



Ferrite meter TQ-7

Operation manual



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Preface

This manual introduces the device structure, working principal, technical specifications as well as information necessary for proper operation of the TQ-7 ferrite meter (hereinafter referred to as the ferrite meter or device). Please, read carefully this manual before using of the device.

Only personnel who have completed a training course and are familiar with the operating documentation are allowed to operate the device. In order to carry out testing procedure in correct way, it is necessary to determine control tasks, select control schemes, select probes, evaluate the control conditions of similar materials, etc.

Continuous improvement of the device performance, increase of reliability and ease of use may need some modifications, which may bring inconsistencies to the manual in real operation, but does not impair the technical characteristics of the device.

1. General

1.1 Intended use

1.1.1 Field of application

The TQ-7 ferrite meter is designed to measure the percentage of ferrite phase in steel samples. It can be used in laboratory, field and workshop conditions at enterprises of mechanical engineering, energy, radio electronics and other industries.

1.1.2 Operation conditions

The device is intended for use under the following environmental conditions:

- temperature range -20 °C ... +55 °C;
- relative air humidity up to 95% at a temperature of +35 °C.

1.2 Delivery set

The contents of basic delivery kit are given in Table 1.

* Number and type of probes are on customer's request.

Table 1

| Name, type | Quantity |
|--|----------|
| Electronic unit | 1 pc. |
| Magnetic induction probe | 1 pc.* |
| Ferrite phase content control specimen | 1 pc. |
| USB A – micro USB cable | 1 pc. |
| Charger | 1 pc. |
| Carrying bag | 1 pc. |
| User manual | 1 copy |
| Calibration certificate | 1 copy |

1.3 Specifications

The main metrological and technical characteristics are given in Table 2.

| Parameter | Magnetic induction probe |
|--|---|
| Measurement range | 0 – 100 % |
| Limits of absolute measurement error | $\pm (0.03 d + 1)$, where d is the percentage of the measured ferrite phase content) |
| Resolution in the measurement range of 5 ... 100%: | 0,1% |
| Display parameters | TFT, 240 × 320 dpi |
| Power supply | three Ni-Mh AA-type batteries |
| Rated supply voltage | 4,5 V |
| Time of continuous operation from a fully charged new battery under normal climatic conditions | not less than 16 h |
| Dimensions of electronic unit | 160 x 85 x 28 mm |
| Weight | 0,5 kg |
| Average service life, years, not less than | 5 |
| Mean time between failures, h, less than | 12 500 |

1.4. Principle and structure

1.4.1 Structure

The device comprises an electronic unit in impact-resistant housing with a rubber bumper and replaceable magnetic induction probes. The housing of the electronic unit is IP54 class dust- and moisture-proof one.

At the top of the front panel of the electronic unit there is a color TFT display, which displays measurement results and service information necessary to control the device. The display provides complete visual control of the measurement process using color indication.

Under the display there is a film keyboard for controlling the device.

On the upper end wall of the electronic unit there is an ODU connector ("Lemo B0"-type) for connecting the probe, and a micro-USB connector to charge the built-in battery.

Note : It is not recommended to take measurements during charging because of possible increase in measurement error.

1.4.2 Operating principle

The operating principle of the ferrite meter is based on recording the electromotive force (EMF) arising in the winding of a differential-type magnetic induction probe when it is placed on a magnetic or non-magnetic base of the test object. The level of EMF depends on the size of the gap between the probe working part of the and the base. In general, this dependence is a non-linear function.

The electronic unit provides EMF measurement on the signal and reference windings, linearization of the transfer characteristic of the measuring path, statistical processing and display of measurement results.

1.4.3 Operating modes

The ferrite meter has several operating modes:

- **DOTTED** mode for measurement in a certain point
- **CONTINUOUS** mode for scanning the test object
- **SETUP** mode for setting up and selecting measurement parameters

1.4.4 Display

The information displayed on the screen is divided into three main blocks: block of results and parameters, top information line and bottom information line (see Figure 1).

The top information line contains the following information:

- battery charge level (in all operating modes)
- units of measurement used
- setup icon (in **SETUP** mode)

In all measurement modes, the bottom information line contains information on the type of connected probe and the current configuration name (see Figure 1).

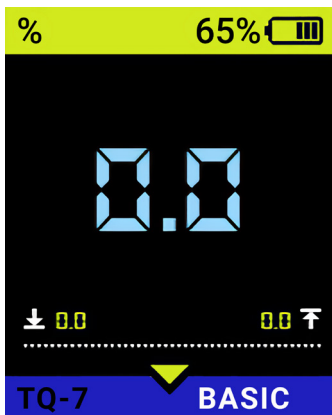


Figure 1


1.4.5 Keyboard

The keyboard (Figure 2) contains 8 function buttons and an on/off button.



Figure 2






Main functions of the buttons:

- the button  is used to turn the device on/off.

ATTENTION:

Device will automatically turn off after the time set in the energy saving menu item if no buttons are pressed during this period and the measurement process is not in progress.

