RT8220 Circuit Description

1. Power Supply

Power is taken from three AAA batteries. The batteries are used in series to provide a nominal voltage of 4.5VDC. This voltage is used as the input to a TC55 voltage regulator that maintains a constant supply voltage of 3VDC. A 22uF capacitor is used on the output of the regulator to minimize the voltage drop when large current demands such as RF transmission are present.

2. Low voltage detection

The low voltage detect circuit monitors the output from the TC55 regulator. Low voltage detection is accomplished by a MC33464 voltage sensing IC and is used to hold the micro in a reset state to prevent erroneous output due to a low supply voltage. The output of the MC33464 is a complimentary drive. This means it is capable of outputting both a high and a low voltage level. When the input (supply voltage) to the MC33464 is above 2.7 +/- .67VDC the supply voltage is passed through to the output with a small loss due to the p-channel output drive. When the input is below 2.7 +/- .67VDC, the output to the micro is pulled to ground by an n-channel FET. The output of the MC33464 is connected to the reset pin of the micro, which holds the micro in reset while the voltage at the pin is at a low logic level.

3. Keypad inputs

The six keypad signals are combined on three input lines to the micro. This is accomplished by using two different commons that are capable of floating the ground of the input while it is not being read. There are two buttons connected to each input line and three buttons connected to each of the two common outputs. The two buttons that share an input line are connected to different commons. To read the status of a button, one of the commons is driven to ground while the other common is floating in a high impedance state. The three buttons connected to the grounded common will be read as a logic low if they are pushed. The other three buttons have no effect if they are pushed because they are floating. This process is reversed to read the other three buttons.

4. LCD display and backlight LED's

The LCD is driven directly from the output pins of the micro. It contains four common backplanes so it is driven at a ¼ duty cycle. The signal to the LCD is a dynamic signal in which the RMS value of the waveform determines if a segment is to be active or not. A segment is guaranteed to be off if the RMS voltage between the segment and the backplane is less than 1.02V and it is guaranteed to be active if the RMS voltage is greater than 1.45V. The voltage waveform on the segments is output directly from micro. The levels are set by the voltage divider made up of R4, R5, and R6. Since all three of these resistors are equal in value, the possible voltage levels of a segment are 0V, Vdd/3, 2*Vdd/3, and Vdd. The segment voltage and backplane voltage are varied between these levels to attain the correct RMS voltage for a segment to be on or off.

The backlight for the LCD is made up of two LED's and a NPN transistor configured as a constant current source. The LED's are right-angle surface mount and are located at the two upper corners of the LCD. The anodes of the LED's are connected directly to the positive battery terminal rather than the regulated supply to minimize voltage fluctuation due to the large current draw of the LED's. The cathodes of the LED's are connected together and to the collector of Q3. Q3 is controlled by the micro through a voltage divider that maintains a constant voltage on the base of Q3 and hence maintains constant current flow through the transistor. The constant voltage on the base of Q3 is necessary to keep the brightness of the LED's constant regardless of the battery voltage.

5. A to D conversion

The A/D circuit is used to measure the room temperature as well as measure the battery voltage. The temperature is measured by a thermistor. This is accomplished by the micro by measuring the time it takes to charge a small capacitor through the thermistor. Since the resistance of the thermistor changes proportionately with temperature, the room temperature can be calculated based on the charge time measurement. The same general algorithm is used for the measurement of the battery voltage except the resistance through which the capacitor is charged is fixed. The charge time of the capacitor varies with the voltage level of the battery because the time constant of the circuit is fixed.

6. EEPROM

The EEPROM chip AT25010 is used to store non-volatile memory. The memory is arranged as 128 8-bit words that are accessed serially. Data is read from the EEPROM from the serial output pin (pin 2) directly into the P0_1/RXD (pin 14) input on the micro. Data is written to the EEPROM from the output pin S22 (pin 48) of the micro to the serial input pin (pin 5) of the EEPROM. All writes and reads occur while the chip select (pin 1) of the EEPROM is held low by the S18 (pin 48) output port of the micro. No data can be transferred while the chip select is at a logic level high.

7. RF Transmitter

RF Transmission is accomplished through the use of the RFM HX1002 303.825MHz Transmitter chip. The RT8220 transmits commands using on-off keyed (OOK) modulation. The micro controls the transmitter through data port P0_2/TXD (pin 15). This pin is connected directly to the data input (pin 1) of the HX1002, which in turn controls the RF output. While the data input pin is at ground, the carrier signal is zero. The data sent to the transmitter chip from the microprocessor contains a signal synchronizing algorithm, a preamble with transmitter identification and a control code. The antenna is a microstrip line approximately 1/8 wave length long connected to the 50 ohm output (pin 4) of the HX1002 chip.

8. Microcontroller Clock

A 32.768kHz crystal drives the micro.

9. On/Off Only Jumper

If resistor R9 is present, the transmitter operates the control as an on/off model with only one flame and one fan level.