

QuintSonic T (Tablet)

Short instructions



ElektroPhysik

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Technische Änderungen vorbehalten

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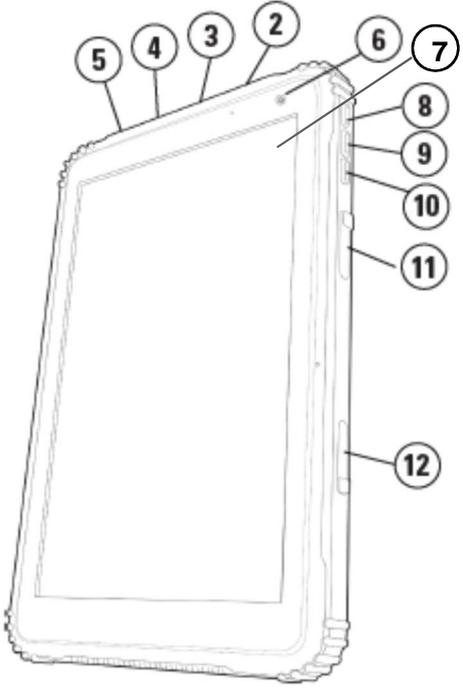
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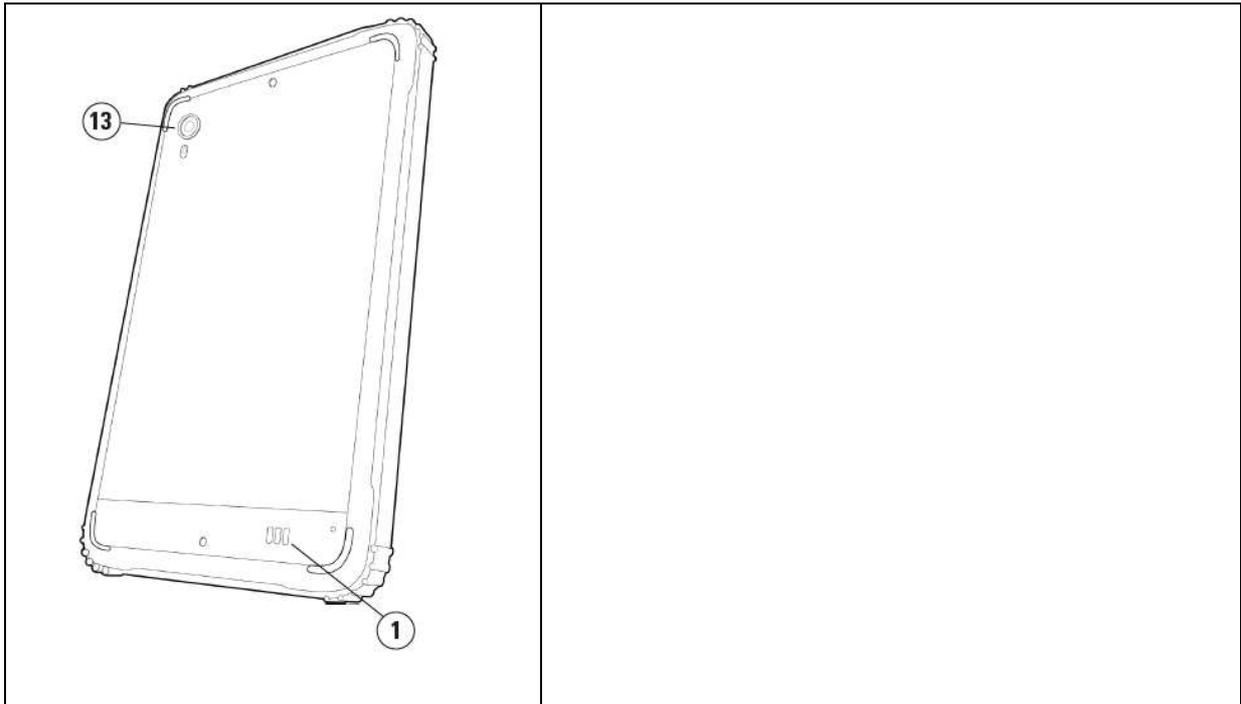
1. Measuring principle

The working principle of QuintSonic is based on the reflection of ultrasonic waves at the interfaces between the individual layers of a coating system. For measurement, a liquid or pasty couplant is applied on the sample at the point of measurement. The sensor is put on the measuring spot. The high-frequency ultrasonic sound generator of the sensor head emits an ultrasonic pulse of a broad bandwidth to travel through sensor head, couplant and finally through the coating system. At each interface between two layers as well as at the interface to the base, some of the sonic energy reflects. These portions of pulse – also referred to as “echoes” – return to the measuring head at different velocities and the receive signals are registered in the measuring head. As the time of travel is a function on the sound velocity in the respective material, it can be used as indicator for the coating thickness. Thickness is calculated according to the time of travel and sound velocity, transferred to the gauge and shown on display.

1.1 FUNCTIONS

1.1.1 Front and rear functions

	FUNCTIONS
	<ol style="list-style-type: none"> 1. SPEAKER 2. CHARGING CONNECTOR 3. USB PORT COVER 4. HDMI PORT COVER 5. AUDIO JACK BEHIND HDMI COVER 6. 2-MP CAMERA 7. CORNING-GLASS 8. ON/OFF SWITCH 9. VOLUME UP KEY 10. VOLUME DOWN KEY 11. SD CARD SLOT 12. SIM CARD SLOT (MICRO-SIM) 13. 5-MP CAMERA



2. Setting up the instrument and taking first readings

2.1 Charging the tablet

1. Open the cover of the charging connection – see (2).

1. Connect the mains cable to the charging port.

1. Plug the charger into a mains outlet.

Note: The battery is not charged when you unpack your tablet. We recommend to fully charge the tablet before first use on battery power.

LED signal	Description
Lights red	Battery fully charged
Flashes red	Battery charging

2.2 Connect QuintSonic ultrasound sensor to the table



Connect the USB sensor connector to the USB-Port (3) of the tablet.

2.2.1 Turning the tablet on

Press the ON/OFF switch for a couple of seconds (approx. seconds).

2.3 First steps in MICROSOFT WINDOWS 10

2.3.1 Correct operation of the Multi-Touch screen

The QuintSonic Tablet has a Multi-Touch display. Use these finger gestures to operate the screen of your tablet:

Simple tapping

Tap with your finger on the display.

Function:

- Using buttons on the screen
- Enter text using the on-screen keyboard
- Selection of screen elements: e.g. options, Entries, Images and Symbols
- Starting Apps

Easy to tap and hold

Touch an item and hold your finger on it.

- Detailed information about an element can be indicated
- The menu of an item is displayed and additional Actions can be executed.

Drag

1. Touch an item and hold your finger on it.

2. Continue to touch the item with your finger and move your fingertip across the screen until you reach the desired position.

3. Then release your finger from the display to place the item in the desired position.

- Move elements such as images and symbols to the display

Swipe or push

Move your finger on the display vertically or horizontally

- Scroll through the home screen, web pages, lists, Entries, photos, contacts, etc.
- Closing an app (Drag the app to the bottom of the screen edge of the display.)

Zoom in

Touch the display with two fingers, then move your fingers apart.

- Zoom in on images or web pages

Zoom out

Touch the display with two fingers and then move your fingers towards each other.

- Reduce the size of images or web pages

2.3.2 Swipe left

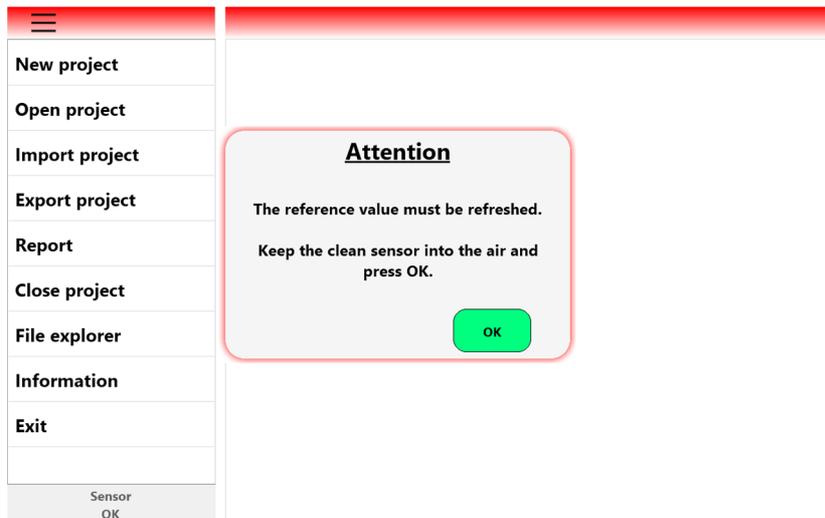
Swipe the display from the right edge of the tablet to access the ACTION CENTER. The ACTION CENTER provides access to system commands such as tablet mode, rotation lock, hint, flight mode, location, scheduled mute, battery level, Bluetooth, VPN, power save mode, project WLAN, and all setting options.

2.3.3 Swipe right

Quickly swipe the display from the left edge of the tablet to see the apps currently running. - Tap the thumbnail of a running application to open it.

3. Start screen of QuintSonic software

The QuintSonic App starts automatically when the QuintSonic Tablet is switched on.



You will now be prompted to record a reference signal. Check the transparent measuring surface at the front of the sensor. There must be no impurities or residues of coupling agent on the measuring surface. If necessary, clean the measuring surface with water and a soft cloth.

Hold the sensor in the air and tap the "OK" symbol.

The reference measurement is performed.

3.1 Main menu:



The main menu allows to :

Create new projects „New Project“,

Open existing projects „Open Project“,

Import projects „Import project“ or
Export projects „Export project“.

from the currently opened project a report can be created with the measured and statistical values „Report“.

Before creating a new project or opening another project, the current project must be closed. „Close project“.

