Introduction to Electronics Workshop

Hands-on activity pre-requisites

1. ADALM2000 drivers installation

https://github.com/analogdevicesinc/plutosdr-m2k-drivers-win/releases

2. Install Scopy software from:

https://github.com/analogdevicesinc/scopy/releases/download/v1.3.0/scopy-v1.3.0-Windows-setup.exe

or:

Hands-on activity

DEMO 1

HOME MADE BATTERY - INSTRUCTOR-LED

Description

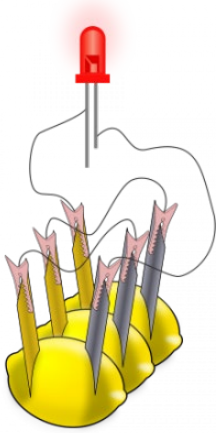
This demo is instructor-led and intends to implement a proof of concept for a battery powered LED using unconventional materials.

- Materials:
  - ADALM2000 Active Learning Module
  - Jumper wires (wires with alligator clips will work best)

- 3 lemons: large, fresh, "juicy" lemons work best.
- Zinc plated screws or nails
- Copper plated coins or copper nails or heavy gauge (14 or 12) copper wire.
- Red LED

Hardware Setup

- Insert a copper penny into a small cut or push a copper nail or heavy gauge wire into one side of the lemon.
- Push a galvanized (zinc coated) screw or nail into the other side of the lemon. The zinc and copper electrodes must not touch.



Results

You should be able to observe how the Red LED is lit by the 4 or more lemon-cells battery

DEMO 2

NPN TRANSISTOR CHARACTERISTICS

Description

The demo will describe the output characteristics of a BJT NPN transistor using modern instrumentation tools.

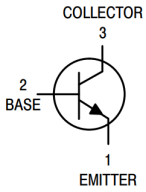
Materials:

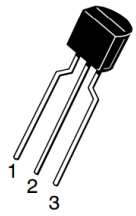
- ADALM2000 Active Learning Module
- Jumper wires
- 1 - 100KΩResistor
- 1 - 100ΩResistor

- 1 - small signal NPN transistor - 2N3904
- 1 - small signal PNP transistor - 2N3906

Theory of operation

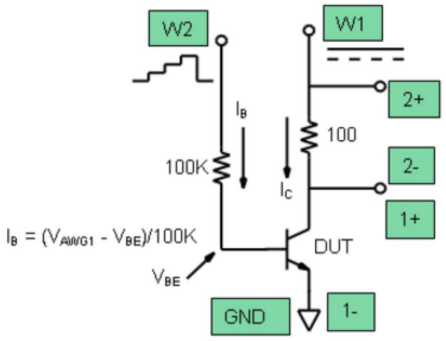
- 2N2904 Pinout





Hardware setup

- Place the transistor and resistors on the breadboard.
- Make the connections between ADALM2000 and circuit as shown below.



Steps

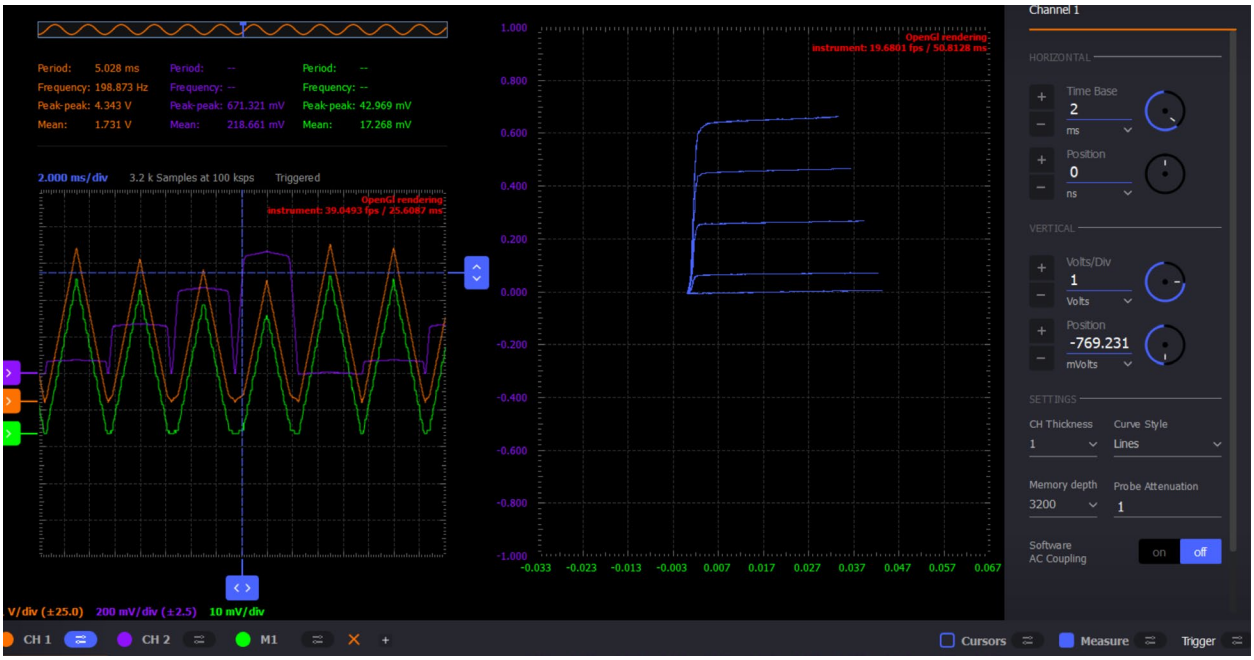
1. Open Scopy application
2. Create a CSV file with a column having integer values from 0 to 5(0, 1, 2, 3, 4), save it
3. Open the Waveform generator instrument and select Channel 2, load the previously created csv file and make the setup:

