DIY Kit 130. Door Minder

This kit uses an infrared (IR) beam to monitor door & passage-ways or any other area. When the beam is broken a relay is tripped which can be used to sound a bell or alarm. Suitable for detecting customers entering a shop, cars coming up a driveway, etc. The IR beam is very strong. Distances over 25 yards can be monitored with this Kit. A 12VDC unregulated supply is required to power the kit. A 12V wall adaptor is fine. Provision has been made so that only one power supply needs to be used to power both units. The relays in this kit are rated to switch mains voltages.

The kit is constructed on single-sided printed circuit board. Protel for DOS Autotrax & Schematic were used.

CONSTRUCTION

The kit is built on two separate PCBs – a transmitter PCB (K130T) and a receiver PCB (K130R). Refer to the parts list to see which components belong to which board. Use the component overlay on each PCB to place the components.

Transmitter board

Insert the lowest height components first. Leave the infrared LED and power jack until last. Make sure that the electrolytic capacitor and diode are inserted correctly. A socket is supplied for the IC.

The IR LED can be mounted vertically or at right angles to the PCB. This will depend on how the transmitter will be mounted when in use. In either case the LED must be inserted the right way round. The flat edge on the LED should line up with the flat edge on the PCB overlay.

Lastly, if the distance to be monitored is less than about 10 yards then you will need to fit the 5mm tubing over the IR LED. This narrows the radiating angle of the IR beam and makes it much more directional. The IR output is strong. It can easily bounce off walls etc to give false readings.

Receiver board

As with the transmitter board, start with the lowest height components first - resistors, diodes, capacitors and transistors. Note the polarity of the electrolytic capacitors and diodes. Next insert the screw terminal block, power jacks and relay. Last of all is the infrared receiver module. The orientation is clearly shown on the PCB overlay: the detecting lens bump faces outwards. Power must be center positive. A protection diode D4 is there to protect the circuit if the wrong polarity is plugged in.

CIRCUIT DESCRIPTION

Transmitter Board

The transmitter board consists of two oscillators, one running at approx. 250Hz and the other running at 38KHz. The 38KHz frequency acts as a carrier wave and is required by the IR receiver module on the receiver board. This carrier wave is "ANDed" or modulated with the 250Hz frequency to produce an output signal that contains bursts of 38KHz at a rate of 250Hz. This signal is used to drive an infrared LED.

The oscillators are made using a 4093 quad 2-input NAND gate IC. One gate, IC1:D, is used for the 250Hz oscillator. Resistor R1 and capacitor C1 set the frequency. Another pair of gates, IC1:A and IC1:B, make up the 38KHz oscillator. Resistors R2 and R3 and capacitor C2 set the frequency. Gate IC1:C "ANDs" these signals together.

Transistor Q1 provides a constant current source for the IR LED. The zener, Z1, on the base of Q1 keeps the emitter at a constant voltage. Therefore the voltage across R6 is also constant. For the values shown the current through the LED, when on, is fixed at approx. 85mA. The peak current through the LED is set by R7 and determines the range of the kit. Reduce it to say 22R to get greater range if needed. There is a polarity protection diode D1 to make sure the power supply is center positive.

Receiver Board

The receiver consists of an IR receiver module that detects the incoming IR beam. The IR signal is used to keep a capacitor charged which in turn holds a relay operated. When the beam is broken the capacitor discharges and the relay releases.

The IR detector module, RX1, is made up of an an amplifier/filter circuit tuned to detect a 38KHz frequency. The output pin is low whenever a 38KHz signal is detected. You may download the Data Sheet from

http://kitsrus.com/pdf/pic1081scl.pdf

Pinout: with the lens bubble facing you – left pin Vout, center pin Ground, right pin Vcc. (The Kodenshi PIC26043S we have been using will be replaced by the Waitrony PIC1081SCL, 7/2001. See waitrony.com.)

When the IR beam is present the relay is operated

The output of RX1 is the 250Hz signal from the transmitter. This signal is passed via transistor Q1, capacitor C1and diode D2 to capacitor C2.

C2 is fully charged during the high portion of the signal. It starts to discharge during the low portion of the signal via LED L1, resistor R4 and transistor Q2. However the discharge time is much longer than the off time of the signal so the voltage across C2 is always enough to keep transistor Q2 on and therefore the relay operated.

When the beam is broken the output of RX1 is high. Transistor Q1 is off and capacitor C2 is no longer being recharged. It will eventually discharge to the point where transistor Q2 will turn off and the relay will release. The "turn off" delay is determined by the time constant of resistor R5 and capacitor C3. With the values used it is approximately half a second.

