

By Keith Austermiller, KB9STR

An RF Driven On-Air Indicator

A fun and useful accessory for the shack.

Ever wish you had a way to show others around your shack that you're on the air? Commercial radio and television stations have ON AIR signs. Your amateur station should have one as well. The sign could be used to promote Amateur Radio, dress up your station or prevent interruptions while making a long CW contact.

The ideal sign should light up at the presence of RF and turn off after the transmission has ended. The sign should work without having to be connected to the station's transmitter and work on all modes, including AM, FM, SSB and CW. The circuit built to do this also needs to be sensitive enough to work with a VHF handheld transceiver yet still be able to handle a high powered HF rig. With all these things in mind, I set out to design a circuit that would be as simple as possible to build and use readily available parts.

After reading "The No Fibbin' RF Field Strength Meter" in *QST*,¹ I was convinced this was the type of circuit I was looking for. Most field strength meter circuits use a diode detector feeding a sensitive microammeter. I got out my breadboard and began experimenting with some diodes taken out of an old CB radio. I keyed my handheld transceiver and noticed a very small current reading on my multimeter. Positioning the transceiver antenna closer to the circuit brought better results; I added a transistor to the circuit to drive a relay that would ultimately switch and light a 12 V dc lamp. This worked well, as long as the transceiver antenna was close to the circuit's detector.

Trying the same experiment using my HF rig on SSB yielded poor results. Lengthening the "antenna" to the diodes and wrapping it around the rig's feed line to try to increase the amount of RF seen by the detector still worked poorly. Things didn't seem too promising until I reread that article and realized that germanium diodes were used as detectors. The diodes I had been using were silicon, and were not as suitable for use as RF detectors. I decided to make another detector circuit, this time using 1N34A germanium diodes. The only problem was that I didn't have any in my parts junk box and none of the local electronic stores had any stock either. A mail-order supplier came to the rescue, and an order was placed.

In the meantime, I decided to look for a better amplifier circuit. I needed a way to get more gain than I was realizing in my previous circuit. Luckily, I came across an experiment in the "Hands-On Radio" series in the April 2003 issue of *QST* that had a good explanation of operational amplifier circuits.³

The noninverting op-amp seemed to be perfect for my circuit. And, sure enough, a detector circuit designed around germanium diodes with an op-amp gave great results with SSB, CW and FM. The handheld transceiver now no longer had to be right next to the detector to activate it and the circuit also worked well with an HF rig.

The final circuit is shown in Figure 1. RF enters through the antenna, which can be as simple as a piece of wire. The germanium diodes D1 and D2 and capacitors C1 and C2 make up a voltage-doubling detector circuit. The output voltage from the diodes is fed to op-amp U1, an LM324. U1 needs only a single-ended power supply. R1 adjusts the amount of voltage fed to the op-amp and serves as an RF sensitivity control. Resistors R2 and R3 determine the amplifier voltage gain which, in this case, is about 50. The output from the op-amp is fed to Q1 and Q2,

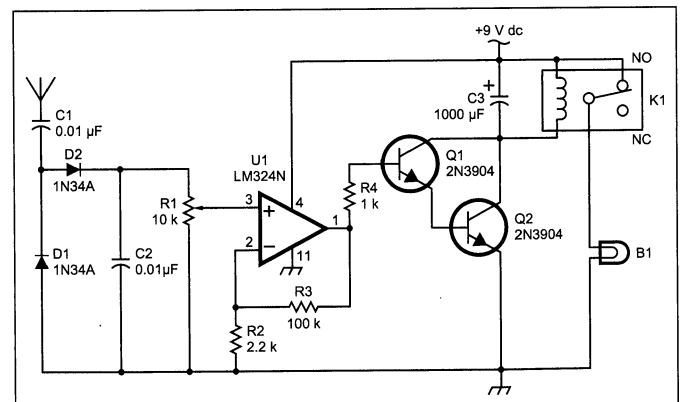


Figure 1—The schematic and parts list for the on-air indicator. (RS=RadioShack, www.radioshack.com; M=Mouser Electronics, www.mouser.com.)

C1, C2—0.01 µF capacitor (RS 272-131).

