Dyson School of Design Engineering, Imperial College London

DE1.3 Electronics 1

Lab 0 – Setting up the Home Lab Kit and the Signal Generator

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Introduction

This document outlines the preparation you need to make before you start the Laboratory Session. In a sense, this is Lab Session 0.

The Home Lab Kit

Once receiving your parcel, you must complete the survey on Teams to let me know that your parcel has arrived.

The parcel contains the following:
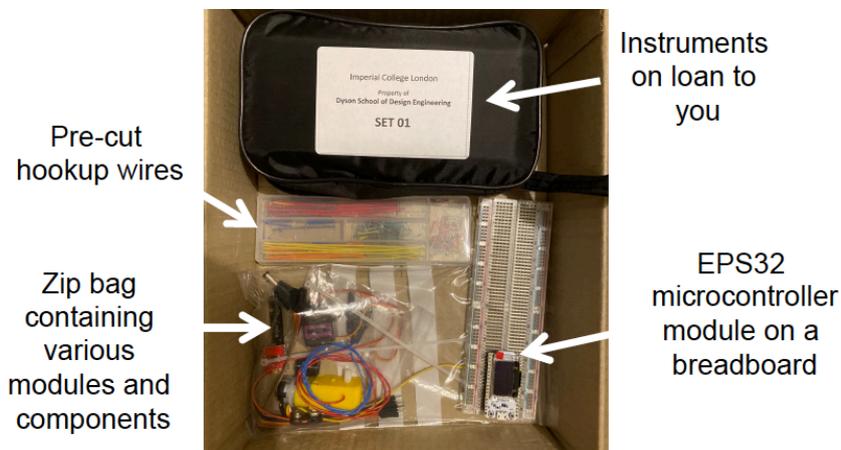
Open the black pouch and take a photo on your phone so that you know how to repack this before returning to the Department next academic year. Check that it has everything in the diagram below:

Open the back of the multimeter by removing the single screw. Install a 9V battery in the multimeter.

Check the contents of the zip bag against the photograph on page 2.
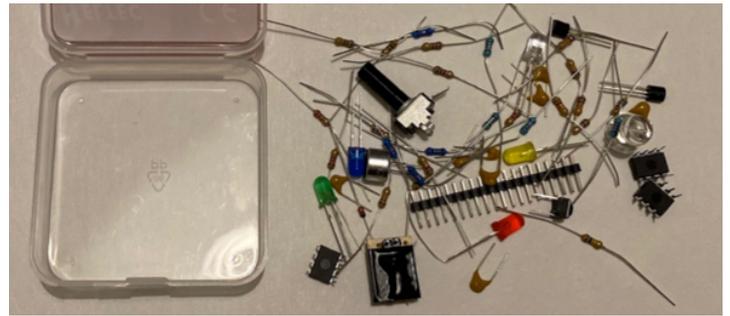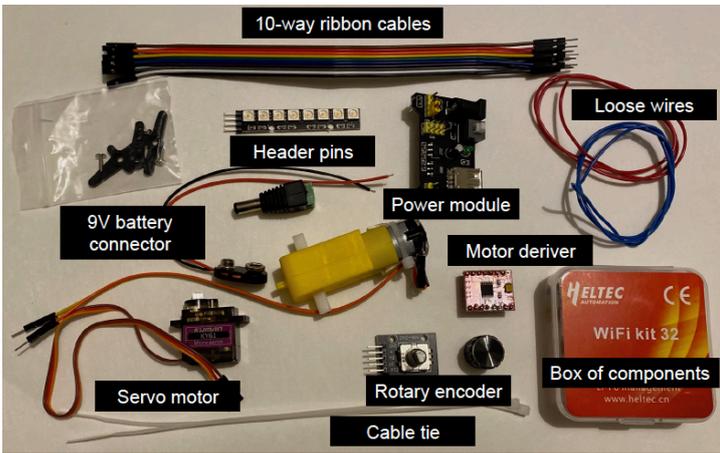
The zip bag has a plastic box with small components. Make space on a flat table without gaps or holes, and tip out the contents of the plastic box. These components are very small and you are likely to loose them unless you do the following:

