UJT CHARACTERISTICS

Aim To plot the VI characteristics of a unijunction transistor and to measure its intrinsic stand off ratio.

Components and equipments required UJT, voltmeters, ammeters, rheostats, dc sources, bread board and CRO.

Theory A unijunction transistor consists of a bar of highly doped N-type semiconductor to which a heavily doped P-type rod is attached. Ohmic contacts are made at opposite ends of the N-type bar, which are called base$_1$(B_1) and base$_2$(B_2) of the transistor. P-type rod is called the emitter.

Refer the equivalent circuit of the UJT given in figure. The inter base resistance R_{BB} of the N-type silicon bar appears as two resistors R_{B1} and R_{B2}, where R_{BB} equals the sum of R_{B1} and R_{B2}. The intrinsic stand off ratio η is given by the expression

$$\eta = \frac{R_{B1}}{R_{BB}} \text{ with } I_E = 0$$

Due to the applied voltage at the B_2 of the transistor, a positive voltage gets developed across R_{B1} and is equal to ηV_{BB}.

When V_E is less than the voltage across R_{B1}, diode becomes reverse biased. When V_E increases, a forward current flows through the emitter to B_1 region.

If V_E is raised further, a sudden reduction of R_{B1} occurs. This happens because the increase in current reduces R_{B1}. Reduction in R_{B1} causes the increase in current through it. This further reduces R_{B1} and so forth. In other words, a regenerative action takes place at a particular value of V_E, called peak voltage which is expressed as $V_p = \eta V_{BB} + V_D$, where V_{BB} is the base supply voltage and V_D is the junction voltage drop. After a particular value of V_E, called valley point, emitter current increases with V_E, similar to that of an ordinary forward biased diode.

As explained above, when V_E is rises, forward resistance across the junction decreases and the junction behaves as a short circuit. Then current through the E-B_1 junction increases and hence voltage across the junction decreases. This is equivalent to a negative resistance

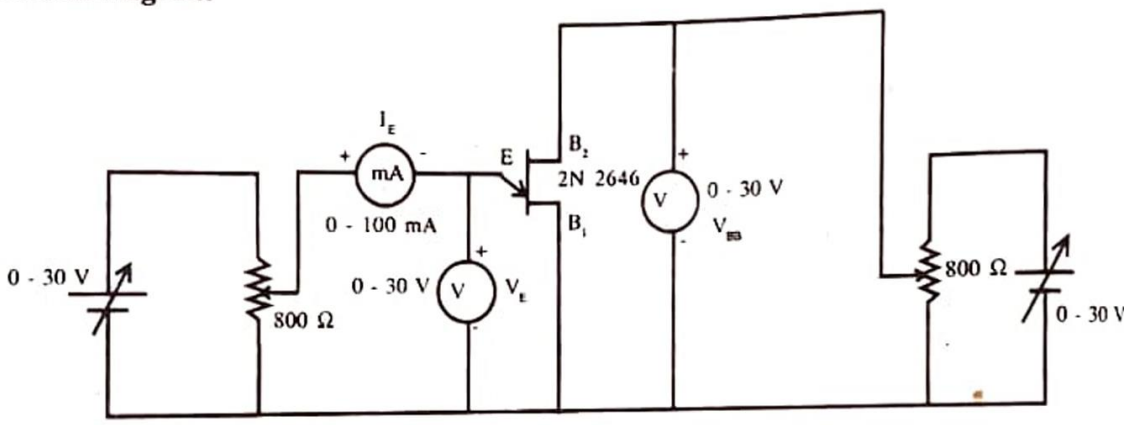
across the junction. This continues up to a voltage called valley voltage V_V after which junction behaves as an ordinary diode.

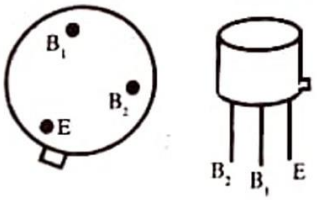
Procedure

1. Identify the leads of UJT correctly and set up the circuit as shown in figure.
2. Keeping $V_{BB} = 0$, Vary V_E from 0 V to 10 V in steps of 0.5 V. Take the voltmeter and ammeter readings at the input side and enter it in tabular column. Repeat it for other values of V_{BB} (say 3 V & 6 V).
3. Plot the VI characteristics with I_E along x-axis and V_E along y-axis.
4. Calculate the intrinsic stand off ratio from the graph using its expression.

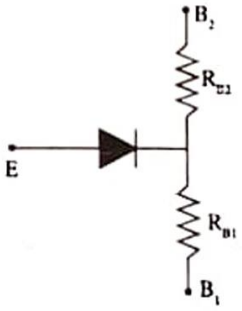
Note: Since peak current I_p is in μA, initial rise of voltage in the graph may not be obtained.

Circuit diagram





Pin out of 2N 2646



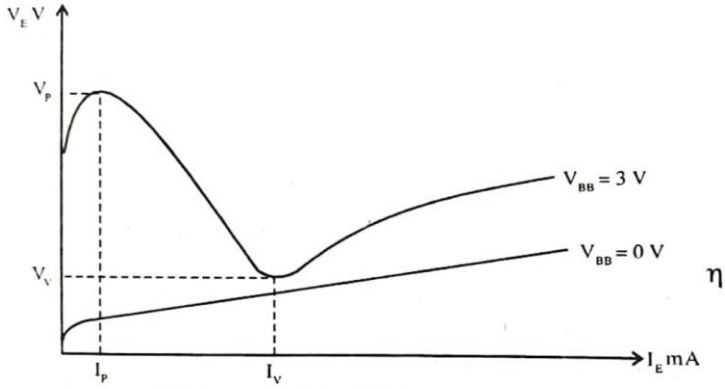
Equivalent circuit of UJT

Details of 2N 2646 η min = 0.56, η max = 0.75
I_p max = 5 μA and I_v min = 4 mA

Tabular column

$V_{BB} = 0$ V		$V_{BB} = 3$ V		$V_{BB} = 6$ V	
V_E V	I_E mA	V_E V	I_E mA	V_E V	I_E mA

Graph



VI characteristics of UJT

$$\eta = \frac{V_P - V_D}{V_{BB}} = \text{.....}$$

Result Intrinsic stand off ratio η = ...

Reference

Electronics Lab Manual Volume I, K.A. Navas, **Rajath Publishers**