Ultrasonic Flaw Detector

A1550 IntroVisor

Operation Manual

Acoustic Control Systems Ltd.
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The operational manual (hereinafter, Manual) contains specifications, device and operation principle description as well as the information required for correct operation of the ultrasonic A1550 IntroVisor flaw-detector tomograph (hereinafter, tomograph or device).

Before device operating, please, read carefully this Manual.

Trained and aware of the operational documents personnel is allowed to operate the device.

The manufacturer keeps continually developing the device, increasing reliability and operation convenience; consequently, it may result in some insignificant changes not mentioned in this manual version and not worsening device specification.

MAIN INFORMATION

Manufacturer:

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1 DEVICE DESCRIPTION AND OPERATION

1.1 DEVICE PURPOSE

1.1.1 Tomograph purpose and field of use

The A1550 IntroVisor flaw-detector tomograph is related to handheld ultrasonic (US) devices of general purpose of portable execution.

The tomograph is a universal device to solve most flaw detection tasks, such as weld control without shear scanning, search for material discontinuity and broken integrity in big volume metals and plastics.

The device provides internal object structure imaging and high test efficiency.

1.1.2 Operation conditions

The device is designed for operation under the following environmental conditions:

– at temperature from -10 to + 55°C;

– at relative air humidity to 95 % at maximum + 35°C.

1.2 SPECIFICATIONS

1.2.1 Main device parameters

The main device parameters are given in table 1.

T a b l e 1

Parameter Name	Value
Velocity value range, m/s	1 000 – 10 000
Operating transducer frequencies, MHz	1.0 – 10.0
Operating frequencies deviation from rated, %	± 10
Thickness range (by steel) with a direct transducer, mm	4 – 900
Permissible basic absolute error limits for thickness ***D*** calibration with a normal transducer, mm	±(0.01·D+0.2)
Defect depth calibration range (by steel) with a normal transducer, mm	7 – 180
Permissible basic absolute error limits for defect depth ***H*** with a normal transducer, mm	±(0.01·H+0.2)
Defect coordinates ranges (by steel) with an inclined transducer 65°, mm: Depths ***H*** Surface ranges ***L***	 3 - 40 5 - 75
Permissible basic absolute error limits for defect coordinates with an inclined transducer 65 °, mm: Depths ***H*** Surface ranges ***L***	 ±(0.03·H+1) ±(0.03·L+1)

Parameter Name	Value
Defect coordinates ranges (by steel) with an inclined transducer 70 °, mm: Depths ***H*** Surface ranges ***L***	 3 - 40 7 - 100
Permissible basic absolute error limits for defect coordinates with an inclined transducer 70°, mm: Depths ***H*** Surface ranges ***L***	 ±(0.03·H+1) ±(0.03·L+1)
Defect coordinates ranges (by steel) with an antenna array of longitudinal waves, mm	10 - 90
Permissible basic absolute error limits for defect depth ***H*** with an antenna array of longitudinal waves, mm	±(0.03·H+1)
Defect coordinates ranges (by steel) with an antenna array of shear waves, mm Depths ***H*** Surface ranges ***L***	 6 - 80 6 - 80
Permissible basic absolute error limits for defect coordinates with an antenna array of shear waves, mm: Depths ***H*** Surface ranges ***L***	 ±(0.03·H+1) ±(0.03·L+1)
Amplifier adjustment range, dB	0 - 80
Permissible basic absolute error limits for signal amplitude ratio on receiver input, dB	± 0.5
Power supply	Battery
Rated power value of a battery, V	11.2
Continuous operation time from a battery at normal environmental conditions, h, at least	8
Overall dimensions of an electronic unit, mm	258x164x110
Weight of an electronic unit, kg, no more	1.9
Mean-time-between-failures, h	30 000
Mean lifetime, years, at least	8

1.3 DEVICE STRUCTURE AND OPERATION

1.3.1 Device structure

The tomograph structure includes an electronic unit with a detachable battery, to which an antenna array (AA) or a piezoelectric transducer (PT) is connected by cables, and an AC power adapter.

1.3.1.1 Electronic unit

The Figure 1 shows an electronic unit. The tomograph is controlled with a membrane keyboard. Indication of signals, calibration data, tomograph state is displayed and indicated with LEDs on the device case.

Figure 1

AA and PT are connected through the connectors placed on the right-side recess of the case.

Device power is supplied from a detachable battery or from a provided power adapter connected to a connector on the back device side.

On the back cover of the device are also located USB jack, for connection to a PC, and a jack to connect the encoder (if “Scan” option is ordered).

1.3.1.2 Power Adapter

To supply a tomograph from external power source and to charge a battery in the electronic device unit, an AC power adapter (15V) is used.

Depending on charging level, a battery charge can last for 6 hours. A tomograph can fully operate during charging.

To avoid device damage, a power adapter cable is recommended first to be connected to an electronic unit, then a supply cable is to be connected to the power adapter, and then to the network system.

ATTENTION: DISASSEMBLING THE DETACHABLE BATTERY IS FORBIDDEN!

1.3.2 Main interface principles

An intuitive interface is implemented in the A1550 IntroVisor. Associative pictogram menu in various modes, explanatory symbols by parameters, names and key schematic symbols allow easy and quickly to learn the device operation process.

The data are displayed on the screen so that the information required for prompt control is always shown.

Tomograph operation is considerably facilitated by configuration library. A user can appropriate a name to each configuration. Thus, the tomograph can be set for various situations and testing objects in advance, and in the field the required object can be selected from the list.

All tomograph settings are saved when device is switched off, stored without a battery or discharged.

1.3.3 Tomograph operation modes

Two main operating modes: TOMOGRAPH/FLAW-DETECTOR and STOP are provided in the tomograph as well as an auxiliary SETUP mode.

A probe impulse is formed, received echo-signals are strengthened and shown on the device display and calibrated in operating modes.

TOMOGRAPH mode is designed for real time section imaging.

In FLAW-DETECTOR mode the device operates as a conventional tomograph.

STOP mode is intended for pause (freezing) of signals (shots) on the display, their record in device memory, and for preview of shots saved earlier.

Parameters are selected and edited in SETUP mode of the device.

1.3.4 Information representation on the screen

A color TFT 640x480 pixels display is used in a tomograph as an indicator.

The screen space in each mode is divided into several functional areas. As example Figure 2 shows the screen in TOMOGRAPH mode.

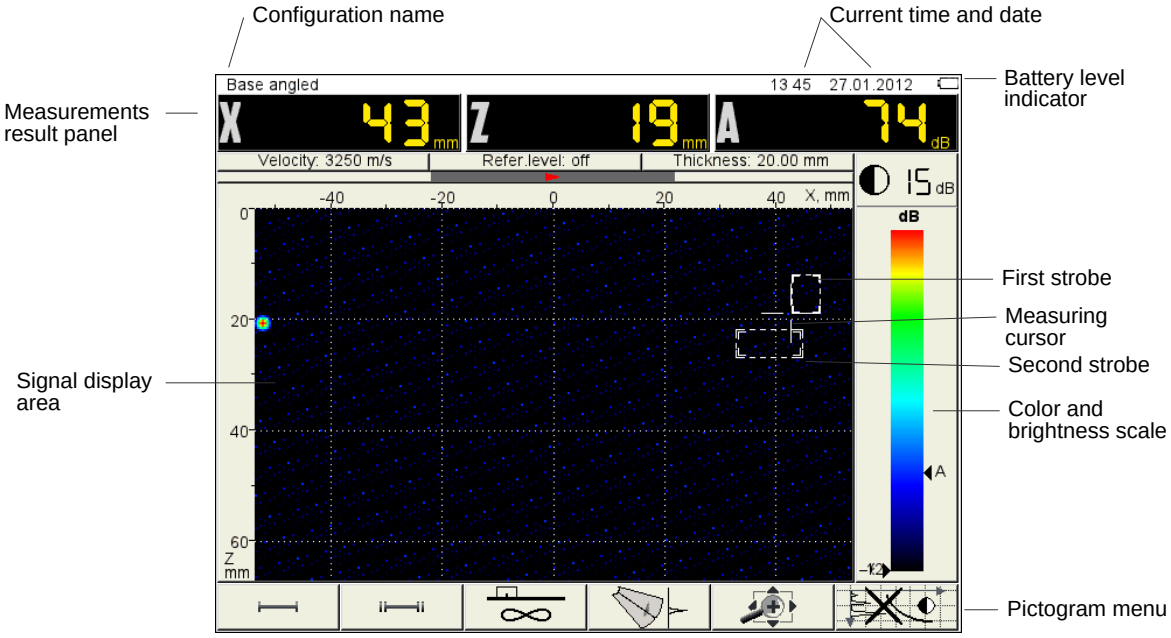


Figure 2

1.3.5 Keyboard

The tomograph keyboard field is shown in Figure 3

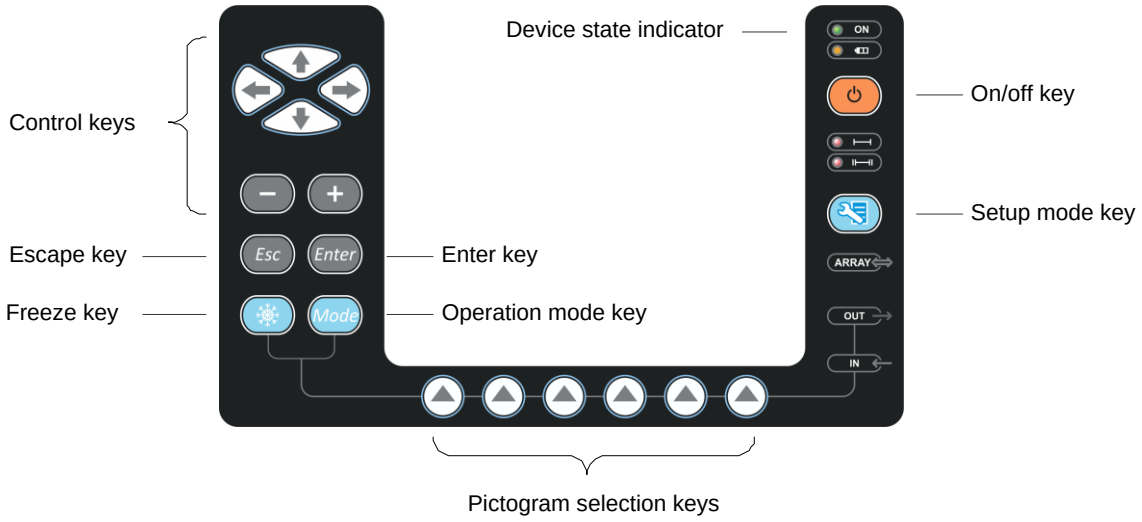


Figure 3

The green LED indicator in the right top corner of the device 

informs on the switched tomograph on.

The LED indicator below  shows a battery charging process. Yellow color indicates the battery charging process, and green – the termination of charging process.

Two red indicators under the key  show monitor response for the first  and second strobes  accordingly.

The symbols of main key functions are marked on the keys. Key symbols are in English for design unification and for tomograph operational documentation to be used in different national areas.

Main functions and parameters are controlled by pictogram selection keys - function keys (F), placed under the display, the corresponding explanatory pictogram is placed over each.

Active parameters are selected and edited by the command keys placed on the left of the display. Their actions are similar for different operating device modes and are designed for intuitive recognition by an operator, i.e. their symbols are typical for action.

An autorepeat mode with speeding-up at key holding for over one second is implemented for some keys.

For switching between operation TOMOGRAPH / FLAW-DETECTOR modes, press the key Mode, in open mode selection window (Figure 4) select an operating mode by the keys. .

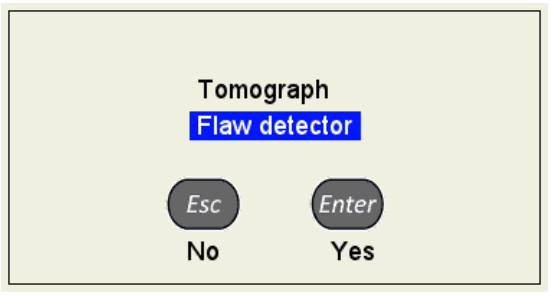


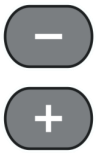
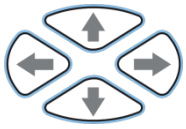
Figure 4

– to confirm selection, press the key Enter, to cancel mode change - Esc.

Device key function description is given in table 2.

T a b l e 2

Key	Key function in modes			
	TOMOGRAPH	SCANNER	FLAW-DETECTOR	SETUP
⏻	Switching the device ON/OFF Hold the key for over 0.5 sec			
🔧	Enter SETUP mode			Exit SETUP mode
Mode	**Simple pressing**			
	Previous perating mode selection	Enter TOMOGRAPH mode	Enter TOMOGRAPH mode	Exit SETUP mode
	Hold - Operating mode selection window call			

Key	Key function in modes			
	TOMOGRAPH	SCANNER	FLAW-DETECTOR	SETUP
	Tomogram brightness adjustment	N/a	Cursor movement	Active parameter value adjustment
	N/a	Reset and clean the scanogram	N/a	Exit changing parameters marked with ►, without saving
	Cursor movement on the tomogram	Cursor movement on the tomogram (horizontal arrows) Moving something depending on the fifth pictogram (vertical arrows)	Sweep length adjustment (horizontal arrows) Attenuator value adjustment (vertical arrows)	Parameter selection for adjustment (vertical arrows) Enter / Exit parameter editing mode
	Enter STOP mode			Deleting the configuration
	N/a	Turning on / off scanning with encoder	Turning on / off reference level	Start parameters setting, marked with ►. Memory clean during system parameters adjustment
	Pictogram selection and function control keys			

1.3.6 Use of pictograms

The device interface is characterized by an associative pictogram menu placed in six rectangular windows at bottom of the screen. Pictograms represent symbols associated with test object or property. Each mode has own pictogram set.

Pictograms can be passive or active. An active state of the current pictogram signifies that the corresponding device properties or parameters can be edited.

NOTE: HEREINAFTER CONDITIONAL NUMBERING FROM 1 TO 6 FROM LEFT TO RIGHT PICTOGRAM WINDOWS AND CORRESPONDING FUNCTION KEYS IS USED!

2 INTENDED USE

2.1 OPERATING LIMITATIONS

The device is designed for operation under environmental conditions specified in clause 1.1.2.

2.2 DEVICE PREPARATION FOR USE

If the device is delivered by air, a battery is to be disconnected from electric circuits according to safety requirements. In this case insert the battery in guiding on the back side of the electronic unit and carefully move it till the fixation click of the holder placed on the battery.

Note – To remove the battery, lift the holder and pull carefully the battery from the guiding.

Protective device screen glass is coated with polyethylene film to prevent scratches during the manufacture and transportation. Before the operation a protective film is recommended to be removed to increase image contrast and brightness on the display.

2.2.1 Switching device ON/OFF

To switch the device ON, press a key  , the LED above the key lights up green, "ACS LLC" logo appears in 10 seconds on the screen, if repress the key  within 10 seconds, the device is switched OFF.

Then in 15-20 seconds a mode window, active at the last switching OFF, appears with corresponding settings.

To switch the device OFF, press the key  .

2.3 OPERATING DEVICE MODES

2.3.1 SETUP mode

SETUP mode is designed for device parameters setting.

The Figure 5 shows the main screen in SETUP mode for operating TOMOGRAPH mode.

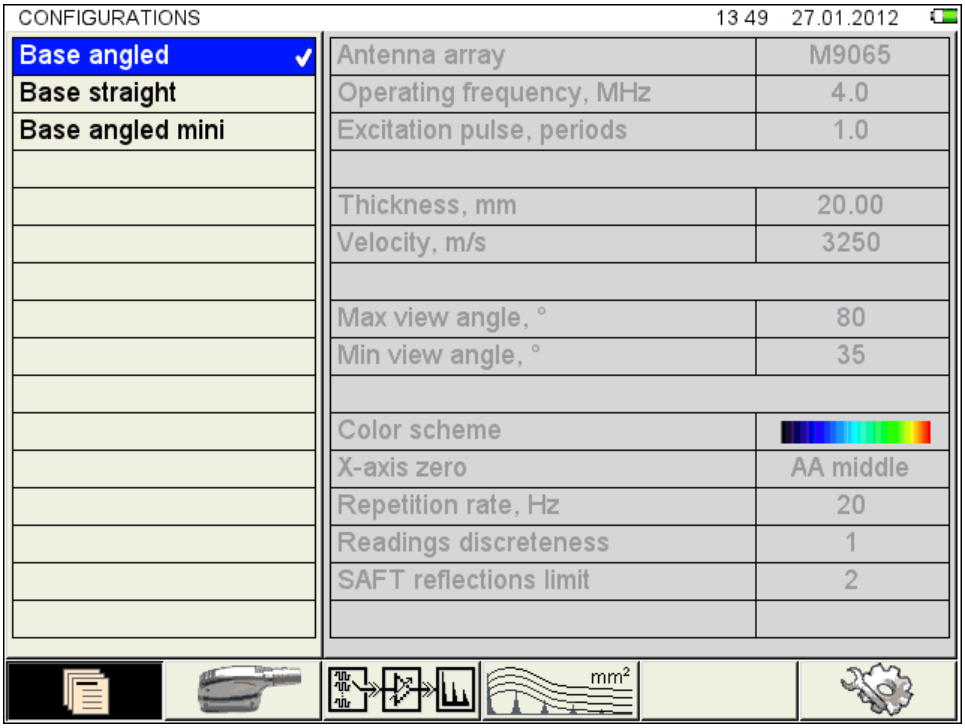


Figure 5

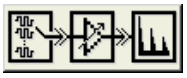
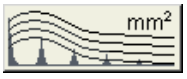
An active pictogram is always presented in pictogram menu.

Left column contains configuration list, the right one contains parameters and values.

To enter editing parameter values mode press  .

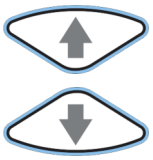
Pictogram functions in SETUP mode during editing are given in table 3

T a b l e 3

Key	Pictogram	Function
F1		Calibration parameters setup
F2		Antenna array parameters selection and setup
F3		Antenna array elements operation checking
F4		Amplitude correction parameter settings
F5	-	N/a
F6		System parameters setup. System parameters are general for all operating modes

Key functionы at calibration parameter editing are given in table 4.

T a b l e 4

Key	Function
	Move up and down for editing parameter selection
	Parameter value editing
	Exit parameter editing
	Exit SETUP mode
	Operating mode window call and exit SETUP mode during operating mode change

2.3.1.1 Calibration parameters editing

Calibration parameter names and allowed values are given in table 5.