C3—1000 µF, 35 V (RS 272-1019).

D1, D2—1N34A germanium diode (M 526-1N34A) (see Note 2).

K1—SPDT relay, 12 V, 30 mA, 400 Ω coil (RS 275-248).

Q1, Q2—2N3904 transistor (RS 276-1617).

R1—10 kΩ potentiometer (RS 271-282).

R2—2200 Ω resistor (RS 271-1121).

R3—100 kΩ resistor (RS 271-1131).

R4—1000 Ω resistor (RS 271-1118).

U1—LM324N operational amplifier (RS 276-1711).

Misc

9 V dc, 1 A ac/dc adapter (RS 273-1771).

B1—Automotive side marker lamp (see text).

Wood, Lucite and plastic stock for housing (see text).

¹Notes appear on page 57.



Figure 2—The on-air sign installed in the author's shack. Note the RF sense antenna at the top left.

which are configured as a Darlington pair. The Darlington ensures that the op-amp load impedance is relatively high and also that the current gain of the relay driver is high.

When the transistor pair is driven high, Q2 allows current through its collector to energize the relay coil, switching on the incandescent lamp or lamps. I used 12 V dc automotive lamps in my circuit. A turn signal or side-marker lamp found at any auto parts store works fine. Depending on the size of the sign and how brightly you want to illuminate it, more than one incandescent lamp can be used. Additional lamps may be added in parallel to the existing lamp; just make sure the power supply can source the additional current required. A holding capacitor, C3, is used to keep the relay coil energized during SSB and CW use. Otherwise the ON AIR sign would be flashing on while you are sending code or speaking. An additional 1000 μ F capacitor can be paralleled with C3 to lengthen the hold time. To power the circuit I used a 9 V ac to dc wall adapter capable of supplying at least 1 A. You will need to ensure it can supply enough current for the number of lamps used. The entire circuit can be

easily built on a small piece of perf board.

After the circuit is completed, all that's left is to find a suitable enclosure. The enclosure needs to be able to house the circuit and make a suitable sign. A shadow box or a deep picture frame would work nicely. I came across a large digital clock that was no longer working and used it for my enclosure. A red piece of plastic, Plexiglas or Lucite may be used as a lens for the front of your sign. This will disguise the circuitry inside the sign when it lights. Find a piece of dark-colored poster board, stencil it and cut out the words "ON AIR." This will allow the light to shine only through the letters and the red lens. Figure 2 shows the sign prominently positioned in my shack.

Operation is pretty simple. First, double-check all the connections and polarity. Place the circuit's antenna near your transmitter's feed line and apply power. The sign should light when you key the transmitter on AM, FM or CW. Because it is RF driven, however, the sign will not light on SSB until you begin speaking. If the circuit doesn't detect RF at first, try moving its antenna to another location. Some adjustment of R1 may be necessary to provide enough input to the amplifier.

This is a fun project that is sure to enhance operation for you and for visitors to the station. It's a good RF indicator for the transmitter and it adds a personal touch that's sure to illuminate your shack.

Notes

¹J. D. Noakes, VE7NI, "The No Fibbin' RF Field Strength Meter," *QST*, Aug 2002, pp 28-29.

²The 1N34A diode is available from several sources including: Mouser Electronics, 1000 N Main, Mansfield, TX 76063; 800-346-6873; www.mouser.com, Ocean State Electronics, PO Box 1458, 6 Industrial Dr, Westerly, RI 02891; 800-866-6626; www.oselectronics.com, Circuit Specialists, 220 S Country Club Dr #2, Mesa, AZ 85210; 800-528-1417; www.circuitspecialists.com.

³H. Ward Silver, NØAX, "Hands-On Radio, Experiment #3—Basic Operational Amplifiers," *QST*, Apr 2003, pp 63-64.

Keith Austermiller, KB9STR, was first licensed in 1998 and received his Extra Class license and an FCC General Radiotelephone license in 2000. Keith develops software for cellular phones, pagers and PDA devices. Ham radio is in the family; his dad is KB9STQ. Keith has an Associate's degree in electronics from Indiana Vocational Technical College. You can reach him at 141 Lewis Dr, Mooresville, IN 46158; kb9str@arri.net. 