



A1220 MONOLITH UPVT ULTIMATE VELOCITY TESTER

Operation manual

Revision 1.7.0

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.

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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 and features are under development.

Specification

Parameter	Value
Operating frequency range	25KHz - 1MHz
Maximal data acquisition length	4000, μ s
Material velocity range	500-15000, m/s
Transmitter output voltage	$\pm$ 20, $\pm$ 100, $\pm$ 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.

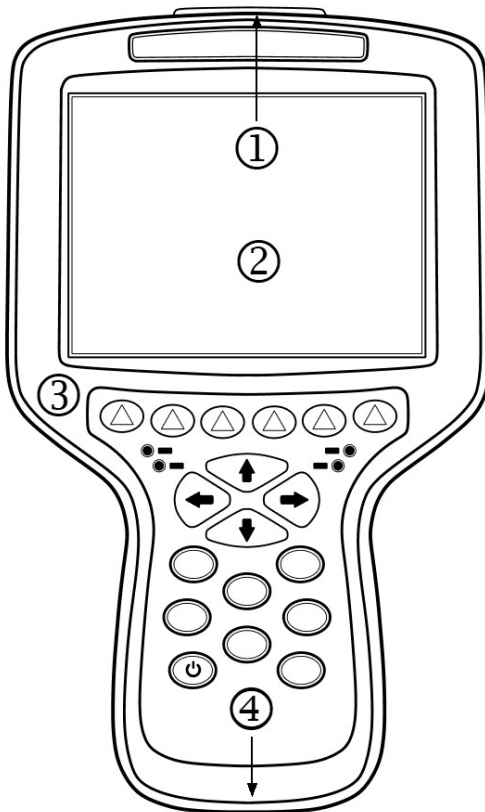
**CAUTION**

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

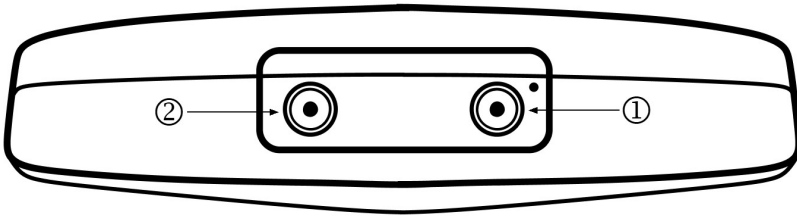
Overview

A1220 MONOLITH UPVT Transducer connectors are located at the top of the instrument ①. The front panel also features a color Display ② and 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.

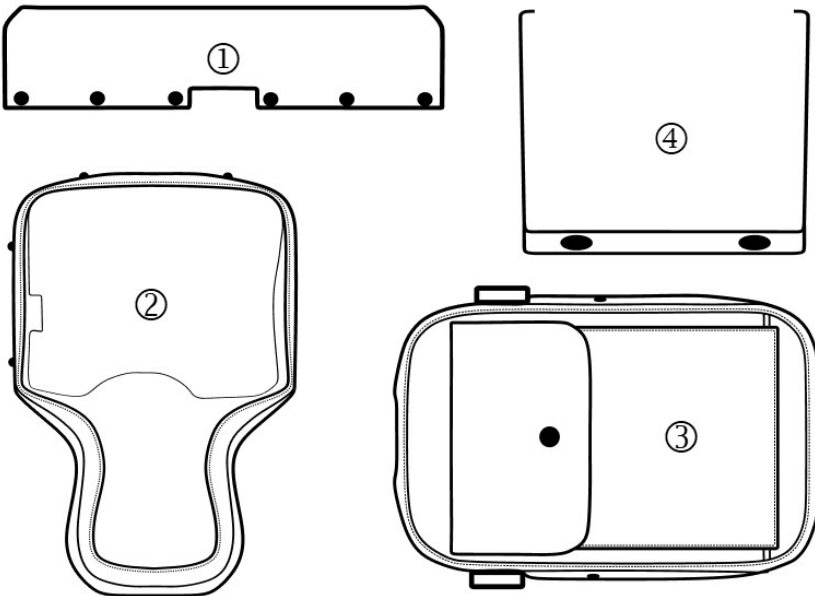


Transducer connectors

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

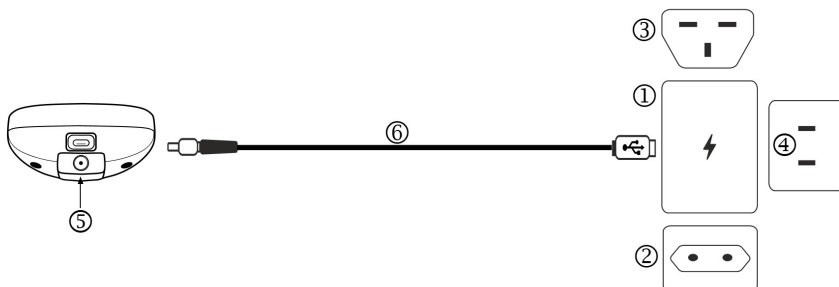
Power Supply Unit



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 ⑥ that 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.

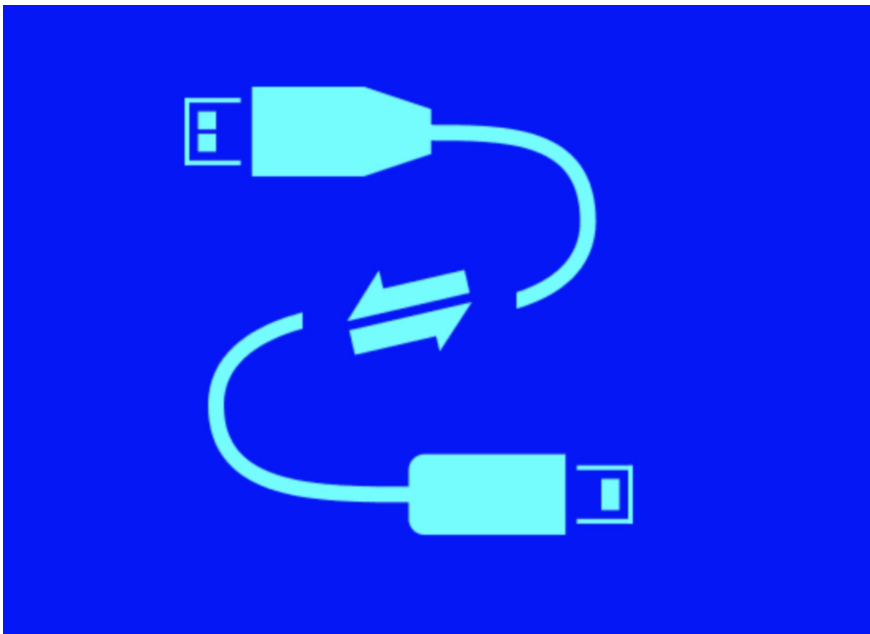
The connection procedure is as follows:

- 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 UPVT will 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.

2 UPVT

2.1 Getting started

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

Startup

[Power on](#)^[15] the A1220 MONOLITH UPVT. After turning on the device and switching to [Pulse Velocity Test](#)^[15] mode, ensure that the battery is sufficiently charged . If the battery is low, charge the device before use.

Operation

- Use the [Project manager](#)^[17] to create a new project or open an existing one
- Ensure that the [Probe name](#)^[25] is set correctly and check other project parameters
- Verify that the correct [Measurement scheme](#)^[25] is selected.
- Make sure the correct [Result type](#)^[25] is set correspondingly
- Perform [Tx/Rx calibration](#)^[32]
- Adjust the [Delay](#)^[25] manually or carry out the [Delay calibration](#)^[36]
- Ensure the [Dead zone](#)^[25] 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](#)^[46] is set according to your requirements, and the [Table](#)^[47] with results is properly displayed. If required, clear the table.
- Before starting work, perform a test measurement either on a inspected object or a calibration sample. Verify that the [Path](#)^[25] 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

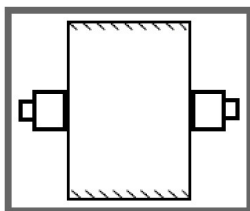
Shut down the [instrument](#)^[15]

2.2 Startup and Shutdown

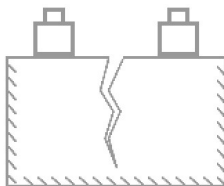
Powering on

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:

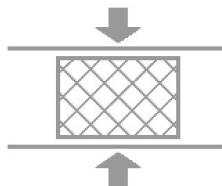
OPERATING MODES



Pulse Velocity Test

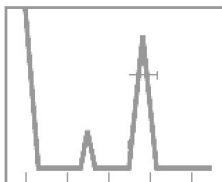


Crack Depth

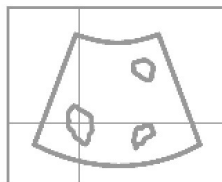


Elasticity Test

①



Pulse-Echo Test



2D Tomography

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

NOTE

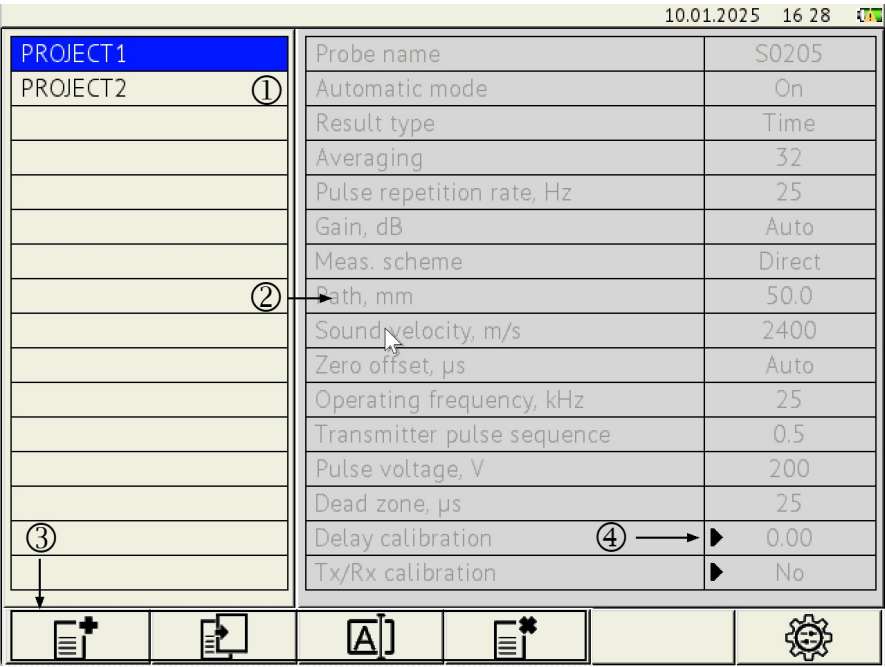
Glyphs for modes that are unavailable in the current firmware are grayed out, indicating that these modes are not accessible to the user.

