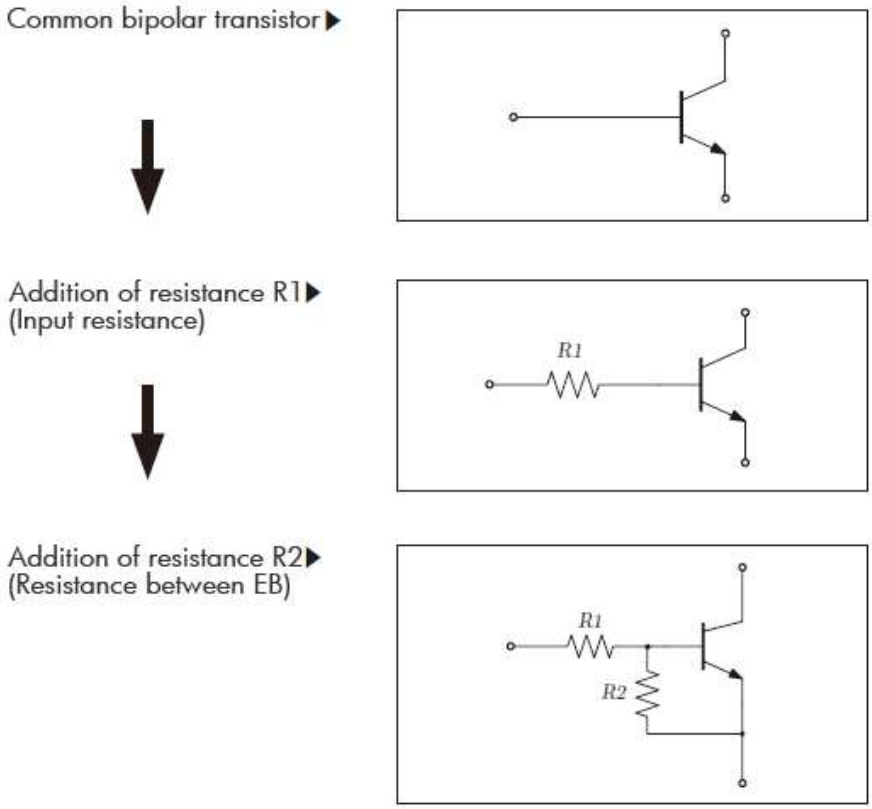
42. Fundamentals of Transistor With Built-In Resistors

The transistor with built-in resistor is the one that resistors equipped to bipolar transistor, oftenly called as digital transistor.

Here is the product list of the transistor. (http://www.chip1stop.com/search.do?classCd=011000&classLv=2&searchType=2&dispAllFlg=true&_ga=2.90469022.523109363.1540771289-365662499.1539562411)

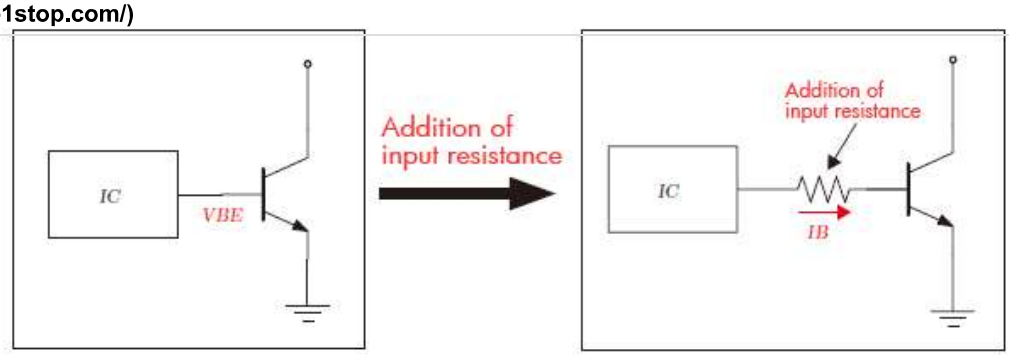


(1) About resistance R1

The role of resistor R1: The performance of the transistor is stabilized by converting the input voltage into the current. The performance of bipolar transistor is unstable if voltage such as output of IC is directly applied on the base terminal. The operation can be stabilized when it is made to operate as current control by putting resistor (input resistor) between

