PCIUT380

Ultrasonic Pulser/Receiver and 80 MHz Analog to Digital Converter Board

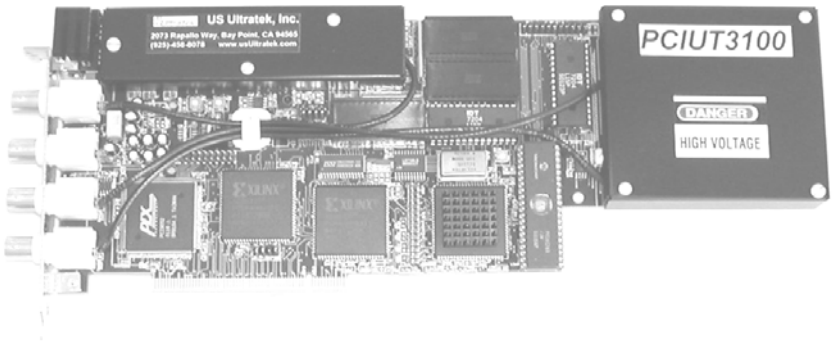
PCIUT3100

Ultrasonic Pulser/Receiver and 100 MHz Analog to Digital Converter Board

PCIUT3100T

Ultrasonic Tone Burst Pulser/Receiver and 50 MHz Analog to Digital Converter Board

User's Guide



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WARNING

PCIUT3100 AND DT16B (DT8B) BOARDS OPERATE ON HIGH VOLTAGES. TO AVOID INJURIES, DO NOT TOUCH OR HANDLE THE BOARDS UNTIL AT LEAST 20 MINUTES AFTER THE COMPUTER'S POWER HAS BEEN TURNED OFF.

1. Welcome

Congratulations on your decision to make PCIUT3100 or PCIUT3100T a part of your testing system!

PCIUT3100 is an all-in-one ultrasonic testing board which includes a pulser/receiver and a high speed analog to digital converter board for PCI bus. It generates a high voltage pulse from the PULSE OUT connector and the ultrasonic signal is received and converted to digital data at a rate of up to 100 million samples per second.

PCIUT380 is the same as **PCIUT3100** except that the conversion rate is 80 million samples per second and the board is shorter than **PCIUT3100**.

PCIUT3100T is an all-in-one ultrasonic testing board which includes a tone burst pulser/receiver and a high speed analog to digital converter board for PCI bus. It generates a high voltage pulse burst from the PULSE OUT connector and the ultrasonic signal is received and converted to digital data at a rate of up to 50 million samples per second.

Options include higher pulser voltage, narrow and wide pulse width, encoder counters, distance gain correction, external clock input, sync output, memory update, and on-board hardware key module.

1.1 PCIUT3100 and PCIUT3100T Board Key Features

- High voltage pulse up to 300 volts (higher voltage available)
- Adjustable pulse width 15 to 2800 ns with special options (PCIUT3100 only)
- Wide-range dynamic gain
- Adjustable DC offset
- Selectable low-pass and high-pass filters
- Low noise receiver
- Low noise pulser as switcher shut down while acquiring data
- High speed analog conversion
- Ability to hold multiple records
- Included oscilloscope software for Windows 95/98/2000/NT/XP
- Software development kit for Windows available

2. System Installation

The software needs to be installed before installing the board in the computer.

2.1 Software Installation

To install the oscilloscope software for Windows:

a) Start the computer. To avoid difficulties with installation, close all Windows applications before proceeding.

b) If you are installing from:

CD - Insert the PCIUT3100 Oscilloscope Software Disk into your CD ROM the installation program should start automatically. If not, click **Start** and select **Run...** In the Run dialog box, type

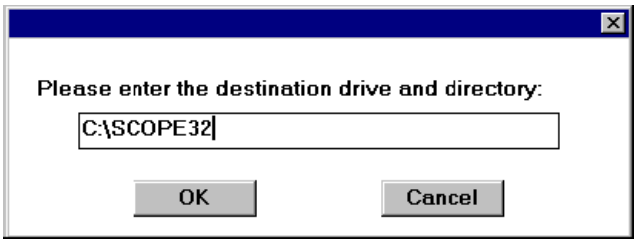
`D:\INSTALL` for Windows 95/98/2000/XP or

`D:\NTINSTALL` for Windows NT

where D: is the letter of your CD ROM drive, then press Enter.

