



R&D: Ultrasonic Technology / Fingerprint Recognition

Przedsiębiorstwo Badawczo-Produkcyjne

**OPTEL** Sp. z o.o.

ul. Otwarta 10a

PL 50-212 Wrocław

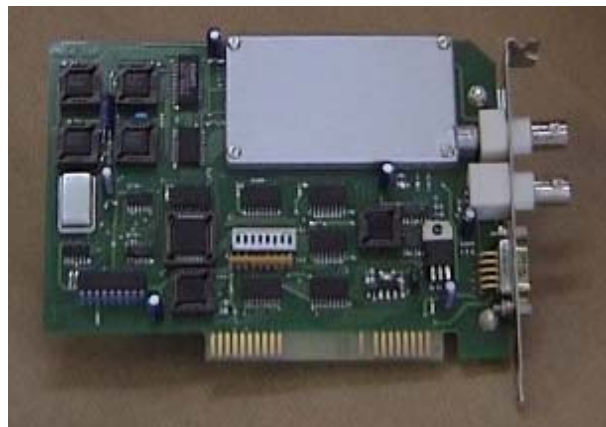
tel.: +48 (71) 329 68 54 fax: 329 68 52

NIP 898-10-47-033

e-mail: [optel@optel.pl](mailto:optel@optel.pl) <http://www.optel.pl>

## Guide to OPKUD and OPBOX Ultrasonic testing units Software Revision 3.0 / 2003

OPKUD-01/100 is designed specially for ultrasonic measurements with the need of A-scan pictures as well as other kinds of measurements which employ mechanical scanning elements or multiplexed channels (the card is capable of controlling such devices) – where B or C-scans can be a result. Together with the pulser&receiver unit OPGUD-01 (placed in a small box), ultrasonic probe and software it could be used as complete ultrasonic testing device. OPKUD-01/100 is a short (8-bit) ISA card and can be installed in a standard PC computer. OPGUD card can be delivered mounted in a box, containing power supply and battery, that can be used with a portable computer, equipped with a centronics interface. This device is named as OPBOX. There are two versions of OPBOX: one version can be used with a normal OPGUD pulser&receiver, the second one contains additional electronics allowing to control the special version of pulser&receiver, containing additional amplifiers and filters. Both card and a box can be supplied with 8 channel multiplexer, where each channel can send and receive in any sequence (the same channel can send and receive too). Each channel of this multiplexer has the same features as OPGUD pulser&receiver.



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### Technical data OPKUD card

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#### A/D converter:

- Resolution: 8 bits
- Sampling frequency: 50 or 100MHz<sup>1</sup>

#### Analog parameters:

- Input channels: 2 (switched): send & receive and receive
- Input amplifier gain: 0dB, 6dB, 14dB, 20dB, 26dB, 34dB, 40dB (hardware amplifier on the card)<sup>1</sup>  
additional 33dB in echo mode (amplifier in the pulser & receiver box)  
total possible gain: 110dB (with software amplification)

-Input attenuator 10dB<sup>1</sup>  
 -Minimal sensitivity: 0.1mV/Div -1mVpp (with software amplification)  
 -Maximal sensitivity: 50mV/Div - 0.5Vpp  
 -Averaging 1 – 256  
 -Bandwidth: 0,1 – 25MHz  
 -Input impedance: 50Ω, 10pF  
**Trigger:** internal (software), external, max 2 kHz  
**Delay time:** Post trigger 256us, measurement accuracy better than 1ns  
**Pulser:** Step pulser, 50V -300V  
 in 8 levels (the voltage depends on the used transducer), 20ns edge falling time, separate, match box size  
**Data buffer:** 256, 512, 1K or 32K<sup>1</sup>

