out.
7-O-2	Seven data bits and two stop bits are transferred. A parity check is carried out, which must produce an odd value.
7-E-2	Seven data bits and two stop bits are transferred. A parity check is carried out, which must produce an even value.

9. Press **START** as soon as the required data transfer format is displayed. The setting is accepted and the entry "FORMAT (4.6.2)" is displayed again.

10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

14.3 Selecting the transfer rate

Specify the rate (given in bits per second) at which the data are to be transferred. The devices must use identical transfer rates (baud rates).

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "COM (4.6)" setting.
5. Press the **MENU** key. The entry "PROTOCL (4.6.1)" is displayed.
6. Use the **DATA** and **MASTER** keys to select the "BAUD (4.6.4)" entry.
7. Press the **MENU** key. The most recently selected transfer rate flashes.
8. Use the **DATA** and **MASTER** keys to select the required transfer rate. The following transfer rates are available: 38,400, 19,200, 9600, 4800, 2400, 1200, 600.
9. Press **START** as soon as the required transfer rate is displayed. The setting is accepted and the entry "BAUD (4.6.4)" is displayed again.
10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

14.4 Selecting a handshake

Specify whether the control signals for data flow control between devices that are not synchronized are sent via additional lines in parallel with the data lines (hardware handshake) or whethet the signals (embedded in the data flow) are sent via the data lines (software handshake).

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "COM (4.6)" setting.
5. Press the **MENU** key. The entry "PROTOCL (4.6.1)" is displayed.
6. Use the **DATA** and **MASTER** keys to select the "HANDSHK (4.6.3)" entry.
7. Press the **MENU** key. The most recently selected setting flashes.
8. Use the **DATA** and **MASTER** keys to select the required type of data flow control. The following control types are available:

NONE	The transmitting and the receiving devices work synchronously, i.e. with the same transfer rate so that the data flow does not have to be interrupted.
XON/XOF	The control signals for interrupting the data transfer are transferred on the data line (embedded in the data flow) (software handshake).
RTS/CTS	(Request to send/Clear to send) The control signals for interrupting the data transfer are transferred via separate control lines (hardware handshake).

9. Press **START** as soon as the required setting is displayed. The setting is accepted and the entry "HANDSHK (4.6.3)" is displayed again.
10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

14.5 Selecting how the data transfer is to be triggered

Specify whether the data are to be transferred manually using the **DATA** key or automatically at the end of a measurement or continuously during measurement.

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "COM (4.6)" setting.
5. Press the **MENU** key. The entry "PROTOCL (4.6.1)" is displayed.
6. Use the **DATA** and **MASTER** keys to select the "TRANSM (4.6.5)" entry.
7. Press the **MENU** key. The most recently selected setting flashes.
8. Use the **DATA** and **MASTER** keys to select the required setting. The following settings are available:

MANUAL	The measuring results are transferred as necessary by pressing the **DATA** key.
AUTOM.	The measuring results are transferred directly following the conclusion of each measurement.
SCANN	Depending on the set transfer rate, the measuring data are transferred during the measurement at approx. 20 values per second.

   For the AUTOM. and SCANN settings, one of the following interface protocols must be chosen (ASCII, M1240, OPTORSS or OPTORSD) and then the "AUTOMAT" setting must be set under PROCESS -> MEASURE -> MEASMOD.

9. Press **START** as soon as the required setting is displayed. The setting is accepted and the entry "TRANSM (4.6.5)" is displayed again.
10. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

14.6 Examples of interface configurations

14.6.1 Interface configuration for data transfer to the printer

Mahr printer MSP2

The following settings are recommended for the Mahr printer MSP2:

PROTOCL: M1240
FORMAT: 8N1
HANDSHK: NONE
BAUD: 9600
TRANSM: MANUAL or AUTOM.

If the "MANUAL (4.6.5.1)" setting was selected under "TRANSM (4.6.5)", the data are transferred to the printer by pressing the **DATA** key on the Millimar.

ASCII printers from other manufacturers

The following settings are recommended for printers from other manufacturers:

PROTOCL: ASCII
FORMAT: 8N1
HANDSHK: NONE
BAUD: 9600
TRANSM: MANUAL or AUTOM.

If the "MANUAL (4.6.5.1)" setting was selected under "TRANSM (4.6.5)", the data are transferred to the printer by pressing the **DATA** key on the Millimar.

