KUBE Electronics AG

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KUBE TR156
Universal PIR Circuit IC

For PIR Motion and Presence Detectors

All functions for a PIR detector are available in a single chip solution. It includes analog and digital circuitry and functions for light switches, presence detectors, air-conditioning controllers, door openers, intruder alarms etc.

Figure 1: KUBE ASIC TR 156

Applications

- Energy monitors
- Presence detectors for building automation
- People detection
- Vehicle detection
- Multirange detectors
- Door openers, 2 sensor heads indoor/outdoor possible with one chip
- Automatic light switches
- Automatic heating/ventilation/AC switches
- Intruder alarms
- Smart thermostats (standby-comfort)
- Hotel room controllers

Features

- All analog and digital functions on a single chip
- Smallest size detectors possible, to integrate in existing controls
- One or 2 sensor inputs
- Compatible with microprocessors or BUS controllers (Echelon, EIB etc.).
- Low current (typically 400 Microamps), 5 Volt supply.
- Integrated voltage regulator.
- Automatic software algorithms.
- Possibility of custom mask for the digital part
- A wide range of optics is available. Specially recommended are cone channel optics TR 230 and TR 232. They allow the construction of supercompact detector units, and to meet most recent CE and IEC 669-2-1 safety requirements.
- Available in SOP28 SMD Package

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Specifications TR156

Basic Operation:
Circuit for a presence (motion) detector. Output signal upon the presence of people, including delay times.

Sensor input:
for a pyroelectric dual-element sensor with J-FET, offset voltage 0.1 ... 2.0 Volts. Pin 14 provides a low frequency stabilized, low noise, EMC protected supply voltage of appx 3.5 V for the sensor. A source resistor of 300 kOhms is recommended on Pin 13 at the amplifier input. The range may be 47 to 330 kOhms. Lower values and a capacitor of 1 nF connected from Pin 13 to ground give lower impedance and improved EMC. Recommended is a metal film (MELF, MMELF) type for this resistor. The other resistors in the circuit may be carbon or conventional SMD.

Amplifiers:
The chip has 2 identical amplifier inputs for 2 sensors. (1) Typical bandpass frequencies are 0.1 to 10 Hz. Gain can be up to 5000.
A typical circuit configuration is shown in the attached schematic. The gain is 1750 @ 1 Hz. The components should be arranged as close as possible to the chip. It is recommended to use small 0805 SMD chips, ceramic capacitors for 22 nF and low leakage, 10Vdc aluminum electrolytics for 22 uF, preferably 105 DegC types, or tantalum capacitors.
The circuit features quick start up after reset (patent pending). No minutes of waiting for amplifier start up.

Comparator:
Each amplifier channel has a programmable window-comparator. The + and - threshold can be set by a single external programming voltage at Pin 2. The threshold can be set fixed, by potentiometer, by thermistor for temperature compensation or microprocessor. The circuit shows possibilities for programming the threshold and recommended voltage levels.
The comparator has also an adaptive mode (patented) for high sensitivity presence detectors (1) (retriggering is made easier by a feedback from Pin 7 to Pin 2).
The comparator includes a 30 ms time window for spike suppression. If Pin 2 is left open, the default threshold is +/- 0.75V.

Timing circuits:
The timing circuits include turn-on and turn-off delays.
Turn-on delay is normally used in HVAC and alarm systems. The detector needs several activations over a defined time period before turning on.
Light switches use turn-on = 0
For intruder alarms, settings of 0 to 16 s are recommended.
HVAC systems generally use 64 or 128 s

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Turn-on delay is set with a voltage on Pin 28 to

Vin(V)	Ton
0 to 0.2	0s
0.5	2s
0.8	4s
1.1	8s
1.4	12s
1.7	16s
2.0	24s
2.3	32s
2.6	48s
3.0	64s
3.3	96s
3.6	128s
3.9	192s
4.2	256s
4.5	384s
4.8 to Vcc	512s

Turn-off delay is used in most application to extend ventilation and light outputs and to bridge periods of no detected signals.
Intruder Alarms generally use a setting of 8 sec.
Light switches and HVAC controllers generally use 128 to 1024 s.
Vin for Toff is applied to Pin 27.

