

The Knight-Kit TR-106 6-Meter Transceiver shown with the V-107 6 and 2 meter V.F.O. The dials for both units are calibrated in 100 kc steps spaced about 3/16" apart. Rocker-type switches are used except for the crystal/v.f.o. selector. A slide switch for a N.L. on-off is located on the rear apron.



CQ Reviews:

The Knight-Kit TR-106 6-Meter Transceiver and V-107 V.F.O.

BY WILFRED M. SCHERER,* W2AEF

A RECENT kit added to the Knight-Kit line of amateur gear is the Model TR-106 6-Meter Transceiver. It incorporates a tunable double-conversion receiver and a 15 watt plate modulated transmitter with three crystal control positions. There also is a v.f.o. position with which an accessory v.f.o., the Model V-107, may be used. A built-in power supply operates from either 120 v.a.c. or 12 v.d.c. merely by attaching the appropriate plug and cable, facilitating either fixed or mobile installation. A 2 meter version of the transceiver, the Model TR-108, also is available.

Other features include: frequency range—50-52 mc, crystal-controlled front-end converter using a Nuvistor, self-adjusting a.n.l. with on-off switch, headphone jack, built-in loudspeaker, illuminated dial, illuminated meter automatically switched to read receiver S-units or transmitter relative-power output, transmitter-on light, adjustable pi-net output for 30-90 ohm loads, p.t.t. operation, crystal/v.f.o. spotting switch, high modulation with peak limiting, r.f., a.f. and mic gain controls, modern styling and rugged construction.

Receiver Section

Referring to fig. 1, the receiver section makes use of a 50 mc crystal controlled converter and a tunable 15.6-17.6 mc i.f. strip with a 2nd i.f. of 1650 kc. High primary and secondary image rejection is thereby obtained along with adequate selectivity for the job at hand.

A departure from the usual in 6 meter receivers is that the converter is installed as an individual self-contained unit and is designed for performance like that obtained with high-grade converters often used separately with a communications receiver.

High sensitivity and low noise are ensured

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through the use of a 6DS4 Nuvistor in the converter r.f. stage which is neutralized using the capacitance bridge method. See fig. 2. The pentode in a 6EA8 is the mixer, while the triode section functions as the h.f. oscillator using a 34.4 mc 3rd overtone crystal with conventional circuitry. Oscillator signal injection to the mixer is obtained through the inter-electrode capacitances of the tube.

The input of the r.f. stage is peaked at 50.5 mc and the output at 51.5 mc, while the mixer output is appropriately peaked in the 16 mc range so that the overall result of the stagger tuning is a relatively flat bandpass for 50-52 mc coverage. The input impedance is 50 ohms.

The converter is a completely shielded unit and has feedthrough type bypasses for all power leads. In addition, the output from the tuned circuit of the mixer is obtained by means of a low impedance link that is coupled with shielded cable to a low-impedance primary at the input of the variable i.f. stage. R.f. isolation is maintained and stray r.f. pickup, noise and spurious signal responses are minimized.

The 15.6-17.6 mc variable i.f. simply consists of a mixer using the pentode in a 6EA8. The triode section of the 6EA8 is a temperature compensated Hartley oscillator that tunes from 13.95 to 15.95 mc to provide a fixed i.f. output of 1650 kc. The mixer input is gang-tuned along with the oscillator to maintain peak performance over the range. Two stages, with double-tuned coupling transformers, are used for the 1650 kc i.f. A.g.c., obtained from the diode envelope detector, is applied to both i.f. stages. The a.n.l. is the self-adjusting series type.

Transmitter Section

The transmitter portion of the set begins with a 12DK6 pentode using fundamental type 8.3 mc crystals in a Colpitts circuit where the screen

