



Sauter, Inc.

Brickworks 1
72336 Balingen, Germany
Email: info@kern-sohn.com

Phone: +49-[0]7433- 9933-0
Fax: +49-[0]7433-9933-149
Website: www.sauter.eu

User Manual for Multimode Ultrasonic Material Thickness Gauge

SAUTER TO

Version 2.1
04/2026
EN



PROFESSIONAL MEASURING

TO-BA-e-2621



SAUTER TO

V.2.1 04/2026

**User Manual for Multimode Ultrasonic Material
Thickness Gauge**

Congratulations on purchasing a multimode ultrasonic thickness gauge from SAUTER. We hope you enjoy using your high-quality measuring device with its wide range of functions. Our customer service team is available by phone to answer any questions, address any requests, or receive your suggestions.

Table of Contents:

1	General Information	4
1.1	Product Specifications	4
1.2	Measuring Principle	4
1.3	Transducer: Technical Data	4
1.4	Configuration	6
1.5	Operating conditions:	6
2	Keyboard and Display	6
2.1	Main screen	7
2.2	Control unit	8
3	Preparation for measurement	8
3.1	Selecting the transducer	8
3.2	Condition and preparation of surfaces	10
4	Operation	11
4.1	Power Supply	11
4.2	Connecting the Probe	11
4.3	Turning on the device (Power ON)	11
4.4	Configuring Standby Settings	12
5	Operation	13
5.1	Setting the operating mode	13
5.2	Selecting the probe	13
5.3	"Probe Zero" function	13
5.4	Calibrating the sound velocity	14
5.5	Performing measurements	17
5.6	Set View Mode	18
5.7	Set the standard thickness	19
5.8	Set limit value	20
5.9	Set resolution	20
5.10	Memory management	21
5.11	Set key tone	23
5.12	Set warning tone	23
5.13	Set LCD brightness level	23
5.14	Set display standby	23
5.15	Set automatic shutdown	24
5.16	Change unit system	24

5.17	Set date and time	24
5.18	Set language	25
5.19	Product Information	26
5.20	Reset System	26
5.21	USB communication	26
6	Measurement technology	26
6.1	Measurement methods	26
6.2	Wall measurement	27
7	Service	27
8	Transport and Storage	27
9	Sound velocity	28
10	Application Notes	29
10.1	Measuring large and small pipes	29
10.2	Measuring hot surfaces	29
10.3	Measuring laminate materials	30
10.4	Measurement through paint layers and coatings	30
10.5	Suitability of materials	30
10.6	Coupling agents	31

1 General

The TO-EE model is an ultrasonic material thickness gauge with multiple operating modes. Based on the same operating principles as SONAR, the device can measure the thickness of various materials with an accuracy of up to 0.1 / 0.01 millimeters. Thanks to the meter's multimode function, the user can switch between pulse-echo mode (defect and depression detection) and echo-echo mode (determination of the actual material thickness without any paint or coating thickness).

1.1 Product Specifications

- Multimode: Pulse-Echo mode (P-E mode) and Echo-Echo mode (E-E mode). In Echo-Echo mode, wall thickness can be measured without accounting for paint or coating thickness.
- Wide measurement range: Pulse-echo mode: (0.7 ~ 600) mm (in steel, depending on the probe). Echo-echo mode: (3 ~ 100) mm.
- V-Path correction to compensate for probe nonlinearity.
- TFT color display (320 × 240 TFT-LCD) with adjustable backlighting allows the user to work in low-visibility environments.
- Up to 100 groups of measured thickness values can be stored in non-volatile memory. A maximum of 100 data records per group is permitted.
- Two AA alkaline batteries are used as the power source. This ensures continuous operation for at least 100 hours (standard brightness setting). Energy-saving functions "Display Standby" and "Auto Power Off" are available.
- USB 1.1 port. Online transfer of measurement data to a PC via USB.

1.2 Measurement principle

The ultrasonic thickness gauge determines the thickness of a part or structure by precisely measuring the time it takes for a short ultrasonic pulse, generated by a transducer, to travel through the thickness of the material, reflect off the back or inner surface, and return to the transducer. The measured bidirectional transit time is divided by two to account for the round trip, and is then multiplied by the speed of sound in the respective material. The result is reflected in the following ratio :

$$H = \frac{v \times t}{2}$$

H = thickness of the test specimen

v = speed of sound in the respective material

t = measured round-trip time

1.3 Transducer overview

Model	Freq [MHz]	Φ [mm]	Measurement range [mm]	Lower limit [mm]	Description
-------	---------------	-----------	---------------------------	---------------------	-------------

N02 <i>ATU- US01</i>	2.5	14	3.0 ~ 300.0 mm (in steel) 40 mm (in gray cast iron HT200)	20 mm	for thick, highly attenuating, or highly scattering materials
N05 <i>ATU- US09</i>	5	10	1 ~ 300.0 mm (in steel)	Φ 20 mm × 3.0 mm	Standard measurement
N05/90° <i>ATU- US10</i>	5	10	1 ~ 300.0 mm (in steel)	Φ 20 mm × 3.0 mm	Normal measurement
N07 <i>ATU- US02</i>	7	6	0.7 ~ 200.0 mm (in steel)	Φ 15 mm × 2.0 mm	For measuring thin- walled tubes or tubes with slight curvature
HT5 <i>ATB- US02</i>	5	12	3 ~ 100.0 mm (in steel)	30 mm	For measurements at high temperatures (below 300 °C)
P5EE <i>ATU- US12</i>	5	10	P-E: 0.7–600 mm E-E: 3 ~ 100 mm	Φ 20 mm × 3.0 mm	Standard measurement and thickness measurement via paint or coating thickness