14.6.2 Interface configuration for data transfer to the computer

Data transfer to a computer is often carried out in a dialog, i.e. using certain commands, the computer can request measuring values or change settings in the instrument. The interface protocols MARTALK, M1240, OPTORSD and OPTORSS are suitable here.

In principle, the ASCII interface protocol is suitable as well, but with this setting, data transfer cannot be started from the computer, but instead only by pressing the **DATA** key on the Millimar.

PROTOCL: MARTALK, M1240, OPTORSD, (OPTORSS, ASCII)
FORMAT: 8N1
HANDSHK: XON/XOF
BAUD: 9600
TRANSM: AUTOM.

OPTORSD interface protocol

Various data can be queried and various settings changed.
The execution of a command is acknowledged.
The following commands can be used:

Requesting the current measuring value
PC : ?<CR>
Mil : xxx.xxx<Unit><CR><LF>

The data format matches that of the numerical measured value display.
No data is sent when the catalog of functions and parameters is open or during master measurement.

Requesting the manufacturer and instrument name
PC : ID?<CR>
Mil : MAHR GMBH,S1840 <CR><LF>

Requesting the software version number
PC : VER?<CR>
Mil : n.nn_<CR><LF>

Requesting the unit of measurement
PC : UNI?<CR>
Mil : mm <CR><LF>

Requesting the serial number
PC : SER?<CR>
Mil : xxxx/xx<CR><LF>

Requesting the linking formula
PC : CHA?<CR>
Mil : -C1-C2<CR><LF>

Setting the unit of measurement to millimeters
PC : mm<CR>

Setting the unit of measurement to inches
PC : in<CR>

Setting the unit of measurement to micrometers
PC : um<CR>

Setting the linking formula
PC: CHA+1<CR> or
CHA-1<CR> or
CHA+2<CR> or
CHA-2<CR> or
CHA+1+2<CR> or
CHA+1-2<CR> or
CHA+2-1<CR> or
CHA-1-2<CR>

When working with two features, please note that only the linking formula for the first feature can be changed.

Entering a seven character text in the first line of the Millimar
PC : DIS <Text><CR>

M1240 interface protocol

Data can be requested, settings changed, measurements started and stopped, the interface activated or deactivated or a reset can be carried out.

However, this does not apply if the user is in the catalog of functions and parameters or if a master measurement is being performed.

The execution of a command is acknowledged with <CR>. The following commands can be used:

Getting the instrument version
PC : I<CR>
Mil :I,MAHRGMBH,S1840,Vn.nn <CR>
with Vn.nn = version number

Starting the measurement with the set measuring period (T-TIMER)
PC : F1<CR>
Mil : F1<CR>

Starting the measurement
PC : F2<CR>
Mil : F2<CR>

Ending the measurement
PC : F3<CR>
Mil : F3<CR>

Switching into the basic status (RESET)
PC : R<CR>
Mil : R<CR>

Starting the master measurement
PC : Z<CR>
Mil : Z<CR>

The two point measurement is started only. It must be ended by pressing any key on the keyboard.

Specifying the unit
PC :P86,1<CR>, sets unit to mm
PC :P86,2<CR>, sets unit to inches
PC :P86,3<CR>, sets unit to µm

Requesting the current measuring value(s)
PC : M<CR>
Mil : M1, xxx.xxx<CR>

The data format of the numerical measuring value display is used.

Requesting the saved measuring values
PC : M70<CR>
Mil : nnnnn, -xxxx.xxx<CR>

A maximum of 400 values are saved. The values are deleted either by reading them out with M70 or by switching off the instrument. The Millimar transfers the feature number and then the measuring value in the data format of the numerical measuring value display.

Requesting the linking formula
PC :P50<CR>
Mil :P50.1+2<CR>, for linking formula C1+C2

Setting the linking formula
PC :P50.1-2<CR>
Mil :P50.1-2<CR>, sets the linking formula C1-C2

Possible links	Syntax
+C1	P50,1 <CR>
-C1	P50,-1 <CR>
+C2	P50,2 <CR>
-C2	P50,-2 <CR>
C1+C2	P50.1+2 <CR>
C1-C2	P50,1-2 <CR>
-C1+C2	P50,2-1 <CR>
-C1-C2	P50,-1-2 <CR>

When working with two features, please note that only the linking formula for the first feature can be changed.

