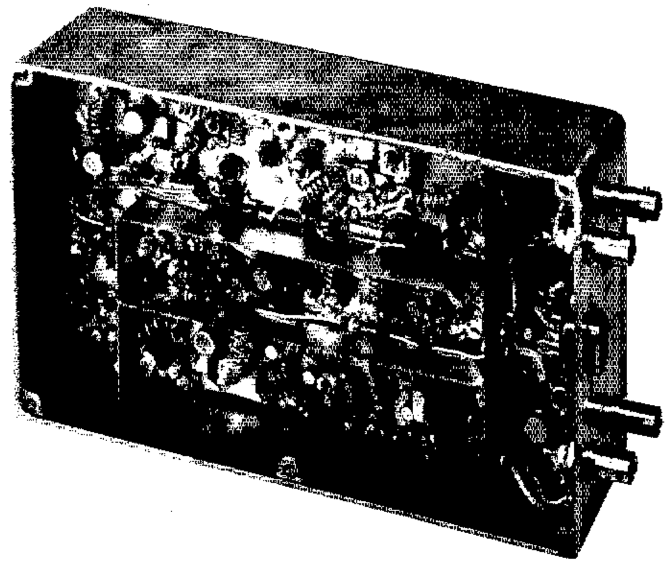
Explore "220" with this State-of-the-Art Transverter!



Part 1: You've never tried your hand on the 1-1/4 meter band? No equipment? Building this high-performance system could be your ticket to a new band and much excitement!

By Richard Stroud,* W9SR/W9BRN

This modern 220-MHz station is an ideal project for hf operators who want to advance to the higher frequencies. It is great also for dedicated vhf enthusiasts who wish to expand their band coverage. A solid-state transverter forms the basic station, and a low-noise remote preamplifier, a 40-W linear amplifier and a dc supply complete the high-performance system. A system block diagram is shown in Fig. 1. Part 1 of this article covers the transverter construction; the preamplifier, power amplifier and dc supply will be presented in Part 2.[1]

Circuit Highlights

While the transverter was designed for use with the 28-MHz Kenwood TS-820 transverter interface, it can be used with any 28-MHz transceiver capable of delivering +5 dBm (3.2 mW) of power. Rf output from the unit is 5 W, and the receiver noise figure is less than 1.5 dB. The transverter is composed of five sections. For convenience, the low-noise front end and the mixer/i-f amplifier section will be discussed together.

Receiver: The receiver design goal was good sensitivity with minimum susceptibility to overload and intermodulation distortion (IMD). This was accomplished by using a low-noise front end followed by an rf power amplifier, a high-level doubly balanced mixer and a low-gain i-f amplifier. Shown in Fig. 2 is the rf-section circuit diagram, while the mixer/i-f section is shown in Fig. 3.

An Avantek AT25A bipolar transistor is used in the low-noise front end. This is an excellent device for this application because it provides a low noise figure *and* good strong-signal performance. It is available directly from the manufacturer.[2] The input to the AT25A is matched for the optimum noise figure, resulting in a noise figure (measured with an AIL 75 Automatic Noise Figure Meter) of 1.4 dB.

Following the first rf amplifier is a double-tuned circuit. Close spacing (5/8 inch, center to center) between the inductors in this circuit results in inductive coupling.[3] This, and the capacitive coupling of C6, produces a 3-dB bandwidth of approximately 3 MHz. A 2N5109 power amplifier follows the double-tuned circuit. Output from this stage is applied to the mixer.

A PIN-diode-switched SRA-1H diode-ring functions as the receive and the transmit mixer. During receive the mixer input is switched to the amplified received signal, and the output is switched to the i-f amplifier, Q3.

A power JFET (junction field-effect transistor) is used as the i-f amplifier. This device appears as a near 50-Ω termination for the mixer at all frequencies of interest. Proper mixer termination ensures that the mixer IMD characteristics specified by the manufacturer will be obtained. The conversion gain during receive is 32 dB. With −46 dBm input signals at 220.1 and 220.2 MHz, the third-order IMD products at the 28-MHz output are 60 dB below the desired signals.

Transmitter: The transmitter design meets the goals of good linearity and low spurious output. In the transmit mode, the mixer input is switched to the 28-MHz input attenuator and the output is switched to the transmitter predrivers. Each predriver (Fig. 4) contains a 2N5109. These stages have been optimized for linearity. Use of a 440-MHz trap and a harmonic filter ensures good spectral purity.

Dc voltage to the predrivers and the bias voltage for Q4 and Q5 are applied when the companion transceiver is placed in the transmit mode. The bias-circuit components for Q4 and Q5 are located below the circuit board. Component placement is not critical, but the cathode lead of each reference diode should be grounded to a solder lug that is placed under the associated transistor mounting stud. This provides bias temperature compensation.

[1]Notes appear on page 18.

*P.O. Box 73, Liberty Center, IN 46766

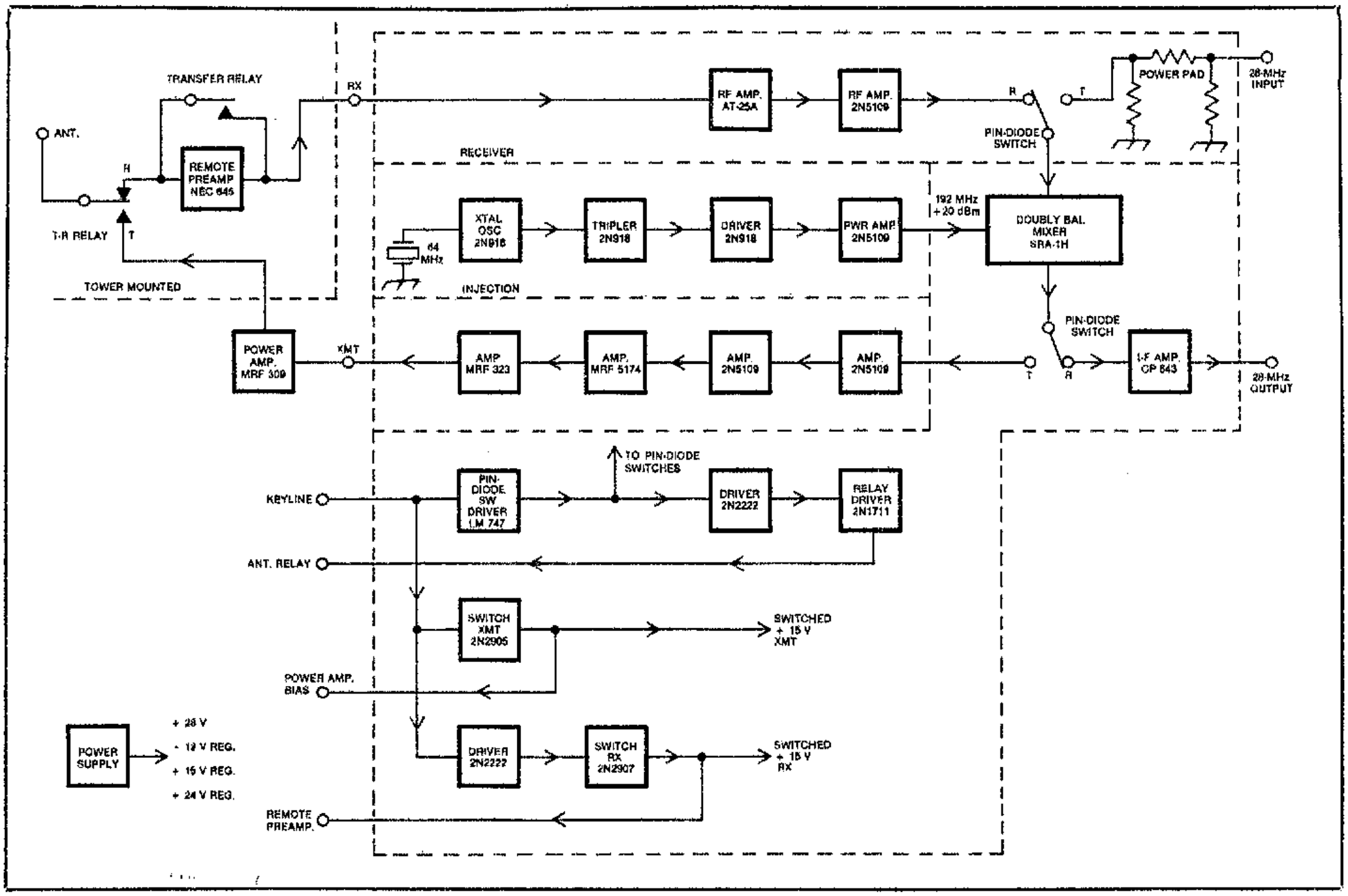


Fig. 1 — 220-MHz station block diagram.

