

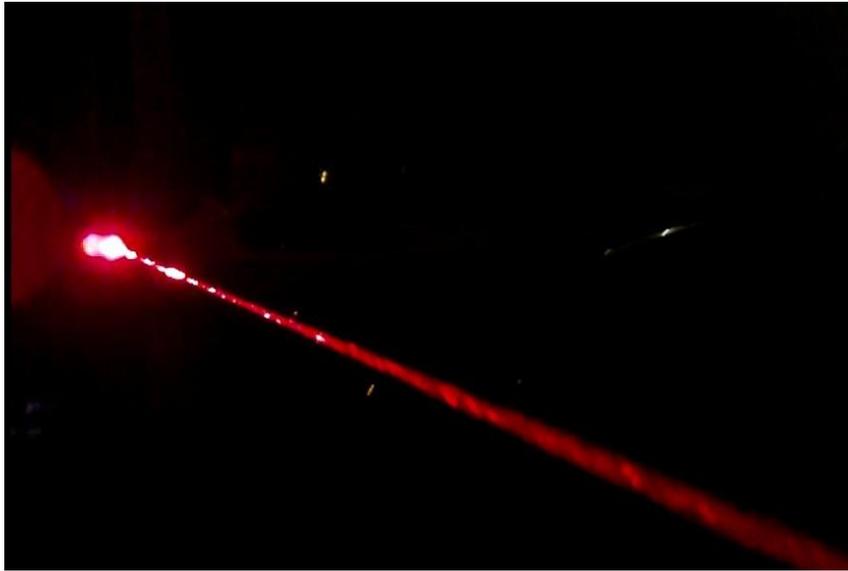
## PHY 315

### Computer Controlled Laser Data Transmitter

Niraj Kumar (Y9378)

**Objective** : Building a computer controlled laser data transmitter which can be used for sending morse codes .

#### Introduction:



The concept of transmission of information over free space has been a subject of immense interest for multiple decades now . While the transmission can be performed over large distances by the use of optical fibres , the effective aim of this project is to perform data transmission via *free space laser data transmission*.

In this experiment , a simple toy laser (0.001 mW) is used and its circuit is modified in such a way that its transmission is controlled via the computer software(MORSE code software) and through which we could send the Morse code signals which would eventually be received in the receiver and its signal can be mapped onto a digital Oscilloscope.

#### Basic Equipments :

- A pocket laser pointer(0.001 mW ) .

- A serial pin connector and USB to Serial convertor .
- An NPN transistor ( 2N4401 ).
- LED , Printed Circuit Board.
- A nine volt battery .
- Morse Code software.
- Receiver .
- Digital Oscilloscope .

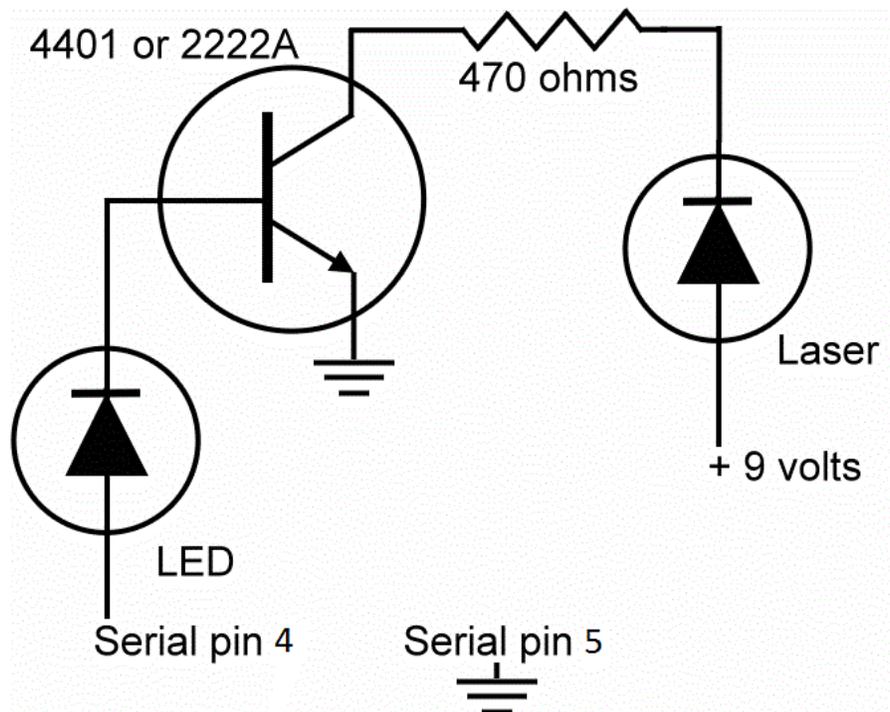
**The experiment is divided into three broad categories :**

