

«Acoustic Control Systems» Ltd.

TECHNICAL PASSPORT OPERATION MANUAL

LOW-FREQUENCY
ULTRASONIC FLAW DETECTOR

A1220 MONOLITH



Москва, 2004

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1. GENERAL INFORMATION

1.1 OPERATION PRINCIPLES

A1220 MONOLITH is a portable ultrasonic low-frequency flaw detector of general application, developed according to GOST 28702-90 of RF.

The device is developed for realization of the active acoustic methods of NDT: through transmission, reflection and combined methods.

In combination with the corresponding probes the device is applicable for thickness gauging, flaw detection and testing of physical characteristics of objects from concrete, metals, composites, plastics.

The device allows forming, registering and saving in non-volatile memory the realizations of ultrasonic pulse signals. The built-in liquid-crystal display screens ultrasonic signals in A-Scan forms and B-scan section images of testing objects. Among the possibilities of the device there are manual and automatic measuring of time intervals, signal amplitudes, automated calculation of defect's coordinates and of object's thickness.

The device can be connected to PC through USB-port. With the special Software IntroVisor the data from the memory of the device can be transmitted to the PC for visualization, documentation, further proceeding and saving on the PC. This Software also allows building the 3D image of the tested object and export and save the data in formats TXT, SEG2, SEGY for analyze and proceeding with the help of standard Software, such as MATHCAD, MATHLAB and other. The USB cable and Software is delivered together with the device in basic delivery set.

1.2 APPLICATION AREAS

The main application areas for A1220 MONOLITH are:

Echo-pulse shear wave thickness gauging and flaw detection of objects from concrete, reinforced concrete, cement, rocks, asphalt at one-side access to the object;

Testing of monolith objects, made from the materials with high coefficient of ultrasound attenuation, such as rocks, stones with echo-pulse method, through-sounding and surface-sounding methods with longitudinal and shear waves;

Flaw detection of long objects (anchor bolts, tubes, rods) with waveguide method;

Measurement of longitudinal, shear and surface waves velocities for research purposes.

Besides the mentioned areas and purposes the device can also be used for other tasks, according to the customer's demands, using the specially developed methodics and the developed especially for these needs probes.

2. OVERVIEW OF THE DEVICE

The device consists of an electronic unit, probes, charging / power supplying unit, cables and additional accessories.

The set of the device and the type of probes depend on the purposes of application and is chosen according to the methodical recommendations.

The device is made for work with the specialized antenna array, separate longitudinal or shear waves probes with dry-point contact and longitudinal probes with liquid contact type.

2.1 ELECTRONIC UNIT OF THE DEVICE

The electronic unit forms the electronic pulses, which disturb the probe; amplifies the received from probes signals; screens the measuring results; saves data to non-volatile memory of the device; transmits data to the PC.

The device can work both with straight single crystal or double crystal probe.

The case of electronic unit is made in small ergonomic design (see figure 1.1) from shock-resistant plastic and according to IP65 protection of internal structure from water and dust.

It has 13-keys film keyboard.

The signals, results of measurements and all the other information is displayed on LCD or indicated with LEDs.



Figure 1.1. Electronic unit of A1220 MONOLITH



Figure 1.2. Device on the flexible stand.



Figure 1.3. Use of blinder.



Figure 1.4. Carrying on the weight.



Figure 1.5. Carrying on the hand.

Probes are connected to the device with the coaxial LEMO connectors, located in the upper part of the device (figure 1.1) and with coaxial cable, delivered in basic set.

Power supply can be either from the built-in accumulator unit or through the charging-power supplying unit from the net, which is connected to a multiconductor LEMO plug (see figure 1.1). Through the same plug the USB connection with PC is made.

All the electronic units and elements of the flaw detector are placed in the case behind the LCD. The accumulator block is located in the handle of the device.

The device in basic set is also supplied with a cover, which additionally to the mechanical protection of electronic unit provides the ergonomic functions (see figures 1.2 - 1.5)

2.2 CHARGING AND POWER SUPPLYING UNIT

This unit provides the power supply of the device from external power sources (like power net) and charging of the accumulator, built-in the unit.

Structurally it consists from 2 parts – net adaptor and charging controlling unit.

The net adaptor transforms the alternating current voltage to the constant 12 V voltage, which is necessary for charging controller. Instead of net adaptor it is possible to use 12 V automobile accumulator connected with the help of a special cable.

The charging controller unit provides the correct charging and training of accumulator block, which is necessary for prolonging the accumulator life. This unit has an additional plug for connection of USB-cable for connection of the device with PC.

2.3 PROBES

The type of the used probes depends on the purposes of testing. There are several types of specially developed low-frequency probes – with liquid contact to the surface and dry-point contact, single probes and arrays.

After agreement with “Acoustic Control Systems” it is allowed to use the probes of other manufactures.

2.3.1 PROBES WITH LIQUID TYPE OF CONTACT

Probes S0205, S0206, S0208 are the single low-frequency wideband (relative bandwidth not less than 100%) straight beam probes with liquid type acoustic contact. The central operating frequency of them is accordingly 25, 50 и 100 kHz.

The distinctive feature of these probes is the low level of own reverberation noises, short (1.5 – 2 period) sending acoustic pulse and high energetic efficiency.

The probe of this type can efficiently work both in single mode and in combined.

The single S0205 probe in combined mode is used for flaw detection of anchor bolts in the object and testing of long objects, like tubes, rods, bars, lists and other) with waveguide method.

Two probes are used for non-destructive testing of concrete, glass fibre plastic, foam plastic, woods and other both with echo-method and with through sounding method.

2.3.2 DRY-POINT CONTACT PROBES

L1803 and T1802 probes are single low-frequency wideband probes with dry point contact type. They have the central operating frequency of 50 kHz and relative bandwidth of more than 100%.

Probes with dry point contact send and receive the ultrasonic oscillations without using any coupling liquids – through the point contact of probe's pin with the surface of object.

L1802 sends and receives longitudinal waves in direction of longitudinal axis.

T1803 sends and receives shear waves in direction of longitudinal axis.

These probes have wide directivity diagrams. This determines their use in general for through sounding and surface sounding methods of testing.

In directions other than along the longitudinal axis the probes with dry-point contact can send and receive several wave types at the same time: longitudinal, shear, surface and other. These characteristics of probes with

dry-point contact are more detailed described in methodical parts of the manual and in specialized literature.

Dry point contact probes are in general used for measure of ultrasound propagation for shear and longitudinal waves in material with the through sounding and surface sounding methods.

2.3.3 ANTENNA ARRAYS WITH DRY POINT CONTACT

M2002 and M2502 probes – are array of probes, double-crystal, low-frequency, wideband probes with dry-point type of acoustic contact. Functionally the probes of this type are the in-phase antenna arrays working on shear waves and have the maximum of directivity diagram in perpendicular to the object's surface direction. The central operating frequency is 50 kHz and relative bandwidth is more then 100%.

Both arrays are built from 24 elements of T1802 type probes with dry-point contact. The elements are divided in two groups: sending and receiving. Structurally all the elements are set in one case as 4x6 array. To provide the acoustic contact of each element with the surface the individual adapting clasp is used.

The M2002 antenna array has a metallic case and integral elastic element on polyurethane base.

M2502 antenna array has a case from shock-resistant and wear-protective plastic and each probe has an individual spring clasp and separate moving unit.

Antenna arrays with dry-point contact are used for testing echo-pulse methods of big-size objects with the high ultrasound attenuation level, like concrete, reinforced concrete, stone, asphalt and other.

The main application – thickness gauging, flaw detection and tomography of structures from concrete at one-side access to the testing area.

2.4 CABLES AND CONNECTORS

The commutation is based on the LEMO connectors. These connections have high reliability, small sizes, provide good fixation, protection from dirt, dust and water.

There is a flexible bushing between the cables and connectors. This prevents cables from cracking.

In the connecting cables of the device the coaxial cables by firm «Raychem» are used, that stays flexible at low temperatures (up to – 30° C). This makes the work easier and minimizes the faults due to connection elements.

3. SET AND ACCESSORIES

3.1 FULL LIST OF COMPONENTS

The minimal necessary set of units and elements of the device, providing its full functional off-line work as a universal low-frequency flaw detector is given in table 3.1.

For the minimal set it is necessary to use the probes, delivered by an order.

Table 3.1. Minimal set

№	Description	Q-ty
	Electronic unit of low-frequency flaw detector with accumulator block	1 pc
	Charging / power supplying unit with controller	1 pc
	Net adaptor	1 pc
	Net cable	1 pc
	USB cable of AB type, 1.8 m	1 pc
	LEMO-LEMO cable double, 1.2 m	1 pc
	Cover for A1220 MONOLITH (including blander and flexible stand)	1 pc
	Stand	1 pc
	IntroVisor – software for data transmission to PC	1 pc
	Passport and operation manual	1 pc

The list of additional accessories, probes and additional devices applicable for use with A1220 MONOLITH is given in the table 3.2. Their use increase the functional and service possibilities of the flaw detector.

Table 3.2. List of additional accessories

№	Description
	Antenna array M2002 (24 elements with DPC, 50 kHz, in metallic case)
	Antenna array M2502 (24 elements with DPC, 50 kHz, as a double crystal probe, lighten case, spring clasp)
	S0205 probe (25 kHz, wideband, with liquid contact) for anchor bolts testing and through sounding
	S0206 probe (50 kHz, wideband, with liquid contact type) for through sounding
	S0208 probe (100 kHz, wideband, with liquid contact type) for through sounding
	T1802 probe (shear wave, DPC, 50 kHz, wideband)
	L1803 probe (longitudinal wave, DPC, 50 kHz, wideband)
	Cable LEMO-LEMO single 1,2 m
	Cable LEMO-LEMO single 2,5 m
	Cable for charging unit from automobile accumulator
	Cassette on 6 elements of AA-type

№	Description
	Power supplying elements of AA type (2,5 Ah) with the widen temperature range (- 40÷ +70°C)
	Radio button «ENTER»
	Radiohead
	Soft transport case
	Shock-resistant waterproof transport case

From the above mentioned accessories different sets can be made, which applicable for different purposes, specialized sets (concrete testing, anchor bolt testing) and universal sets for research tasks in low-frequency ultrasound (for testing of dams, bridges and other) Below are the mostly asked variants of sets.

3.2 SET FOR CONCRETE TESTING

One of the universal applications for A1220 MONOLITH is concrete testing with echo method. The delivery set for this purpose is given in the table 3.3. It provides measuring shear and longitudinal ultrasonic waves velocity, thickness measurement of objects at one-side access, to get the 3D or 2D image of object's internal structure.

The base of the set is single probes and antenna arrays with dry-point contact, which send and receive the shear waves. On the figure 3.1 you can find the photo of the main components of the delivery set. The numbers corresponds to the numbers in the table 3.3.

Table 3.3. Set for concrete testing

№	Cat. №	Description	Q-ty
1.	1005	Electronic unit of low-frequency flaw detector	1 pc.
2.		Charging unit with controller	1 pc.
3.		Net adaptor	1 pc.
4.		Net cable	1 pc.
5.		USB cable of AB-type, 1.8 m	1 pc.
6.		Cable LEMO-LEMO double 1,2 m	1 pc.
7.		Cable LEMO-LEMO single 1,2 m	1 pc.
8.		Cover for A1220 MONOLITH (with blander and flexible stand)	1 pc.
9.		Table stand	1 pc.
10.		IntroVisor – software for connection of A1220 MONOLITH with PC	1 pc.
11.		Passport and operation manual	1 pc.
12.		Antenna array M2502 (24 elements with DPC, 50 kHz, light case, spring clasp)	1 pc.