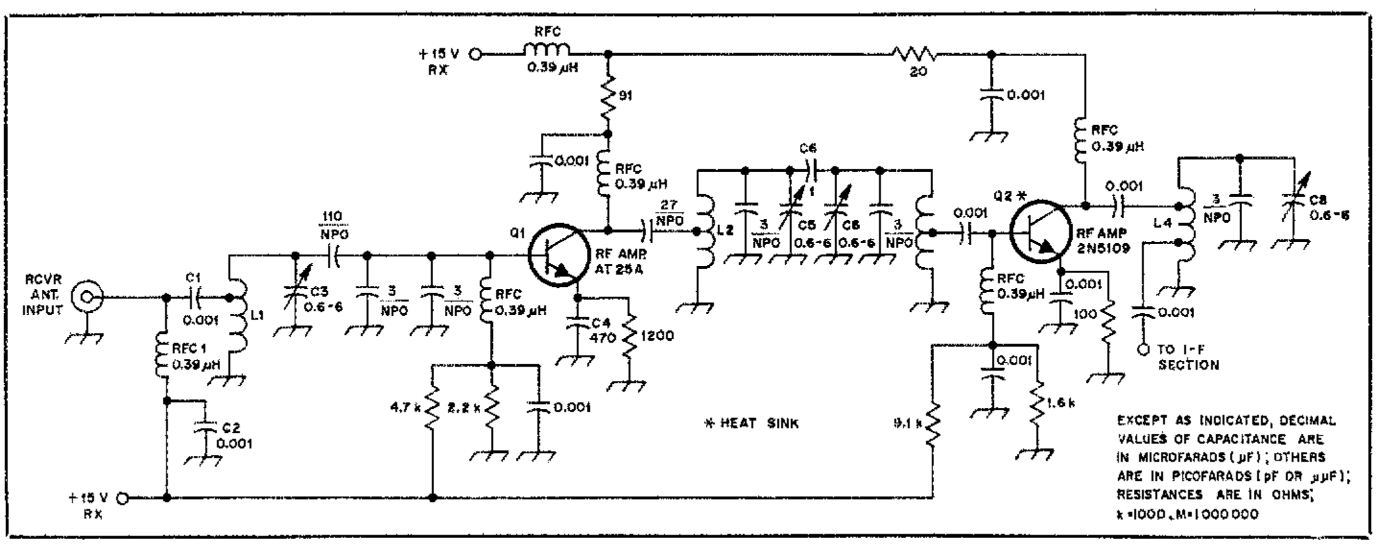


Fig. 2 — Receiver rf-section schematic diagram. NPO capacitors are miniature ceramic, and 0.001-µF units are low-inductance disc ceramic or equivalent. Unless specified otherwise, resistors are 1/4-W carbon types, and capacitors are rated at 50 V.

C3, C5, C7, C8 — 0.6-6 pF piston trimmer, Johanson 4640.
C4 — 470-pF ceramic chip, ATC, JFD or equiv.
L1 — 4 t no. 18 bus wire, 5/32-in. ID × 3/8 in. long, tapped 2-1/2 t from gnd.
L2 — 6-1/2 t no. 18 bus wire, 5/32-in. ID × 3/16 in. long, tapped at 1-3/4 t from gnd.
L3 — 5-1/2 t no. 18 bus wire, 5/32-in. ID × 7/16 in. long, tapped at 1/2 t from gnd.
L4 — 3-1/2 t no. 18 bus wire, 3/16-in. ID × 1/2 in. long, tapped at 5/8 and 1-1/4 t from gnd.
Q1 — Avantek AT25A (see note 2).
RFC — Miniature rf choke, inductance given in µH.

If you intend to use the transverter without the power amplifier, a filter, such as the one shown in Fig. 5, should be included in the output path. There is ample room near the transverter output connector for filter installation.

Local Oscillator: A 64-MHz crystal oscillator, a frequency tripler and two amplifier stages comprise the local-oscillator (LO) chain. (Fig. 6). The oscillator voltage is regulated at 8.2, and the oscillator output is routed to the tripler through a 50-Ω resistive pad. These measures result in good frequency stability. A 2N5109 power amplifier supplies +20 dBm (100 mW) of LO power to the mixer. This LO level is necessary for good mixer IMD performance.

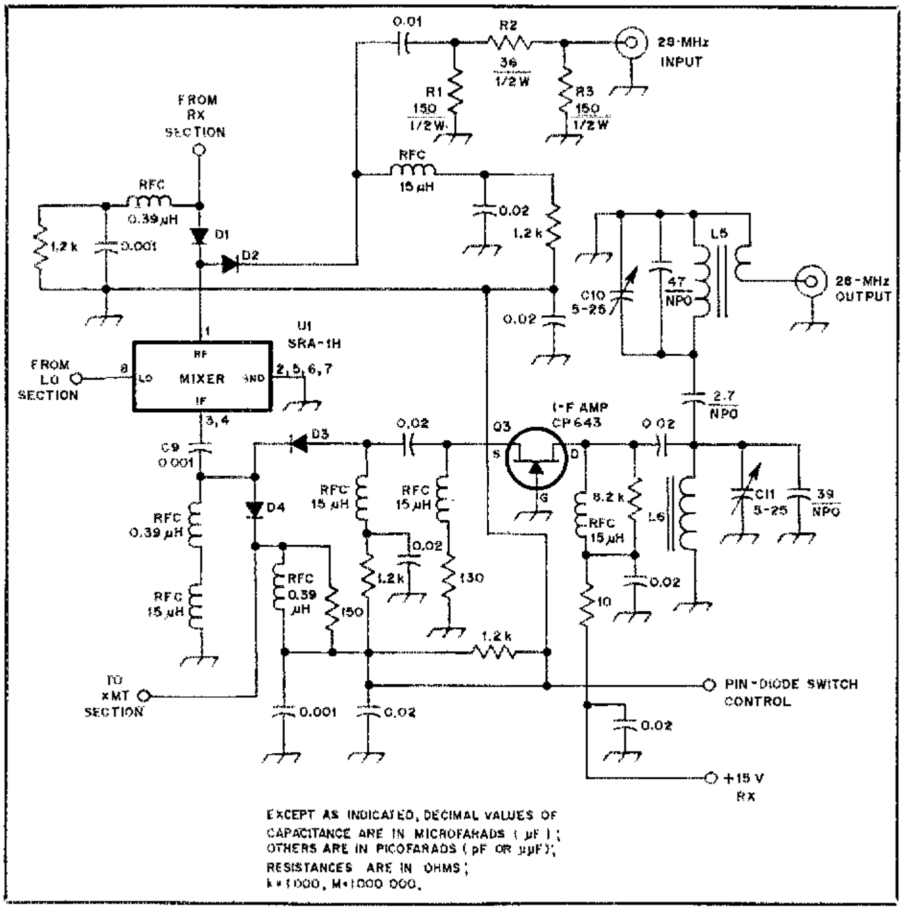


Fig. 3 — Mixer and i-f amplifier schematic diagram. NP0 capacitors are miniature ceramics. Other fixed-value capacitors are low-inductance disc ceramics or equivalent. Unless specified otherwise, resistors are 1/4-W carbon types, and capacitors are rated at 50 V.

