Remote thermostat hardware description.

The remote thermostat unit has a base station and remote stations. The base station communicates to the remote stations using Zigbee wireless communications. The base station stores all of the programmed temperatures and receives the current temperature from the remote units. The base station will display the current and programmed temperature on the Liquid Crystal Display (LCD). The remote units will turn on the heater when the base station checks that the current temperature is less than the desired temperature. The remote stations also have a seven-segment display to show the current temperature when a button is pressed. The base station will be powered by a wall transformer, while the remote units will be powered by two AA batteries.

The base station and the remote station hardware are almost identical although, there are a few differences. Everything will be described under the Base Station section and the differences between the two will be addressed under the Remote Station section.

**Base Station**

**Power supply**

The power supply used to power the base station is a wall transformer with an input of 3-3.3 Vdc and a max current of 1Amp. The microcontroller has a voltage requirement of 2.08-3.6 Vdc. The LCD has a voltage requirement of 2.7-3.3 Vdc. The temperature IC has a voltage requirement of 3.0-5.5 Vdc. The low voltage switch, which acts as an H-bridge, has a voltage requirement of 1.8-5.5 Vdc. The latching relay has a voltage requirement of 2.25-7.8 Vdc.

**Microcontroller**

The microcontroller for the base station 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 60K of flash and 4KB of RAM.

PORTA, bits 3-6, will be used to connect with the user interface switches. PORTB, bits 0-5, will be used to connect with the LCD display. PORTD will be used to connect with the temperature IC, bits 5-7, and the analog switch, bits 2 and 4. The external RF antenna circuit will be connected to RFIN_P and RFIN_M.

**Display**

The display is a 2 line by 16 character LCD which is powered by a 3 Vdc supply. It will be running in 4-bit mode, with only the upper four data lines being utilized. Along with the power and control lines, there will be ten lines total used. There will be a potentiometer to control the contrast. The display will show black characters on a non-backlit background. The display will show the current temperatures in each zone, as well as the temperature setting for the individual zones.

**Switches**

There will be four input switches which the user will use to program the temperature of the different zones as well as the base station. These buttons are normally open and will place a low signal onto the respective pin when pressed. The switches will be labeled “SELECT”, “-”, “+”, and “SET”.

**Temperature IC**

The temperature IC, MAX6662 from Maxim, will provide a 12-bit representation of the current temperature. This will interface into the microcontroller over a 3 wire/SPI bus.

**Antenna system**
The antenna which the microcontroller will use is just a trace on the Printed Circuit Board (PCB). Matching to near 50 Ohms is accomplished with L1, L2, L3, as well as the traces on the PCB. A balun transforms the differential signal to single-ended signal to interface with the PCB antenna.

**Heater control circuit**

The heater control circuit uses a MAX4684 IC which has two internal analog switches to mimic an H-bridge. The +3 Vdc is connected to the Normally Open (NO) contacts of the switch. Ground is connected to the Normally Closed (NC) contacts of the switch. The switch is connected to a latching relay, D3061. When the polarity of the voltage is connected one way the relay is SET. When the polarity of the voltage is connected the opposite way the relay is RESET. When a “SET” signal is input to the analog switch, one ground is switched to +3 Vdc which is sent to the latching relay. When the “RESET” signal is input to the analog switch, the other ground is switched, sending a reversed polarity voltage to the latching relay.

**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.

**Remote Station**

**Power supply**

The remote station will be powered by a 3 Vdc battery pack. The system will go to a low power mode in between temperature requests from the base station to conserve power.

**Microcontroller**
The microcontroller for the base station is the Freescale MC13211. This microcontroller also has a built in RF transceiver. The difference is that the MC13211 has 16KB of flash and 1KB of RAM memory. Since the remote microcontroller will act as a slave to the base station microcontroller, the smaller amount of memory will work just fine.

**Display**

There will be two seven-segment displays to show the current temperature. The display will be on for 30 seconds when the button on front of the unit is pressed.

**Switch**

There will only be one switch which will be used to display the current temperature for thirty seconds after the button is pressed.