Requesting the nominal value
PC :P91,Mn<CR>
Mil :P91,Mn,-xxx.xxx<CR>

Setting the nominal value
PC :P91,Mn, xxx.xxx<CR>
Mil :P91,Mn,xxx.xxx<CR>

Requesting the master value
PC :P8,Mn<CR>
Mil :P8,Mn,-xxx.xxx<CR>

Setting the master value
PC :P8,Mn, -xxx.xxx<CR>
Mil :P8,Mn,-xxx.xxx<CR>

Requesting tolerances
PC :P21,Mn<CR>
Mil :P21,Mn,-xxx.xxx,xxx.xxx<CR>

Setting tolerances
PC :P21,Mn,-xxx.xxx,xxx.xxx<CR>
Mil :P21,Mn,-xxx.xxx,xxx.xxx<CR>

The order of the data segments is always as follows:
P21 --> Mn -->LTol --> UTol

Note that the tolerances must always be entered relative to the nominal value!

Activating the password
PC :P99,2<CR>
Mil :P99,2<CR>

Deactivating the password
PC :P99,0<CR>
Mil :P99,0<CR>

The password itself (the seven digits) can only be entered on the Millimar (see also section 11).
The password itself can neither be set nor changed from the PC.

OPTORSS interface protocol

Only the current measuring values can be requested.

Requesting the current measuring value

PC : ?<CR>

Mil : xxx.xxx<Unit><CR><LF>,

The data format matches that of the numerical measured value display.
No data is sent when the catalog of functions and parameters is open or during master measurement.

MARTALK interface protocol

This protocol is used by the configuration program D 1000 S.

More detailed information can be found in the online help for the D 1000 S program.

15 Working with the parallel (I/O) interface

A wide variety of devices can be connected to the 25-pin interface: PLC, displays, foot switches, recorders, ...

The devices that can be connected can either control the Millimar functions or be controlled by the Millimar. The Millimar can also be used just as data memory or an output device. For this purpose, the Millimar has three digital control inputs and outputs and an analog output.

Using the three digital control outputs, the Millimar can output signals such as the one for "tolerance limits exceeded" to control units or external displays. The function/meaning of the three output signals can be adapted to the measuring task using various modes (0, 1, 2, 3, 4, 5).

The three digital control inputs allow various functions in the Millimar to be started. The three inputs can be assigned to specific functions using the corresponding settings in the catalog of functions and parameters ("SETTING" -> "I/O" -> "INPUT (4.7.1)").
If the Windows program "D1000S" is used, the assignment of the three inputs to specific functions can be adapted to the measuring task using various modes (0, 1, 2, 3, 4).

If the digital control inputs and outputs are not needed, MODE 0 should be selected for the respective outputs and the value 0 should be set for the inputs.

Recorders, devices with analog/digital converters or control units with analog inputs can be connected via the analog output.

Interface assignments

Pin	Desig.	Function
1	—	Do not assign
2	—	Do not assign
3	—	Do not assign
4	GND	Mass connection
5	IN-3	opt. Input E3 (+)
6	IN-3	opt. Input E3 (-)
7	V_{out}	Internal supply +9 V, max. 100 mA
8	IN-2	opt. Input E2 (+)
9	IN-2	opt. Input E2 (-)
10	—	Not assigned
11	IN-1	opt. Input E1 (+)
12	IN-1	opt. Input E1 (-)
13	Analog out	Analog output
14	AGND	Analog mass
15	—	Not assigned
16	—	Not assigned
17	—	Not assigned
18	—	Not assigned
19	—	Not assigned
20	OUT-3	opt. Output A3 (+)
21	OUT-3	opt. Output A3 (-)
22	OUT-2	opt. Output A2 (+)
23	OUT-2	opt. Output A2 (-)
24	OUT-1	opt. Output A1 (+)
25	OUT-1	opt. Output A1 (-)

15.1 Digital control output

Basic circuit diagram of an output:

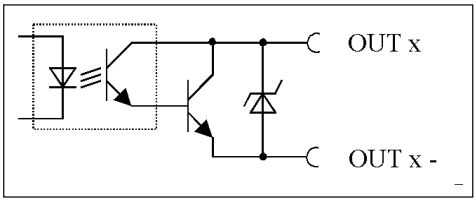


Fig. 8
Basic circuit diagram of an output of the parallel (I/O) interface

The preset functions (modes) can be assigned to the digital control outputs either via the Millimar or via the Windows based configuration program D1000S.

