

## Case Study

# Ultrasonic Imaging

**Every year, osteoporosis is a contributory factor in over 1.5 million new fractures of the hip, spine and forearm in the USA alone, 80% of these affecting women. With effective drug therapies now available, medical device manufacturers are developing equipment for early diagnosis of this debilitating disease.**

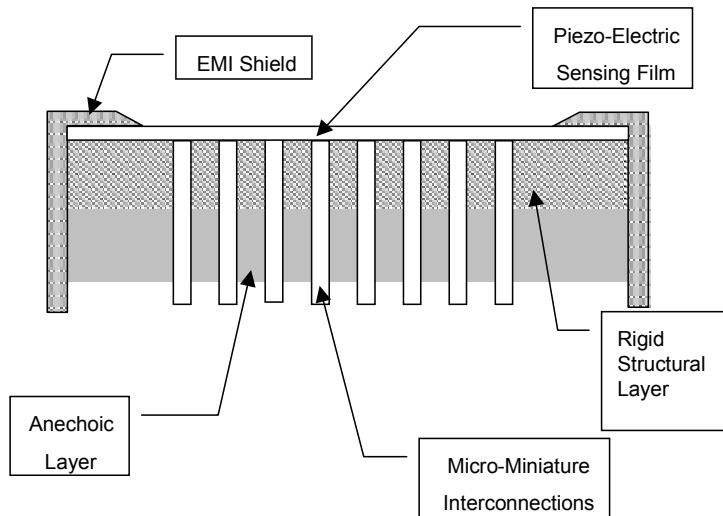


Fig 1: Cross section of the Ultrasonic Sensor Array

Ultrasound bone densitometry offers many obvious benefits to both patients and medical practitioners over traditional X-ray based detection techniques.

Along with an established manufacturer of ultrasound sensors, Plextek has developed technology to be used in medical imaging products for measuring the different densities of bone and other materials, using an ultrasonic sensor array.

The primary focus of this equipment is for the early detection of osteoporosis - the instrument presents an image of a patient's bone to the therapist, so that the degree to which the patient is suffering from the condition can be diagnosed.

What differentiates this new design from other products in the market-place is that it is optimised for low cost, particularly in the area of the sensor. The ultrasound sensor is a novel Polyvinylidene Fluoride (PVdF) element.

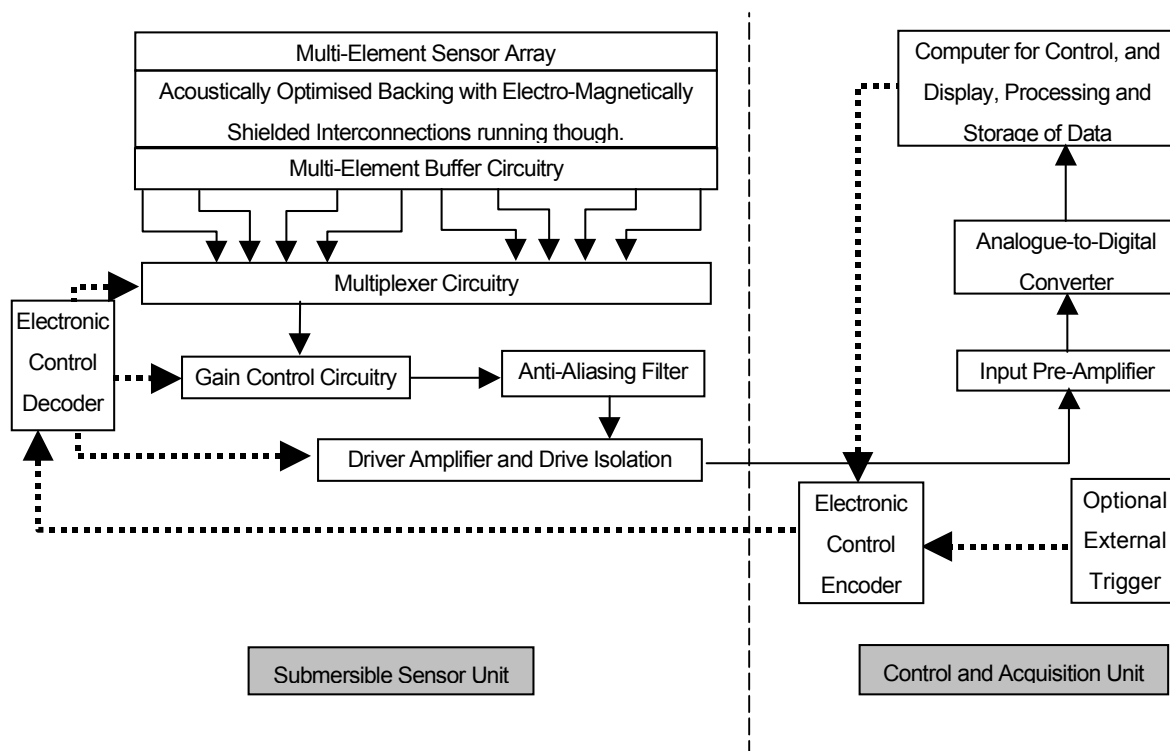
It is cost engineered and manufactured by Plextek using a multi-layer PCB fabrication technique, as opposed to the high precision mechanical assembly that would normally be necessary. Plextek was tasked with developing the sub-systems for the operation of an ultrasound sensor array, which required the conditioning of analogue signals and their conversion into the digital domain. The problems encountered in the measurement and analysis of ultrasonic signals to form images of the human body are remarkably similar to those found in the RF engineering field, where Plextek excels.

The processing of the acoustic channels necessitated the design of analogue receiver channels with very low capacitance, low noise and high input impedance in order to recover the signals from the analogue transducer elements. Sixty-four such channels were integrated onto a single PCB with all of the analogue conditioning and gain control to allow the signals to be sampled in a separate module.

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Images supplied courtesy of Precision Acoustics Ltd.

Block circuit schematic of the signal conditioning and analysis circuit

A serial data link between the sensor module (including the sensor and the signal conditioning described above) and the sampling module allowed these to be remote from each other, improving the logistics of using the equipment.

On the analogue side, there is a need to process the low-level, high frequency signals that are produced by the Receiver-Transducer-Array without introducing additional noise or artefacts. There is also a requirement for high speed, high dynamic range analogue to digital conversion.

The raw information from the sensor array requires conditioning before a useful image can be obtained. For this application the signal conditioning is performed in software running on the host PC, although for real time operation or for applications where a PC platform is not suitable, the signal processing could also be performed in a standard Digital Signal Processing (DSP) chip or custom hardware. Plextek were able to apply imaging techniques to the ultrasound signals that are normally used to solve problems encountered in radar and in extracting information from noisy signals in radio systems.

The project has subsequently been developed further and taken forward into a commercial product.

This product is typical of the portfolio of custom signal acquisition and processing applications that Plextek has successfully developed over the years.

We have also developed many Windows™ based user interface applications that are a vital element of the overall customer perception of a product.

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