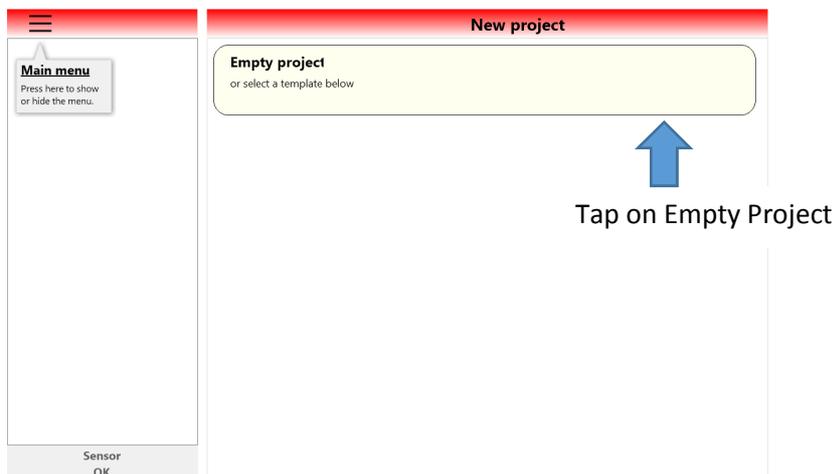
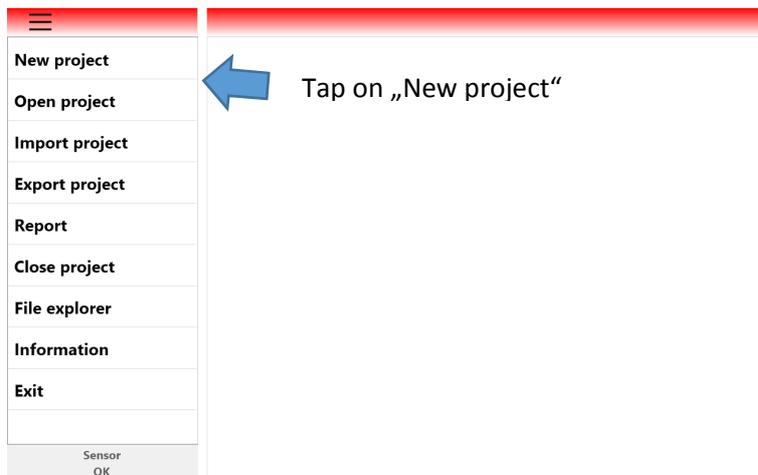
The menu item "File Explorer" opens the Windows Explorer with which files can be copied, renamed or deleted.

In the menu item "Information" the current software version and the information about the connected sensor are displayed.

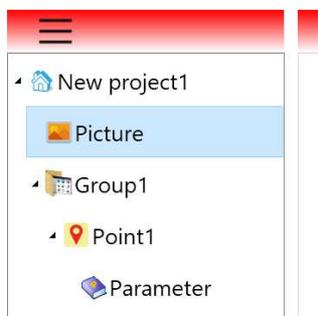
By selecting the menu item "Exit" the app can be left and the tablet can be switched off

3.2 Create a project:

No project has been created after the first switch-on.

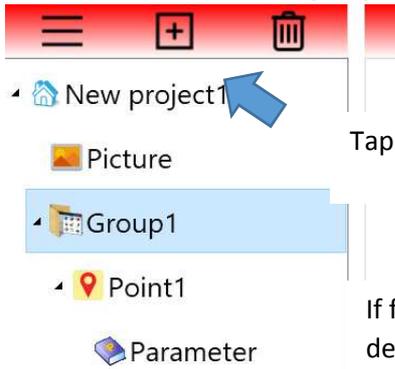


- The structure of the project is displayed:
- Images,
- Group,
- Measuring point and the associated parameter set.



3.2.1 Adding new groups and measuring points

The user can add further groups to each "Project" and further measuring points to each group.



Tap on the + symbol to add further groups.

If further measuring points are to be added to this group. Tap on the desired group, then on the + symbol for another measuring point. Several measurements can be performed at each measuring point. These are consecutively marked Reading 1, Reading 2 etc. for each measurement..

3.3.2 Project, groups and measuring points

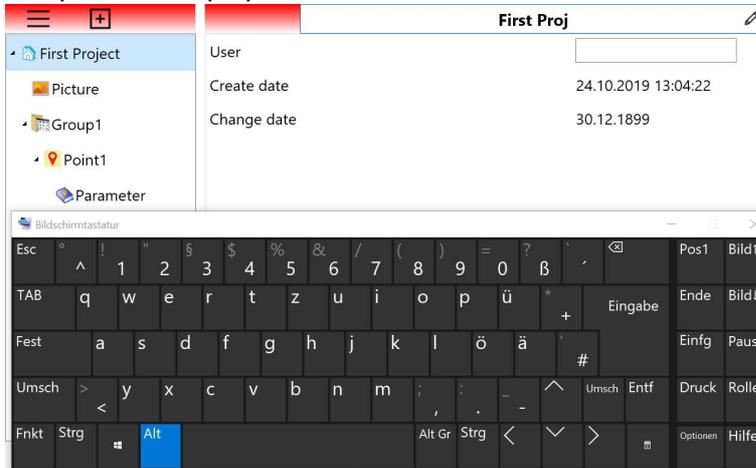
The user can name the project, group and measuring point freely.

Names for a project could be, for example:

- New Project -> Car model
- Group -> Bumber left front / door/ Bumper left back / Rear etc.
- Point -> left / centre / right or 1 / 2 /3 etc.

For example, to name the project name and enter a user name, tap the pencil icon.

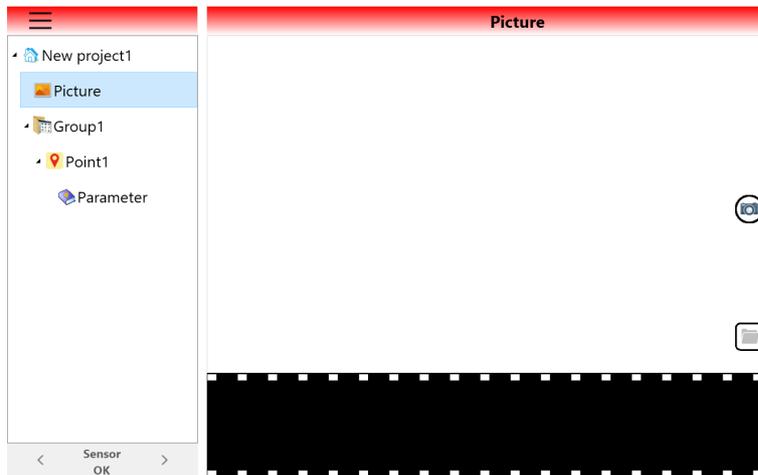
A keyboard is displayed.



Pen Symbol for editing the project name

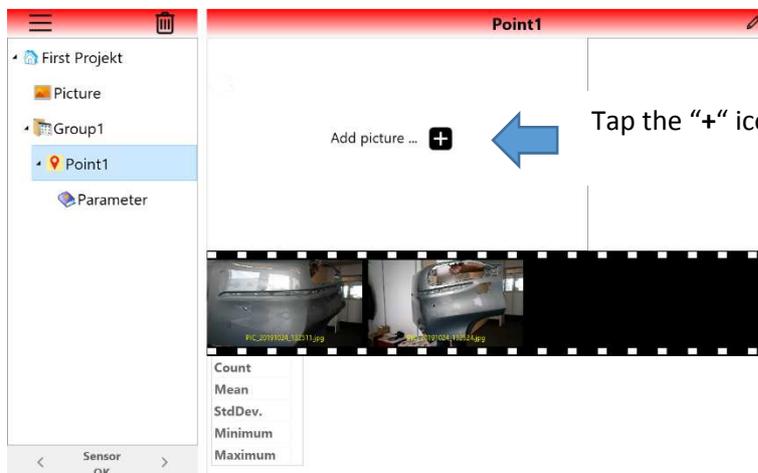
3.3.3 Adding product images

Images can be added to the documentation. For this purpose, a photo can be taken with the internal camera, but also existing images or sketches can be imported. These must be available in bitmap (bmp) or jpg format.

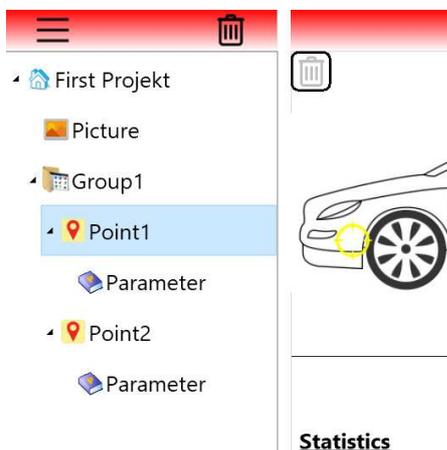


- ← Delete existing images and sketches in the project (trash icon appears as soon as an image is available).
- ← Camera icon for taking pictures.
- ← Folder icon for adding existing images and sketches.

The photos available in the "Picture" folder are then available for use in groups and measuring points.



Tap the "+" icon next to "Add picture,,



The designated measuring point can be marked on the photo or graphic inserted for a measuring point. A yellow circle is displayed.

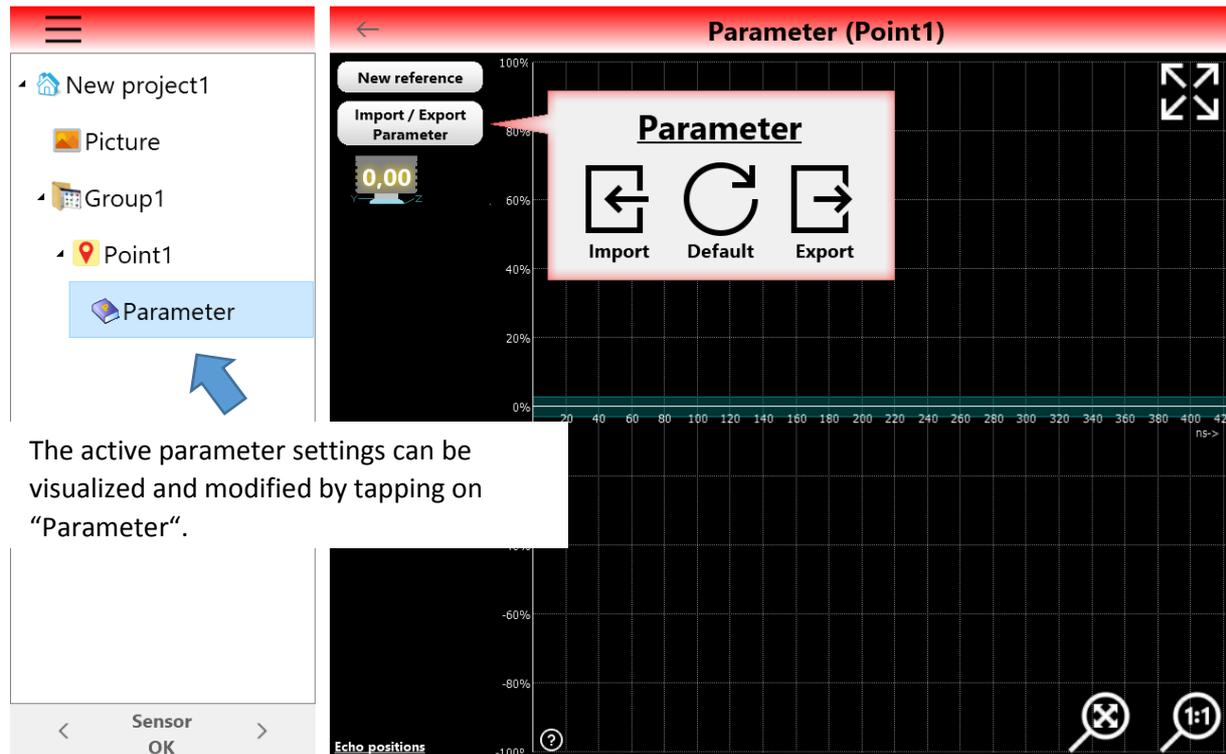
The circle can be moved to the measuring point by tapping on it.

