A1570 EMAT

OEM Ultrasonic Pulser-Receiver Units

User's manual for A1570 EMAT

Revision 1.0.13

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 Description and instrument operation

1.1 The intended use of the instrument

1.1.1 Intended use and application range

The instrument is a portable ultrasonic thickness gauge of general purpose.
The instrument is designed for measurement of thickness of parts and walks of steel tubes and objects made of steel and metal alloys without the use of coupling fluids; ultrasonic thickness measurements of flat rolled stock; ultrasonic thickness measurements of the ship bottom without pretreatment of the surface; evaluation of anisotropy degree of the material.
The instrument can be used under the laboratory, field and workshop conditions in various industries.

The instrument communicates with a PC via the TCP/IP network (LAN or WLAN).

1.1.2 Operating conditions

The instrument is designed to work under the following conditions:
- ambient air temperature range from –30 to + 55 C;
- relative air humidity up to 95% at +35 C.

1.2 Technical specifications

The main metrological specifications of the instrument are listed in the Table 1 5 .

Table 1: Metrologic specification

Parameter	Value
Measurement range in steel with following transducers, mm:	
– S3850 5.0A0D8ES	from 1 to 100,0
– S3955 4.0A0D8ES	from 1 to 100,0
– S7392 4.0A0D10ES	from 1 to 100,0
– S7394 3.0A0R10x10ES	from 1 to 200,0
Measurement accuracy in steel depending on nominal thickness value d, mm	±(0,01·d + 0,02),

The main technical specifications of the instrument are listed in the Table 2 5 .

Table 2: Technical specification

Parameter	Value
Setting range of the ultrasonic sound velocity, m/s	from 500 to 15 000
Operating frequency range, MHz	from 2,5 to 5,0
Power source #1	15V Power supply
Power source #2	18650 li-ion Battery
Rated supply voltage, V	13,2
Period of continuous operation of the instrument powered by the battery under normal environmental conditions, min, h	> 8
Overall dimensions of the electronic unit, mm	
– length	284
– width	170
– height	62
weight of the electronic unit, g	2000
Average service life, years	>5

1.3 Design and operation

1.3.1 Design

In general, the instrument is an electronic unit with replaceable electromagnetic ultrasonic transducers (EMAT) connected via cables.

Figure 1: Overview of the device and EMAT

Front Panel

Figure 2: Front panel of the device

The front panel of the device includes:

- **Power button**: Used to turn the device on and off.
- **Connectors Lemo00 and Lemo2K**: For connecting EMAT.
- **LEDs**: Indicate the status of the device.

Rear Panel

The rear panel of the device has the following elements.

Figure 3: Rear panel of the device

- M12-Female connector for Ethernet
- M8-Female connector for power supply
- M12-Female connector for external trigger
- Connector for WLAN antenna
- Micro-USB connector for maintenance

The rear panel of the device includes:

- **M12-Female connector**: For Ethernet connection.
- **M8-Female connector**: For power supply connection.

- **M12-Female connector**: For external trigger.
- **Connector for WLAN antenna.**
- **Micro-USB connector**: For maintenance purposes.

Bottom Surface

The bottom of the device houses the battery compartment.

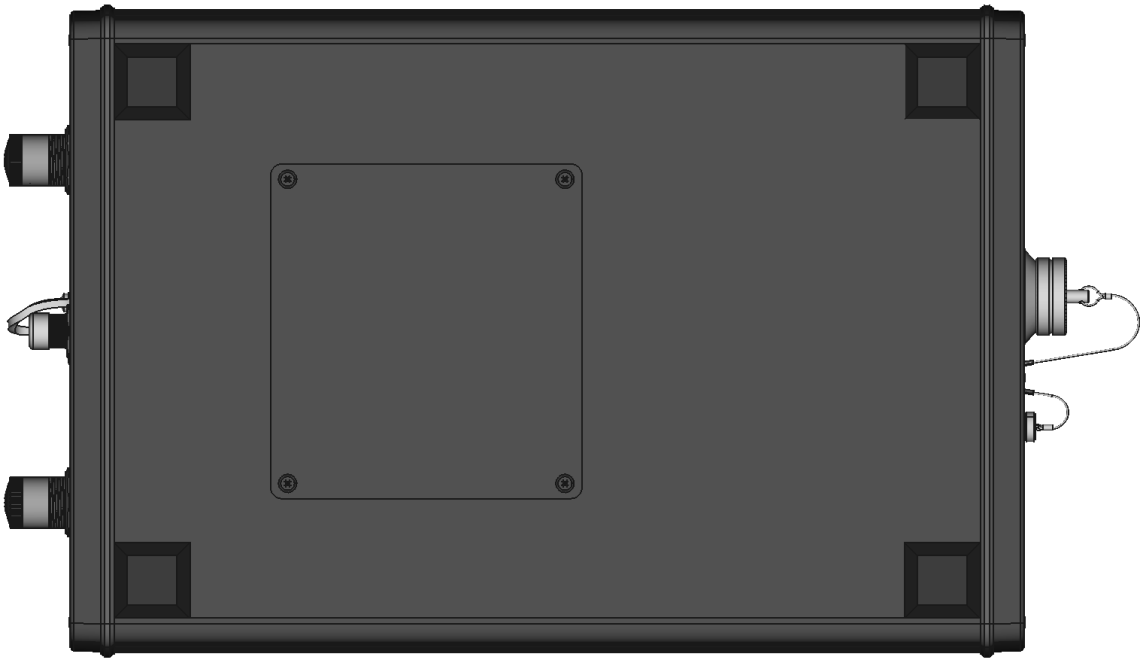


Figure 4: Bottom surface of the device

A1570 Battery compartment

General information

The device uses 18650 li-ion batteries. Batteries can be replaced through the removable battery cover.

⚠ **WARNING** The replacement of the batteries shall only be carried out by personnel that is qualified to handle batteries.

⚠ **WARNING** Only 18650 li-ion batteries shall be used with the A1270 device, or the device will malfunction or be destroyed.

⚠ **WARNING** When changing batteries, always pay attention to the correct polarity or the device will malfunction or be destroyed.

General safety guidelines for the use of Li-Ion batteries.

⚠ **WARNING** These general guidelines do not replace the qualification requirement by the employer:

- Handle discharged batteries with care.

Discharged batteries are also a source of danger, as they can still cause a very high short-circuit current. Therefore, even if lithium-ion batteries appear to be in a discharged state, they should be treated with the same care as if they were not discharged.

- Avoid physical impacts/blows.

Blows and ingress of objects can damage the battery. This can lead to leakage, heat, smoke, ignition or explosion of the battery.

- Keep batteries away from other metallic objects.

E.g. paper clips, coins, keys, screws or other metal objects, can cause a bypass of the terminal contacts. A short circuit between the battery contacts can result in burns or fire.

- If used incorrectly, liquid may leak from the battery.

Avoid contact with it. In case of accidental contact, rinse with water. If the fluid gets into the eyes, seek additional medical attention. Leaking battery fluid can cause skin irritation or burns.

- Do not expose batteries to fire or high temperatures.

If batteries are thrown into a fire or exposed to temperatures above 130°C, the heat build-up can lead to an explosion and/or fire and injury to people. Do not burn batteries!

- Do not disassemble the battery.

Disassembling or altering the battery may damage the protections. This can lead to heat, smoke, ignition or explosion of the battery.

- Do not submerge the battery in liquids such as water or beverages.

Contact with liquids can damage the battery. This can lead to heat, smoke, ignition or explosion of the battery.

- Charge batteries only in chargers recommended by the manufacturer.

For a charger that is suitable for a certain type of battery, there is a risk of fire if it is used with other batteries.

- Use batteries only with dedicated electrical device.

The use of any other electrical device may result in injury or fire.

- Do not use damaged or altered batteries.

Damaged or altered batteries may have unpredictable characteristics that may result in fire, explosion or injury.

- Do not use faulty batteries.

The use of a battery must be stopped immediately as soon as it shows abnormal properties, such as odour, heat, discolouration or deformation. With continued operation, the battery may develop heat and smoke, ignite or explode.

Storage

In any case, the warnings on batteries and the instructions for use must be carefully observed. Use only the recommended types of batteries. Lithium batteries should preferably be stored at room temperature and in a dry place (max. 50°C). Large temperature fluctuations should be avoided. (e.g. do not store near heaters, do not permanently expose to solar radiation).

Battery disposal

The battery shall not be disposed of with normal domestic waste. Please refer to the regional guidelines on battery separation. The proper disposal of batteries protects against potential and negative effects on the environment and human health.

Battery replacement Instructions

- Do not use excessive force when loosening or fastening screws.
- Use a fitting screwdriver according to ISO 7046 size M2.
- Do not exceed a torque of 0.25 Nm.
- Place the device in a clean, secure area.
- Remove screws by turning them counterclockwise and store them safely (see Figure 5 11).
- Lift off the lid carefully.
- Replace batteries, observing correct polarity printed in the battery compartment (see Figure 7 12).
-  **WARNING** Ensure sealing cord is in the designated groove and lid is in place. If the sealing cord is displaced or removed, the device enclosure is not sealed against water intrusion. This will circumstantially lead to damaging the device.
- Insert screws and turn them clockwise until fastened. Observe torque limit of 0.25 Nm.

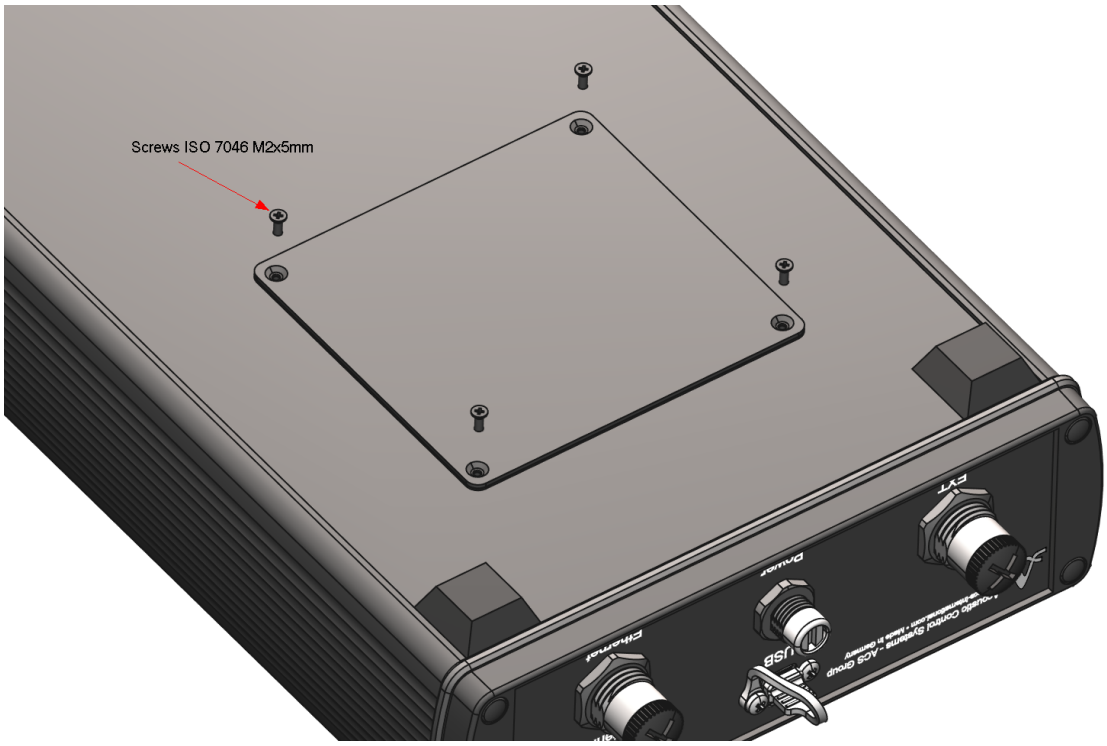


Figure 5: Removing screws from battery compartment

Figure 6: Battery compartment

To replace the batteries, follow these steps:

- Remove the old batteries and dispose of them properly.
- Insert the new batteries, ensuring you follow the safety guidelines and observe the correct polarity. The polarity markings are printed at the bottom of the battery compartment (see Figure 7 12).

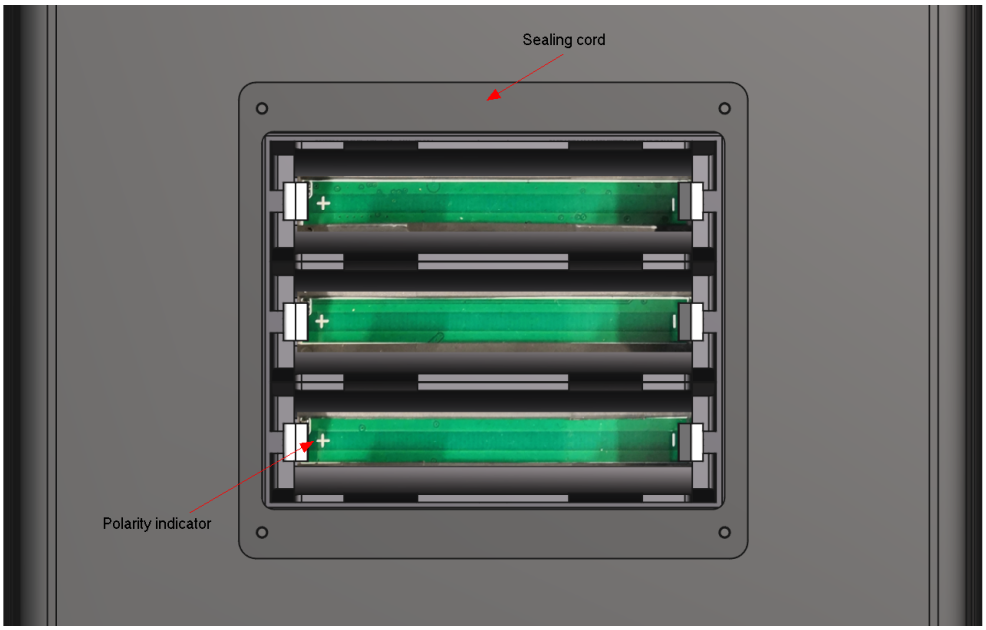


Figure 7: Battery compartment

2 Proper use

2.1 Preparing the instrument for operation

2.1.1 Connecting the transducers

EMAT is used to measure the thickness of the inspected object.