- **Laser Electronics.**
- **Morse Code Transmission.**
- **Laser Signal Receiver.**

## Laser Electronics

This section aims at modifying the laser circuit for the purpose of the experiment :

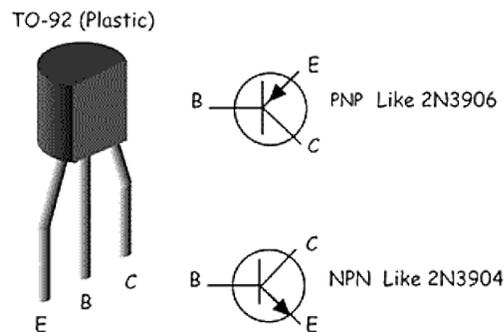
Our circuit is :



1. The toy laser is opened from back side and its batteries removed. Its outer surface connected to positive terminal of the battery and the spring the negative terminal .

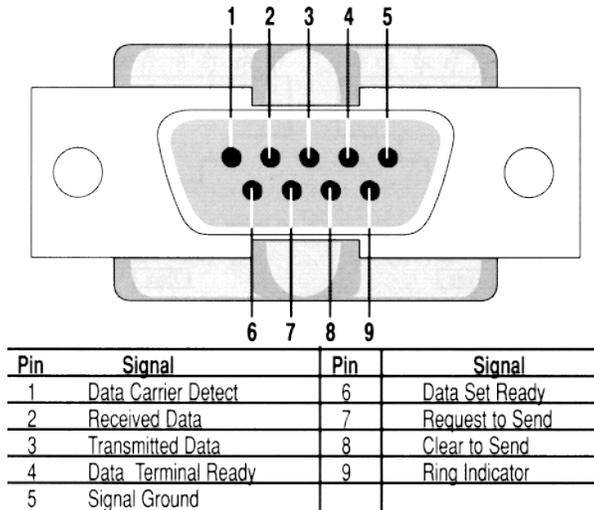


2. Now we put connect the negative terminal of the laser to our circuit using a screw . We also tape the the ON switch such that it is always in pressed state.
3. The LED is used as an indicator that the circuit is on , and it also prevents the the negative swing in the voltage as may be obtained from the serial port pin 4 .
4. The transistor(NPN) is set up to act as a simple switch. It has three leads — the base, the emitter, and the collector. The emitter is connected to the negative side of the power supply, which is called *ground*, because it is often connected to the earth in electronics and radio circuits. The base is connected to the LED that lights up when the serial port signal is on.



5. When the base of the transistor sees the voltage go from 0 to anything more than about a volt, the transistor goes from the "off" state to the "on" state, allowing electrons to flow from the emitter to the collector.
6. The 470 ohms resistance is optional as it is used to prevent too much current from entering the laser .

- When the electrons flow from the emitter to the collector and then through the resistor, they get to the laser, and cause it to light up.
- The circuit is connected through the computer via the serial port (PIN 4 and 5).



- The modern computers do not have a serial port in them , so we require the USB to Serial Coverter .
- Finally the circuit is soldered onto a PCB so that the circuit remains fixed.

## Morse Code Transmission :

- What is a MORSE code ?

### International Morse Code

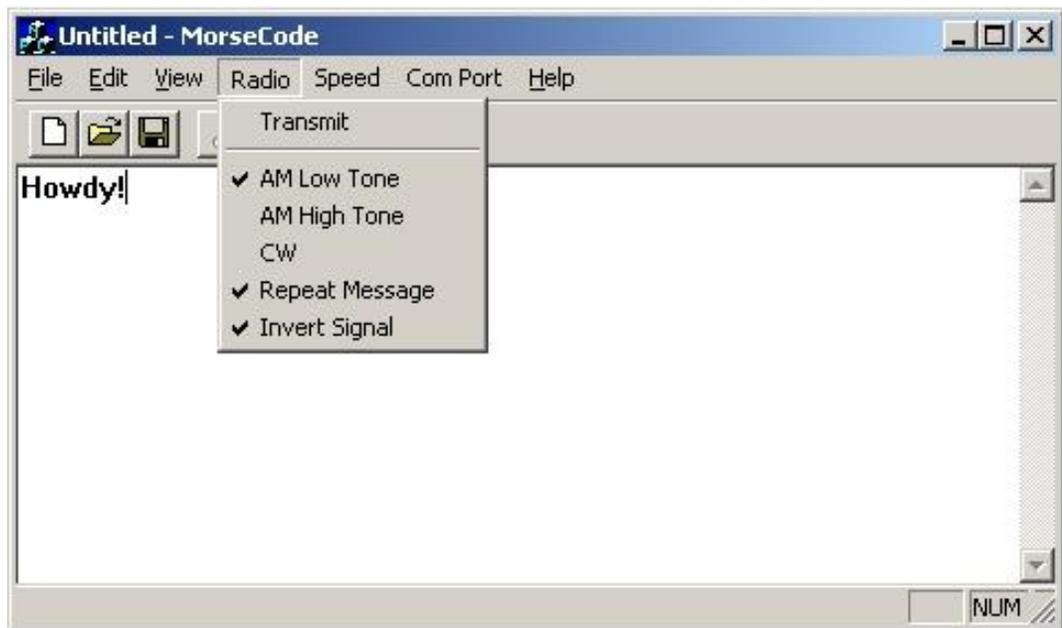
- 1 dash = 3 dots.
- The space between parts of the same letter = 1 dot.
- The space between letters = 3 dots.
- The space between words = 7 dots.

