Wireless Power Panel Meter

Hardware Description

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Introduction:

This document describes the Wireless Power Panel Meter (WPPM) and its hardware implementation. The WPPM consists of two separate MCUs that communicate via RF to calculate the overall power consumption of a household in kilowatts. The first module is the unit that will be mounted outside the power panel. This unit is based around a Freescale MC13213 microcontroller (MCU2). It will be sampling data from two H932 current transformers and an AVT voltage transducer through three A/D ports. With this information MCU2 will calculate the total power cost and transmit the information to MCU1.

The second module is the hand held unit. This unit is comprised primarily of a Freescale MC13213 (MCU1) microcontroller unit, an LCD screen and a keypad. MCU1 will display power, current, and voltage on the LCD display. MCU1 will have a numerical keypad attached for user input. Next we will define in detail the hardware associated with MCU1 and MCU2.

MCU2 - Sensor Reference Board (SRB)

Microcontroller
   The microcontroller for the SRB is the Freescale MC13213. The MC13213 contains an RF transceiver which is an 802.15.4 standard compliant radio that operates in the 2.4 GHz ISM frequency band. The MC13213 also contains a HCS08 8 bit microcontroller with 60K of flash and 4KB of RAM. Port B bits PTB4-PTB6 will be used as Analog to Digital inputs.

Power Supply
   We will be using a wall transformer that will convert 120V AC to 3.0V DC at 560ma output for this board. This board requires a power supply because it will be continuously sampling data.

Current Transducers
   Two H932 Current Transducers (CT’s) will be connected to PTB5 and PTB6. The CT’s supplied from Flex-Core have a 0-120amp range with a 5V DC output at max reading. These will be connected in series with a voltage divider to the A/D ports on the MC13213. The voltage divider will change the voltage range from 0-5 V DC to 0-3 V DC at max current draw.

Voltage Transducer
   One Voltage Transducer (VT) will be connected to PTB4. The VT is an AVT-300A supplied from Flex-Core that is rated at 0-300V AC with a 0-1ma output DC at full voltage reading. The VT will be connected to the A/D in series with a 3.00K resistor to provide 0-3V DC to the A/D port.

Crystal
   The specifications for the external crystal are very specific. Freescale requires that a 16 MHz crystal with a <9 pF load capacitance is used. The external 8pF capacitors and the internal capacitance of the crystal provide the needed capacitance for proper operation.

Antenna
   Both modules will use an identical antenna setup. The antenna design we used is from Freescale reference design. This design uses a 2.45GHz balun that converts from single-ended to differential signals that is sent to an antenna that is traced into the PCB. The antenna circuitry
connects to the microcontroller via three pins; RFIN_P (positive RF connection), RFIN_M (negative RF connection), and CT_Bias (bias control voltage for the modem).

**MCU1 - Network Coordinator Board (NCB)**

**Microcontroller**

The microcontroller for the NCB is the Freescale MC13213. The specifications for MCU1 are the same as MCU2 with the exception that no analog to digital converts will be used. Also a 2x16 LCD and keypad will be connected.

**Power Supply**

We will be using a 3V battery pack for this board. The system will go into low power mode after one minute of displaying information to conserve power.

**LCD**

The LCD used in this project is a 2x16 character display module. This LCD requires a total of 16 connections. There are three control lines (RS, R/W, E), which are connected to the microcontroller PTA0, GND, and PTA6. The R/W control line is grounded because the LCD is only used as an output. The eight LCD data lines are connected to PTB0-PTB7. This LCD requires 3.0V of power. The backlight will not be used. The LCD will get its power directly from the battery.

**Button**

Only one button on PORTA will be used for the main interface for simple operation. One press of the button will move the user from state to state in a continuous pattern. There are four total states on the NCB that will be cycled through. The button is connected to the keyboard interrupt module on the board. When in low power modes a button press will wake up the microcontroller.

**Keypad**

This unit will be connected to a 3x4 keypad that will allow the user to input the cost per kW hour. The keypad has three 10K ohm current limiting resistors and is connected to 3.0V DC from the battery.

**Crystal**

The specifications for the external crystal are very specific. Freescale requires that a 16 MHz crystal with a <9 pF load capacitance is used. The external 8pF capacitors and the internal capacitance of the crystal provide the needed capacitance for proper operation.

**Antenna**

The antenna setup is the same as MCU1.