T a b l e 5

Parameter	Value	Description
Antenna array	M9065 / M9060 / M9170	Antenna array selection for use
Operating frequency, MHz	1.0 / 1.8 / 2.5 / 4.0 / 5.0 / 7.5 / 10.0	Ultrasound operating frequency at testing
Impulse, periods	from 0.5 to 8.0 with step 0.5	Electric pulse form for AA PT excitation in meander period number
Thickness, mm	from 1.00 to 250.00 with step 0.05	OK thickness setting
Velocity, m/s	от 1 000 до 10 000 with step 1	Velocity of operating wave propagation in OC material
High limit of beam, ° (for angled AA)	from 1 to 90 with step 1	Setting of high limit of AA beam.
Low limit of beam, ° (for angled AA)	from 0 to 89 with step 1	Setting of low limit of AA beam
View angle ±, ° (for straight AA)	from 1 to 90 with step 1	Setting the view angle of the AA

Parameter	Value	Description
Color scheme	/ / /	Selecting the color scheme
X-axis zero	AA middle/AA front	X-axis zero selection relatively to AA
Frame rate, Hz	5 / 10 / 20	Information refresh rate selection on the screen
Readings discreteness	0.1 / 1	Selecting discreteness of shown results
SAFT reflections limit	from 1 to 20 with step 1	Setting the maximum amount of signal reflections, from the borders of a plate-parallel OC, used in image reconstruction

2.3.1.2 Antenna array parameters editing

The figure 6 shows antenna array parameters editing in SETUP mode for operating TOMOGRAPH mode.

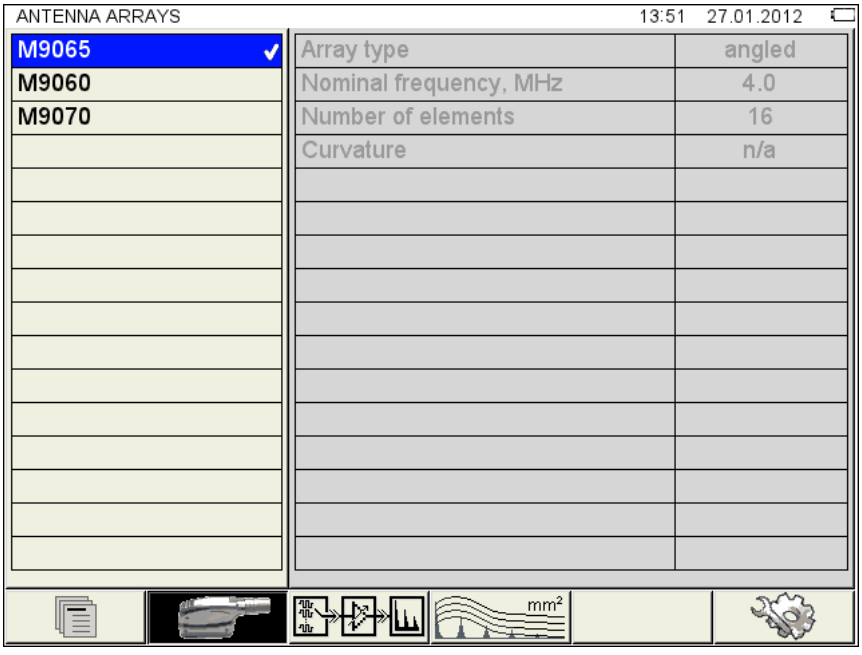


Рисунок 6

To switch to antenna array parameter editing hold  for a while.

In parameters edeting aditional AA parameters are available. (Figure 7).

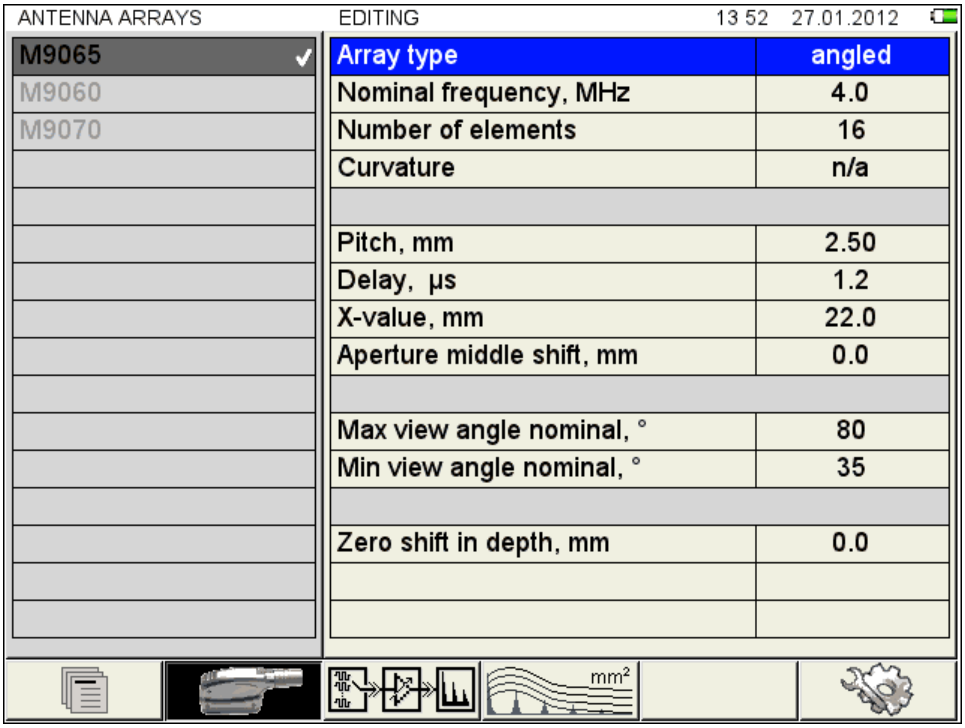


Figure 7

Antenna array parameters and permissible values are given in table 6.

T a b l e 6

Parameter	Value	Description
Array Type	angled/straight	AA type setting
Nominal Frequency, MHz	1.0 / 1.8 / 2.5 / 4.0 / 5.0 / 7.5 / 10.0	AA nominal frequency
Number of Elements	from 4 to 16	Number of AA elements
Curvature	n/a, longitudinal, transversal	Presence and direction of curvature on the surface of the AA. Longitudinal – along the tube axes Transversal – across the tube axes
Curvature diameter	From 500 to 800 with step 100	Curvature diameter settings
Pitch, mm	from 0.00 to 10.00 with 0.01 step	Distance between AA elements
Delay, µs	from 0.0 to 100.0 with 0.1 step	Setting of signal delay time in AA
X-value, mm	from 0.0 to 50.0 with 0.5 step	X-value setting
Aperture middle shift, mm	from 0.0 to 50.0 with 0.5 step	Aperture center shift settings

Parameter	Value	Description
Max view angle nominal, ° (for angled AA)	From 0 to 89 with 1 step	AA passport value
Min view angle nominal, ° (for angled AA)	From 1 to 90 with 1 step	AA passport value
View angle nominal, °	From 1 to 90 with 1 step	AA passport value
Zero shift in depth, mm	From 0.0 to 50.0 with 0.5 step	Pasport value for AA with delay lines

2.3.1.3 Gain selection and antenna array operation checking

The Figure 8 shows the device display at gain selection and antenna array elements operation checking. Receiver and sender signal is shown on the screen

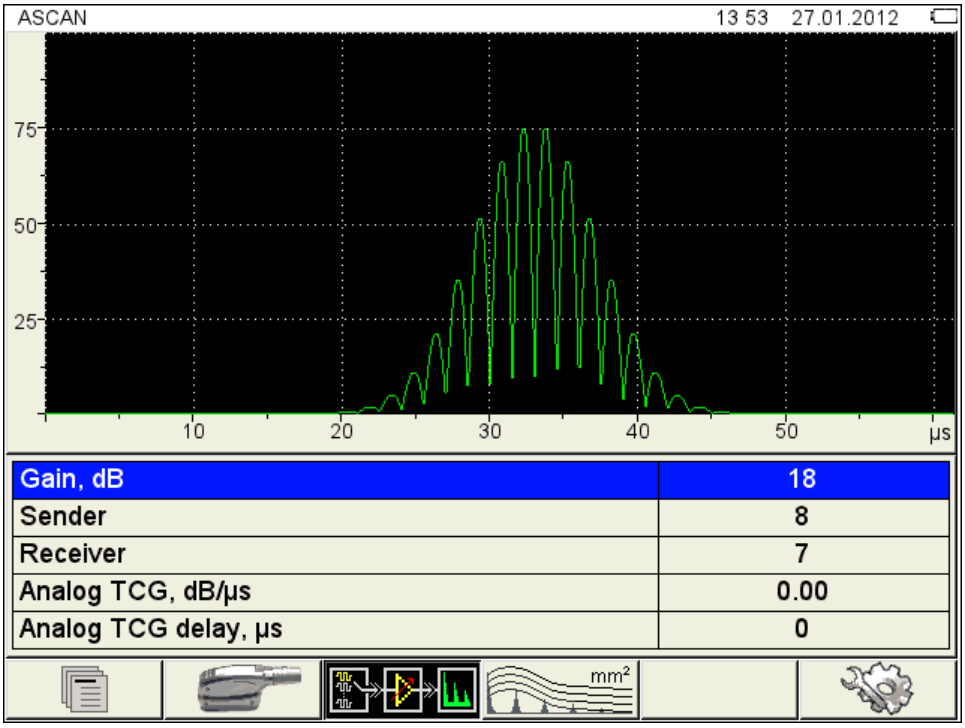


Figure 8

Gain parameters and permissible values are given in table 7

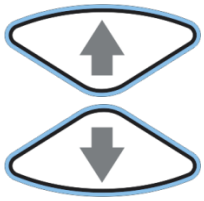
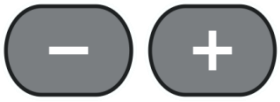
T a b l e 7

Parameter	Value	Description
Gain, dB	from 0 to 80 with 1 step	Reception path gain coefficient
Sender	from 1 to 16 with 1 step	Number of AA element set for sending
Receiver	from 1 to 16 with 1 step	Number of AA element set for receiving
Analog TCG, dB/us	from 0.00 to 1.00 with step 0.01	Setting the analog TCG value

Parameter	Value	Description
Analog TCG delay, us	от 1 до 50 с шагом 1	Setting analog TCG delay value

Key functions at analog gain selection and antenna array operation checking are given in table 8.

T a b l e 8

Key	Function
	Move up and down for editing parameter selection
	Parameter value editing
F1, F2, F4	Exit gain parameter editing
	Exit SETUP mode
	Operating mode window call and exit SETUP mode during operating mode change

2.3.1.4 Amplitude correction parameters editing

Screen view in amplitude correction parameters mode is shown on figure 9.

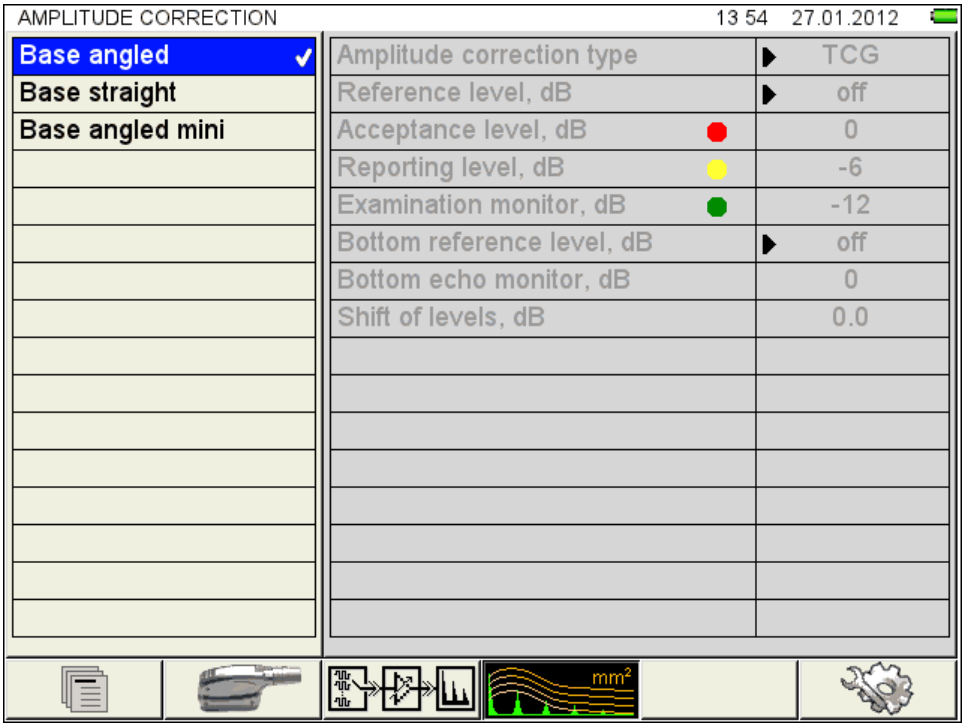


Figure 9

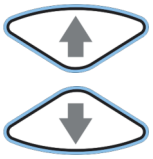
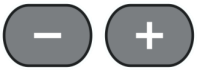
Amplitude correction parameters and permissible values are given in table 9.

Table 9

Parameter Name	Value	Description
Type of amplitude correction	TCG	Enter TCG setting menu with the key Enter
Reference level, dB	off / from 0 to 160	Enter reference level setting mode by pressing Enter
Acceptance level, dB	form - 4 to + 16 with step 1	Increasing or lowering measured values relative to the reference level
Reporting, dB	from - 10 to + 10 with step 1	Increasing or lowering measured values relative to the reference level
Examination monitor, dB	from - 16 to + 4 with step 1	Increasing or lowering measured values relative to the reference level
Bottom reference level, dB	off / from 0 to 160	Enter bottom reference level setting by pressing Enter
Bottom echo monitor, dB	from - 16 to 0 with step 1	Reference level for strobe 2. Used only while controlling with a straight AA.
Shift of levels, dB	from - 4.0 to + 4.0 with step0.1	Increasing or lowering measured values while calibrating reference levels

Key functions while editing amplitude correction parameters are shown in table 10.

Table 10

Key	Function
	Selected point amplitude adjustment
	Changing the value
	When choosing “Type off amplitube correction” or “Reference level” enter their setting modes

Key	Function
	Exit SETTINGS mode
	Changing the operating mode and exit settings mode if choosing another operating mode

2.3.1.5 Device system parameters

System parameters are the same for all operating modes

The Figure 10 shows the device display at system parameters setting.

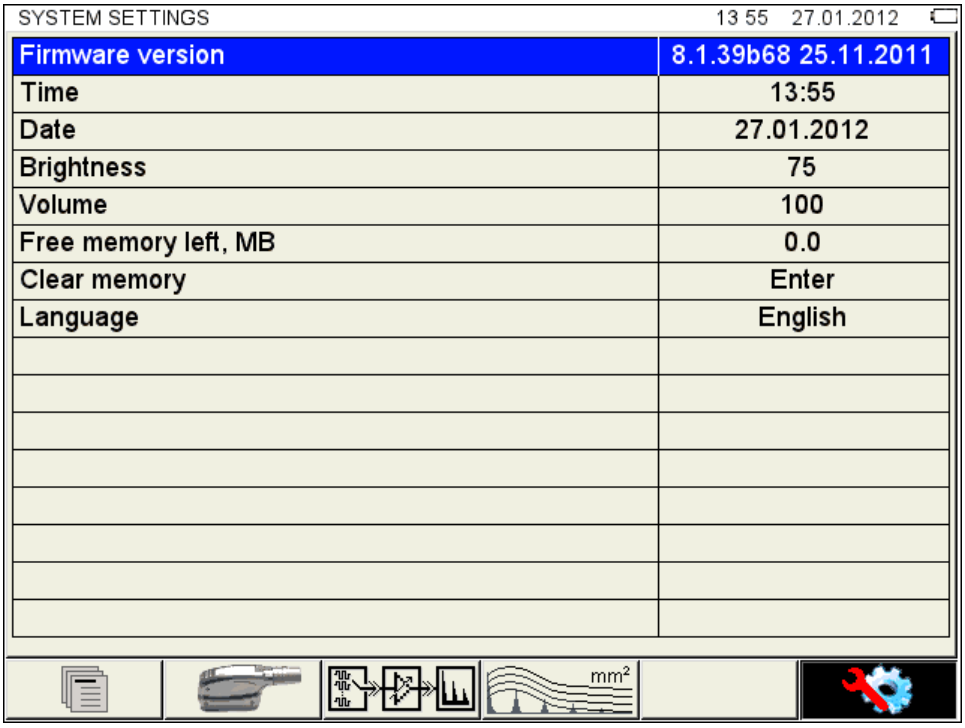


Figure 10

Parameters and permissible values are given in 1able 11.

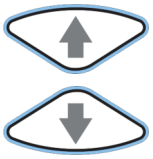
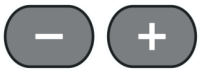
T a b l e 1 1

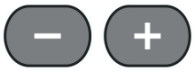
Parameter	Value	Description
Firmware version	X.X.X	The current firmware version
Time	DD.MM	The current time in 24-hour format HOURS:MINUTES Enter Time setting mode by the key 
Date	DD.MM.YYYY	The current date in DATE.MONTH.YEAR format Enter Date setting mode by the key 
Brightness	from 0 to 100	Display brightness setting

Parameter	Value	Description
Volume	OFF / from 10 to 100 with 10 step	Sound level setting
Free memory, MB	XXXX.X	Amount of free memory
Clear memory	Enter	Starting memory cleaning - Enter NOTE: A FULL MEMORY CLEANING, ALL SETTING AND DATA ARE TO BE DELETED!
Language	Русский / English / Français	Device Interface Language selection

Key functions for system setting editing are given in table 12.

Table 12

Key	Function
	Move up and down for editing parameter selection
	Parameter value editing
	Enter in editing mode at «Time» или «Date» selection
	Exit SETUP mode
	Operating mode window call and exit SETUP mode during operating mode change

– To edit parameters “Time” or “Date”, select an appropriate parameter and press the key  . In open editing window (Figure 9) with keys  select a group for editing and correct values with keys  or  . To confirm changes, press the key  , to cancel -  .

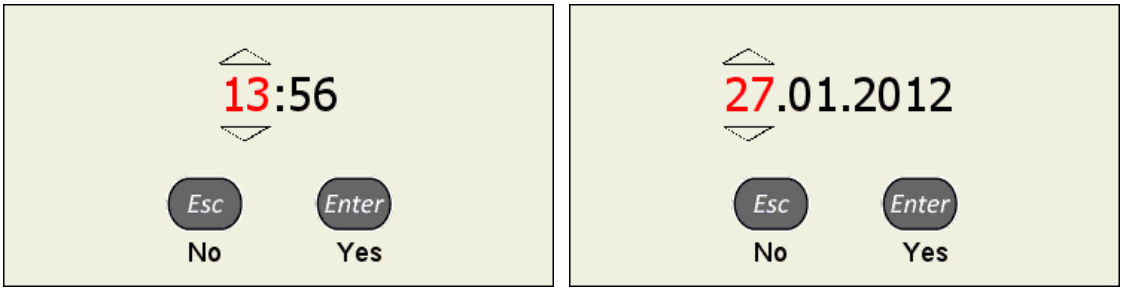


Figure 9

Starting “Clear memory” is accompanied with a warning box (figure 12).

