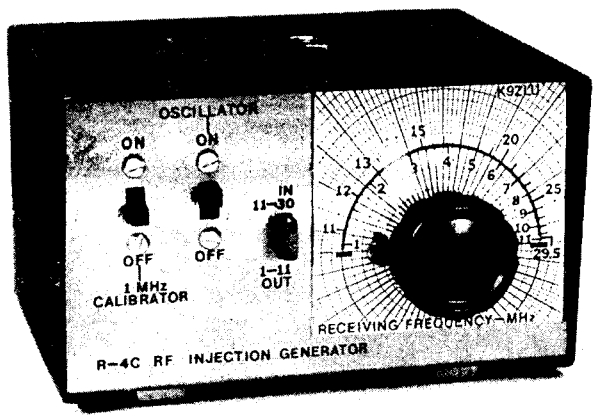
General-Coverage Reception with the Drake R-4C Receiver



With this low-cost adapter, you now can enjoy the full capabilities of the R-4C. The basic idea is adaptable to other such receiver types as well.

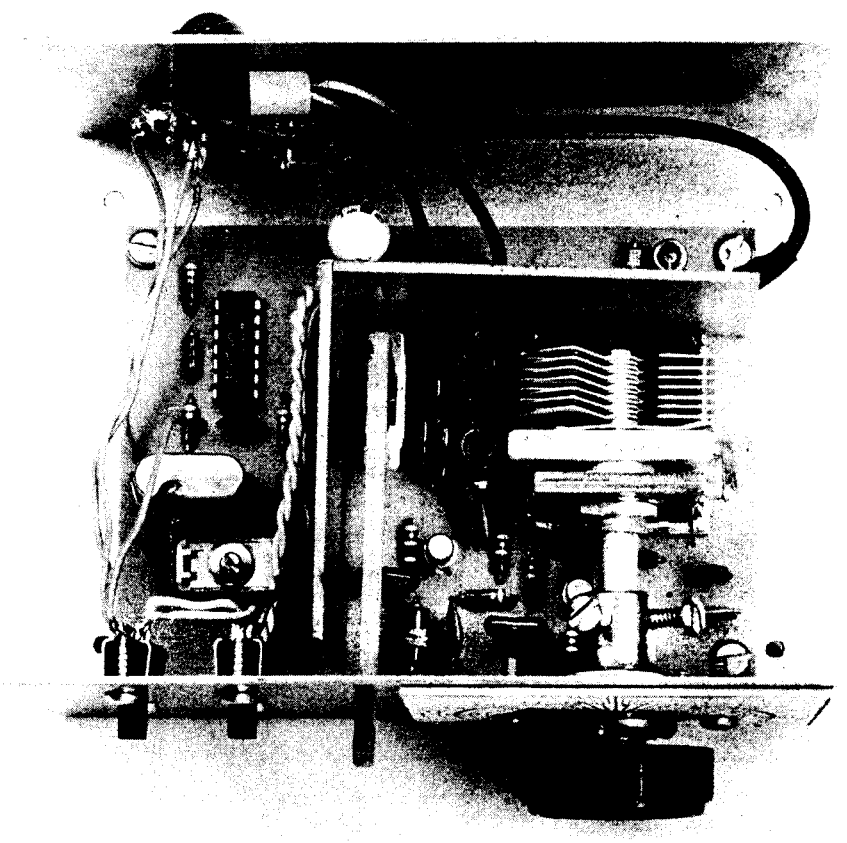
By Robert H. Luetzow,* K9ZLU

This rf injection generator is designed as a general coverage receiving adapter for use with the Drake R-4C receiver and may also be used with the R-4B series. The output of the generator is connected to an unused auxiliary crystal socket at the rear of the receiver chassis and provides the rf voltage required to permit reception on frequencies between 1.5 and 30 MHz. Operation between 5 and 6 MHz is *not* recommended because of the i-f arrangement of the receiver. If all new parts are used for construction of the unit, the total cost of this project should not exceed $40. The basic design may be altered as required to be used with other types of receivers.

The Circuit

An injection frequency between 12.6 and 40.6 MHz with an amplitude of approximately 1.3 volts is required at the auxiliary crystal socket. Injection frequencies needed for specific receiving frequencies are shown in Table 2-1 of the R-4C manual, and the preselector settings may be found in Fig. 3-2.

