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This issue 01, 10/1998 applies to the gauge version 00.21 and the DSP software version 1.00.
The software version is indicated in the display test (ref. chapter 5.3 Basic settings).

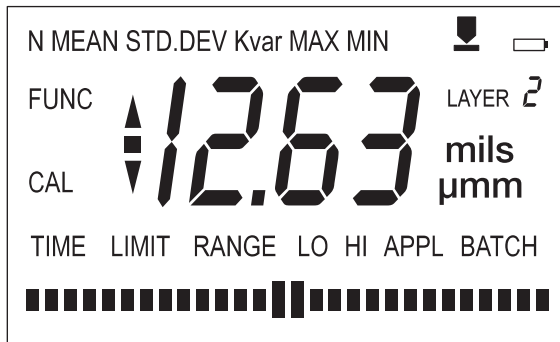
This information will help you to quickly find your way through the operating manual.

Please open the foldout page inside. You will find an overview of the QuintSonic display as well as brief operating instructions for the basic functions.

QuintSonic

Technical Reference and Operating Manual

ElektroPhysik



Display indications

The display indications below the measured value depend on the setting which is currently being processed.

N	Number of readings
MEAN	Mean value
STD.DEV	Standard deviation
Kvar	Variation coefficient
MAX	Maximum reading
MIN	Minimum reading
Cp	Process capability index
Cpk	Process capability index (Mean value position)
	Display for an active measurement
	PC mode (keyboard blocked)
	Indication of exhausted battery
FUNC	Secondary function of key
CAL	Calibration
	Position of reading
Large-size no.	Display of reading
LAYER	Number of current material layer
mils/μm/mm	Unit of reading
TIME	Time and date setting
LIMIT	Limit default
RANGE	Default measuring range
LO	Lower limit value
HI	Upper limit value
APPL BATCH	Batch measurement mode
	a) Analog thickness display
	b) Battery charge indicator

Operation of basic functions

Defining the number of layers and material allocation

Select the number of layers using the LAYER key. Use the keys FUNC and CAL/MATERIAL plus the arrow keys to set the material for the layer and the substrate.

Recording reference echo

The gauge is turned on, probe delay is without couplant and free from any contamination or dirt accumulations. Hold the probe in the air and press the probe key once. Recording of the reference echo is confirmed by an acoustic signal.

Calibration of a 1-layer coating

Press the CAL key twice. Place probe delay vertically to the calibration standard and carry out several measurements. Use the arrow keys to adjust the displayed reading to the value of the calibration standard, and end the calibration by pressing the CAL key.

Erasing the complete memory

Turn the instrument off, then press the three keys CLEAR/CLR STATS, FUNC and ON/OFF one by one, and keep them pressed for approx. 3 seconds. The erasure is confirmed by a beep tone.

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Introduction **1**

1.1 Safety information

The QuintSonic gauge is designed and tested according to DIN EN 61 010 Part 1, March 1994, Safety requirements for electric measurement, control and laboratory equipment, and was in technically perfectly safe condition when leaving our works.

To maintain this condition and to ensure a safe operation, it is absolutely necessary that you read the following safety information before putting the gauge into operation.

Moreover, the QuintSonic gauge corresponds to the standard specifications DIN EN ISO 2178, 2360, as well as DIN 50982, ASTM B499, B244 and BS 5411.

 **Attention:**

The QuintSonic gauge is meant for coating thickness and wall thickness measurement. Medical or any other applications are not permitted!

Batteries

The QuintSonic gauge can be operated with storage batteries or a power supply unit. Please only use the products recommended by us for the battery operation and observe the safety and maintenance information in chapter 3 Start-up.

As soon as you connect the power supply unit to the QuintSonic gauge, the batteries are charged. Please read chapter 7 Maintenance and care for more details on how to handle batteries.

Software

According to the current state of the art, software is never completely free of errors.

Before using any software-controlled test instruments or gauges it is therefore necessary to ensure that the required functions operate perfectly in the intended combination.

If you have any questions concerning the use of your Elektro-Physik test device, please contact your nearest Elektro-Physik representative.

Errors and exceptional stresses

If you have reason to believe that a safe operation of your QuintSonic gauge is no longer possible, the gauge must be disconnected and secured against unintentional reconnection.

A safe operation is no longer possible, e.g.

- if the gauge shows visible damages,
- if the gauge no longer operates perfectly,
- after prolonged storage under adverse conditions,
- after being subjected to heavy stresses during transportation.

1.2 Important information on ultrasonic measurement

Please read the following information before using your QuintSonic gauge. It is important that you understand and observe this information to avoid any operator errors that might lead to false measurement results. False measurement results could lead to personal injuries or damages to property.

Preconditions for measurement using ultrasonic measurement devices

This operating manual contains essential information on how to operate your measurement device. In addition, there are a number of factors which affect the measurement results. A description of these factors would go beyond the scope of an operating manual. The following list therefore only mentions the three most important conditions for a safe and reliable ultrasonic measurement:

- the operator (inspector) training
- the knowledge of special technical requirements and limitations of measurements and testing

- the choice of appropriate measurement device

The operation of an ultrasonic measurement device requires a proper training in ultrasonic test and measurement methods.

A proper training comprises for example adequate knowledge of:

- the theory of sound propagation
- the effect of sound velocity in the test material
- the behavior of the sound wave at interfaces between different materials
- the propagation of the sound beam
- the influence of sound attenuation in the test object and the influence of surface quality of the test object.

Lack of such knowledge could lead to false test or measurement results with unforeseeable consequences. You can contact for example NDT societies or organizations in your country, e.g. in Germany: **Deutsche Gesellschaft für Zerstörungsfreie Prüfung e.V. (DGZfP)**, Motardstraße 54, D-13629 Berlin; or also Elektro-Physik, Technical Training Dept., for information concerning existing possibilities for the training of ultrasonic inspectors, as well as on the qualifications and certificates that can finally be obtained.

Technical test requirements

Every ultrasonic measurement is subject to specific technical test and measurement requirements. The most important ones are:

- the definition of the scope of measurement
- the choice of the appropriate measurement method
- the consideration of material properties
- the determination of limits for recording and evaluation.

It is the task of those with overall responsibility for measurement and testing to ensure that the inspector is fully informed about these requirements. The best basis for such information is experience with identical test objects. It is also essential that the relevant test specifications be clearly and completely understood by the inspector. Elektro-Physik regularly holds specialized training courses in the field of ultrasonic test and measuring techniques.

The scheduled dates for these courses will be given you on request.

1.3 Limitations of measurement

The information obtained from ultrasonic measurements only refers to those parts of the test object which are covered by the sound beam of the probe used.

Any conclusions from the measured parts to be applied to those parts of the test object that have not been measured should be made with extreme caution.

Such conclusions are generally only possible in cases where extensive experience and proven methods of statistical data acquisition are available.

The impedances of the superimposed layers must not be too similar, otherwise the sound waves are not reflected from the boundary surfaces of the individual layers. This is a case where the coating thickness measurement using the QuintSonic reaches its physically preset limits.

Ultrasonic coating thickness measurement

All coating thickness measurements using ultrasonics are based on a time-of-flight measurement. Accurate measurement results require a constant sound velocity in the test object.

Wall thickness measurement

In test objects having steel as base material, the sound velocity in the test object is mostly constant – even in the case of different alloying constituents. The sound velocity variations are so slight that they are only of importance in precision measurements. However, in other materials, e.g. nonferrous metals and plastics, the sound velocity is subject to major variations so that the measuring accuracy can be affected by this.

Effect of the test object's material

If the test object's material is not homogeneous, the sound may propagate at different sound velocities in different parts of the test objects. An average sound velocity should then be taken into account for the range calibration. This is achieved by means of a reference block whose sound velocity corresponds to the average

sound velocity of the test object.

If substantial sound velocity variations are to be expected, then the instrument calibration should be readjusted to the actual sound velocity values at shorter time intervals. Failure to do so may lead to false coating thickness readings.

Effect of temperature variations

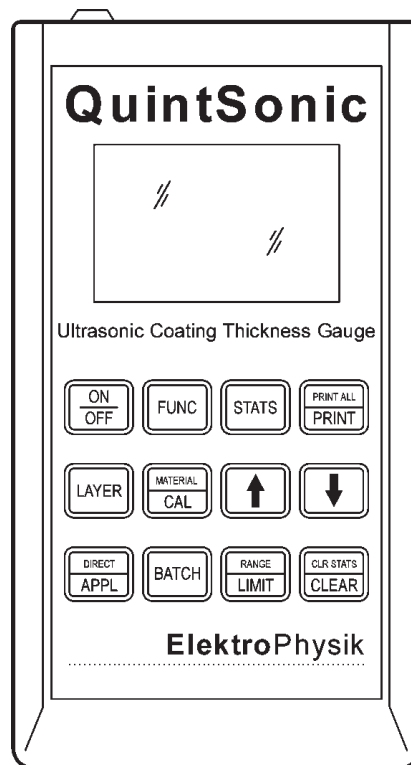
The sound velocity within the test object also varies as a function of the material's temperature. This can cause appreciable errors in measurements if the instrument has been calibrated on a cold reference block whereas the measurement is carried out on a hot test object.

1.4 QuintSonic

The QuintSonic gauge is a lightweight and compact coating thickness gauge, especially developed for the nondestructive measurement of coating thicknesses of all insulants having smooth and flat surfaces. Typical application examples are parquet lacquerings as well as varnished metal and plastic surfaces. The QuintSonic gauge enables you to measure up to three super-imposed layers which can also be applied on a metallic base. The different impedance of adjacent layers is a prerequisite for successful measurements. If the impedance values of two layers are too close to one another, the boundary layer cannot reflect the sound wave, and the gauge can give no reading.