13.		S0206 Probe (50 kHz, wideband, liquid contact type) for through sounding	2 pc.
14.		T1802 probe (shear wave, with DPC; 50 kHz, widerange)	2 pc.
15.		Radio head	1 pc.
16.		Shock resistant transport case	1 pc.



Figure 3.1. Set for concrete testing

3.3 SET FOR ANCHOR BOLTS TESTING

The set provides anchor bolt testing in monolith structures. See table 3.3. Using special methodical recommendations it is possible to use the same set for testing the long objects (rods, bars and so on) with waveguide method.

Table 3.3. Set for anchor bolt testing

№	Cat. №	Description	Q-ty
1.	1005	Electronic unit of low-frequency ultrasonic flaw detector	1 pc.
2.		Charging unit with controller	1 pc.
3.		Net adaptor	1 pc.
4.		Net cable	1 pc.
5.		USB-cable of AB-type, 1.8 m	1 pc.
6.		Cable LEMO-LEMO single, 1.2 m	1 pc.
7.		Cover with flexible stand and blander	1 pc.
8.		Table stand	1 pc.
9.		IntroVisor – software for connection of A1220 MONOLITH with PC	1 pc.
10.		Passport and operation manual	1 pc.
11.		Probe S0205 (25 kHz, widerange with liquid contact type for anchor bolts testing and through sounding	1 pc.
12.		Soft transport case	1 pc.

4. TECHNICAL CHARACTERISTICS

4.1 PARAMETERS

4.1.1.	Maximal depth of echo-signal visualization at testing with shear waves ¹ , mm	2150
4.1.2.	Maximal duration of signal realizations, screened on the display, us	1600
4.1.3.	Thickness of concrete ² , measured with echo-method at the backwall signal level on not less then 6 dB of relative noises level ³ , mm	600
4.1.4.	Minimal diameter of air-filled cylindrical hole defect at the depth of 100-400 mm, detected with a signal/noise relation of not less then 6 dB, mm	50
4.1.5.	Error of thickness and defect depth measurements is not more then, %	± 10
4.1.6.	Switching to operating mode after turning on not more then, sec	5
4.1.7.	Time for making one measurement and saving reading to the memory, sec	10
4.1.8.	Number of saved single non-rectified A-Scans	200
4.1.9.	Maximal length of one continuous B-Scan at testing depth of 1 m and testing step with AA 20 mm (BAND mode), meters	10
4.1.10.	Maximal square of testing surface at testing depth of 1 m and testing step with AA 20 mm (MAP mode), m ²	2
4.2.1.	Ultrasound adjustment range for materials, m/sec	1000÷9999
4.2.2.	Pulse signal amplitude (half signal swing), V	10, 50, 200
4.2.3.	Pulse generator form	Meander, 0,5÷5 periods
4.2.4.	Set meander frequency of pulsing, kHz	15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 70, 85, 100, 125, 170, 250
4.2.5.	Pulsing repetition frequency, Hz	1÷50
4.2.6.	Reception track frequency bandwidth, kHz	10÷300
4.2.7.	Attenuation adjustment range, dB	0÷106 with step 1
4.2.8.	ADC sampling frequency, kHz	1000
4.2.9.	ADC digit capacity, bit	10
4.2.10.	Received signal equalization number	1, 2, 4, 8, 16, 32

¹ For transversal waves velocity 2700 m/sec.

² For concrete 400, longitudinal waves velocity 4700 m/s, transversal 2700 m/s, attenuation 20 dB/m on frequency 50 kHz, with AA M2502.

³ Under the noise level meant the amplitude of signals, determined by the structural heterogeneity of testing object.

4.2.11. Connected digital filter	Band with central frequency equal to generator meander frequency
4.2.12. Number of programmable TVG points for functional generator	32
4.2.13. TVG adjustment range, dB	30
4.2.14. Sweep durations, usec	150, 300, 450, 800, 1100, 1600
4.2.15. Limits for sweep delay adjustment, usec	0÷120
4.2.16. Limits for monitor gate, % from vertical axis	0÷100
4.2.17. Time interval measurement discreteness, usec	0,1

4.2 POWER SUPPLY AND POWER CONSUMPTION

4.3.1. Built-in recharging battery type	MiMe
4.3.2. Nominal voltage of battery, V	7,2
4.3.3. Capacity of battery, Ah	2,5
4.3.4. Continuous operation time of the device from the battery without the backlight, hours	14
4.3.5. Average current consumption at work without the display backlight, mA	180
4.3.6. Average current consumption at work with the display backlight, mA	220
4.3.7. Average current consumption at work with the display backlight and heating, mA	500
4.3.8. Allowed voltage range for power supplying from alternating current net (50÷60 Hz), V	100÷240
4.3.9. Recharging time of leer accumulator, hours	3
4.3.10. Discharging time in battery training mode, hours	4

4.3 SIZE, WEIGHT, RELIABILITY

4.4.1. Electronic unit sizes, mm	245×120×40
4.4.2. Electronic unit weight, g	650
4.4.3. AA M2502 sizes, mm	140×88×74
4.4.4. AA M2502 weight, g	750
4.4.5. Display resolution, pixels	320×240
4.4.6. Display sizes, mm	76×57
4.4.7. Operating temperature range, °C	–20÷+45
4.4.8. Allowed temperature range for storage and transportation, °C	–30÷+50
4.4.9. Maximum operating temperature at air humidity of 98 %, °C	35
4.4.10. Operating atmosphere pressure, kPa	84÷106,7

4.4.11	Allowed shaking time in transportation package (with acceleration of 3 g at beating frequency of 80 - 120 pro minute), not less then, hours	1
4.4.12	Average life length up to fault, not less then, hours	5000
4.4.13	Total lifelength of the device, years	10
4.4.14	Specified lifelength, years	5

5. WARRANTY

The manufacturer warrants the device from faults for 2 years from the date of sale. The warranty loses its force in case of mechanical damages of the device or in case, when the device was repaired by the other persons. In other cases the manufacturer provides the free of charge repair. The transportation inbound and outbound are covered by the customers.

The warranty on ultrasonic probes and antenna array – 1 year. The warranty loses its force in case of mechanical damages on the devices, mechanical wear of wear plates and damages of probes.

With all the questions of repair, replacement of spare parts and supply of accessories contact the manufacturer or his official representative.

“Acoustic Control Systems” Ltd. (ACS)

Russia, 119048, Moscow, Usacheva str. 35, POB 148

Tel/fax +7 095 244 3194, 244 2535, 245 5896

E-mail: market@acsys.ru

Website: www.acsys.ru

6. INDIVIDUAL MARKS

Production number:
Probe type:
Probe's production number:

Date of sale	Check

Repair information

Date	Fault type	Repair type	Execution signature

7. OPERATION OF THE DEVICE

7.1 INTERFACE

The device has an intuitive interface: all the set parameters, results of measurements and other information is supplied with the clarifying inscriptions and symbols. There are also associative pictograms on the display for quick access to the menu items and for switching between the modes. This makes operation of the device easier.

Controlling of the device is made with the keyboard and display. All the readings, parameters, menu parameters, modes marking and other information is indicated on the display.

From the keyboard the operator can control the operation modes, adjust the parameters, activation of functions and procedures.

The operation is accompanied with the sounds, which can be switched off if not necessary.

The device has non-volatile memory and all the parameters are saved, when the power is off or the batteries are empty.

The device has the adjustment library (up to 100 configuration), which provides easy and quick adjustment of the device and readjustment of the parameters by using the earlier saved configurations.

7.1.1 OPERATION MODES OF THE DEVICE AND CONNECTION BETWEEN THEM

There are several modes in the device: MENU, REVIEW, ZOOM, STOP, BAND, MAP, LINK. In these modes the device forms pulses, amplifies received signal, screens signals on the display, makes measurements and saves results in the memory.

For quick access to the menu items and control in the operation modes the pictograms are used. To enter and exit the pictograms use BAR key.

The left pictogram in the lower line of the display switches the operation modes. Each mode has its own pictogram and the inscription in the upper line. To switch between the modes press BAR key and list the items with ENTER or LEVEL (arrows up and down) keys. The list is arranged in a circle. If there is no data in the modes BAND and MAP, then these modes will not be indicated in the list.

The general information about the modes with the corresponding pictograms and connections between them is represented on the menu graph on the figure 7.1.

Besides there are additional modes in the modes REVIEW and ZOOM – STROBE and TVG adjustments.

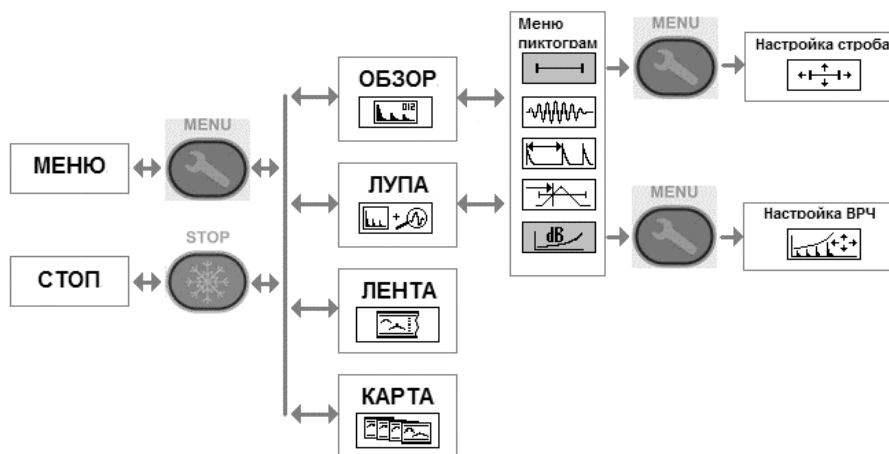


Figure. 7.1. Graph for modes connections

In the modes REVIEW and ZOOM the device works as a classic flaw detector. The signals are represented as a A-Scan with possible automatic and manual measurements of signal amplitude, time interval and distance (based on ultrasonic velocity).

The REVIEW mode screens A-Scan signal in maximal size on the display, the digital measuring information is minimized, which is comfortable for general ultrasonic signal form analysis.

The ZOOM mode represents the maximum measuring information, the sizes of signal screening area are limited. On the display the operator can see two A-Scans at the same time – the general and the stretched time interval – signal in the strobe area.

The single signal realizations in modes REVIEW and ZOOM can be saved in the memory of the device in STOP mode.

BAND and MAP modes are used for continuous testing of structures areas and provide quick saving of significant number of realizations in the device's memory.

In the BAND mode the operator can build one maximum long cross section of the testing object (B-Scan).

The MAP mode provides building the picture from several B-Scans – the section of the rectangular area, limited in length. Using the PC this data can be rebuilt in 3D image of the object's internal structure in this area.

All the single signals and sections saved in the memory of the device can be then reviewed on the display.

Parameters, device adjustments and other necessary items are set in a special MENU mode.

The data transmission to the PC is made in LINK mode. It turns on automatically at connection of the device to PC. Then the controlling of the device is made from the PC.