The instrument uses two types of *transverse* wave EMATs: radial and linear polarization, both based on pulsed and permanent electromagnet technologies.

- EMAT S3850 5.0A0D8ES: This type has radial polarization and an electric solenoid. This type should be connected to "LEMO 2K" connector.
- EMAT S7392 3.0A0D10ES and EMAT S7394 2.5A0R10x10ES: These types have permanent solenoids and can be connected to the instrument's electronic unit using "LEMO 00" connector.

IMPORTANT Observe the markings on the cable and connector to ensure proper connection (see Figure 8 13).

Figure 8: Lemo connectors of A1570

2.1.2 Switching On/Off the instrument

The device offers the following options for power management:

A. Batteries present; power supply not connected or turned off

To turn on the device, press the "Power" button on the front panel for more than 3 seconds.
- All LEDs will initially turn on to indicate the start of device initialization.
- The LEDs will then cycle through from "10%" up to the current state of charge (SoC) of the batteries.
- If no errors are detected, the "100% ON" LED will light up, indicating the device is ready for use.

To turn off the device press the "Power" button on the front panel for more than 3 seconds.

B. Batteries present; power supply connected and turned on

When the power supply is turned on, the device will automatically turn on.
- The loading procedure is similar to the first scenario.
- The difference is that the LEDs from "10%" and up will remain constantly lit.

The device remains on as long as the power supply is connected and turned on. If the power supply is disconnected, follow the procedure outlined in the first scenario

C. No batteries; power supply connected

When the power supply is turned on, the device will automatically turn on.
- The loading procedure is similar to the first scenario.
- However, the state of charge will not be shown.

The device remains on as long as the power supply is connected and turned on. If the power supply is disconnected, the device will shut down immediately.

Attaching power supply

To attach the power supply, remove protective cap and carefully screw the 4-pole M8 plug into the corresponding connector. Then, plug the power supply into an electric outlet.

For further information, please refer to the "Maintenance" 16 section.

2.1.3 Connecting LAN-cable

The device connects to the user's environment via LAN cable or WLAN.

Using a LAN connection:

1. Connect the 4-pole M12 LAN cable to the device. You can use the cable from the delivery kit or any suitable LAN cable with the appropriate plug.
2. Remove the protective cap from the device before plugging in the cable.

IMPORTANT Ensure the cable and connector use A-coding for compatibility (see Figure 9 15).

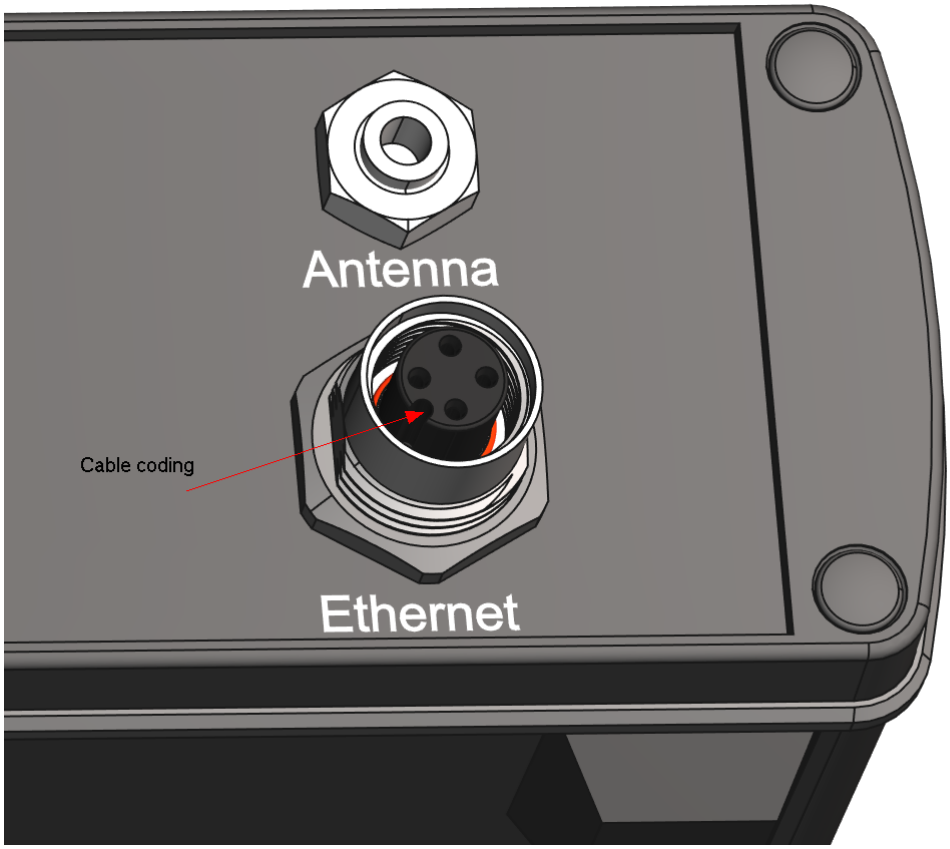


Figure 9: LAN connector

2.2 Using the instrument

2.2.1 Working with the instrument

During the inspection the temperature dependence between the ultrasonic propagation velocity in cooled or heated materials shall be considered. For the best measurement results the instrument must be adjusted to the ultrasonic velocity by the calibration sample with the same temperature as the temperature of the inspected object.

3 Maintenance

Maintenance of the thickness gauge includes the following:
1. Cleaning: Regularly clean the electronic unit to remove dust and dirt.
2. Charging: Charge the rechargeable battery as needed.

3.1 Accumulator

The rechargeable battery is designed to be operated in a broad temperature range. At negative temperatures battery capacity decreases. At lower temperatures the battery capacity is 15% less as compared to the normal temperature conditions.
If the rechargeable battery goes dead the instrument will be switched off automatically.
The rechargeable battery has a built-in protection against overcharge, over discharge, over current and overheating.
The battery service life is designed for the whole guaranteed service life of the instrument.
The battery must be replaced by the service centers only.

 **WARNING** THE WARRANTY WILL BE VOIDED IF THE USER REPLACES THE BATTERY INDEPENDENTLY!

3.2 Charging the battery

The battery shall be charged via an external charger.
The battery charging time depends on the discharge level. The complete charging takes maximum 2 hours. Multiple recharging is allowed.

 You can conduct the measurements during battery charging.

 **WARNING** TO AVOID THE BATTERY DAMAGE DON'T STORE THE INSTRUMENT WITH THE DISCHARGED ACCUMULATOR!

3.3 Check battery state of charge

If the batteries are present and there is no error, you can check the state of charge (SoC) of the entire battery pack. To do this, press the power button briefly.
- If there is no connected power supply or the power supply is turned off, the LEDs will light up sequentially from "10%" to the current SoC several times.
- If a power supply is connected and turned on, the LEDs from "10%" to the current SoC will light up simultaneously for 2 seconds.

After checking the SoC, the LEDs will return to their previous state.

3.4 Troubleshooting

If you have questions about operating the thickness gauge, contact the manufacturer's representatives for assistance and expert consultation.

3.4.1 Error messaging via LEDs

If error occurred in runtime, LEDs provide the code of the error. On error state the LED "10% Error" will briefly on following by an error code. Please consult the following tables to find out the error source.

State of LEDs indicating error code:

Error code	LED "10%"	LED "25%"	LED "50%"	LED "75%"	LED "100%"
1	ON				
2		ON			
3	ON	ON			
4			ON		
5	ON		ON		
6		ON	ON		
7	ON	ON	ON		
8				ON	
9	ON			ON	

Please find error codes description in the table below:

Error code	Error description
1	General error
2	Temperature of battery is out of range (low or high)
3	Battery Temperature Sensor Failure
4	Charger Failure
5	Battery Voltage Fault (over- or undervoltage)
6	Battery Gauge Error
7	FPGA error
8	Battery low state of charge warning
9	Battery low state of charge error

4 Transportation

The thickness gauge should be transported in the case included in the delivery kit.
The packaged instruments can be transported by any vehicle types for any distances without speed restrictions.
The packaged instruments shall be properly fastened in the transport vehicle. The packaged instruments shall be protected from precipitation and water splashes if the instruments will be transported in an open transport vehicle.
The packaged instruments should be properly and steadily fixed to prevent shocks of devices against each and against vehicle walls during the transportation.
The transportation conditions should confirm to the requirements of the technical conditions and regulations applicable to each type of transportation.
If shipped by air transport, properly packed instruments should be placed in hermetically sealed and heated compartments.
In case the transportation conditions differ from the operation conditions, the instruments shall be kept under normal environmental conditions for at least 2 hours prior to operation.

5 Managing A1570 via web interface

The A1570 EMAT offers management via a web interface in a browser. This includes the following features:

- **Configuring Ultrasonic Parameters and Acquiring Live A-Scan Vectors:** Set up and adjust ultrasonic inspection parameters, and view live A-Scan vectors.
- **Thickness gauge:** Demonstration of thickness measurement.
- **Updating Device Firmware:** Update the firmware of the device easily through the web interface.
- **Changing Network Settings:** Modify network settings such as IP addresses and access modes.
- **Maintenance and Logging:** Perform maintenance tasks and access logging information for troubleshooting and tracking device activity.

5.1 Accessing the A1570 web interface

To open the web interface, use the Chrome browser.

1. In the address bar, enter the default IP address of the device. By default it is 192.168.0.1 (for access via LAN) and 192.168.0.2 (for access via WLAN).
2. Press Enter to access the web interface of the device.

5.2 Vectors acquisition in the web interface

The start page of the web interface enables users to configure parameters for ultrasonic inspection and initiate vector acquisition (see Figure 10 20). This page facilitates general device verification and demonstration. No thickness estimation is conducted on this page.

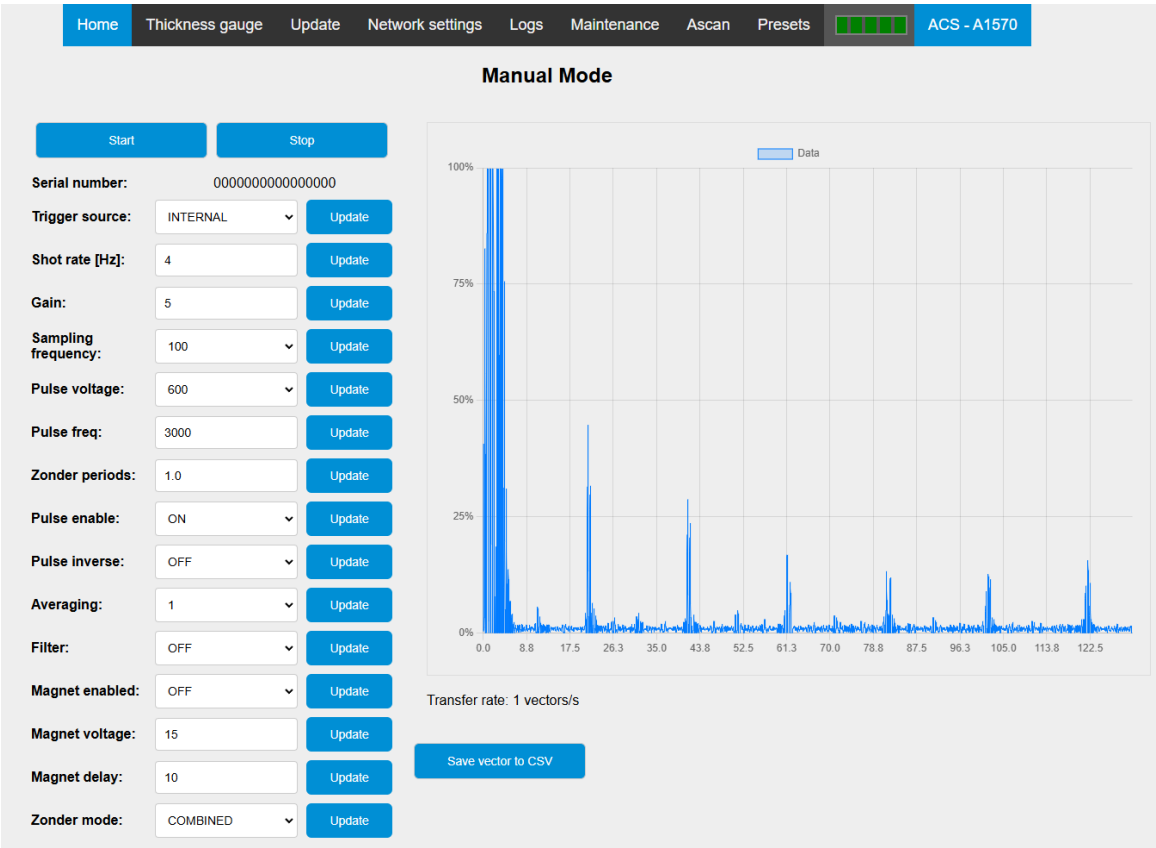


Figure 10: Vectors acquisition in web-interface

Controls Overview

Control name	Description
"Start" button	Initiates acquisition of A-Scan vectors from the device.
"Stop" button	Terminates acquisition of A-Scan vectors.
Serial number	Displays the device's serial number.
Trigger source	Selectable between internal timed trigger and external trigger.
Shot rate	Set the data acquisition shot rate from 1 to 4Hz.
Gain	Adjustable analog input amplifier gain from 0 to 40 dB.
Sampling frequency	Set the sampling frequency of the analog-to-digital converter (ADC). Options: 25, 50, or 100 MHz.
Pulse voltage	Choose the generator V_P voltage. Options: 200, 400, 600 V.
Pulse freq	Set the frequency of the generated pulse in KHz (matching the frequency of the inspection probe). Range: 1 000-10 000 KHz.
Zonder periods	Adjustable transmitter burst periods from 0.5 to 8 (fractional values permit half-wave emission).

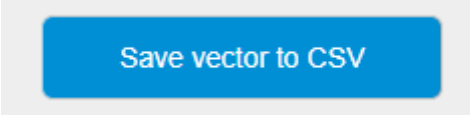
Control name	Description
Pulse enable	Toggles transmitter pulse generation.
Pulse inverse	Controls initial pulse burst polarity (ON: negative first half-wave; OFF: positive first half-wave).
Averaging	Set the number of vectors acquired and averaged internally (range: 1-16).
Filter	Digital filter applied. Set as indexes: OFF, 1, 2, 3, 4.
Magnet enabled	Activates impulse magnet sensors.
Magnet voltage	Configurable voltage for impulse magnet sensor from 15 to 25V.
Magnet delay	Adjustable microsecond delay between magnet start and acquisition begin.
Zonder mode	Switchable between normal and eddy-current measurements.