Table 1.3. Sauter product names in italics

1.4 Configuration

	No.	Item	Qty.	Remarks
Default configuration	1	Housing	1	
	2	P5EE probe (5 MHz)	1	
	3	Coupling agent	1	
	4	Equipment packaging	1	
	5	User manual	1	
	6	Alkaline battery	2	Type AA
Optional configuration	8	Probe N02 (2.5 MHz)		See Table 1.3.
	9	Probe N05/90° (5 MHz)		
	10	Probe N05 (5 MHz)		
	11	Probe N07 (7 MHz)		
	12	Probe HT5 (5 MHz)		

1.5 Operating conditions:

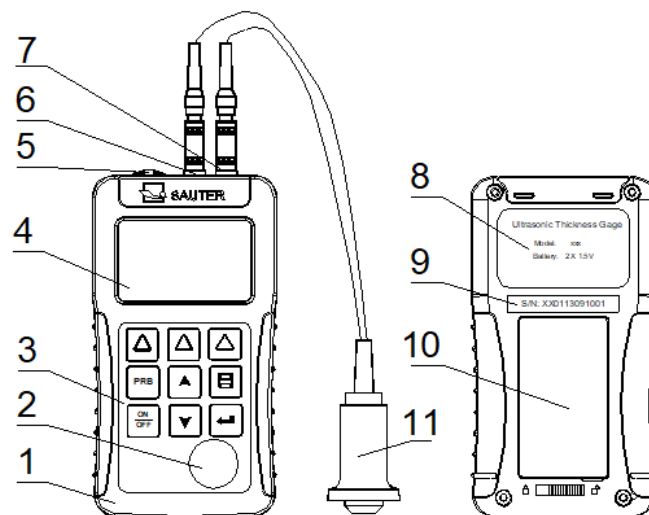
Operating temperature: 0° C ~ +50° C

Storage temperature: -20° C ~ +70° C

Relative humidity: ≤ 80%

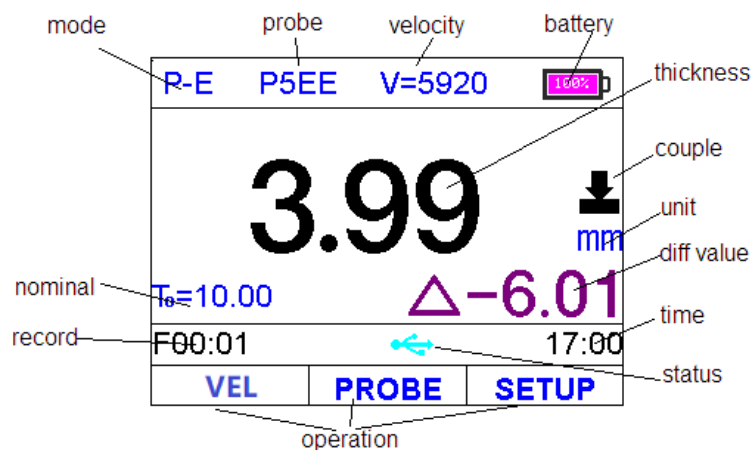
Vibrations, strong magnetic fields, corrosive media, and heavy dust accumulation must be avoided at the installation site.

2 , and Display



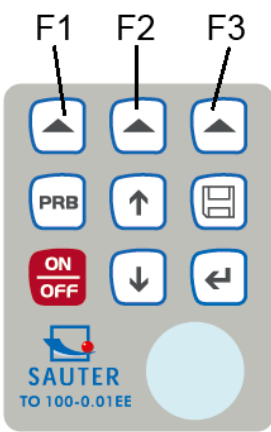
- 1 Housing
- 2 "Probe Zero" plate
- 3 Keyboard
- 4 TFT display
- 5 USB port
- 6 Pulse generator jack
- 7 Receiver jack
- 8 Sticker
- 9 Serial number
- 10 Battery compartment cover
- 11 Probe

2.1 Main screen



Function	Explanation
Mode	"E-E" indicates that the meter is operating in echo-echo mode; "P-E" indicates that it is operating in pulse-echo mode;
Probe	Probe selection
Velocity	Sound velocity
Battery	Displays the remaining battery capacity
Thickness	Last measurement result
Unit	Unit system: mm or inches
Diff value	Measurement result when working in Diff mode
Time	System time
Status	USB communication status
Operation	Indicates which operation is currently active
Record	Displays the selected data group and the number of records
Couple	Displays the coupling status
Nominal Thickness	Keyboard shortcuts

2.2 Control Unit

The device's design allows the user quick access to all device functions. A user-friendly menu system enables access to any function by pressing a few buttons.  Function keys for selecting the desired function on the display. In the following sections of this manual, they are designated from left to right as F1, F2, and F3.			
	ON/OFF or CANCEL		Procedure: Probe Zero
	Save measurement result		Confirm/Enter
	Plus or scroll up		Minus or scroll down

3 Preparing for measurement

3.1 Selecting the 's transducer

The measuring instrument is designed to perform measurements on a wide variety of materials, ranging from various metals to glass and plastics. However, different material types require the use of different transducers. Selecting the correct transducer for the specific application is essential to ensure accurate and reliable measurements. The following sections highlight the important characteristics of the transducer that should be considered when selecting one for a specific application.