C10, C11 — 5- to 25-pF miniature ceramic, Erie, JFD, Murata or equiv.
D1-D4, incl. — PIN diode, Unitrode UM6601, HP 1N5719, Motorola MPN 3401 or equiv.
L5, L6 — 13 t no. 28 enameled wire on a Micrometals T25-6 core.[4] L5 secondary is 2 t closewound over gnd end of primary.
Q3 — CP643 power JFET, Teledyne Crystalonics, 147 Sherman St., Cambridge MA 02140.
RFC — Miniature rf choke. Inductance given in µH.
U1 — High-level diode-ring mixer. Mini-Circuit Labs SRA-1H or equiv.

Switching and Control: Straightforward switching circuits (Fig. 7) are used to control the transverter. An LM-747 dual op-amp is used as the PIN-diode-switch driver. The op-amp sections are connected in parallel to supply sufficient current to the diodes. A 2N2907 saturated switch provides receiver on/off control, and a 2N2905 is used to switch the transmitter voltage and the power-amplifier bias. Grounding the transverter key line through the mating transceiver enables the transmit circuits. The key line is connected to transverter connector pin 4 of the TS-820. Pin 4 is wired to a normally open relay contact (RL-2) that is

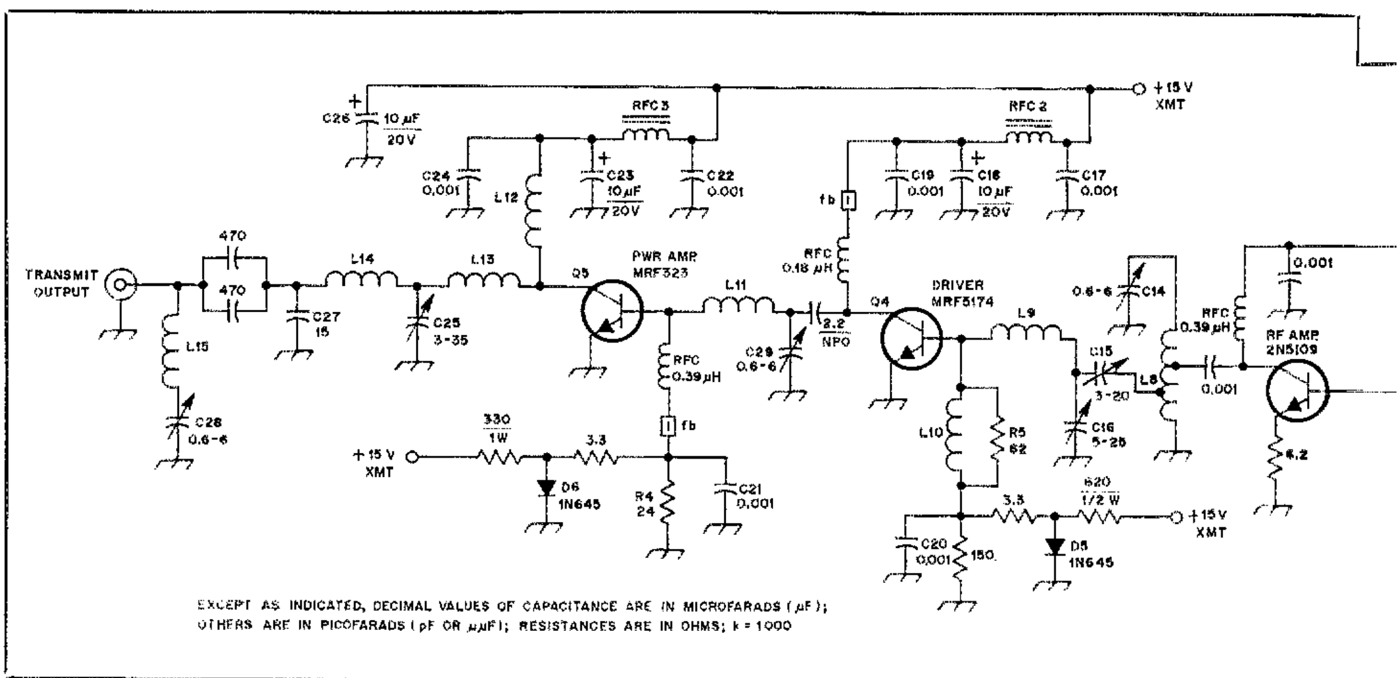
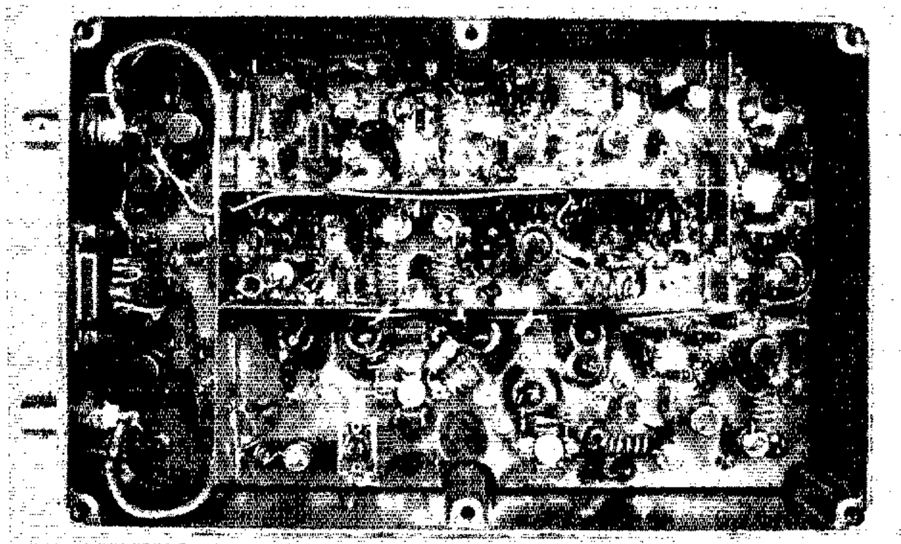


Fig. 4 — Transmitter section schematic diagram. NP0 capacitors are miniature ceramics. Unless otherwise specified, 0.001-µF capacitors are low-inductance disc ceramics, resistors are 1/4-W carbon types, and capacitors are rated at 50 V minimum.

C12, C17, C19-C22, incl. C24 — 0.001-µF feedthrough, Allen Bradley FA5C, Spectrum Control 54 794 001 or equiv.
C13, C14, C29 — 0.6-6 pF piston trimmer, Johanson 4640.
C15 — 3-20 pF miniature ceramic, Erie, JFD, Murata or equiv.
C16 — 5-25 pF miniature ceramic, Erie, JFD, Murata or equiv.
C18, C23, C26 — 10-µF, 20-V tubular electrolytic or tantalum.
C25 — 3-35 pF compression trimmer, Arco 403 or equiv.
C27 — 15-pF dipped mica.
L7 — 5-1/4 t no. 18 bus wire, 5/32-in. ID × 7/16 in. long, tapped at 1/2 and 1-1/2 t. from gnd end.
L8 — 5-1/2 t no. 18 bus wire, 5/32-in. ID × 1/2 long, tapped at 3/4 and 1-5/8 t from gnd end.
L9 — 3-1/2 t no. 22 bus wire, 5/32-in. ID × 1/4 in. long.
L10 — 7 t no. 28 enameled wire wound on R5.
L11 — 5 t no. 18 bus wire, 5/32-in. ID × 7/16 in. long.
L12 — 2 t no. 22 bus wire, 3/16-in. ID × 5/16 in. long.
L13 — 3/4-in. length (total) no. 18 bus wire in a hairpin shape.
L14 — 2 t no. 18 bus wire, 5/32-in. ID × 1/2 in.



Interior view of the 220-MHz transverter. The LO chain occupies the upper center section with the receiver front end immediately below it.