1 - software selected

### Signals on external connectors:

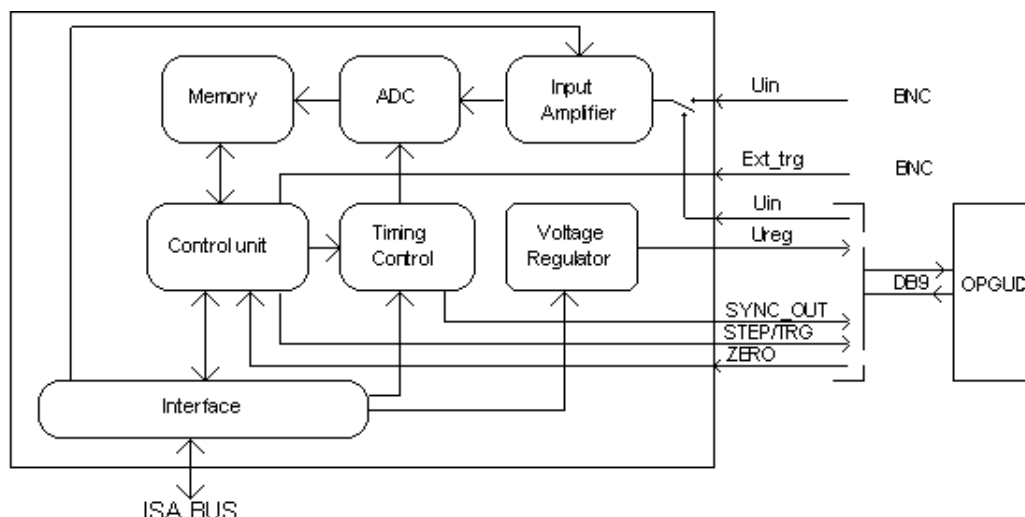
#### DB9:

- Uin - measured input signal;
- SYNC\_OUT- pulse generator control;
- STEP/TRG - step motor control or external trigger input (software selected);
- ZERO (TTL-input signal) - position marker (e.g. generated by an optical or mechanical sensor).
- Ureg (out) - software controlled voltage (2-10V, 8 steps) used for pulse amplitude control of the OPGUD pulser&receiver units;

#### BNC:

- Uin - measured input signal;
- EXT\_TRG external trigger;

### Block diagram of the card:



### Characteristic of the card:

It can work in two modes:

- Automatic: The measurement is controlled with the software and the sync\_out signal triggers the measured unit (scan A and B)

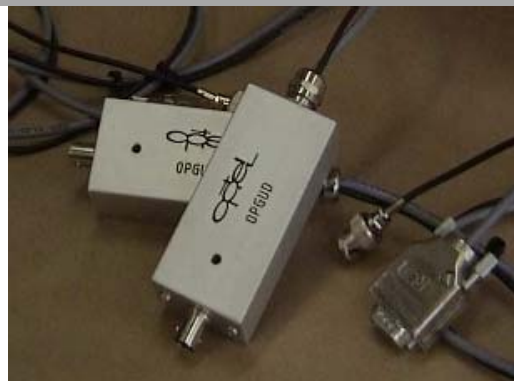
- Classical oscilloscope: measurement is controlled by the external TTL trigger signal.

**One of the most important features of the card is a precise synchronization between the trigger signal and the moment when the sampling of the input signal starts. This synchronization is significantly better than 1ns, that causes, that time of flight measurements can be made with accuracy better than 0.1ns.**

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, but is achieved with much cheaper electronics.

### OPGUD-01 Pulser&Receiver

The basic version of our pulser&receiver circuit have the size of a matchbox and integrated amplifier. It is powered directly from our oscilloscope card and enable the adjustment of the transmitter voltage directly from a PC. This device is intended for use with our OPKUD card or OPBOX.



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### Specifications:

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<b>Pulser:</b>	Step pulser, 50V –360V in 8 levels (the voltage depends on the used transducer), 20ns edge falling time, separate,
<b>Amplifier:</b>	33dB
<b>Size:</b>	40x85x25mm

### Features:

Pulser circuit waveforms: The rising edge of the Trigger signal (described as Trig Inp) initiates the transducer charging process which takes about 3 $\mu$ 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).

### Comments:

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).

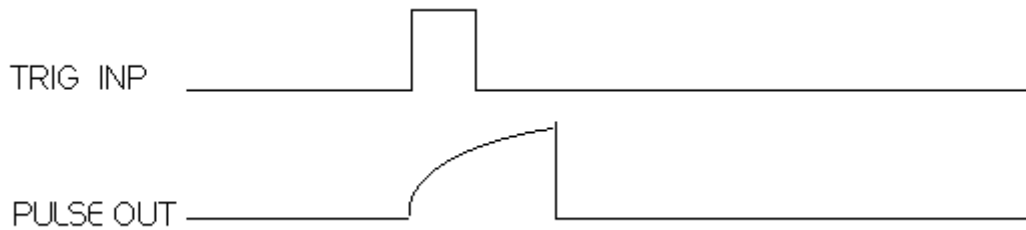
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**Signal form:**

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**Ultrasonic Testing Box  
OPBOX-01/100**

