Laboratory Experiment on the Logic Trainer

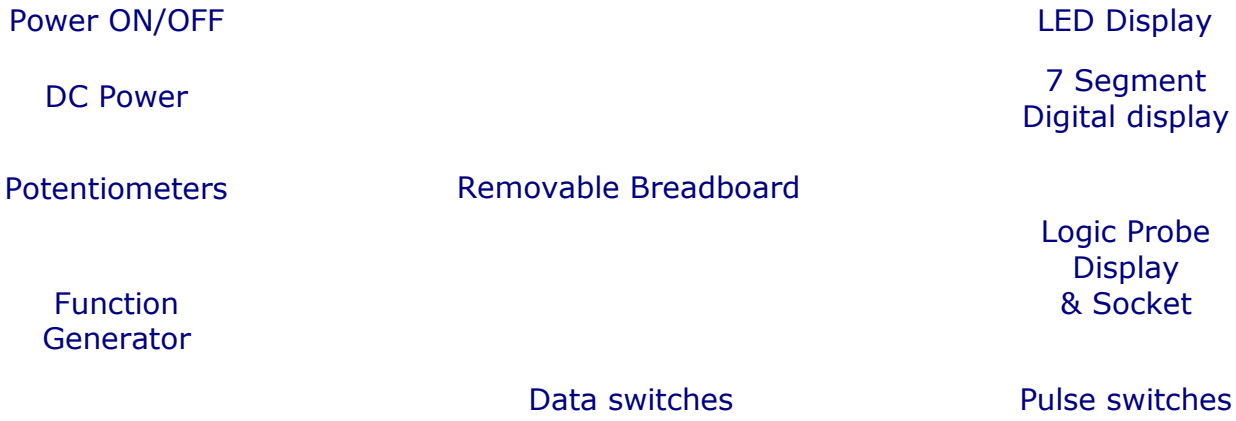
Introduction to the Equipment used for Digital Experiments

Objective:	To familiarise oneself with the Digital Trainer set and the use of the Logic Probe.
Equipment required:	Logic probe Digital Trainer

Familiarisation with the Digital Trainer set

Digital Trainer:	The digital trainer set contains a built-in power supply, clock generator, LED monitors, pulse generator and logic switches as illustrated by Figure 1. It is very useful for carrying out experiments on digital IC's.

Figure 1: Digital Trainer set



Removable Breadboard:
Breadboard is suitable for all DIP sizes and components with lead and solid AWG #22-30.

DC Power Supply :
There are 4 DC outputs available:-

1) +5V @ 1A 2) –5V @ 1A 3) 0 to +15v @ 500mA 4) 0 to –15V @ 500mA

Potentiometers :
The 2 available potentiometers are:-
Variable 1K
Variable 100K

Function generator:-

Function	Frequency Range (for all functions)
Sine wave – 0 to 8Vpp	1Hz to 10Hz
Triangular wave – 0 to 6Vpp	10Hz to 100Hz
Square wave – 0 to 8Vpp	100Hz to 1KHz
TTL Output	1KHz to 10KHz
	10KHz to 100KHz

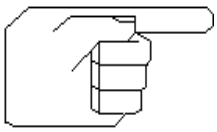
Data Switches:
There are 16 toggle data switches with corresponding output points. When Switch is at "Down" position, the output is "LOW"; when in the "UP" position, the output is "HIGH"

Pulse Switches:
Two sets of push-button pulse switches are provided. The outputs correspond to A, and B.

Logic Probe Display & Socket
A socket is provided for a probe to be inserted. The display for the probe is a small LCD panel that shows either a H or L. H stands for logic High and L stands for logic Low.

Digital and LED Display :

The digital display provides a 2-digit 7-segment display facility.
The LED display consists of 8 red LEDs with corresponding input terminals. When the input is "HIGH", the LED will light up. When the input is "LOW" or when there is no input, the LED will be turned off.



1. **Treat the trainers as your own.**
2. **PLEASE DO NOT write on the trainers.**
3. **Handle the switches and pins carefully.**
4. **Report to the TSO any damages on the trainers.**

Experiment 1A – Data & Pulse switches and LEDs

1. Connect a wire from one of the data switches to an LED pin.

2. Connect a second wire from another data switch to another LED.

3. Toggle the switches.

What happens?

4. Connect a wire from a pulse (push button) switch output, A, to an LED, and a second wire from the other switch output $\overline{A}$, to another LED.

5. Push the push-button switch, A, a couple of times

What are your observations?

6. Repeat steps 4 & 5 above, but using pulse switch generator output, B.

Are the results the same?

7. From your experiments on the pulse (push button) switches, compare the outputs A and Ã of switch A and hence, sketch the waveforms which would be obtained from these two outputs when switch A is activated once.

Double click on the diagram below (figure 1) to launch the bit-map object so that you can draw your waveforms.

