announcing

"OPERATION CRYSTAL"

a challenge to all radio amateurs

Your solution to this problem will prepare your family and your community for emergencies

OLD-TIMER AND NOVICE ALIKE CAN MAKE A VALUABLE CONTRIBUTION TO THE PUBLIC WELFARE IN "OPERATION CRYSTAL"

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Your car radio soon goes dead after you run out of gas . . . but the disaster goes on, gets worse . . . two days, three days . . . no trains, no trucks, no food . . . you recall how easy it was to get information with radio, newspaper and telephone . . .

The third day your neighbor’s portable radio goes dead . . . the storekeeper laughs when you mention batteries . . . you remember how fresh milk used to taste . . . and you say you’ll never eat cold canned food again, if you get out of this . . .

*If* you get out . . . but you can’t get out without information! Is help on the way? Or are worse disaster areas taking up all the relief? Should you start hiking? Which way? North? South? East? West? Will there be more bombs? More hurricanes? Where will they hit? And when?

Still no radio, no newspapers, no telephone . . . just rumors—wild, contradictory rumors that may lead you the wrong way . . . one neighbor says flee . . . another says stay.

Superhuman effort has kept one broadcasting station on the air, perhaps on the Crystal frequency. But you can’t hear the official reports and advice without power or batteries.

What is the answer? You, the radio amateur have the answer—right in your junk box. You guessed it. A crystal diode detector.

There are probably as many ways to hook up a powerless diode detector in an emergency as there are amateurs. What works best on the broadcast band in your locality?

G-E HAM NEWS will award $10 tube certificates for the three most outstanding emergency crystal diode designs submitted for publication for each issue during 1955. In addition, we will award copies of our first *Bound Volumes* (plus a complete set of subsequent issues) and one-year subscriptions to G-E HAM NEWS for other designs accepted for publication. Be sure to include in your contribution some notes on local receiving conditions. DO NOT SEND IN YOUR MODEL. All material submitted becomes the property of G-E HAM NEWS.
During a recent hurricane, our editor was visiting New Jersey. Although the storm merely piled the community, 25,000 homes were without power for the entire week-end.

Fretting because he couldn't turn on the BC set to learn about progress of the storm, it occurred to W2ZBY that every home ought to be equipped with a crystal detector for emergency purposes—and, furthermore, that the neighborhood ham is the logical person to show folks how to provide themselves with each on affair.

Impressed with the endless variety of crystal set designs possible with modern components, we decided to ask you fellows to help. Receiving conditions vary almost from house to house—depending on signal strength of local broadcasting stations, available space for antennas, the character of grounds, and so on. Old timers' experience should enable them to make significant contributions to this emergency and civil defense need. But that's not to say novices can't do just as well or better. And, incidentally, what better way is there for a novice to get some basic practical experience with tuned circuits? Let's have your contributions, fellows.

—Eighteenth Murray

The basic component in a simple radio detector is a rectifier to pick up the audio envelope from the incoming RF signal. In the early days of crystal sets, a small chunk of the mineral galena was found to be a pretty "hot" rectifier. The rectified signal was then taken off the piece of galena with a very fine wire called the "cat whisker."

The big trick was to find a good "sensitive" spot on the galena. This inconvenience is eliminated today by germanium diodes which can be purchased at almost any hardware store. Thus the germanium diode—often called a crystal diode—looks like a good set for simple diode detector service.

We might be worth mentioning at the outset that a poor connection caused by rust or corrosion of some other kind can serve the same rectifying purpose. The rust, or corrosion creates a "semi-conductor"—passing RF current in one direction. Each one in a while one finds an audio-amplifier system attached to the corroded metal—like, for instance, a baffle of proper dimensions with rusty pipes—and sad to relate, we actually have a "ringer burble." This phenomenon is, of course, the basis for the oft-used tales in ham circles about the old lady next door complaining she can hear your voice CQ'ing in the light in her yard or booming out of the drain pipe in her back.