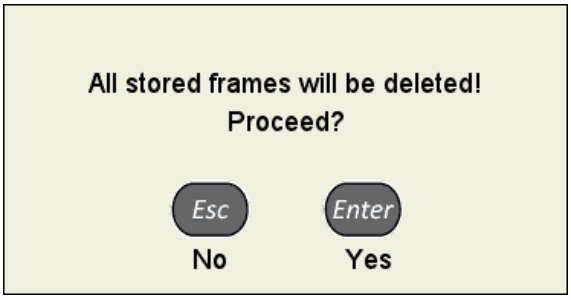


Figure 10

2.3.1.6 Configuration preview, creation and deletion

The first line with default configuration in the configuration list is highlighted at entering the mode, thus all parameters of the configuration are shown in preview mode on the right (Figure 13). The current configuration is marked with «✓».

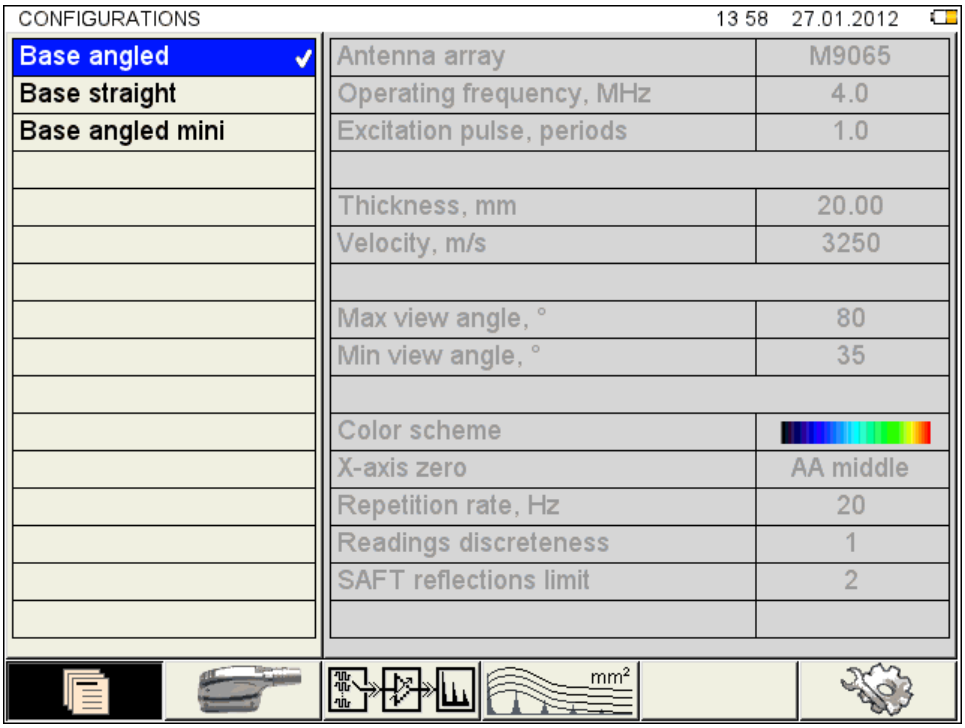


Figure 11

Looking through the configuration parameters

To view saved parameters, click its name by the keys  .

Choosing a configuration

To continue working with another list configuration, with keys   highlight it and press  . To return into measurements mode using the chosen configuration press  .

Deleting a configuration

To delete any saved configuration, press  , thus deletion confirmation window appears (Figure 14).

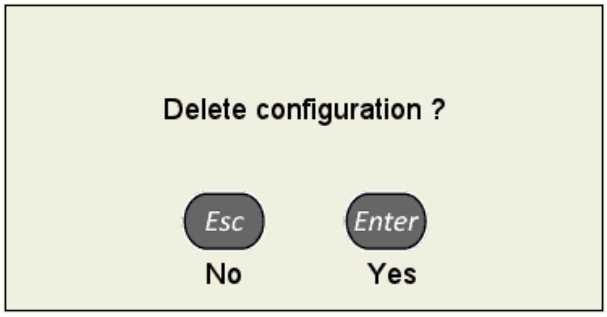


Figure 12

Note – In configurations list two default configurations are always present: “Base angled”, “Base straight” and “Base angled mini”.

WARNING: IT IS IMPOSSIBLE TO DELETE A BASE OR CURRENT CONFIGURATION

At an attempt to delete above-mentioned configurations the appropriate information window appears (Figure 15).

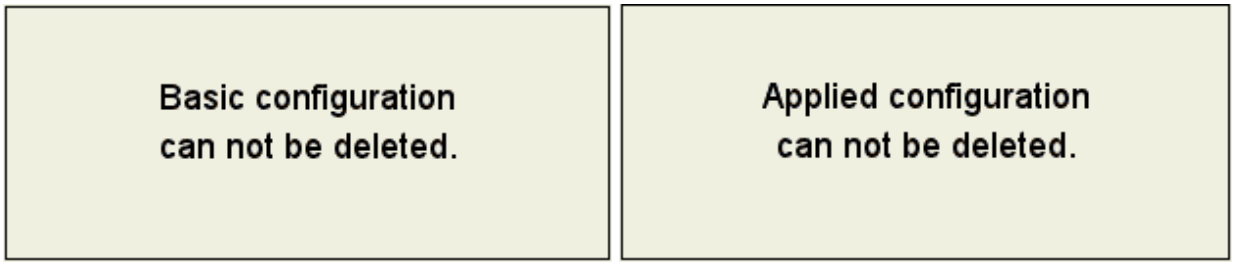


Figure 13

To return calibration mode without the current configuration change, press the key  .

Creating a new configuration

To create a new configuration based on the current one, move to configuration line which will be base for editing with  , for example, «Base» (Figure 13).

To change configuration value setting, press the key  . Parameter values are accessible for editing (Figure 18)

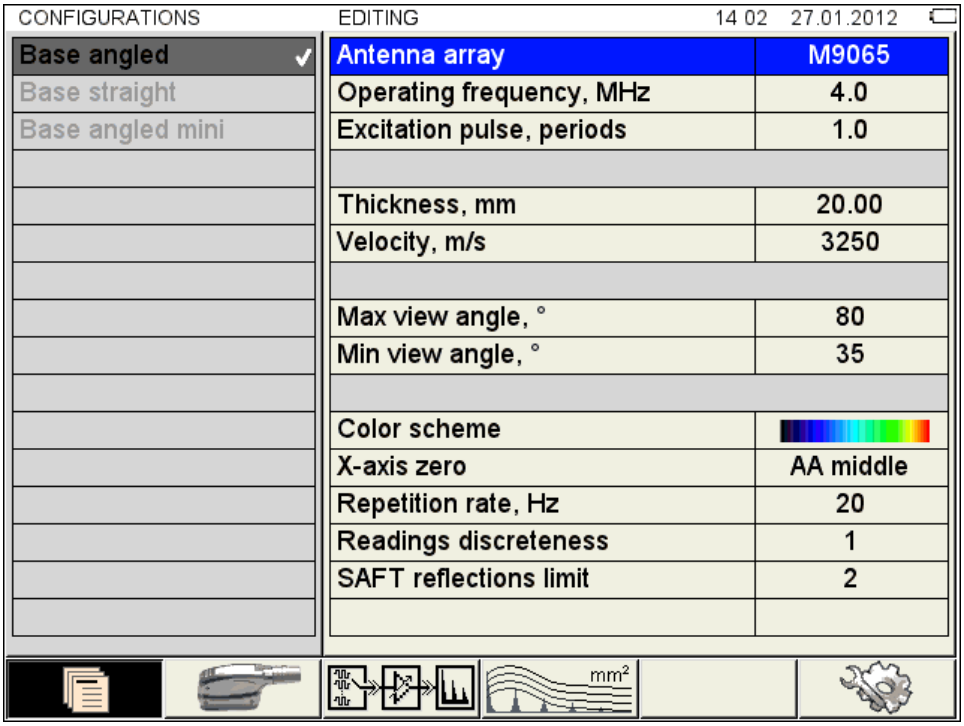


Figure 18

At any configuration parameter value changing, a new line is added into the end of the configuration list and becomes active. A line consists of the edited configuration name with asterisks «*» in the end. Thus configuration, selected as a base, remains unchanged.

Note – Making a new configuration on the basis of base configurations the word ”base” in the automatic name forming isn`t used.

The Figure 17 shows the display at «Base angled» configuration changing.

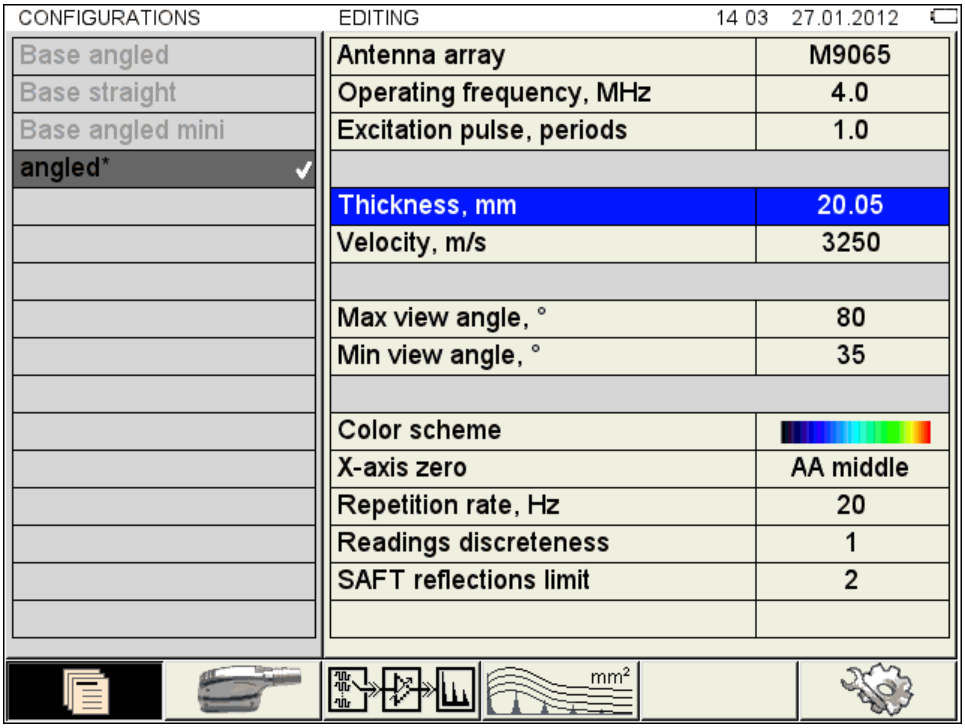


Figure 14

After changing, exit parameter editing pressing the key  .

The left column with configuration names and highlighted temporal name of a new configuration becomes active (Figure 18).

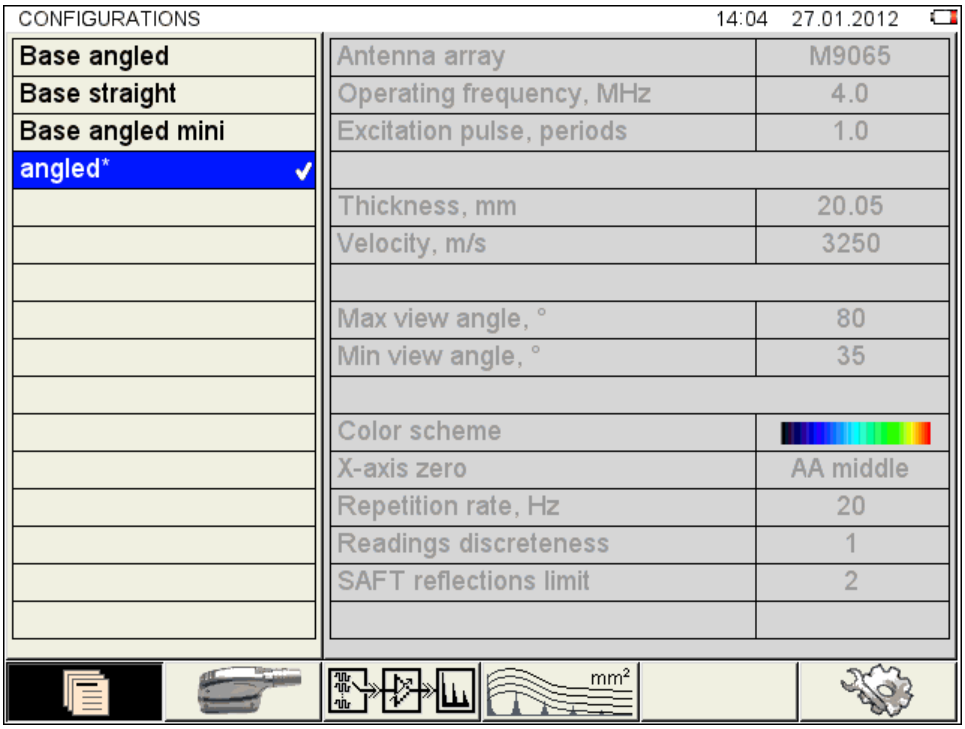


Figure 15

On default the new configuration becomes current.

To save configuration, it should be appropriated with a name by pressing the key  . The name editing window appears (Figure 19).

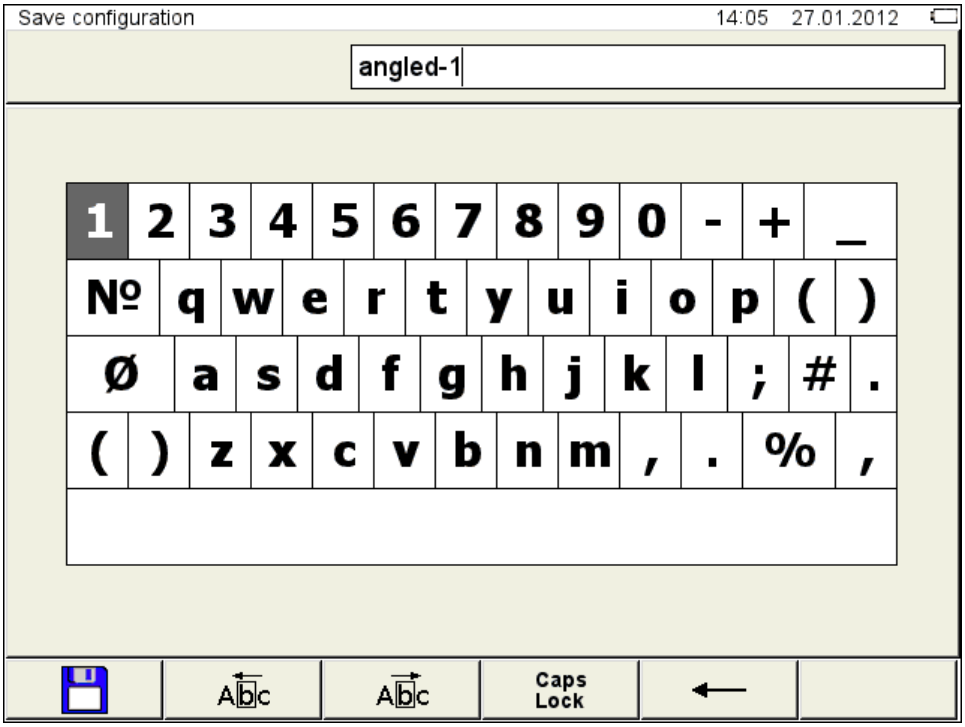


Figure 16

By default a configuration is offered to be saved under the base configuration name and adding a hyphened ordinal number.

If the name of the edited configuration already ends with a hyphen with an ordinal number, then on default the number will be increased by 1.

The configuration can be appropriated with any name (Figure 20).

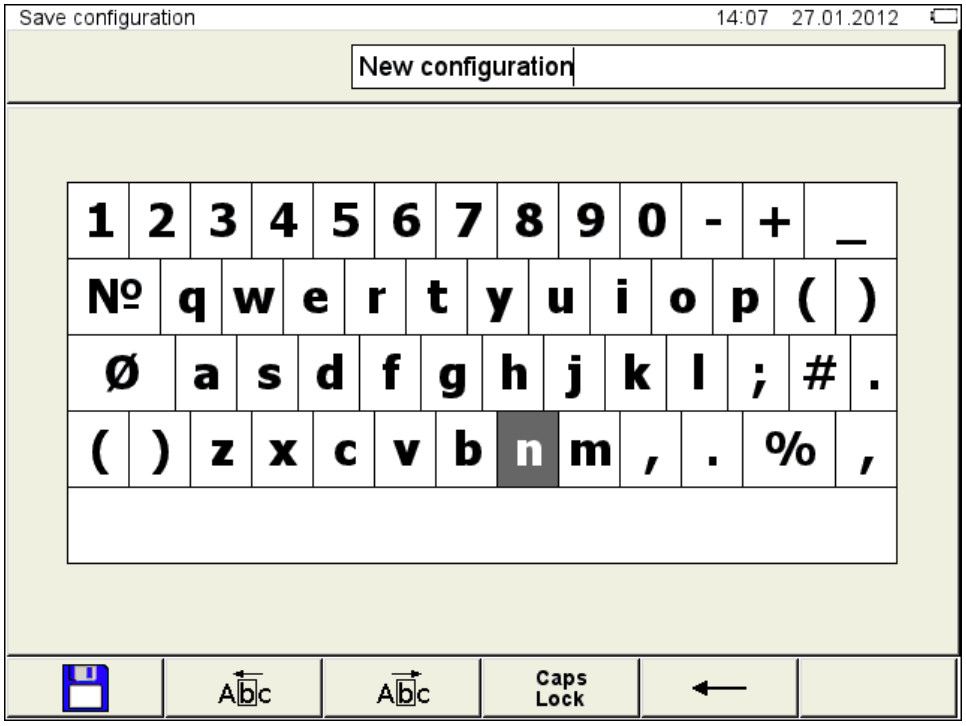


Figure 17

To save a formed name, press F1 key (). A configuration under a new name appears in the list (Figure 21).