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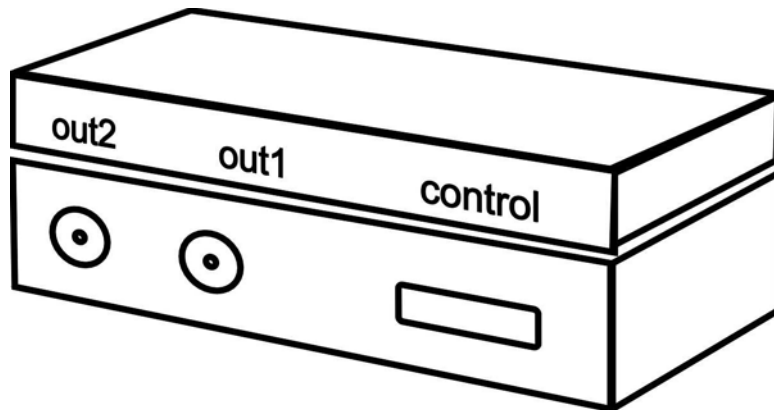
This device contains an Opkud card (special version), power supply with integrated sealed lead acid battery and parallel interface. It has size, suitable for convenient work with a notebook computer placed on it. On the picture it is shown with a standard pulser&receiver OPGUD.

**Interface:** Parallel (Centronics DB25 - female) EPP mode necessary  
**Power supply:** 220 or 110V, 4 hours work with the internal battery Sealed Lead-Acid  
**Size:** 255x295x50mm  
**Weight:** 2700g

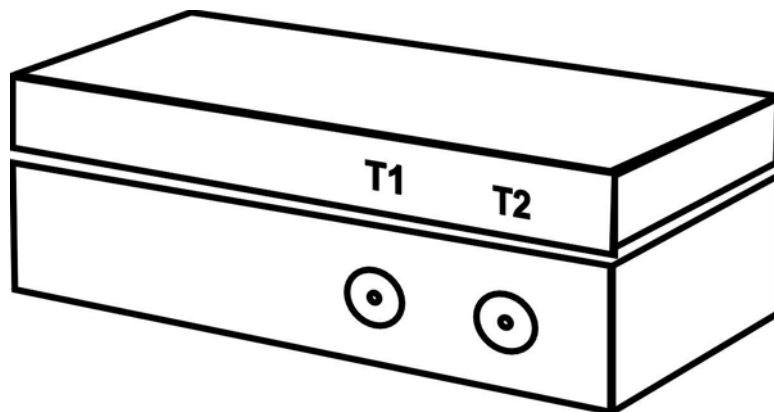
## Special External Pulsar/Receiver with Amplifier

The Pulsar/Receiver is equipped with additional amplifiers and can be used only with modified version of OPBOX, containing an interface for controlling it. One amplifier is used for PE (Pulse-echo - one-transducer) mode and second one for TT (two-transducers or through transmit ) mode.

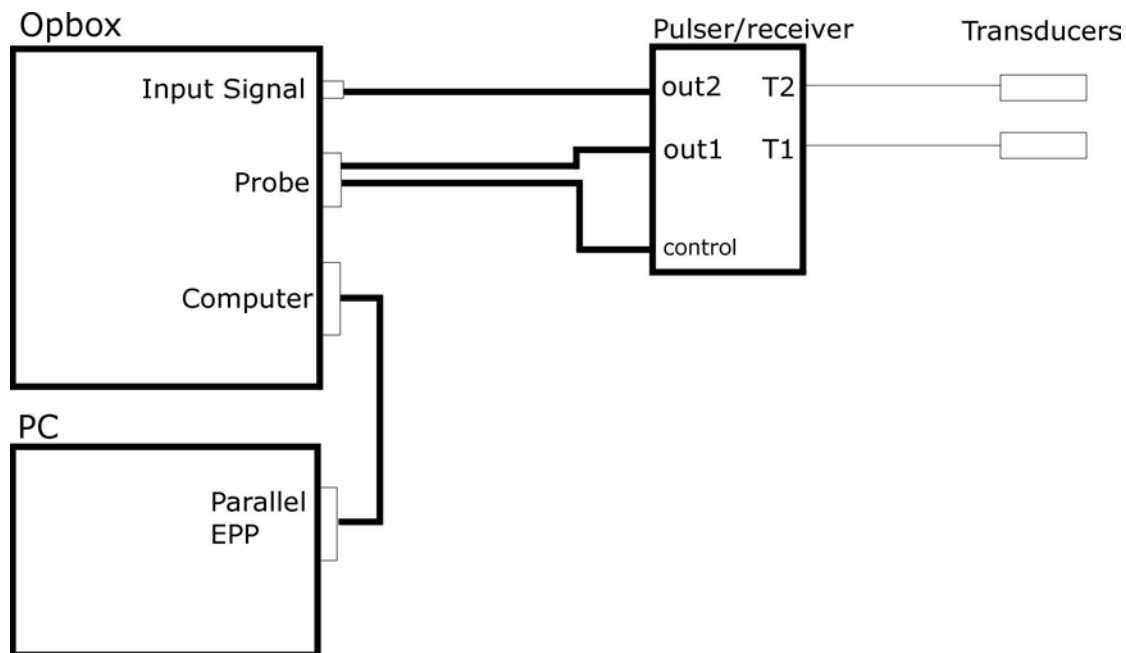
Gain range of both of amplifiers is 0 – 50 dB controlled with 0.2 dB step.



