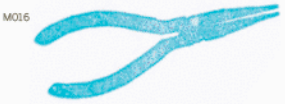
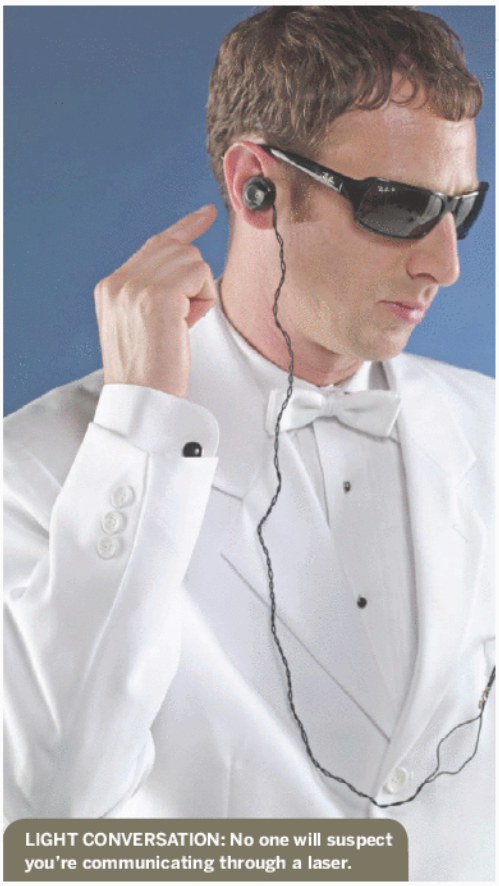
SIMPLE LASER COMMUNICATOR

TALK IN SECRET OVER YOUR PRIVATE LASER BEAM LIGHT LINK.



BY SIMON QUELLEN FIELD



LIGHT CONVERSATION: No one will suspect you're communicating through a laser.

Photography by Garry McLeod

How would you like to talk over a laser beam? In about 15 minutes you can set up your own laser communication system using a cheap laser pointer and a few parts from RadioShack. The audio signal from a microphone varies the power feeding the laser, so that its brightness changes, following the shape of the original sound wave. At the receiving end, a solar cell or photo-resistor converts the oscillating light signal back into the original sound.

The communication is completely private, with no wire connection to tap into. Only you will be able hear what comes over the secret laser link.

MATERIALS

Laser pointer You can get one for $10 from my Scitoys Catalog, scitoyscatalog.com.
Batteries, 1.5V, any size Get the same number of batteries and voltage that the laser takes, typically 3x 1.5V.
Battery holder for the 1.5V batteries If you can't find a 3-battery holder, wire a 1-cell and a 2-cell holder in series, or use a 4-cell holder and bridge 1 compartment with wire.
Stiff wire or rubber band
Audio output transformer, 1kΩ primary coil, 8Ω secondary RadioShack part #273-1380 or Scitoys Catalog #XFORMR
Alligator clip leads (2–10) with points fine enough to connect to the inside of the laser pointer. You can substitute wire and solder, but the clip leads are easier. RadioShack #278-1156 will do nicely.
2-lead bicolor LED to protect the laser from voltage spikes if it doesn't have built-in protection.
Hookup wire
Mini portable amplifier such as RadioShack #277-1008. Alternately, you can use a stereo system.
Microphone with cable and plug that fits amplifier or stereo input

RECEIVER OPTION #1: SOLAR CELL WITH EARPHONE (SIMPLEST)
Small solar cell Scitoys #3SOLARCELLS or RadioShack #276-124
Piezoelectric earphone Scitoys #EARPHONE
Transparent tape

RECEIVER OPTION #2: PHOTOCELL WITH EARPHONE (CHEAPER AND STURDIER)
Piezoelectric earphone Scitoys #EARPHONE
9V battery and battery clip
Photoresistor, cadmium sulfide (CdS) RadioShack #276-1657
220Ω resistor

TOOLS

Soldering equipment
Transistor radio
Earphone plug to fit your radio, such as RadioShack #42-2434
Phono/mic plug to fit the phono/mic input jack of your mini amplifier (or stereo), such as RadioShack #42-2434 or #42-2457

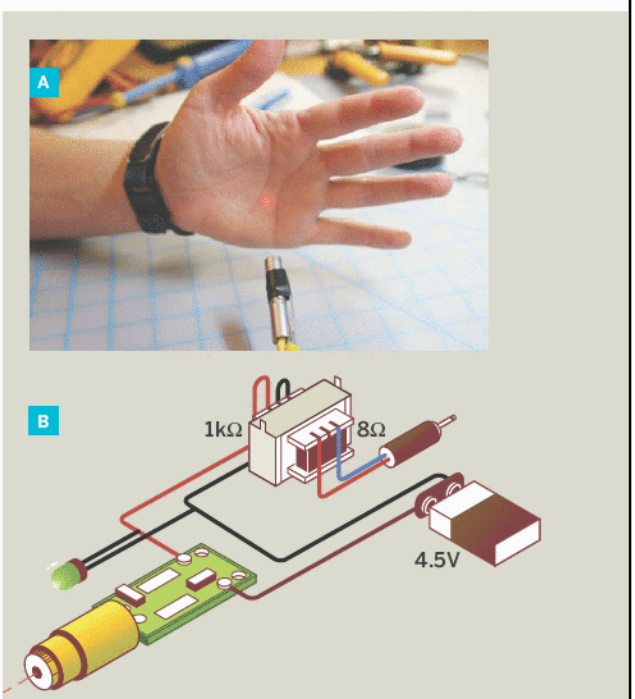


Fig. A: The laser pointer with its button taped down to the always-on position.
Fig. B: The transmitter wiring diagram.

