THEORY OF OPERATION FOR WIRELESS KEYPAD LRL061

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 433.92 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) PIC16LF1829 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 PIC16LF1829 is grounded giving a logic zero state. This transition is sensed by the PIC16LF1829 (U1), which will wake up from its normal sleep mode and read which switch was pressed.

MICROCONTROLLER

The PIC16LF1829 (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. R2 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 the five White LEDs is limited by R1 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 (U4).   Just prior to this application of power, the Reset line of the microcontroller U1 is strongly pulled high by PA4 through R9 until the under-voltage detector device has gone through its initialization and released the reset pin. When the microcontroller resets, C4 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 it's 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 C5, C15 to C17 are used to store energy for use during transmission.

433.92 MHz TRANSMITTER

Device U2, a Si4012 PLL transmitter circuit takes data from the microcontroller U1 being transmitted over the I2C 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 I2C bus. A 10 MHz crystal X1 is the frequency reference for the PLL synthesizer inside U2. The PLL synthesized transmit frequency is applied to the PCB trace loop antenna that is matched by C11 and C12. The antenna is then finely matched by an internal variable capacitor controlled by U2. C14 and C13 form a 630 MHz 2nd harmonic trap. C8 and C9, L1 and L2 RF decouple the antennal from the power source. C6 and C7 provide smoothing and decoupling of U2 from the battery. C10 provides proper loading for the crystal.

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