Front view of Pulsar/Receiver



## Rear view of Pulsar/Receiver



### Diagram of connections of all parts of the system.

The "Diagram" shows how all parts of the system are connected. "T1" and "out1" serves in one-transducer mode, connecting additionally "T2" and "out2" you can work with two-transducers mode where T1 is sending transducer and T2 is receiving one.

The Pulsar&Receiver is featured with switch able pass filter. It is 0.5 to 8 MHz or 0.5 to 15 MHz bandwidth.

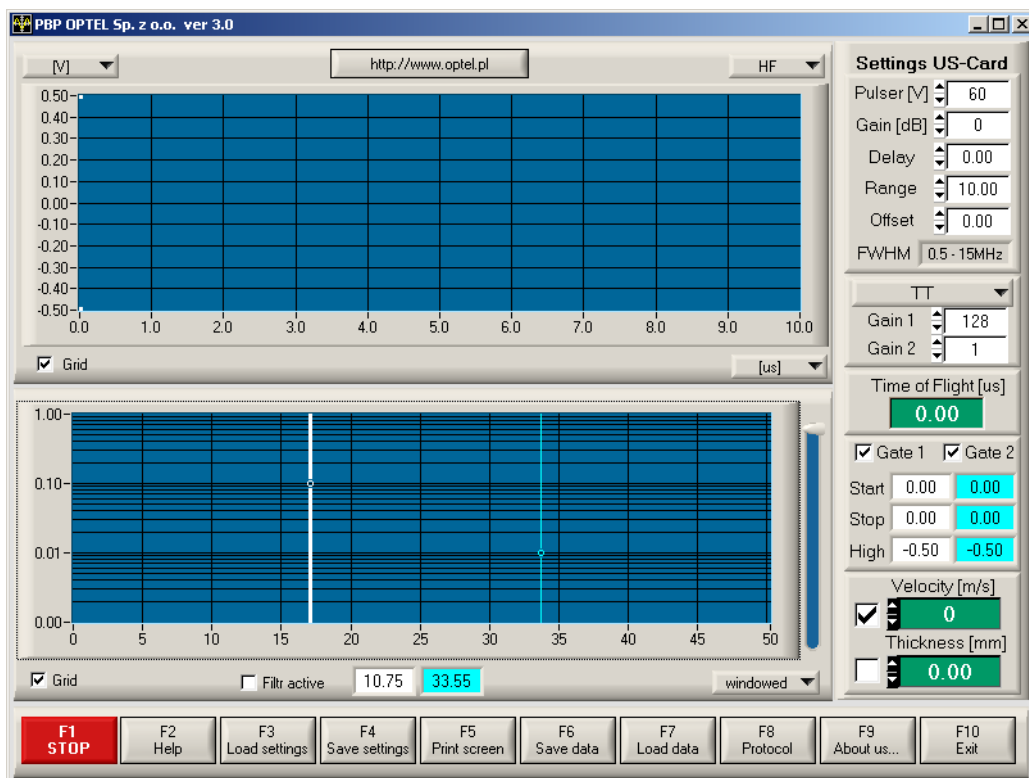
Using this version of pulser&receiver the amplification on both channels (TT and PE) is the same and can be controlled from computer.

