Kit 26 – One Way Audio by Fibre Optic Cable

This Kit allows you to send sound through 1mm plastic fibre optic *(FO)* cable. On the transmitter *(Tx)* circuit board *(marked KIT 26T)* there is a microphone and a circuit to modulate the light emitted from an LED. The LED is contained in a plastic case that allows easy connection of the FO cable. On the receiver, *(Rx)* board *(marked KIT 26R)* there is a photo-optic receiver, an amplifier, and a speaker. Because the signal travels in the FO cable as a light wave it is unaffected by any electric or magnetic fields that it travels through. Each board requires a 9V battery, or a DC supply, such as a plug pack.

Fourteen feet of 1mm diameter plastic (FO) cable is supplied. This Kit can be used to send a signal in well over 200 yards of cable. Note that the plastic FO cable used here is not the same as the glass FO cable that is used in long distance telecommunications. However, plastic cable introduces most FO concepts, is far easier for the experimenter to use and certainly has definite uses for short distance communication in electrically noisy environments.

Assembly Instructions

First, check all the components against the component listing. Make sure all components are components are correctly identified.

Note! **C1 on the Tx board is incorrectly marked. It should be a 10uF ecap, and the negative side must go to earth (ie. towards R2)**

The FO emitter & detector modules are very similar. The detector, which goes on the receiver board, has a red dot marked on its black case. The emitter, which goes on the transmitter board, has a pink dot on a blue case. The components for both boards are mixed together. Assemble one board at a time, using the circuit diagram, and following the PC board overlay.

It is generally best to add the lowest height components first. So, start with the resistors and leave the FO modules and terminal blocks until last. The IC sockets can be soldered in place and the IC's added later. The electret microphone must be inserted with the metal case connected to the negative rail (that is, to the ground side of the circuit.) This is marked with a - sign on the transmitter circuit board. Also, make sure to get the electrolytic capacitors around the correct way. The negative side is marked, and the longer lead is positive.

To get the highest transmission efficiency, make sure that the ends of the FO cable are square cut cleanly. You can experiment with different degrees of smoothness. You will find that the LED gives out enough signal that even with the worst cutting you will almost certainly get good reception over the 14 feet of cable supplied. However, to get good reception over 200 yards then the ends of the cable must be well finished.

After the units are built up, connect the 9V battery to the Tx unit. You should see the red LED glow from within its plastic case. If you do not see it, you may have mixed up the detector with the transmitter.) On the Rx unit connect the battery. It should cause the speaker to make a noise. Turn the volume control (trim pot) to about half way. Place the Tx in one room near a radio or the TV. Unwind the FO cable making sure there are no kinks. The FO cable must not be bent too sharply - a radius or curvature of at least 1 inch (2 cm) should be maintained.

At the Rx end, check that the end of the FO cable shows red light coming from the transmitter. Wave it 1" - 2" in front of the receiver. You should hear sound which is being picked up by the Tx unit in the other room. Push the cable into the receiver and tighten the plastic nut. The sound should be clearly heard.

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Circuit Description

The electret microphone converts sound waves to an electrical signal in the Tx circuit. R1 provides DC bias for the microphone and should be removed if you wish to connect any other input instead. This signal is coupled via C2 and amplified by two LM358 op amps (both contained in one package), and converted to an optical signal by the LED emitter, driven from transistor Q1.

R3 and R6 set the gain of IC1A to 1+R3/R6, or 221. Since IC1A is direct coupled, R4/R2 determine the DC input and thus the DC output level. IC1B is also direct coupled and provides both the DC base current for Q1 and the AC modulation current. R7 determines the DC bias current for Q1. The modulated collector current drives the LED emitter. This optical signal is fed into the plastic fibre optic cable.

At the other end of the cable, the optical signal is directed at a photo-darlington detector in the receiver that converts it into an electrical signal again. The signal is amplified by op amp IC2 and power amp IC3 before being fed into a speaker where it becomes a sound wave. A voltage regulator has been used in the receiver gain stage to reduce DC supply ripple caused by the higher currents drawn in the power amplifier section.

C1 and C2 are filter caps, C3 couples the detector voltage imposed across R1, into IC2. R2 and R4 set the op amp input to half the supply voltage, since only one supply is used rather than positive and negative supplies, as is usually the case. The gain of IC2 is adjustable by the pot in the feedback circuit. The range is therefore 1+1M/110k to 1+1M/10k, or 10 to 101. This is used as a volume control.

IC2 output is coupled via C6 into an LM386 power amp IC with gain set to 20. R6 and C8 act as a low pass filter on the input. R7 and C9 form a zobel network that provides a high frequency load to ensure stability.

