A1220 MONOLITH UPVT

ULTIMATE VELOCITY TESTER

Operation manual

Revision 1.6.0

Acoustic Control Systems - ACS Group
Saarbrücken, Germany 2025

This instruction manual contains essential information on how to use this ACS product safely and effectively.
Before using this product, thoroughly review this instruction manual. Use the product as instructed.

1 Instrument description

This manual provides basic operating instructions for the A1220 MONOLITH UPVT. The information in this manual is organized to explain the technology, safety details, hardware, and software. Practical measurement examples help the user become familiar with the instrument’s capabilities.

1.1 Product description

A1220 MONOLITH UPVT is a multifunctional concrete testing instrument. It is designed to provide comprehensive assessments of concrete structures. A1220 MONOLITH UPVT integrates various testing methods, enabling accurate evaluation of material properties and structural integrity. The device supports multiple testing modes, including:

- `Ultrasonic Pulse Velocity Testing (UPVT)` – for assessing concrete quality, homogeneity, and detecting internal defects. A1220 MONOLITH UPVT complies with the following standards standards IN EN 12504-4, BS 1881 : Part 203 : 1986, ASTM C597 – 16, IS 516 (Part 5/Sec 1) : 2018
- `Compressive Strength Measurement` – for determining the mechanical strength of concrete.
- `Concrete Defectoscopy` – for identifying cracks, voids, and inhomogeneities.
- `Synthetic Aperture Focusing Technique (SAFT)` Thickness Gauge – for precise thickness measurement and obtaining a tomographic image of the structure
- `Crack Testing` – for detecting and analyzing cracks in concrete structures.

NOTE

Currently, the UPVT function is fully operational. Other operational modes ans features are under development.

Specification

Parameter	Value
Operating frequency range	25KHz - 1MHz
Maximal data acquisition length	4000, μs
Material velocity range	500-15000, m/s
Transmitter output voltage	±20, ±100, ±200, V
Transmitter pulse form	Bipolar meander, 0.5 - 5.0 periods
Pulse repetition rate	1-45, Hz
Gain setup range	0-100, step 1, dB
Number of the programmable points of DAC function	24
Dynamic range of DAC function	30, dB
Power supply	Built-in battery
Operation time	14, h
Battery charging time	3, h
Display type	TFT (640 x 480)
Electronic unit dimensions	260×156×43, mm
Electronic unit weight	0.8, kg

Operating conditions

Parameter	Value
Operating temperature range	from -20 to +55 ˚C
Relative air humidity at +35°C	max 95 %

1.2 Maintenance

Cleaning

- The A1220 MONOLITH UPVT instrument must be regularly cleaned from dirt and dust using a cleaning agent for plastics
- If the screen's protective glass is dirty, please wipe it with a soft cloth moistened in a household cleaning agent for plastic glasses
- The keyboard allows the application of alcohol for cleaning
- If dirt or foreign matter gets in the arming connectors, use a soft brush for cleaning

Storage

- Store the A1220 MONOLITH UPVT in a hardshell case included in the delivery set
- Store A1220 MONOLITH UPVT in racks
- The arrangement of the device in warehouses shall enable its free movement and unrestricted access to them.
- The distance between the devices and the walls, floor of the warehouse, and other warehoused instruments shall be at least 100 mm.
- The distance between the heating units of the storage room and the devices should be min. 0.5 m.

- The storage room shall be free from the current-conducting dust, admixtures of aggressive gases, and corrosive vapors able to attack the instruments.

Transportation

- Transport the A1220 MONOLITH UPVT in a hardshell case included in the delivery set.
- The packaged devices can be transported in any vehicle at any distance without speed limits.
- Fix the package steadily to prevent their hitting during the transportation.
- Protect the package from rain and water splashes while opening the vehicle.
- The arrangement and fixation of the packed devices in transport facilities should provide their stable position and exclude strokes against each other as well as against the walls of the transportation facilities.
- The conditions for device transportation should meet the requirements of the valid specifications, rules, and norms for each transport type.
- If shipped by air, place the device in hermetically sealed heated compartments.
- If transportation conditions differ from the operation conditions, the device shall be kept under normal weather conditions for at least 2 hours before the operation.

1.3 Environmental ratings

A1220 MONOLITH UPVT is a rugged and durable instrument that you may use in harsh environments. A1220 MONOLITH UPVT was designed to meet the requirement of the IP64 standard.

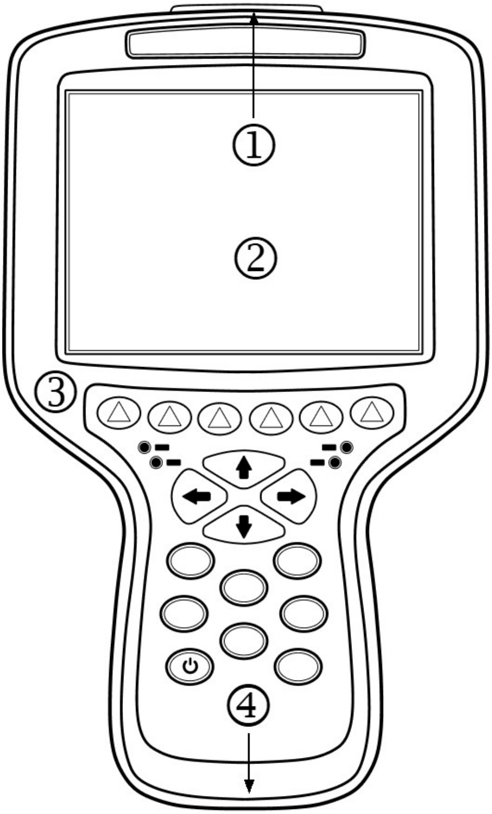
CAUTION

ACS Solutions GmbH cannot guarantee any level of ingress protection once the instrument seals have been tampered with or manipulated. You must exercise sound judgment and take appropriate precautions before exposing the instrument to harsh environments. To maintain the original ingress protection level, you are responsible for the proper care and maintenance of all seals that are routinely exposed. Furthermore, you are required to return the instrument to an authorized ACS Solutions GmbH service center annually to ensure that the seals are properly inspected and maintained.

1.4 Instrument

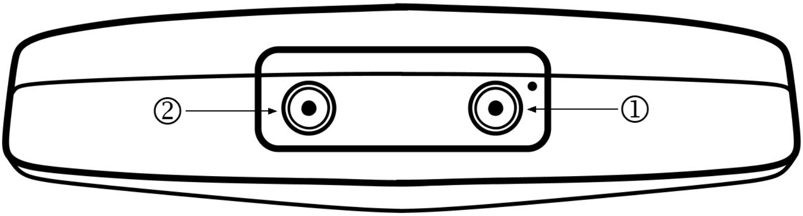
Overview

A1220 MONOLITH UPVT `Transducer connectors` are located at the top of the instrument ①.The front panel also features a color `Display` ②and a `Keypad` ③. Bottom side of the instrument has a rubber flap seal for the `DC power` and `micro USB` communication connectors ④. `Transducer connectors` are located at the top of the instrument ①.

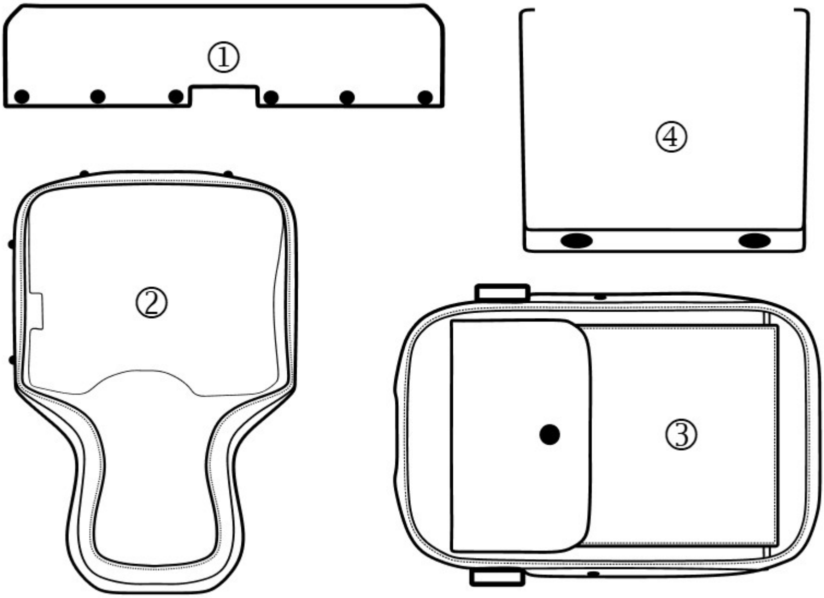


Transducer connectors

A1220 MONOLITH UPVT has two `LEMO` sockets on its top side (see `Transducer Connectors` in the overview). The transducer is connected to `LEMO-1` ①, which is marked with a dot, and the receiver is connected to `LEMO-2` ②.



Accessories and their usage



A1220 MONOLITH UPVT comes with the following accessories to enhance usability and protection:

- `Blind` ①: This Blind (sunshade) helps reduce glare on the display when working in bright outdoor conditions

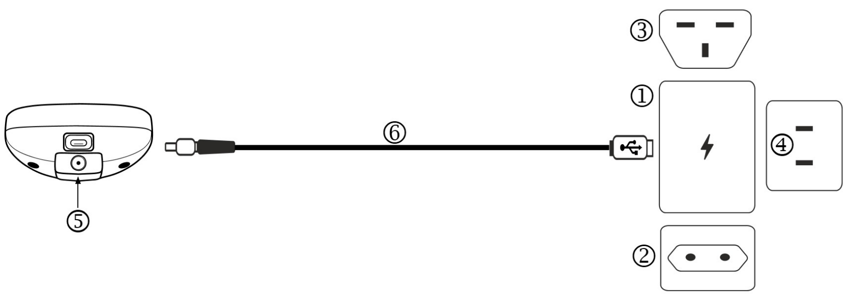
- `Softcover` ②: designed to protect A1220 MONOLITH UPVT keeping it clean and dry. The device is usually already placed in the soft cover.
- `Mapcase` ③: a body-mounted holder designed to support the instrument around your waist. It allows you to carry and use the instrument hands-free, especially useful during field operations
- `Stand` ④: The metal stand allows the instrument to be placed on a flat surface at a slight angle for more comfortable use

Power Supply Unit

CAUTION

Charging of A1220 MONOLITH UPVT and its simultaneous connection to a PC is prohibited.

The instrument's battery is charged with the included power adapter ①, which comes with an interchangeable universal plug system for convenience. The adapter supports the following plug standards: ②:`EU (Type C)/CEE 7/16`, ③:`UK (Type G)/BS 1363`, and ④: `US (Type A)/NEMA 1-15`.



A1220 MONOLITH UPVT connects to the power adapter ⑤ (see `overview` section) using a specialized cable ⑥that has a standard USB Type-C connector on one end and a `5.5×2.5mm PD` barrel connector on the other. The nominal charging voltage is 15 V.

CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord and power supply delivered with A1220 MONOLITH UPVT. Do not use this AC power cord and power supply with other products.

Transferring data to a computer

Measured data and screenshots are stored on the internal storage of A1220 MONOLITH UPVT. To transfer the data to a personal computer, A1220 MONOLITH UPVT must be connected to the PC. For this purpose, use the cable supplied with the instrument, which features a `USB-A` connector on one end and a `micro-USB` connector on the other.

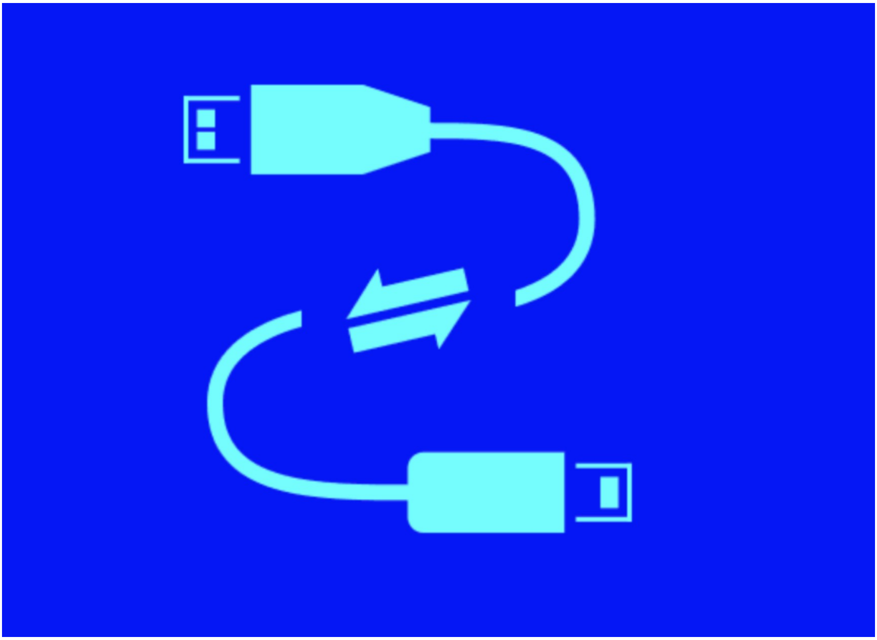
The connection procedure is as follows:

- Power on the instrument
- Connect the `USB-A` cable to the personal computer
- Connect A1220 MONOLITH UPVT via instrument's `micro-USB` port

Once connected, the internal storage will become accessible to the user via `Windows explorer` as a mass storage device. Inside the `UPVT` folder, you will find subfolders for individual projects:

IMAGE

During an active connection between A1220 MONOLITH UPVT and the PC, the screen and keypad are disabled, and the instrument's display shows screen:



Once the cable is disconnected from the personal computer, A1220 MONOLITH UPVTwill automatically reboot and switch back to normal operating mode.

CAUTION

The USB connection between the computer and A1220 MONOLITH UPVT is only supported on computers running the Windows operating system.

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2 UPVT

2.1 Getting started

Check this quick start guide to start using the instrument as quickly as possible.

Startup

Power on 16 the A1220 MONOLITH UPVT. After turning on the device and switching to Pulse Velocity Test 16 mode, ensure that the battery is sufficiently charged . If the battery is low, charge the device before use.

Operation

- Use the `Project manager` 18 to create a new project or open an existing one
- Ensure that the `Probe name` 26 is set correctly and check other project parameters
- Verify that the correct `Measurement scheme` 26 is selected.
- Make sure the correct `Result type` 26 is set correspondingly
- Perform `Tx/Rx calibration` 33
- Adjust the `Delay` 26 manually or carry out the `Delay calibration` 37
- Ensure the `Dead zone` 26 is set correctly
- Go to the measurement window by pressing . If necessary, press it again to switch to edit the parameters.

Device Performance Check

- Ensure that the Measurement averaging 47 is set according to your requirements, and the Table 48 with results is properly displayed. If requred, clear the table.
- Before starting work, perform a test measurement either on a inspected object or a calibration sample. Verify that the Path 26 parameter is set correctly. Occasionally, users may encounter difficulty in securely attaching the sensors to the measurement object. In some cases, sensor vibration or displacement during measurement may lead to inaccurate results. If this occurs, press the 

button to repeat the measurement.

Shutdown

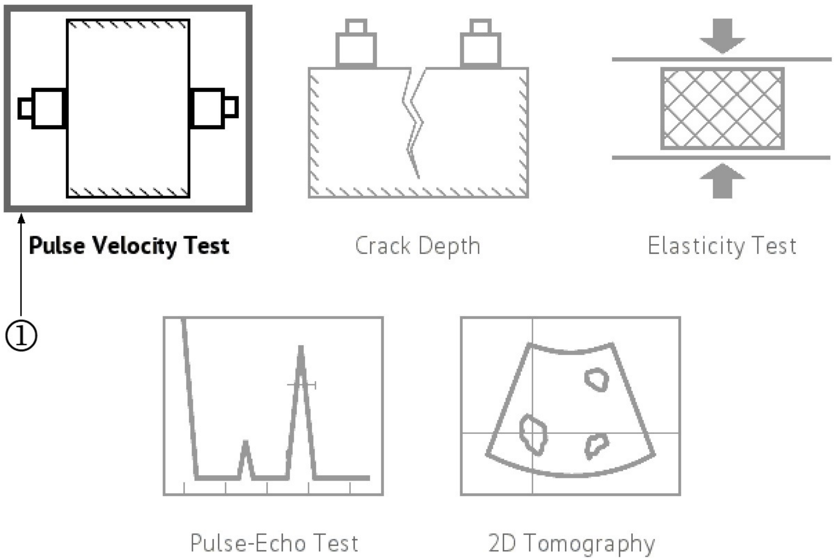
Shut down the instrument 16

2.2 Startup and Shutdown

Powering on

To power on the device, press  and hold it or 2 seconds. After this, a window for selecting the measurement function (corresponding glyph) will appear on the screen:

OPERATING MODES



To move the function selector (bounding box ①), use , ,  and . To select a function, use 

.

NOTE

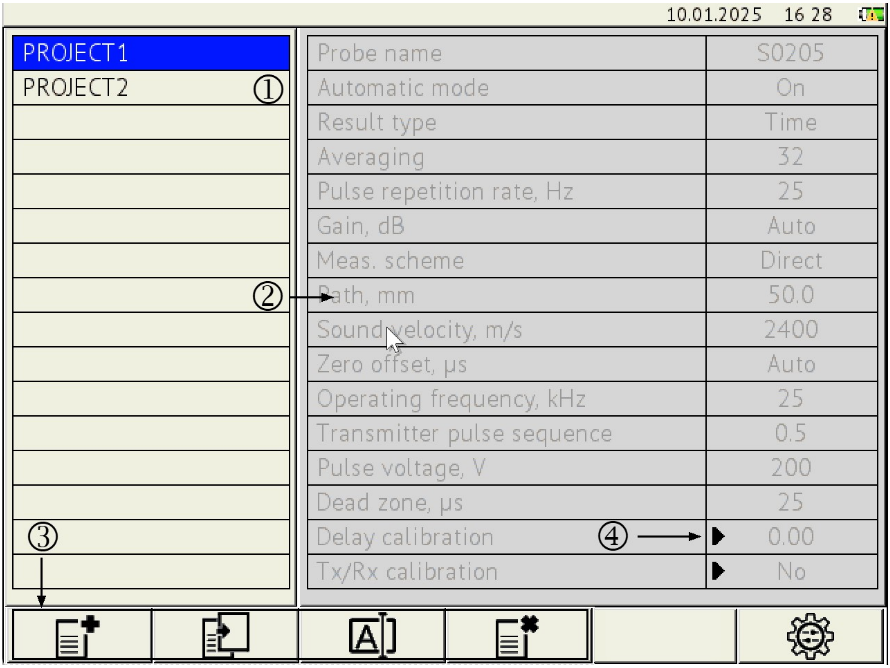
Glyphs for modes that are unavailable in the current firmware are grayed out, indicating that these modes are not accessible to the user.

Powering off

To turn off the device, press and hold the  button.

2.3 Project manager

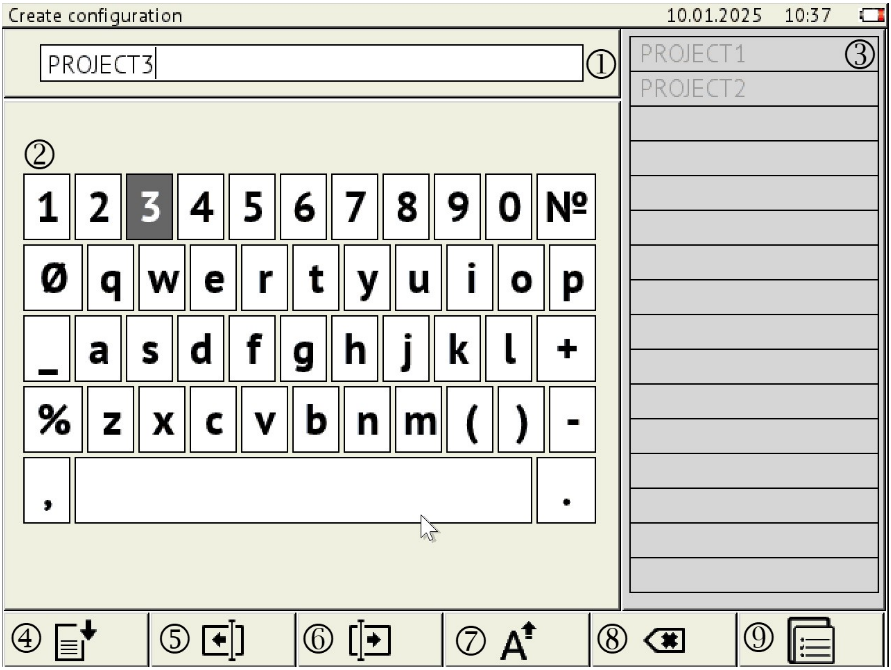
The Project Manager allows user to manage projects. A project represents a collection of all the necessary parameters for performing inspection task. Parameters include both measurement parameters, calibration settings, noise levels, and others. Projects settings are stored in a folder with the same name on the instrument storage.



	Description
①	List of projects. The user can navigate through the projects using and . Use to go to ②
②	Project settings. User navigates through the settings using and .A project has two typed of settings. There are parameters and routines. Parameters are just values that can be adjusted using the and buttons. To enter a routine, the button is used. Routines are denoted by a filled black triangle, see ④. Use to return to ①
③	Functional panel offers a variety of functions for working with projects, such as copying, renaming, deleting, and also accessing system settings.

