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OPCARD 2.0 PCI-bus Ultrasonic Card with Integrated Pulser and Receiver

INSTRUCTION MANUAL

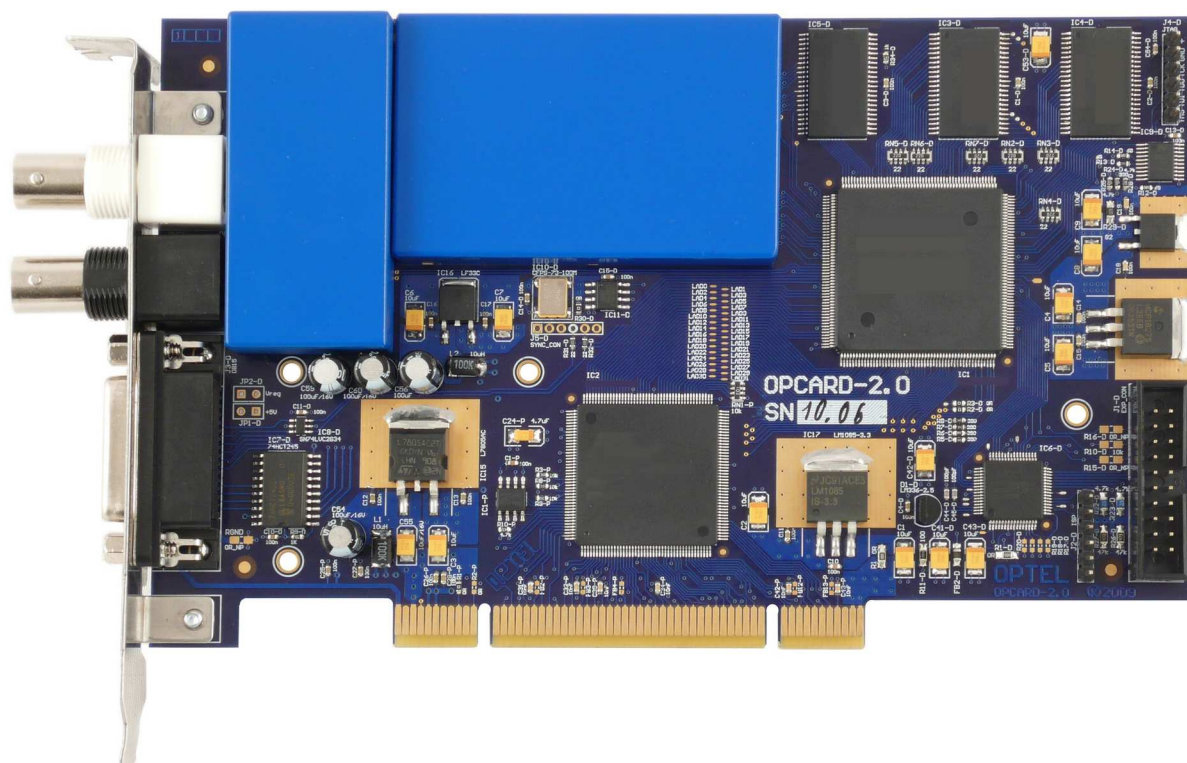


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1. Warranty

Manufacturer :Optel sp. z o.o. certifies that this product met its published specifications at the time of shipment from the factory. This product is warranted against defects in material and workmanship for a period of warranty. During the warranty period the manufacturer will either repair or replace products which prove to be defective. Damage to the product should be reported to the manufacturer. The warranty period shall be extended by the duration of the repairs from the date of delivery of the product for. The documentation does not provide schematic, diagnostic tips or any other service information about the device. In case of any accident repairs performed by the manufacturer - free of charge if the damage is the fault of the manufacturer during the warranty period, for payment if the damage is caused by the user. The user should not make any repairs, alterations or changes. Warranty does not cover damage resulting from product misuse or inconsistent with the instruction manual for maintenance or repair by unauthorized persons and damage to the product due to improper power supply voltage, Buyer - supplied software or interfacing.

2. Technical description

2.2 Standard equipment

- Ultrasonic Card OPCARD2.0
- Signal cable
- Control cable
- Instruction manual

2.3 Purpose

OPCARD 2.0 is a complete ultrasonic testing device, suitable for all ultrasonic measurements and due to many additional digital inputs/outputs and internal processor it can be used as a controller for more complicated devices.

The card can work together with following devices:

- 32 channel multiplexer - the card can control it directly;
- Scanner - it has input for incremental encoders;

The card has an implemented one channel pulser & receiver and can be used with one transducer or with two (one is sending, and the second one receiving).

2.4 Technical Data

2.4.1 Analog parameters:

Input Amplifier Gain: -28dB to 68dB (step 1dB, error +/- 0.3dB)

Input Post-Amplifier: off or +24dB

Input Attenuator: off or -20dB

Input Range: +/- 275mV
(+/-2.5V with Attenuator active)

Full Bandwidth: 0.5 MHz - 25 MHz (-3dB)

Switchable Filters(-3dB): 0.5 - 6MHz,
0.5 - 10MHz,
0.5 - 15MHz,
0.5 - 25MHz,
1 - 6MHz,
1 - 10MHz,
1 - 15MHz,
1 - 25MHz,
2 - 6MHz,
2 - 10MHz,
2 - 15MHz,
2 - 25MHz,
4 - 6MHz,
4 - 10MHz,
4 - 15MHz,
4 - 25MHz

Pulser:

Pulse Voltage off(0V) to 360V (positive pulse, Short circuit step pulser)

Charging Time regulated from 0 to 3.1us in 0.1us steps

Fall Time <= 20 ns

Pulse Duration Short circuit, bandwidth up to about 50MHz

Output impedance < 1 Ohm

A/D data acquisition:

Resolution 10 bit

Sampling 100; 50; 33,3; 25; 20; 16,7; 14,3; 12,5,

Frequency(MHz)

11,1; 10; 9,1; 8,3; 7,7; 7,14 and 6,67

Data Buffer from 1 to 262143 (256k) samples in step of 1

Delay Time Post trigger from 0 to 65535 sample periods in step of 1

Hardware data processing:

Hardware Positive¹⁾, Negative¹⁾, Absolute data processing;

3 x measure gate;

Peak detector;

Hardware averaging x4.

DAC (TGC) with arbitrary waveform generator:

Frequency: Frequency:

Resolution: Resolution:

Max. gain changing: Max. gain changing:

Trigger:

On-board trigger timer;

Application trigger rate Softwarecontrolled;

External trigger 2x inputs, TTL Signal.

Counters / Input for incremental encoder:

Counters for Incremental Encoders 2 channel, 16-bit.

2.4.2. Inputs / Outputs

Analog:

2 x BNC or Lemo connectors

DB15 connector:

Inputs:

2 inputs for Incremental encoders;
2 general purpose digital line;

Outputs:

Trigger output signal (Sync Out);
3 general purpose output;
2 fast output buffers for clock synchronization.¹⁾

¹⁾ available in selected designs

Others:

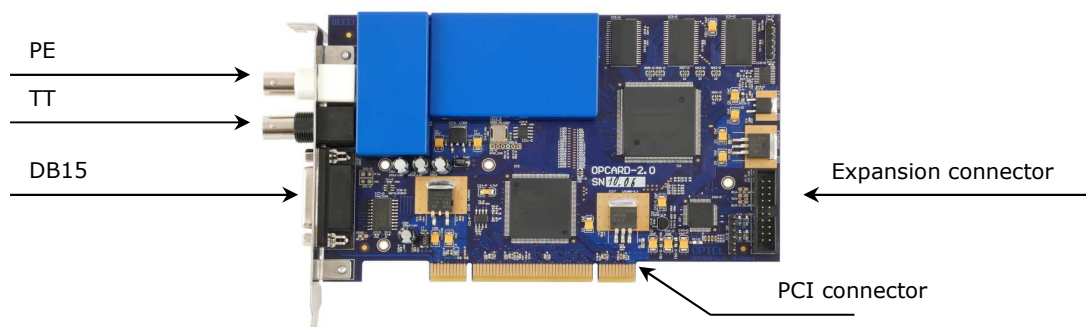
+12V, -12V fused supply for powering external devices;
+5V or Vreg (0-9V) output for control/supply external device.

PCI Connector:

PCI rev2.2, 32bit, 33MHz, 132MB/s max transfer bandwidth
Universal connector for 3.3V or 5V PCI sockets.

Expansion connector:

2x10pin 2.54mm connector for special functions daughter-boards
+12V, -12V, +5V, +3.3V power pins;
I/O pins serial interfaces (3.3V signal levels): RS232, SPI, I2C and others;
Inputs for general purpose counters;
Interrupt input;
Analog input for A/D converter.