4. Measuring

4.1 Selecting a parameter set

Each measuring point of a group is connected to a parameter set. It can be measured directly with the default parameter set. The settings correspond to those described in chapter 4.2.

Alternatively, an already defined parameter set can be imported. If the parameter set has already been adapted, it can be exported for further measurement tasks.



4.2 Proceeding with a new measuring task

First approach a new measurement task with minimal means. A good starting point is the "Default" parameter set. This has the following settings:

Range: 300 ns corresponds to approx. 350 μm at a sound velocity of 2375 m/s. If you expect a greater layer thickness, select a larger measuring range, e.g. 750 ns (approx. 890 μm .) Always use the smallest possible measuring range for your measurement results. In this way you always work with the maximum possible resolution.

Clipping-Method: global Clipping $\pm 3\%$

Optimization: OFF

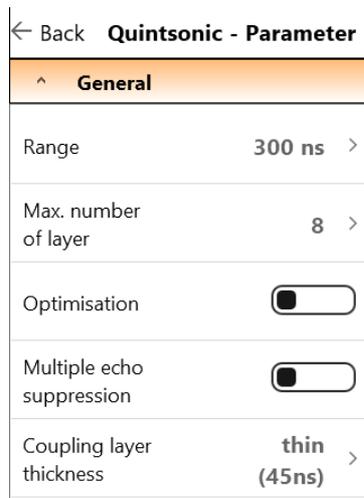
Number of layers: Default set to 8 - layers, for example for an unknown number of layers. Otherwise set to the expected number of layers.

Echo-Selection method: first echoes

Blocked domain: inactive

Velocity (default 2375m/s)

4.3 Adjusting the parameter set

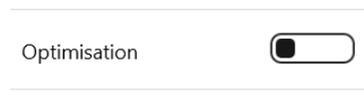


4.3.1. Range:

Always use the smallest possible measuring range for your measurement result. This ensures that you always work with the maximum possible resolution. For automotive painting, for example, select 300 ns; this corresponds to approx. 350 μm at a sound velocity of 2375 m/s. If you expect a higher layer thickness, select a larger measuring range such as 750 ns (approx. 890 μm).

4.3.2 Max number of Layer:

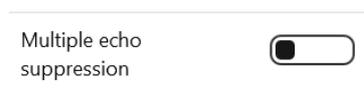
Adjustable from 1-8 layers. If the number of layers is unknown, choose a number of 8.



4.3.3 Optimisation:

The echo signals visible in the A-scan have a given signal width due to a physical property of the measuring head. With very small layer thicknesses, these echo signals come so close to each other in the A-scan that they touch each other and, with even smaller layer thicknesses, even partially overlap each other. As a result, their pulse peaks shift slightly, so that the echo lines determined also have a slightly offset position. This can occur especially with two echo pulses pointing in the same direction (both positive or both negative).

In order to compensate for the resulting deviations, the so-called optimization can be activated. In the case of typical industrial paints, optimisation should be taken into consideration from thicknesses of less than 20 μm . Adjacent coating echoes pointing in different directions are less affected than echoes pointing in the same direction.



4.3.4 Multiple Echo Suppression

Due to the strong differences in the acoustic properties of polymer coatings and (e.g.) metal, strong echoes occur at the layer boundary between polymer and metal when measuring layer thickness on metals. This echo is the largest negative echo in the time domain. The following echoes are multiple echoes of the coating, if these echoes are determined in the same layer thickness as in the time domain before the largest negative echo, the multiple echoes can be suppressed by the function "Multiple echo suppression". However, only echoes with the same layer thickness are suppressed. Due to the attenuation within the layers, however, slight differences in layer thickness may occur. We recommend to eliminate multiple echoes by exactly entering the number of layers up to the substrate. A possible alternative is to insert a blocked domain after the substrate echo, but this assumes that the total layer thickness is constant.

Coupling layer
thickness

thin
(45ns)

>

4.3.5 Coupling layer thickness

In the case of rough surfaces or concave geometries, there is a time interval between the exit echo from the sensor (Y) and the entrance echo (Z) into the layer. If this distance is greater than 45ns for the setting "thin", the entry echo is no longer recognized as such and the next higher setting "middle" (90ns) must be selected. If the maximum setting "thick" of 150 ns is not sufficient, the setting "user defined" can be selected. Here, the distance between the exit echo from the sensor (Y) and the first negative echo is to be set via the faded-in slider..

4.3.6 Clipping

The background noise and smaller false echoes that occur in the clipping area (marked as a blue band in the A-scan) are ignored during mathematical analysis and evaluation..

In order to extract the echoes optimally, there are different clipping methods to adapt the processing to the respective measurement task. All these methods have in common that they cut out different, interfering parts of the echo signal. Global clipping is the standard method and should always be used first for new measurement tasks because it is easy to handle.

4.3.6.1 Global Clipping

Two adjustable limit values are provided here: an upper limit value and a lower limit value. These values appear as horizontal lines in the A-scan of the echo signal. The area between the two limit values is called the "restricted zone". In the entire time domain of the echo signal, all signal components that lie within the exclusion zone are suppressed and are not used for the layer thickness calculation..

The upper clipping limit is pre-set to +3% and the lower to 3%.

Coatings with little difference in the acoustic properties of the layers to each other show only a small echo amplitude in the representation of the ultrasonic course. These may still be within the clipping limits. In this case, the clipping limits must be adjusted. The limit values should be set so high that all desired echoes are still reliably evaluated in successive measurements despite slight amplitude fluctuations. The condition for the evaluation of an echo is that the echo signal leaves the exclusion zone, passes through its extremum (maximum for positive echoes, minimum for negative echoes) and then returns to the exclusion zone.

In the case of very closely adjacent echoes with the same sign (i.e. two consecutive positive echoes or two consecutive negative echoes), the signal between the two echoes may not return to the exclusion zone but remain outside the exclusion zone. In order to enable the extraction of the two

← Back Quintsonic - Parameter

^ General

Range 300 ns >

Max. number of layer 8 >

Optimisation

Multiple echo suppression

Coupling layer thickness thin (45ns) >

^ Clipping

Method global >

Analysis absolute extrema >

Clip-limit pos. 3,0% neg. -3,0% >

^ Echo selection

Method first echos >

echoes, the additional function "Analysis local extremes" can be activated. Here, a further parameter "Minimum step height" can be activated. Any signal change in the echo direction that exceeds this step height is then evaluated as an echo. The value should always be set slightly smaller than the step heights actually observed in the A-scan, so that a reliable echo extraction is guaranteed. Basically, the evaluation of local extremes should only be activated if a correct echo evaluation cannot be achieved in the standard mode.

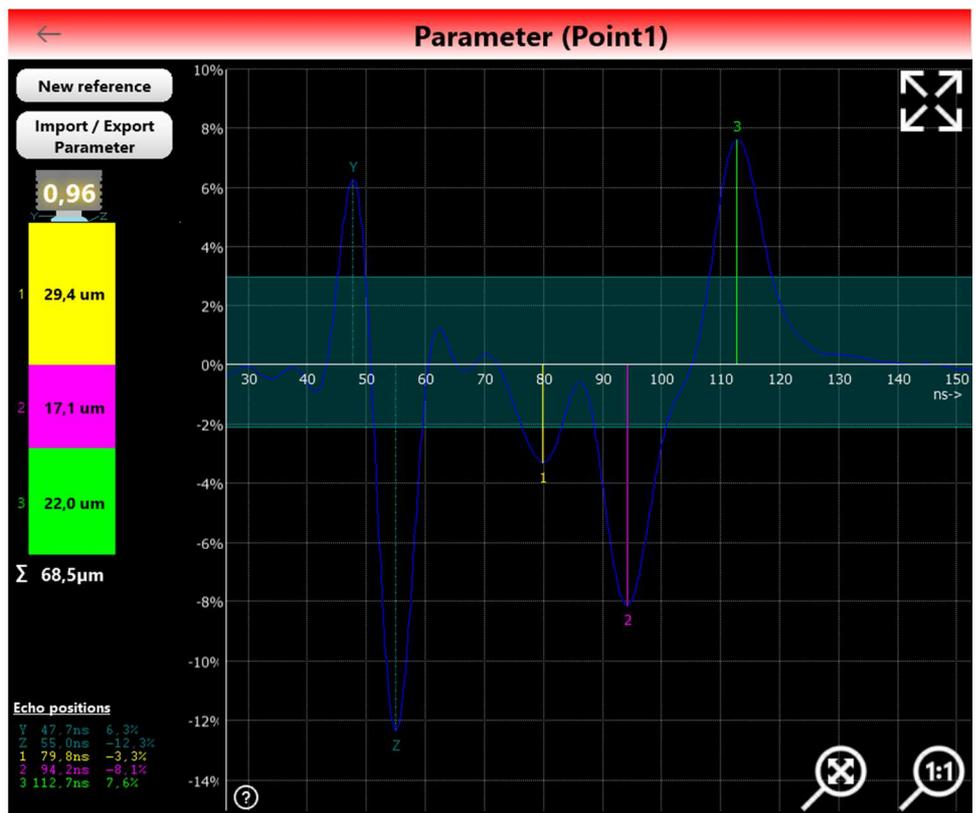
To adjust clipping limits, tap „Clip -Limit“

The sliders for positive and negative clipping are displayed. In this example, echo 1 is not evaluated if the clipping limit is -3%. In this example, tap the black area of the negative clip limit and move the slider up until the negative clipping limit line (-2.1%) intersects the amplitude. Now Layer 1 is also evaluated reliably.

← Back Clip limit

positive clip limit 3,0%

negative clip limit [%] -2,1%



4.3.6.2 Domain-Clipping

With this method, the user can divide the entire time range of the echo signal into different ranges and set a separate limit value for each range. This is always advantageous if the layer echoes have very different heights, so that too much compromise would have to be made with global clipping.