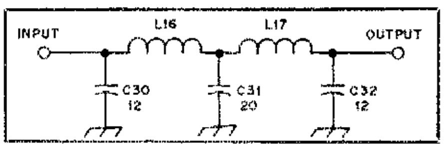
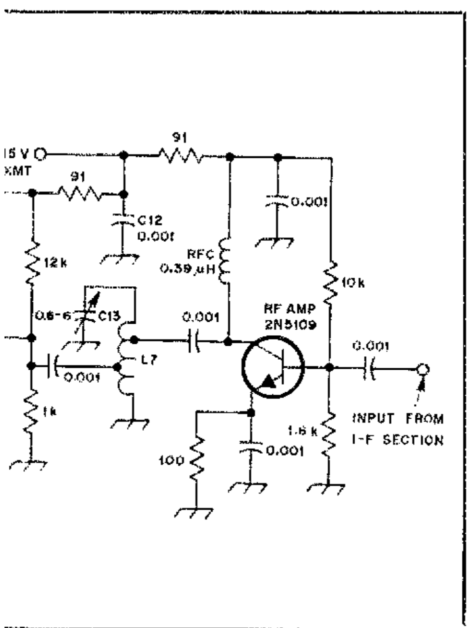


Fig. 5 — Schematic diagram of low-pass harmonic filter. This same circuit is used in the power amplifier (Part 2).

L16, L17 — 5 t no. 20 bus wire, 1/8-in. ID × 7/16 in. long.
C30, C32 — 12-pF dipped mica.
C31 — 20-pF dipped mica.



long.
L15 — 3 t no. 22 bus wire, 1/16-in. ID × 3/8 in. long.
Q4 — Motorola MRF5174.
Q5 — Motorola MRF323.
RFC — Miniature rf choke, inductance given in μH.
RFC2, RFC3 — 1-1/2 t ferrite choke, Ferroxcube VK 200 19/4B or equiv.

grounded during transmit. This contact is normally unused, and wiring it to pin 4 is a simple modification.

A 2N1711 (Q6) is used to switch the antenna relay. It is capable of sinking 250 mA of collector current. The antenna relay should be connected between a suitable voltage source and the collector of Q6. The power supply described in Part 2 has provisions for powering a 28-V relay.

I used separate input and output connectors rather than internal antenna switching to have the flexibility to add a remote preamplifier and a power amplifier. Use of a PIN diode T-R switch was discounted because of the slight loss involved, and because I planned to use a tower-mounted preamplifier and relay.

A remote preamplifier is desirable if a long feed line is necessary, or if you want the minimum noise figure. The transverter has a receiver noise figure of less than 1.5 dB, however, and it will do a commendable job without the preamplifier. If the preamplifier is not used, RFC1, C1 and C2 may be omitted and the input connector may be attached directly to L1.

Construction

Anyone familiar with vhf techniques should be able to duplicate my results without difficulty if the layout shown in the photographs is followed carefully. I built the transverter around many "on-hand" and surplus components; other builders may wish to substitute noncritical components as availability and their junk boxes dictate.

The construction method I used is a good alternative to etched circuit boards when breadboarding and building prototypes. A 1/16-inch thick, double-sided copper-clad board is cut to size and tinned on both sides. Teflon press-fit terminals, inserted at key locations as construction progresses, are used to support component leads. Ground connections are made by soldering directly to the tinned board. Teflon terminals are available in many sizes and styles from surplus outlets. I use 3/16-inch-high units that mount in a 0.089-inch diameter hole. Before inserting the terminal, hand chamfer the hole slightly on the circuit side of the board with an oversized drill bit.

A diecast box (Bud CU247), measuring approximately 4-1/2 × 7-1/4 × 2 inches, houses the unit. The circuit board is mounted above the bottom on 5/8-inch threaded aluminum spacers. I drilled 1/8-inch holes in the bottom to allow adjustment of the piston capacitors. Each transverter section is isolated by 3/4-inch-high tinned brass shields. To avoid unintentional coupling, all coils should be positioned as shown in the photographs. All rf leads should be kept short. Low-inductance 0.001-μF capacitors, connected with short leads, should be used for bypassing. The LO crystal can be held in place by means of GE RTV® silicone adhesive.

All rf input and output connections are made through UG-1094 (BNC type) connectors. The power and control connections are made through a 9-pin jack. Short lengths of miniature coaxial cable connect the receiver input and the transmit output connectors to glass-insulated feedthrough terminals mounted on the shield wall. These terminals are the rf termination points for the receiver and transmitter circuits. The 28-MHz input and output connectors are also attached to feedthrough terminals by miniature coaxial cable. These "feedthroughs" are mounted on the circuit board at appropriate points, and the cables pass under the board to the connectors.

The doubly balanced mixer is located under the circuit board, with the pins protruding into the receiver compartment. Notches at the bottom of the shields near the mixer allow clearance for the lead from L21 and the mixer output-coupling capacitor, C9.

Q3 is mounted by inverting it in a hole drilled in the board (leads on the circuit side of the board). The index tab is then soldered to the board. This provides a good rf ground (the gate is connected to the case) and heat sinking of the device.

Adjustments

A 6-dB resistive pad (R1, R2 and R3) is included in the 28-MHz input line. This pad terminates the transceiver output and reduces the drive power to the correct level for the mixer. If your transceiver output differs from that of the TS-820 (+5 dBm), adjust the pad resistor values to obtain approximately +2 dBm (1.6 mW) at the mixer. Do not exceed 1/2 W of drive, or damage to the mixer may result.

The value of R4 should be selected to provide a Q5 quiescent collector current of 25 mA. Resting current for Q4 should

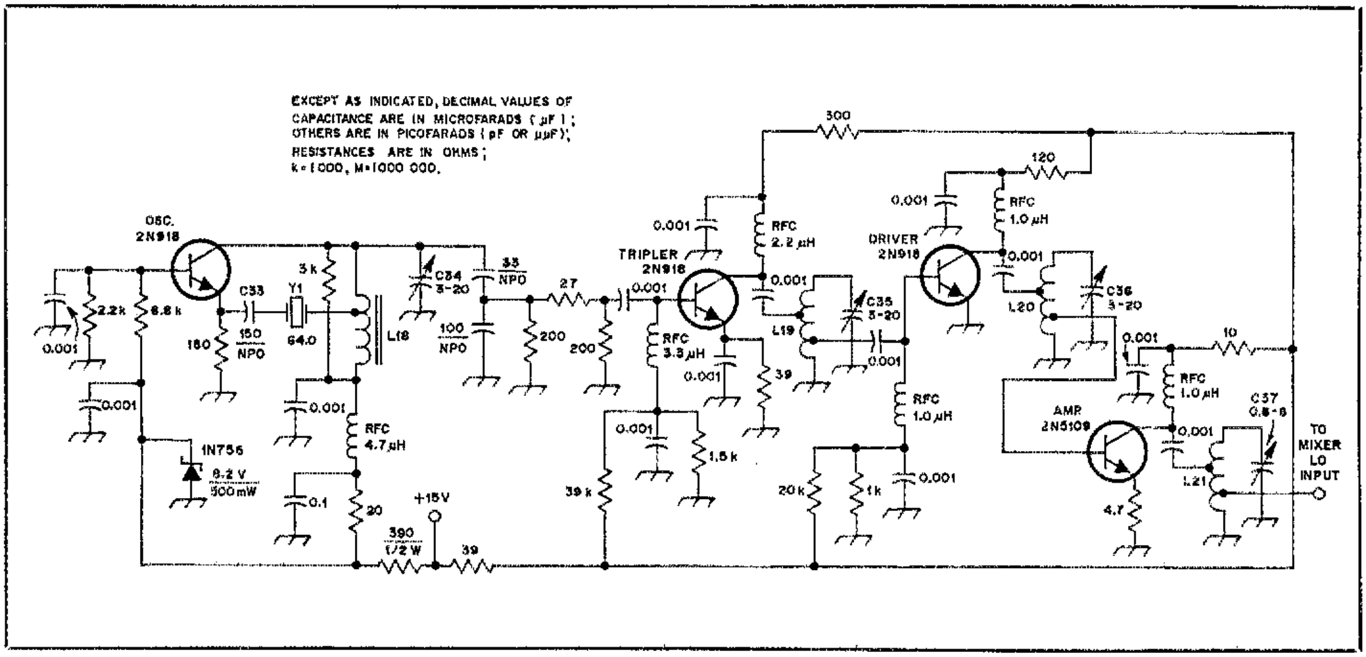


Fig. 6 — Local-oscillator section schematic diagram. NP0 capacitors are miniature ceramic, and 0.001-μF units are low-inductance disc ceramic. Unless otherwise specified, resistors are 1/4-W carbon types and capacitors are rated at 50 V.