Capacitor C1 prevents a steady DC voltage on the collector of Q1 from charging C2. This would occur if the

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beam was not present or the beam was a **continuous** 38KHz signal. In other words, the receiver module will only respond to a **pulsed** 38KHz signal. LED L1 gives a visual indication when the IR beam is present and is used to help with installation and setup. It can, of course, be removed if it is not wanted.

Zener diode Z1, resistor R6 and capacitor C4 provides a stable 5.6V supply for the IR module. The relays provided with this kit are mains rated but use with care. RUDH 110V/10A; RWH 250V/12A, 120VAC/15A.

INSTALLATION

For ease of operation, the transmitter board can be powered from the receiver board when they are relatively close together. Two plugs have been supplie d for this. Connecting wire for the length required must be supplied by you. Otherwise two separate power supplies are required.

The receiver board contains two DC jacks connected in parallel. Power from a 12VDC source is connected to one jack. A lead can then be connected to the other jack and run to the transmitter board. DC plugs to make up a lead are supplied with the kit.

Aligning the transmitter and receiver is simply a matter of pointing the transmitter IR LED at the receiver board and moving it around until the red LED on the receiver board lights. This indicates that the beam is being received. The relay will be operated.

Note:

With power applied the relay is normally operated and only releases when the beam is broken. The relay contacts labelled "NO" (Normally Open) and "NC" (Normally Closed) refer to when the relay is released.

With the relay operated, the "NO" contact will be connected to the "C" contact and the "NC" contact will be unconnected.

IF IT DOES NOT WORK

Poor soldering ("dry joints") is the most common reason that a circuit does not work. Check all soldered joints carefully under a good light. Re-solder any that look suspicious. Check that all components are in their correct position on the PCB. Are the electrolytic capacitors and diodes the right way round? Have you fitted the 5mm tubing over the IR LED on the transmitter board?

Web Address & Email

You can email us at **peter@kitsrus.com**

See our website at

http://kitsrus.com

This is an improved (natually!) version of the door minder published in *Silicon Chip*, april, 1999. It was developed originally by Oatley Electronics.

7/2001. Added two input protection diodes. New IR Receiver Module used.

PARTS LIST – K130

Transmitter board

Resistors (0.25W carbon)

47 yellow violet black	R6	1
1K brown black red	R5	1
1K8 brown grey red	R3	1
6K8 blue grey red	R2	1
47K yellow violet orange	R1,4	2

Capacitors

1nF ceramic 102	C2	1
100nF monobloc 104	C1	1
100uF 25V electrolytic	C3	1

Semiconductors

4.7V 400mW zener diode	Z1	1
BC557 transistor, PNP	Q1	1
4093 CMOS IC	IC1	1
Quad 2-input NAND with schmitt trigger inputs		
IR LED, EL-1L7	L1	1

Miscellaneous

2.5mm DC jack	X1	1
Diode 1N4004	D1	1
Tubing, 5mm x 25mm long to fit over L1		1
PCB, K130T		1

Receiver Board

Resistors (0.25W carbon)

470 yellow violet brown	R3,6	2
6K8 blue grey red	R1,2,4	3
47K yellow violet orange	R5	1

Capacitors

10uF 16V electrolytic	C1,2,3	3
100uF 25V electrolytic	C4,5	2

Semiconductors

1N4148 signal diode	D1,2	2
1N4004 power diode	D3,4	2
5.6V 400mW zener diode	Z1	1
BC547 transistor, NPN	Q2	1
BC557 transistor, PNP	Q1	1
LED, 5mm red	L1	1
IR receiver module	RX1	1

Miscellaneous

2.5mm DC jack	X1,2	2
Terminal block, 3-way	X3	1
Relay, 12V SPDT	RL1	1
"Goodsky" RWH-SH-112D		
PCB, K130R		1

Extras

2.5mm DC plugs		2
(for optional power lead to the transmitter board)		