IC and the base terminal. This is because of output current change in linear by base current control while it is

oltage control. A transistor that input resistor R1 is equipped is the transistor with built-in

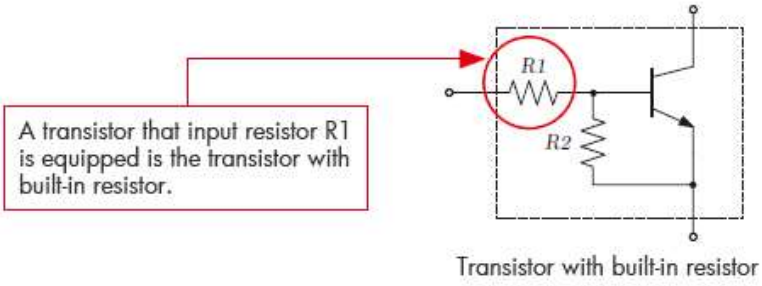


Operation is unstable.

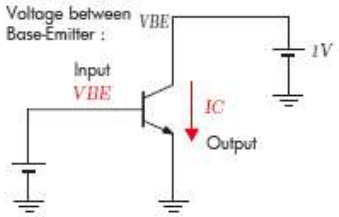
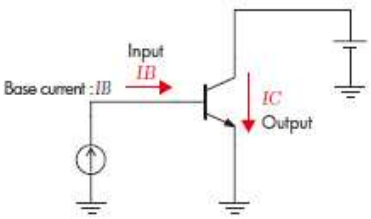
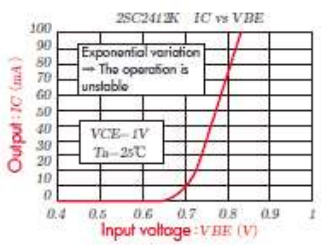
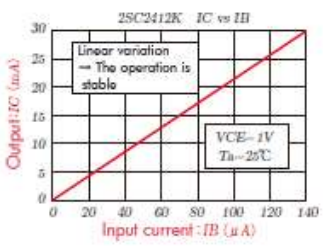
Operation is unstable in the input voltage (The output current changes exponentially in the input voltage).

Operation is stable.

The operation stabilize when adding input resistance and made the input to electric current (Base current:IB). (The output current changes into linear for the input current.)

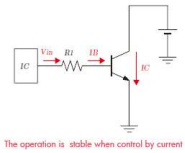


Compares the operation of transistor when the input is the voltage, and when the input is current.

	Voltage control Input: Voltage VEB between emitter-base	Current control Input: Base current IB
Measurement circuit diagram		
Theoretical formula	$IC = Is \cdot e^{\left[\frac{VBE}{KT/q}\right]}$ Is:Constant determined by device k:Boltzmann constant T:Absolute temperature q:Charge of electron Exponential changes	$IC = hFE \cdot IB$ hFE:Amplification factor It is almost constant according to the device. Linear changes
Input output characteristic		

It is understood that the output changes exponentially to the input in the left voltage control while the output changes current is greatly changed by the slight changes in input, and operation becomes unstable. For example, the right graph, output current becomes double from from 9mA to 18mA when the input current changes double from 40 μ A to 80 μ A however, in the left graph the output current becomes 7 times from 10mA to 70mA when the input voltage changes slightly by 14% from 0.7V to 0.8V. Under such circumstances, it is not suitable for actual use because the output current changes greatly when there is slight noise in the input voltage.