## Software

In order to use the Ultrasonic Testing Card OPGUD or OPBOX-01/100 with a described software, the following equipment is necessary:

Computer System:	IBM PC
Display Adapter:	SVGA Adapter working in mode 640x480 or higher (recommended 800x600)
Operations System:	Windows 95, 98, ME, XP or Windows NT or 2000.
Interface for OPBOX:	Centronics with EPP mode

## Main Panel Overview:

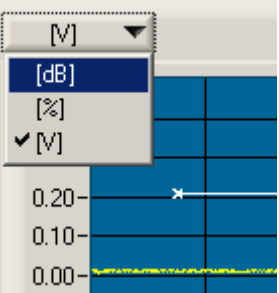
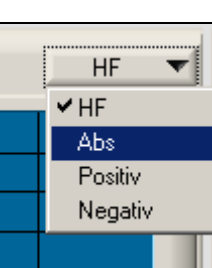
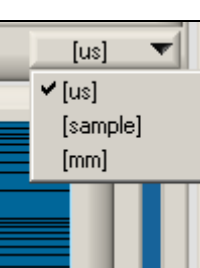
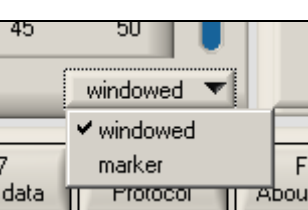
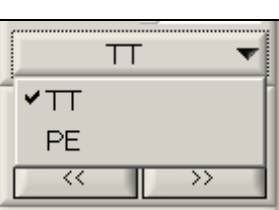


## Overview of Hotkey Selection:

Hotkey	Function	Description
[F1]	RUN / STOP	enables / disables selected acquisition mode
[F2]	Help	About as...
[F3]	Load settings...	Load in a previously saved data file and restore the capture settings as they were when the data was saved
[F4]	Save settings...	This option creates one file that contains both the current settings and the current data. The setting saved are the same in the Save Settings option.
[F5]	Print	This option will create a hardcopy of the screen into IBM Graphics mode compatible printers. The printout will include everything currently on the

		screen.
[F6]	Save data	Save waveform with current settings
[F7]	Open data	Open waveform with settings
[F8]	Protocol	
[F9]	About us...	Short information about OPTEL
[F10]	Exit	Exit to system

On the scope screen:

	<p>Choose units axis Y between [dB], [%], [V]</p>
	<p>Choose between RF Signal and Detector (absolut, Positiv and Negativ) display in upper window.</p>
	<p>Choose units axis X between [us], [sample], [mm]</p>
	<p>Choose mode of Fourier spectrum display, marker mode allows to choose the signal region, form which FFT is made.</p>
	<p>TT – Through Transmission Mode PE – Pulse Echo Mode</p>
<p>Grid ON/OFF</p>	<p>Toggle on/off the display of the division grid</p>

Filtr active	Toggle on/off filtering of signal
Pulser [V]	Amplitude of Pulse
Gain [dB]	-20 to 40dB with 1dB step
Delay	Begin of signal window
Range	Length of signal window
Offset	Voltage offset
Find First Echo	Search the first echo
<< >>	Search the next signal or the last before the signal that is displayed
Velocity [m/s]	

### Measuring - Cells:

Time of flight [us]	Time of flight
Thickness [mm]	Thickness

### Description of software for measurement of time of flight.

This software package allows to measure time of flight.

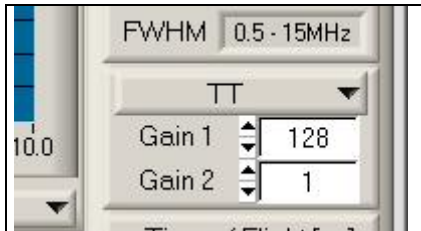
For each measurement it is necessary to choose reference signal and compare it with the signal, coming from the measured medium (reflected or transmitted through it). This allows to use this software with almost any kind of samples, containments etc. For people using this software it is necessary to have some knowledge about such kind of measurements, physics of ultrasounds etc

### The time of flight and thickness measurement method.

Time of flight - Using white marker in the upper window the interesting part of the signal should be chosen (or signal from the first wall).

Thickness – Using blue marker in the upper window the signal from the second wall should be chosen.

Guide to control amplify and filter :

 <p>The screenshot shows a control panel with a vertical scale on the left labeled '10.0'. The main panel includes a 'FWHM' dropdown menu set to '0.5-15MHz', a 'TT' dropdown menu, and two gain controls: 'Gain 1' with a value of '128' and 'Gain 2' with a value of '1'.</p>	<p>Toggle filter of 0.5 – 15 MHz with 0.5 – 8 MHz</p>
	<p>Gain setting with 0 - 255 levels, corresponding to range 0 – 50 dB</p>