BNC:

PE	- Measured input signal (sending/receiving);
TT	- Measured input signal (receiving)

DB15:

1	GPO0/SYNC_OUT	GPO0 out/ Trigger for external pulser
2	GPO2	GPO2
3	GND	Ground
4	GPI1/EXT_Y	GPI1 input/external input trigger Y
5	GPI3	GPI3 digital line
6	FastGPO1	Fast digital clock line 1 □)
7	VREG/+5V	voltage regulator for external pulser or power supply +5V (selectable by jumper on the card)
8	+12V	PCI power supply +12V
9	GPO1	GPO1 digital line
10	GPO3	GPO3 digital line
11	GPI0/EXT_X	GPI0 input/external input trigger X
12	GPI2	GPI2 digital line
13	FastGPO0	Fast digital clock line 0 □)
14	GND	Ground
15	-12V	PCI power supply -12V

Expansion connector:

1	+12V	
2	-12V	
3	GND	
4	GND	
5	-12V	
6	+3,3V	
7	SCK	SPI
8	SCL	I ² C
9	MISO	SPI
10	SDA	I ² C
11	MOSI	SPI
12	TxD	RS232 (LVTTL)
13	SSEL	SPI
14	RxD	RS232 (LVTTL)
15	EXT-INT	Interrupt input
16	CTL2	Control line
17	GPI00/AINO	Digital I/O or analog input
18	CTL3	Control line
19	GPI01/AIN1	Digital I/O or analog input
20	nc	

Caution:

Upper BNC connector is connected with the pulser. The maximum voltage of the pulse on this connector can reach about 360 Volts. Due to the short duration it is not dangerous to the human, but can destroy electronic circuits or transducers if not used carefully..

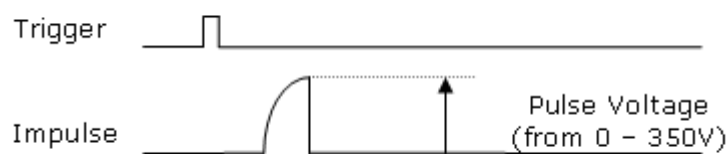
If you work with multiplexed signal from the multiplexer it should be given to the BNC connector TT. Connecting it to the BNC connector PE may result in damage of the multiplexer..

2.5 Operating principle:

One of the most important features of the card is a precise synchronization between the transmitter trigger signal T_NAD and the moment when the sampling of the input signal starts.

This time is software programmable in the range of from 0 to 65535 sample periods with a resolution of 1 sample and has stability within the range of 1ns. It is particularly important in the case of scanning devices, since it allows to achieve a very small time skew between different positions (channels). 1ns would correspond to a clock frequency of 1GHz which is much higher than the actual frequency used.

Signal form of the implemented pulser



Pulser circuit waveforms: The rising edge of the Trigger signal (described as Trig Inp) initiates the transducer charging process which takes about 3 μ s. After this time a transistor switch which discharges the transducer is turned on (discharge time is about 20ns, but it can be longer, if the capacitance of the transducer is too large; the limit is reached, if the transducer is made from the standard ceramics, is 0.1 mm thick and has 8 mm diameter).

Because of the very low output impedance of the device (<1 Ohm) and short discharge time the pulse generated with this device could be concerned as a real pulse answer for the most transducers. Transducers with a parallel matching inductance should not be used, since they do not allow the transducer to be pre-charged (the inductance causes a short-circuit).

3. Software Package

The software (for Windows 2000/XP/Vista/7.0/8.0/10.0) includes all necessary functions for ultrasonic measurements.

The card can work together with following devices:

- 2 - 32 channel multiplexer series OPCOM
- Phased Array Multiplexer series OPPPA

OPCARD 2.0 can control it directly:

Scanner - it has input for incremental encoders;

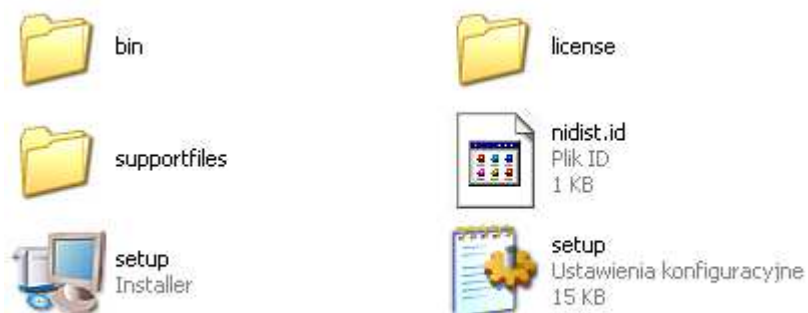
DVD includes:



Where:



Install:



3.1 Software installation

3.2 Standard software OPCARD 2.0

3.2.1 Main panel

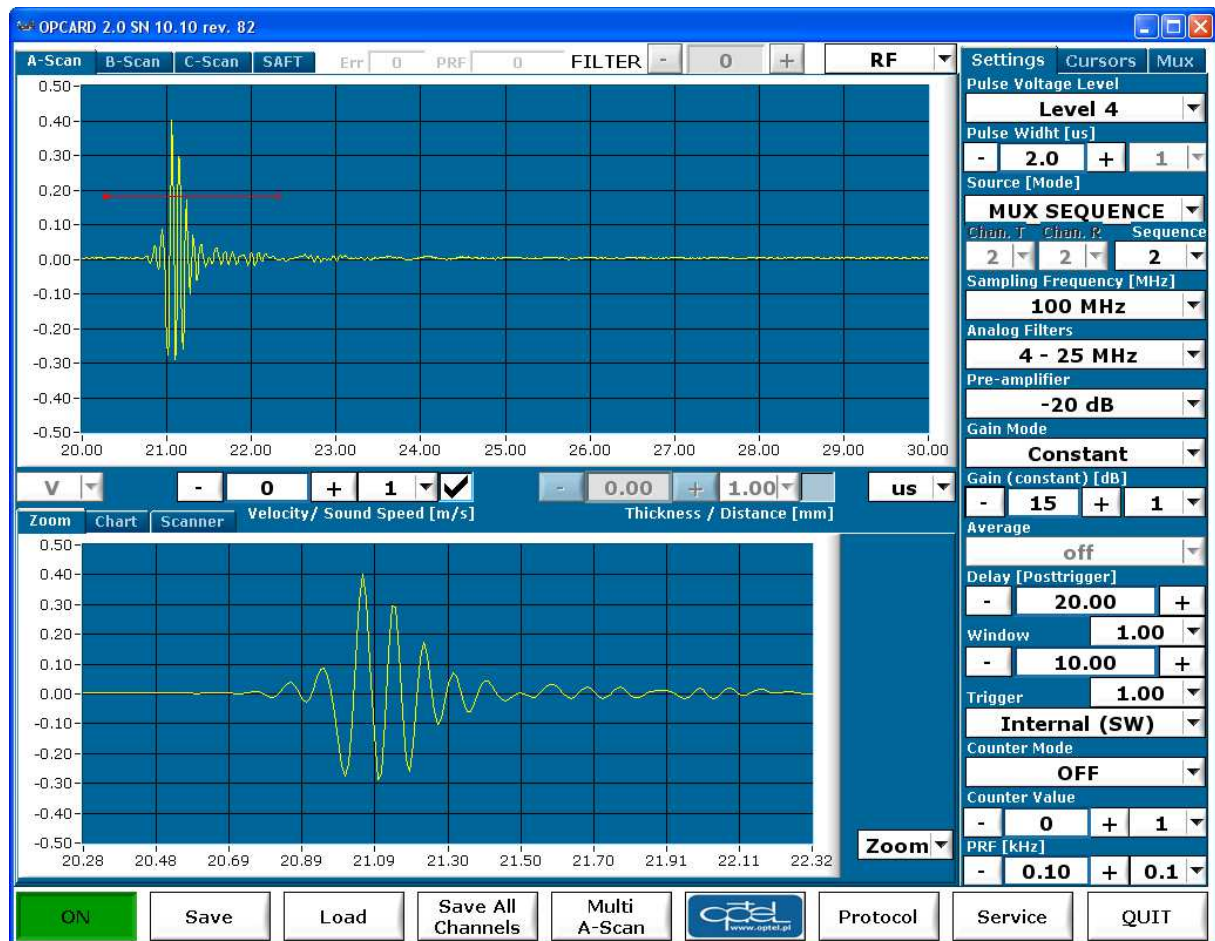


Fig. 1 Main panel – A- scan tab

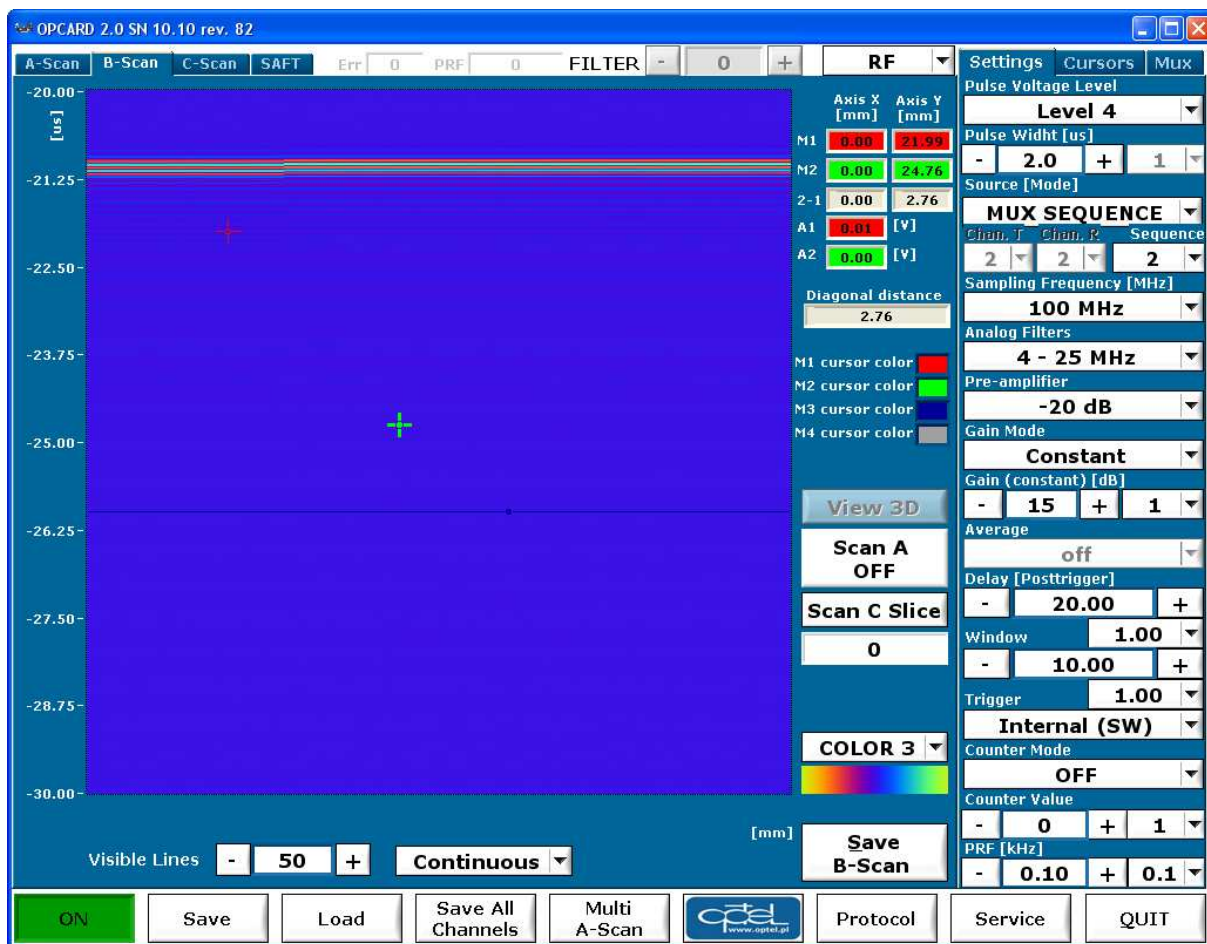


Fig.2 Main panel – B scan tab

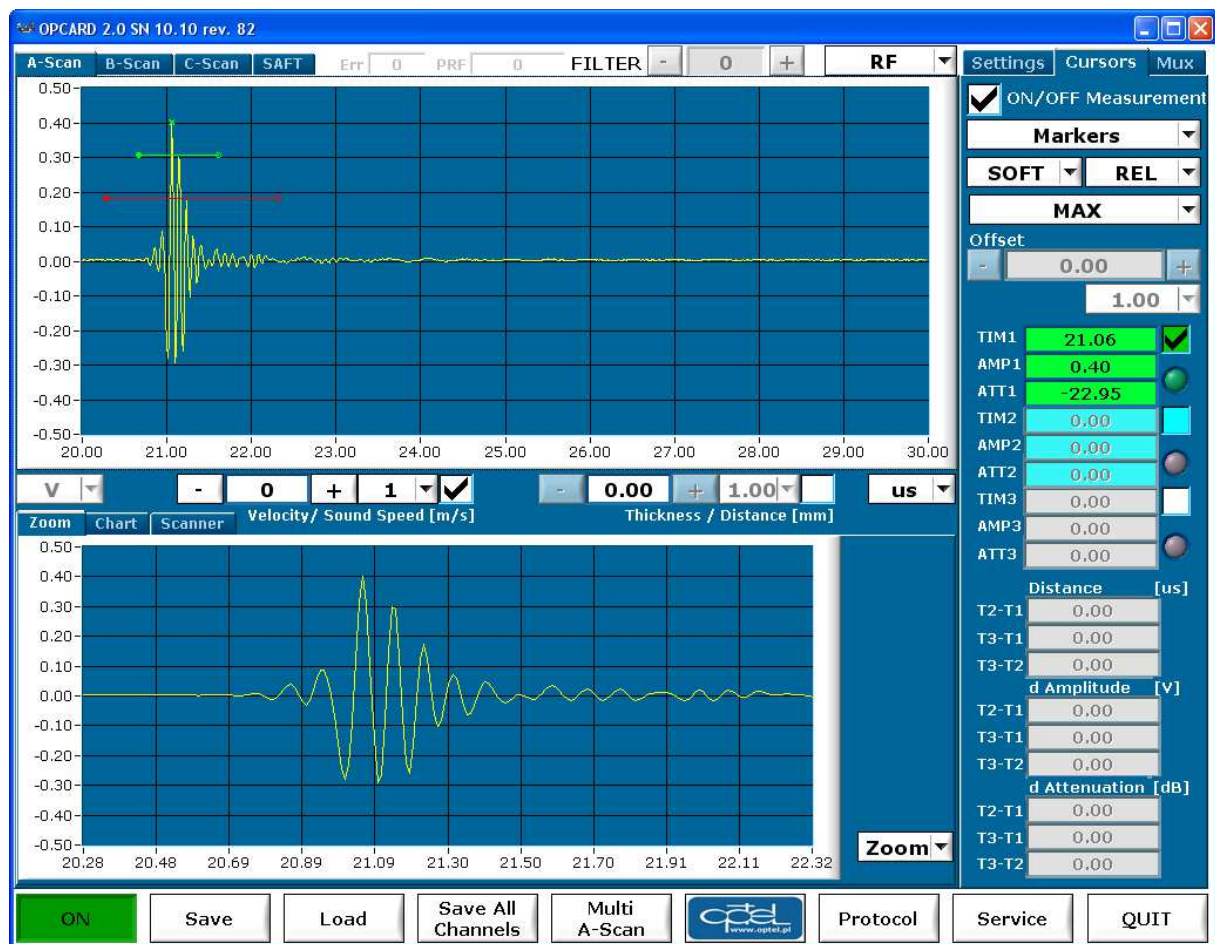


Fig.3 Cursors settings tab

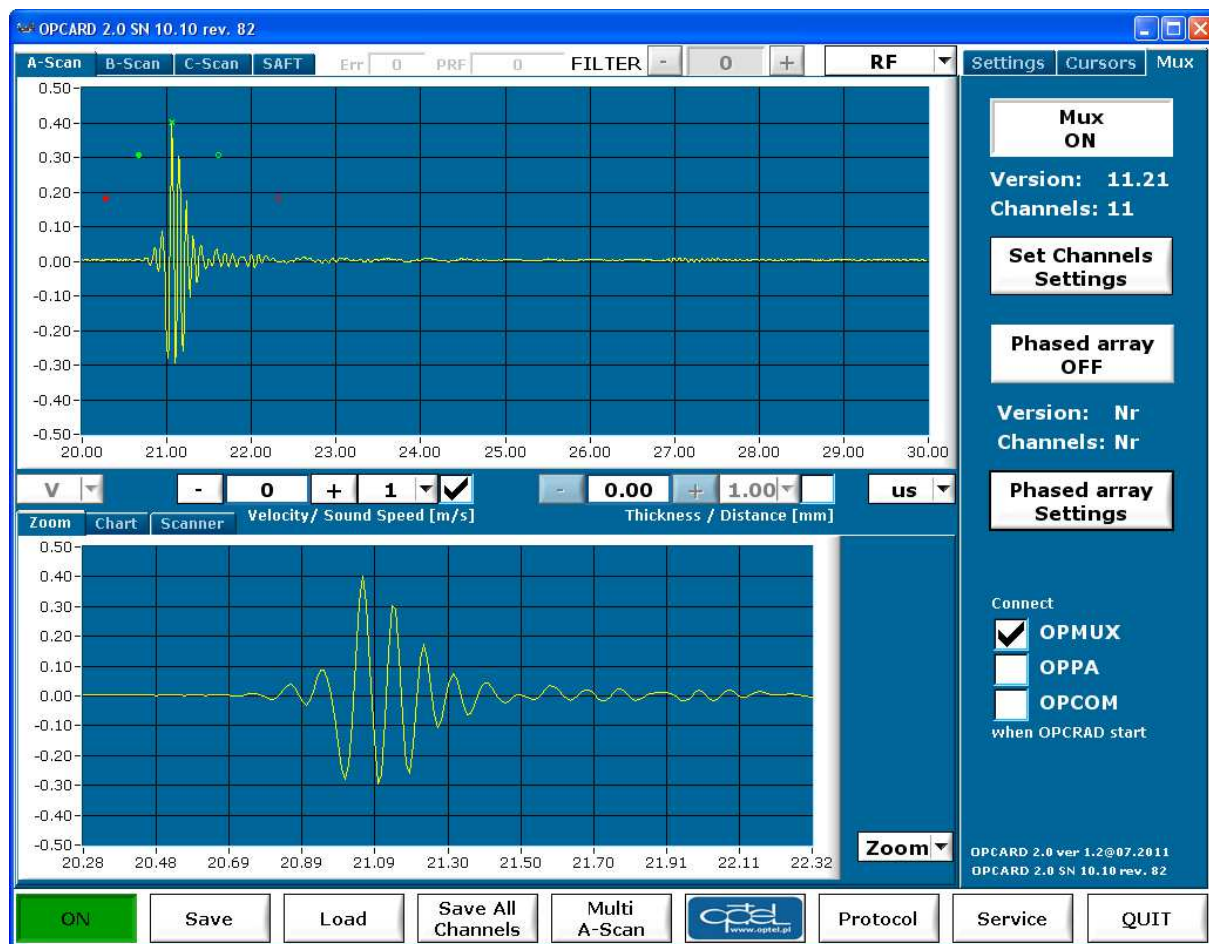
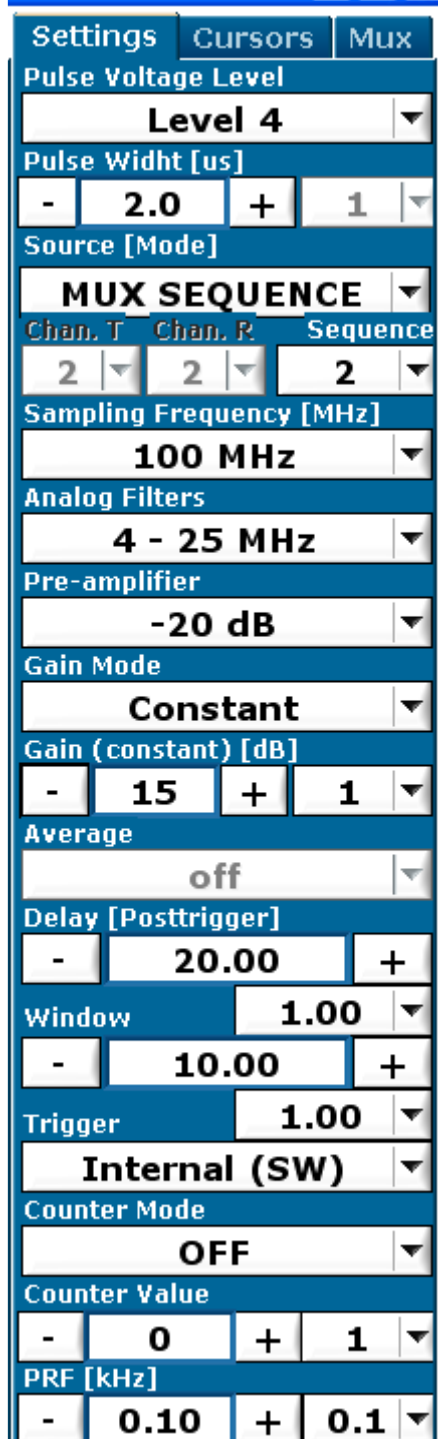


Fig. 4 Multiplekser settings tab

Hotkey	Function
F1/ ON/OFF	enables / disables selected acquisition mode -start /stop measurement
SAVE	Saving the configuration/settings file
LOAD	Load the configuration/settings file
Save All Channels	Saving the configuration for all multiplexer channels
Show Channels	Go to Multi – A-Scan (Show Channels)panel
Protocol	Go to Protocol/Report Panel
Quit	Quit

Setting on the main panel	Function
	Pulser Ampl - Set impulse voltage from off to 360V range in 16 levels Pulser Time - Set impulse length from 0us to 3.1us (step 0.1us, 1us) Source- PE – Measured input signal (sending/receiving); TT – Measured input signal (receiving); MUX SEQUENCE - Measured input signal (receiving from multiplexer in sequence mode); MUX RTS - Measured input signal (receiving from multiplexer in RTS mode); PA - Measured input signal (receiving from PA device) Ch T, Ch R, Sequence - This function allows choosing the channel, if multiplexer or PA is used. Filtr [MHz] – Set bandwidth pass filter: 0.5 -6MHz, 0.5 - 10MHz, 0.5 - 15MHz, 0.5 - 25MHz, 1 - 6MHz, 1 - 10MHz, 1 - 15MHz, 1 - 25MHz, 2 -6MHz, 2 - 10MHz, 2 - 15MHz, 2 - 25MHz, 4 -6MHz, 4 - 10MHz, 4 - 15MHz, 4 - 25MHz; Atten Hilo – Set attenuator and/or postamplifier: 0dB, -24dB, +24dB, +4dB; Trigger – Set Trigger Mode – internal/external. Internal – software trigger Ext.1 - Counter for Inc. Encoder Channel 1 Ext.2 - Counter for Inc. Encoder Channel 2 Counter Mode – Set counter mode: off, enable, disable. Counter Value - Set divider for counter for incremental encoder – for both encoder channels. Delay - The time distance between the pulse (trigger) and the beginning of the data window Sampling – Set sampling frequency: 100MHz, 50 MHz, 33.3 MHz, 25 MHz, 20MHz, 16.7MHz, 14.3 MHz, 12.5 MHz, 11.1 MHz, 10 MHz, 9.1 MHz, 8.3 MHz, 7.7 MHz, 7.1 MHz, 6.7 MHz. Depth – Set the length of the data window/memory GainMode - Set gain mode (switching between DAC and constant gain and freehand DAC) Gain [dB] – Set constant gain / amplification in range from -30 to +65[dB]

