

# REMOTE SURGERY LASER COMMUNICATIONS DEVICE

## INTRODUCTION

Clinical engineers are highly skilled members of the NHS team. Their role is to design equipment for monitoring, diagnosis, treatment and rehabilitation or research. To find out more about what they do, visit [www.nhscareers.nhs.uk](http://www.nhscareers.nhs.uk)

In this activity you will take on the role of a clinical engineer and use your technical knowledge to build and evaluate a piece of hi-tech communications equipment.

## BACKGROUND

The DistantDoc Corporation has developed a prototype laser communications device which it hopes will be useful in remote surgery applications. The device uses a laser beam to provide a high quality, fast communications link.

They have provided you with some instructions on how to build a simple prototype version of the device so you can carry out an initial evaluation. DistantDoc are proposing that a production version of this device is used to provide a dedicated communications link for remote surgery purposes between buildings on a hospital site.

It is envisaged that data from any surgeon working remotely will be carried over the major distances by standard, high capacity broadband links. This link will terminate in a hub sited somewhere within the hospital. From this hub, telephone and computer communications traffic will be directed down standard copper wire cables. Data necessary for remote surgical procedures will be prioritised and communicated to the relevant location in the hospital using the Remote Surgery Laser Communications Device (RSLCD).

The maximum distance that the device would be used over would be 200 metres.

The RSLCD uses a *modulated* laser beam to provide voice or data communication.

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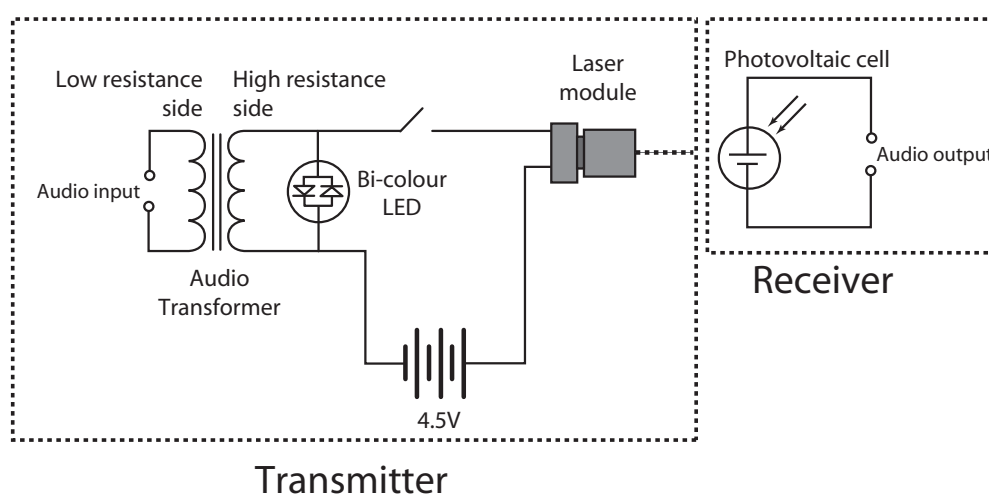
## DISTANTDOC CORPORATION – RSLCD PROTOTYPE PLANS

### How does the RSLCD work?

A small transformer uses an audio or data signal to modulate the power supplied to a laser emitter. The modulated power supply causes the power of the laser beam to fluctuate with the applied signal. A receiver picks up the laser beam and transforms the modulated laser beam back into the original audio or data signal.

### Circuit schematic

A schematic diagram showing the transmitter and receiver is given below.



### How does it work?

- The laser module is powered by a 4.5 volt d.c. supply.
- A signal is applied to the low resistance side of the audio transformer.
- This signal modulates the voltage supplied to the laser module, causing the power of the emitted beam to fluctuate with the applied signal.
- The bi-colour LED is included in the circuit to protect the laser module from voltage spikes which may occur when the unit is switched on or off. It will also light up to show when a signal is present and/or the laser is energised.
- The laser beam strikes the photovoltaic (PV) cell in the receiver and generates a potential difference (p.d.) proportional to the power of the beam. This p.d. therefore fluctuates in exactly the same way as the original signal.
- Passing the signal through an amplifier and speaker should result in the signal being audible.

## SAFETY INSTRUCTIONS

- On no account should you look directly into the beam or point it in such a way that it might shine into the eyes of anyone else.
- Batteries should not be inserted into your device until it is complete and in a position to be safely tested.
- As an additional safety precaution, keep a piece of electrical tape stuck over the laser aperture until your device is ready for use in a carefully controlled manner. The tape will prevent accidental discharge of the laser beam during the construction process.
- While working on the laser devices suitable warning signs should be placed on doors leading into the lab to inform visitors of possible risks.

## THE CONSTRUCTION PROCESS

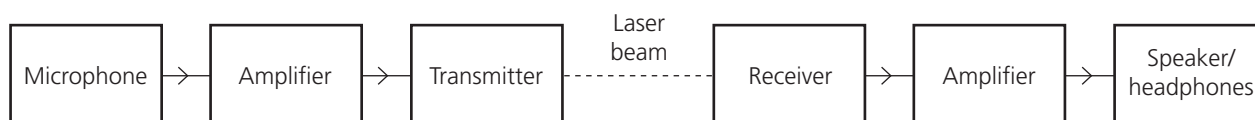
It should be possible to construct the communicator quite easily from the schematic diagram above. But read through these construction tips first:

- You will be working with a laser beam. Although this is a very weak beam it may still have the potential to cause eyesight damage. **Read through the safety instructions.**
  - Use speaker cable for the audio input and output leads.
  - Make sure that the audio input and audio output leads are at least 50 cm long and terminate in 3.5 mm mono jack plugs.
  - If your audio transformer has 3 leads leaving the high resistance side, ignore the centre lead and just use the two outer ones.
  - If you are planning to fit your transmitter and receiver into their own project boxes, do not connect the audio jack plugs until the wires have been threaded through the relevant holes.
  - Use wires to connect the LED to the circuit board so that it can be poked through the hole in the top of the transmitter project box.
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## OPERATING THE PROTOTYPE RSLCD

Once you have built your communicator it is quite simple to get it working.

- Use retort stands and clamps to hold your transmitter and receiver firmly in position.
- Make sure that you have set your laser beam up in a safe position where it is not going to shine directly at or reflect towards other people.
- If the location in which you are operating your device is fairly dark you may be able to remove the lid of the receiver project box, completely exposing the PV cell. If the room is quite light, keep the lid in place and make sure that the laser beam shines through the hole in the box lid.
- If you have a microphone and two small amplifiers you can set the communicator up as below for voice communication.



- If you have a radio/CD player and one small amplifier you can use your communicator to transmit music.