The detailed description of the modes, their features and possibilities are given in the part 7.2 of this manual.

7.1.2 INFORMATION ON THE DISPLAY

The device has monochrome graphic liquid-crystal display with the size 320 x 240 pixels. The suspend backlight with white light-emitting diod provides the high contrast in any condition.

When the operator works at low temperatures (below zero), the heating of the display turns on. It provides the good dynamic changes of information on the display and good contrast at the temperatures up to -20°C .

The display is divided on several functional areas. As an example there is a display in REVIEW mode on the figure 7.3.

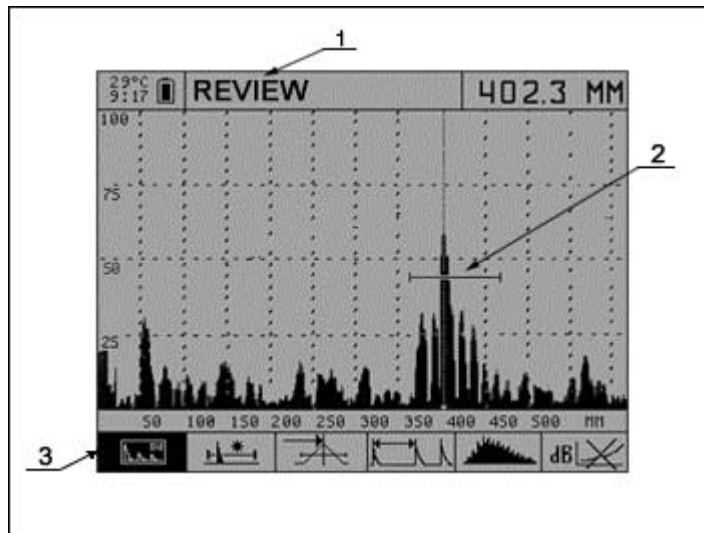


Figure 7.3. Information on the display

(1 – name of mode; 2 – signal image area; 3 – pictograms)

The upper line indicates the auxiliary information and the name of the current mode. It also indicates the temperature of the system board, equivalent operation time (counter) from the last recharging, indication of rechargeable battery. In the right part of the upper line is indicated the measuring information in functional modes.

There are pictograms in the lower line of the device. They allow choosing the operation mode, switching of the signal screening form, strobes adjustment, thresholds and other.

The results of measurements, current parameters and device adjustments are screened in the middle part.

7.1.3 KEYBOARD

The keyboard is represented on the figure 7.2. There are On/Off key, 12 functional keys and three LEDs on it.

LEDs indicate the operation state of the device, connection to the external power net and state of the accumulator. There is also a special LED indicated the monitor gate of the device.

There is a special symbol indication on the keys, which means the function of the key, and the text meaning of the key.



Figure 7.2. Keyboard of A1220 MONOLITH

The switching keys MENU, STOP и BAR, which switch the device in different states and modes, are made with the following principle: First press – enter; second press exit to the previous state.

Controlling keys RANGE, PAPAM и LEVEL influence the current active object. Their functions are similar for the different operating modes and the symbols on them indicate their functions.



For example, RANGE keys (arrows left and right) switch the sweep duration (the horizontal scale of the signal), list the pictograms, horizontally move the strobe and so on.









LEVEL keys (arrows up and down) control the attenuation (vertical signal level), list the menu lines, vertically moves the strobe, switch pictogram and so on.

PARAM keys («+» и «-») change the active parameter meaning, enlarge or shorten the strobe length and the position of the cursor and other.

The table 7.1 represents the brief description of the keys with their main functions in different modes.

Table 7.1. General keys functions







KEY	FUNCTIONS OF KEYS IN DIFFERENT MODES					
	REVIEW	ZOOM	BAND	MAP	STOP	MENU
 ON/OFF	Power On / Off. It is necessary to hold it less then 0.5 sec.					
 RANGE	Switch the sweep duration. Single press.	Moves cursor in horizontal direction.		Move the active pictogram.	Choose the section of the adjustment menu.	

KEY	FUNCTIONS OF KEYS IN DIFFERENT MODES					
	REVIEW	ZOOM	BAND	MAP	STOP	MENU
 PARAM	Move the measuring cursor.		Change the threshold of image comparison.		Move the measuring cursor.	Change the active parameter.
 LEVEL	Control of attenuation.		Nothing	Vertical move of cursor.	List the A-Scans.	Choose the active menu adjustment line.
 MENU	Switch to menu mode.				Nothing	Return to MENU.
 STOP	Switch to STOP mode.		Permission for rewriting the earlier saved realization.		Exit from STOP.	Nothing
 LIGHT	Display backlight On / Off.					
 BAR	Activation of pictograms. Exit from pictograms.				Confirmation of deleting from memory.	
 ENTER	Nothing		Recording of signal realization in the memory.		Record of A-Scan to memory.	Activation of function.
 RET	Help parameter list. Cancel the deleting from the memory.					

When the sound is on, pressing the keys is accompanied with the ton signal.

Some functions are realized with pressing the combinations of buttons. In the table 7.2 are represented the keys combinations and their functions.

Table 7.2. Keys combinations

 	Emergence reset. All the preliminary parameters are restored.
 	Changing the contrast of the display. Press and hold LIGHT key and press “+” (higher contrast) or “-” (lower contrast) keys. Available in all modes.
 	The direct choice of adjustment configuration from the library. Available only in REVIEW and ZOOM modes.

More details the functions of keys are described in corresponding parts of the manual, describing the modes.

7.1.4 PICTOGRAMS

Pictograms are the special feature of the interface. They are located in six small rectangular windows in the lower part of the display. Pictograms are the symbols, associated with the object or function they are connected to.

Each mode has its own list of pictograms. The number of pictograms that can be screened on the display at the same time is from 2 to 6, depending on the mode.

The pictograms can be in passive state (black symbols on the white background) and active state (inverse image). The active pictogram means, that its parameter or feature can be changed.

In MENU and STOP modes there is always an active pictogram and it is possible to list the active window with the RANGE (arrows left and right) keys and change the parameters and adjustments or realize functions.

In the modes REVIEW, ZOOM, BAND and MAP the pictograms are in passive state and shows the current adjustment of the device.

In this modes to activate the pictograms the operator needs to press BAR. Then the pictogram that was used the last in previous time will be activated. At that the controlling keys will change their functions due to the kind of pictogram. Listing the pictogram is made with RANGE keys. LEVEL and ENTER keys will change the kind of active pictogram.

Turning off the active pictogram and returning to the current mode is made with the second press of BAR key.

7.1.5 ADDITIONAL POSSIBILITIES

Additional to interface there are radio-head and radio-button, enlarging the possibilities of the device.

When the device is used in noisy environment, the built-in loudspeaker can be not enough for signal indication of monitor gate. That's why to the basic set can be added the head-phone for hearing the signal indication of the device on the distance up to 3 meters.

Another additional accessory that can be used with the device is a radio-button. It has the same function as ENTER button, which is used in BAND and MAP modes for recording the echo-signals in the device's memory. It is recommended to use it for remote control when the device is on the distance from operator.

7.2 OPERATION MODES

7.2.1 «MENU» MODE

In the MENU mode the parameters of probes, testing object, characteristics of sending-receiving track, controlling the service parameters, configuration of BAND and MAP modes and operation with device memory is set.

To enter the MENU from operation modes is possible with pressing MENU key. To exit this mode, press MENU key again. You will exit to the mode you were previously working in.

The number of parameters and menu items in the MENU mode is more than 20. The combination of the parameters forms the adjustment configuration. It is possible to create and save 20 adjustment configurations in non-volatile memory of the device. It is also possible to give any name to the configuration and then choose the configuration from the library by its name.

The figure 7.4 represents the screen view in the MENU mode. In the upper line of the screen is given the name of the active configuration, in the lower – the pictogram menu. Above the pictograms there is an area of parameters adjustment (up to 5 items) and upper there is an renewed signal realization. This allows without switching to operation mode control the right adjustment of the parameters.

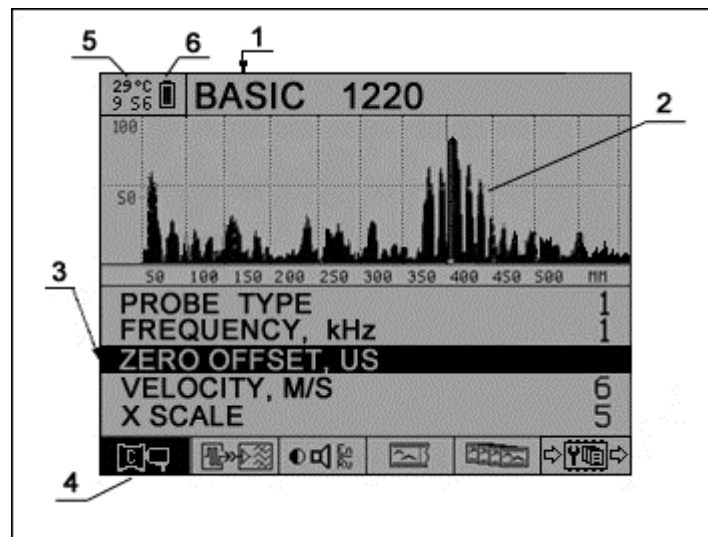


Figure 7.4. Display in MENU mode:

- 1 – configuration name, 2 – signal representation area, 3 – active menu line,
4 – active pictogram, 5 – internal temperature, 6 – battery symbol**

There is an active pictogram in MENU mode and active line of parameters. To list the parameters use LEVEL keys.

«+» and «-» keys change the parameter in active line. If the active line corresponds to the specific device function, then to activate is press ENTER.

To remove saved item from memory it is necessary to confirm it with pressing BAR key or cancel it with RET key.


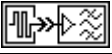

Because of the great number of parameters in the menu the menu was divided in 5 groups. Each group has its own pictogram in the lower line.




Active group is shown with the inverse pictogram. Switching the pictograms and the active group correspondingly is made with RANGE keys.

For quick on-time review of all the main parameters of the device use RET key. When pressed and hold it shows the list of parameters and when it is leaved the device returns to the current mode.

Table 7.1 shows the list of all menu items, corresponding to them parameters and functions, adjustment range and necessary comments. The table is divided in functional groups, which are headed with corresponding to the group pictogram.

Table 7.1. List of parameters and functions in MENU mode

Menu line	Parameter	Step	Comments
 Parameter of probe and testing object			
PROBE TYPE	SINGLE. / DOUBLE		Set probe and sending-receiving track type
PROBE FREQuENCY, KHZ	25,0÷250	5	Set the operating frequency, detect the central frequency of bipolar pulsing signal.
DELAY, US	0÷140	1	Double time of signal propagation in the probe's wear plate (hardware delay time).
VELOCITY, M/SEC	1000÷9999	1	Ultrasonic oscillation velocity in the testing object.
SCALE, x	us/mm	1	Scale type in REVIEW and ZOOM modes.
 Characteristics of sending-receiving track			
PUlse, v	10/50/200		Pulse amplitude.
number of periods	0,5÷5,0	0,5	Form of pulsing.
pulsing frequency, hz	1÷20	1	Pulsing frequency.
filter	Вкл. / выкл.		Band digit filter at the central operating frequency.
AVERAGING, times	1,0÷16,0	1	Realization equalization number between their screening.
 Service and additional adjustments			
language	Русский / English		Switch of language for all inscriptions
sound	On / off		Sound indication
BIG PRINT	signal / depth / time / attenuator		Choice of parameter that is screened on the display in REVIEW mode.