A fellow located close enough to a high power broadcast station can pick up the local program by putting on a pair of headphones and touching the pink tips to his water pipes, a window screen or his bed springs.

A slightly more complicated—yet very un-electronic—type of rectifier can be made with a pair of razor blades, a bar of soap, and a needle. Another version—reported from Alaska—is a "razor blade"—and a safety pin used as a "cat whisker."

However, for more reliable performance, we suggest the crystal diode. And this can be hooked up in a variety of ways. Perhaps the simplest again suitable only to strong signal areas—is illustrated in Figure 1.

Here a piece of wire for an antenna is connected to one side of the diode, the other side of the diode to the earphones—which are by-passed by C—and the other side of the earphones to ground. The efficiency of the antenna and grid required will vary with local conditions—depending principally on the strength of the incoming signal.

However, while you get farther away from the broadcast transmitter, you find the need for more over-all efficiency. Here, ground mistakes can frequently mean the same thing. Thus the next step is to employ a tuned circuit, as in Figure 4. In this circuit, D and C are tuned to the frequency of the station desired—and it still must be proper selection with the other components.

From this point on the experimenter can branch out into countless forms of antennas, grounds, and tuned circuits.

For instance, Don Nograd, W2JKH—designer of the Signal Filter, the SBF Jr., and other pieces of somewhat more complicated gear that have been described in past years of G-E HAM NEWS—reports considerable success many years ago with an arrangement like that shown in Figure 3.
The accompanying chart shows inductance of coils wound one-turn-per-inch. To find the inductance of a multturn coil of the same dimensions, use

\[ L = \frac{L_1}{N^2} \]

where \( L \) is the unknown inductance and \( N \) is the turns-per-inch of the coil in question. [Note: \( W \) is the total number of turns on the coil!]

Example: You have a 2.5-in. core coil 3 inches long and 1.5 inches in diameter and wish to know the inductance. The turns-per-turn, \( N \), is 25, and from the chart the minimum is 0.014. Subtracting in the above,

\[ L = \frac{L_1}{N^2} = \frac{0.014}{25^2} = 0.014 \times 625 = 0.086 \mu \text{H} \]

Similarly, to find the number of turns necessary to arrive at a desired inductance with a coil of specified length and diameter, use

\[ N = \sqrt{\frac{L_1}{L}} \]

Example: You have a 0.1-inch diameter, 2.5-inch coil 2 inches long and want to know how many turns are required to obtain an inductance of 0.01 micromho. From the chart, \( L = 0.02 \mu \text{H} 

Example: You have a ribbed coil 2.5 inches in diameter which coil has 7 turns-per-inch, and you want to wind a coil with 20 turns-per-inch. Subtracting in the above formula,

\[ L = \frac{L_1}{N^2} = \frac{0.014}{25^2} = 0.014 \times 625 = 0.086 \mu \text{H} \]

On the chart follow the 0.2 horizontal line over to where it intersects the 2.5-inch diameter curve. From the chart and down to the vertical axis read the length of winding required—this time, 3 inches. This chart is prepared from data furnished by the Crouse-Hinds Division, General Electric Company. In the case of parallel inductors, the above would hold only for the total length of the wires. For a turns-per-inch, the above would hold well only for short turns, say 3 or 4 turns. In the case of parallel inductors, the above would hold only for the total length of the wires. For a turns-per-inch, the above would hold well only for short turns, say 3 or 4 turns.
This simple crystal set was built and used in Texas—
and it brought in KDKA from Pittsburgh, WFA from Los Angeles, and many stations in between. Let's take a closer look at it.

In the first place, the antenna was about 180 feet long. It was 30 feet above ground level—exactly the height that a radio was in the house.