The generator circuitry is shown in Fig. 1. It consists of a band-switched, grounded-drain Colpitts oscillator coupled to a source follower to provide isolation from the R-4C. Band switch S1 selects coils L1 and L2 for oscillator fre-



The crystal calibrator may be seen at the left of the photo, with the power supply components arranged along the top of the pc board. Phono jacks, mounted on the rear panel, are used for the antenna input/output and rf output connections. The supply voltage lines and ground strap pass through a grommet and are secured by a cable clamp attached to the rear panel.

*1327 Grayston Ave., Huntington, IN 46750

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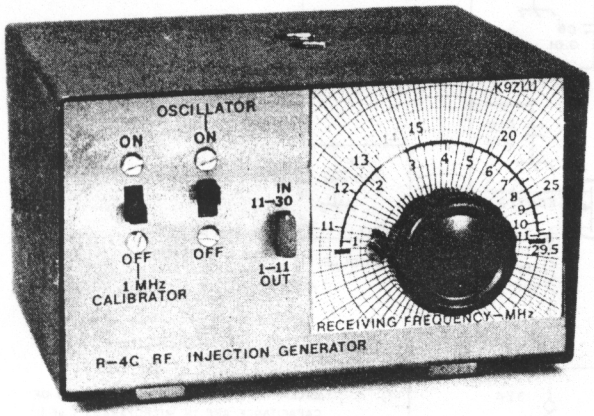

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The Circuit

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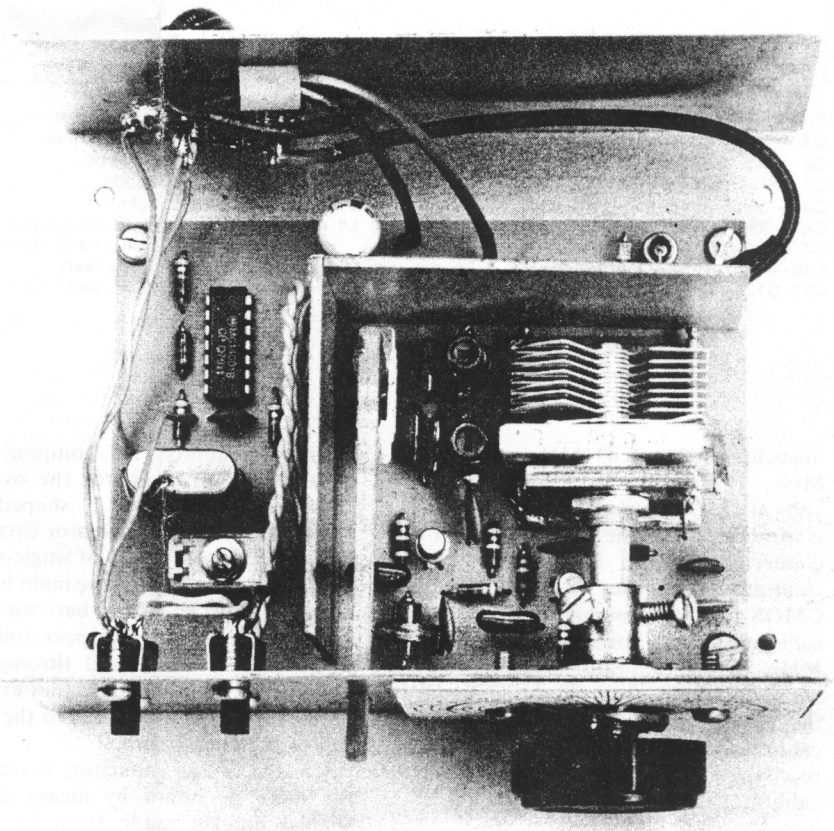