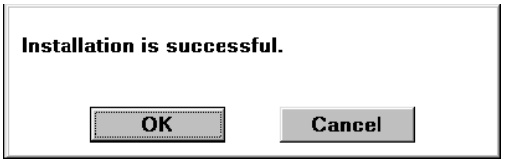
A Network - Open Network Neighborhood, and find the drive on the network computer and double-click `INSTALL.EXE` for Windows 95/98/2000/XP or `NTINSTALL.EXE` for Windows NT.

At any point in the installation process before files are actually copied, you can cancel with no changes made to your disk by clicking on the **Cancel** button.



c) The next dialog box shown above allows the user to change the default directory for the oscilloscope program. To change the drive or path name, type the new drive or path name in the text box. When the installation path is set, click **OK** or press Enter to start the installation.

d) The next dialog tells the user how the installation went. Click **OK** at this point.



Install will create a program group called PCIUT3100 Scope with a program icon in it.

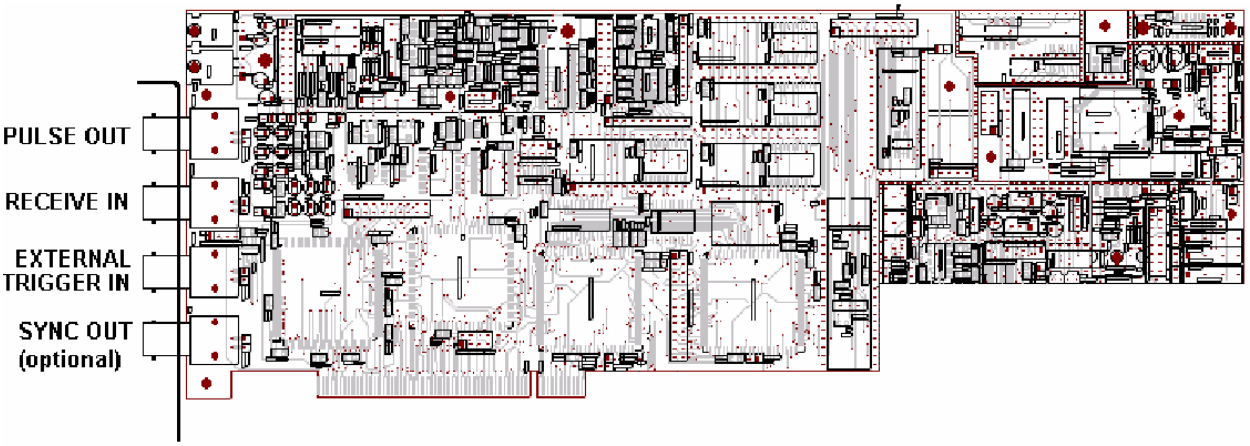
2.2 System Requirements

PCIUT3100 board comes with the following components:

- **PCIUT3100** or **PCIUT3100T** pusler/receiver and analog to digital converter board
- CD with the scope software
- User's Guide

The following figure shows the board layout. To use PCIUT3100 board, you need the following items:

- An IBM 486 or higher or 100% IBM-compatible computer with a minimum of 16 MB of RAM, one free PCI slot
- 2 MB of hard disk space
- VGA or higher resolution monitor
- Windows 95/98/2000/NT/XP



2.3 Hardware Installation

Complete the following steps to install the **PCIUT3100(T)** board.

a) Be sure the board has no damage from shipping; have a screwdriver ready for removing the computer cover.

b) Turn off the power switch on your computer.

c) Remove the computer's cover according to the instructions in the manufacturer's manual. Save the screws for replacing the cover.

d) Select an available PCI expansion slot which is a white edge connector.

e) At the back panel opening of the slot you have chosen for the board, unscrew and remove the slot cover. Save the screw for later use.

f) Discharge any electricity from your body by touching the back frame of the computer or any other grounded metal surface.

g) Remove the board from its static-protective bag. Avoid touching the gold contacts at the bottom of the board.

h) Holding the board at its sides fit the lower edge into the slot, as described below:

Gently press down on the edge facing you. Continue pressing until the contacts are seated firmly into the bottom of the slot. When the board is correctly installed, the gold contacts are no longer visible.