Parameter Modification:
1. Enter new values in input controls
2. Press "Update" button to apply changes

On the right pane of the screen the user has the last vector acquired from the device. The horizontal axis corresponds to millimeters. The vertical axis is from 0 to 100% and corresponds to amplitude of a sample in acquired vector.

Below the plot, view the current transfer rate of the vectors. This value updates every 5 seconds.

To save the last acquired vector as CSV-file, press button "Save vector to CSV". The file will automatically create with current date and timestamp.



Battery indicator

The battery indicator, located in the top-right corner of the interface, provides real-time information about the battery status. The indicator updates every 10 seconds and displays the following states:

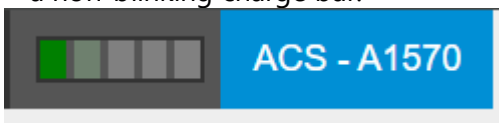
State of Charge

The indicator shows the current battery charge as a percentage.

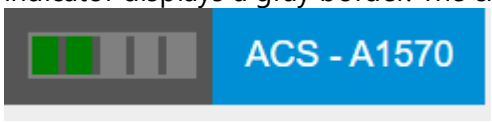
Charging Status

- Charging in Progress: If a charger is connected and the device is charging, the indicator displays a black border with a blinking charge bar.

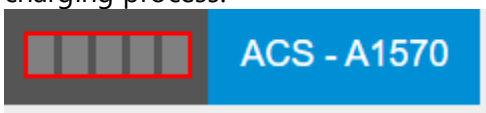
- Charging Complete: Once charging is complete, the indicator shows a black border with a non-blinking charge bar.



Power Source Unplugged
When the device is operating on battery power only (i.e., the charger is unplugged), the indicator displays a gray border. The charge percentage is shown without any blinking.



Charging Error
If a charging error occurs, the indicator will display a red border, signaling an issue with the charging process.



5.3 Presets management

The device offers a fine-grained setup of measurement parameters to accommodate various measurement needs. Different specimens may require specific settings depending on factors such as sensor type, material, and thickness. Presets are designed to simplify this process by allowing users to define and save sets of parameters for reuse under different conditions.

For each combination of sensor, material, and thickness, the user should create a dedicated preset. These presets ensure consistent and accurate measurements without the need to manually reconfigure settings each time. Each preset is stored in the device memory and can be selected during thickness measurements.

Accessing the Presets Page

The "Presets" page is accessible to all users and provides options to create, edit, or delete presets.

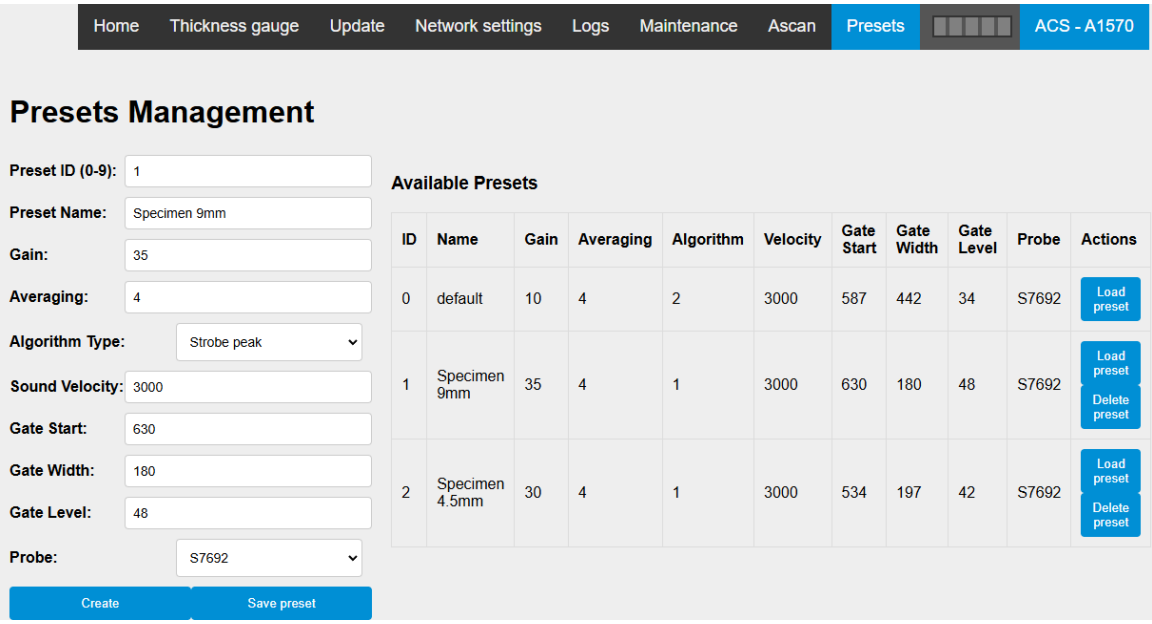


Figure 11: Presets management page

Loading a Preset for Editing

To edit a preset, locate the desired row in the presets table and click the Load Preset button. This action loads the selected preset for modification.

Deleting a Preset

To remove an existing preset, click the Delete Preset button in the corresponding row of the presets table. Note that the device is delivered with a default preset, which cannot be deleted. This default preset can serve as a base for creating new presets.

Creating a New Preset

To create a new preset, users can either:

- Load an existing preset (default or user-created) and modify its parameters, or
- Manually enter all required fields.

Once the desired parameters are defined, click the Create button to save the new preset in the device memory. The device supports up to 10 user-defined presets. If this limit is reached, a warning will appear when attempting to create another preset. In such cases, the user must first delete an existing preset to free up space.

Editing Preset Parameters

To edit the parameters of an existing preset:

1. Load the preset from the table.
2. Modify one or more fields as needed.
3. Click the Save Preset button to apply and save the changes.

WARNING If the Save Preset button is not clicked, any changes made will not be saved to the device memory.

All parameters can be edited at any time. Users also have the option to create a dummy preset and fill in the parameters later, as described in the chapter "Ascan Measurement 24 ".

5.4 Ascan Measurement

Setting Up and Validating Presets on the Ascan Measurement Page

To properly configure a preset, the user should navigate to the **Ascan Measurement** page. This page allows the modification and validation of presets while providing live measurement data. The live data array (plot) helps define parameters for specific thickness measurements effectively.
The web interface leverages functions embedded in the A1570 device, resembling SCPI operations internally (see Introduction to the SCPI Language 37).

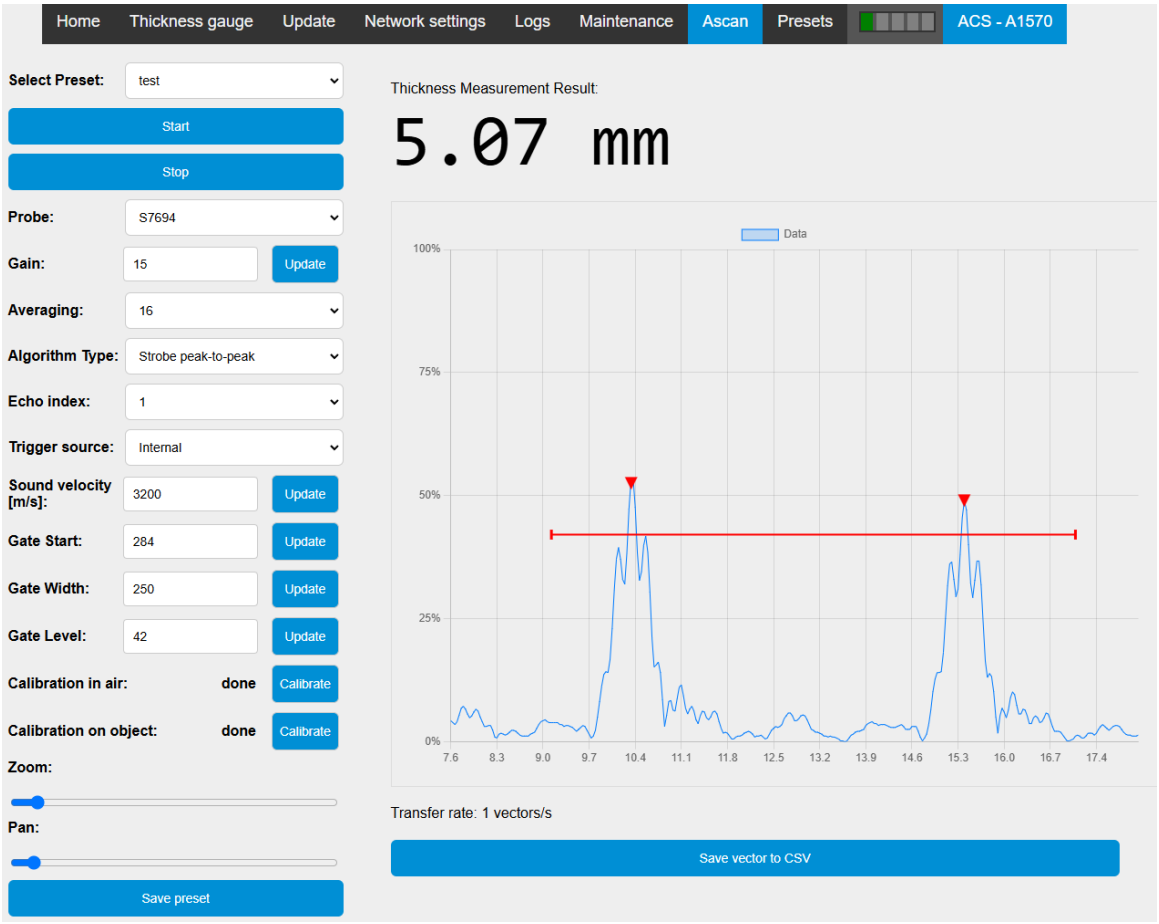


Figure 12: Ascan measurement page

Step-by-Step Guide to Setting Up a Preset:

Select and Load a Preset

Choose a preset created on the "Presets Management 22 " page. Use the Start and Stop buttons to toggle live data acquisition. While live data acquisition is active, changes made to the parameters will be immediately reflected on the device.

Select the Proper EMAT Probe Type

The EMAT probe type determines critical settings like transmitter parameters, excitation pulse voltage, and more. It is essential to select the correct probe type to ensure accurate measurements and optimal device performance.

Choose a Processing Algorithm

The user has three algorithm options for data processing:

- Automatic Mode: The device automatically adjusts all parameters; no additional user input is required (see Figure 13: Automatic processing algorithm 25).

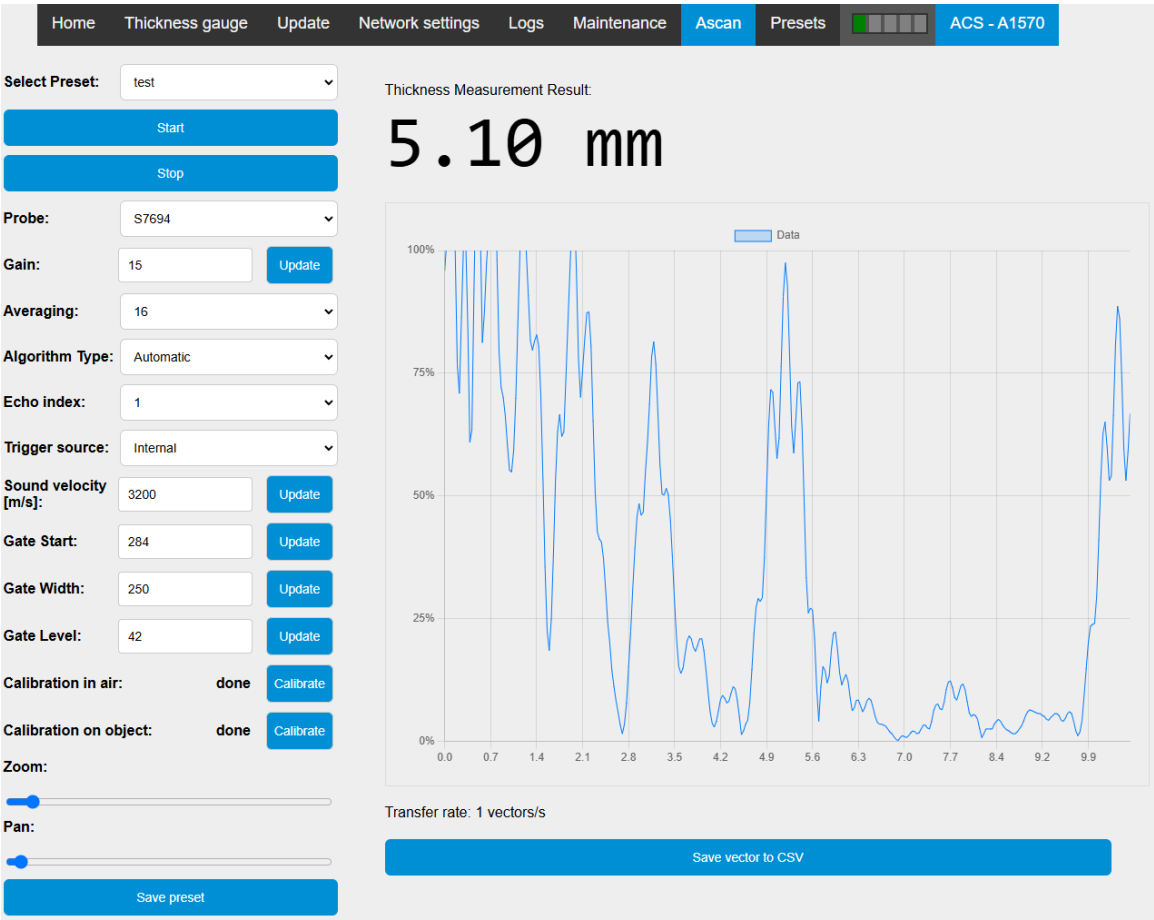


Figure 13: Automatic processing algorithm

- Strobe Peak Algorithm: Identifies the first local maximum within the measurement gate (see below for gate setup).
  - When the peak is detected, it will be displayed as a red marker on the plot. Its distance is shown in the thickness readings (see Figure 14: Strobe peak processing 26).