Component Listing

Resistors 1/4W, 5%:

10R (brown, black, black)	1
100R (brown, black, brown)	2
1K (brown, black, red)	1
10K (brown, black, orange)	1
22K (red, red, orange)	2
100K (brown, black, yellow)	4
220K (red, red, yellow)	1
680K (blue, grey, yellow)	1
1M (brown, black, green)	1
100K Koa trimpot (104)	1

Capacitors:

100 uF electrolytic	1
10 uF electrolytic	3
100 nF monoblock (104)	4
10 nF mylar (103)	2
47nF box poly	1

Misc.

Kit 26R, Receiver PCB	1
Kit 26T, Transmitter PCB	1
LM 358 IC	2
LM 386 IC	1
78L05 regulator	1
BC547 transistor	1
IF-D93 detector (red dot on black case)	1
IF-E96 emitter (pink dot on blue case)	1
Electret Microphone	1
Speaker 8 ohm, 1W	1
8 pin DIL IC socket	3
2 pole terminal block	3
9V battery snap	2
3mm nut & bolt set	1
1mm Fibre Optic Cable (~14ft)	4M

What To Do If It Does Not Work

Poor soldering is the most likely reason that the circuit does not work. Check all solder joints carefully under a good light. Next, check that all components are in their correct position on the PCB. Check the IC's, and the electrolytic capacitors are in the correct way around. If possible, follow the circuit with a voltmeter to make sure all voltages are correct. Check the ends of the cable are cut properly and inserted into the transmitter LED & receiver unit correctly.

If you have trouble with RF interference, you can place a capacitor directly across the transmitter R2 and/or R3. 100-220pF should be sufficient.

What To Learn From This Kit

The Kit introduces you to fibre optics using plastic fibre optic cable. Glass fibres are now used with digital transmission in modern communications. One fibre is now capable of carrying many thousands of simultaneous voice or data transmissions, using a combination of optical carrier frequencies and digital multiplexing. However, it all started with simple analog transmission such as this.

You can try an experiment. Slowly pull the FO cable from the transmitter. Notice how the sound will diminish. Point the end towards a light bulb and you will hear a hum from the mains frequency, which is modulating the brightness of the light bulb, just as the audio signal does to the LED transmitter.

You can also experiment with how important preparation of the ends of the cable is to efficient transfer of the audio signal. Take one of the ends and rough it up badly. Notice how much the sound changes as you gradually smooth and polish the end at a 90 degrees angle.

You may download data sheets for the photo-transmitter, photo receiver, and both the IC's used in this kit, from our website at :

http://www.kitsrus.com

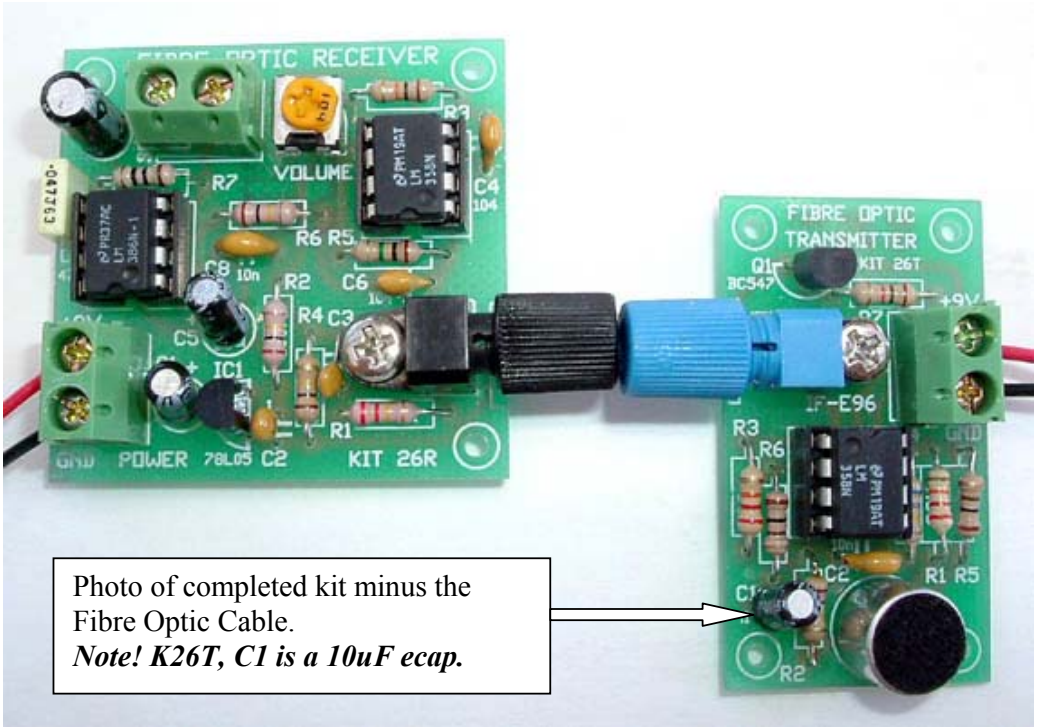
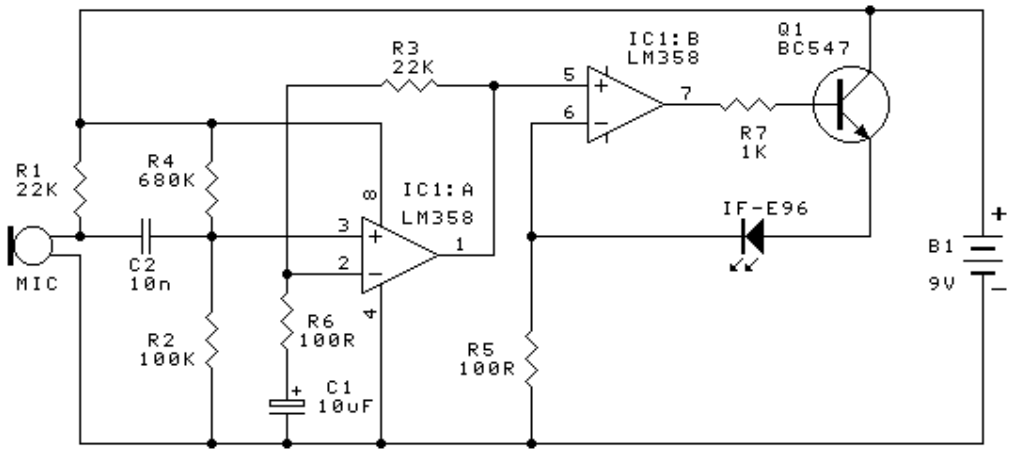