Modes of the digital control outputs:

MODE 0

No signals are transmitted to the outputs. Select this setting if the digital control outputs are not to be used.

MODE 1

A1 = Signal "Measurement is running"
A2 = Signal "Measurement is complete"
A3 = Signal "Measurement is valid"

MODE 2

A1 = Signal "Measurement is valid"
A2 = Signal "Meas. exceeds warning limit"
A3 = Signal "Meas. out of tolerance"

MODE 3

A1 = Signal "Valid"
A2 = Signal "Rework"
A3 = Signal "Reject"

MODE 4*

Enables the connection of the Millimar 1840/ SG control unit.
A1 = Signal "Valid"
A2 = Signal "Rework"
A3 = Signal "Reject"

MODE 5

A1 = Signal "Measurement is valid"
A2 = Signal "Measuring value < Lower warning limit"
A3 = Signal "Measuring value > Upper warning limit"

15.2 Digital control input

Basic circuit diagram of an input

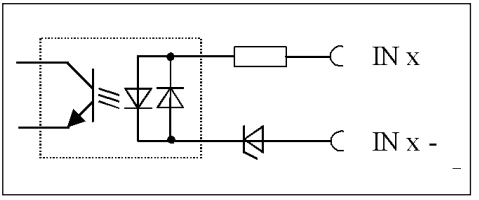


Fig. 9
Basic circuit diagram for an input of the parallel (I/O) interface

The functions can be assigned to the digital control inputs either via the Millimar or via the Windows based configuration program D1000S.

While it is possible to assign specific functions to a specific control input via the Millimar, only preset function packages (modes) can be assigned via the D1000S. Here, the mode assigned via the D1000S overrides the function assignmets of the Millimar.

In case the Millimar function assignment differs from the standard modes, the Millimar transmits the "Mode 5" signal while uploading data to the D1000S. This means for the D1000S „Do not override the Millimar function assignment".

The D1000S acknowlegdes this by returning "Mode 5" to the Millimar thus leaving the Millimar function assignment unchanged. If, however, the D1000S sends a different mode, the preset functions of this mode override the Millimar function assignment.

Modes of the digital control inputs which can be assigned via the D1000S:

MODE 0

Signals at the inputs are ignored.

MODE 1

E1 = Measurement period**
E2 = Start signal for master measurement**
E3 = Acceptance signal for master measurement via the RS-232 interface**

MODE 2

E1 = Start signal for measurement***
E2 = Stop signal for measurement***
E3 = Reset signal for deleting the Max, Min and average memories**

MODE 3

E1 = Measurement period**
E2 = Signal for transmitting the measuring value***
E3 = Start and acceptance signal for master measurement**

MODE 4*

Enables the connection of the Millimar S 1840/ SG control unit.

E1 = Measurement period**
E2 = Start signal for master measurement***
E3 = Acceptance signal for master measurement***

MODE 5

Do not override Millimar function assignment.

* If MODE 4 is selected for the input signal, MODE 4 is also set for the output signal and vice versa.

** Status controlled

*** Impulse controlled

Functions which can be assigned to the digital control inputs via the Millimar:

Via the "SETTING" -> "I/O" -> "INPUT (4.7.1)" item of the catalog of functions and parameters, Millimar functions can be assigned to one of the digital inputs.

For each function select the number of the input via which the corresponding function is to be triggered. Entering the input numer "0" means that this function will not be triggered via any of the inputs.

Each function can be assigned to just one of the inputs whereas each of the inputs can be assigned several functions.
If several functions are assigned to one input, the functions are triggered according to an internally specified sequence.

The following are possible functions:

START	Start signal for measurement
STOP	Stop signal for measurement
MEASURE	Measurement period
CLRMXMN	Reset signal for deleting the Max, Min and average memories
TXVALUE	Signal for transmitting the measuring value via the RS-232 interface.
MAST EN	OK signal for the master measurement assigned to a second input.The MASTER function can either be assigned to the same input as the MAST EN function or to a different (2nd) one.
MASTER	Start signal for master measurement
M1SEL	Displays feature 1 (if "Autodetect" is on).
M2SEL	Displays feature 2 (if "Autodetect" is on).
CLRSTO	Deletes all values in the measuring value memories.
SENDSTO	Transmits all values out of the measuring value memories.