2.3.1 Functional panel

Create new project



Create new project window has following elements:

	Description
①	Project name filed. Use either keyboard k or by selecting the name of an existing project from project list.
②	Keyboard panel. To navigate the keyboard, use , , and . Confirm the input by pressing .
③	The project list enumerates the names of all existing projects. Activate the list of projects with ⑨. Use and to navigate through the list. Press to copy the project name into ①
④	Save project key
⑤	Moves the editing cursor in the project name field ① one position to the left
⑥	Moves the editing cursor in the project name field ① one position to the right
⑦	Toggle between uppercase and lowercase
⑧	Deletes the character to the left of the cursor.
⑨	Active project list ③

Copy project

Select the project to be copied and press . The window that appears will help you specify the project name and save the project with the desired name. Pressing will open a window identical to the one used for creating a new project.

Rename project 

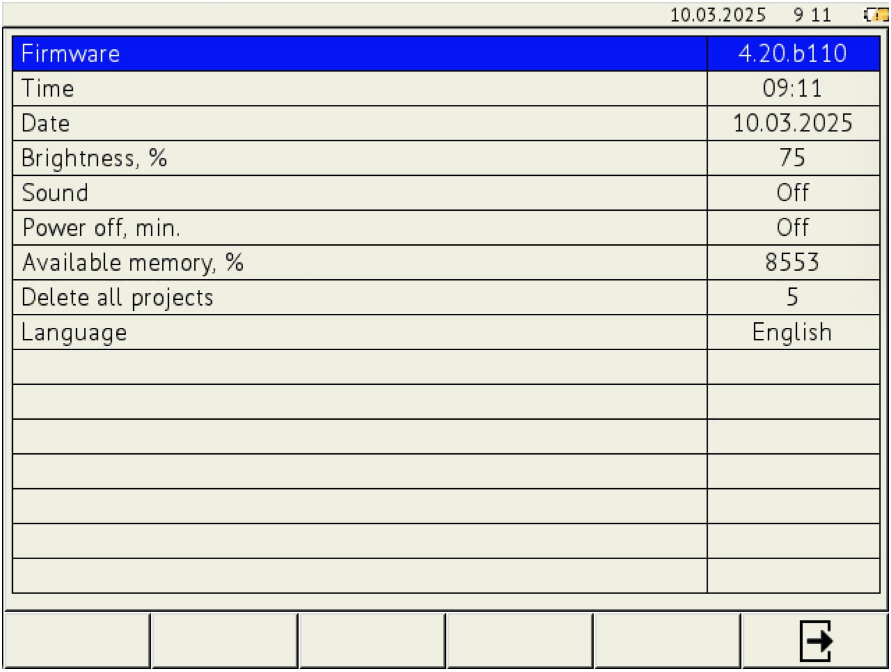
The user can change the name of any previously saved project. Pressing  will open a window identical to the one used for creating a new project.

Delete project 

The user can delete any of the already saved projects. After pressing , the user must confirm the deletion.

2.3.2 System settings

The system settings page contains essential settings for the measurement instrument, including language, time, and power options. Descriptions of individual settings is provided below.

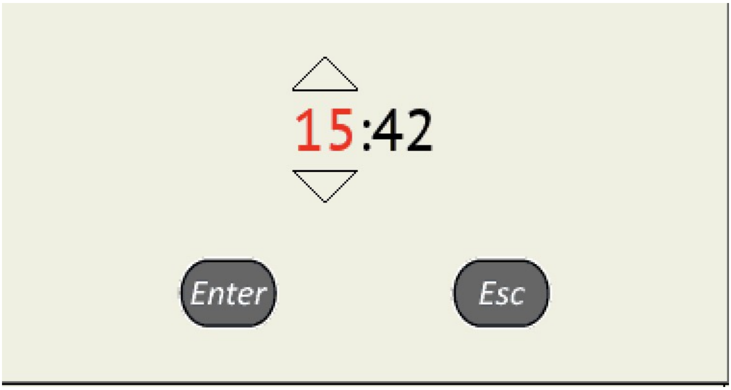


Firmware

The version consists of several separate number blocks: XX.YY for a release version and XX.YY.bZZZZ for a beta version. The XX block represents the major version, YY represents the minor version, and ZZZZ is the beta identifier, prefixed with 'b'.

Time

System time. To edit the time, press Enter. Use and to switch between hours and minutes. To edit the selected value, use and .



Date

System date. To edit the date, press Enter. Use and to switch between days, months, and years. To edit the selected value, use and .

Brightness
The screen brightness can be adjusted in the range of 5% to 100%. The default value of 75% provides sufficient brightness while maintaining moderate battery consumption. To edit this parameter, use the and buttons.

Sound

The operator can enable sound notifications. The device emits special sounds during measurement. During signal search, the device produces short sounds. A successful time detection event is accompanied by a prolonged signal.

Power off

If `Power off = off`, the device will continue operating even if no buttons are pressed. If `Power off = X`, the device will turn off if no button is pressed within `X` minutes. The operator can set `X` to a maximum of 60 minutes.

Available memory, MB

The indicator shows the total available memory for all accessible instruments.

Delete all project

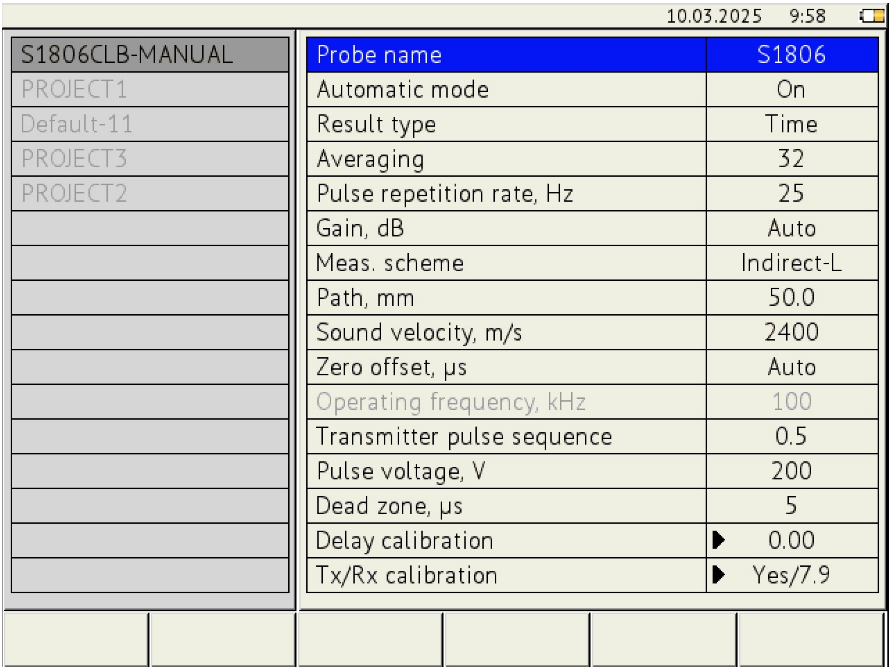
Deletes all saved projects from the device. This action is irreversible. The number on the right indicates the total number of projects in the active instrument.

Language

Sets the device's interface language. Currently, only English is supported

2.3.3 Project parameters

This chapter describes the main project parameters:



Probe name

The A1220 MONOLITH UPVT is compatible with all transducer mentioned here 63. After creating a project, the operator can use  and to select the desired transducer type. Additionally, A1220 MONOLITH UPVT allows the use of third-party transducers by setting `Probe name = CUSTOM`.

NOTE

When using a `CUSTOM` transducer, the user must carefully verify all project parameter values to ensure proper instrument operation

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Automatic mode

If A1220 MONOLITH UPVT cannot carry out the measurement task due to weak signal sensitivity, acoustic interference, or other reasons, the operator can switch the device to manual mode by setting Automatic mode = Off. In this mode, the instrument does not automatically adjust the gain nor perform automatic time detection. The measured signal is displayed on the device's screen as it is. The operator can use the Detection tool 48 of to measure the time. After setting `Automatic mode = Off`, the `Gain` parameter will be set to 80% if it was previously set to `Auto`. The user can modify the `Gain` as needed. When the user switches back to automatic mode by setting `Automatic mode = On`, the `Gain` remains unchanged. This design allows the operator to quickly revert to automatic mode and check if the device can now automatically detect the propagation time. Similarly to the `Gain` parameter, the `Zero offset` parameter may change when the `Automatic mode` is toggled. If `Zero offset` is set to `Auto` and `Automatic mode = off`, the `Zero offset` automatically resets to 0. However, if `Zero offset` is manually assigned a specific value (other than `Auto`), altering the `Automatic mode` will not affect the `Zero offset` setting.

Result type

This parameter allows user to define the primary and additional measurement parameters. If the measurement involves determining time, set `Result type = Time`. In this case, the measured time will be recorded in the results table, and the velocity will be calculated based on the user-defined `Path` parameter. The results panel will appear as shown in the image below. The time indicator is highlighted in yellow, confirming that it is the measured parameter.

The `Path` is marked with the symbol indicating that the value was set by the user.

If the measurement involves determining velocity, set `Result-Type = Velocity`. In this case, the velocity will be recorded in the results table. The velocity is calculated based on the measured time and the user-defined `Path` parameter.

If the measurement involves determining the path, set `Result-Type = Path`. In this case, the velocity must be defined by the user, which will be denoted by .

Averaging

This parameter defines the averaging factor. Averaging reduces thermal and electrical noise in the measured signal and is particularly beneficial when using DPC or other transducers. It also helps to minimize noise in cases of high signal attenuation. However, increasing the averaging value slows down the instrument's operation speed. The standard averaging range is from 32 to 128. Use and to adjust the value as needed.

Pulse repetition rate, Hz (PRR)

The `PRR` (Pulse Repetition Rate, Hz) defines the number of transmitter pulses emitted per second. The total measurement time is determined by `averaging/PRR`. A high `PRR` accelerates the measurement process, while a low `PRR` slows it down. Adjust the `PRR` by considering the following

- Small concrete objects (with at least one dimension less than 250 mm) may introduce residual sound. If the `PRR` is high, this residual sound can interfere with the measurement by overlapping with subsequent transmitter pulses. These disturbances are commonly referred to as ghost echoes.
- Thick concrete with a low attenuation factor may also produce ghost echoes, as the ultrasound requires more time to dissipate.
- However, a high `PRR`, combined with higher `averaging`, can improve the signal-to-noise ratio (`SNR`) when the analog `gain` is close to 80–100 dB. To determine the optimal parameters for `averaging` and `PRR`, it is often sufficient to check the stability of readings at several points on the control object.
- The operator can set the `PRR` value from "5 to 45, with typical values ranging from 25 to 35.

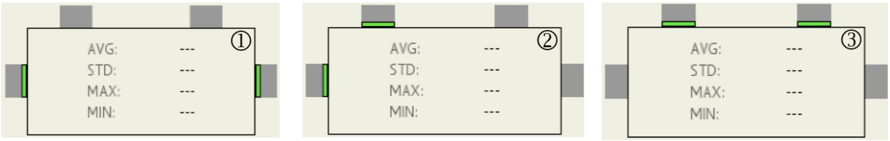
Gain

Analog `Gain` is an amplification factor applied to the ultrasonic measurement signal to increase/decrease its amplitude. This ensures that weak signals are amplified to a level suitable for processing or analysis while maintaining signal integrity. Proper adjustment of the analog `Gain` is crucial for optimizing measurement accuracy and sensitivity.

A1220 MONOLITH UPVT automatically adjusts the `Gain` for a new measurement cycle using the signal measured during the previous cycle. If the device cannot automatically select the appropriate `Gain`, the user can set the value manually using  and . The device can be returned to automatic `Gain` adjustment if the operator decreases the value to `0` with  and then presses  again.

Instead of the Gain value, Auto will appear. The Gain parameter may be automatically adjusted when the user switches the Automatic mode. For more detailed information, please refer to the Automatic mode section.

Measurement scheme



There are three measurement schemes available. The schemes differs in respect to arrangement of transmitter and receiver.

- Direct scheme ①. The transmitter and the receiver are located on the opposite sides of the inspection object;
- Semi-direct scheme ②. The transmitter and the receiver are located on adjacent sides of the inspection object;
- Indirect-L scheme ②. The transmitter and receiver are located on adjacent sides of the inspection object. The DPC transducers are positioned facing each other in such a way that a longitudinal (P) wave propagates from the transmitter to the receiver. For more information, refer to the Transducers 63 and Holders 74 chapters.
- Indirect-S Scheme. The transmitter and receiver are located on adjacent sides of the inspection object. The DPC transducers are positioned facing each other in such a way that a shear (S) wave propagates from the transmitter to the receiver. For more information, refer to the Transducers 63 and Holders 74 chapters.

Path

The Path parameter represents the distance that an ultrasonic wave travels from the transmitter to the receiver. If Result type = Time or `Result type = Velocity` the Path parameter is utilized to calculate the `Sound velocity`. If `Result type = Path` the user-defined `Path` value is disregarded. Instead, the `Path` is calculated based on the measured velocity and time. To adjust the `Path` parameter, use  and .

Sound velocity

The Velocity parameter denotes the speed at which an ultrasonic wave propagates through a material. When `Result type = Path` is selected, the user-defined sound velocity is used to compute the `Path`.To adjust `Sound velocity` use  and .

Zero offset

`Zero offset` parameter represents the acquisition delay. In the case of thick objects, the ultrasonic pulse arrives with a significant delay. The ultrasonic signal from the start of measurement until the pulse arrival is unnecessary. In such cases, the operator can exclude the irrelevant portion of the signal using the `Zero offset` parameter. If `Zero offset = Auto`, the device automatically detects the pulse and trims the signal accordingly. Alternatively, the operator can manually set the `Zero offset` to one of the following values 0, 50, 100,...600 µs. To adjust `Zero offset` use  and . To set the `Zero offset = Auto` ensure that the current `Zero offset = 0` then press . `Zero offset` parameter may be automatically adjusted when the user switches the `Automatic mode`. For more detailed information, please refer to the `Automatic mode` section.

Operating frequency

The `Operating frequency` sets the frequency of the transmitter pulse. The `Operating frequency` must match the frequency of the selected transducer. For a predefined transducer from the list `Probe name` list, the operation frequency is set automatically. If the `Probe name = CUSTOM` the operator is responsible for setting the frequency correctly. To adjust the `Operating frequency` use  and .

Transmitter pulse sequence

This parameter determines the number of pulses emitted by the transmitter. If the `Transmitter pulse sequence` is set to 0.5, 1.0, or 1.5, the transmitter will emit one pulse, two pulses, or three pulses, respectively. It is important to note that pulse polarity alternates. For example, if the first pulse is negative, the second pulse will be positive, and the third pulse will be negative again. In most cases, setting the `Transmitter pulse sequence = 0.5` allows reaching a maximum measurement accuracy. However, if the measured signal is too weak, increasing the number of pulses may help improve the signal. Keep in mind, though, that increasing the number of pulses will reduce the accuracy of determining the wave's arrival time. To adjust the `Transmitter pulse sequence` use  and .

Pulse voltage

The A1220 MONOLITH UPVT can operate with three transmission voltages: 50, 100, and 200 volts. If, despite the `Gain` being set to its minimum, the measured signal is still in overflow, the operator can reduce the transmission voltage to decrease the signal power of the measured signal. Use 200 volt by default when working with transducers of between 50 and 200 kHz. To adjust `Pulse voltage` use and

Dead zone

The `Dead zone` defines a time interval from the start of the measurement. Withing `Dead zone` detecting the arrival pulse time is not feasible. The `Dead zone` varies for different transducers and may be caused by factors such as: piezoceramic noise, electrical leakage, transmitter-receiver crosstalk and acoustic vibrations. The `Dead zone` is predefined for transducers in the probe name list. If the P`robe name = CUSTOM` the operator is responsible for setting `Dead zone` correctly. To adjust `Dead zone` use and . Study section 61 to familiarize yourself with how the `Dead Zone` is represented on the A-scan.

Delay calibration

refer to page 37 for more information.

Tx/Rx calibration

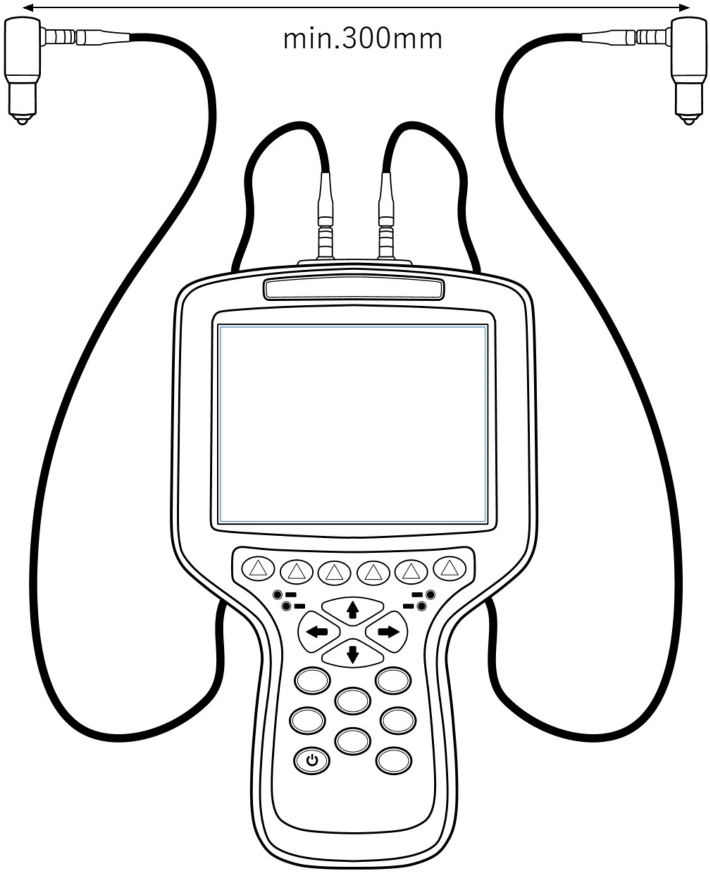
Refer to page 33 for more information

2.3.4 Tx/Rx calibration

The `Tx/Rx calibration` function measures the noise of the transmitter and receiver under varying measurement parameters. This multi-dimensional `Calibration function` (`Threshold function`) is used for automatic signal detection and is essential for proper instrument calibration.

Preparation

Connect both transducers before executing the `Tx/Rx calibration`. Ensure that the transducers are positioned at a minimum distance of 300 millimeters apart. The tips of the transducers should not point toward each other. If the transducers are installed in the housing, they need to be removed from the housing. Transducers should not be held by hand. Place the transducers on a flat, stationary surface. Do not touch the transducers until the calibration is complete.



Tx/Rx calibration

Perform the TX/RX calibration using the following steps:

- go to the project parameters and press , see ①
- confirm the necessity of performing the calibration ②
- wait for the calibration to complete ③
- confirm successful calibration ④.An indicator of successful Tx/Rx calibration is the change of ⑤ from `No` to `Yes`.

NOTE

If the `TX/RX calibration` fails, repeat the process a few times. If the calibration is still unsuccessful, contact the distributor for assistance

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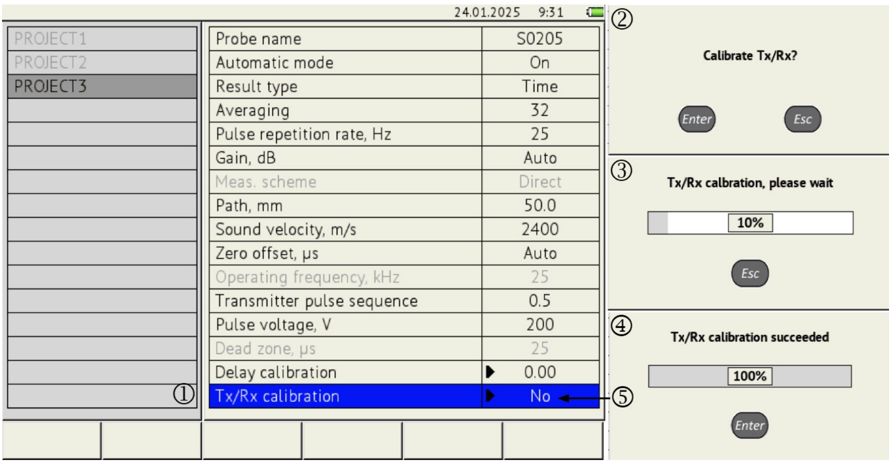
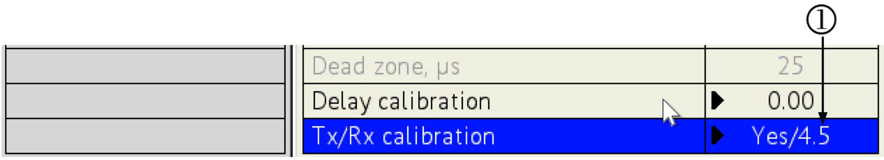


Adjustment

In rare cases, the threshold function measured in air may not be precise enough for successful automatic measurements on the actual object. The instrument may produce false triggers if the threshold function is set too low (e.g., in the case of a weak signal). Conversely, if the threshold function is set too high, the instrument may miss the required wave (e.g., in the case of strong interference). Signal attenuation can occur due to increased material damping. Interference or acoustical noise may be caused by external factors such as, for example, construction work.