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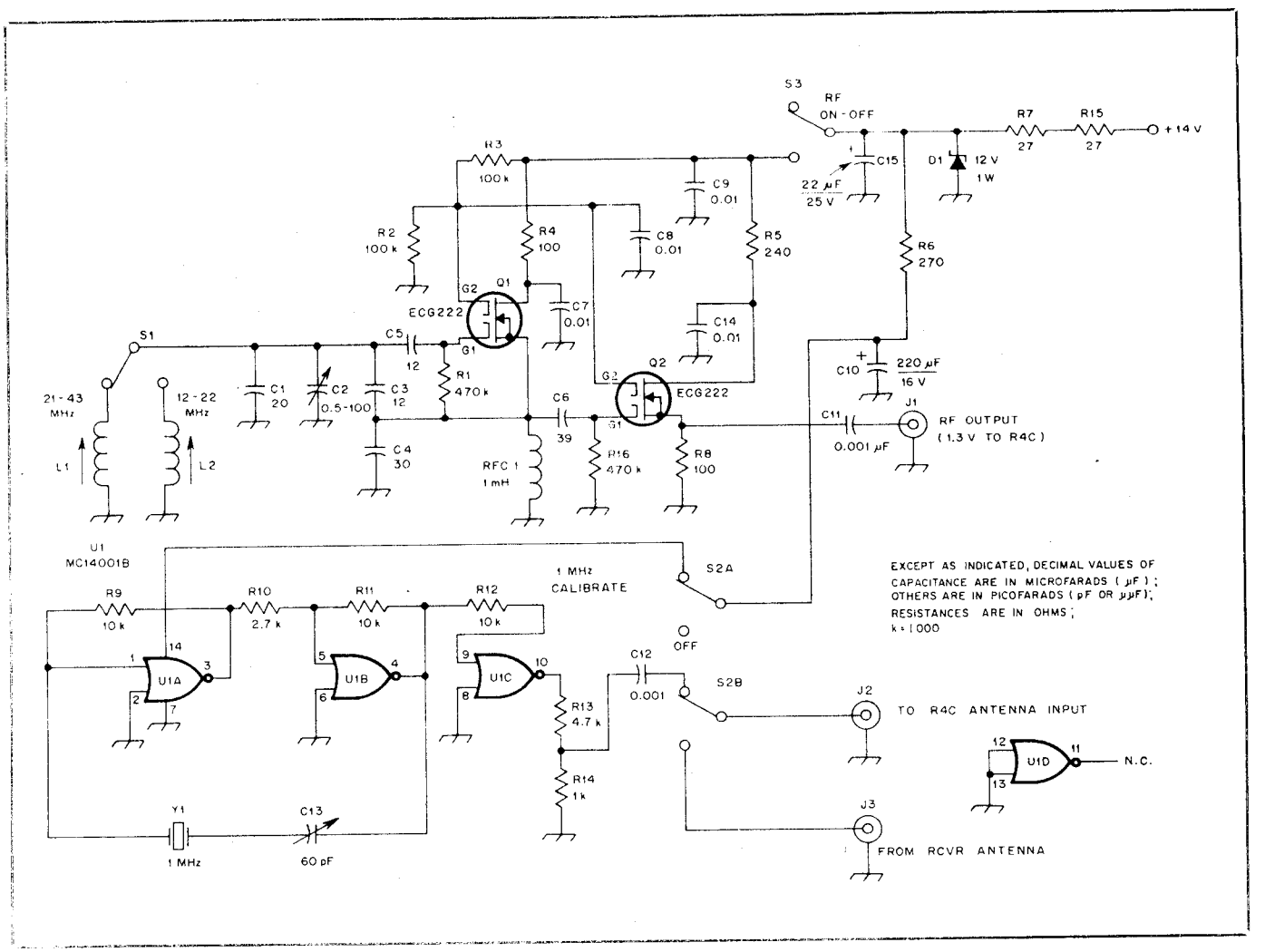

Fig. 1 — Schematic diagram of the rf injection generator. All resistors are 1/4-watt types, 10% tolerance.
C1 — 20 pF silver mica, 100 V.
C2 — 0.5-100 pF air variable.
C3, C5 — 12 pF silver mica, 100 V.
C4 — 30 pF silver mica, 100 V.
C6 — 39 pF silver mica, 100 V.
C7, C8, C9, C14 — 0.01 μF disc ceramic, 50 V.
C10 — 220 μF, 16-V electrolytic.
C11, C12 — 0.001 μF disc ceramic, 50 V.
C13 — 60 pF compression trimmer.
C15 — 22 μF, 25-V electrolytic.
D1 — 12-V, 1-W Zener diode.
J1-J3, incl. — Phono jacks.
L1 — Adjustable 0.5-0.7 μH, slug-tuned phenolic form, pc mount, 1/4-in. (6 mm) dia, 7 turns no. 24 enam. (see text).
L2 — Adjustable 1.5-2.6 μH, same form as L1, 12 turns no. 24 enam.
Q1, Q2 — N-channel, dual-gate MOSFET, 12,000 μmhos, ECG222 or equivalent.
S1 — Spdt slide switch (see text).
S2 — Dpdt slide switch.
S3 — Spdt slide switch.
U1 — Quad NOR gate, MC14001B or equivalent.
Y1 — 1-MHz crystal, HC-6/U holder.

quencies of 21 to 43 MHz or 12 to 22 MHz, respectively. Approximately 1.6 volts at 12.6 MHz and 1.3 volts at 40 MHz is available from the generator when it is connected to the receiver. A crystal calibrator (U1) uses a quad NOR gate CMOS IC to generate a good, clean calibration signal for use between 1 and 30 MHz. S2, the calibrator ON/OFF switch, is wired to supply the calibrating signal to the R-4C antenna circuit when the calibrator is turned on, and connect the receiving antenna to the circuit when the calibrator is off.

