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Ultrasonic Pulse Generator Receiver

1.Instrument Overview

1.1 Product Description

PR10 developed by YUSHI INSTRUMENTS is a computer-controlled ultrasonic pulse generator and receiver with excellent performance.

The product includes a control program software based on the Windows platform, which can select the trigger source, transmission voltage, repetition frequency and pulse width, and can also switch the single/twin mode of the receiver, adjust the damping and gain to meet the different needs of users.

Users can also use the open SDK software development kit to independently develop application software under various mainstream Windows systems.

Connecting an ultrasonic probe and an oscilloscope can help perform ultrasonic flaw detection, thickness measurement, probe detection, etc. It has a wide range of uses in non-destructive testing, material analysis and other fields.

1.2 Structural Composition

The product includes the instrument itself and the corresponding control software. The instrument parameters are set in the control software.

The ultrasonic pulse generator and receiver is an independent instrument with dimensions of 140 mm in length, 88 mm in width and 30 mm in height.

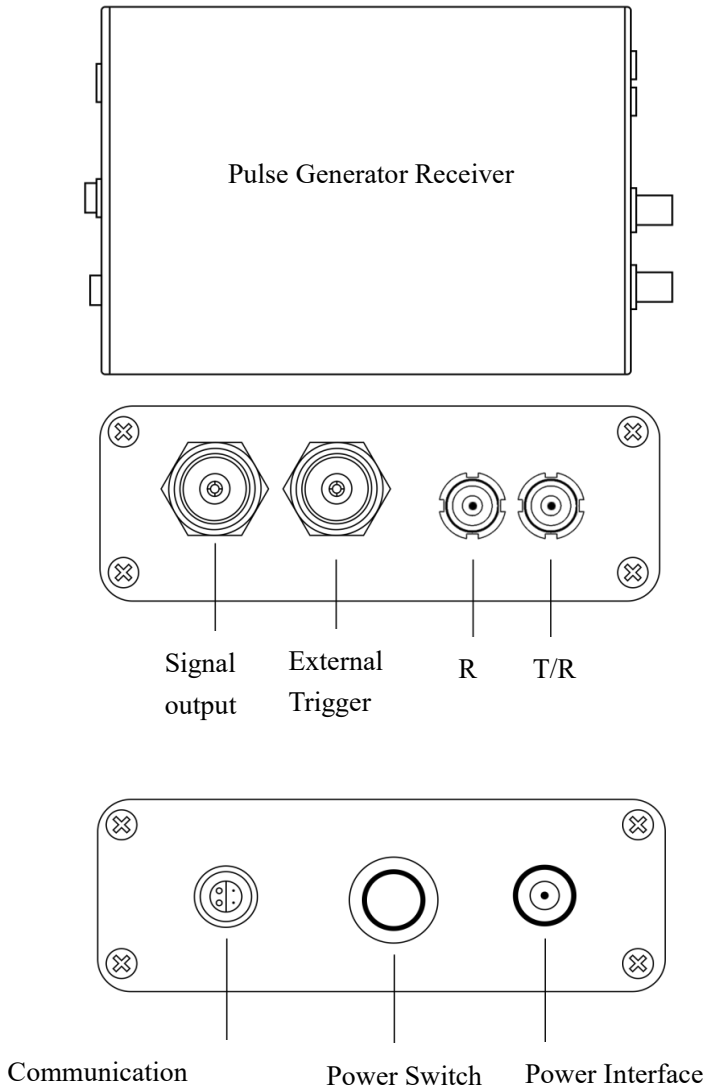


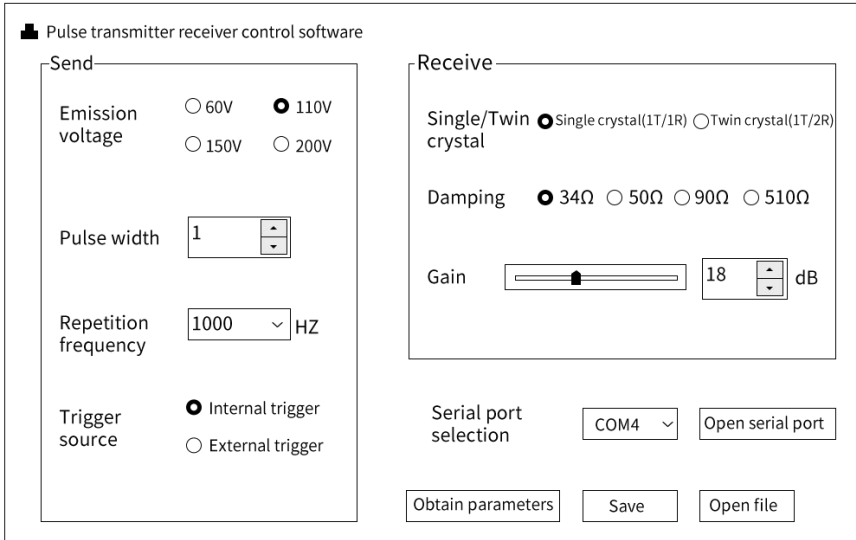
Figure 1.1 Pulse Generator Receiver

In addition to the round power switch button, the instrument body has 6 interfaces, Figure 1.1 Schematic diagram of ultrasonic pulse generator and receiver:

- 2 BNC connectors (Q9 interfaces): one is the signal output interface for connecting to an oscilloscope to display the received waveform; the other is the input end for external triggering.
- 2 C5 interfaces: single crystal probe connection interface (T/R), dual crystal probe requires two interfaces (T/R and R);
- 1 half-moon communication interface: Connect to computer via USB - 4-core half-moon data cable
- 1 3.5*1.35DC power interface: connect to a 5V 1A power adapter.

2.Control software

The interface of the ultrasonic pulse transmitter receiver control software is shown as follows:



picture2.1Control software interface

2.1 Emission Area Parameters

The Emission part is used to adjust the ultrasonic pulses parameters.

•Emission Voltage

There are 4 emission voltages, 60V, 110V, 150V, 200V optional (when the damping is $34\ \Omega$, 200V emission voltage can not be adjusted), which is used to select the required pulse amplitude.

- **Pulse Width**

The pulse width can be adjusted from 1 to 40 times (1 times about 28ns).

- **Repetition Frequency**

The repetition frequency is the number of ultrasonic pulses emitted per second when the instrument is used as a generator, with 4Hz, 8Hz, 16Hz, 20Hz, 100Hz, 500Hz, 1kHz, 2kHz eight gears to choose from to meet different applications.

- **Trigger Source**

Trigger source can be selected internal trigger and external trigger, when the internal trigger is selected, the instrument itself is used as the ultrasonic pulse generator, when the external trigger is selected, it needs to be connected to a special device or signal generator.

2.2 Receiving Area Parameters

The receiver parameters are used to control the ultrasonic pulse receiver.

- **Single/Twin Crystals**

The instrument supports pulse echo mode and one- transmit one- receive mode.

Single crystal represents pulse echo mode, pulse transmission and echo reception through interface 1; The twin crystals represent one- transmit one- receive mode, transmitting pulses through interface 1 and receiving through interface 2.

- **Damping**

Damping has 34 Ω , 50 Ω , 90 Ω , 510 Ω four gears.

- **Gain**

Gain control the amplification and attenuation of the received signal, the selection range from -4dB to 55dB, can be adjusted by sliding, or adjusted by 1dB step-by-step, can meet the requirements of the most applications.

2.3 Software Connection and Usage

1. Use the power adapter to connect the instrument and the power supply, and turn on the instrument;
2. Connect the USB port of the data cable to the computer port, and insert the other end into the half-moon socket of the instrument;
3. Open the software on the computer;
4. Select the corresponding serial port of the instrument and open the serial port;
5. Click to obtain parameters, you can synchronize the settings of the instrument, if the connection is improper or the power is not turned on, the prompt "Please check the connection" will pop up;
6. Click Save. The software will save the parameter settings to a file.
7. Click Open file, you can open the previously saved file and synchronize the parameter settings at that time.

Announcements:

Do not modify the contents of the saved file at will. Incorrect parameters will cause hardware damage beyond repair!

3.Function Application

3.1Probe Detection

Working Principle:

By performing fast Fourier transform on the echo signal of the ultrasonic pulse, its spectrum is obtained, thereby determining its center frequency and comparing it with the nominal frequency of the probe to achieve the purpose of probe detection.

★To perform probe detection, an oscilloscope with FFT or Math function is required. The following steps take an oscilloscope with FFT function as an example.

Operating Steps:

1. Connect the instrument to the power supply and turn on the switch;
2. Connect the probe to the instrument interface;
3. Connect the oscilloscope, adjust the oscilloscope display;
4. Use the probe to measure the standard test piece, and adjust the oscilloscope so that the screen shows a measurement waveform, at this time the oscilloscope can be paused;
5. Turn on the FFT mode and set the frequency range and center frequency as needed;
6. Adjust the spectrum waveform, calibrate 3dB, and check the center frequency.

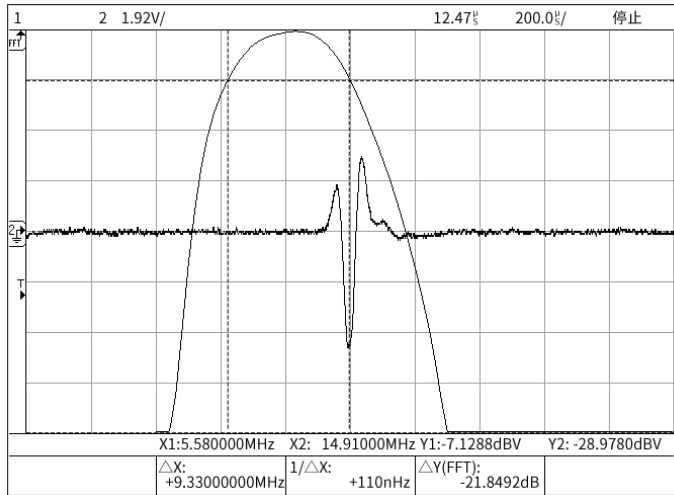


Figure 3.1 Probe Detection Example

As shown in Figure 3.1, the probe center frequency measurement value is $(X1+X2)/2=10.245\text{MHz}$.