The operator can adjust the threshold function using a scaling factor ①. To do this use and . The scaling factor ranges from 1.5 to 10.

NOTE

The default scaling factor is individually configured for each type of transducer

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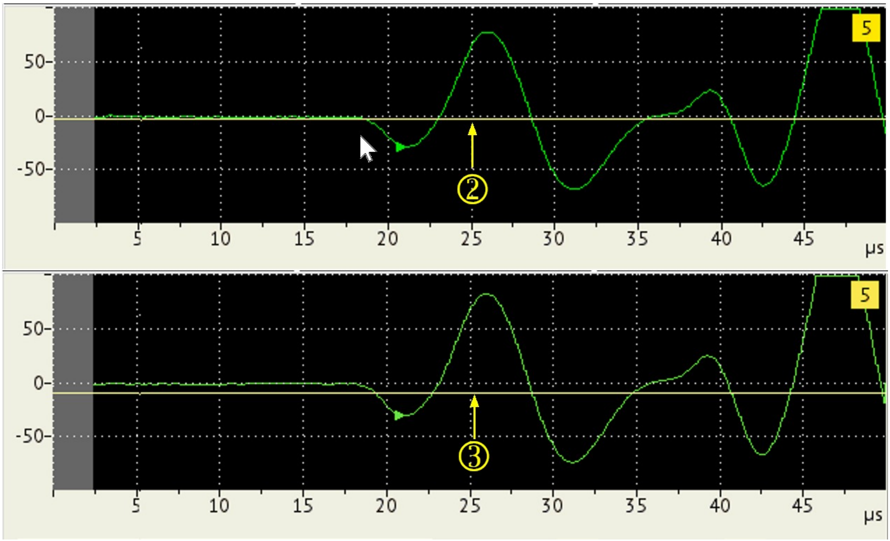
The effect of changing the scaling factor is visible on the A-scan display. A case with a decreased scaling factor, see ②, where the threshold function nearly merges with the signal baseline. Increasing the scaling factor raises the threshold function, see ③.



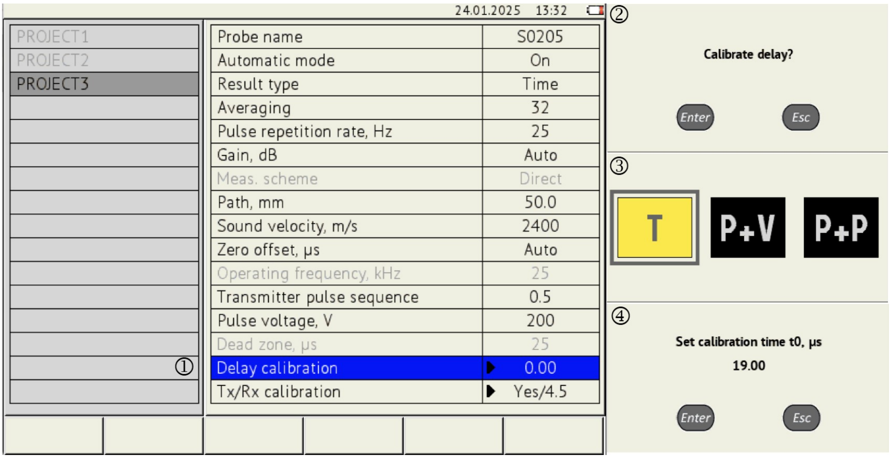
2.3.5 Delay calibration

For successful `UPVT` measurements, it is necessary to calibrate the delay. The delay is added to the sample propagation time. If the delay is not accounted for, the material velocity as well as time and path will be determined with an error. The delay arises due to various factors such as transducer delay, circuitry delay, and internal timings, synchronization, buffering etc. The delay also depends on the measurement scheme. Thus, the delay for the same pair of transducers in a `direct measurement` scheme and an `indirect measurement` scheme will differ. The A1220 MONOLITH UPVT instrument offset uses three types of calibration routines.

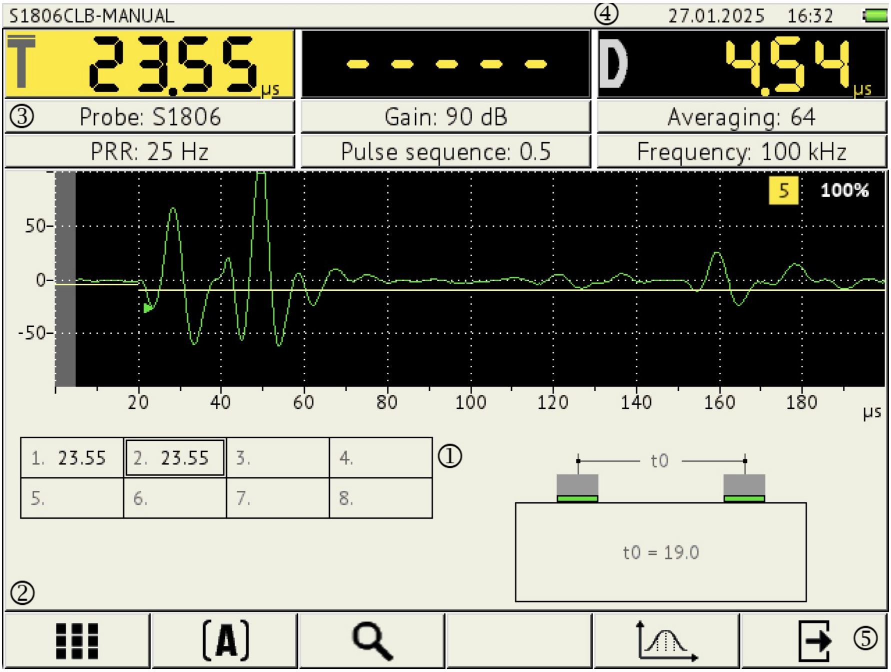
T calibration

`T calibration` is used in cases where the time of ultrasonic wave propagation is known. This method of calibration is particularly useful when applying user-defined calibration samples. This approach requires only the propagation time `T`. In some cases `T` can be measured using a high-frequency ultrasonic flaw detector or other instruments. The measured time `T` is then used for calibrating A1220 MONOLITH UPVT low-frequency transducers. To calibrate, follow theses steps:

- Go to the project parameters, see [chapter](26), select `Delay calibration` and press Enter ,see ①. Confirm with Enter to start the calibration, see ②. Select the `T-calibration` with and , confirm with Enter , see ③. Enter the time `t0` and confirm with Enter , see ④.



- Perform between 1 and 8 calibration measurements, see table ①.The more measurements you take, the more accurate the calculated delay will be. Note that the measured times should not differ significantly from each other.The measurement flow is the same as in regular measurements , and the functional panel ② remains unchanged. Indicator ③ displays the average or the last measured time. Indicator ④ shows the calculated delay value.



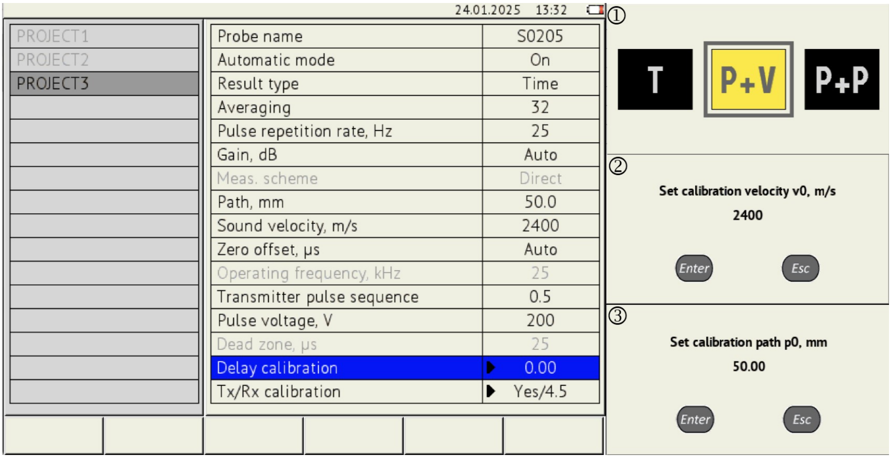
- Finalize the calibration procedure by pressing ⑤.

P+V calibration

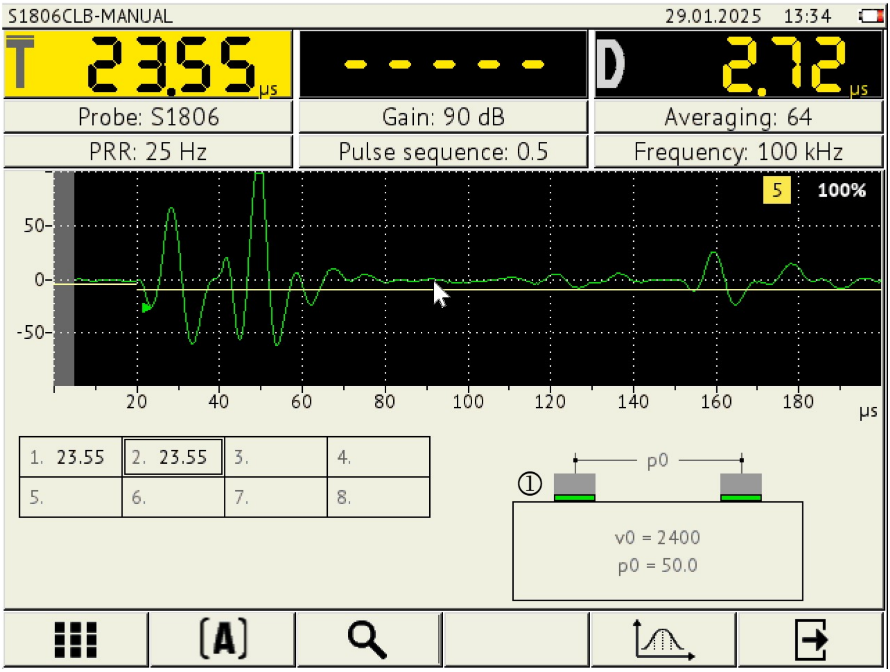
`P+V calibration` can be considered as the easiest method for an indirect measurement scheme. The path `P` is usually known since the transducers are mounted in a holder with a known pitch size. The `velocity` may already be known or measured using another method such as `P+P calibration` where the operator may employ high-frequency transducers. To calibrate, follow theses steps:

- Initiate the `P+V calibration` process. For reference, check the `T calibration` section. Confirm `P+V` using  ,see ①.

Set the required velocity `V` using and ,see ②. Then, set the required path `P`, see ③.



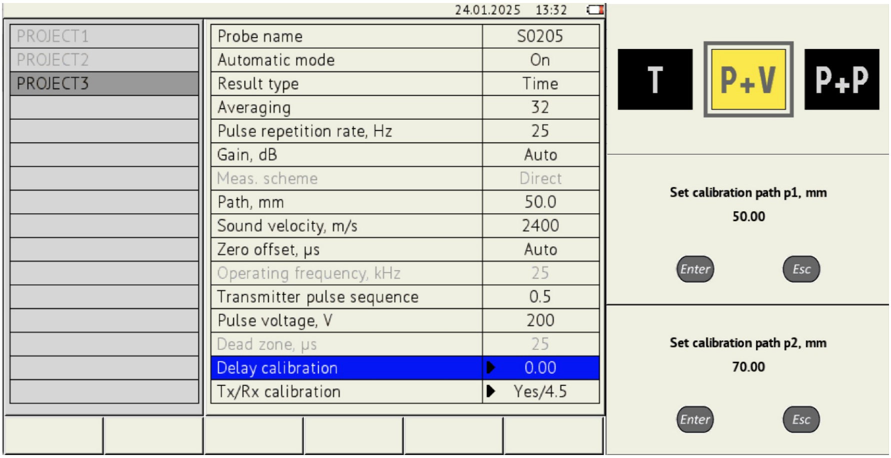
- The `P+V calibration` procedure is similar to the one described in the `T calibration` section. Diagram ① explains the parameters path `p0` and velocity `v0`.



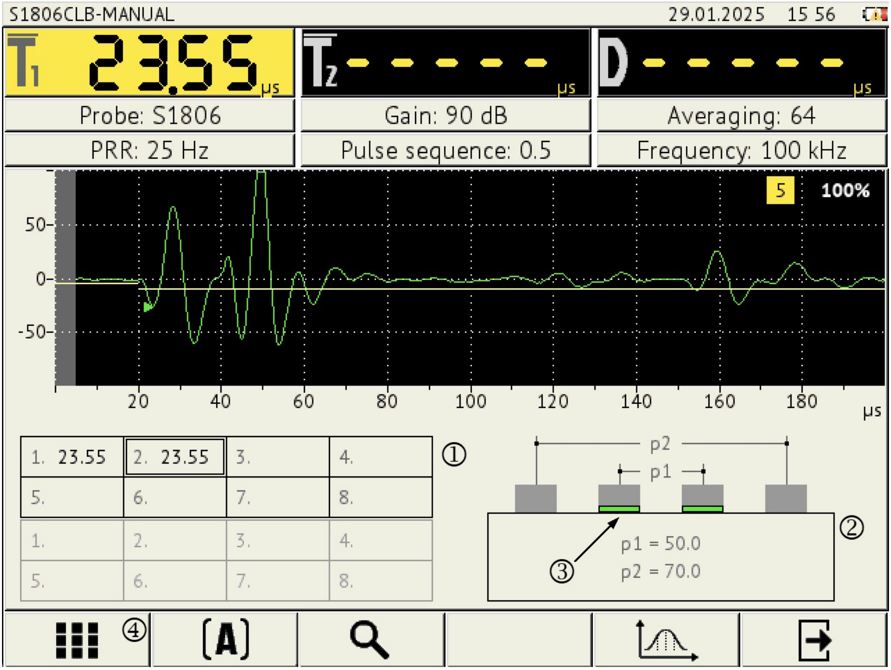
P+P calibration

`P+P calibration` can be useful when neither the time nor the velocity of ultrasonic wave propagation are known. In this method, two samples of different lengths are required. The path or length can be measured using a ruler or a caliper. One important condition for successful calibration is to ensure equal velocity in both samples. It is recommended to produce calibration samples from the same material batch. Consider using `P+P calibration` when working with low-frequency transducers. Since calibration samples may be too massive and cannot be used in situ. Use `P+P calibration` to estimate the delay on the tested objects.

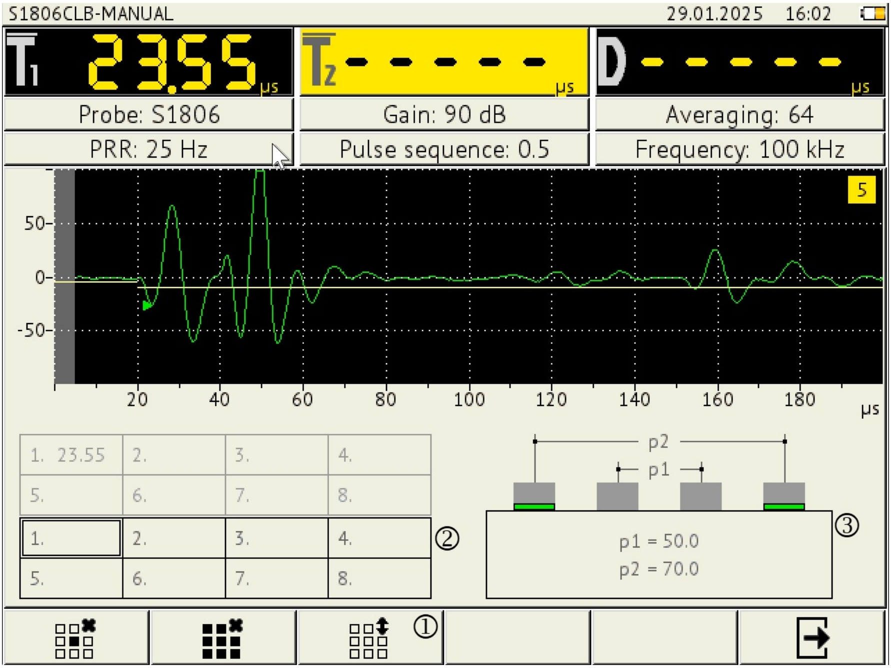
After confirming the `P+V calibration` first enter the length of the short sample `p1`, then the length of the long sample `p2`.



The `P+V calibration` consists of two stages. In the first stage, a measurement is performed on a sample with a length of `p1`. The measured values are placed in the tow upper rows of the table ①. Diagram ② informs the operator which of the calibration samples is currently active highlighting the foot of the active transducers ③.



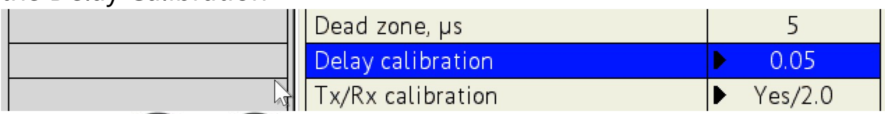
The operator can either complete the upper table or interrupt the measurements and proceed to the second stage. Use `table manager` ④ to do so.



Use ① to switch the measurement to the p2-sample. Now, the two lower rows of the resulting table ② are active. Diagram ③ highlights a different pair of sensors.

Manual adjustment

The operator can adjust the delay even after the calibration. Select the Delay Calibration

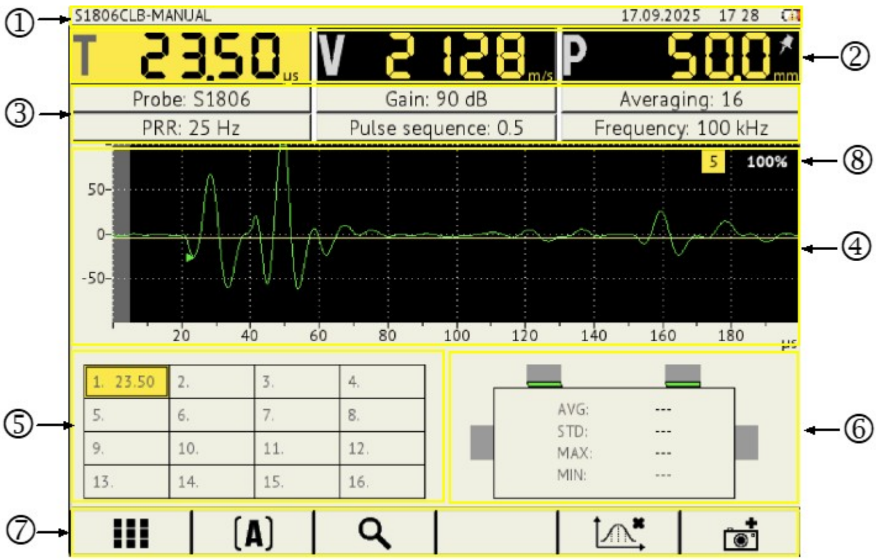


and press + or − to manually increase or decrease the delay value.

2.4 Main window

2.4.1 Overview

Use  to exit the [Project manager](#) 18 and enter the main window. The window has following controls:



Information panel ①

The `Information panel` is used to display the `Project name`, `Date`, `Time`, and `Battery status`.

Results panel ②

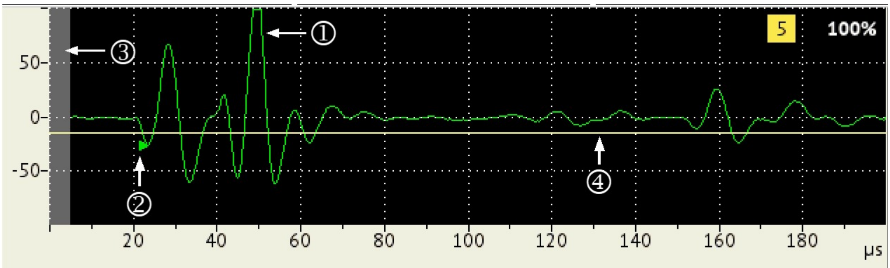
Read more about the results panel on page 26, refer to the `Result type` parameter.

Parameters panel ③

The `Parameters panel` displays key project parameters, including `Probe name`, `Gain`, `Averaging`, `PRR`, `Transmitter pulse sequence`, and `Operating frequency`. Having these parameters in the main window is practical, as they will also be captured in a screenshot. For more information refer to page 26.

Ascan ④

The `Ascan` displays the measured ultrasonic signal ①. A triangle marker ② serves as a time reference, indicating the measured arrival time of the ultrasonic wave at the receiver. Additionally, the `Ascan` shows the `Dead zone` 26 ③ and the `Calibrationfunction` 33 ④.



Results table ⑤

The results table allows you to save up to 16 values of `Time`, `Velocity`, or `Path` depending on `Result type` 26 parameter. If the user switches the `Result type`, the table values will be recalculated. The operator can delete a specific table entry or clear the entire table 48.

Measurement scheme ⑥

This is a graphical diagram that reminds the user which `Measurement scheme` 26 is currently active. In the inner area displays some statistical information about the measured values from Result table, including: average, standard deviation, maximum, and minimum.

Control panel ⑦

The `control panel` provides the operator with additional options for managing the table, cursor, ascan , and saving screenshots. A description of the `control panel` functions is provided on page 47.

Zoom indicator ⑧

Displays the current `zoom` level as a percentage 53.

