

The Heathkit HW-16 Novice

C.W. Transceiver



CQ

Reviews:

The Heathkit HW-16 Novice C.W. Transceiver

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MUCH of the amateur gear placed on the market in recent years has been designed with the phone operator in mind, particularly for use with single-side-band. Cost is relatively high and provisions are sometimes not included for c.w. operation, and where they are furnished, it is often done simply as an "afterthought".

As a different approach, the Heath Company has come up with a low-cost c.w.-only job, the HW-16 Novice C.W. Transceiver. Although directed at the 80-40-15 meter Novice, it also provides high performance

with the basic essentials for the General, Advanced and Extra Class licensees as well and consequently will not be outmoded for c.w. use when the Novice upgrades his license status. It also makes a convenient and all-inclusive package for fixed, portable or field-day operations.

The transmitter section is adjustable for power inputs of 50-90 watts and is crystal-controlled. A v.f.o. input also is provided for later use. Grid-block keying is used on the transmitter, while the receiver is muted with bias and its input is cut off with a solid-state TR switch. There are no relays and

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full break-in is possible, even at high speeds. Built-in sidetone permits keying to be monitored, an especially helpful feature for both the Novice and high-speed artist.

The output is fixed for 50-ohm loads and only one tuning adjustment is required for the entire transmitter when the frequency or bands are changed. There also are r.f. and a.f. gain controls, a power level control and two crystal sockets, one each for standard-size holders (pin spacing of .486") with pin diameters of .050" and .093". 80 or 40 meter crystals or v.f.o. may be used.

The receiver is a dual-conversion job for high image rejection and frequency stability. The latter is ensured with a crystal-controlled h.f. front-end, augmented by the use of a low-frequency v.f.o. at the second conversion. The frequency ranges cover the lower 250 kc portion of the 80, 40 and 15 meter bands. Sharp selectivity, especially tailored for c.w., is provided with a 500 c.p.s. crystal-lattice filter, while a clean-tone c.w. beat is obtained from a product detector excited by a crystal-controlled b.f.o.

Other Features

A large easy-to-read circular dial has one scale calibrated quite linearly from 0-250 kc in 5 kc steps spaced about $\frac{1}{8}$ " apart. It is operated by a pinch-drive mechanism that furnishes vernier tuning with about 20 kc of coverage realized with one revolution of the tuning knob.

The rear of the set is equipped with phono-type jacks for the antenna and a loudspeaker, while standard-type phone jacks are provided for the key and headphones. An auxiliary socket supplies power and block-grid keying facilities for an external v.f.o.

A built-in power supply is an all solid-state affair and is protected from overload by a self-resetting circuit breaker.

The dimensions for the set are $6\frac{1}{2}" \times 13\frac{3}{4}" \times 11\frac{1}{2}"$ (H.W.D.) and it weighs 20 pounds.

Circuit Details

A block diagram for the HW-16 is shown at fig. 1. The transmitter section starts off