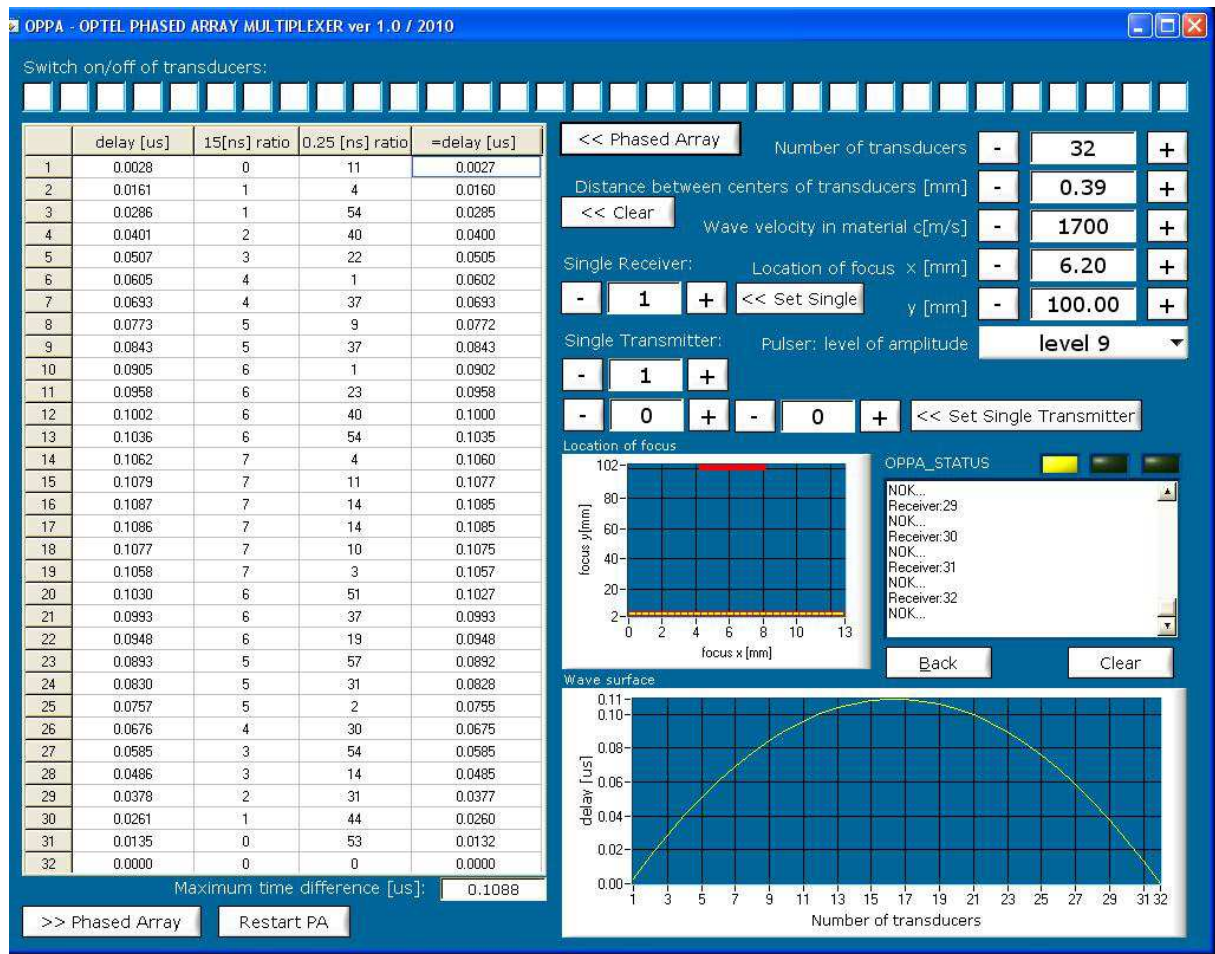
3.2.2. Cursors Tab

Cursor Settings	Function
OPC...ings Cursors Mux ☐ ON/OFF Measurent Markers SOFT REL MAX Offset - 0.00 + 1.00 TIM1 0.00 ☒ AMP1 0.00 ATT1 0.00 ☐ TIM2 0.00 ☒ AMP2 0.00 ATT2 0.00 ☐ TIM3 0.00 ☒ AMP3 0.00 ATT3 0.00 ☐ Distance [us] T2-T1 0.00 T3-T1 0.00 T3-T2 0.00 d Amplitude [us] T2-T1 0.00 T3-T1 0.00 T3-T2 0.00 d Attenuation [dB] T2-T1 0.00 T3-T1 0.00 T3-T2 0.00	ON/OFF Measurement – turn off/ on cursor measurement. Auto/Markers – set measurement mode: Auto – automatic, Markers – up to three markers. Soft/Hard – set measurement mode: SOFT software calculation, HARD – hardware calculation; Rel/Abs – set cursors mode: Rel – cursors position is constant, Abs – cursors position is changing according delay and depth value. MAX/LEVEL – set measurement mode within the measurement gate: MAX – calculating maximum value, LEVEL – calculating level value. Offset – (only for Auto mode), distance between first maximum value and second one of the signal. ☒ - on/off particular marker ☐ - alarm In the part of the cursor screen the positions of this gates and the maximum amplitude, attenuation, phase of signal is shown here.

3.2.3. Multiplexer Tab

Multiplexer tab	Function
SettingsCursorsMux MuxON Version: 11.21Channels: 11 Set Channels Settings Phased arrayOFF Version: NrChannels: Nr Phased array Settings Connect ☒ OPMUX ☐ OPPA ☐ OPCOM when OPCRAD start OPCARD 2.0 ver 1.2@07.2011OPCARD 2.0 SN 10.10 rev. 82	MUX on/off – turn off/on multiplexer device Version – actual version number Channels – number of available channels Set Channels Settings – showing multiplexer settings panel PA on/off – turn off/on PA device Set PA Settings – showing PA multiplexer settings panel

3.2.4. PA settings Panel



With this panel you can make all the settings that control the multiplexer operating in phased array mode.

Multiplexer operates with 32 ultrasonic transducers thus has 32 independent transmitting and receiving channels. Each channel is equipped with individual programmed delay lines, so the pulse transmitter on the channel is being shifted in time relative to other channels with the selected value (range: 0 - 3888.75 us). Power transmission is common to all transmitters and adjusted in the range 0 - 10V.

It is possible to broadcast a group of arbitrarily selected channels and to receive any pre-programmed channels in any order.

Switch on/off of transducers –top row of windows is used to enable/disable of each multiplexer channel;

Number of transducers: number of active channels in the measurement ultrasound head;

Distance between centers of transducers: physical parameter of an ultrasonic probe, determines the distance between the segments of the measuring head.

Wave velocity of material: velocity of sound in the test medium

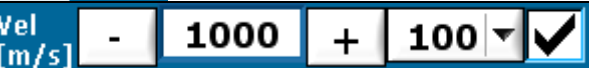
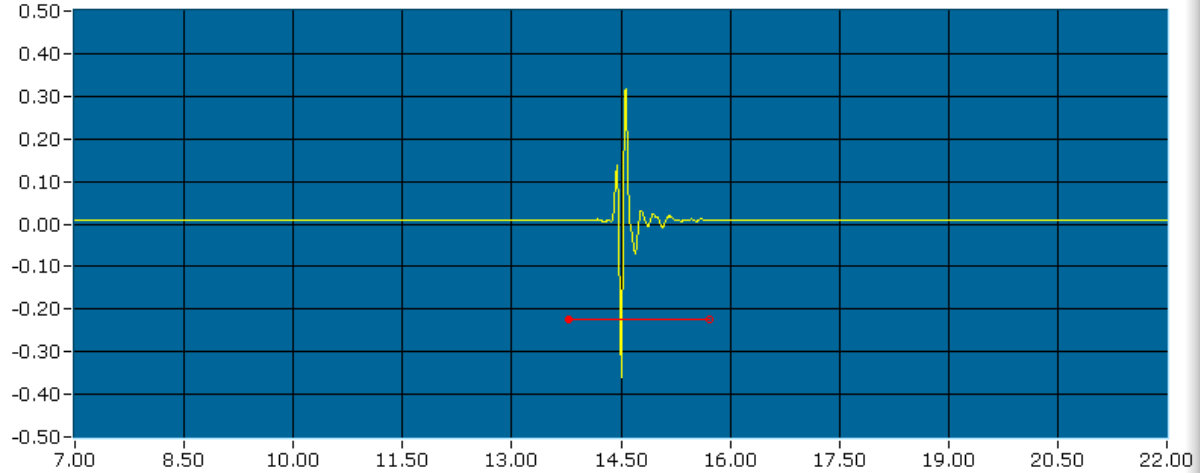
Location of focus: the location where is to be focused energy, from the edge of the head

Y [mm]: distance from the front of the head where is to be focused energy

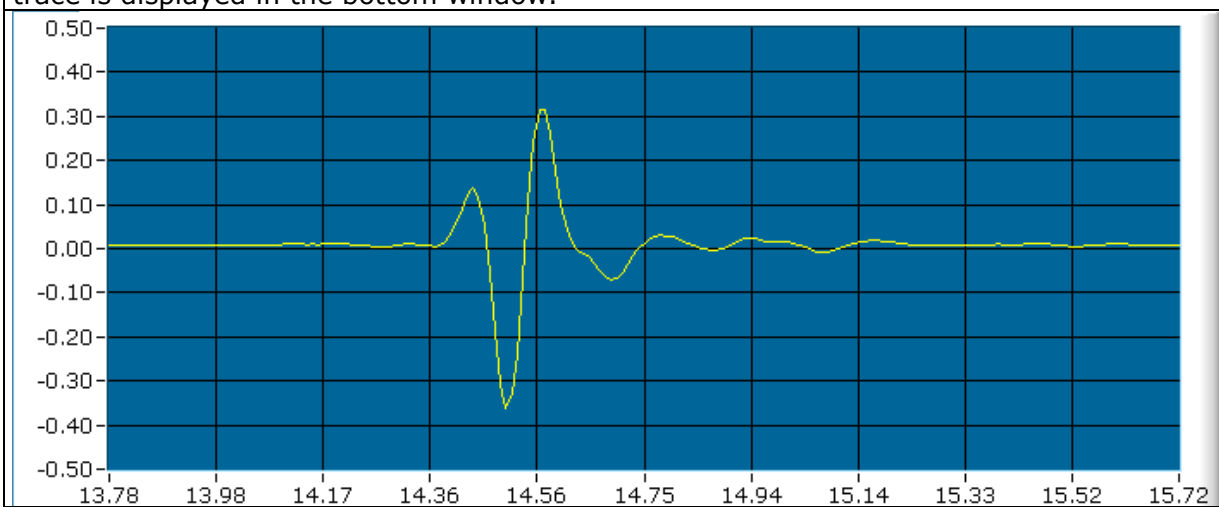
Level of amplitude: determining the amplitude of the transmitter - common to all channels.