2.4.2 Control panel

The control panel offers the operator the following functions:

	Description
①	Table editor 48
②	Detection tool 48
③	Zoom tool 53
④	Measurement averaging 54
⑤	Screenshort 55

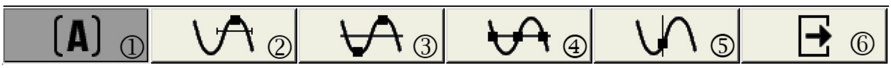
2.4.2.1 Table editor

The `Table editor` has following functions:

The operator can delete an entry in the table by pressing ①. First, navigate to the desired entry using , , and , then press ①. The operator can clear the entire table by pressing ②. Press ③ to exit.

2.4.2.2 Detection tool

The A1220 MONOLITH UPVT automatically detects the arrival time of the ultrasonic wave at the recierver. In most cases automatic detection works fine. However, in some cases, automatic detection may yield unstable results (e.g., large inspection depths, poor material sound conductivity, poor surface quality, too noise environment). With the help of the `Detection tool`, the operator can manually define/edit the arrival time of the ultrasonic wave. The tool has 5 detectors.

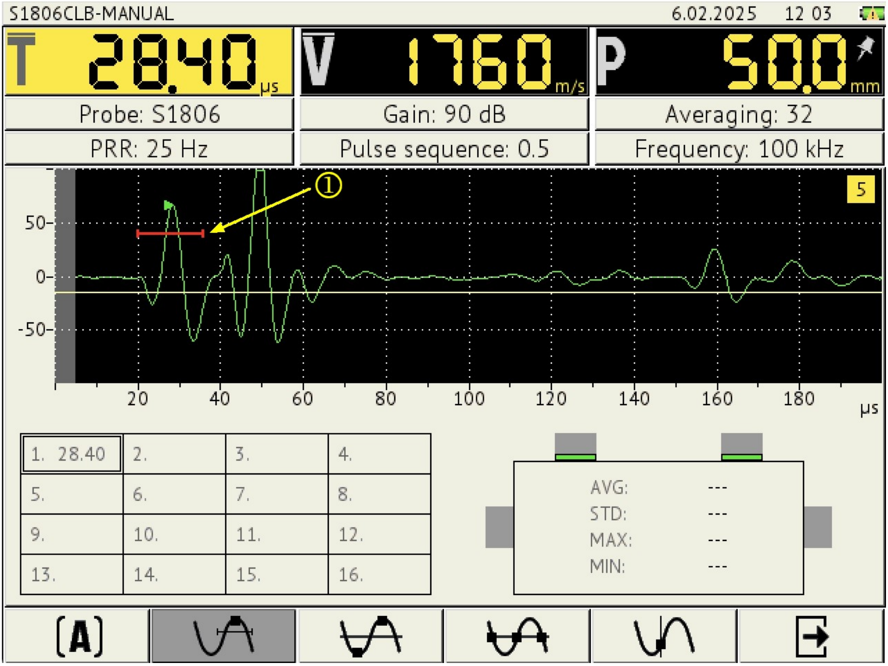


Function disabled ①

The manual detection tool is disabled. The A1220 MONOLITH UPVT detects he arrival time automatically using `Threshold function` that was measured during the Tx/Rx calibration 33.

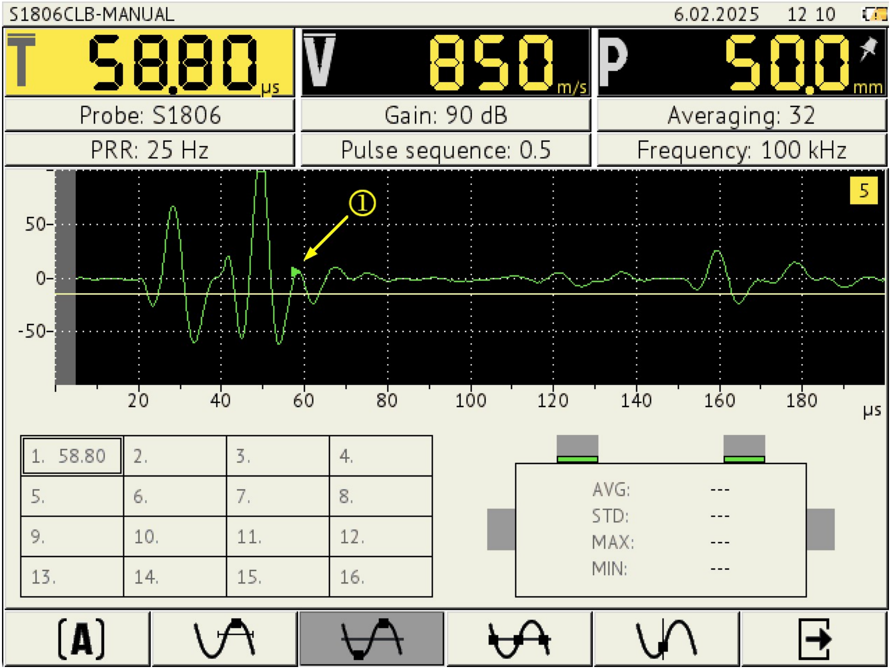
Gate detector ②

The `gate detector` finds the maximum or minimum extremum at an arbitrary location of the ascan. The gate is indicated by a red line ①. Use the  and  to change the vertical position of the gate. Use the  and  arrows to move it horizontally. Use the  and  to increase or decrease its the length.The following image shows the gate detecting a positive peak:



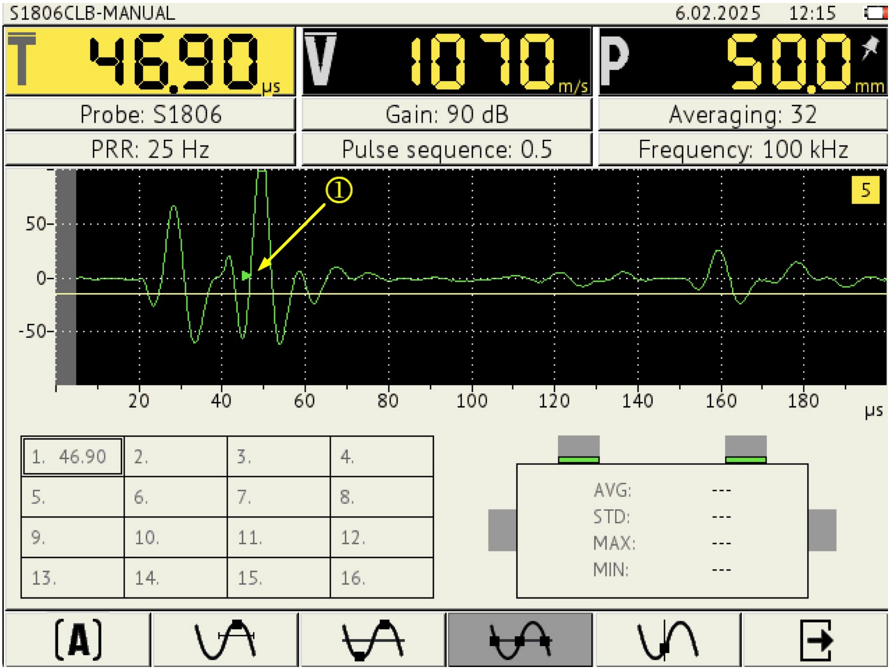
Peak detector ③

`Peak detector` automatically calculates the positions of peaks on the ascan. Use  and  to navigate through these peaks. The following image shows the positive peak ① detection.



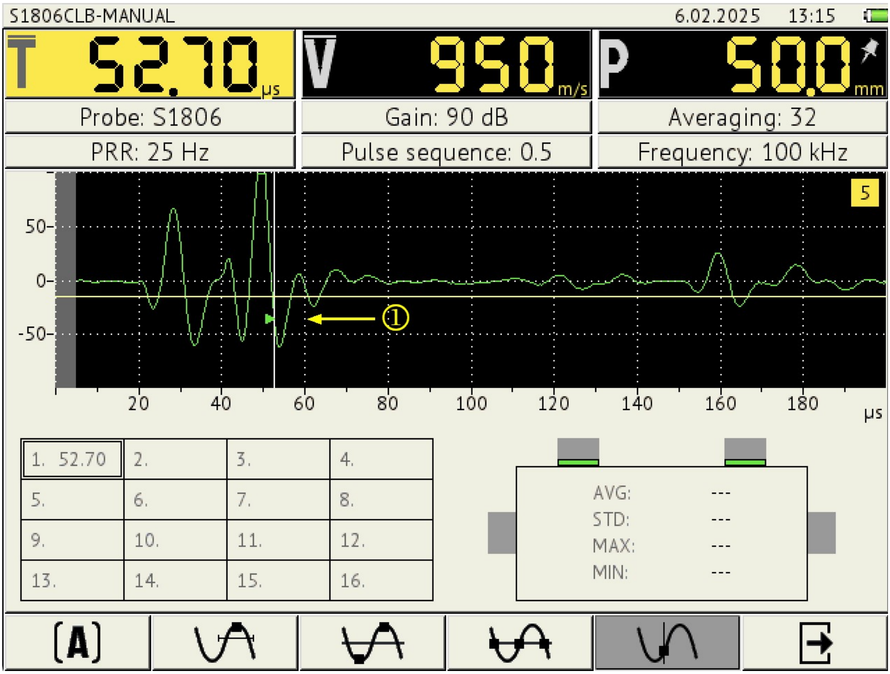
Zero-cross detector ④

Zero-crossing detector automatically calculates the positions of zero-crossings on the ascan. Use  and  to navigate through zeros-crossings. The following image shows zero-crossing ① detection.



V-detector ⑤

V-detector (V stands for vertical) represents a vertical cursor that moves along the time axis of the ascan. Use  and  buttons to move the cursor horizontally. The following image shows a V-detector ① example:

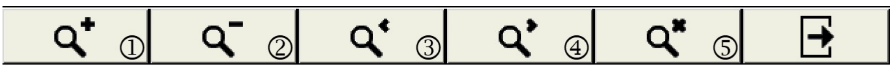


Exit ⑥

Used to exit the `Detection tool`

2.4.2.3 Zoom tool

The `Zoom tool` provides the operator with controls to adjust the `Ascan` magnification and viewport.



Zoom in ①

By default, the `Ascan` timebase is 200 µs. Each press of ① increases magnification and reduces the visible time window in the following sequence (relative to the default): 100% → 125% → 150% → 200% → 250% → 500% → 1000%.

Zoom Out ②

The inverse of ①; decreases magnification and expands the visible time window.

Pan left ③, Pan Right ④

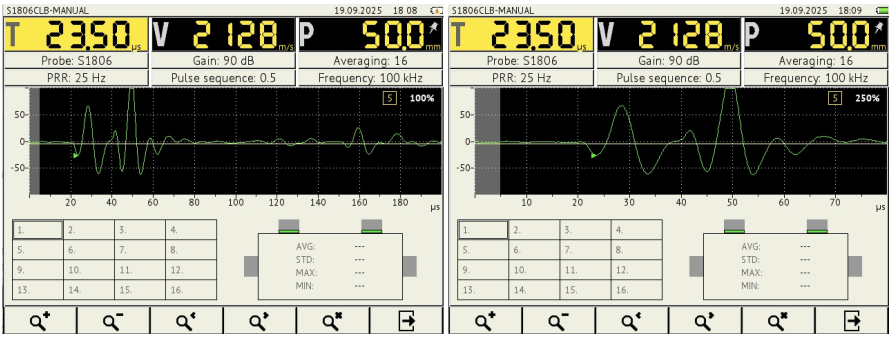
After zooming, parts of the signal may move outside the visible area. Use ③ or ④ to bring the signal back into view.

Reset View ⑤

Clears all `Zoom tool` adjustments and returns the `Ascan` to the default view.

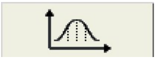
Zoom Indicator

The on-screen indicator in the top-right corner displays the current A-Scan zoom level. Examples below show the indicator at 100% and 150%.



2.4.2.4 Measurement averaging

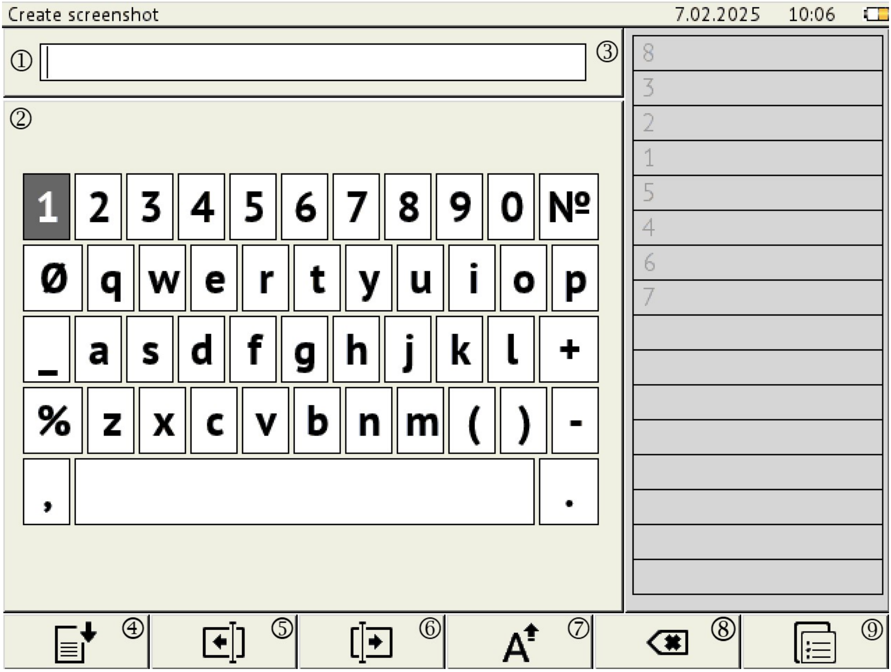
The operator may choose whether the `Results panel` 45 displays the last measured value or an average of the values in the table.

 enables averaging, while  disables it. When averaging is enabled, a horizontal line appears above the measured value . If averaging is disabled the measured value does not have a horizontal line .

2.4.2.5 Screenshot

Main window

The screenshot function  allows the operator to save the current screen as a graphic file. The main window of the screenshot function looks as follows:

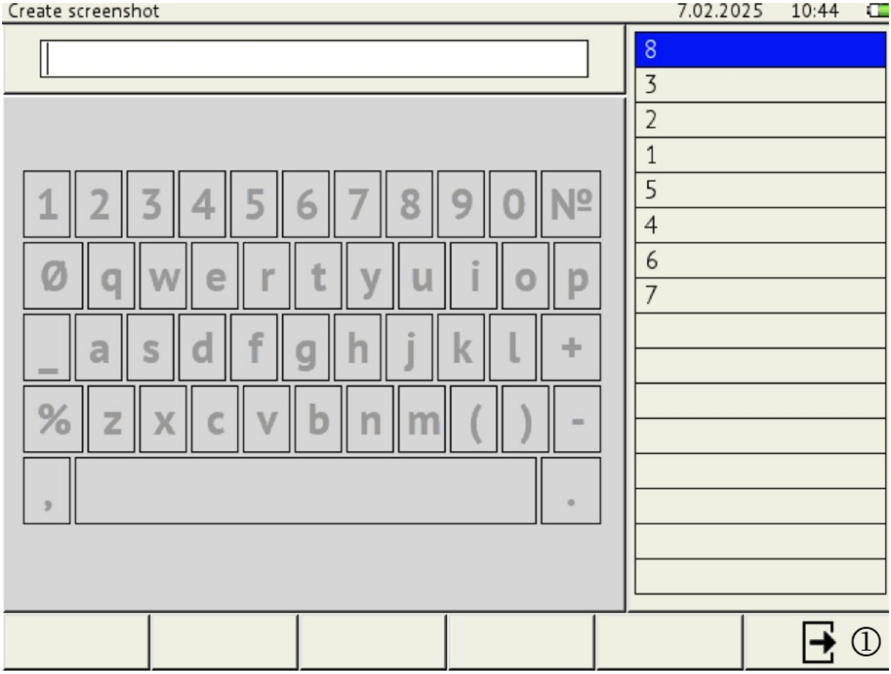


See the enumerated controls in the following table:

	Description
①	File name input filed
②	Keyboard. Use , , and to navigate the keyboard. Confirm input pressing
③	Screenshot list
④	Save screenshot control. By pressing it the screenshot ill be saved.
⑤	Move the current cursor position in field ③ one step to the left
⑥	Move the current cursor position in field ③ one step to the right
⑦	Uppercase / lowercase switch
⑧	Delete character in field ③
⑨	Activate screenshot list. Read more about the list in the next section.

Screenshot list

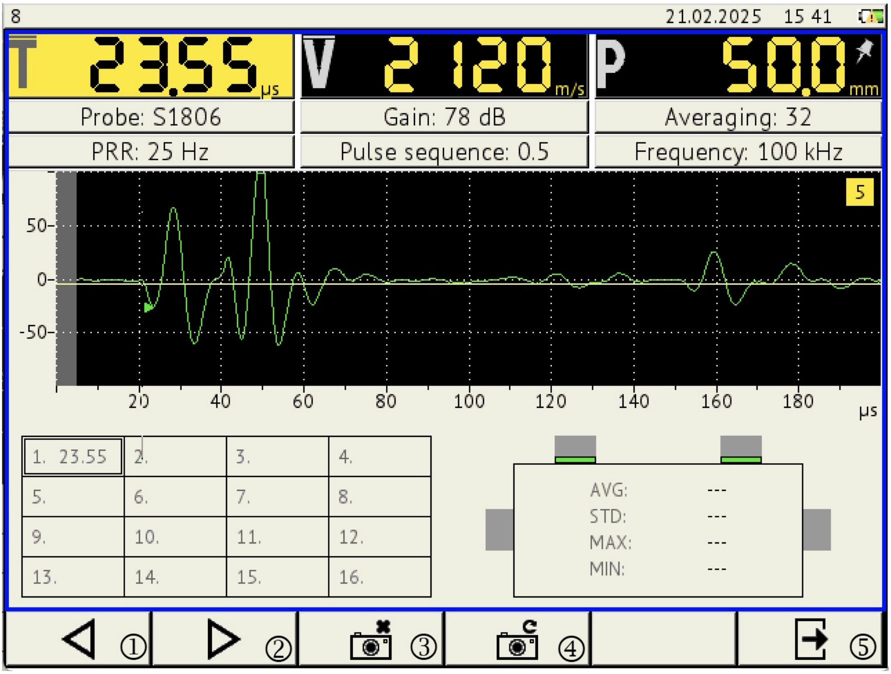
The list allows the operator to see the names of previously saved screenshots. The operator can reuse the name of an already saved screenshot to overwrite it or slightly modify the name without having to type it all again. Activate the list by pressing ⑨.



To navigate the list, use and .Press select the name. Press ① to go to the main window of the screenshot function.

2.5 Screenshot manager

`Screenshot manager` offers various functions for working with screenshots. To prevent the operator from accidentally confusing the manager window with the main window, the main `Screenshot manager` window has a blue border. To start working with `Screenshot manager` press



Scrolling Through Projects

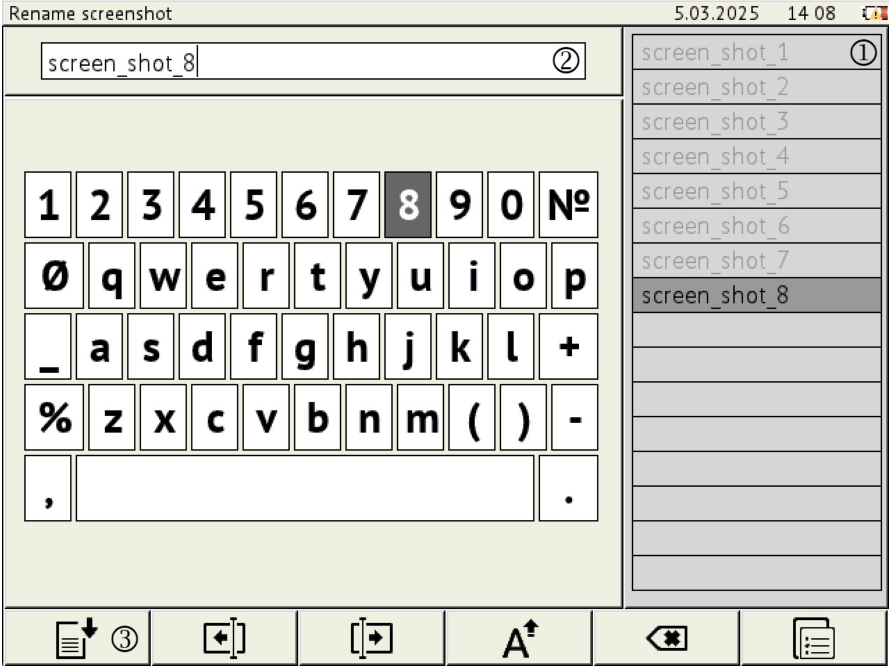
The operator can use buttons ① and ② to scroll through the screenshots sequentially. The name of the currently active screenshot is displayed in the information panel 45.

Deletion

The current screenshot can be deleted using functional button ③.

Active screen and renaming

By pressing ④, the operator can open a special window that allows them to: change the name of an existing screenshot, overwrite an existing screenshot with another one, or select the desired screenshot from the list and open it on the screen.



The controls of `screenshot manager` window are described on page 55. One important addition is the ability to rename a screenshot selected in ①. If the operator enters a new name in the field ② and clicks ③, the selected screenshot in ① will be renamed. If the operator attempts to save a screenshot with a name that already exists, a corresponding notification will be displayed.

