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OPVibr
Ultrasonic vibration measurement system
Ultrasonic vibrometer

INSTRUCTION MANUAL

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2. 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.

3. Technical description

3.2 Standard equipment

- Ultrasonic vibrometer OPVIBR
- Ultrasonic probe (ultrasonic sensor)
- Data acquisition system (In current version of system: oscilloscope USB PICOSCOPE 2204A-D2 produced by Pico Technology)
- BNC Cable
- Power supplay
- Manual

3.3 Purpose

OPVIBR is vibrometer used to study vibrations occurring in many areas of life - in the diagnosis of drives of machinery or measurements of vibration impacting on humans and the vibration, the source of which is a man.

The device provides a non-contact vibration measurement that does not affect at the tested object.

The instrument is used in the research of components of engines , pumps, gears, bearings, fans and other rotating machinery.

Advanced software of vibrometer enables a quick and convenient signal processing.

4. Specification

Parameters	Value	Caution
The frequency range of transmitted wave:	30kHz-800kHz	in internal clock mode: 284 089,29 Hz, ±100ppm
The amplitude of the transmitted wave:	max. 70Vpp	ver 1.0: max.50Vpp
Output voltage range:	0-5V	
The frequency range of vibration:	1Hz - 30kHz	
The minimum measurable amplitude of the vibration:	<1µm pp	It may vary depending on the vibration frequency
Output resistance:	3.9kΩ	
Supply	12VDC; 0.5A	
Dimensions:	140x35x150mm	WxHxL

5. Description of Input/Output

BNC:	Transmitter	- Output of continuous wave transmitter
	Output	- Output of demodulated signal
	Receiver	- Input of receiver transducer
	ext. Clk	- Input for external clock (optional)
Switch	Clk int/ext	- switch of clock internal / external
DC2.1	12VDC	- power supplay

Caution:

BNC connector is connected with the wave generator. The maximum voltage of the pulse on this connector can reach about 70 Volts peak-peak. In some cases it is dangerous to the human, and can destroy electronic circuits or transducers if not used carefully

6. Working principle

OPVibr was created to measure vibration – its frequency and amplitude. The device generates continuous wave with constant amplitude and frequency on analyzed, vibrating surface using piezoelectric transducer. Reflected wave has modulated frequency and phase – deviation of frequency and phase contains information about movement of analyzed object. This signal is received by another, isolated transducer and then, OPVibr amplifies and demodulates it.

There are two ways of wave modulation:

- Doppler effect: When acoustic wave (carrier) approaches to the vibrating element, it can be perceived like harmonically-moving sound source.
- Periodic changes of signal phase induced by position change of reflecting surface.

Demodulation is based on comparison of generated and received waves. Identical center-frequency of wave is achieved by using same, stable time base. It also makes measurement precision independent from absolute value of frequency – only jitter is significant.

Figure 1. Ultrasonic measurement system

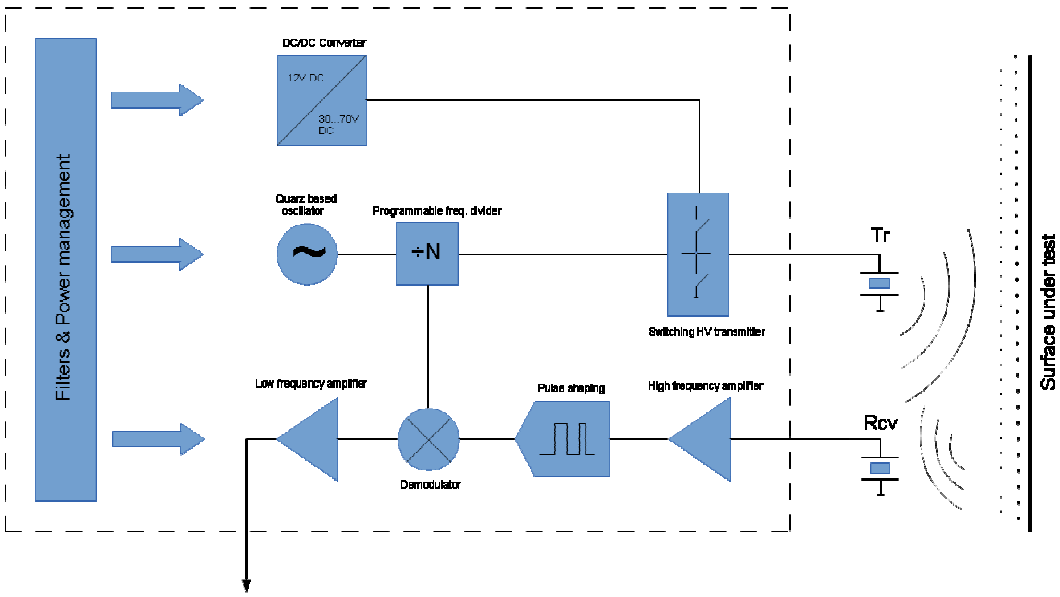

Figure 2. Block diagram of device

7. Description of Input/Output (IO), functional blocks of device

7.2 Input/Output:

- Output of continuous wave transmitter,
- Output of demodulated signal,
- Input of receiver transducer,
- Input for external clock (optional)