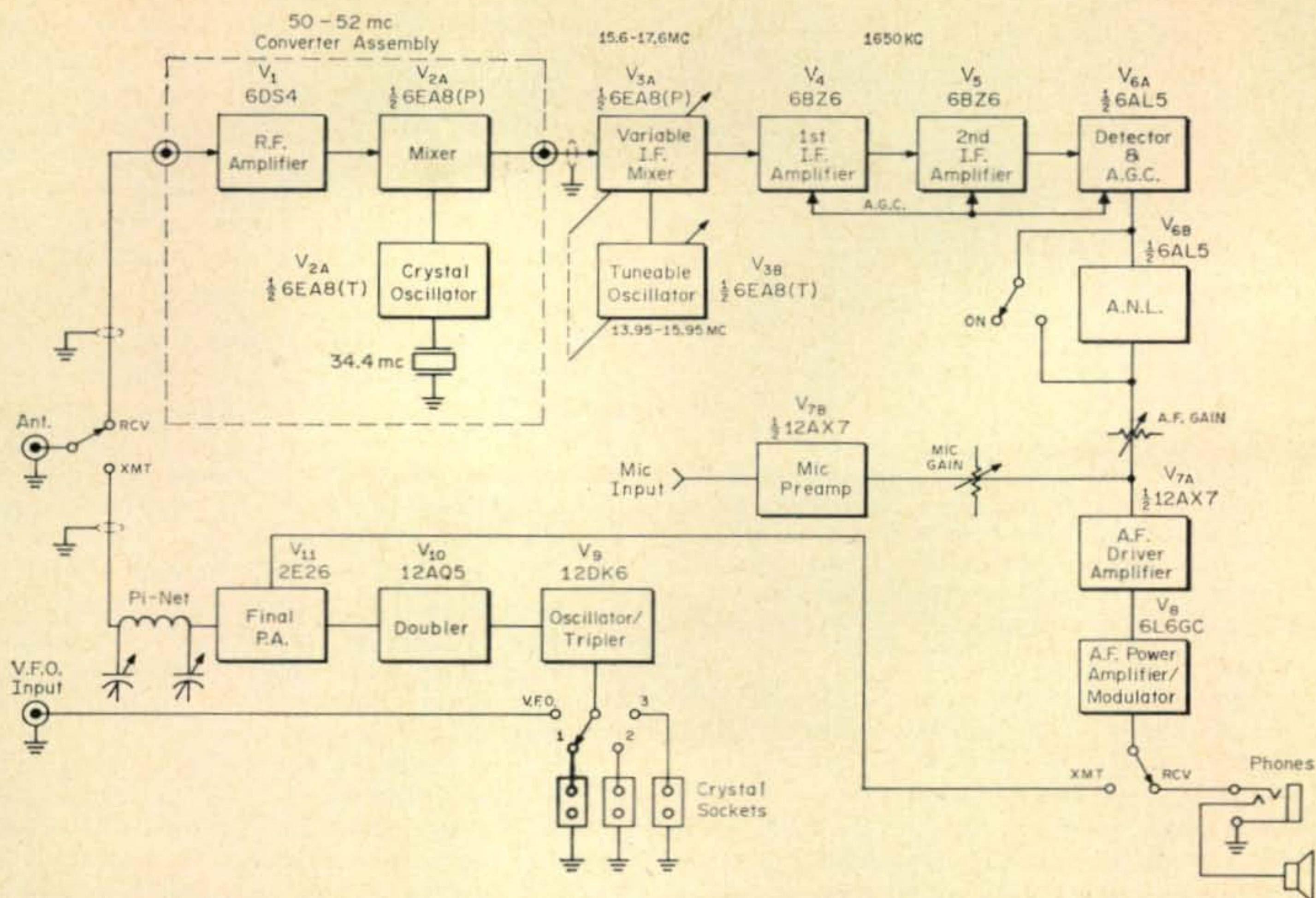
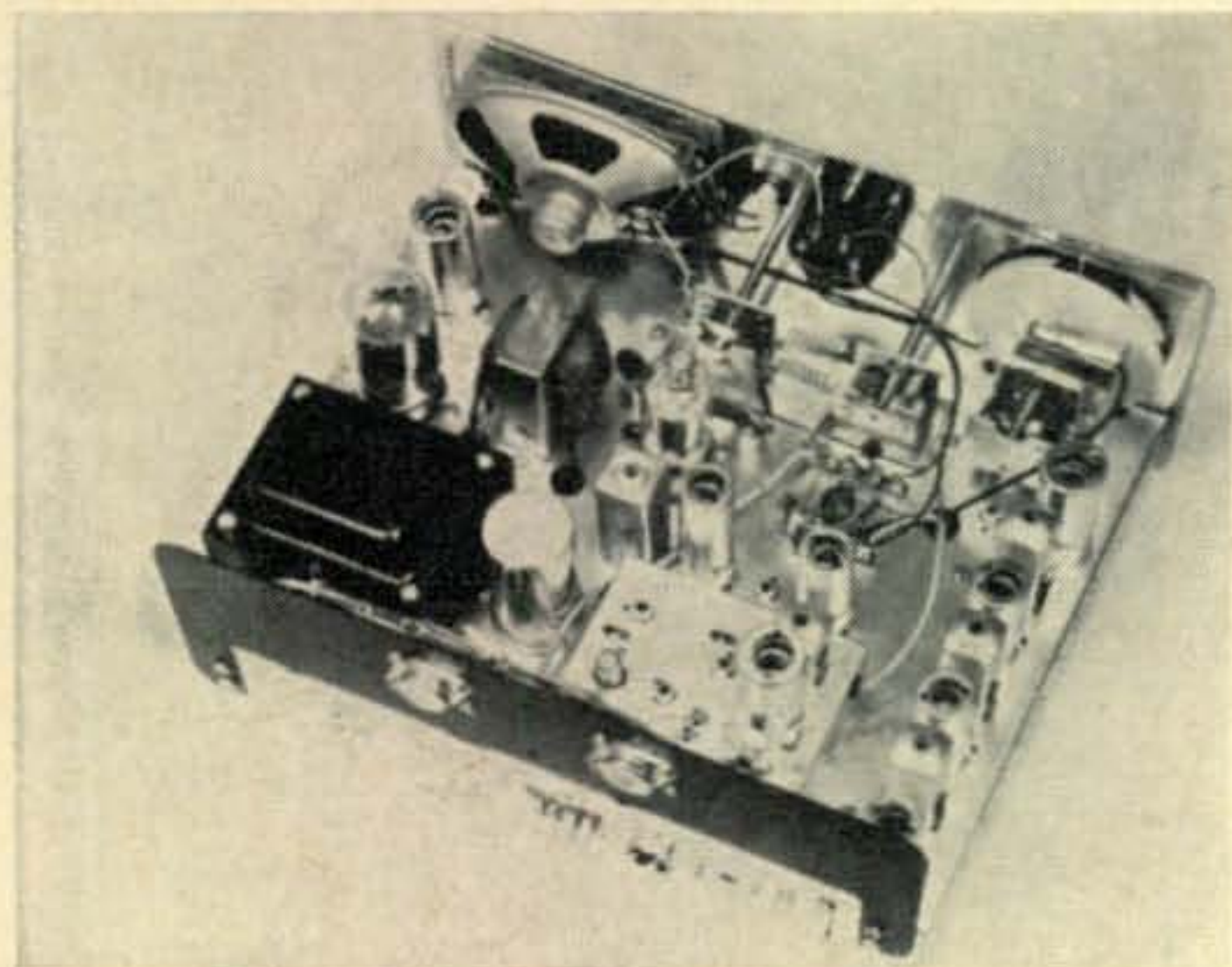