In addition, the user may use list ① to select a screenshot that will be shown on the screen without walking through the entire list of screenshots sequentially. To do this, simply select the desired screenshot from list ① and close the window with 

.

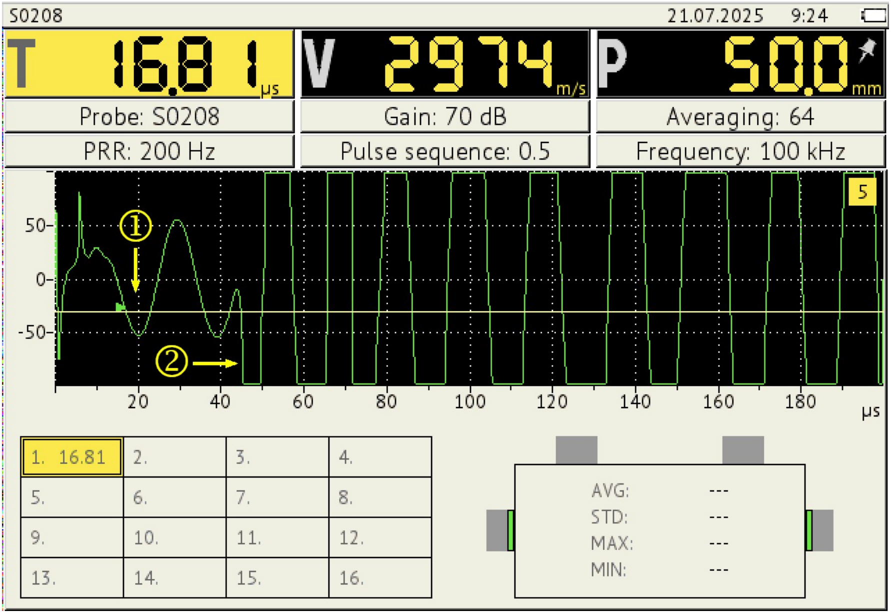
2.6 Guide

2.6.1 Dead zone

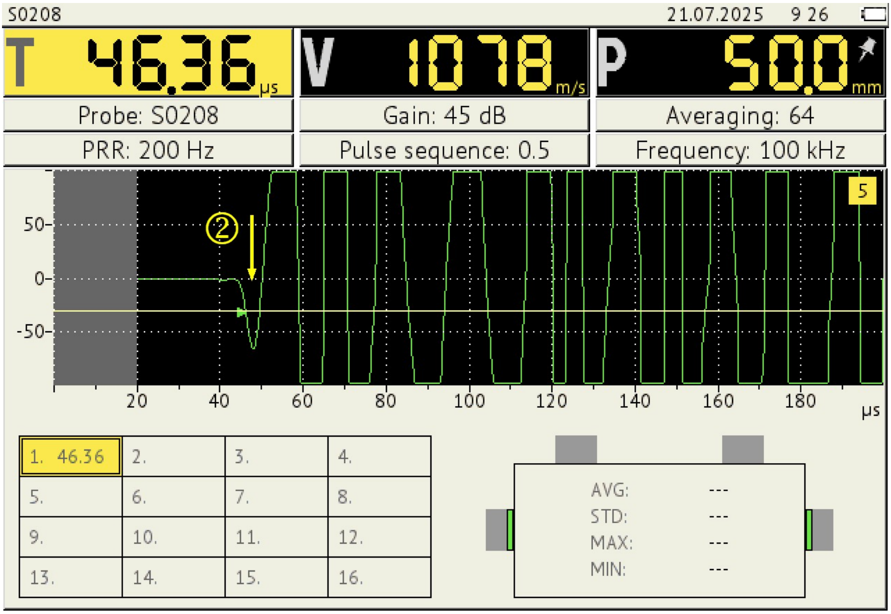
When using low-frequency ultrasonic transducers (single DPC, single PET or array), a so-called `Dead zone` may appear at the beginning of the A-scan. This `Dead zone` can result from several factors, including:

- `Reverberations` within the transducer. These are back-reflected waves from the rear side of the transducer, which may interfere with signal reception near the surface.
- `Long ring-down time` of the transducer. Low-frequency transducers tend to exhibit longer ring-down periods, meaning the element continues to vibrate for several microseconds after excitation. During this time, weak near-surface echoes are masked and cannot be reliably detected.
- `Excessive gain` settings. Using too much gain may saturate the receiver, producing artificial echoes and reverberations, especially in the near field. This can obscure real signals and exaggerate dead zone effects.
- `Poor acoustic coupling`. Air gaps, trapped bubbles, or simply poor dry contact between the probe and the test surface can cause multiple parasitic reflections, which interfere with the actual ultrasonic signal.

The `Dead zone` may interfere with time-of-arrival estimation. `Dead zone` artifacts often affect signal stability. As a result, the A1220 MONOLITH UPVT may interpret the A-scan as unstable and fail to complete data acquisition and detection. This can cause the measurement process to repeatedly restart from the initial point. The following figure shows an example of a false trigger caused by a reverberation signal in the dead zone ①. However, the correct arrival pulse is ②.



Setting the `Dead zone` parameter to 20 µs allows the detection algorithm to ignore the false signal. The correct arrival pulse is ②.



2.6.2 Transducers

The A1220 MONOLITH UPVT can operate with a wide range of transducers featuring various frequencies, wave types, and emission principles. The following chapters provide the operator with information about their properties and application specifics.

2.6.2.1 DPC

In this chapter provides detailed information about DPC sensors and their measurement schem 26, as well as the range of allowable and recommended distances between the emitter and receiver (also called `pitch`). Additionally, a list of compatible calibration blocks is provided.

NOTE

The table headings use the following abbreviations for measurement schemes 26:

- D-L: `Measurement scheme = Direct`, using a longitudinal wave
- D-S: `Measurement scheme = Direct`, using a share wave
- I-L: `Measurement scheme = Indirect-L` (L = longitudinal)
- I-S: `Measurement scheme = Indirect-S` (S = share)

The sign `[+]` indicates that the particular DPC supports the corresponding scheme. The column `Freq. kHz` refers to the transducer frequency. The `Type` can be either `L` or `S`, which correspond to longitudinal and shear waves, respectively. The superscript numebr, for example `[+]`[1], indicates the calibration block required for performing the delay calibration. For more information about calibration blocks refer 68.

Measurement scheme

Before starting work, the operator must determine which type of measurement is the most suitable for the task. In some cases, through-object measurement (`Direct`) may be required. In other cases, surface scanning (`Indirect`) should be used.

Trans.	Type	Freq. KHz	D-L	D-S	I-L	I-S
S1905	L	25	[+]n/d			
S1902	S	25		[+]n/d	[+]n/d	[+]n/d
S1844	L	50	[+]n/d			
S1801	S	50		[+]n/d	[+][1]	[+]n/d
S1802	S	50		[+]n/d	[+][1]	[+]n/d
S1803	L	100	[+][1]			
S1806	S	100		[+][1]	[+][1]	[+][1]
S1805	L	150	[+][1]			
S1807	S	150		[+][1]	[+][1]	[+][1]
S1808	S	250		[+][1]	[+][1]	[+][1]

`[n/d] = not defined yet`

The following table associates the index used in the upper table with the corresponding calibration block 68.

Index	Block
1	TK300 69

Pitch-range

The following table helps the operator choose the appropriate DPC depending on the possible pitch.

Trans.	Type	Freq. KHz	D/L, mm	D/S, mm	I/L, mm	I/S, mm
S1905	L	25	≥200			
S1902	S	25		≥100	[n/d]	[n/d]
S1844	L	50	≥100			
S1801	S	50		≥55	80-150	90-180
S1802	S	50		≥55	80-150	90-180
S1803	L	100	≥50			
S1806	S	100		≥30	40-100	50-100
S1805	L	150	≥30			
S1807	S	150		≥20	40-80	50-100
S1808	S	250		≥15	20-40	30-70

[n/d] = not defined yet

Recommended pitch

The following table offers the operator recommended pitch values. When selecting these parameters, the physical characteristics of the DPC and the specifics of the calibration blocks were taken into account.

Trans.	Type	Freq. KHz	D/L, mm	D/S, mm	I/L, mm	I/S, mm
S1905	L	25	≥250			
S1902	S	25		≥120	[n/d]	[n/d]
S1844	L	50	≥150			
S1801	S	50		≥80	120	90
S1802	S	50		≥80	120	90
S1803	L	100	≥75			
S1806	S	100		≥40	70	70
S1805	L	150	≥50			
S1807	S	150		≥25	60	70
S1808	S	250		≥20	30	50

[n/d] = not defined yet

2.6.2.2 PET

In this chapter provides detailed information about piezo-electronic-transducers and their measurement scheme 26, as well as the range of allowable and recommended distances between the emitter and receiver. Additionally, a list of compatible calibration blocks is provided.

Measurement scheme

Transducer	W-Type	Freq. KHz	D/L	D/S	I/L	I/S
S0205	L	25	[+][1]			
S0206	L	50	[+][1]			
S0208	L	100	[+][1]			

The following table associates the index used in the upper table with the corresponding calibration block 68.

Index	Block
1	TK100 72

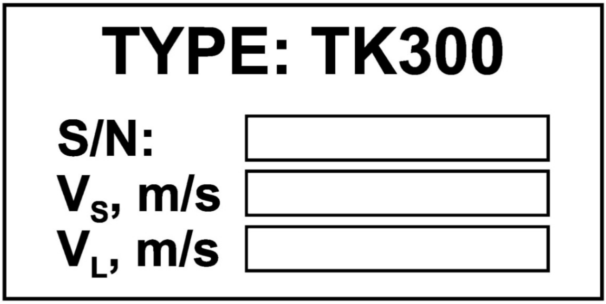
2.6.3 Calibration blocks

This chapter describes the calibration blocks used for delay measurement in the UPVT.

2.6.3.1 TK400

General information

The calibration block TK400 is made of polymethyl methacrylate (PMMA) and measures 180 × 150 × 50 mm. The top and bottom surfaces of the block are treated with glass bead blasting to ensure better contact with DPC transducers, which results in reduced transparency of the sample. In the upper right corner of the TK400, there is a label indicating the `S`- and `L`-wave velocities, as well as the serial number `S/N` and the `Type`:



NOTE

Refer to 63 for the list of transducers that can be calibrated using the TK400.

Direct measurement scheme, D-L and D-S

In case of the direct D-L or D-S measurement scheme 63), use the dedicated positions (marked circles) for the sensors located on the top and bottom surfaces of the block. The markings are designed so that the top and bottom sensors are positioned directly opposite each other. Make sure that the correct sound velocity is set.

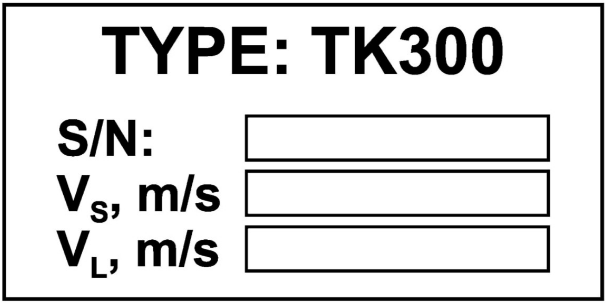
Indirect measurement scheme, I-L and I-S

`Chapter is under construction`

2.6.3.2 TK300

General information

The calibration block TK300 is made of polymethyl methacrylate (PMMA) and measures 180 × 100 × 50 mm. The top and bottom surfaces of the block are treated with glass bead blasting to ensure better contact with DPC transducers, which results in reduced transparency of the sample. The bottom part of the block is covered with a `rubber absorber`, which reduces reflections from the block's bottom surface. The block has a serial number `S/N` and specified values for shear (V_s) and longitudinal (V_L) wave velocities.

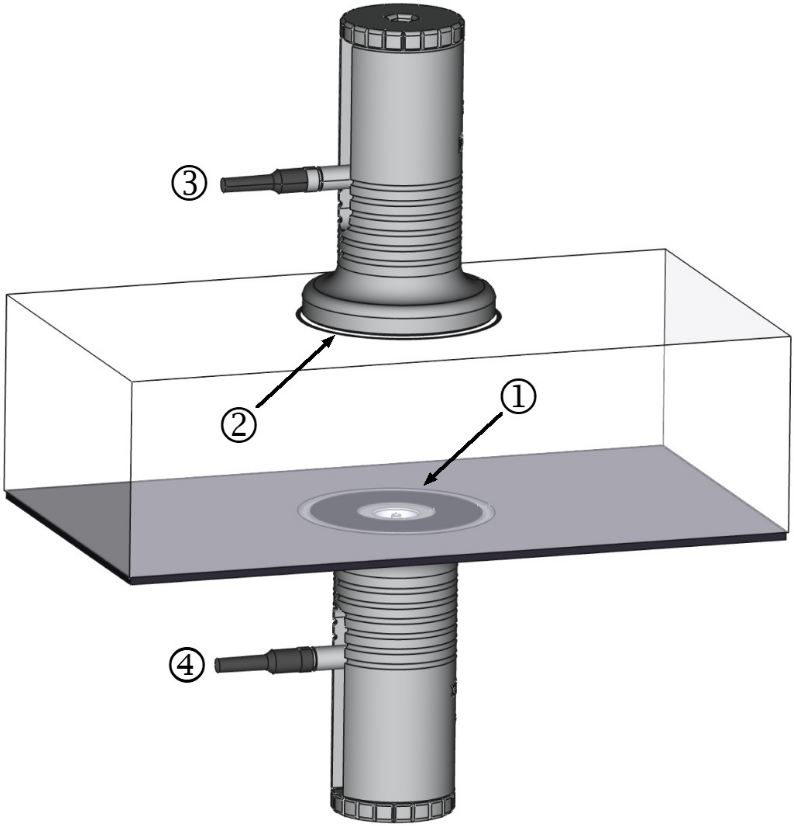


NOTE

Check the list of transducers 63 that can be calibrated using the TK300.

Calibration: Direct scheme

To perform Delay calibration 37, use D18-XX 74 holder. Insert the holder into the opening on the rubber absorber side ①. On the opposite side, the correc position for the holder is marked with a circular indicator ②. Firmly press both holders with the sensors against the `TK300` block. Use the supporting surface underneath to ensure proper contact.

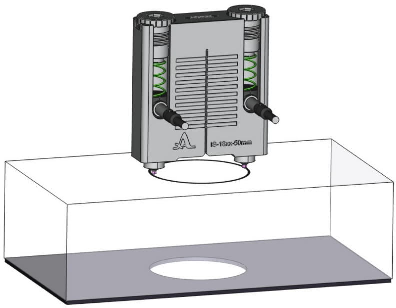


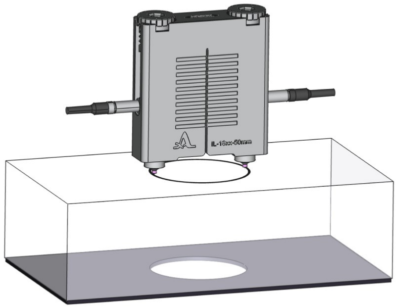
NOTE

Ensure that the LEMO connectors of the transmitter ③ and receiver ④) are oriented in the same direction.

Calibration: Indirect scheme

To perform Indirect calibration 37 use IL-18XX-YYYmm 74 or IS-18XX-YYYmm 74 holder. Calibrate on a rubber-free surface. The holder must be positioned as close to the center of the `TK300` as possible.





2.6.3.3 TK100

The `TK100` calibration block is made of PTFE with 15% carbon content. Its dimensions are 70 mm in diameter and 150 mm in length. `TK100` was developed specifically for low-frequency piezoelectric transducers and is intended for use in the Direct scheme 26 only.The unique material composition of TK100 results in an ultrasonic velocity nearly twice as low as that of PLEXOGLAS. This property allows efficient calibration of low-frequency transducers (starting from 25 kHz) with wide beam angles and high acoustic power, even on a relatively compact block size. The block has a serial number `S/N` and specified values longitudinal (V_L) wave velocity:

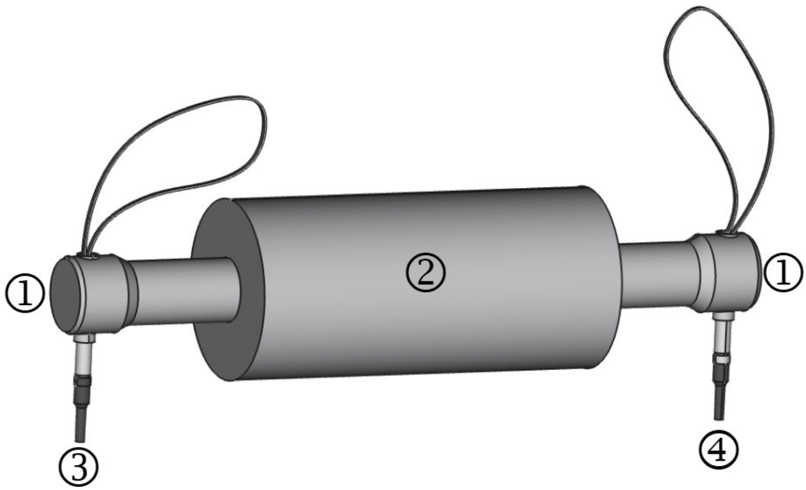
NOTE

Check the list of transducers 63 that can be calibrated using the TK100.

To use `TK100` as a coupling block, apply either water or gel as the coupling agent. For calibration purposes, water is recommended, as it is the easiest to remove after use.

Calibration:Direct scheme

Place the transducers ① at the center of each end face of `TK100` ②. Ensure proper acoustic coupling between the transducers and the surface. In some cases, it may be necessary to gently rotate the transducer while applying pressure to achieve optimal contact. Make sure that the water layer between the transducer surface and the block is as thin as possible.



NOTE

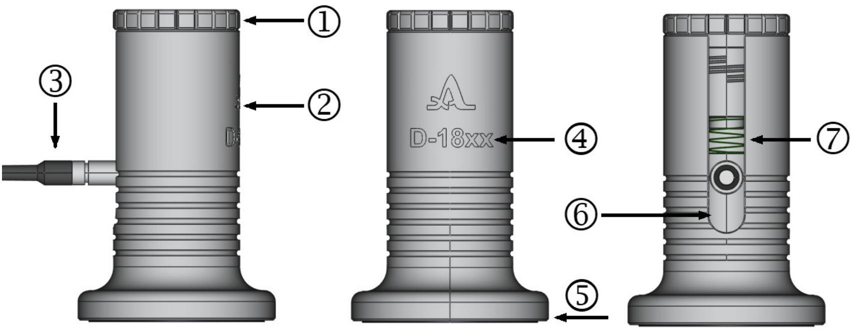
Ensure that the LEMO connectors of the transmitter ③ and receiver ④) are oriented in the same direction.

2.7 Holders

For performing measurements with DPC transducers, it is recommended to use specialized holders. This chapter provides a detailed description of these accessories.

D-18XX

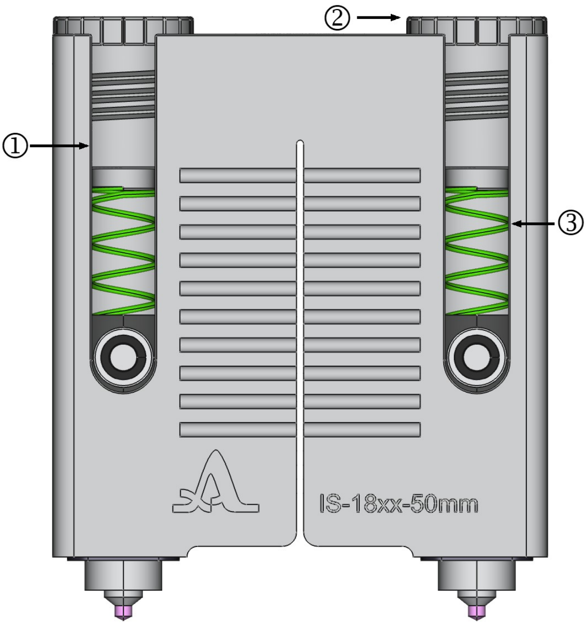
The D-18XX holder is used for measurements in the Direct scheme 26 with all DPC transducers of the S18XX series, where "XX" represents a number. The D-18XX holder is shown in the following figure:



	Description
①	Threaded housing cap. The cap ensures proper contact between the transducer ⑥ and the test object via the springs ⑦.
②	Housing
③	LEMO cable connected to the transduce ⑥
④	Identification label
⑤	Rubber pad for protecting the transducer during contact with concrete
⑥	S18XX transducer
⑦	Spring for pressing the transducer against the surface

IS-18XX-YYYmm

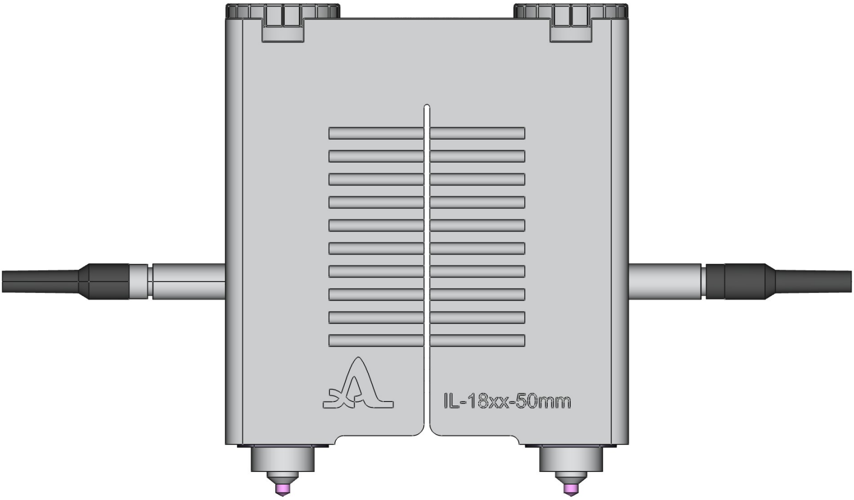
The `IS-18XX-YYYmm` holder is designed for performing measurements using the Indirect scheme 26 with `S-Type` (shear) waves. For this type of measurement, the DPC transducers are positioned such that the LEMO connectors of both transducers are parallel to each other. Like the `D-18XX` , the `IS-18XX` is mechanically compatible with all `18XX` series transducers. The `YYY` parameter indicates the distance between the transducers pins. This distance is selected based transducer frequency and the measurement task.



