PB58 POWER BOOSTER AMPLIFIER WITH +/-140V COMMON MODE RANGE

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The APEX PB58 power booster amplifier is normally used in a composite configuration with a low power low voltage precision opamp. This method yields excellent performance, but has the following drawbacks:

- Low common mode input voltage range
- Requires separate +/-15V supplies

Add a few extra discrete components to the PB58 and a hybrid amplifier can be made that has exceptional common mode voltage range. Figure 1 shows this amplifier.

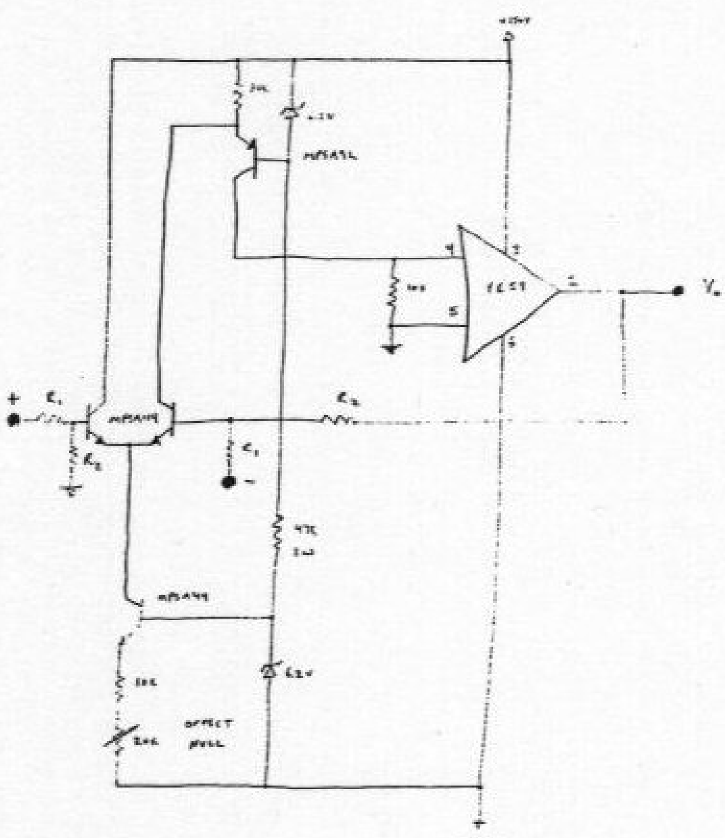

Figure 1.

Two transistors form a differential pair for the front end. The current from one of the transistors is fed through a current mirror and to the input of a PB58. The configuration acts as one big opamp, but requires no extra power supplies. The differential pair has a common mode range in this circuit of about +/-140V.

For common mode rejection, connect the amplifier as shown in Figure 2.

The gain is set by R2/R1. Not that is a gain of 10 is used, then the common mode voltage range is greater than +/-1000V. Basically, the common mode voltage range of the input is

$$\pm R2/R1 * 140V$$

However, the input impedance of this circuit is definitely finite and power dissipation must be taken into consideration.

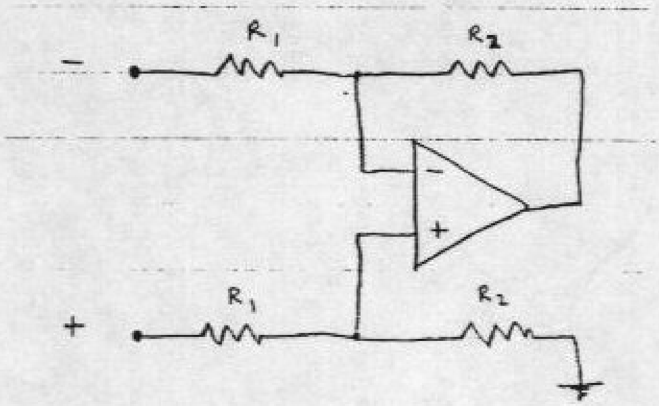

Figure 2.

DOUBLE POWER BOOSTER BANDWIDTH!

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Introduction

The typical application for the APEX PB58 power booster amplifier is in a compposite configuration with a driver opamp. This combination works extremely well for most situations. However, due to stability problems, the composite amplifier is not as fast as the PB58 alone. By adding a few simple components, a new composite amplifier can be built retaining the full bandwidth of the PB58. Similarly, by adding a transistor and a resistor, the PB58 can be turned into a voltage feedback power opamp which does not need the extra +/-15V supplies.