Powering off

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

2.3 Project manager

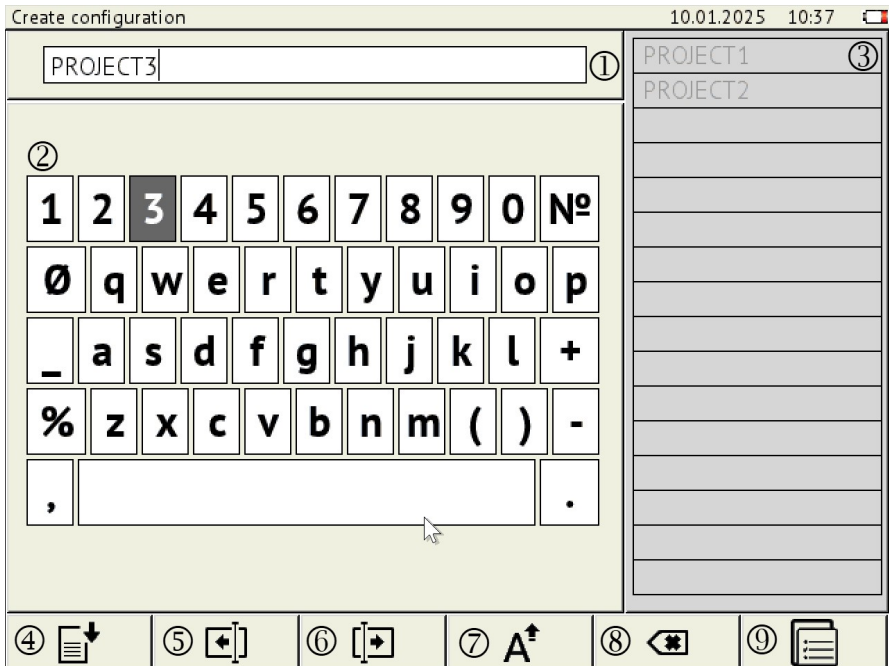
The Project Manager allows user to manage projects. A project represents a collection of all the necessary parameters for performing inspection task. Parameters include both measurement parameters, calibration settings, noise levels, and others. Projects settings are stored in a folder with the same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

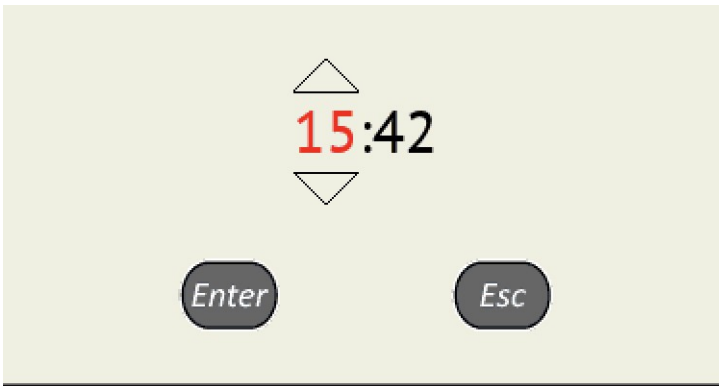
Pressing  will open a window identical to the one used for creating a new project.

Delete project

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

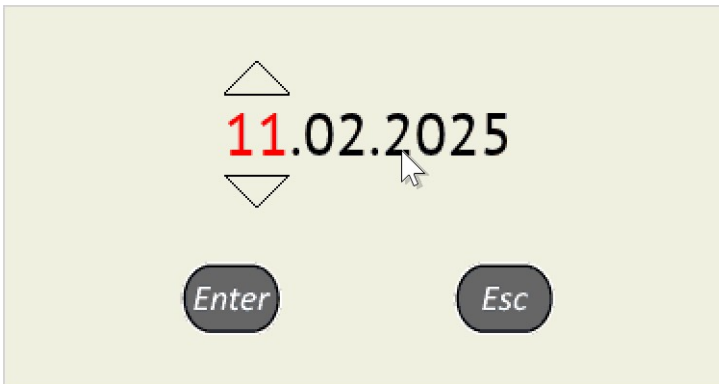
2.3.2 System settings

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



Date

System date. To edit the date, press . 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:

S1806CLB-MANUAL		Probe name	S1806
PROJECT1		Automatic mode	On
Default-11		Result type	Time
PROJECT3		Averaging	32
PROJECT2		Pulse repetition rate, Hz	25
		Gain, dB	Auto
		Meas. scheme	Indirect-L
		Path, mm	50.0
		Sound velocity, m/s	2400
		Zero offset, μ s	Auto
		Operating frequency, kHz	100
		Transmitter pulse sequence	0.5
		Pulse voltage, V	200
		Dead zone, μ s	5
		Delay calibration	► 0.00
		Tx/Rx calibration	► Yes/7.9

Probe name

The A1220 MONOLITH UPVT is compatible with all transducer mentioned [here](#)⁶². 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

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](#)⁴⁷ 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.

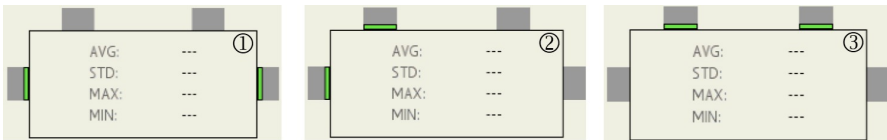
Gain

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](#)^[62] and [Holders](#)^[72] 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](#)^[62] and [Holders](#)^[72] 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 Probe name = CUSTOM the operator is responsible for setting Dead zone correctly. To adjust Dead zone use  and . Study [section 60](#) to familiarize yourself with how the Dead Zone is represented on the A-scan.

Delay calibration

refer to [page 36](#) for more information.

Tx/Rx calibration

Refer to [page 32](#) for more information

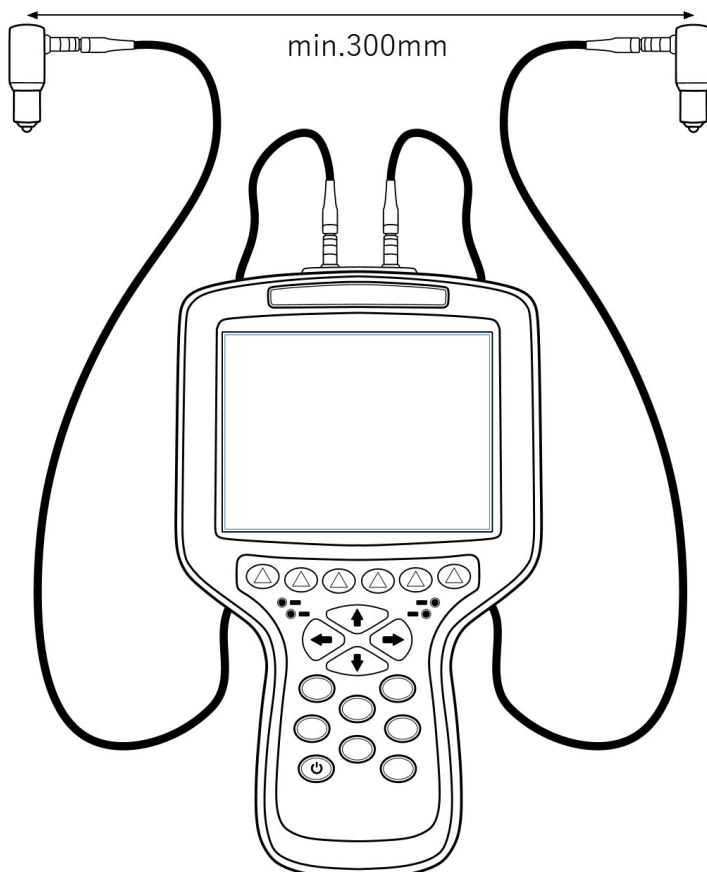
2.3.4 Tx/Rx calibration

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

24.01.2025 9:31

PROJECT1	Probe name	S0205
PROJECT2	Automatic mode	On
PROJECT3	Result type	Time
	Averaging	32
	Pulse repetition rate, Hz	25
	Gain, dB	Auto
	Meas. scheme	Direct
	Path, mm	50.0
	Sound velocity, m/s	2400
	Zero offset, µs	Auto
	Operating frequency, kHz	25
	Transmitter pulse sequence	0.5
	Pulse voltage, V	200
	Dead zone, µs	25
	Delay calibration	0.00
①	Tx/Rx calibration	No ⑤

②

Calibrate Tx/Rx?

Enter Esc

③

Tx/Rx calibration, please wait

10%

Esc

④

Tx/Rx calibration succeeded

100%

Enter

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.

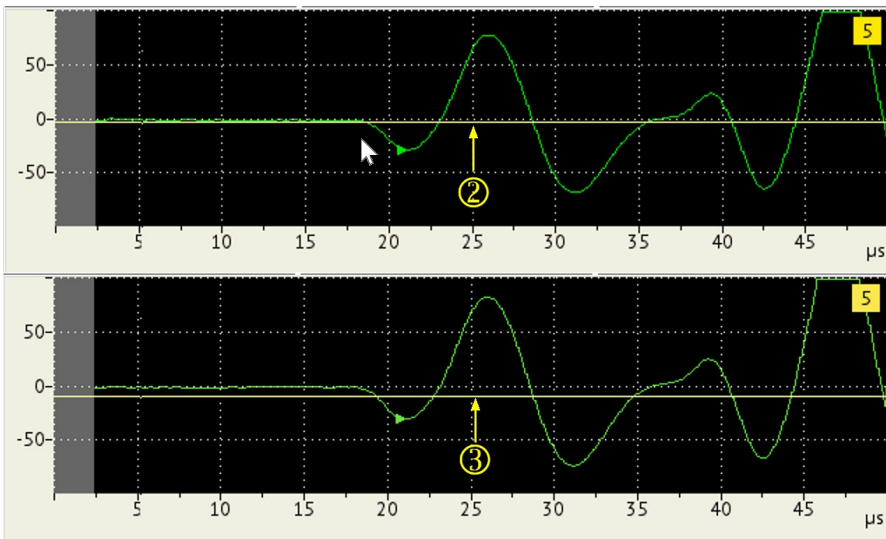
	Dead zone, μ s	25
	Delay calibration	▶ 0.00
	Tx/Rx calibration	▶ Yes/4.5

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

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

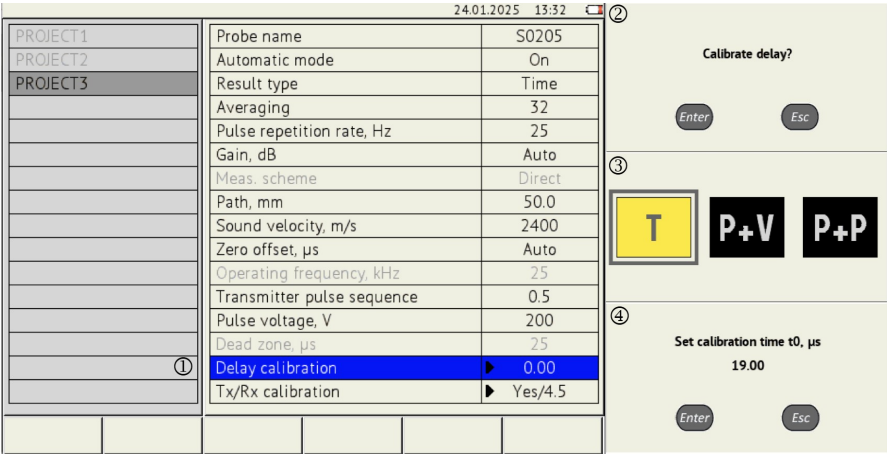
For successful UPVT measurements, it is necessary to calibrate the delay. The delay is added to the sample propagation time. If the delay is not accounted for, the material velocity as well as time and path will be determined with an error. The delay arises due to various factors such as transducer delay, 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

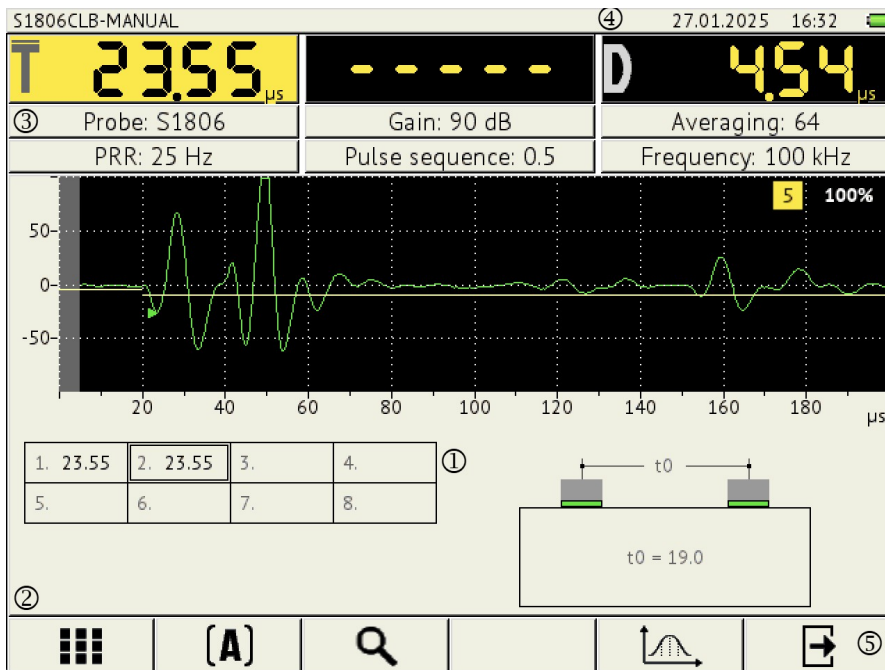
T calibration is used in cases where the time of ultrasonic wave propagation is known. This method of calibration is particularly useful when applying user-defined calibration samples. This approach requires only the propagation time T. In some cases T can

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 these steps:

- Go to the project parameters, see [chapter 25](#), 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 t_0 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 these 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.

