DESIGN WITH DISCRETE TRANSISTORS.

ONE-TRANSISTOR SHUNT-FEEDBACK GAIN STAGES.

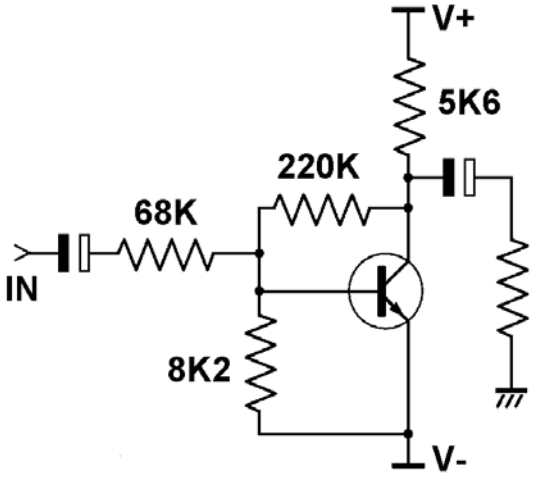

Fig 15: Circuit of single-transistor gain stage, shunt-feedback version.

A single transistor can give gain in either series & shunt mode.

Single-transistor shunt-feedback gain stages are inherently inverting, and of very poor linearity by modern standards. The stage is inevitably a collection of compromises. The collector resistor should be high in value to maximise the open- loop gain; on the other hand, this reduces the collector current of TR1, its transconductance, and hence reduces open-loop gain once more. The collector resistor must also be reasonably low in value as the collector must drive external loads directly. This stage has only a modest amount of shunt feedback, and the input can hardly be called a virtual earth. However such circuits were very common in low-end discrete preamplifiers, when the cost of an active device was a serious matter.

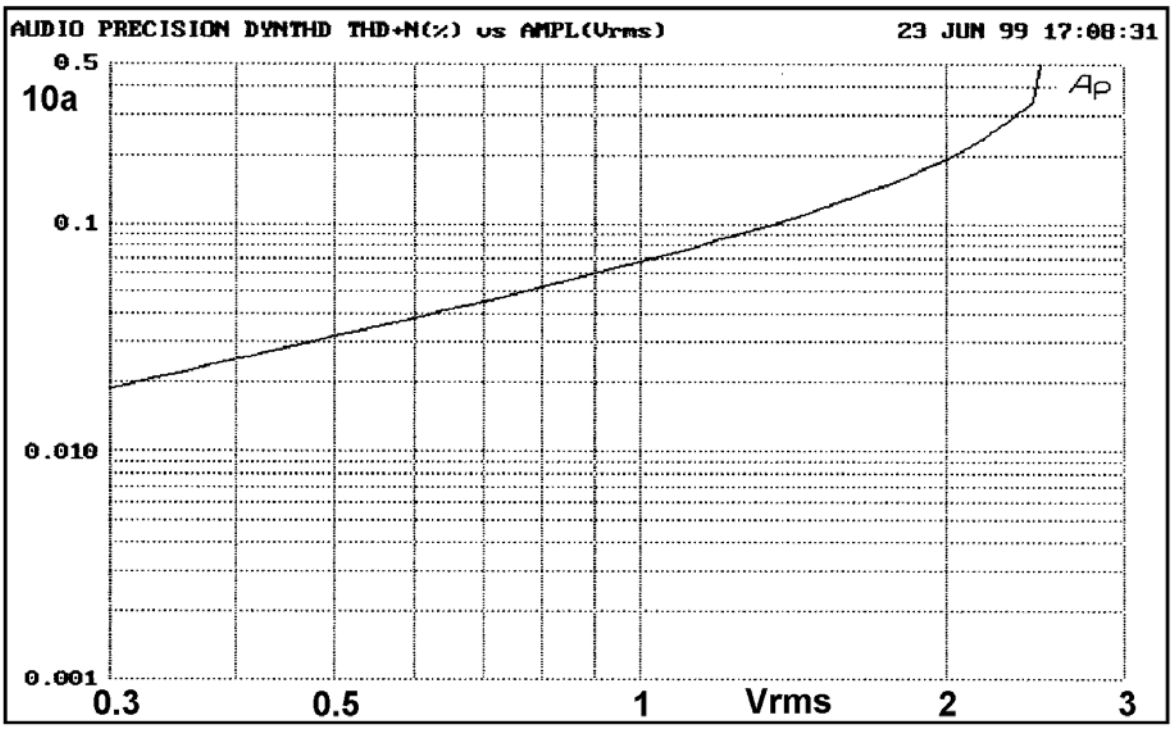

Fig 16: Single-transistor shunt-feedback gain stage, distortion versus level. Gain is three. 10A

ONE-TRANSISTOR SERIES-FEEDBACK GAIN STAGES.