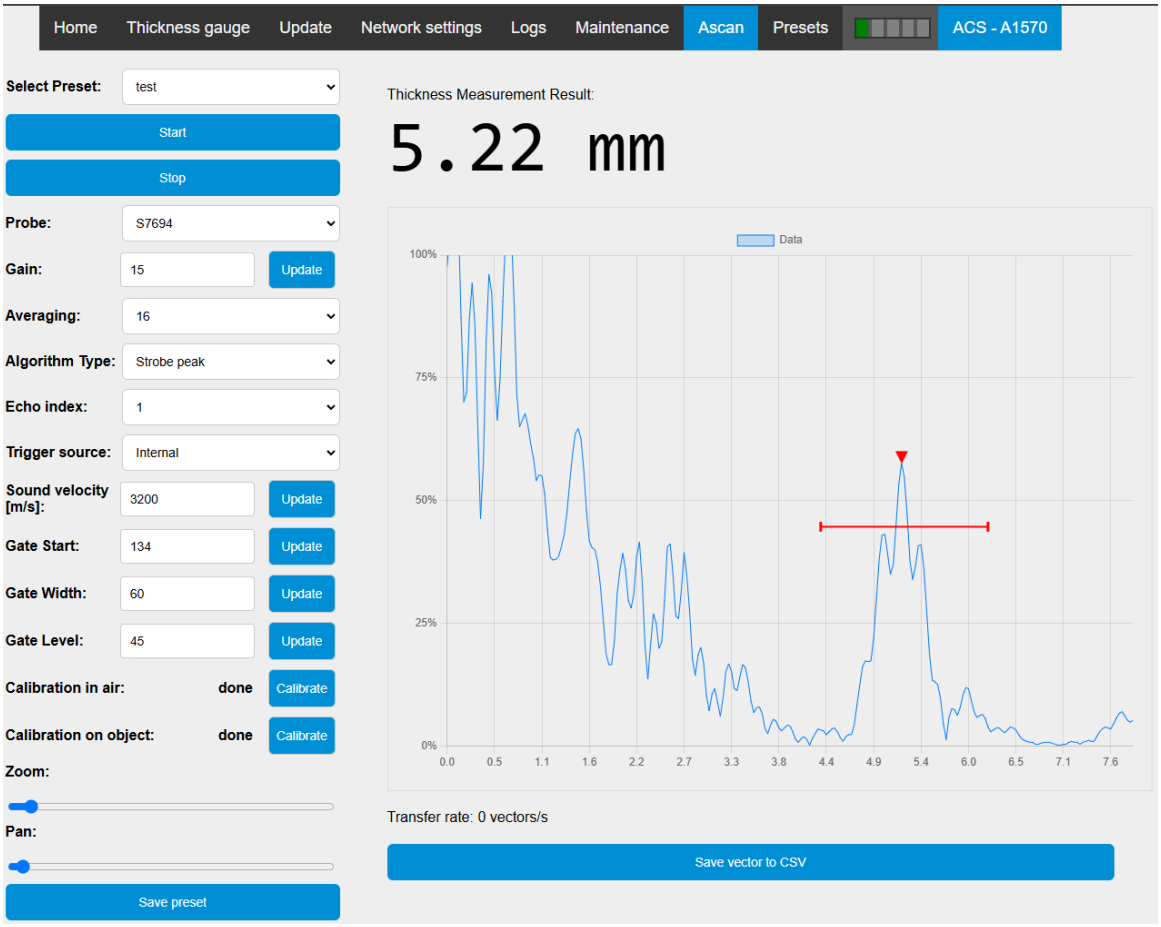


Figure 14: Strobe peak processing

- Strobe Peak-to-Peak Algorithm: Detects two local maxima within the measurement gate and calculates the distance between them.
  - When the peaks are detected, they will be shown on the plot as two red markers. The distance between them will be displayed in the thickness readings (see Figure 12: Ascan measurement page 24).

If no thickness could be determined, a dash ("-") will appear in the thickness reading (see Figure 15: Unable to find thickness during setup 27). Adjust parameters and check probe functioning.

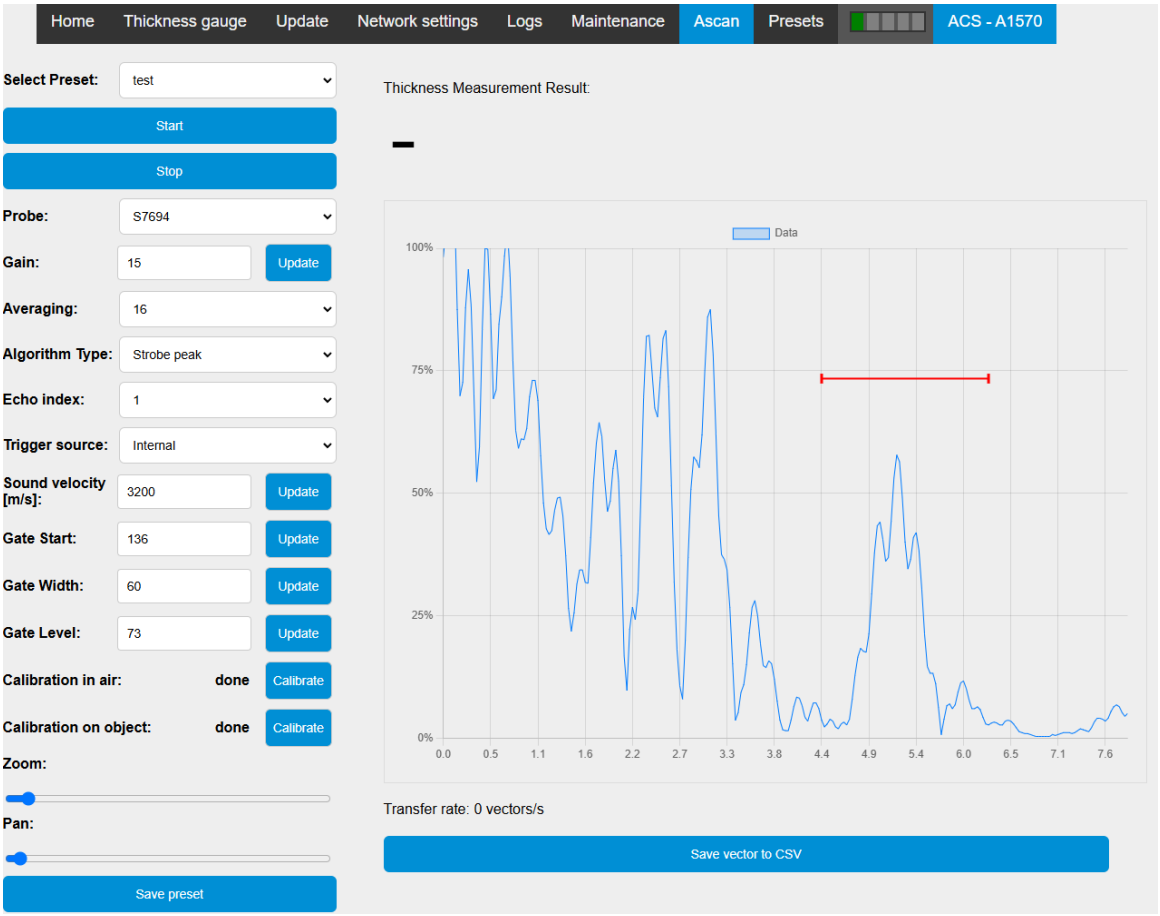


Figure 15: Unable to find thickness during setup

Define the Measurement Gate

The measurement gate is the range within which the processing will occur. Users can set the gate either:

- By entering values in the corresponding text fields, or
- By dragging an interactive gate directly on the live A-scan view.

In Automatic Mode, the device determines the gate internally, and the interactive gate option is hidden.

Use the zoom and pan sliders to focus on the desired inspection range for precise gate adjustment.

Adjust Signal and Gate Levels

Fine-tune the Analog Gain and/or Gate Level to optimize signal detection and processing. Additionally, set the Sound Velocity to match the actual specimen thickness for accurate thickness readings.

Other settings

Averaging

Averaging helps stabilize the signal by acquiring multiple measurements and computing an averaged result. For optimal performance, it is recommended to use the maximum averaging value.

Trigger Source

The Trigger Source determines how measurements are initiated:

- **Internal** Mode: Measurements are launched automatically using an internal timer.
- **External** Trigger: Measurements are initiated through the auxiliary EXT input of the A1570 device, allowing external control over the measurement process.

Special Consideration for the Strobe Peak Algorithm:

For some materials, the first backwall echo may fall within the signal's "dead zone" and become undetectable.

- When multiple echoes are visible: Use the **Strobe Peak-to-Peak** algorithm to process echoes (e.g., 2-3, 3-4).
- When only one echo is detectable: Use the **Strobe Peak** algorithm and specify the echo number in the Echo Index parameter.

For instance (see Figure 16: Echo index setup 28):

- The 1st echo is lost in noise.
- The 3rd echo is distorted by wave transformations or noise.
- The 2nd echo is visible and clear.

Set the measurement gate to the 2nd echo and assign "2" as the Echo Index. The device will then detect the position of the maximum in the 2nd echo and adjust the thickness measurement accordingly.

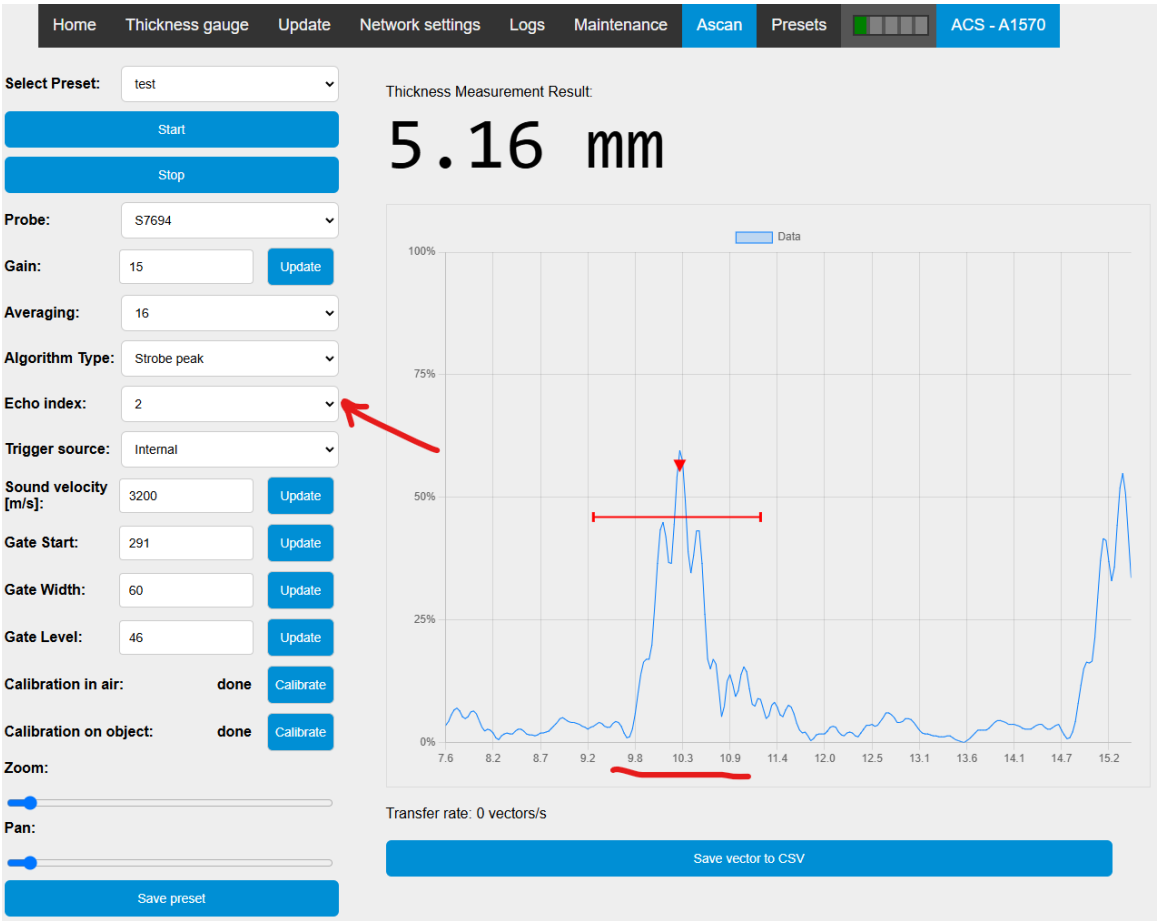


Figure 16: Echo index setup

Calibrating the EMAT Probe

Calibration is essential for ensuring the proper functionality of the processing algorithms. Follow these steps to calibrate the probe:

Air Calibration:

1. Lift the probe into the air.
2. Press the **Calibrate** button.

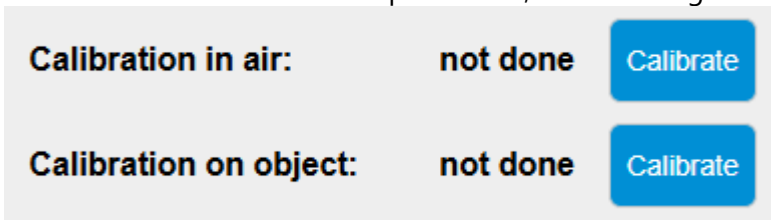
Figure 17: Calibrate probe in air

Calibration on object:

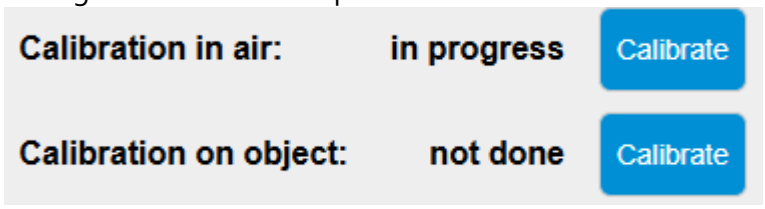
1. Place the probe on the provided calibration specimen (a 5mm-thick coin).
2. Press **Calibrate** near the corresponding field.

Figure 18: Calibrate device on calibration sample

When no calibration has been performed, the following indication is shown to user:



During the calibration the process will be shown as follows:



If an error occurs during calibration, the user will be notified (see Figure 19: Calibration error 30). Repeat the calibration process.

- If repeated attempts fail, it may indicate a malfunctioning probe or device.
- In such cases, contact your reseller or the ACS Support-Team for assistance.