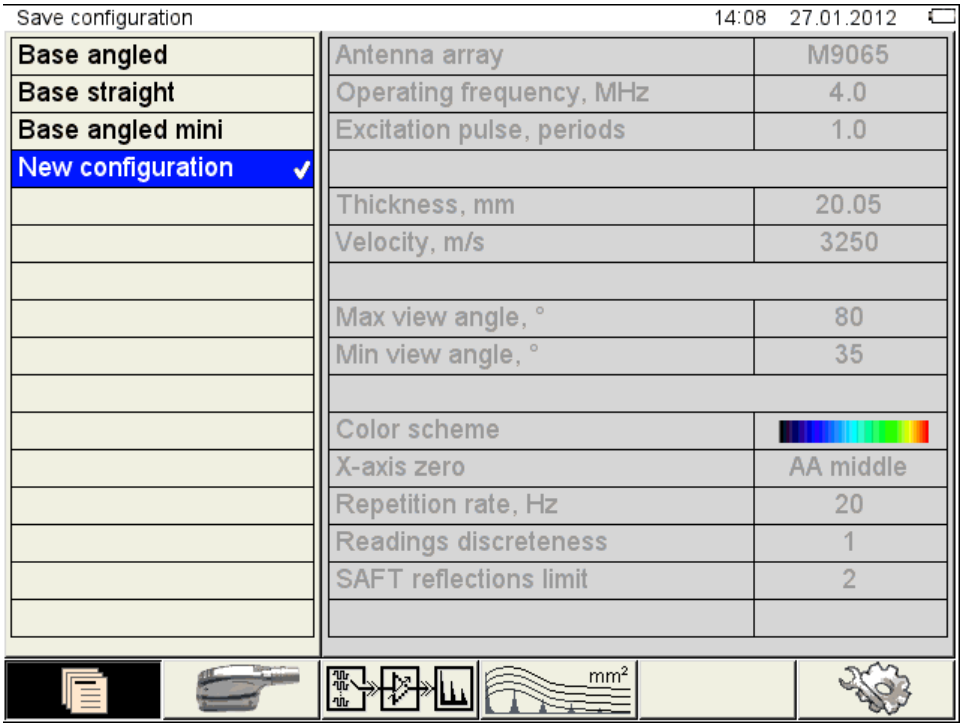
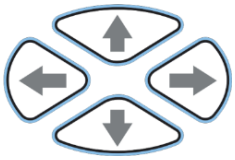


Figure 18

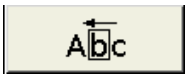
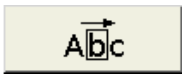
Key functions during name editing are given in table 13.

T a b l e 1 3

Key	Function
	Move on the key-in field on the device screen
	Move left/right on the name field
	Input in the name field of the symbol/ action highlighted in the key-in field on the device screen
	Operating mode selection call and exit SETUP mode at operating mode changing without name saving
	Exit name editing in the SETUP mode without name saving

Pictogram functions in SETUP mode during name editing are given in table 14.

T a b l e 1 4

Key	Pictogram	Function
F1		Save a formed name
F2		Left cursor movement in the name field
F3		Right cursor movement in the name field
F4		Enter uppercase letters
F5		Left symbol deletion
F6		Switch between keyboard layout display (Russian interface only)

2.3.2 SETUP mode for operation in FLAW-DETECTOR mode

Mode SETUP – FLAW DETECTOR is meant for adjusting and setting parameters of the device for work in FLAW DETECTOR mode.

The Figure 22 shows the main display in SETUP mode for FLAW-DETECTOR mode.

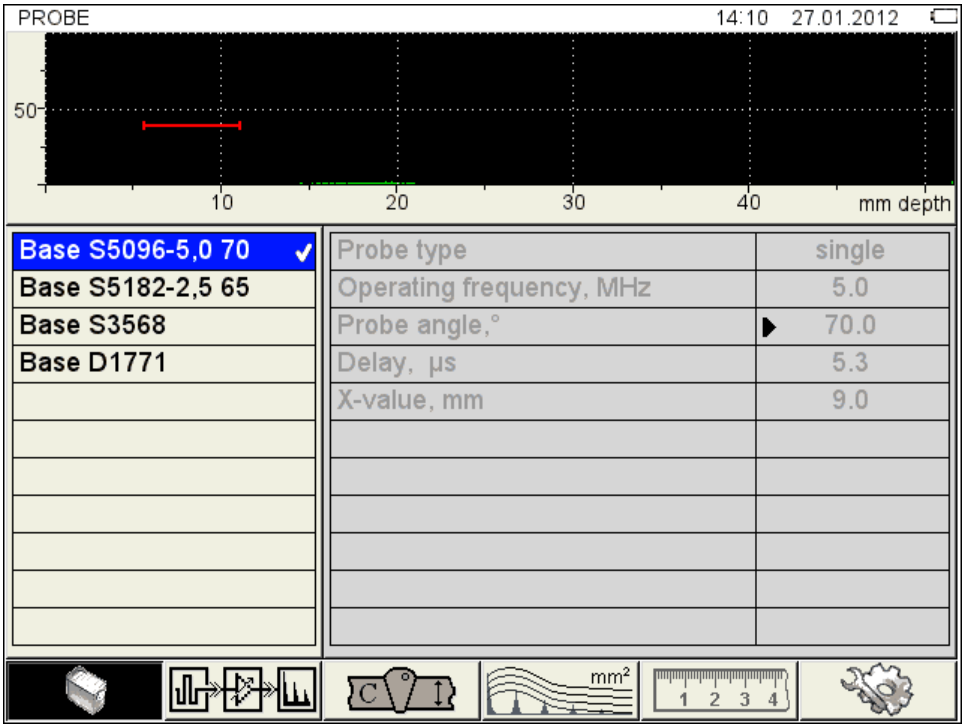


Figure 19

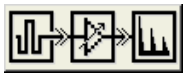
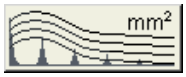
An active pictogram is always presented in pictogram menu.

Signal A-scan is at upper of the screen, for visual test of selected parameters.

Left column contains configuration list, the right one contains parameters and values. Preview, selection, editing and creation of a new configuration are similar to SETUP/TOMOGRAPH mode. (п. 2.3.1.6).

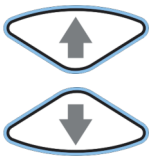
Pictogram functions in SETUP/TOMOGRAPH mode in editing parameters mode are given in table 15.

Table 15

Key	Pictogram	Function
F1		PT parameters settings
F2		Signal parameter settings
F3		OC parameter settings
F4		Amplitude correction parameters setting
F5		Visualization parameter settings
F6		System settings

Key functions during parameter editing are given in table 16.

Table 16

Key	Function
	Move up and down for editing parameter selection
	Parameter value editing
	Exit parameter editing
	Exit SETUP mode
	Operating mode window call and exit SETUP mode during operating mode change

2.3.2.1 PT parameter editing

Calibration parameters and permissible values are given in table 17.

Table 17

Parameter Name	Value	Description
PT type	sngl / dbl.	Applied PT type selection: single; double-single
Operating frequency, MHz	1.0 / 1.8 / 2.5 / 4.0 / 5.0 / 7.5 / 10.0	Adjusted depending on material properties
Angle of incident, degree	from 0.0 to 90.0 with 0.5 step	Setting of PT angle of incident. At zero-point setting, THICKNESS parameter is automatically changed into OFF state. Start calibrating on specimen V2/25 procedure by pressing Enter
Delay, µs	from 0.0 to 100.0 with 0.1 step	Delay setting in PT prism
Arrow, mm	from 0.0 to 50.0 with 0.1 step	Transducer arrow setting

To make calibration on specimen V2/25 press Enter and follow the instructions, appearing on the screen (figures 20, 21, 22).

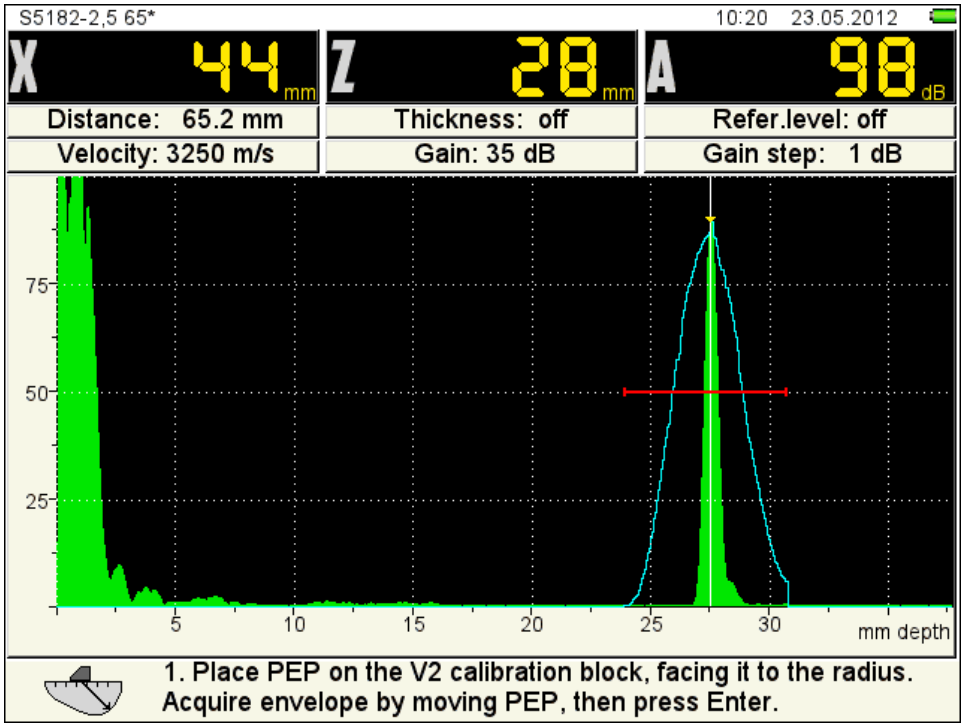


Figure 20

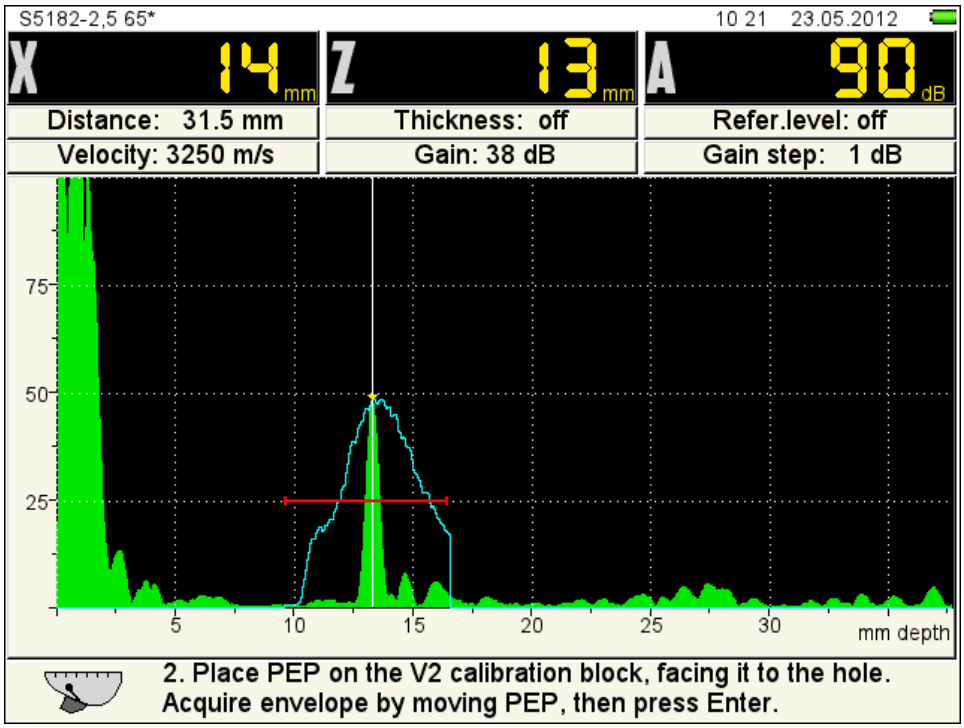


Figure 21

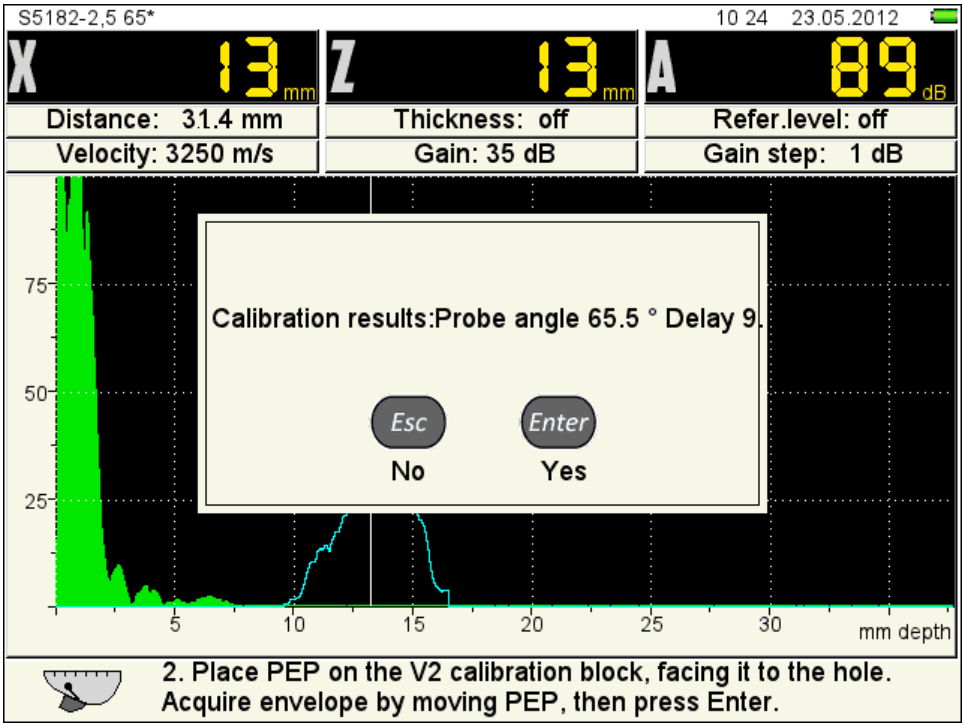


Figure 22

2.3.2.2 Signal parameters editing

Screen view while editing signal parameters is shown on figure 23.

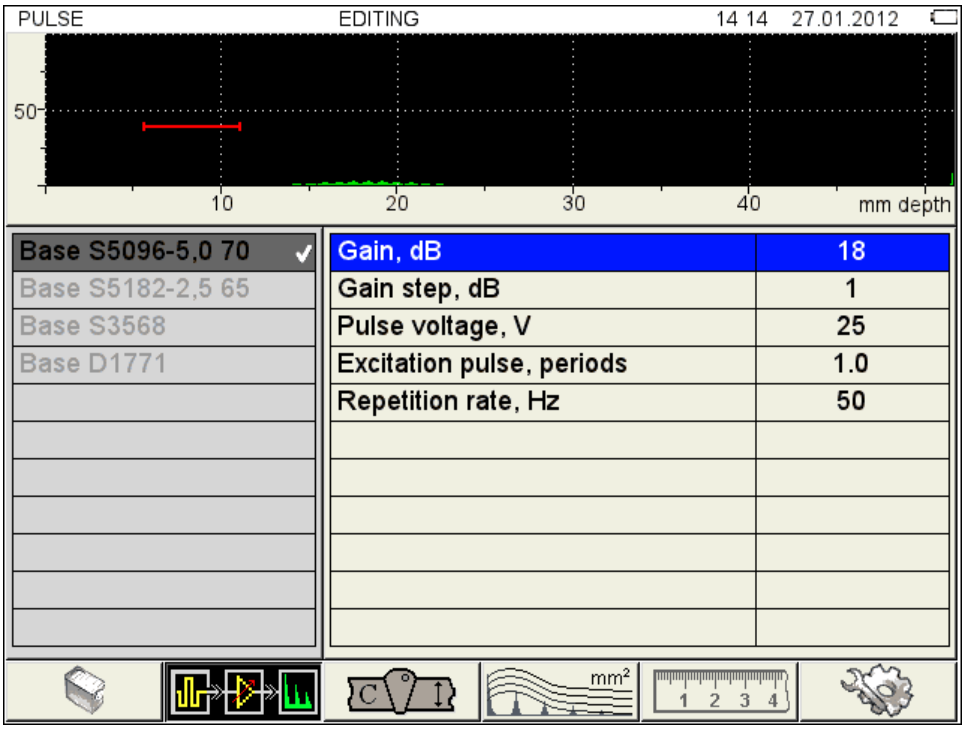


Figure 23

Signal parameters and permissible values are given in table 18.

Table 18

Parameter	Value	Discription
Gain, dB	from 0 to 80	Reception path gain setting
Step of gain, dB	1 / 6 / 10	Selection of step of gain
Pulse voltage, V	25 / 50 / 100	Probe pulse amplitude
Excitation pulse, periods	from 0.5 to 8.0 with step 0.5	Determination of probe pulse form
Frame rate, Hz	5 / 10 / 50	The number of displayed frames

2.3.2.3 Editing object of control (OC) parameters

Screen view in OC parameters editing mode is shown on figure 24.

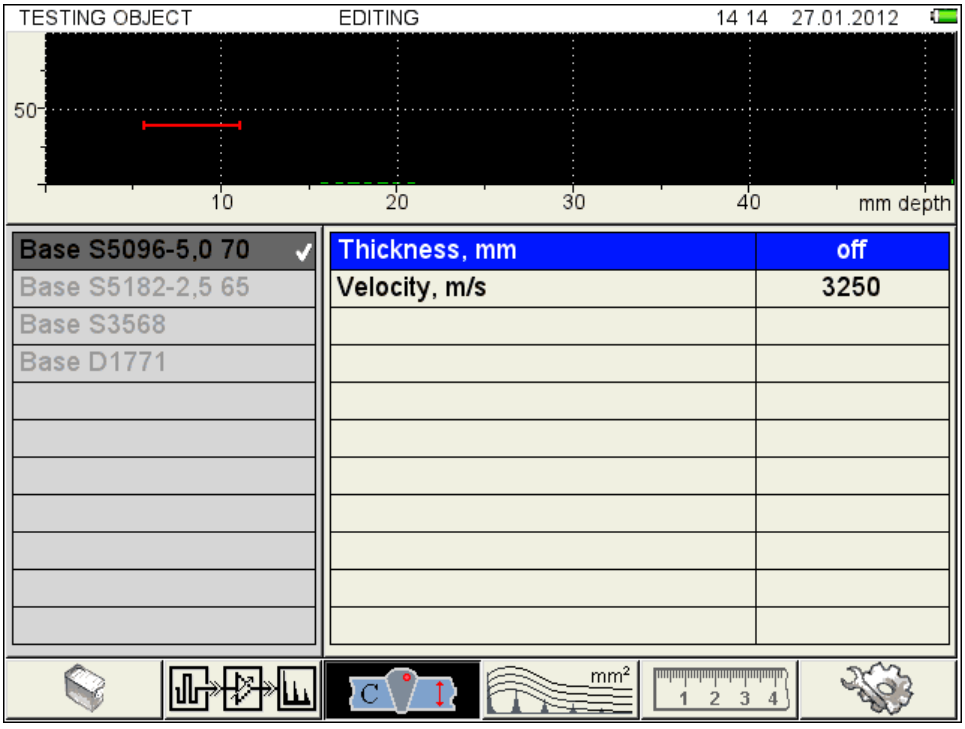


Figure 24

OC parameters and permissible values are given in table 19.

Table 19

Parameter Name	Value	Description
Thickness, mm	OFF / from 1.00 to 100.00 with step 0.05	OC Thickness setting/switching off Switching with the key Enter At setting of zero-angle of incident, the parameter value is automatically changed into OFF state
Velocity, ms	from 1 000 to 10 000 with 1 step	US velocity setting

2.3.1.8 Amplitude correction parameters editing

Amplitude correction parameters and permissible values are given in table 20.