In general, the best transducer for a given application is one that emits sufficient ultrasonic energy into the material being measured so that a strong, stable echo is received by the measuring device. The strength of the ultrasonic wave during propagation can be influenced by several factors. These are listed below:

- Initial signal strength: The stronger the signal at the start, the stronger its return echo. The initial signal strength is largely determined by the size of the ultrasonic transducer in the probe. A large radiating surface emits more energy into the material being measured than a small radiating surface. Therefore, a so-called "1/2-inch" transducer emits a stronger signal than a "1/4-inch" transducer.

- Absorption and scattering: When ultrasound propagates through any material, it is partially absorbed. If the material through which the sound propagates has a granular structure, the sound waves are scattered. Both effects reduce the intensity of the waves and thus the measuring device's ability to detect the returning echo. Higher-frequency ultrasound is absorbed and scattered more than lower-frequency ultrasound. Although it may seem advisable to use a lower-frequency transducer in every case, lower frequencies are less directional than higher frequencies. Therefore, a higher-frequency transducer is the better choice for determining the precise location of small depressions or defects in the material being measured.
- Transducer Geometry: The physical constraints of the measurement environment sometimes determine a transducer's suitability for a specific measurement task. Some transducers may simply be too large to be used in space-constrained areas. Additionally, the contact area available for the transducer may be limited, requiring the use of a transducer with a small contact surface. Measuring on a curved surface, such as an engine cylinder wall, may require the use of a transducer with a correspondingly curved contact surface.
- Material Temperature: When measurements must be taken on very hot surfaces, high-temperature transducers must be used. These transducers are manufactured using special materials and techniques that allow them to withstand high temperatures without damage. In addition, caution is advised when performing "Sensor Zeroing" or "Calibration to Known Thickness" with a high-temperature transducer.

Choosing the right transducer often involves balancing different characteristics. It may be necessary to test different transducers to find the one best suited for the specific application.

The transducer is the device's "working tool." It transmits and receives ultrasonic waves, which the device uses to calculate the thickness of the material being measured. The transducer is connected to the device via the supplied cable and two coaxial connectors. When using transducers, the orientation of the dual coaxial connectors is irrelevant: either connector can be plugged into either of the device's two sockets.

The transducer must be used correctly to achieve accurate and reliable measurement results. Below is a brief description of the transducer, followed by its operating instructions.



The left illustration shows a typical transducer from below. The two semicircles of the contact surface are visible, as is the barrier separating them. One of the semicircles is responsible for propagating ultrasound into the material being measured, and the other semicircle is responsible for guiding the echo back into the transducer. When the transducer is in contact with the material being measured, the area directly beneath the center of the contact surface is measured.

The right-hand illustration shows a top view of a typical transducer. Press the transducer upward with your thumb or index finger to secure it in place. Moderate pressure is sufficient, as the transducer only needs to be held still and the contact surface must lie flat against the surface of the material to be measured.

3.2 Condition and Preparation of Surfaces

In any ultrasonic measurement scenario, the shape and roughness of the measurement surface are of the utmost importance. Rough, uneven surfaces can restrict the propagation of ultrasonic waves through the material and lead to unstable and therefore unreliable measurements. The surface to be measured should be clean and free of small particles, rust, or scale. The presence of such obstacles prevents the transducer from making proper contact with the surface. A wire brush or scraper often helps in cleaning surfaces. In extreme cases, rotary grinders or grinding wheels can be used. However, care must be taken to avoid surface cracks, which prevent proper coupling of the transducer.

Extremely rough surfaces, such as the pebbly surface of some cast irons, are the most difficult to measure. Such surfaces act on the sound beam like frosted glass on light; the beam is diffused and scattered in all directions.

Rough surfaces are not only an obstacle to measurement but also contribute to excessive wear on the transducer, particularly in situations where the transducer “scrubs” along the surface. The transducer should be checked regularly for signs of uneven wear on the contact surface. If the contact surface is worn down more on one side than the other, the sound beam penetrating the test piece may no longer be perpendicular to the material surface. In this case, it is difficult to precisely locate the smallest irregularities in the material being measured, as the focus of the sound beam is no longer directly beneath the transducer.

4 Operation

4.1 Power Supply

Two AA alkaline batteries are required for power. The battery compartment is located on the back. The cover is secured with two screws. To insert the batteries:

- Loosen the two screws on the battery cover.
- Lift the cover upward to remove it.
- Insert the batteries into the battery compartment.
- Close the battery compartment and tighten the screws.
- Turn on the device to ensure that the batteries are inserted correctly and securely.

4.2 Connecting the Probe

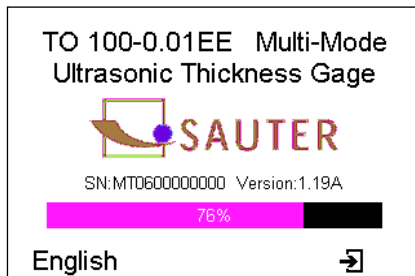
To prepare the device for operation, you must connect a probe to it. The device is equipped with Lemo connectors.

When connecting a probe to the device, it is not only important that a physical connection is properly established. It is also important that the device is correctly configured to work with the installed probe.

4.3 Turning on the device (Power ON)

To start the device, press the "  " button until the display turns on. While the device boots up, the display shows the device's serial number, the installed software version, and the system date and time.