The QuintSonic gauge has three preset basic settings for the coating material and seven for the base material. The calibration values are determined by you once by means of microsections and then stored under an application number in the data memory. All you have to do in repetitive measurements is to set the corresponding application number.

Your QuintSonic gauge is used with one active probe that contains transmitter and preamplifier.

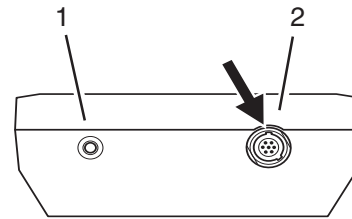


Special features of the QuintSonic gauge

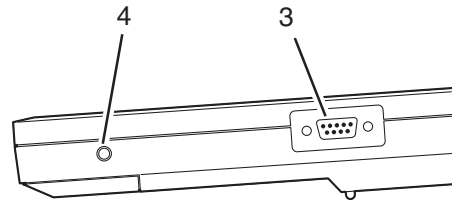
- Low weight (270 g) and small dimensions
- Easy-to-clean operator control panel
- Easy-to-survey measured-value monitoring on the large-size LC display
- Coating thickness measurement of up to three superimposed layers is possible
- Measured-value memory for max. 99 groups of measurement series and max. 7,900 readings in total (depending on the number of readings per measurement series)
- Two operating modes: DIRECT and APPL-BATCH mode with extensive statistics functions
- Possibility of documentation via a printer

Inputs and outputs

On the QuintSonic gauge, the sockets for the power supply unit (1), included in the standard package, and for the probe (2) are situated at the head end.



There is a serial connector socket (3) on the right side of the instrument for connecting the optional printer MiniPrint 4100. The printer has a guide pin which fits into the hole (4) for mechanical stability.



1.5 How to use this operating manual

For a quick grasp of the operating manual

Before operating the QuintSonic gauge for the first time, it is absolutely necessary that you read the chapters 1, 3 and 4 of this manual. They will inform you about the necessary preparations of the instrument, the use of different probe types, and give you a description of all keys and display indications.

In doing this, you will avoid any interferences or failures of the instrument and be able to use the full range of instrument functions.

You will find the latest changes to this operating manual in chapter 11 Changes. It describes corrections that have become necessary at short notice and not yet been included in the general manual. If no corrections have become necessary, this chapter is empty.

1.6 Layout and presentation in this manual

To make it easier for you to use this manual, all operating steps, notes, etc., are always presented in the same way. This will help you find individual pieces of information quickly.

Listings

Listings are presented in the following form:

- Variant A
- Variant B
- ...

Operating steps

Operating steps appear as shown in the following example:

- Loosen the two screws at the bottom
- Remove the cover
- ...

Note and attention symbols

 **Note:**

Note contains e.g. references to other chapters or special recommendations for a function.

 **Attention:**

The **Attention** symbol indicates peculiarities and special aspects in the operation which could affect the accuracy of the results.

Scope of supply and accessories **2**

Scope of supply and accessories

This chapter informs you about the scope of supply (standard package) and accessories available for the QuintSonic gauge.

2.1 Scope of supply

Description	Order number
Ultrasonic coating thickness gauge QuintSonic with data logger, probe CTF1 and probe cable	85-160-0001
including:	
operating manual, German,	20-160-0001
operating manual, English,	20-160-0002
couplant, bottle containing 100 g,	
battery pack (NiMH cells),	
power supply unit, 90 ... 264 V, with Euro/US adapter,	
carrying case	

2.2 Accessories

Description	Order number
Portable data printer MiniPrint 4100	80-201-0002
including:	
power supply unit, 90 ... 264 V, with Euro/US adapter	
4 NiMH batteries	
ink ribbon, black	
3 rolls of printer paper	
ink ribbon, black	85-159-0028
1 roll of printer paper	06-007-0011
rubber case for QuintSonic	82-010-0014
neck strap for rubber case	82-010-0016
dual bag for QuintSonic and MiniPrint 4100	82-010-0009
carrying case with belt for QuintSonic and MiniPrint 4100	82-010-0015

Description	Order number
Interface cable RS232C, 25-pin, coupling for PC	85-139-0001
Interface cable RS232C, 9-pin, coupling for PC	85-139-0002

Start-up 3

3.1 Power supply

Required accessories for the coating thickness gauge QuintSonic are a battery pack and a power supply unit. As soon as the gauge is connected, the batteries will be charged. The charging time for an empty battery pack is approx. 3 hours.

Notes:

Batteries from other manufacturers cannot be charged in the gauge.

No alkaline batteries (AlMn) must be used.

The battery pack should always be fully charged. If you abort the charging process prematurely, the battery pack can no longer be charged up to its full capacity.

Faulty measurements due to too low supply voltage are excluded.

Inserting the battery pack

- Loosen the two bottom screws at the instrument rear and remove the cover.

- Insert the battery pack into the battery compartment as shown in the figure. A pole reversal is excluded.
- After that, retighten the screws of the battery compartment cover.

Note:

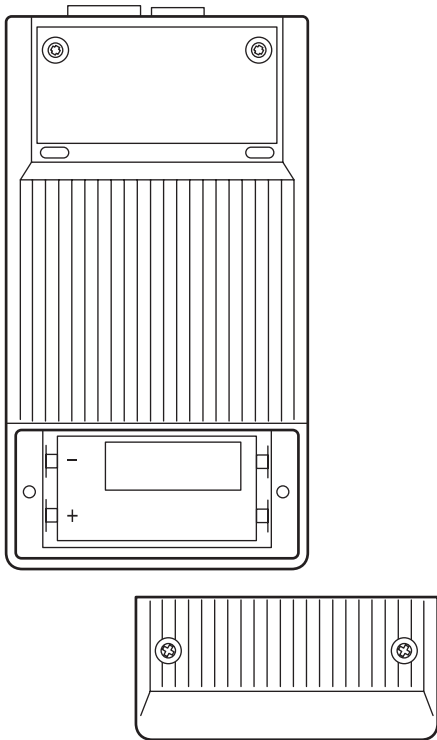
If the battery symbol at the top right corner of the LC display is flashing, the battery capacity is becoming exhausted. You can check the battery charge by pressing the FUNC key twice (please refer to chapter 4.1, Display indications). In this case, replace the battery pack at once by a charged battery pack, or connect the QuintSonic gauge to a socket outlet via the power supply unit.



Warning:

If you want to change the batteries please note the following: A new battery pack must be inserted within 2 minutes after removing the old battery pack, otherwise measured values and calibration values as well as the basic settings are lost.

For more details on how to handle batteries, please read chapter 7, Maintenance and care.



Operation using the power supply unit

The power supply unit is delivered with two different plug attachments (Euro/US adapter) so that you can use it for different socket-outlet types.

Notes:

If power supply units from external third-party manufacturers are used, the required limit values for emitted interferences or noise immunity are not guaranteed.

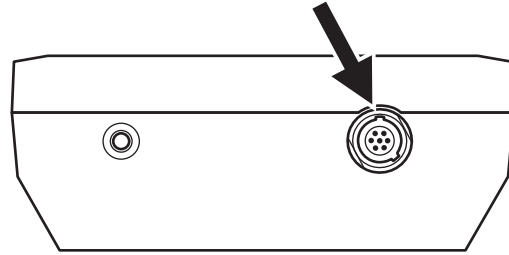
The plug attachment of the power supply unit is not designed for multiple exchanges. Please select the suitable plug attachment once during start-up and slip it on the power supply unit.

Please use the power supply unit included in the supply if you want to carry out longer measurement series. The moment you connect the power supply unit to the coating thickness gauge QuintSonic, the batteries are charged. You can carry out measurements with the gauge during charging. As soon as the batteries are charged, the gauge automatically switches over to trickle charge or floating operation.

3.2 Connecting the probe

To prepare the gauge for operation, you have to connect the CTF 1 probe.




- Connect the probe cable with the connector socket at the head end of the instrument. Place the cable plug on the socket so that the red marking of the plug points upward.
- Push the plug into the connector socket until it snaps into place.





Fundamental principles of operation 4

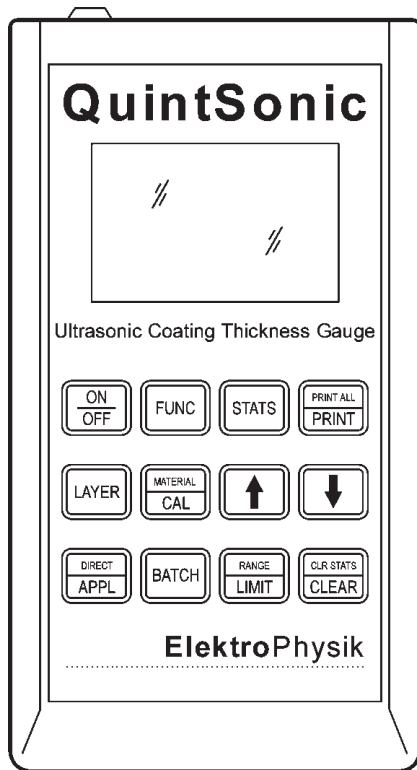
4.1 Display indications



Abbreviation	Description
N	number of readings
MEAN	mean value
STD.DEV	standard deviation
Kvar	variation coefficient
MAX	maximum reading
MIN	minimum reading
Cp	process capability index
Cpk	process capability index (mean value position)
	display for an active measurement
	PC mode: data transfer is active (keyboard blocked)
	indicator for discharged battery pack (flashing)
FUNC	secondary function of key is activated (upper key labeling)

Abbreviation	Description	Abbreviation	Description
CAL	mode for the calibration using calibration standards or with default sound velocity is active	HI	mode for defining the upper limit value for RANGE or LIMIT is active
	position of reading referred to the predefined limit values	APPL BATCH	mode for storing measurement series is active
large-size number	display of reading		a) analog coating thickness display referred to the preset limit values
LAYER	number of the currently active material layer		b) battery charge status (press the FUNC key twice) left end of bar graph = low charge right end of bar graph = high charge
mils/ μ m/mm	units set for the measured value		
TIME	mode for the time and date setting is active		
LIMIT	note that limit values have been preset		
RANGE	mode for the preset measured-value range		
LO	mode for defining the lower limit value for RANGE or LIMIT is active		

4.2 Keys



The following table gives you an overview of the functions of the QuintSonic keys.

