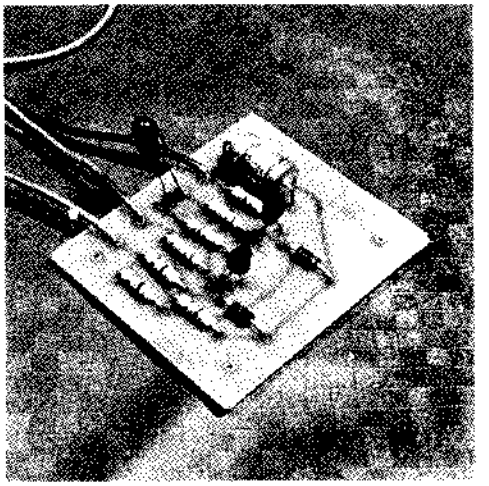
A Bilateral CLIPPING INDICATOR



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IDEALLY, WE WOULD ALL LIKE TO OPerate our stereo systems loud enough to obtain satisfyingly realistic sound levels and at the same time stay within the amplifier's power capability to avoid the extra listener's fatigue added by clipping distortion. Many amplifiers come equipped with power indicating meters but these have very limited usefulness in audio applications, due to the inability of a meter movement to follow the transient nature of music.

This article will show you how to put together a clipping indicator which will show instantly and in real-time whenever the amplifier is driven to clipping. (It is the author's experience that this type of indicator will give a very visible indication of clipping even on single-pulse high-frequency transients.) There are a couple of ways to do this. Among the simplest is with a single switching transistor connected as shown in Fig. 1.

The device works as follows: when the amplifier's output approaches the positive power-supply voltage, (clipping the waveform) the center-point of voltage-divider R1-R2 forward-biases the base of transistor Q1, turning it on and forcing current through the LED. Connecting the other end of the voltage-divider to the amplifier's negative

FIG. 1

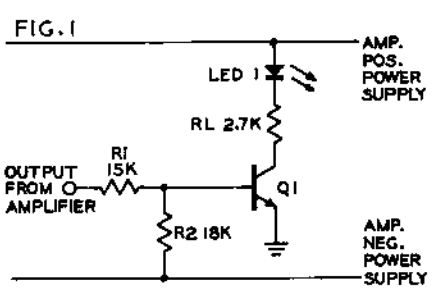
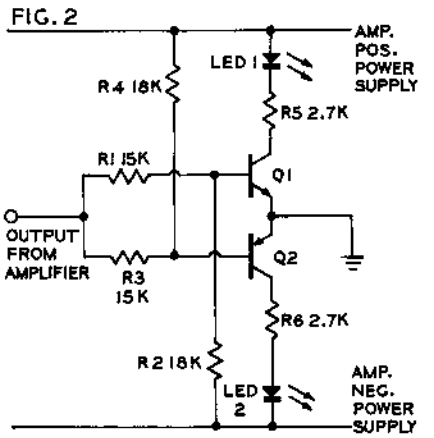


FIG. 2



power-supply provides a convenient means of establishing a specific reference for any size amplifier, large or small, as well as sensing the instantaneous value of the supply-voltage, which tends to rise and fall somewhat depending on load and power-level.

Of course, such a simple circuit costs very little, but it has at least one disadvantage; it only indicates for one polarity of clipping (positive). If musical waveforms were always symmetrical this would be of no practical consequence, but this isn't the case. Piano music, for instance can show asymmetry as high as 12dB on peaks. Thus for a "fail-safe" indicator it would be useful to have a circuit which would operate in either direction.

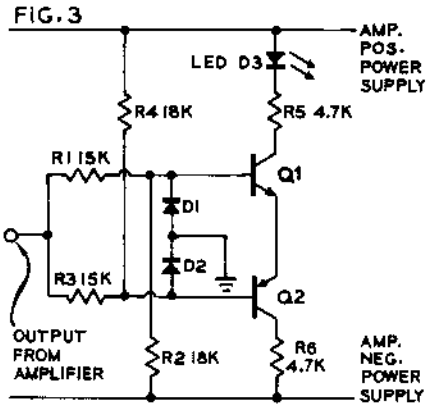
An obvious method of accomplishing this is to employ a complementary symmetry version of the circuit using a PNP transistor and another LED as shown in Fig. 2. This, of course, solves the problem of indicating either polarity of clipping, but it seems a bit redundant. For our purposes it is of interest only *when* the amplifier is overdriven. Whether it is clipping the positive or negative peak at any particular instant is unimportant.

A solution I like better is illustrated in Fig. 3. You will notice that this is quite similar to our second circuit. The only differences seem to be the inclusion of a pair of diodes between the bases of the switching transistors and the elimination of one LED. A closer examination reveals that the emitters of the two transistors are no longer tied directly to ground, so the circuit now operates a bit differently. Before, the transistors operated simply as common-emitter switches. Now, however, they function in all three modes of transistor operation:

Assume the waveform is clipping in the positive direction. At that point the voltage-divider R1-R2 places a forward bias on the base of transistor Q1 (whose emitter is indirectly grounded through D2), essentially as before. Q1 now acts as a common-emitter switch for the LED, and simultaneously as an emitter-follower to drive transistor Q2, which in turn acts as a common-base amplifier, forcing the LED drive current to flow through R6 as well. For negative polarity clipping, the circuit operates in the same manner, but with the roles of Q1-Q2 interchanged. Thus the LED sees the necessary drive current for either polarity input.