24.01.2025 13:32

①

PROJECT1	Probe name	S0205
PROJECT2	Automatic mode	On
PROJECT3	Result type	Time
	Averaging	32
	Pulse repetition rate, Hz	25
	Gain, dB	Auto
	Meas. scheme	Direct
	Path, mm	50.0
	Sound velocity, m/s	2400
	Zero offset, μ s	Auto
	Operating frequency, kHz	25
	Transmitter pulse sequence	0.5
	Pulse voltage, V	200
	Dead zone, μ s	25
	Delay calibration	► 0.00
	Tx/Rx calibration	► Yes/4.5

T

P+V

P+P

②

Set calibration velocity $v0$, m/s
2400

Enter

Esc

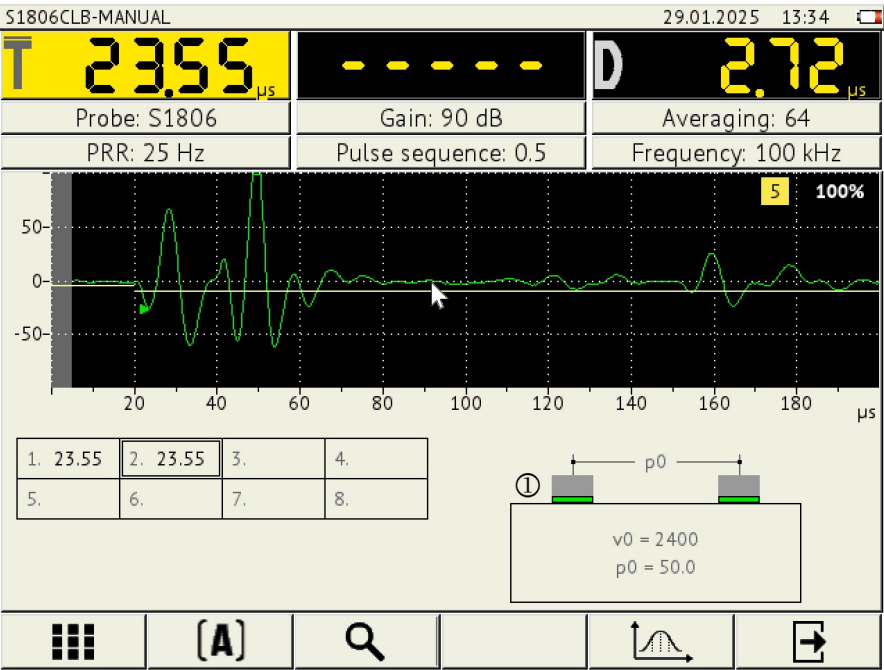
③

Set calibration path $p0$, mm
50.00

Enter

Esc

- 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.

24.01.2025 13:32

PROJECT1	Probe name	S0205
PROJECT2	Automatic mode	On
PROJECT3	Result type	Time
	Averaging	32
	Pulse repetition rate, Hz	25
	Gain, dB	Auto
	Meas. scheme	Direct
	Path, mm	50.0
	Sound velocity, m/s	2400
	Zero offset, μ s	Auto
	Operating frequency, kHz	25
	Transmitter pulse sequence	0.5
	Pulse voltage, V	200
	Dead zone, μ s	25
	Delay calibration	0.00
	Tx/Rx calibration	Yes/4.5

T

P+V

P+P

Set calibration path p1, mm

50.00

Enter

Esc

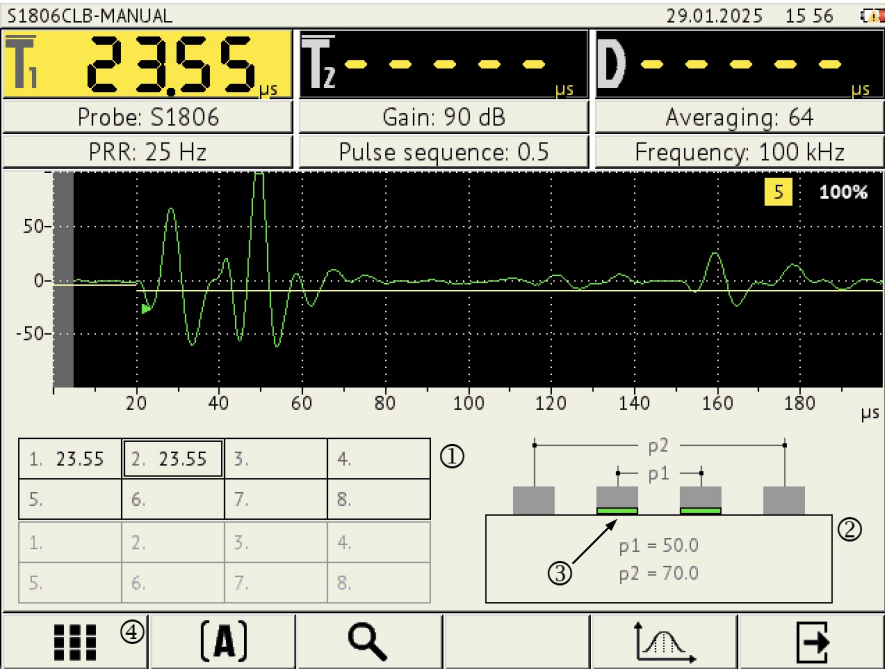
Set calibration path p2, mm

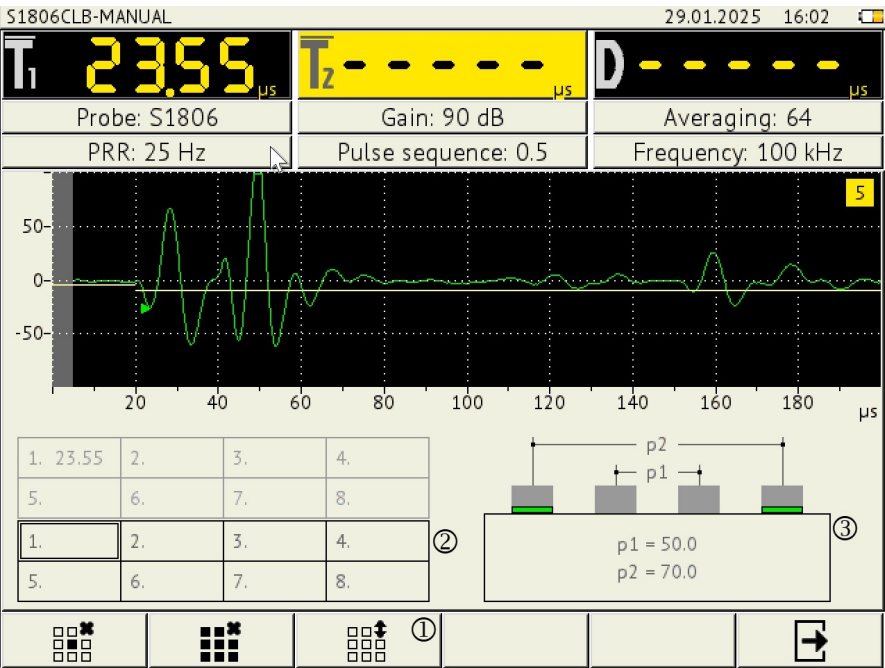
70.00

Enter

Esc

The P+V calibration consists of two stages. In the first stage, a measurement is performed on a sample with a length of p_1 . 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.





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

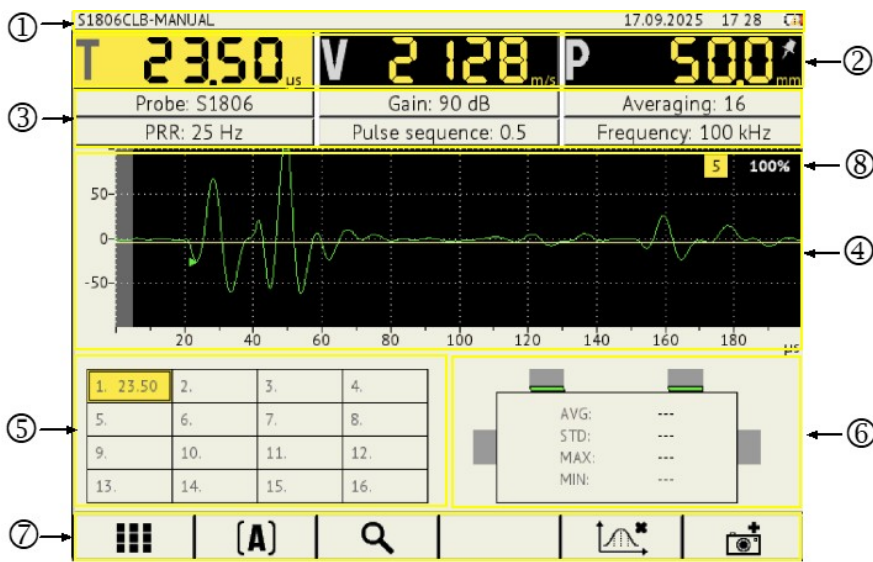
	Dead zone, μs	5
	Delay calibration	0.05
	Tx/Rx calibration	Yes/2.0

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](#) ¹⁷ 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

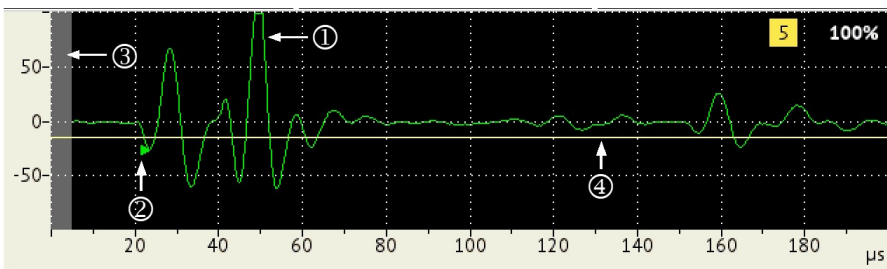
Read more about the results panel on [page 25](#), refer to the Result type parameter.

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 25](#).