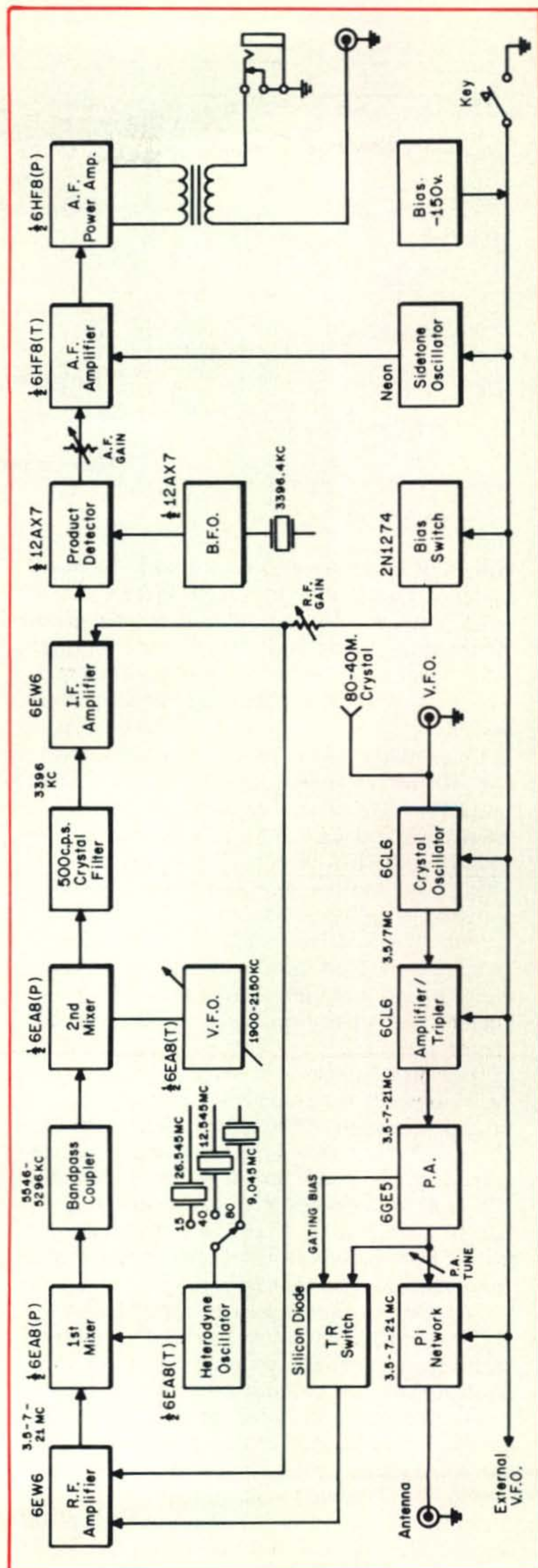
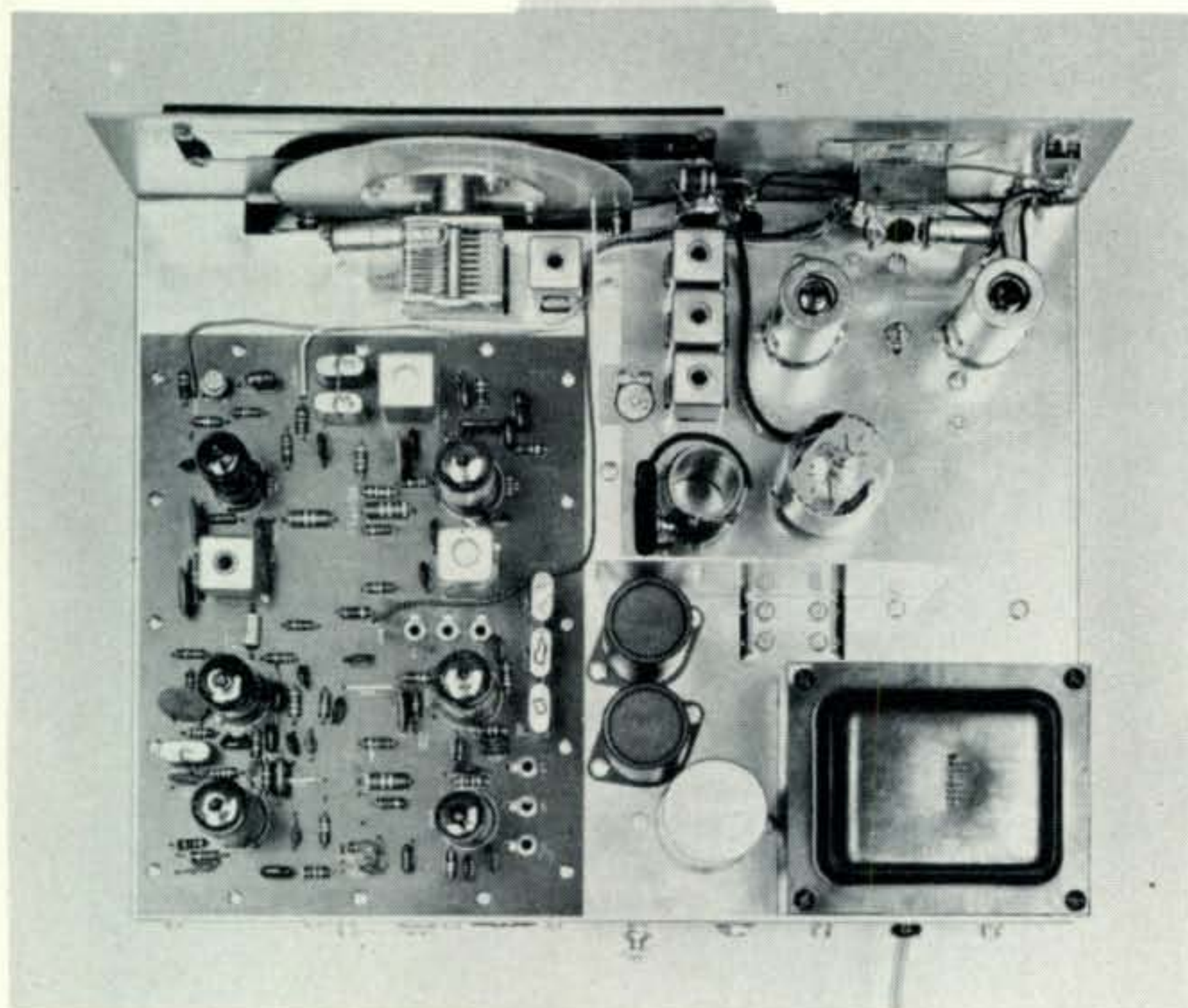


