Schottky diode pair makes an rf detector stable

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If broadband rf detection is to be efficient at low signal levels, detection thresholds must be stable—a design goal achievable with a pair of matched Schottky diodes. The diode-stabilized circuit shown here, for instance, maintains a detection stability of ±0.06 decibel over a temperature range of -20°C to +90°C for an rf drive level that is a 10th of that of a conventional detector.

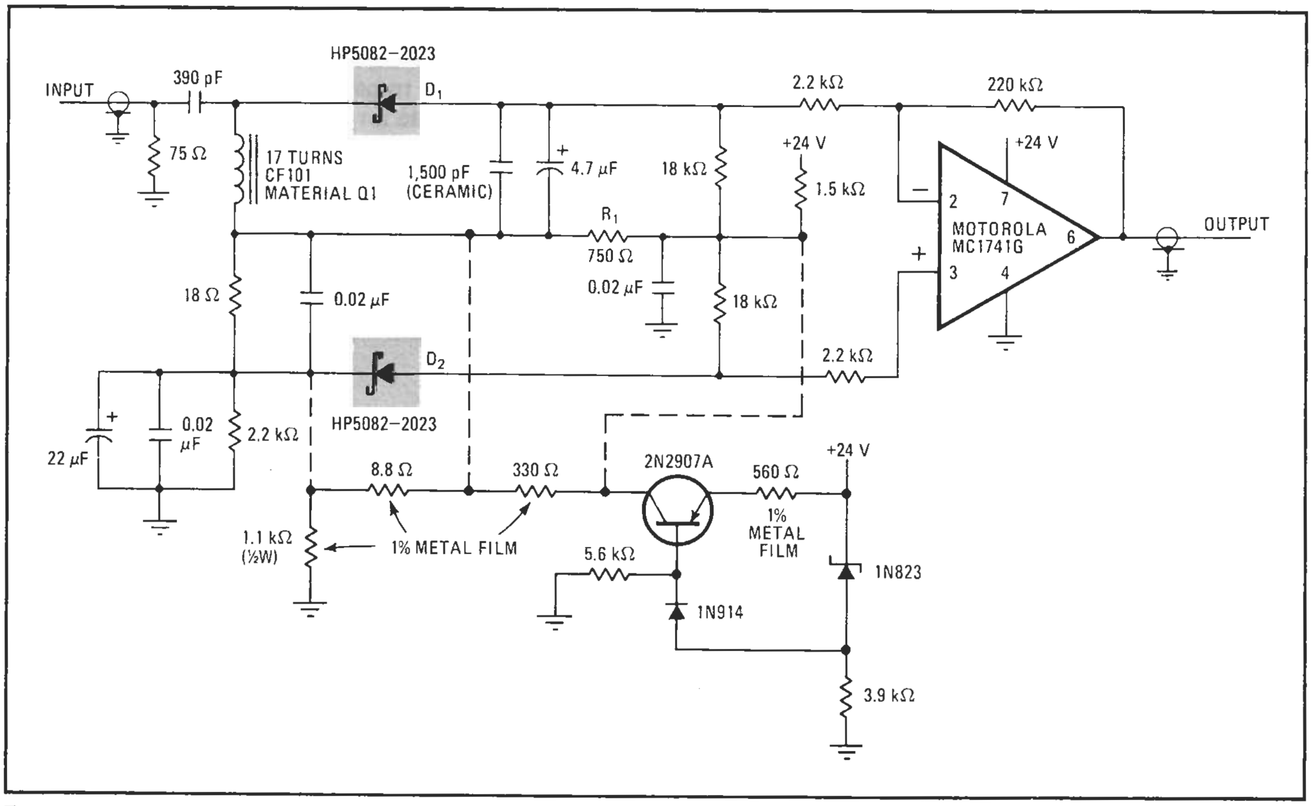
With such a circuit, the amount of rf circuitry required can be much reduced because accurate stabilized detection thresholds can be set for low rf drive levels. Also, the circuit's temperature stability and detection efficiency permit the realization of a sensitive receiver—one that can have a high video gain as well as a low rf gain.

Normally, it is hard to achieve high detection efficiency at a low rf drive level while keeping detection efficiency constant over a wide temperature range. This is because of the nature of the forward blocking voltage of a diode. For example, at room temperature, a silicon diode has a forward voltage of about 500 millivolts and a temperature coefficient of 2 mV/°C, so that the forward voltage will vary considerably—from 370 mV at 90°C to 590 mV at -20°C.

The rf drive level needed to start the detection action must exceed the diode's forward blocking voltage so that load current may flow. However, since the forward voltage changes by 220 mV from -20°C to +90°C, the rf drive level required must vary accordingly to maintain detection action. The inherent detection efficiency, therefore, is low and strongly dependent on temperature, limiting the maximum video gain that may follow the detector.

The rf detector depicted here, though, solves these problems. The two Schottky diodes, D_1 and D_2, are matched to within 5 mV from 0.1 to 0.5 milliampere and are connected in a half-wave rf detector configuration. The dc bias developed across diode D_2 and resistor R_1 serves as an arming bias for the detector diode, D_1, establishing temperature tracking between the two diodes.

The voltage drop across resistor R_1 establishes a reverse offset bias on diode D_1, in this way setting a known rf threshold that the rf drive level must exceed before detection action takes place. And the voltage drop across diode D_2 acts as a temperature-dependent forward arming bias on diode D_1. The level of this arm-



Temperature stabilized. High-efficiency rf detector operates at low input drive levels over a wide temperature range. Matched Schottky diodes (D_1 and D_2) and a fixed rf threshold bias (via resistor R_1) permit the circuit to hold voltage detection stability to ±0.06 dB from -20°C to +90°C for a 55-mV input. Sensitivity to supply-voltage changes can be minimized by adding colored network (and omitting R_1).

ing bias tracks the forward blocking voltage of diode D_1 as the temperature changes.

Because of this temperature-compensating arming bias, it is possible to realize constant detection efficiency over a wide temperature range, in addition to a constant rf threshold detection level. For a constant rf input of 55 mV, the detection voltage developed by the circuit varies only 1.8 mV between −20°C and +90°C. Rf peak voltages as large as 80 mV can be detected quite efficiently.

The operational amplifier at the output of the circuit senses the detection voltage and translates it to a 12-volt level. This output voltage varies only 2.1% from −20°C to +90°C for a constant rf input drive. Here, the op amp's gain is 40 dB, a figure that can be safely increased to 50 dB without adversely affecting the output stability of the circuit.

The circuit's performance will be further enhanced if the detector is made insensitive to variations in supply voltage. This can be done by adding a current source (shown in color in the diagram). The current source keeps the rf threshold voltage constant, despite supply variations of ±0.5 V. In connecting this source, resistor R_1 must be omitted. □