The device's startup screen appears as shown in the following figure:

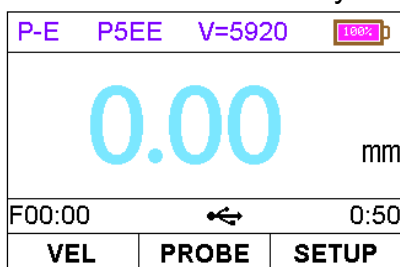


Press the F1 key to switch to a different language.

Press the F3 key to skip the boot check process and switch directly to measurement mode.

The device performs a self-test and then automatically switches to measurement mode if no further keys are pressed.

The device is now ready for the first measurement.



The device automatically reloads the last settings. It has a special memory in which all settings are retained, even when the power is turned off.

To turn off the instrument, hold down the button  until the shutdown message appears.

The meter also features an automatic shut-off function to conserve battery power. If no operation occurs for a certain period of time (set as the automatic shut-off delay), the meter will automatically turn off.

Note: The device turns off automatically when the battery charge is too low.

4.4 Configuring Standby Settings

To conserve battery power, the device supports the following power-saving modes:

Run state [*Operating mode*] - The device operates at full frequency

Standby state [*Standby mode*] - After 5 seconds (default setting), the brightness of the LCD display is set to a low level and the CPU operates at a lower frequency. This has no effect on the data or memory. Pressing any key or performing a measurement returns the device to operating mode and restores the default brightness.

Power off state [*Power-off mode*] - After 2 minutes (default setting), the device switches from standby mode to power-off mode. The device and display are turned off and consume almost no power. Pressing any key prevents the device from entering power-off mode; a "Idle Timeout!" message is displayed, and the device returns to operating mode.

The transition from operating mode to standby mode occurs according to the display's standby delay setting. The user can configure this delay in *the* "Display Standby Delay" dialog box. The device can be returned from standby mode to operating mode by any user activity.

5 Operation

5.1 Setting the Operating Mode

Users and inspectors frequently encounter coated materials such as pipes and tanks in the field. Typically, inspectors must remove the paint or coating before measurement or account for a certain margin of error caused by the paint or coating thickness or by the measurement speed.

This error can be eliminated with this measuring device by using a special echo-echo mode designed for measurements in such cases. The measuring device is equipped with this user-friendly feature, so it is not necessary to remove the paint or coating.

To switch between P-E mode and E-E mode, press " " in the "Test Settings" dialog box.

Test Settings		
Work Mode		P-E
Probe Set		P5EE
Velocity Set		5920m/s
View Mode		Normal Mode
Nominal Thickness		10.00mm
		

5.2 Probe Selection

Ensure that you have set the correct probe model in the device. Otherwise, the measurement may be inaccurate. In *the* "Probe Model" dialog box, use the " " and " " buttons to scroll to the probe model currently in use.

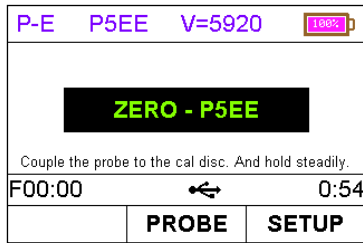
Then press the " " or F3 key to confirm your selection. Press " " to cancel the operation and exit the dialog box.

Probe Model		
 <u>P5EE</u>		
N05		
N07		
HT5		
N02		
		

5.3 "Probe Zero" Function

The " " button is used to zero the device in the same way that a mechanical micrometer is zeroed. If the measuring device is not correctly zeroed, all measurements taken with the device may be subject to a certain error. When the device is zeroed, this fixed error value is measured and automatically corrected in all subsequent measurements. The instrument can be zeroed as follows:

1. Connect the transducer to the device. Ensure that the connectors are fully engaged. Ensure that the contact surface of the transducer is clean and free of any foreign objects.
2. Press the " " button to activate "Probe Zero" mode (see figure below).
3. Apply a single drop of coupling agent to the surface of the probe's metal plate.



4. Press the transducer against the probe plate and ensure that the transducer lies flat against the surface.
5. When the progress bar is complete, remove the transducer from the probe plate. Repeat this process up to four times if necessary.
6. At this point, the internal error factor is successfully calculated by the device and compensated for in all subsequent measurements. When performing the "Probe Zero" function, the device always uses the sound velocity value of the built-in probe plate, even if a different velocity value was entered for the actual measurements. Although the device remembers the last *zero setting*, it is generally advisable to perform the "Probe Zero" function when the meter is turned on, as well as when using a different transducer. This ensures that the device is always correctly zeroed.

Press  in "Probe Zero" mode to exit the zeroing function and return to measurement mode.

5.4 Calibration of the Sound Velocity

In order for the measuring device to perform accurate measurements, it must be set to the correct sound velocity for the material being measured. Different types of materials have different intrinsic sound velocities. If the measuring device is not set to the correct sound velocity, all measurements taken with the device will be subject to a certain percentage error. **Single-point calibration** is the simplest and most commonly used calibration method, which optimizes linearity over wide ranges. **Two-point calibration** enables greater accuracy in narrow ranges by calculating the probe's zero point and the velocity.

Note: Single-point or **two-point calibration** must be performed on a material after removing paint or coating. Otherwise, it will result in a calculated material velocity that differs from the actual material velocity of the material being measured.

5.4.1 Calibration to Known Speed

Note: This procedure requires measuring a sample of the specific material whose exact thickness is known, e.g., by measuring it using another method.

A table of common materials and their sound velocities can be found in Appendix A of this manual.

In the "Set Velocity" dialog box, press the F1 / F2 and  /  keys to adjust the velocity value up or down until it matches the sound velocity of the material to be measured.