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](#) ③ and the [Calibrationfunction](#) ④.



Results table ⑤

The results table allows you to save up to 16 values of Time, Velocity, or Path depending on [Result type](#) ²⁵ 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](#) ⁴⁷.

Measurement scheme ⑥

This is a graphical diagram that reminds the user which [Measurement scheme](#) ²⁵ 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](#) ⁴⁶.

Zoom indicator ⑧

Displays the current zoom level as a [percentage](#) ⁵².

2.4.2 Control panel

The control panel offers the operator the following functions:



	Description
①	Table editor  47
②	Detection tool  47
③	Zoom tool  52
④	Measurement averaging  53
⑤	Screenshot  54

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 receiver. 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.



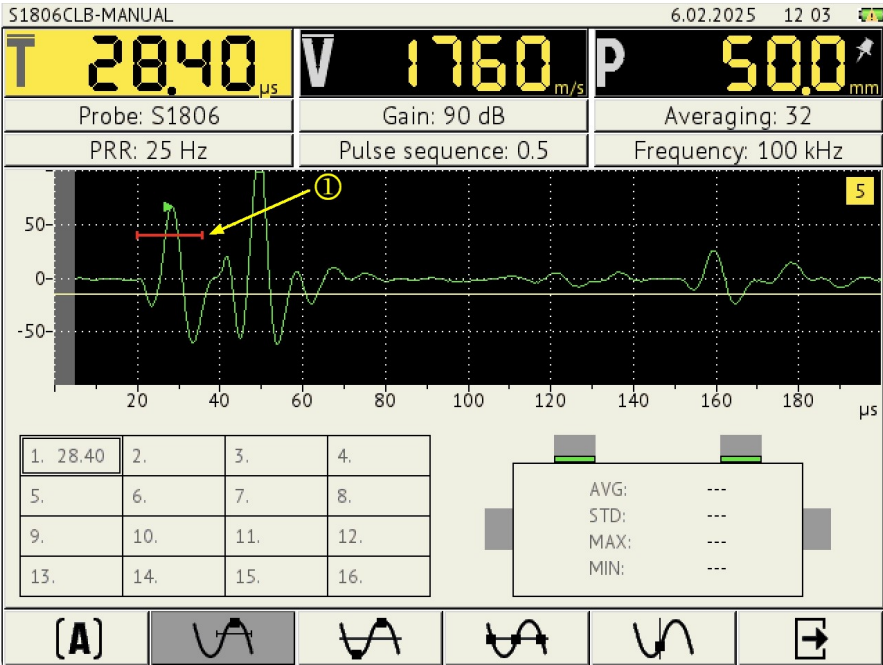
Function disabled ①

The manual detection tool is disabled. The A1220 MONOLITH UPVT detects the arrival time automatically using `Threshold` function that was measured during the [Tx/Rx calibration](#)³².

Gate detector ②

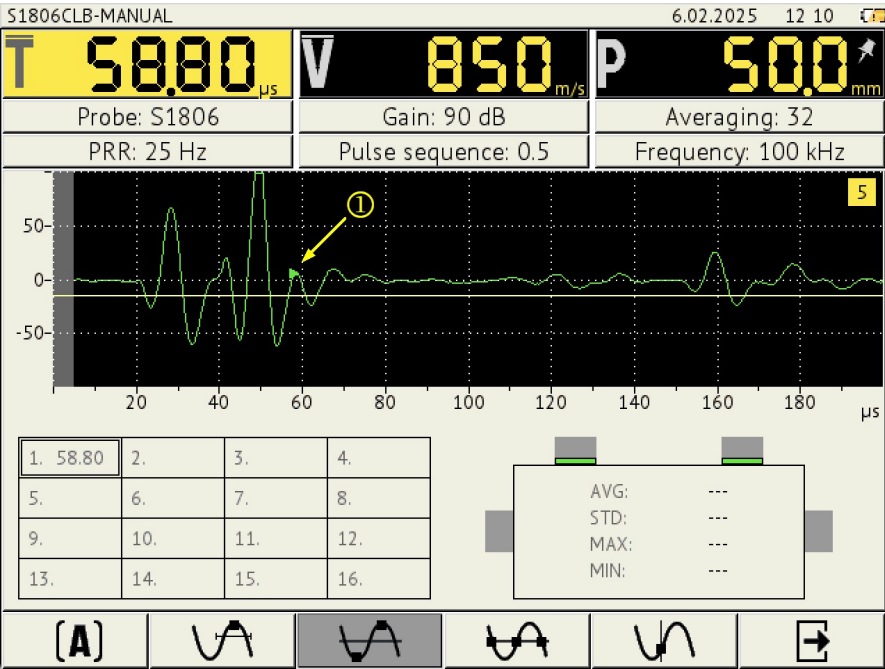
The `gate detector` finds the maximum or minimum extremum at an arbitrary location of the ascan. The gate is indicated by a red line

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 length. The following image shows the gate detecting a positive peak:



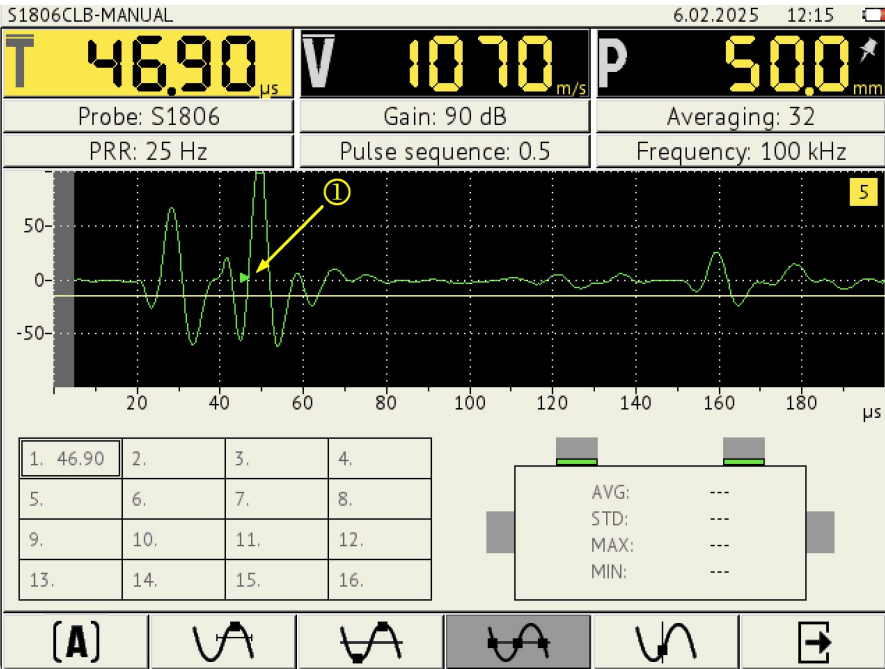
Peak detector ③

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.



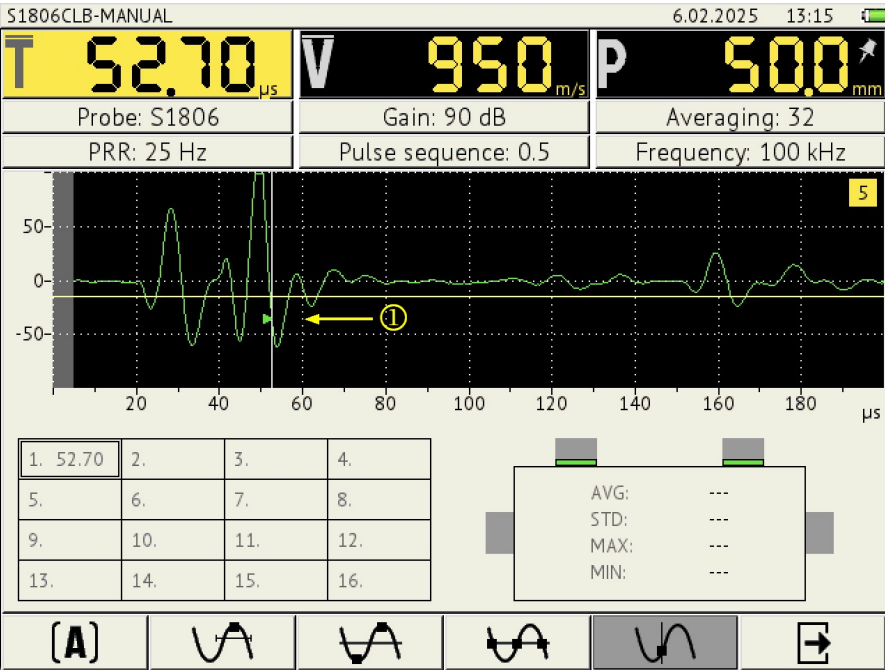
Zero-cross detector ④

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

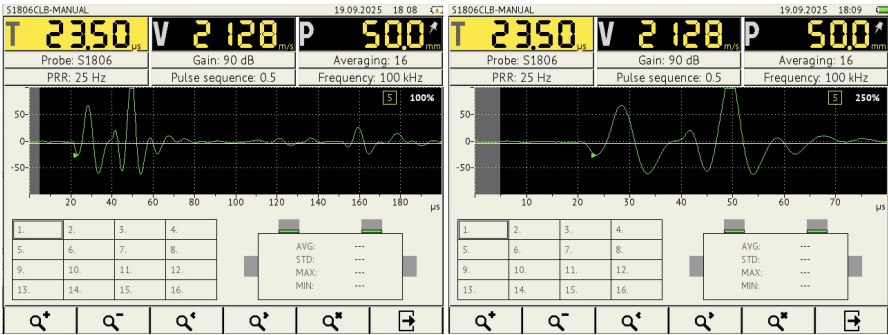
After zooming, parts of the signal may move outside the visible area. Use ③ or ④ to bring the signal back into view.

Reset View ⑤

Clears all Zoom tool adjustments and returns the A-scan 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](#)⁴⁴ 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

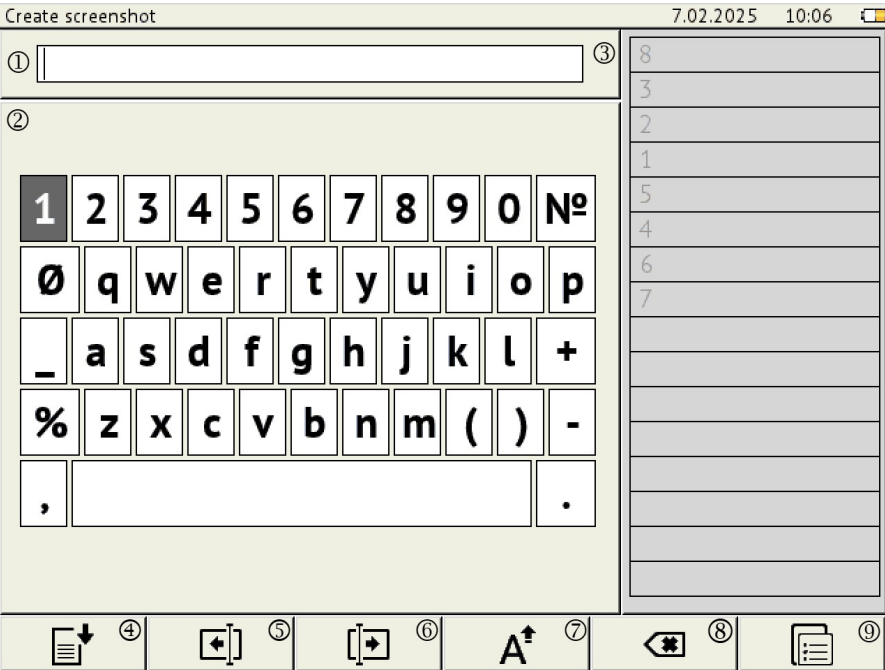
does not have a horizontal line .