C34-C36, incl. — 3-20 pF miniature ceramic, Erie, JFD, Murata or equiv.
C37 — 0.6- to 6-pF piston trimmer, Johanson 4640.
L18 — 11 t no. 28 enameled wire on a Micro-metals T20-22 core, tapped at 3 t from gnd end.
L19 — 4 t no. 18 bus wire, 3/16-in. ID × 9/16 in. long, tapped at 3/4 and 3-3/4 t. from gnd end.
L20 — 4 t no. 18 bus wire, 3/16-in. ID × 1/2 in. long, tapped at 3/4 and 3 t. from gnd end.
L21 — 3-3/4 t no. 18 bus wire, 3/16-in. ID × 9/16 in. long, tapped at 3/4 and 1-1/2 t from gnd end.
RFC — Miniature rf choke, inductance given in μH.
Y1 — 64.00-MHz series-resonant crystal, CR80 style, McCoy, Jan Crystals or equiv.

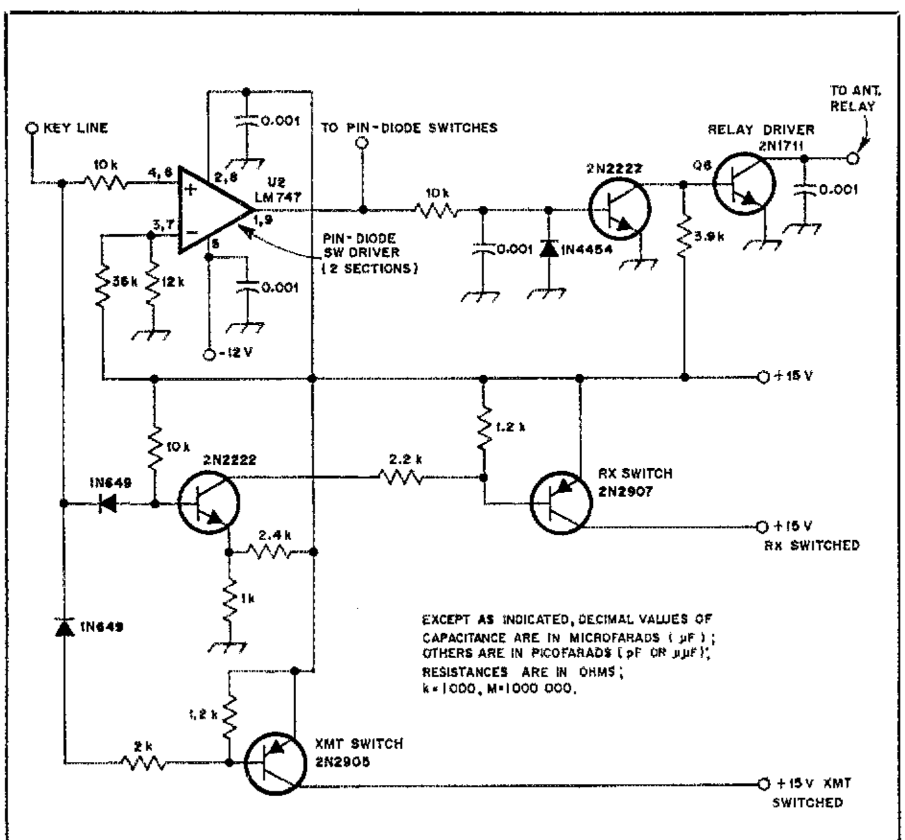


Fig. 7 — Transverter switching and control section. Resistors are 1/4-W carbon types, and capacitors are disc ceramic. U2 is a dual op-amp with the sections connected in parallel.

be approximately 15 mA.

Adjust the harmonic trap (L15 and C28) for minimum output at 440 MHz. This adjustment will interact with the setting of C25 slightly, so both should be optimized for maximum desired output and minimum second harmonic.

The LO-injection frequency can be adjusted to 192.0 MHz by selecting the correct value for C33. Measure the frequency with a counter connected to mixer-pin 8. As an alternative, the LO frequency can be adjusted until a received signal of known frequency appears at the proper dial point on the 28-MHz receiver. If a high-quality crystal is used, the frequency should be close to 192 MHz with the value shown.

All remaining adjustments are made in the conventional manner; the receive circuits are peaked for best signal-to-noise ratio, and the transmit stages are adjusted for maximum output power. This completes the transverter portion of the system. With it, you are ready to begin exploring 220!

Notes

[1] Part 2 of this article will appear in a subsequent issue of *QST*.
[2] Avantek, Inc., 3175 Bowers Ave., Santa Clara, CA 95051. Approximate cost is $12.
[3] mm = in. × 25.4.
[4] Cores are available from Amidon Associates, Inc., 12033 Otsego St., N. Hollywood, CA 91607.

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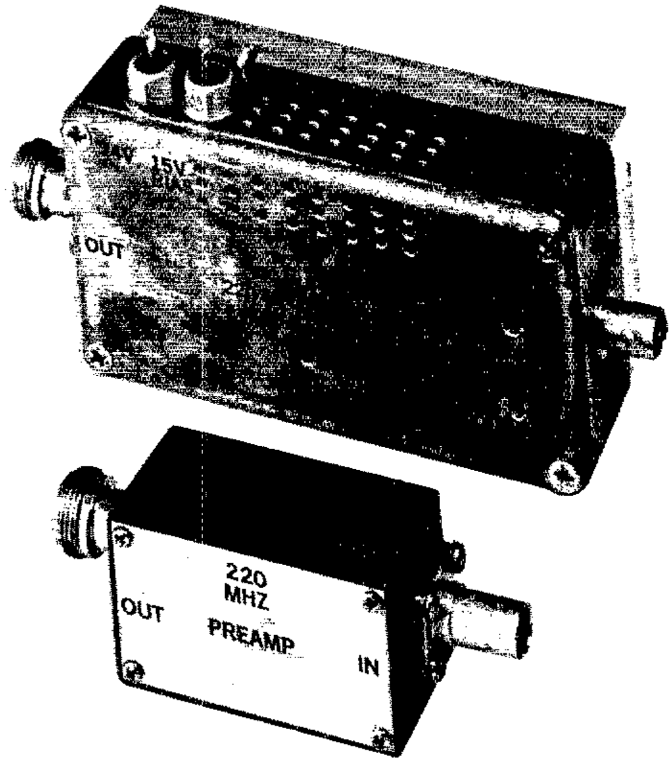


Part 2: Ready to improve the performance of your 220-MHz station? Building a remote preamplifier and a 40-W linear amplifier is a great way to do it.

By Richard Stroud,* W9SR/W9BRN

If you have completed construction of the transverter described in Part 1, you probably have begun exploring the 220-MHz band.[5] You can make your explorations more enjoyable by increasing the effectiveness of your station. In addition to improving the all important antenna, there are two approaches to enhanced station performance. First, the receive capability can be improved by using a low-noise preamplifier (Fig. 8) mounted near the antenna. Remote preamplifier mounting reduces the effect of feed-line loss on the system noise figure and allows full utilization of the low preamplifier noise figure.

The second approach is to increase the transmit power level. An output power of 40 to 50 W is suitable for general operating. The amplifier in Fig. 9 provides a minimum output of 40 W with good IMD characteristics. This power level is compatible with many of the high-power amplifiers used in this band. Using this equipment and an 11-element Yagi at 50 feet,[6] I have been able to work similar stations regularly at a distance of 150 miles.

Signal-quality reports on ssb and cw have been good. A spectrum analyzer was used to evaluate the transverter/amplifier combination for spectral purity. All harmonics and spurious emissions are 70 dB or more below the carrier (Fig. 10). Shown in Fig. 11 is a power supply capable of providing the necessary voltages for the transverter, the preamplifier and the linear amplifier.