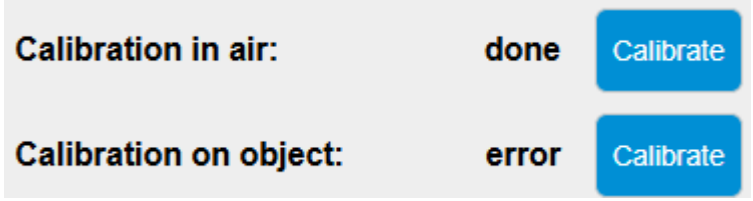


Figure 19: Calibration error

After successful calibration, the status will show as "done".

IMPORTANT Please note that calibration in air must be completed before calibration on the calibration sample. Failure to do so will result in an error status, and feasible thickness measurements will not be possible.

IMPORTANT Do not forget to save the settings by pressing "Save preset" button

5.5 Web interface for thickness gauge demonstration

The Thickness Gauge interface serves as a demonstration tool or for quick startup during initial integration of the device into your acquisition pipeline.
Measurement configurations are managed through presets (refer to Ascan Measurement 24 for detailed instructions). By selecting the appropriate preset, all relevant settings are automatically applied.

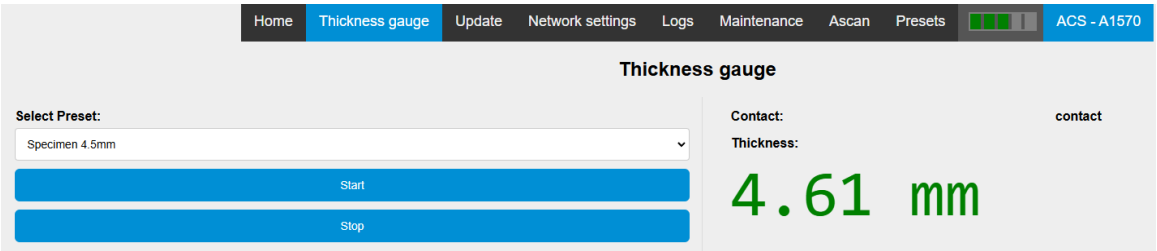
Start Thickness Measurement

Initiate the thickness measurement process:

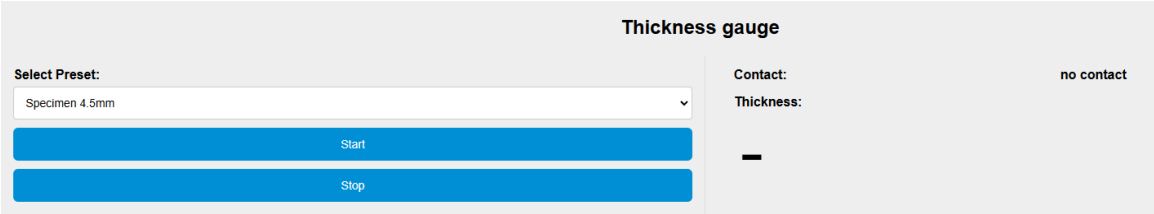
1. Click the "Start" button to commence measurement.
2. Monitor the real-time measurement value and probe contact status. The values will be updated every second.

During the measurement process, the interface will display:

- Thickness readings.
- The contact status between the probe and the specimen.



If no contact is detected or the measurement fails, a dash ("-") will be shown in place of a reading.



Stop Thickness Measurement

To conclude the measurement process:

1. Click the Stop button to halt the measurement.
2. The final measurement value will remain displayed on the interface.

5.6 Updating firmware using web interface

Updating firmware of the device is possible using web interface.

Prerequisite: The user must download the firmware archive before starting the update process.

Steps to Update Firmware:

1. Navigate to the "Update" page in the web interface.
2. Select the firmware file by clicking the "Browse" button and using the file selection dialog.
3. Once the file is selected, press the "Update A1570" button to begin the update process.

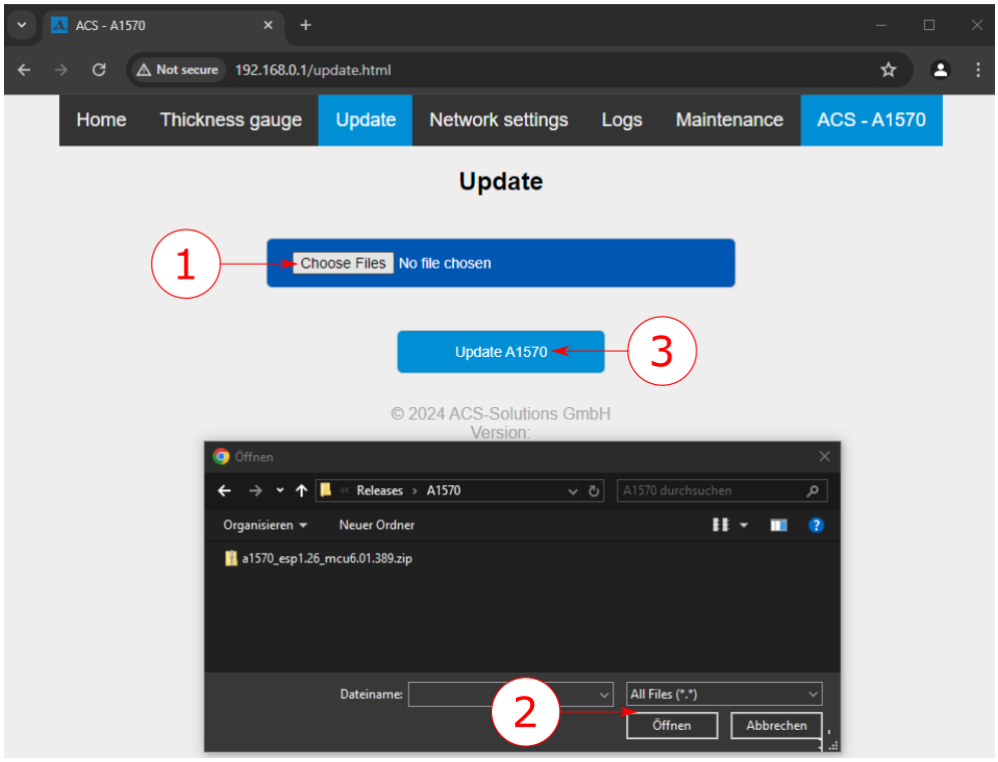


Figure 20: Updating in web interface

- The device will download the selected file and update its firmware. A progress bar will appear, displaying the progress of the update (see Figure 21 33).

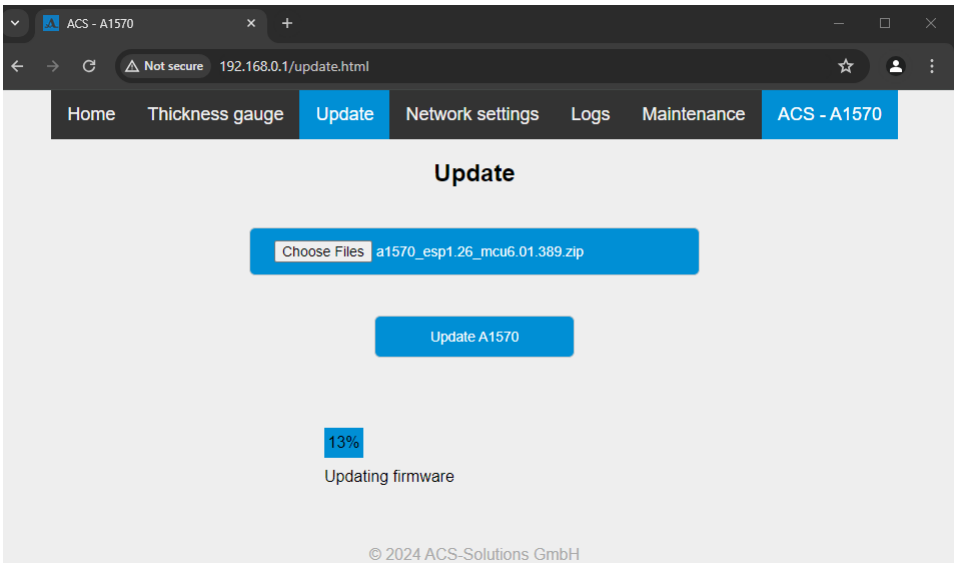


Figure 21: Updating progress

- Once the update is complete, a notification will appear below the progress bar. Restart the device to apply the changes.

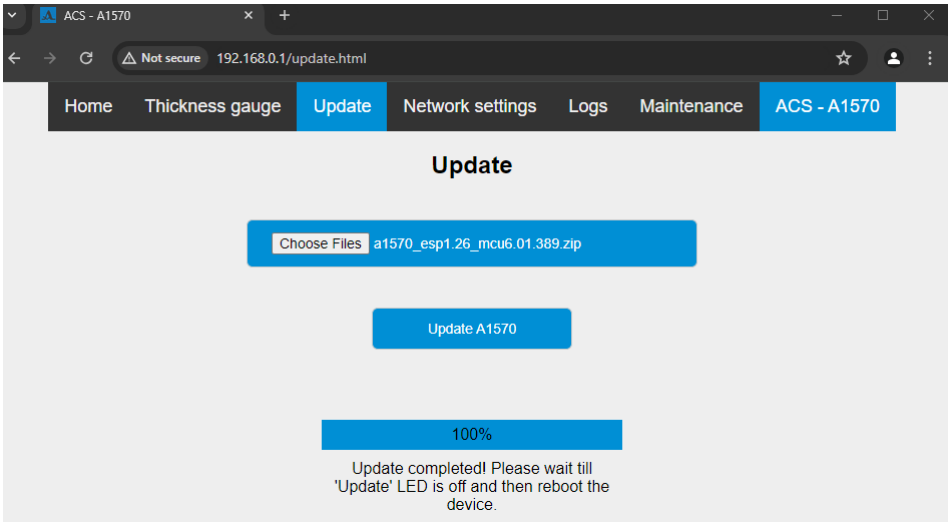


Figure 22: Updating sucessfully finished

If the update fails:

- The user will receive a notification indicating the failure (see Figure 23 34).
- In this case restart device, reload updating page and try the update procedure again.
- If multiple attempts are unsuccessful, contact the ACS-Solutions GmbH service team for assistance.

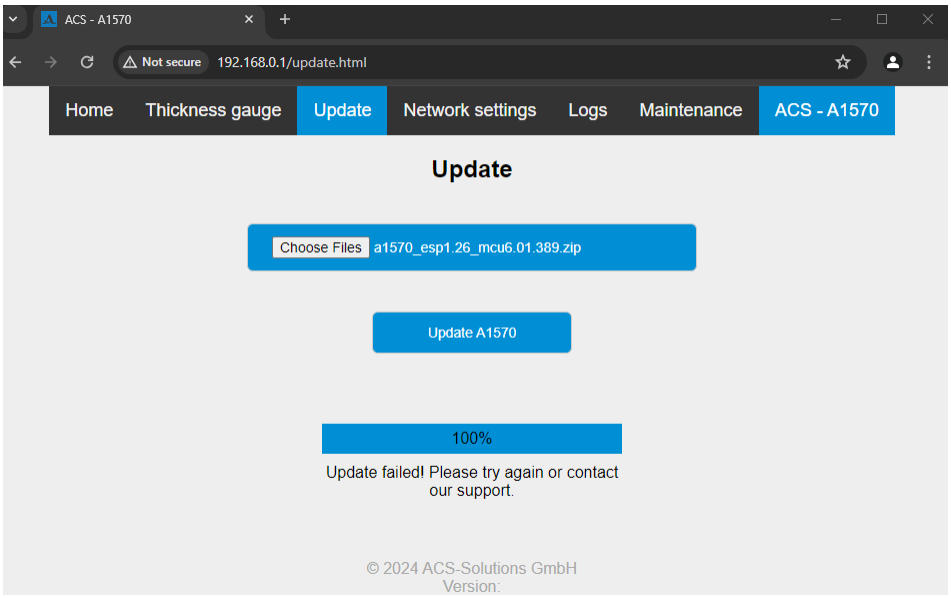


Figure 23: Updating failure

5.7 Network settings

To change or review network settings, user should open the "Network settings" page (see Figure 24 34).

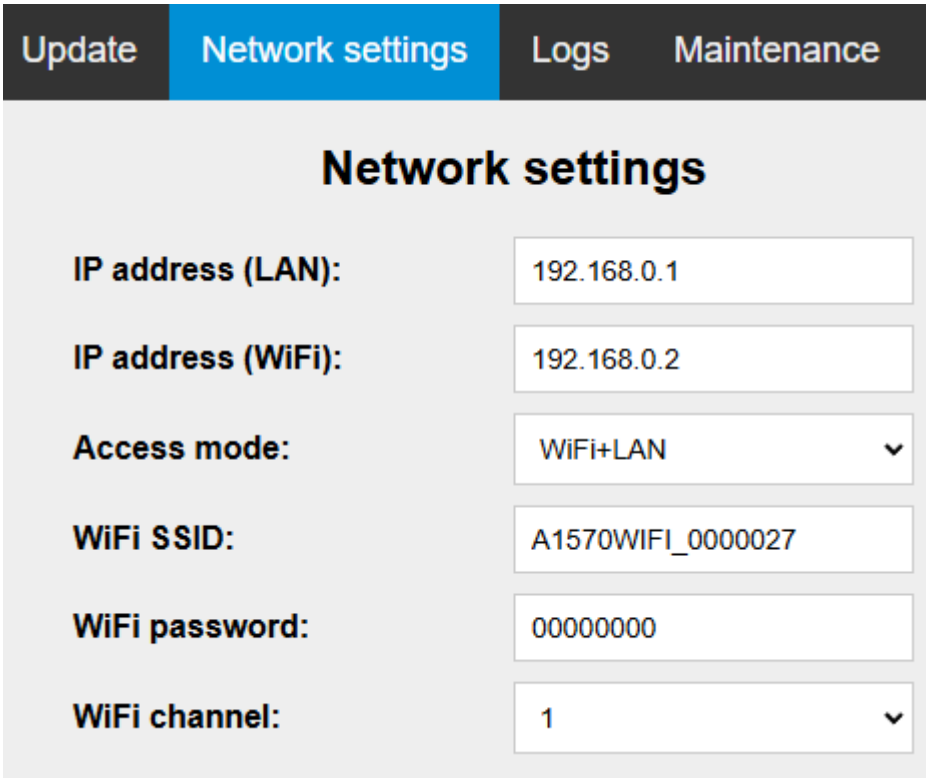


Figure 24: Network settings

On this page, you can edit the following settings:

Control name	Description
IP address (LAN)	Set the IP address the device will use when connected via a LAN cable.
IP address (WiFi)	Set the IP address the device will use when connected via WLAN.
Access mode	This device offers two modes for network connectivity: LAN-only or both LAN and WLAN. You can choose the mode that best fits your needs. **1. LAN-only Mode** In this mode, only the LAN (Local Area Network) connection will be active. The WLAN (Wireless Local Area Network) functionality will be disabled. This mode is ideal for scenarios where a wired connection is preferred or required. **2. LAN and WLAN Mode** In this mode, both LAN and WLAN connections will be activated upon device startup. You can connect to either network interface based on your preference or availability. This mode provides flexibility, allowing you to utilize either a wired or wireless connection as needed.
WiFi SSID	To connect a user's device to the WLAN, enter the name of the access point (SSID). By default, the SSID is formatted as **A1570WIFI_** followed by the device's serial number. However, the SSID can be customized to any desired name for convenience.
WiFi password	Enter the password for the WLAN access point.
WiFi channel	The WiFi transmitter in the A1570 device operates in the **2.4 GHz** frequency range. It supports channel numbers ranging from **1** to **13**, providing flexibility for network configuration.

