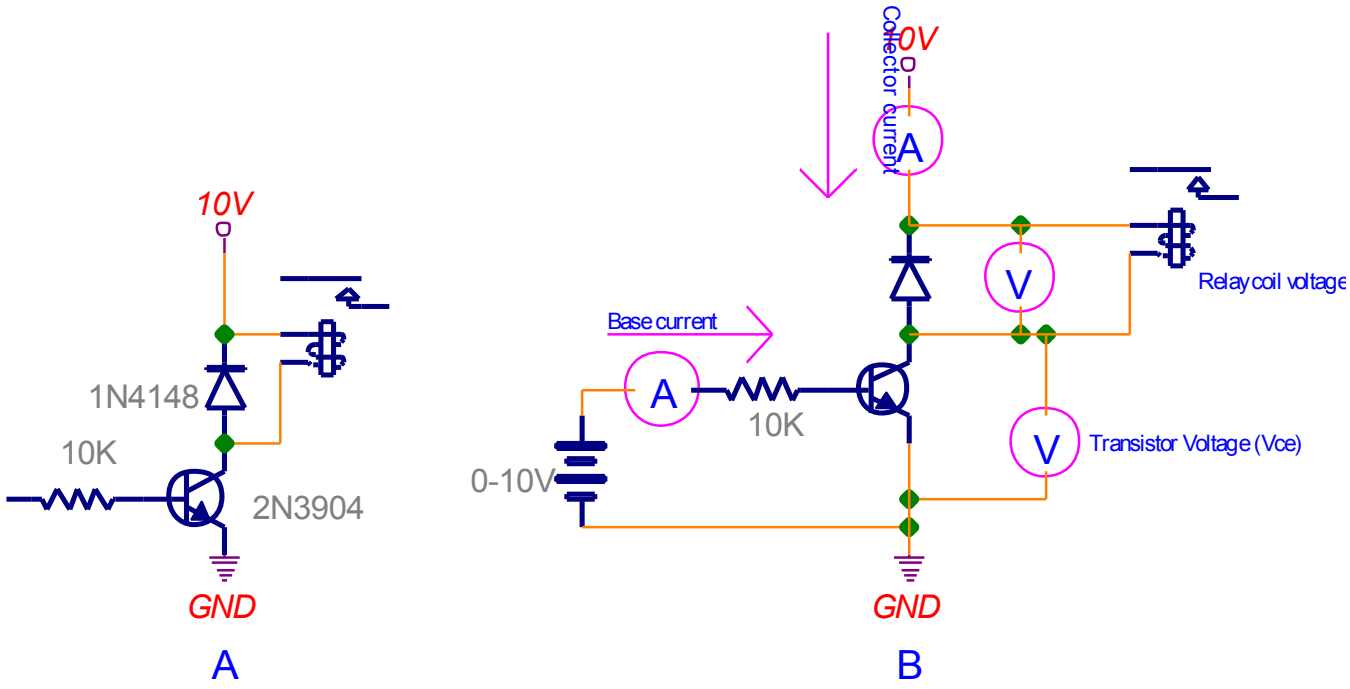
Transistor Relay Driver Demo

The basic transistor relay driver circuit is shown in **fig. A**. In **fig. B** we've added ammeters to measure the base and collector currents as well as voltmeters to measure the voltage across the transistor and the relay coil.



The following lists the input condition (i.e. the battery voltage) and all other voltages and currents. Note: The relay coil voltage and the transistor voltage must add up to the power supply voltage (10V in this case). We'll assume the relay coil has a DC resistance of 50Ω, the transistor has a gain (h_{fe}) of 100, and V_{be} = 0.7V when forward biased.

Vbat = 0; Ibase = 0 so Icolletor = 0 so Vcoil = 0 and Vtransistor = 10V
Vbat = 1V; Ib = 30uA so Ic = 30mA so Vcoil = 1.5V and Vtrans = 8.5V
Vbat = 2V; Ib = 130uA so Ic = 130mA so Vcoil = 6.5V and Vtrans = 3.5V
Vbat = 3V; Ib = 230uA, Ic wants to be 230mA which would make Vcoil = 11.5V
(Note: The coil voltage can't be larger than the power supply voltage so the transistor is saturated)
Vbat = 3V; Ib = 230uA, Vtrans = 0.2V leaving Vcoil = 9.8V & Ic = 196mA.
Any further increase in Ib won't put any more current through the relay coil.

In reality the DC gain (h_{fe}) can vary a lot as the collector current changes and won't be 100 for all collector currents. According to the datasheet the gain drops off substantially at high currents (Ex: h_{fe} = 30 when Ic = 100mA).

Ex: Trans is fully on (i.e. saturated), Vtrans = 0.2V and Vcoil = 9.8V
Ic = 196mA (9.8V/50Ω)
Ib = 6.5mA (Ic/30)
Vbat = 65V (Vbat/10KΩ) (neglect 0.7V V_{be})
Since 65V is much higher than needed the base resistor should be reduced to say 1KΩ where Vbat=6.5V would be enough to saturate the transistor.