Cheap Can Be Good

BUILD YOUR OWN SCOPE DISPLAY DETECTOR

$6.00 In Parts

The detector in a sweep set-up can cost you from $25 to $150, if you go into the marketplace. However, for about six dollars in parts and an hour of your own time, you can build your own and perhaps add a few wrinkles found in only the more expensive versions (if at all), thereby expanding the usefulness of your scope/sweep system.

Detectors come in two basic versions: the feed-through detector (Diagram 2) and the terminated detector (Diagram 1). Both have special features, as we shall see. The basic difference between the two is that on the terminated model there is only one input (terminated at the input with 75 ohms to ground), while on the feed-through version the termination is *removable* for device-application in numerous additional testing applications.

The basic terminated version is shown in Diagram 1. It consists of a terminating resistor, a diode and filter capacitor, and a resistor. The slightly more complicated voltage doubler approach (twin diodes) with an external (removable) terminator, *the so-called feed-through approach,* is shown in Diagram 2.

by:
Steve Richey
Richey Development Company
Oklahoma City, Oklahoma

In the feed-through version, the RF input is bridged through the termination *externally.* With the addition of the input .001 capacitor and a second diode, the unit becomes a voltage doubler, which means that you end up with approximately 3 db increased DC output level. This is handy for driving scopes where you always seem to be on the bottom *border line* of having adequate vertical sensitivity with the scope.

Note in the photo of the feed-through version that all leads internal to the detector are kept as short as practical. This is the *only* warning; otherwise, follow your common sense and good construction practices. The parts required probably are lying around your own junk box. The 1N82 (or 1N82A) diodes are the common UHF tuner-type diodes found in abundance at most TV service shops (and in UHF to VHF converters, such as the Blonder Tongue UX-3). For ease of installation, repeatable performance, and proven RF detection ability, the 1N82 family of diodes is recommended; i.e. do *not* substitute unless you *know* the substitution is guaranteed to be better for this application.

Both detectors, as shown in schematic form, provide a positive output voltage. If you need a negative output voltage, for some reason, simply reverse the polarity of the diodes.

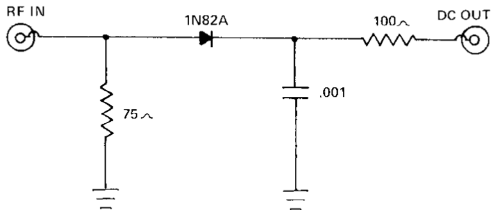


DIAGRAM 1

Detector Uses

Other than the most common use for a detector, which is as a demodulating device in a sweep set-up, many other everyday uses for the detector are possible.

For example:

(1) *Observing Video Wave Form*—Changing the .001 output (at DC) capacitor from a .001 to a 10 pF capacitor, and eliminate the 100 ohm resistor (see Diagram 3). With this simple change, the video output of a signal processor, modulator, etc. can be sampled for signs of sync clipping, modulation percentage, and other maladies;

(2) *Measuring Return Loss*—The feed-through detector can be used to measure return loss, as shown in Diagram 4. To make this measurement, insert attenuation into the variable pad box *equal to ½ of the amount of return loss you wish to verify* (i.e. if you believe the return loss to be 16 db, or that is the spec which you are going to verify, insert/switch in ½ of that value, or 8 db, of pad/loss

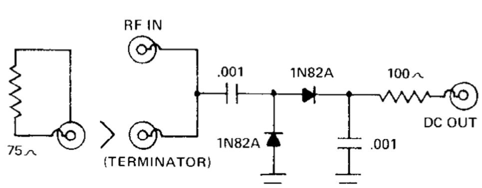
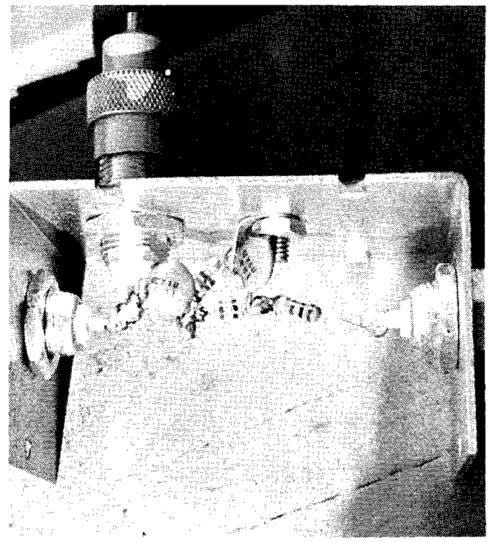


DIAGRAM 2



KEEP LEADS SHORT, especially on RF-IN end of of detector

into the pad box). Note the peak-to-valley response of the display, as a function of amplitude, on the scope display screen (i.e. make note of the upper and lower limits on the scope screen of the sine wave display).