Generator Construction

The most stringent construction requirement of the generator is the mechanical rigidity required to secure oscillator stability. All components are mounted on a pc board; the overlay is shown in Fig. 2. An L shaped shield encloses the tunable generator circuitry. It is fashioned from pieces of single-sided pc board and connected to the main board by means of short lengths of bare wire. These wires (soldered to the copper foil of the shield pieces) are passed through small holes in the main pc board (not evident in the pc layout) and soldered to the ground foil of the main board.

C2, the tuning capacitor, is secured to the main pc board by means of an L shaped bracket made from sandwiched pieces of circuit board material. This bracket is mounted so it will align the tuning capacitor shaft with the vernier dial mechanism mounted on the front panel. The vernier mechanism was removed from a readily available 8:1 reduction drive dial assembly (Calectro E2-744).† A piece of clear plastic, salvaged from an electronic parts package, is used as dial pointer. If the construction described is followed closely, the dial layout shown in Fig. 3 can be used. Any change in parts values in the VFO circuitry will cause a corresponding change in the tuning dial layout. The markings are used only to locate the correct calibration signal. If you wish to make your own dial layout, do so only after the generator has been completed and installed in the cabinet *with the cover*

†[Editor's Note: Various types of reduction drives are available from Radiokit, Box 411, Greenville, NH 03048.]

in place. A shadow front 3 × 5 × 4-inch (76 × 127 × 102-mm) metal box (Calectro H4-746) was used for the unit shown in the photographs.

The band switch is made from a slide switch (mounted on the main pc board) that has a piece of unclad circuit board material notched to fit the switch actuator and epoxied to it. This arrangement results in a push-pull switch that is activated by the extension arm through an elongated slot in the front panel. The coil forms used for L1 and L2 are 1/4-inch (6.4 mm) slug-tuned pc-mount units from a Radio Shack assortment.

This receiving adapter is designed to use the + 14 V supply available at the R-4C ACCESSORY socket. It has been observed that some receivers have a high amount of ac ripple in the accessory supply, which causes ac modulation of the received signal. If an excessive amount of ac ripple is present in your receiver supply, the simple ripple filter shown in Fig. 4 may be constructed on a small piece of perf or pc board and attached to the rear of the oscillator compartment shield. Zener diode D1 and resistors R7 and R15 should be removed. The output of the ripple filter is then connected to the point on the circuit board that was formerly the junction of D1 and R7.

You should also check C166, C167 and C201 in the receiver accessory supply if it has a high ripple content. Note that the R-4C accessory supply is rated only for 50 mA and is not protected by a fuse. So make sure there are no wiring errors in the receiving adapter circuit!