Set Velocity		
05920 m/s		
*Press [PRB] to select velocity from material table		
		

You can also press the  key to select from the preset velocities.

5.4.2 Calibration to a Known Thickness

Note: This procedure requires measuring a sample of the specific material whose exact thickness is known, e.g., by measuring it in another way.

1. Perform the "Probe-Zero" function using a 4.00 mm standard plate.
2. Apply the coupling agent to the test piece.
3. Press the transducer against the sample and ensure that the transducer lies flat against the surface of the sample. A thickness value should appear on the display, and the connection status indicator should remain lit.
4. Once you have obtained a stable reading, remove the transducer. If the displayed thickness differs from the value shown during transducer coupling, repeat the step in section 3.
5. Press the  or  key to open the "Input Nominal Thickness" dialog box. See the figure below.

Input Nominal Thickness		
010.02 mm		
After adjustment, *One Point Cal - Press <ENTER> to finish calibration. *Two Point Cal - Press <PRB> to calibrate next point.		
		

6. Press F1 / F2 and  or  to enter the thickness value until it matches the thickness of the test piece.
7. Press  / F3 to confirm the entry. The measuring device exits the input field and returns to measurement mode. It now displays the calculated sound velocity value, determined based on the entered thickness value.

The meter is now ready to measure.

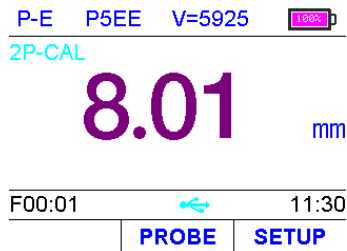
5.4.3 Two-point calibration

Note: This procedure requires two known thickness points on the test specimen that are representative of the area to be measured.

1. The "Probe-Zero" function must first be performed on the device's standard plate.
2. Apply the coupling agent to the test piece.
3. Press the transducer against the test piece at the first/second calibration point and ensure that the transducer lies flat against the surface of the test piece. A (possibly incorrect) thickness value should appear on the display, and the connection status indicator should remain lit.
4. Once you have obtained a stable reading, remove the transducer. If the displayed thickness differs from the value shown during transducer coupling, repeat the step in section 3.
5. Press the  or  key to open the "Input Nominal Thickness" dialog box. See the figure on the right.
6. Press F1 / F2 and  or  to enter the thickness value until it matches the thickness of the test piece. Then press  to calibrate the second point (see the following figure):

Input Nominal Thickness		
010.02 mm		
After adjustment, *One Point Cal - Press <ENTER> to finish calibration. *Two Point Cal - Press <PRB> to calibrate next point.		
		

Figure below: Measuring the second point during two-point calibration.



7. Repeat steps 2 through 6 at the second calibration point.
8. Finally, press the " " / F3 button to complete the two-point calibration. The meter is now ready to take measurements within this range.

5.5 Taking Measurements

When the device displays thickness measurements, the display shows the last measured value until a new measurement is taken.

For the transducer to function properly, there must be no air gaps between the transducer face and the surface of the material being measured. This is achieved by using a "coupling fluid," commonly referred to as "coupling agent." This fluid serves to transmit (couple) the ultrasonic waves from the transducer into the material and back again. Before attempting to take a measurement, a small amount of coupling agent should be applied to the surface of the material being measured. Normally, a single drop of coupling agent is sufficient.

After applying the coupling agent, press the transducer (contact surface facing down) firmly against the area to be measured. The coupling status indicator should appear, and a numerical reading should appear on the display. If the device has been properly set to "zero" and to the correct sound velocity, the number on the display indicates the actual material thickness directly beneath the transducer.

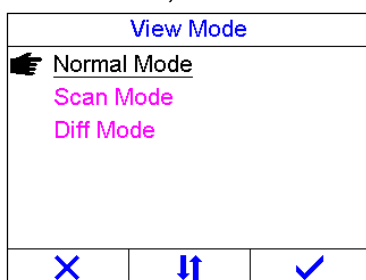
If the coupling status indicator does not appear or appears unstable, or if the numbers on the display appear irregularly, first check whether there is a sufficient film of coupling agent under the transducer and whether the transducer is sitting flat on the material. If the condition persists, it may be necessary to select a different transducer (size or frequency) for the material being measured.

While the transducer is in contact with the material being measured, the device performs four measurements per second, continuously updating its display. When the transducer is removed from the surface, the display shows the last measurement taken.

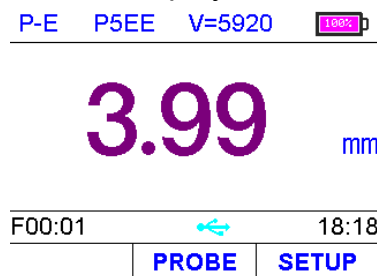
Note: When removing the transducer, a thin film of coupling agent is occasionally pulled between the transducer and the surface. If this occurs, the measurement is taken through this coupling agent film, resulting in a reading that is higher or lower than it should be. This effect is evident when one thickness value is observed while the transducer is in contact and a different value is observed after the transducer is removed. In addition, measurements through very thick paint layers or coatings can result in the paint layer or coating being measured rather than the actual material. The user of the device is solely responsible for the proper use of the device and for detecting such effects.

5.6 Setting the View Mode

Three view modes can be selected to display the measurement value: Normal Mode, Scan Mode, and Diff Mode.