3.2 Thickness Measurement

Working Principle:

Using ultrasonic pulse reflection principle to measure the waveforms, and the thickness of the workpiece can be obtained through calculation.

Operating Steps:

1. Connect the instrument to the power supply and turn on the switch;
2. Connect the probe to the instrument interface;
3. Connect the oscilloscope, adjust the oscilloscope display;
4. Use the probe to measure the standard test piece, and adjust the

oscilloscope so that the screen shows a appropriate measurement waveform.

5.After getting the desired waveform, pause the oscilloscope and adjust the measurement cursor to get the time interval Δt between two echoes.

6.The thickness of the workpiece can be obtained by the sound velocity $v \times \Delta t/2$ of the material.

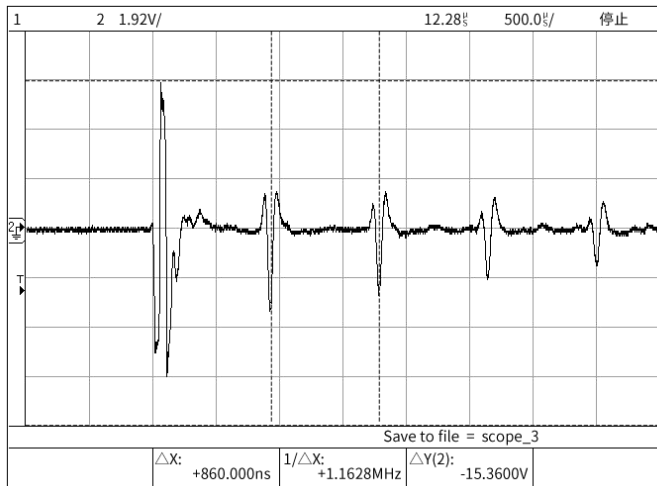


Figure3.2 Thickness Measurement Example

As shown in Figure 3.2, the thickness of the test block is $5900 \times \Delta X/2 \approx 2.5\text{mm}$, the sound velocity used in this calculation is 5900m/s of steel, which is not the exact sound velocity of the test block, so the calculation result has errors. In practical application, the exact sound velocity of the object to be measured should be selected.

In the same way, the material sound velocity can also be calculated by using known material thickness.

4. Technical Specifications

4.1 Control Parameters

	Control Parameters	Range	Stepping
Launch area	Emission voltage	60V、110V、150V、200V	chose
	Pulse Width	1~40 (one time is approximately 28ns)	One time
	Repetition rate (internal trigger)	4Hz、8Hz、16Hz、20Hz、 100Hz、500Hz、1kHz、2kHz	chose
	Trigger source	Internal trigger, external trigger	chose
Receivin g area	Single/ twin crystal	single crystal (1T/1R)、twin crystal (1T/2R)	chose
	damping	34Ω、50Ω、90Ω、510Ω	chose
	gain	-4dB~55dB	1dB

4.2 Technical Specifications

Pulse type	Negative peaking pulse/square wave pulse
Rise time	generally between 4.5-8.5ns, the damping will reach 20ns when it is 510 Ω
Fall time	generally between 3.5-6.5ns
Pulse width	one time pulse width is approximately 28ns
Band width	0.5-20MHz
Excitation mode	Pulse-echo (P-E), Penetration (T-T)
Repetition frequency	Internal trigger: 4Hz-2kHz; External trigger: 0-20kHz
External trigger	Rising edge trigger; Trigger voltage: 3.3V

Note 1: Choosing the higher emission voltage will result in longer fall time and rise time.

Note 2: The wider the pulse width, the smaller the emission voltage.

Note 3: As the repetition rate increases, the emission voltage will also decrease slightly.

4.3 Host Specifications

Power supply	DC:5V1A	Operating temperature	0-55℃
Outline size	14cm*8.8cm*3cm	Weight	230g

4.4 Standard Configuration

Host machine PR10	1	Connecting lineQ9-Q9	2
Data lineUSB-4 core half moon	1	Power adapter	1
Communication USB flash disk	1	Control software(Stored in USB flash drive)	1

5. Maintenance and Repair

5.1 Environment Requirements

Strict collision avoidance, during the use and storage of the instrument, pay attention to dust, moisture, and acid and alkali substances. The instrument should be kept away from strong electromagnetic fields.

If there is any quality problem, please contact the manufacturer.

Since the devices are high-tech products, the maintenance work should be completed by trained maintenance personnel, please do not disassemble or repair without the help of personnels.