Chuck Brodeur

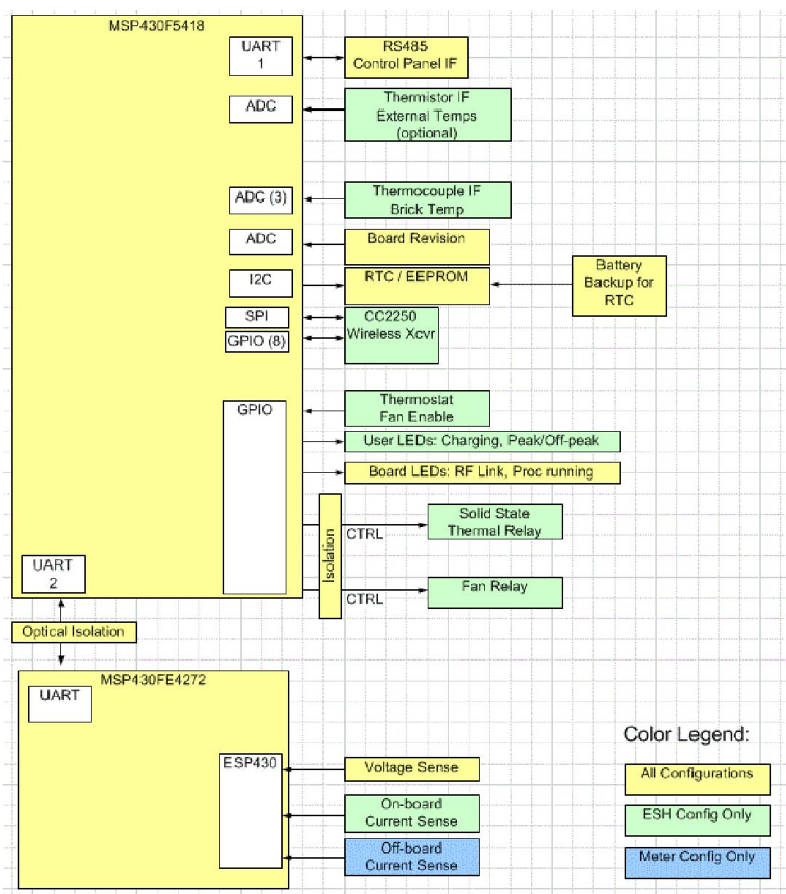
Solid State Relay Controller / Energy Meter

The project required a single PCB that could switch three 10A loads (@ 110 or 220VAC) using solid state relays, communicate wirelessly, and measure energy consumed. There were also a number of other requirements, including RS485 communications, local and remote temperature monitoring, and fan control.

The form factor was such that it needed to fit within a specific piece of equipment with no mechanical modifications to the equipment, and was subject to high temperatures. It also had to be able to be configured for use in a series of industrial control panels that the client also built.

Challenges included working with high voltage and current (and meeting international safety specifications), and meeting a low cost target.

The block diagram is shown below:



As can be seen, a distributed processing approach was taken. A Texas Instruments MSP430 was utilized for the energy metering portion and optically isolated from the rest of the system. A simple capacitor-resistor drop (CR Drop) AC/DC converter (not shown) provided power to the meter. The particular MSP430 utilized included an energy metering module. The energy meter measured current using a toroid current transformer (off-board due to system wiring.)

The overall system was controlled by another MSP430 with the IO necessary to support the various peripheral components, such as thermistors, a thermocouple, a radio, etc.

The TI CC2250 sub-Mhz radio chip was used to support the Zigbee interface, with an off-board antenna (due to the metal enclosure.)

Discrete solid state relays were designed to keep the cost as low as possible and thermal analysis and testing done to ensure reliability and long life. Off the shelf heat sinks were required due to the excessive load and operating temperatures. Thermistors monitored the PCB temp at each relay and alerted the host system if safe temperatures were exceeded.

A transformer-based AC/DC supply was used for the primary DC power with an internationally approved transformer to minimize the time at the regulatory offices. Fusing was provided where necessary, as well as transient suppression. Approval for use in multiple types of equipment was attained from UL and Intertek agencies.

The Mentor Graphics DxDesigner and PADS PCB workflow was used. The PCB consisted of 4-layers with 2oz copper external, and 1 oz copper internal to support the 10A current requirement at each relay.

Photos of the board assembly are shown below.

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