Fig. 1—Block diagram for the HW-16. Details are given in the text.



Top view of the HW-16. The circuit board for the receiver is at the left with its v.f.o. tuning capacitor and dial near the panel. The transmitter section is at the upper right, the power supply is at the lower right.

with a 6CL6 crystal oscillator with 80 or 40 meter crystals in a modified Pierce circuit used between the control and screen grids. A separate input jack to the grid permits v.f.o. operation for upgraded licensees. The plate circuit is fix-tuned to 40 meters and thus allows the tube to function as a doubler with 80-meter crystals (or v.f.o.) for 40 or 15 meter operation, or as an amplifier with 40-meter crystals. Low-C is used here and with 80-meter operation, the circuit inductor merely serves as an r.f. choke and the pentode plate operates as an untuned amplifier.

The 6CL6 driver stage is bandswitched with fix-tuned circuits at the plate. It functions as an amplifier for either 80 or 40 meter-band operation, as a tripler for 15-meter use.

The final stage is a 6GE5 Compactron beam-power tube which operates as a straight-through Class-C amplifier on all bands. A pi-network output circuit is designed with fixed loading for essentially 50-ohm impedances (or s.w.r. up to 2:1) and is obtained by fixed capacitors engaged with the bandswitch. Capacitance-bridge neutralization is employed.

R.f. output is sampled and rectified by a diode to provide d.c. to operate the relative-output meter which also can be switched to indicate the p.a. cathode current.

A control is included to adjust the p.a. screen voltage, so that the power level may be set within the legal bounds of 75-watts input for Novice-Class operation. This is indicated by a red calibration marker on the meter. For higher-class operation, the input

may be raised to 90 watts. The block-grid keying is used on all stages of the transmitter, including an external v.f.o. that might be in use.