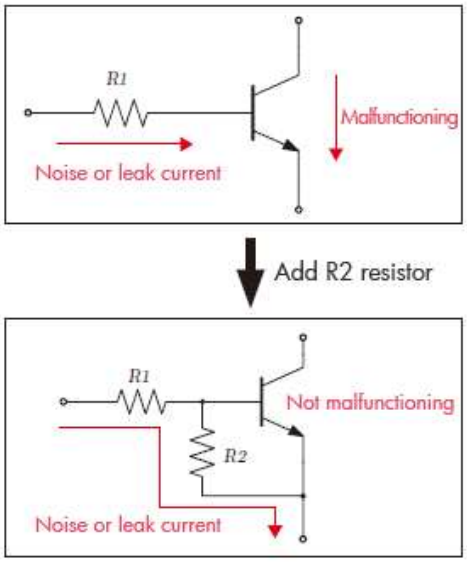
when seen the input-output characteristic. In other words, in the voltage control the output



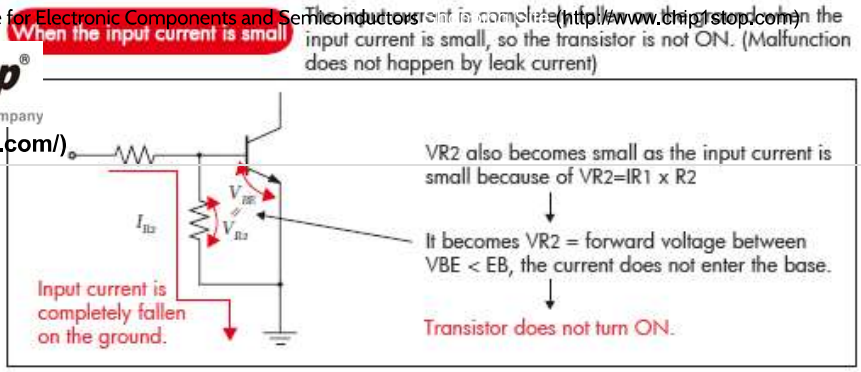
Thus, bipolar transistor requires the input resistance R1 to convert the voltage output from IC to the base current as the current control is more stabilized.So digital transistor is suitable to reduce the product points, space because it is inbuilt with this R1.

(2)About resistance R2

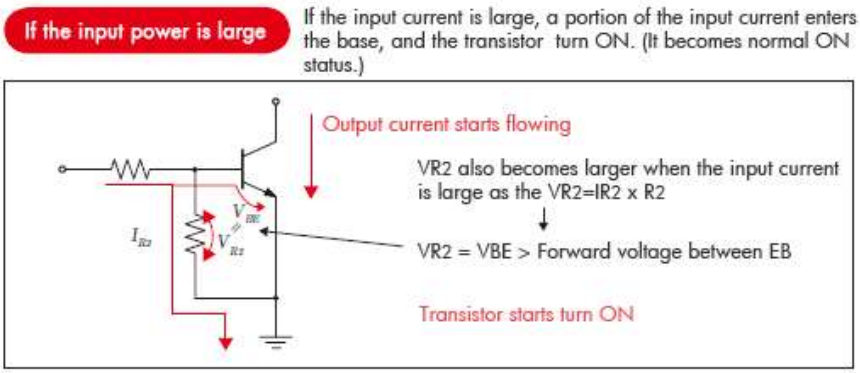
The role of resistance R2: It absorbs the leak current, and prevents the malfunction. Resistance R2 prevents the transistor from malfunctioning by dropping the leak current and the noise that entered from the input to the ground.



Input currents will all fall on the ground if it is a minute current, if the input current is large, then a large portion of the input current will start entering the the base of the transistor, and ON the transistor.



When VR2 = VBE < (Forward voltage between EB = 0.7V)



When VR2 = VBE > (Forward voltage between EB = 0.7V)

Thus, the stable operation is achieved by resistance R2, although voltage of certain level is required to turn on the transistor.

Here is the product list of the transistor. (http://www.chip1stop.com/search.do?classCd=011000&classLv=2&searchType=2&dispAllFlg=true&_ga=2.90469022.523109363.1540771289-365662499.1539562411)