A	• —	V	• • • —
B	— • • •	W	— — • •
C	— • — •	X	— • • —
D	— • • •	Y	— • — —
E	•	Z	— — • •
F	• • — •	.	• — • • — —
G	— — • •	,	— — • • — —
H	• • • •	?	• • — — • •
I	• •	/	— • • •
J	• — — —	@	• — — • • •
K	— • —	1	• — — —
L	• — • •	2	• • — — —
M	— —	3	• • • — —
N	— •	4	• • • •
O	— — —	5	• • • • •
P	— • — •	6	— • • • •
Q	— — • —	7	— — • • •
R	• — • •	8	— — — • •
S	• • • •	9	— — — — •
T	—	0	— — — — —
U	• • • —		

Morse Code is a method of transmitting textual information using a series of on-off tones or lights, that can be received using a receiver and can be decoded by a skilled observer.

### Approach 1

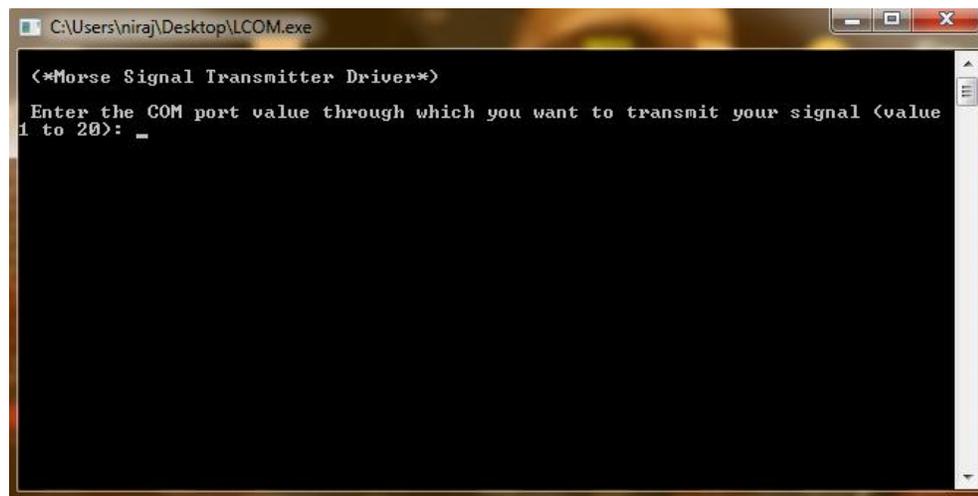
1. In this experiment, using the Morse code software, a signal is sent using the *Data Terminal Ready* pin 4 of the serial port and enters into the circuit.
2. Normally when nothing is being sent on the pin 4 of the serial port, then the pin 4 shows a fluctuating voltage and thus the transistor is in ON state but we get a constant reading on the Oscilloscope.
3. When the character is sent, it is in the form of dots and dashes. So this dot or a dash corresponds to rapid change in the voltage output at pin 4. This gets detected in the oscilloscope.
4. The software for MORSE code transmission looks like :



5. Now suppose a letter "AB" is sent using the morse code software, then this signal consists of **dot dash dash dot dot dot** in this sequence.
6. Here in the software, the option "Invert Signal" is used because the transistor inverts the signal i.e. when the serial port is ON, the laser output is turned OFF and vice-versa. So using the "Invert Signal", the signal gets inverted twice and we get the proper signal.
7. The speed of the transmission can also be changed using the *Speed* option in the software.