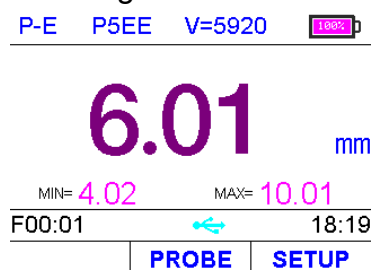


Normal Mode. As shown in the figure on the right, the last thickness measurement value is displayed.

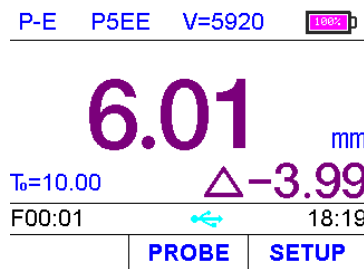


Scan Mode. In addition to the last thickness measurement, the minimum and maximum thickness values during the measurement are also displayed.

Pressing "  " resets the minimum and maximum values.



Diff Mode. Both the last thickness measurement and the difference in thickness (between the absolute thickness and the nominal thickness) are displayed.



Although the gauge is ideal for single-point measurements, it is sometimes advisable to examine a larger area and search for the point with the thinnest thickness. The gauge features a "Scan Mode" function that makes this possible.

In **Normal Mode**, the gauge takes ten measurements per second and displays them, which is quite sufficient for single measurements. In Scan Mode, however, the gauge takes more than ten measurements per second and displays the readings during the scanning process. While the transducer is in contact with the material being measured, the gauge tracks the minimum and maximum values detected. The transducer can be "scrubbed" across a surface, and any brief signal interruptions are ignored.

5.7 Set Normal Thickness

In differential measurement mode, the nominal thickness of the test specimen must be set. The setting procedure is as follows:

Press the F1 / F2 key to move the highlighted cursor. Press the arrow keys to increase / decrease the values.

Press the  key or the F3 key to confirm the setting.

Press the " " key to cancel the change and exit the mode.

Nominal Thickness		
010.00 mm		
←	→	✓

5.8 Set Limit

Test results outside the limit values are displayed in red to alert the user. To change the limit value setting, press the F1 / F2 key to move the highlighted cursor. Press the arrow keys to increase or decrease the values.

Bottom Limit		
000.20 mm		
←	→	✓

Press the " " button or the F3 button to confirm the setting. Press the " " button to cancel the change and exit the mode.

Top Limit		
020.00 mm		
←	→	✓

5.9 Setting the resolution

The display resolution of the measuring device can be set to a range of 0.1 mm or 0.01 mm.

Resolution Set		
0.1mm		
☞	0.01mm	
✕	↕	✓

When the resolution is set to 0.01 mm, the surface of the test piece should be smooth to obtain accurate test results. When measuring rough surfaces or coarse-grained materials, it is recommended to use the low resolution.

5.10 Memory management

5.10.1 Saving a data set

Pressing the " " button as soon as a new measurement value appears saves the measured thickness value in the currently selected data group. It is added as the last data record in the group.

5.10.2 Viewing Saved Data Records

This function allows the user to view data records from a desired data group that was previously saved in memory. The procedure is as follows:

Activate the "Memory Manager" function (figure on the right).

Press  or  to move the cursor; press the  or F3 key to open the "View Record Data" dialog box (see the following figure).

Memory Manager		
*F00	1/100	
F01	0/100	
F02	0/100	
F03	0/100	
F04	0/100	
	COMMAND	

Press  or  to move the cursor to the desired record.

Press F3 to delete the selected record.

Press F2 to delete all records in this group.

To exit, press  / F1.

View Record Data-F00		
No.1	0.00mm	
		

5.10.3 Select current data group

The measuring device contains 100 data groups (F00 ~ F99) in which the measured values can be stored. A maximum of 100 data records (thickness values) can be stored in each group. To change the target data group for storing measured values, proceed as follows:

Enable the "Memory Manager" function. Press  or  to select the desired data group. Press F2 to display the command list. Then select the "Set" command and confirm with .

Memory Manager	
*F00	1/100
F01	0/100
F02	0/100
F03	0/100
F04	00
Set	
Clear	
Clear All	
	

After completing the above steps, the newly selected data group is set as the current data group for saving new measurement results.

5.10.4 Deleting a Data Group

It may be necessary to completely delete all measurements from an entire data group. This allows the user to create a new list of measurements starting from memory location No. 00. The procedure is described in the following steps.

Activate the "Memory Manager" function.

Press  or  to select the desired data group. Press the F2 key to open the command list. Then select the "Clear" command and confirm it with .

Memory Manager	
*F00	1/100
F01	0/100
F02	0/100
F03	0/100
F04	00
Set	
Clear	
Clear All	
	

If the "Clear All" command is selected and confirmed, all data groups on the meter will be deleted.

Note: Once deleted, the data cannot be recovered!

5.11 Setting the Key Tone

The key tone can be turned on or off. When the key tone is on, the buzzer in the device emits a short beep after each key press.

5.12 Set warning tone

The warning tone can be turned on or off. When the warning tone is on, the buzzer in the device emits a long audible alarm after each new measurement value. If the device issues an action warning, an alarm also sounds when this setting is enabled.

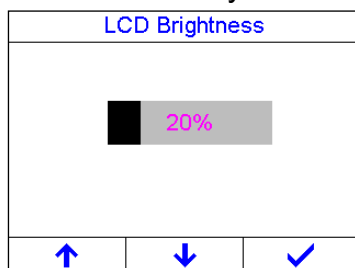
5.13 Setting the LCD Brightness Level

The different brightness levels of the LCD screen affect standby time and continuous operation.

The setting can be changed by scrolling with the F1 (Increase) and F2 (Decrease) keys or by pressing the arrow keys.