Additionally, our device is equipped with high-voltage converter – the circuit requires only one supply voltage. OPVibr also has built-in quartz based clock, which guarantees stable time base.

7.3 Transmitter

Female BNC connector to plug the transducer generating continuous wave. Transducer is driven with sine wave with amplitude of 35 Vpp and frequency of approximately 300 kHz. This output is AC coupled.
Connect transducer to this output.

7.4 Receiver

Female BNC connector to plug the transducer receiving wave reflected from the oscillating surface.
Connect transducer to this input.

7.5 External clock

Female BNC connector. Optional input to external clock, setting the continuous wave frequency. It allows to synchronize the device with other set of transducers. Input accepts 5V TTL/CMOS voltage logic level. To use this input, user must set the switch to clk ext position. Frequency of signal on Transmitter output is equal to the frequency of clock divided by 88. Clock signal should have low jitter to minimize noise of the output signal.

7.6 Output of demodulated signal

Female BNC connector. Output of signal achieved by demodulation of reflected wave. Its amplitude and frequency is correlated with oscillations of reflecting surface. Output voltage is in range of 0 up to 5V and is DC coupled. Coefficient of relation between AC voltage and oscillation amplitude is about 100mVrms/1um.
Connect this output to oscilloscope input.

8. Data acquisition system

OPVibr contains analog output 0...5 V; demodulated signal can be observed using standard oscilloscopes. Fourier transformation (DFT) and digital filtration can be very useful in signal analysis. DFT significantly facilitates measurement of vibration frequency, existence of harmonics and amplitude of signal with high level of noise. Digital filtering helps in dealing with noise in signal.
In current version of system, oscilloscope USB PICOSCOPE 2204A-D2 produced by Pico Technology was used. It has two input channels and signal generator.
Crucial parameters of this oscilloscope are (recommended values are listed in brackets)

- Analog bandwidth 10MHz (>50kHz)
- Sampling rate 100Msps (>300ksps)
- High input impedance (>100kΩ)
- Up to 12bit resolution (>8bit)

Detailed information about to oscilloscope and its' software can be found on producers' web site: Pico technology .

Producer provides controlling software for PC with oscilloscope. Figure 3 and figure 4 shows two useful modes of operation – real time view of signal (3) and magnitude of Fourier transform of the signal.