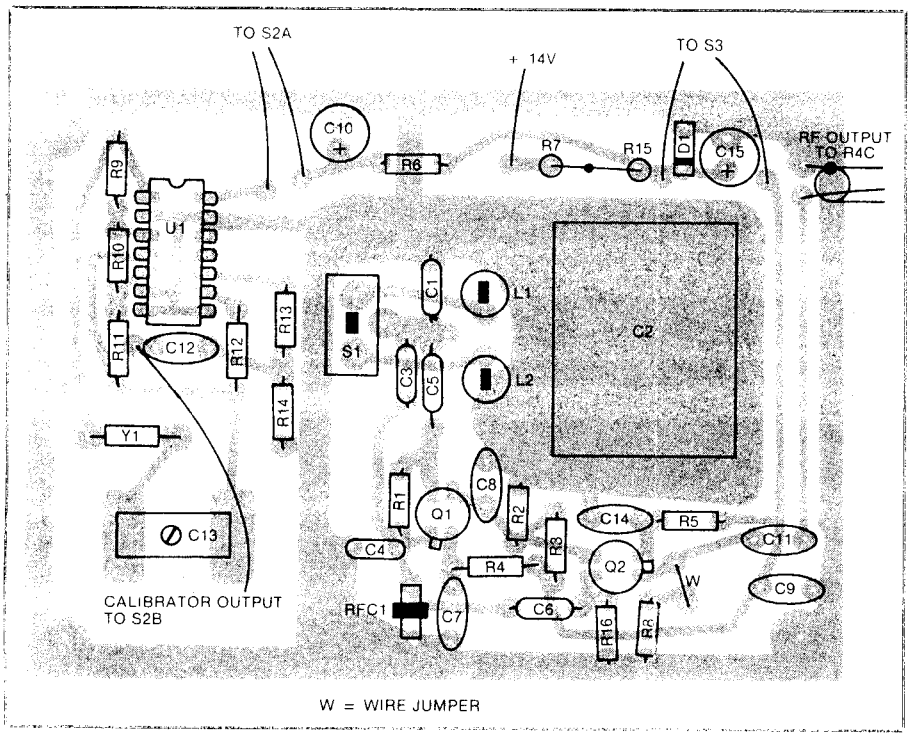

Fig. 2 — Parts-placement guide for the general-coverage receiving adapter. Parts are placed on the unclad side of the board; the shaded area represents an X-ray view of the copper pattern.

Interconnection

A short piece of RG-174/U coaxial cable is used to interconnect the rf generator and the R-4C. One end of the cable is terminated with a plug made from the bottom section of an HC-6/U crystal holder. The center conductor of the cable is connected to one pin, the other pin is left empty and the braid of the cable is attached to the body of the crystal case which is then filled with epoxy. When connecting the generator to the receiver, the crystal holder plug is arranged so that the center conductor of the cable from the generator is connected to the *top* hole of an auxiliary crystal socket at the rear of the R-4C. *Nothing* is connected to the bottom pin of the socket. A partial diagram of the R-4C circuitry involved is shown in Fig. 5. A ground lead (made

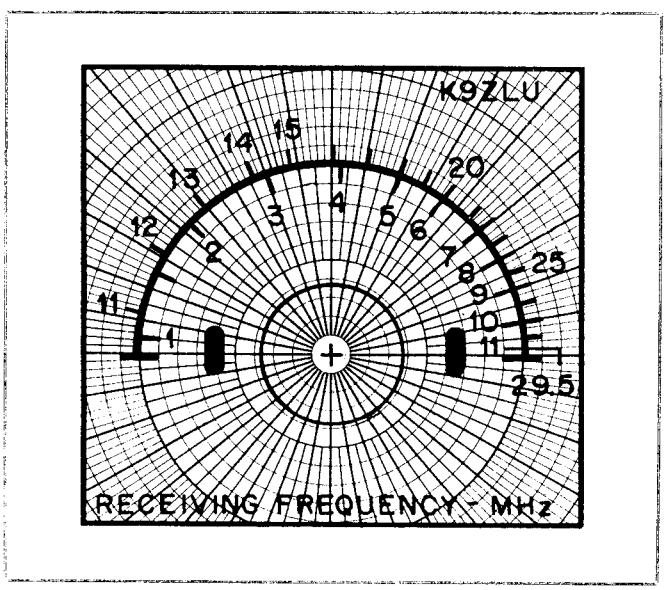

Fig. 3 — The dial layout for the general-coverage receiving adapter. If the VFO circuit parts values do not vary widely from those given in Fig. 1, this pattern may be used directly. Refer to the text for further information.

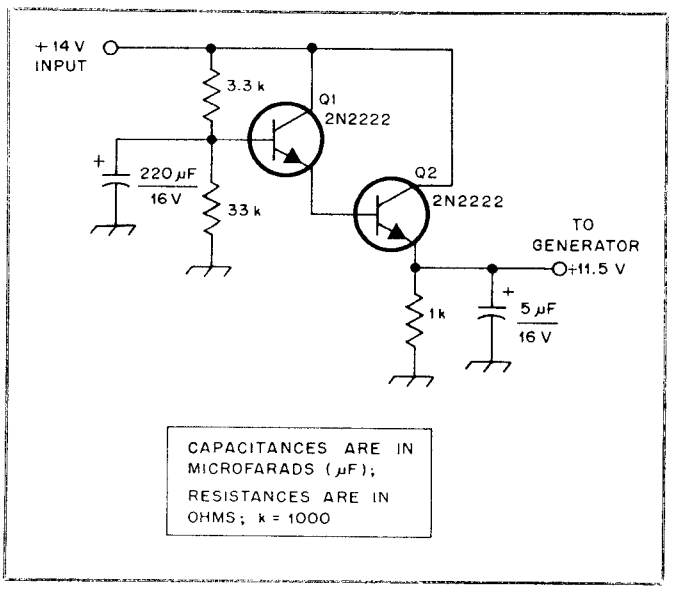

Fig. 4 — This optional ripple filter may be constructed on a piece of perf or pc board. Its use is discussed in the text.
Q1,Q2 — Npn silicon bipolar transistor, general purpose type, 500 mW, 2N2222 or equivalent.