1. Prepare two cardboards or stiff sheets of paper. Put down labels for the components as shown in Appendix B.
2. Sort out the components by type and value. You would need to use the multimeter to measure values of the resistances and capacitances and make sure that the colour code and capacitor markings match those of the measured values.
3. Use sticky tape and tape down each component time under the corresponding label.
4. Be sure that you return all components back to your cardboard "store" after use. Otherwise you will not be able to find a component later on during the term.

The breadboard

The breadboard has four regions. The middle part is for your circuits, separated into upper and lower regions, which are not connected together. In either regions, the vertical contacts (in rows ABCDE, and FGHIJ) are shorted together. The upper and lower perimeters are the power rail regions. Both are further divided into two sides: right and left. The horizontal rows are connected on the left and on the right for both upper and lower regions. They are marked with BLUE and RED lines. The left and right rows are separated at the middle (i.e. left and right rows are NOT joined together).

You MUST always use the RED row as power rail, and the BLUE row as GND rail.

Connect the GND and 3.3V rails as shown in the diagram, but leave the right top RED rail unconnected. This is reserved for use as the 5V rail later.
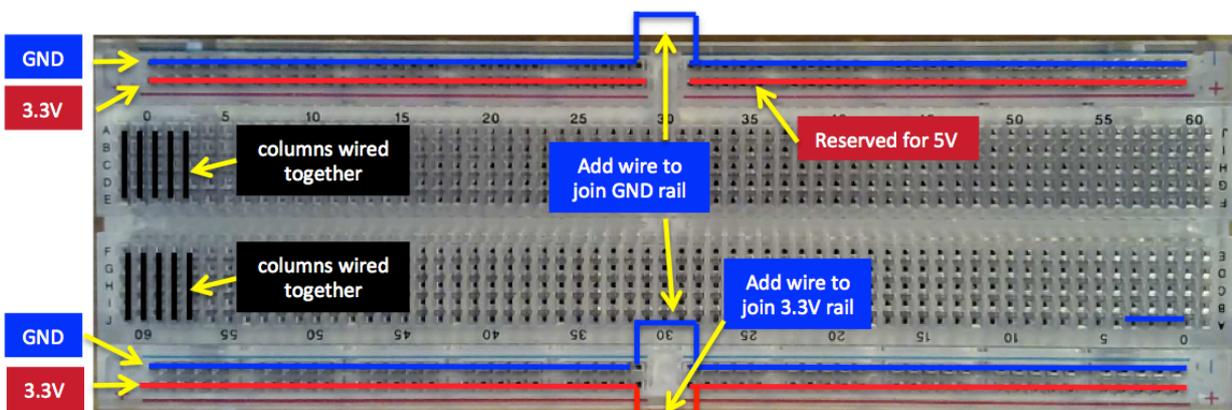
Preparing the Signal Generator

The ESP32 microcontroller module is made by a company called Heltec (Wifi 32 Kit). This is preloaded with a programme that I wrote to provide you with a signal generator which you will need for Lab Session 1 to 3. You now need to wire up the breadboard with a rotary encode, which serves as control of the signal generator. Note that the ESP32 module pinout diagram is shown in Appendix C.

Step 1: Using the hookup wires, connect the breadboard's horizontal power strips to 3.3V and GND as shown on the right.