Clipping	
Method	domain >
Analysis	absolute extrema >
Clip-limit	pos. 3,0% neg. -3,0% >
Domain 1	(from "Z") 0,0ns > Level -8,1%
Domain 2	(from "Z") 34,2ns > Level -3,2%
Domain 3	(from "Z") 55,0ns > Level 2,0%
Domain 4	(from "Z") 74,4ns > Level -8,0%
Domain 5	- >

Range limits (time values) are ideally set in such a way that there is exactly one echo to be evaluated in each time period. The time range of the first echo does not have to start at position from Z = 0. The range can also be selected so that possible false echoes are suppressed at the beginning of the time range.

In the case of positive echoes, the peak of the echo must be greater than the limit; the restricted zone is less than the limit. For negative thresholds, this is exactly the opposite.

Normally positive echoes are above the zero line, negative echoes below the zero line. For some specific measurement tasks, however, the baseline of the echo signal may deviate to such an extent from the zero line that, for example, positive echoes may occur below the zero line. In this case, it is possible to reverse the evaluation direction for individual time segments by activating the "Inverse" function, so that these echoes can also be extracted

← Back Clipping domain 2

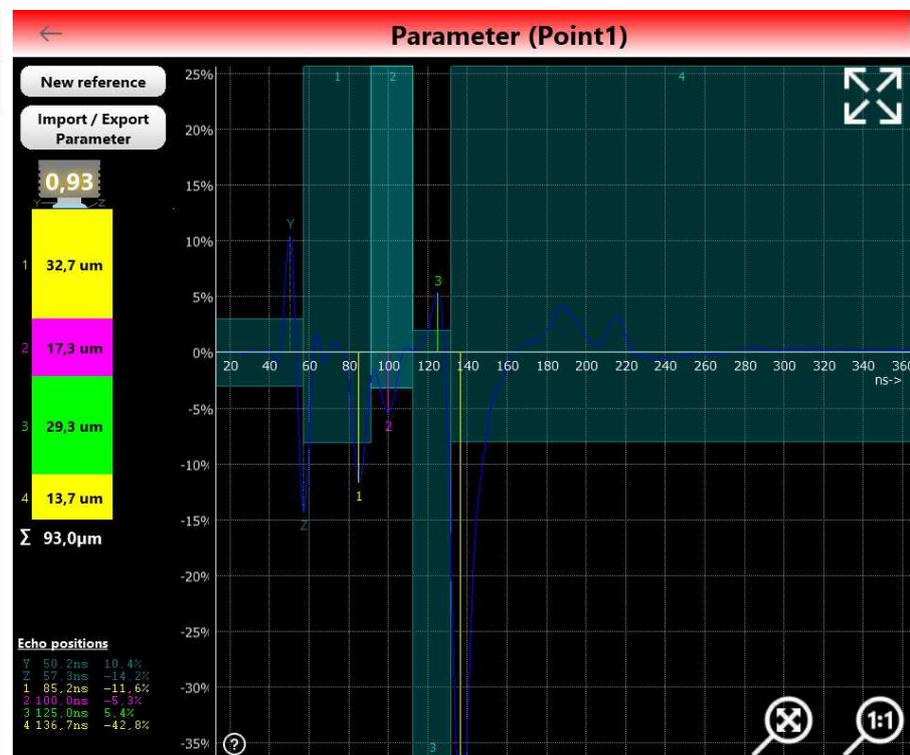
inverse

Position from "Z"

34,2 ns

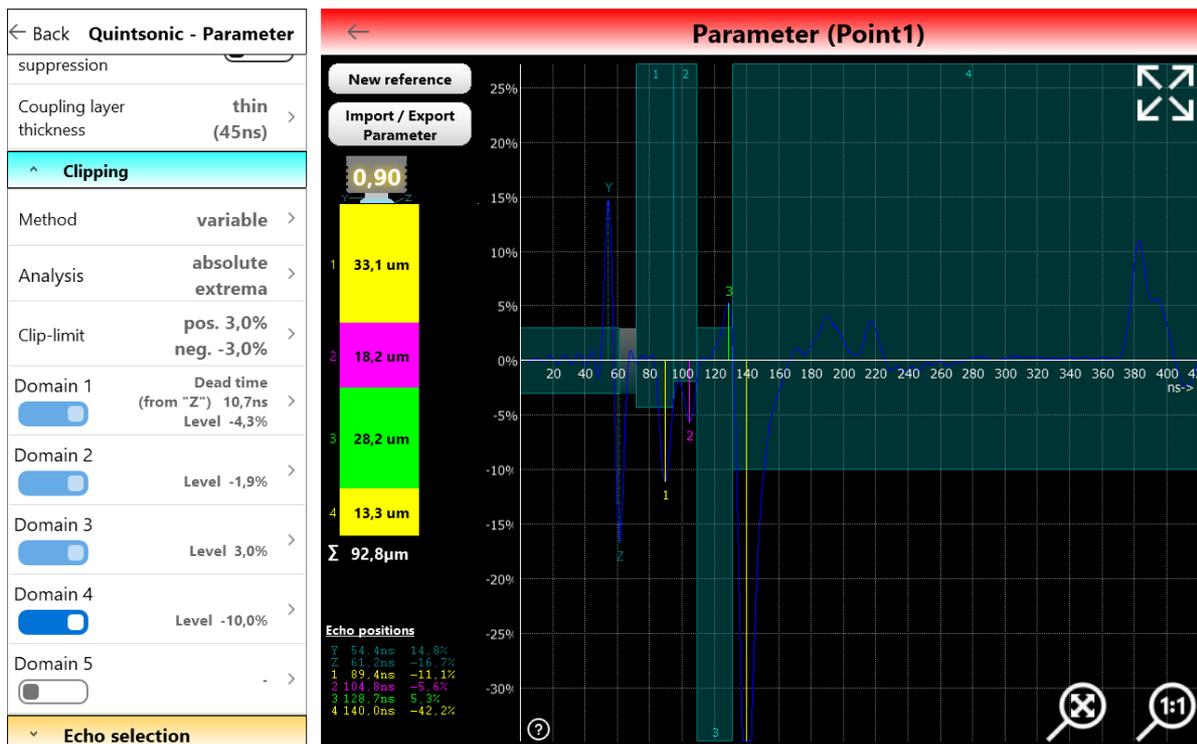
Level

-3,2%



4.3.6.3 Variable Clipping

Similar to range clipping, variable clipping divides the entire time range of the echo signal into adjacent subranges. Here, too, an amplitude limit is defined for each range, which controls the clipping function in this range. The "Inverse" function is also available and also functions as described for range clipping. In contrast to range clipping, however, the time limits of the ranges are not fixed, but depend on the position of the echoes found; therefore, there are no adjustable time limits here.

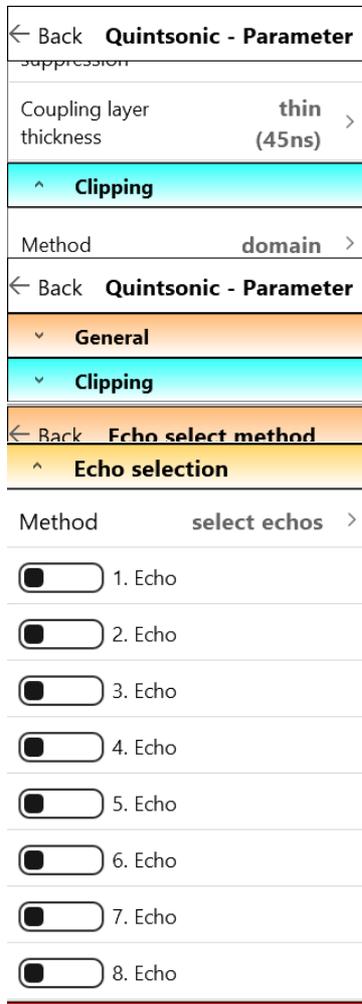


The first section always starts at the position of the negative coupling echo (Z) or according to the setting "Position from Z" for the suppression of false echoes or signal overshoots at the beginning of the time range. As soon as the first echo is found using the corresponding amplitude limit, the system switches to the second section and continues working with the amplitude limit of the second section. The second section again extends to the position of the next echo found, then switches to the third section and so on.

The starting position and length of the individual sections are thus "triggered" by the position of the echoes found. This procedure ensures that there is exactly one echo at each end of the section when the clipping pass is completed. This offers the great advantage that for each expected layer echo, depending on its expected height and direction, an optimally fitting amplitude limit value can be set that does not have to be oriented to the size of neighbouring echoes. Furthermore, the automatic time triggering ensures that each echo is always extracted with the corresponding amplitude limit value even if the echoes are shifted over time due to layer thickness fluctuations; there can be no shifts to adjacent sections.

Variable clipping is the most flexible of the three clipping methods. It is particularly useful if the amplitudes of the layer echoes are known in advance (e.g. by reading from a previously viewed A-scan). The independence from layer thickness fluctuations is an important advantage in practice.

4.3.7 Echo Selection



In Echo-selection you can set in which order or with which option the echoes are selected.

4.3.7.1 First Echos

From left to right, i.e. starting from the first echo, a maximum of as many echoes as the pre-set number of layers (here = 2) are evaluated. If the number of echoes is not sufficient for the pre-set number of layers, fewer layers are output accordingly. The setting "First echoes" is the default setting.

4.3.7.2 Last Echoes

From right to left, i.e. starting from the last echo, a maximum of as many echoes as the pre-set number of layers is evaluated. If the number of echoes is not sufficient for the pre-set number of layers, fewer layers will be displayed. This setting is e.g. advantageous for the evaluation of wall thicknesses independent of the detected number of layers. If the number of layers to be evaluated is set to 1, only the wall thickness is evaluated; if the number is greater than 1, the last thickness value displayed is always the wall thickness value.

4.3.7.3 Highest Echoes

Starting from the largest echo, a maximum of as many echoes as the specified number of layers (here = 2) is evaluated in terms of size. This setting is advantageous if the size of all layer boundary echoes clearly differs from the size of the false echoes, so that further, more

complicated selection measures can be easily dispensed with.

4.3.7.4 Select Echoes

From a sequence of up to 8 echoes (coupling echoes not included) certain echoes can be manually selected as valid. The user can mark these echoes accordingly in a table (see figure). All non-selected echoes are suppressed.

This selection method can be used whenever the number and sequence of layer echoes and false echoes are known and constant and no sporadic disturbances occur that temporarily change this sequence.