15.3 Application examples for using digital control inputs and outputs

Example 1: Connecting to a PLC

When the Millimar is connected to a PLC, the PLC supply voltage should supply the power needed for the Millimar optocoupler. This is the only way that a galvanic separation between the PLC and the Millimar can be guaranteed.

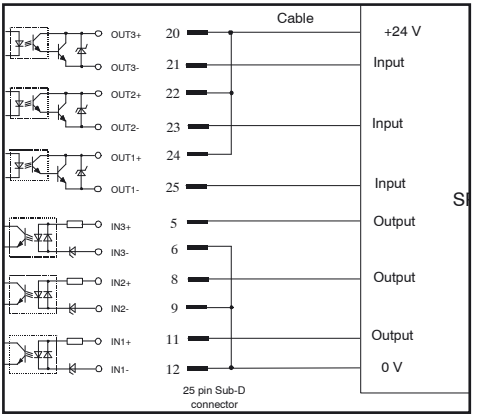


Fig. 10
Connecting the Millimar to a PLC

Example 2: Connecting instruments without a power supply of their own

The internal auxiliary power of the Millimar can be used to connect switches or lamps to it. A galvanic separation is only ensured if the connected device can guarantee such a separation.

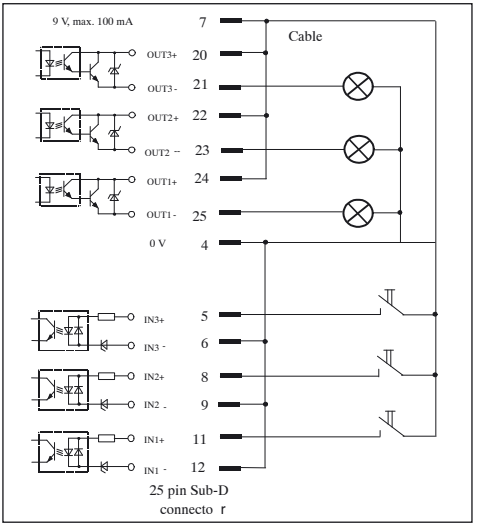


Fig. 11
Connecting lights for classification of the measuring results

15.4 Analog output

The analog output is used for connecting recorders, instruments with analog/digital converters or controls with analog inputs.

The analog output can be used to output either the feature displayed in the light bar and in the first line of the display or the feature output in the second line of the display.

The sensitivity of the analog output can be set within a wide range. However, the resolution of the analog output can never be better than the resolution of the digital/analog converter of the Millimar.
Due to the digitalization of the probe signals, the arithmetic processing of signals and the output to the D/A converter, there is a certain delay between the input signal and the voltage output at the analog output.

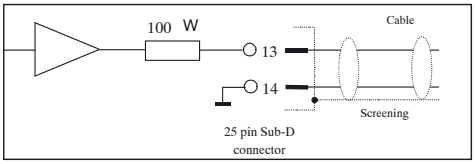


Fig. 12
Basic circuit diagram of an analog output of the parallel (I/O) interface

15.4.1 Selecting the feature to be displayed

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "I/O (4.7)" setting.
5. Press the **MENU** key. The entry "INPUT (4.7.1)" is displayed.
6. Use the **DATA** and **MASTER** keys to select the "A-OUTP (4.7.3)" entry.
7. Press the **MENU** key. The entry "FEATR. (4.7.3.1)" is displayed.
8. Press the **MENU** key. The entry "DAC OFF (4.7.3.1.1)" is displayed.
9. Use the **DATA** and **MASTER** keys to select the required feature output. The following outputs are available:

DAC OUT	No features are output using the analog output.
LINE 1	The feature displayed on the top line of the display is output. However, this is only possible if two features are displayed simultaneously (see section 3.5)!
LINE 2	The feature displayed on the bottom line of the display is output.
ANALOG	The feature displayed on the light bar is output. The voltage output depends on the distance of the light point from the origin of the display range.