Please also observe the description of the individual operating steps in chapter 5 Operation.

Key	Description
ON/OFF	turns the instrument on or off
FUNC	activates secondary key function (upper key labeling)
STATS	displays or prints out statistical values in the DIRECT mode
PRINT/ PRINT ALL	prints out the measured and statistical values (only in the APPL-BATCH mode) prints out the complete memory contents (in the DIRECT mode)
LAYER	selects the number of layers
CAL/MATERIAL	calibrates the probe and selects the coating and substrate material
↑	increases an adjustment value, or transfers a value to the data memory

Key	Description
↓	reduces an adjustment value
APPL/ DIRECT	changes between APPL-BATCH and DIRECT modes
BATCH	selects memory group
LIMIT/ RANGE	sets limit values per layer or RANGE defines evaluation range
CLEAR/ CLR STATS	deletes the last reading or statistics

4.3 Turning the instrument on and off

Turning on

- Press the ON/OFF key to turn the instrument on.

A short intermittent tone will sound and you will see the set units. The other display indications depend on the mode that you were in before turning the instrument off the last time – either in DIRECT or in APPL-BATCH mode.

- If you have connected a probe to the gauge when turning it on for the first time, the display prompts you alternately with PROb and CAL to record a reference echo (please see chapter 5.1, Calibrating the probe).
- If you have not connected any probe to the gauge and if you have carried out a total reset, PROb is displayed and the instrument is automatically turned off. Without a preceding total reset, you can view and print out statistical data (please see chapter 4.2, Keys).

Turning off

- Press the ON/OFF key to turn the instrument off.

If you make no data entries and change no probes, the instrument is automatically turned off after about 1.5 minutes. (This setting only applies to the battery operation and can be changed, ref. chapter 5.3, Basic settings). This helps reduce power consumption so that you will not waste any battery operating time.

All basic settings and stored readings are kept after the instrument has been turned off.

4.4 How to use the probe

To be able to measure without any interferences, you should observe some rules concerning the handling of the probe:

- Connect the probe to the gauge before turning it on for the first time or after a total reset. Otherwise the message PROb is displayed, and the instrument is automatically turned off.
- If you want to disconnect the probe cable from the gauge or from the probe, pull it on the corrugated sleeve of the plug, and not on the cable.
- If you change the probe with the gauge being turned on, PROb appears on the display, and the instrument is turned off. When you turn the instrument on again, you are prompted by a flashing PROb / CAL to record a reference echo.
- If you have changed the probe with the gauge being turned off, you must record the reference echo after turning back on again, as the probe change is not recognized.
- If the gauge is turned on without a probe but with a previously recorded Ref-Echo, only the measured values in the data memory can be displayed and printed out. All other operating functions are blocked.
- Hold the probe as vertical as possible against the layer to be measured.
- The surfaces must be clean, free of contaminants and must be level; any rust must be removed. Couple the probe using couplant and by strongly pressing the bell-shaped housing with the test object. The couplant layer must be sufficient but as thin as possible.



Attention:

The probe's contact surface must not come into contact with any organic solvent.

- You should only use the couplant from Elektro-Physik included in the supply in order to avoid faulty measurements. The couplant should not be allowed to dry otherwise it will be measured as a layer.
- You can also use water for coupling onto coated metallic objects; the resolution can be increased by doing this.

- The probe is designed for measurements on smooth, flat surfaces. Measurements on rough surfaces can scratch the probe delay and lead to false measurement results.

 **Note:**

The probe must be calibrated at least once a day (please also refer to chapter 5.5, Calibrating the instrument).

- The gauge operates using the ultrasonic pulse-echo method. The times of flight of the sound waves reflected from the varnish or lacquer coating layers are indicated as digital readings by means of state-of-the-art electronics and an evaluation by complex signal processing.

 **Attention:**

The physical limits of the method are reached if reflections from the boundary layers fail – single layers can no longer be resolved. Moreover, the evaluation can be influenced by interactions with the sound waves from the probe or between coupling layer and the base material. In the case of multiple layers, additional interactions of the sound waves occur between the individual layers.

Due to the almost unlimited number of combinations of coatings and base materials, measuring errors or measured-value deviations can occur in some applications. We would therefore recommend checking of the measurement results of the QuintSonic gauge once for every application by another method of measurement (microsection or similar). Please use this reference test for a system check in this application.

Operation 5

5.1 Calibrating the probe

Before you can carry out basic settings and coating thickness measurements, you have to record a reference echo for calibrating the probe. The reference echo must be recorded at least once a day – even more often, if necessary, with high demands on the measuring accuracy and with major variations of the ambient temperature (ref. chapter 5.5, Calibrating the instrument on this). The probe tip must show no couplant or dirt accumulations.

- Clean the probe tip with water and a soft cloth.

The gauge is turned on.

- Press the CAL key.
PROB and CAL are alternately displayed.
- Hold the probe in the air and press the key on the probe once.
You will hear an acoustic signal, and four horizontal dashes (----) will appear on the display.

The reference echo is now recorded and the probe is calibrated.

5.2 Selecting the operating mode

You can choose between the operating modes DIRECT and APPL BATCH with the QuintSonic gauge.

DIRECT mode

The DIRECT mode is well suited for the simple and quick measurement with measured-value indication on the display and subsequent printout of the statistical evaluation if necessary. The single readings obtained are not saved in this operating mode, but only used for statistical calculations. Up to 7,900 single measurements can be statistically evaluated in the DIRECT mode. The DIRECT mode is activated during the initial start-up, in the case of a probe change, or after a change between coating and wall thickness measurement.

When you turn the instrument on, you will be in the mode that was last used for a measurement. If you want to switch from the APPL-BATCH mode over to the DIRECT mode, proceed as follows:

The instrument is turned on, and you will see APPL BATCH below the units on the display.

- Press the FUNC key and then the DIRECT/APPL key.
DIRE appears on the display, and you can start with the measurements.

APPL-BATCH mode

The APPL-BATCH mode is well suited for the comparison of several measurement series and for the management of measurement series in which different probes have been used for carrying out the measurements. The integrated data logger has 99 application memory locations (APPL) available which can be subdivided into 98 batch memory locations (BATCH) each. In this memory range, you can file - depending on the APPL BATCH configuration - up to 250 separate measurement series and statistically evaluate every single measurement series as such if required. The maximum total data acquisition capacity is 7,900 single readings. You can print out single readings and statistics any time you want.

A new application is initialized as a 1-layer application with the default material POLY. After selecting the APPL no., the number of layers and the material (sound velocity) can be set for this application.

If you want to switch from the DIRECT mode over to

the APPL-BATCH mode, proceed as follows:

The instrument is turned on.

- Press the APPL/DIRECT key.
The display indicates APPL BATCH and the pair of numbers of the APPL-BATCH memory location last used, e.g. 2 : 1.
- Press the APPL/DIRECT key one more time.
- Continue your measurements in the indicated APPL-BATCH memory location, or select a new memory location.

Selecting an APPL-BATCH memory location

To select a memory location, you have to select an application memory (APPL) and a batch memory (BATCH). The calibration values and all settings of the layers, the base material and the measurement mode are stored in the APPL memory locations. The measured values, the limit values for measuring range and alarm thresholds, as well as date and time of the first measurement are stored in the BATCH memory locations. Once a calibration has been carried out, you don't have to repeat it – all you have to do is to recall

the corresponding APPL memory location number. After that, you can select a BATCH memory location and start to measure.

The instrument is turned on and you are working in the APPL-BATCH mode.

- Press the APPL/DIRECT key.
The pair of numbers of the APPL-BATCH memory location last used is displayed.
- Use the arrow keys to select the required application memory location and press the APPL/DIRECT key again.
- Press the BATCH key.
The pair of numbers is displayed.
- Use the arrow keys to select the required batch memory location and press BATCH again.

The new memory location is now selected and you can start to measure.

 **Notes:**

If the memory location is full, the message FULL appears on the display.

If you keep an arrow key pressed after pressing the

APPL/DIRECT key, the individual application memory locations or batch memory locations are scrolled through at high speed. The display stops at the first free memory location, and the corresponding memory location number flashes. This search function is no longer active when the APPL/DIRECT key is pressed another time.

No single readings can be stored in the batch memory location 99. When displaying and printing out the statistics from batch no. 99, total statistics of all readings from all batches of the corresponding application will be output.



Attention:

You will not be able to change an application's number of layers after a measurement reading has been saved. A flashing indication will appear as a warning (dEL) if you try to do this.

- The sequence is aborted by pressing CLEAR. All settings and readings will be retained.
- The sequence is continued by pressing LAYER; the complete application is deleted when doing this.