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:

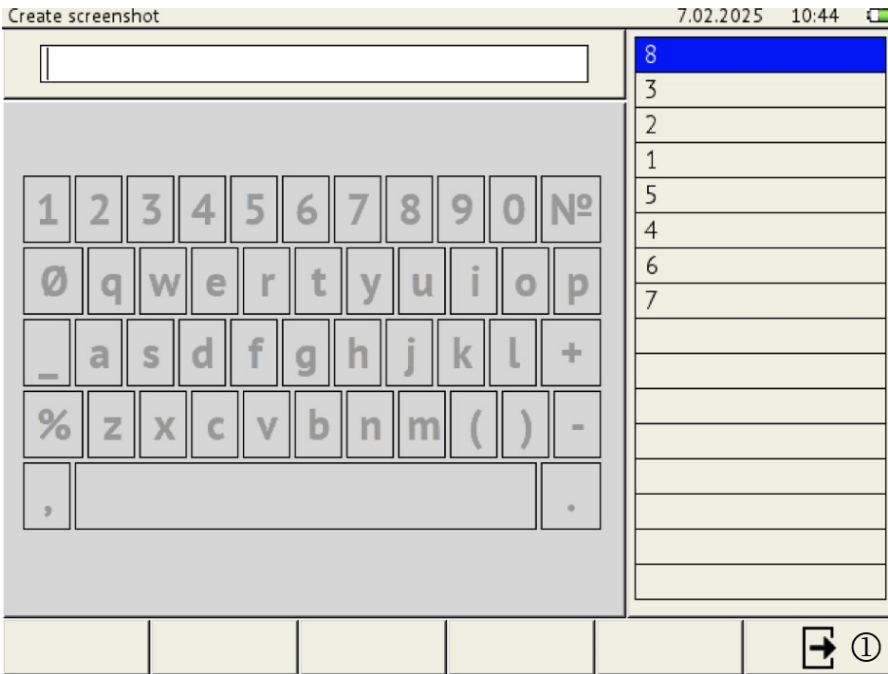


See the enumerated controls in the following table:

	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.

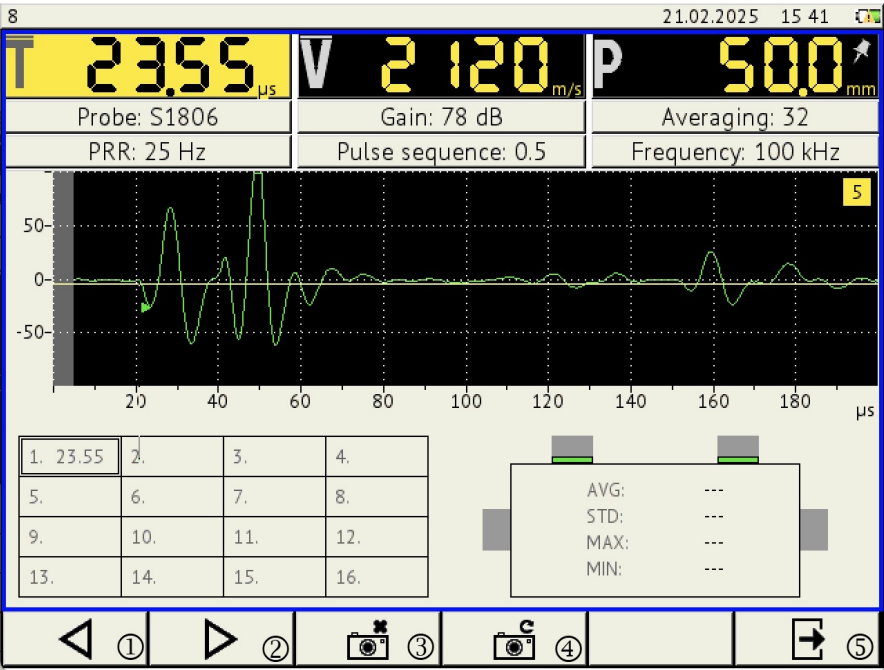


To navigate the list, use  and . Press  **select the name**. Press ① to go to the main window of the screenshot function.

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

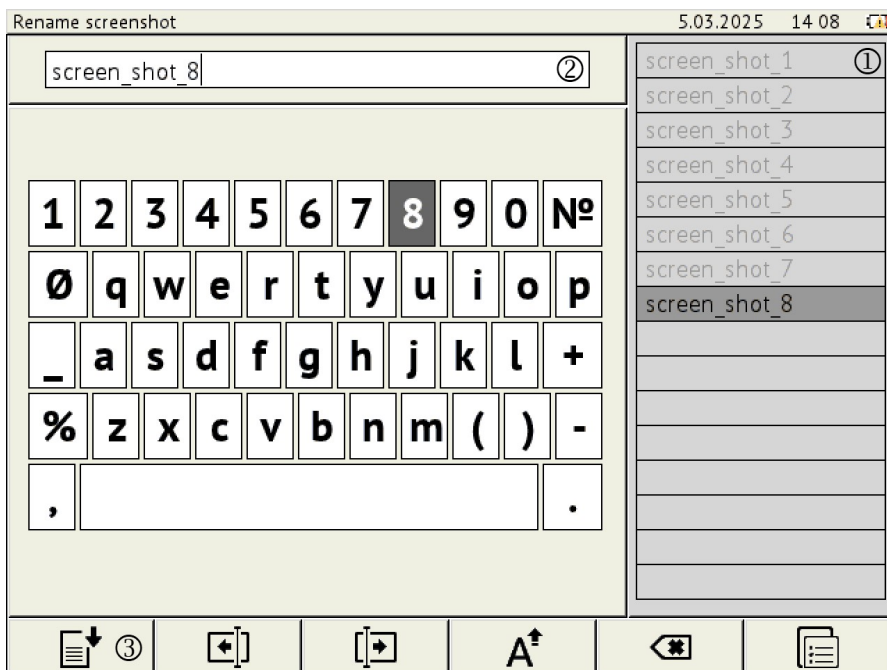
The operator can use buttons ① and ② to scroll through the screenshots sequentially. The name of the currently active screenshot is displayed in the [information panel](#) ⁴⁴.

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 54](#). 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 .

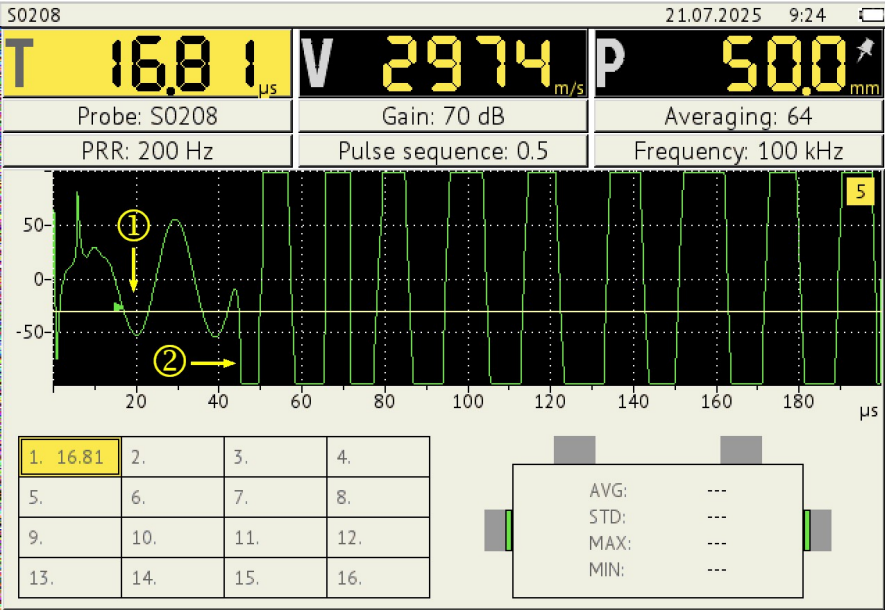
2.6 Guide

2.6.1 Dead zone

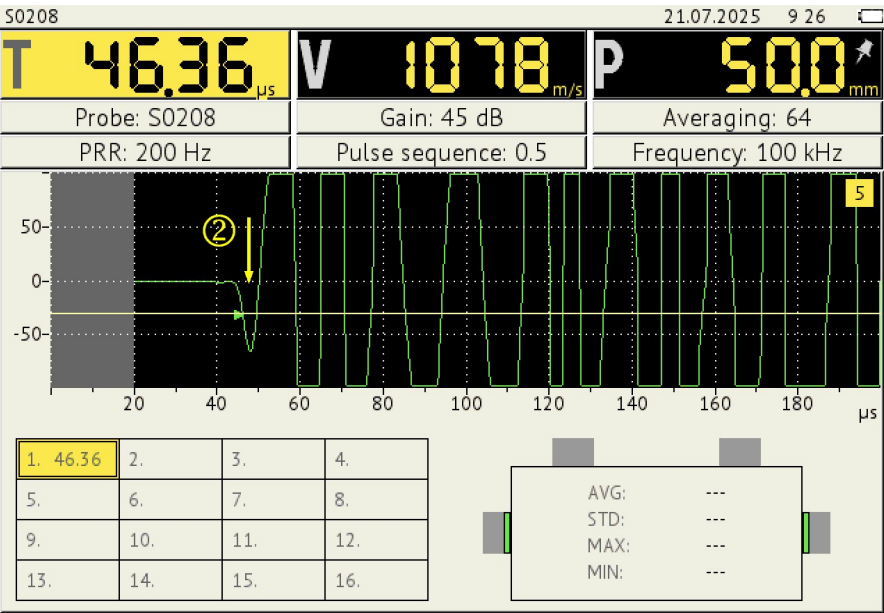
When using low-frequency ultrasonic transducers (single DPC, single PET or array), a so-called `Dead zone` may appear at the beginning of the A-scan. This `Dead zone` can result from several factors, including:

- `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](#)²⁵, 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](#)^[25]:

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

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 number, for example $[+]^1$, indicates the calibration block required for performing the delay calibration. For more information about calibration blocks [refer](#)^[67].

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](#)⁶⁷.

Index	Block
1	TK300 ⁶⁷

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](#)^[25], 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](#)⁶⁷.

Index	Block
1	TK100 ⁷⁰

2.6.3 Calibration blocks

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

2.6.3.1 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.

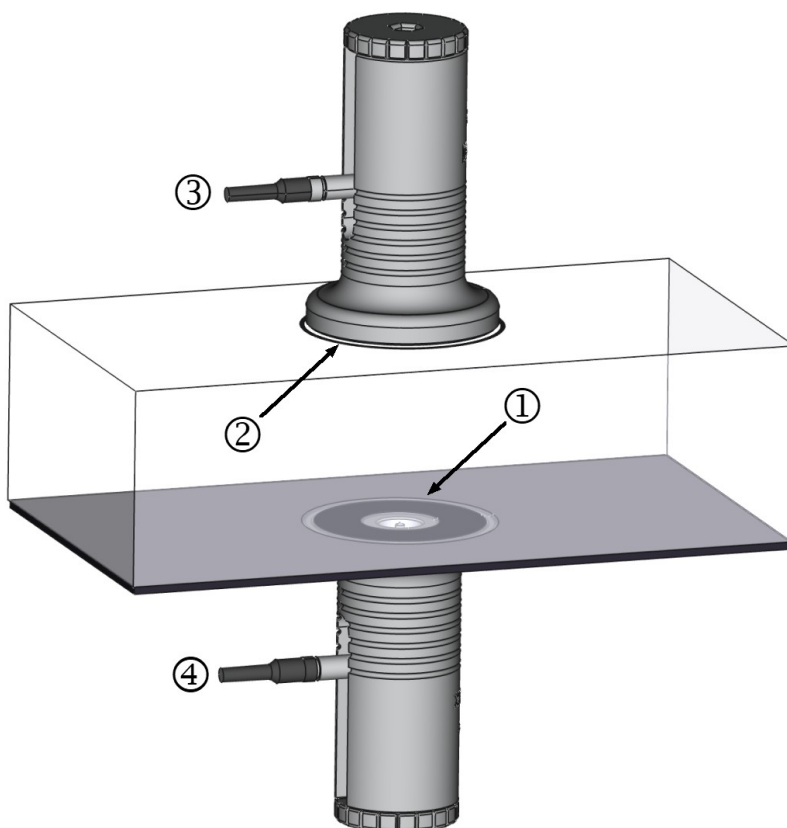
TYPE: TK300	
S/N:	
V_s, m/s	
V_L, m/s	

NOTE

Check the list of [transducers](#) ⁶² that can be calibrated using the TK300.