After setting above parameters, click **<<Phased array** to cause the calculating of the delays for all channels. Clicking of the button **>>Phased array** enables the saving settings in the registers of the multiplexer. PA device is ready for use in phased array mode. **Back** button closes the panel.

3.2.5. Main panel with zoom and FFT

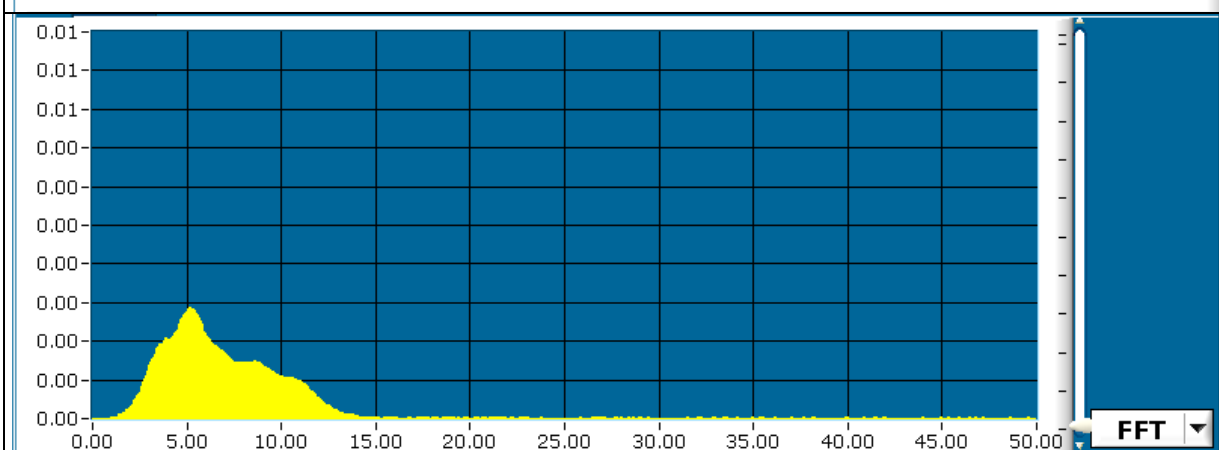
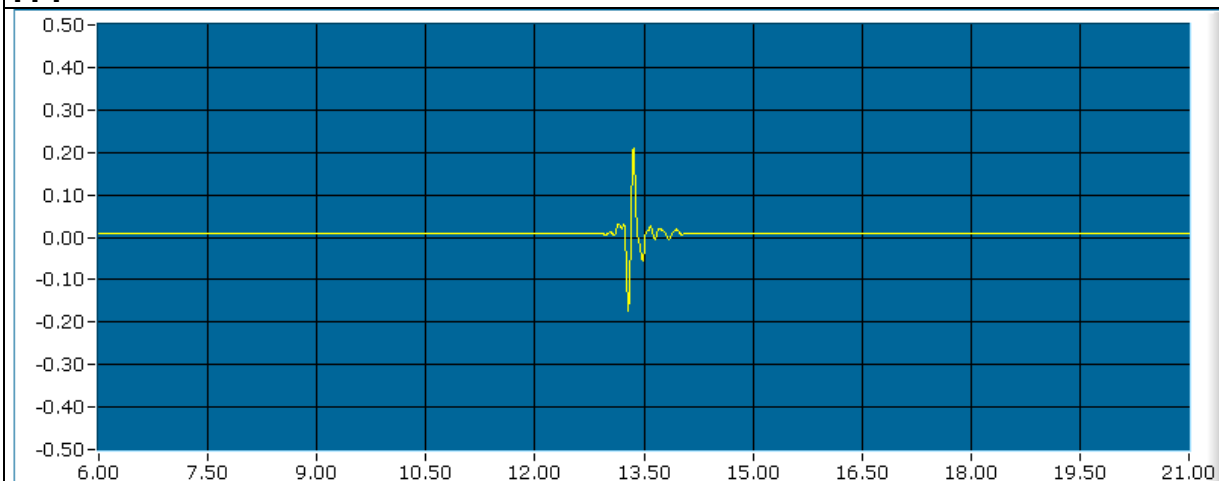
On the top of main panel	Function
	Choose between RF Signal and Detector (absolute, Positive and Negative) display in upper window.
	Set ratio for analog/absolute filter.
	Choose units axis Y among [dB], [%], [V]
 	This function works on following basis: the user chooses, which signals should be used for thickness and/or velocity measurement (for example the reflection from first and second wall of a sample with parallel walls) This allows to use this software with almost any kind of samples, containments etc. It is essential that staff who use this software has specialized knowledge of measurement
	Choose units axis X among [us], [mm], [inch]
On the bottom of main panel	
   	Bottom window can be used to show many different results. Its modes can be selected by click on the beam, placed on its right bottom side.
ZOOM	
	

Upper window – yellow trace of the measurement signal – red zoom cursor. Zoomed trace is displayed in the bottom window.



Bottom window – with zoom of the measurement signal chosen by red cursor in the upper window

FFT



This function shows the real part of the FFT of the whole signal, shown in the upper window

3.2.6. Amplification of the received signal and gain curve (TGC function)

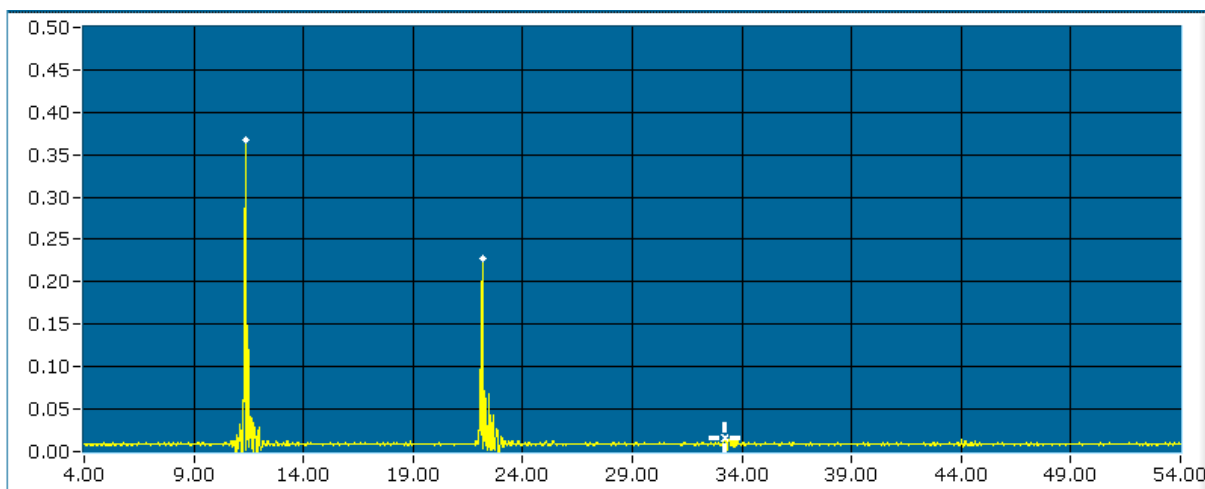
The OPCARD 2.0 has not only a simple amplifier, but a special function, allowing amplifying the signal depending on the time, passed from the start (trigger). This function is called time-gain compensation (TGC).

OPCARD 2.0 allows setting the curve which by using arbitrary waveform generator controls the amplifier during measurement. Upper window allows to create it if it is used gain curve mode. It is possible to select following modes:

1. Constant: Gain is not changed during the measurement time.
2. DAC Curve: curve is being created according to earlier saved signal in mode "gain constants". User defines how to curve goes pointing peaks of the signal. It will compensate exponential signal decay (typical for sound signals) by amplifying the signal by an defined factor that depends on elapsed time.
3. Free hand: Amplification depends on the curve that can be freely drawn at the upper window.

