ORCHID TECHNOLOGIES ENGINEERING & CONSULTING, INC.

New Life for Aging Electronic Products

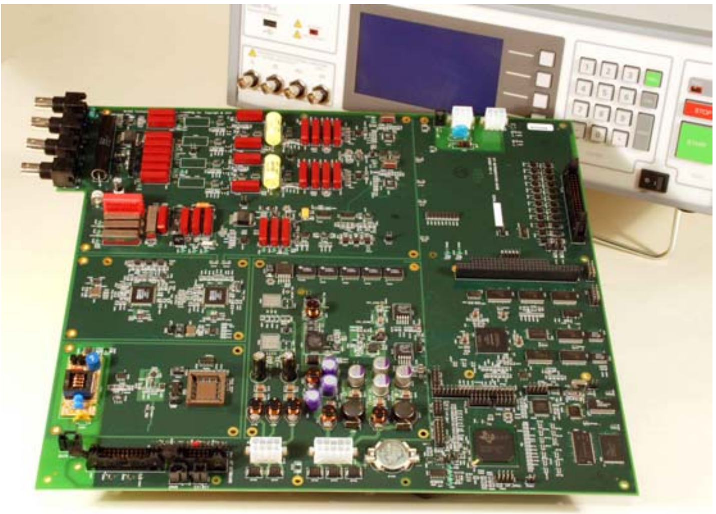
By Paul Nickelsberg, President and Senior Engineer, Orchid Technologies

Many Original Equipment Manufacturers, (OEM's), struggle to continue shipping aging or obsolete electronic products. Electronic products designed five to ten years ago are still relevant in the marketplace. Often these venerable old products have gained particular acceptance amongst a select group of customers. In many cases these old products fulfill a need in a unique manner. Examples include: designs that are grandfathered into an application due to regulatory considerations; designs having unique form-fit-and-function; designs running special software ; designs subject to contractual support and service requirements; designs in which a new contract stipulates delivery of older gear as part of a larger system offering. Any one or all of these reasons can lead an OEM to continue the production of electronic equipment well into its end of useful component life.

As electronic product designs age, component parts become increasingly difficult to obtain. Component buyers may experience difficulty in obtaining key parts within the design. Component part prices may increase. A point comes when component parts begin going end-of-life at an alarming rate. Quick fixes are no longer sufficient. Sometimes an OEM will procure a 'life-time' supply of problem parts – but this supply can be quickly wiped out should unforeseen demand develop. Lack of component parts puts an end to production.

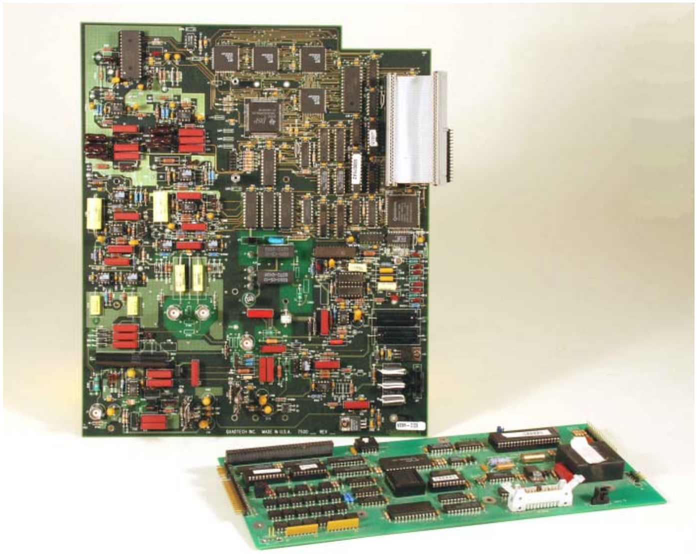
There is an alternative. Profitable, old products can be redesigned. Either preserving the original form fit and function, or adding new features. Product redesign is a cost effective means by which to extend the life of a marketable product.

Orchid Technologies Engineering and Consulting, Inc. recently completed the redesign of the precision LCR instrument shown in the photograph. Accurate to 0.05% of full scale, the original 1988 instrument design was very well executed. However vintage 1980's state of the art electronic components were going end-of-life rapidly.



Our first step was to study the existing design. We worked to put ourselves into the minds of the original designers. Through a process of study and review we identified a redesign approach. We generated a detailed development plan proposing significant technical improvements and cost reductions. Then we set to work.

Chief among the technical improvements and costs reductions were i) reduce circuit board count from two to one board, ii) simplify external connection methods, iii) simplify complex shielding methods, iv) remove requirement for SRAM battery backup with FRAM, v) replace floppy drive with USB stick, vi) replace obsolete TMS320C31 DSP with new TMS320C6713 and port firmware accordingly, vii) replace obsolete Analog Devices 32 bit DDS circuitry with new 48 bit DDS circuitry improving sine wave spectral purity thereby, viii) replace obsolete Burr Brown (TI) Analog to Digital Converters with new Analog Devices SAR converters, ix) reduce most digital logic to a single Altera Cyclone FPGA, x) replace through hole components with SMT parts. Our new instrument is form, fit, and function compatible with the old, while achieving improved accuracy to 0.01% with a 3x increase in measurement speed.



The original LCR instrument circuit board set (shown at the right) required separate analog and digital circuit boards to perform its functions. These circuit boards were shielded with a complex jumble of sheet metal, spacers, and screws. Additionally, expensive coax cables were installed to make the DUT connection. Orchid's new design is elegantly simple. All circuitry (analog and digital both) is now on a single board, Altera FPGA devices integrate digital functions and system shielding has been simplified. The result is a lower cost, easier to build easier to service assembly that has another five to seven years product life.

An obsolete 33MHz Texas Instruments TMS320C31 DSP performed high speed sine wave correlation functions. Twenty years ago, TI's DSP processors used a TI-proprietary 32 bit method to represent floating point numbers. Today modern TI DSP processors such as the 200MHz TMS320C6713 can represent floating point number with 64-bit precision using industry standard IEEE floating point methods. Updating the DSP processor required that we port the old DSP source code to the new floating point DSP processor. The benefit was greatly increased mathematical precision together with vastly increased DSP execution speed. These two factors alone served to improve instrument precision from 0.05% to 0.01% accuracy.

Integration of digital circuitry onto a single Altera FPGA both saves space and reduces overall digital system signal noise. Taking the care to energize digital busses only when required. The new design greatly reduces digital signal noise in the precision analog circuitry. Modern FPGA technology allows us to replace an entire circuit board with a single high-density component.

Redesign is a perfect solution to nagging production problems. At Orchid Technologies we have redesigned electronics for industrial, aviation, medical, automotive, consumer, and telecommunications markets. Orchid's ability to focus multidisciplinary resources in analog design, high-speed digital design, programmable logic design, power, software, and microcomputer design results in successful redesign work for our clients.

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