Calibration: Direct scheme

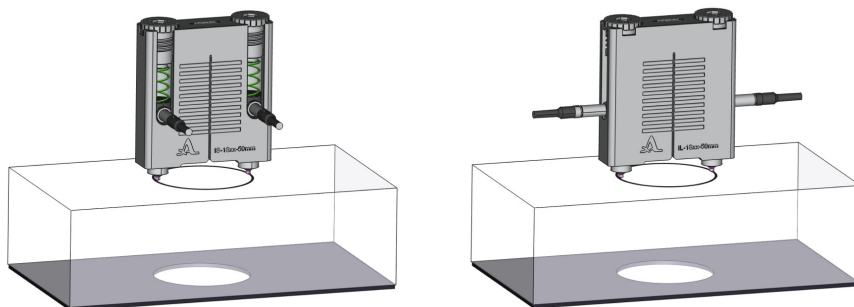
To perform [Delay calibration](#) ³⁶, use [D18-XX](#) ⁷² holder. Insert the holder into the opening on the rubber absorber side ①. On the opposite side, the correct position for the holder is marked with a circular indicator ②. Firmly press both holders with the sensors against the TK300 block. Use the 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](#) ^[36] use [IL-18XX-YYYmm](#) ^[72] or [IS-18XX-YYYmm](#) ^[72] holder. Calibrate on a rubber-free surface. The holder must be positioned as close to the center of the TK300 as possible.



2.6.3.2 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](#) ^[25] 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

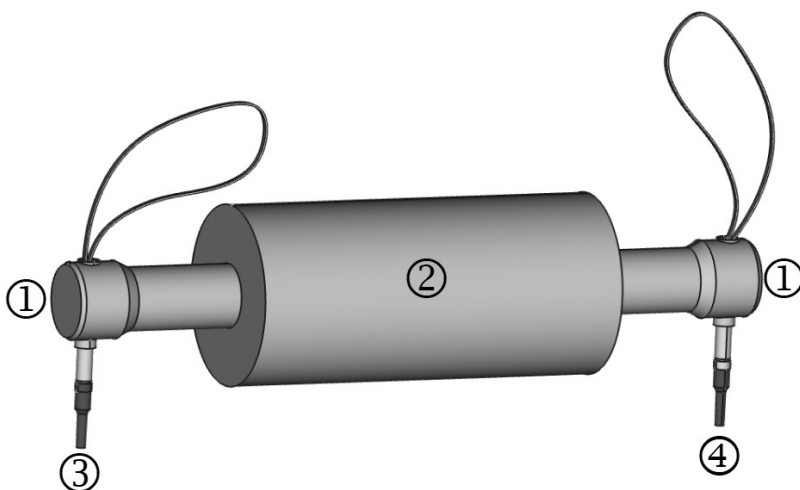
Check the list of [transducers](#) ⁶² that can be calibrated using the TK100.

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

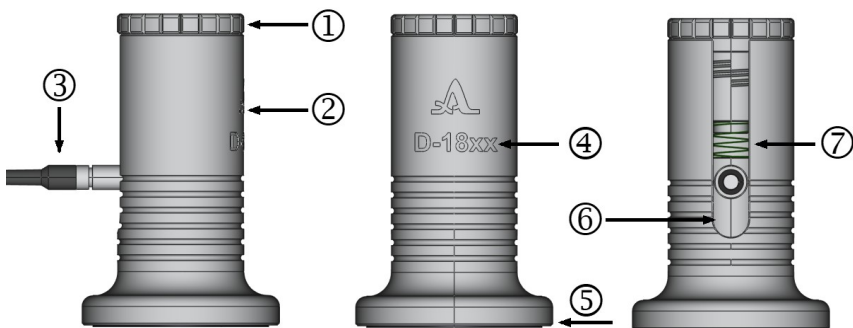
Ensure that the LEMO connectors of the transmitter ③ and receiver ④) are oriented in the same direction.

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

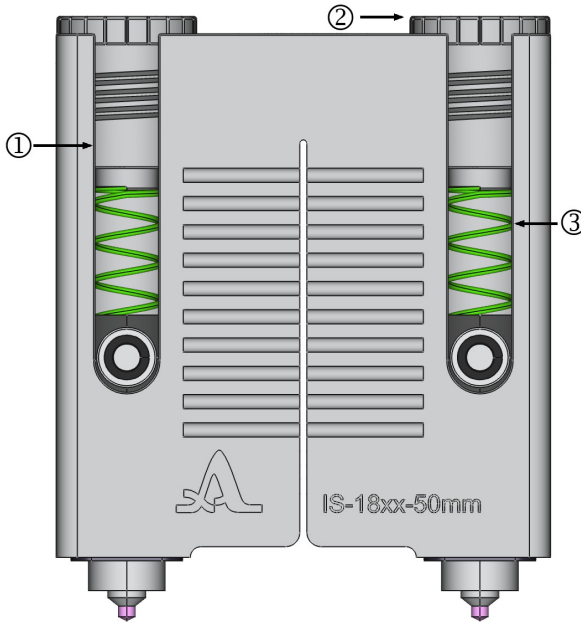
The D-18XX holder is used for measurements in the [Direct scheme](#) ²⁵ with all DPC transducers of the S18XX series, where "XX" represents a number. The D-18XX holder is shown in the following figure:



	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

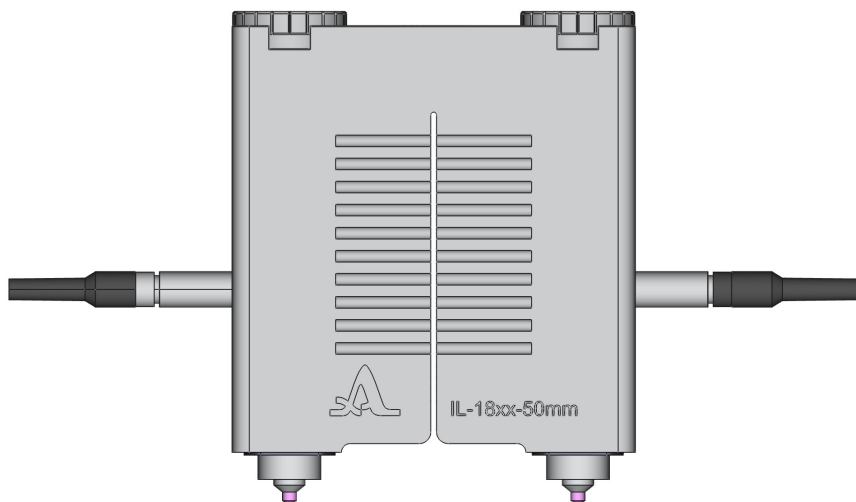
The IS-18XX-YYYmm holder is designed for performing measurements using the [Indirect scheme](#)^[25] with S-Type (shear) waves. For this type of measurement, the DPC transducers are positioned such that the LEMO connectors of both transducers are parallel to each other. Like the D-18XX , the IS-18XX 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](#)^[25] 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.



3 2D Tomography

3.1 Getting started

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

Startup

[Power on](#)^[15] the A1220 MONOLITH UPVT. After turning on the device and switching to [2D Tomography](#)^[15] mode, ensure that the battery is sufficiently charged. If the battery is low, charge the device before use.

Operation

- Use the [Project manager](#)^[17] 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](#)^[17].

3.2.1 Functional panel

Detailed description of Functional pannel read on [page](#)^[19].

3.2.2 System-settings

Detailed description of System settings read on [page](#)^[19].

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

Averaging

For detailed information refer to [page](#)²⁵. 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](#)²⁵. 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](#)²⁵. 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](#)²⁵. This parameter can be changes at any time causing the recomputing of all taken data. Press  to open the [tool](#)⁸³ for velocity calibration.

Operating frequency

For detailed information refer to [page](#)²⁵. 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](#)²⁵. 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](#)²⁵. This parameter will be locked as soon as the first measurement position is recorded. Delete all project data to unlock it.

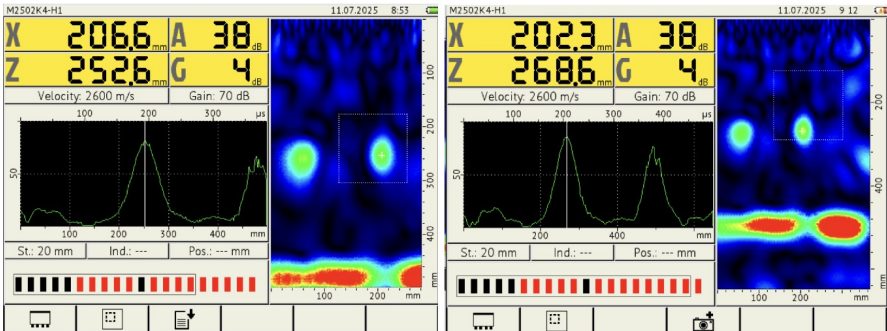
Zoom

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

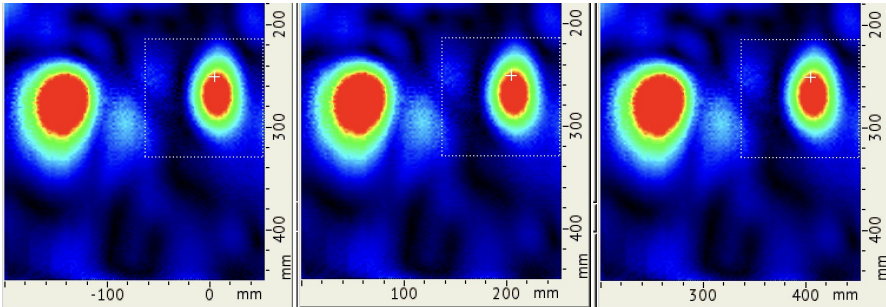
Step denotes the distance between measurement positions. The maximum number of positions is limited to 57. For step selection guidelines, refer to [page 98](#). To adjust the step value, use the  and .

