

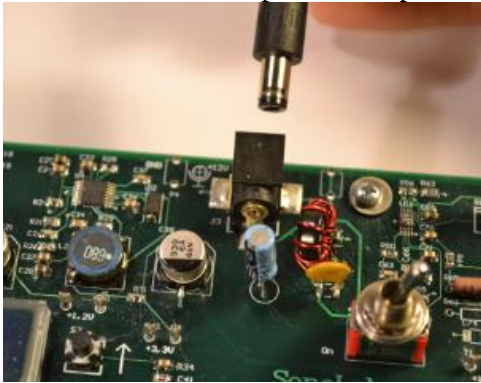
SonoLab Echo-I User Manual

Overview:

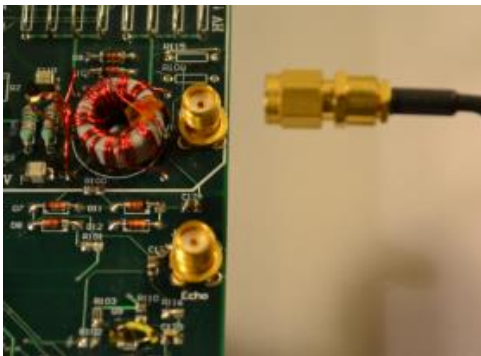
SonoLab Echo-I is a single board digital ultrasound pulse-echo solution. The system has a built in 50 volt high voltage generation circuit, a bipolar pulser, a transmit/receive switch, a two-stage programmable gain amplifier for time-gain-control (TGC), and a 100MHz digitizer. The echo can be viewed by oscilloscope or on a free Matlab graphic user interface (GUI) on PC.

Power up

1. Connect the AC adapter to the power jack of the Sonolab.



2. Connect the transducer to the SMA connector on the board.



3. Turn on the power switch.
4. The LCD screen should light up.
5. After 5 seconds, the green microcontroller live pulse LED should flash at a frequency of about 2Hz.

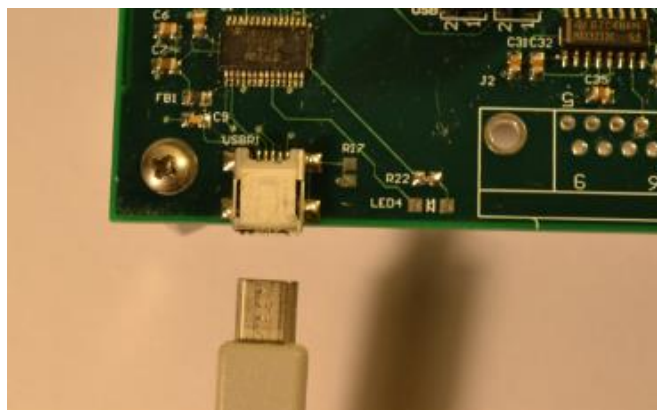


View Echo on Oscilloscope

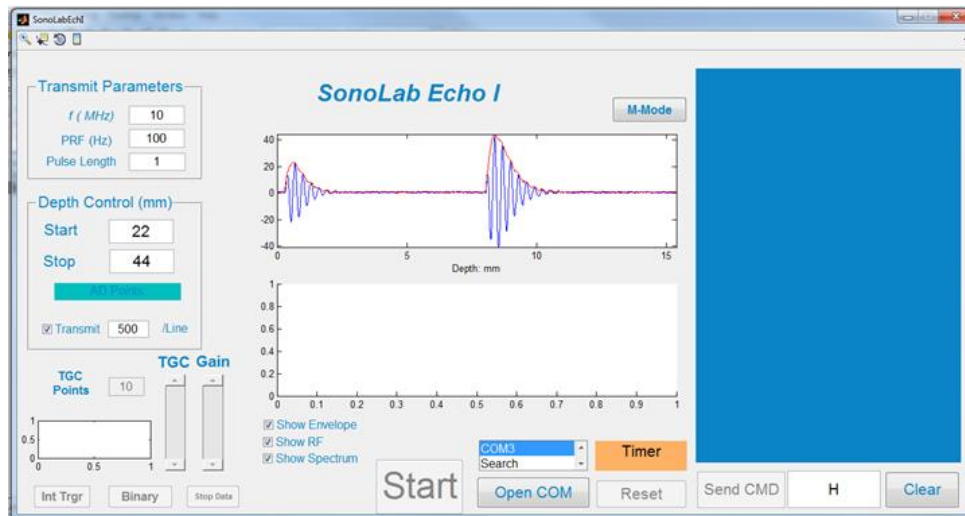
1. Oscilloscope set up:
 - a. Set trigger:
 - i. Source: to 'Ext', external mode.
 - ii. Edge: up edge
 - iii. Trigger mode: auto
 - b. Set horizontal control to 2 μ s/div.
 - c. Set Channel 1 to 1v/div, ac coupling.
2. Connect trigger output to oscilloscope external trigger input.
3. Connect RF output to oscilloscope to channel 1 input.
4. Locate transducer and your target in water tank.
5. Press the 'Start' button to start transmitting.
6. Adjustment:
 - a. Adjust trigger level to see a stable echo.
 - b. Adjust the distance between the transducer and the target to see echo move back and forth.
 - c. Adjust oscilloscope horizontal control if echo is too close or too far from the trigger time.
 - d. Adjust oscilloscope vertical control if the echo amplitude is too small or too big.
 - e. Adjust 'Gain' on Sonolab for the echo amplitude if necessary, using a small screw driver.