Menu line	Parameter	Step	Comments
WARMING	on / off		Is used at the temperature of system board lower then 10°C. At that the time counter is speed up in 4 times.
CLEAR TIMER			Counter clearance of general operation time of the device.
 Parameters of BAND mode			
REVIEW bandS	L / N	1	Set of number L from N earlier made arrays of BAND type and switch to its review with ENTER key.
band step, MM	10÷100	5	Choice of probe's step
create band, M	K		ENTER create new array BAND and close the previous one. As a K-parameter the possible length of the new array is set, that can be saved in the memory of the device.
 Parameters of MAP mode			
review MAPS	L / N	1	Set the L number of array from N previously made and switch to its review with ENTER.
map step, MM	10÷100	5	Step of probe, which is equal for horizontal and vertical testing
ROWS	5÷88	1	Number of lines in the array
columns	10÷202	1	Number of columns in array
create map, kb	K / M		ENTER create a new MAP array. As a parameters are used K – the necessary memory volume and M – the accessible memory volume.
 Operations with memory of the device			
SETUP PAGE	1÷20	1	Choice of configuration from saved in the memory.
COPY SETUP to	1÷20	1	Set the number of configuration, to which after pressing ENTER the adjusted parameters from the current configuration will be saved.

Menu line	Parameter	Step	Comments
edit PAGE name			Press ENTER to start named edition. Listing the symbols if made with horizontal arrows, to set the symbol use + / - keys. To finish correction press ENTER.
DELETE band	N		Press ENTER to delete the last BAND array with N-number. Need to be confirmed.
DELETE map	N		Press ENTER to delete the last MAP array. Need to be confirmed.

7.2.2 «REVIEW» MODE

In the REVIEW mode the operator can see the graphic image of time signal realization both in real scale and with equalization of realizations.

There are the following measurements possible for the received signals: time interval of signal delay to the beginning of pulsing or between two signals, distance to the reflector (for echo-pulse method) at the known ultrasonic velocity, signal amplitudes. The measurements can be made automatically or manual.

The example of display in REVIEW mode is represented on the figure 7.5.

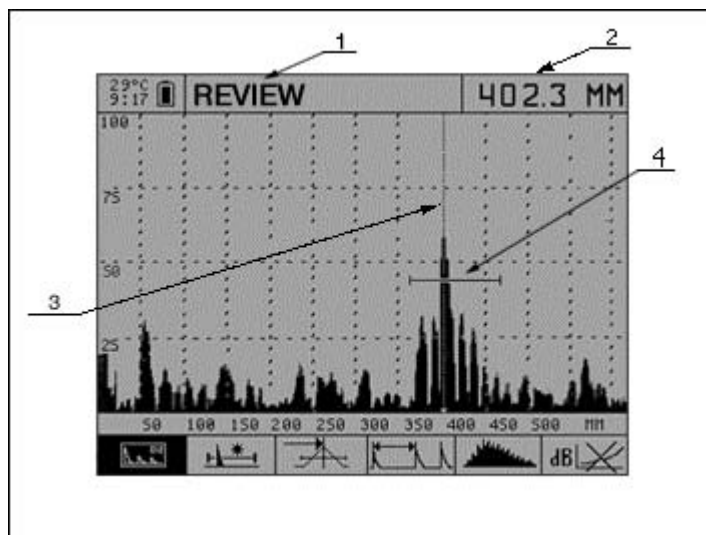
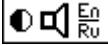


Figure 7.5. Display in REVIEW mode:
1 – mode name, 2 – measured depth meaning,
3 – vertical cursor, 4 - strobe


The display is divided in 3 parts: the upper – information part, the central part – graphic area for signal representation, the lower part – pictograms.

In the upper part besides the service information and the name of the mode there is also an area on the right for indication of one digit value. That can be either the delay time or distance or amplitude or attenuation. The choice of which parameter will be indicated is made in the MENU in the part “Service and additional adjustments” (pictogram ) , the line “in the REVIEW mode” (part 7.2.1 of this manual). For quick review of the set parameters of the device use RET key, which when pressed and hold shows the list of parameters on the screen and when left – list of parameters disappears from the display.

In the REVIEW mode the sizes of graphic area for signal representation is 320 x 180 pixels. The signals can be screened in RF-form or in rectified form (A-Scans, as an envelope line or filled contour).

The horizontal axis shows time or distance and is marked either in us or in mm. Switching the sweep duration in REVIEW mode is made with RANGE keys.

The vertical axis shows the signal amplitude either in linear scale or in percents from the full screen size. Changing the amplitude scale of the signals is made with LEVEL keys and choosing the pulsing signal amplitude in the MENU.

There is a possibility in the device to use the equalized time signal realizations, which provide the lower level of not correlated noises. This is important for analysis of low level signals, when the warmth noise level becomes noticeable. When making adjustments in the MENU (part “Characteristics of sending-receiving track”, pictogram ) , line “Accumulation, times”), the meaning of more then 1 makes the equation of the set in this item number of realizations and screening of the result signal on the display. At that in the same number of times the screen updating will be lower.

For weak signal correction depending on time is used the TVG function, which is made digitally. The characteristic of TVG is organized as a linear-broken line in logarithmic scale, that has up to 32 unit points. The maximal depth for regulating of each point is 30 dB.

To turn on the TVG adjustment is made when the TVG pictogram is active with pressing MENU key. At that the active pictogram for TVG edit appears (see table 7.2) (figure 7.6).

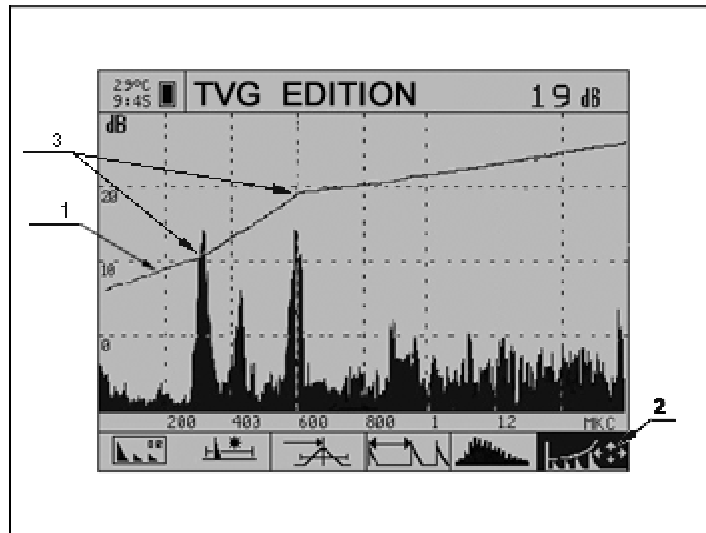


Figure 7.6. Display at TVG adjustment:
1 – TVG line, 2 – active pictogram, 3 – unit points of TVG

In some cases the received signal filtration is the most effective method. There is a digital band filter with the central frequency equal to operation frequency in the device. The filter can be turned on in the MENU.


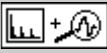

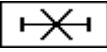










Besides the signal there are also the vertical line of measuring cursor and the horizontal level and strobe interval indicator in the graphic area of the display.

With the cursor the delay time or time interval and signal amplitude can be measured. The cursor can be set either automatically at turned on strobe or manually by moving the cursor with PARAM (+ / -) keys. The cursor is always on the display in REVIEW mode.

The strobe is used for automatic measurements in the specific time intervals (which are of interest for operator). When the pulse signal appears in strobe's time interval and signal amplitude crosses the strobe threshold, the cursor automatically sets on the fixed pulse and the measured parameter is indicated. Additionally this process can be accompanied with the sound indication and the LED indication on the keyboard of the device (which are monitors). Turning on the strobe and choosing the monitoring way is made in the active pictogram "Strobe control". When this pictogram is active press MENU and will appear the strobe editing pictogram (see table 7.2). At that in the upper left corner will be indicated the meaning the strobe parameter – its beginning and end or its level.

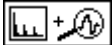
Table 7.2 represents the meaning of other pictograms for REVIEW mode, that allow to change the signal representation on the screen, measuring modes. The ZOOM has the same menu of pictograms.

Table 7.2. Pictogram menu for REVIEW and ZOOM modes

No	Pictograms	Meaning
1	Switch of modes	
		REVIEW mode. The maximal size of signal realization screening. Meaning of one parameter is screened.
		ZOOM mode. Minimal size of signal realization screening. Main results of measurements and parameters on the screen.
		BAND mode. Maximal long B-Scan.
2	Strobe adjustment	
		Strobe OFF. There is no automatic measurement.
		Strobe ON. Monitors, when signal crosses the threshold.
		Strobe ON. Monitors, without the signal crossing the threshold.
3	Type of threshold	
		The threshold unit works, when the signal crosses the threshold.
		The threshold unit works at the moment of maximal signal in strobe.
4	Way of interval measurement	
		Measure the interval from the beginning of pulsing up to the moment of threshold unit response.
5	Switch of signal form	
		Envelope of rectified signal.
		Filled envelope of rectified signal.
6	Work with TVG	
		TVG OFF.
		TVG ON.
		TVG adjustment. The signal and TVG characteristic is indicated in logarithmic scale. Add and delete the point. Set the point level in dB. Activated with MENU key. Exit with MENU or BAR keys. Active keys: ENTER – add and delete points; RANGE – set the cursor in the point; STOP – reset the TVG parameters

7.2.3 «ZOOM» MODE

The ZOOM mode, its functions, controlling units and menu of pictograms are the same as in REVIEW mode and described in the previous part.

To switch to ZOOM mode, use the first (from left) pictogram; to this mode corresponds the following pictogram .

The particular features of the ZOOM mode is the greater number of parameters and measuring results on the display and also the screening of two kind signal realizations (see figure 7.7). The lower window shows the stretched time interval (signal in strobe area). The upper window shows the smaller image of general signal realization. When changing the strobe parameters they are screened on the place of measurements results (the beginning, the end and the level of strobe are indicated).

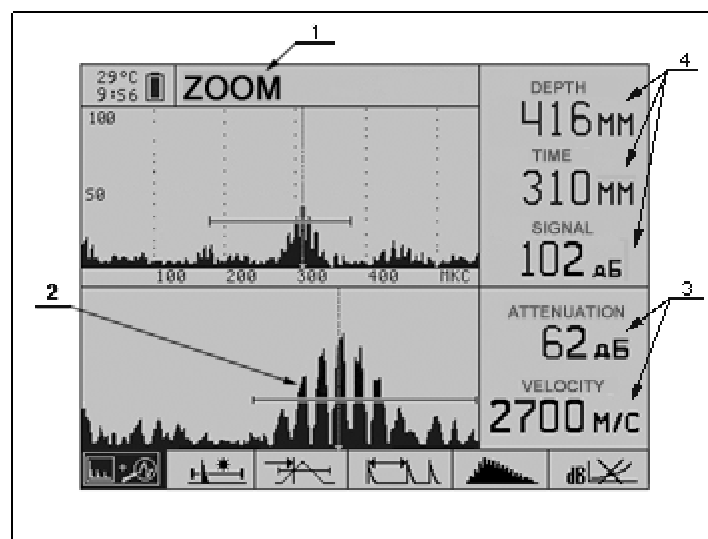


Figure 7.7. Display in ZOOM mode:

**1 – mode name, 2 – signal in strobe area,
3 – device settings, 4 – measured signal parameters**

It is recommended to work in this mode, when it is necessary to see the signal and at the same time to be able to analyze the specific parts of it. The signal delay time is measured more exactly (up to 0.1 us).