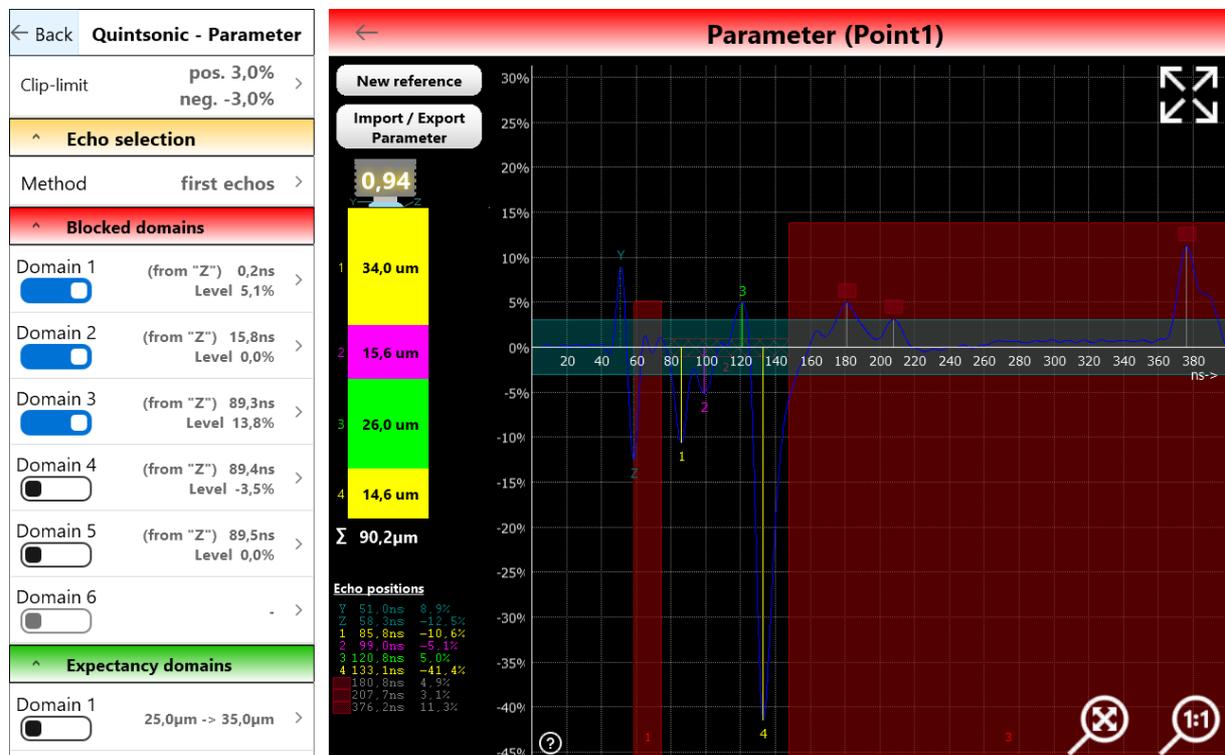
4.3.8 Blocked Domains

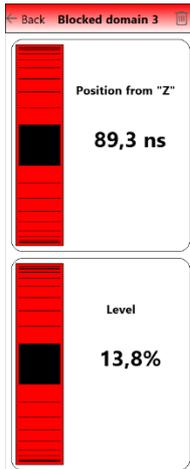
Using this selection method, the user can set up time ranges (lock ranges) in which all existing echoes are suppressed up to an adjustable amplitude limit.

A positive limit value suppresses all echoes whose peak values are below this value; a negative limit value suppresses all echoes whose peak values are above this value. A setting greater than any positive echo in that range or less than any negative echo in that range will cause all echoes in that range to be suppressed. A setting to 0 does not create a blocking effect and is used to create gaps between two blocking ranges.

Up to 8 restricted areas can be defined. The ranges can be activated or deactivated individually. Each range is identified by its start time, measured from the coupling echo (Z), and by its amplitude limit value. A range extends from its start time to the start time of the next activated one. If a range is no longer followed by another activated range, it extends to the end of the measuring range. In the A-scan, the restricted areas are represented by darker areas that are still transparent for the signal path.

In this example, a blocking area (domain 1) is set up from coupling echo Z with a height of 5.1 % to blocking area 2 (domain 2). This suppresses false echoes and overshoots in this range. Blocking zone 2 has a height of 0 %, which means that all subsequent echoes up to blocking zone 3 are evaluated. Blocking range 3 with a height of 13.8 % starts on the time axis at 89.3 % after the coupling echo Z and suppresses all subsequent echoes up to the set echo height. No further stopband is set up, so stopband 3 extends to the end of the measurement range (Range)





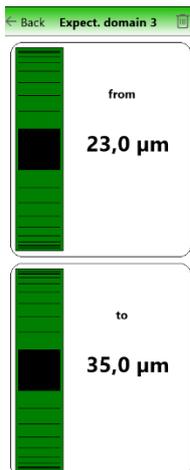
Blocking ranges are defined by the sliders for the position from the coupling echo Z and for echo amplitude in %.

The blocked areas are designed to exclude entire contiguous time periods from the evaluation. This is helpful in zones with many false echoes, e.g. with filled materials. Also for the suppression of interference beyond the boundary to the substrate until the end of the measuring range.

4.3.9 Expectancy domains

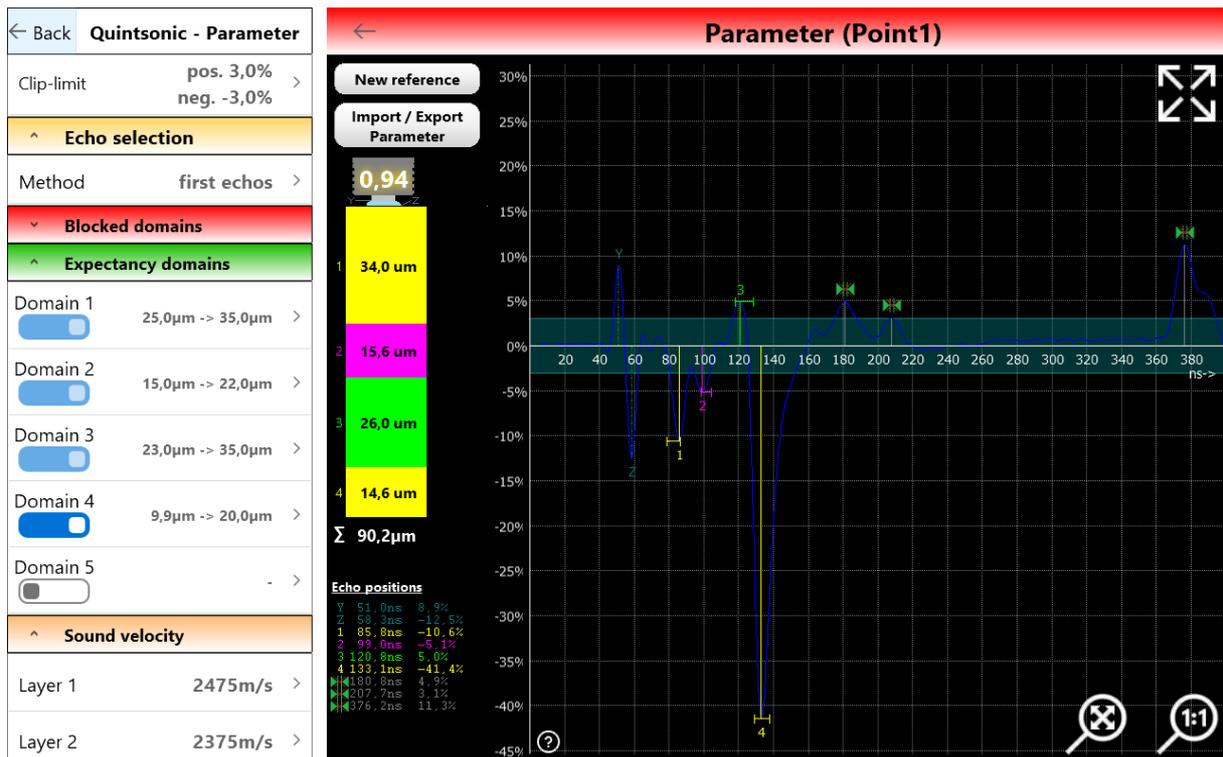
Expectancy domains are the counterpart to restricted domains. Echoes lying within expectancy domains are included in the evaluation, echoes lying outside the domains are suppressed, for example unwanted false echoes and multiple echoes.

Expectancy domains are not linked to fixed time values but are to be understood as layer thickness ranges. These can be, for example, the tolerance ranges of the respective layer.



For each expected value, a tolerance band with a lower and an upper limit must be specified within which the respective layer thickness value should lie. When evaluating, these limits are always related to the position of the previous valid echo, meaning that only the current layer is considered, regardless of the thickness of previous layers and the position of the corresponding echoes.

If several echoes are found in an expectancy domain, the largest echo is marked as valid; all other echoes in this expectancy domain are invalid. All echoes behind the last expectancy domain are considered as not belonging to any expectancy domain and are also invalid



An expectancy domain is completely defined by its lower and upper limits (layer thickness values). In the A-scan, expectancy domains are indicated by horizontal lines in the width of the tolerance band. The assignment to the respective layer is determined by the position in Y-direction and corresponds to the layer thickness column on the left.

If a layer thickness falls beyond the specified tolerance band, then the expectancy domain in question contains no echo. Subsequent expectancy domains are therefore no longer correctly evaluated. In such a case, the tolerance limits must be corrected. The evaluation is automatically adjusted directly.