Table 20

Parameter Name	Value	Description
Type of amplitude correction	TCG / DGS / DAC	Selection of the type of amplitude correction.
Acceptance level, dB	from - 4 to + 16 with step1	Changing of calibrated values relatively to reference levels
Reporting level, dB	from - 10 to + 10 with step 1	Changing of calibrated values relatively to reference levels
Examination monitor, dB	from - 16 to + 4 with step 1	Changing of calibrated values relatively to reference levels
Shift of levels, дБ	from - 4.0 to + 4.0 with step 0.1	Changing of calibrated levels at calibration

Amplitude correction setting – TCG

TCG function is supposed to be used for correction of signals of the same reflectors placed on different depth.

Screen view in TCG parameters setting is shown on figure 28.

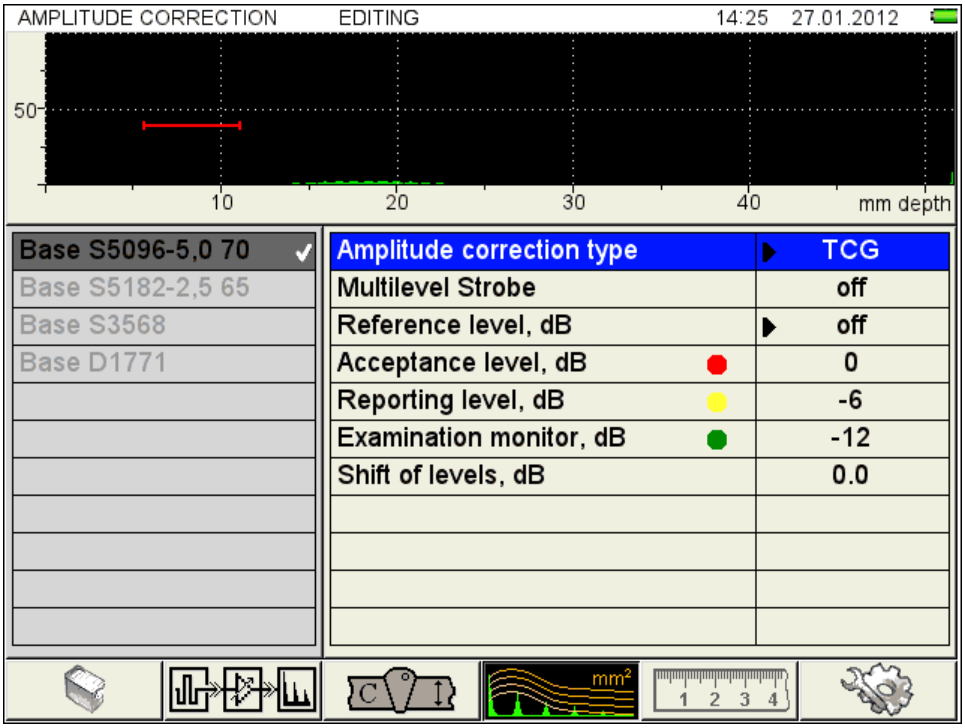


Figure 25

TCG parameters and permissible values are given in table 21.

T a b l e 2 1

Parameter	Value	Description
Multilevel strobe	on / off	Three strobes are shown on the screen: examination, reporting and acceptance. On/off - Enter
Reference level, dB	off / from 0 to 200 with step 1	A level when signal amplitude is counted in vertical cursor area (at switched reference level) Reference level setting with the key Enter

For reference level setting, move to this parameter and press the key Enter. The reference level setting window appears (Figure 26).

Receive the reference reflector signal within the strobe to set a reference level by pressing the key Enter. The signal level value is set as reference level, setting window is closed.

At pressing the key Esc setting window is exited without reference level value changing.

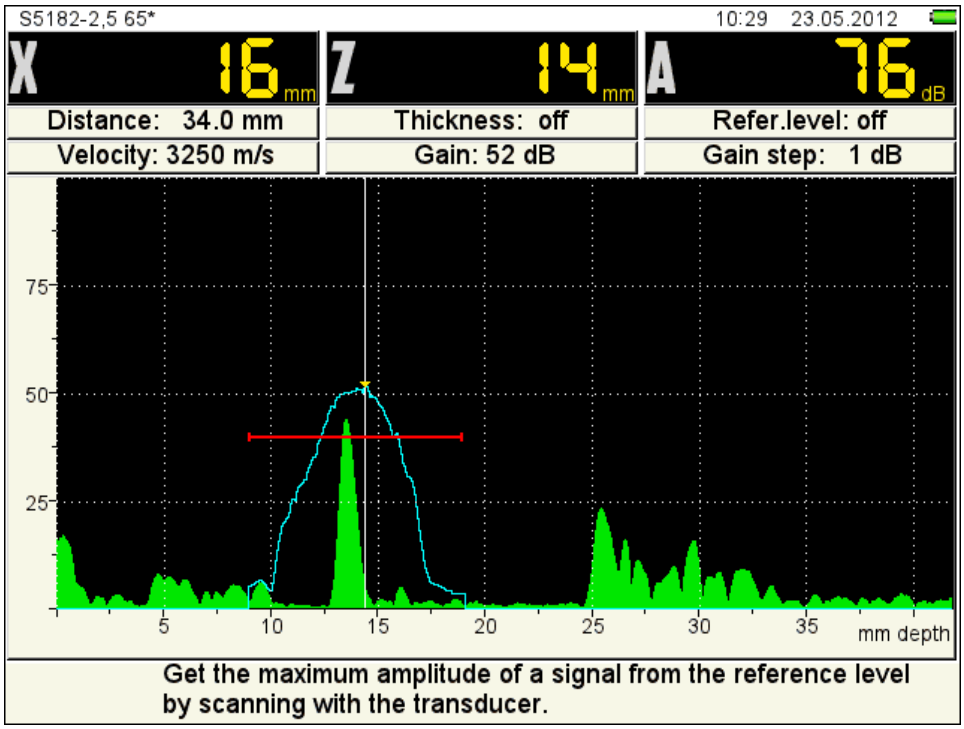


Figure 26

To set TCG the control material sample specifying the control reflectors size is required – close and distant (for this purpose notches are usually used which help for signal searching by direct and once-reflected beams).

A temporary echo-signal realization appears on the screen as a linear polygonal function in a logarithmic scale, having up to 32 knot points. Maximum depth of every knot point is 30 dB.

Setting process:

– Set a sweep so that signals from all defects in a prospective test area have been presented on the screen..

– Pass in TCG setting mode

– Find a signal peak from a near reflector. Then to put a calibration cursor on it and to create a new node with the key  .

– Repeat node creation procedure for a distant reflector. (figure 28).

– Correct the position moving a cursor on nodes and new nodes, so that amplitudes from near and distant reflectors were set at one level.

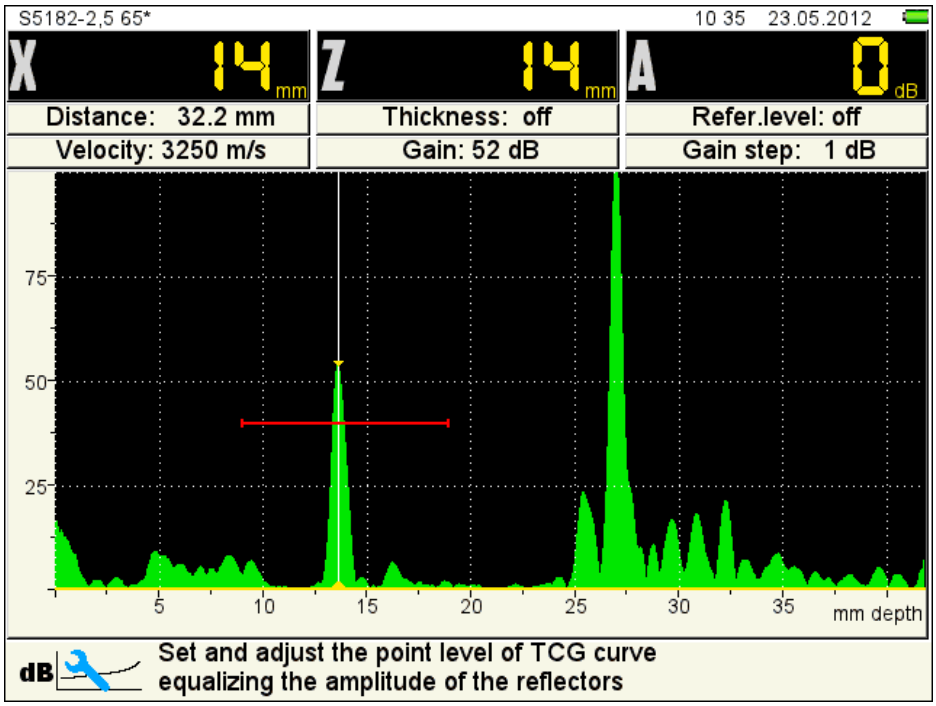


Figure 27

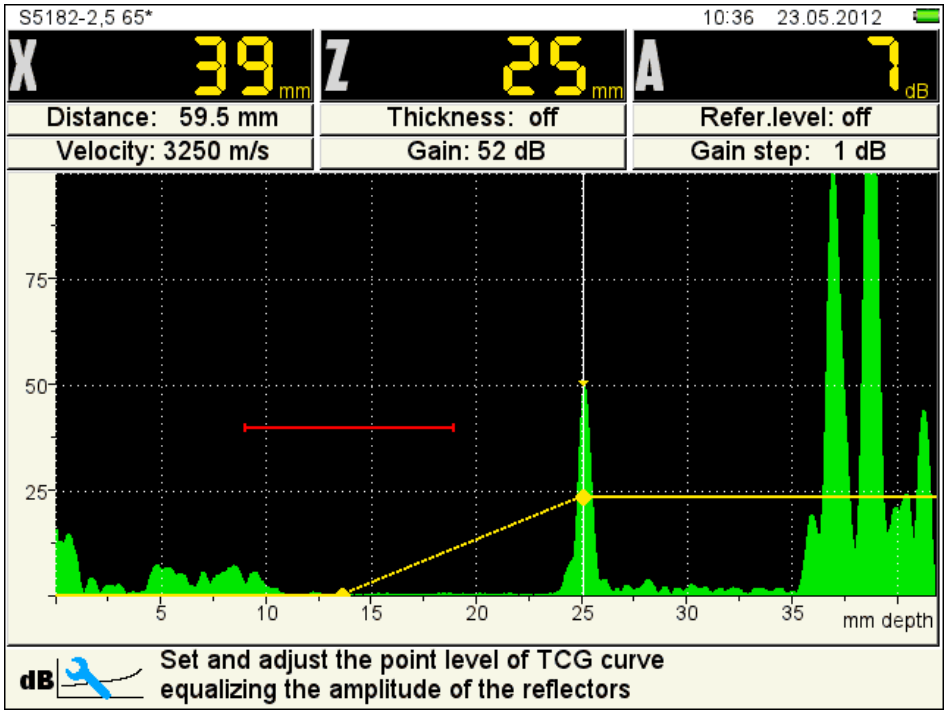


Figure 28

To save the settings press Enter, TCG setting confirmation window appears (Figure 29).

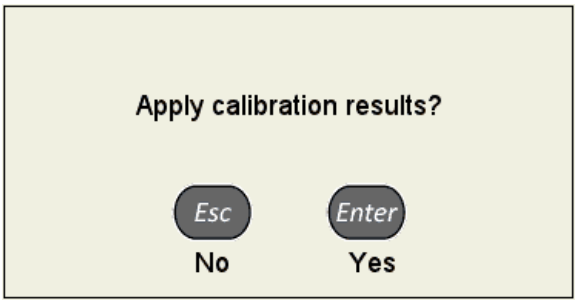


Figure 29

Screen view after setting TCG parameters is shown on figure 33.

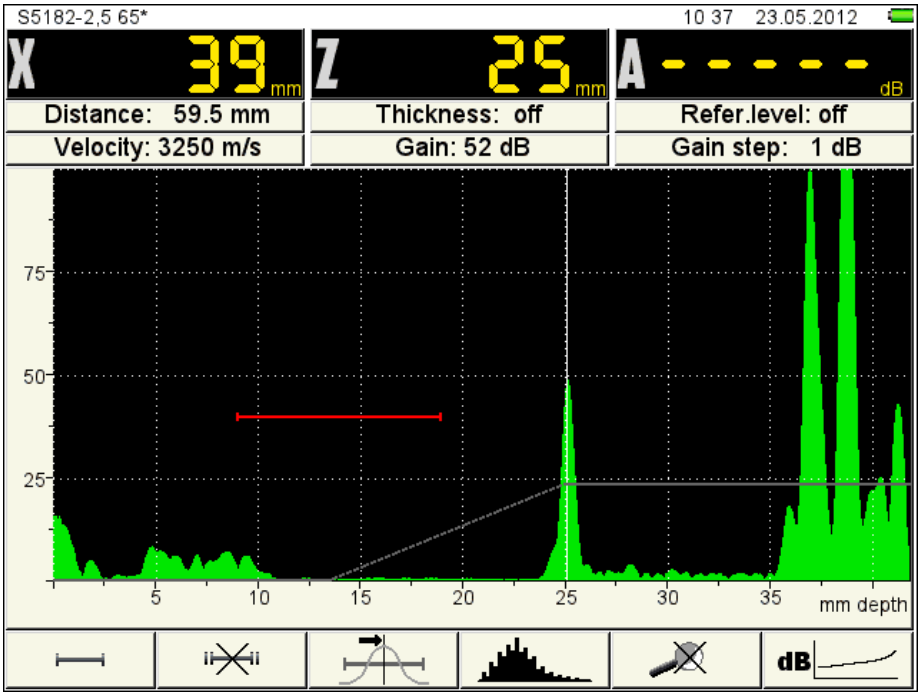
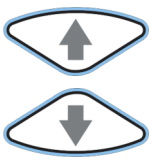
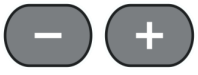


Figure 30

By pressing Esc you exit settings window without saving the settings

Key functions at TCG setting are given in table 22.

Table 22

Key	Function
	Selected point amplitude adjustment. If there is no point at the cursor, the keys are unable
	Cursor movement

Key	Function
	Cursor movement to the closest point in the corresponding direction
	Exit TCG setting
	Confirmation window call for TCG setting
	Point addition/deletion in the cursor position
	N/a
	Operating mode window call and exit SETUP mode at operating mode changing

Amplitude correction setting – DGS

The device has an automatic DGS-diagram calculation function for double transducers. With DGS-diagram test sensitivity can be set and an equivalent square of the defect can be automatically calculated.

Screen view in setting DGS parameters is shown on figure 31.

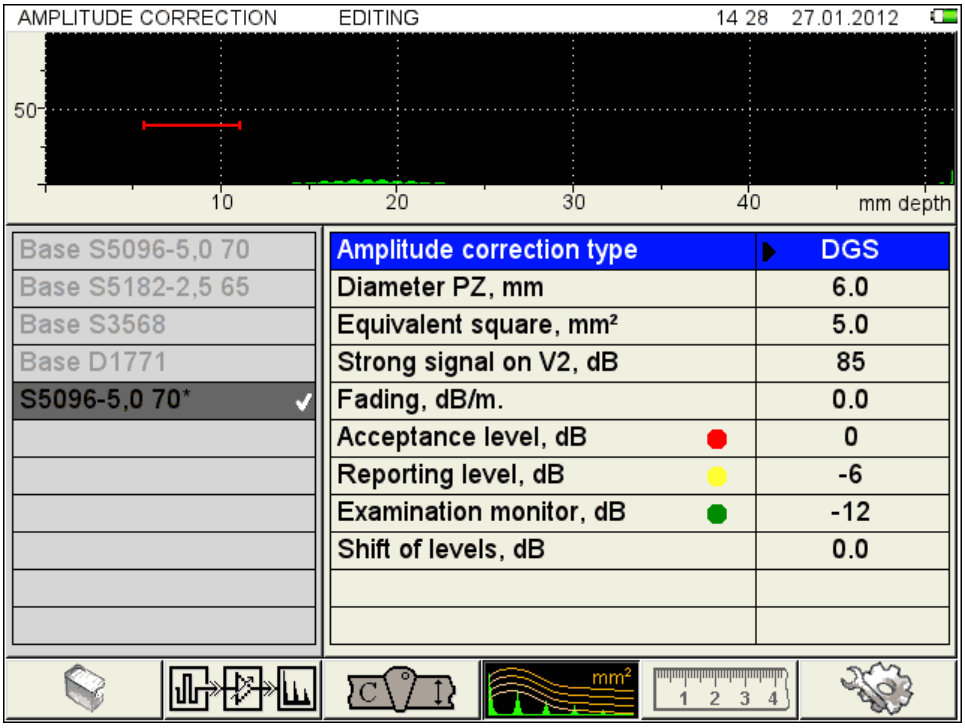


Figure 31

TCG parameters and permissible values are given in table 23.

Table 23

Parameter Name	Value	Description
Diameter of piezoelement, mm	from 0.0 to 25.0 with 0.1 step	Diameter of piezoelement is specified in PT passport or is to be measured
Equivalent square, sq.m	from 0.0 to 25.0 with 0.1 step	Value of acceptance equivalent square of the flat-bottomed hole sets DGS curve of the acceptance level (it's specified in US control methodology)
Reference signal on V2, dB	from 0 to 200 with 1 step	It is set under V2/25 calibration sample. Depending on the angle of incident of applied transducer, the signal level is determined in dB from cylindrical 5mm dia hole: - by big contact V2/25 surface, if angle of incident is less or equal 62◦; by small contact V2/25 surface, if angle of incident is more 62
Fading, dB/m	from 0.0 to 99.9 with 0.1 step	Fading coefficient setting (it's specified in US control methodology)

To set DGS press Enter.

DGS setting window will appear (figure 32).