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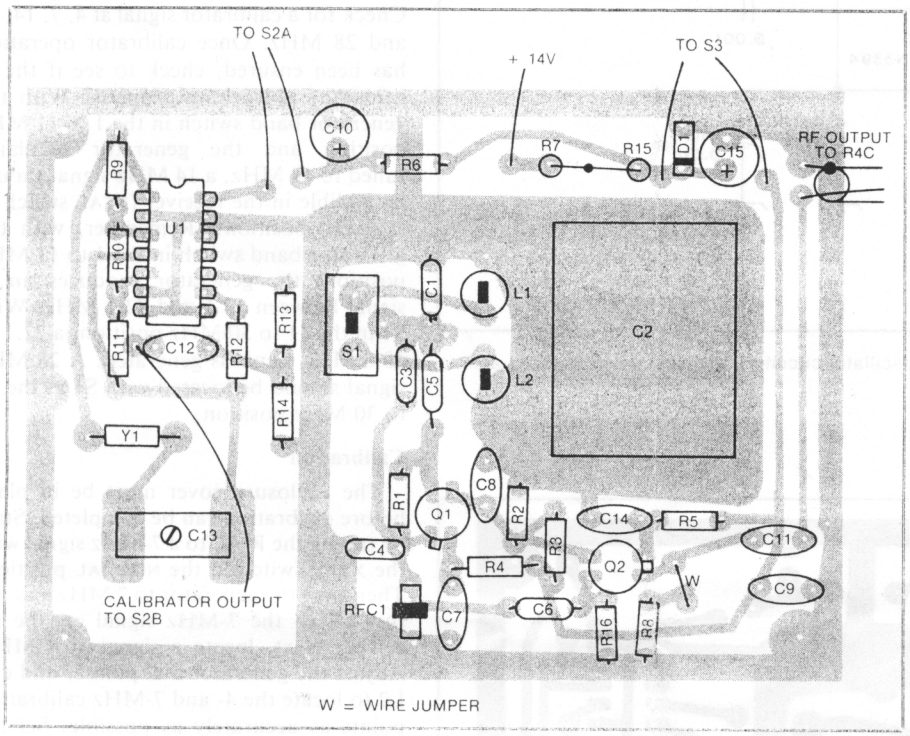

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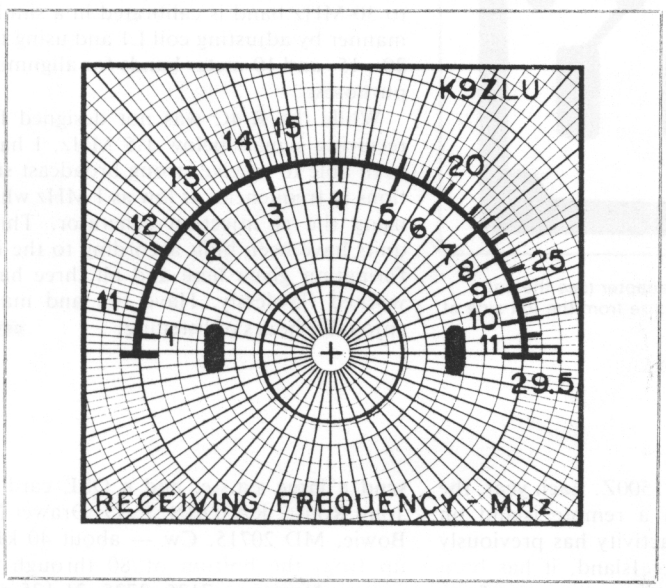

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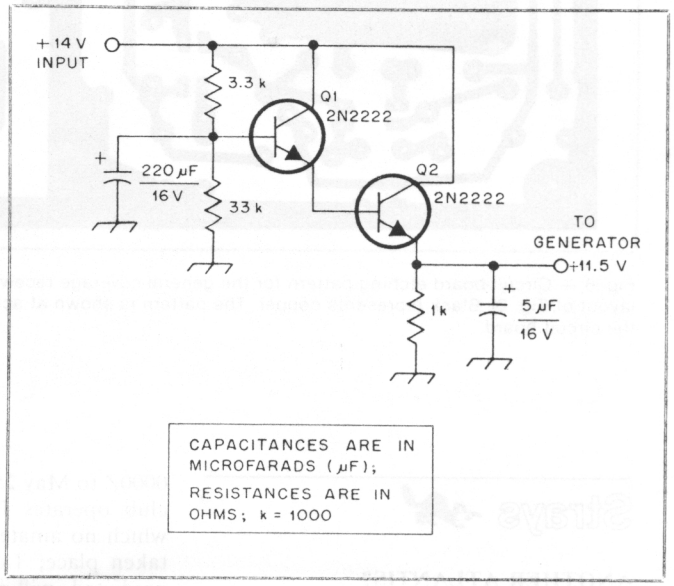

