Mainboard 0.3 – I2C

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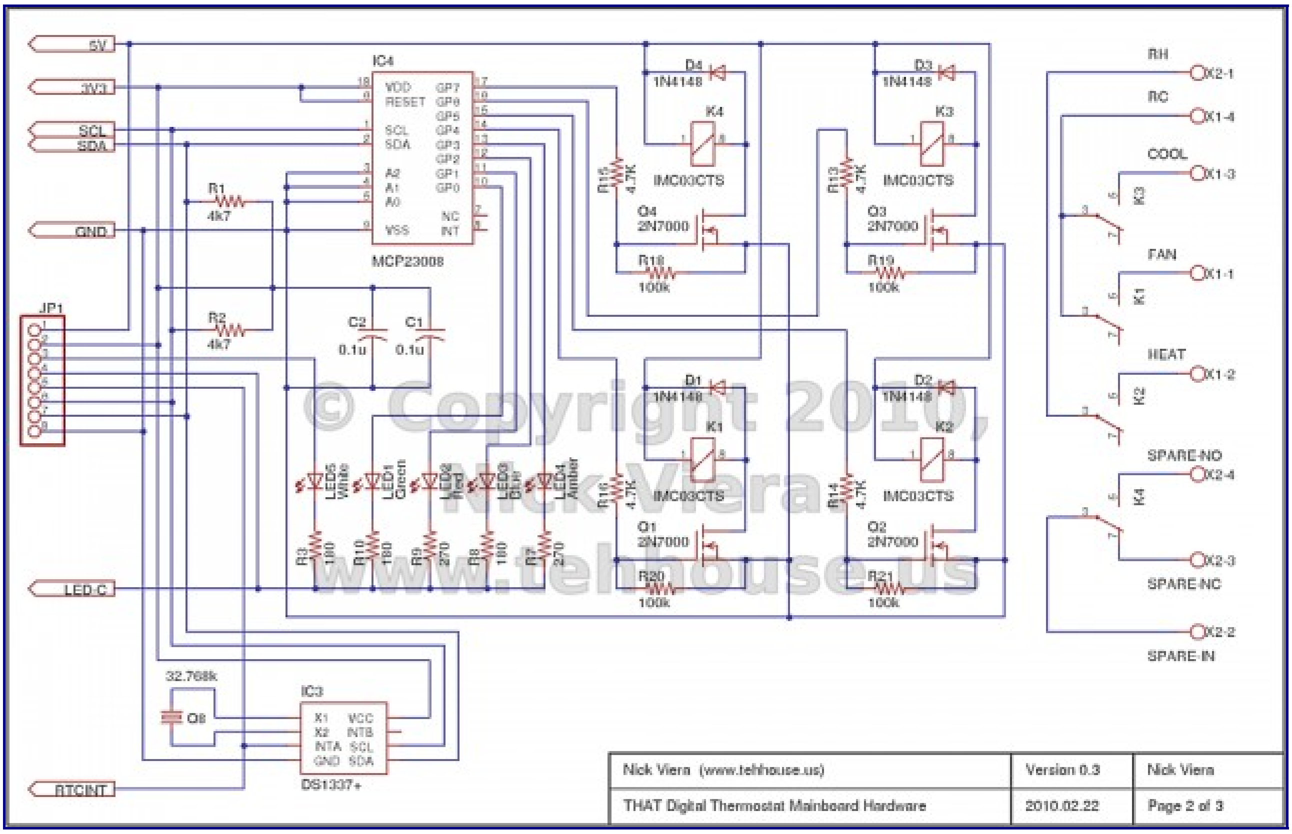
The latest version of my mainboard prototype is hardware version 0.3. The schematic for this hardware is large so I've split it up into 3 separate schematics, titled "i2c", "lcd", and "mcu".

The i2c schematic includes the i2c devices (the I/O Expander and Real Time Clock) and attached hardware. I decided to use an i2c I/O port expander because I was running out of I/O pins on my microcontroller.

Rather than having to reduce the number of LEDs and switches used by my thermostat module, I opted to use the inexpensive MCP23008 port expander from Microchip. Using the port expander, I now have a couple extra pins to work with, as well as having the ability to toggle the status LEDs independantly from the HVAC relays.

The i2c schematic also includes the 4 HVAC relays and 4 of the 5 status LEDs. The crystal shown is the 32.768kHz crystal used by the DS1337 real time clock IC. 32.768kHz is desireable for generating a clock signal when using a chip with a 16-bit counter since the count to 32,768 will occur exactly once per second. The i2c schematic is shown below.



Notes:

- R1 and R2 are pullup resistors for the I2C bus lines. The criteria for their selection is listed in the Atmel Atmega324 datasheet, shown below.
- MOSFETs Q1 through Q4 are used as buffers so that the relays can be driven without exceeding the current limit per I/O pin of the AVR microcontroller.
- D1 through D4 are flyback diodes to prevent large voltage spikes from appearing across the MOSFETs' drain-source junction when the relay coils are de-energized.

C_i[1]	Capacitance for each I/O Pin		–	10	pF
f_{SCL}	SCL Clock Frequency	f_{CK}[4] > max($16f_{SCL}$, 250kHz)[5]	0	400	kHz
Rp	Value of Pull-up resistor	$f_{SCL} \le 100$ kHz	$\frac{V_{CC} - 0,4V}{3mA}$	$\frac{1000ns}{C_b}$	Ω
		$f_{SCL} > 100$ kHz	$\frac{V_{CC} - 0,4V}{3mA}$	$\frac{300ns}{C_b}$	Ω