RADIO

REJUVENATION for the AM Detector

AM detector uses voltage-doubler action—drives audio output stage direct

By LEONARD E. GEISLER*

FOR years, radio manufacturers have been foisting the diode detector circuit (Fig. 1-a) and its low-level highly distorted audio output onto an unsuspecting public. (Don't think output is distorted? See Fig. 1-b.)

Many serious workers have explored various types of detectors, looking for one which would yield high output with low distortion. None, however, is nearly as perfect as that which we shall describe here. The use of negative feedback techniques to reduce conventional detector distortion has been described,[1] but apparently not adopted.

On the other hand, we have developed a very simple, inexpensive detection system which neatly sidesteps most, if not all, failings of the conventional detector. Using either tubes or semiconductors, this detector reproduces *all* the information on the original carrier—excepting sidebands lost during rf and if amplification—without introducing appreciable distortion of its own. (This *is not* an original circuit; it is the familiar half-wave voltage doubler.)

What it is and how it works

The circuit uses a pair of diodes—vacuum-tube or semiconductor—*wired as a simple diode integrator*. Parts used are at an absolute minimum (see Fig. 2). Values of C1 and C2 are usually 47 and 470 $\mu\mu$f, respectively. R1 may be from 250,000 ohms to 2 megohms. The output coupling capacitor can be any value from .001 through 0.1 μf to suit individual taste.

When a modulated rf wave is introduced at point A, the negative-going portion of the sine wave causes D2 to conduct and both C1 and C2 are placed in series across the input. Both capacitors are presented with the same amount of input voltage from the if transformers, but since C1 is much smaller than C2, most of the charge appears across it. As the wave falls back through zero and to its maximum positive excursion, D2 is cut off and C2 is effectively isolated from point A. D1 now conducts, discharging C1. At this time, point B has a charge of approximately $\left(\frac{C1}{C2}\right)$ V. As the wave proceeds to its maximum positive value, D1 still conducts heavily and does so until the wave, reversing, reaches the zero line once more. When the next negative-going portion arrives, D2 does not conduct until the voltage at point A exceeds the charge at point B. The voltage presented to C1 and C2 is therefore slightly less than on the first negative wave. However, the potential at point B rapidly builds up to the peak-to-peak value of the input waveform. By inserting R1 between point B and ground, the charge on C2 is bled off to produce a useful output. The additional resistor and capacitor (R2 and C3) shown between X and ground provide a takeoff point for recovery of avc bias. A useful byproduct of this R-C circuit is that it acts as a bass-boosting device at low settings of R1. If it is undesirable or sound is too high in the "off" position use a volume control near the 2-mehohm value, or replace it with a 250,000-ohm fixed resistor and put a 500,000-ohm volume control directly between amplifier grid and ground.

Due to the unbalanced manner in which the conventional diode detector loads the if transformer's secondary, the diode fails to produce undistorted af output. The diode integrator–detector, on the other hand, presents essentially a capacitive load to both the positive and the negative excursions of the rf waveform. C1 appears in parallel with the trimmer capacitor on the if transformer secondary and therefore the action of the detector has little effect on the tuned circuit. What additional capacitance there is can be trimmed out and the secondary of the if transformer is in resonance once more. Therefore, this is essentially a no-load detector. It allows maximum output voltage to be developed, something practically impossible with conventional methods of detection. Rectified rf dc voltages of 100 or more are easily obtained between point B and ground—depending on the turns ratio of the if transformer secondary. The audio "ripple" component of the dc output is very large in amplitude, often exceeding 35 volts peak to peak, more than sufficient audio drive for a conventional output tube such as the 6AQ5, 6V6, etc. Normally, diodes do not amplify, but the action of this circuit is such that amplification seems to be taking place. Actually, most of the output developed is that which is usually wasted.

FM–AM detector

By substituting an rf transistor for D1 and a 1N34-A diode for D2, this circuit becomes an excellent FM detector. See Fig. 3 for details.[2] By inserting a limiting circuit ahead of the integrator, with provisions for switching in and out, the circuit detects AM or FM "at the flick of a switch." It is not very adaptable to conventional FM reception with vacuum-tube diodes. However, as an AM detector, the vacuum-tube version is exceptionally immune to QRM—noise—and has proved to be an ideal detector for converting or repairing old communications type receivers. END

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[1]John Markus and Vin Veluff, Editors, "Stabilized Negative Impedances," *Electronics For Communication Engineers*, McGraw-Hill.