- If you encounter excessive resistance, remove the board and re-seat it, do not try to force it into place.
- Be sure that the top of the board is level, and that the screw holes are aligned.

i) Use the screw that you removed from the slot cover to secure the back plate of the board to the chassis of the computer.

j) Replace the computer cover and screws.

k) Connect the cables as shown in Figure 1 for pulse/echo method

l) Or as shown in Figure 3 for through transmission method.

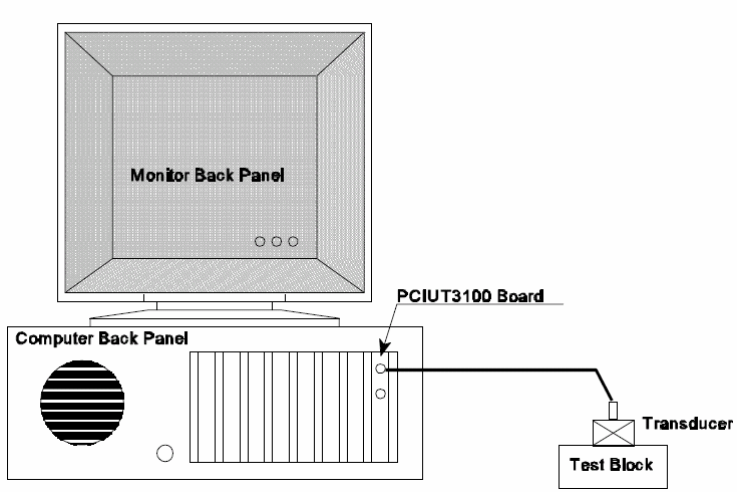