Fig. 1—Block diagram for the TR-106 transceiver. Power switching setup is not indicated.

of the tube serves as a triode plate. Frequency tripling to 25 mc is obtained with a tuned circuit at the pentode plate which is electron-coupled to the oscillator. A 12AQ5 is then used to double to 50 mc and to provide plenty of r.f. drive for a 2E26 straight-through final amplifier that utilizes an adjustable pi-net output circuit. Bias for the final is obtained from a grid leak and a "protective" self-bias cathode resistor. The 12AQ5 is inductively coupled to the 2E26 through a double-tuned circuit, providing sufficient bandpass without retuning and ensuring a measure of harmonic minimization. Neutralization of the final is not required.



Top-chassis view of the TR-106. The preassembled converter is shown in the foreground. The p.a. output circuit components are at the upper center. The receiver-tuning capacitor is at the upper right corner. Switching transistors for 12 v.d.c. operation are on the rear panel of the set (shown in foreground).

A four position switch allows the selection of any one of three crystals, for which there are plug-in sockets on the panel, or v.f.o. control for which there is a jack on the rear apron.

The a.f. power output stage of the receiver also serves as the modulator for the transmitter. This stage uses a 6L6GC which can provide more than enough a.f. power; however, the operating voltages and the transformer design have been set so that clipping takes place just before 100 per cent modulation.

A speech amplifier is used ahead of the a.f. driver, a 12AX7. Both a mic gain and the receiver a.f. gain controls are in the driver grid circuit, but interaction between the two is avoided using the scheme shown at fig. 3. A feature, particularly beneficial with v.h.f. gear, is that the cathode resistors of all the a.f. stages and the final p.a. are bypassed separately both for a.f. and r.f. to minimize the chances of r.f. feedback.

High frequency roll-off above 3000 c.p.s. is obtained with suitable shunt capacitors at the grids of the speech and a.f. power amplifiers. Switching between transmit and receive is handled by means of a relay operated by a p.t.t. button on the mic, but another switch also is provided on the panel. This is very handy for tuneup. During switching, a high voltage surge capacitor, connected across the primary of the a.f. output transformer, protects it against damage by voltage transients that might occur at the time.

The S meter functions in a bridge circuit connected in the B plus feed to the a.g.c. controlled 2nd i.f. During transmit, the B plus is removed and a diode automatically rectifies the r.f. out-

