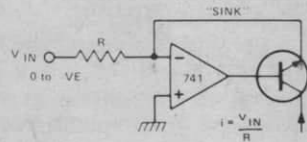
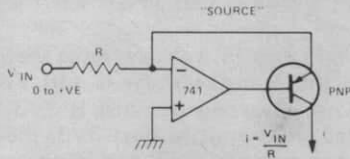


VOLTAGE TO CURRENT CONVERTER

The virtual earth of an op-amp and the current source characteristic of a transistor can be combined to produce a precision linear voltage to current converter. Consider the 'SOURCE' circuit. A positive voltage is applied and the op-amp adjusts itself so that a 'virtual earth' condition is maintained. This means that a current i flows through the input resistor R , where $i = V_{IN}/R$. Now this current has to go somewhere, and so it flows through the PNP transistor and comes out of the collector and into its load. Thus, the input voltage generates a current which is linearly proportional to it. There are, however, three sources of error that will affect this linearity. First the input offset voltage of the op-amp may become significant at low levels of V_{IN} . Second, the input bias current may well rob a lot of the current when V_{IN} is low. Third, the base current of the transistor must be subtracted from the final output current. Note that the current gain of the transistor will change with collector current variations, and



so the base current loss is not a fixed percentage. However, a precise voltage to current converter can be made using an op-amp with a FET input so that the bias current is low. Also, an input balance can be used to zero out the input offset voltage, and if a FET is used to replace the bipolar transistor, then the base current problem can be removed.

The 'SINK' circuit merely swaps the transistor to an npn type. Note that the input voltage now must be negative.