Figure 1. System Configuration in Pulse/Echo Mode

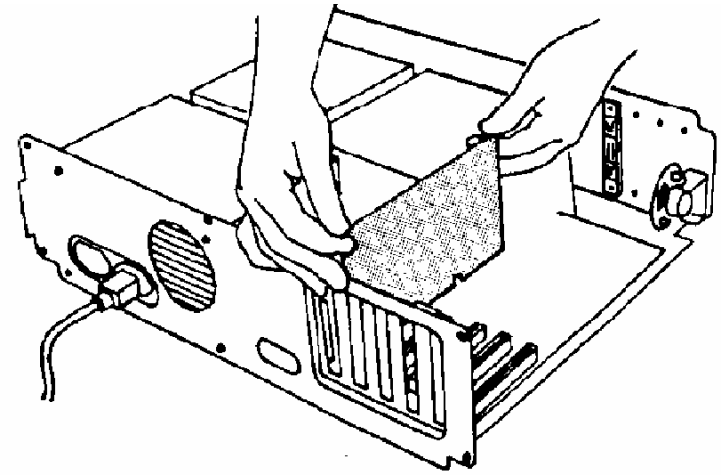


Figure 2. Installation of the PCIUT3100(T) board in a PCI slot

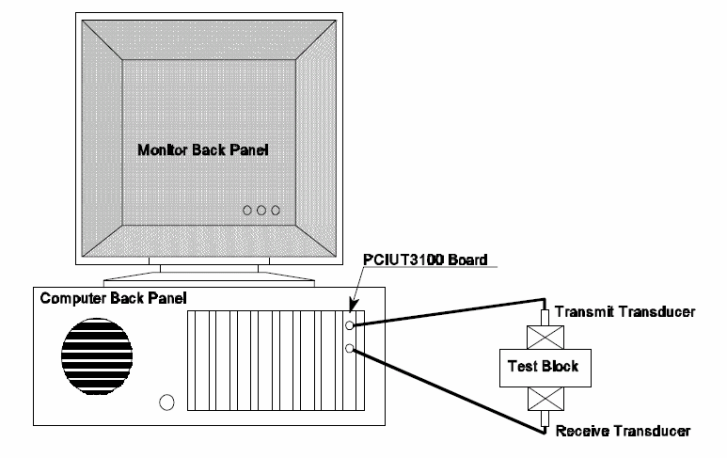


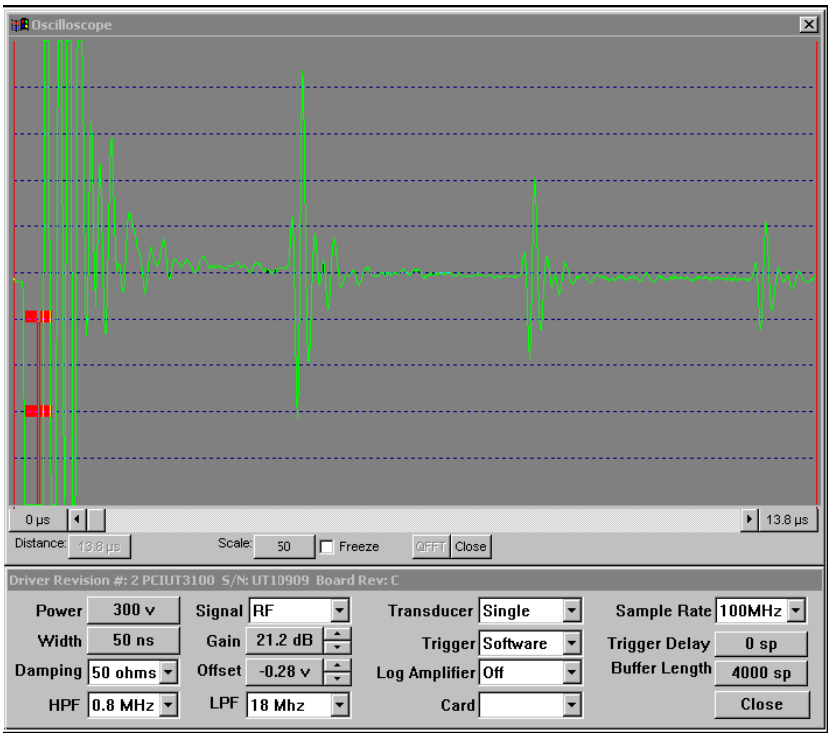
Figure 3. System Configuration in Through Transmission Mode

3. Quick Start

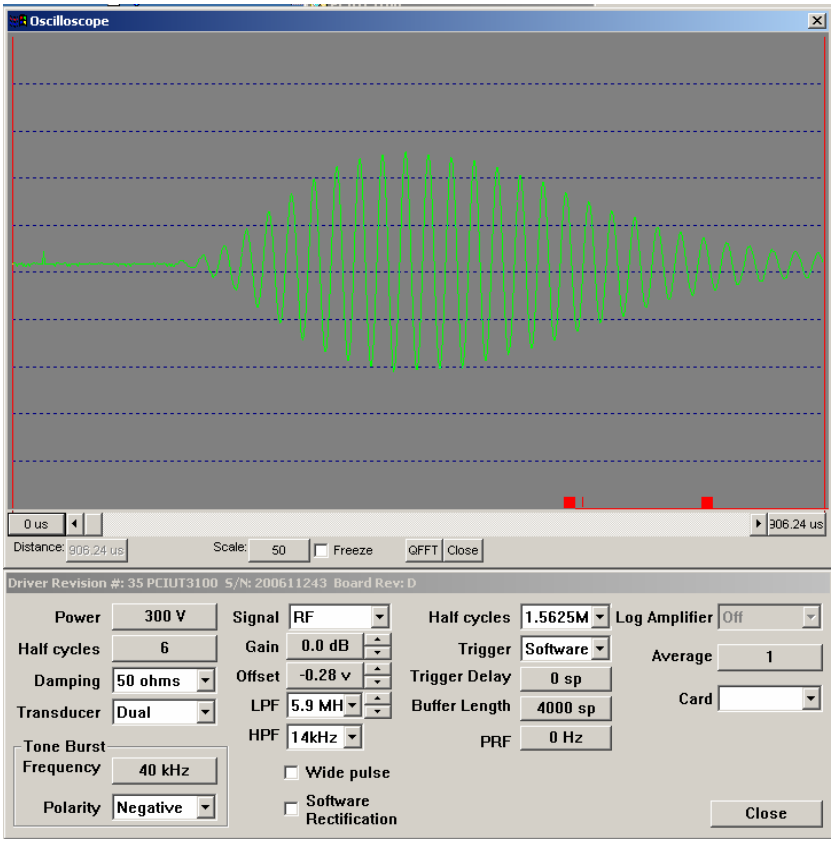
After installing the software and hardware, a program group named "PCIUT3100 Scope" will appear on the screen with an icon in it (see the following figure).