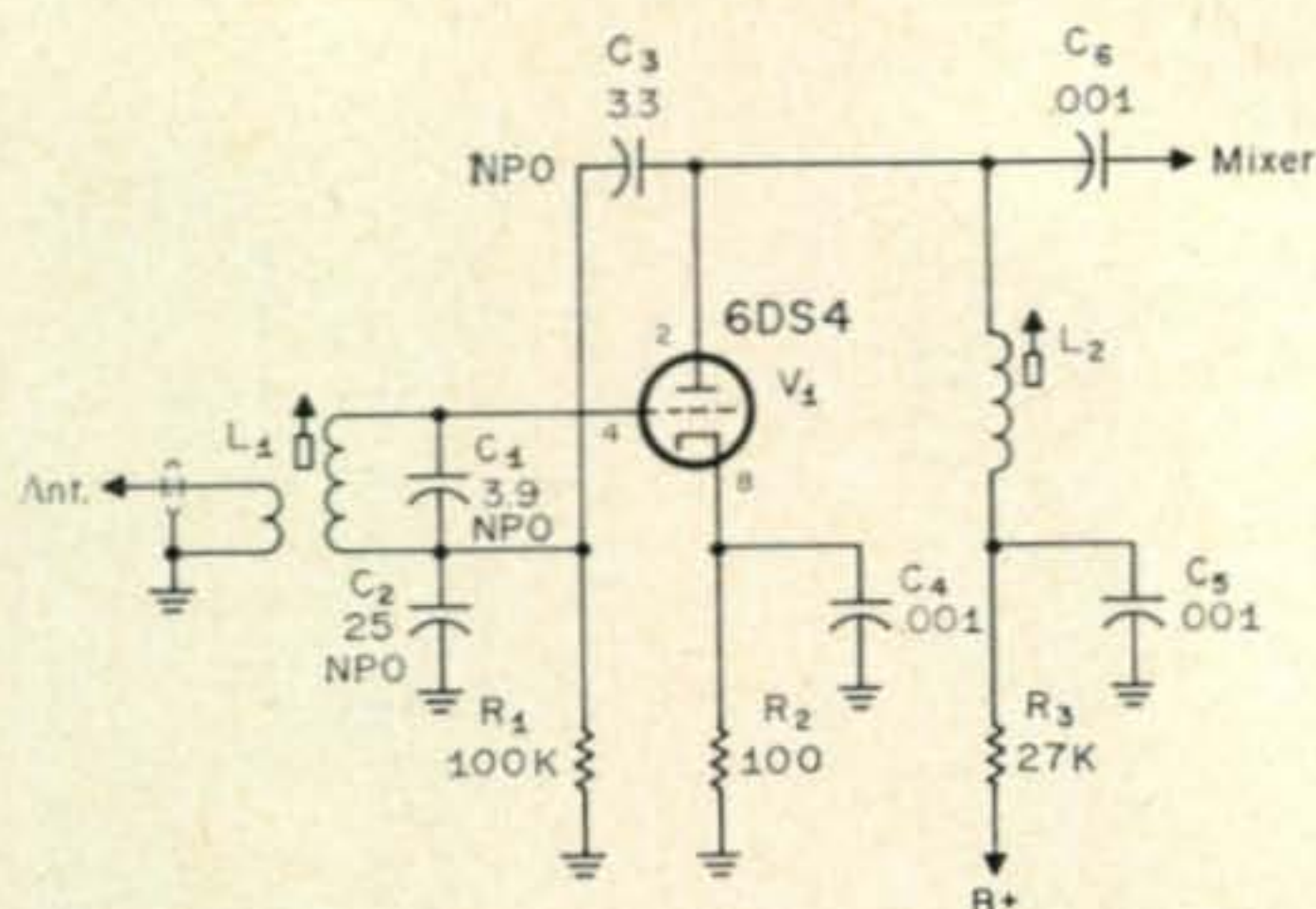


Fig. 2—Neutralization of the r.f. stage in the v.h.f. converter for the TR-106 is accomplished with the capacitance-bridge scheme as commonly used in a single-ended p.a. for transmitters. Circuit stability is obtained by properly proportioning the ratio C_3/C_2 with that of the grid-plate and grid-circuit-cathode capacitances at the tube.

put to actuate the meter for indicating the relative-output power. No manual meter switching is needed.

Power Supply

The power supply utilizes silicon diode rectifiers in a voltage-doubling setup with R/C filtering. The power transformer has two primaries, one for 120 v.a.c. operation, the other for 12 v.d.c. operation with power-type switching transistors employed in place of a vibrator as used before the advent of transistors. The switching rate is about 90 c.p.s. Separate fuses are provided for a.c. and d.c. operation and individual power cables with appropriately jumpered plugs are used for each type of primary power.

Assembly

The TR-106 went together quite easily. First of all, the v.h.f. converter is supplied already assembled and aligned. All you have to do is mount it on the chassis at the designated time and connect its power leads and shielded input and output cables. The rest of the work is conducted following step-by-step instructions that are given on the left pages of the manual in which the opposite pages on the right illustrate each associated step. Parts such as resistors and small capacitors are furnished on cards with each component individually identified by number. On the other hand, the neophyte might have difficulty in recognizing other components, because an illustrated hardware and parts identification sheet was not supplied with the kit.

An interesting twist in kit assembly instructions is that at many points it is suggested that the builder rest a while before continuing the work; good advice that should reduce fatigue and thus minimize the possibility of errors. Working at an easy pace, 25 hours of time were involved in assembling the transceiver.

Alignment

No adjustment of the converter is needed. The rest of the receiver may be aligned using a signal generator or with 8.3 mc crystals in conjunction with the crystal-spotting position. A v.t.v.m. is