Press the  button or the F3 key to confirm the setting.

Press the  key to cancel the change and exit the dialog box.



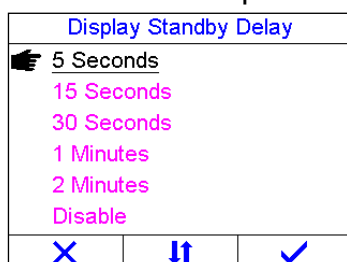
Lower brightness consumes less power and thus extends the operating time.

Note: Reduce the brightness of the LCD screen in well-lit conditions to save energy.

The settings are shown in the right-hand illustration of the "Display Standby Delay" dialog box.

Press the arrow keys or the F2 key to select the desired setting.

If the "Disable" option is selected, the device will not switch to standby mode.



The device enters standby mode after a specified period of time. Perform a measurement or press any key to wake the device from standby mode.

5.14 Set Display Standby

Standby mode reduces the LCD brightness and puts the CPU into power-saving mode. The transition from operating mode to standby mode is controlled by the "Display Standby Delay" setting.

5.15 Setting automatic shutdown

The transition from standby mode to shutdown mode is controlled by the "Auto Shutdown Delay" setting.

The user can configure *the* delay time in the "Auto Shutdown Delay" dialog box.

Press the arrow keys or the F2 key to select the desired setting.

If the "Disable" option is selected, the device will not shut down automatically.

Auto PowerOff Delay		
☛	2 Minutes	
	5 Minutes	
	10 Minutes	
	Disable	
X	↕	✓

Note: If the battery voltage is too low, the message "Battery Exhausted!" appears on the LCD display and the device shuts down automatically.

5.16 Change Unit System

The device supports both the metric and imperial *unit* systems. Press " " when the "Unit System" option is selected in the "System Configuration" *dialog* box to switch between the imperial and metric unit systems.

System Configuration		
Warn Sound	On	
LCD Brightness	35%	
Disaplay Standby	5 Seconds	
Auto Poweroff	2 Minutes	
Unit System	Imperial	
Date/Time Set	...	
←	↕	→

5.17 Setting the Date and Time

To ensure accurate documentation, you should always make sure you are using the correct date and time settings. Open the System Time dialog box to set the system date and time.

The date format: Year-Month-Day

The time format: Hour - Minute - Second

Use the F1 and F2 keys to move the cursor. Use the arrow keys to increase or decrease the values.

Press the " " / F3 key to confirm the setting. Press the " " key to cancel the changes and exit the dialog box.

System Date&Time		
Thu Mar 20 16:09:53 2014		
Date:	2014-03-20	
Time:	16:09:46	
←	→	✓

Once the setting is complete, the current date and time are maintained by the device's internal clock.

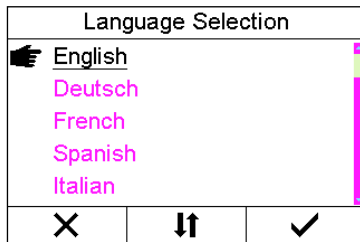
5.18 Setting the Language

You can select the operating language of the meter.

Use the arrow keys and the F2 key to select the operating language.

Press the  key or the F3 key to confirm your selection.

Press the " " key to cancel the selection and exit the dialog box.



Note: The user can also change the operating language during the startup process on the startup screen.

5.19 Product Information

Information about the device model, software version, and serial number is displayed in windows as shown in the following figure.

Press the  ,  , F1, or F3 key to exit the dialog box.

About Me		
Model:	TO 100-0.01EE	
Version:	1.19A-BTLE-D	
SN:	MT0600000000	
CPLD:	1.05-V10U	
LCD:	ILI9325	
X		✓

5.20 Reset System

If the device can no longer be operated or if a restoration of factory settings is required, you can reset the device.

Use the "System Reset" function. If this function is selected, all data stored in the device as well as the user calibration will be deleted. The device settings will be reset to their default values.

To reset the device:

- Activate the "System Reset" function. The dialog box shown on the right appears.
- Press the " " button or the F3 key to confirm the reset process. Press the F1 key to cancel the reset.

Warning		
Reset system settings to original?		
NO		YES

NOTE: The effects of resetting the device may be irreversible. Do not press any keys during the reset process.

5.21 USB Communication

The device has a USB port on the top left. The device can be connected to a PC using the USB cable.

- Plug the mini-USB connector of the USB cable into the USB port on the top of the device.
- Plug the other end of the USB cable into the USB port on the computer.

6 Measurement Technology

6.1 Measurement Method

- Single-point measurement method: the probe is placed at any point on the workpiece. The device displays the thickness at the probe's placement location.

- Two-point measurement method: the probe is used to measure the same point on the test piece twice, with the probe's plane of separation remaining at 90° between the two measurements. The smaller value should be the thickness at that point.
- Multi-point measurement method: multiple measurements are taken within a circle with a diameter of 30 mm, with the thickness value of the tested part being the minimum value.
- Continuous measurement method: A continuous measurement is performed along the specified path at intervals of less than 5 mm using single-point measurement, with the thickness value of the tested part being the minimum value.

6.2 Wall measurement

During the measurement, the probe separation plane may run along the pipe axis or the vertical pipe axis. For larger pipe diameters, the measurement must be performed on the vertical axis. For smaller pipe diameters, the measurement must be performed in both directions, with the thickness value being the minimum value.

7 Service

If the device exhibits other unusual deviations, no permanently mounted parts may be disassembled or repaired. In this case, our customer service must be notified by email or telephone to initiate the appropriate service procedure.