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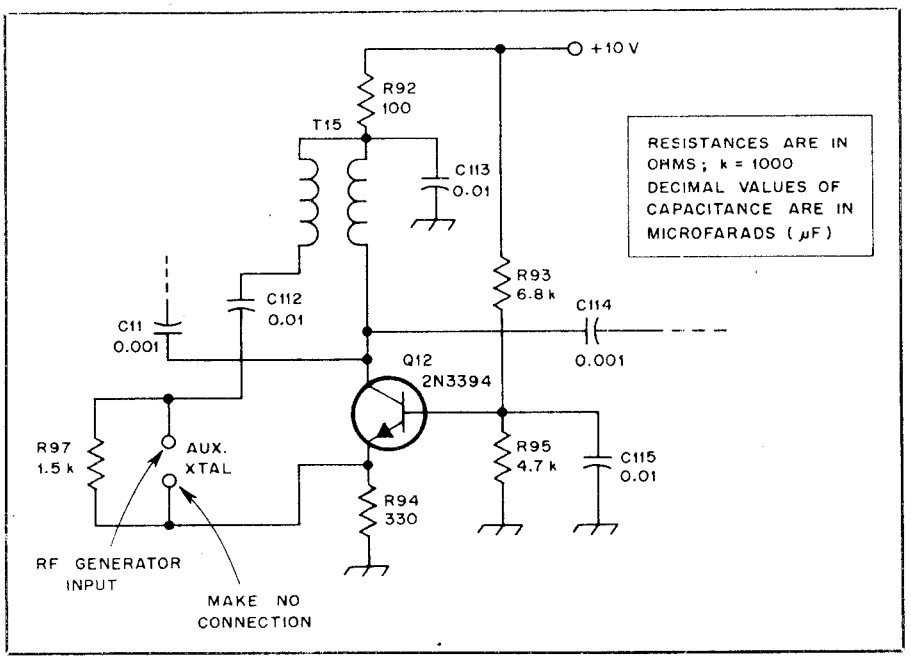

Fig. 5 — A partial diagram of the R-4C crystal oscillator circuitry. Component designations are those of the manufacturer.

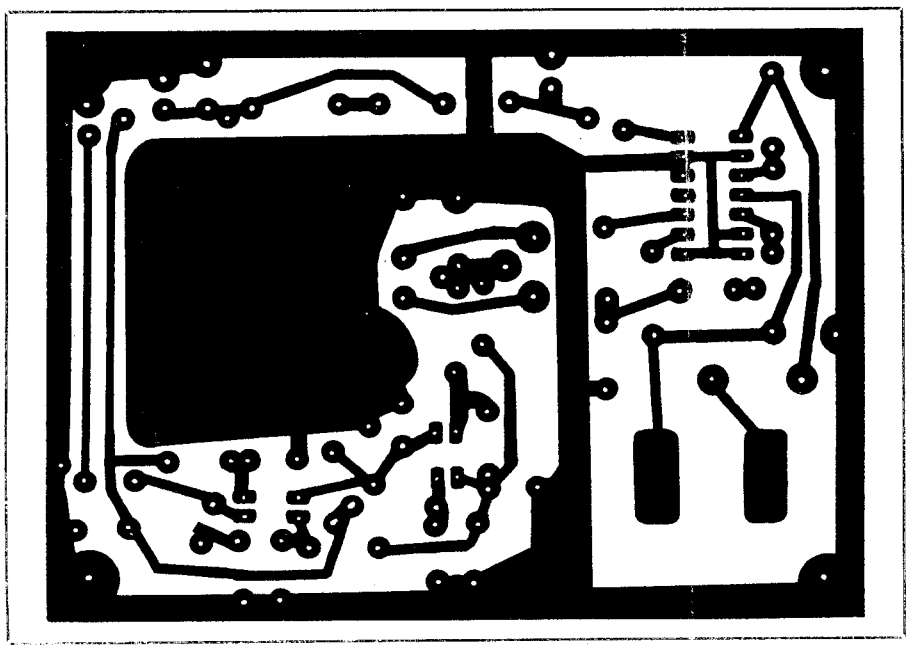

Fig. 6 — Circuit-board etching pattern for the general-coverage receiving adapter (see the parts layout of Fig. 2). Black represents copper. The pattern is shown at actual size from the foil side of the circuit board.