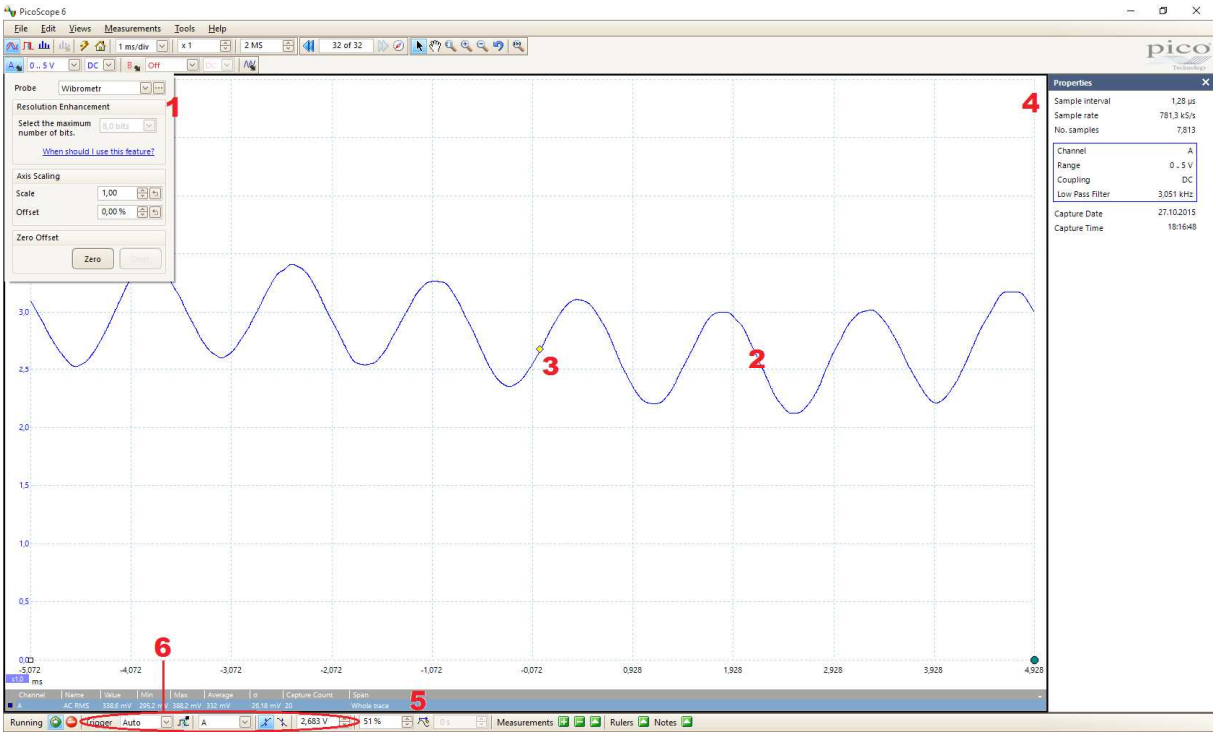

Figure 3. Main screen from oscilloscope software (PICO OSCILLOSCOPE).