8 Transport , and Storage

Keep the device away from vibrations, strong magnetic fields, corrosive media, dirt, and dust. The device must be stored at normal temperature.

9 Sound velocity

Material	Sound velocity	
	in/ μ s	m/s
Aluminum	0.250	6340 – 6400
Steel, standard	0.233	5920
Stainless steel	0.226	5740
Brass	0.173	4399
Copper	0.186	4720
Iron	0.233	5930
Cast iron	0.173 – 0.229	4400 – 5820
Lead	0.094	2400
Nylon	0.105	2680
Silver	0.142	3607
Gold	0.128	3251
Zinc	0.164	4170
Titanium	0.236	5990
Tin	0.117	2960
Epoxy resin	0.100	2540
Ice	0.157	3988
Nickel	0.222	5639
Plexiglass	0.106	2692
Polystyrene	0.092	2337
Porcelain	0.230	5842
PVC	0.094	2388
Quartz glass	0.222	5639
Rubber, vulcanized	0.091	2311
Teflon	0.056	1422
Water	0.058	1473

10 Application notes

10.1 Measuring Large and Small Pipes

When measuring a pipe section to determine the wall thickness, the orientation of the transducer is important. If the pipe diameter is greater than approximately 4 inches, measurements should be taken with the transducer positioned such that the gap in the contact surface is perpendicular (at a right angle) to the pipe's longitudinal axis. For smaller pipe diameters, two measurements should be taken: one with the gap perpendicular to the contact surface, and the other with the gap parallel to the pipe's longitudinal axis. The smaller of the two displayed values is considered the thickness at that point.



Perpendicular

Parallel

10.2 Measuring Hot Surfaces

The speed of sound propagation through a material depends on its temperature. As materials heat up, the speed of sound propagation decreases. For most applications with surface temperatures below approximately 100 °C, no special procedures need to be followed. At temperatures above 100 °C, the change in the sound velocity of the material being measured has a significant effect on the ultrasonic measurement. At such elevated temperatures, it is advisable to perform a calibration procedure on a test specimen of known thickness that has the same temperature as the material being measured or a comparable temperature. This allows the measuring device to correctly calculate the speed of sound propagation through the hot material.

When measuring hot surfaces, it may be necessary to use a specially designed high-temperature transducer. Such transducers are made of materials that can withstand high temperatures. However, it is recommended to keep the probe in contact with the surface only for as long as necessary to obtain a stable measurement. If a transducer comes into contact with a hot surface, it begins to heat up, and thermal expansion as well as other effects can compromise measurement accuracy.

10.3 Measuring Laminate Materials

Laminate materials are unique in that their density (and thus the speed of sound) can vary significantly from one piece to another. Some laminate materials may even exhibit significant variations in sound velocity across a single surface. The only way to reliably measure such materials is to perform a calibration procedure on a sample of known thickness. Ideally, this sample material should be part of the same object being measured or at least come from the same batch. By individually calibrating each test specimen, the effects of sound velocity variations can be minimized.

Another important factor to consider when measuring laminate materials is the fact that trapped air gaps or pockets cause the ultrasonic beam to reflect prematurely. This effect is noticeable as a sudden decrease in thickness on an otherwise homogeneous surface. Although this can interfere with an accurate measurement of the total material thickness, it indicates the presence of air gaps in the laminate material.

10.4 Measurement Through Paint Layers and Coatings

Measuring through paint layers and coatings is also unique in that the sound velocity for paint layers and coatings differs significantly from the sound velocity of the material being measured. A perfect example of this would be a mild steel pipe with approximately 0.6 mm of coating on the surface, where the speed of sound for the pipe is 5920 m/s and for the coating is 2300 m/s. If the calibration procedure for mild steel pipes and the measurement are performed through both materials, the actual coating thickness appears to be 2.5 times greater than it actually is due to the differences in velocity. This error can be corrected by using a special echo-echo mode to perform measurements in such cases. In echo-echo mode, the paint or coating thickness is completely eliminated, and only the steel is measured.

10.5 Suitability of Materials

Ultrasonic thickness measurements require that a sound wave be transmitted through the material being measured. Not all materials exhibit good acoustic conductivity. Ultrasonic thickness measurement is practically applicable to a wide variety of materials, including metals, plastics, and glass. Some cast materials, concrete, wood, fiberglass, and certain types of rubber are considered difficult to measure.

10.6 Coupling agents

All ultrasonic applications require a medium to couple the sound waves from the transducer to the test specimen. A high-viscosity liquid is typically used as the medium. The propagation of sound waves used for ultrasonic thickness measurement in air is ineffective.

A variety of coupling agents can be used in ultrasonic measurement. Propylene glycol is suitable for most applications. For difficult applications requiring maximum transmission of sound energy, glycerin is recommended. On some metals, however, glycerin can promote corrosion through water absorption and may therefore be undesirable. Other suitable coupling agents for measurements at normal temperatures include water, various oils and greases, gels, and silicone fluids. Measurements at elevated temperatures require specially formulated heat-resistant coupling agents.

During ultrasonic thickness measurement, the device may use the second echo instead of the first echo from the back of the material being measured when operating in standard "pulse-echo" mode. This can result in a thickness measurement that is twice as large as the actual thickness. The user of the device is solely responsible for the proper use of the device and for detecting such effects.

Note:

The CE Declaration of Conformity is available at the following link: <https://www.kern-sohn.com/shop/de/DOWNLOADS/>