Standalone Opamp

By adding two external components the PB58 can be turned into an opamp. This configuration will have the following benefits:

- No need for +/-15V supplies that other drivers require.
- No need for separate driver stage.
- Higher bandwidth than when used with separate opamp.
- Acts just like a voltage mode opamp (ok for filters, integrators...).

Figure 1 shows the internal schematic of the PB58. It is normally run in a current feedback configuration. This is good for speed, but the input components of the amplifier do not address input offset and temperature compensation.

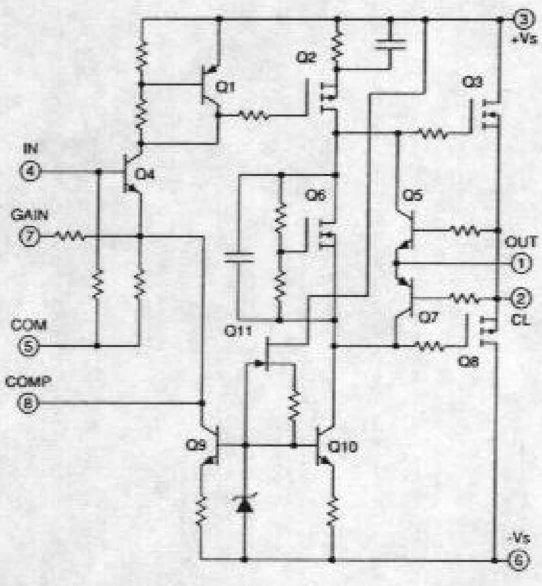

Figure 1.

By adding an external NPN transistor connected as an emitter coupled pair with Q4 (see Figure 2) we get fully differential high impedance inputs. The emitter is connected to the COMP pin. Feedback is now connected to the base of the new transistor. To bias this configuration properly, the current from Q9 must be doubled. This operates the differential pair so that when both inputs are equal, each transistor carries the same current. All of the normal Q9 bias current is needed to bias Q4 properly for best operation. It is not possible to double the Q9 current, so an external resistor is added (Rbias) from the COMP pin to -Vs. Contact APEX to find out what the Q9 current is.

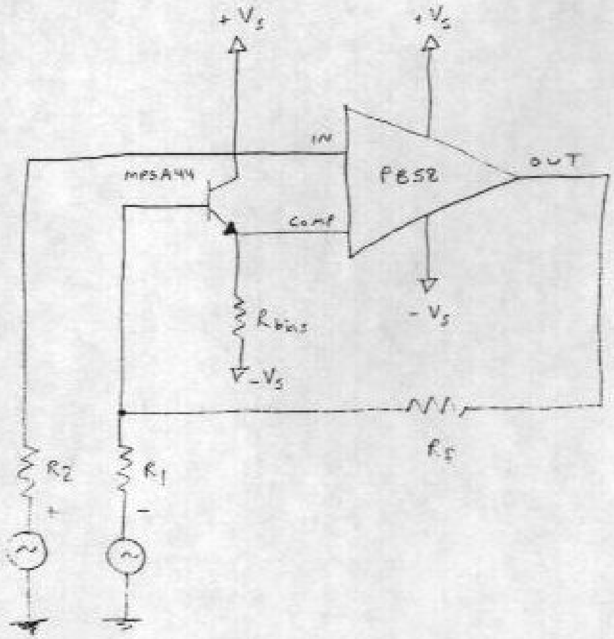

Figure 2.

This configuration works just like an ordinary opamp (Figure 3). It works fine with +/-150V supplies using an MPSA44 transistor. Power considerations must be looked at. A collector resistor may need to be added to cut transistor dissipation. Depending on the Q9 bias current ans the supplies, a larger transistor may be required.

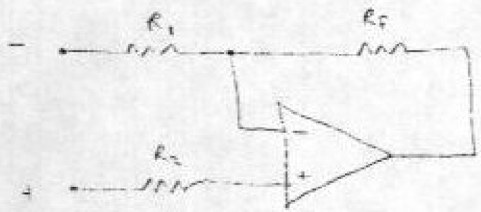

Figure 3.