4. Select Channel 1, make the setup:

5. Open the scope and select the XY view
6. Add a math channel with the following function: M1 = t0/100 - it represents the Ic current, given the 100 ohms collector resistor

Results

7. Observe the out characteristics of the NPN transistor Ic = f(Vce)



Challenge

- Obtain the characteristics for a PNP transistor provided.
- The curve trace should look like the one in the image:

Tips: you need to create another csv file for the base control signal of the transistor.

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Demo 3:

TRAFFIC LIGHTS CONTROL

Description

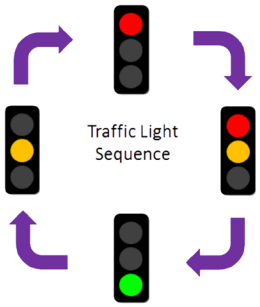
This demo will showcase the usage of logic gates to implement a logic function which describes the functionality of a well known device: a traffic light.

Materials

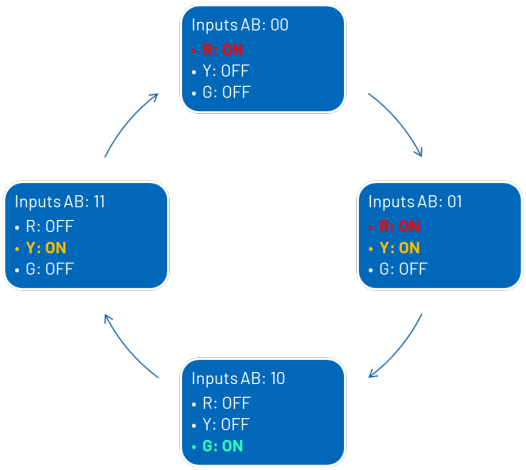
- ADALM2000 Active Learning Module
- Jumper wires
- 1 SN74HC08N part
- 1 SN74HC32N part
- 1 SN74HC04N part
- 1 Yellow LED
- 1 Red LED
- 1 Green LED

Theory of operation

Logic sequence of a traffic light is the one bellow:



You will use two logic inputs to control the traffic lights, those inputs are marked A and B, the sequence is the one bellow:



Truth table for the logic function that describes the traffic lights sequence:

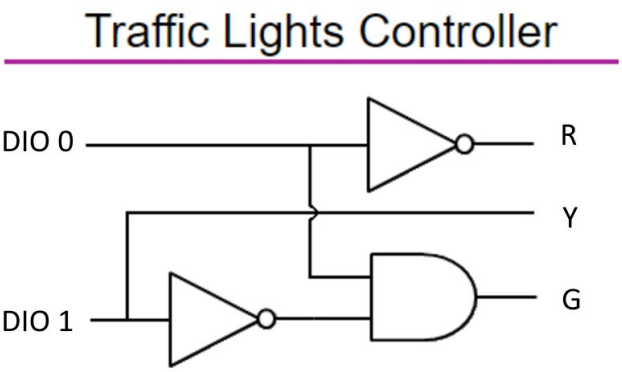
DIO 0	DIO 1	R	Y	G
0	0	1	0	0
0	1	1	1	0
1	0	0	0	1
1	1	0	1	0

Y = DIO1

R = not(DIO0)