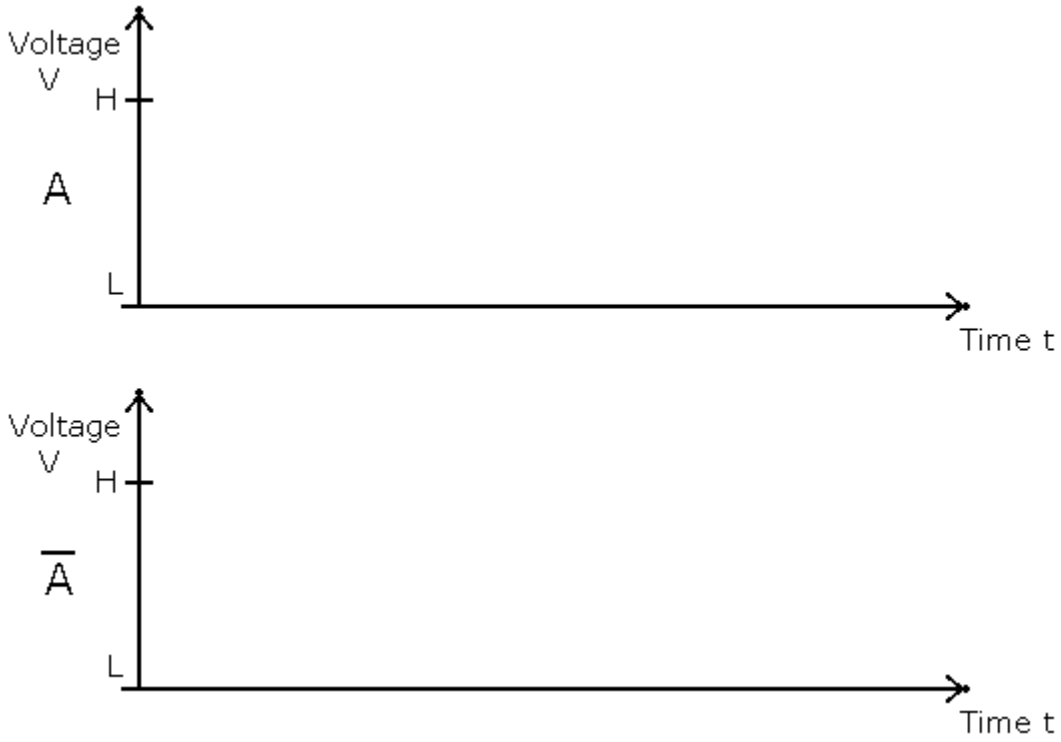


Figure 1

What are your conclusions?

Experiment 1B – Logic probe

1. A logic probe is the digital equivalent of an analogue multi-meter. It can be used to monitor the logic levels at the various nodes of a digital circuit. The probe must be inserted into the socket on the trainer and the display for this simple probe is a small LCD panel next to the socket. The outcome of the probe is a H or L indication on the LCD panel, showing the logic level at the node being probed. The probe is an indispensable tool for digital troubleshooting.

2. Using the tip of the logic probe, touch the +5V of the power supply and then touch the Ground (Gnd) Point.

What are your observations on the LCD panel?

3. Using the tip of the logic probe touch one of the data switches outputs. Toggle the corresponding data switch.

What are your observations on the LCD panel?

4. Using the tip of the logic probe touch the TTL output at the function generator section of the digital trainer set. Initially ensure the frequency control is turned to the MINIMUM setting and then vary the frequency of the function generator by turning the frequency control knob.

What are your observations on the LCD panel?

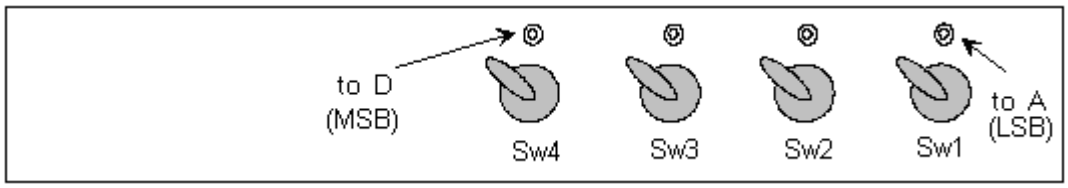
Experiment 1C – Displaying Decimal Digits using BCD Code

1. Using four of the toggle switches, connect a wire from each of the switch output to an LED.

2. Using the Digital Display module (BCD to 7 segment module), make the following connections using the same 4 switches you selected in step 1.

   Switches: Sw1 to A, Sw2 to B, Sw3 to C, Sw4 to D

   In connecting the 4 switches to the A,B, C, D inputs of the Digital Display module on the trainer, ensure that the switch Sw1 which is connected to A, is the LSB input, and switch Sw4 connected to D is the MSB input, as illustrated below.



3. By toggling the switches (Sw1, Sw2, Sw3, Sw4), complete the table.

MSB Sw_4	Sw_3	Sw_2	LSB Sw_1	LED_4	LED_3	LED_2	LED_1	Dec. No. displayed
0	0	0	0					
0	0	0	1					
0	0	1	0					
0	0	1	1					
0	1	0	0					
0	1	0	1					
0	1	1	0					
0	1	1	1					
1	0	0	0					
1	0	0	1					

4. Change the switch connections to the Digital display by connecting switch Sw4 (i.e. MSB to A), switch Sw3 to B, switch Sw2 to C and switch Sw1 to D (i.e. LSB to D) and observe what happens to the decimal number displayed as you go through the switch combinations listed in the table above.

What are your observations and conclusion from steps 3 and 4?

Review

The BCD (Binary Coded Decimal) is a 4-bit code that is used to represent each decimal digit of the decimal numbering system. BCD is a code and is not a numbering system, meaning that each bit of a BCD number does not carry a positional weight as in straight binary. A decimal number such as 54, when represented in BCD would be expressed as 0101 0100. Note that each decimal digit is simply replaced by its BCD equivalence according to the code specified in table 1, and that any leading 0s (if any) must not