In the IS-18XX-YYYmm holder, each transducer is mounted in an individual shaft ①. A threaded cap ② applies pressure to a spring ③, which in turn presses the DPC transducer against the output opening of the shaft.

IL-18XX-YYYmm

The IL-18XX-YYYmm holder is designed for performing measurements using the Indirect scheme 26 with P-Type (longitudinal) waves. The IL-18XX-YYYmm holder differs from the IS-18XX-YYYmm in that the DPC transducers are oriented facing each other.


IL-18xx-50mm

3 2D Tomography

3.1 Getting started

Check this quick start guide to start using the instrument as quickly as possible.

Startup

Power on 16 the A1220 MONOLITH UPVT. After turning on the device and switching to 2D Tomography 16 mode, ensure that the battery is sufficiently charged . If the battery is low, charge the device before use

Operation

- Use the `Project manager` 18 to create a new project or open an existing one.

3.2 Project manager

The main project management window in 2D Tomography is the same as the main window in UPVT mode. For a detailed description, please refer to page 18.

3.2.1 Functional panel

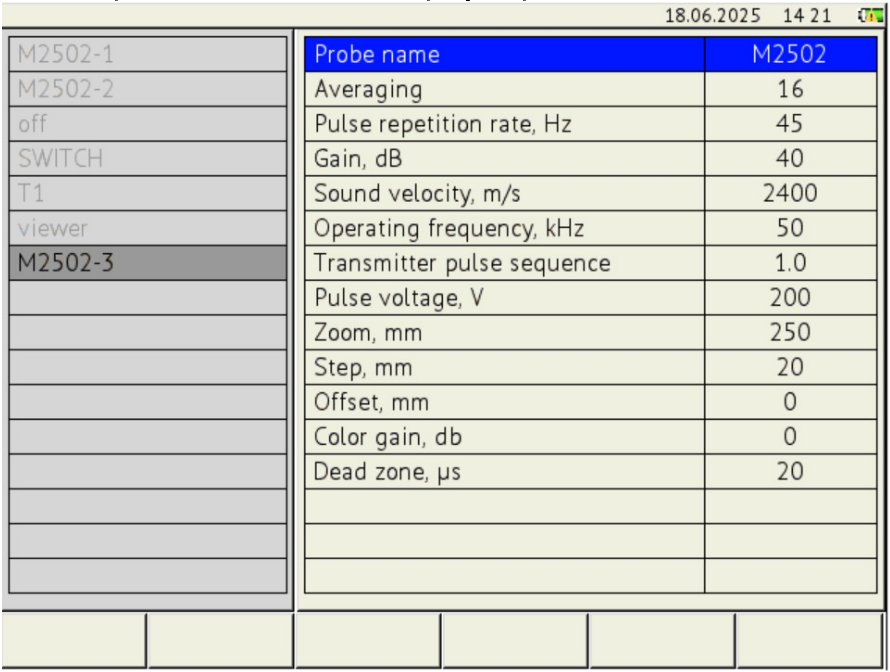
Detailed description of `Functional pannel` read on page 20.

3.2.2 System-settings

Detailed description of `System settings` read on page 20.

3.2.3 Project parameters

This chapter describes the main project parameters:



Probe name

After creating a project, the operator can use ⊕ and ⊖ to select the desired transducer or array sensor.

NOTE

Currently, the device supports the `M2502` array in 2D Tomography mode. In the future, the number of supported arrays and sensors is expected to expand. Support for third-party (or `CUSTOM`) arrays and sensors will also be added.

This parameter will be locked as soon as the first measurement position is recorded.

Averaging

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Pulse repetition rate, Hz (PRR)

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Gain

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Sound velocity

For detailed information refer to page 26. This parameter can be changes at any time cousing the recomputing of all taken data. Press Enter to open the tool 85 for velocity calibration.

Operating frequency

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Transmitter pulse sequence

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Pulse voltage

For detailed information refer to page 26. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

Zoom

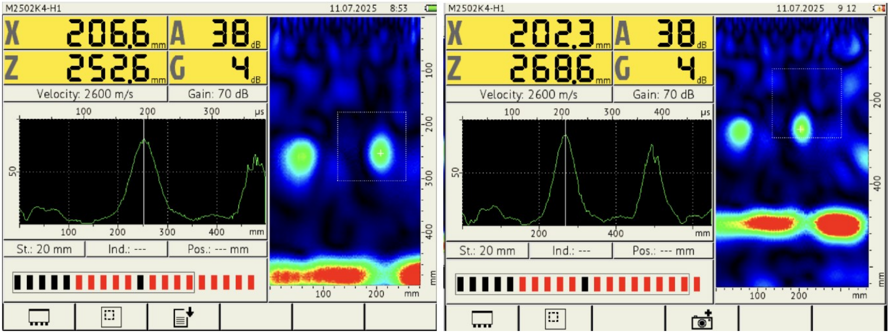
`Zoom` defines the physical size of the image. Its value can range from 250 mm to 2000 mm. The image depth is always equal to the selected `Zoom` value, while the width is calculated automatically. Note that the image resolution is fixed at 221 × 391 pixels and does not depend on the `Zoom` setting. However, the physical size of each pixel (in millimeters) does change. The operator can estimate the size of a single pixel (in mm) by dividing the selected `Zoom` value by the number of pixels along the vertical or horizontal axis. To adjust the `Zoom`, use + and −.

NOTE

The operator can change the `Zoom` parameter at any time, even after measurements have already been taken. This will trigger a complete recalculation of the image and may take some time to process

---

The following example shows an example with Zoom set to 500 mm and 600 mm, respectively. As seen in the image on the right, the back-wall signal has shifted upward due to the increased inspection depth.



This parameter can be changed at any time, causing all previously acquired data to be recalculated.

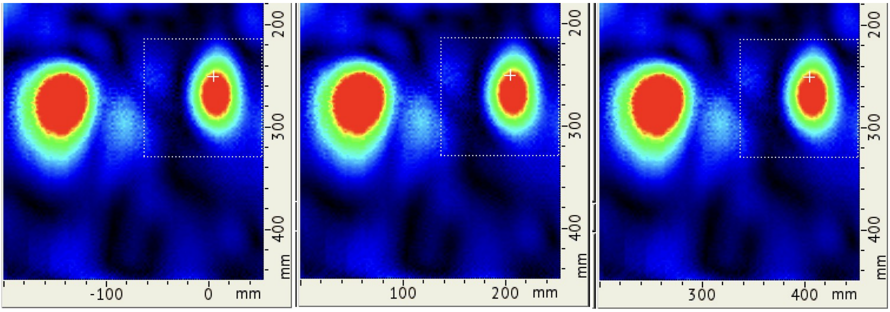
Step

`Step` denotes the distance between measurement positions. The maximum number of positions is limited to 57. For step selection guidelines, refer to page 100. To adjust the step value, use the and .

This parameter can be changed at any time, causing all previously acquired data to be recalculated.

Offset

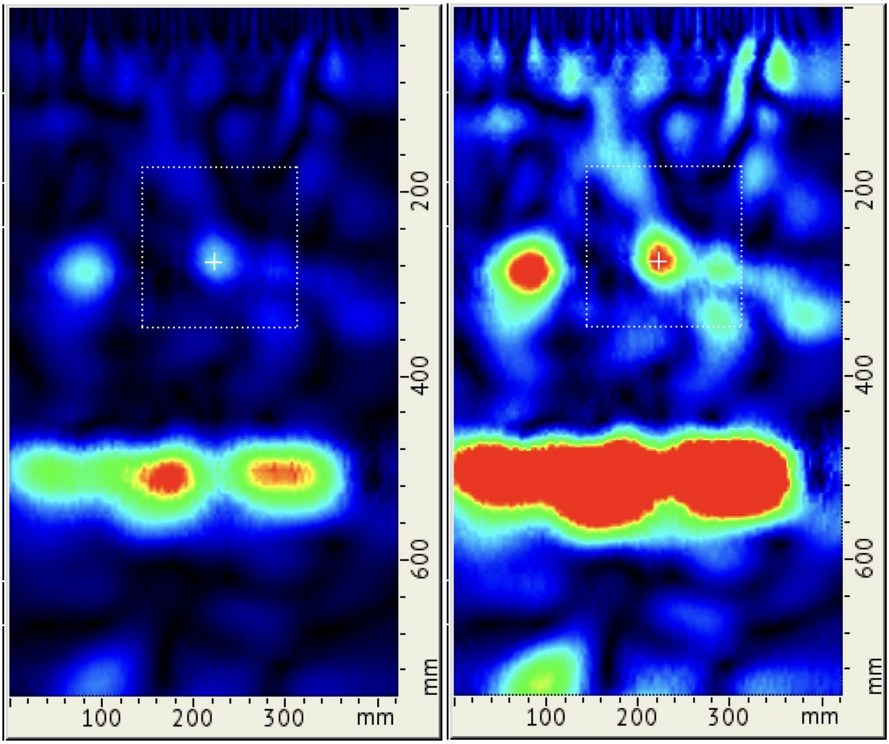
The `Offset` parameter allows shifting the horizontal axis of the image. This parameter is particularly useful when the operator is scanning an extended area consisting of multiple segments. For example, one project may contain data from 0 to 300 mm, the next from 300 to 600 mm, and so on. The data from individually scanned projects can be stitched together into a single large image using the `Offset` parameter. To ensure smoother transitions between segments, it is recommended to use overlapping segments with an offset of approximately 100 mm. The `Offset` value can also be negative. The following figure shows images with offsets of –200 mm, 0 mm, and +200 mm, respectively. To adjust `Offset` use and .



This parameter can be changed at any time, causing all previously acquired data to be recalculated.

Color gain

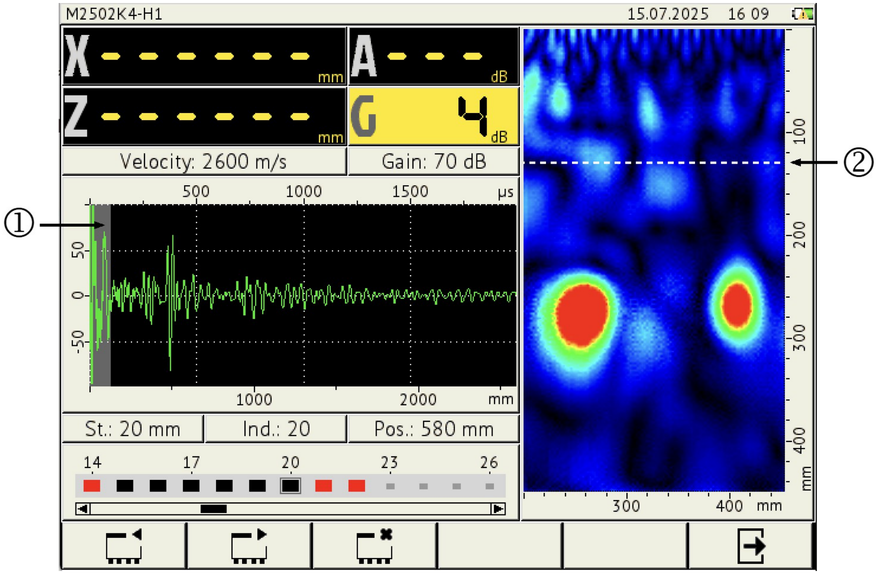
`Color gain` amplifies the resulting image and is measured in decibels `(dB)`. It is especially useful when signal indications are weak or not clearly visible. To adjust the `Color gain`, use the and buttons. The user can also adjust the `Color gain` using and , both in the Main window 90 and in the Measurement Editor 96. Compare the tomographic images in the following figure: one with low `Color gain` (left) and one with high `Color gain` (right).



This parameter can be changed at any time, causing all previously acquired data to be recalculated.

Dead zone

Refer to page 61 for more details on the `Dead zone`. Set a `Dead zone` to exclude unwanted portions of the A-scan from tomographic image. On A-scan, the dead zone is displayed as a semi-transparent gray area ①. On the B-scan, the boundary of the `Dead zone` is shown as a white dashed line ②.

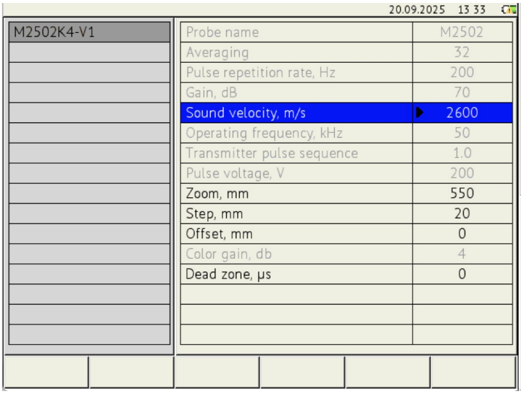


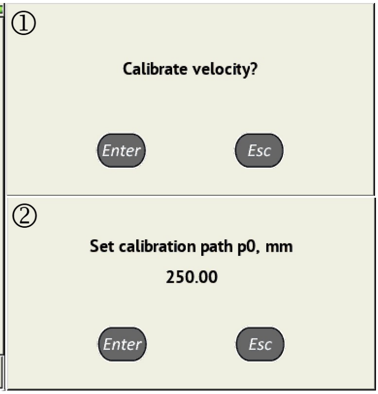
NOTE

Regions on the B-scan that fall within the `Dead zone` may have been processed with reduced accuracy or errors. The operator should not rely on these indications.

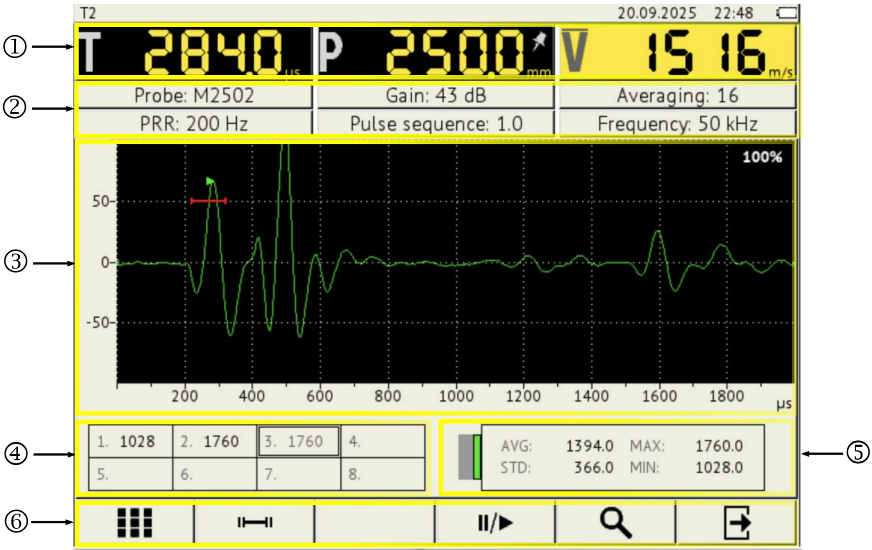
3.2.4 Velocity tool

To obtain a correct tomographic image, the velocity in concrete must be known. The velocity can be measured with dedicated instruments such as `UK1401` or A1220 MONOLITH UPVT 15. If no external instrument is available, use the built-in `Velocity tool`. While it does not yield a metrological value, its estimate is typically closer to the true site-specific velocity than a handbook value. In the Project parameters 79 tab, select the `Sound velocity` parameter and press . Confirm that you want to perform the calibration ①, then enter the thickness of the concrete section at the calibration location ②.





Main Window



Measurement workflow

The Velocity tool performs data acquisition and then displays the measured Ascan ③. It then searches for the time of the maximum within the measurement gate ④. The time is used to calculate the average velocity in concrete. Up to 8 measurement takes (traces) can be used for the velocity computation.The operator can either perform all 8 measurements at the same point, or move the sensor for each new take in order to achieve spatial averaging.

Results panel ①

The result panel displays the time of the last measurement, the calibration distance, and the calculated average velocity.

Parameters panel ②

Refer to page 45 for more details.

Ascan ③

Ascan displays the measured ultrasonic signal.

Results table ④

The Results table can store up to eight velocity values. A single value is sufficient to complete the calibration.

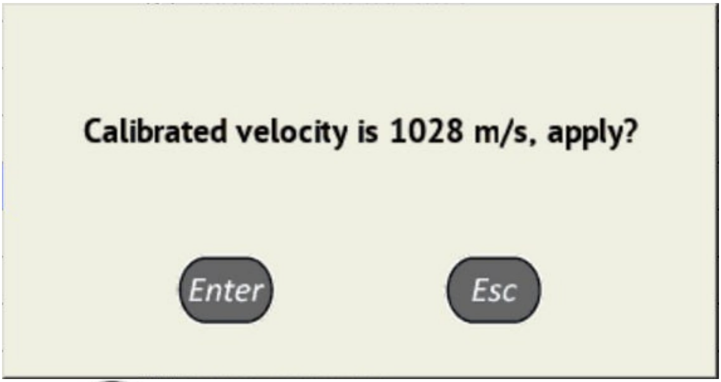
Measurement scheme ⑤

This graphical diagram indicates which measurement scheme is currently active. At present, 2D Tomography supports only the direct scheme. Additional schemes are planned for future releases. The diagram also displays summary statistics for the velocity values in the Results table ④: AVG (mean velocity), STD (standard deviation), MIN (minimum velocity), and MAX (maximum velocity).

Control panel ⑥

The `control panel` provides the operator with additional options for managing the table, gate, start/stop and saving zoom. For more details, refer to page 88.

Exit calibration ⑦



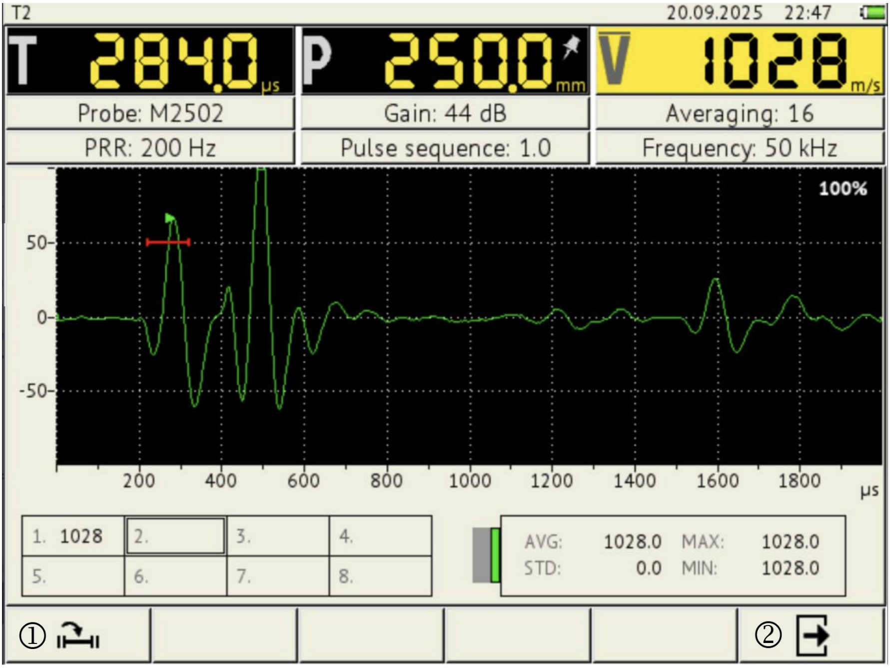
Press  to confirm successful completion of the velocity calibration. If the resulting velocity is not acceptable, press  to cancel and repeat the calibration.

3.2.4.1 Control panel

The `Table editor` and the `Zoom` tool are documented. Refer to page 47 10 for details. This chapter describes the `Gate detector` and the `Start/Stop`.

Gate detector ②

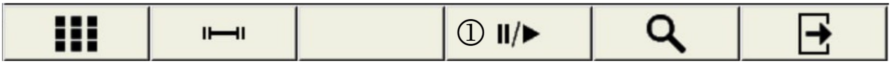
The `Gate detector` lets the operator define the region of interest in which the echo arrival time is searched. Accurate estimation of this time, together with the known specimen thickness, enables correct velocity calculation.



Set the `Gate` position with , , , and its length with and , for more inforamtion refer to page 48. If the `Gate` is outside the visible time window, press ① to center it on the current screen. Press ② to exit the `Gate detector`.

