CHAPTER – 1

INTRODUCTION

1.1 Semiconductor Curve tracer

A semiconductor curve tracer is a specialised piece of electronic test equipment used to analyze the characteristics of discrete semiconductor devices such as diodes, transistors, and thyristors. Based on an oscilloscope, the device also contains voltage and current sources that can be used to stimulate the device under test (DUT).

In our Project we have created a simple Output characteristic curve tracer for the BJT or MOSFET.

CHAPTER - 2

BJT:

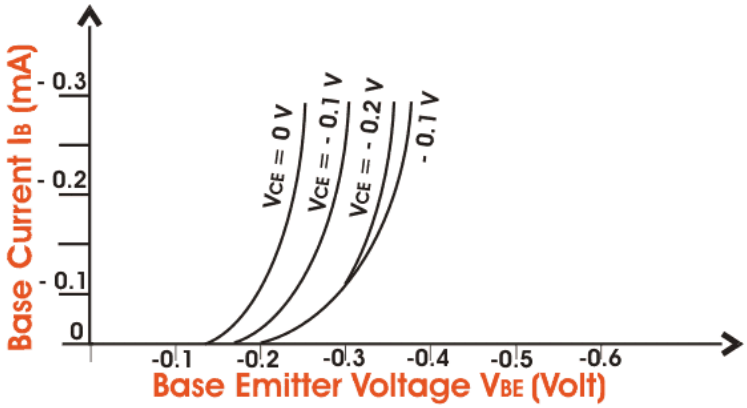
2.1 Regions of operation:

Applied voltages	B-E junction bias (NPN)	B-C junction bias (NPN)	Mode (NPN)
E < B < C	Forward	Reverse	Forward-active
E < B > C	Forward	Forward	Saturation
E > B < C	Reverse	Reverse	Cut-off
E > B > C	Reverse	Forward	Reverse-active

2.2 Common Emitter Characteristics:

2.2.1 Input characteristics:

IB (Base Current) is the input current, VBE (Base - Emitter Voltage) is the input voltage for CE (Common Emitter) mode. So, the input characteristics for CE mode will be the relation between IB and VBE with VCE as parameter. The characteristics are shown below

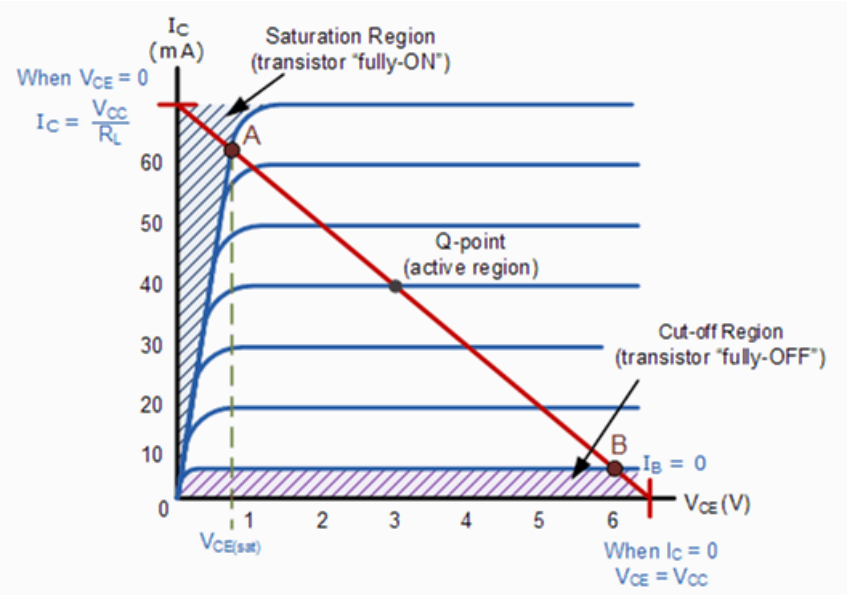


Input characteristics

The typical CE input characteristics are similar to that of a forward biased of p-n diode. But as VCB increases the base width decreases.