Tips: You may find the breadboard connections very stiff because they are all new. You can use one of the 10-way ribbon cable provided to loosen to contact of the breadboard holes before plugging in the wire. Further, you will find it much easier to insert the wire if you use a pair of small piers gripping the end of the wire and insert it vertically and not at an angle.
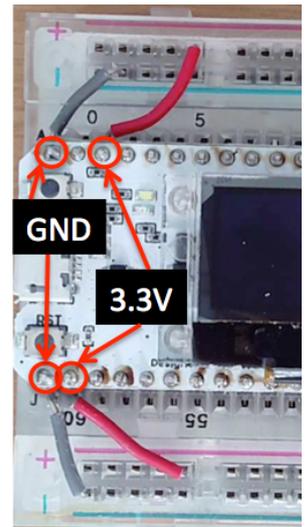
Step 2: Separate the 10-way colour ribbon (M-F) into two 5-way cable. Plug one of them to the 5 pins of the rotary encoder and secure both end with some tapes as shown.
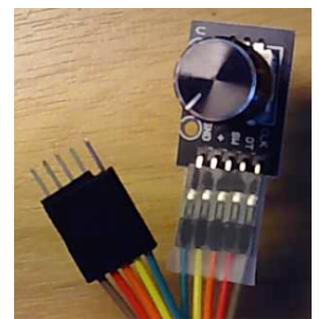
Step 3: Pick up three 0.01uF capacitors and insert them between GND and three columns of connections as shown. These are to be connected to the pins on the encoder labeled as CLK, DT and SW.

Step 4: Insert three wires as shown between the three pins on the encoder and the ESP32 pins 19, 22 and 21 respectively.

Step 5: Connect the + pin on the encoder to 3.3V rail and GND pin to the GND rail.

Step 6: Plug in the 5-way ribbon cable attached to the encoder. Make sure that you have it the right-way-round.

Step 7: Secure the ribbon cable onto the breadboard so that it will not pull out easily.

Step 8: Snap off 4 pins from the 20 way header pin strip, and insert it on the lower GND rail. This will be used to connect the GND clip of the oscilloscope to your circuit.

Step 9: Pick up a longish wire, and twirl it around a pencil. Insert the wire to pin 26 of the ESP as shown. The signal generator will produce the signal on this pin. The twirl in the wire reduce the chance of it being pulled out when you connect the signal to the oscilloscope.

Step 10: Check to make sure that all your connections are made correctly, particularly the 3.3V and the GND wires.

Step 11: Use the MicroUSB cable provided, connect the EPS32 module to a 5V USB power source. This could be your laptop USB port, a USB charger port or a USB portable power pack.

The OLED display on the ESP32 module should show a menu similar that shown below. You now have a working Signal Generator to use with your Home Lab Experiments.
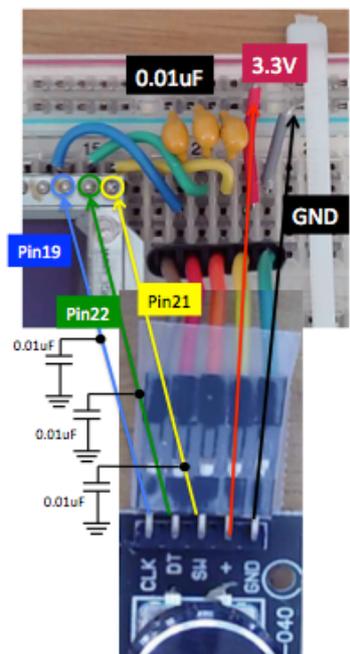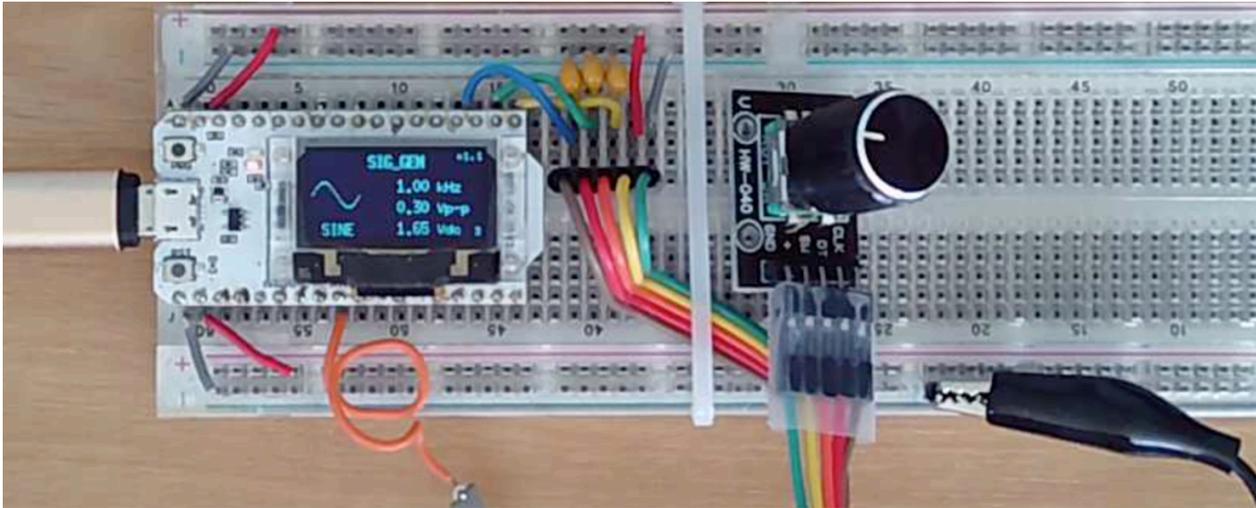
Appendix A – Home Lab Kit – List of contents