7.2.4 «BAND» MODE

In this mode it is possible to build the image of the cross section B-Scan of the testing object (perpendicular to the surface). It is built when the object is scanned with the probe along one line with a fixed step.

On the display the operator will see the image of the section as a binary image, on which black parts will be marked the places where the signal crossed the threshold, all the other places stays white. It is possible to get the half-toned B-Scan or colored image of the section on the display of PC, after sending the saved BAND to the PC and process it with the special software.

The example of display in this mode is represented on the figure 7.8. The structure is similar to the ZOOM mode, but differs with the type of digit data on it and with B-Scan represented in the lower window (the horizontal scale of it can be changed through pictogram menu).

On the right part of the display are given the main parameters of the device and the current position of the cursor in meters. When the size of B-Scan is larger then the window area, then the picture moves. At that all the received earlier information is saved.

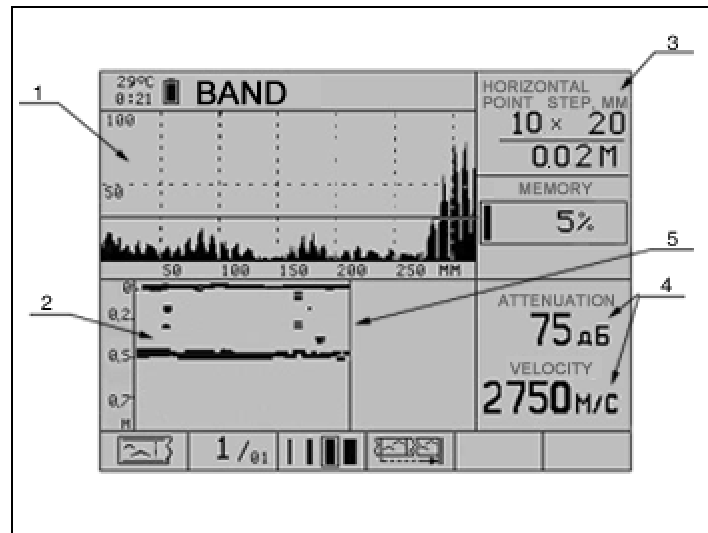


Figure 7.8. Display in BAND mode:

**1 – A-Scan of signal, 2 – B-Scan of the signal,
3 – parameters of vertical cursor in B-Scan area, 4 – device settings,
5 – vertical cursor**

The functions and available keys in this mode are represented in table 7.1

It is impossible to control amplification and reviewing depth range in this mode. These parameters are set at the moment of new array creation. That means, that before creating the new BAND array it is necessary to set the parameters of single A-Scan in REVIEW or ZOOM mode and only after that start creating the BAND.

Switching to BAND mode is possible in several ways:


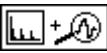




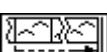
- when creating the BAND array,
- then reviewing the results from the MENU mode in the item “Parameters of BAND mode”,
- by switching the modes in the first left pictogram.

The pictogram in the second position allows to review the previously saved BAND arrays. The addition of the new realization is only possible in the last array.

When necessary the last BAND array can be deleted. To do it use “Operations with memory” in the MENU of the device.

It is also possible to correct the single, earlier saved A-Scan with the possibility either of automatic positioning of cursor in the end of array or of reviewing the made correction (the forth from left pictogram).

Table 7.2. Pictograms for BAND mode

No	Pictogram type	Meaning
1	Switching between the modes	
		REVIEW mode.
		ZOOM mode.
		BAND mode. Create and save maximal long B-Scan.
		MAP mode.
2	Reading from memory	
	N / M	Reading from memory and screening of earlier saves BAND array under the number N from M possible variants.
3	Adjustment of scale	
		Choice of horizontal scale for B-Scan screening.
4	Correction of one A-Scan	
		Reviewing the made correction of A-Scan, after making one.
		Set the cursor to the end of BAND, after correction of a single A-Scan from the array.

7.2.5 «MAP» MODE

This mode is used, when the operator need to test the limited (rectangular) area of the testing object. The results are shown are a set from B-Scans (sections perpendicular to the object's surface), The object is scanned along the marked lines (preliminary made on the surface) with a fixed step.

The section image is screened in binary form, on which with the black color the areas of crossing the threshold with the signals are marked, all the other areas are which. After saving this data and transmitting it to the PC it is possible to build the halftoned or color image with the help of the special Software.

The example of display in this mode is represented on the figure 7.9. The same as in BAND mode the lower window in graphic area shows the B-Scan of the current line. The upper right corner shows the position of the current cursor in meters. The A-Scan image is represented in the lower right corner of the display and in the upper left part is given the scheme of the map. The

scheme is supposed for the saved A-Scans. The black square shows that the A-Scan is already saved.

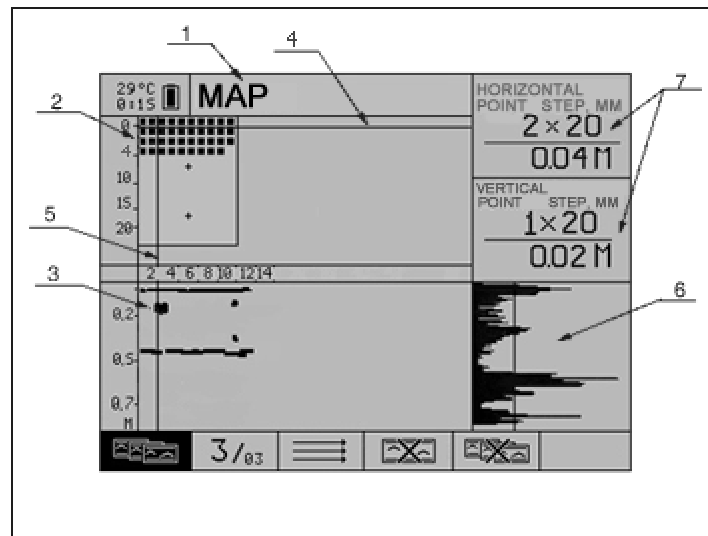


Figure 7.9. Display in MAP mode:

- 1 – mode name, 2 – scheme of scanning,**
- 3 – B-scan of the line, on which the horizontal cursor is set, 4 – horizontal cursor,**
- 5 – vertical cursor, 6 – A-Scan of one realization,**
- 7 – parameters of vertical and horizontal cursors**

Functions and available keys are represented in the table 7.1.

It is impossible to control amplification and reviewing depth range in this mode. These parameters are set at the moment of new MAP array creation. That means, that before creating the new MAP array it is necessary to set the parameters of single A-Scan in REVIEW or ZOOM mode and only after that start creating the MAP.

Switching to MAP mode is possible in several ways:

- when creating the new MAP array,
- then reviewing the results from the MENU mode in the item “Parameters of MAP mode”,
- by switching the modes in the first left pictogram.

When necessary it is possible to delete the last MAP type in MENU in the item “Operation with memory”.

In the MAP mode it is possible to review the earlier saved arrays in the second pictogram. The third pictogram allows to change the direction of scanning – horizontal or vertical. It is possible to clear the line of the MAP array (forth pictogram is active) or clear the whole map (the fifth pictogram) (see figure 7.10). After activating the forth and the fifth pictogram you will get the additional window on the display, where you need to confirm (BAR) or cancel (RET) clearance.

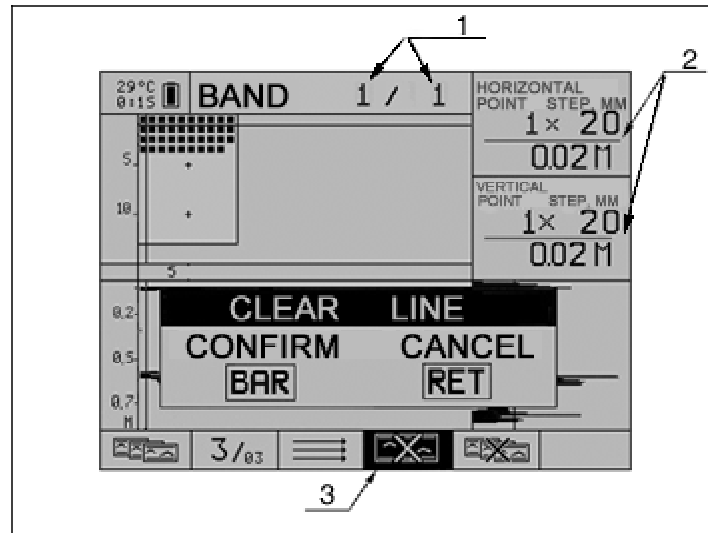


Figure 7.10. Display in MAP mode at the activated line clearance pictogram

Table 7.3. Pictograms for MAP mode

No	Pictograms	Meaning
1	Switching between the modes	
		REVIEW mode.
		ZOOM mode.
		BAND mode. Create and save maximal long B-Scan.
		MAP mode.
2	Reading of memory	
	N / M	Reading from memory and screening of earlier saves MAP array under the number N from M possible variants.
3	Direction of scanning	
		Horizontal scanning
		Vertical scanning
4	MAP correction	
		Line clearance (needs clearance confirmation: BAR – OK, RET – cancel)
		MAP clearance (needs clearance confirmation: BAR – OK, RET – cancel)

7.2.6 «STOP» MODE

This mode is supposed for freezing the image of signal realization on the display for saving the realization in the device's memory, reviewing earlier saved realizations with all the accompanying parameters and conditions of testing.

To enter and exit "STOP" mode is only possible in REVIEW and ZOOM modes and is activated with STOP key. If the operator doesn't need to save the signal realization, he only need to press STOP key again to return to measuring mode.

The example of image screening in STOP mode is represented on the figure 7.11.

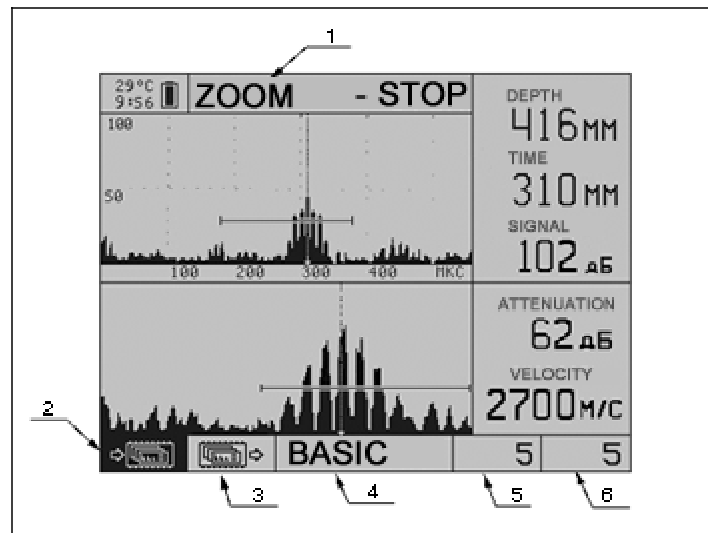


Figure 7.11. Display in turned on STOP function in ZOOM mode:
1 – mode name, 2 – pictogram, meaning the “freezed” realization,
3 – pictogram, meaning the review of earlier saved realizations,
4 – configuration named, 5 – write-through number,
6 – the set by the operator number

The picture 7.12 represents the image of ZOOM-STOP mode with indicating all main parameters, at which the realization was saved. To indicate the parameters on the display press and hold RET key.