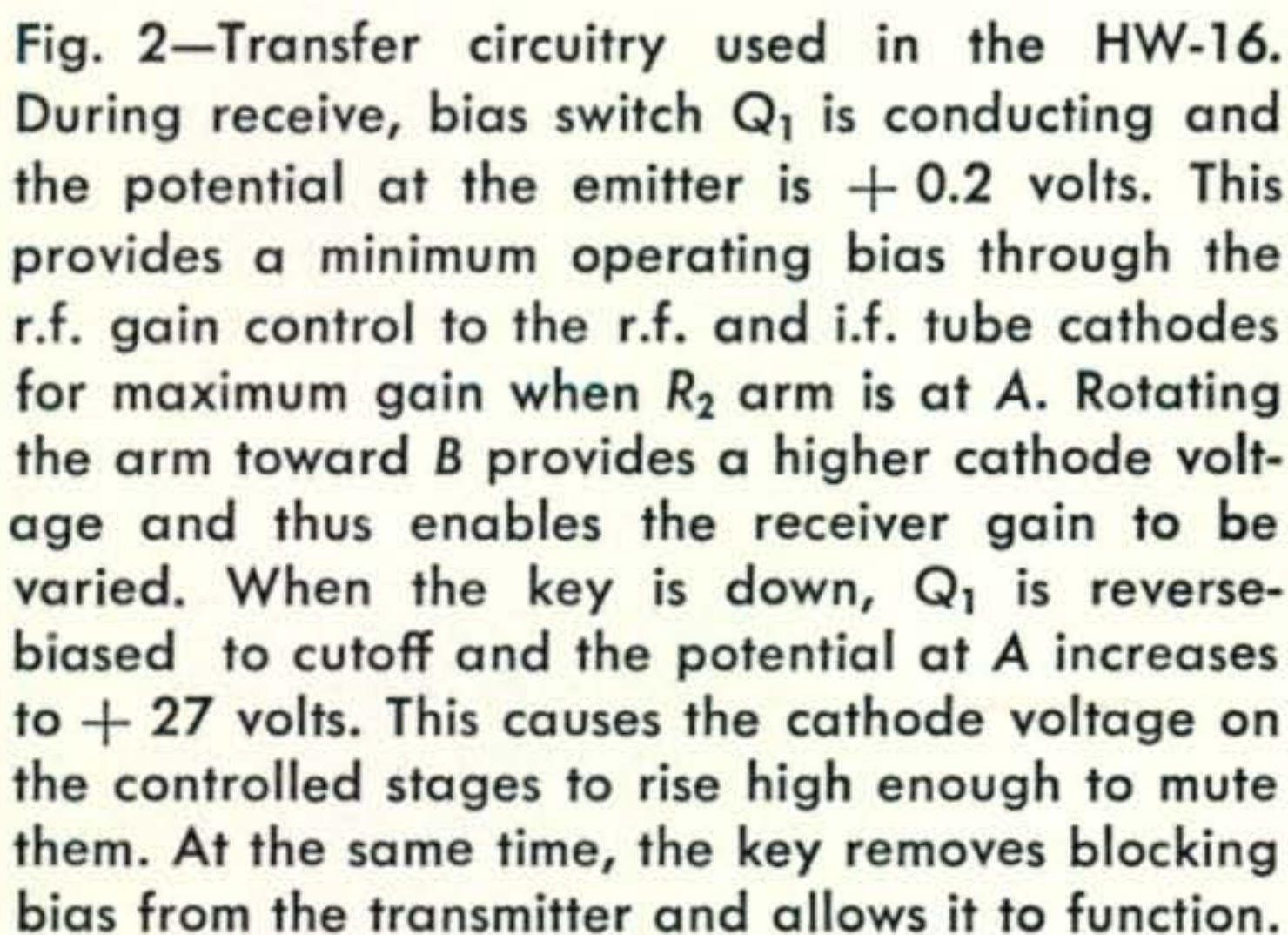
Receiver Section

The dual-conversion receiver uses a first i.f. of 5546-5296 kc and a second i.f. of 3396.4 kc. It has a 6EW6 r.f. stage, the input of which is tuned by the p.a. Pi-network. The plate is fix-tuned with bandswitched broadband circuits for the related range. The first-conversion stage is a 6EA8 the pentode section of which is the mixer. The triode portion is the heterodyning oscillator which is crystal-controlled using a plate-tuned configuration. Injection to the mixer is through stray-capacitance coupling within the tube.

The mixer output is coupled through a bandpass circuit to the second-conversion stage consisting of another 6EA8 pentode mixer with the triode used for a tunable injection oscillator. This v.f.o. functions in a Colpitts circuit on a single range of 1900-2150 kc with injection to the mixer taken from a tap on the feedback capacitance divider. The resulting i.f. at the mixer output is 3396 kc.

This signal is fed to an i.f. amplifier stage through a two-pole crystal filter using 3395.15 and 3395.45 kc crystals to provide a 6-db bandwidth of 500 c.p.s.

An audible beat is obtained from a conventional-type product detector with a b.f.o. signal derived from a crystal-controlled triode, oscillator. The frequency is 3396.4 kc,



so that a beat of about 1000 c.p.s. is obtained when the signal is peaked in the filter passband.

