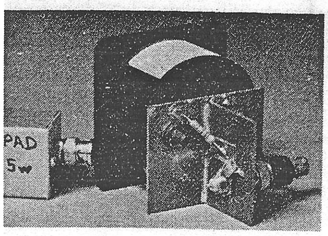
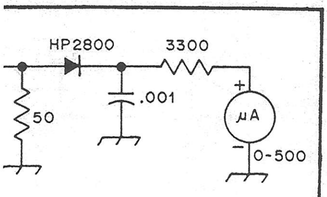


eter seen assembled on the back

cuit of an rf power meter which
on the back of a 500-μA meter.



POWER METER (+17dBm, FULL SCALE)

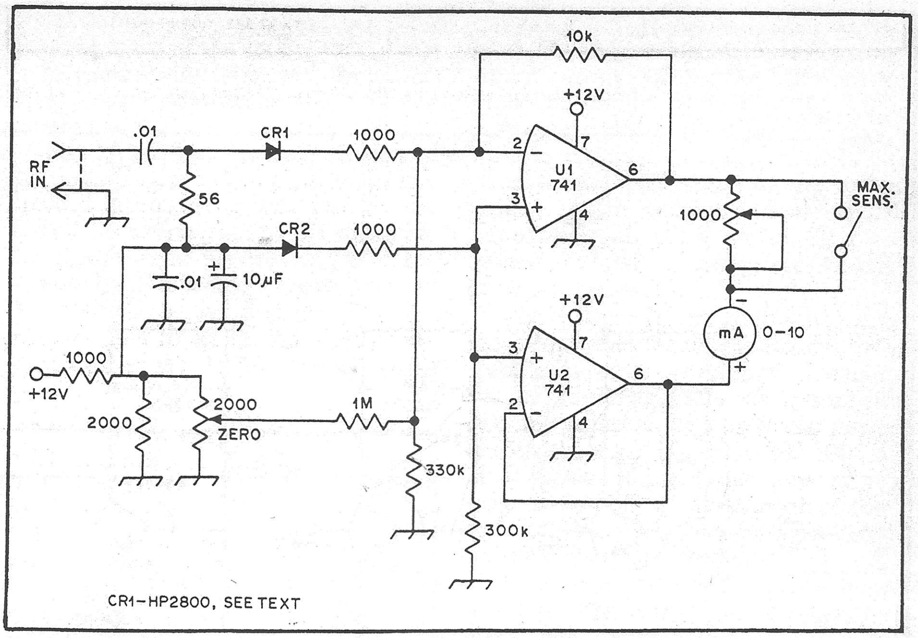
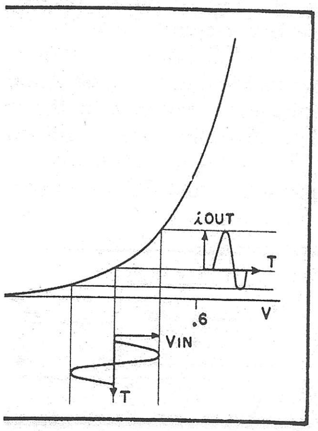


Fig. 11 – Circuit for proper biasing to obtain square-law detection.

re easily calibrated by noting
ircuit is still a peak-reading
'his allows a dc calibration to

that a power of 10 mW was
asured. This power would
to 1-volt peak across a
sistor. To calibrate the meter
V, place 1-volt dc across the
and note the meter re-
milarly, 2-volts dc would
to 40 mW. Using this
calibration curve can be
for the power meter. In the
n, such a calibration was
correspond within 1 dB of
industrial instrumentation.
sensitivity near 1 mW is
r most situations, it is often
be able to measure powers
much lower. One approach to
be to precede the diode
ith a broadband amplifier. A



ll-signal waveform applied to a
r and the resultant output.

better approach, however, is to increase the basic detector sensitivity before adding amplifiers. The simplest way to do this is by biasing the diode detector with dc.

Shown in Fig. 10 is a small-signal waveform applied to a diode detector and the resulting output. Note that an input voltage as small as that shown (about 0.1-volt peak) would produce no current in a diode with zero bias. However, when the voltage is applied to the biased diode, we see a definite current flow. The current that flows is not what we would expect if the diode were replaced with a resistor. Instead, we see that the positive-going half of the input voltage yields a much larger current flow than the negative part. The result is that if the diode current is monitored, a dc component is present. This form of detection is usually referred to as "square law" detection. The mathematics are outlined in the appendix under a discussion of distortion phenomena.

In order to achieve square-law action, a diode must be biased carefully. Specifically, it should be biased at a constant current level from a low impedance dc source. While this could be achieved with a battery and a variable resistor, a much better method is to use an operational amplifier.

Shown in Fig. 11 is a circuit to accomplish this biasing. A pair of identical diodes are used. However, only one (CR1) has rf applied. The other serves as a reference for properly biasing the detector. With this circuit, input powers as low as −26 dBm (3 microwatts) can be detected.

The calibration is straightforward. An oscillator is built to deliver about +10 dBm output. This power is easily measured with the peak detector described earlier. The oscillator output is applied to a step attenuator with up to a 40-dB range. The available output powers are now suitable for the square-law detector, and are well defined within the errors of the collection of instruments.

The diode square-law detector is quite flat from about 1 MHz up through the vhf spectrum. Either hot-carrier diodes or small-signal silicon switching diodes can be used. If better op amps were used with lower drift specification,

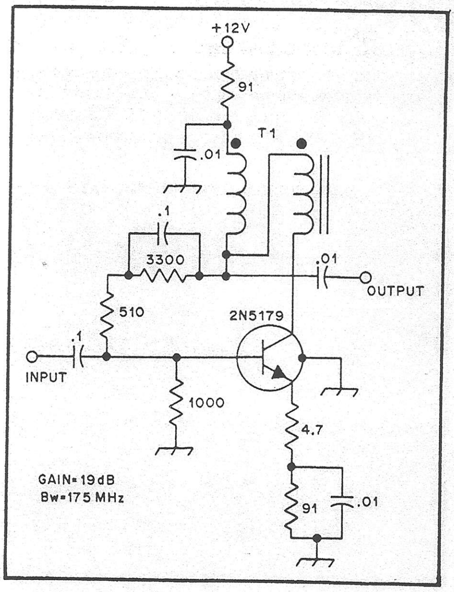


Fig. 12 – Diagram of a broadband amplifier which can be used to extend power-meter sensitivity to lower power levels. T1 contains 7 bifilar turns of enameled wire on an Amidon FT-23-43 toroid core. Circuit gain is 19 dB and the bandwidth is 175 MHz.