In the second place, the antenna itself was a simple affair to tune as today's BC set was to tune with its tuning knob—but much more efficient. Both the series-tuned circuit of L and C, and the parallel-tuned circuit of L and C, must be tuned to the desired frequency, and the coupling between the coils must be perfect. Varying this coupling can change the tuning of the resonant circuits, of course, and this is what complicates matters a bit in tuning such an arrangement.

To return, for a moment, to the subjects of grounds and antennas. The average home contains quite a few possibilities. Another G-R ham—Bill Coffey, W3ZIH—found a few loops of wire strung around a window frame pretty effective. Another GM here—who in this instance prefers to remain unnamed—suggested that as long as the telephone wires weren't working and it was a real doozy emergency the telephone wire would make a nice antenna. He also commented that your body—floating with RF of undetermined phase—often does quite well as a fly-hook.

Another G-R ham found the best ground at his home is the kitchen sink drain pipe. The sink empties into a deep well through a forty-foot 3-inch pipe buried about two feet underground. For some reason this pipe surpasses the well, the water pipes and the drain to the septic tank.

**How about components?**

Figure 4 shows a fairly efficient little BC receiver made by W3ZHY with the relatively new "loopstick"...

![Fig. 4](image)

**Type antenna.** (The circuit is the same as Figure 2.) The broadcast band can be tuned by sliding the ferrite ring in and out. Although the slug in this particular loopstick is designed to be cemented permanently in place, a simple method of arranging for tuning is to use a ferrite ring with an arm cut away, and then cement a soft rubber washer into the top end of the loopstick coil. This acts as a fiction-type holder for the rematch coil. The coil is tuned with a 200 microfarad ceramic capacitor. A mini trimmer could be used to band-set the receiver with a variety of antennas.

The phone tips are held by clips pulled from an old tube socket. One clip is soldered to one of the loopstick terminals; the other is forced in between the loopstick coil and a paper-wound radiator coil as shown in Figure 4.

The single earphone is illustrated in an inexpensive 1-1000 earphone outlet purchased from Allied Radio in Chicago. The entire receiver can be housed in the cardboard box the loopstick came in; a pill box or any other convenient nonmetallic container.

A 3-volt battery—worked out of AN 65— is shown in Figure 5. This employs the common coil and microfarad capacitor provides additional coupling. Other arrangements may work better in other locations.

We're thought of installing a diode detector in an empty "can" on one side of a bobed set, in a box, and in an empty wristwatch case—comic strip style. Any more ideas?
SWEEPING THE SPECTRUM

It never fails to happen! Just when you want every- thing working in apple-pie order, things start going haywire. Our editor reports the case. He recently planned to entertain VE3EDY at his shack. Earlier that day he threw the switch on his SSB rig—and nothing! No output from his Model 104A exciter. After a lot of hit-and-trial, gnashing, and so on he gave up and hauled the entire rig to VE3UJ's lab.

W3UJ turned the rig on and off and behold it worked fine. They went through it with a fine-tooth comb and found nothing wrong. Back to W3ZBY again, and it still worked fine. The only explanation any of us have been able to offer is that bouncing it over the rocky road from Boston to the G.E. Research Laboratory shook out a gremlin or two.

However, the real hucker is that 75 turned out to be so skittish that night the boys considered themselves lucky to make the one QSO they did—W2/G in Kansas.

We admit that with all the precision test equip- ment available to us in these parts, one of our own mainte- nance techs can go thoroughly after checking power lines, components, and connections—it is a healthy, walking with a baseball bat. This disclaimer is added in view of the fact that we have often times heard of and often face intermittent shorts and open connections. But, alas, the cure is not permanent.

One of our G.E. hams—W3FIV—had a hand in developing Alkane, the new wire insulation you may have heard about. Alkane can be used safely at much higher temperatures than even G.E.'s famous Fluon.*

In experiments, Alkane has been baked for six months at 100 degrees F. with no signs of deterioration or loss of insulating strength.

The pulling, bending and shearing of wire during con- struction of transmitters and motors and winding coils quite a severe strain on the insulating material. And as you know, proper operation demands that the insula- tion not be broken. In experiments with Alkane, the coated wire has been pounded flat without breaking the insulating film.