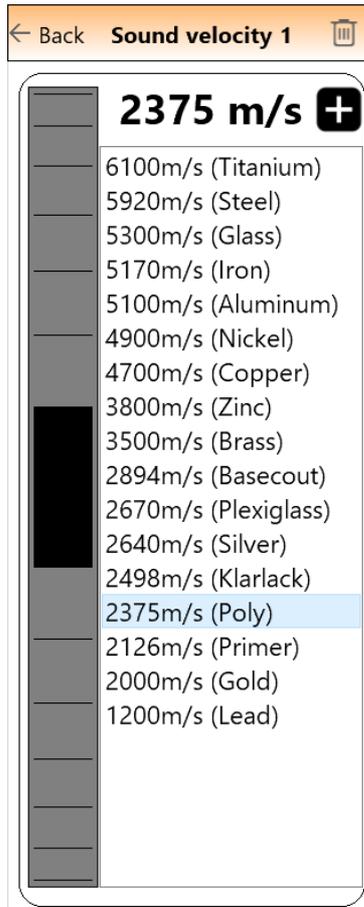
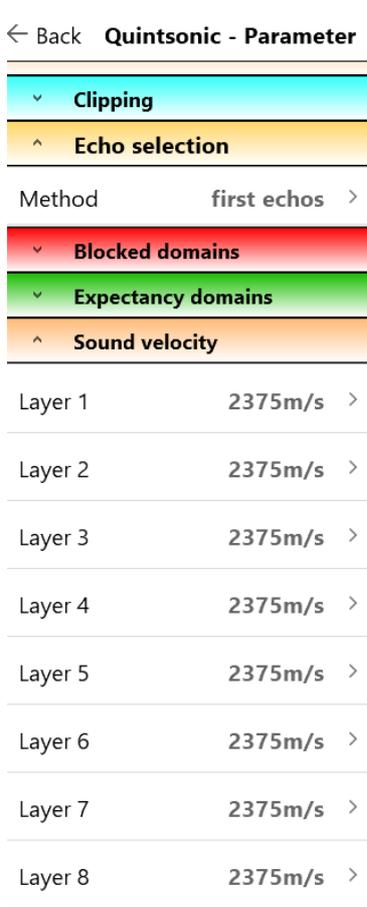
4.3.10 Velocities

The layer thicknesses are calculated from the time differences of the echoes, taking into account the respective sound velocities. The sound velocities depend on the material and must be set separately for each layer. The default value is 2375 m/s, which is an average value for polymer coatings. The sound velocities of most industrial coatings are within a window of 2375 m/s \pm 15%.

Sound velocity calibration is essential for accurate measurement results. This can be done either via known sound velocities of the coating or via a calibration standard.

In the setting "Sound velocity" a separate sound velocity setting is available for each layer.

Tap on the layer whose velocity you want to adjust, Layer 1.. Layer 2 etc..

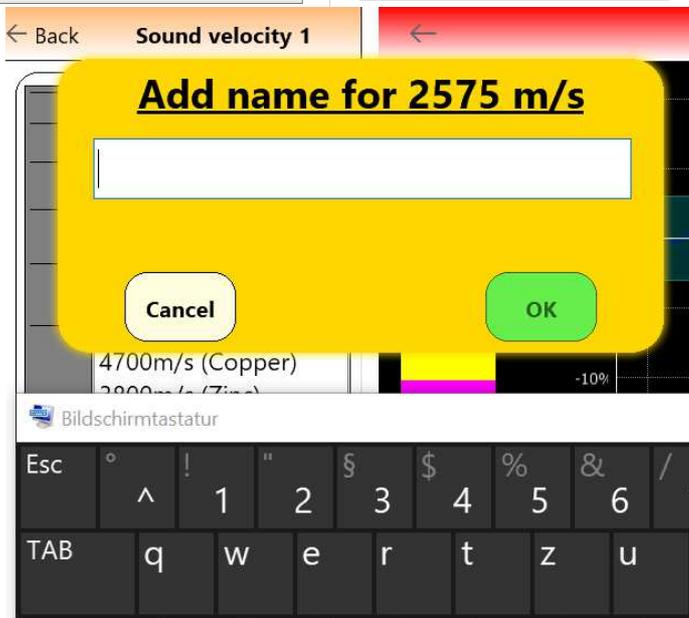


The corresponding configuration window, in this case Sound velocity 1.

By tapping on an already existing entry, e.g. clear varnish, or by tapping and dragging the black field, it is possible to set the appropriate sound velocity.

If a calibration standard with known layer thicknesses is available, move the black field until the measured layer thickness matches the calibration standard. Moving the field to "Top" results in higher sound velocities and thus higher layer thickness indications. Shifting the field to "Bottom" results in lower sound velocities and thus also smaller layer thicknesses.

The sound velocities determined in this way can be saved for further applications, for example using the product name. Tap on the + symbol to the right of the sound velocity displayed. An entry field and the keyboard field will open. Enter a designation and confirm with OK.



5.0 First measurement

Apply coupling agent at the measuring spot. For smooth surfaces, use a drop of water. For rough or curved surfaces, use coupling gel. Apply a thin layer of coupling gel to the measuring spot.

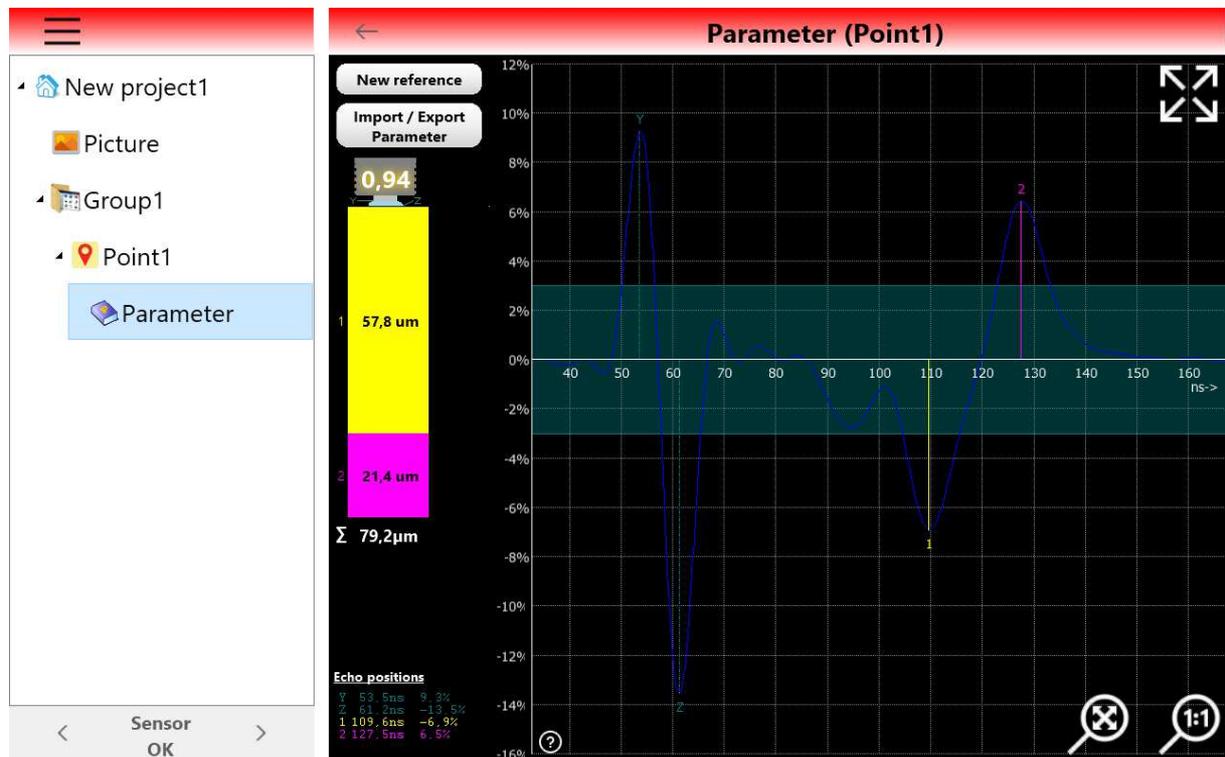
For measurement, grip the grey, spring-mounted sensor sleeve to hold the sensor between your thumb and forefingers. Place the sensor vertically on the measuring object. Push the spring-mounted sleeve down to the stop.



Now measurement and calculation of the coating thickness are carried out. This procedure takes approx. 1 second. Wait for the audible signal to confirm measurement has been completed. Then lift the sensor from the measuring object.

The measurement result and the time sequence of the transmitted ultrasonic signal are displayed as well as the total layer thickness and, depending on the object to be measured, one or more individual layer thicknesses (see figure).

The time course of the reflected ultrasonic signal provides information about the individual layer thicknesses of the measured layer system.



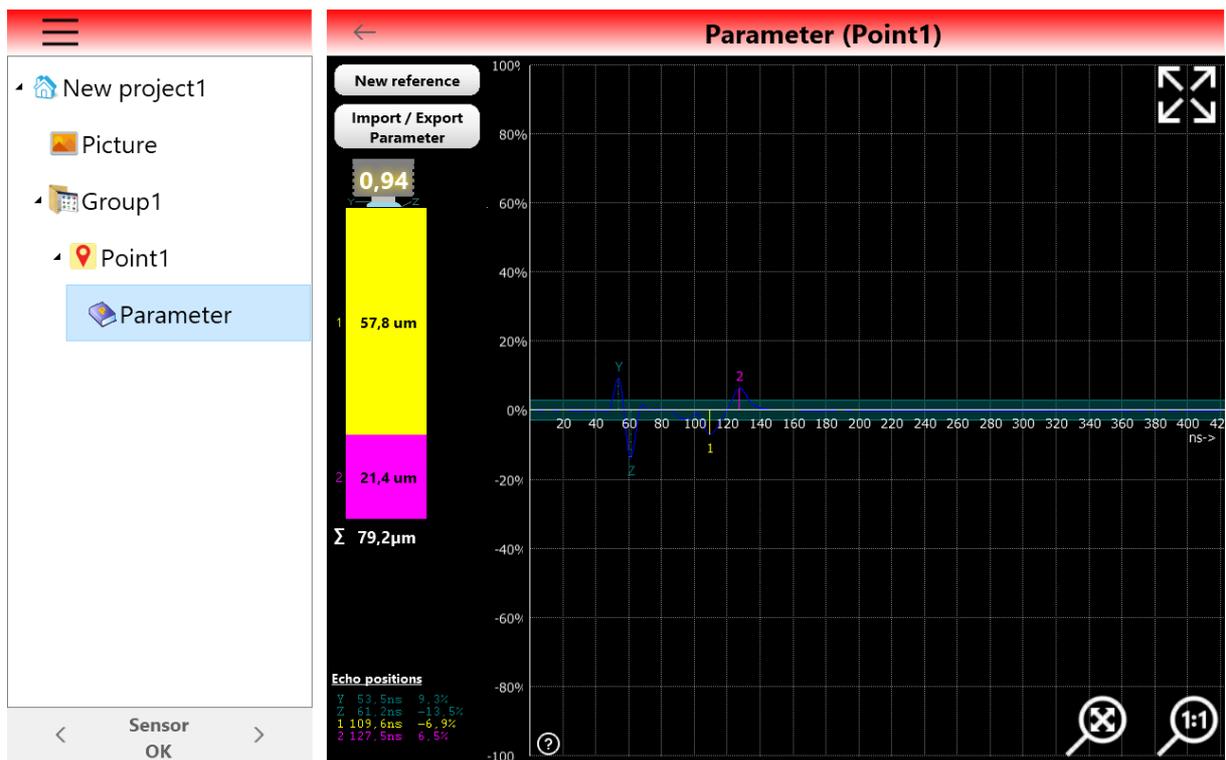
The signal contains a number of positive and negative impulses, including the coupling echo impulses and the echo impulses of the searched echoes at the layer boundaries.