3.1 Starting the Program

The program for displaying the wave form is called **Standard Scope**. Double-click this icon to run the program. The following figure appears on the screen for the PCIUT3100 board.



The following figure shows the display when a PCIUT3100T board is in the computer.



The following sections describe the parameters for different applications.

3.2 Applications with PCIUT3100 Board

To set up PCIUT3100(T) parameters, it is good to know how the system works. Here is the explanation:

The PCIUT3100 board generates a negative high voltage pulse (PCIUT3100T generates a burst pulses) from the PULSE OUT connector and then starts taking data,

The pulse excites the ultrasonic transducer with user-defined pulse voltage, pulse width (or a number of cycles), and damping.

The receiver on the board inputs the ultrasonic signal through RECEIVE IN connector, or directly from the PULSE OUT connector.

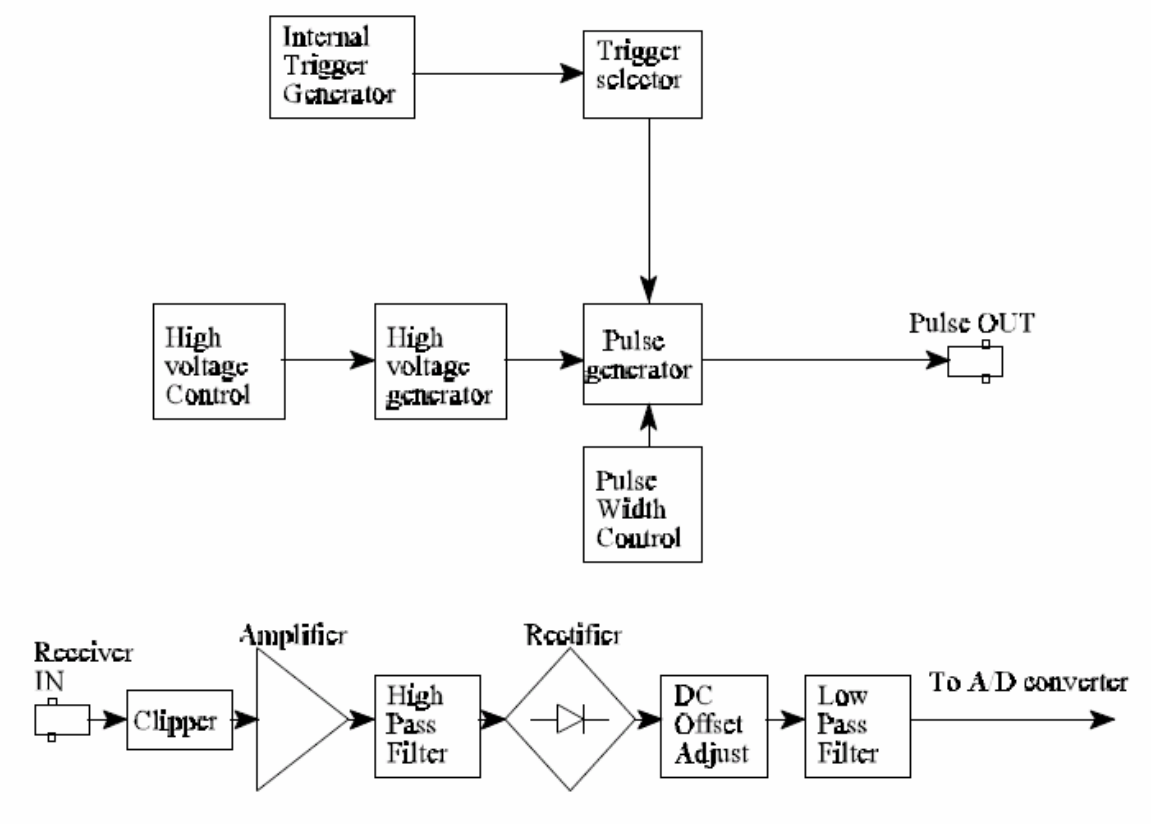
The receiver clips out the high voltage of the signal, and then makes the signal go through the amplifier, high pass filter, rectifier, DC offset adjustment, and low pass filter (see the following figure),

