Transmitter Theory of Operation

The transmitter has an LM555 (U1) IC operating at a frequency of 38 KHz. The exact frequency is set by adjusting R2. This must be adjusted for best range, (see test instructions).

The receiver is very sensitive and can be overpowered if the transmitter puts out too much infra-red signal.

Depending on the range you are going to use your kit you have to change the value of R4. If you are going to work at a distance of 10 feet or less, R4 should be between 120 and 160 ohms. Over 10 feet you can use a value as low as 22 ohms. It may be necessary to determine the exact value by trial and error. This kit will give a range up to 40 feet.

The transmitted IR signal must be modulated. This is necessary because the TSOP-xxxx family of IR Receivers only detects a modulated signal, and it also conserves battery power. The modulation is accomplished by using a multivibrator circuit. This circuit is made up of Q1, Q2 and associated components.

The Infra-Red LED on the transmitter must be able to be aimed toward the receiver when our kit is completed. You must allow enough lead on the IR LED to achieve this. If you use any type of enclosure the IR LED must be aimed through an opening in the enclosure, or you can locate it outside of the enclosure. You may want to add an ON-OFF switch in series with the + battery lead. (you supply this switch).

Receiver Theory of Operation

The receiver consists of an Infra-Red amplifier/detector module and a circuit to detect any modulated output from this module, and operate a relay or other load of your choice. This kit operates on 8 to 12 Volts DC.

TSOP-xxxx Theory (U2)
The infrared signal generates an equivalent photo current in the photo PIN diode. The DC part of the signal is blocked in the bias circuit and the AC part is passed to a trans impedance amplifier followed by an automatic gain-control amplifier and an integrated band pass filter. A comparator, an integrator and a Schmitt Trigger stage perform the final signal conditioning. The 'Automatic Gain Control' and the 'Automatic Threshold Control' circuits dynamically control the operating points as well as the threshold levels required to suppress noise from disturbance sources. The digital output signal has an active low polarity and consists of an envelope signal of the incoming optical burst without the carrier frequency. U3 is a 5 Volt regulator for the IR receiver. (Receiver data sheet is available at www.vishay.com)

Additional Circuit Theory

The rest of the circuit converts the modulated signal into a DC signal to control a relay, light or whatever else you may need. We use 3 sections of an LM324 Quad op amp to accomplish this. The first section has a gain of 470 as determined by the ratio of R2/R11. This connects to a second section which acts as a buffer and feeds a voltage doubler rectifier circuit consisting of C2, R10, D1, D2, R7 and C3. This changes the AC Modulation from Pin 2 into a DC voltage. Since the overall circuit gain is very high it only takes a very small IR signal to produce the DC voltage we need. This DC voltage is fed into a third section of U1. When this voltage falls below about 1/6 of the applied voltage the output voltage abruptly changes to less than 1 volt.
(This section has an output voltage about 8 volts when NO IR SIGNAL is present.) If this circuit is wired in the DETECT mode, this causes Q1 to conduct. When Q1 conducts it can energize a relay, a light or another device you have wired to the output of your kit. You may also wire your kit in the INTERRUPT MODE. The output transistor will supply about 80mA of current. If you need more than this you will need to connect a relay or a larger transistor to your kit. The circuit board is designed so you can use a small DIP style relay. (You must furnish this part.)

**DETECT MODE:**

With this circuit you can make a device operate as long as an IR signal is being picked up by the receiver. For this mode you may want to operate at a greater distance. You can change R4 in the transmitter to a value as low as 22 ohms or you could connect a second resistor and IR LED in parallel. If you want to activate a device and have it stay on for a few seconds you could increase the value of R7 (up to about 1 megohm) and if that doesn’t give enough time you can increase the value of C3 (up to 100uF). Doing this will give almost a minute of time before the receiver times out. You could also use your own latching circuit, so you could give one burst of IR to turn on a device and a second burst of IR to turn it off again.

**INTERRUPT MODE:**

You can place the receiver on one side of a doorway or opening and the transmitter on the other side. Be sure the sensor on the receiver and the IR LED on the transmitter are ‘looking’ at each other and aligned. In this mode whatever you have connected, a light, alarm, etc. will be OFF until the beam is broken. This way you can tell when someone or something is coming. You could also connect a counter to this configuration to see how many people or objects pass this point.

