Copperhead (Rev. B)

Version B.1: 1/14/2014

Introduction:

The Copperhead board is the motion sensor board that is capable of interfacing wirelessly to the GulfStream family of products. This board is based on the EM3585 micro-controller with a JTAG interface, one switch, one LED, a PIR motion sensor, and a thermistor. This board receives power from one CR2450 3V battery.

Hardware Description:

The Copperhead board is using the EM3585 micro-controller operating at 2.4 MHz with 512kB of flash and 64kB of RAM. The board has a single switch, one LED, a PIR Motion Sensor, and a thermistor. A JTAG port is also available for programming/debugging the internal CPU Flash memory. The board is powered by a single CR2450 3V battery.

The following describes the program address memory map of the EM3585 (refer to page 12-17 of the reference manual for more details). The reference manual can be found here(http://www.silabs.com/Support%20Documents/TechnicalDocs/EM358x-RM.pdf).

Address Range	Device
0x00000000 – 0x0007FFFF	FLASH (512KB)
0x20000000 – 0x20002FFF	SRAM (12 KB)

There are several mapping ranges for each (see the attached Figure for more details)

The EM3585 CPU has several general purpose I/O lines, PA (7:0), PB (7:0) and PC (7:0).

There is one connector, J1, which provides a JTAG port.

The EM358 CPU has 24 general purpose I/O lines.

GPIO(PA0): Not Used.
GPIO(PA1): Not Used.
GPIO(PA2): Not Used
GPIO(PA3): Not Used.
GPIO(PA4): Not Used.
GPIO(PA5): Not Used.
GPIO(PA6): Output of the PIR sensor (0: no motion, 1:motion detected).
GPIO(PA7): Drives GREEN LED (0: LED OFF, 1: LED ON).
GPIO(PB0): Power to the Thermistor (0: OFF, 1: ON).
GPIO(PB1): Available.
GPIO(PB2): Available.
GPIO(PB3): Power to the PIR sensor (0: OFF, 1: ON).
GPIO(PB4): Switch, normally open (1: pressed, 0: not pressed) pulled high externally.
GPIO(PB5): Not Used.
GPIO(PB6): Drives RED LED (0: LED OFF, 1: LED ON).
GPIO(PB7): Drives BLUE LED (0: LED OFF, 1: LED ON).
GPIO(PC0): Not Used.
GPIO(PC1):Thermistor output, must be input to the ADC port.
GPIO(PC2): Not Used.
GPIO(PC3): Not Used.
GPIO(PC4): Not Used.
GPIO(PC5): Not Used.
GPIO(PC6): Not Used.
GPIO(PC7): Not Used.

The following table provides the signal assignments of JP1.

JP1 Pin Number	Signal
1	VDD (3.3V)
2	JTDO (PC2)
3	JRST (PC0)
4	JTDI (PC3)
5	GND
6	JTCK
7	JTMS (PC4)
8	RESET*
9	PTI_EN (PA4)
10	PTI_DATA (PA5)

PIR Motion Sensor:

The PIR (Passive Infrared) motion sensor is the EKMB130113K from Panasonic. The circuit is powered by PB3 (0: OFF, 1: ON). The sensor output is fed to PA6, which is pulled low. When no motion is detected, the output is low, and when motion is detected, the output is high. For more information, refer to its data sheet (http://www3.panasonic.biz/ac/e_download/control/sensor/human/catalog/bltn_eng_pir.pdf).

Temperature Sensor:

The temperature sensor uses the NTCLE203E3104HB0 thermistor (100KOhm resistance at 25°C) in series with a high precision 82KOhm resistor. The circuit is powered/enabled by an I/O line (PB3) and the voltage across the 82KOhm resistor is measured using the A/D input (PC1). The sensor and the resistor form a voltage divider circuit, with voltage Vin = (3.0 x 82000) /(82000 + Rsensor) going to the A/D converter input. The value of Rsensor is given by: Rsensor = 82000 X ((3.0V/Vin) -1). Using the table lookup in the data sheets of the NTCLE203E3104HB0 along with interpolation, the temperature can be determined from the calculated value of Rsensor. For more information on the thermistor, refer to the data sheet: http://www.vishay.com/docs/29048/ntcle203.pdf .

After Rsensor is calculated using the above equation, the NTCLE203E3104HB0 table is looked up to determine the two entries which include that resistance value. Assume that Rsensor is between resistance value R1 and R2 (i.e., R1 < Rsensor < R2), with their corresponding temperatures T1 and T2 (where T1 < T2), respectively. Using linear interpolation, the temperature that corresponds to Rsensor can be calculated using the following equation: T = T1 + (T2 – T1) X (Rsensor – R1) / (R2 – R1).

The response time (in stirred air) for the thermistor, is 7s.

Conversion from ˚C to ˚F can be done using the following equation: T (˚F) = 32 + 9 * T (˚C) / 5.

LED:
The LED is connected to PA7, PB6, and PB7.

Switch:
The switch is set to be Normally Open (NO) and is connected to PB4.