Wired Intruder Detector with E931.97

A wired Intruder Detector is quite a common application for the 931.97.
The requirements for this application are

- no false alarms
- detection of humans
- adjustable detection range
- reliable operation

To avoid false alarms, the unit should be used indoors, not facing moving curtains, sunlight and not been exposed to sudden temperature changes or hot and cold air movement.

The type of lens, the mounting height, the enclosure and the insulation against temperature changes of the detector have the most influence on avoiding false trigger.

Functions and Implementations

For details referring to components, see fig 1.

Motion Detection

The E931.97 contains a second order band pass filter for the signal processing. Together with the circuitry required to operate the analog PIR detector, once achieves a 3rd order high pass filter function and a second order low pass filter function. The filter removes unwanted out of band signals.

In order to create an alarm condition, the circuit must observe 2 consecutive signal pulses above the threshold within a time window of 4s. There must also be a change in polarity between the 2 pulses.

The LED output indicates whenever the trigger threshold is exceeded. The REL output becomes active, once movement has been detected (alarm condition). The REL output remains active, until no further movement is detected and the user defined On Time has lapsed. The On Time is calculated from the moment, where no further motion is detected.

If the signal from the detector is more than twice as high as the threshold, the E931.97 will immediately generate an alarm condition.

Relay Switching

The unit can be configured for normally open relays, where the coil needs to be driven permanently (J3 to VDD and J4 to REL). In cases of power failure and motion detection, the relay contacts will open and the alarm panel will act accordingly.

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Motion Detection

The 4 LEDs are driven, whenever the RELAY output is active. The auxiliary output (CON3) can be used to observe the status on the RELAY output or the LED output. J5 is provided to select the source.

Connection of PIR Detector

The PIR detector contains a pyro ceramic, which is connected to the gate of a JFET. The drain terminal needs to be connected to a positive supply voltage (2V to 12V) and the source requires a resistor to ground. The JFET provides the impedance conversion from the internal pyro ceramic to the external load.
The DC voltage on the source can be between 0.1V and >1V, depending on detector type, supplier and operating conditions – specifically the temperature.

The PIR detector generates a relatively small signal of some 100uV as a result of movement. The signal value depends to a large extend on the lens, the size and temperature of the moving object and the distance of the object to the detector.

Resistor R2 is the source resistor for the detector. The supplier recommends values between 50k and 150k. For very low power applications, many users choose much higher resistor values.
Capacitor C4 reduces any RF signal coupled from the environment onto the source of the detector as it would result in noise due to the demodulation across the source-gate diode inside the detector. Some detector manufacturers have this capacitor already integrated.

Capacitor C3 in conjunction with resistor R8 removes any DC content from the detector output signal. The CR combination is selected to act as a first order HP filter to remove unwanted lower frequency content. The value for resistor R8 should be a few times higher than resistor R2 to avoid any attenuation of the signal. R11 is a short to pin 13 of the E931.97.

It is important, that the noise on the drain voltage of the PIR detector is below 1mV as the drain source voltage attenuation is only 30 dB in the frequency band of interest.

Supply voltage regulation

The unit is supplied with a unregulated supply voltage, which can be between 8V and >20V. The integrated shunt regulator limits the supply voltage to 3V. The maximum shunt current can be 5mA. The voltage range for the unregulated supply is primarily defined by the value and the power rating of the resistor R1 and the total current consumption of the circuitry connected to the regulated supply.
Capacitors C1, C5 and C2 are supply bypass capacitors to eliminate transients on the supply voltage of the E931.97 and the PIR detector.

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Range / Sensitivity Adjustment

The DC voltage on the SENS input defines the threshold of the comparators. 0V results in 50uV peak, >0.25*VDD results in 460uV. The range is covered with a resolution of 127 equal steps. RV2 in conjunction with R6 is provided for adjustment.

Relay Switching Time

The time, how long the relay output is active after no further motion is detected, can be adjusted the same way as the sensitivity.
A range of 2s to approx. 4000s is provided. RV3 is provided for adjustment.

Instead if trim pots, once can use fixed resistors, if no adjustment is required.

Protection against Polarity Errors

Diode D1 protects the circuit against damages in case the supply has been accidentally inverted.

Not populated Components

The application PCB allows different options for components. The components marked with an “X” are not populated.

Calculation of component values

R6, RV2,RV3:
1 / (1+ R6/(RV2//RV3)) must yield slightly more that 0.25 to ensure full range for Sensitivity and On Time.
Choose preferred value for RV3 and RV2 first.