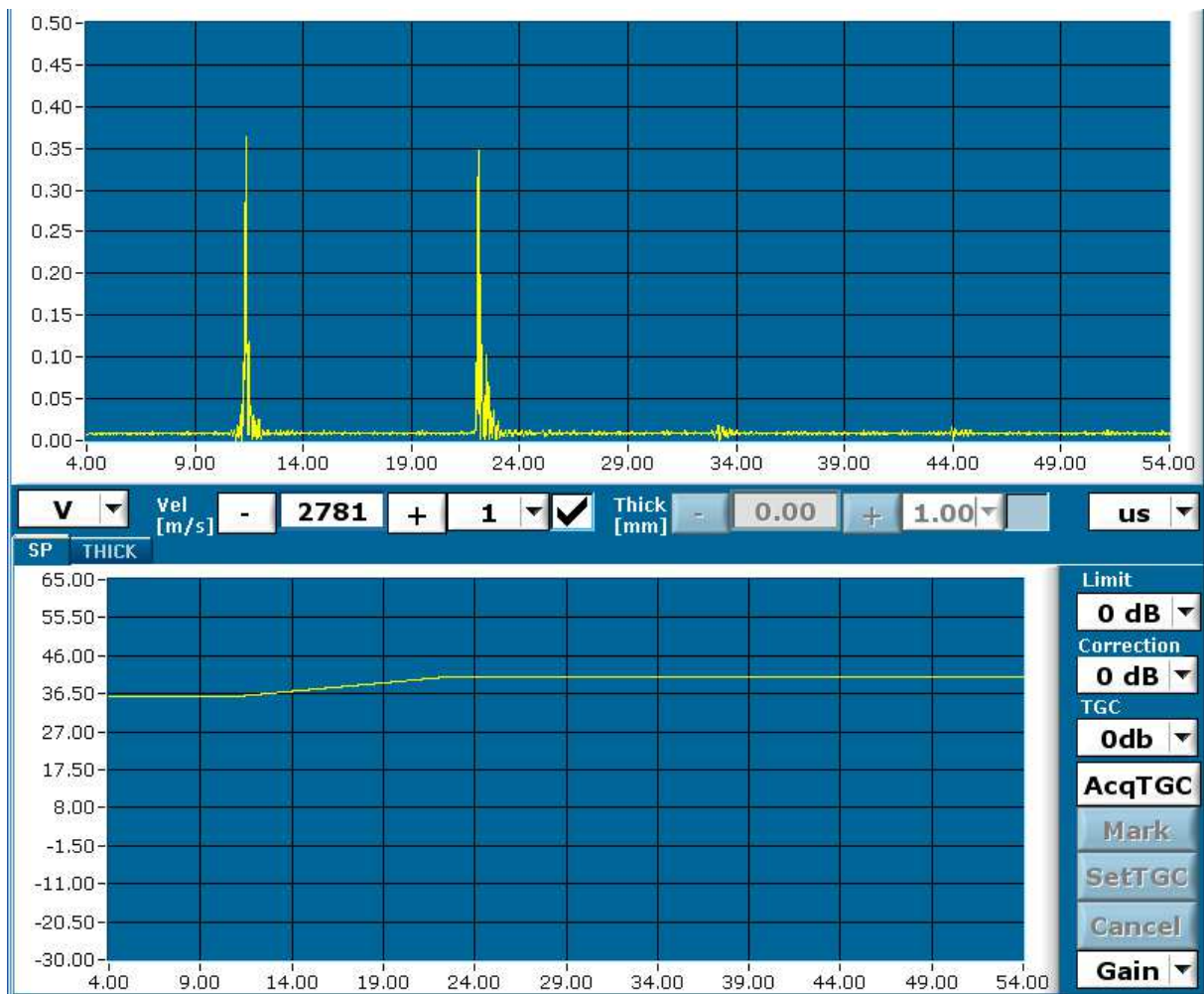
DAC:

Change **Gain** Mode to **DAC** mode. To draw the curve the user must click on **Acq** button. White cursor cross in the below window allows create the curve. First, the echoes height must be set. Select desired echoes clicking **right mouse** button or clicking **Mark** button on them. Notice, this procedure is always performed on the signal acquired with constant amplification (gain const mode).



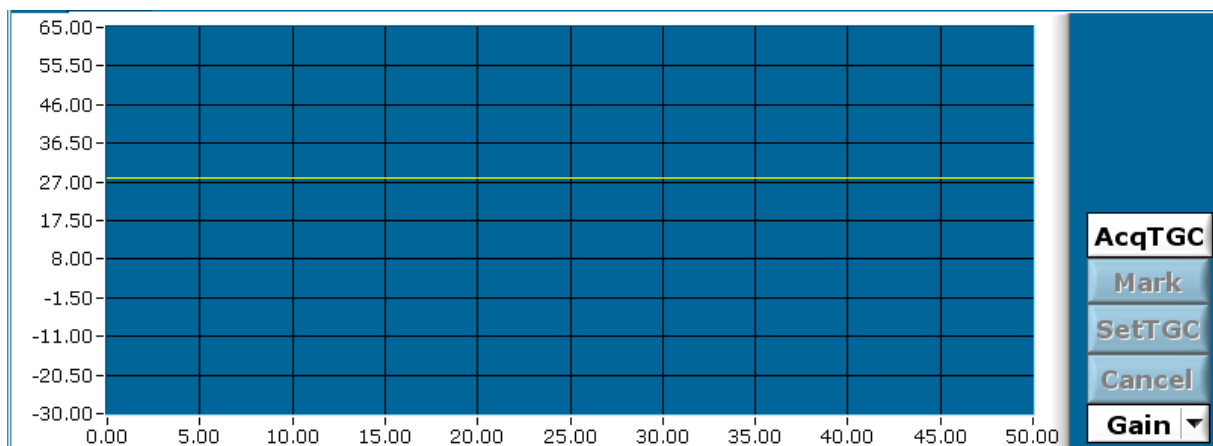
After the points are ready, click **Set** button a to complete the procedure for determining the parameters of the curve and make the transition to the TGC function, taking into account the set curve.

Result of TGC function:

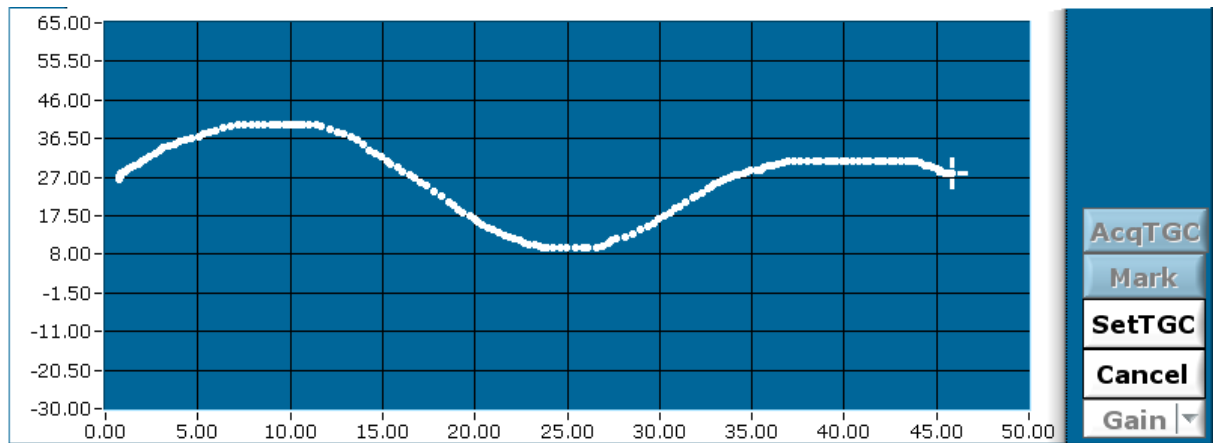


To correct curve use **Limit** and **Correction** buttons. This requires some experience especially in the case when echoes amplitude is very small. The curve will be changed automatic. Use DAC curve can be corrected in ± 6 db position.

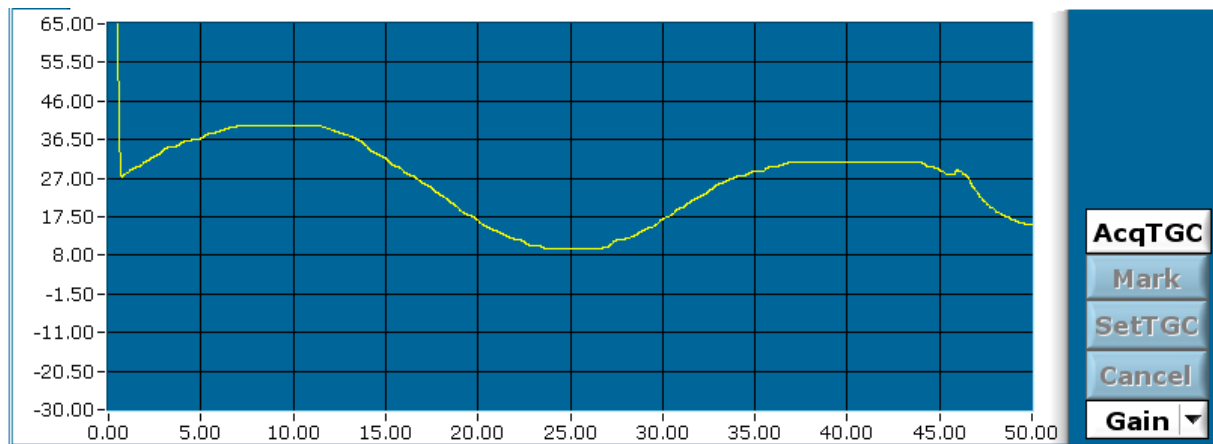
Free hand DAC:



White cursor cross in the upper window allows drawing the curve in the user wished way– after click on button: **Acq.**



To draw the curve the user has to click on **Acq**. After the curve is ready - on **Set** After the points are ready, click **Set** button a to complete the procedure for determining the parameters of the curve and make the transition to the TCG function, taking into account the set curve. Click **Cancel** to go back to the previous curve. Click **right mouse** button - to clear curve.



