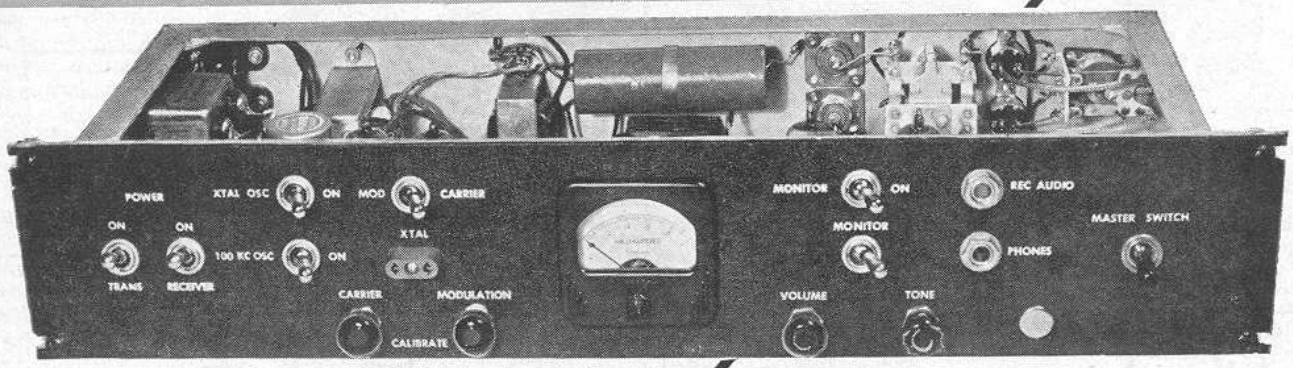
A Complete Control Unit for the Ham Station



Front view of the complete control unit, showing layout of panel controls. Standard panel measures 3½" x 19". Power supply and the relays are visible at the rear of the open frame chassis.

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A centralized control assembly for use with amateur rigs in the 100-150 watt power class. The design permits primary power distribution and power switching as well as transfer from "send" to "receive" with a single control switch. Also incorporated are operational accessories such as 100 kc. standard and additional marker oscillators, an r.f. carrier and a.f. modulation monitor with meter-type indicator, as well as "Monitone" CW and AM monitoring facilities.

TRANSMITTERS of the hundred-watt power class are tremendously popular with amateurs, and an examination of modern designs of such equipment indicates that this popularity is well deserved. It will be noted that certain criteria are evident in the designs, irrespective of whether they are commercial units, kits intended for home assembly, or "home brew" designs, such as have appeared in various publications. Invariably, such equipment tends toward a neat, compact, self-contained assembly. Dependable circuits featuring modern tube types are used, with TVI reduction measures incorporated in the design. Such rigs, in their compact form, are able to be nestled beside a receiver to provide a true "desk-top" station.

Equally obvious, and most important, is the attention being directed toward ease of operation. Operational convenience, in fact, is of prime importance to any amateur station. Naturally, such features as bandswitching for both transmitter and receiver, complete front panel control, pie-tank tuning circuits for final r.f. stages, and the like, all contribute to operating ease.

Additionally, when discussing station operating convenience, it is worthwhile to consider the role played by accessories such as monitoring and measuring equipment, for both transmitting and receiving. Likewise, no station can be conveniently operated unless the transfer from receive to transmit can be made with a single switch.

It was with these particular needs in mind, that a complete control unit was designed and assembled, in order to coordinate the operational activities of the station and thereby make operating a decided pleasure.