Device will automatically go to standby mode after the time set in the energy saving menu item if no buttons are pressed during this period and the measurement process is not in progress!

- the button  is used to enter the SETUP mode.
- the button  performs different functions depending on the operating mode and state of the ferritometer.
- the button  is used to return to the previous window.
- the button  is used to start the adjustment procedure.
- arrows , are used to select and change active parameters. Their actions are similar for different operating modes and are designed for intuitive learning, since their symbols correspond to the nature of their action.

2. Operation

2.1 Operating limitations

The device is intended for operation in the environmental conditions specified in paragraph 1.1.2.

2.2 Getting ready to work

2.2.1 Probe connection


Magnetic induction probes are used to determine the percentage of ferrite phase or ferrite number.

The probe should be connected to the electronic unit following the markings on the cable and connector.

The probe could be connected/ disconnected at any time regardless whether the electronic unit is turned on or not.


2.2.2 Turning the device on/ off

Connect the probe to the electronic unit of the device.

To turn on the ferrite meter, press and hold  button.

When the device is turned on, it is automatically configured to work with the connected probe. During the setup it is advisable to use the spatial orientation of the probe which will be used during taking measurements.

When the automatic setup of the probe is finished, start the calibration procedure described in paragraph 2.3.2.5.

To turn off the ferrite meter, press and hold  or wait until it automatically turns off after the time set in the energy saving parameters, if no buttons are pressed or no measurement is taken.

All the device settings are saved when it turned off or the battery is completely discharged.

2.3 Using the device

2.3.1 Taking measurements

The effect of temperature on measurement results should be taken into account. In order to obtain the best measurement accuracy, the device should be set up using a sample having the same temperature as the test object.

2.3.2 SETUP mode

The **SETUP** mode includes a list of parameters available for editing as well as adjustment and calibration procedures, and a configuration database.

The **SETUP** mode menu is shown in Figure 3. The name of current configuration is displayed in the top information line.

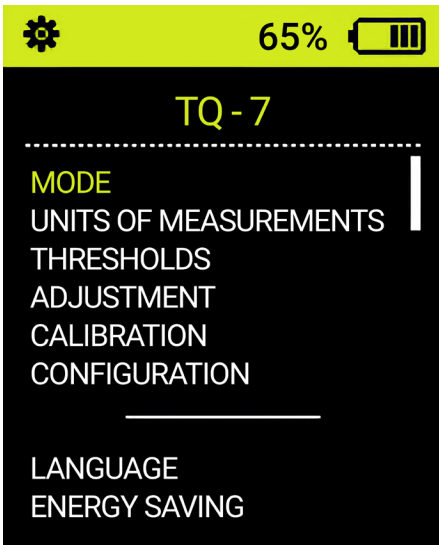





Figure 3

The menu items of **SETUP** mode, their corresponding functions and parameters are shown Table 3. The menu items of the SETUP mode, the corresponding parameters and functions are given in Table 4.





Tables 3-4

| Button | Function |
|---|----------------------------------|
|  | Navigate through menu items |
|  | Enter the selected item settings |
|  | Exit SETUP mode |

| Menu item (parameter) | Parameter value | Description |
|---|--|---|
| Mode | dotted / continuous | Selection the measurement method |
| Units of measurement | % / FN | Selection of units of measurement |
| Thresholds | from 0 to 100 (%) from 0 to 120 (FN) | Setting the operation thresholds |
| Adjustment | - | Starting adjustment procedure using one control sample |
| Calibration | - | Starting the calibration procedure for several control samples (default mode is not available, enabled by the Manufacturer) |
| Configuration | From 1 to 10 (it is possible to create up to 10 configurations for each probe type) | Selection of existing configuration or creating new configuration |
| Language | ENGLISH / DEUTSCH | Selection the interface language |
| Energy saving: • automatic shutdown time, minutes • standby time, s | 0,5 / 1 / 2 / 3 / 4 / 5 Never / 3 / 4 / 5 / 10 / 15 / 30 | Energy saving parameters |
| Turning off | - | Turning off the device |

The functions of the keys active in each menu item are given in Table 5.

Table 5

| Button | Function |
|---|---|
|  | Changing the parameter value |
|  | Navigate through menu items |
|  | Exit with confirmation of the changes made |
|  | Return the previous menu (all changes made will be saved) |

2.3.2.1. Mode

This menu item allows to select the measurement mode:

The **DOTTED** mode is the main operating mode of the device providing obtaining measurement results in the selected units (percentage or ferrite number) over the entire range of measured values. Separate measurements are carried out each time the probe is placed on the test object. The measurement results are recorded and subjected to statistical processing (calculation of the arithmetic mean, minimum and maximum values).

For this mode, in addition to measurement result displaying on the screen, the display of additional information may be enabled. Select **SHOW** next to the required option:

- **MAX/MIN** – the minimum / maximum value during the measurement process
- **AVERAGE** – the arithmetic mean value and standard deviation
- **HISTORY** – the history of measurements taken

The **DOTTED mode** menu is shown in Figure 4.