View Echo on Matlab

1. Download the Matlab files into a folder in your computer.
2. Connect the board to a USB port of your computer using the mini-USB connector on Sonolab:
 - i. Download and install virtual COM port driver to use a USB port as a serial port by following the instructions from the link: www.ftdichip.com/Drivers/VCP.htm.
 - ii. Connect the mini-USB connector of the board to a USB port of the PC.
3. Adjust 'Gain' on Sonolab for the echo amplitude if necessary, using a small screw driver.
4. Adjust 'Offset' on Sonolab to display echo in the middle of the graph, using a small screw driver.



5. Open Matlab and run 'SonolabEchI.m'.
6. The software will automatically detect the 1st available serial port. If you are using a desktop computer, and connected the board through mini-USB, you need to click 'Search' in the drop list to show the virtual COM.

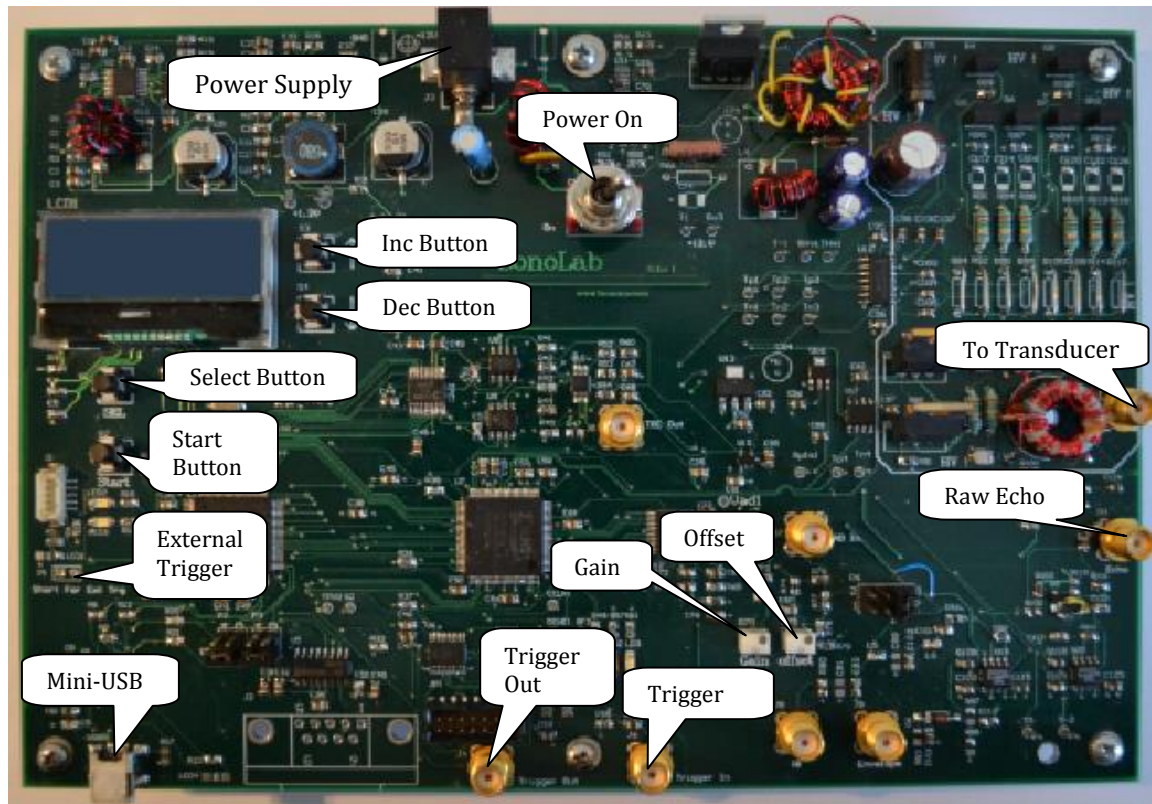


7. Click 'Open COM'.
8. Turn on the board. In 5 seconds, the message window on the right will show the board booting up information.
9. Click 'Start' button to start transmitting; the timer will start to count and an echo curve will be displayed in the window.