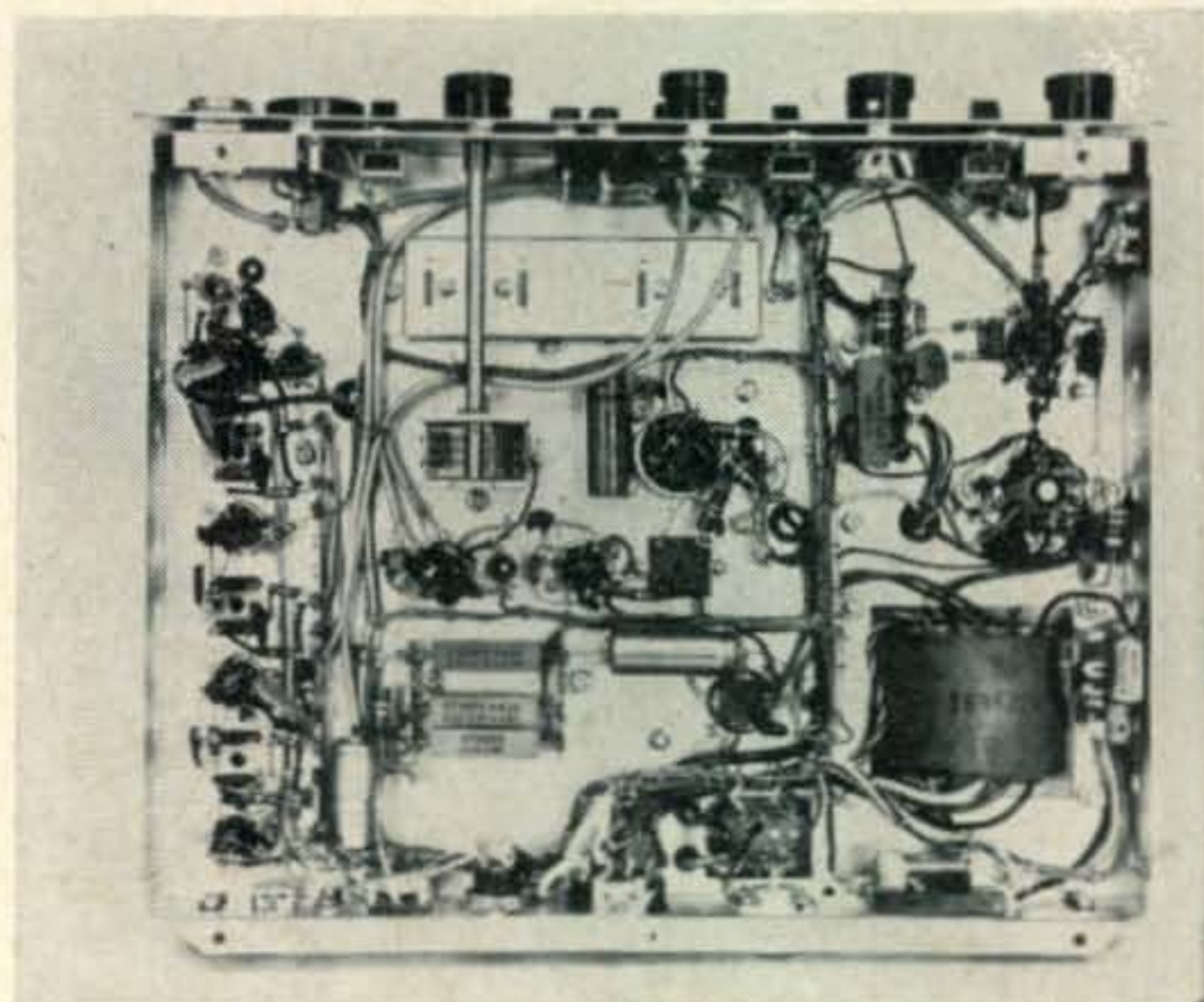
recommended for an accurate indicator, but the S-meter or background noise may be used as a substitute. The most stringent part of the tune-up is setting the calibration of the tuning dial. This requires one signal near the bottom of the band, another near the top, for which the builder most likely will have appropriate crystals. Transmitter adjustment is conducted in normal tune up fashion using the transmitter crystals.

Performance

With a 50 ohm source, the noise figure of the receiver was better than that of many converters we've checked out, measuring at 3.4 db. Taking into account the overall response of the setup, this would result in a sensitivity close to the specification of $0.5 \mu\text{v}$ for 10 db S/N ratio. The i.f. selectivity at the 6 db points amounted to 10 kc (rated at 8 kc). Signal rejection at the 1st i.f. (16 mc) and at the 2nd i.f. (1650 kc) was up to the ratings of 50 and 70 db respectively, while image rejection came within the rating of 55 db or better.

Frequency stability for the receiver was 15 kc drift during the first 20 minutes from a cold start at 70° ambient, 2 kc the next 30 minutes and 1 kc per hour thereafter. This is well within the requirements for a.m. reception in relation to the i.f. bandwidth and eliminates the need for chasing a signal around as is so often experienced with some transceivers.

With 120 v.a.c. or 13.6 v.d.c. power applied, the transmitter carrier input was 14 watts, the r.f. output 6.75 watts. Modulation was possible up to just under 100% where both the negative and positive peaks squared off. No negative-peak overmodulation nor carrier breakup was observed. Good waveform was found below the clipping point. In this regard, high mic gain can result in excessive clipping and distortion, so during operation it will be best to adjust the mic gain to where the relative-output meter kicks only slightly. It was gratifying to find that this rig "fully" modulates, inasmuch as many 6 meter signals we've heard produce little effective voice power due to insufficient modulation.



Under-chassis view of the TR-106. A neat wiring job can be made which is facilitated by a wiring harness furnished with the kit.

Although protective cathode bias is used on the final p.a., loss of excitation should not be tolerated very long, since the plate dissipation of the 2E26 (without r.f. drive) was found to rise somewhat above the tube rating.

As may be seen from the photographs, the TR-106 is nicely styled in a wrap-around case. Its size is $5\frac{1}{2}" \times 13\frac{1}{8}" \times 11"$ (H.W.D.).

V-107 V.F.O.