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

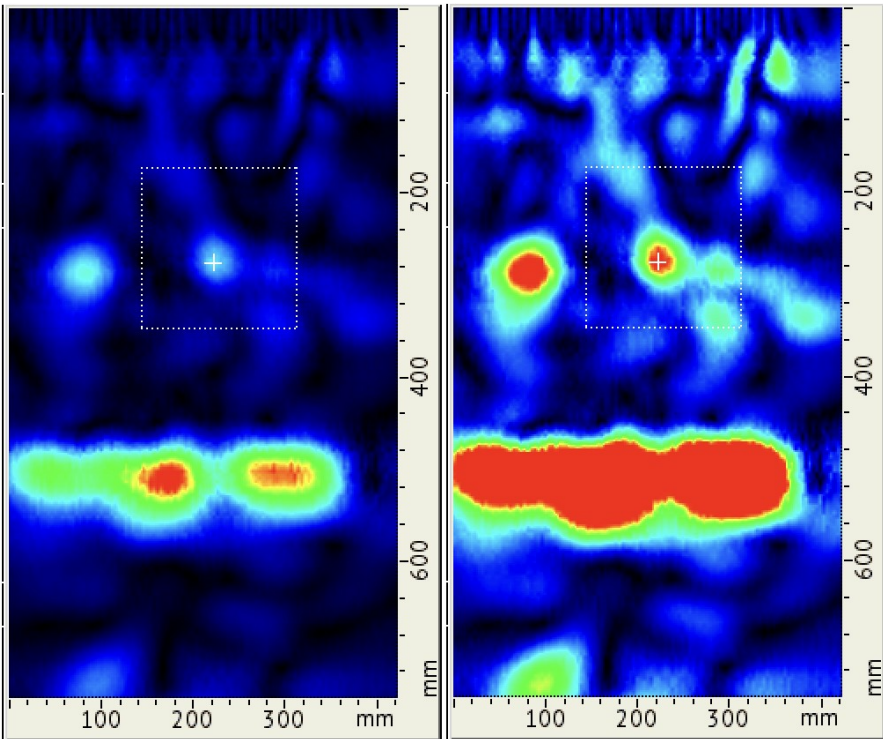
mm, 0 mm, and +200 mm, respectively. To adjust Offset use  and .



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

Color gain

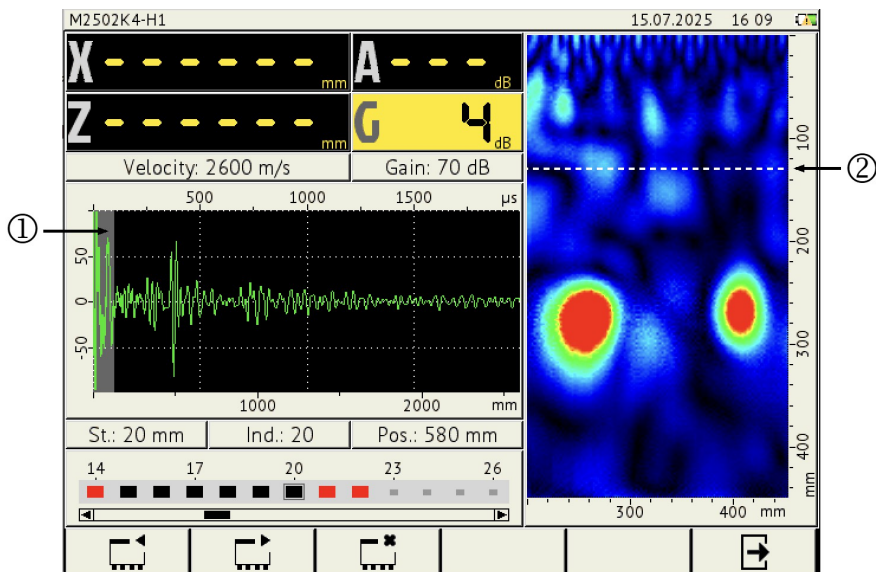
Color gain amplifies the resulting image and is measured in decibels (dB). It is especially useful when signal indications are weak or not clearly visible. To adjust the Color gain, use the  and  buttons. The user can also adjust the Color gain using  and , both in the [Main window](#)^[88] and in the [Measurement Editor](#)^[94]. 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 60](#) 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](#) ¹⁴. 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](#) ⁷⁷ tab, select the **Sound velocity** parameter and

press **Enter** . Confirm that you want to perform the calibration ①, then enter the thickness of the concrete section at the calibration location ②.

20.09.2025 13:33

M2502K4-V1

Probe name	M2502
Averaging	32
Pulse repetition rate, Hz	200
Gain, dB	70
Sound velocity, m/s	2600
Operating frequency, kHz	50
Transmitter pulse sequence	1.0
Pulse voltage, V	200
Zoom, mm	550
Step, mm	20
Offset, mm	0
Color gain, db	4
Dead zone, μs	0

①

Calibrate velocity?

Enter

Esc

②

Set calibration path p0, mm

250.00

Enter

Esc

Main Window

20.09.2025 22:48

①

T 2840 P 2500 V 15 16 m/s

②

Probe: M2502

Gain: 43 dB

Averaging: 16

PRR: 200 Hz

Pulse sequence: 1.0

Frequency: 50 kHz

③

50

0

-50

200

400

600

800

1000

1200

1400

1600

1800

μs

100%

④

1. 1028	2. 1760	3. 1760	4.
5.	6.	7.	8.

AVG: 1394.0

MAX: 1760.0

STD: 366.0

MIN: 1028.0

⑤

⑥

⏏

⏮

⏭

⏪

⏩

🔍

📄

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 44](#) 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.

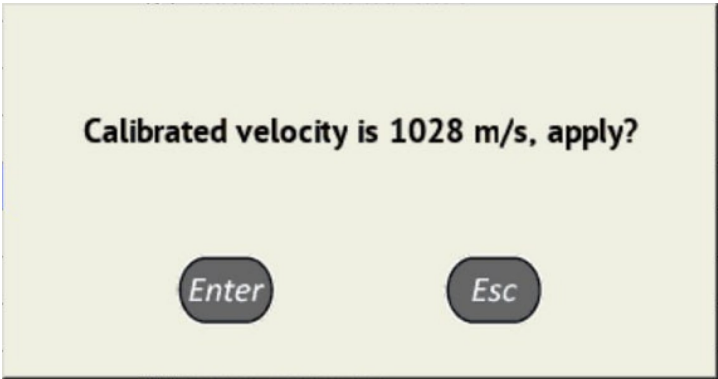
Measurement scheme ⑤

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 86](#).

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

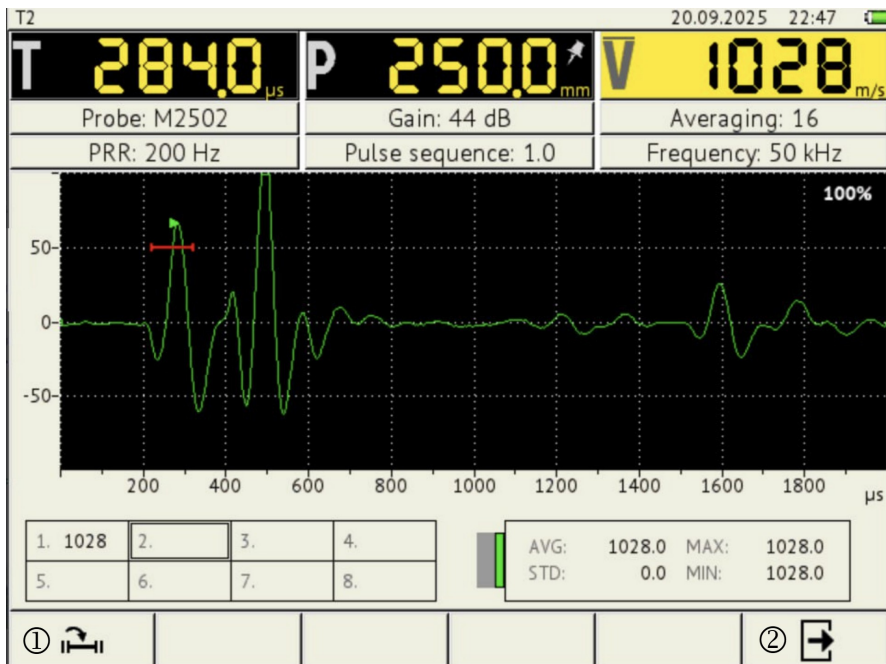
The Table editor and the Zoom tool are documented. Refer to [page 46](#) 10 for details. This chapter describes the Gate detector and the Start/Stop.



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.

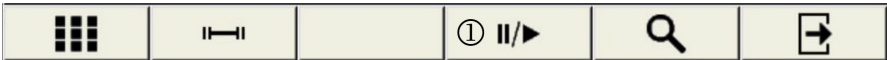


Set the Gate position with , , ,  and its length with  and , for more information refer to [page 47](#). If the Gate is outside the visible time window, press ① to center it on the current screen. Press ② to exit the Gate detector.

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.

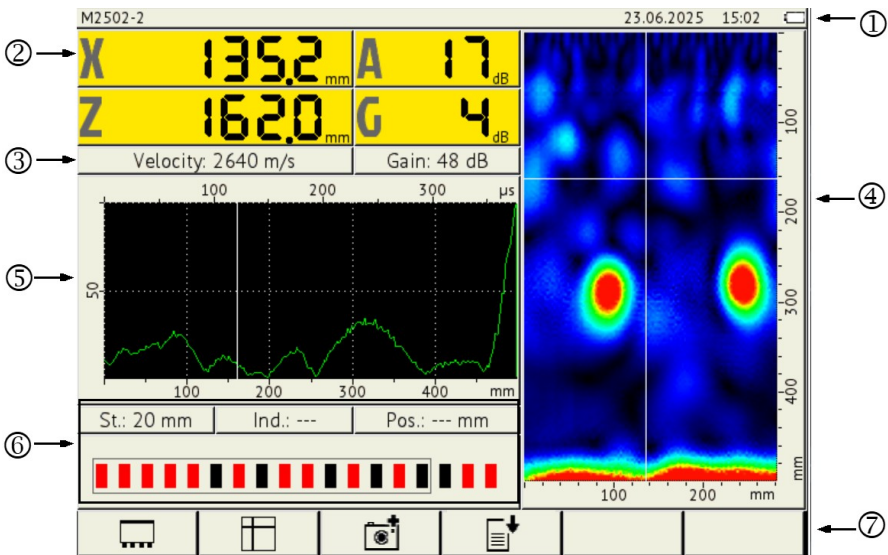


3.3 Main window

The main window has three primary views: Analysis, Recalculation, and Scan. Use  to exit the [Project manager](#)⁷⁶ 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 93](#).

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 77](#).

B-scan ④

The B-scan displays tomographical image. The B-scan also shows the cursor. Move the cursor using , ,  and . Refer to [page 93](#) 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](#).⁹³ 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

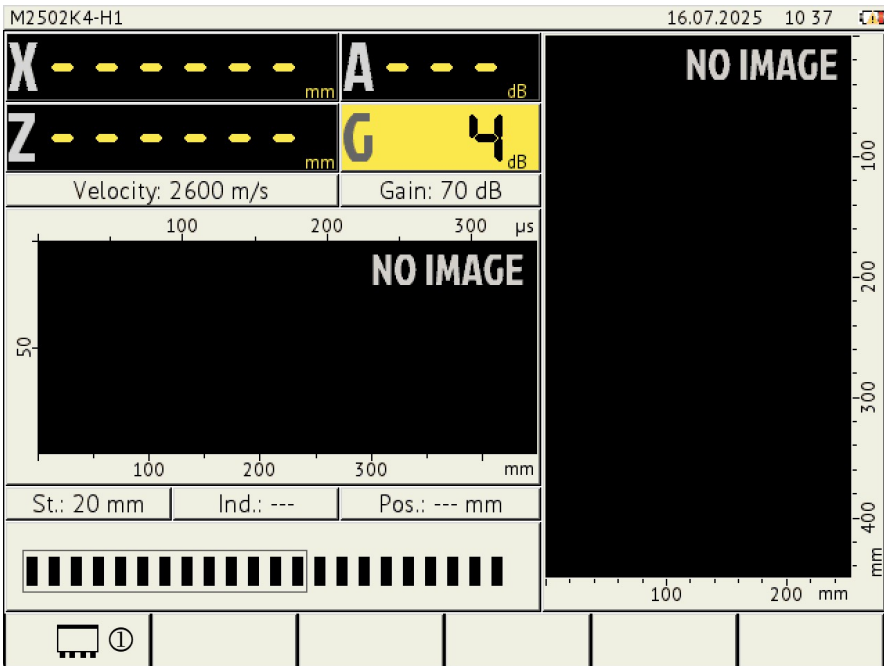
For details on the Map, refer to [page 98](#).