Actions:

- "Update Settings" Button: Press this button to apply the entered parameters.

IMPORTANT Ensure your settings are correct before restarting the device. Incorrect settings may prevent you from connecting to the device after its restart.

- "Restore to Defaults" Button: Press this button to restore the network settings to factory defaults. The default settings are listen in Table 3 36

Table 3: Default network settings

Setting	Value
IP LAN	192.168.0.1
IP WLAN	192.168.0.2
Access Mode	LAN + WLAN
WiFi SSID	A1570WIFI_<serial_number_of_device>
WiFi Password	00000000
WiFi channel	1

6 SCPI Programming Manual

This manual provides detailed information about the SCPI commands and queries that are available for communicating with A1570 instruments.

Related Documents and Resources

- Standard Commands for Programmable Instruments (SCPI), Volume 1-4, Version 1999.0 May 1999, SCPI Consortium
- IEEE Std 488.2-1992, The Institute of Electrical and Electronics Engineers
- IEC 60488-2:2004, Standard digital interface for programmable instrumentation - Part 2: Codes, formats, protocols and common commands
- https://www.ivifoundation.org/resources/default.aspx
- https://www.ivifoundation.org/shared_components/

6.1 Introduction to the SCPI Language

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based programming language for test and measurement instruments. SCPI commands use a hierarchical structure known as a tree system. Associated commands are grouped under a common node or root, thus forming subsystems. A portion of the SOURce subsystem illustrates this, below.

```
SOURce:
      TRIGgering:
            INTerval {<range>|MIN|MAX|DEF}
            INTerval?
```

`SOURce` is the root keyword of the command, `TRIGgering` is a second-level keyword, and `INTerval` is a

Syntax Conventions

The command syntax format is illustrated below:

```
TRIGgering:INTerval {<range>|MIN|MAX|DEF}
```

Most commands (and some parameters) are a mixture of upper- and lower-case letters. The upper-case letters indicate the command's abbreviated spelling, which yields shorter program lines. For better program readability, use the long form.

For example, consider the keyword `TRIGgering`, above. You can type `TRIG` or `TRIGgering` in any comb

- Braces ({ }) enclose the parameter choices. The braces are not sent with the command string.

- A vertical bar (|) separates parameter choices. For example, `{<range>|MIN|MAX|DEF}` in the above command indicates that you can specify a numeric range parameter, or "`MIN`", "`MAX`" or "`DEF`". The bar is not sent with the command string.
- Angle brackets (< >) indicate that you must specify a value for the enclosed parameter. For example, the above syntax statement shows the <range> parameter in angle brackets. Do not send the brackets with the command string. You must specify a value for the parameter (for example "`TRIGgering:INTerval 100000`") unless you select one of the other options shown in the syntax (for example "`TRIGgering:INTerval MIN`").
- Optional parameters are enclosed in square brackets ([ ]). The brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument uses a default value.

Command Separators

A colon (:) separates consecutive keywords. You must insert a blank space to separate a parameter from a command keyword.
A semicolon (;) separates commands within the same subsystem and can also minimize typing. For example, the following string:

```
TRIGgering:INTerval 10000;MODE INTERNAL
```

is equivalent to the following two commands:

```
TRIGgering:INTerval 10000
TRIGgering:MODE INTERNAL
```

Use a colon and a semicolon to link commands from different subsystems. For example, in the following example, an error is generated if you do not use both the colon and semicolon:

```
TRIGgering:INTerval 10000;:GAIN:LEVel 33
```

Using the MIN, MAX and DEF Parameters

For many commands, you can substitute "`MIN`" or "`MAX`" in place of a parameter. In some cases you may also substitute "DEF". For example, consider The following example:

```
TRIGgering:INTerval {<range>|MIN|MAX|DEF}
```

Instead of selecting a specific value for the <range> parameter, you can substitute MIN to set the range to its minimum value, MAX to set the range to its maximum value or DEF to set the range to its default value.

Querying Parameter Settings

You can query the current value of most parameters by adding a question mark (?) to the command. For example, The following example sets the triggering interval to 10000 microseconds:

```
TRIGgering:INTerval 10000
```

You can then query the count value by sending:

```
TRIGgering:INTerval?
```

SCPI Command Terminators

A command string sent to the instrument must terminate with a <new line> (<NL>) character (ASCII decimal 10). The IEEE-488 EOI (End-Or-Identify) message is interpreted as a <NL> character and can be used to terminate a command string in place of a <NL> character. A <carriage return> followed by a <NL> is also accepted. Command string termination will always reset the current SCPI command path to the root level.

For every SCPI message that includes a query and is sent to the instrument, the instrument terminates the returned response with a <NL> or line-feed character (EOI). For example, if `R?` is sent, the response is terminated with a <NL> after the block of data that is returned. If a SCPI message includes multiple queries separated by semicolons (for example "`:SOURce:TRIGgering:MODE?;:GAIN:LEVel?`"), the returned response is again terminated by a <NL> after the response to the last query. In either case, the program must read this <NL> in the response before another command is sent to the instrument or an error will occur.

IEEE-488.2 Common Commands

The IEEE-488.2 standard defines a set of common commands that perform functions such as reset, self-test and status operations. Common commands always begin with an asterisk (*), are three characters in length and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands as shown below:

```
*RST; *CLS; *ESE 32; *OPC?
```

SCPI Parameter Types

The SCPI language defines several data formats to be used in program messages and response messages.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific

notation. Special values for numeric parameters such as MIN, MAX and DEF are also accepted. You can also send engineering unit suffixes with numeric parameters (e.g., M, k, m or u). If a command accepts only certain specific values, the instrument will automatically round the input numeric parameters to the accepted values. The following command requires a numeric parameter for the range value:

```
TRIGgering:INTerval {<range>|MIN|MAX|DEF}
```

Because the SCPI parser is case-insensitive, there is some confusion over the letter "M" (or "m"). For your convenience, the instrument interprets "mV" (or "MV") as millivolts, but "MHZ" (or "mhz") as megahertz.
The following conventions for prefixes are used in A1570 device:

Prefix	Meaning
UV	microvolts
MV	millivolts
V	volts
KV	kilovolts
HZ	hertz
KHZ	kilohertz
MHZ	megahertz
GHZ	gigahertz
DB	decibel
PS	picoseconds
NS	nanoseconds
US	microseconds
MS	milliseconds
S	seconds
MIN	minutes
HR	hours

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (like EXTernal). They have a short form and a long form just like command keywords. You can mix upper- and lower-case letters. Query responses will always return the short form in all upper-case letters.

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrument will accept "OFF" or "0". For a true condition, the instrument will accept "ON" or "1". When you query a Boolean setting, the instrument will always return "0" or "1". The following example requires a Boolean parameter:

ASCII String Parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote.

```
SENSe:PROBe:TYPE <quoted string>
```

For example, The following example sets probe type to S7394 for thickness measurement (the quotes are not accounted).

```
SENSe:PROBe:TYPE "S7394"
```

You can also set the same probe type using single quotes.

```
SENSe:PROBe:TYPE 'S7394'
```

Data types

The following conventions are used throughout the manual.

Data types	Parameter	Description
<numeric>	Number	{<integer>|<real>}
<frequency>	Frequency	<numeric>{[HZ]|KHZ|MHZ|GHZ}
<time>	Time	<numeric>{[S]|MS|US|NS|PS}
<numeric list>	Numeric list	<numeric 1>,<numeric 2>,...,<numeric N>
<bool>	Boolean parameter	{0|1|ON|OFF}
<char>	Character parameter	Predefined set of character strings without quotes
<string>	String parameter	Quoted string
<binary array>	Binary array	Binary array

6.2 Commands and Queries

6.2.1 Common Commands and Queries

6.2.1.1 Identification query *IDN?

Description	This query returns the unique identifier of the instrument
Syntax	*IDN?
Parameter	None
Query Response	Manufacturer, Model, Serial number, Firmware version
Data Format	<arbitrary ASCII response data>
Name	Manufacturer
Description	Defines the manufacturer of the instrument. For example: `ACS-Solutions GmbH`.
Name	Model
Description	Identifies the model of the instrument (for example `A1570`).
Name	Serial number
Description	Identifies the serial number of the instrument (for example: `1190065)`.
Name	Firmware version
Description	Identifies the version of firmware that is loaded on the instrument. Since the instrument consists of many components, a version of all the elements will be returned. For example `ESP 1.25 MCU 6.01.244 FS 1.0`, where `ESP` stands for the version of ESP32 module firmware, `MCU` stands for the version of microcontroller firmware, `FS` stands for the version of filesystem

Example	`> *IDN?`
	`< ACS-Solutions GmbH,A1570,123456789,`
	`ESP 1.25 MCU 6.01.244 FS 1.0`

6.2.2 Device Command and Queries

SOURce Subsystem 47

Command/Query	Mnemonic	Link
Start vectors acquisition	[SOURce:]STARt	see 47
Start thickness measruement (automatic)	[SOURce:]STARt:MEASurement	see 47
Start thickness measurement (single peak)	[SOURce:]STARt:MAXStrobe	see 47
Start thickness measurement (peak-to-peak)	[SOURce:]STARt:P2Peak	see 48
Start probe calibration in air	[SOURce:]STARt:CALibration:AIR	see 48
Start probe calibration on object surface	[SOURce:]STARt:CALibration[:OBJect]	see 48
Stop acquisition	[SOURce:]STOP	see 48
Constant gain at input	[SOURce:]GAIN[:LEVel]	see 49
Acquisition triggering mode	[SOURce:]TRIGgering:MODE	see 49
Periodic acquisition interval	[SOURce:]TRIGgering:INTerval	see 50
Shot rate	[SOURce]:TRIGgering:RATE	see 51
Input sampling rate	[SOURce:]FREQuency	see 51
Transmitter burst frequency	[SOURce:]TRANsmitter:FREQuency	see 52
Transmitter pulse amplitude	[SOURce:]TRANsmitter:PULSe[:LEVel]	see 53
Transmitter burst period	[SOURce:]TRANsmitter:PERiod	see 53
Transmitter burst duration	[SOURce:]TRANsmitter:DURation	see 54
Transmitter enable	[:SOURce:]TRANsmitter:ENABle	see 55
Transducer polarity mode	[SOURce:]TRANsmitter:MODE	see 55
Sound velocity	[SOURce:]VELocity[:SOUNd]	see 56
Zonder mode	[SOURce:]ZONDer:MODE	see 56

Command/Query	Mnemonic	Link
Enable sending processed vector during thickness measurements	[SOURce]:SNDVector[:ENABle]	see 57

SENSe Subsystem 58

Command/Query	Mnemonic	Link
Acquisitions per averaged vector	[SENSe:]AVERage:COUNt	see 58
Constant averaging interval	[SENSe:]AVERage:PERiod	see 59
Random averaging interval	[SENSe:]AVERage:PERiod:RANDom	see 60
Delay between starting of magnet and acquisition begin	[SENSe:]MAGNet:DELay	see 61
Turn on magnet during data acquisition	[SENSe:]MAGNet:ENABle	see 62
Magnet voltage setting	[SENSe:]MAGNet:VOLTage	see 62
Probe delay for thickness measurement	[SENSe:]PROBe:DELay[:PROCessing]	see 63
Probe type	[SENSe:]PROBe[:TYPE]	see 63
Dead zones	[SENSe:]DEZones	see 64
Noise properties	[SENSe:]CALibration:NOISe	see 65
Eddy current properties	[SENSe:]CALibration:EDARray	see 66
Enabling software averaging	[SENSe:]SOAVerage[:ENABle]	see 67
Software averaging limit	[SENSe:]SOAVerage:COUNt	see 67
Measurement gate begin	[SENSe:]STRObe:BEGin	see 68
Measurement gate width	[SENSe:]STRObe:WIDTh	see 68
Measurement gate level	[SENSe:]STRObe:LEVel	see 69

FETCh Subsystem 70

Command/Query	Mnemonic	Link
Fetching A-Scan vector	FETCh[:ARRay]?	see 70
Fetching measurement result	[FETCh:]RESult[:MEASure]?	see 71

SYSTem Subsystem 72

Command/Query	Mnemonic	Link
Count of detected errors	SYSTem:ERRor:COUNt?	
Reads out error message queue	SYSTem:ERRor[:NEXT]?	see 72
Version of SCPI standard	SYSTem:VERSion?	