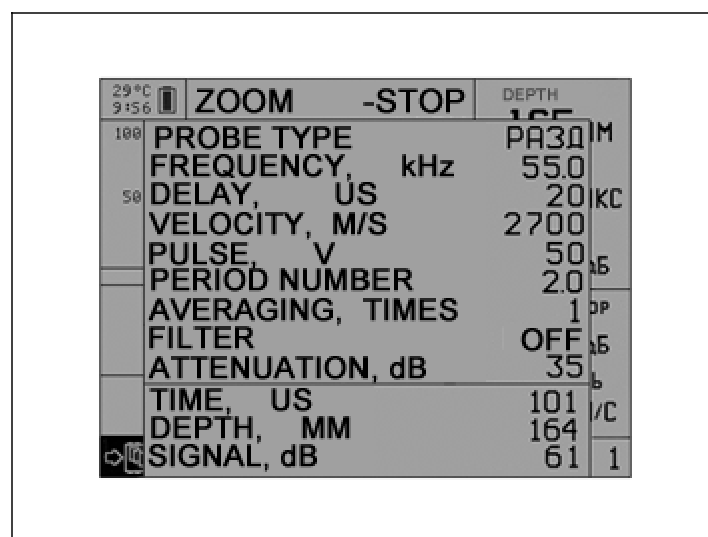



Figure 7.12. Display in ZOOM-STOP mode with indication of all the parameters

IF it is necessary to save the realization under another number, then it is necessary to choose the pictogram of number with RANGE keys.

Change the meaning there with “+” and “-” keys.

Press ENTER and the realization will be saved under the set number. The device will return to the operating mode.

No	Pictograms	Meaning
1		In this pictogram it is possible to save the realization with pressing ENTER key.

2		In this pictogram with + or – keys it is possible to review the earlier saved realizations.
3	Configuration name	Name of configuration, in which the realization was saved.
4	Realization index	Realization index that is set automatically.
5	Realization number	General number of saved realizations.

7.2.7 CONNECTION TO PC (“LINK” MODE)

The work of flaw detector in connection with PC is described in “Operation manual for IntroVisor Software”, which is supplied on the CD in basic delivery set.

To connect the device to the PC you need to make the following steps:

- Connect A1220 MONOLITH to the charging-supplying unit with controller;
- Turn the device On;
- Connect USB cable to USB-port of the computer;
- Connect USB cable to charging-supplying unit of A1220 MONOLITH;
- On the device will see the notification of connection to computer;
- Follow the instructions of the PC or start the Software for data transmission.

8. GENERAL INSTRUCTIONS

8.1 PREPARATIONS FOR MEASUREMENTS

8.1.1 PREPATATION OF THE SURFACE

If you suppose to work with the probes of liquid contact type, then it is necessary to clear the surface of testing object from dirt and dust, and put some contact liquid before making testing.


For testing the anchor bolts it is necessary to thoroughly clean the head of bolt from rust and aliasing up to the basic metal.

If the operator supposes to work with dry-point contact probes, then it is necessary to clean the surface from dust and sand and remove all the materials from the surface that could prevent low-frequency ultrasonic penetration in the material. No coupling liquids are necessary for testing.

If the operator supposes to work with antenna array, preparations of the surface are the same as for operation with dry-point contact probes, but additionally it is necessary to remove the hardly aliasing, that could course the break of acoustic contact of some antenna array's elements with the surface. When the antenna array is put on the uneven surface, all its elements contact the surface with their wear pins when the difference of the surface is not more then 8 mm.

Before scanning with antenna array it is necessary to put the marks on the surface of the object. On the surface is marked the scanning line, which then in divided with horizontal strokes equal to scanning step. The scanning will be made with antenna array along the marked line with the fixed step. On the screen the operator will get the binary image of internal structure in the scanning plane (perpendicular to the surface).

8.1.2 SWITCHING ON

To turn the device on, press On/Off key . You will hear a sound indication (trill) and on the display will appear the model of the device and the current version. When there is nothing written on the display, please, adjust the contrast.

8.1.3 ADJUSTMENT OF GENERAL PARAMETERS

General parameters are those parameters that do not depend on the operation mode. They are as follows:

- contrast;
- sound;
- display backlight;
- heating;
- time counter clearance;

- language

Backlight and contrast can be regulated directly in any mode. Backlight turns on or off with pressing LIGHT key. To adjust the contrast use the combination of LIGHT+PARAM keys.

All the other parameter are adjusted in MENU mode (item 7.2.1 of this manual).

8.1.4 CONNECTION OF PROBES

8.1.4.1 WORK WITH TWO PROBES OF LIQUID CONTACT TYPE

This is used for through-sounding and surface sounding. Two S0206 probes, connected to the electronic unit with two single LEMO-LEMO cables are used (see table 3.2).

At first it is necessary to set the parameters of these probes in the device. As an example below is given how to set the parameters for S0206 probe.

Table 8.1.4.1 Example of parameters set for S0206 probe.

PROBE TYPE	double
PROBE FREQUENCY, KHZ	50
DELAY*, US	Is given in the passport of the probe
VELOCITY, M/S	The velocity is set for the ultrasound propagation in the material of the object. It can be either measured or take from the table.
SCALE X	US/MM
PULSE, V	10, 50, 200
PERIODS NUMBER	0,5÷1
SOUNDING, HZ	До 20
AVERAGING, TIMES	1÷16. The more averaging, the high the signal/noise relation, but more time is needed to process the information.

The exact adjustments the operator should set depending on the testing object.

*Note: In this item is set the summarized delay time for two probes. For the probes of ACS production the double delay time is given in the passport, that's why when setting this parameter it can be just taken from the passport.

Figure 8.1.4.2 Connection of two S0206 probes



The probes are connected with the cables to the corresponding plugs.

It is necessary to connect the sending probe to the plug, marked with red dot. The receiving to another one.

8.1.4.2 SINGLE PROBE WITH LIQUID CONTACT TYPE

In this probe the same piezo-plate is used for signals sending and receiving. As an example of adjustments on this kind of probe we will take S0205 probe for anchor bolt testing.

Table 8.1.4.2 Set parameters for S0205 type of probe in single mode.

PROBE TYPE	SINGLE
PROBE FREQUENCY, KHZ	25
DELAY*, US	Is given in the passport of the probe
VELOCITY, M/S	The velocity is set for the ultrasound propagation in the material of the object.
SCALE X	US/MM
PULSE, V	50÷200
PERIODS NUMBER	1÷2
SOUNDING, HZ	Up to 20
AVERAGING, TIMES	1÷16. The more averaging, the high the signal/noise relation, but more time is needed to process the information.

The probe is connected with one single LEMO-LEMO cable (see table 3.2). The commutation between the generator and input amplifier is made automatically inside the device, after setting PROBE TYPE menu item on SINGLE mode.

Figure 8.1.4.2. Connection of S0205 probe in single mode



The single cable should be connected to the plug that is NOT marked with a red dot.

8.1.4.3 DOUBLE CRYSTAL PROBE WITH DRY-POINT CONTACT

Настройка параметров и подключение преобразователей выполняется аналогично отдельным ПЭП с жидкостным контактам. Рассмотрим установку параметров на примере преобразователя T1802.

Табл. 8.1.4.3 Пример настройки прибора для преобразователя T1802.

PROBE TYPE	DOUBLE
PROBE FREQUENCY, KHZ	50
DELAY*, US	Is given in the passport of the probe
VELOCITY, M/S	The velocity is set for the ultrasound propagation in the material of the object.
SCALE X	US/MM
PULSE, V	50÷200
PERIODS NUMBER	1÷5
SOUNDING, HZ	Up to 20
AVERAGING, TIMES	1÷16. The more averaging, the high the signal/noise relation, but more time is needed to process the information.

Figure 8.1.4.3 Connection of T1802 probe



The dry-point contact probes are connected to the device with double LEMO-LEMO cable to the corresponding plugs.

The sending probe is connected to the marked with red dot plug, the receiving to the another one.

8.1.4.4 CONNECTION OF ANTENNA ARRAY (DOUBLE CRYSTAL PROBE)

Antenna array is a kind of double crystal probe.

Table 8.1.4.4 Parameters for work with AA M2002 or M2502

PROBE TYPE	DOUBLE
PROBE FREQUENCY, KHZ	55.0
DELAY*, US	18
VELOCITY, M/S	The velocity is set for the ultrasound propagation in the material of the object.
SCALE X	US/MM
PULSE, V	200
PERIODS NUMBER	1.0
SOUNDING, HZ	Up to 20

<p>AVERAGING, TIMES 1÷16. The more averaging, the high the signal/noise relation, but more time is needed to process the information.</p>




For connection the double LEMO-LEMO cable is used.

Figure 8.4 Connection of Antenna array M2002 or M2502.

The way of connection doesn't matter. It is possible to use the cable of up to 6 meters in length.


8.1.5 TVG EDITION

For compensation of signal level reducing due to the ultrasound attenuation and divergence (influence of directivity diagram) there is a compensating function in the device – time variable gain (TVG).

Its principle is in changing the signal amplification with the depth. This function is set with the help of broken line, which is called TVG-line. To start the TVG function it is necessary to activate it. To do it, it is necessary to choose the last pictogram  in REVIEW or ZOOM modes and press LEVEL keys or ENTER.

 means that TVG is ON.

 means that TVG is OFF.

For TVG edition, choose  pictogram and press MENU. At that on the screen alongwith the signal you will see the TVG-line. This line is a set of unit points, connected with lines. The maximal number of points is 32, the minimal possible number of points – 2 (the first and the last).

To add a new point set the cursor in the necessary place with PARAM keys and press ENTER, the second press of ENTER will remove the point. At that in the upper right corner will be indicated the amplification level in the chosen point in dB. The amplification level for the points between the unit points is calculated by the linear function. Measurements of TVG are applied at once. Moving from one point to another is made with RANGE keys. To exit the TVG edition mode press RET or MENU.

8.1.6 CONFIGURATIONS LIBRARY


The operation with configurations library is made in MENU in the item “Operations with memory of the device” (see item 7.2.1). There is a concept of CURRENT configuration in the device. This is a configuration the parameters of which can be changed (edited). The parameters of “current” configuration are used for operation in REVIEW, ZOOM modes and for creation of new BANDs and MAPs.

The configuration can be saved in the device memory only from the “current” state. When one of the saved configurations is opened, its parameters are copying to the Current configuration. The parameters that are general for all the modes are saved in current configuration. When turned on the device starts working with them. When activating the BAND and MAP modes the parameters of the already made BAND or MAP are loaded to the Current configuration. When exiting from these modes the current configuration sets the parameters that were before the MAP or BAND loading.

8.1.6.1 CREATION AND SAVING OF NEW CONFIGURATIONS

To save the configuration with the necessary parameters it is necessary to set these parameters in the current configuration and, if necessary, edit the configuration made. After that it is necessary to save this new configuration in the library under any number from 1 to 20.