2.2.2 Output characteristics:

Output characteristics for CE mode is the curve or graph between collector current (IC) and collector - emitter voltage (VCE) when the base current IB is the parameter. The characteristics is shown below in the figure.



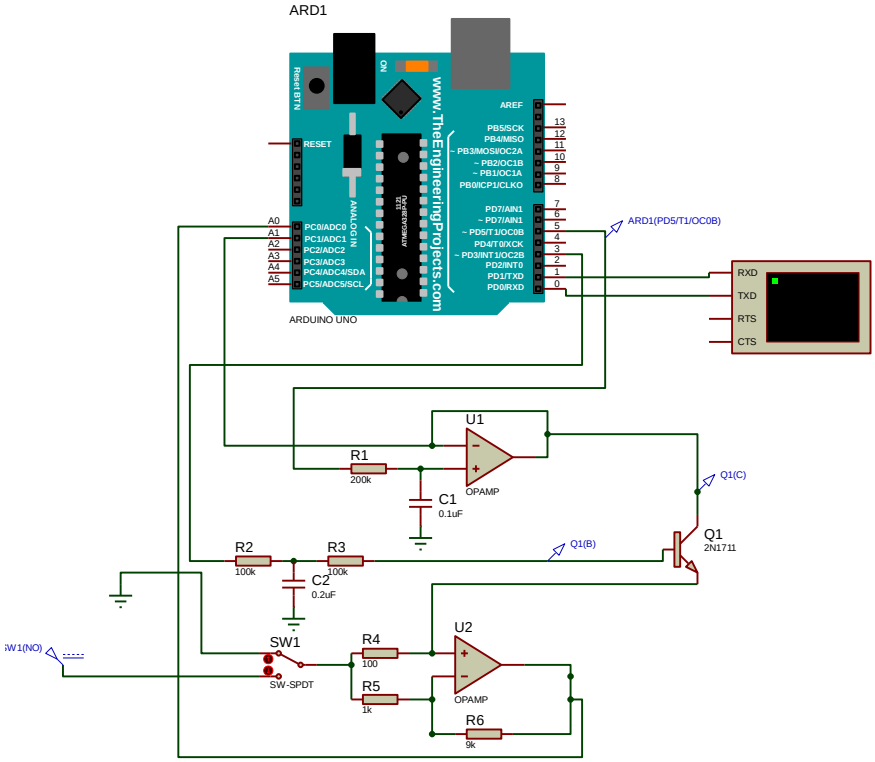
Output characteristics

Like the output characteristics of common - base transistor CE mode has also three regions named (i) Active region, (ii) cut-off regions, (iii) saturation region. The active region has collector region reverse biased and the emitter junction forward biased. For cut-off region the emitter junction is slightly reverse biased and the collector current is not totally cut-off. And finally for saturation region both the collector and the emitter junction are forward biased.

Description:

The Baud rate is set as 9600. The loop initiates only in arrival of the value ‘H’ from the Processing app. Digital pin5 is used to generate triangular wave. The PWM wave is increased in step of 4 from 0 to 255 and when it reaches 255 it is then decreased. At digital input pin 3 it is used to give it to the base. The PWM value is increased in 5 step for five output characteristic curves.