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**Transmitter Parts List**

- R1,5,6,9 1K RES (BRN BLK RED)
- R2 50K Trim Pot (Vertical)
- R3 470 Ohm RES ohm (YEL VIO BRN)
- R4 120 Ohm RES ohm (BRN RED BRN)
- R7, R8 10K RES (BRN BLK ORG)
- C1 .001 uF CAP Disc or Mono (Marked 102)
- C2 10 uF CAP Elect or Tant (Watch Polarity)
- C3 1 uF CAP Elect or Tant (Watch Polarity)
- U1 LM555 IC (Watch Orientation)
- U1S 8 pin IC socket (Watch Orientation)
- Q1, Q2 2N3904 Transistor (Watch Orientation)
- D1 Infrared LED (CLEAR or Blue)
- D2 Red LED (Watch Orientation)
- J1 Battery connector (Watch Polarity)
- PC Board 080-00394

**Receiver Parts List**

- R1 10K RES (BRN BLK ORG)
- R2 470K RES (YEL VIO YEL)
- R3,5,9,11 1K RES (BRN BLK RED)
- R4 6.8K RES (BLU GRA RED)
- R6,R8 3.3K RES (ORG ORG RED)
- R7 100K RES (BRN BLK YEL)
- R10 22K RES (RED RED ORG)
- D1, D2 1N4148 Diodes (Watch Polarity)
- C1 .1uF CAP Mono or Disc (Marked 104)
- C2,3,4 4.7uF CAP Elect (Watch Polarity Stripe is NEG)
- Q1 2N3906 Transistor (Watch Orientation)
- Q1 2N3904 Transistor (See Special Orientation)
- U1 LM324 IC (Watch Orientation)
- U1S 14 Pin IC Socket (Watch Orientation)
- U2 TSOP1136 IC (Watch Orientation)
- U3 78L05 IC (Watch Orientation)
- PC Board 080-00395

Wires to connect power
Receiver Assembly Instructions

Separate and identify each component in your kit. Our instructions will lead you through the assembly process in the most logical manner, starting with the parts that are the lowest to the board - up to the parts that would be in the way.

FOR EACH STEP:

1. Find the proper component.
2. Insert the leads so the part is flush with the Printed Circuit Board.
3. Solder part and cut off excess leads.
4. Check off and proceed to the next part.

*Insert and solder all parts one at a time:*

- [ ] R1 - 10K (BRN BLK ORG)
- [ ] R2 - 470K RES (YEL VIO YEL)
- [ ] R3 - 1K RES (BRN BLK RED)
- [ ] R4 - 6.8K RES (BLU GRA RED)
- [ ] R5 - 1K RES (BRN BLK RED)
- [ ] JUMP - Install Jump - Use a cutoff resistor lead
- [ ] R6 - 3.3K RES (ORG ORG RED)
- [ ] R7 - 100K RES (BRN BLK YEL)
- [ ] R8 - 3.3K RES (ORG ORG RED)

Install R9 ONLY for the DETECT mode - See Receiver Theory

- [ ] R9 - 1K RES (BRN BLK RED)
- [ ] R10 - 22K RES (RED RED ORG)
- [ ] R11 - 1K RES (BRN BLK RED)
- [ ] D1 - 1N4148 Diode (Watch Polarity)
- [ ] D2 - 1N4148 Diode (Watch Polarity)
- [ ] U1S - 14 pin IC Socket (Watch Orientation)
- [ ] C1 - .001 uF CAP Disk or Mono (Marked 104 or .1)
- [ ] Q1 - Install the proper transistor for your needs

(See RECEIVERTHEORY section to decide how you want your kit to work, also see note on parts placement diagram.)

- [ ] U3 - 78L05 IC (Watch Orientation)
- [ ] C2 - 4.7uF CAP Elect (Watch Polarity - Stripe is NEG)
- [ ] C3 - 4.7uF CAP Elect (Watch Polarity - Stripe is NEG)
- [ ] C4 - 4.7uF CAP Elect (Watch Polarity - Stripe is NEG)
- [ ] U2 - TSOP1138 IC (Watch Orientation)
- [ ] Connect wire for your power source (Watch Polarity)

VERY CAREFULLY check all of your connections and part locations. This completes assembly of the RECEIVER portion of your kit.