To edit the configuration name choose the “EDIT NAME” item in the Operations with memory part of the MENU.

Choose the pictogram  in the menu mode, which corresponds to the Operation with memory part. Choose “EDIT NAME” line and press ENTER. On the upper part of the display will be selected the name of configuration (see figure 8.5).

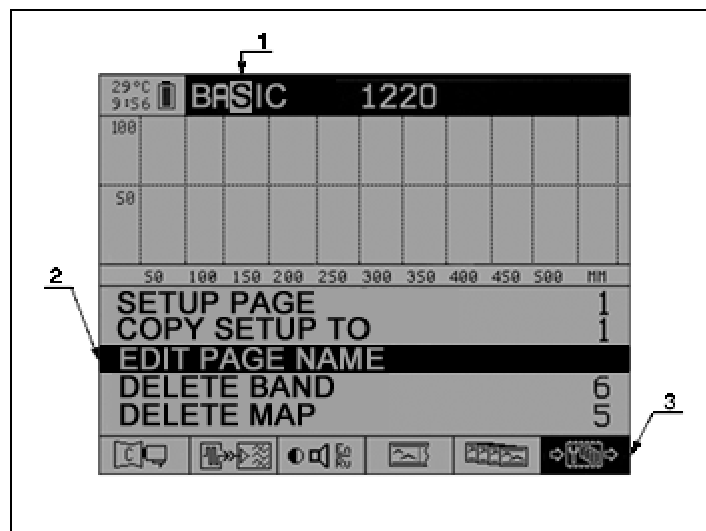


Figure 8.5 Display in MENU mode. Configuration name edition.
(1 – active menu part; 2 – active menu item; 3 – the letter to change).

The changing of name is made with RANGE keys (choice of the letter position) and + / - keys for choosing the necessary letter. The second press of ENTER will exit from name editing.

After that to save the prepared configuration to the memory choose the line “COPY SETUP TO”. With PARAM keys choose the number of position to save the configuration and press ENTER.

8.1.6.2 READING OF CONFIGURATION FROM THE LIBRARY

TO use the previously save configuration, it is necessary to load its parameters to the current configuration.

Choose the “SETUP PAGE” line in the MENU and with PARAM keys set the necessary number of configuration and press ENTER.

8.1.6.3 CHANGING OF SAVED CONFIGURATIONS

To change the parameters in previously saved configuration, load this configuration to the current one, set (change) the necessary parameters and copy it from current on to the same number (save under the same number).

8.2 MAKING MEASUREMENTS

The measurements are made in “REVIEW” and “ZOOM” mode.

There are two measuring ways supposed in the device: automatic and manual.

In manual mode the operator can measure the time, depth and signal amplitude in the point of crossing the vertical strobe. The measurement exactness by time and depth depends on the signal stretching – compressing level.

In automatic mode the measurements are made with the higher exactness. And if the high exactness of measurements is required, then it is better to work in automatic mode. In this mode for selecting the place for measurement by time, the strobe is used. There are several algorithms of automatic measurements:

- Time (depth) measurement in the place of threshold exceeding and local maximum's amplitude measurement after the exceeding. The strobe level is used as a threshold. In case of RF-form of signal the local maximum considered to be the absolute value (modulus). That means, that if the strobe is lower then the middle of the screen, then the device will measure the first local minimum.

- Time (depth) and maximum amplitude measurements in the whole interval, limited with strobe. At that the maximum is detected in the signal, higher then the strobe level.

- Registration of no strobe exceeding. At that the current position of cursor is measured.

Additionally the automatic monitoring is accompanied with sound indication and red LED on the front panel of the device.

There is also the measurements between two cursors are possible. When switching the “way of interval measurement” the cursor is “frozen”, that is indicated on the display with solid line with “clips”. The position of this cursor can be received both in manual and automatic mode. At that the second cursor appears on the display. The measurements are similar to measurements with one cursor, but the counting is made in relation to the “frozen” cursor.

8.2.1 ULTRASOUND TIME PROPAGATION MEASUREMENT

Set the probes parameters (according to the item 8.1.4 – “Connection of probes”). Set the way of signal screening and operation type of automatic algorithm, if necessary (table 7.2.2 in item 7.2.2 of the manual).

Manual mode. To switch to manual mode is made with turning off of strobe (see table 7.2.2). In this case it is enough to regulate the cursor position with PARAM keys. On the display will appear the meanings, corresponding to the cross point of signal with vertical cursor.

In “ZOOM” mode on the display will be the meaning of time, the corresponding to this time depth and signal amplitude.

In “REVIEW” mode in the upper right corner will be indicated only one of the three mentioned parameter with big letters, which is set in the menu (MENU, “Service and additional adjustments”, BIG PRINT – see item 7.2.1, table 7.2.1).

When working in one of the automatic algorithms it is necessary to adjust the strobe position. For that choose the corresponding first strobe pictogram (second from left in menu of pictograms) and press ENTER.

When entering the strobe adjustment mode the pictogram view changes (see table 7.2.2). At strobe adjustment on the display you will see the beginning, the end and the amplitude of strobe instead of signal parameters (see figure 8.6).

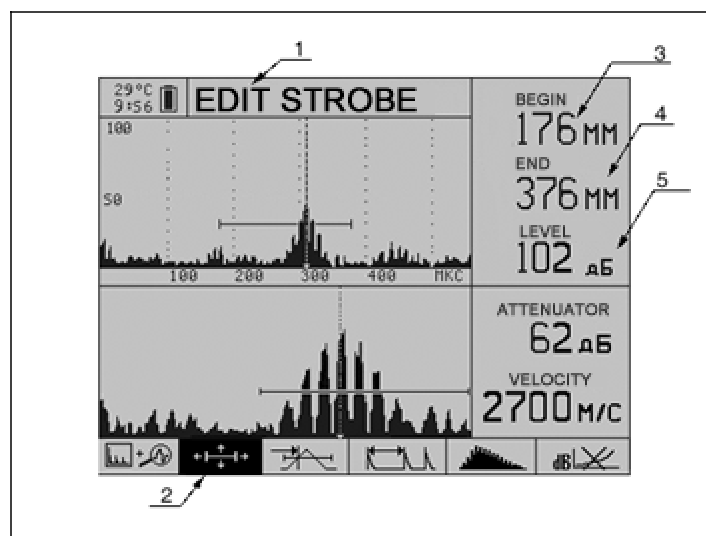


Figure 8.6 Display at strobe adjustment
(1 – mode’s name; 2 – active pictogram; 3 – beginning of strobe;
4 – end of strobe; 5 – strobe level).

In REVIEW mode in the upper right corner of the display will be indicated the adjusted parameter of strobe. The key functions at strobe adjustment are given in table 7.2 “Strobe adjustment” part.

8.2.2 ULTRASONIC VELOCITY MEASUREMENTS

There are different ways of ultrasonic velocity measurements described in the specialized literature. That’s why in this part in this part we will describe only the general.

Before starting measurements, it is necessary to set the parameters of the probes in the menu (part 8.1.4 “Connection of probes”)

Usually the ultrasonic velocity is measured at the fixed length or height, which hereafter we will called – the base. The base should be chosen according to the methodics of measurements for a specific object. After measuring the ultrasonic propagation time on this fixed base, recalculate the velocity by divided base value on time propagation. How to measure the time interval is described in the previous part.

One more method, which is often used in practice. In this case the thickness of the object on which the ultrasonic velocity will be measured should be known. The time interval from the beginning to the first “backwall” signal is measured. At the same time on the display will be indicated the corresponding to this time interval depth meaning. Adjusting the velocity meaning in the device, get the exact thickness meaning (should be equal to the known on). When the reading of the device is exactly the same as the real thickness of the object, then the right ultrasonic velocity is set in the device.

8.2.3 THICKNESS MEASUREMENTS

The measurement of object’s thickness is made by A1220 MONOLITH with Antenna array (M2002 or M2502), which elements (T1802) send the transversal waves in the object.

The parameters in the device should be made according to item 8.1.4.4 of this manual. For better review switch the scale sweep duration in mm. Set MM in line SCALE X of “Probe’s and object parameters” part of the MENU. The division of this scale corresponds to the echo-method – to the depth of reflectors location under the object’s surface. This depth is recalculated from the set in the device ultrasonic propagation velocity in the testing object. **In the device should be set the transversal waves velocity. Please, pay attention that the exactness of readings directly depend on the correctness of the set velocity meaning!** The methodics of transversal waves velocity measurements are given in the attachment.

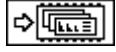
Before taking measurements it is necessary to prepare the object’s surface according to item 8.1. “Preparations for measurements” of this manual. After that put the antenna array in the place subjected to measurement and press it to the surface with the force of 5-10 kg.

Set the strobe in the place of supposed signal area. (How to work with strobe, see item 8.2.1 “Propagation time measurement” of this manual). When the signal from backwall or some flaw crosses the strobe level, the meaning of corresponding thickness will be indicated on the display. To fix the measured thickness press STOP key and the image on the display will be “frozen”.

8.2.4 SAVING THE MEASUREMENT RESULTS

The signal realizations and measurements can be saved in the device in STOP mode. To switch to this mode press STOP in REVIEW or ZOOM modes. To exit STOP-mode press STOP key again.


In STOP mode the image on the display with all the measured parameters is frozen. The manual cursor is always available in this mode. Be careful when using it. If you move the cursor manually, then the measured before entering STOP mode parameters are deleted.

To save the frozen object press ENTER at active left pictogram. . The realization with all the parameters meanings is saved in the memory. The named of configuration is indicated in the lower middle window of the screen. On the left is given the number, which can be set by the user. The number is given automatically when saving the new realization.

After saving the realization to the memory the device will return to the mode from which the STOP was entered.

8.2.5 REVIEW AND CORRECTION OF THE RESULTS

To review or resave the realization enter the STOP mode too.

To review the previously saved realizations, go to STOP mode from REVIEW or ZOOM modes. Choose the second from left pictogram , which symbolizes the review from memory. With PARAM keys set the number of saved realization that you would like to review. With pressing RET key on the display you will see the parameters of the device at which the realization was received.

8.2.6 «BAND» MODE

Before making testing in BAND mode, you need to put marks on the surface of testing object. Mark the line with strokes, where the antenna array will contact the surface. The strokes are equal to step of measurement.

8.2.6.1 CREATE AND DELETE BAND

Before creating a BAND array, set the parameters of the device, as you do in REVIEW and ZOOM modes. Pay attention that in already created BAND the parameters can not be changed. If it is necessary to change the parameters, then you need to create a new Band. The only exceptions are the general parameters that can be changed in already created BAND. The

strobe in BAND can be stretched on the whole screen and its level can be changed while making measurement and saving data to BAND.

When creating the BAND it is necessary to set the step for indicating the real coordinates for horizontal axis. To set the step for BAND, in the Menu choose “BAND STEP, MM” line in BAND mode parameters part of the menu. Set its meaning in MM.

To generate the new BAND press ENTER at the active line CREATE BAND. As a parameters in this item indicated the necessary memory volume and the available memory in kBytes. If the necessary volume is higher then the available memory, then the new BAND will not be created. To create a new one in this case it is necessary either to delete the last saved Band or to transmit all the data from memory to computer. When transmitting to the computer, all the bands can be deleted.