Now take *all* of the attenuation (8 db in our example) out of the pad box *and connect the device under test* to the end of the 2 db of cable line. If the second scope display *is equal to or less* amplitude than your initial display with the pad box attenuation switched in, the return loss is 16 db (or better).

However, if the second display has a *greater* (scope screen display) amplitude than the reference display, use the variable attenuator to *switch in pad* (1 db at a time) until you *return* the display to the *original* reference level. The amount which you have to switch into the variable pad box to bring the display *back* to the *original* reference is *subtracted* from your original goal (16 db), and that is the return-loss match of the device. For example, having to switch in 2 db of pad to bring the second display to the original reference display results in 16 minus 2 db, or a 14 db return-loss match.

(3) *Checking Antennas*—By substituting your downline from the antenna (can*not* be performed on antennas *with* pre-amps) for the 2 db of cable shown in Diagram 4, the termination and basic frequency response of an antenna at the end of a downline can be checked. The procedure is *exactly* the same as with measuring return loss (number three), just given.

(4) *Cable Length To Shorts/Opens*—The length of (trunk, distribution) cable to a short or open can be calculated with a fair degree of accuracy with the *same basic set-up* outlined for measuring return loss. By connecting the (unknown) length of cable *in place of* the 2 db of cable (delay line) shown in Diagram 4, the spacing (in frequency) between successive dips on the display is a measurement of standing waves (i.e. indicating an open or shorted condition). Into your set-up *insert a variable marker* or signal generator (RCA WR99A, Mid State MC-50, Measurements 950, DBC FST-4, etc.) to indicate the exact frequency of each "dip" (see Diagram 5). If you determine that from "dip to dip" is (for example) 1.5 MHz, *the length of cable* from the point where you are plugged in, *to the short or open* can be computed as follows:

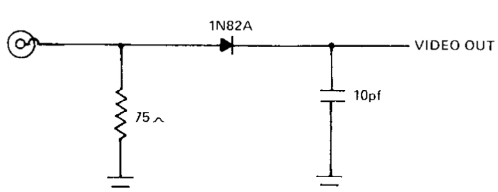


DIAGRAM 3

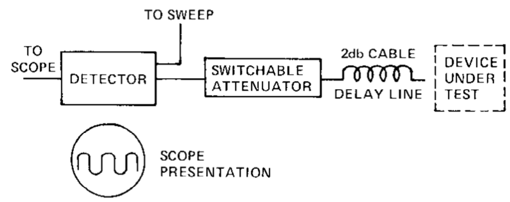


DIAGRAM 4

$$\text{Distance} = \frac{984 \times (\text{velocity of cable prop})}{2\ (\text{frequency})}$$

If we assume a cable velocity of propagation of 0.82 and we have 1.5 MHz between successive "dips," the equation works out:

$$D = \frac{984 \times .82}{2\,(1.5)} \quad \text{or} \quad \frac{806.88}{3} \quad \text{or} \quad 268.96 \text{ feet}$$

This can be a very handy tool; I have personally used it to locate a broken center conductor while installing new cable.

Good luck—*and may all of your detectors be flat ones!*

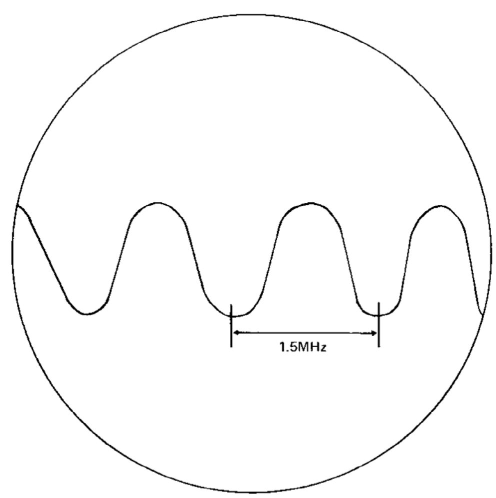


DIAGRAM 5