

## ARB-1410 Arbitrary Waveform Generator Board and WaveGen1410 Software

### Overview

The ARB-1410 is a PCI-bus based, highly precise (14-bit), high speed (100 MSample/sec), arbitrary waveform generator card. Using WaveGen1410 Software, it is capable of providing an extensive variety of simple or complex acoustic emission waveforms of all shapes and amplitudes up to +/- 150 Volts.

### Options

The standard ARB-1410 generates a +/- 10 Volt signal output at frequencies up to 15 MHz.

An optional on-board Medium Voltage, high bandwidth (MVHBW) output provides +/-35 Volts at frequencies up to 2 MHz, while the High Voltage (HV) option provides an output of +/-150 Volts at frequencies up to 700 kHz. These high voltage outputs are available directly on the board (no external high voltage amplifiers required) for connecting directly to the transmitting sensor without the need for extra hardware. In addition, a four (4) channel Output Multiplexer option allows the board to control up to 4 separate transmitting sensors for increased versatility.

### System Description

A simplified block diagram of the ARB-1410, Arbitrary Waveform Generator board is shown in Figure 2. As can be seen, the board interfaces to the system via the PCI-bus, the



Figure 1. ARB-1410 Arbitrary Waveform Generator Board

de-facto industry standard for today's PC Computers. The PCI-bus is also the interface to the WaveGen1410 software for loading waveforms into the 512K Word memory.

The ARB-1410 uses digital synthesis to generate an analog output waveform. Waveform sample points are clocked from the RAM buffers via FPGA (Gate Array) to a high speed 14 bit digital-to-analog converter stage (the Waveform DAC) at rates up to 100 MSamples per second (based on the setting of the programmable Timebase generator). Waveforms are generated based on an external trigger input, gate input or internal computer generated trigger with programmable repetition rate. The FPGA provides the complete on-board circuit and timing control for precise waveform generation and repetition rate control. Additionally, the FPGA controls the output amplitude and offset via additional DAC's (including the Amplitude Control DAC and the DC Offset control DAC). The output digitized waveform is smoothed by passing it through 1 of 8 software selectable filters that vary in frequency cutoff between 10 kHz to 40 MHz. The output amplitude range is controlled by the 0/20/40 dB attenuation stage through the output buffer and the AC/DC output coupling selection. This provides the standard path for generating +/-10 Volt signal outputs, the typical range of AE signal outputs. Optionally, as can be seen via the dashed lines, a 4 channel Multiplexer Output is available for computer control of up to 4 low or high voltage outputs. Also, one of two higher voltage options can be provided (see the lower dashed lines in the figure) including a +/-35 Volt full-power output for up to 2 MHz waveforms or the +/- 150 Volt full-power output for output frequency waveforms up to 700 kHz.

### Applications:

With the provided user-friendly WaveGen1410 software, the ARB-1410 can be used to:

- ◆ Synthesize waveforms for Acousto-Ultrasonics signal generation or Guided Wave Inspection
- ◆ Serve as an AE-CAL residing within the AE system
- ◆ Test the response of the AE System utilizing it as an AE waveform signal simulator
- ◆ Replay captured waveforms from your AE system with the ability to import and process AE waveforms from files
- ◆ Act as a high performance electronic signal generator or synthesizer

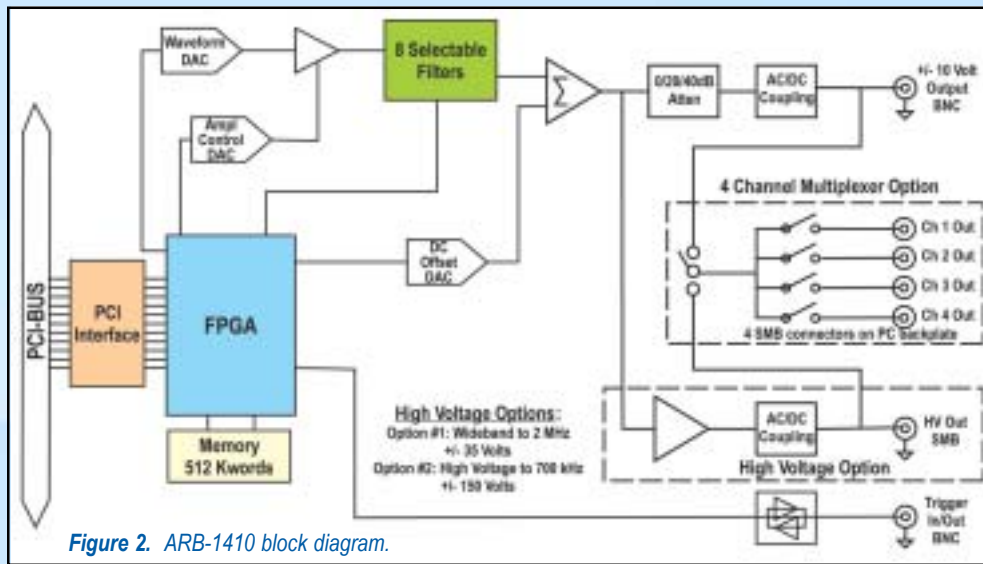


Figure 2. ARB-1410 block diagram.