STATus Subsystem 73

Command/Query	Mnemonic	Link
Read battery state of charge	[STATus:]BATTery?	see 73
Read charging status	[STATus:]CHSTatus?	see 73

6.2.2.1 SOURce Subsystem

6.2.2.1.1 Start acquisition

Description	Method will start an acquisition of A-Scans
Syntax	[SOURce:]STARt[:ASCAN]
Notes	Once started, a sequence of acquisitions will be continued by the instrument even if the instrument disconnected.
Example	`> SOUR:STAR`

Description	Method will start thickness measurement
Syntax	`[SOURce:]STARt:MEASurement`
Notes	Start continuous thickness measurement
Example	`> SOUR:STAR:MEAS`

Description	Read actual state of measurement
Syntax	`[SOURce:]STARt[:ASCAN]?`
Notes	Return 1 if the acquisition is started, 0 otherwise
Example	`> SOUR:STAR?`

6.2.2.1.2 Start thickness measurement (automatic)

Description	Method will start thickness measurement in automatic mode
Syntax	[SOURce:]STARt:MEASurement
Notes	Start continuous thickness measurement
Example	`> SOUR:STAR:MEAS`

6.2.2.1.3 Start thickness measurement (single peak)

Description	Method will start thickness measurement with search of maximum in measurement gate
Syntax	[SOURce:]STARt:MAXStrobe
Notes	Start continuous thickness measurement, apply processing algorithm to search for a local maximum in a measurement gate (see also Measurement gate begin 68)
Example	`> SOUR:STAR:MAXStrobe`

6.2.2.1.4 Start thickness measurement (peak-to-peak)

Description	Method will start thickness measurement with search of distance between peaks in measurement gate
Syntax	[SOURce:]STARt:P2Peak
Notes	Start continuous thickness measurement, apply processing algorithm to search for a distance between two maxima in a measurement gate (see also Measurement gate begin 68)
Example	`> SOUR:STAR:P2Peak`

6.2.2.1.5 Start calibration in air

Description	Method will start EMAT calibration in air
Syntax	[SOURce:]STARt:CALibration:AIR
Notes	After the calibration its result will be saved in internal memory until the next device start
Example	`> STAR:CAL:AIR`

6.2.2.1.6 Start calibration on object

Description	Method will start EMAT calibration on calibration object
Syntax	[SOURce:]STARt:CALibration[:OBJect]
Notes	After the calibration its result will be saved in internal memory until the next device start
Example	`> STAR:CAL`

6.2.2.1.7 Stop acquisition

Description	The method is used to stop a sequence of measurements.
Syntax	[SOURce:]STOP
Example	`> SOUR:STOP`

6.2.2.1.8 Constant gain at input

Description	This property sets or gets analog amplification in decibels
Syntax	[SOURce:]GAIN[:LEVel] <numeric | char> [SOURce:]GAIN?
Parameter	<char> = {MINimum | MAXimum | DEFault | UP | DOWN} <numeric> {0 to +40 dB} • MINimum - 0 dB • MAXimum - +40 dB • DEFault - 0 dB • UP - increases the current value by 1 dB • DOWN - decreases the current value 1 dB
Unit	dB - decibel
Query Response	<numeric> in decibel
Notes	Default units are dB. The suffix dB can be omitted.
Example	> GAIN:LEV 10 DB > GAIN? < 10

6.2.2.1.9 Acquisition triggering mode

Description	This property is used to choose which event initiates an acquisition.
Syntax	[SOURce:]TRIGgering:MODE <char> [SOURce:]TRIGgering:MODE?
Parameter	<char> = {INTernal, EXTernal} • INTernal – Periodic mode with internal triggering: One acquisition will be performed every Triggering Interval[50] seconds. • EXTernal - External trigger will be used for the initiating the acquisition cycle. If the acquisition cycle includes multiple shots, the first shot will be done on external trigger, all the following shots in the cycle will be started with the Triggering Interval[50].
Query Response	{INTERNAL, EXTERNAL}
Notes	
Example	> TRIG:MODE INTERNAL > TRIG:MODE? < INTERNAL

6.2.2.1.10 Periodic acquisition interval

Description	This property sets or gets time in seconds between two consecutive acquisition in periodic (INTERNAL) mode.
Syntax	[SOURce:]TRIGgering:INTerval <time|char> [SOURce:]TRIGgering:INTerval?
Parameter	<time> = {10 MS to 1 s} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 10 MS • MAXimum - 1 S • DEFault - 10 MS • UP - increases the current value by 10 MS • DOWN - decreases the current value by 10 MS
Unit	Possible suffixes are: • S - seconds (default) • MS - milliseconds • US - microseconds • NS - nanoseconds • PS - picoseconds
Query Response	<time> in seconds
Notes	See also Acquisition Triggering Mode 49.

Example	`> TRIG:INT 100000 US`
	`> TRIG:INT?`
	`< 100.0E-3`

6.2.2.1.11 Shot rate

Description	Measurements are launched automatically using an internal timer. The timer frequency is defined by the **Shot Rate** setting, expressed in Hertz (measurements per second).
Syntax	[SOURce]:TRIGgering:RATE <numeric|char> [SOURce]:TRIGgering:RATE?
Parameter	<numeric> = {1 to 4 Hz} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 1 • MAXimum - 4 • DEFault - 1 • UP - increases the current value by 1 Hz • DOWN - decreases the current value by 1 Hz
Unit	Possible suffixes are: • HZ - Hertz (default)
Query Response	<numeric> in Hertz
Notes	See also Acquisition Triggering Mode 49.

Example	`> TRIG:RATE 1`
	`> TRIG:RATE?`
	`< 1`

6.2.2.1.12 Input sampling rate

Description	This property gets or sets frequency in Hz for AD conversion of the input signal.
Syntax	[SOURce:]FREQuency <numeric|char> [SOURce:]FREQuency?
Parameter	<numeric> {25 | 50 | 100} in MHz <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 25 MHz • MAXimum - 100 MHz • DEFault - 25 MHz • UP - increases the current value • DOWN - decreases the current value
Unit	HZ - hertz
Query Response	<numeric> in Hz

Example	`> FREQ 100 MHZ`
	`> FREQ?`
	`< 100000000`

6.2.2.1.13 Transmitter burst frequency

Description	This property sets or gets the frequency in hertz for a pulse burst sent to a transmitting transducer.
Syntax	[SOURce:]TRANsmitter:FREQuency <frequency|char> [SOURce:]TRANsmitter:FREQuency?
Parameter	<char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 20 KHZ • MAXimum - 20 MHZ • DEFault - 5000 KHZ • UP - increases the current value by 1000 HZ • DOWN - decreases the current value by 1000 HZ
Unit	Possible suffixes are • HZ - Hertz • KHZ - kilohertz • MHZ - megahertz
Query Response	<frequency> in hertz
Notes	Due to implementation the period of the pulse is always a multiple of 10nS. For that reason, the real pulse frequency might differ from the requested one. For example, when Transmitter burst frequency 52 = 805 kHz (period ≈1242,23nS) is set, the real period of the impulse is 1240nS and the real pulse frequency is ≈806kHz.
Example	> TRAN:FREQ 100 KHZ > TRAN:FREQ? < 100000

6.2.2.1.14 Transmitter pulse amplitude

Description	This property sets or gets an amplitude in volts for a pulse burst sent to a transmitting transducer.
Syntax	[SOURce:]TRANsmitter:PULSe[:LEVel] <numeric|char> [SOURce:]TRANsmitter:PULSe[:LEVel]?
Parameter	<numeric> = {200 | 400 | 600} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 200 V • MAXimum - 600 V • DEFault - 200 V • UP - increases the current value • DOWN - decreases the current value
Query Response	<numeric> in volts
Notes	In this context, pulse voltage is the highest voltage of the half-wave. For example, a one-period-long 200V pulse peak-to-peak voltage is 400V (-200V to +200V).

Example	`> TRANsmitter:PULS 200 V`
	`> TRANsmitter:PULSe?`
	`< 200`

6.2.2.1.15 Transmitter burst period

Description	This property sets or gets the period in seconds for a pulse burst sent to a transmitting transducer.
Syntax	[SOURce:]TRANsmitter:PERiod <time|char> [SOURce:]TRANsmitter:PERiod?
Parameter	<char> = {MINimum | MAXimum | DEFault | UP | DOWN} <time> = {10 to 250 NS} • MINimum - 10 NS • MAXimum - 200 NS • DEFault - 140 NS • UP - increases the current value by 10 NS • DOWN - decreases the current value by 10 NS

Unit	Possible suffixes are: • S - seconds (default) • MS - milliseconds • US - microseconds • NS - nanoseconds • PS - picoseconds
Query Response	<time> in seconds
Notes	Transmitter burst frequency[52] and Transmitter burst period[53] change the same physical pulse parameter and the second is introduced for user's convenience. Transmitter burst frequency[52] = 10^6 / Transmitter burst period[53] . Due to implementation a pulse period is always a multiple of 10nS. For that reason, a real pulse period might differ from the requested one. For example, when Transmitter burst period[53] = 125 ns (frequency = 8000kHz) is set, the real period of the impulse is 120ns and the real pulse frequency is ~8333 kHz.

Example	`> TRAN:PER 200 NS`
	`> TRAN:PER?`
	`< 200E-9`

6.2.2.1.16 Transmitter burst duration

Description	This property sets or gets number of periods in transmitter burst.
Syntax	[SOURce:]TRANsmitter:DURation {numeric|char} [SOURce:]TRANsmitter:DURation?
Parameter	<numeric> = {0.5 to 8.0} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 0.5 • MAXimum - 8.0 • DEFault - 0.5 • UP - increases the current value by 0.5 • DOWN - decreases the current value by 0.5
Query Response	<numeric>
Notes	For example, when Transmitter burst duration[54] = 1, the pulse duration is one full period (negative and positive half waves), or 1uS for Transmitter burst frequency[52] = 1000 KHz. If the duration is 0.5, pulse duration is a half period. I.e. either positive or negative half-wave (depending on Transducer polarity mode[55]).

Example	`> TRAN:DUR 5`
	`> TRAN:DUR?`
	`< 5`

6.2.2.1.17 Transmitter enable

Description	This property defines if the transmitter generates pulse
Syntax	[SOURce:]TRANsmitter:ENABle <char> [SOURce:]TRANsmitter:ENABle?
Parameter	<char> = {OFF | ON | 0 | 1} • DEFault - OFF • OFF or 0 – no pulse will be generated. • ON or 1 – pulse will be generated according to other transmitter settings (amplitude, polarity, duration, frequency).
Query Response	{OFF | ON }
Example	> TRAN:ENAB ON > TRAN:ENABLE? < ON

6.2.2.1.18 Transducer polarity mode

Description	This property defines the initial polarity of the pulse burst generated at the transducer output
Syntax	[SOURce:]TRANsmitter:MODE <val> [SOURce:]TRANsmitter:MODE ?
Parameter	<char> = {OFF | ON | 0 | 1} • DEFault - OFF • OFF or 0 – the burst starts with the positive pulse. • ON or 1 – the burst starts with the negative pulse.
Query Response	{OFF | ON | 0 | 1}
Example	> TRAN:MODE ON > TRAN:MODE? < ON

6.2.2.1.19 Sound velocity

Description	This property sets or gets sound velocity used for thickness estimation
Syntax	[SOURce:]VELocity[:SOUNd] {numeric|char} [SOURce:]VELocity[:SOUNd]?
Parameter	<numeric> = {1000 to 10000} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 1000 • MAXimum - 100000 • DEFault - 3200 • UP - increases the current value by 1 • DOWN - decreases the current value by 1
Query Response	<numeric>
Example	> VEL 3456 > VEL? < 3456

6.2.2.1.20 Zonder mode

Description	This property switches between normal and eddy-current measurements
Syntax	[SOURce:]ZONDer:MODE <char> [SOURce:]ZONDer:MODE?
Parameter	<char> = {COMBINED | EDDY} • DEFault - COMBINED
Query Response	<char>
Notes	The value should be in '' or ""
Example	> ZOND:MODE "COMBINED" > ZOND:MODE? < COMBINED

6.2.2.1.21 Enable sending processed vector during thickness measurements

Description	Toggle receiving processed vector during thickness measurements.
Syntax	[SOURce]:SNDVector[:ENABle] <char> [SOURce]:SNDVector[:ENABle]?
Parameter	<char> = {ON | OFF} • DEFault - OFF
Query Response	<char>
Notes	The vector should be requested with SCPI command FETCh:ARRay? During measurement process many signals could be acquired (including contact detection, gain estimation etc.) With the command you toggle sending the vector used for thickness estimation. This vector is an envelope of the signal. Amplitude range from 0 to 511. The data array of 8192 samples (16k bytes) corresponding to the signal used for thickness measurement estimation will be returned.

Example	`> SNDVector ON`
	`> SNDVector?`
	`< ON`

6.2.2.2 SENSe Subsystem

6.2.2.2.1 Acquisitions per averaged vector

Description	A1570 can make several pulses/acquisitions in a row and internally calculate an averaged vector from the results, when Acquisitions per averaged vector[58] >= 0.
Syntax	[SENSe:]AVERage:COUNt <numeric> [SENSe:]AVERage:COUNt?
Parameter	<numeric> = {0 | 1 | 2 | 3 | 4}
Query Response	<numeric>
Notes	Number of acquisitions required to produce one averaged data vector is calculated as 2 Acquisitions per averaged vector[58] .Acquisitions per averaged vector[58] does not affect the quantity of acquired data vectors sent to a client by A1570. For example, if Periodic acquisition interval[50] = 1000000 US and Acquisitions per averaged vector[58] = 3, one vector is sent by A1570 each second, and every sent vector is a result of internal averaging of $2^3 == 8$ acquisitions performed over a relatively short period of time (see Constant averaging interval[59] and Random averaging interval[60] for timings).
Example	> SENS:AVER:COUNT 4 > SENS:AVER:COUNT? < 4

6.2.2.2.2 Constant averaging interval

Description	This property is defined in seconds and gets or sets a constant part of an interval between acquisitions in averaging mode. When A1570 performs several pulses/acquisitions in a row for the following averaging, a pause will take place after an acquisition is finished. It is calculated as FixedDelay + Constant averaging interval[59] + RandomInterval, where FixedDelay is a hardware delay of 22µs and RandomInterval is a random number in a range from 0 to Random averaging interval[60] .
Syntax	[SENSe:]AVERage:PERiod <time|char> [SENSe:]AVERage:PERiod?
Parameter	<time> = {1 to 100} US <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 1 US • MAXimum - 100 US • DEFault - 18 US • UP - increases the current value by 1 US • DOWN - decreases the current value by 1 US
Unit	Possible suffixes are: • S - seconds (default) • MS - milliseconds • US - microseconds • NS - nanoseconds • PS - picoseconds
Query Response	<time> in seconds
Notes	Default units are seconds.