The first pulse (Y) stands for the interface between sensor feed and coupling medium. This pulse is always positive, since it is a boundary crossing from the hard probe feed to the softer coupling medium. The second impulse, always negative, represents the boundary transition between the coupling medium and the top layer (Layer1).

All other pulses in this example also indicate a boundary crossing from one layer to the next layer or substrate. Depending on the object to be measured, however, there may also be interferences (interference pulses and noise) and multiple reflections may occur. In this example, the interference components are very low and there are no multiple reflections.

The timescale of the received ultrasonic signal is plotted against the last evaluated layer echo. However, it may happen that the last echo was too small for an evaluation with the standard settings. To ensure that all echoes are displayed in the range section press the symbol 

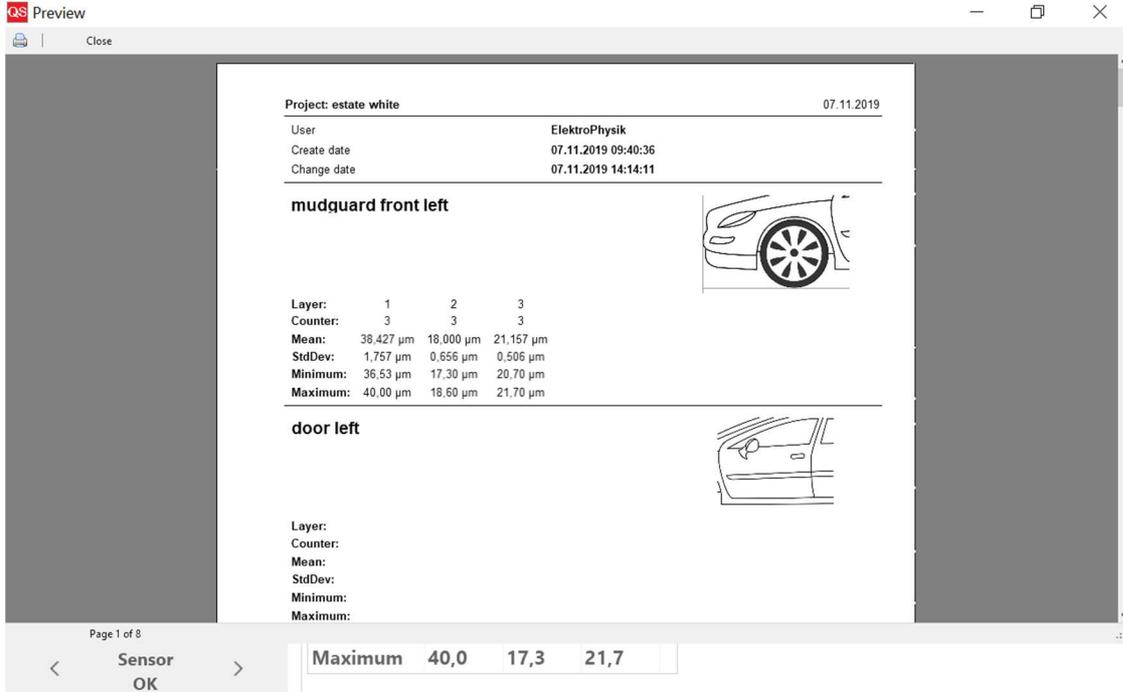
The time course of the complete range is shown on the display. The display can be enlarged in both X and Y direction. Touch the display with two fingers and then move your fingers apart. By moving one finger on the display, the display can also be shifted in vertical or horizontal direction, e.g. so that the echoes are displayed in the centre of the display.



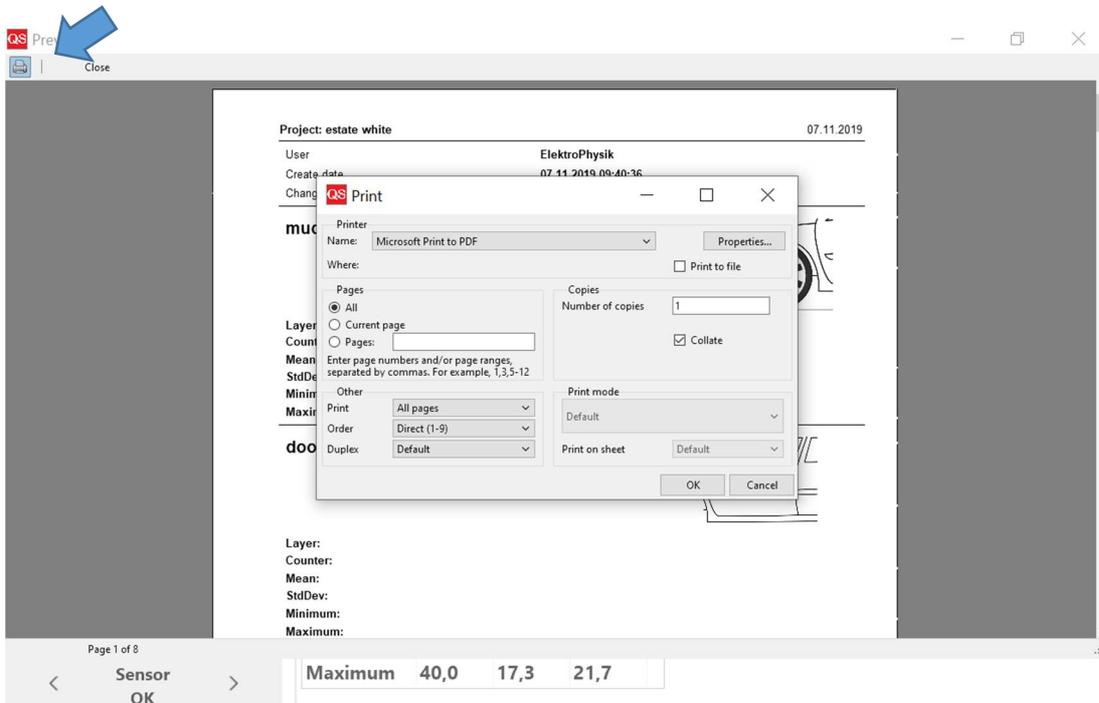
6.0 Report function

Tap on "Report" in the main menu to create a report of the currently active project.

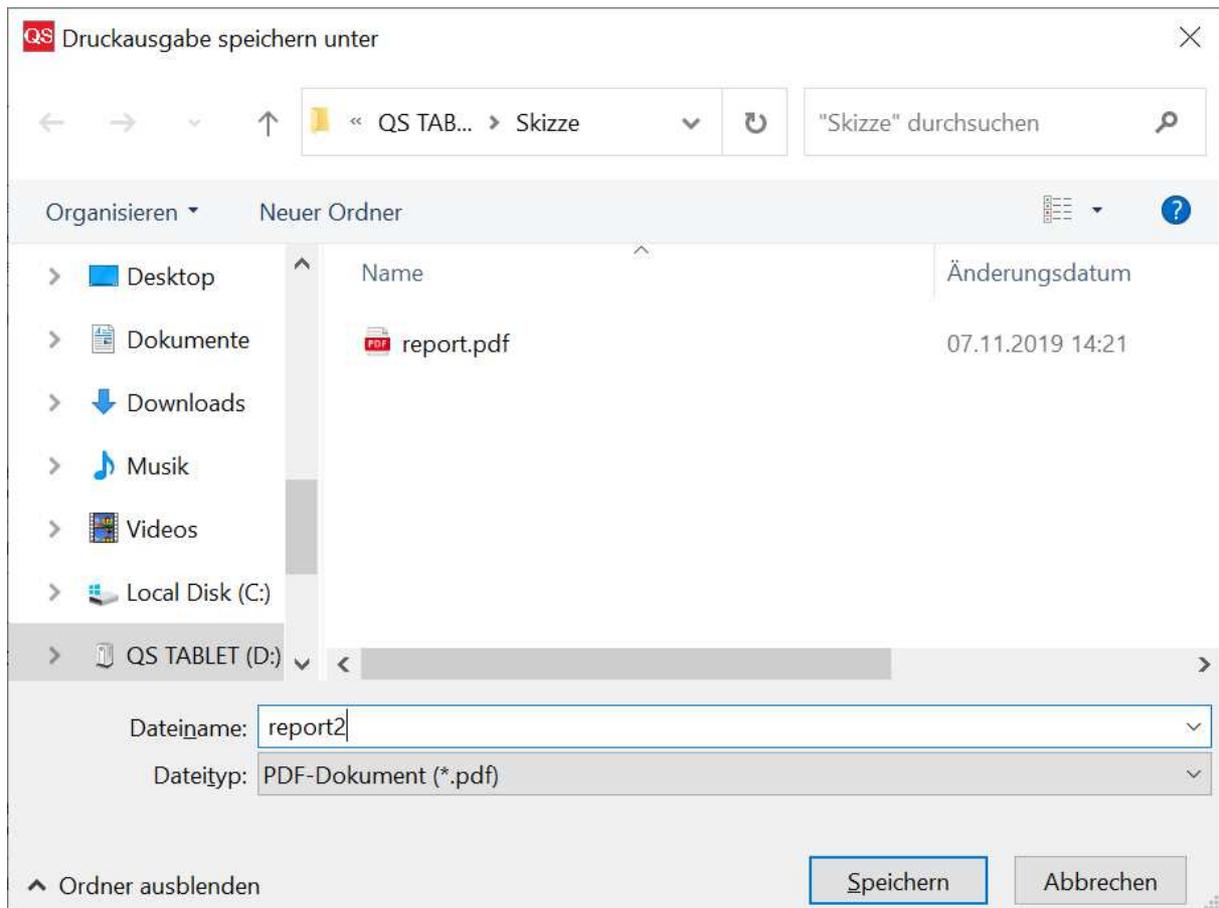
By tapping on the report display and swiping upwards, you can "browse" through the individual pages of the report.



A PDF file can be generated from this report by tapping on the printer icon at the top left of the display.



This PDF file can be stored on the local memory or on a MicroSD card.



7.0 Basic settings of the tablet

WiFi and Bluetooth are deactivated in the basic settings of the tablet by default. QuintSonic T is an autonomous measuring system and does not require a wireless connection. If the connection to a Wi-Fi network is established, the Windows operating system is automatically updated. This may affect functions of the QuintSonic T App and restrict correct functioning.