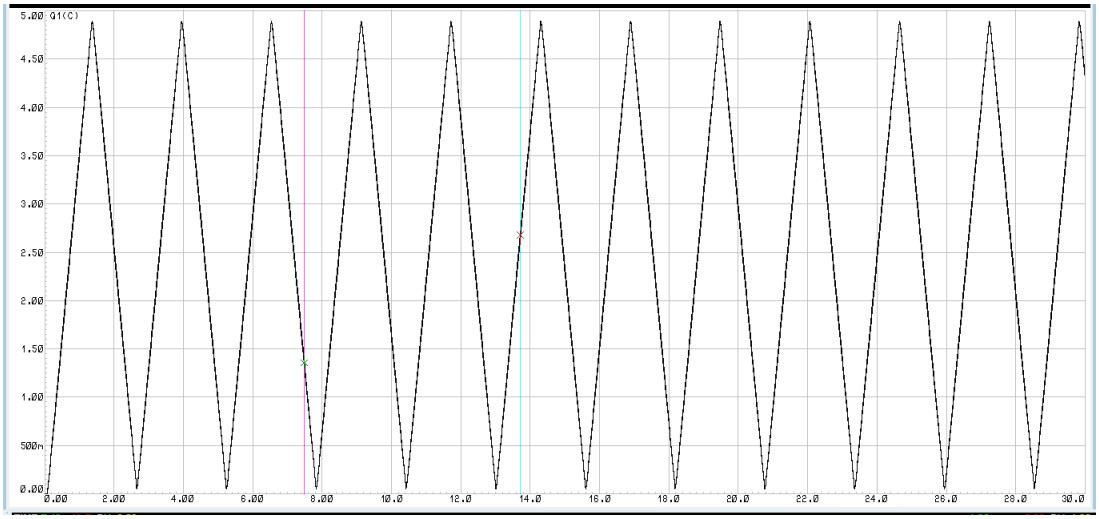
Circuit Diagram



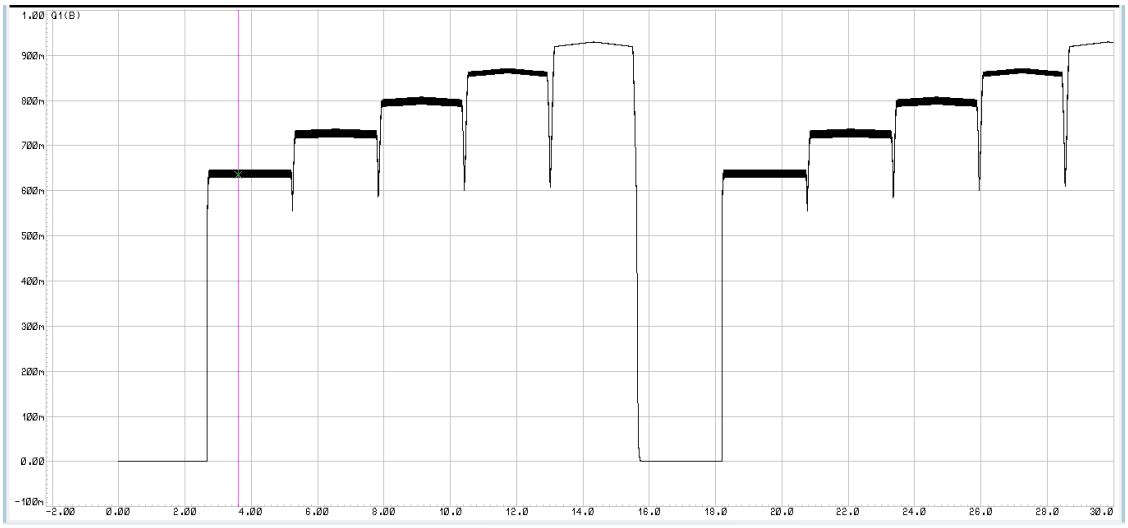
CHAPTER - 3

Circuit Diagram Description:

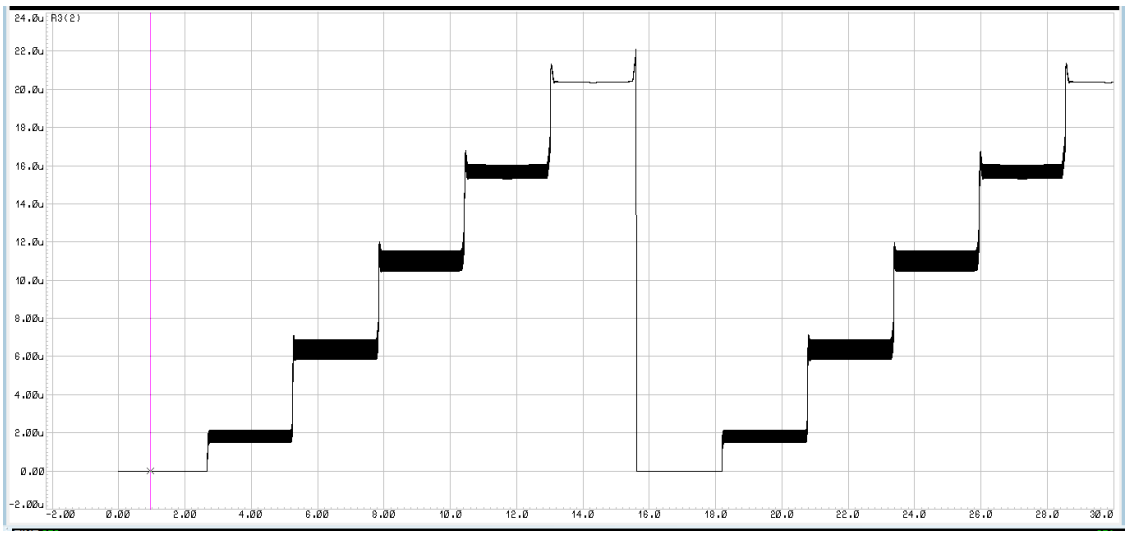
The Arduino digital pins are used to generate PWM signal which are then converted into analog signal by using Opamp. The collector pin is given to the output of Opamp U1. Opamp U1 is configured as Voltage follower. The non-inverting terminal acts as an integrator which is then given to the voltage follower. The Integrator helps to smoothen the Analog Corresponding value of the PWM signal. Thus a triangular voltage is given at the input of the collector terminal of the BJT. The Base of the transistor is given through a Passive integrator and voltage to current converter. The current is then increased in five discrete steps. The emitter terminal is given to the non-inverting terminal of opamp U2. The Opamp U2 acts as a differential amplifier. The output is given to the A0 pin of the Arduino which reads its corresponding analog signal. There is a provision made for converting the value from npn to pnp transistor. The switch can be either be connected to the GND in case of the NPN and to VCC in the case of PNP transistor.