Single-transistor series-feedback gain stages are made by creating a common-emitter amplifier with a

feedback resistor in the emitter. This gives voltage feedback to the emitter. The gain is the ratio of the collector and emitter resistors, if loading is negligible. Note that unlike opamp series-feedback stages, this one is inherently inverting. To make a non-inverting gain stage requires at least two transistors.
This very simple stage naturally has disadvantages. The output impedance is fairly high, being essentially the value of the collector resistor. The output is neither good at sinking or sourcing current.
The distortion performance is indifferent, giving 0.3% THD at 1Vrms in, 3Vrms out. Compare this with the shunt-feedback one-transistor gain stage described above, which gives 0.7% under the same conditions.

Fig 17: Circuit of single-transistor series-feedback gain stage.

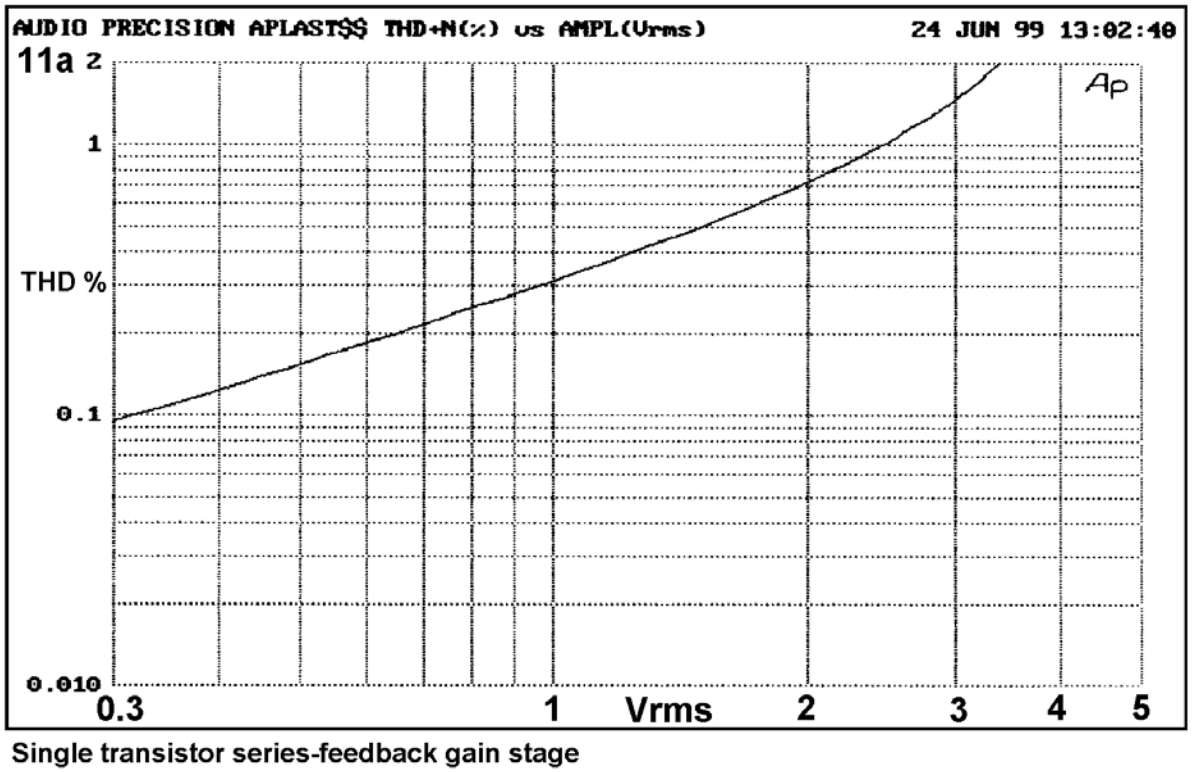

Fig 18 Single-transistor series-feedback gain stage, distortion versus input level. Gain is three. 11A