[2]P. L. Burton and F. Willis, "Unusual Transistor Circuits," *Wireless World*, March 1958.

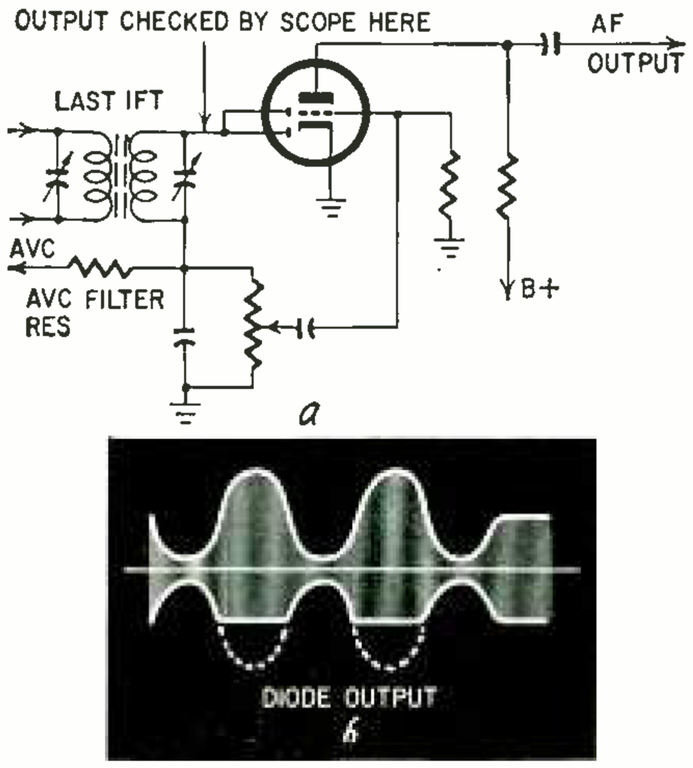

Fig. 1-a—Conventional diode detector circuit. Dc flows in if transformer's secondary, upsetting circuit Q; b—waveform showing how conventional diode conducts during more than 50% of rf cycle, generating unwanted distortion.

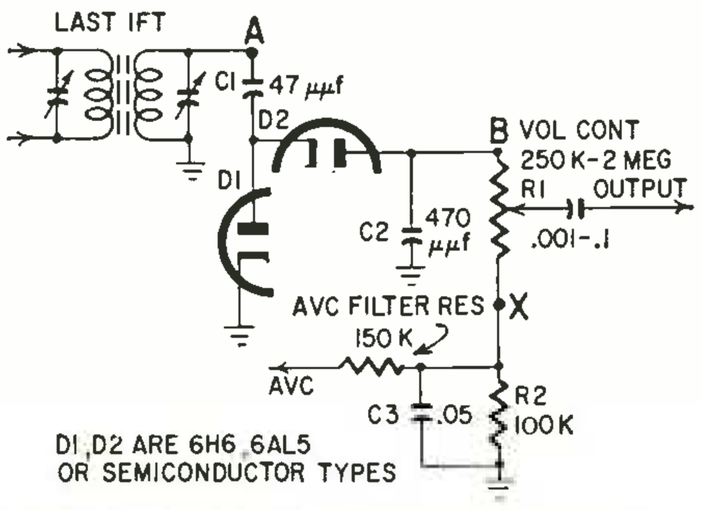

Fig. 2—Diode integrator–detector circuit. Diodes may be 6AL5, 6H6 or semiconductor units such as 1N35's.

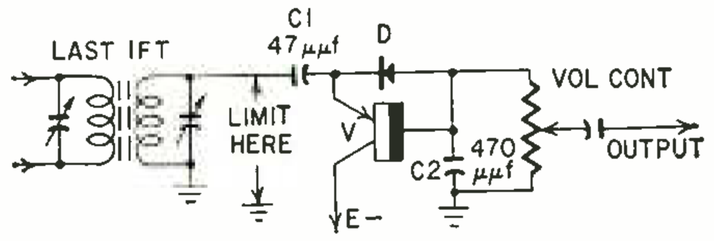

Fig. 3—FM detector version of Fig. 2 circuit. Using transistor instead of diode permits better discrimination of FM. Pair of back-to-back diodes inserted at "Limit Here" eliminates unwanted AM component from output. Switching out diode limeters converts detector back to AM operation.