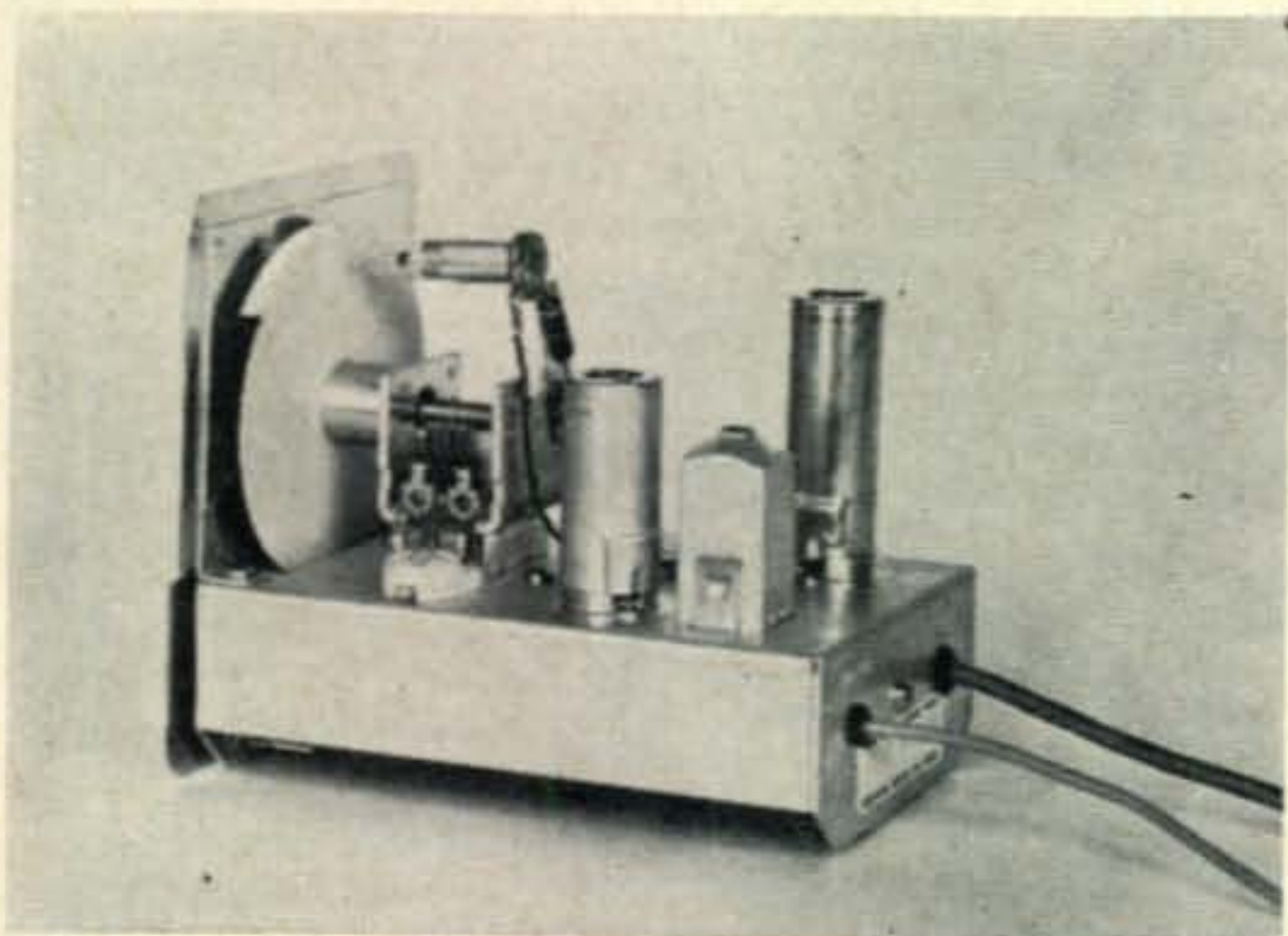
The Model V-107 Accessory v.f.o. is designed for use with either 6 or 2 meter gear. On 6 meters it takes care of only the lower portion of the band from 50 to 52 mc. Full band coverage is obtained with 2 meters.

A 12DK6 pentode functions as an electron-coupled oscillator in the familiar series-tuned Colpitts or Clapp circuit using the screen grid for a triode oscillator plate, while output is obtained from the pentode plate which is tuned to the oscillator frequency.

The actual frequency range of the v.f.o. is 8.333-8.666 mc, which when multiplied in the transmitter, provides the 6 meter coverage. For 2 meter use the v.f.o. has to be aligned to operate on 8.0-8.222 mc. Temperature compensation, double-spaced tuning capacitor, voltage regulator, rugged components and careful structural design provide excellent thermal, mechanical and electrical characteristics that result in good frequency stability. Special attention also has been paid to operating voltages that will result in as harmonic-free an output as possible for minimizing spurious signals that could cause TVI. Frequency multiplication is left up to the transmitter itself.

Power for the v.f.o. is obtained from an external source, such as the TR-106 Transceiver. For use with other gear, the power requirements are: 12.6 v. a.c. or d.c. @ 150 ma and 200 v.d.c. @ 30 ma. The r.f. output potential is rated at 20 v. r.m.s. minimum into 47,000 ohms shunted by 30 mmf. The unit has its own STANDBY-OPERATE switch, but it also may be controlled by the transmitter switching facilities.