Voltage at Collector Pin



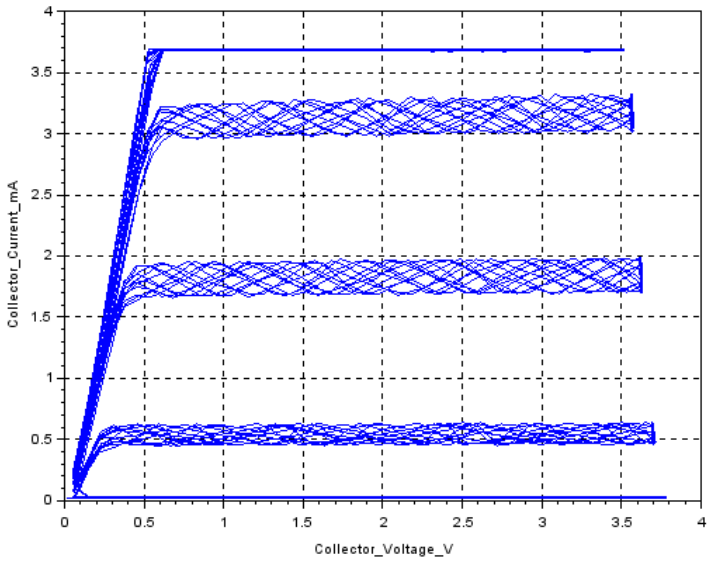
Voltage at Base Terminal



Corresponding value of current

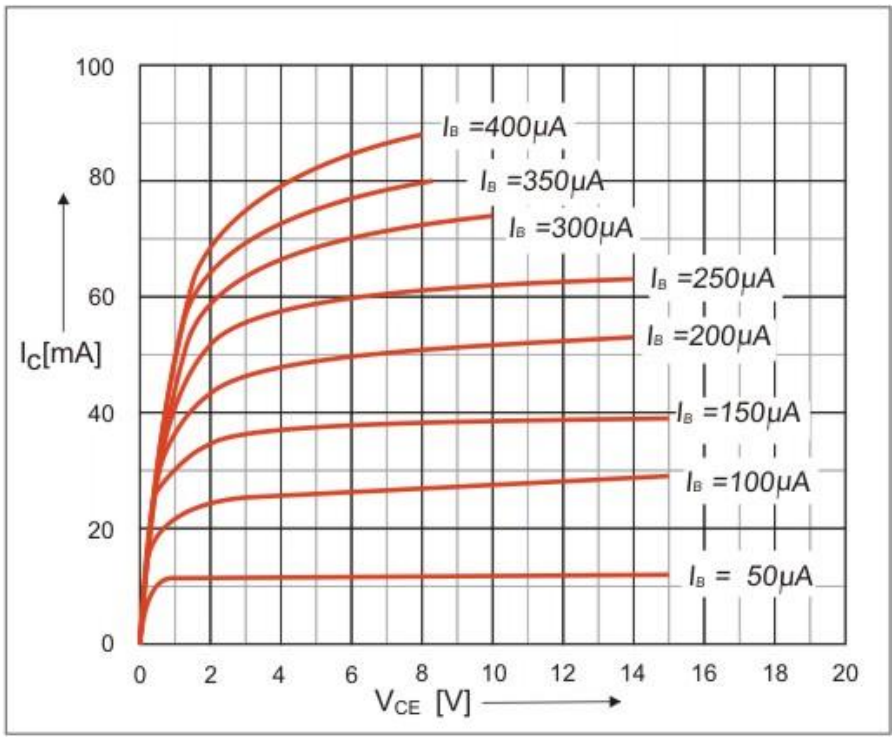
CHAPTER - 4

4.1 BC547

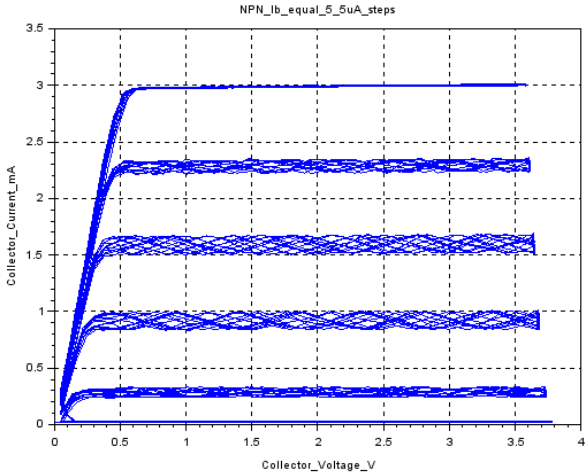


BC 547 Output characteristics

BC 547 Characteristic curve from Datasheet



4.2 BD 139



BD 139 Output characteristics

Chapter - 7

Conclusion

Thus, we have the possibility to trace the characteristics of not only BJT but also several semiconductor devices at a time. This could be used in semiconductor industries.

Reference:

- https://www.google.co.in/amp/www.instructables.com/id/Arduino-BiCMOS-Curve-Tracer/%3famp_page=true
- https://www.google.co.in/amp/s/www.elprocus.com/arduino-project-on-transistor-curve-tracer/amp/
- http://www.idea2ic.com/BiCmosCurveTracer/Arduino%2520BiCmos%2520Curve%2520Tracer.html