

SchmartBoard 2010 MCU Challenge

Project Number: MP002

Title: Harvesting Remote Sensor.

Abstract:

The Harvesting Remote Sensor consist at the core of a Schmartboard PIC Board populated with MCU p/n PIC18F2620, is a remote sensor because it makes use of RF(802.15.4) to communicate with a central controller . It uses Energy Harvesting from a solar panel transducer with an EnerChip module. The sensor itself reports temperature and humidity acquired from a very low power sensor.

Description:

The firmware is based on the MiWi P2P protocol stack. The RF transceiver IC used is the MRF24J40, actually module MRF24J40MA is used on the project. In order to maintain compatibility with the original code that Microchip supplies, the firmware is almost the same and *#define* were used to define the SchmartBoard Hardware.

At the beginning of the project was known that the SchmartBoard needed to be modified in some way in order to develop the Harvesting application. First, voltage regulator was removed because the Harvesting Module couldn't work to supply Voltage and Current. Even if it could, a linear voltage regulator is not the way to go with harvesting energy. But in any case we need a voltage regulator because the debugging and programming tools demands more energy than the available if using the EH. The voltage regulator was change for a 3.3V Output and soldered on a separate SOT-223 board.

MRF24J40MA module was also soldering on a home made SMT to DIP board ion order to allow easy prototyping.

The temperature and humidity sensor used is Sensirion p/n SHT15. This sensor was choose because it draws little current while in sleep (typ. 0.3uA).

The I2C like protocol was implemented and considerations was taken to safe energy even more. The serial bus only need a Pull-Up resistor in the SDA line, but the resistor couldn't be to big because of the rising/falling times of the signal, so a more intelligent approach was needed and very popular in today's harvesting firmwares; the pull-up supply voltage is provided by on I/O of the MCU.

At some point on the design was noted that the supply voltage of the RF module need to be cut-off while the MCU was sleeping, the need came from the fact that the sleep current of the module was not the 2uA sleep current ofMRF24J40 IC. What happen was that, even if all the MCU I/O lines that connect with the module were connected to GND, the consumption was still some tens of uA's. The important thing is that the module retain it's configuration while the voltage cut down so no re-initialization was needed which translates into less manipulation of the microchip stack. A P-ch mosfet was used for that purpose.

Available current waveforms were acquire with an instrument that allow little adjustments to the firmware in order to achieve the lowest current consumption. But not all is about the average current, for the harvesting and RF mixture the key is to estimate or even better measure the energy pulses that are extracted from the Eh module.

It was noted that the sensor measurements also produce some current pulses and were taken into account.

It wasn't possible to finish the Harvesting code but at the end the RF firmware works with the EH module, the sensor data acquisition need to be improved in some way because it overload the EH module, and probably resets the MCU.

Pictures of the Current Waveforms acquired are supplied.