Start/Stop tool ③

If the operator cannot maintain proper sensor coupling to the specimen while adjusting the `Gate`, use the `Start/Stop tool` to pause data acquisition and freeze the current `Ascan`. While paused, you can use the `Zoom tool` and `Gate detector` without coupling quality affecting the result. Press ① to pause. The Start/Stop icon changes color when acquisition is paused.



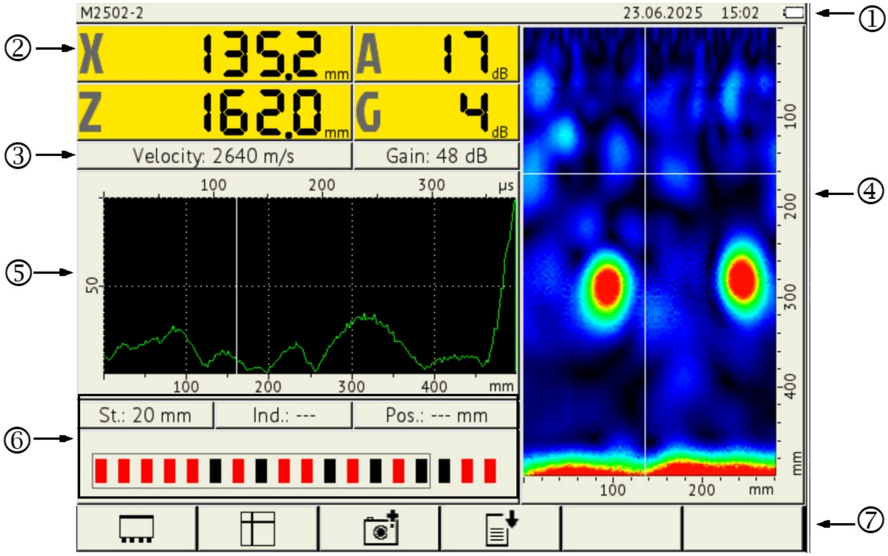
Press ② again to resume measurements.

3.3 Main window

The main window has three primary views: Analysis, Recalculation, and Scan. Use  to exit the [Project manager](78) 78 and enter the main window in one of these views.

3.3.1 Analysis view

The main window switches to the `Analysis view` when the project already contains measured data and tomographic processing has been completed. In this view, the operator can analyze results using the universal cursor and capture screen shots for documentation or further review.



Information panel ①

The `Information panel` is used to display the `Project name`, `Date`, `Time`, and `Battery status`.

Results panel ②

Read more about the `Results panel` on page 95.

Parameters panel ③

The `Parameters panel` displays two key project parameters, `Sound velocity` and `Gain`. Having these parameters in the main window is practical, as they will also be captured in a screenshot. For more information refer to page 79.

B-scan ④

The B-scan displays tomographical image. The B-scan also shows the cursor. Move the cursor using , , and . Refer to page 95 for a detailed description of the cursor.

A-scan ⑤

A-scan is a one-dimensional graph that displays B-scan data along the vertical axis. The displayed position is determined by the cursor. 95 Using the A-scan the operator can evaluate the amplitude of a defect - for example, in relation to the acoustic noise of the image or compare or to the back-wall signal.

Map ⑥

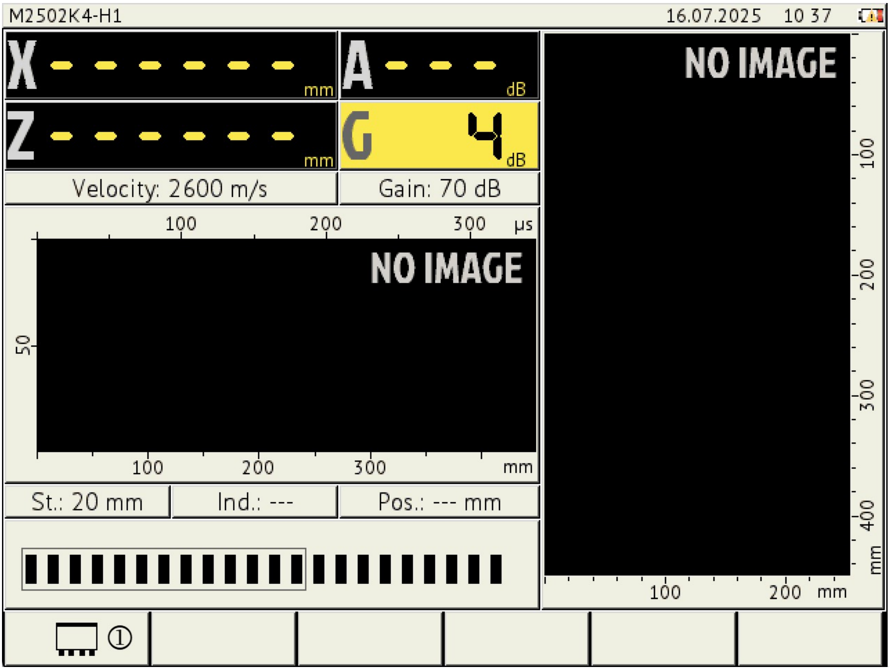
For details on the `Map`, refer to page 100.

Control Panel ⑦

For details on the `Control panel`, refer to page 94.

3.3.2 Recalculation view

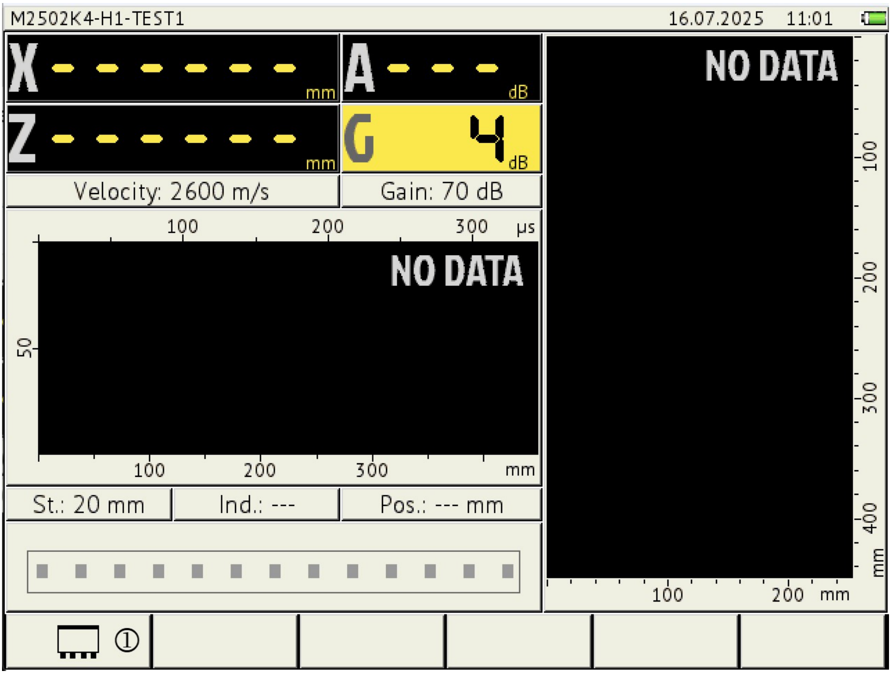
The main window switches to the `Recalculation view` if the operator changes any parameter that requires raw data to be reprocessed. In this state, both A-scan and B-scan appear blacked out with NO IMAGE indicator. The Map 100 highlights positions with available measurements ready for recalculation.



Press ① and follow the steps described in [Measurement editor] 96.

3.3.3 Scan view

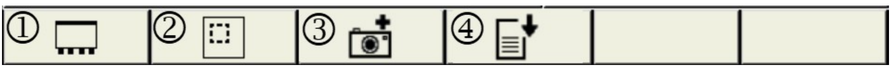
The main window switches to the `Scan` view when no measured data is available in the project. The `Scan view` differs from the `Recalculation view` in that the [Map] 100 does not contain any measurements.



Press ① and follow the steps described in [Measurement editor](96).

3.3.4 Control panel

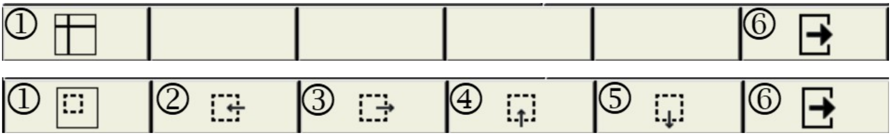
The `Control panel` offers the operator the following functions:



	Description
①	[Measurement editor](96)
②	[Cursor manager](95)
③	[Screenshot](55)
④	[Save project](95)

3.3.4.1 Cursor manager

For data analysis on B-scan the A1220 MONOLITH UPVT offers two kinds of cursors: `cross cursor` and `area cursor`. To move cursor use , , and , they also available in `Main window`. The cursor manager offers the following functions (depending on selected cursor type):



Press ① to switch between the cursor types. For `area cursor` use ②-⑤ to change the size of area. Press ⑥ to exit.

The result of analysis is a point, its properties are displayed in `Result panel` - the coordinate (① and ②) and the amplitude (③):

In case of `area cursor`, the desired point is the point with maximal amplitude inside the area. The A-scan shows the signal corresponded to the X coordinate. Beside the `Dead zone`, the operator can see the vertical cursor corresponded the Z coordinate.

3.3.4.2 Save project

The A1220 MONOLITH UPVT offers to change some project parameters outside the `Project Manager`. Except the cursor values, the operator can change the the color gain. Use  and  to adjust its value. The actual value is shown in result panel ①:

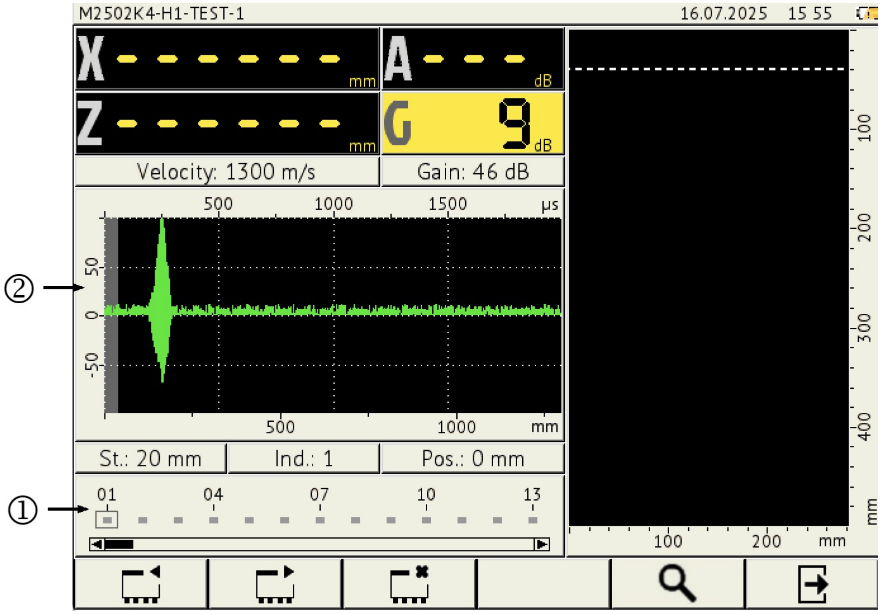
If the project has some changes and not saved parameters, use  to save them before the exit to the `Project manager`.The  control is available only when there are unsaved parameter changes. If there is nothing to save, the control is hidden.

3.3.4.3 Measurement editor

The `Measurement editor` allows the user to perform measurements at specific positions, remove data from selected positions, compute tomographic images, and recompute all data positions if parameters have been changed.

Initialization

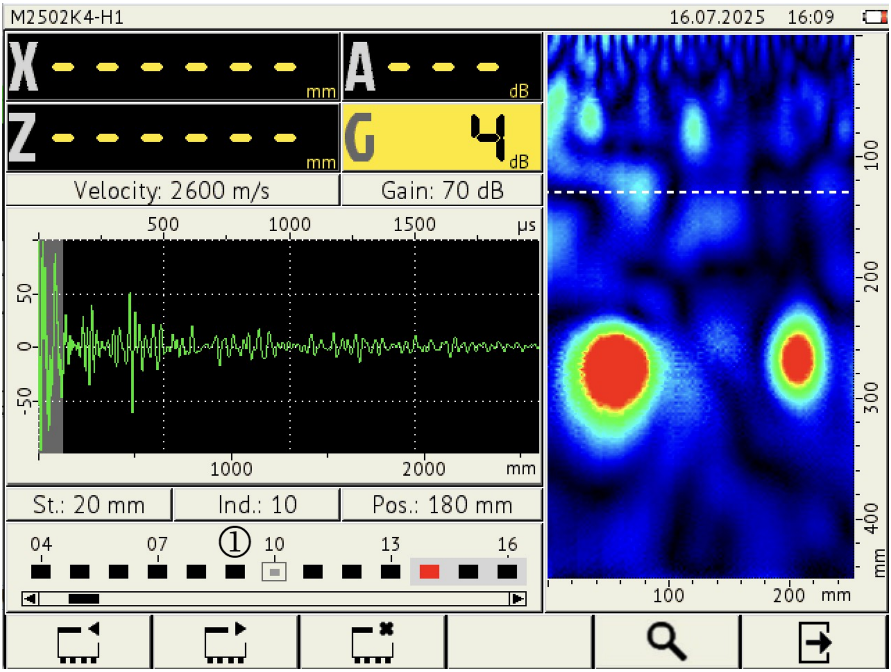
Depending on the view from which the `Measurement editor` is accessed, the system performs different initialization steps. If the operator enters the `Measurement editor` from the Scan view 93, the A1220 MONOLITH UPVT initializes all required resources and places the Map 100 cursor at the first position ①. The A1220 MONOLITH UPVT is now ready to perform measurements. The A-scan shows the ultrasonic signal as it is measured, in real-time.②.



If the operator enters the `Measurement editor` from the Analysis view 90 or Recalculation View 92, A1220 MONOLITH UPVT prompts the user to perform a recalculation of the existing data.

If the operator confirms, A1220 MONOLITH UPVT initializes the necessary computational resources and starts the recalculation process. The progress of the recalculation is displayed in the progress bar below.

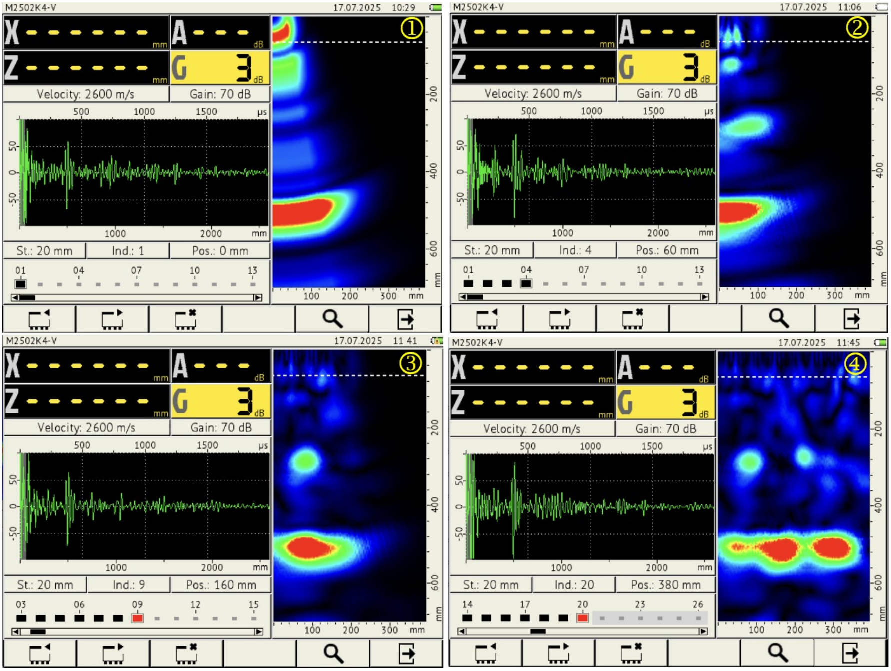
Upon completion, A1220 MONOLITH UPVT signals that it is ready for measurement by placing the cursor on Map 100 at the nearest unfilled position ①.



Measurement

A1220 MONOLITH UPVT performs the measurement when the Enter is pressed. At this moment, A1220 MONOLITH UPVT saves the measured A-scan, performs tomographic processing, and adds the processed result to the final image.The processing takes approximately one second. During this time, acquiring a new block of data is not possible. After processing is complete, the device automatically moves to the next available position, and the operator can repeat the measurement process.

The following Figures illustrate the step-by-step formation of a tomographic image. In Figure ①, only one position has been measured. At this stage, defect localization is poor. As four positions are processed together (Figure ②), the first reflector begins to emerge. By the time nine positions have been measured (Figure ③), the first reflection becomes clearly distinguishable. When data from twenty positions is available (Figure ④), both reflectors are clearly visible in the final tomographic image.



Deleting

The `Measurement editor` provides the operator with the ability to delete previously recorded measurement data. Deletion may be necessary if the operator determines that the data is inaccurate. This may happen, for example, if the sensor was not properly positioned during the measurement or if the A-scan contains interference. Use the and keys to navigate through the positions in the Map 100. To delete a selected measurement, press .

Gain

The operator may adjust `Gain` and using and `Color gain` and using the buttons. For more details, refer to page 78.

Zoom tool

For more information about the Zoom tool , refer to page 53.

3.3.5 Map

The `Map` is a versatile control and informative indicator. It appears in two locations within the software. In the Main window 90, it provides an overview of the measured positions. In the Measurement editor 96, this control allows the user to navigate between measured positions, delete measurement data, and select the position where the next measurement should be performed. Additionally, the `Map` highlights positions with ultrasonic signal saturation, lables skipped positions, and indicates the currently visible area of the inspected object.

General information

In order to obtain a high-quality tomographic image, a sufficient number of measurement positions is required. In most cases, for medium inspection depths, a satisfactory image can be achieved using 12 or more positions, especially at frequencies between 25 and 100 kHz. Whenever possible, it is recommended to cover the entire visible area of the object (region of interest, `ROI`). This ensures the best possible image quality.

ROI

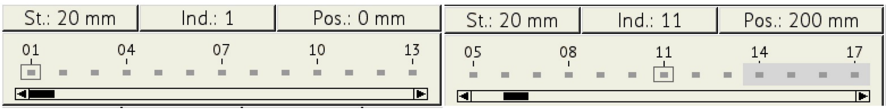
The region of interest ROI corresponds to the width of the image, which is defined by the Zoom 79 parameter. Before starting a measurement, the operator specifies the maximum inspection depth and width. Based on this, the Map highlights all measurement positions that fall within the ROI.

Step Selection Guidelines

The Step 26 between measurement positions should be selected based on the average wavelength in the inspected object. The recommended step size is approximately one-quarter of the wavelength. Using a step size of half the wavelength may lead to the appearance of artifacts in the resulting image. To calculate the wavelength, divide the wave velocity by the frequency using the following formula: v/f.

Map in measurement editor

In the Measurement editor 96, the boundary of the ROI may not always be visible on the map, as shown in the left image - where all positions lie entirely within the ROI.

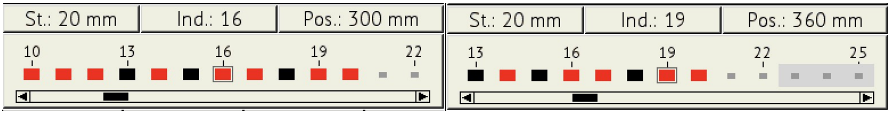


The operator can shift the active position 96 to the right, making the boundary clearly visible, as shown in the right image.

NOTE

Measurements can still be performed outside the visible inspection area, the further they are from the ROI, the less influence they have on the resulting image.

If the project already contains data, the map appears as follows:



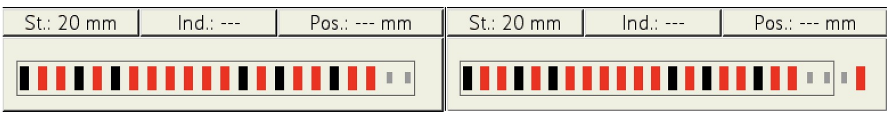
Each measurement position is color- and size-coded, with the following meaning:

- A large black rectangle indicates that the position contains valid measurement data.
- A large red rectangle indicates that the position contains data, but the signal was saturated.
- A small grey rectangle indicates that no data is available at that position.

Map in main window

In the Main window 90, the `Map` displays all measured positions at once, providing an overview based on the size of the `ROI` (see left image), or based on the last measured position if it lies outside the `ROI`. Positions that fall within the `ROI` are shown inside frame. Each measurement position is color- and size-coded, with the following meaning:

- A large black rectangle indicates that the position contains valid measurement data.
- A large red rectangle indicates that the position contains data, but the signal was `saturated`.
- A small grey rectangle indicates that no data is available at that position.