The output signal from the receiver is passed to the A/D circuit and it converts the signal to digital data.

The digital data are saved in the memory which is on the PCIUT3100(T) board.

The scope program transfer the digital data from the PCIUT3100(T) board to the computer RAM and display the waveform on the computer screen.

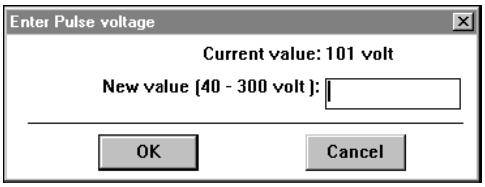
The parameters are described in section 4.



4. About Parameters

The parameters in the dialog box can be changed by clicking the combo boxes or the buttons. Clicking a combo box opens up a list. You can change the value by clicking an item on the list. To change the value on a button, such as power, simply click the button, and a dialog box will pop up with an edit box and the range for that parameter. You can enter a value in the edit box. If the value you entered is lower than the range, the minimum value will be used.

For example, when you click the power button, the following dialog box will pop up. If you enter 30, the program will use 40 instead.



4.1 Pulse Power

Pulse power ranges from -40V to -300 (350 optional) in 256 steps. The higher the voltage is, the stronger the echo will be. However, some transducers may become saturated with high voltage pulse. You can adjust this parameter until you are satisfied with the signal. For PCIUT3100T the voltage value will be the peak-to-peak voltage. For example, PCIUT3100T generates +/-150V if 300V is entered.

4.2 Pulse Width (Half Cycles)

For a standard PCIUT3100 board, the pulse width ranges from 50 ns to 480 ns in 256 steps. The pulse width has a close relationship with transducer frequency. It can be roughly calculated by using the following formula:

$$W = 500 / F_t$$

where W is the pulse width in nanoseconds and F_t is the transducer frequency in MHz.

For example, if you have a 5MHz transducer, the pulse width would be

W = 500 / 5 = 100 ns

The result is just a starting point. You can adjust the value to find the best signal.

Other pulse width range is also available upon request. However, it is always in 256 steps.

For a PCIUT3100T board, this field specifies the number of Half Cycles. The value could be from 1 to 32 half cycles. Every 2 half cycles make a complete cycle. You can start with 4 half cycles and increase the number of the cycles until obtaining the maximum response.

4.3 Damping Resistors

Damping resistors can change the shape of the pulse. It is useful for the transducer frequency 10 MHz and above. You can select different resistor until you get the best signal. The selections are

620 ohms
339 ohms
202 ohms
159 ohms
60 ohms
55 ohms
50 ohms
47 ohms

This function is not installed on the PCIUT3100T board. But it can be done as an option.

4.4 Signal

There are four choices for the Signal parameter. They are

- Full - Full wave rectification
- +half - Positive half of the signal
- -half - Negative half of the signal
- RF - No rectification

Full wave rectifier is used for flaw detections, and the rest of them can be used for thickness measurements.

4.5 Gain

Gain is used to control the amplitude of the signal. It ranges from 0 dB to 80 dB at a 0.01 dB step. Adjust the gain until the signal fits in the display window without any saturation.

4.6 DC Offset

DC offset is used to adjust the height of the base line of the signal. Adjust this parameter until the base line in the middle of the display window for the RF signal or at the bottom of the display window for full wave, + half, and -half.