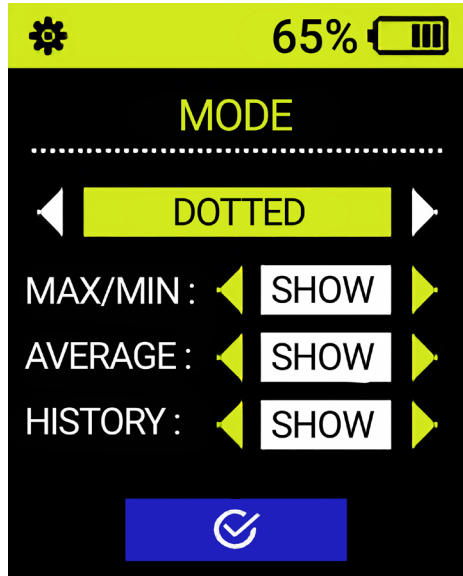
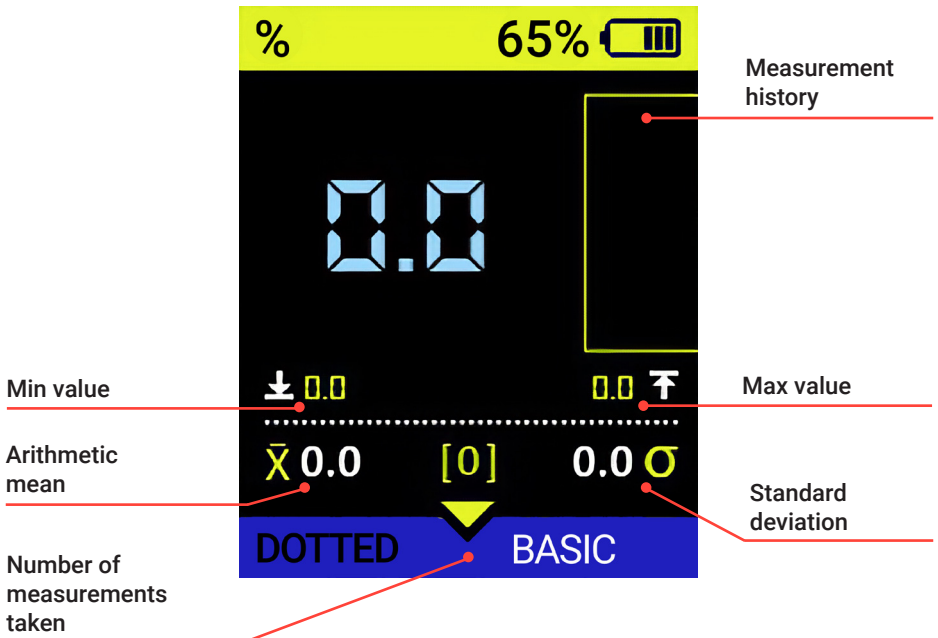


Figure 4



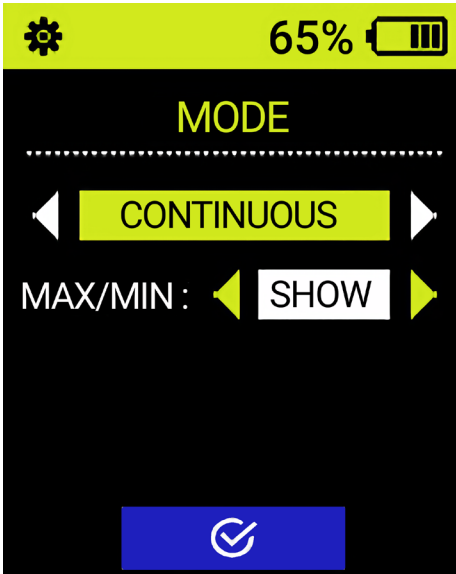
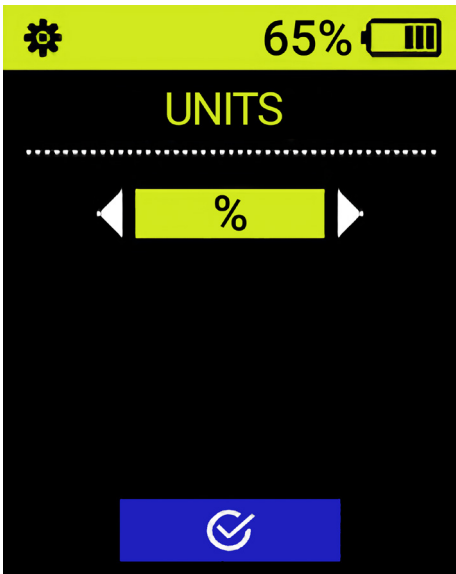


Figure 5

The **CONTINUOUS mode** displays the current value of the ferrite phase percentage or ferrite number in real time when scanning over the test object and ensures that the result is updated at least four times per second. This mode is intended for monitoring special areas of test object and for comprehensive testing of the device performance.