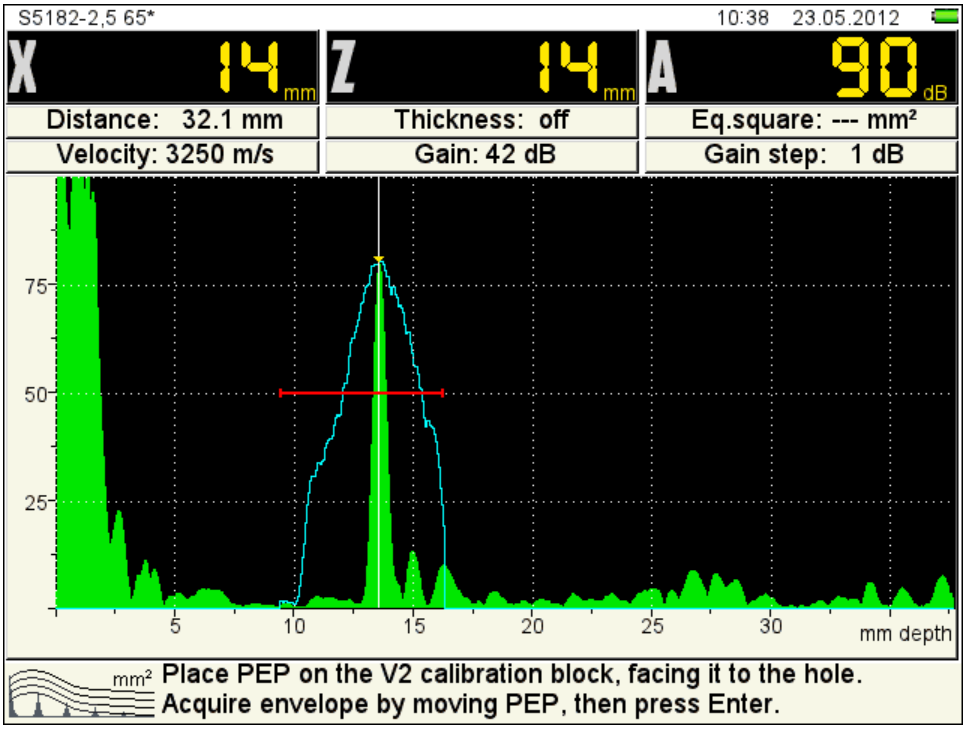


Figure 32

If the parameters are set correctly, the device display shows three DGS-curves corresponding to acceptance, reporting and examination levels (Figure 33).

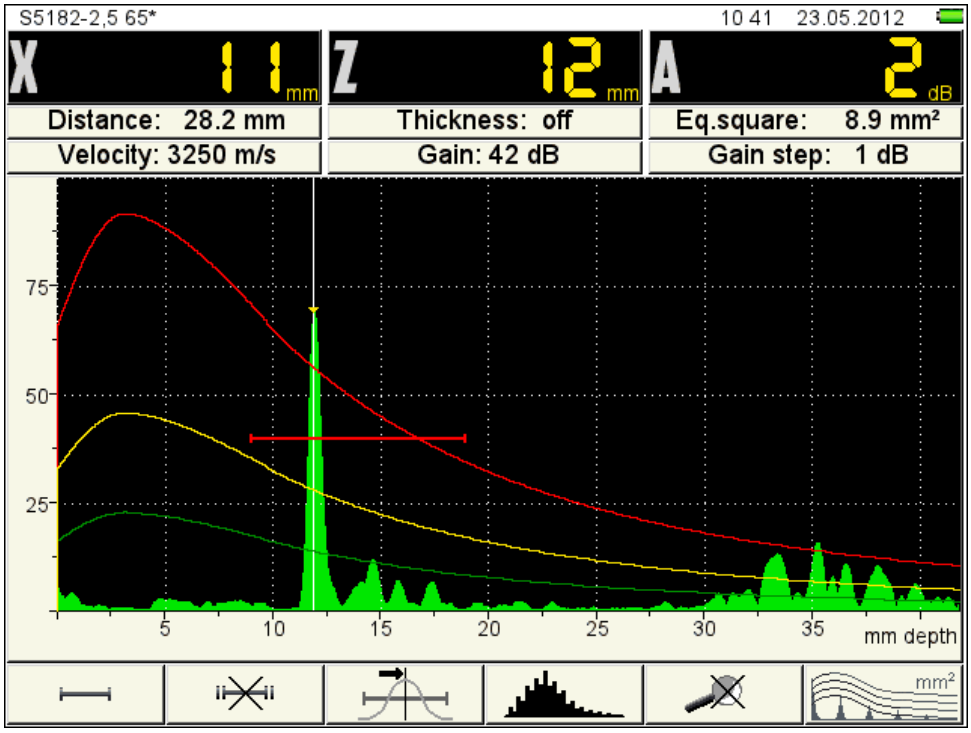


Figure 33

If the calculation parameters are set incorrectly, the information window appears (Figure 37) and the pictogram is shown as follows - 

. In this situation check if the parameters are set correctly.

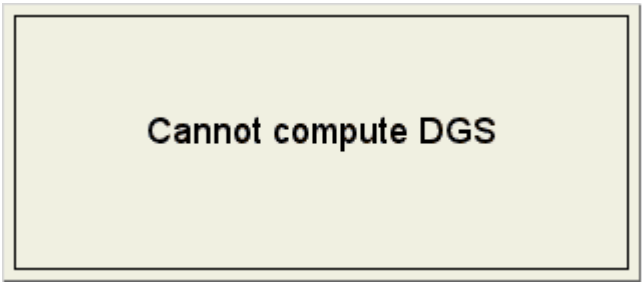


Figure 34

Besides it, the following parameters: OPERATING FREQUENCY, ANGLE OF INCIDENT, DELAY, VELOCITY are used in calculations. Changing of any parameter used at DGS-diagram calculation results in an automatic recalculation.

At exceeding of signal amplitude of DGS curve examination/reporting level and if a signal is in the strobe range, a DGS is activated.

The signal amplitude value (considering a sign) is displayed relatively to acceptance level, namely:

- A "plus" sign - a signal exceeds acceptance level for this value;
- A "minus" sign - a signal lower acceptance level for this value.

By pressing the key 

the setting window is exited without setting saving.

To save setting, press the key Enter, the DGS setting confirmation window appears (Figure 35).

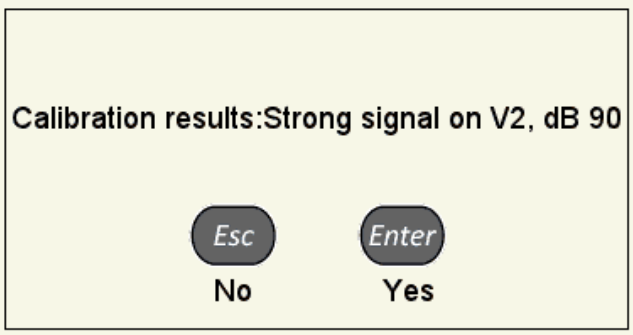
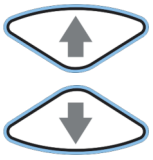


Figure 35

Pressing Esc you exit DGS settings window without saving changes.

The key functions at DGS setting are given in table 24.

Table 24

Key	Function
	Gain adjustment
	N/a
	Sweep length adjustment
	Exit DGS setting
	Confirmation window call for DGS setting
	N/a
	N/a
	Operating mode window call and exit SETUP mode at operating mode changing

Amplitude correction setting – DAC

Screen view in DAC parameters setting is shown on figure 39.

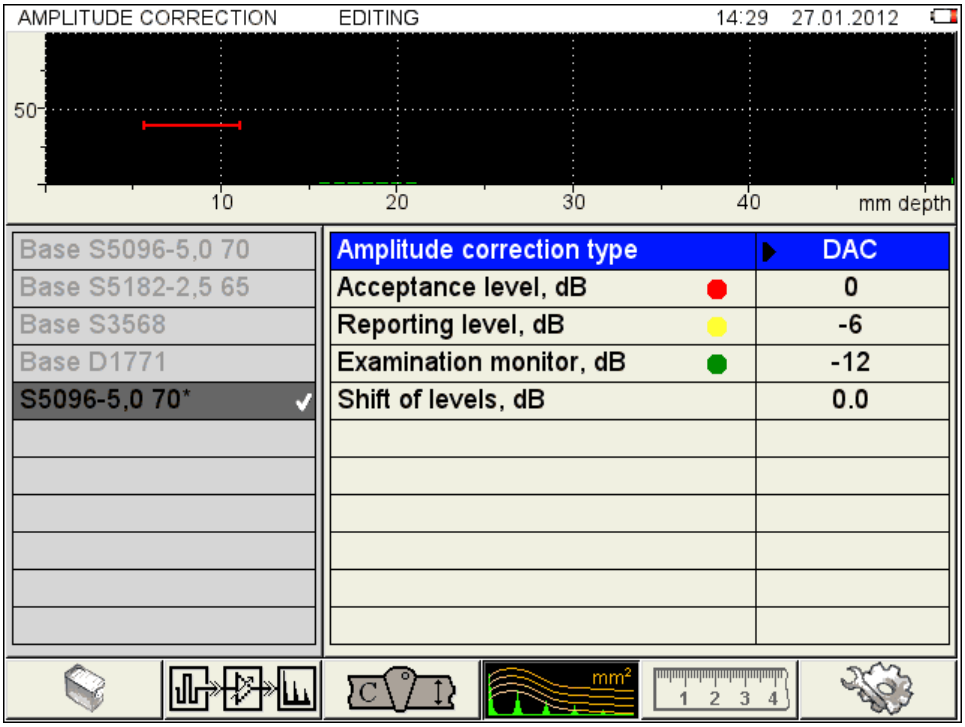


Figure 36

To set DAC press Enter.

DAC settings window will appear (figure 37).

To determine DAC curve, temporal envelope signals are to be collected from test reflectors in the DAC setting sample. For this purpose to:

- find a peak signal from the first reflector and its repeated movement near this position to create the first temporal envelope;
- find the maximum signal from the second reflector and create the second temporal envelope. Repeat creation for all control sample reflectors;

– After temporal envelope creation from all control reflectors, press the key Enter. DAC curve automatically formed on envelope peaks appears on the screen (Figure 38).

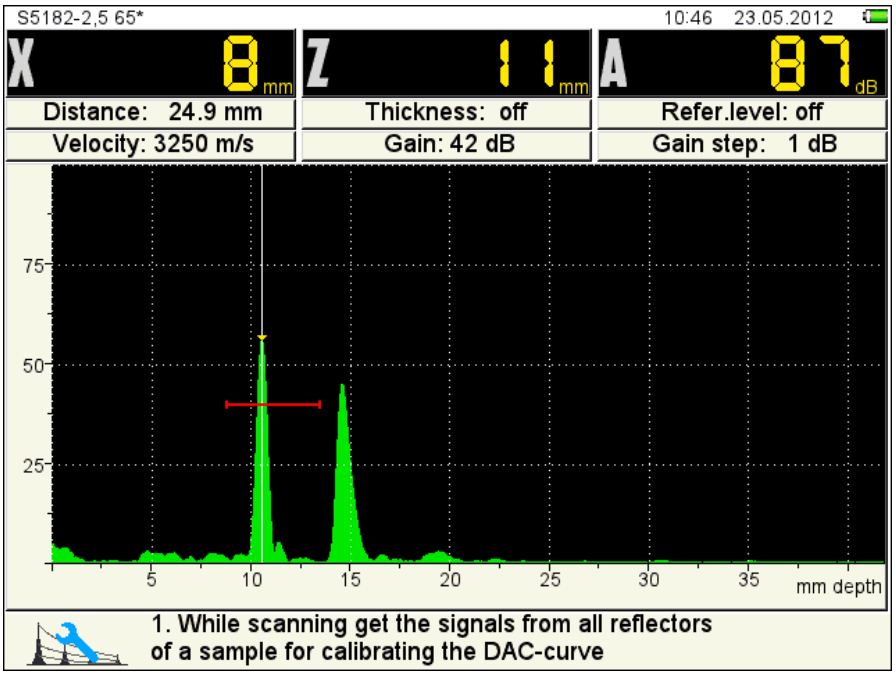


Figure 37

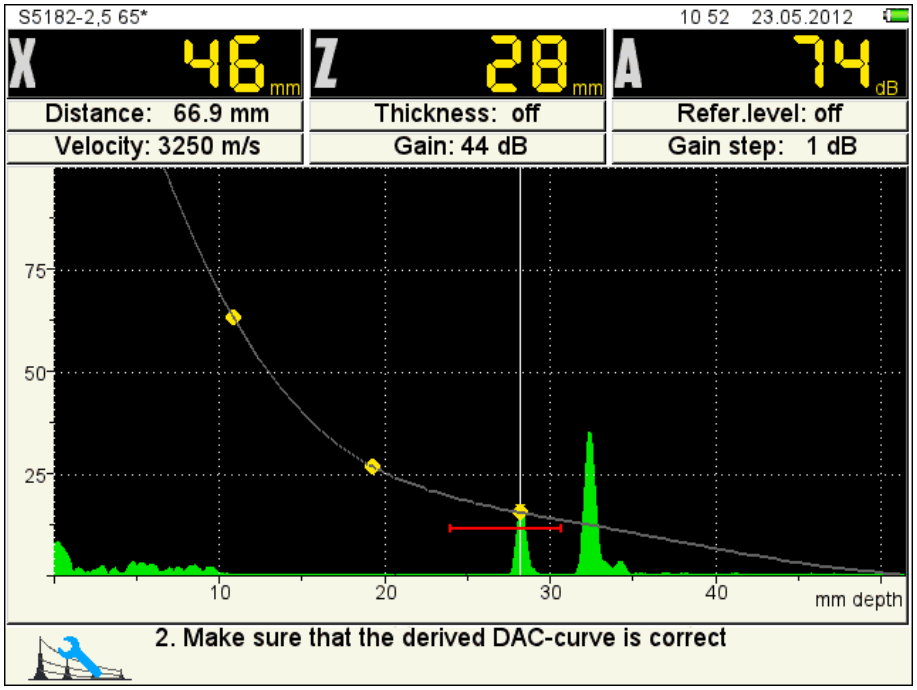


Figure 38

To save setting, press the key Enter, the DAC setting confirmation window appears (Figure 39).

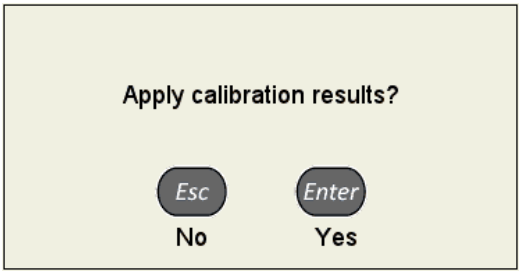


Figure 39

Pressing Esc you exit DAC settings window without saving changes.

After DAC setting exit, the device display shows three DAC-curves corresponding to acceptance, reporting and examination levels (Figure 40).

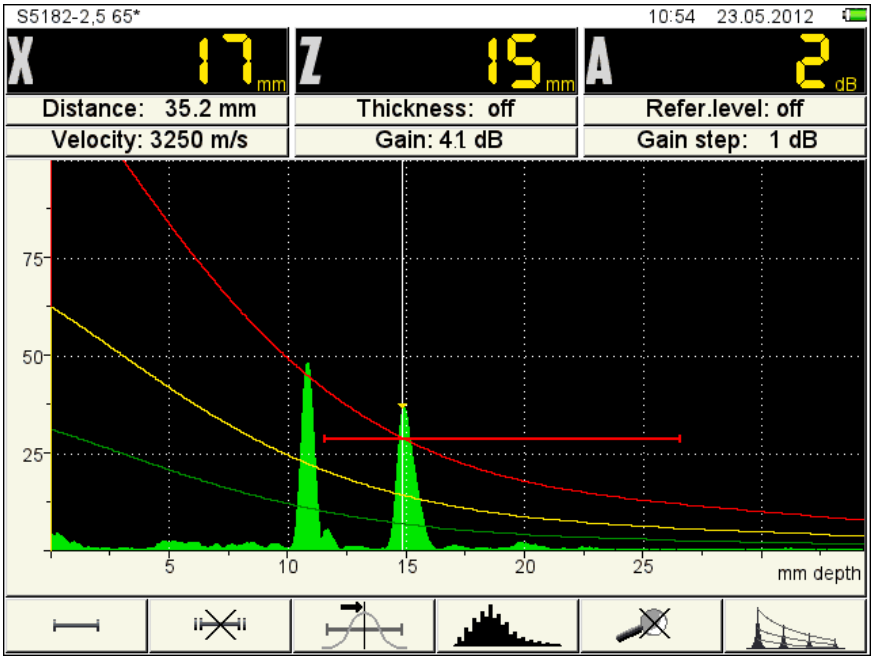
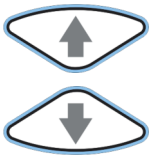


Figure 40

The key functions at DAC setting are given in table 25.

Table 25

Key	Function
	Gain adjustment
	N/a
	Length adjustment
	Exit DAC setting
	The first pressing – curve creation The second pressing – curve application
	N/a
	N/a

Key	Function
Mode	Operating mode window call and exit SETUP mode at operating mode changing

2.3.2.4 Visualization parameters editing

Screen view in visualization parameters setting is shown on figure 44.

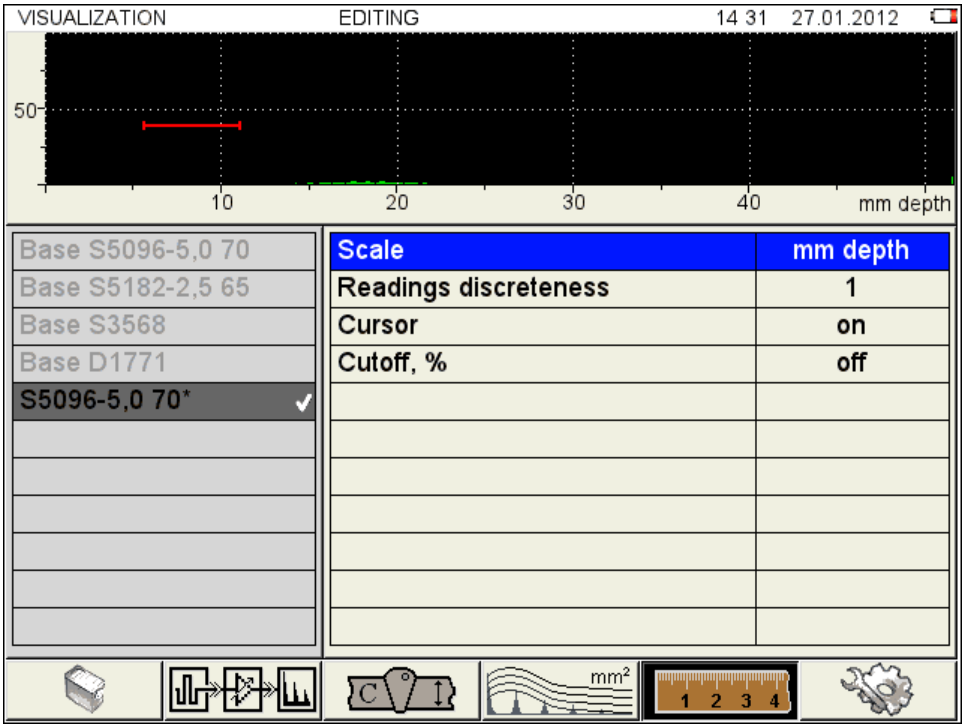


Figure 41

OC parameters and permissible values are given in table 26.

T a b l e 2 6

Parameter Name	Value	Description
Scale	µs/ mm / mm depth	Horizontal scale unit selection
Discreteness	0.1 / 1	Selecting the discreteness of the results
Cursor	On / off	Calibrating cursor control on the display
Cutoff, %	off / from 1 to 100 with 1 step	Cutoff level at signal displaying

2.3.2.5 Preview and configuration creation

Preview and new configuration creation for FLAW-DETECTOR mode is similar to TOMOGRAPH mode and described in details in clause 2.3.1.6.