- [ ] Connect whatever you want (relay, light, etc) to your kit.

Transmitter Assembly Instructions

Separate and identify each component in your kit. Our instructions will lead you through the assembly process in the most logical manner, starting with the parts that are the lowest to the board - up to the parts that would be in the way.

FOR EACH STEP:

1. Find the proper component.
2. Insert the leads so the part is flush with the Printed Circuit Board.
3. Solder part and cut off excess leads.
4. Check off and proceed to the next part.

*Insert and solder all parts one at a time:*

- [ ] R1 - 1K (BRN BLK RED)
- [ ] R3 - 470 Ohm RES ohm (YEL VIO BRN)

See THOERY section to determine the value of R4

- [ ] R4 - 120 Ohm RES ohm (BRN RED BRN)
- [ ] R5 - 1K RES ohm (BRN BRN RED)
- [ ] R6 - 1K RES ohm (BRN BRN RED)
- [ ] R7 - 10K RES ohm (BRN BRN ORG)
- [ ] R8 - 10K RES ohm (BRN BRN ORG)
- [ ] R9 - 1K RES ohm (BRN BRN RED)
- [ ] U1S - 8 pin IC socket (Watch Orientation)
- [ ] C1 - .001 uF CAP Disk or Mono (Marked 102)
- [ ] Q1 - 2N3904 Transistor (Watch Orientation)
- [ ] Q2 - 2N3904 Transistor (Watch Orientation)
- [ ] C2 - 10 uF CAP Elect / Tant (Watch Polarity Stripe = NEG)
- [ ] C3 - 1 uF CAP Elect or Tant (Watch Polarity Stripe = NEG)

The LED's, D1 and D2, must be positioned properly, if you are going to use an enclosure. See THEORY section for more information in about their location.

- [ ] D1 - Infrared LED (CLEAR or Blue) (Watch Orientation)
- [ ] D2 - Red LED (Watch Orientation)
- [ ] J1 - Battery Connector (Watch Polarity) If you are going to use a switch you should place it in series with the + Battery Connector Wire. See THEORY section for more Info.

This completes assembly of the TRANSMITTER portion of your kit, VERY CAREFULLY check all part locations and connections.
**IR10R - Receiver Test Instructions**

Before you install U1 and apply power to your completed receiver make one last check of all parts and solder connections. If everything is OK, install U1 (Watch Orientation). Apply Power. If anything gets HOT or Smokes remove power and find the problem before continuing. Usually SMOKE indicates that a part has been destroyed and must be replaced.

The best way to test your receiver is by using an infrared remote control from a TV or other device. Aim the remote at the sensor on your receiver, and press any button.

Whatever you have connected to your receiver (relay, light, etc.) should activate while you hold the button down. If it does not, check your work and fix the problem.

Install the receiver into an enclosure if you are using one.

**IR-10T-Transmitter Test Instructions**

Before you install U1 and apply power to your completed transmitter make one last check of all parts and solder connections. If everything is OK, install U1 (Watch Orientation). Apply Power. If anything gets HOT or Smokes remove power and find the problem before continuing. Usually SMOKE indicates that a part has been destroyed and must be replaced.

If the RED LED lights when you apply power the transmitter is usually working.

Aim the IR LED toward the receiver. The receiver should work just like when you used your remote control. If this does not work check your work and fix the problem.

Adjust R2 for maximum range.

Install the transmitter into an enclosure if you are using one.

Be sure you read the THEORY section about the value of R4. The value of this resistor may need to be changed depending on the distance between your receiver and transmitter.
IR-10TR
SPECIFICATIONS

- Receiver Operates on 8 to 12v DC
- Transmitter Operates on 8 to 12vDC or a 9 Volt battery
- Receiver can be built in the DETECT mode or INTRERUPT Mode
- Receiver Size: 2.08” x 1.325”
- Transmitter Size: 1” x 1.6” (Not including Battery)