4.7 Low Pass Filter and High Pass Filter

These two filters can be used to set up a frequency band to eliminate the noise of unwanted frequencies. To set the biggest band window use **0.6MHz** (**14kHz** for PCIUT3100T) for the high pass filter and **All** for the low pass filter. To reduce the high frequency noise, lower the low pass filter. To reduce the low frequency noise, increase the high pass filter. For full wave rectified signal, the low pass filter can be used to smooth out the echoes of the signal. This feature is very useful for flaw detections because it allows a digitizer to catch the peaks of the signal easily.

4.8 Card Selection

This option allows a user to install multi PCIUT3100 boards in a computer. By changing this parameter you can view all the parameters on other boards, and change the parameters on them.

4.9 Transducer Method

This option controls a relay to connect the PULSE OUT connector and the RECEIVE IN connector. So in pulse/echo mode you do not have to connect them together. If single is selected, the two connectors will be connected together, and if dual is selected the relay will be open so that you can use two-transducer method: one for transmitting and the other one for receiving.

4.10 Sampling Rate

The sampling rate combo box has the following options:

- 100 MHz (not available for PCIUT3100T)
- 50 MHz
- 25 MHz
- 12.5 MHz
- 6.25 MHz
- 3.125 MHz
- 1.5725 MHz
- external clock

The sampling rate should be 5 to 8 times higher than the transducer frequency.

4.11 Trigger Delay

Trigger delay specifies how many samples the A/D converter should skip before taking data. It could be from 0 to 32766 in step of 2 for the PCIUT3100 board, and 0 to 2047 for the PCIUT3100T board.

4.12 Buffer Length

Buffer length specifies how many samples that the board will convert the analog signal to digital data. It can be from 16 to 16384 samples in step of 4.

4.13 Logarithmic Amplifier

This menu item is enabled if the PCIUT3100(T) card is installed with a logarithmic amplifier (log amp). Click the drop-down box to select on or off. When the log amp is on, the signal is sensitive to pulse voltage. So adjust the pulse voltage until the signal is in the way you want.

4.14 PRF

This parameter is for PCIPR300 cards only. It should be 0 for PCIUT3100 cards since the display of the scope cannot catch up with the high rate. The user can write his own code with the optional software development kit to handle the high frequency PRF as well as handle the big data rate acquired by the boards.

4.15 Frequency

This parameter is for PCIUT3100T cards only. It should be set the same as the transducer frequency. Due to the clock limitation some frequencies may not be available at high frequency end.

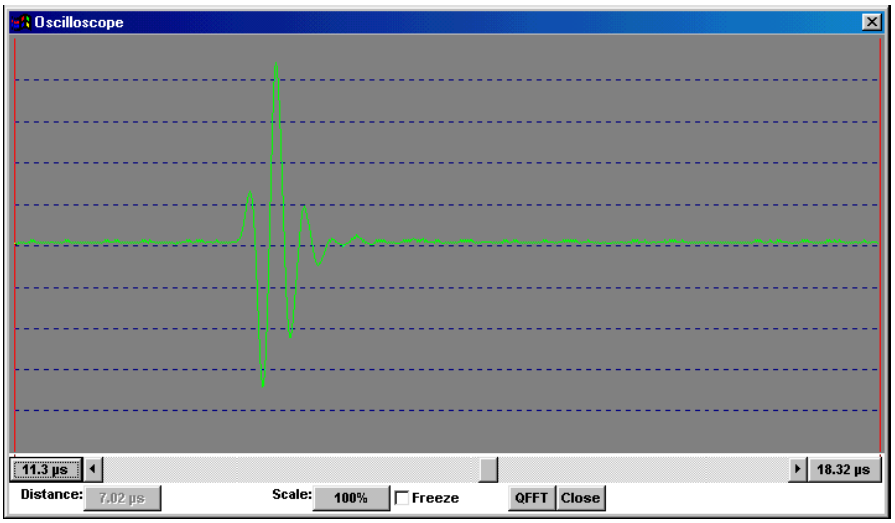
4.16 Polarity

This parameter is for PCIUT3100T cards only. It specifies the polarity of the starting half cycle. If 1 half cycle is used it is better to set it to Negative. Otherwise it doesn't affect the signal that much.