Construction

The preamplifier and the linear amplifier follow the construction techniques used for the transverter. A piece of 1/16-inch-thick, double-sided copper-clad board is the circuit foundation and ground plane. Grounded component leads are soldered directly to the board. Teflon press-fit terminals are used where insulated supports are required. The power supply has conventional point-to-point wiring.

Preamplifier: A 1-1/2 × 1-1/4 × 2-1/4-inch aluminum box (Pomona no. 2417) houses the remote preamplifier. Two no. 4-40 screws are used to mount the circuit board to the bottom of the box. No. 8 nuts, placed over the screws, serve as spacers between the box and the circuit board. Both sides of the board are tinned, and short lengths of bus wire connect the clad surfaces. The bus wires are passed through drilled holes, then are soldered on each side.

A BNC connector was chosen as the antenna input for its compatability with the transfer relay I used. Others may wish to use a type-N connector, which generally yields a lower VSWR. Copper straps (3/16-inch wide) are placed under the upper connector mounting screws and soldered to the circuit board below. This continues the ground path from the connector to the board without a significant impedance variation.

The transistor used in the preamplifier is an NEC 645-35 uhf device. It is operated at a collector voltage of 8 V and a current of 7 mA. A 5/8-inch-high shield across the transistor isolates the input and output circuits. Power is routed to the preamplifier through the output coaxial cable. An internal regulator prevents voltage variations resulting from long cable runs. If you wish to power the preamplifier directly, disconnect RFC6 from the output jack and apply 12 to 15 V to the choke. If this is done, C49 can be omitted and R13 can be connected directly to the output jack.

Two 470-pF chip capacitors are used to bypass the Q7 emitter leads. One capacitor is placed under each emitter

[5]Notes appear on page 36.

*P.O. Box 73, Liberty Center, IN 46766

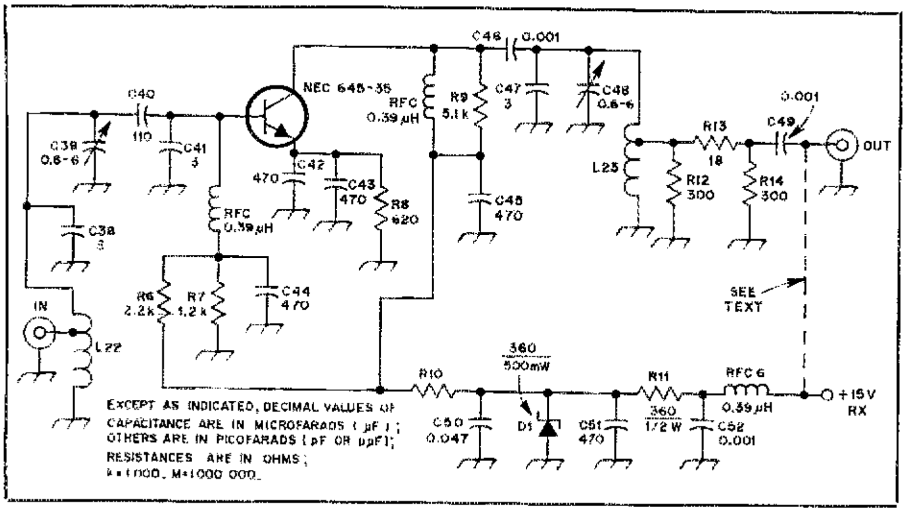


Fig. 8 — 220-MHz remote preamplifier schematic diagram. The power supply may be connected to RFC6 rather than through the coaxial line, if desired (see text). Unless specified otherwise, all resistors are 1/4-W, 5% carbon types.

C38, C40, C41, C47 — NP0 disc ceramic.
C39, C48 — 0.6- to 6-pF piston trimmer, Johanson 4640.
C42-C45, incl. — Ceramic chip capacitor (ATC, JFD or equiv.).
L22 — 4-1/2 t no. 20 bus wire, 1/8-in. ID × 7/16 in. long, tapped at 4 t from gnd.
L23 — 5 t no. 20 bus wire, 1/8-in. ID × 1/2 in. long, tapped 1-1/2 t from gnd.
Q7 — NEC 645-35. Available from California Eastern Laboratories, 3 New England Executive Park, Burlington, MA 01803 (unit cost is approximately $7).
RFC4-5, incl. — 0.39-µH miniature rf choke.

Interior view of the remote preamplifier. A BNC type of connector is used at the preamplifier input. A shield isolates the input and the output circuits.

lead. Access to the trimmer capacitors is provided by drilling two 1/8-inch-diameter holes in the box bottom. Be sure to have the cover in place during final alignment. Adjust the trimmers for the lowest noise figure attainable.

Measured noise figure of the preamplifier is 0.8 dB, and the gain is 24 dB. Because of the high gain, the overall system dynamic range is degraded slightly — a tradeoff to obtain minimum noise figure. A remote transfer relay is used to bypass the preamplifier. This avoids overload when strong interfering signals are present. I used a surplus Amphenol 360-11890-20 relay. It is located with the T-R relay and the preamplifier on the tower. It should be housed in a watertight enclosure as close to the antenna as possible. The transfer relay cannot be used with an antenna having a dc path across the feed line, as the preamplifier supply voltage appears at the antenna when the relay is in the bypass position.

Linear amplifier: A Bud CU-124 diecast box (approximately 2-1/4 × 4-1/4 × 1 inch) houses the power amplifier. A 1/2-inch-thick aluminum plate, cut to the outline of the box bottom, serves as the heat sink. I cut two 1/8-inch-wide grooves in the plate to increase the surface area and to improve the heat radiation. Each groove is 1/4-inch deep and runs the full length of the plate. The plate was drilled and tapped for the no. 4-40 screws that are used to attach it to the box. The box bottom is cut away to clear the transistor mounting flange. Oversized holes drilled in the box provide clearance for the feedthrough capacitors and the Teflon terminals that protrude from the bottom of the circuit board. The transistor mounting flange is bolted directly to the heat sink. Heat-sink compound (Dow Corning 340 or equiv.) is applied to the transistor flange and the heat sink. This heat sink is satisfactory for normal ssb and cw operation; if long key-down periods are expected, a larger heat sink may be required.

For ease of assembly, the solder-in standoff capacitors and most other components should be mounted before the circuit board is secured in the box. All six transistor leads are cut to a length of 1/4 inch. The copper foil under the base and collector tabs is removed to avoid shorting to the ground plane. Input and output connections are made directly to the transistor tabs. The threaded stud of the reference diode (D8) is used as one of the transistor mounting screws. This places the diode in good thermal contact with the transistor, thus providing bias temperature compensation. The diode body is soft copper, so don't over tighten it. After the circuit board, the box and the transistor are bolted to the heat sink, the four emitter leads are laid flat against the circuit board and soldered in place.

Capacitors C56 and C57 should be low-inductance chip types. One capacitor is mounted on each side of the transistor base lead and soldered directly to the ground plane (see photo). C63 should also be a low-inductance capacitor. The harmonic-filter capacitors (C66, C67 and C68) are small dipped-mica units with the leads cut to a length of approximately 1/8 inch. It is important to position the filter inductors (L29, L30 and L31) as shown in the photograph. This will prevent inductive coupling across the filter. If a spectrum analyzer is available during alignment, the lead length of the mica capacitors and the inductance of L30 and L31 can be adjusted to minimize or "notch" the second harmonic.

A pattern of holes is drilled in the cover and the side of the box near R19 to allow air flow around that resistor. Adjustment holes (1/8-inch diameter) are also drilled in the cover above C54, C55 and C62.

The resting (no drive) Q8 collector current should be adjusted to 45 mA by selecting the value of R16; the resistance needed depends on the individual transistor. Raising the resistance of R16 will increase the collector current. To protect Q8, start with a low resistance and work up to the desired current. Do not apply collector voltage with R16 open, even momentarily, as the transistor can be damaged by the resulting high collector current.