The subsequent setting of the material is also disabled. The instrument indicates this by a tow-tone alarm.

5.3 Setting the basic functions

Before using the instrument, you can set various basic functions, e.g.

- set time and date for the statistical evaluations of measurement series,
- select the required units of measurement (μm or mils),
- define statistical presettings,

plus a number of other default data described below.

Note:

You should connect a probe to the gauge before turning it on for the first time or after a total reset. Otherwise the message PROb is displayed, and the instrument is automatically turned off.

Function	Keys to press
Setting time and date	CAL + ON/OFF
LCD test	\uparrow -key + ON/OFF
Function mode	FUNC + ON/OFF
APPL-BATCH directory	APPL + ON/OFF
Total reset	FUNC + CLEAR + ON/OFF

Setting the time and date

The instrument provides quartz-controlled time data. In combination with the data printer, the current time and date are printed out for every statistics printout. However, time and date can also be viewed and updated on the display if required.

The QuintSonic gauge is turned off.

- Press CAL and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see the two-digit number of the year (Yr), e.g. 98.

- Set the current year using the arrow keys.
The ↑ key increases the displayed value, the ↓ key reduces it.
- After setting the correct year, press CAL.
The value is now stored, and you will move to setting of the month (Mo).
- Set the current month using the arrow keys.
- Press CAL.
You will move to setting of the day (da).
- Set the current day using the arrow keys.
- Press CAL.
You will move to setting of the hour (Hr).
- Set the current hour using the arrow keys.
- Press CAL.
You will move to setting of the minute (Mn).
- Set the current minute using the arrow keys.
- Press CAL.

You have now set and stored the time and date.

 Note:

You can abort the setting process any time by pressing the CLEAR/CLR STATS key. The old setting will then be kept.

Carrying out an LCD test

You can check that all displays are correctly shown in the LCD window.

- To achieve this, press ↑ and keep it pressed while you press the ON/OFF key.
All display fields are visible in the LCD window.

After that, the current version of the operating software and the evaluation software is displayed, and the instrument changes to the normal operating mode.

Checking the battery charge

You can check the current status of the battery pack.

The instrument is turned on.

- Press the FUNC key twice.
- If no power supply unit is connected, bAtt appears on the display.
- When the batteries are being charged, the message LOAd is displayed.
- If a power supply unit is connected and the battery charger is not active, the message MAIN is displayed.
- In battery operation, the horizontal bar graph shows the remaining capacity of the battery pack (left = low, right = high battery capacity).
- Press FUNC again to exit the test mode.

FUNC		Function mode	
1	0	Units	metric [μm]
	1		imperial [inch]
2	0	Off mode	Short-time duty (1.5 min)
	1		Continuous mode
3	0	Measuring mode	coating thickness
	1		wall thickness
4	0	Display backlight	deactivated
	1		activated
5	0	Key lock	deactivated
	1		activated
6	0	Calibration mode	calibration standard
	1		sound velocity
7	0	Format of date and time	Standard (Euro)
	1		US
8	0	Acoustic signal	activated
	1		deactivated

Selecting the function mode

You can select eight function modes via the FUNC key. You can choose between 0 and 1 for each function mode according to the table opposite. All eight settings are at 0 on delivery and after a reset.

The changes only become active when all eight function modes are run through. However, the old setting will be retained if you abort the sequence beforehand.

The individual function modes are described on the following pages.

Units (Func 1)

The instrument is turned off.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the units setting on the display.
- Use the arrow keys to choose between the value 0 for the unit μm and the value 1 for the unit mils.
- Press the FUNC key to go to the next function mode.

Off mode (Func 2)

You can determine whether the instrument should be turned off during a shutdown period or not. The setting 0 (short-time duty) is well suited for single measurements with shutdown periods that would quickly discharge the battery pack. In this mode, the instrument is automatically turned off after 1.5 min.

The instrument is turned off.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting of the units.
- Press the FUNC key once so that 2.0 or 2.1 will be displayed.
- Use the arrow keys to choose between the value 0 for the short-time duty and the value 1 for the continuous running duty.
- Press the FUNC key to go to the next function mode.

Measuring modes (Func 3)

You can choose between wall and coating thickness measurement.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key twice so that 3.0 or 3.1 will be displayed.
- Use the arrow keys to choose between the value 0 for the coating thickness measurement and the value 1 for the wall thickness measurement.
- Press the FUNC key to go to the next function mode.

Display backlight (Func 4)

The QuintSonic gauge has a switchable display backlight. If the backlight is activated, the light will be on forever.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key three times so that 4.0 or 4.1 will be displayed.
- Use the arrow keys to choose between the value 0 for the deactivation of the display backlight and the value 1 for the activation of the display backlight.
- Press the FUNC key to go to the next function mode.

Key lock (Func 5)

You can “lock” certain keys to prevent any accidental deletion of the calibration or other settings. The function applies to the keys LAYER, LIMIT, RANGE and MATERIAL. The CAL key can only be used for recording the reference echo.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key four times so that 5.0 or 5.1 will be displayed.
- Use the arrow keys to choose between the value 0 for key release and the value 1 for key lock.
- Press the FUNC key to go to the next function mode.

Calibration mode (Func 6)

You can decide whether you want to carry out the calibration using a calibration standard or whether you want to enter an already known value for the sound velocity of the material to be tested.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key five times so that 6.0 or 6.1 will be displayed.
- Use the arrow keys to choose between the value 0 for calibration using a calibration standard and the value 1 for the entry of a known value for the sound velocity.
- Press the FUNC key to go to the next function mode.

Format of date and time (Func 7)

You can decide whether you want to set the date and time display in the standard (Euro) format (DD-MM-YY) or in the US format (MM-DD-YY; time 0-12 am/pm). The date and time are printed out on the report printout.

- Press the FUNC key and keep it pressed while you press the ON/OFF key.
An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key six times so that 7.0 or 7.1 will be displayed.
- Use the arrow keys to choose between the value 0 for standard (Euro) format and the value 1 for the US format.
- Press the FUNC key to go to the next function mode.

Acoustic signal (Func 8)

You can decide whether the acoustic signal should be activated or deactivated. The acoustic signal, which is given when turning on and off, when the alarm thresholds are exceeded or when warnings or error messages appear, is not suppressable.

Press the FUNC key and keep it pressed while you press the ON/OFF key.

An acoustic signal is given, and you will see 1.0 or 1.1 for the current setting on the display.

- Press the FUNC key seven times so that 8.0 or 8.1 will be displayed.
- Use the arrow keys to choose between the value 0 for the activation of the acoustic signal and the value 1 for the deactivation of the acoustic signal.
- Press the FUNC key to save all settings and to go to the normal measuring mode.

Defining the number of layers and the material allocation

In order to define several layers, you have to specify the number of superimposed layers of the coating to the measured. One layer is set on delivery. In the case of multilayer coatings, you can allocate a material to the individual layers. You have a choice between three materials:

- polymer (POLY), e.g. paint coatings, plastic coatings
- rubber (RUbb)
- glass (GLAS), e.g. enamellings

The gauge is turned on.

- Press the LAYER key.
A flashing LAYER is displayed plus two numbers indicating the number of the currently set layers.
- If you want to specify another layer, use the arrow key \hat{u} to increase the layer number.
The large number indicates the new number of layers.
- Press the LAYER key again.

- Press the keys FUNC and CAL/MATERIAL.
The currently set material for the first layer is displayed.
- Use the arrow keys to select the required material for the first layer and confirm your choice with the CAL/MATERIAL key.
The display changes over to the second layer.
- Select the required material for the second layer as described in the last step.

As long as you have not yet completed the choice of the layer material using the CAL/MATERIAL key, you can abort the process by pressing the CLEAR/CLR STATS key without changing the current setting.

When you have selected the material for the last preset layer, the display automatically changes over to selecting the base material.

You have a choice between seven base materials:

- polymer (POLY)
- iron (IRON)
- aluminium (ALUM)
- glass (GLAS)

- wood (WOOD)
 - ceramics (CERA)
 - no base material (NONE)
- Use the arrow keys to select the required base material and end the selection by means of the CAL/MATERIAL key.
Four horizontal dashes (----) are displayed.

As long as you have not yet completed your choice of the base material with the CAL/MATERIAL key, you can abort the process by pressing the CLEAR/CLR STATS key without changing the current setting.

Notes:

If you want to change an already preset number of layers, you have to delete a possibly existing current reading.

In wall thickness measurements, only the substrate materials POLY, IRON, ALUM, GLAS and CERA are available.

Limit values

You can specify an upper and a lower limit value (LIMIT) for every single layer.

- Readings beyond the set limit values are indicated during the measurement by a double beep tone and will be provided with an identifying marking in the printout of statistical values.
< : reading is smaller than the lower limit value
> : reading is greater than the upper limit value
- An analog bar graph is shown below on the display, and a trend display appears to the left of the reading.

The arrowhead pointing upward (▲) indicates a reading above the upper limit value; at the same time you will see the right section of the bar graph below on the display. The arrowhead pointing downward (▼) indicates a reading below the lower limit value; at the same time you will see the left section of the bar graph below on the display.

The black square (■) is displayed when the reading is within the preset limit values; at the same time, the bar indicator adjusts itself in its mid position.

The limit values for the total coating thickness are calculated from the sum totals of all Lo or all Hi values.

LIMIT setting

 **Note:**

Both limit values cannot be set below a minimum distance for metrological reasons. If you try to set a smaller distance, the minimum distance is automatically selected.

The instrument is turned on, the number of layers and the material allocations are already defined.