The lines which out so long ago sharply separated the SSB ops from the AM best are getting pretty blurred three days. Our mail and reports on the sales of commercially-made SSB equipment tell us that SSB now is considered a "normal" means of communi- cation by the ham fraternity generally. Our editor confirms this too, because he operates SSB and tells me the phrase "I just got on SSB" is cropping up pretty regularly in the regular tables.

The editor also reports that the boys are using about every tube in the book for linear amplifiers. That reminds us that until a very short time ago we were continually flooded with requests for linear operating data on various tubes. These requests have dwindled to a mere trickle. And that, we feel, is a healthy sign.

In true amateur spirit, the boys are trying all kinds of tubes with all kinds of circuits.

Time was when our Power Packer and Lazy Liner were standards (and we still think the EA1A is hard to beat for hams-per-dollar)! In fact, not long ago we at G.E. estimated a pretty large percentage of amateur SSB operations. Now, with the indices of hundred's more SSB stations—thousands for all— expect to take pride in the fact we have been relegated to a pretty tiny percentage of the SSB world. But to those in G.E. FAST NEWS who helped make SSB practical for the average ham.

We still harbor any articles on SSB equipment. But we are quite frank to admit that a greater amount of valuable space is being done by the individual hams themselves. In short, we succumb to the force of numbers.

Here at G.E. we say "Progress is our most important product." And we are humbly appreciative of the fact that we have had the advantage to promote amateur progress by disseminating in SSB.

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The Rochester, N.Y., Amateur Radio Association has set up "Operation Aid"—a tracer committee dedicated to helping the disabled, sick or hospitalized ham get on the air. They receive any ham—new G.E. member or not—reports the club bulletin, RARA Reg.

RARA Reg. also say: "One hand in pocket, no get shucker."
A new G-E been tested miniature of possible interest to amateurs in 110-volt plate voltage applications is the 6CA5. Designed primarily for use in audio-frequency power output stages, the tube features high power sensitivity at relatively low plate and screen voltages. Maximum plate dissipation is 7 watts.

**GENERAL**
- Heater Voltage, AC or DC: 6.3 Volts
- Heater Current: 1.2 Amp
- Direct Interectedode Capacitance (approx.)
  - Grid 1 to Plate: 0.3 μf
  - Input: 16 μf
  - Output: 9 μf

**MAXIMUM RATINGS—DESIGN CENTER VALUES**
- Plate Voltage: 120 Volts
- Screen Voltage: 120 Volts
- Positive DC Grid 1 Voltage: 8 Volts
- Plate Dissipation: 3.0 Watts
- Tube Dissipation: 1.4 Watts
- Heater-Cathode Voltage: 100 Volts
- Heater Positive with Respect to Cathode DC Component: 200 Volts
- Total DC and Peak: 300 Volts
- Grid 1 Circuit Resistance: 500 kΩ
- With Grid 1 at Peak: 2.5 MΩ
- With Cathode Bias: 2.5 MΩ
- Bulb Temperature at Hottest Point: 180°C

**TYPICAL OPERATION—CLASS A**
- Plate Voltage: 110—125 Volts
- Screen Voltage: 110—125 Volts
- Grid 1 Voltage: 4.0—4.5 Volts
- Peak AF Grid 1 Voltage: 4.0—4.5 Volts
- Plate Resistance (approx.): 10,000 Ohms
- Transformer (approx.): 8100
- 9000 μhms
- Zero-Signal Plate Current: 33 mA
- Max. Signal Plate Current: 33 mA
- Zero-Signal Screen Current: 3.5 mA
- Max. Signal Screen Current: 3.5 mA
- Load Resistance: 750
- Total Harmonic Distortion (approx.): 5
- 6 Percent
- Max.—Sign. Power Output: 1.1—1.5 Watts

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