Feedthrough power-line filters (FL1 and FL2) were used for the 24-V and the bias-voltage connectors. Feedthrough capacitors of 470- to 1000-pF capacitance could be used as substitutes for the filters. The 24-V supply is connected permanently to the amplifier. Applying the 15-V bias potential turns the unit on. Bias switching is controlled by the T-R circuitry in the transverter.

This amplifier has a gain of nearly 10

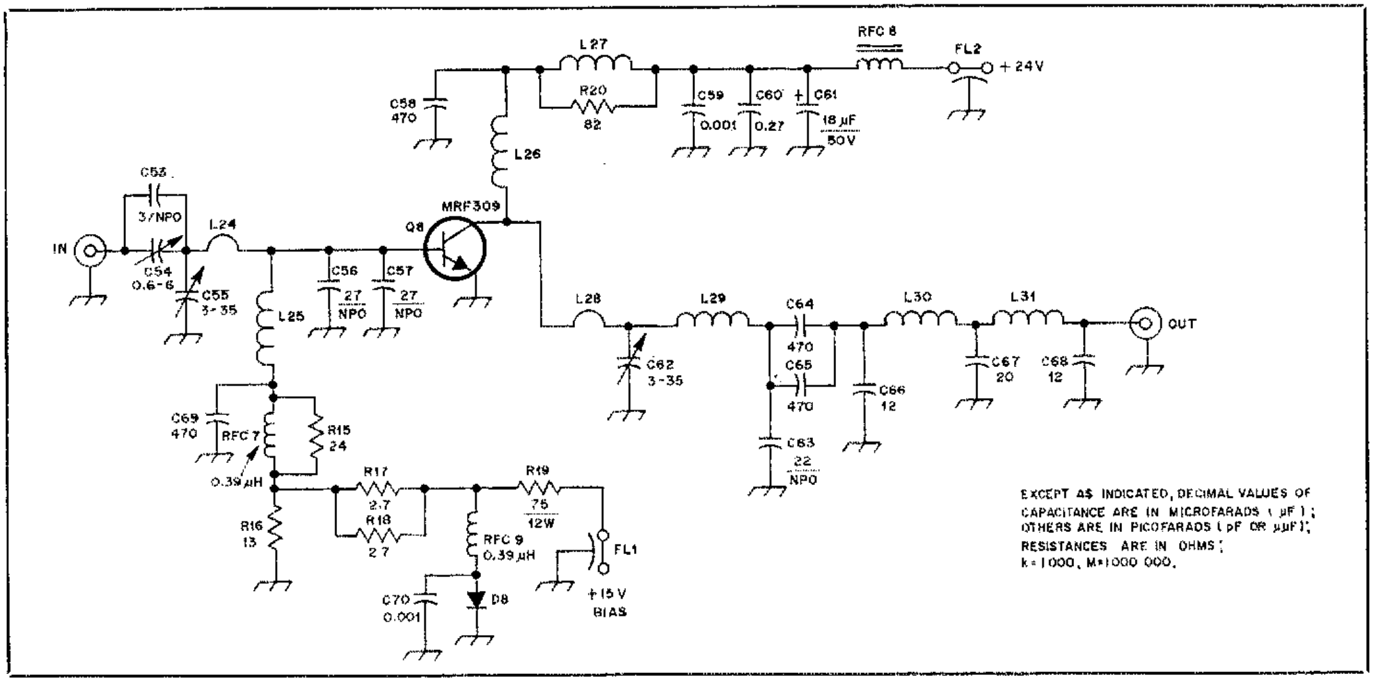
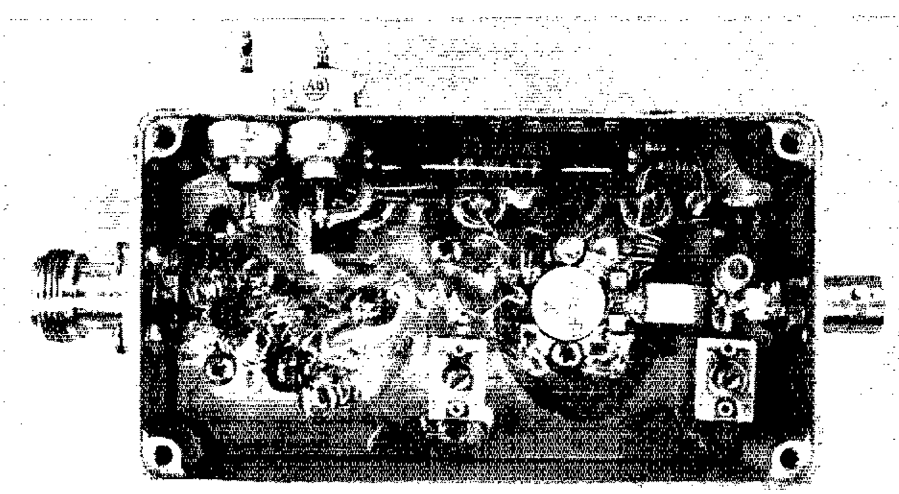


Fig. 9 — 40-W linear power amplifier schematic diagram. Unless otherwise specified, all resistors are 1/4-W, 5% carbon types. Capacitors are rated at 100 V.

C54 — 0.6- to 6-pF piston trimmer, Johanson 4640.
C55, C62 — 3- to 35-pF mica compression trimmer, Arco 403 or equiv.
C56, C57, C63 — Ceramic chip capacitor (ATC, JFD or equiv.).
C58, C59, C69 — Standoff capacitor, Allen Bradley SS5D, Spectrum Control 54 803 003 or equiv.
C64, C65 — Disc-ceramic capacitor.
C66-68, incl. — Dipped-mica capacitor.
D8 — Silicon diode, Unitrode UT5105 or equiv.
FL1, FL2 — Feedthrough line filter, Allen Bradley F1B or equiv. 470- to 1000-pF feedthrough capacitors may be used as substitutes.
L24 — 1-in. length of 1/2-inch-wide copper strap formed in a 1/2 turn.
L25 — 3 t no. 20 bus wire, 1/8-in. ID × 1/4 in. long.
L26 — 2 t no. 18 bus wire, 5/32-in. ID × 3/8 in. long.
L27 — 9 t no. 28 enameled wire wound on R20.
L28 — 9/16-in. length of no. 18 bus wire.
L29 — 2 t no. 18 bus wire, 1/8-in. ID × 7/16 in. long.
L30, L31 — 5 t no. 20 bus wire, 1/8-in. ID × 7/16 in. long.
Q8 — Motorola MRF309 rf power transistor. A 2N6439 or a TRW J02015A may be used as a substitute.
RFC7 — 0.39-µH miniature rf choke.
RFC8 — 1-1/2 t ferrite choke, Ferroxcube VK200 19/4B or equiv.



Interior view of the linear amplifier. It is important that the harmonic-filter inductors (near the type-N output connector) be positioned as shown to prevent unwanted coupling across the filter.

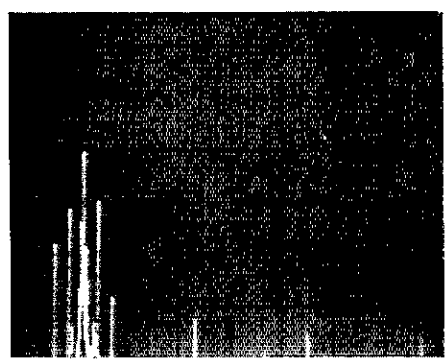


Fig. 10 — Spectral display of the transverter/amplifier signal at the 50-W output level. The largest signal is the 220.1-MHz carrier. It has been notched 60 dB to permit viewing on the spectrum analyzer. The carrier reference level is actually 30 dB above the top of the display. Each vertical division is 10 dB, and each horizontal division is 100 MHz. Display center frequency is 500 MHz. All spurious signals resulting from oscillator harmonics and undesired mixer products are more than 70 dB below the carrier, and all harmonics are at least 90 dB down. This meets FCC requirements for commercial equipment.

dB, and, when operated from a 24-V, 3-A supply, is capable of over 50 W of output. Linearity is very good up to an output level of approximately 42 W. During two-tone IMD testing at an output power of 40 W, the third-order products were found to be 35 dB below the desired output signals.