The v.f.o. has a vernier driven dial (6:1 ratio) that is back lighted and which has two calibrated scales, one for 6 meters around one half of the



Chassis view of the Knight-Kit V-107 6 and 2 meter v.f.o. The taller tube shield surrounds the voltage-regulator tube.

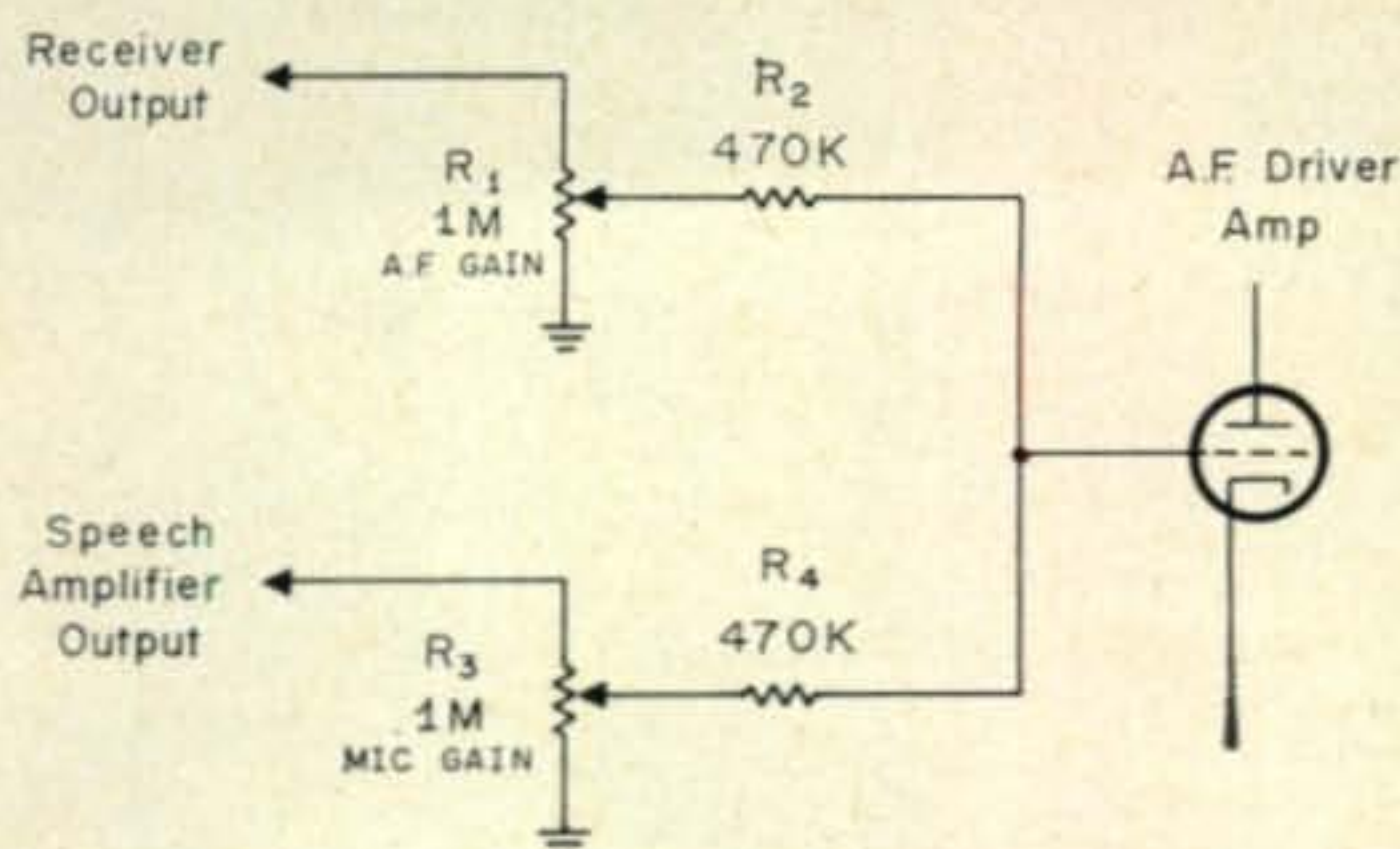


Fig. 3—Circuitry used in the TR-106 for connecting both the A.F. and MIC GAIN controls across the amplifier-tube grid without causing interaction between the controls. It is seldom seen in amateur gear, but is quite common in audio equipment. R_2 and R_4 prevent resistive loading or a short-circuit at the output of one control by the other control when the latter is near or at minimum setting.

perimeter, the other for 2 meters along the second half. The dial is positioned on the shaft of the tuning capacitor according to the band for which the v.f.o. has been set up. In this respect, operation without realignment is possible on only one range at a time, thus making the job a one band affair according to the user's choice.

The v.f.o. may be aligned and calibrated by zero-beating against transmitter crystals in the spotting position of the receiver or by listening on a receiver that tunes the 8-8.66 mc range. With the former method, it was found that there were several points where the zero-beat could be obtained. Incorrect adjustment is indicated when tracking with proper calibration cannot be achieved over the v.f.o. scale or if the transmitter does not function with the v.f.o. after tuneup has been made using crystals. In either case, it will be necessary to start over again, re-adjusting the coil slug to a new point where a beat with the crystals can be obtained.