Type	Qty	Description
Plastic case	1	68 ohm resistor
	2	100 ohm resistor
	2	220 ohm resistor
	4	1K resistor
	1	1.1K resistor
	1	2k resistor
	1	8.2k resistor
	5	10k resistor
	2	20k resistor
	1	82k resistor
	1	100k resistor
	4	200k resistor
	1	10K ohm potentiometer
	4	0.01uF capacitor
	2	0.1uF capacitor
	1	0.33uF capacitor
	1	0.68uF capacitor
	2	1uF capacitor
	1	2.2uF capacitor
	1	4.7uF capacitor
	1	10uF capacitor
	1	220uF capacitor
	2	2N7000 MOSFET
	1	1N914 diode
	5	Colour LED
	1	LM386 audio amp
	2	MCP6002
	1	Electret microphone
	1	20 way header pin
	1	miniature switch
	1	8 ohm miniature speaker module

Zip Bag	1	DRV8833 dual motor driver
	1	MG90S 180 degree servo motor
	1	DC motor with gear
	1	Neopixel LED strip (8-LEDs)
	1	MB102 breadboard power module
	1	KY-040 rotary encoder
	1	2-way Dupont ribbon cable (Female-Female)
	1	10-way Dupont ribbon cable (Male-Female)
	2	0.5m single core wire (2 different colours)
	1	5.5 X 2.1mm DC Screw Terminal Connector
	1	9V battery connector
	1	Knob for rotary encoder
	2	200mm cable tie
	2	100 mm cable tie
	1	push pin magnet

Instruments Bag	1	DSO Shell 200kHz 1Msample/sec oscilloscope
	1	DT-9305A+ multimeter
	1	High impedance probe
	1	Pair of multimeter leads
	1	Instrument bag
	1	USB to MicroUSB data cabel

Others	1	Heltec Wifi 32 kit on a breadboard
	1	Box of assorted pre-cut hookup wires

68Ω (1)   100Ω (2)   220Ω (2)   1kΩ (4)

1.1kΩ (1)   2kΩ (1)   8.2kΩ (1)   10kΩ (5)

20kΩ (2)   82kΩ (1)   100kΩ (1)   200kΩ (5)

10kΩ pot (1)   0.01uF (4)   0. 1uF (2)

0.33uF (1)   0.68uF (1)   1uF (2)

2,2uF (1)   **4.7uF (1)**   **10uF (1)**   **220uF (1)**

2N7000 (2)   **1N914 (1)**   **LED (5)**

LM386 (1)   **MCP6002 (2)**

Switch   Mic   8Ω speaker

Appendix C – Pinout Diagram of Heltec Wifi 32 Kit (ESP32 module)