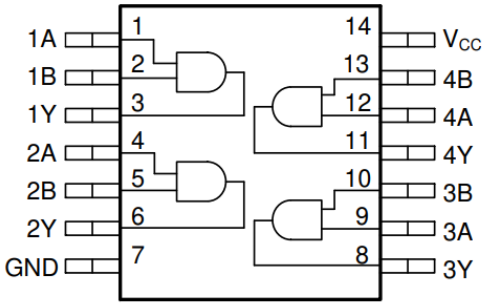
G = DIO0 AND (not(DIO1))

Logic gates diagram to be implemented in hardware:



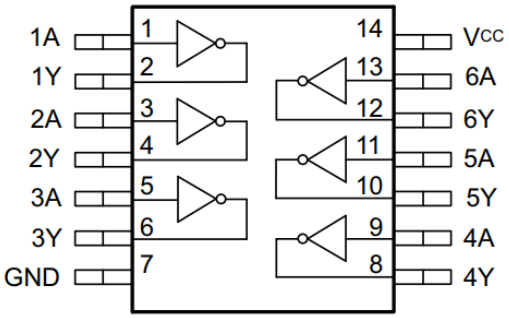
Hardware setup

- SN74HC08N Pinout



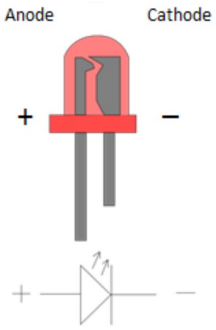
Functional pinout

- SN74HC04N Pinout



Functional pinout

LED terminals:

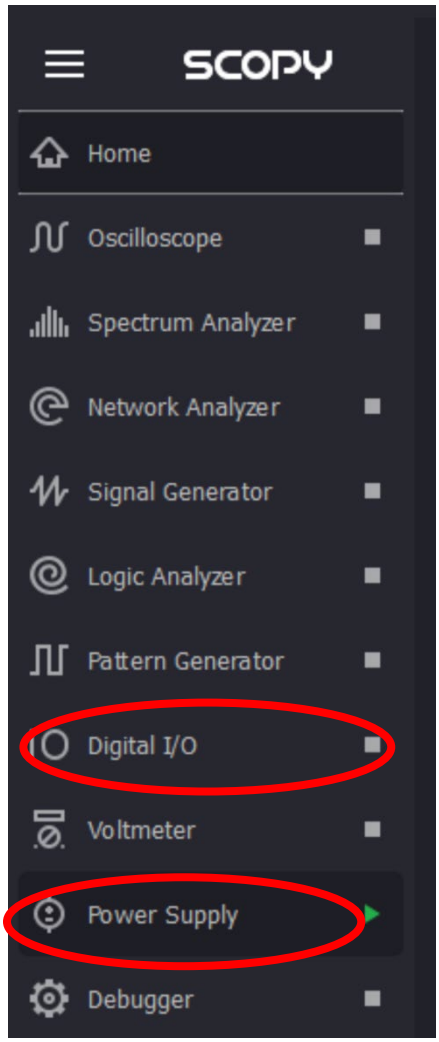


Steps

- Place the ICs on the breadboard with each pin row on one side of the breadboard delimitator.
- Open **Scopy** application
- Open the **Oscilloscope** instrument
- Open the **Power** instrument
- Connect the V+ wire to pins 14 of the both ICs - VCC
- Connect GND pin of the M2K to pin 7 of both ICs
- Connect DIO 0 pin to SN74HC04N pin 1
- Connect DIO 0 pin to SN74HC08N pin 1
- Connect DIO 1 pin to SN74HC04N pin 3
- Connect DIO 1 pin to Y LED
- Connect SN74HC04N pin 2 to R LED
- Connect SN74HC04N pin 4 to SN74HC08N pin 2
- Connect SN74HC08N pin 3 to G LED
- Set the V+ to 3.3V and press the **Enable** button

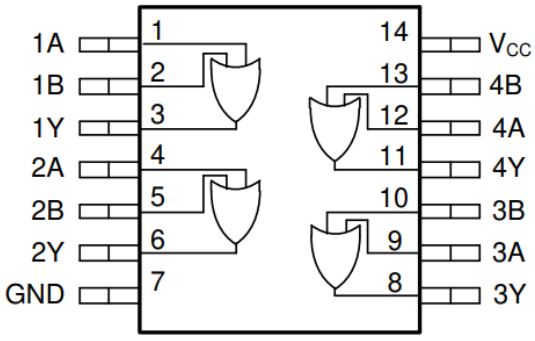
Results:

- Open the Scopy Digital IO and Power instruments:
- Toggle the DIO0 and DIO1 digital pins according to the logical function truth table and verify the outputs match the table results



Challenge

- Implement a logical OR function using **SN74HC32N** part from the kit
- Pinout:



Functional pinout