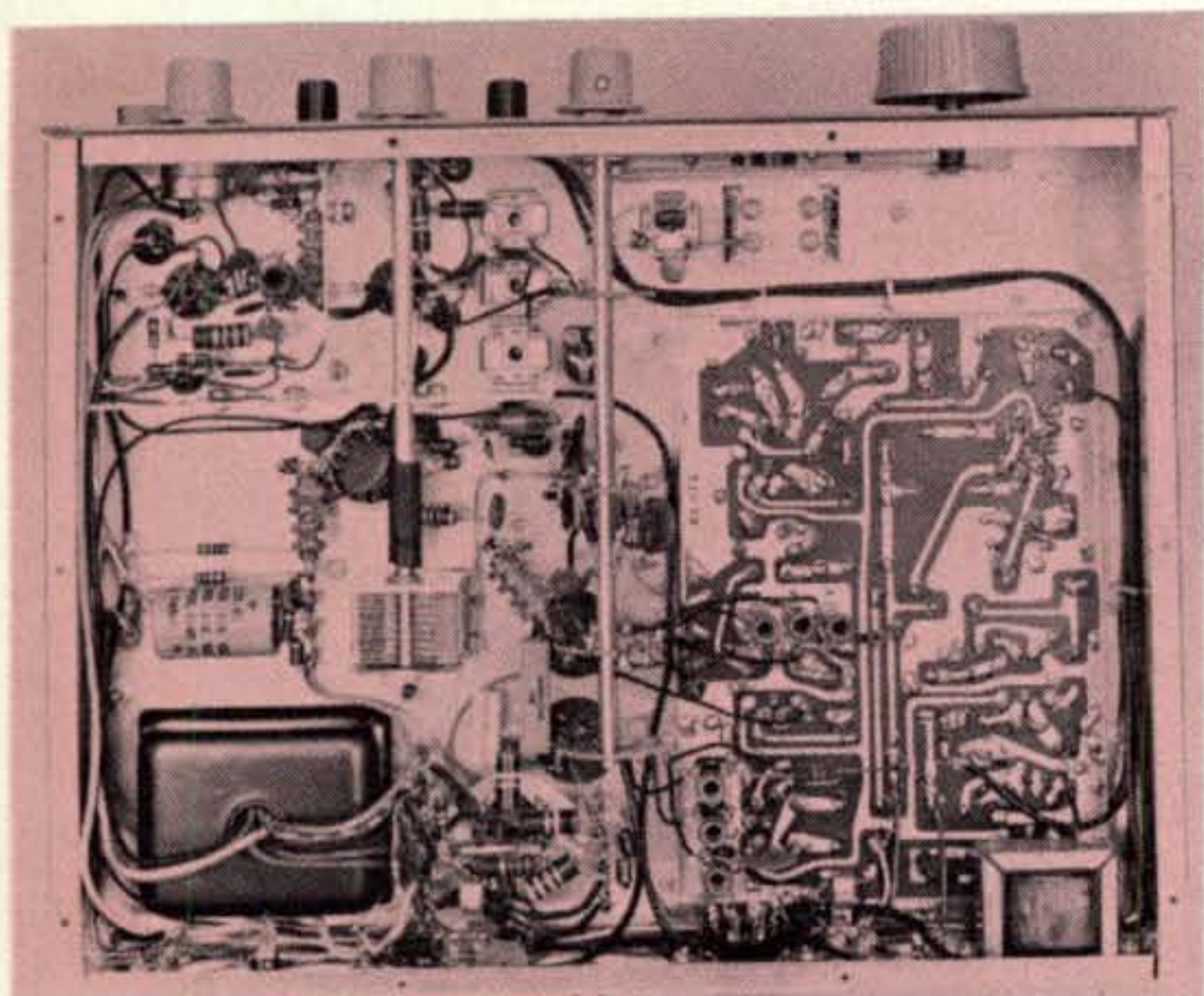
The output from the a.f. power amplifier can be fed either to an external loudspeaker or to headphones. A closed-circuit phone jack is in series with the speaker jack and when the headphones are plugged in, the speaker remains in the circuit, but due to the high impedance of the phones, the speaker level drops to an insignificant amount without affecting headphone operation.