10. Press **START** as soon as the required setting is displayed. The setting is accepted and the entry "FEATR. (4.7.3.1)" is displayed again.
11. If no other settings are to be made in the catalog of functions and parameters, press **START**. The current measuring value or result is displayed again.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

15.4.2 Setting the sensitivity of the analog output

1. Press the **MENU** key. The catalog item "FEATURE (1)" is displayed.
2. Use the **DATA** and **MASTER** keys to set "SETTING (4)".
3. Press the **MENU** key. The entry "DISPLAY (4.1)" is displayed.
4. Use the **DATA** and **MASTER** keys to select the "I/O (4.7)" setting.
5. Press the **MENU** key. The entry "INPUT (4.7.1)" is displayed.
7. Use the **DATA** and **MASTER** keys to select the "A-OUTP (4.7.3)" entry.
7. Press the **MENU** key. The entry "FEATR. (4.7.3.1)" is displayed.
8. Use **MASTER** to select the "FACTOR (4.7.3.2)" setting.
9. Press the **MENU** key. The entry "V/mm is displayed along with the value + 00001.00 below it.
10. Enter the sensitivity of the analog output as required (see the section "Changing numerical values for parameter settings" in section 0).

The sensitivity to be entered depends on the feature to be indicated.

DAC OFF
Sensitivity setting with no significance

LINE 1, LINE 2
The sensitivity is always specified in V/m – irregardless of the adjusted unit of measurement.
The numerical value to be entered depends on the output voltage required for a certain display value.
Example for computing the numerical value: For a display value of 30 µm a voltage of 5V is to be output: 5 V : 0.03 mm = 166.667 V/mm.

ANALOG
The numerical value to be entered depends on the analog voltage to be output when the distance between light point and origin of the display range is maximum. Example: A voltage of 3 V is to be output when a measured value of 100 µm is indicated in a display range of 100 µm. Sensitivity value to be entered: 3.000.

11. Press **START** twice as soon as the required value is entered. The setting is accepted and the entry "FACTOR (4.7.3.2)" is displayed again.
12. If no other settings are to be made in the catalog of functions and parameters, press **START**.

    If further settings are required, use the **ESC, MASTER, DATA** and **MENU** keys to navigate to the corresponding item in the catalog of functions and parameters and make the required settings.

16 Restoring factory settings

Pressing the **ESC** key directly after switching on the instrument initializes the instrument, i.e. resets it to the basic settings present at delivery. This is indicated by the message "INITALL", which is shown on the display during the initialization.

1. Press the **ESC** key when switching on the Millimar. The message "INITALL" is displayed. Then the flashing message "DEUTSCH (4.3.1)" is displayed.

2. Use the **DATA** and **MASTER** keys to set the display language and accept it by pressing **START** twice. The flashing message "MM (4.4.1)" is displayed.

3. Use the **DATA** and **MASTER** keys to set the unit of measurement and accept it by pressing **START** twice. The message "MAHR" is displayed and then the current measuring value.

17 Error messages

Error message	Routine	Possible cause	Remedy
OVFLOW	Measurement	The probe value exceeds the measuring or plausibility range.	Select a larger measuring or plausibility range. Correct the overmodulation of the probe.
OUT LIM	Calibration: the calculated correction factor is beyond the permissible range.	The specified gage blocks were not used or the dimensions were entered incorrectly.	
		The setpoint generator was not properly set.	
		The probe or setpoint generator was connected to the wrong input socket.	
ERR RXD	RS232 interface	An interruption signal (break) > 700 ms is present at the RXD input.	Check the connection between the RS232 interface and the external device (e.g. computer, printer, PLC).
FRM FEH		A two point master measurement was selected even though the linking formula includes two probes. A two point measurement can only be made if either the "C1" or "-C1" setting was selected under "FORMULA (1.3)"!	Select either the "C1" or "-C1" setting under "FORMULA (1.3)".
OVF LCD		The number of digits to be displayed exeeds the number of digits the can be indicated on the display.	
ERR CTS		CTS was not acknowledged for more than 3 seconds.	The measuring value must be sent again.
The display does not change even though the measuring pin is moving. However, the probe raw value with **TEST** is OK.		The setting "AUTOMAT (3.1.1.2)" was selected under PROCESS --> MEASURE --> MEASMOD (3.1.1) for recording the measuring values.	If necessary, select the "NORMAL (3.1.1.1)" mode.

18 Technical data

General

Dimensions (Height x Width x Depth)	487 x 47 x 104 mm
Weight	1.4 kg
Supply voltage	9 V DC
Using wide-range AC adapter	100 V to 240 V, 47 Hz to 63 Hz
Power consumption	12 W
Protection rating	IP53 (IP43 when used with conductive dusts), IEC60529

Carrier frequency

S1840 M	20 kHz
S1840 T	13 kHz
S1840 F	5 kHz

Effective value for excitation voltage

S1840 M	5 V
S1840 T	3 V
S1840 F	2 V

Measuring range

S1840	4000 µm (+/- 2000 µm), resolution 0.1 µm 400 µm (+/- 200 µm), resolution 0.01 µm

Sensitivity correction

Max. deviation between channels 2 and 1	+/- 1.2 %

Resolution (max.)