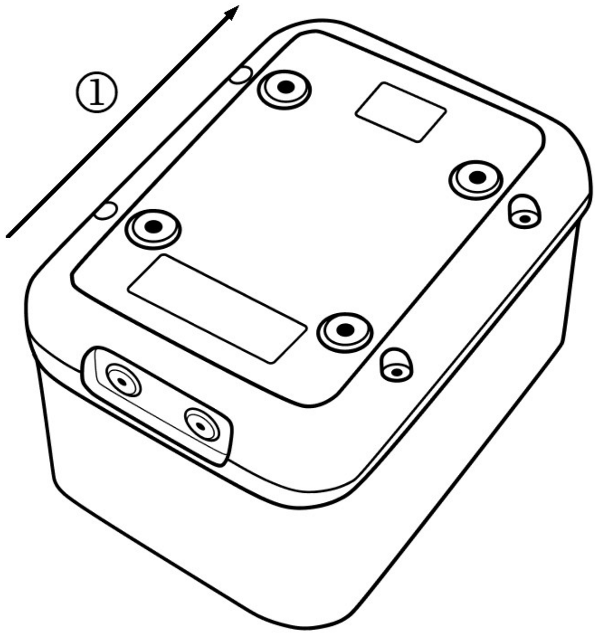


3.4 Guide

3.5 Transducers

M2502

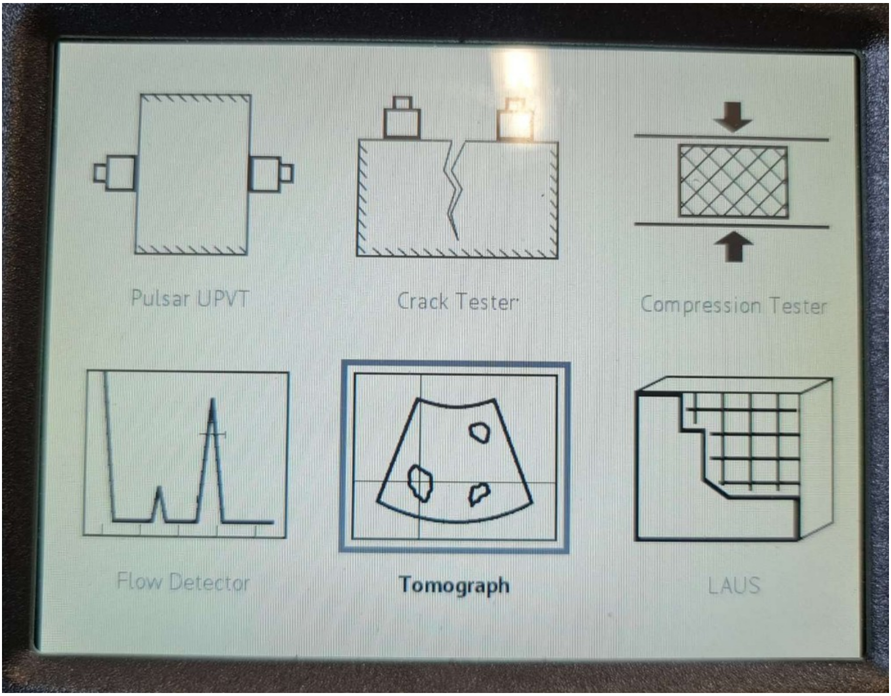
The `M2502` is a linear array composed of 12 DPC transmitters and 12 DPC receivers of shear (S) type. This array was developed for acquiring ultrasonic measurement data to be used in tomographic image reconstruction. To ensure optimal spatial coverage and high-quality iaging, scanning should be performed along the long axis of the transducer. The scanning direction is indicated ①.

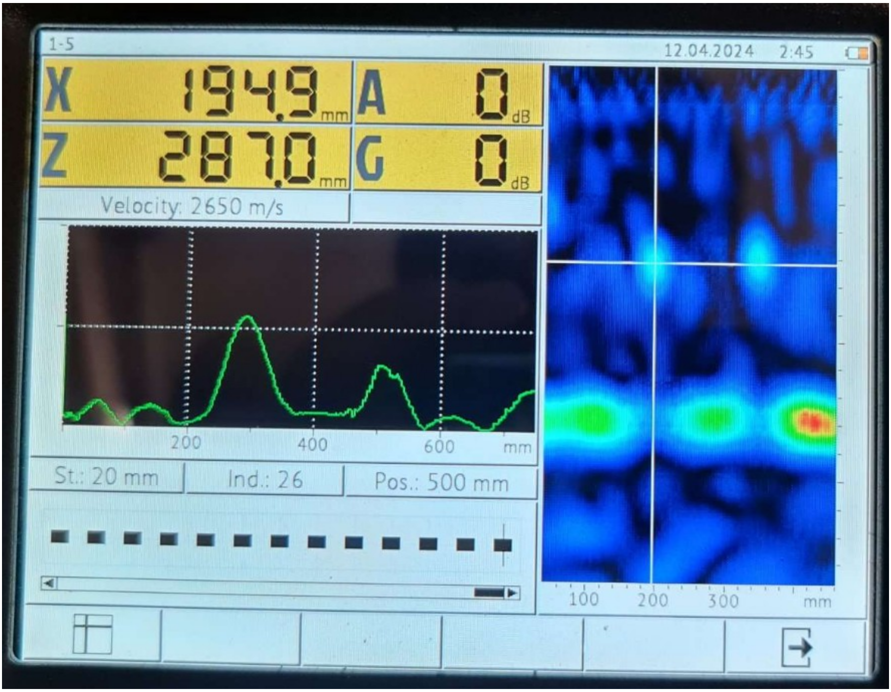

①

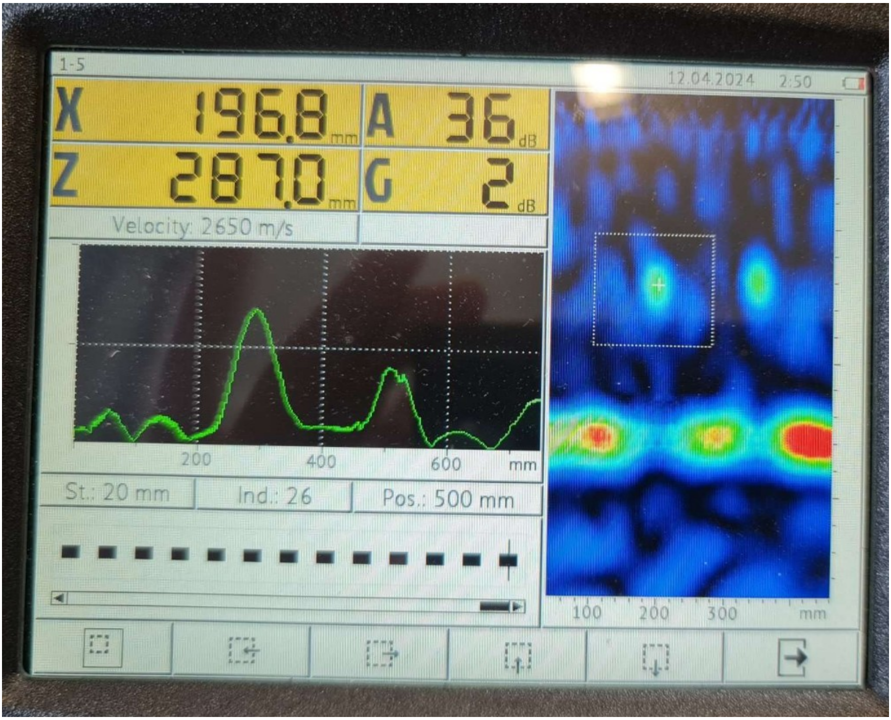
4 Under construction

ULTIMATE VELOCITY TESTERAll matherials under construction

4.1 SAFT (UNDER CONSTRUCTION)

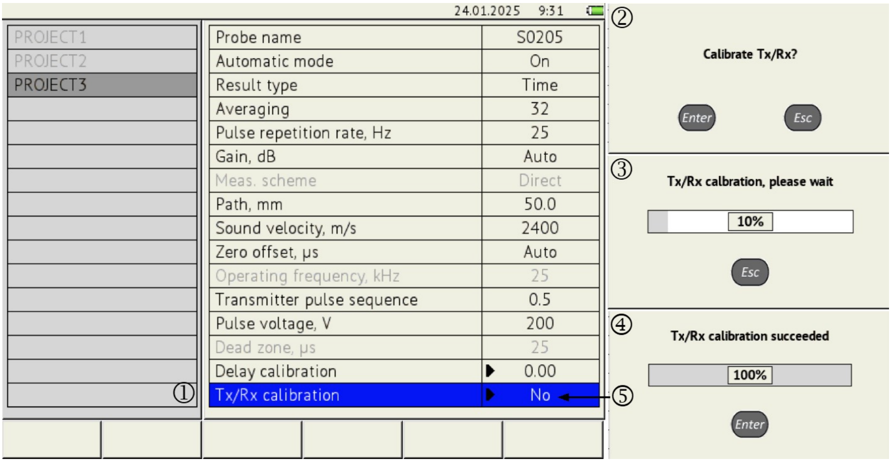



1-5
12.04.2024 2:45
X 194.9 mm
A 0 dB
Z 287.0 mm
G 0 dB
Velocity: 2650 m/s
200
400
600
mm
St.: 20 mm
Ind.: 26
Pos.: 500 mm
100
200
300
mm


1-5
12.04.2024 2:50
X 196.8 mm
A 36 dB
Z 287.0 mm
G 2 dB
Velocity: 2650 m/s
200
400
600
mm
St.: 20 mm
Ind.: 26
Pos.: 500 mm
100
200
300
mm

4.2 Corrections

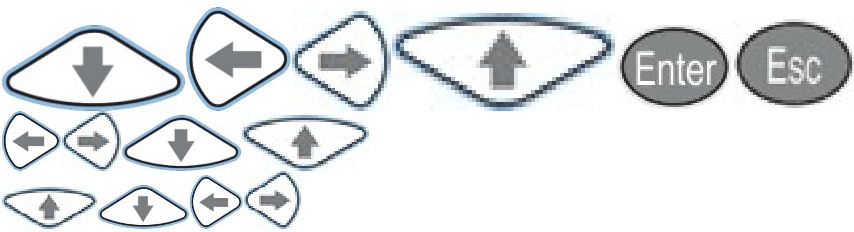
1. Изменить Noise threshold на Tx/Rx calibration??



2.Ищменить патмер Probe name на Transmitter type.

3. Добавить списьк скриншотов в просмотрщик по *

4.В DETECTION TOOL изменить иконку "автоматического детектирования"



4.3 IMPORTANT NOTES

1. Подумать как тестировать максимальное допустимое усиление что бы не было "насыщения" сигнала

4.4 METROLOGY

Enter topic text here.

Немного по метрологии датчиков:

S1803 –

LONGITUDINAL WAVE

DPC TRANSDUCER

100 KHZ

S1844 –

LONGITUDINAL WAVE

DPC TRANSDUCER 50 KHZ (NON-DAMPED, NARROW-BAND)

4.5 S1806

S1806
S1806 Тестирование по датчику следующее:
Измерение задержки на калибре ТК400 на 50мм - ок
Повтор скорости на 70мм - ок
Повторо скрости на 100мм - ок
Границы датчкиа: от 50мм до 100 с калибровкой на 50.
(возможно от 100 и выше придется работать с ручным подбором усиления)

Те эе тесты повтороили на большом лабораторном блоке

4.6 Sensors

A1220 MONOLITH UPVT моежт работать с разлдиными единичными трансдьюссерами или группами трансдюссеров объединенных объединенный в специализированные многоэлементные решетки. Зачастую, трансдюссер помещаются в специальыне transdusser housing. Это сделано для обеспечения повторямоести калибровки и измерений.

Notations:

DPC	Type	Freq. KHz	D/L	D/S	I/L	I/S	CLB
S1801	S	50	no	yes	yes*	yes	PCB.B.20, PCB.A.10 only [*]
S1802	S	50	no	yes	yes*	yes	PCB.B.20, PCB.A.10 only [*]
S1803	L	100	yes	no	no	no	PCB.A.10
S1805	L	150	yes	no	no	no	PCB.A.10
S1806	S	100	no	yes	yes	yes	PCB.A.10
S1808	S	250	no	yes	yes	yes	PCB.A.10
S1905	L	25	yes	no	no	no	-
S1902	S	25	no	yes	yes	yes	-
S0205	L	25	yes	no	no	no	-
S0206	L	50	yes	no	no	no	PCB.B.20
S0208	L	100	yes	no	no	no	PCB.A.10

Анализа по сенсорам и по калибрам

Here, everything depends on the frequency, block size, and wave type. Below are four cases:

CASE 1 Standard Calibration Block (Size: 150 mm x 180 mm x 50 mm, Details: This block is delivered with the instrument by default)

1 LW-direct: All sensors up to 100 kHz and higher (S1803, S1805, S0208).
2 LW-indirect: All sensors up to 50 kHz and higher (S1801, S1802, S1820).
3 SW-indirect: All sensors up to 100 kHz and higher (S1806, S1808, S1820).
4 SW-direct: All sensors up to 100 kHz and higher (S1806, S1806).

CASE 2 Larger Calibration Block: This block is larger than the standard one. We are currently estimating its exa

1 SW-direct, 50 kHz: Sensors (S1801, S1802, S1808, S1820).
2 SW-indirect, 50 kHz: Sensors (S1801, S1802, S1808, S1820).
3 LW-direct, 50 kHz: Sensors (S1844, S0205).

CASE 3 Special Calibration Block: Air-Diffuser

1. LW-direct, 25 kHz: Sensors (S1905, S0205)

CASE 4 Calibration on the Inspected Sample: This calibration block will be significantly larger.

1 SW-indirect, 25 kHz: Sensor (S1902).
2 LW-indirect, 25 kHz: Sensor (S1902).

4.6.1 DPC

4.6.2 S1806

For performing UPVT measurements with one-sided access (indirect measurement scheme), the S1806 transducers must be placed in a special transducer housing. The following illustration shows all its elements.

	Description
①	Threaded sensor cover. The cover has a slot for the spring that presses the transducer
②	Spring
③	Transducer
④	Transducer Housing. The distance between the transducers is 50mm
⑤	A 20-cent coin is used to tighten cover

4.6.3 S1803

S1803 is a 100 KHz longitigunal wave DPC transducer. This transducer испльзуется для сквозного прозвучивания direct measurement scheme. Так как длинна волны такого трансдюссера при средней скорости бетона 3600-4200 m/s находится в интервале от 36-42 mm. Предпочтительные размер объекта контрля для этих DPC от 30mm.

4.6.4 LF Piezoelectric Transducers

A1220 MONOLITH UPVT supports the following Low Frequency Piezoelectric Transducers (LFPTs): S0205 with a frequency of 25 KHz ①, S0206 with a frequency of 50 KHz ②, and S0208 with a frequency of 100 KHz ③. These transducers use longitudinal ultrasonic wave. To operate these transducers, a coupling medium such as water, oil, or gel is required. One significant advantage of these transducers is their small aperture size, which allows them to be used on relatively rough surfaces while maintaining a high sound transmission coefficient to the object. LFPTs are compatible with all measurement schemes.

The choice of transducer frequency in ultrasonic pulse velocity (UPV) testing depends on several factors, including the material being tested, the desired penetration depth, and the required resolution. Here's a general guide on when to use different frequencies:

S0205 (25 KHz)

S0205 has a Low frequency,a high penetration depth, a low resolution:

- Ideal for testing large and thick concrete structures where deeper penetration is required
- Suitable for materials that attenuate higher frequency signals quickly
- Better suited for materials with larger grain sizes or aggregates, where higher frequencies might scatter too much

S0206 (50 KHz)

S0206 has a medium frequency, a moderate penetration depth, and a moderate resolution:

- Suitable for materials of moderate thickness where a balance between penetration and resolution is needed
- General Purpose: Can be used for a variety of materials and conditions, providing a good compromise between depth and detail
- Concrete Structures: Commonly used for general concrete testing where both depth and resolution are important

S0208 (100 KHz)

Has a High frequency, a low penetration depth, and a high resolution

- Ideal for testing thin sections and materials with fine grain structures
- Suitable for detecting small defects or fine cracks within a material
- Best for identifying surface or near-surface flaws where detailed resolution is crucial

---

NOTE

The penetration depth can vary depending on the conditions of the concrete being inspected, such as its homogeneity, presence of reinforcing materials, and moisture content. Assuming standard properties of concrete, the inspected thickness in a direct measurement scheme would be approximately: S0205 - 2 meters, S0206 - 1 meter, S0208 - meters

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4.6.5 Notes

Размеры калибрацинный блокво и принцип из работы зависит в большей стпени от частоты преобразователя.

PCB-10

Стандратный калибрационный plexiglas образец который который в входит в состав стандартной поставки. Этот образе имеет размеры 100 x 100 x 100 миллиметров и хорошо подзодет для калибровки всех пребразователей с частотами 100 КГц и выше.

PCB-20

Калибрационный плексиглазовай образец для преобразователей с частотоами от 50 до 100 КГц. Этот образец иметт болошие размеры чем PCB-10. PCB-20 не входит в состав стандартной поставки.

ACB-15

Специальныое калибровоное устройто применямое для измерния дажерки преоразователей с частотой до 25 KHZ типа L. ACB-15 вялется дифузионным рассеивателем и работает через воздух.

4.6.6 Calibration distance

Во время каибровки зарежки особенно важным являстся работата с правильным расстоянием между transducers.
Растояние должно быть выбрано что бы:
- обеспечить минимальное влияние возможноых mode conversion и геометрических переотражений на основлную волну

- Обеспечить сигнал основной волны в области от 30 до 80 процентов высоты экрана. При увеличении расстояние - силгнал ослабевает
- достигнуть максильманого расстояния с целью наилучшего пространственного усреданеине времени распротсрanния. Так как материалы по своей натуре не идально-однородны слишком маленькое расстояние медду датчками обеспечить локальную регистрацию что может привести к погрешностям изммрения.

Следушая таблица показывает

При калибровки задержки (ссылка) реккомендуется использовать такой расстояени мержу излучателе и приеником, при котором
-
-

Ввиду того что продольная и поперечная волны в бетоне затухают по разному и растояние кри выполнении калибровки может так варрироваться. Расстояние нужно выбирать таким: что бы с обдной стороны полезниый сигнал находтся за мертвой зоной а с другой стороны не сильно затуха и в то же рмеф не был в насыщении.
Следующая таблка показывзвает рукомендуемые pitch во время калибровки

Это было все проверено на пластике волна - лонг
S1801 + S1802

Область калибровки от 150 до 80мм
Рабочая област от 150 до 80
Рекомендованное для калировки и работы 100
А какое минимальное расстояние?
если подходит ближе - вырождается сигнал и становистя чутка странным

S1807 IS 150KHz
хорошо работает 100мм и до 50 (при 40 так же залазит продолька)

S1807 IL 150KHz
хорпошо работет на от 80 до 40 (ниже сорока каша - но еще нужно проверить)

S1806 IS 100KHz
хорпошо работет на от 100 до 50 (при 40 уже залдазит продолька)
На бетоне скорее всего диапазон расширится - но пока не можем полностью сказать

S1806 IL 100KHz
хорпошо работет на от 100 до 40 при калибровке на пластике (на пластике пока не можем до какого сможем ниже опусттся - нужны держалки, при 20 - каша)

На бетоне скорее всего диапазон расширится - но пока не можем полностью сказать

S1808 IS
Увренно работат от 70 до 30 на пластиуе на калибровке при пороге 3 - расширение диапазоно возможно но придется подбирать порого вручную.

S1808 L
с 40 до 20мм - если увеличиваю - сигнал очень слабеет и нужне подбор фуккнции

А вот провека на бетоне

Калибровка задержки выполняется на специальных калибровочных образах. Эти образцы имеют органиченные разрмеы

Для удобства работы it is recommendet to use the same di

4.7 Product Overview

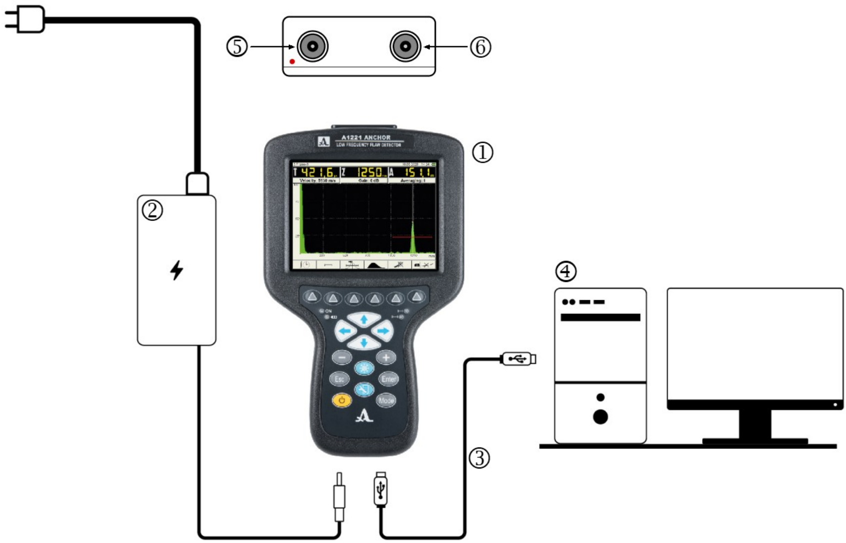
COMING SOON

4.7.1 Connectors

CAUTION

Charging of the A1220 MONOLITH UPVT and its simultaneous connection to a PC is prohibited.

The following diagram illustrates the interfaces of the device:



	Description
①	A1220 MONOLITH UPVT
②	Low noise DC power supply with JACK connector
③	USB cable for connecting the device to a PC
④	PC, Windows
⑤	Transmitter LEMO connector, marked with a dot, red color cable
⑥	Receiver LEMO connector, black color cable

CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord and power supply delivered with the A1221A1220 MONOLITH UPVT. Do not use this AC power cord and power supply with other products.