**WaveGen Software:**

The WaveGen software provides the Windows based tools to setup and control the ARB-1410 Arbitrary Waveform generator Board. The ARB-1410 can be used alone or in conjunction with a PAC DiSP, PCI-2, SAMOS, MISTRAS, LAM, SPARTAN, NDT Automation AD-1210-PCI UT A/D card, or other data acquisition system, to form an Acousto-Ultrasonic analysis system.

WaveGen software enables the user to program and generate various types of waveforms as shown below using an easy-to-use setup menu. The waveform view provides the user with a simulated waveform so that the user can verify the type of waveform being programmed.

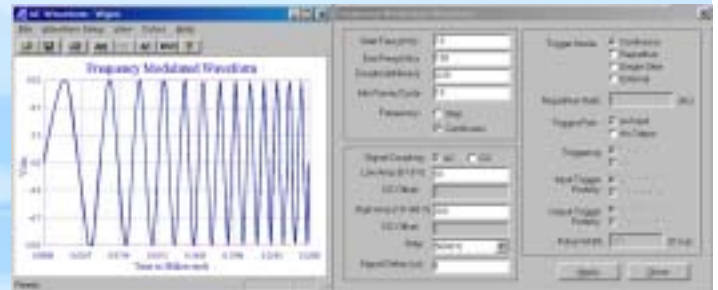


Figure 5: Frequency Modulated Waveform (also known as a chirp), where amplitude is constant and frequency is varied. With this mode, multiple sine waves are generated whose frequencies are between a minimum and a maximum value (both values are programmed by the user).

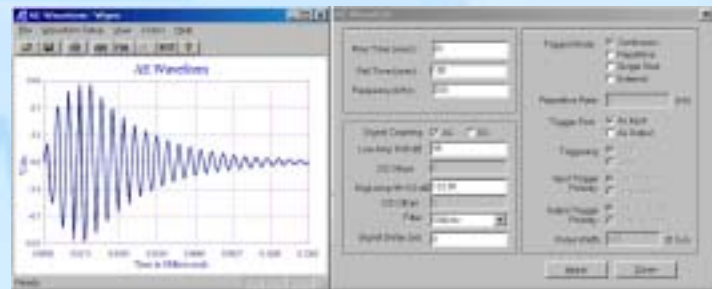


Figure 6: AE-CAL, AE Waveform Simulator: a special waveform modulated by an exponential rise and decay. In this mode, the user has control of the following parameters: rise time, fall time, amplitude in dB, carrier frequency, just as an AE-CAL2.

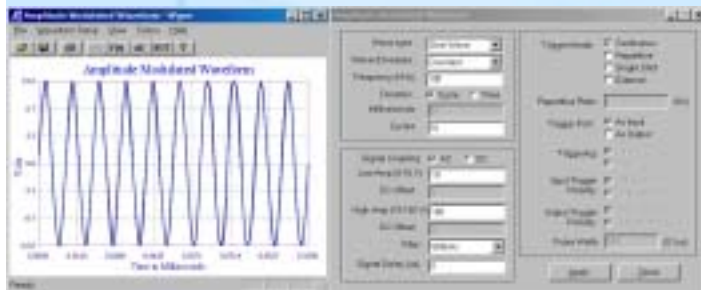


Figure 3. Constant Amplitude Waveform, with a single frequency, either burst or continuous.

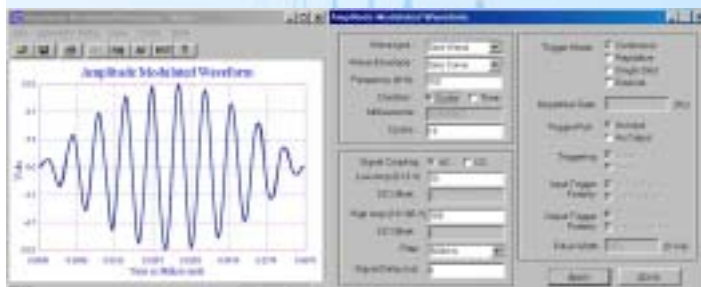


Figure 4: Amplitude Modulated Waveform (where frequency remains constant and amplitude is varied): typically a single frequency sine (or square) wave being modulated by 3 kinds of envelope: sine, triangular and constant amplitude envelope.

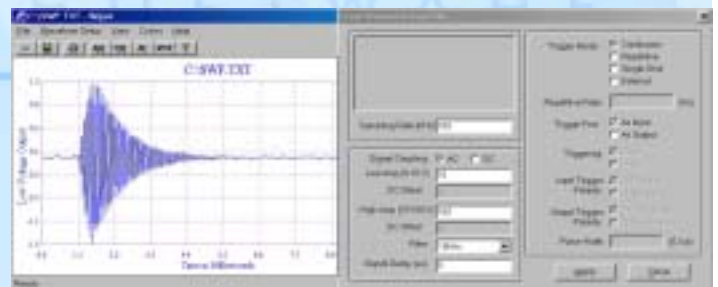


Figure 7: ASCII Waveform File Input allows the user to import externally generated, complex waveshapes not capable of being programmed by the amplitude or frequency modulated waveshapes. This feature also allows import and replay of previously captured waveforms.