The frequency stability of the v.f.o. was; 3 kc drift during the first 30 minutes of operation from a cold start at normal ambient, another 4 kc the next 30 minutes and then 1 kc or less per hour. Hard banging of the v.f.o. case did exhibit slight frequency vibration and shaking the unit introduced some frequency shimmy; however, such conditions are not likely to occur with fixed operation, nor would these effects be detrimental to a.m. work. Line-voltage variations of $\pm 10\%$ produced only a ± 200 c.p.s. change which shifted slowly as the tube heater temperature drifted. Unlike some 6 meter v.f.o.'s and even with crystals, the frequency does not shift or creep at the start of each transmission.

A tendency toward r.f. feedback was evidenced by a slight ripple of the v.f.o. output, unless its output coil is tuned to a critical point. We therefore suggest that when this circuit is finally tuned, you listen on a receiver with a b.f.o. for the attainment of the setting on L_2 that results in a T9 signal when the output is near maximum.

[Continued on page 100]



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it still further by adjusting the *L* control. As these controls interlock somewhat, the best null will be arrived at by successive approximations. Final adjustment is best done by plugging a scope into the OUTPUT position, as the attainable null gives almost no reading on the v.u. meter.

When the best possible null is obtained, recheck by replacing the sine wave input to the patch by a voice signal, and note the results. With the equipment used, and any ordinarily good phone line, the null obtained with a sine wave input will be about -40 d.bm, plus or minus 5 db. With a voice signal, null depth will be about 10 db less, the exact difference will depend upon the amount of limiting used and the speaker's voice pattern.

The null obtained on a long distance circuit will not be exactly the same as that on a local circuit, but, with the resistive pad between the hybrid transformer and the line, this difference is not likely to cause any trouble with vox operation, and the unwanted signal, under worst conditions, is not likely to exceed -20 d.bm.

Performance

This phone patch works consistently and well, somewhat outperforming two commercially made phone patches, and providing monitoring and recording conveniences not included in the commercial devices. Frequency characteristics are ideal for male voices speaking American English, and are workable, although not ideal, for female voices, and for most western European languages.

The monitoring feature makes possible continuous "riding of gain," adjustment of limiting for ambient conditions, and insertion of fill-ins and translations when that is desirable or necessary. The recording feature is most helpful at times, and the beeper prevents any possibility of trouble from the recording feature. ■

Priscilla Paris [from page 32]

She has a 2-meter rig and is hoping to build other gear, though her busy schedule leaves little time for it.

Originally residents of the San Francisco Bay area, the Paris Sisters—Albeth, Sherrell and Priscilla, and all "real sisters—moved to Los Angeles to be near the center of the entertainment world. Priscilla has been in the entertainment field since she was four years old and during the past fifteen years the girls have toured most of the world and have entertained in night clubs, on TV and at military bases.

The Paris Sisters have made many hit records, among them "I Love How You Love Me" (which earned them a Gold Record) and "Soldier Boy." They are currently making records for "Reprise." They are under contract to MGM which will develop television and motion picture properties for the girls as well. They are doing a TV series entitled "The Glass House," and have appeared with such TV stars as Red Skelton, Dinah Shore, Jack Paar, Arthur Godfrey, Roy Rogers, Steve Allen, Arthur Murray, Ed Sullivan, etc. Supper clubs where they have entertained include Harrahs at Lake Tahoe; The Roosevelt, New Orleans; The Dunes, Flamingo, Tropicana and Sands at Las Vegas; and world-wide spots like The Copa and The Latin Quarter in Tokyo, and El Patio in Mexico City.

Young, talented and beautiful, these girls are a favorite with servicemen at bases around the world, and most recently in Viet Nam. Such appearances are no novelty to Priscilla and her sisters for as pre-teenagers they performed for many military camp shows around San Francisco.

WN6RNR not only stars as a singer, but she also plays guitar and writes songs, many of which she and her sisters have presented in supper clubs and on TV appearances.

Good luck to you, Priscilla—we're hoping you'll make that General soon and continue on the air as an amateur operator as well as a successful, professional star! ■

CQ Reviews the TR-106 [from page 53]

The V-107 is styled to match the TR-106 Transceiver. Its size is $5\frac{1}{2}" \times 4\frac{5}{16}" \times 6\frac{1}{2}"$ (H.W.D.)

The Knight-Kit TR-106 6-Meter Transceiver is priced at \$139.95 (kit), including preassembled and aligned front-end converter, all necessary parts, noise-canceling p.t.t. microphone, assembly and operating manuals. The latter, by the way, includes interesting data on TVI traps, a.c. power line filters, R/C filter for BCI, mobile noise suppression, etc. The TR-108 2-Meter Transceiver kit is \$144.95, equipped as above. The V-107 v.f.o. kit is \$19.95. Crystals are not furnished with the kits but are available at \$2.95 each. Other accessories are a mobile mount at \$7.50 and a base on which to mount the v.f.o. and a transceiver together for desk-top use, priced at \$6.95. These products are marketed by Allied Radio Corp. 100 N. Western Ave., Chicago, Ill. 60680. ■