For this mode, in addition to the measurement result displaying on the screen, the display of minimum / maximum value may be enabled. Select **SHOW** option next to the **MAX/MIN** parameter. The **CONTINUOUS mode** menu is shown in Figure 5.



2.3.2.2 Units of measurement

This menu item allows to select the units of measurement: percentage (%) or ferrite number (FN).

The **UNITS OF MEASUREMENT** menu is shown in Figure 6.

Figure 6

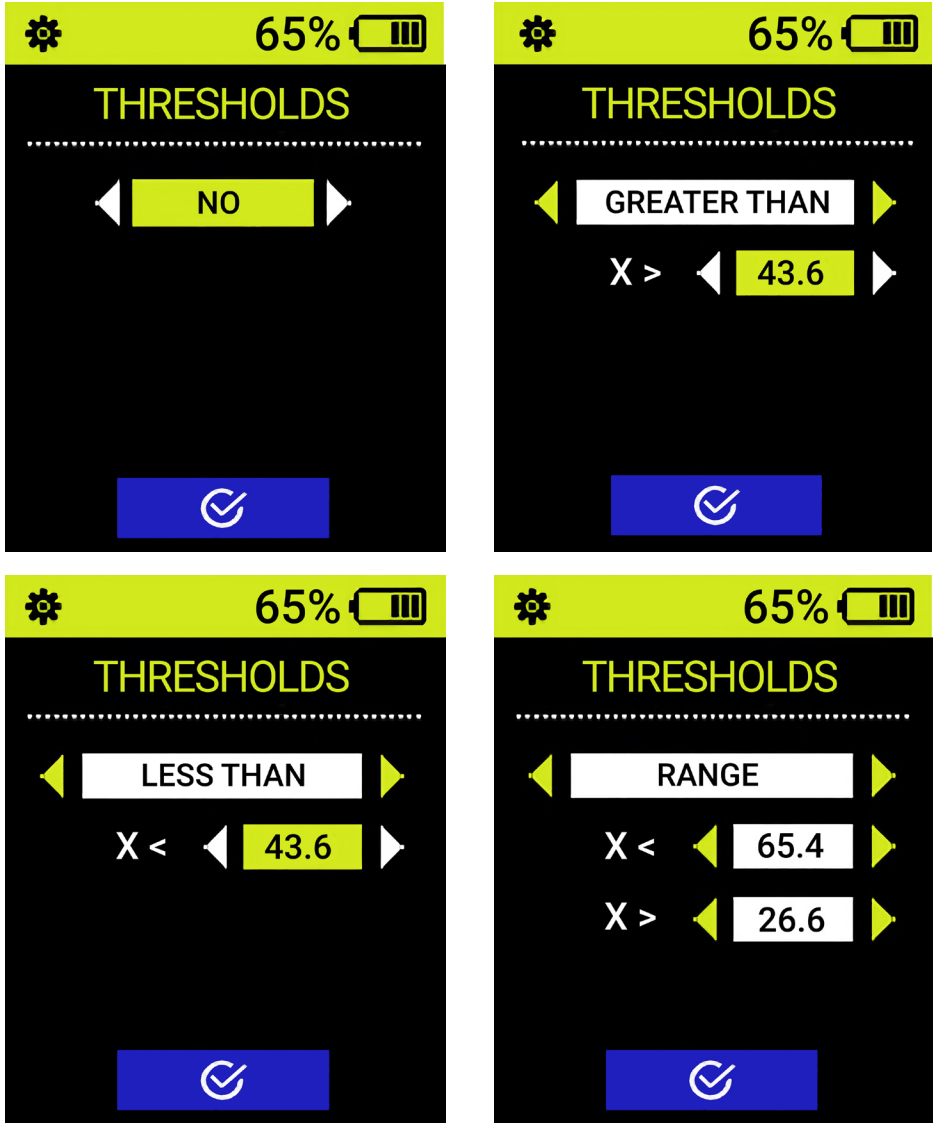
2.3.2.3 Thresholds

This menu item allows to set up the upper and the lower limits of operation threshold or specify the operation threshold range.


Acceptable values range from **0 to 100%**. After setting the thresholds, both the sound accompaniment and the red highlighting of values that go beyond the specified limit are triggered.


The **THRESHOLDS** menu is shown in Figure 7.


Figure 7



2.3.2.4 Adjustment

This menu item is intended to adapt the device to the connected probe and additional calibration setup. To enter the adjustment mode, press the button .

Then lift the transducer into the air and press the button  the air calibration process will take place (Figure 8, a, b); When performing the adjustment, only one point can be saved, otherwise the adjustment process is similar to the calibration process described in paragraph 2.3.2.5.

If you do not enter any adjustment point values (press the button  immediately after performing air calibration), the adjustment value will be reset to the base value and the device will display the main screen.

ATTENTION:

When resetting the calibration results, the adjustment result will also be reset!