An input VSWR of 1:1 can be obtained by adjusting C54 and C55. The output network is aligned by adjusting C62 for maximum output power. Final adjustment of C62 should be performed at full output power.

Power supply: A conventional design using IC voltage regulators was used for the power supply shown in Fig. 11. None of the supply components are critical, and builders are encouraged to use any suitable materials they have on hand. It is necessary only to ensure that the output voltages are near the specified values and that the current capacity is ample. I obtained my transformers from a scrapped

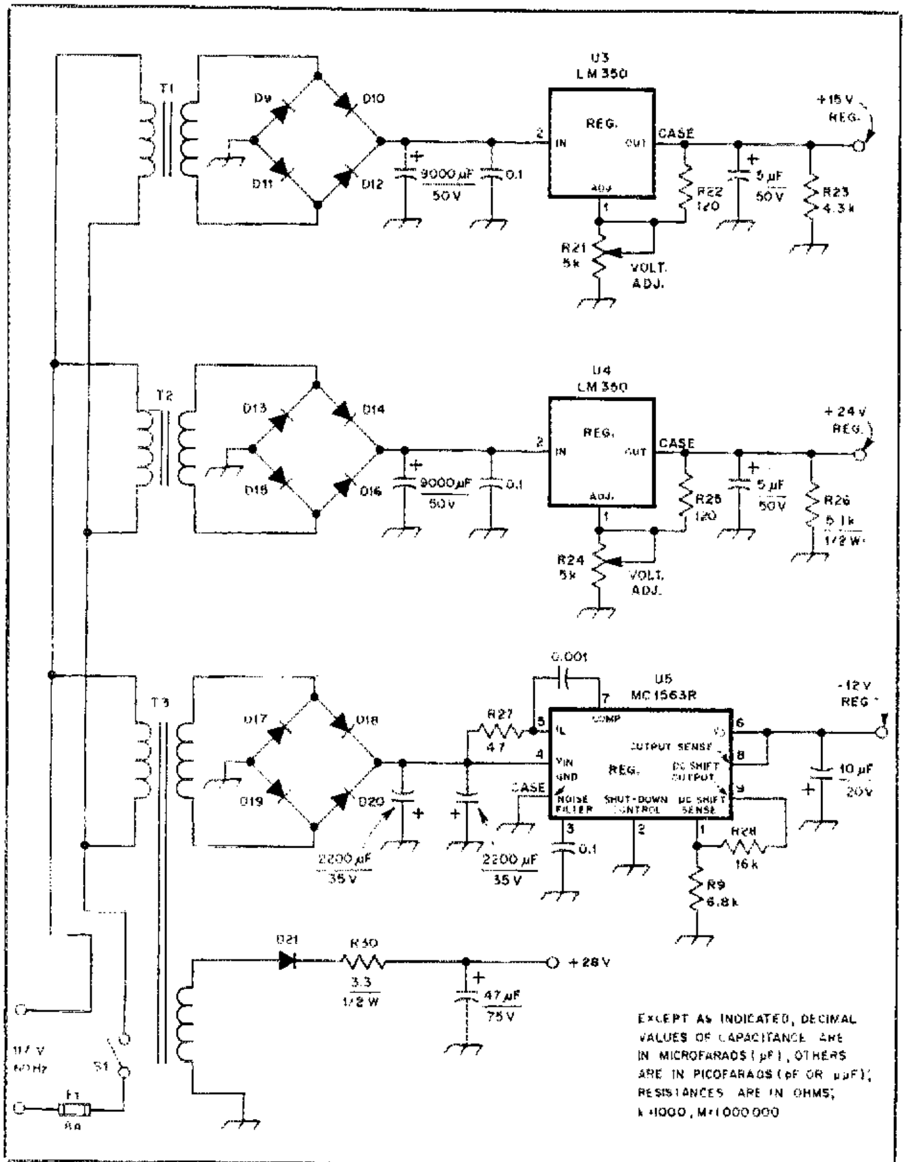
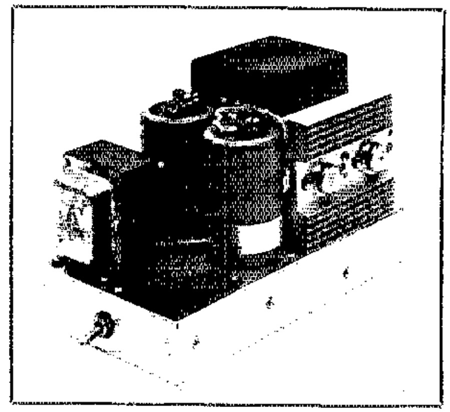


Fig. 11 — Power supply schematic diagram. This supply provides all the necessary voltages for operation of the transverter system. Unless otherwise specified, all resistors are 1/4-W, 5% carbon types, and capacitors are rated at 100 V. Polarized capacitors are electrolytic. Others are disc ceramic.

D9-12, incl. — 3-A, 100-V silicon rectifier diodes.
D13-16, incl. — 5-A, 100-V silicon rectifier diodes.
D17-21, incl. — 1/2-A, 100-V silicon rectifier diodes.
S1 — 10-A spst toggle switch.
T1 — 18-V, 2-A power transformer.
T2 — 26-V, 3-A power transformer.
T3 — 12.6-V, 0.5-A power transformer.
U3, U4 — Adjustable 3-A voltage regulator, National LM350 or equiv.
U5 — Adjustable 0.5-A negative voltage regulator, Motorola MC1563R, MC1463R or equiv.



This version of the transverter power supply was constructed around surplus transformers. The devices mounted on the finned heat sink are the regulators for the positive supplies.

stereo amplifier and from a local "junk" dealer.

A 5 × 9 × 1-1/2 inch chassis serves as the power-supply base. You may wish to use a larger chassis, especially if larger transformers are used.

The LM350 regulators are mounted on a standard heat sink which is bolted to the chassis top. Aluminum brackets under the chassis support the −12 V regulator and the power diodes. Mica insulating washers are used under the LM350s and the diodes. Be sure to apply heat-sink compound to the mounting surfaces of these devices and to the heat sinks.

The value of R28 can be selected to set the negative supply output to −12 V. R21 and R24 are adjusted to set the voltage of the +15- and +24-V supplies. An octal socket is used as the supply output connector.

With the addition of these units, the performance of your 220-MHz station will rival that of many stations currently active on the band. It is my hope that with the construction of this transverter system many new "explorers" will be heard on 220 MHz.

Notes

[1]R. Stroud, "Explore '220' with this State-of-the-Art Transverter!" *QST*, Aug. 1982, pp. 14-18.
[2]mm = in. × 25.4; m = ft × 0.305; km = mi X 1.6.

Strays

HIS DISABILITY ISN'T A HANDICAP

☐ Success stories like this one are heartening, for, despite being blind, Dr. Walter Horn (I4MK) of Persiceto (Bologna), Italy, is a chief electronics engineer at Akron, Bologna, and has designed many sophisticated circuits over the years. He believes that he is the only unsighted person in the electronics profession in Italy.

Dr. Horn has designed amateur equipment that has been described in *QST* and other amateur literature. He is currently developing a general-coverage receiver, a low-noise synthesizer, a 150- to 170-MHz synthesized transceiver and a solid-state a-m broadcast transmitter. (I wonder what he does to keep busy during his spare time!)

Walter equates his career to that of Marconi by saying, "G. Marconi proceeded from long waves to short waves, perhaps because he was tired of winding coils!" Walter has also gone from long waves (relative) to short ones (vhf). He summarizes by saying that, for the blind, "the most difficult task is certainly that of coil winding, especially if they are taped."

Other blind amateurs may get inspiration from talking to I4MK on the air. I'm sure he has some interesting tales to relate. — *Doug DeMaw, W1FB*

I would like to get in touch with . . .

☐ anyone who has an operating manual and/or a schematic for a Sigma AF-250L a-m/fm analyzer. Bob Witte, KBØCY, 2253 Evelyn Ct., Loveland, CO 80537.