Lecture 02.02 Measuring voltage

Voltage can be measured with several different instruments, used in different measurement applications.

02.02.1 Multimeter

A multimeter, such as the Fluke shown in Figure 02.4 can be used to measure voltage, current, resistance, and sometimes capacitance. These small, usually hand-held devices have two probes, used in two different connections: high-resistance and low-resistance.

high-resistance connection Each probe is connected to a location on the circuit in order to measure the voltage, resistance, or capacitance *across* the circuit connecting the locations. The hot probe is connected to the V or Ω port.

low-resistance connection In order to measure the current *through* the multimeter, circuit must first be broken and the multimeter placed into the circuit. The hot probe is connected to the A, mA, or μA ports.

The dial selects the *measurement mode*. The multimeter shown in Figure 02.4 is in dc voltage-measurement mode.

Figure 02.4: the front panel of a Fluke multimeter, connected in high-resistance mode.

measurement mode

Going from bottom-left, clockwise, the modes are, with high-resistance connection assumed unless otherwise stated:

1. ac voltage,
2. dc voltage,
3. dc voltagesmall signal,

Figure 02.5: the front panel of the Tektronix DPO 2012B oscilloscope.

4. resistance,
5. diode test mode,
6. current (low-resistance connection), and
7. small current (low-resistance connection).

02.02.2 Oscilloscope

An oscilloscope is an instrument that measures and displays a voltage signal through time. It allows us to "zoom-in" on a window of time, through which the signal is diplayed. If the oscilloscope is properly triggered, the signal will appear stationary. This occurs when the window is set to a time interval that is an integer multiple of the signal's period. This allows the signal to trace over itself and appear continuous.

We are using the Tektronix DPO 2012B oscilloscope, with front panel shown in Figure 02.5. Its manual can be found here:

`ricopic.one/resources/dpo2012b.pdf`.

There are two inputs, `1` and `2`. This oscilloscope has advanced functionality, including cursors for precisely measuring waveform properties, signal averaging, signal math, fast-fourier transform (FFT), and trace capturing.

Also in the lab is the BK Precision 2120B oscilloscope, with front panel shown in Figure 02.6. Its manual can be found here:

Figure 02.6: the front panel of the BK Precision 2120B oscilloscope.

`ricopic.one/resources/BK_2120B.pdf`.

There are two inputs, `CH1` and `CH2`. This oscilloscope is old-school and lacks modern features such as cursors and trace capture, but it has everything we need to understand the primary functionality of oscilloscopes.