THEORY OF OPERATION FOR WIRELESS KEYPAD LRL071

The Wireless Keypad system consists of eight functional groups: keypad input, micro controller, non-volatile memory, LED keypad illumination circuit, under-voltage reset circuit, battery voltage measurement, energy storage, and 902/903 MHz PLL synthesized transmitter.

KEYPAD INPUT CIRCUITRY

Five SPST momentary switches SW1- SW5 are connect to ground on one side and input pins on the (U1) PIC16LF18856 micro controller on the other. These pins are held at a positive logic level, 1.8 to 3 volts by internal pull-up resistors. When a switch is closed the input pin of the PIC16LF18856 is grounded giving a logic zero state. This transition is sensed by the PIC16LF18856 (U1), which will wake up from its normal sleep mode and read which switch was press ed.

MICROCONTROLLER

The PIC16LF18856 (U1) is the heart of the system. All inputs are sent to it and all outputs come from it. It normally is in a sleep state with all clocks stopped. Depression of any key will bring it into an active state for at least five seconds. When active, U1 uses an internal RC oscillator to generate a 250 KHz clock for internal operation. All clocks are stopped when sleep mode. When a valid entry code or Lock key combination is entered a data packet is transmitted. Prior to transmission of a data packet, the clock increases to 8MHz, it remains at this speed while transmitting. C2 provides decoupling for U2. R1 provides a pull-up for the reset line.

NON-VOLATILE MEMORY

U1 contains 128 bytes of Electrically Erasable Programmable Read Only Memory (EEPROM) stores the rolling code counter, and the user programmable entry code.

LED KEYPAD ILLUMINATION CIRCUIT

Ambient lighting is measured using a phototransistor on the first key depression. If lighting is over the set point then keypad illumination is inhibited, if below the lighting is enabled. Current to each Orange LED is limited by RN1 and RN2 to 2.6 mA. The LED’s are driven by a 8% duty cycle 60 Hz pulse. This results in an average current of 220uA for the entire LED array. Annunciator LED is driven by a separate I/O pin to provide a high intensity optical indicator for user feedback.

UNDER-VOLTAGE RESET CIRCUIT

When the microcontroller U1 is in its active state, power is applied to the VCC pin of the under-voltage detector device (U3). Just prior to this application of power, the Reset line of the microcontroller U1 is strongly pulled high by RN3 until the under-voltage detector device has gone through its initialization and released the reset pin. When the microcontroller resets, C12 will hold the under-voltage reset VCC high, preventing a second initialization. U1's strong pull-up is then turned off and the under-voltage reset now will reset the microcontroller if the battery voltage drops below 1.8 volts. This will prevent unrecoverable lockups if the battery voltage drops below is specified operating voltage. When the microcontroller enters sleep mode, the under-voltage detector VCC is removed to eliminate the 500nA under-voltage detector supply current draw.

ENERGY STORAGE

Four capacitors C3, C13 to C15 are used to store energy for use during transmission.

902MHz TRANSMITTER

Device U3, an AX5043 PLL transmitter circuit takes data from the microcontroller U1 being transmitted over the SPI bus and loads it into an internal FIFO for transmission. Control signals to set frequency, power level, and starting and stopping transmissions are also sent over the SPI bus. A 25MHz crystal X1 is the frequency reference for the PLL synthesizer inside U2. The PLL synthesized transmitter differential output is applied to the single ended PCB trace antenna that is matched by the LC network left of U3. C18,C19 and L1 form a 900MMHz low pass filter. C8 through C11 provide smoothing and decoupling of U3 from the battery.

DUAL FREQUENCY SWITCHING

The AX5043 PLL has two separate VCO's set to each channel of the dual frequency protocol.   Software switches between the VCO's to provide fast frequency switching.

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