- Press the LIMIT/RANGE key.
LIMIT Lo flashes on the display, and the lower limit value that was last set is displayed (default = NONE).
- Set the required lower limit value using the arrow keys.
- Press the LIMIT/RANGE key again.
LIMIT Hi flashes on the display, and the upper limit value that was last set is displayed.
- Set the required upper limit value using the arrow keys, and close by pressing the LIMIT/RANGE key once again.

If you have defined several layers, the display will jump to the next layer number. Set the limit values as described.

LIMIT appears on the display to indicate that you have specified limit values for this layer. You can delete the limit values of the individual layers:

- Press the LIMIT key to select the layer.
- Press the CLEAR/STATS key to delete.

 **Note:**

A bar graph appears on the display during limit setting indicating the position of the reading in the set range during the measurement.

RANGE setting

You should use the RANGE function in critical applications (e.g. with rough surfaces) to avoid faulty measurements.

If you know approximately the thickness of the total layer, you can specify range values within which the echo is evaluated (RANGE). By doing this, you will simplify the evaluation of the echoes. In the basic setting, RANGE covers the complete measuring range of the probe.

Note:

The impedances of adjacent layers must not be too similar, otherwise there is no reflection that could be evaluated.

The gauge is turned on.

- Press the keys FUNC and LIMIT/RANGE successively.
The lower range value that was last set appears on the display and RANGE LO flashes (default = NONE).

- Use the arrow keys to select the required lower range value, and complete your choice by pressing the LIMIT/RANGE key.
- RANGE Hi flashes on the display, and the upper range value that was last set is displayed.
- Set the required upper range value using the arrow keys, and close by pressing the LIMIT/RANGE key once again.

If you have defined several layers, the display will jump to the next layer number. Set the limit values as described.

RANGE appears on the display indicating that you have specified range values. You can deactivate the range values for every coating by pressing the CLEAR/CL STATS key after selecting the RANGE for the corresponding layer.

Note:

With rough surfaces, select a value for LO RANGE which is above the roughness value, and for HI RANGE a value which is above the total coating thickness.

Carrying out total reset

You can reset the QuintSonic gauge to its factory default settings. Calibrations, layer selection, limits, range, all readings, and the APPL-BATCH structure are deleted in this process.

- Turn the instrument off.
- Press the three keys CLEAR/CLR STATS, FUNC and ON/OFF one by one and keep them pressed.
A long acoustic signal is given confirming the complete deletion.

5.4 Measuring the coating thickness

Make sure that the probe is connected to the instrument and the QuintSonic gauge is turned on. A calibration may be required for the selected probe (ref. chapter 5.5 Calibrating the instrument).

- Check that the material surface and the probe tip are free from dirt, residual paint, etc.
- Apply an adequate amount of couplant.
- Place the probe vertically against the surface of the coating.
- Press either the probe key or the ↵ key to start the measurement.
The probe symbol flashes on the display, and an acoustic signal is given – you can now lift the probe off the test object. Another acoustic signal is given after a short while – the measured value is displayed and transferred to the statistics.

The displayed reading applies to the total coating thickness, provided that no layer data was set. If you have measured a multilayer coating, you can have the

thicknesses of the individual layers displayed one by one.

- Press the LAYER key.
The reading for Layer 1 is displayed.
- Press the LAYER key again.
The reading for 2 is displayed.

Every time the LAYER key is pressed again, the reading of a previously defined layer is displayed.

If the displayed reading flashes, the reading is uncertain, and the measurement has to be repeated.



Attention:

In the subsequent measurement, the current layer that was last set is displayed in each case.

If you have defined limit values when specifying the individual layers, the position of the reading within these limit values is shown in a graphic display. The arrowhead pointing upward (▲) indicates a reading above the upper limit value; at the same time you will see the right section of the bar graph below on the display. The arrowhead pointing downward (▼) indicates a reading below the lower limit value; at the same time you will see the left section of the bar graph below on

the display. The black square (■) appears when the reading is within the preset limit values; at the same time, the bar indicator adjusts itself to its mid position.

If you print out a series of readings, the values situated beyond the preset limits are identified:

- < : reading is smaller than the lower limit value
- > : reading is greater than the upper limit value

5.5 Calibrating the instrument

Note:

Before carrying out the instrument calibration, please observe the notes concerning the probe calibration in chapter 5.1, Calibrating the probe.

If the demands on accuracy are high, or in the case of measured-value deviations, you have to calibrate the QuintSonic gauge. You can carry out a calibration both for the total coating thickness and for every single layer with a multilayer coating. The calibration also includes the material allocation to every single layer and to the base material.

General information on the calibration

Please observe the following:

- Make a calibration standard (e.g. microsection) for every application and determine its coating thickness by means of another measuring method.
- Before calibrating, you have to clean the probe tip and the calibration standard. Any foreign bodies will corrupt the reading.

- When carrying out any calibrations and measurements, you have to leave the probe positioned until an acoustic signal is given; after that, you can lift off the probe. A second acoustic signal confirms that the measured-value calculation has been completed.
- The more the calibration standard resembles the test object, the more accurate the calibration and consequently also the measurement will be.
- You can abort the calibration process with the CLEAR/CLR STATS key as long as you haven't yet pressed the CAL key to close the process.

Note:

In the case of varnish or lacquer coatings and other plastic coatings, the sound velocity seldom deviates by more than $\pm 15\%$ from the preset value. Should larger calibration steps be required, there's reason to believe that a measuring error has occurred.

The thicker the calibration standard, the smaller the calibration errors. A calibration using reference coatings $< 40\ \mu\text{m}$ is doubtful, with a reference coating $< 20\ \mu\text{m}$ it's useless. If only such thin calibration standards are available, it's better to use the default setting of the instrument.

**Attention:**

If the instrument is turned off during the calibration process due to exhausted batteries, you have to repeat the complete process.

Calibration of a 1-layer coating

In this simple calibration method, the total coating is regarded as one single layer even if the total coating consists of several layers.

Note:

For the calibration using calibration standards, you have to set the function 6 in the function modes to the value 0 (ref. chapter 5.3, Setting the basic functions).

The gauge is turned on.

- Press the CAL key.
PROb and CAL are alternately displayed.
- Press the CAL key again.
A flashing CAL appears on the display and a non-flashing MEAN.

- Place the probe tip provided with couplant vertically on the calibration standard and carry out several measurements.
The mean value is displayed in each case.
- Use the arrow keys to vary the displayed reading until you have set the value of your calibration standard.
- Press the CAL key again to end the calibration.
The display shows a non-flashing CAL.
- Press the LAYER key.
LAYER appears on the display next to the number of the current layer and SNGL.
- Carry out several measurements using couplant on the calibration standard that corresponds to the layer.
The mean value is displayed in each case.
- Use the arrow keys to vary the displayed reading until you have set the value corresponding to the calibration standard.
- Press the CAL key again to end the calibration for this layer.
- Repeat the calibration for all layers.
A non-flashing CAL appears on the display.

Calibration of a multilayer coating

Using this calibration method, you can carry out an accurate calibration of every single layer of a multilayer coating.

The gauge is turned on.

Variant 1: calibration using 1-layer standard

- Press the CAL key.
PROb and CAL are alternately displayed.
- Press the CAL key again.
A flashing CAL appears on the display and a non-flashing MEAN.

 **Attention:**

Carry out several single measurements during the calibration. Too few single measurements result in an inaccurate mean value of the readings.

VARIANT 2: calibration using a multilayer standard

- Press the CAL key.
PROb and CAL are alternately displayed.
 - Press the CAL key again.
A flashing CAL and a non-flashing MEAN appear on the display.
 - Press the LAYER key.
LAYER is displayed next to the number of the current layer and SNGL.
 - Press the LAYER key again.
LAYER and MULT are displayed.
 - Carry out several measurements using couplant on the calibration standard.
The mean value is displayed in each case.
 - Press the CAL key.
The measured value of the first layer is displayed (LAYER 1).
 - Use the arrow keys to vary the displayed reading until you have set the value corresponding to the calibration standard layer.
- Press the CAL key again to end the calibration for the layer 1.
A flashing CAL and a non-flashing MEAN as well as LAYER 2 appear on the display.
 - Use the arrow keys to change the displayed reading for LAYER 2 to the corresponding value.
 - Press the CAL key to end the calibration for the layer 2.
A flashing CAL and a non-flashing MEAN as well as LAYER 3 appear on the display.
 - Repeat these steps up to the last layer.
A non-flashing CAL appears on the display.

Entry of sound velocity

If the sound velocity of the material to be tested is known, you can directly enter the value in the gauge. This enables you to easily carry out the calibration of a 1-layer or multilayer coating.

Note:

You have to allocate the value 1 to the function 6 in the function modes for this calibration mode (please see chapter 5.3 Setting the basic functions).

The gauge is turned on.

- Press the CAL key twice.
The sound velocity of the material of layer 1 is displayed, alternately flashing with M/S.
- Use the arrow keys to set the sound velocity for layer 1, and then confirm the value by pressing the CAL key.
The sound velocity of the material of layer 2 is then displayed.
- Set the sound velocities for all selected layers in this way.

Note:

The sound velocity can be set independently of the selected material within the range of 500 ... 9999 m/s.

Deleting the calibration

You can delete the calibration for all layers.

The instrument is turned on.

- Press the CAL key twice.
- Press the CLEAR/CLR STATS key.
The calibrations are deleted for all layers.

5.6 Evaluating the measurement results

The QuintSonic gauge enables you to carry out a statistical evaluation of your measurement series. It calculates the corresponding statistical values of the selected measurement series within the APPL-BATCH structure. The printout is made via the printer MiniPrint 4100. You can print out either all measured single values, including statistics (FUNC + PRINT/PRINT ALL), or only the statistical values (PRINT/PRINT ALL).