R4 < R(relay coil) * β(Q1)
R14 < (1-4/12) * R3* β(Q3)
R7 < R3* β(Q2)

R2 = 47k to 150k, power consumption is uncritical in this application.
R8 > 5 * R2
C3 = 1/(2*π*fo*R8), fo = cut off frequency (0.2Hz)

R1 < (12V-3V)/Imax
Imax = I(U1)+I(R2)+I(R6)+I(R4)+I(R14)+I(R7)+100uA

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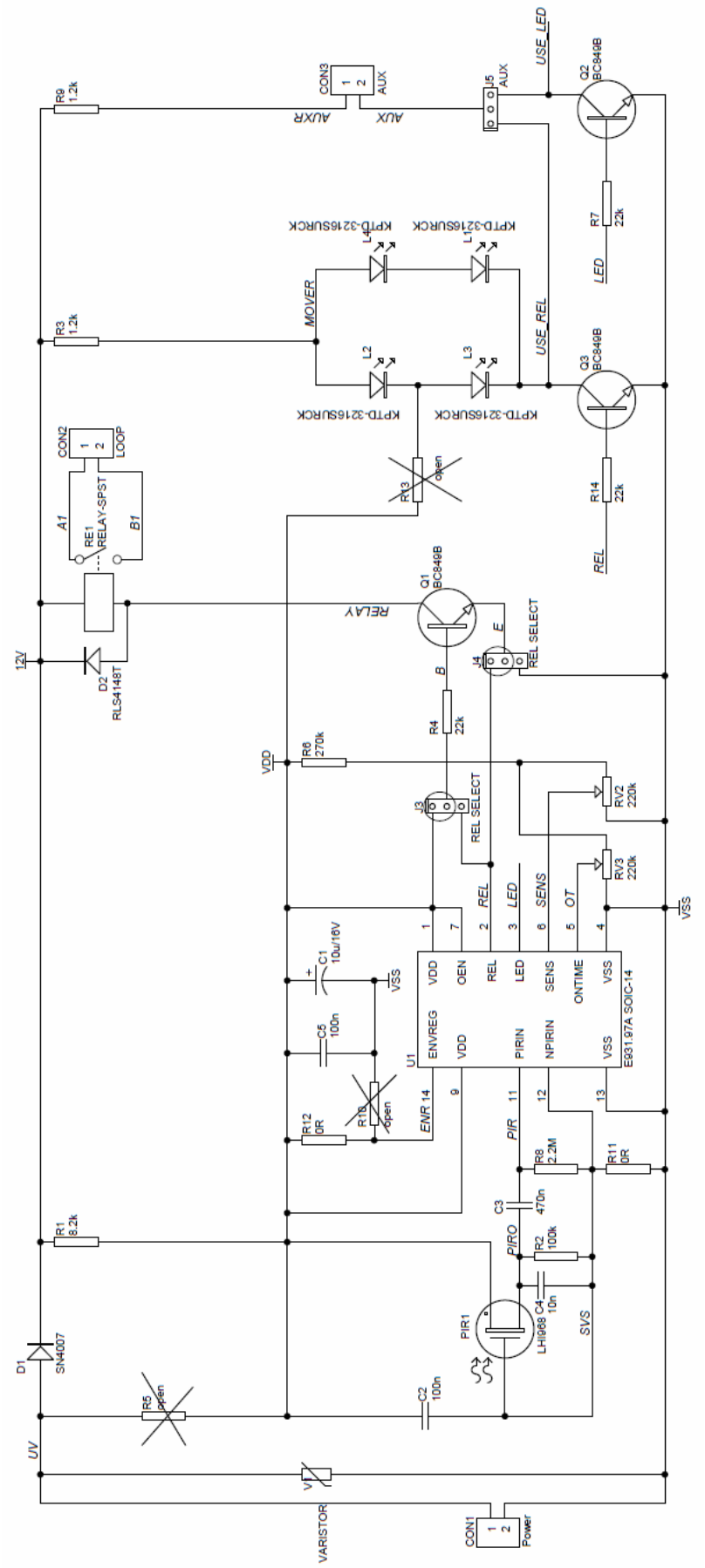

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PCB Top View

Small PIR lens to be removed when used in enclosure provided

R10 Disable regulator
R12 Enable regulator
Only one of the resistors can be fitted at a time

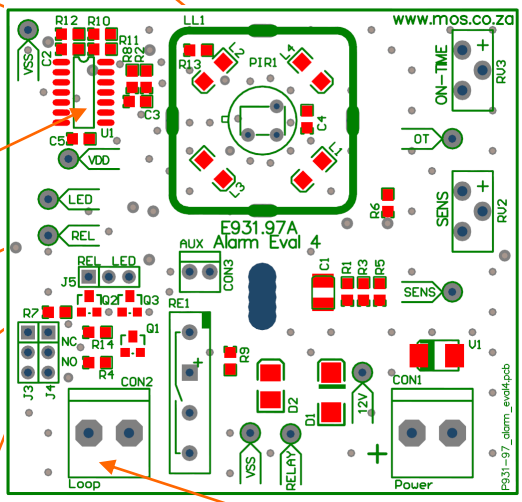
E931.97A
Low Power PIR controller IC

PIR Detector

Use REL or LED signals for the AUX output

Relay Mode:
Normally Closed 

Normally Open 



On-time: **CCW=minimum**

Sensitivity: **CW=Less Sensitive**

R1 is used with regulator
R5 can be used for direct 3V

Supply connections

Relay outputs for alarm loop

CW = Clockwise
CCW = Counter Clockwise

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