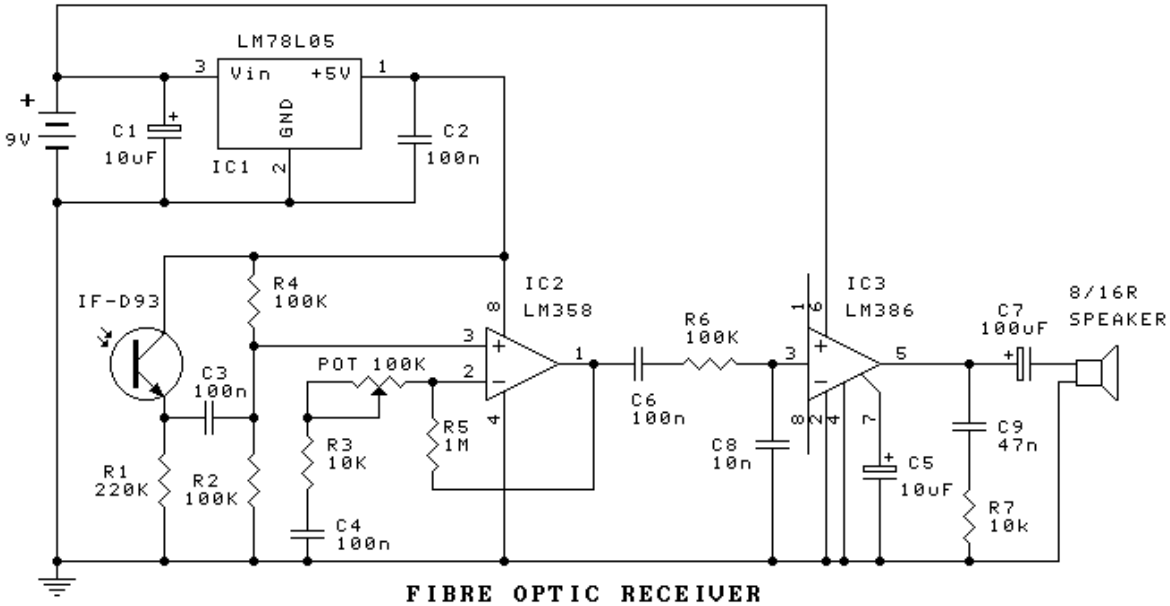
Photo of completed kit minus the Fibre Optic Cable.
Note! K26T, C1 is a 10uF ecap.

Circuit Diagram for K26T



FIBRE OPTIC TRANSMITTER

Circuit Diagram for K26R



FIBRE OPTIC RECEIVER