



Darlington Pair

What is a Darlington Pair?

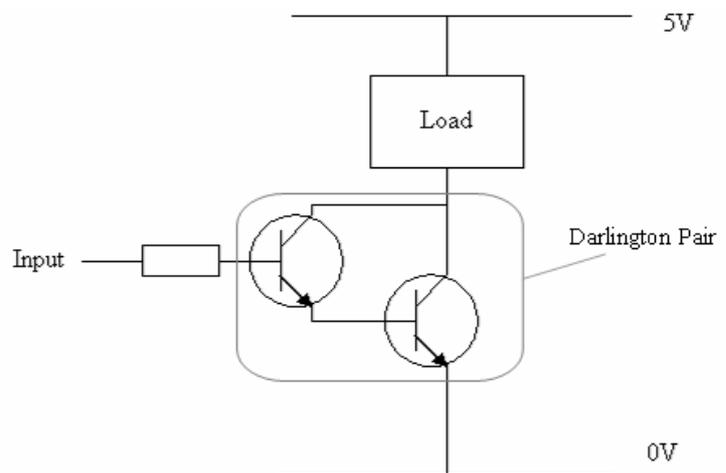
A Darlington pair is two transistors that act as a single transistor but with a much higher current gain.

What is current gain?

Transistors have a characteristic called current gain. This is referred to as its h_{FE} .

The amount of current that can pass through the load when connected to a transistor that is turned on equals the **input current x the gain of the transistor (h_{FE})**

The current gain varies for different transistor and can be looked up in the data sheet for the device. Typically it may be 100. This would mean that the current available to drive the load would be 100 times larger than the input to the transistor.



Why use a Darlington Pair?

In some application the amount of input current available to switch on a transistor is very low. This may mean that a single transistor may not be able to pass sufficient current required by the load.

As stated earlier this equals the **input current x the gain of the transistor (h_{FE})**. If it is not be possible to increase the input current then we need to increase the gain of the transistor. This can be achieved by using a Darlington Pair.

A Darlington Pair acts as one transistor but with a current gain that equals:

Total current gain ($h_{FE \text{ total}}$) = current gain of transistor 1 ($h_{FE \text{ t1}}$) x current gain of transistor 2 ($h_{FE \text{ t2}}$)

So for example if you had two transistors with a current gain (h_{FE}) = 100:

$$(h_{FE \text{ total}}) = 100 \times 100$$

$$(h_{FE \text{ total}}) = 10,000$$

You can see that this gives a vastly increased current gain when compared to a single transistor. Therefore this will allow a very low input current to switch a much bigger load current.

Base Activation Voltage

Normally to turn on a transistor the base input voltage of the transistor will need to be greater than 0.7V. As two transistors are used in a Darlington Pair this value is doubled. Therefore the base voltage will need to be greater than $0.7V \times 2 = 1.4V$.

It is also worth noting that the voltage drop across collector and emitter pins of the Darlington Pair when the turn on will be around 0.9V Therefore if the supply voltage is 5V (as above) the voltage across the load will be will be around 4.1V ($5V - 0.9V$)