In every application, total statistics on all measured values of all measurement series in that application can be printed out in the corresponding BATCH 99 by pressing the PRINT/PRINT ALL key. The single values of all measurement series are likewise printed out via FUNC and PRINT/PRINT ALL.

Statistics

A printout of the statistical values can be made in the DIRECT mode and in the APPL-BATCH mode. The printout of the single readings is only possible in the APPL-BATCH mode.

The instrument is turned on and using the APPL-BATCH mode.

- Press the STATS key to display the number of measurements (N).
If the arrow key is pressed during this (approx. 1 second), the current number and the single reading are displayed.
Every time the STATS key is pressed again, another statistical value is displayed; and the display appears in the order of the table.

- Press the PRINT/PRINT ALL key to successively display all statistical values one by one.

If you have connected the printer PRT 1, you can print out the statistical values.

- Press the STATS key to display and at the same time print out the number of measurements (N).
Every time the STATS key is pressed again, another statistical value is displayed and simultaneously printed out.

You can generate a list of all statistical values.

- Press the PRINT/PRINT ALL key.
The statistical values of all measurement series filed in this application memory are printed out.

Display/printout	Statistics
N	Number of single values
Mean	Mean value of single values
St.D	Standard deviation
Kvar	Variation coefficient
Max	Maximum single value
Min	Minimum single value
Cp	Process capability index
Cpk	Process capability index (mean value)

Moreover, you can generate a complete printout of all measured values and statistical values.

- Press the FUNC key and then the PRINT/PRINT ALL key.
All measured values of the individual measurement series within the current application memory, including the statistics, are printed out.

 **Note:**

A printout of the complete memory contents is only possible in the DIRECT mode.

 **Notes:**

If you have entered an upper and a lower limit value, the readings are identified with a corresponding marking.

< : reading is smaller than the lower limit value

> : reading is greater than the upper limit value

Faulty measurements are included in the statistical evaluation. You should therefore delete any faulty measurements right after the measurement, subsequent corrections of the measurement series are not possible (ref. chapter 5.7 Delete functions).

Printout of memory allocation

To check the memory locations, you can print out a list. You will then receive the following detailed information:

- allocated application memory (APPL)
- probe type calibrated for the application
- allocated batch memory (BATCH)
- number of readings in the batch memory locations

The instrument is turned off, the printer MiniPrint 4100 is connected.

- Keep the APPL/DIRECT key pressed and, in addition, press the ON/OFF key until an acoustic signal is heard.
The list indicating the memory allocation is printed out.

You will find an example of a printout in chapter 6, Documenting measurement results.

Transferring readings to the PC

If you connect the serial interface RS 232C of the gauge with the serial port of a PC, you can transfer the measurement data to the PC. A reading is transferred in each measurement.

The QuintSonic gauge is connected to a PC and is using the APPL-BATCH mode.

- Press the FUNC key and then the PRINT/PRINT ALL key.

All readings of the individual measurement series within the current application memory, including the statistical values, are transferred to the PC.

The readings can be displayed on the monitor by means of a standard terminal program.

You will find more details on the data transfer in the chapter 9.1, Description of interface.

5.7 Delete functions

The QuintSonic gauge has a number of different delete functions available for measured and calculated values enabling you to selectively delete single values, individual measurement series or limit values. Any calibrations or other measurement series within an application memory are maintained in this process.

Deleting the last reading

The last reading is displayed.

- Press the CLEAR key.
An acoustic signal will confirm that the value is deleted.

Deleting single and statistical values

You are using the DIRECT mode.

- Press the FUNC key and then the CLEAR/CLR STATS key. An acoustic signal will confirm that all single and statistical values are deleted.

Deleting a measurement series including statistical values

You can delete a measurement series together with the statistical values within a batch memory (BATCH). The calibration values in the overriding application memory (APPL) are maintained in this process.

Start by selecting the application memory location and the batch memory location where the measurement series to be deleted is stored.

- To do this, press the APPL/DIRECT key and select the required application memory location using the arrow keys. Finally, press the APPL/DIRECT key again.
- After that, press the BATCH key and select the required batch memory location using the arrow keys. Finally, press the BATCH key again.
- Then press the keys FUNC and CLEAR/CLR STATS one after the other.

Deleting a measurement series including statistical and limit values

You can delete a measurement series together with the statistical and limit values within a batch memory (BATCH). The calibration values in the overriding application memory (APPL) are maintained in this process.

Start by selecting the application memory location and the batch memory location where the measurement series to be deleted is stored.

- To do this, press the APPL/DIRECT key and select the required application memory location using the arrow keys. Finally, press the APPL/DIRECT key again.
- After that, press the BATCH key and select the required batch memory location using the arrow keys.
- Then press the CLEAR/CLR STATS key.
An acoustic signal will confirm that the measurement series, statistical and limit values are deleted; the number of the batch memory location flashes, LIMIT is blanked out on the display.

Deleting limit values

You can delete limit values specified for a measurement series within a batch memory (BATCH). Any calibration and measured values are maintained.

Start by selecting the application memory location and the batch memory location where the limit values to be deleted are stored.

- To do this, press the APPL/DIRECT key and select the required application memory location using the arrow keys. Finally, press the APPL/DIRECT key again.
- After that, press the BATCH key and select the required batch memory location using the arrow keys. Finally, press the BATCH key again.
- Then alternately press the keys LIMIT/RANGE and CLEAR/CLR STATS until all limit values are deleted. An acoustic signal will confirm that the limit values are deleted; LIMIT is blanked out on the display.

Deleting the RANGE values

You can delete preset RANGE values for a measurement series within a batch memory (BATCH). Any calibration and measured values are maintained.

Start by selecting the application memory location and the batch memory location where the RANGE values to be deleted are stored.

- To do this, press the APPL/DIRECT key and use the arrow keys to select the required application memory location. Finally, press the APPL/DIRECT key again.
- After that, press the BATCH key and select the required batch memory location using the arrow keys. Finally, press the BATCH key again.
- Then press alternately the keys LIMIT/RANGE and CLEAR/CLR STATS one after the other until all RANGE values are deleted.
An acoustic signal will confirm that the RANGE values are deleted; RANGE is blanked out on the display.

Deleting all measurement series in an application memory

You can delete all measurement series, including their corresponding statistical, limit and calibration values, within an application memory (APPL).

Start by selecting the application memory location where all measurement series should be deleted.

- To do this, press the APPL/DIRECT key and use the arrow keys to select the required application memory location.
- After that, press the CLEAR/CLR STATS key. Three short acoustic signals are heard. You can abort the deleting process at this point by pressing the APPL/DIRECT key.
- To finally delete all measurement series, press the CLEAR/CLR STATS key again.
A long acoustic signal will confirm that the measurement series are deleted; the number of the application memory location flashes on the display.

Deleting all measurement series in all application memory locations

You can delete all measurement series, including their corresponding statistical, limit and calibration values, in all application memory locations.

- Turn the instrument off.
- Press the three keys CLEAR/CLR STATS, FUNC and ON/OFF one after the other and keep them pressed. A long acoustic signal is heard and confirms that everything has been completely deleted.

5.8 Measuring the wall thickness

You can also use the QuintSonic gauge as a thickness gauge for wall thicknesses. To be able to do this, you have to change the measurement mode from coating thickness measurement to wall thickness measurement in the function modes (please see section Measuring modes in the present chapter).

The QuintSonic gauge enables a very accurate and high-resolution wall thickness measurement on plastic materials and metals. The measurement of wall thickness can be carried out through a coating, i.e. the coating doesn't have to be removed and thus destroyed.

Measuring range:

Wall thickness measurement	Measuring range
Base material / steel	100 µm ... 8 mm
Base material / plastic	200 µm ... 3 mm



Attention:

The maximum permissible coating thickness varies depending on the application case due to different

sound attenuation conditions in the coating and base material, as well as due to impedance conditions. The coating thickness must not exceed 200 µm on plastics. As faulty measurements may occur due to unfavorable material combinations in the case of coated metals - especially if the coating is applied to both sides -, we recommend a checking by means of a reference block with known wall thickness in order to avoid measuring errors. The input of layer and material data is also necessary with uncoated materials, however, only one reading is output – the wall thickness.

Calibration is only possible for the base material. However, entry of the number of layers is required together with the corresponding material.

In measurements involving plastics as base material, the single layers and the base material have to be calibrated as in coating thickness measurements. Non-coated plastic sheets having a thickness less than 200 µm can be measured in the single layer mode using the material setting NONE:

No calibration is generally required in measurements involving steel as base material.

Basically, only the material need be entered regarding non-coated materials.

Documenting measurement results 6

6.1 Printer

The portable printer MiniPrint 4100 is supplied with power from four NiMH batteries. You can operate the printer via the power supply unit included in the supply, and also charge the batteries. A fully charged battery lasts for several thousand printed lines. The charging time is approx. 14 hours. The charge status of the batteries is indicated by two light-emitting diodes (LED's). The red LED (LOW) signals that the batteries are discharged. The yellow LED (CHARGE) signals with connected power supply unit that the batteries are being charged. As soon as the yellow LED is extinguished, the batteries are fully charged. The internal charging circuit of the MiniPrint 4100 is switched to trickle charging or floating operation. Therefore, the batteries cannot be overcharged.



