Chuck Brodeur

Battery Powered Optical Power Meter with USB

The client required a next-generation product to replace a legacy design. The new product needed to have a lower cost, incorporate new features, and be easier to assemble, configure, and test. It also had to fit in a new smaller form factor that they had envisioned.

The basic function of the product is to monitor optical power on a fiber-optic link. It displays the power reading and has an optional USB interface. When not using USB, it is powered from a coin cell and is capable of running for 3 years on a single cell. When connected to USB, it uses that as a power source.

The legacy design utilized a custom ASIC to do the measurement and control a segmented LCD display. Adding USB was one of the primary updates. The approach taken for the next-gen product was to replace the ASIC with a low-cost microcontroller with an integrated USB port. A micro was chosen that also included an analog to digital converter (ADC) which replaced a discrete chip. The micro also included a built-in multi-segment LCD controller. A Texas Instruments MSP430 was selected after a careful analysis of several options from multiple manufacturers.

To meet the battery performance requirements, low power modes of the micro were used, as well as switching of the power to the analog components. An inverting power supply was used to create a negative power rail from a single coin cell. It was switched off when not making analog measurements.

All system configuration and calibration data are stored in the MSP430 internal EEPROM during manufacturing test. The firmware also includes support for image update over USB using an internal bootloader.

A simplified block diagram is shown below:

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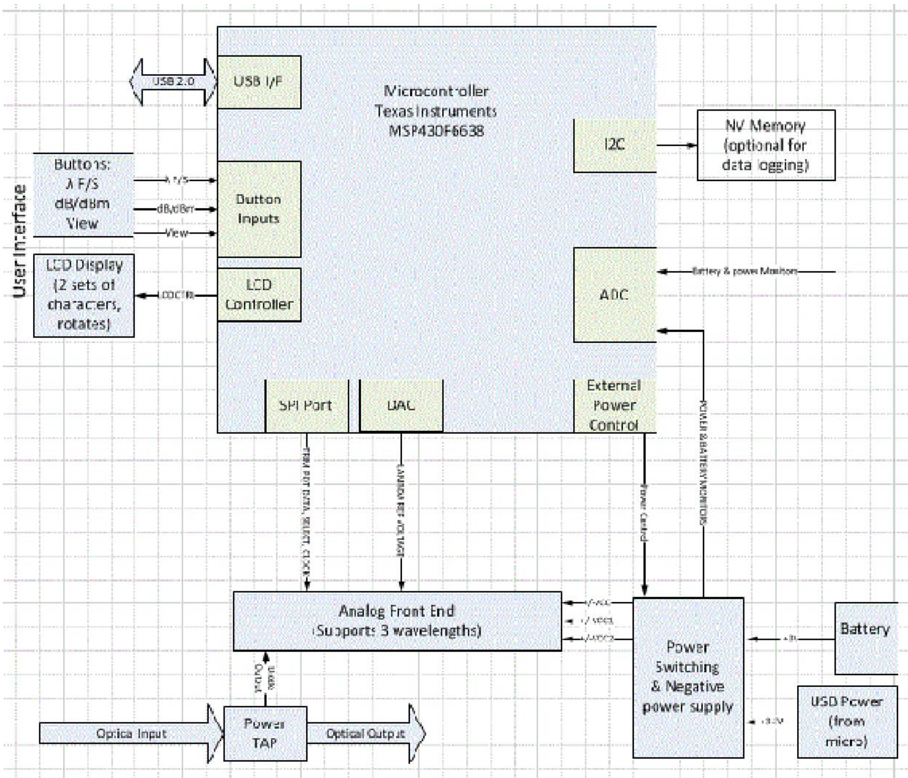

A completely new custom PCB was designed following the new approach.

The toolset included OrCAD for schematic capture, Altium Designer for PCB design, and IAR Workbench for the embedded development.

3D Models were generated in Altium Designer for use by the enclosure designer prior to boards being built. This allowed verification of the button and display locations, PCB mounting, and plastics before any physical items were manufactured.

The 3D rendering of the top side of the PCB can be seen below:

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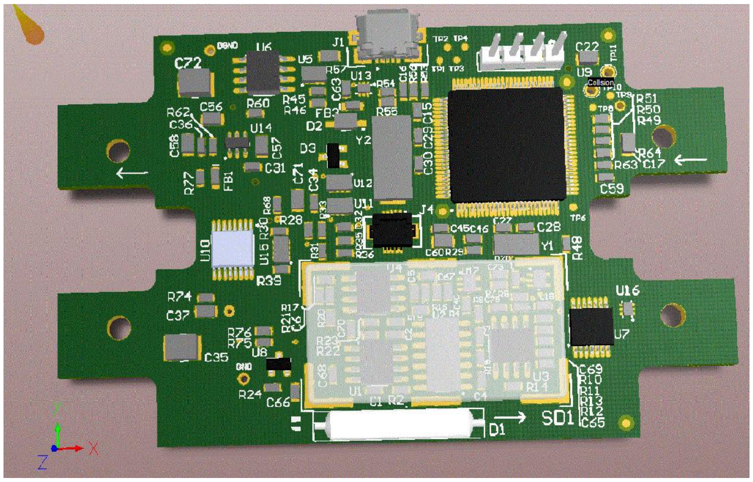

The 3D rendering capability is one of the reasons why Summit Design recommends Altium Designer. The ability to import manufacturer's models and create a 3D model for the mechanical designer can save design spins.

A photo below shows the bottom side of the board with the user buttons and LCD glass. Electrical connections to the glass are through zebra-style connectors from exposed pads on the PCB.

As part of design verification testing, a pre-production unit was tested over a range beyond the spec. Also, power was margined beyond the operating spec. A single electrical issue was discovered involving a diode which had a reverse leakage rating which was higher than it should have been. While it did not affect the system operation, it would have had a negative impact on battery life operating at high temperatures.

Regulatory testing included IEC / FCC Radiated emissions, as well as radiated and conducted susceptibility, and ESD susceptibility. A single electrical issue was discovered and corrected during the ESD testing, which caused the micro to reset under certain conditions.

These examples show why thorough testing is important during a product development to ensure that the shipping product is reliable in all operating conditions.

The product is currently in production and shipping to customers.