**Standard ARB-1410 Specifications:**

- **Analog Output Channels:** 1
- **Amplitude Range:**  $\pm 10$  mV to  $\pm 10$ V full scale into 50 Ohms
- **Resolution:** 14 bit D/A converter
- **Amplitude Accuracy:**  $\pm 1\%$  of full-scale output
- **Signal/Noise Ratio:**  $>60$  dB for  $\pm 10$  Volts full scale
- **Output Impedance:**  $\pm 10$  Volt range: 3 Ohms typical  
All other ranges: 50 Ohms typical
- **Output Current:** 200 mA peak
- **Sample Clock Update Rate:** Variable up to 100 MSamples/sec.
- **Output Bandwidth ( $\pm 3$ dB):**  $< 100$  Hz – 15 MHz
- **Frequency Accuracy:**  $\pm 0.05\%$
- **Analog Filters:** 1 Fixed, 7 Selectable filters  
(via software menu selection)
- **Cutoff Frequencies:** Fixed: 40 MHz  
Selectable: 10 MHz, 5 MHz, 1 MHz,  
500 kHz, 100 kHz, 50 kHz,  
10 kHz
- **Filter Type:** Fixed: 3<sup>rd</sup> Order passive  
Butterworth  
Selectable: 4<sup>th</sup> Order active Butterworth
- **Waveform Memory:** 512 kSamples maximum
- **Operating Modes:** Free Run, S/W programmable Single  
Shot, S/W programmable Repetitive,  
TTL External trigger
- **Form Factor:** Full size PCI slot
- **Outline Dimensions:** Full size PCI board: 4.2" H x 13.31" L  
x 0.8" W (10.67 x 33.81 x 2.03 cm)
- **Power Requirements:** 20 Watts total
  - **PCI Bus +5 Volts:** 1.5 Amps (7.5 Watts maximum)
  - **PCI Bus + 12 Volts:** 1 Amp (12 Watts maximum)
- **Operating Temperature:** 0° to +50° C
- **Relative Humidity:** 10% - 90% non condensing
- **External Connectors:** 2 BNC: Waveform Output,  
Trigger Input/Output
- **Weight:** 14 oz. (0.42 kg)

**Standards / Approvals:**

- **Electrical Safety:** EN60950 (IEC-950)
- **EMC Emission:** EN55011, EN55022
- **EMC Immunity:** EN50082-1, IEC-1000-4-2, IEC-1000-4-3,  
IEC-1000-4-4

**Medium Voltage, High Bandwidth Output Option Specifications:**

- **Amplitude Range:**  $\pm 35$  Volts full scale
- **Signal/Noise Ratio:**  $>60$  dB
- **Output Impedance:** 50 Ohms typical
- **Output Current:** 400 mA peak

- **Output Bandwidth ( $\pm 3$ dB):**  $< 100$  Hz – 2 MHz
- **Form Factor:** Full size PCI slot (adjacent vacant slot  
recommended for cooling/airflow)
- **Power Requirements:** 44 Watts total
  - **PCI Bus +5 Volts:** 1.5 Amps (7.5 Watts maximum)
  - **PCI Bus + 12 Volts:** 3 Amps (36 Watts maximum)  
(via Aux power connector)
- **External Connectors:** 2 BNC: Standard Waveform Output,  
Trigger Input/Output  
1 SMB: High Voltage Output
- **Weight:** 18 oz. (0.51 kg)

**High Voltage Output Option Specifications:**

- **Amplitude Range:**  $\pm 150$  Volt full scale into 10 kOhms
- **Signal/Noise Ratio:**  $>60$  dB full scale
- **Output Impedance:** 50 Ohms typical
- **Output Current:** 20 mA peak
- **Output Bandwidth ( $\pm 3$ dB):**  $< 100$  Hz – 700 kHz
- **Form Factor:** Full size PCI slot (adjacent vacant slot  
recommended for cooling/airflow)
- **Power Requirements:** 44 Watts total
  - **PCI Bus +5 Volts:** 1.5 Amps (7.5 Watts maximum)
  - **PCI Bus + 12 Volts:** 3 Amps (36 Watts maximum)  
(via Aux power connector)
- **External Connectors:** 2 BNC: Standard Waveform Output,  
Trigger Input/Output  
1 SMB: High Voltage Output
- **Weight:** 18 oz. (0.51 kg)

**4-Channel Multiplexer Option Specifications:**

- **Inputs:** 1 (Standard or High Voltage Output,  
jumper selectable)
- **Outputs:** 4
- **Switching:** Relay switched, independently  
selectable, under software control
- **External Connectors:** 4 SMB Waveform Voltage Outputs
- **Form Factor:** Half size PCI slot (in addition to Waveform  
Generator Board slot)

**For more information:****Call (609) 716-4000****or Email us at [sales@pacndt.com](mailto:sales@pacndt.com)**

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