## Approach 2

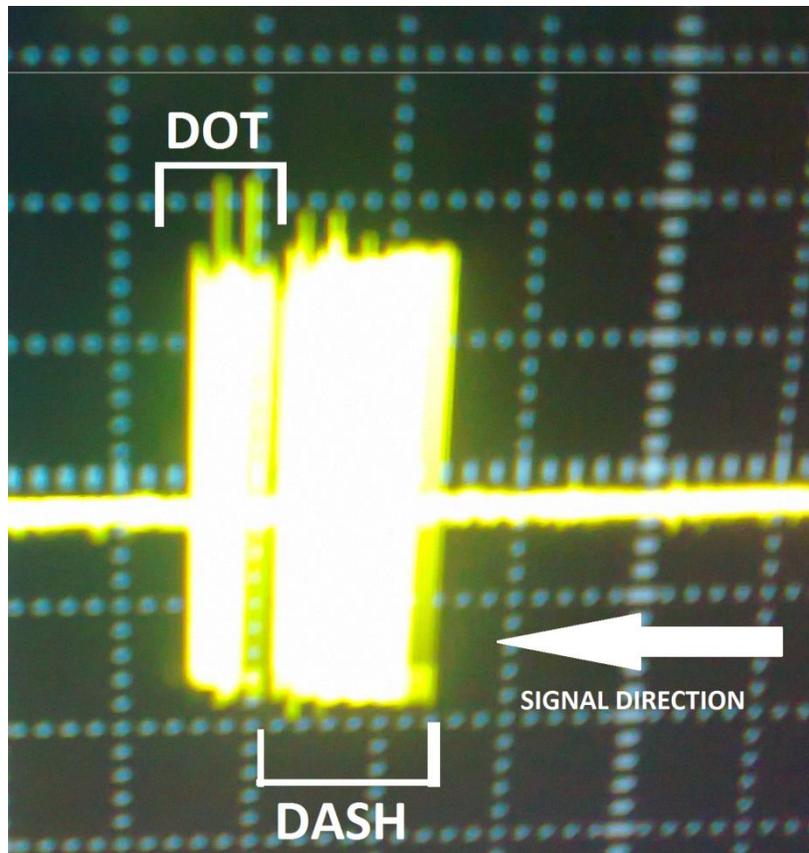
1. We designed our own command line based interactive C++ program for the transmission of Morse code implementing Win32 library.
2. First we create a handle to the COM device through which we want to transmit our signal. We can change the duration of each dot and thus change the speed of transmission, the least value being 1ms.
3. Then we convert our signal into morse code through the function *conv2morse()*, into an integer containing 1s and 2s, where 1 represents a dot and 2 represents a dash.
4. These morse code signals are in an inverted form just for the sake of faster code execution. These signals are sent to the *trnsmt()* function which uses the *EscapeCommFunction()* win32 library function to send signals through the COM port's Data Terminal Ready pin(DTR), sending SETDTR as parameter to turn on the laser, and CLRDTR to turn it off.



## Laser Signal Receiver :

We use the video output of 45-7252 channel receiver(Industrial fibre optics) provided in the laboratory to read the signals. The output of this receiver is connected to the channel input of Gwinstek GDS\_1062 Digital oscilloscope. We note down the signals by observing sharp voltage changes and the duration of their persistence.

Below shown is Morse code signal for character "A" :



### Technical Challenges :

*CHALLENGE* : After integrating the circuit , we got the a very low laser intensity and it was insufficient to produce a signal in the Oscilloscope.

*SOLUTION* : We removed the 470 ohm resistor, we was causing a substancial drop of current in the circuit. It worked and we obtained a sufficient intensity.

*CHALLENGE* : The MorseCode software is not able to send signals at a very fast rate.

*SOLUTION* : We made our own version of MorseCode in C++, which can go as fast as 1KHz, though it is tougher to note discrete voltage peaks at such a range.

### Conclusion :

- The method of transmission of signals emphasized in the experiment is a very **cost-effective** and **safe** method to send and receive data.
- This experiment is depicted using a toy laser, but if lasers of sufficient power is used say (1mW) , then this method can actually send up signals to very large distances(upto a mile for example).

- It is at the same time safe, because suppose some third person intervenes the signal in between partially and receives the data, then the amplitude of the signal at receiving station decreases and thus we could determine whether the signal has been intercepted.

### Bibliography :

- [http://scitoys.com/scitoys/scitoys/computers/laser/free\\_space\\_laser\\_data\\_transmitter.html](http://scitoys.com/scitoys/scitoys/computers/laser/free_space_laser_data_transmitter.html)
- [http://scitoys.com/scitoys/scitoys/computers/radio/computer\\_controlled\\_transmitter.html](http://scitoys.com/scitoys/scitoys/computers/radio/computer_controlled_transmitter.html)
- [http://en.wikipedia.org/wiki/Morse\\_code](http://en.wikipedia.org/wiki/Morse_code)