Attention:

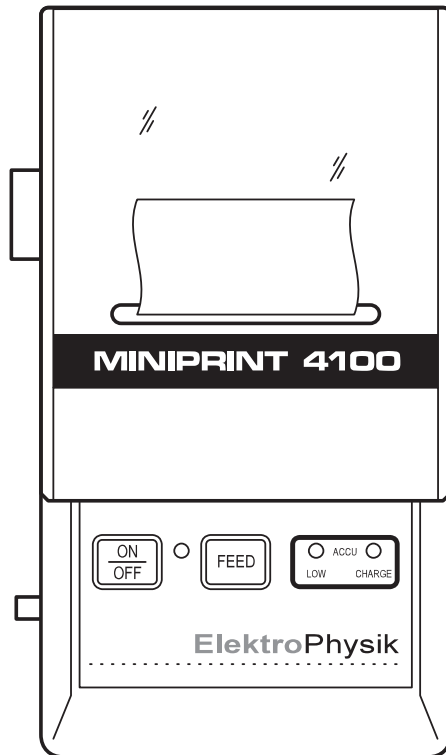
Printer explosion hazard!

Before connecting the power supply unit to the printer MiniPrint 4100, you must ensure that the instrument only contains rechargeable NiMH batteries!

If non-rechargeable alkaline batteries are inserted into the instrument, they can explode and cause severe injuries to the operator!

The printer MiniPrint 4100 enables to print out

- all single readings,
- the statistical values and
- the memory allocation



Key	Description
ON/OFF	To turn the instrument on or off
FEED	Line feed

LED	Description
green	Printer is turned on
red (LOW)	Batteries are discharged
yellow (CHARGE)	Batteries are being charged

6.2 Printer start-up

On delivery, the printer MiniPrint 4100 is equipped with 4 discharged NiMH batteries and a roll of paper. You have to charge the batteries by means of the power supply unit included in the supply before using the printer for the first time. The charging time is approx. 14 hours.

Note:

The printer MiniPrint 4100 can only be activated if it's connected with the QuintSonic gauge and the gauge is turned on.

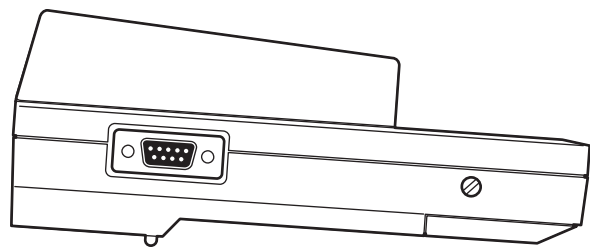
Charging batteries

- Connect the printer MiniPrint 4100 with a socket outlet (220 V) via the power supply unit. The yellow LED (CHARGE) is lit.
- Disconnect the power supply unit from the mains supply when the yellow LED is extinguished. The batteries are now charged.

Connecting the printer

- Connect the lateral 9-pin female connector of the printer MiniPrint 4100 with the 9-pin interface of the QuintSonic by intermating the two instruments alongside one another. Make sure the guide pin on the printer housing fits in the corresponding hole on the gauge.
- Turn on the gauge using the ON/OFF key.
- After that, turn on the printer using the ON/OFF key.
- Check that the papertape sticks out of the plexiglass cover – if required, press FEED several times.

You can now print out measured values and statistics from the QuintSonic.



Changing the roll of paper

The gauge and the printer are turned on.

- Push the plexiglass cover aside toward the back and remove the remaining used roll of paper.
- Take the papertape of the new roll so that it is unrolled downwards from the roll.
- Check that the papertape has a straight edge of cut
 - if required, cut a piece off using scissors.
- Put the end of the papertape below the ink ribbon cartridge in the metallic paper guide.
- Press FEED until the papertape juts out approx. 2 cm in front of the ink ribbon cartridge.
- Roll up the paper and put the roll of paper into the metal tray behind the ink ribbon cartridge.
- Put the plexiglass cover over the roll of paper and lead the end of the papertape through the slot in the cover.
To do this, bend the papertape forward below the cover. The papertape will then easily slide through the slot.

Changing the ink ribbon cartridge

The ink ribbon is provided in the form of an endless loop in a plastic cartridge and can be easily exchanged.

- Push the plexiglass cover aside toward the back and remove the roll of paper.
- Pull the paper still wound up cautiously out toward the back.
- Press from above on the right side of the ink ribbon cartridge (marking “Push”) with your index finger. The left side of the cartridge is then lifted up so that you can easily remove it by pulling it upward.
- Check that the ink ribbon of the new cartridge is stretched tight. If necessary, turn the corrugated tightening element in the direction of the arrow.
- Lead the new ink ribbon cartridge straight from above into the printing unit and make sure the ink ribbon is not twisted.
- Install the roll of paper according to the instructions in the previous section.

Changing the batteries

If the battery operating times of the MiniPrint 4100 become shorter and shorter, you have to replace them by new batteries. The batteries are placed in two compartments within the printer.

The first compartment is at the rear of the unit.

- Loosen the two bottom screws at the unit rear and remove the cover.
- Remove the old batteries and insert the new batteries into the battery compartment according to the identification marking. A pole reversal is not possible.
- After that, tighten the screws of the battery compartment lid again.

The second compartment is below the roll of paper.

- Push the plexiglass cover aside toward the back, and remove the roll of paper.
The roll of paper is in a metal tray.
- Lift the metal tray upward to take it out of the housing.
The batteries become visible.

- Replace the used batteries by new ones of the same type.
- Cover the compartment with the metal tray and place the roll of paper and the plexiglass cover back again (please see section Changing the roll of paper above).
- Charge the new batteries.

Carrying out printer self-test

The printer MiniPrint 4100 has a self-test function so that you can check the correct functioning of the printer and of the ink ribbon.

The printer is connected with the QuintSonic gauge.

- Turn on the QuintSonic.
- If necessary, turn off the printer by pressing the ON/OFF key, and the green LED is extinguished.
- Keep the FEED key pressed and, in addition, press the ON/OFF key until the printout starts.
The printer starts with the self-test and prints out line by line, always offset by one character, the fonts available.

- After approx. 20 lines, you can break off the self-test by pressing the ON/OFF key.

Printout of gauge name and software versions

You can print out the gauge name and the current software versions.

The printer is turned on and connected with the turned-off QuintSonic gauge.

- Press \hat{u} and keep it pressed while you press the ON/OFF key.

Following data are printed out:

- Company name
- Gauge name
- Version no. of the operating software and date
- Version no. of the evaluation software and date

After that, the QuintSonic changes to the normal operating mode.

6.3 Printout of measurement results

Printout of APPL-BATCH directory

The gauge is turned off.

- Turn on the printer.
- Press the DIRECT/APPL key, then press the ON/OFF key, and keep both keys pressed until you hear an acoustic signal.
The APPL-BATCH directory is printed out via the printer.

Example:

In this printout example, you can see all application memory locations that have been created (APPL. No.), the probe used (Probe CTF), the number of the batch memory location (BATCH No.), and the number of readings of the batch memory location (Number).

```
ELEKTRO-PHYSIK
QuintSonic Pro
Appl-Batch
Directory

APPL. No. 2
Probe CTF1
BATCH No. 1
Number    0

APPL. No. 3
Probe CTF1
BATCH No. 1
Number    3

End
```

Printout of statistical values

You can print out the statistical values of a measurement series in the APPL-BATCH mode.

The gauge and printer are turned on, you have selected the required application memory location (APPL) and the required batch memory location (BATCH).

- Press the PRINT/PRINT ALL key.
You will receive a printout including the statistical values of the measured layer from the currently selected measurement series.

Display/printout	Statistics
N	Number of single values
Mean	Mean value of single values
St.D	Standard deviation
Kvar	Variation coefficient
Max	Maximum single value
Min	Minimum single value
Cp	Process capability index
Cpk	Process capability index (mean value)

```

ELEKTRO-PHYSIK
QuintSonic Pro
STATS. PROGRAM

26-OCT-98 14:25

Probe CTF1
APPL. No. 15
BATCH No. 1
L1 POLY 2490 m/s
L2 POLY 2375 m/s
L3 POLY 2310 m/s
SB IRON
26-OCT-98 09:30

STATISTICS
N 3
Mean 97.7 µm
St.D 0.6 µm
Kvar 0.005
Max 98.0 µm
Min 97.0 µm

LAYER 1
Mean 43.3 µm
St.D 0.6 µm
Kvar 0.013
Max 44.0 µm
Min 43.0 µm

LAYER 2
Mean 15.0 µm
St.D 0.0 µm
Kvar 0.000
Max 15.0 µm
Min 15.0 µm

LAYER 3
Mean 39.3 µm
St.D 0.6 µm
Kvar 0.014
Max 40.0 µm
Min 39.0 µm
    
```

Printout example

Printout of single readings and statistics

You can print out the single readings and the statistical values of a measurement series in the APPL-BATCH mode.

The gauge and printer are turned on, you have selected the required application memory location (APPL) and the required batch memory location (BATCH).

- Press the keys FUNC and PRINT/PRINT ALL. You will receive a printout including the single readings and the statistical values of the measured layer from the currently selected batch memory location (BATCH).

```

ELEKTRO-PHYSIK
QuintSonic Pro
STATS. PROGRAM

26-OCT-98 14:232

Probe CTF1
APPL. No. 15
BATCH No. 1
L1 POLY 2490 m/s
L2 POLY 2375 m/s
L3 POLY 2310 m/s
SB IRON
26-OCT-98 09:30

  1  98 µm
L1  44 µm
L2  15 µm
L3  39 µm

  2  98 µm
L1  43 µm
L2  15 µm
L3  40 µm

  3  97 µm
L1  43 µm
L2  15 µm
L3  39 µm

STATISTICS
N      3
Mean  97.7 µm
St.D   0.6 µm
Kvar  0.005
Max   98.0 µm
Min   97.0 µm

LAYER 1
Mean  43.3 µm
St.D   0.6 µm
Kvar  0.013
Max   44.0 µm
Min   43.0 µm

LAYER 2
Mean  15.0 µm
St.D   0.0 µm
Kvar  0.000
    
```

Printout example

Printout of single readings

You can print out a single reading in the DIRECT mode.