Vin(V)	Toff
0 to 0.2	2s
0.5	4s
0 .8	8s
1.1	12s
1.4	16s
1.7	24s
2.0	32s
2.3	48s
2.6	64s
3.0	96s
3.3	128s
3.6	256s
3.9	512s
4.2	768s
4.5	1024s
4.8 to Vcc	2048s

Applied voltages refer to ground. Potentiometers or resistors are recommended in the range of 20 kOhms to 2 Megohms. Pin 26 provides a pulsed, short duty cycle Vcc to supply potentiometers or resistors for lowest power. However, Pins 27 and 28 can also be programmed with fixed or external voltages. The voltages on Pin 27 and 28 may be tied to ground for test purposes (shortest Ton and Toff).

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For lowest part count, the chip features default values without external components. (1)
Pin 1 provides an automatic mode (pat.pend.): Turn-off time is prolonged when only few signals are detected (Toff is doubled if first retrigger occurs not before the second half of original Toff. Max Toff is 2048sec). Pin open = enable, Pin grounded = disable.

Manual override:
The circuit can manually be switched on and off, e.g. for semi-automatic light switches or remote control. This circuit includes the required anti-bounce circuit for push buttons, time windows and quick reset of the activated sensor and amplifier. Apply a rising edge transient to Pin 5 to switch manually. (1)
Disactivate manual control with Pin 5 left open.

Daylight Sensor: (Pin 25)
A daylight photocell can be used to inhibit switching during daytime and/or to switch light off when there is enough daylight. The circuit is compatible with most photocells or photoresistors. A voltage below 1.1V at Pin 25 will turn the output OFF. The circuit includes multiple verification and hysteresis to avoid malfunction upon short light changes and shadows.
When Pin 4 is grounded, the response is delayed by about 5 Minutes (photocell use).
When Pin 4 is tied to Vcc, the response is within 500 ms. In this mode, Pin 25 can be used to inhibit detection, for external control (e.g. daytime mode in intruder alarms).

Clock oscillator:
Single Pin with external NP0 capacitor 220 pF at Pin 3. Use shortest connections. Frequency is also determined by a 1.2 MOhm resistor at Pin 6.

Outputs:
The main output Pin 24 can drive:
- TTL and C-MOS loads
- LED (integral current limiter to 0.5 mA)
- Relay driver transistors.

For power relays, output Pin 24 provides PWM modulation to reduce current drain. This mode is switched on automatically when a bipolar transistor is driven by the output, i.e. the output is not allowed to rise above 2 volts. (1)
This function can be avoided if a base resistor is used.

The output is also available as inversed (Pin 7).

There is a "Presence" output (Pin 23) independent of the time settings, for an LED (integral current source 0.5 mA) to visualize that the detector works. This LED is delayed by 5 seconds (on) and 96 seconds (off) to the sensor activation, so that a person can observe the unit switching.

(1) Please inquire for the use of these special functions available on the chip.

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Start up functions:
The circuit is resetted when powered and in an initial ON state until operational (for appx. 20 sec.).

RF protection:
PIR circuits are always very sensitive to radio interference, especially in the 100 to 1000 MHz range from mobile telephones etc. It is recommended to use the shortest possible connections for the external components and between the sensor and the chip. A double layer PCB is recommended with the lower layer being a full ground surface. External wire connections should be blocked with small ceramic capacitors (1 nF), and ferrite bead inductors depending on requirements. KUBE offers circuit and layout design support and EMC testing to international standards. (CE, EN, IEC and others)

Operating conditions:
Supply voltage Vcc 4.5 to 5.5 VDC, typically 400 uA, max. 1 mA
Temperature -20 to +80 DegC

Package:
Standard version (TR156 R10K):
28 Pin SOP, surface mount, for lead-free soldering.

Custom versions with lower Pin count or DIL available on request.