2.3.3 TOMOGRAPH mode

This mode is the main operating mode.

In TOMOGRAPH mode the device operates with AA, and real time section images are formed.

The received section can be additionally processed, improving image perception and quality, allowing to calibrate, i.e. with increase of test productivity, received information interpretation becomes simpler and more accessible due to its spatial representation.

2.3.3.1 Device screen in TOMOGRAPH mode

The Figure 45 shows the device screen in TOMOGRAPH mode.

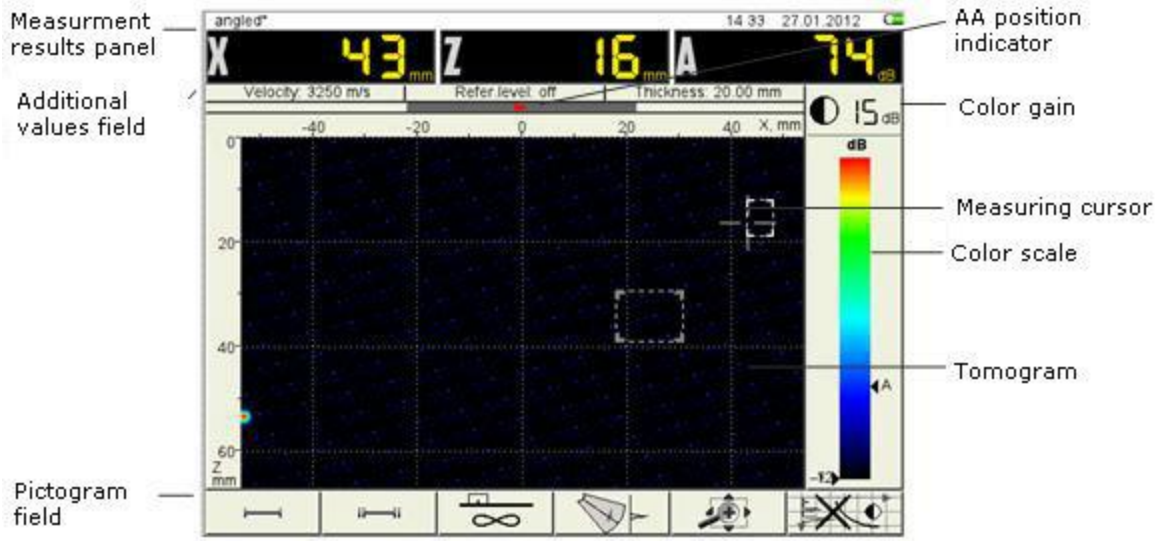


Figure 42

The **calibration results panel** consists of three blocks (Figure 43). The parameters displayed in blocks are changed depending on a device operating mode. In operating mode - the calibration cursor coordinates and below signal amplitude are displayed.

Figure 43

The **auxiliary value field** displays the parameters set by the user.

The **AA position indicator** shows an array position on the sample and its direction: a green triangle - to the left, a red triangle - to the right.

Along the top and left tomogram borders horizontal and vertical marks are placed. The positive scale of the horizontal marking is always directed to where an arrow indicates. By default the scale marking begins from zero, i.e. negative values are out of visible tomogram area and the array center is placed precisely over the tomogram edge, i.e. at a scale zero point.

По обеим сторонам цветовой шкалы расположены треугольные индикаторы:

On the right - a black triangle shows color under the calibration cursor;

- **On the left** – color triangles (at switched reference level on) specify examination, reporting and acceptance levels.

The **pictogram area** is placed below. Each pictogram is controlled by the corresponding key on the device panel. The main key functions and corresponding pictograms in TOMOGRAPH mode are as follows:

– F1 – setting first strobe;

– F2 – setting second strobe;

– F3 – choosing reconstruction algorithm;

– F4 - turning sector scan with calibrating A-scan;

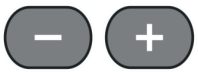
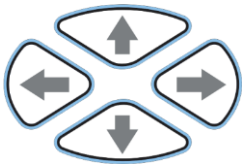
– F5 – image moving on the screen, its scaling to select the most convenient area of the visualized cut review, AA direction selection (in first strobe).

– F6 – turning on / off spatial TCG

2.3.3.2 Key functions in the main TOMOGRAPH mode

Key functions in the main TOMOGRAPH mode are given in table 27.

T a b l e 2 7

Key	Function
	Switching the device ON/OFF
	Operating mode window call
	Tomogram gain coefficient control (plus gain, minus fading)
	Calibration cursor moving on the tomogram (with simultaneous calibration cursor coordinate measuring and gain with movement of the triangle indicator on the color scheme)
	N/a
	N/a
	Enter STOP mode
	F1 – F6 – corresponding parameter editing
	Enter SETUP mode

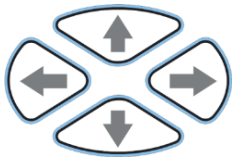
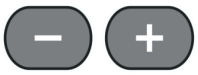
2.3.3.3 Control pictogram functions

F1 (setting first strobe)

F2 (setting second strobe)

Key functions at active pictogram  or  are given in table 28.

Table 28

Key	Function
	Activation and moving, correspondingly, the upper, bottom, left or right strobe border on the screen. An active strobe border becomes yellow
	Strobe size change, accordingly, reducing or increasing
	Reference level activation / deactivation At deactivation reference level value is saved and can be applied at the next reference level activation by the same key
	Enter STOP mode
	Exit editing mode with edited strobe deactivation Thus reference level is disconnected automatically
	F1, F2 – exit editing mode F3 - F6 – exit editing mode with pressed key function activation
	Operating mode window call
	Enter SETUP mode

Depending on an active border in the calibration value panel: in the first block – coordinate of the left (X1) axis or the upper (Z1) strobe border, in the second – coordinate of the right (X2) or bottom (Z2) strobe border, in the third – signal amplitude (Figure 44).

Figure 44

F3 (tomogram reconstruction algorithm selection and display type on the screen)

Pushing F3, an algorithm choice window appears (figure 45).

Figure 45

Key functions at active pictogram corresponding to the function F2 key are given in table 29.

Table 29

Key	Function
	Selection of reconstruction algorithm
	Color regulation 
	N/a
	N/a
	F3 – exit setting mode F1, F2, F4 – F6 – exit setting mode with pressed key function activation
	N/a
	N/a

Tomogram reconstruction algorithm:

 - Surface defect mode;

 - Plate mode;

 - Half-space mode;

 - Vertical crack mode;

 - Multiple algorithms mode.

General description of modes of discontinuity flaw image visualization are given in table 3 0 .

T a b l e 3 0

Symbol	Inspected object	Reflector	Sounding	Purpose
	half-space	point	direct	For items of irregular shape, without definite thickness, or items with rough back surface
	slab, 10 < d ≤ 100 мм	point	direct and reflected	For plane-parallel items with known thickness
	plate, d < 10 мм	point	reflected	For plane-parallel items with known thickness, small thickness objects while finding flaws near the surface
	slab or plate, d ≤ 100 мм	flat	direct and reflected	For detection of vertically-oriented flaws and plain surfaces, mirroring the ultrasound
	slab or plate, d ≤ 100 мм	volumetric	direct and reflected	Universal mode for plane-parallel items with known thickness and all types of discontinuity flaws

In the calibration value panel of the first block – X-axis coordinate cursor, in the second – Z-axis, in the third – signal amplitude under the cursor (Figure 46).

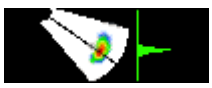
Figure 46

F4 (sector scan activation with calibrating A-scan)

The mode simulates phased array with a shaking beam.

The display is divided into two windows. The tomogram window is on the left and is bordered with operating array angle in the window. Synthesized calibration A-scan is displayed on the right in the window. Its line is on the tomogram window as well.

Defects are not searched automatically. Calibration is carried out manually by a cursor, its moving on the A-scan line.

The Figure 47 shows the display at an active pictogram 

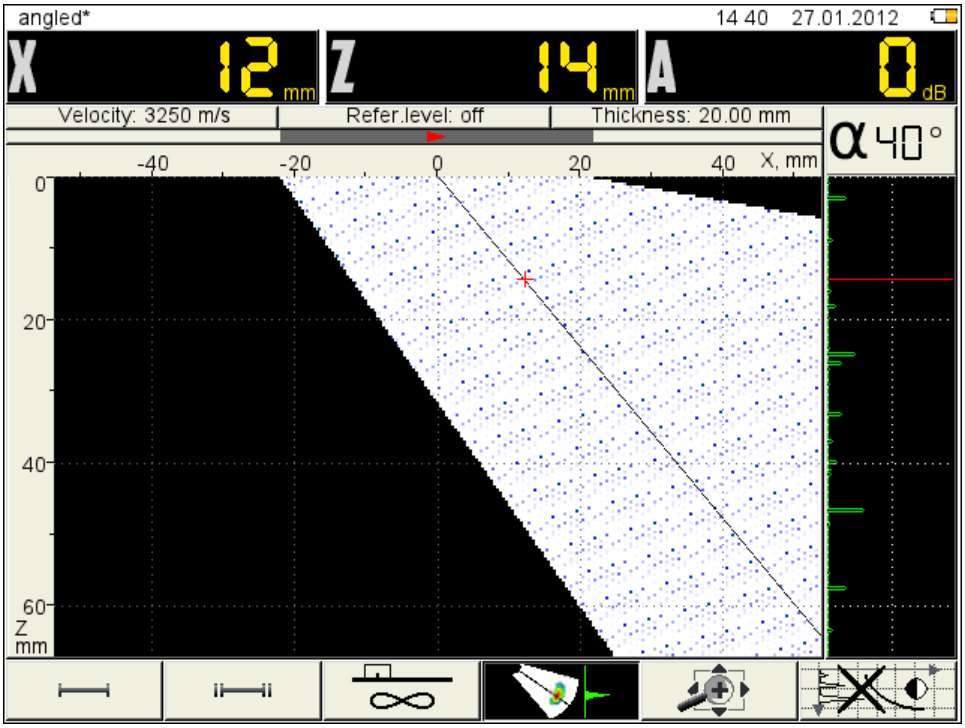
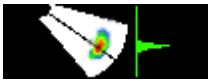


Figure 47

Key functions at active pictogram  are given in table 31.

T a b l e 3 1

Key	Function
	Calibration A-scan line angle regulation
	Calibration A-scan line incident regulation
	Calibration cursor movement on the calibration A-scan line
	Calibration cursor set at the point corresponding calibration A-scan peak
	Enter STOP mode
	N/a
	F4 – exit mode F1 –F3, F5, F6 - exit setting mode with pressed key function activation
	Operating mode window call
	Enter SETUP mode

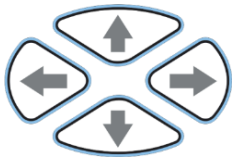
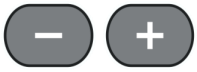
In the calibration value panel in the first block – X-axis coordinate cursor, in the second – Z-axis, in the third – signal amplitude under the cursor (Figure 48).

Figure 48

F5 (image moving on the screen, its scaling to select the most convenient area of the visualized cut review, AA direction selection)

Key functions at active pictogram  are given in table 32.

T a b l e 3 2

Key	Function
	Image moving in the corresponding direction relatively to coordinate origin
	Smooth changing of the image scale relatively to its center horizontally and top image border vertically
	AA direction switching
	Enter STOP mode
	N/a
	F5 – exit setting mode F1 – F4, F6 – activating function according to the function key
	Operating mode window call
	Enter SETUP mode

In the calibration values in the first block – X-axis coordinate cursor, in the second –Z - axis, in the third – signal amplitude under the cursor (Figure 49).

Figure 49

AA direction:

 (red triangle) – to the right;

 (green triangle) – to the left.

The positive direction of the horizontal scale is switched accordingly

F6 (turning on / off spatial TCG)

Turning on / off spatial TCG.

If TCG setting hasn`t been done before, then if F6 is pressed a box will appear (figure 50).

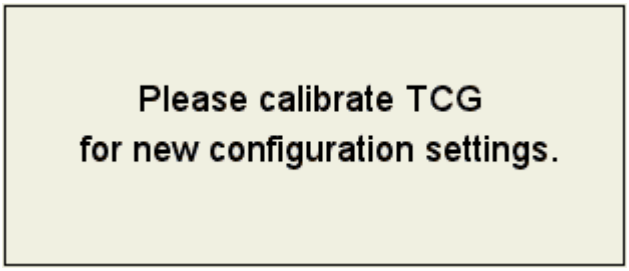
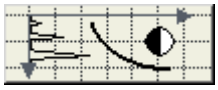
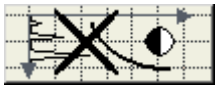


Figure 50

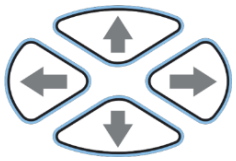
If spatial TCG is on the strobe gate will turn green.

 - on.

 - off.

Key functions with spatial TCG turned on are shown in table 33.

T a b l e 3 3

Key	Function
	Moving the strobe.
	Smooth brightness regulation 
	Enter STOP mode
	N/a
	N/a
	F6 – turning on / off spatial TCG F1 – F5 – activating function according to the function key
	Switching to FLAW DETECTOR mode
	Enter SETTINGS mode

In the calibration value panel in the first block – X-axis coordinate cursor, in the second – Z-axis, in the third – signal amplitude under the cursor (Figure 51).

Рисунок 51

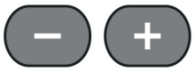
2.3.1 FLAW-DETECTOR mode

Operation with two strobes is implemented in the device possibility of work.

Strobes are used for setting of test zone, sensitivity levels, monitor activation and defect coordinate calibration and signal amplitudes from reflectors with specified period.

Calibration can be carried out both in automatic, and in manual modes.

An automatic mode – when one or two strobes are activated. The point amplitude value is calibrated exceeding strobe level and having high strobe amplitude. If a signal is lower a strobe it is not fixed and calibrated.

Manual - a calibration mode when strobes are deactivated. Signal is calibrated by the cursor moving with keys  .

2.3.1.1 The device display in FLAW-DETECTOR mode

The Figure 5552 shows the device screen in FLAW-DETECTOR mode52.

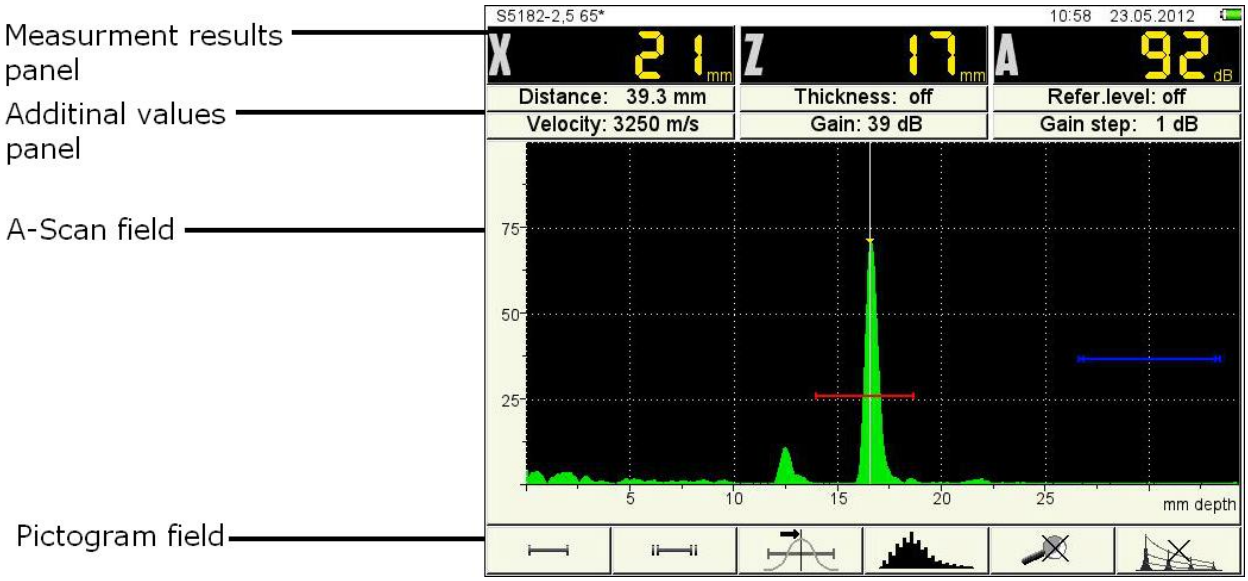


Figure 52

The **calibration results panel** consists of three blocks (Figure 56). Displayed parameters in blocks are changed depending on a device operating mode. In the operating mode of first block– surface is displayed, in the second – the depth, in the third - monitor activation or manual calibration amplitude (both strobes are deactivated).

Figure 53

The **auxiliary value field** displays the parameters set by the user.

The **A-scan field** shows a grid, vertical and horizontal scales, strobes, and if activated cursor and marker. The cursor and marker are repainted at calibration value refresh.

The device scale switches between microseconds and millimeters.

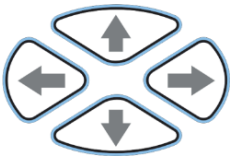
The **pictogram field** is placed below. Each pictogram is controlled by the corresponding key on the device panel. The main key functions and corresponding pictograms in FLAW-DETECTOR mode are as follows:

- F1 - the first strobe adjustment;
- F2 - the second strobe adjustment;
- F3 - activation type;
- F4 - signal type;
- F5 – LOUPE mode;
- F6 – amplitude correction activation/deactivation.

2.3.1.2 Key functions in the main FLAW-DETECTOR mode

Key functions in the main FLAW-DETECTOR mode are given in table 34.

Table 34

Key	Function
	Switching the device ON/OFF
	Operating mode window call
	Calibration cursor moving
	Up/Down – attenuator value changing Right/Left – sweep length changing
	Reference level activation/deactivation confirmation window call
	N/a
	Enter STOP mode
	F1 - F6 – corresponding parameter editing
	Enter SETUP mode

2.3.1.3 The active pictogram functions

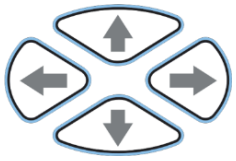
F1 (The first strobe)

F2 (The second strobe)

The key functions at active pictogram  or  given in table 35.

Table 35

Key	Function

Key	Function
	Strobe movement in the corresponding direction
	Strobe length changing relatively to the left border
	N/a
	Enter STOP mode
	Strobe deactivation and exit SETUP mode. Strobe is deactivated at enter SETUP mode by the key F1 or F2 correspondingly
	F1 or F2 –exit editing mode F2 or F1, F3 – F5 - exit editing mode with pressed key function activation
	Operating mode window call
	Enter SETUP mode

In the calibration value panel of the first block – strobe start (X1), in the second – strobe end (X2), in the third – strobe level (A) (Figure 54).

Figure 54

F3 (Activation)

Monitor activation type activation:

 - the first exceeding;

 - the strobe peak;

 - between strobe peaks (if both strobes turned on).