7.1 Show Windows Action Center

Swipe the display from the right edge of the tablet to the left to access the ACTION CENTER.

The ACTION CENTER provides access to system commands such as tablet mode, rotation lock, flight mode, location, scheduled mute, battery level, Bluetooth, VPN, power save mode, project, Wi-Fi and all setting options.

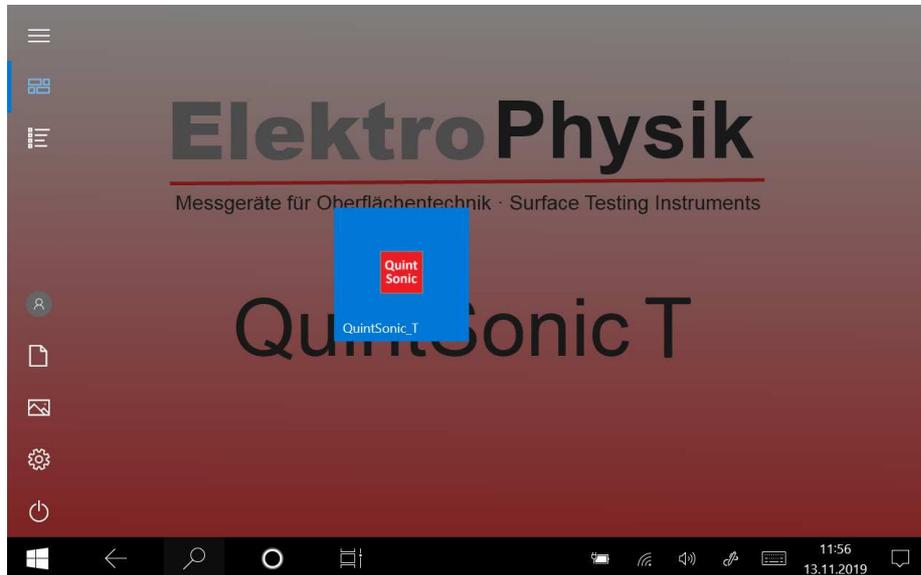


7.2 Show currently running APPS

Quickly swipe the display from the left edge of the tablet to see the apps currently running. Tap the thumbnail of a running application to open.



By tapping on the Windows icon the Windows interface can be accessed with e.g. access to all apps



8. Limits to the measurement technique

As any measuring technique, also the ultrasonic coating thickness measurement is subject to certain limitations – mostly of physical nature. The following section will refer to such limitations, their origin and how to deal with them.

Formulating conclusions to non-inspected areas

The results obtained from measurement solely relate to areas of the sample that have been inspected. Conclusions to other areas of the measurement object are not admissible.

They are only allowed if extensive experience on the process of manufacture is available and if appropriate methods for statistical evaluation can be applied.

Differences in acoustic impedance

The acoustic impedance values of layer interfaces must vary sufficiently in order to ensure the reflection coefficient at the layer interface is high enough for being evaluated. If this is not the case, the ultrasonic thickness measurement is pushed to its physical limits. If impedance values do not vary sufficiently, a clear separation of the layers is not possible any more.

Sound velocities

Ultrasonic coating thickness measurement is based on the measurement of travel times taking into account the sound velocities in the individual layers. For the calculation of the layer thickness, it is presumed on the assumption that the velocities in the individual layers are known and constant. For reliable measurement, all conditions must be fulfilled. As the sound velocity is used as a constant of proportionality to calculate the coating thickness, a sound velocity error of 5% will result in an error of 5% accordingly. For that reason, it is vital to adjust the correct sound velocity.

Sind If the sound velocities of the materials to be measured are not known (as this generally is the case with industrial coatings because of strong material variations that may occur), it is required to determine the sound velocities prior to measurement. This can be done by means of an optical evaluation of sample cross-sections. First the cross-sections of samples are measured by means of the QuintSonic gauge. After this, the measuring system can be calibrated according to the results obtained by the cross-section. Through the calibration procedure, the correct sound velocities will be adjusted automatically.

If a material presents discontinuities (caused by the manufacturing process, for instance,) the sound velocity in this material may vary. The variations may occur continuously or in steps. In such case, an average sound velocity should be used. To determine the average sound velocity, a sample cross-section should be made for optical evaluation. If the sound velocity jumps at certain points, additional sound wave reflections will be produced at such points and lead to erratic readings if disregarded.

Wall thickness measurement

Measuring objects with steel bases mostly exhibit a constant sound velocity in the base, even if the alloying elements vary. For wall thickness measurement of the steel base, it is important to know

that the variations of sound velocity are so small that they can almost be neglected as far as their influence on the measuring precision is concerned.

In other materials, however, such as non-ferrous metals or plastics, the sound velocity is subject to higher levels of variation that may impair the measuring precision. For that reason it is required to determine the sound velocity by means of a suitable method such as mechanical thickness measurement of the uncoated sample. For thinner bases, it is recommended to make a material cross sections.

Also strong sound attenuation may impair measurement. It occurs in some kinds of plastic materials, for instance. In such materials, sound attenuation becomes stronger with increasing wall thickness. When reaching a certain material thickness (depending on the type of material), the sound attenuation is so strong that the amplitude of the reflected sound wave will not be strong enough for being processed. This may be the case with plastic materials of around 1 to 2 mm thickness. For such materials, the ultrasonic method is not suitable. If you have a new measuring tasks, it is recommended first to create an A-scan image to check whether the amplitude of the receive signal is strong enough to ensure reliable testing.

Variations of the sound velocities as function of material temperature

The sound velocity is also influenced by the temperature in the material layers. The temperature coefficients also depend on the type of material with some materials exhibiting a non-constant temperature profile.

The QuintSonic sensor features an integrated temperature compensation for the sound velocities of layers. The temperature compensation is adjusted to an average temperature coefficient of typical industrial coating materials.

The temperature compensation will only work if sensor head and measuring object have the same temperature. Generally, ultrasonic coating thickness measurement systems are not able to record the current temperature distribution within a layer system that could be used for correction accordingly.

For that reason, larger measuring error may occur if a cold sensor is placed on a warm measuring object or vice versa. Whenever possible, it is recommended, prior to measurement, to provide for a temperature adjustment of sensor and measuring object.

Good results can be achieved by storing sensor and measuring object in the same room for a period of about 15 or better 30 minutes prior to measurement so that sensor and measuring object can adapt to the ambient temperature accordingly.

In the ideal case, measurement should take place under the same temperature conditions under which the determination of sound velocity has been carried out. In such case, the different temperature coefficients in the individual layers will no longer have an effect on measurement.

9. Technical data:

Measuring method	ultrasound pulse travel time method
Technical features	SIDSP® technology, digital pulse generator, digital data acquisition and processing, 32-bit-MicroController
Maximum number of layers	8
Measuring ranges	Measuring range 1: 10..300 ns, corresponding to approx.12..356 μm ¹⁾ Measuring range 2: 10..750 ns, corresponding to approx.12..890 μm ¹⁾ Measuring range 3: 10..1600 ns, corresponding to approx.12..1900 μm ¹⁾ Measuring range 4: 10..3300 ns, corresponding to approx.12..3900 μm ¹⁾ Measuring range 5: 10..6300 ns, corresponding to approx.12..7500 μm ¹⁾
Display resolution	Measuring range 1: 0.2 ns, corresponding to approx.0.25 μm ¹⁾ Measuring range 2: 0.4 ns, corresponding to approx.0.5 μm ¹⁾ Measuring range 3: 0.8 ns, corresponding to approx.1 μm ¹⁾ Measuring range 4: 1.7 ns, corresponding to approx.2 μm ¹⁾ Measuring range 5: 3.3 ns, corresponding to approx.4 μm ¹⁾
Repeatability ³⁾	Measuring range 1: 0.2 ns, corresponding to approx.0.25 μm ¹⁾ Measuring range 2: 0.4 ns, corresponding to approx.0.5 μm ¹⁾ Measuring range 3: 0.8 ns, corresponding to approx.1 μm ¹⁾ Measuring range 4: 1.7 ns, corresponding to approx.2 μm ¹⁾ Measuring range 5: 3.3 ns, corresponding to approx.4 μm ¹⁾
Accuracy ³⁾	Measuring range 1: 0.2 ns, corresponding to approx.0.25 μm ^{1) 2)} Measuring range 2: 0.4 ns, corresponding to approx.0.5 μm ^{1) 2)} Measuring range 3: 0.8 ns, corresponding to approx.1 μm ^{1) 2)} Measuring range 4: 1.7 ns, corresponding to approx.2 μm ^{1) 2)} Measuring range 5: 3.3 ns, corresponding to approx.4 μm ^{1) 2)}
Measuring and processing time	ca. 1 s
Calibration	sound velocity calibration for up to 5 layers

¹⁾ at a sound velocity of 2375 m/s (average value for industrial paints)

²⁾ completely determined by the accuracy³⁾ of sound velocity values; the statistical error contribution of the measuring system can be neglected

³⁾ according to DIN 55350, part 13

10. Declaration of conformity

Producer:

Name: Bullitt Mobile Limited

Address: One Valpy, Valpy Street, Reading, Berkshire, England RG1 1AR

GERÄTETYP : Robust Tablet

MODELLCODE : T20

We, Bullitt Mobile Limited, declare under our sole responsibility that the product described above complies with the applicable EU harmonisation laws: **RE Directive (2014/53/EU)**

Applied/fulfilled harmonized standards	
RE Directive 2014/53/EU, Article 3(1)(a) Security	EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013
RE Directive 2014/53/EU, Article 3(1)(a) Health	RE Directive 2014/53/EU, Article 3(1)(a) Health
RE Directive 2014/53/EU, Article 3(1)(b) EMV	Draft EN 301 489-1 V 2.2.0, Draft EN 301 489-17 V3.2.0, Draft EN 301 489-19 V2.1.0, Draft EN 301 489-52 V1.1.0 EN 55032:2015, EN 55024:2010+A1:2015
RE Directive 2014/53/EU, Article 3(2) Radiation	EN 301 511 V12.5.1, EN 301 908-1 V11.1.1 EN 301 908-2 V11.1.1, EN 301 908-13 V11.1.1 EN 300 328 V2.1.1, EN 303 413 V1.1.1 EN 301 893 V2.1.1
CE	Documented by: Shenzhen NTEK Testing Technology Co., Ltd
	Certificate no. : RE-17092006

APPLICATION OF THE DIRECTIVE:

SIGNATURE : Wayne Huang

POSITION : Director of ODM Management

DATE OF SIGNATURE : 21st September 2017