5. More about the Program

5.1 Oscilloscope Window

The following figure shows the oscilloscope window. There are two buttons and one horizontal scroll bar right under the wave form area.



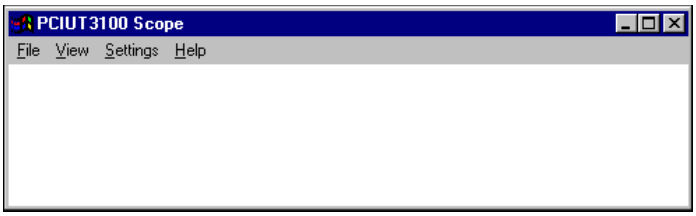
The first button shows the starting time of the wave form which is shown in the window, and the second button shows the ending time of the wave form. You can use the horizontal scroll bar to move the view area of the wave form. The distance button shows the time between the two red vertical lines. You can use the two red lines to measure the time difference between the two interesting echoes. To do this, move the mouse cursor on one of the red lines. Then the mouse cursor changes to the following figure.

Now press down the left mouse button and drag it to the desired position. Move the other red line in the same way. The distance button should show the time difference between the two red lines. Change the scale to a smaller number to zoom out, and change it to a bigger number to zoom in. The range of the scale is from 2% to 100%.

You can freeze the wave form by clicking the Freeze check box, and make it active again by making it unchecked. The QFFT button is used to copy a waveform segment to the Windows clip board and generate the frequency spectrum of the signal segment. However, you need to purchase the software and hardware package to do generate the spectrum. Even if you don't have the QuickFFT software the button is still useful for copying the waveform to the Windows clip board and then pasting the waveform to Excel, Word or Notepad for farther analyzing the data and saving the data into a file.

5.2 Exit the Program

To close the oscilloscope window click the **Close** button on the scope window. Then you will see the program window as below:



To exit the program, click **File** from the main menu bar and select the **Exit** menu item.

6. Specifications

Pulse Voltage	-40V to -300V in 256 steps. Higher voltages are available upon request.
Pulse Width	50 ns to 728ns in 256 steps Optional 15ns is available for PCIUT3100 boards upon request.
Damping	620, 340, 200, 160, 60, 55, 50, or 47 ohms
Internal Trigger	1 Hz to 5000 Hz in 10 Hz increments when internal trigger is selected.
Receiver Gain	0 dB to 80 dB in 0.1dB increments.
DC Offset	-2.5V to 2.5V in 5mV increments
Low Pass Filter	All, 48MHz, 28MHz, 18MHz, 8.8MHz, 7.5MHz, 6.7MHz, or 5.9MHz
High Pass Filter	4.8MHz, 1.8MHz, 0.8MHz, or 0.6MHz
Waveform	Full rectify, + half rectify, - half rectify, or RF
Sampling Rate	PCIUT380: 80, 40, 20, 10, 5, 2.5, and 1.25MHz PCIUT3100: 100, 50, 25, 12.5, 6.25, 3.125, 1.5725MHz, and external clock PCIUT3100T: 50, 25, 12.5, 6.25, 3.125, 1.5725MHz, and external clock
Resolution	8 bits (0 to 255) or 9 bits (0 to 511)
Memory	16 kilo samples and optional 256 kilo samples
Waveform Length	16 to maximum memory available in 4-sample steps
Trigger Source	+external, -external or software
Connectors	PCIUT380: 2 LEMO 00 connectors for pulse out, and receiver in PCIUT3100(T): 2 BNC connectors for pulse out, and receiver in
Post Trigger delay	2 to 32764 samples in 2 sample step
Dimensions	PCIUT380: 7"x4" not including LEMO 00 and PCI edge connectors PCIUT3100(T): 12.5"x4.25" not including BNC and PCI edge connectors
Add-on Options	- BNC external clock connector - BNC or LEMO 00 trigger in connector - BNC or LEMO 00 trigger sync output connector - Logarithmic amplifier - Quadrature encoder counters - Distance gain correction (DAC) - Two additional 14-bit A/D converters - 256K sample memory upgrade - Windows software development kits - Hardware security key module - Hardware key development kit