The r.f. gain control affects the r.f. and i.f. stages. There is no a.g.c.

Referring to fig. 2, when the key is de-

pressed, it removes the blocking bias from the transmitter stages and mutes the receiver through a "bias-switching" transistor. A diode TR switch, activated by d.c. from the p.a. cathode, disables the receiver antenna input. Unlike most conventional TR switches, this one does not generate r.f. harmonics. It is one often used in advanced CB gear, but it is the first such arrangement we've seen in ham equipment. Also shown at fig. 2 is the sidetone-oscillator circuitry which is a relaxation type using a neon bulb.

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Bottom-chassis view of the HW-16. It is a neat and uncluttered affair with plenty of "elbow room." The p.a. tuning capacitor is at left of center.

volts bias. A 3-ampere circuit breaker is contained in a small glass envelope below the chassis and is installed in the 120 v.a.c. circuit to provide overload protection. Should the circuit-breaker trip, it will reset itself after several seconds.

Assembly

From our past experiences with kits, the HW-16 is one of the easiest to put together, so the work should pose no problems for the newcomer.

The receiver section is assembled (by the consumer) on a printed-circuit board, thus simplifying much of the work and ensuring proper wiring and lead dress and minimizing the possibility of errors. The transmitter and power supply are built on the chassis with point-to-point wiring. Only three stages are involved for the former and there is plenty of room in which to do the work.

Although the job can be done in about 15 hours by an experienced hand, we recommend that the newcomer take his time, carefully studying each instruction step and making certain it is understood before proceeding with it. Frequent reference to the top and bottom chassis-view photographs at the rear of the manual will be helpful for noting exactly how most of the components should be positioned, particularly in one or two "tight" spots, such as where the resistors are clustered around electrolytic capacitor *S* as outlined in most of the steps in column 1 on page 29 and as illustrated in pictorial diagram 15. It also will pay to look ahead to

see how the bandswitch will eventually be mounted, so that a few components, which are to be previously installed near it, will allow proper clearance.

After the wiring is completed, examine each connection carefully to make sure it is well soldered, especially on the circuit board and at tie-strip terminals where two or more leads are connected. Also check the circuit board for "solder" shorts between foils. A magnifying glass will be helpful for these observations.

On the referred-to photos, the components are identified by the schematic designations, thus making it easier to locate the various parts, should this be necessary with tracking down difficulties or with other service work.¹

Alignment

Initial test and alignment requires the use of a v.t.v.m. (or 20,000 ohms-per-volt v.o.m.), a few 80 and 40 meter crystals and a 50-ohm dummy load. The inductors and transformers have been preset at the factory, so only slight retuning may be needed, thus making the alignment simply and quickly accomplished. The receiver v.f.o. similarly requires only slight retouching which is done in conjunction with a crystal near each end of the 80-meter range.

Performance

The measured performance of the HW-16 was as follows: Transmitter Power Output: 38 and 45 watts with input of 75 and 90 watts respectively, slightly less on 15 meters; Receiver Sensitivity: 1, 0.5 and 0.25 μ v on 80, 40 and 15 meters respectively²; Image Rejection: at least 70 db on 80 and 40, 65 db on 15; I.F. Signal Rejection (5.5 mc): 50, 40 and 60 db on 80, 40 and 15 respectively, (3396 kc) at least 75 db on all bands; Selectivity: 490 c.p.s. @ 6 db, 2.3 kc @ 60 db; Stability: 250 c.p.s. drift after 15 minutes from cold start at 68° F. ambient, 350 c.p.s. next 30 minutes, 100 c.p.s. or less per hour thereafter. With $\pm 10\%$ line-voltage changes the frequency shift was ± 40 c.p.s. at instant of change, otherwise ± 10 c.p.s. No frequency shifting or microphonics occurred under conditions of vibration.

Although no obvious TVI precautionary measures are included in the unit, such as

¹ An X-ray view of the circuit board also is included.

² For 10 db signal-to-noise ratio.