Control Panel ⑦

For details on the Control panel, refer to [page 92](#).

3.3.2 Recalculation view

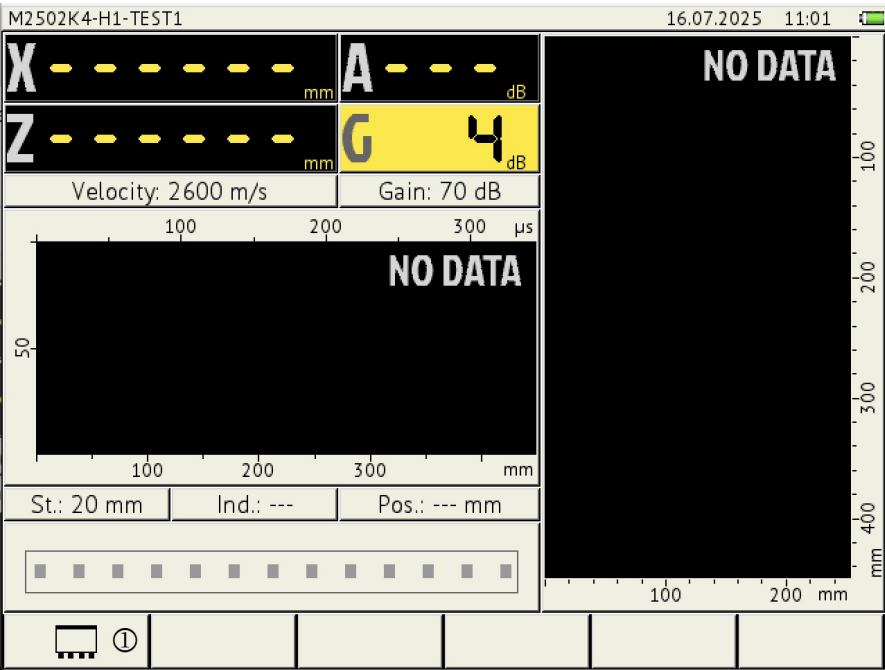
The main window switches to the Recalculation view if the operator changes any parameter that requires raw data to be reprocessed. In this state, both A-scan and B-scan appear blacked out with **NO IMAGE** indicator. The [Map](#)⁹⁸ highlights positions with available measurements ready for recalculation.



Press ① and follow the steps described in [Measurement editor](#)⁹⁴.

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](#)⁹⁸ does not contain any measurements.



Press ① and follow the steps described in [Measurement editor](#)⁹⁴.

3.3.4 Control panel

The Control panel offers the operator the following functions:

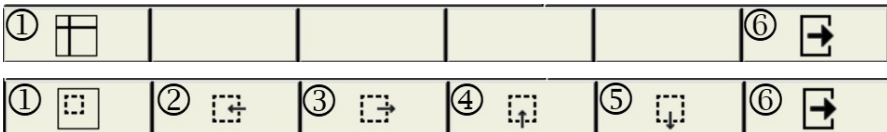
①		②		③		④			
	Description								
①	Measurement editor ⁹⁴								
②	Cursor manager ⁹³								
③	Screenshot ⁵⁴								
④	Save project ⁹³								

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:

X	43.16 mm	A	39 dB
Z	2.6 mm	G ①	7 dB

If the project has some changes and not saved parameters, use



to save them before the exit to the `Project manager`. The



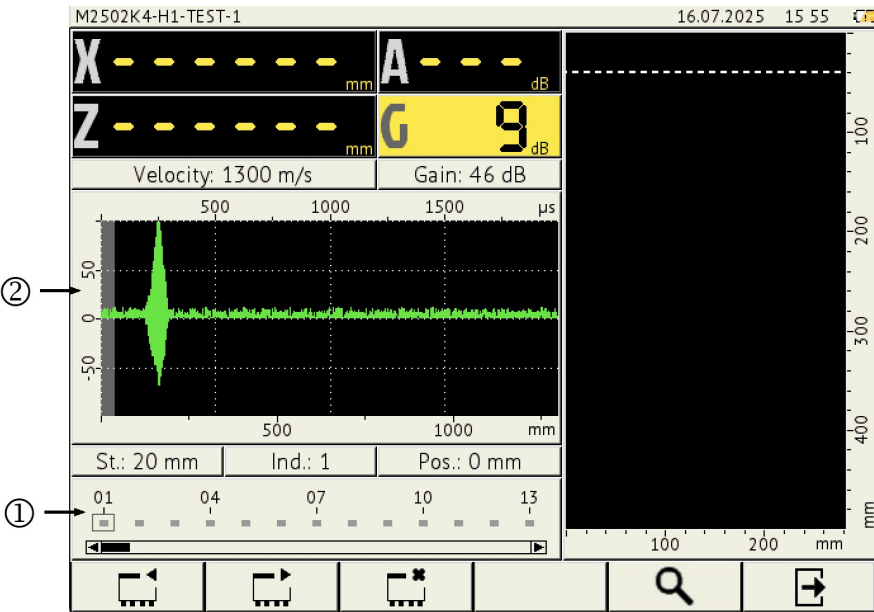
control is available only when there are unsaved parameter changes. If there is nothing to save, the control is hidden.

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](#)⁹¹, the A1220 MONOLITH UPVT initializes all required resources and places the [Map](#)⁹⁸ 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.



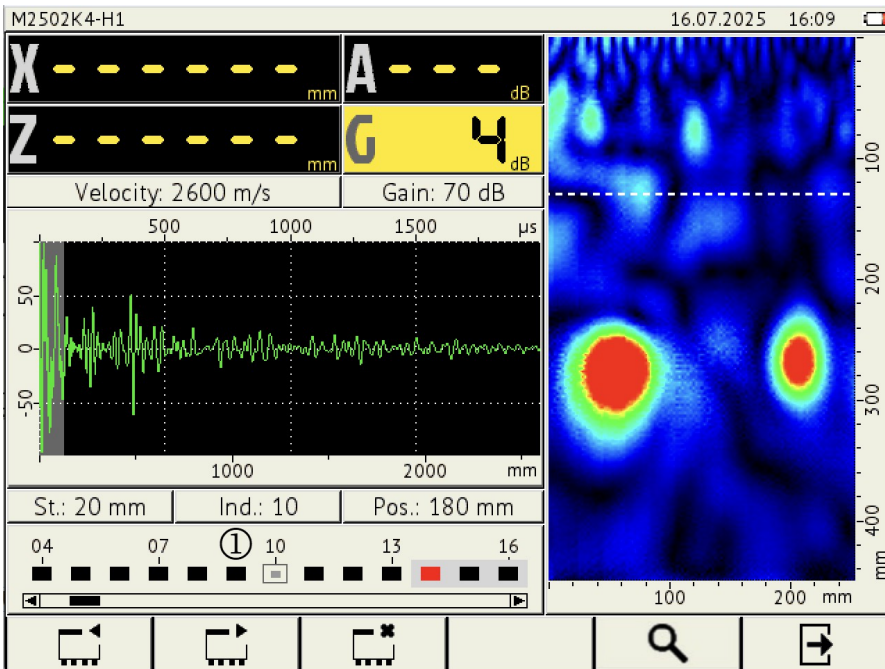
If the operator enters the Measurement editor from the [Analysis view](#)⁸⁸ or [Recalculation View](#)⁹⁰, A1220 MONOLITH UPVT prompts the user to perform a recalculation of the existing data.

Recompute image (up to 2 minutes)?	Yes	No
------------------------------------	-----	----

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.

Computing block 5 of 18

Upon completion, A1220 MONOLITH UPVT signals that it is ready for measurement by placing the cursor on [Map](#)⁹⁸ at the nearest unfilled position ①.

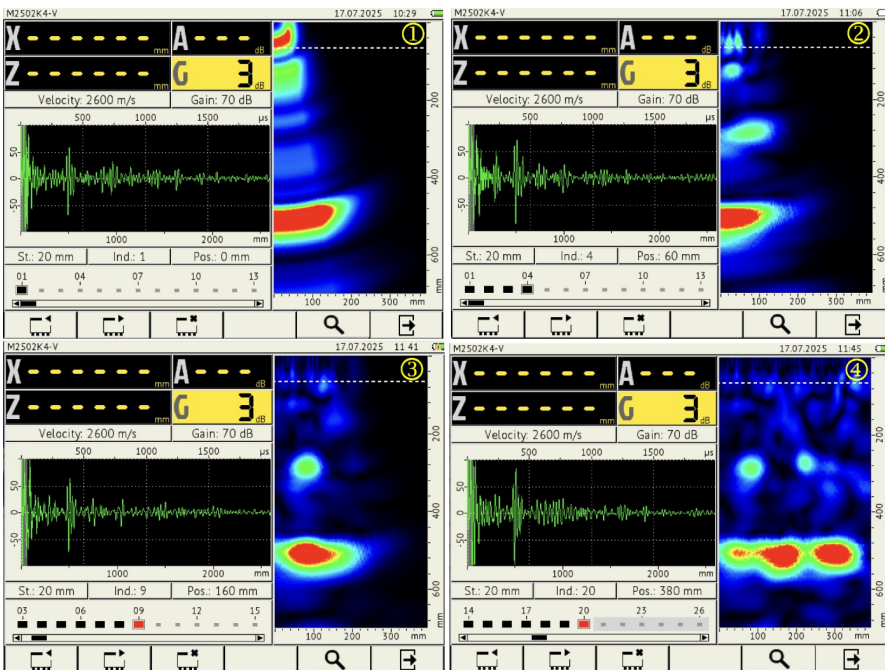


Measurement

A1220 MONOLITH UPVT performs the measurement when the  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](#) ^[98]. 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](#) ^[76].

Zoom tool

For more information about the Zoom tool , refer to [page](#) ^[52].

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](#) ^[88], it provides an overview of the measured positions. In the [Measurement editor](#) ^[94], 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, labels 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

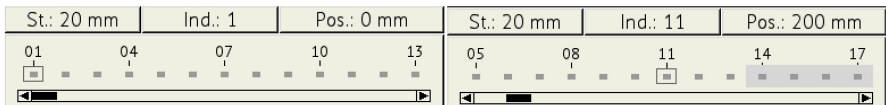
The region of interest ROI corresponds to the width of the image, which is defined by the [Zoom](#) ^[77] parameter. Before starting a measurement, the operator specifies the maximum inspection depth and width. Based on this, the Map highlights all measurement positions that fall within the ROI .

Step Selection Guidelines

The [Step](#) ^[25] 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](#) ^[94], 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 .

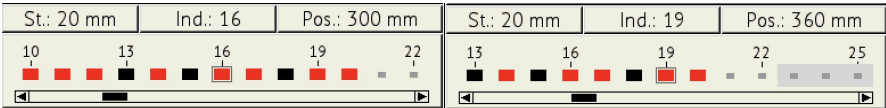


The operator can shift the [active position](#) ^[94] to the right, making the boundary clearly visible, as shown in the right image.

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](#)⁸⁸, 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 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 imaging, scanning should be performed along the long axis of the transducer. The scanning direction is indicated ①.