The **ADJUSTMENT** menu is shown in Figure 8.

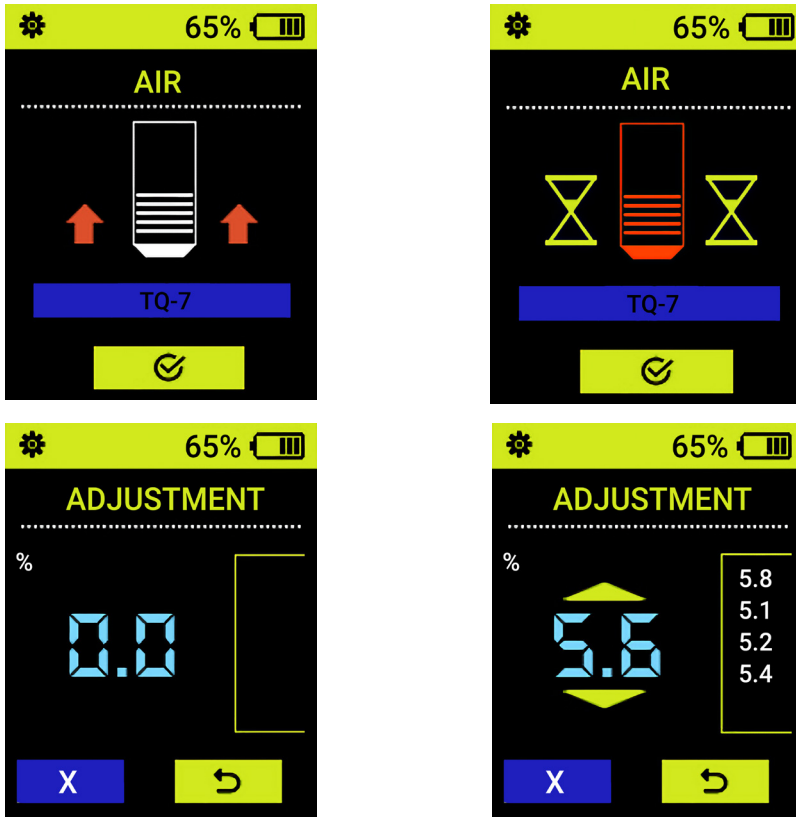


Figure 8

2.3.2.5 Calibration

ATTENTION:

Calibration mode is blocked by default! To start the CALIBRATION mode, contact the Manufacturer!

This menu item is intended to perform device calibration using ferrite phase content control samples included in the delivery set or using a representative area of the test object. Calibration allows to reduce the effect of temperature and magnetic properties of base and coating materials on measurement results.

It is possible to utilize up to 30 ferrite phase content control samples for the calibration procedure. The control samples should be prepared before calibration.

The surface of the control samples should not show any traces of contamination. To achieve the best measurement accuracy, the control sample parameters (thickness, material grade, surface roughness, and curvature) must be identical to that of test object.

When entering the calibration menu, the probe will be automatically compensated.

To perform calibration, follow the instructions on the screen:


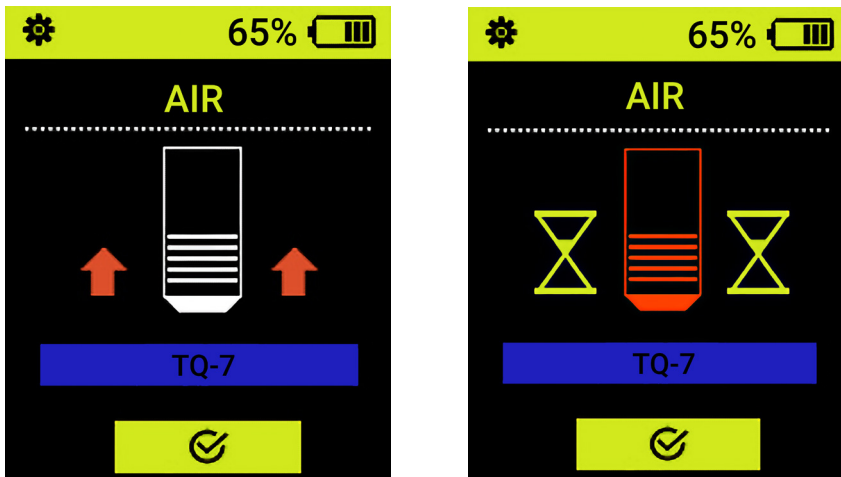
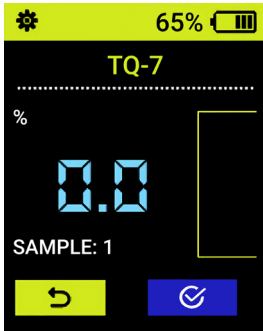
- Enter the **CALIBRATION** menu. The name of the connected probe will be displayed on the screen
- Lift the probe and press  button, the calibration process in the air will occur, see Figure 9 below.