S1840	0.1 µm

Limiting frequency

60 Hz (-3dB); can be set using "FILTER (4.2)"

Setting duration

Analog output	20 ms
Digital switching outputs	20 ms

Error limits

Analog output	5 mV or 0.3 % of the output voltage
Digital switching outputs	0.2 µm or 0.3 % of the probe value displayed

Switch repeatability limit for digital outputs 0.2 µm

Hysteresis of digital outputs 0.1 µm

Temperature coefficient 0.005 %/°C

Max. number of probes for connection

S 1840 M, S 1840 F	2
S 1840 PE	1

19 Contacts at Mahr

The following contact persons are available to assist you:

Mahr GmbH Esslingen

Postfach 100254, 73702 Esslingen, Germany

or

Reutlinger Straße 48, 73728 Esslingen, Germany

E-mail: mahr.es@mahr.de
Telephone: (+49) 0711/9312-600
Fax: (+49) 0711/9312-725

20 Warranty

The unit supplied by us has been built and produced with care. Before being delivered, it also underwent further extensive testing.

We therefore guarantee that the unit complies with the relevant safety conditions and combines sturdy construction with problem-free functionality.
The duration and conditions of the warranty are set out in the general terms and conditions of delivery of Mahr GmbH or in the contract of sale.

Please also note the enclosed service plan with basic information on the maintenance intervals to be observed. Specific service intervals are to be kept to, depending on the range of applications. Proof of regular maintenance can be one of the conditions for accepting any claims under the warranty.

Unless any other arrangements have been made, the following conditions shall apply:
The warranty does not include natural wear and tear or faults arising from incorrect handling, inappropriate use or non-observance of these operating instructions. In particular, the manufacturer can only be held liable for the function and safety features of the unit if any intervention in the unit, other than those mentioned in these operating instructions, is carried out by either the manufacturer himself or a representative expressly appointed by him.

The extreme precision of this instrument is only guaranteed when original Mahr accessories are used.

Loss of warranty:

Storage temperatures below –10 °C or above +50 °C and relative humidity levels above 85 % will invalidate the warranty for the instrument.

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Navigating in the catalog of functions and parameters

Opening the catalog

Open the catalog by pressing the **MENU** key during ongoing operation (i.e. when the current measuring value is displayed). In the top line of the display a text is displayed instead of a number (e.g. "FEATURE 1") and in the bottom line, an ordinal number (e.g. "1.").

Meaning of the elements displayed

The text in the top line indicates the respective currently selected function/setting, while the ordinal number in the bottom line indicates the position of this function/setting in the catalog of functions and parameters.

Key functions

In the catalog of functions and parameters, only the **DATA**, **MASTER**, **MENU**, **ESC** and **START** keys have functions.

The red arrows that are engraved on the **DATA**, **MASTER**, **MENU** and **ESC** keys on the instrument indicated the direction in which the user moves in the catalog of functions and parameters upon pressing the respective key.

Navigating in the catalog

Use the **DATA** and **MASTER** keys to display other functions/settings on the same level in the catalog.

Use the **MENU** key to show the sub-functions/ settings for a function/sub-function currently being displayed (i.e. the next level down in the catalog).

Use the **ESC** key to return to the higher level in the catalog.

Use **START** to accept the parameter settings. Simultaneously, the user returns to the higher level in the catalog.



The following four flow charts show the levels of the catalog of functions and parameters in adjacent columns.

(1) The function "FEAT. 2" and the function "FEAT. 1" (instead of "FEATURE") are only displayed if the setting "2 FEAT" was selected under SETTING -> DISPLAY -> FEATURE. The functions and settings under FEATURE, FEAT. 1 and FEAT. 2 are identical.

(2) The function "DET LIM" is only displayed if the "AUTODET" setting was selected under SETTING -> DISPLAY -> FEATURE.

(3) The function "MASTER" is only displayed if the "MAST 1P" setting was selected under PROCESS -> MASTER.

(4) The functions "MSTR.MAX" and "MSTR.MIN" are only displayed if the "MAST 2P" setting was selected under PROCESS -> MASTER.