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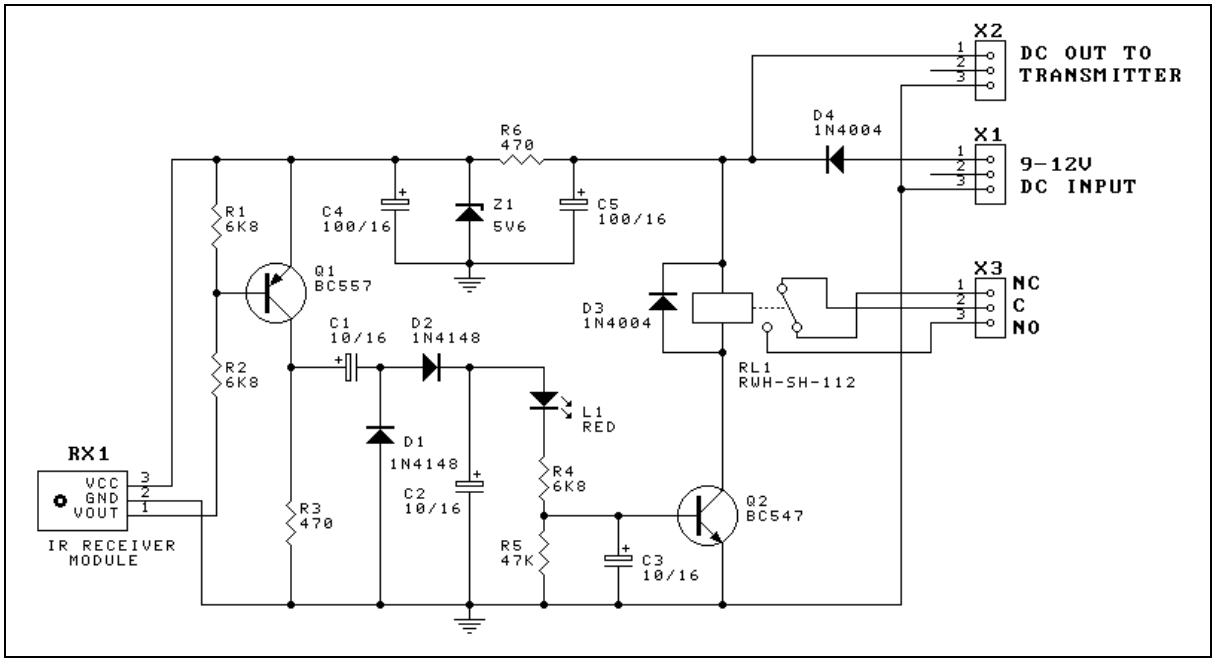
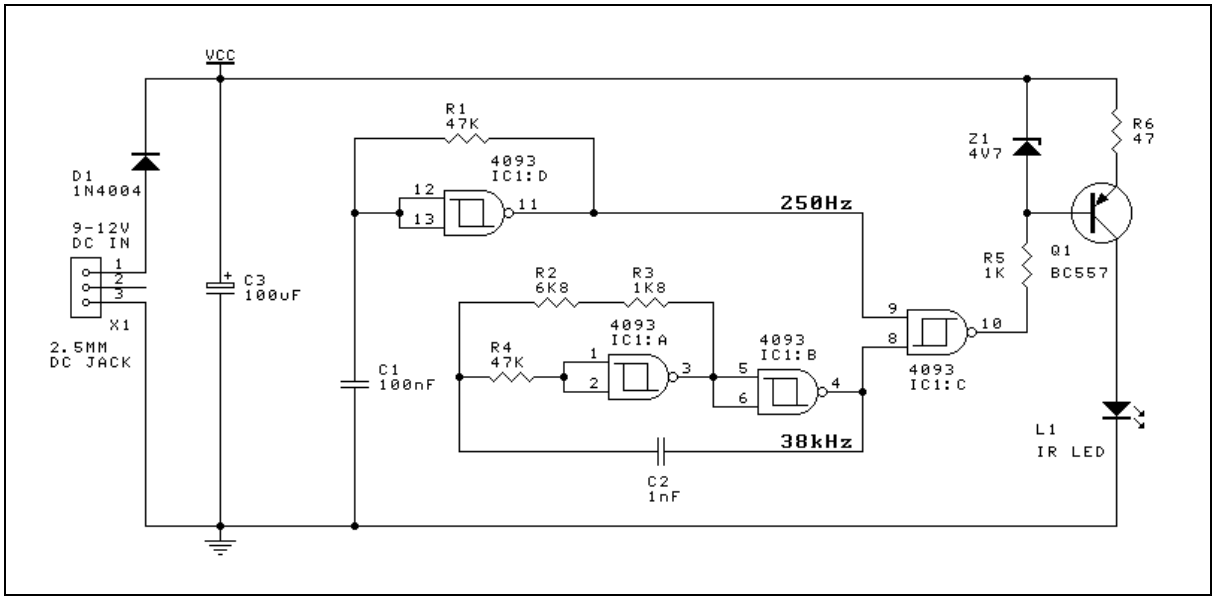


Door Minder - Receiver Module



Door Minder - Transmitter Module