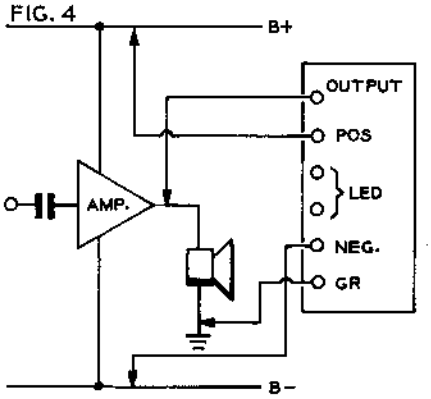
I have tried to make this circuit

FIG. 3



almost universal, and it may be used with nearly any solid-state power amplifier or amplifier section of a receiver. In some low-powered amplifiers (below 30 W/chan.), the circuit may not operate due to insufficient voltage for triggering. This can be solved by substituting a slightly lower value, say 13K, for resistors R1 + R3, and changing R5 + R6 to 2.2K. 10K 1W resistors are advised for R5 + R6 with amplifiers over 300 W/chan.

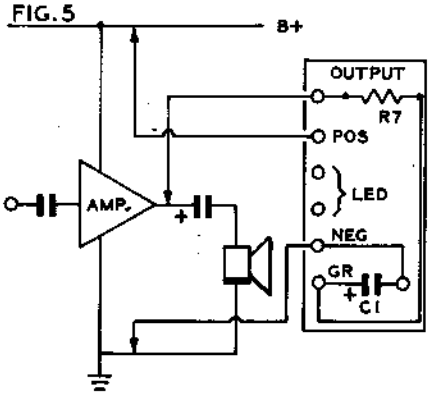
FIG. 4



For most amplifiers, the hookup diagram is shown in Fig. 4. Some amplifiers, however, have only a single-polarity power-supply, (such as the Williamson Twin 20, Dynaco's Stereo 120 and SCA80) with a blocking capacitor in series with the speaker. For these amplifiers, follow the hookup diagram in Fig.5. Note that in this case no external connection is made to the indicator's "ground" terminal, and C1 plus R7 must be installed as in schematic Fig. 6. (Do not use these 2 components on installations with amplifiers using dual-polarity power-supplies.)

The active parts are all non-critical, so long as the sustaining voltage of each transistor is higher than one side of your power-supply voltage. For power-supplies up to ±50 volts you can use 2N5210 for the NPN types and 2N5087 for the PNP. Above ±50 volts (up to +120) you can use 2N5550 and 2N5400 for the NPN and PNP transistors

FIG. 5



respectively. Virtually any LED will do, though I favor the big jumbo types, such as the Monsanto MV5050. The other diodes can be 1N4001 though any small diode will serve.

For those of you with access to circuit-board kits, I have included artwork for a circuit-board. You can also order the board, or a whole kit ready for assembly, from Old Colony Sound.

The LED may be installed remote from the board, or the board may be installed behind the front panel of your amplifier on standoffs, with the LED mounted standing up on the underside of the board and protruding through a hole in the front panel.

When you get the indicators installed, those of you with low efficiency acoustic-suspension speakers may be surprised at the low sound levels at which your amplifier clips, even with the 250+ watt-per-channel amplifiers so common today. This is most especially true with music of wide dynamic range and uncompressed peaks. For instance with the "Lincoln Mayorga & Distinguished Colleagues" series of records, a VU meter showed calibrated readings as low as 2 to 3 watts average at the same time as the clipping indicators were flashing merrily away on a 100 watt-per-channel amplifier!

Incidentally, this is one good reason why you don't often see circuits of this type offered on power-amplifiers. The manufacturers would prefer not to admit that their products can *ever* be overdriven, let alone at relatively low levels. At Bryston, we prefer to be more honest. We install clipping indicators on our power amplifiers because we feel the customer would rather listen to his system within its linear range than be "fooled" into thinking he can play it louder than his amp is capable of.

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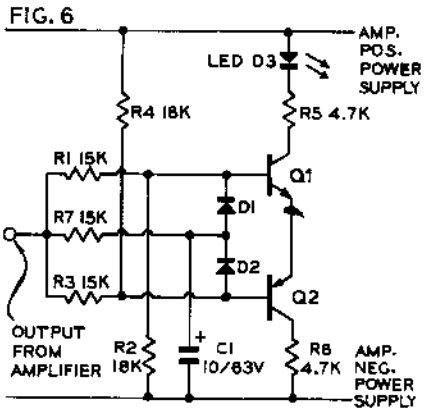
Fig. 7a, below, details the parts layout on the C1-B circuit board which is shown in full size negative form in Fig. 7b, below right.

FIG. 6



PARTS LIST:

R1, R3, R7*	-	15K ½W
R2, R4	-	18K ½W
R5, R6	-	4.7K ½W
D1, D2	-	1N4001 or equiv.
D3	-	Monsanto MV5050 or equiv.
Q1 NPN	-	2N5550 or equiv.
Q2 PNP	-	2N5400 or equiv.
C1*	-	10uF @ 63V (or higher)

* These components not used on amps with dual-polarity power-supplies.