To delete the bands in the device, you will need to delete from the last saved band. To delete the band choose DELETE BAND line in the MENU (part Operations with memory) and press ENTER. The figure in this line means the number of the band to be deleted. If there are no bands saved, then you will see N/A on the screen.

8.2.6.2 SAVING DATA TO BAND ARRAY


The saving of realization to the band mode is made with ENTER key. At that the vertical cursor, which means the horizontal position, will move automatically on the next position.

In the upper right corner will be indicated the parameters of vertical cursor: number of step from the beginning; the testing step in mm and the recalculated length of the band from the beginning to the current position.

Under these parameters is the window with the percentage of available memory.

There is also the attenuation level and set velocity given on the display.

To review the other parameters press RET key.



The far left pictogram in the lower part of the display means the mode (in this case it means BAND). The next pictogram is used for switching between bands, it is indicated, which is the current band and how many bands there are in general. This information is duplicated in the upper part of the display after the mode's named. The third pictogram shows the current scale. In BAND mode it is possible to change the screening scale of B-Scan. For example,  shows that the thinnest line is used for screening the realization. The last pictogram shows the algorithm of cursor moving. More detailed this will be described in the following part.

8.2.6.3 REVIEW AND CORRECTION OF PREVIOUSLY SAVED REALIZATIONS IN BAND

To review the saved band choose the item REVIEW BAND in the MENU, choose the necessary BAND with PARAM keys and press ENTER. The saved bands can also be reviewed from the current band. For that

choose the second pictogram (with the number of current band) and with LEVEL keys set the necessary band number.

To review the realization from band set the vertical cursor with keys on the necessary realization. At that on the display you will see the A-Scan of this realization. The strobe level can be changed (with PARAM keys). At that the B-Scan image will be changing.

As was already said, it is impossible to change the parameters settings in already created band. But it is possible to rewrite the single realization, with parameters that were set at creating the band. For that set the vertical cursor on the realization, which should be rewritten and press STOP key, to start pulsing. To save realization press ENTER. Depending on the set mode, the vertical cursor will be set either on the last saved position in band (pictogram ) or on the next position (pictogram .

8.2.7 «MAP» MODE

Before starting testing put the marks on the object's surface. It is necessary to mark several parallel line on the area subjected to testing. Each line should be divided with strokes (steps of antenna array). The distance between the lines and the strokes is set in the menu before starting testing (see below).

8.2.7.1 CREATE AND DELETE MAP

Before creating a new MAP array it is necessary to set the parameters (the process is similar to REVIEW and ZOOM modes). Pay attention that it is impossible to change any parameters in already created MAP. And if it necessary to change any parameter, then you will need to create a new map (the old in this case can be deleted). The exceptions are the general parameters: they can be changes in the created map.

Strobe in the MAP can be stretched to the whole display and its level can be changed during the process of saving data to MAP.

When creating the MAP it is necessary to set the map step for indicating the real coordinates. To set the step for map, choose the MAP STEP, MM line in the "Parameters of MAP mode" part of the Menu – set its meaning in mm.

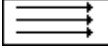
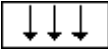
Then set the number of columns (steps in horizontal line) and number of lines (steps in vertical lines). At that in the CREATE MAP line of the menu will be indicated the necessary memory volume and the available memory in kBytes.

To create a new map choose the line CREATE MAP and press ENTER. If there is more memory needed then available, then the new MAP will not be created. To create the new MAP in this case it is necessary to delete one or several MAPs from the memory of the device. It is possible to delete the MAPs from the memory starting from the last one. For that choose DELETE MAP from "Operations with memory of the device" part of the Menu and press



ENTER. The figure in this line means the number of MAP which will be deleted. When there are no MAPs in the memory there will be N/A in this line instead of figure.

8.2.7.2 SAVING DATA TO MAP

To save the realization to memory press ENTER. At that depending on direction of testing the vertical cursor, meaning the position, will automatically move to the next position.

To set the direction, choose the corresponding pictogram and with LEVEL keys set the necessary direction.  - the vertical cursor will move horizontally,  - the vertical cursor will move vertically.

The second pictogram, where the number of current map and general quantity of maps are indicated, is used for switching between the maps. The number of current map and general number of maps in the memory are also shown in the upper part of display after the name of the mode.

The forth and the fifth pictograms mean the function of current line clearance and the whole map clearance (accordingly). To clear the line with LEVEL keys (no pictogram should be active) choose the necessary line. With BAR key switch to pictograms, choose  and press ENTER. It is necessary to confirm the delete. To clear the MAP choose the pictogram .

In the upper right corner is given the information about the cursor current position.

8.2.7.3 REVIEW AND CORRECTION OF THE SAVED IN MAP REALIZATIONS

To review the saved maps choose the REVIEW MAP item in the “Parameters of map mode” part of the menu and press ENTER. Each realization, saved in the map, can be reviewed. For that with RANGE and LEVEL keys choose the position to be review. At that in the left lower part the A-Scan corresponding to this realization will be indicated.

The strobe level can be changes with PARAM keys. At that the B-scan of the corresponding line will be changing.

It is impossible to change the parameters in already created map, the exceptions are the general parameters. To review the parameters that were set at map creation press RET.

Each realization can be rewritten with the parameters that were set at creation of this map. With RANGE and LEVEL keys choose the necessary realization. To start pulsing, press STOP. With ENTER key save the new realization to the memory.

9. MAINTENANCE

9.1 BUILT-IN RECHARGABLE UNIT

As a rechargeable unit the set of 6 NiMH elements is used. It is protected from short circuit and overheating. To avoid damaging the elements it is not recommended to demount the set and repair the rechargeable unit.

9.1.1 CONTROL IN OPERATION PROCESS

The built-in controller controls the discharging level. In the display the state of rechargeable unit is indicated with a battery symbol in the upper left corner. The full dark symbol means the fully-charged accumulator. While discharging the symbol will become empty. When there is not enough power in the rechargeable block the device will automatically turn off, at that all the adjustments and saved readings will be saved.

The power consumption and as a result the time of work depend on several factors:

- backlight – on or off
- pulsing frequency
- accumulation (averaging) – on or off
- pulsing amplitude
- heating – on or off.

That's why it is rather difficult to estimate a general operation time. To count the operation time there is a special function in the device – continuous operation time counter. This time is indicated in the upper left corner under the battery symbol. The speed of time counting depends on power consumption at the set parameters. To clear the time counter there is a special line in the menu "CLEAR COUNTER" in the "Service and additional adjustments" part of the menu.

9.1.2 RECHARGING

Recharging is made through the charging-power supplying unit. It follows from its name, that this unit is supposed to recharge the built-in accumulator, and also for power-supplying of the device during the recharging process.

This unit consists of two parts: net adaptor and charging controller. The net adaptor transforms the inputting voltage of 100-240V 50-60Hz net to the constant 12V. The controller provides the recharging of accumulator in a special algorithm and provides the training of accumulator. The training mode turns on after pressing a button on the controller.



Recharging is made through a special plug on the upper part of the case with the help of charging unit.

Depending of the discharge level the recharging can take up to 3 hours.

To indicate the mode there are 3 LEDs of different color on the front panel of flaw detector: red, yellow and green.

- red LED: shows the presence of voltage on the controller's input (for example from net adaptor);
- yellow LED: indicates the recharging process. When the controller is connected to the device or when there is a power sent to the controller, the controller starts testing the accumulator block. At that the yellow LED blinks. If the accumulator block is almost empty, this process can take up to a minute. After that the recharging process starts – the yellow LED lights continuously during this process. If the yellow LED permanently blinks and you didn't press the button on the charging unit, that means the defect in the charging unit or in accumulator or in the cable between them.
- Green LED: indicates the end of recharging process.

The charging process takes not more then 3 hours and depends on the discharge level of accumulator.

The charging time doesn't depend of the turned ON or OFF state of the device.



Figure 9. Connection at charging

9.1.3 TRAINING OF RECHARGABLE UNIT

The elements of the accumulator block have the “memory” effect. It means that the capacity of the block reduces during the exploitation. To neutralize this effect it is necessary periodically to fully discharge the block. There is such a mode in the charging unit. When pressing the button on the controller the controller starts to discharge the accumulator. The yellow LED starts blinking. The controller starts training only when the charging has

already begun (permanent yellow LED) or already finished (permanent green LED).

9.2 POWER SUPPLYING FROM NET

For power supplying from net use the net adaptor, which has the voltage transformation unit inside. This enables to connect to the nets of different voltage and also reduce the influence of voltage instability. Adaptor is protected from overvolutaging at the input and from short circuit on the output.

9.3 POWER SUPPLYING FROM CAR ACCUMULATOR

It is possible to provide the power-supply of the device from car accumulator. In this case the additional cable connected the controller to cigarette lighter socket.

9.4 TROUBLESHOOTING AND POSSIBLE CORRECTIVE MEASURES

9.4.1 FIRST SWITCH ON

If there is no image on the display at first switch on or if the whole display is black, then you need to adjust the contrast.

9.4.2 EMERGENCY RESET

IF there is no information on the display and no sound signals at pressing the buttons when the device is turned on, then one of the reasons for that can be a processor failure (if the batteries are OK and there is a good electric contact in their circuit).



To avoid this troubleshooting you need to reset the device. For then press and hold BAR key and together with it press ON/OFF key.

If the device doesn't turn on, please, repeat this action one more time in 10-15 seconds.

The device will turn on with double sound indication. The parameters of the device will be reset and you will need to readjust them again.

The configuration library at emergency reset will not be cleared.

After that the device is ready for work.

9.4.3 POSSIBLE TROUBLESHOOTING

Basing on exploiting experience of analogue devices the possible troubleshooting, which can be corrected by the operator, are given in the table 4.

Table 9.4.3 Possible troubleshooting

Troubleshooting	Possible reasons	Corrective measures
There is no image on the screen after switching on or the display is fully black.	Processor fail and as a result problems with contrast.	Turn the device off. Reset it (emergency reset keys combination) and adjust contrast.
There are no symbols on the display after pressing On/Off key.	Rechargeable battery is empty.	Connect the power-supplying unit and turn the device on again.

If this doesn't help or if you have any other problems, please, call the manufacturer or his official representative in your country.

9.4.4 PERIODICAL MAINTENANCE

It is not recommended to demount the device, because this can cause the damage of its internal parts. If there are any faults or any questions, please, contact the manufacturer or his official representative.

It is necessary to clean the case of the device from dust and dirt with the cleaning means for plastics. It is recommended to clean the display with the soft tissue and cleaner for plastic glasses. The keyboard is better to clean with spirits.

10. WORK WITH THE COMPUTER

10.1 CONNECTION TO THE COMPUTER



Figure 10. Connection to the USB-Port of the computer

To connect the A1220 Monolith to the computer you need to do the following:

- connect the recharging-power supplying unit with controller to the device;
- turn A1220 Monolith on;
- Connect USB cable to USB-port of the computer;
- Connect the USB cable to the recharging / power supplying unit of the device.

On the display you will see the window with registering to computer note.

After that follow the instructions of the computer or start the special software for data transmission.

ATTENTION: The A1220 MONOLITH should be connected or disconnected from PC only in turned ON state.

The work of the device with PC is detailed described in the Operation Manual for the Software.

11. ATTACHMENT