Example	`> SENSe:AVERage:PERiod 50 US`
	`> SENSe:AVERage:PERiod?`
	`< 50.0E-6`

6.2.2.2.3 Random averaging interval

Description	This property is defined in seconds and gets or sets a random part of an interval between acquisitions in averaging mode. When A1570 performs several pulses/acquisitions in a row for the following averaging a pause will take place after an acquisition is finished. It is calculated as FixedDelay + Constant averaging interval[60] + RandomInterval, where FixedDelay is a hardware delay of 22µs and RandomInterval is a random number in a range from 0 to Random averaging interval[60].
Syntax	[SENSe:]AVERage:PERiod:RANDom <time|char> [SENSe:]AVERage:PERiod:RANDom?
Parameter	<time> = {1 to 10} US <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 1 US • MAXimum - 10 US • DEFault - 1 S • UP - increases the current value by 1 US • DOWN - decreases the current value by 1 US
Unit	Possible suffixes are: • S - seconds (default) • MS - milliseconds • US - microseconds • NS - nanoseconds • PS - picoseconds
Query Response	<time> in seconds
Notes	For example, when Acquisitions per averaged vector[58] = 1, Constant averaging interval[59] = 100 us and Random averaging interval[60] = 10 us, the second acquisition will take place in 122-132 µs after the first acquisition is finished.

Example	`> SENSe:AVER:PER:RAND 2 US`
	`> SENSe:AVER:PER:RAND?`
	`< 2.0E-6`

6.2.2.2.4 Magnet delay

Description	This property is defined in seconds and gets or sets a delay between starting of magnet and acquisition begin if the magnet is enabled with Magnet enabled[62] .
Syntax	[SENSe:]MAGNet:DELay <time|char> [SENSe:]MAGNet:DELay?
Parameter	<time> = {10 to 1300} US <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 10 US • MAXimum - 1300 US • DEFault - 650 US • UP - increases the current value by 1 US • DOWN - decreases the current value by 1 US
Unit	Possible suffixes are: • S - seconds (default) • MS - milliseconds • US - microseconds • NS - nanoseconds • PS - picoseconds
Query Response	<time> in seconds
Notes	

Example	`> MAGNet:DELay 20 US`
	`> MAGNet:DELay?`
	`< 20.0E-6`

6.2.2.2.5 Magnet enabled

Description	This property gets or sets enabling magnet during the acquisition.
Syntax	[SENSe:]MAGNet:ENABle <char> [SENSe:]MAGNet:ENABle?
Parameter	<char> = {OFF | ON | 0 | 1} • DEFault - OFF • OFF or 0 – no magnet will be turned on. • ON or 1 – magnet will be turned on.
Query Response	{OFF | ON }
Notes	

Example	`> MAGNet:ENABle OFF`
	`> MAGN:ENAB?`
	`< OFF`

6.2.2.2.6 Magnet voltage

Description	This property gets or sets an amlitude in Volts for turning of the magnet (if it is enabled with Magnet enabled 62)
Syntax	[SENSe:]MAGNet:VOLTage <numeric|char> [SENSe:]MAGNet:VOLTage?
Parameter	<numeric> = {15 to 25} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 15 V • MAXimum - 25 V • DEFault - 20 V • UP - increases the current value by 1 V • DOWN - decreases the current value by 1 V
Query Response	<numeric> in Volts
Notes	

Example	`> MAGNet:VOLTage 20`
	`> MAGN:VOLT?`
	`< 20`

6.2.2.2.7 Processing probe delay

Description	This property gets or sets a probe delay used for thickness measurement
Syntax	[SENSe:]PROBe:DELay[:PROCessing] <numeric|char> [SENSe:]PROBe:DELay[:PROCessing]?
Parameter	<numeric> = {0 to 100} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 0 MS • MAXimum - 100 MS • DEFault - 0 MS • UP - increases the current value by 1 MS • DOWN - decreases the current value by 1 MS
Query Response	<numeric> in microseconds
Notes	This property will be overwritten after calibration on object (see Start calibration on object 48).

Example	`> PROB:DEL 20`
	`> PROB:DEL?`
	`< 20`

6.2.2.2.8 Probe type

Description	This property gets or sets a probe class used for calibration and thickness measurement
Syntax	[SENSe:]PROBe[:TYPE] <string> [SENSe:]PROBe[:TYPE]?
Parameter	Supported classes: • S3850 • S3950 • S7392 • S7394 • S7692 • S7694
Query Response	Current probe class
Notes	This property should be set before starting calibration or thickness measurement. The value should be in `''` or `""`

Example	`> PROB "S7394"`
	`> PROB?`
	`< S7394`

6.2.2.2.9 Dead zones

Description	This property gets or sets dead zones for calibration on object and thickness measurement
Syntax	[SENSe:]DEZones <string> [SENSe:]DEZones?
Parameter	List `gain:value` separated with semicolon (;)
Query Response	List `gain:value` separated with semicolon (;)
Notes	Each dead zone value is set in ADC samples (from 0 to 8192) This property will be overwritten during calibration in air (see Start calibration in air 48) The value should be in `''` or `""`

Example	`> SENSe:DEZones '0:10;5:11;10:12;15:13;20:14;25:15;30:16;35:17;40:18'`
	`> SENSe:DEZones?`
	`< 0:10;5:11;10:12;15:13;20:14;25:15;30:16;35:17;40:18`

6.2.2.2.10 Noise properties

Description	This property gets or sets noise properties used during thickness estimation with pulse magnets
Syntax	[SENSe:]CALibration:NOISe <string> [SENSe:]CALibration:NOISe?

Parameter	JSON with format:
	`{`
	`  "command" : "noise_function",`
	`  "noise_end" : 700,`
	`  "noise_level" : 306,`
	`  "noise_start" : 400`
	`}`

Query Response	JSON with noise properties
Notes	Should be written as one line without `\n` symbols. JSON-string should be enclosed with `' '`. JSON should contain string element `"command"` equals to `"noise_function"` JSON may contain no or more noise parameters. If some parameters are not in the JSON, their setting will be skipped. I.e. the following content is valid (but makes little sense): `{ "command" : "noise_function" }` This property will be overwritten during calibration of pulse magnet probe in air (see Start calibration in air 48)

Example	`> SENSe:CALibration:NOISe`
	`'{"command" : "noise_function",`
	`"noise_end" : 222, "noise_level" : 333,`
	`"noise_start" : 111}'`
	`> SENSe:CALibration:NOISe?`
	`< {"command" : "noise_function",`
	`"noise_end" : 222,`
	`"noise_level" : 333,`
	`"noise_start" : 111}`

6.2.2.2.11 Eddy current properties

Description	This property gets or sets properties of eddy-current signal used during contact detection with pulse magnet probes
Syntax	[SENSe:]CALibration:EDARray <string> [SENSe:]CALibration:EDARray?

Parameter	JSON with format:
	`{`
	`"command": "calibration_eddy_array",`
	`"eddy": [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,...] ,`
	`"eddy_start" : 30`
	`}`
	Where element `"eddy"` contains array of 64 elements values of ground eddy signal to be used in contact detection for pulse magnets.

Query Response	JSON with eddy signal properties
Notes	The value should be written as one line without `\n` symbols inside. `"eddy_start"` is the start sample in eddy vector where valuable signal starts. JSON-string should be enclosed with `' '`. JSON should contain string element `"command"` equals to `"calibration_eddy_array"` JSON may contain no or more eddy parameters. If some parameters are not in the JSON their setting will be skipped. I.e. the following content is valid (but makes little sense): `{ "command": "calibration_eddy_array" }` This property will be overwritten during calibration of pulse magnet probe in air (see Start calibration in air 48)
Example	`> SENSe:CALibration:EDARray '{"eddy": [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63], "eddy_start" : 30, "command": "calibration_eddy_array"}'` `> SENSe:CALibration:EDARray?` `< {"eddy": [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63], "eddy_start" : 30, "command": "calibration_eddy_array"}`

6.2.2.2.12 Software averaging enabling

Description	The property sets or gets enabling of "infinite" software averaging for thickness measurement
Syntax	[SENSe:]SOAVerage[:ENABle] <char> [SENSe:]SOAVerage[:ENABle]?
Parameter	<char> = {ON, OFF} • DEFault - OFF
Query Response	<char>
Notes	Software averaging should be configured with Software averaging limit 67 as well
Example	> SOAV ON > SOAV? < ON

6.2.2.2.13 Software averaging limit

Description	The property sets or gets number of measurements in one "infinite" software averaging
Syntax	[SENSe:]SOAVerage:COUNt {numeric|char} [SENSe:]SOAVerage:COUNt?
Parameter	<numeric> = {1 to 100} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 1 • MAXimum - 100 • DEFault - 1 • UP - increases the current value by 1 • DOWN - decreases the current value by 1
Query Response	<numeric>
Notes	To enable the "infinite" software averaging, you should use Software averaging enabling 67
Example	> SOAV:COUN 55 > SOAV:COUN? < 55

6.2.2.2.14 Measurement gate begin

Description	The measurement gate is the range within which the processing will occur. See processing algorithms[25] for detailed explanation. The setting defines **begin** of the measurement gate.
Syntax	[SENSe:]STRObe:BEGin {numeric|char} [SENSe:]STRObe:BEGin?
Parameter	<numeric> = {0 to 8192} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 0 • MAXimum - 8192 • DEFault - 0 • UP - increases the current value by 1 • DOWN - decreases the current value by 1
Query Response	<numeric>
Notes	The value is set in ADC samples. If you need to define it in distance or time units, please recompute it using current sound velocity and sampling rate
Example	> STRO:BEGin 1000 > STRO:BEGin? < 1000

6.2.2.2.15 Measurement strobe width

Description	The measurement gate is the range within which the processing will occur. See processing algorithms[25] for detailed explanation. The setting defines **width** of the measurement gate.
Syntax	[SENSe:]STRObe:WIDTh {numeric|char} [SENSe:]STRObe:WIDTh?
Parameter	<numeric> = {0 to 8192} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 0 • MAXimum - 8192 • DEFault - 0 • UP - increases the current value by 1 • DOWN - decreases the current value by 1
Query Response	<numeric>
Notes	The value is set in ADC samples. If you need to define it in distance or time units, please recompute it using current sound velocity and sampling rate
Example	> STRO:WIDTh 1000 > STRO:WIDTh? < 1000

6.2.2.2.16 Measurement strobe level

Description	Additionaly to the measurement gate as range, its level is defined. This level is used during processing as a threshold for peaks search. See processing algorithms25 for detailed explanation. The setting defines **level** of the measurement gate.
Syntax	[SENSe:]STROBe:LEVel {numeric|char} [SENSe:]STROBe:LEVel?
Parameter	<numeric> = {0 to 100} <char> = {MINimum | MAXimum | DEFault | UP | DOWN} • MINimum - 0 • MAXimum - 100 • DEFault - 0 • UP - increases the current value by 1 • DOWN - decreases the current value by 1
Query Response	<numeric>
Notes	The value is set in % of screen height.

Example	`> STRO:LEVel 50`
	`> STRO:LEVel?`
	`< 50`

6.2.2.3 FETCh Subsystem

6.2.2.3.1 A-Scan fetching

Description	This query requests one a-scan data from the instrument
Syntax	FETCh[:ARRay]?
Query Response	<binary data>
Notes	Fetching data should be performed after acquisition start. If the data is requested prior the start, a time-out error might be thrown (depending on SCPI client settings)

Example	`> FETC:ARR?`
	`< #516412D...D`
	Where:
	• # - always sent before definite block data (ASCII format)
	• 5 - specifies that the byte count is five digits (16412) (ASCII format)
	• 16412 - specifies the number of data bytes that will follow, not counting <NL><END> (ASCII format)
	• D...D - 16412 bytes (ASCII format)
	where first 28 bytes is a vector header with meta-information
	• in the header bytes 16, 17 is a word with vector index (a counter of vectors started after the first data acquisition).
	the last 16384 bytes is a vector of 8192 2-bytes signed words in little-endian format

6.2.2.3.2 Fetching measurement result

Description	This query requests the last thickness measurement result
Syntax	[FETCh:]RESult[:MEASure]?

Query Response	<string>
	JSON containing all measurement properties.
	Format:
	`{`
	`"command": "measurement_result",`
	`"contact": false,`
	`"contact_quality": 0,`
	`"counter" : 0,`
	`"gain": 0,`
	`"thickness": 65535,`
	`"timestamp" : "12:10:49"`
	`}`
	
	`command` - identifier of the result, always `"measurement_result"`
	`thickness` is returned in micrometers as integer value. Values `65535` and `-1` should be interpreted as failed measurement (e.g. no contact with object found).
	`counter` - 32-bit iterator which is incremented each finished measurement, starts from 0.
	`gain` - analog gain estimated during the measurement
	`timestamp` - string with time of the last finished measurement.
	`contact` - boolean describing presence of contact.
	`contact_quality` - estimated quality of contact:
	0 - No Contact,
	1 - Low Contact,
	2 - Medium Contact,
	3 - Full Contact

Notes	The result of a measurement is saved internally for future requests until the next measurement is completed. • **Repeat Requests**: If no new measurement has started, the command will return the same JSON data each time. • **Multiple Measurements**: If several measurements are completed between requests, only the most recent result will be delivered.
Example	`> RES?` `< {"command": "measurement_result", "contact": false,"contact_quality": 0, "counter" : 0, "gain": 0, "thickness": 65535, "timestamp" : "12:10:49"}`

6.2.2.4 SYSTem Subsystem

6.2.2.4.1 Reads out error message queue

Description	This method reads out error message queue.
Syntax	SYSTem:ERRor?
Query Response	<numeric>,<string>
Example	> SYSTem:ERRor? < 0, "No error" > SYSTem:ERRrr? > SYSTem:ERRor? -113,"Undefined header;Command: SYST:ERRrr"

6.2.2.5 STATus Subsystem

6.2.2.5.1 Battery state of charge

Description	Read battery state of charge in %
Syntax	[STATus:]BATTery?
Query Response	<numeric> = {0 - 100}
Example	> BATT? < 55

6.2.2.5.2 Charging status

Description	Read charging status
Syntax	[STATus:]CHSTatus?
Query Response	<char> = {IDLE | OFF | CHARGING | ERROR}
Notes	IDLE: working on battery, no charger attached OFF: charger is attached, but charging is disabled CHARGING: charger is attached and charging is enabled ERROR: error during charging detected
Example	> CHST? < DONE

6.3 SCPI Examples

Comprehensive examples can be found in the GitHub repository of ACS-Solutions GmbH:

https://github.com/Acoustic-Control-Systems/a1570

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