System Requirement

1. Computer clock: $\geq 2.2\text{GHz}$
2. Memory: $\geq 2\text{G}$
3. Operating system: Windows Xp, Windows 7
4. Matlab: R2012a or later

Connector Description:



1. Power Supply: 7 – 12VDC, 1A, two options
 - a. Barrel Power Jack: the inner contact is positive input.
 - b. Banana Power Jack: the red is positive input.
 - c. Do not use two options at the same time.
2. Power Switch
On: turn to left side; off: turn to right side
3. To Transducer: connect to any transducer with impedance around 50 ohms, frequency 1 – 10MHz.
4. USB Port: connect to USB port on any PC, download free driver from www.ftdichip.com/Drivers/VCP.htm.
5. Select Button:
Press the button to select the parameter that you want to adjust. The selected parameter will be displayed on the LCD screen.
6. Inc Button
Press the button to increase the value of the selected parameter. The increased value will be displayed on the LCD screen.
7. Dec Button
8. Press the button to decrease the value of the selected parameter. The decreased value will be displayed on the LCD screen.
9. Start Button
Press the button to start or stop transmitting ultrasound pulse.
10. Ext Trigger Jumper:
 - a. Open: use system internal trigger for ultrasound pulse transmission.
 - b. Short: use external trigger signal for ultrasound pulse transmission.
11. Raw Echo: Echo directly from transducer after T&R switch circuit.
12. Trigger Out: send out trigger signal for each ultrasound pulse transmission. It is recommended to use this signal for trigger of oscilloscope for echo display.
13. Trigger In: input trigger signal for ultrasound pulse transmission when Ext Trigger Jumper is short.

Electrical Characteristic

1. Power supply

The system works from 7 to 12 VDC.

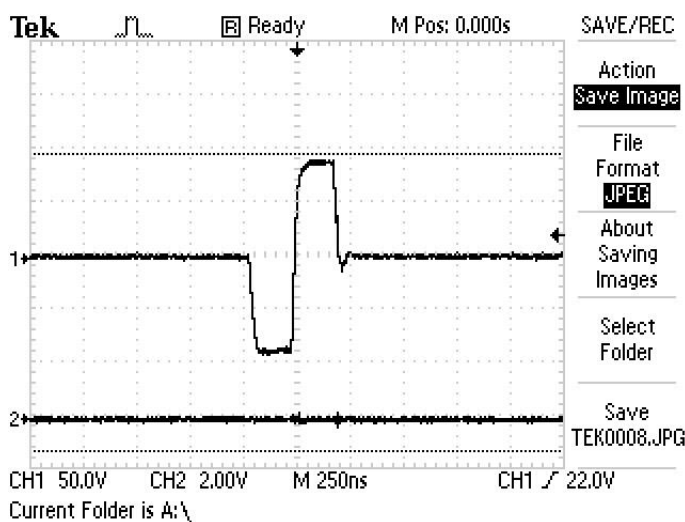
- 7 vDC: 420mA.
- 10 vDC: 390 mA
- 12 vDC: 370 MA

2. Transmit Frequency

A 200 MHz clock is used to generate the transmit pulse. The nominal time unit is 5 ns. For a frequency with a period of an integer multiple of 5 ns, such as 1 MHz, 2 MHz, and 2.5 MHz, the output frequency will be exactly as specified. Otherwise it will be rounded to a nearby possible frequency. For example, 4.90 MHz will be rounded to 4.88MHz.

3. Transmit Pulse Amplitude

A 50 volt high voltage power supply and it will provide a 200 volt peak to peak pulse on a 50 ohm load.



4. Output Impedance

The final stage of the transmitter is a class-D amplifier and it has very low output impedance. The peak instant output current is 2A. When load impedance is lower or transmit pulse is longer, the transmit pulse amplitude will decrease.

Controls

1. Depth for Data Acquisition

The system will start echo data digitizing from “Start Depth” and stop at “Total Depth”. Sound velocity of 1540 m/s is used for the delay calculation unless a new value is entered.

The depth control has no effects when echo is viewed on an oscilloscope.

2. TGC curve

TGC curve is controlled by the slope and the gain level. The real time curve is displayed on the GUI. TGC curve is the most commonly used control to adjust echo curve amplitude.