This amplifier by itself can handle many situations without the need for a composite opamp configuration. It also maintains high bandwidth, especially at low gains. Stability should be inherent, and bandwidth can be rolled of with the addition of a capacitor in parallel with Rf.

Typical Application

Figure 4 shows the recommended composite application. Using a LF156 opamp, the units gain bandwidth was only 80kHz, half of what the PB58 can do by itself. This is due to stability. When using two amplifiers in one large feedback loop, it is easy to get excessive phase delays and hence oscillation. The driver stage must be slower than the output buffer stage and control the closed loop bandwidth bandwidth.

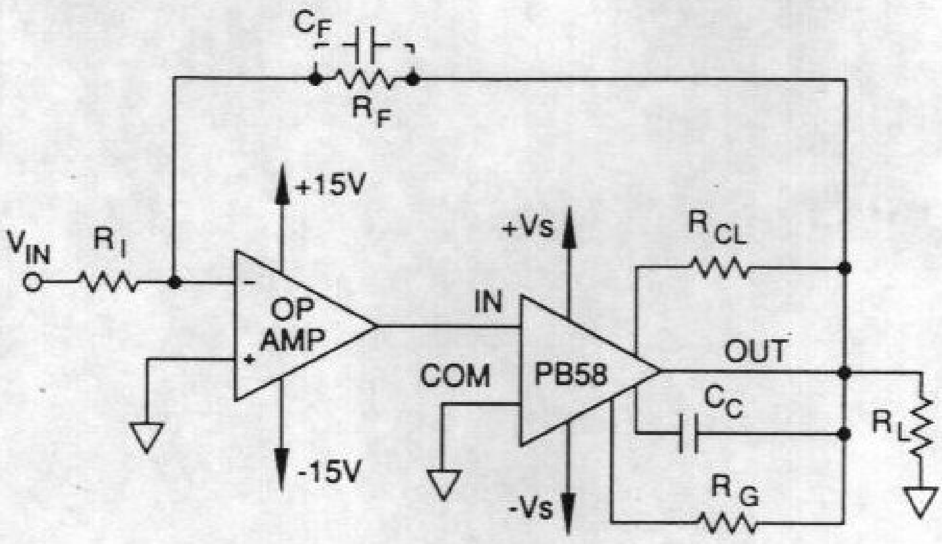

Figure 4.

Using the output amplifier we developed previously, a different composite amplifier configuration can be made which will not reduce the bandwidth. Figure 5 shows this application.

Gain is -Rf/R1. The dc stability is enhanced by the addition of a precision opamp. It senses and integrated the low frequency error at the inverting input of our output buffer. This is referenced to ground (can be any voltage set at the positive input of the precision opamp). The opamps output sets the positive input of the output buffer thereby reducing the input offset error. R3 and R4 should have the same parallel impedance as Rf and R1. R3 should be about 10 times R4. This will limit startup transients and utilize the full output swing of the precision opamp. The low frequency point is set by the integrating components of R2 and C. This should be set as low as possible depending on the application.

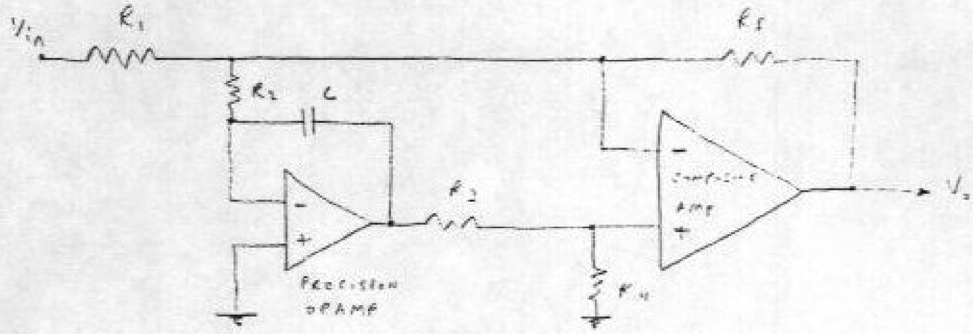

Figure 5.

Since the feedback is around only the output stage, there are no additional phase delays to worry about. This allows the overall closed loop bandwidth to remain high.

All other considerations such as output current limiting and power dissipation are treated normally.