Figure 9







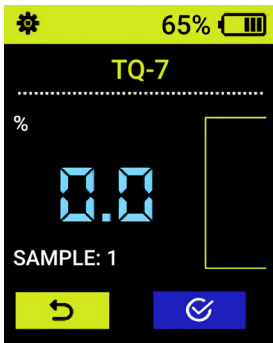
- proceed to calibration using control samples (see Figure 10.)

Figure 10

At all stages of calibration using control samples,  and  buttons are displayed on the screen. Use   buttons to navigate.

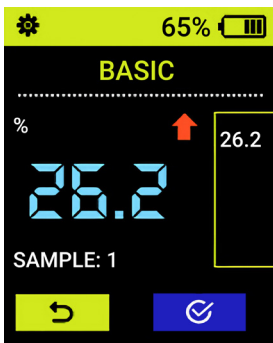
When you press the button , all measurement results will be saved as calibration settings.

Pressing the button  will reset the calibration mode and exit to the device settings menu.



- choose a control sample with required percentage of ferrite phase
- place the probe on the control sample (see Figure 11.)

Figure 11



- the measurement result will be displayed on the screen. The red up arrow will appear in the right upper corner indicating that the probe needs to be removed from the sample. The measurement result will be shown in the column on the right (see Figure 12.)
- remove the probe from the sample
- the average value of ferrite phase percentage will be automatically calculated after each measurement
- measurement results will be displayed in the column on the right, the calculated average value will be shown in the center of the screen.

Figure 12

NOTE: It is necessary to perform from 4 to 6 measurements to carry out the subsequent manual correction of the calculated average value.



- after the fourth measurement, additional arrows will appear above and below the average value, indicating that its manual correction is available (see Figure 13.)

ATTENTION!

If the seventh measurement is taken, the previous six measurement results will be reset!

Figure 13

Use ▲ ▼ buttons to set the value of ferrite phase percentage as close as possible to the actual one. The measurement results displayed in the column in the right will be reset (see Figure 14.)

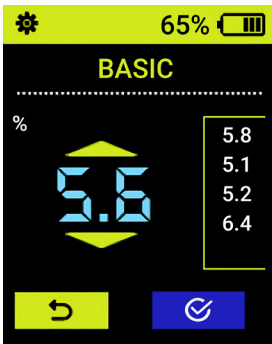


Figure 14

- After receiving the correct result, to save it as a calibration point, press the key ►
- To return to the previous calibration point, press the button ◀
- press ↶ button to exit the **CALIBRATION** menu and return to **SETUP** mode.
- To save the settings as a configuration, press the button ☑. The device will then switch to the configuration name selection mode (see 2.3.2.6).
- Saving the resulting settings is possible by entering at least 3 samples of ferrite phase content specimens.
- In order to add additional calibration points, choose control specimens with another percentage of ferrite phase and repeat the measurement procedure described above.

To delete previously saved measurements, you should start new measurements from the beginning or increase the number of measurements to 6.





ATTENTION:

When resetting the calibration results, the adjustment result will also be reset!

2.3.2.6 Configuration



By default, the device has a pre-installed configuration named DIN EN ISO8249 (units of measurement - %).

For saving and further use, for each current set of parameters (probe, control object) you can create your own configuration.

The selection of the on-screen button is carried out using the buttons  . To select a function, go to the corresponding button using the buttons  . The currently active button will turn yellow.




When entering the CONFIGURATION menu from the main screen or via the main menu, the functions of the on-screen buttons are shown in Table 6. In this menu you can select a new configuration.

Table 6








| Button | Function |
|---|---------------------------------|
|  | Return to main menu |
|  | Select configuration as current |

If the function is activated, then when entering the CONFIGURATION menu after measuring samples from the CALIBRATION function, the functions of the screen buttons are given in Table 6.1. In this menu, you can delete the old, add a new one, or save the calibration results under an existing name.

Table 6.1

| Button | Function |
|---|--|
|  | Delete configuration |
|  | Create new configuration |
|  | Set configuration as active/ Select configuration |

To add new configurations, select the CALIBRATION item in the settings menu:

- Use   buttons to select  button for creating new configuration or  to save it under the name of a previously selected configuration
- When selecting a new configuration name in the window that opens, use the alphanumeric field to assign a name to the new configuration, confirming each selected character with the button .
- use screen keyboard to type the configuration name, confirming each symbol by pressing  button. To delete a symbol, press .

The view of the CONFIGURATION item screens when creating a new one is shown in Figure 15

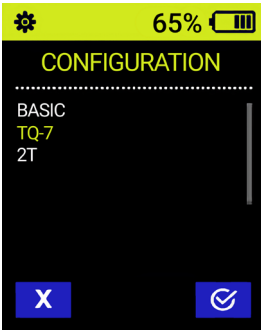






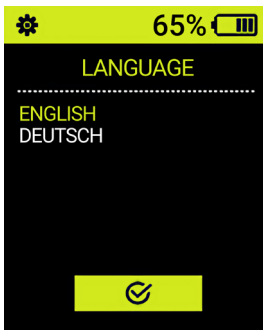
Figure 15

To delete a configuration, select the button  and confirm  or decline  the deletion in the window that opens. You can also exit the CALIBRATION mode by pressing the button .