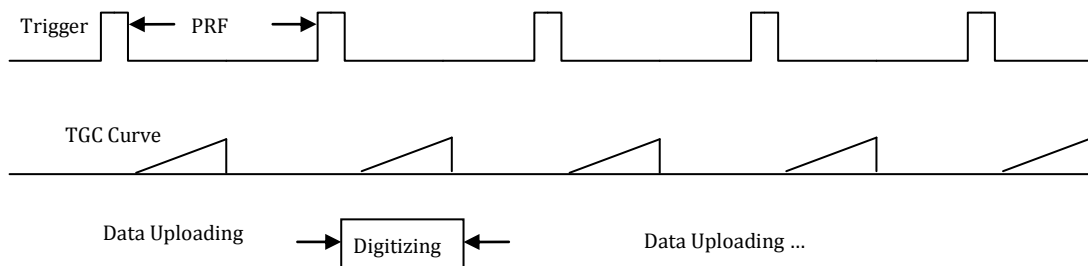
3. Data Transfer

Data can be transferred to PC in text mode or binary mode. The binary mode is faster since less data bytes are required for the same RF line.

For each RF line, it can be transferred to PC completely. In this mode, the spectrum of the RF line can be calculated and displayed.

The RF line can also be down-sampled to 500 points, and then transfer to PC. The spectrum of the RF line will not be available in this mode.

Control Timing



1. System is in idle mode by default when powered up.
2. Upon each rising edge of trigger signal, ultrasound sound pulse is sent out and TGC curves are applied automatically by DAC.
3. The time between two trigger signals is $1/\text{PRF}$.
4. Once data is digitized the system enters the data uploading phase. The baud rate is 115200 bps, so most of the time is for data uploading. System will not start digitizing until data uploading is done.

RS232 Port Command Description:

The following command is processed automatically by the Matlab GUI provided free by BioSono Inc.

You may develop your own software by sending commands to the serial port:

1. Set Center Frequency: 0 Frequencyx100
 - a. Set frequency to 10MHz: 0 1000
 - b. Set frequency to 2.25MHz: 0 225
2. Set Pulse Length: 1 Pulse_Length
 - a. Set Pulse Length to 1: 1 1
 - b. Set Pulse Length to 3: 1 3
3. Set Start Depth in mm: 2 Start_Depth
 - a. Set Start Depth to 2mm: 2 2
 - b. Set Start Depth to 5mm: 2 5
4. Set Total Depth in mm: 3 Stop_Depth
 - a. Set Stop Depth to 6mm: 3 6
 - b. Set Stop Depth to 9mm: 3 9
5. Set TGC1 level: 4 TGC1_Level
 - a. Set TGC1 level to 0: 4 0
 - b. Set TGC1 level to 255: 4 255
 - c. Range: 0 - 255
6. Set TGC1 Slope: 5 TGC1_Slope
 - a. Set TGC1 Slope to 0: 5 0
 - b. Set TGC1 Slope to 255: 5 255
 - c. Range: 0 - 255
7. Set TGC2 Level: 6 TGC2_Level
 - a. SetTGC2 Level to 0: 6 0
 - b. Set TGC2 Level to 255: 6 255
 - c. Range: 0 - 255

8. Set TGC2 Slope: 7 TGC2_Slope
 - a. Set TGC2 Slope to 0: 7 0
 - b. Set TGC2 Slope to 255: 7 255
 - c. Range: 0 - 255
9. Set Pulse Repetition Frequency (PRF): 8 PRF
 - a. Set PRF to 100: 2 100
 - b. Set PRF to 1000: 2 1000
 - c. Range: 1 – 2000
10. Start Ultrasound Transmit: a
11. Stop Ultrasound Transmit: b
12. Set Trigger Source: c 0/1
 - a. Set Internal Trigger: c 1
 - b. Set External Trigger: c 0
13. Set Data Transfer Mode: d 0/1
 - a. Set Data Transfer Mode in text: d 0
 - b. Set Data Transfer Mode in binary: d 1
14. Set Sound Speed in m/s: e Sound_Speed
 - a. Set Sound Speed to 1540m/s: e 1540
 - b. Range: 0 – 10000
 - c. Default value: 1540
15. Enable/Disable data stream: f 0/1
 - a. Enable data stream: f 1
 - b. Disable data stream: f 0
16. Set Arbitrary TGC1: g data1 data2 .. Datan
 - a. Set 4 6 1 66 for TGC1: g 4 6 1 66
 - b. Maximal data point: 10
17. Set Arbitrary TGC2: i data1 data2 .. Datan
 - a. Set 5 6 1 86 for TGC2: i 5 6 1 86
 - b. Maximal data point: 10
18. Set Line number to skip to slow down data stream: j Line_Number
 - a. Start Upload every 100 lines: j 100