ASSEMBLE THE TRANSMITTER

NOTE: I recommend soldering this project, but initially it's easier to make it and test it using alligator clip leads.

Remove the batteries from the laser. Connect the external battery pack to the laser's power contacts with 2 alligator clips; usually you'll connect one lead to the battery case and the other to the spring inside. Some laser pointers are easy to disassemble; you can remove the circuit board and see the power contacts conveniently marked with a plus and a minus. If it doesn't light, try reversing the power; this won't harm the laser.

Figure out how to hold the laser's button down with a rubber band, wire, or tape (Figure A).

Remove the batteries. Following the schematic in Figure B, connect the 1,000-ohm (1kΩ) side of the transformer in-line between the battery pack and the laser, using the outside 2 wires of the transformer. We don't need the center tap wire.

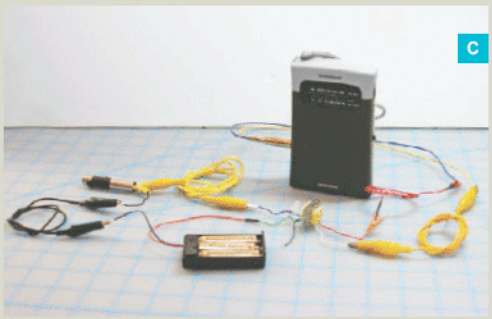
Connect the bicolor LED between the same 2 wires of the transformer. This protects the laser from high voltage spikes, since so many cheap lasers nowadays have no onboard protection circuit. If you see the LED flash, that indicates a spike.

Now connect the earphone plug to the 8Ω side of the transformer with alligator clips. That's it! We have a laser transmitter, in just a few minutes! We'll plug it into a transistor radio for testing (Figure C).

ASSEMBLE A RECEIVER

For the simplest receiver, connect the 2 leads from a piezoelectric earphone to a small solar cell. You can attach them using transparent tape instead of

Illustration by Julian Honoré/p4rse.com



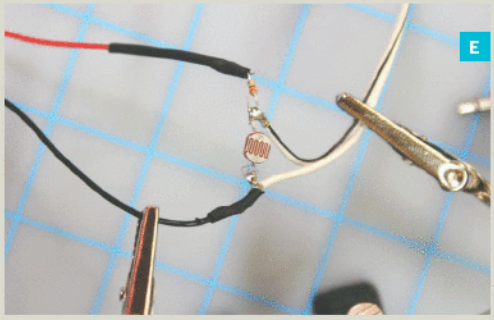


Fig. C: Transmitter ready for testing with a radio. Fig. D: Simplest receiver: just an earphone and a solar cell.

Fig. E: The photocell (i.e. photoresistor) uses battery power. Fig. F: The working transmitter is fed by a microphone.

Photography by Ed Troxell (A, C and F) and Simon Quellen Field (D and E)

soldering, which can be difficult on solar cells (Figure D).

For a sturdier and cheaper alternative, use a cadmium sulfide (CdS) photoresistor, which changes its resistance proportional to the amount of light hitting it. Paired with a battery, this acts like a solar cell. To make the receiver, connect the earphone and a 9V battery across the photoresistor, so that battery, earphone, and photoresistor are all parallel. Add a 220Ω resistor in series with the battery to reduce power consumption and prevent heating of the photoresistor (Figure E).

SETUP AND TESTING

We'll test the system by transmitting a radio signal and amplifying the receiver so we can hear it across the room. First, replace the earphone of your receiver with an audio plug (or just clip the audio plug to the earphone wires), and plug it into an amplifier or stereo.

With the radio off, plug in the transmitter. Turn up the volume on the amplifier until you hear a hiss, then turn it down until it isn't noticeable.

Aim the laser across the room so it hits the solar cell or photoresistor. You may hear some clicks or pops. Now turn on the radio and adjust its volume until you hear it across the room. If you don't hear it, try increasing the amp's volume before you turn up the radio. If you pull out the earphone plug, the radio should be just audible.

Depending on your signal source, you also might want to reverse the transformer. Some devices, like iPods, don't have enough power to drive 8Ω speakers, so you should connect them across the 1kΩ side. This arrangement will dim the laser, but won't affect its range much.

When you can hear the radio, break the laser beam with your hand, and notice that the music stops. Try chopping up the audio with your fingers.

The system is ready. To send secret voice communications, move the amp from the receiver to the transmitter and plug in a mic. You're ready for the field; just be careful with the volume, to protect the laser.

Simon Quellen Field (sfield@scitoys.com) is the president and CEO of Kinetic MicroScience (scitoys.com), and the author of several books on science and computing.