2.3.2.7 Language

Selecting the device interface language:

- English
- German



The **LANGUAGE** menu is shown in Figure 16.

Figure 16

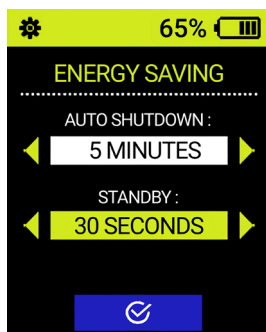
2.3.2.8 Energy saving

Setting the time for the device to turn off completely, go into standby mode, and setting the screen brightness.

The permissible energy saving parameters are given in Table 7.

Table 7

| Menu item (parameter) | Parameter value | Description |
|----------------------------------|----------------------------------|---|
| Automatic shutdown time, minutes | 0,5 / 1 / 2 / 3 / 4 / 5 | The period of time after which the device will turn off automatically, if no buttons are pressed or no measurement is taken during this period |
| Standby time, s | Never / 3 / 4 / 5 / 10 / 15 / 30 | The period of time after which the device will turn into standby mode (low power consumption, decreased screen brightness), if no buttons are pressed or no measurement is taken during this period |
| Screen brightness, % | From 20 to 100 (step 10) | Adjusting the screen backlight. It is not recommended to use maximum brightness to avoid accelerated battery discharge. |



The **ENERGY SAVING** menu is shown in Figure 17.

Figure 17

2.3.2.9 Turning off

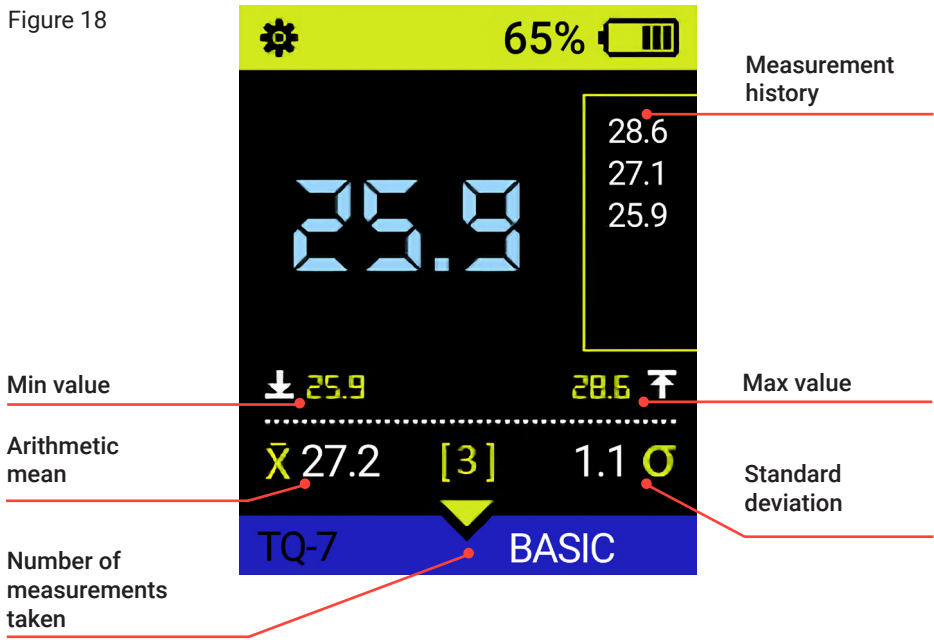
To turn off the device, hold down the power button while in measurement mode.

2.3.3 DOTTED mode

In the **DOTTED mode**, separate measurements are carried out each time the probe is placed on the test object.

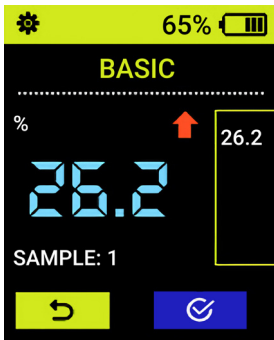
The DOTTED mode menu is shown in Figure 18.

Figure 18



To carry out the measurement:

- enter the **DOTTED mode**
- bring the probe vertically to the test object surface
- place the probe on the test object surface and press firmly
- as the red up arrow appears, read the measurement result
- lift the probe, the red arrow should go out. When the **HISTORY** option is enabled, the measurement results will be displayed in a column on the right
- carry out next measurement if necessary



The **DOTTED mode** menu in the process of taking measurements is shown in Figure 19.

Figure 19



2.3.4 CONTINUOUS mode

In the **CONTINUOUS mode**, measurements are carried out in real time when scanning over the test object.

The **CONTINUOUS mode** menu in the process of taking measurements is shown in Figure 20.

Figure 20

3 Maintenance

Maintenance of the ferrite meter consists of cleaning the electronic unit from dust and dirt, charging the battery, repairing and verification.