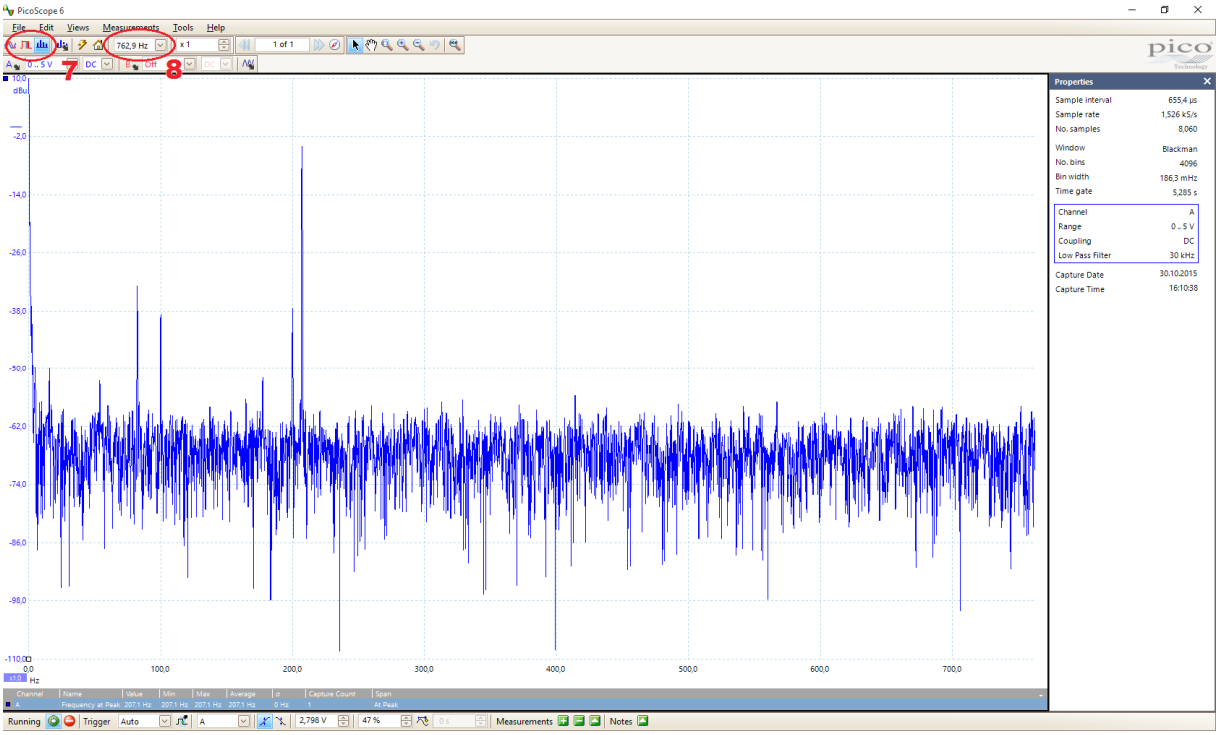

Figure 4. Screen of measurement of software in FFT mode

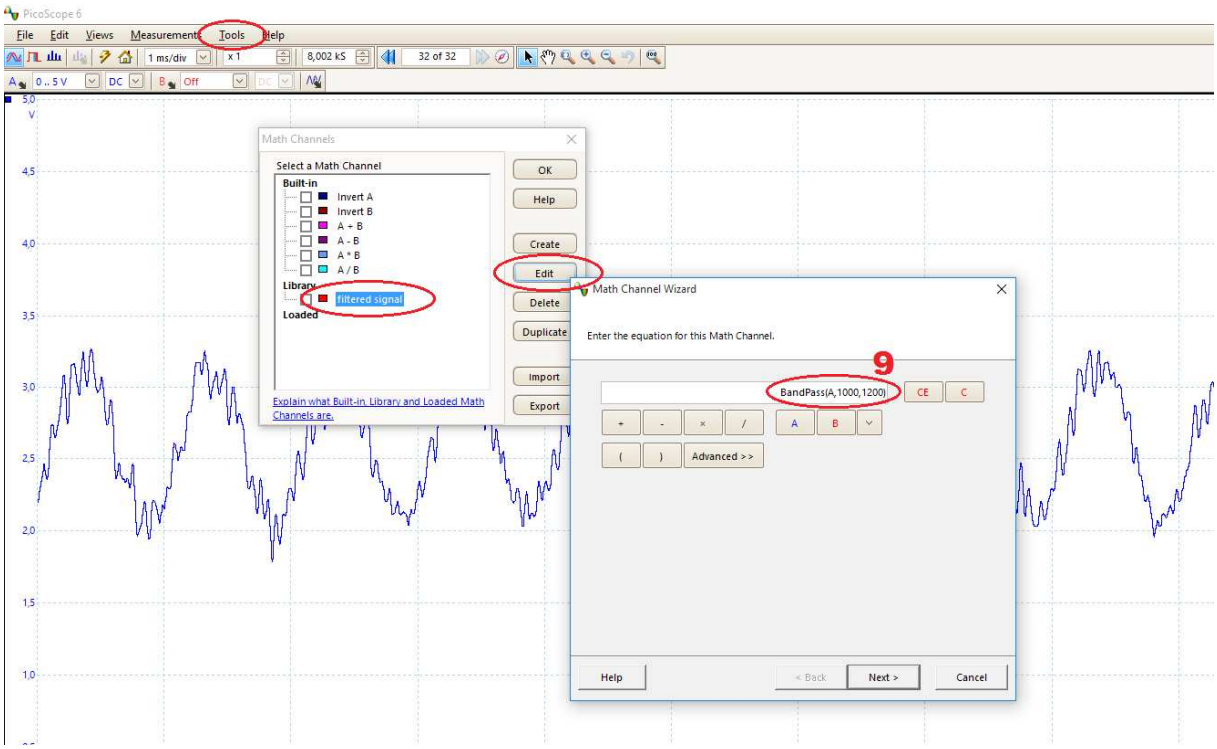

Figure 5. Setting up a digital filter

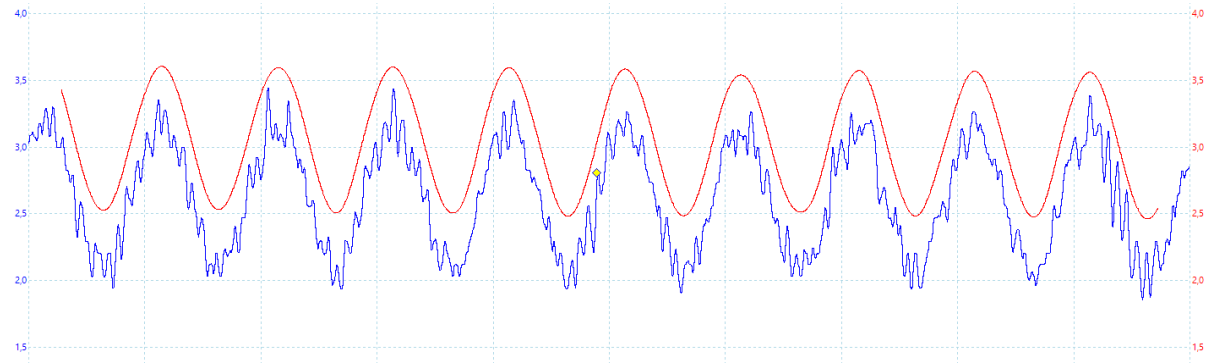

Figure 6. Comparison of filtered and raw signal

Legend:

1. Area of probe settings
2. Measured signal
3. Indicator of trigger level
4. Table of oscilloscope settings
5. Table of set measurements
6. Trigger settings
7. Spectrum mode switch
8. Setting of frequency / sampling axes
9. Bandpass filter setup

9. PICO Oscilloscope Software

For more information about PICO Oscilloscope Software please visit *Pico Technology* website: https://www.picotech.com/oscilloscope/2200/picoscope-2200-manuals