from a piece of coaxial cable braid) is connected between the ground foil of the generator circuit board and the receiver chassis. This additional ground lead helps reduce the detuning effects of hand capacitance. Keep all connecting leads as short as possible.

Preliminary Checks

After making the proper generator/receiver interconnections, turn on the receiver, generator and 1-MHz calibrator. Check for a calibrator signal at 4, 7, 14, 21 and 28 MHz. Once calibrator operation has been ensured, check to see if the rf generator is working properly. With the generator band switch in the 1 to 11 MHz position and the generator oscillator tuned to 14 MHz, a 14 MHz signal should be audible in the receiver (XTAL switch in NORMAL position.) Remember, with the generator band switch in the 1 to 11 MHz position, the generator produces an rf signal between 12.1 and 22.1 MHz. With S1 in the 11 to 30 MHz position, a 22.1 to 40.6 MHz signal is generated. A 28 MHz signal should be located with S1 in the 11 to 30 MHz position.

Calibration

The enclosure cover must be in place before calibration can be completed. Start by tuning the R-4C to a 7-MHz signal with the XTAL switch in the NORMAL position. Then tune the generator to 7 MHz and adjust L2 so the 7-MHz signal can be received. Next, locate a signal at 4 MHz. Adjust the generator dial pointer and coil L2 to locate the 4- and 7-MHz calibration points as accurately as possible. Set the R-4C to receive WWV at 10 MHz and adjust C13 in the calibrator circuit for zero beat. You may need to readjust coil L2 and the dial pointer to ensure the 4- and 10-MHz dial settings are accurate. The 11- to 30-MHz band is calibrated in a similar manner by adjusting coil L1 and using the 20-, 15- and 10-meter bands for alignment purposes.

While the R-4C was not designed for receiving signals below 1.5 MHz, I have been able to receive strong broadcast stations at frequencies as low as 1 MHz while using the rf injection generator. Three units have been built according to the information given here and all three have worked flawlessly. Have fun and many enjoyable hours of listening! QST

Strays

ANOTHER ATLANTIS?

☐ The Bowie (Maryland) Amateur Radio Club will be operating a mini-DXpedition from Tangier Island, Virginia, May 23 at 0000Z to May 25 at 1500Z. Each year, the club operates from a remote island on which no amateur activity has previously taken place; Tangier Island, it has been predicted, will eventually disappear from Chesapeake Bay because of erosion. To receive an Island Certificate, amateurs working the station, N3GR/4, should send a large s.a.s.e. and a QSL card to John Rouse, KA3DBN, P. O. Drawer M, Bowie, MD 20715. Cw — about 40 kHz up from the bottom of 80 through 10 meters; Novice — 7125, 3725, 21,125 and 28,125 kHz; ssb — 3895, 7245, 14,305, 21,380 and 28,590 kHz. — *John Rouse, KA3DBN, Bowie, Maryland*

RADIOKIT

GENERAL COVERAGE RECEPTION WITH DRAKE R-4C

Parts List

Resistors

2	27 ohm ¼w
2	100 ohm
1	240
1	270
1	1K
1	2.7K
1	4.7K
3	10K
2	100K
2	470K
16	

Capacitors

2	12 pF silver mica
1	20 pF " "
1	30 pF " "
1	39 pF " "
2	.001 disc 50v
4	.01 disc 50v
1	22 uF 25v radial
1	220 uF 16v radial
13	

Coils

1	1mh RFC 70F103 AI
1	¼" PC coil form 23A013-2
1	¼" PC coil form 23A013-3
24"	#24 wire

Crystal

1	1MHZ (HC33)

Capacitors (Var)

1	5-100 pF HF100
1	60 pF (padder) Arco 404

Semiconductors

2	ECG 222
1	MC 14001B
1	12V 1W Zener

Miscellaneous

1	14 pin socket
3	phono jacks (hardware)
2	SPST slide switches
1	DPDT slide switch
1	8:1 drive (Calectro)
1	Knob
1	Enclosure(3x5x4) LMB 453N
1	PC board