The cursor and marker position is the same in calibration mode.

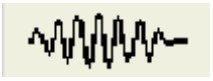
Marker position coincides with the second strobe.;

F4 (Signal type)

Signal type switch:

 - detected contour;

 - detected field;

 - radio-signal;

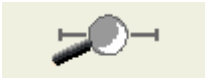
 - spatial envelope.

Signal type is changed in the A-scan zone simultaneously.

Calibration is not carried out at an activated radio-signal.

F5 (LOUPE)

 - LOUPE mode is activated;

 - LOUPE mode is deactivated.

At activated LOUPE mode two signals are displayed simultaneously.

Before LOUPE mode activation, switch the first strobe on. Then after switching, A-scan with strobes is displayed in the upper window, and prolonged time period corresponding to the first strobe appears in the bottom graphic window. The bottom window allows detailed estimation of the signal form of time realization which is within the first strobe.

The Figure 58 shows the display in LOUPE mode.

.

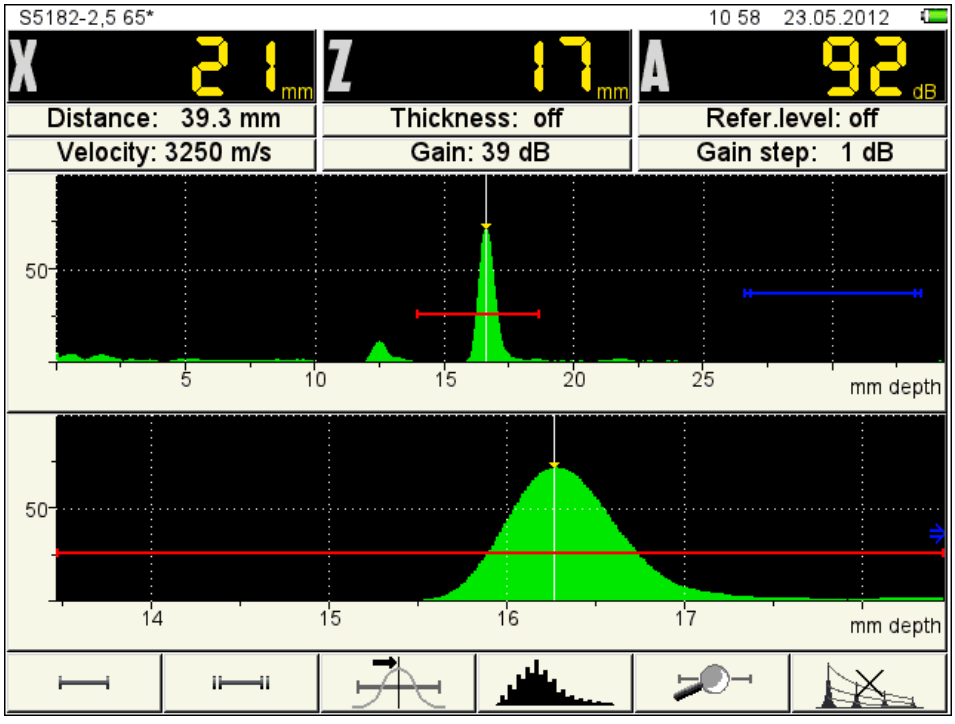
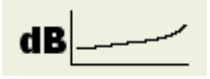
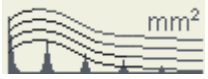
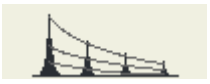


Figure 55

F6 (amplitude correction activation)

 /  - TGC curve is activated/deactivated;

 /  - DGS curve is activated/deactivated;

 /  - DAC curve is activated/deactivated.

Amplitude correction type selection and parameter setting are described in clause 2.3.3.4

2.3.2 STOP mode

2.3.2.1 TOMOGRAPH/STOP mode

Tomograms are saved and previewed at pressing the key  in Tomograph mode (Figure 59).

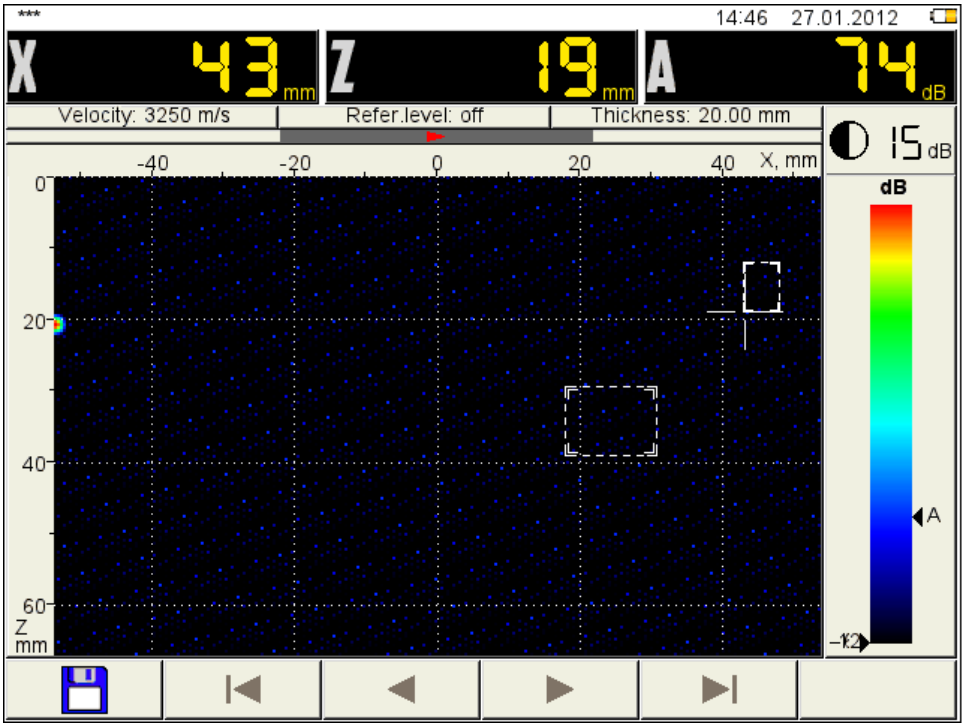


Figure 56

The key functions in STOP/ TOMOGRAPH are given in table 36.

T a b l e 3 6

Key	Pictogram	Function
F1		Shot save
F2		Move to the first saved shot
F3		Move to the previous saved shot
F4		Move to the next saved shot
F5		Move to the last saved shot
F6	Del	The current shot deletion

A confirmation window appears at pressing the key F6 (figure57).

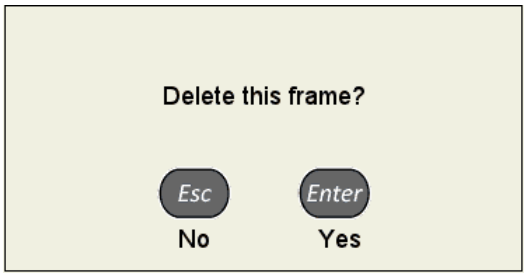


Figure 57

The device enters a new shot name editing at pressing the key F1 (Figure 58).

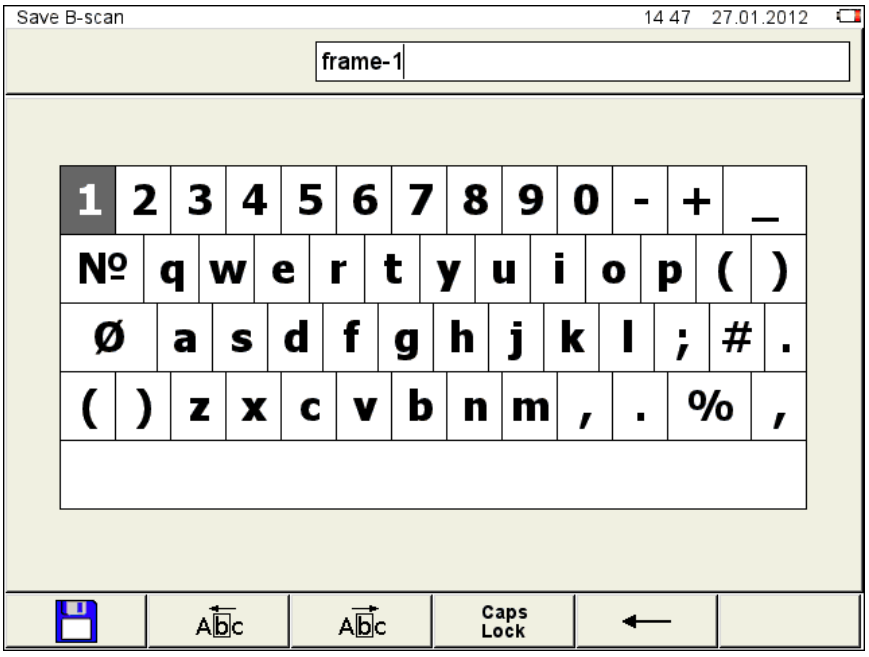


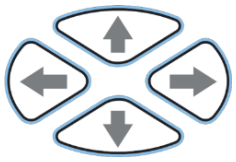
Figure 58

By default a shot is offered to be saved under the previous name with an ordinal number. The shot can be appropriated with any name.

The shot name formation is similar to configuration name editing (clause 2.3.1.6).

The key functions в режиме STOP/ TOMOGRAPH are given in table 37.

Table 37

Key	Function
	Calibration cursor movement in the corresponding direction
	Color regulation 
	Enter measuring of distance between defects

Key	Function
Esc	Move a cursor to the last position at calibration. If defect distance measuring is active – deactivate it.
	Exit STOP/ TOMOGRAPH mode
Mode	Operating mode window call
	N/a

In the calibration value panel in the first block – X-axis coordinate cursor, in the second – Z-axis, in the third – signal amplitude (Figure 59).

Figure 59

By pressing the key Enter the defects distance measuring mode (Figure 60), thus the calibration cursor becomes bold.

Distances between the current (set or found) defect and any another are measured in this mode.

Move the calibration cursor to a specified point by arrow keys. Thus the cursor becomes double at the calibration point.

The calibrated values are displayed in the value panel.

Pressing Enter the measuring cursor is moved to the point from which the distance was measured.

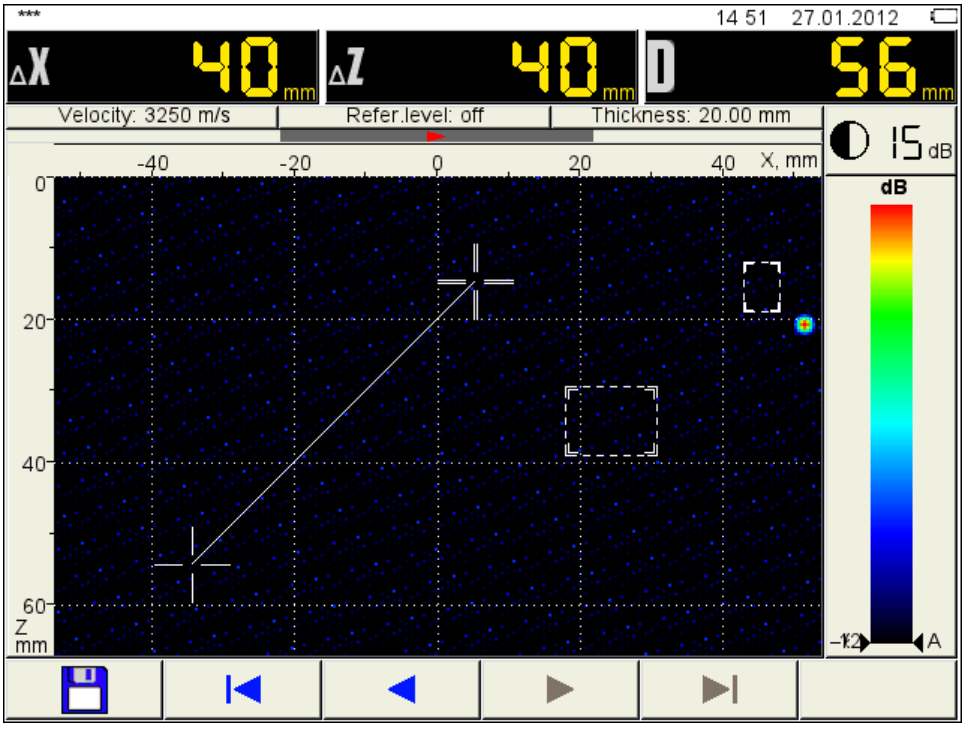


Figure 60

2.3.2.2 STOP/ FLAW-DETECTOR MODE

A-scans save and enter preview are activated in FLAW-DETECTOR mode at pressing the key  (Figure 61).

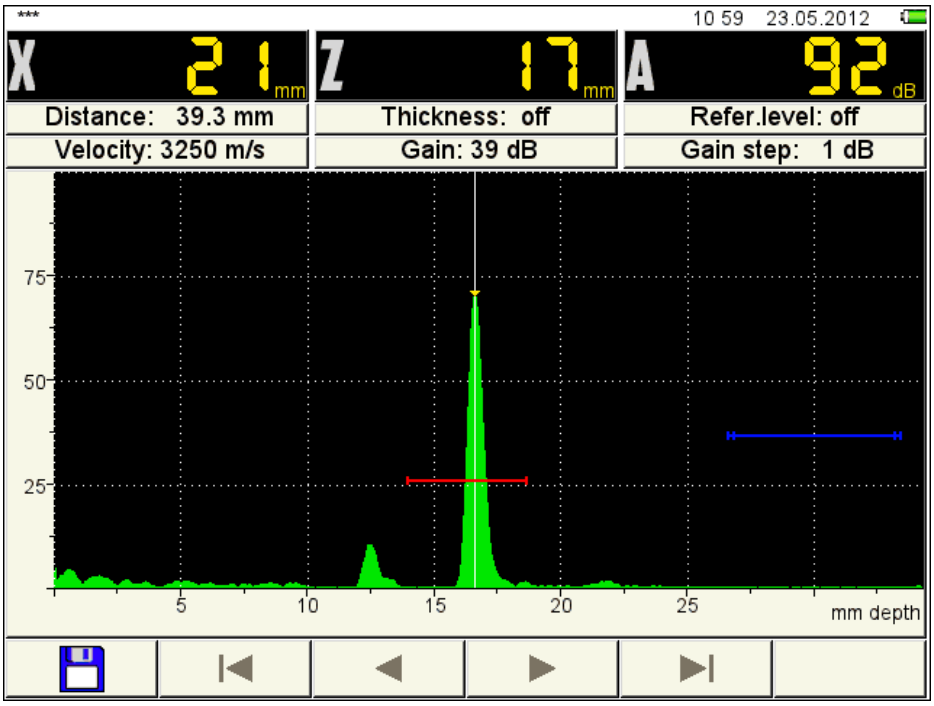
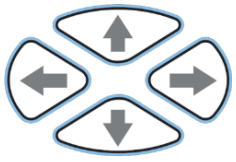


Figure 61

The pictogram functions and shot name formation is similar to STOP – FLAW-DETECTOR mode.

The key functions in STOP - FLAW-DETECTOR are given in table 38.

T a b l e 3 8

Key	Function
	N/a
	Calibration cursor moving
	N/a
	Exit STOP/FLAW-DETECTOR mode
	N/a
	Operating mode window call

Key	Function
	N/a

2.4 SURFACE PREPARATION FOR CALIBRATION

Thin and exfoliating scale, rust or dirty surface of a measured product affect ultrasound penetration into OK material. Therefore before calibration on such surface, layers are to be smoothed up, wiped and abrasive particles are to be removed, then contact liquid is to be put on a surface.

Smoothing rough corroded product surfaces, besides increase of measurement accuracy, allow to prolong US transducers service life. Especially, it is important for PC transducers.

Requirements to admissible waviness and to surface preparation are specified in the specifications and technical documentation for control of appropriate products.

Calibration is carried out in TOMOGRAPH and FLAW-DETECTOR modes.

3 MAINTENANCE

3.1 POWER SUPPLY AND POWER CONSUMPTION

3.1.1 The power supply control

In operation, the built-in discharge detector indicates the level of discharge of the power source. On the display the level of discharge is indicated by the symbol of the batteries located in the top right corner of the screen. Completely filled green symbol indicates fully charged batteries. During operation the battery symbol is being cleared and changes color from orange to red. At a critical level of discharge of the battery, the unit will automatically shut off, saving all settings and stored information.
During the discharge of the battery to the level of 10% and before turning off the power during critical low AB the device displays an appropriate warning.

3.2 SCHEDULED MAINTENANCE

During operation the device case is recommended to be cleaned regularly of dirt and dust with cleanser for plastics. If the indicator protective glass is dirty, it is recommended to be wiped with the soft tissue moistened with household cleanser for plastic glass. The dirty keyboard can be wiped with alcohol. If special cleanser is unavailable, the tomograph can be cleaned with soap solution.

Should dirt and foreign particles are penetrated in connectors, clean them with soft brush.

3.3 MALFUNCTIONS

In case of any malfunctions or any questions on tomograph operation, please, contact company representatives by phones indicated in the device passport.

4 STORAGE

The tomograph is to be stored in the transport bag provided. Storage conditions are No.1 according to GOST 15150-69 standard rules.

Devices should be stored on racks.

The devices are to be placed in storehouses providing free movement and access.

The distance between storehouse walls, floor and devices is to be at least 100mm.

The distance between storehouse heaters and devices is to be at least 0.5m.

Avoid any conductive dust, corrosive gas and vapor admixture causing device material corrosion in storage area.

5 TRANSPORTATION

The tomograph should be transported in the transport bag provided.

Transportation conditions of environment factors should meet the transportation conditions No. 5 according to GOST 15150 69 standard rules.

The packed devices can be transported to any distances by any transport without speed limitation.

The packed devices should be fixed on vehicles and if open vehicles, should be protected from atmospheric precipitations and water.

The packed devices are to be placed and fixed on vehicles to provide the stable position, to exclude bangs between each other and on the vehicle walls.

Device transportation conditions should meet the requirements of specifications and norms corresponding for each type of transport.

During delivery by air the packed devices should be placed in the pressurized and heated compartments.

After transportation at the temperatures deviated from operational conditions, before device operation, leave it at ambient environmental conditions at least for two hours.

APPENDIX A

(Reference)

Recommended literature on ultrasound test

[1] GOST 14782-86 Non-destructive tests. Welded joints. Ultrasonic methods.

[2] Non-destructive test and diagnostic: The manual edited by V.V. Kliuev

[3] Non-destructive Testing Handbook. V.3. Ultrasonic Testing. Yermolov I.N., Lange Y.V.

[4] Ultrasonic Testing: Tutorial for first and second qualification levels experts / Yermolov I.N., Yermolov M.I.N.

[5] Technology of Ultrasonic test of welded joints / V.G. Scherbinsky

[6] Ultrasonic flaw detection in mechanical engineering: Tutorial /Y.F.Kretov.

A1550 IntroVisor Ultrasonic Flaw Detector

OPERATION MANUAL

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