Ordering Information:
PIR Chip TR156

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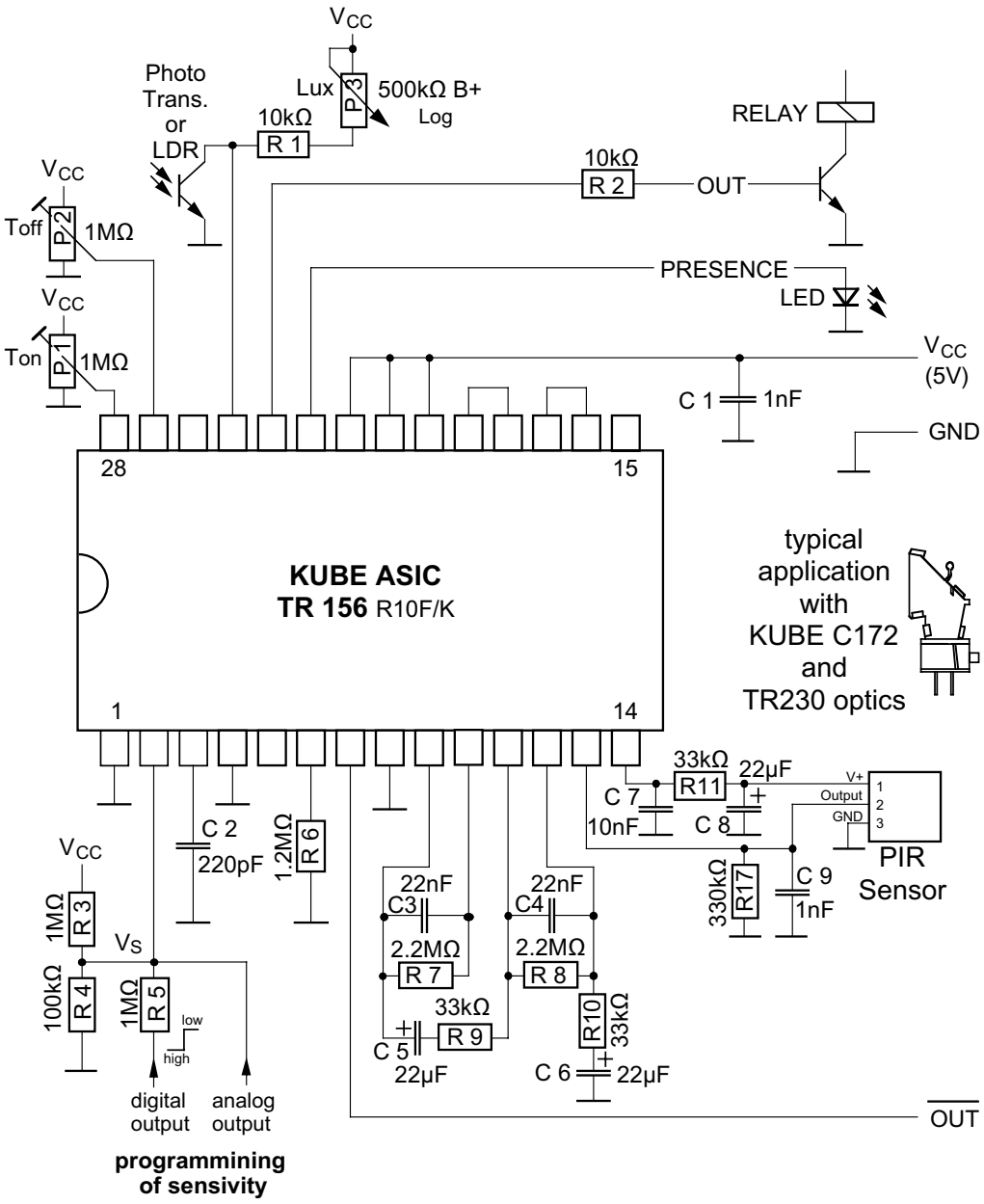

low sensitivity	V_S ~	1V	range appx. 6m with TR 230 / 232 optics
medium sensitivity	V_S ~	0.5 V	range appx. 9m with TR 230 / 232 optics
high sensitivity	V_S ~	0.25 V	range appx.12m with TR 230 / 232 optics

Pins 15/16/17 can be used as general purpose OpAmp

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