For all issues regarding the use and repair of the device, please, contact the manufacturer.

The verification interval of the device is 1 year.

3.1 Basic prevention measures

Main prevention measures are listed in Table 7.

Table 7

| Inspection period | Prevention measures |
|----------------------------|--|
| Before each use | Check the electronic unit, cable, and probe for damage. Check connectors and plugs for dirt and foreign objects. |
| Before taking measurements | Check functionality of control and cable connections. Perform calibration. |
| After each use | Clean the probe. Check the electronic unit, cable, and probe for damage. |

3.2 Battery

The battery of the device is designed to operate over a wide temperature range. At negative temperatures, the battery capacity decreases: at the lower value of the temperature range the capacity is approximately 15% lower than that at normal temperatures.

When the battery is completely discharged, the device turns off automatically.

The battery is equipped with built-in protection against overcharge, over discharge, excess current and temperature.

The battery life is intended for the entire warranty period of operation the device. Battery replacement is carried out only in service centers.

ATTENTION:

Replacement of the battery by the user independently results in the void of the device warranty!

3.3 Battery charging

The battery can be charged from an external charger or from a personal computer.

ATTENTION:

To avoid device failure, use only the power adapter included in the delivery set!

To charge the battery, remove the cover from the battery pack and connect the power adapter to a 220/230 V power supply.

The battery charging time depends on the discharge degree. Full charging time is 4-5 hours. Multiple recharging is allowed.

ATTENTION:

To avoid battery failure, do not store the device with discharged batteries!

To charge the battery, remove the cover from the battery pack and connect the power adapter to a 220/230 V power supply.

The battery charging time depends on the discharge degree. Full charging time is 4-5 hours. Multiple recharging is allowed.

ATTENTION:

To avoid battery failure, do not store the device with discharged batteries!

3.4 Troubleshooting

If a malfunction occurs, you should turn off and turn on the device. If the problem is not solved, you should use the recommendations given below.

Table 8

Troubleshooting solutions for some problems are shown in Table 8.

| Problem | Analysis | Solution |
|---|-------------|--------------------|
| When turning on, the indicator blinks or the device turns off immediately | Low battery | Charge the battery |

| | | |
|---|--|---|
| Large variation in readings when measuring at one point | The control conditions regarding the choice of location the probe are not observed | Locate the probe in accordance with paragraph 2.1 |
| Measurement results exceed the error limits | Contamination inside the probe | Carefully disassemble the probe and clean it |
| There are no measurement results on the display | 1. No contact in the probe connector 2. Broken connecting cable | 1. Reconnect the probe 2. Repair broken cable |

If you encounter any other malfunctions in the operation of the device or have any questions about its use, please, contact representatives of the manufacturer.

4 Storage

The device must be stored in the carrying bag included in the delivery set.

The device should be stored on racks.

The arrangement of the devices in storage facilities must ensure their free movement and access to them.

The distance between walls, storage facility floor and the device must be at least 100 mm.

The distance between storage heaters and the device must be at least 0.5 m.

The storage facility should be free of conductive dust, admixtures of aggressive gases and vapors that cause corrosion of the device materials.

5 Transportation

The device must be transported in the carrying bag included in the delivery set.

Transportation of packaged devices can be carried out over any distance by any type of transport without speed restrictions.

Packed devices must be secured in vehicles, and they must be protected from precipitation and splashing water, when using open vehicles

The placement and fastening of packaged devices in vehicles must ensure their stable position and exclude the possibility of hitting against each other, as well as against the walls of vehicles.

The transportation conditions of the device must comply with the requirements of the rules and regulations in force for each type of transport.

When transporting by air, the packed device should be placed in sealed and heated compartments.

After transportation at temperatures different from operating conditions, before operating the device, it must be kept in normal climatic conditions for at least two hours.

6 Certificate of Acceptance

MF-71L ferrite meter serial No _____,

is recognized as suitable for use

Ferrite phase content control specimen of _____%/FN

Date of manufacture _____

Shipping date _____

QC department representative _____

STAMP

7 Warranty

7.1 The warranty period for the device is 2 years from the date of sale (shipment).

7.2 The warranty period for the probes is 1 year from the date of shipment.

7.3 The manufacturer guarantees the compliance of the MF-71L ferrite meter with the requirements of document "MF-71L ferrite meter. Technical Specifications.

7.4 The manufacturer's warranty does not apply to cables and consumables.
Parts subject to ordinary wear and tear: 30 days.

7.5 The manufacturer undertakes to repair the device free of charge during the warranty period, including replacing it as a whole, if during the warranty period the device fails or its characteristics are below the specifications given in this operation manual.

7.6 Warranties become void in the following cases:

- there are traces of mechanical damage, exposure to water or other active media on the electronic unit housing;
- the components of the electronic unit show signs of self-repair, disassembly, etc.
- the malfunction occurred due to a violation of the established rules for using the device, actions of third parties or force majeure circumstances.



 **TEQTO**

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