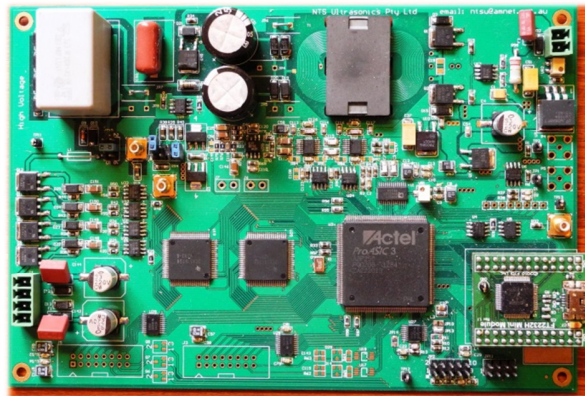# ULTRASONIC INSTRUMENTATION

NTS Ultrasonics Pty Ltd designs ultrasonic instrumentation for non-destructive testing and similar applications. Recent designs are of the "black box" type with all function control carried out from an external computer or microprocessor. Circuits have been developed with SPI, USB 2.0, and gigabit Ethernet communications interfaces.

Several "standard" versions of the circuit have been developed (UT-1X, UT-2X). Clients can choose one of these, or ask for a new variation to suit a particular application. All versions implement on-board control of the circuit using a field programmable gate array (FPGA) device, which can be supplied pre-configured, or configured by the client. If clients have specific requirements, the FPGA configuration can be customized prior to delivery.

Specifications will vary, but the following are typical for a single channel system.

Function	Value
Number of transmitter channels	one per ultrasonic board
Pulse shape	Square wave, -ve polarity
Transmitter voltage:	Max voltage 300 vdc
Transmitter voltage step:	25 v
Tuning (transmit pulse width)	Adjustable period (0.01 us/step)
Number of pulses/cycle	1 (burst mode is optional)
Damping	50/470//1000 Ohm user selectable
Number of receiver channels	one per ultrasonic board
Input bandwidth	750KHz to approx. 35 MHz (broadband)
Gain control	80 dB under software control
Gain control step	0.3 dB
Input noise level	1.5 nV/(Hz)$^{1/2}$ or better over full bandwidth (with transducer connected)
Digitizing frequencies	12.5 MHz, 25 MHz, 50 MHz, 100 MHz – user selectable
Digital resolution	10 bit (1024 levels) standard (12 it optional)

USB 2.0 (if applicable)	480 Mb/s
SPI (if applicable)	Max clock: 30 MHz
Ethernet (if applicable)	1000-BaseT

Customizing.

All N.T.S. Ultrasonics Pty Ltd products can be customized to some extent to suit individual client requirements. With the UT-1X and UT-2X the functionality of the circuits can be altered significantly by changing the configuration of the on-board FPGA. Please make special requirements known when enquiring about these circuits.

Other ultrasonic circuits.

N.T.S. Ultrasonics Pty Ltd can supply other single channel or multi-channel ultrasonic circuits, and has a range of pulser/preamp circuits useful for remote ultrasonic applications.

Software.

The UT-1X, UT-2X, and other computer controlled circuits are supplied with test (or base) software that operates under various Windows operating systems, and which allows the hardware of the circuit to be demonstrated and tested. The data from the circuits will be displayed in A scan format. The base software package will be fully tested for software control of all controlled functions (gain, digitizing frequency, transmitter voltage, transmitter tuning, etc) and any special functions configured into the FPGA (e.g. hardware gates, peak detection, time of flight measurement).

NTS Ultrasonics Pty Ltd does not offer a general purpose ultrasonic NDT software package for the electronic hardware it produces. However, software packages can be put together for specific applications. These software packages can be "demonstration" packages, not fully developed, but sufficient to allow the client's own programmers to get started on developing their own in-house software. Or, the software package can be fully developed, but limited in functionality to the specific inspection specified by the client. Various software options are available: analog B scan, digital B scan, C scan, save data, recall data, analyze data, save/recall setups, export data into pre-formatted report sheets, etc.

Remote ultrasonics.

Some applications require considerable distance between the location of the operator and the ultrasonic search unit. USB cables can only be used for lengths up to about 3 metres, so USB based ultrasonics must be located close to the host computer. Transducer cable lengths over 25 metres need to be avoided and NTS Ultrasonics offers several solutions.
1. Remote pulser/preamps. These sit at the end of a long coaxial cable (possibly several 100s of metres long) and
    a. Reconstruct the transmit pulse (which will be distorted by the long cable), and
    b. Condition the echo signal for the coaxial cable so that distortion and noise interference are minimized.
    c. They can be powered through the coaxial cable, so that one cable conducts the transmit pulse, returns the echo pulses and transmits the DC voltage for the preamp power.
2. Ethernet based ultrasonic instrumentation. By its nature, Ethernet communications can be used of long cable lengths (in excess of 100 metres).
3. SPI based ultrasonic instrumentation. An SPI based instrument can be controlled by an external microprocessor, which in turn will have some sort of long distance communications (Ethernet, fibre optic, wireless GSM, etc). NTS Ultrasonics was the first ultrasonic equipment supplier anywhere to offer SPI communications in an ultrasonic instrument, although they since been copied by others.

Prototype development.

In general, the instrumentation products sold by NTS Ultrasonics Pty Ltd, are never fully "standardized". Rarely do two different clients want the same thing, although we do try to encourage clients to consider the standard offerings we have. Much of our work involved developing new circuit designs, FPGA configurations, or software for clients. As such, these "new" arrangements are prototypes. We have a variety of project types we can offer where a client wants something that is not "off the shelf"" development projects, investigations, etc.

Other products.

In addition to instrumentation, NTS Ultrasonics Pty Ltd, also offers search units. In particular, ultrasonic wheel probes or roller search units. We also offer bubblers, squirters, and other search unit designs on a customized basis. We also offer high power ultrasonic systems.
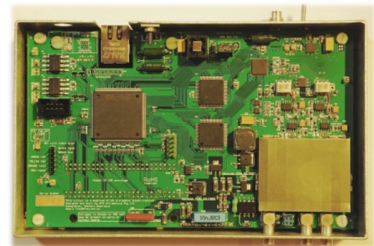
For more information on ultrasonic instrumentation, please contact:

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