- To do this, connect the printer to the gauge and turn it on.
- Carry out a measurement in the DIRECT mode.
The displayed reading is automatically transferred to the printer.

Printout of all readings

You can print out the readings of all measurement series (BATCH) from all application memory locations (APPL) in the DIRECT mode.

The gauge and printer are turned on, you are in the DIRECT mode.

- Press the keys FUNC and PRINT/PRINT ALL.
You will receive a printout including the readings of all measurements series (BATCH) from all application memory locations (APPL).

Maintenance and care **7**

7.1 Care

Instrument care

Clean the instrument and its accessories using a moist cloth. Use water or a mild household detergent.

 **Attention:**

Do not use any solvents!
The plastic parts can be damaged or become brittle by them.

How to use NiMH batteries (MiniPrint 4100)

A wrong way of handling batteries can lead to damages within the instrument. Please therefore observe the following tips:

- Only use leak-proof batteries!
- Turn off the printer if you are not going to make a printout.
- Remove the batteries from the instrument if you are not going to use it for a longer period of time.

 **Note:**

Used or defective batteries are special refuse and have to be disposed of according to legal regulations!

How to use the NiMH battery pack (QuintSonic)

NiMH batteries are very “easy-care” batteries. They can be recharged even when only partially discharged without any considerable capacity losses.

 **Note:**

All battery types may only be charged within a temperature range of 10 ... 40 °C.

7.2 Maintenance

In general, the coating thickness gauge QuintSonic and the printer MiniPrint 4100 require no maintenance work.



Attention:

Any repair work may only be executed by authorized Elektro-Physik Service personnel.

Technical data 8

Technical data

Function principle Ultrasonic pulse echo method
Probe CTF 1, active PVDF polymer probe (Polyvinylidenfluorid)
Minimum resolution 1 µm for all measuring modes

Measuring ranges

Measuring mode	Measuring range
Coating thickness polymer	10 µm ... 500 µm
Wall thickness steel	100 µm ... 8 mm
Wall thickness plastic	200 µm ... 3 mm

Units of measurement mm or mils

Statistics functions Mean value, standard deviation, variation coefficient and process capability index

Data Logger Number of
Application memory locations 99
Batch memory locations 99
Storable measurement series max. 250 (depending on the APPL BATCH configuration)
Storable readings 7,900 (depending on the number of readings per measurement series)

Display	4-digit LCD with analog bar graph display
Duration of measurement	1 - 3 seconds (depending on the application)
Number of material layers	Maximum 3 layers
Power supply	1 battery pack or type AA, NiMH (QuintSonic), 4 x type AA NiMH (MiniPrint 4100) or via plug-in power supply unit (90 V ... 264 V)
Quick charging function	3 hours
Operating time	> 2,500 measurements with 1 battery pack
Operating temperature	0 °C ... 55 °C
Charging temperature of battery	+ 10 °C ... + 40 °C
Storage temperature	- 20 °C ... + 70 °C (instrument) - 10 °C ... + 60 °C (probe)
Dimensions (L x W x H)	150 mm x 82 mm x 35 mm
Weight	308 g including battery pack

9.1 Description of interface

The QuintSonic gauge can be connected to a computer via the bidirectional RS232C interface.

Data format

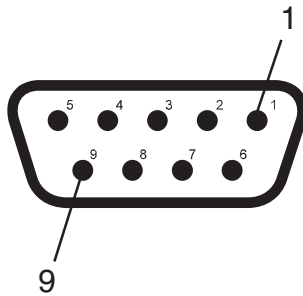
The physical data transfer via the RS232C interface is made in the following data format:

Baud rate: 9600

Data bits: 8

Stop bit: 1

Parity: none



Interface allocation

The connection to a PC is made via the 9-pin D-SUB socket shown here. You can see the pin assignment in the drawing opposite.

Pin-Nr.	Signal
1	–
2	RxD →
3	TxD ←
4	–
5	GND
6	–
7	–
8	–
9	–

Remote control

The QuintSonic can be remotely controlled from a PC.

The data transfer is carried out by means of remote-control codes. For more details, please contact the Elektro-Physik Service Center.

Annex 10

10.1 Definitions for statistics

The statistical evaluation is meant to help you to assess your measurements better and to make your decisions on the quality of the tested material more reliable.

Mean value \bar{x} (Mean)

The mean value \bar{x} is the total of single values, divided by the number of readings.

$$\bar{x} = \frac{\sum x}{n}$$

Standard deviation s (St. D)

The standard deviation is a measure for the variation of readings.

The standard deviation s results from the positive square root of the variance s^2 .

$$s^2 = \frac{\sum (x - \bar{x})^2}{n-1}$$

The variance is the total of the squared deviations of the readings from their arithmetic mean value, divided by the number of readings reduced by 1.

Variation coefficient (Kvar)

The variation coefficient is the standard deviation divided by the arithmetic mean value; the data being indicated as a percentage.

$$\text{Kvar} = \frac{s}{\bar{x}}$$

Process capability index (Cp)

The Cp index is a measure for the variation of readings in relation to the specification limits, it only takes the variation into account and is calculated from

$$C_p = \frac{\text{OSG} - \text{USG}}{6s}$$

USG = lower specification limit (LSL)

OSG = upper specification limit (USL)

Process capability index (Cpk)

The Cpk index takes the position of the mean value with regard to the specification limits into account in addition to the variation.

$$C_{pku} = \frac{\bar{x} - USG}{3s}$$

$$C_{pko} = \frac{OSG - \bar{x}}{3s}$$

$$C_{pk} = \text{Min}\{C_{pku}, C_{pko}\}$$

10.2 Error messages

The list of errors below informs you about the detection and elimination of errors or faults.

Errors causing an instrument turn-off:

dSP	The communication with the Digital Signal processor doesn't work.
PROb	No probe is connected after a total reset or after the initial start-up.
BATT	The battery voltage is too low when turning the instrument on. If the battery voltage becomes too low during the operation, a flashing battery symbol appears on the display.

Error messages appearing only for approx. 1.5 seconds:

dEL	Subsequent change of the APPL memory setting is not possible. All values will be overwritten.
ERR	The recording of the reference echo was not successful -or- Readings are not available for all predefined layers.

FULL	The memory is full.
OVER	The reading is outside the probe's measuring range.
OCCU	The existing application was initialized with a different probe from the one which is currently connected, or the set mode (coating thickness/wall thickness measurement) does not correspond to the mode of the application.

 **Notes:**

The time and date data are maintained at a reset.

If the instrument cannot be turned off using the keypad, remove the battery pack for a short time before the reset.

If you cannot eliminate an error message or its cause, make a reset.

- To do this, turn the instrument off.
- Keep the two keys FUNC and CLEAR/CLR STATS pressed and, in addition, press the ON/OFF key.

 **Attention:**

A long acoustic signal confirms the reset. All readings, calibration values and preset limit values are deleted.

10.3 EC declaration of conformity

The QuintSonic gauge and the printer MiniPrint 4100 conform to the requirements of the following EU directives:

- 89/336/EEC (Electromagnetic compatibility)
- 73/23/EEC, amended by 93/68/EEC (Low-voltage directive)

The conformity to the requirements of the EU directive 89/336/EEC is proven by the compliance with the standard specifications

- EN 55011, 03/1991, Class A, Group 2, and
- EN 50082-2, 03/1995.

The conformity to the requirements of the EU directive 73/23/EEC, amended by 93/68/EEC, is proven by the compliance with the standard specifications

- EN 61010, Part 1, 03/1994, and
- EN 61010-1/A2, 05/1996.

10.4 Service addresses

The QuintSonic gauge is manufactured according to state-of-the-art methods using high-quality components. Thorough in-process inspections and a quality management system certified to DIN EN ISO 9001 ensure an optimum workmanship of the gauge.

Should you nevertheless detect an error or malfunction on your gauge, please inform the Elektro-Physik Service responsible for your products, giving the details and a description of the error or malfunction.

Keep the shipping container for any repair work possibly required that cannot be executed on site.

If there's anything specific you would like to know about the use, handling, operation and specifications of the gauges, please contact your nearest Elektro-Physik representative, or the following addresses direct:

Germany

Elektro-Physik GmbH & Co. KG
Pasteurstr. 15
D- 50735 Köln

Tel.: 00 49 - 2 21 - 7 52 04 - 0
Fax: 00 49 - 2 21 - 7 52 04 - 67
eMail: service@elektrophysik.com

Great Britain

Elektro-Physik GB Ltd.
1a Princess Street
Knutsford Cheshire, WA 16 6BY

Tel.: 00 44 - 15 65 - 65 12 21
Fax: 00 44 - 15 65 - 75 50 78

USA

Elektro-Physik USA Inc.
770 West Algonquin Road
Arlington Heights, IL 60005

Tel.: 00 1 - 8 47 - 4 37 - 66 16
inside USA: 1 - 8 00 - 7 82 - 15 06
Fax: 00 1 - 8 47 - 4 37 - 00 53

Changes **11**

Changes

This chapter contains the latest technical changes and additions if any.

Otherwise this chapter remains empty.

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