Result of TGC function (free hand DAC).

3.2.7. B-scan configuration Tab



Fig. 5 Main panel – B-scan tab

B-Scan		Function
Visible Lines		How many lines are showed on the picture (max 800)
-	101	
COLOR 1		Set three different colors palette.
Continous		Set three different scroll modes. Continous – data Scroll off the left edge of the plot area , new data appears on the right side; Block – Erase the entire plot when the data reaches the right edge; Sweep – Allow new data to overwrite old data, new data appears on the left side of data window.

3.2.8 Multi A-scan panel

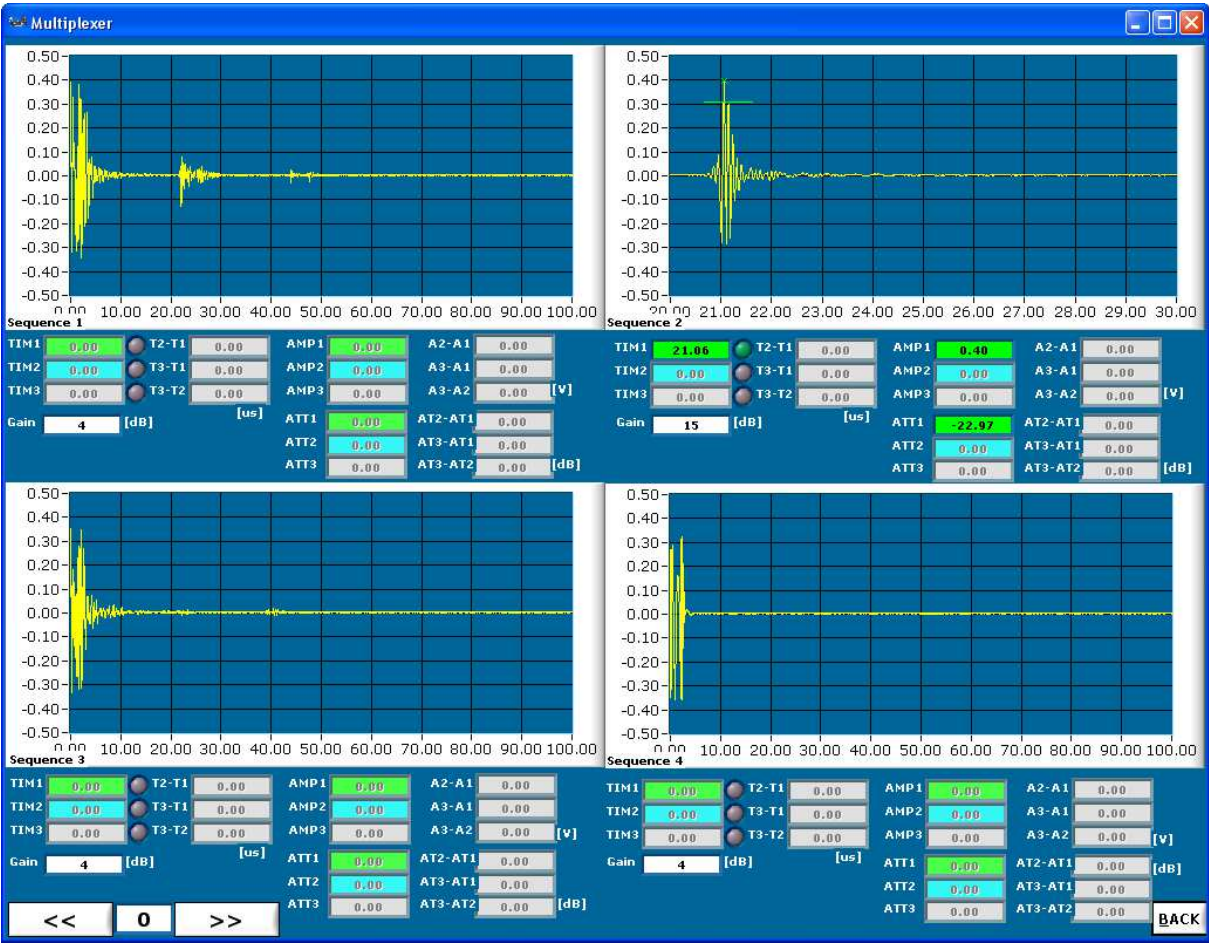
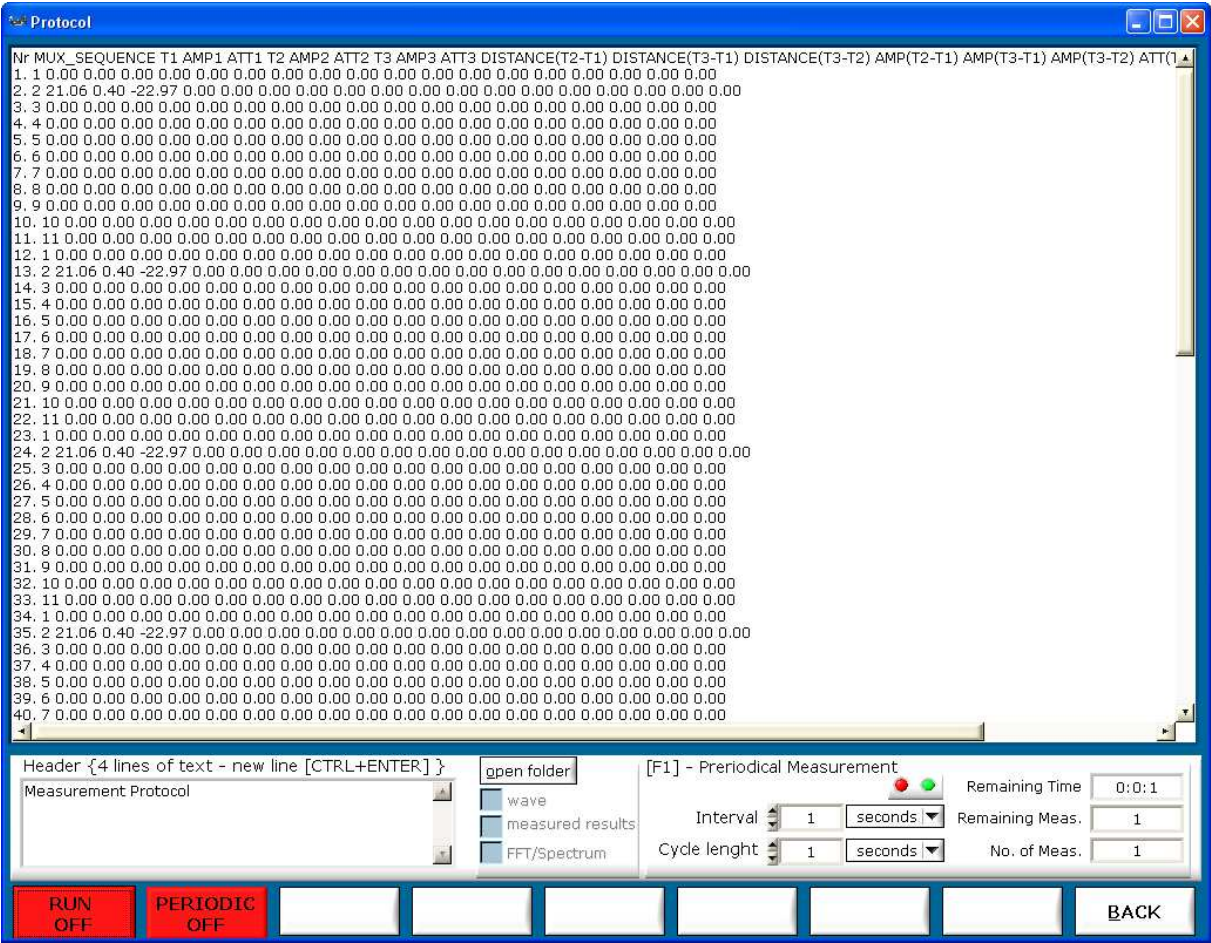


Fig. 6 Multi A-scan panel

This feature is only available if the multiplexer is connected to the OPCARD 2.0. You can watch four channels at the same time - waveforms and measurement results according to parameters set by setting cursors.

<<0>>	Select to group of channels to be shown.
BACK	Back to the main panel

3.2.9. Measurement protocol



Elementy panelu	Funkcja
RUN OFF /ON	Enable/ disable raport
	Measurement results are shown on the screen as text.