Design Considerations

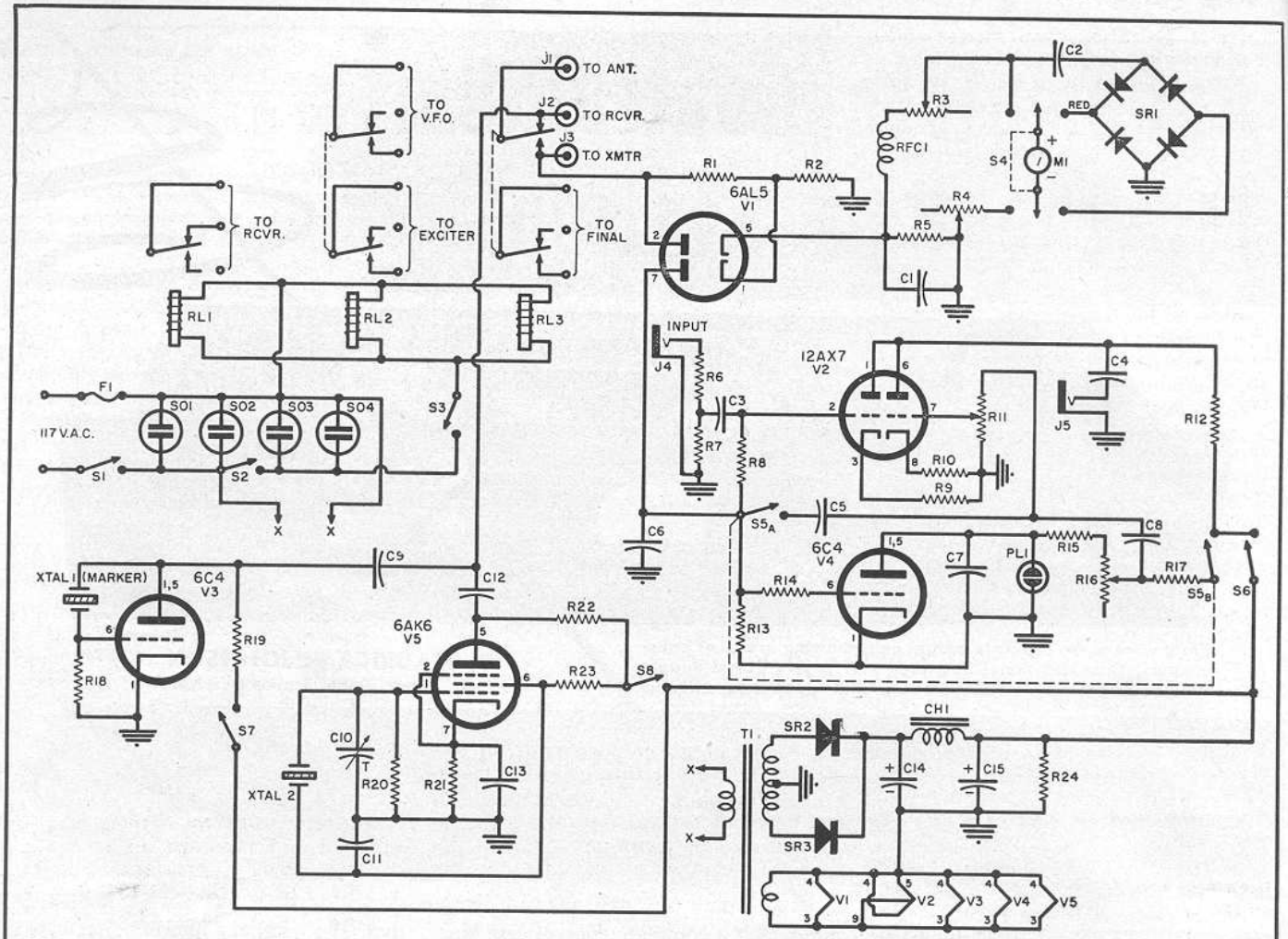
The control unit to be described is intended to consolidate the switching requirements of the transmitter and receiver in the normal procedures of send-receive operation. In addition, included within the unit are certain accessories which were considered essential or desirable in the operation of the ham station.

In considering the design, it was initially decided that the most logical placement for the control unit would be directly below the receiver. It is usually necessary to elevate the receiver over the operating desk in order to position the tuning knobs at the most comfortable height of six to eight inches above the table. This indicated that a 3½" panel could be fitted below the usual receiver, and the design of the control unit was undertaken with this stipulation in mind. It was found practical, nevertheless, to include all features desired in the unit within this limitation of space.

The first requirement of the design to receive consideration was for the primary power demands of the transmitter, receiver, and the accessories. Power needs of a ham station of the 100-watt class are such that the usual home a.c. circuits may be used without undue loading. It was thus decided that the primary power distribution and switching could be included within the assembly, resulting in a single neat power cord to connect the complete ham station to the home a.c. source.

For switching and distribution purposes, power needs can be split into two categories; namely, that needed for receiving equipment, and that used for transmission. Reference to the schematic will show that four power connectors are available, all supplied through the main switch S_1, and fused in the return leg of the circuit. Two outlets are directly energized by S_1, to supply receiver and a desk lamp or other external accessory if desired. It will be noted that an internal power pack is also activated by S_1 in order to power the accessories used in reception and transmission, as will be discussed later.

An additional switch, S_2, powers the remaining two outlets for the v.f.o. and transmitter. In addition, power is thus made available to the send-receive relay circuits, which may now be activated by a key type send-receive switch, S_3. To accomplish complete changeover from receive to transmit, three relays were used in this circuit. Naturally, the exact switching requirements are governed by the receiver, v.f.o., and transmitter being used, as well as the antenna system. It should be pointed out that the system being described was designed to be used with the 100-watt bandswitching rig discussed by the author in the December, 1954 issue



R1—33,000 ohm, 1 w. res.
R2—15,000 ohm, 1 w. res.
R3—25,000 ohm linear taper pot (Ohmite AB)
R4—250,000 ohm linear taper pot (Ohmite AB)
R5—47,000 ohm, 1 w. res.
R6—6800 ohm, ½ w. res.
R7—1000 ohm, ½ w. res.
R8—560,000 ohm, ½ w. res.
R9, R10—1200 ohm, ½ w. res.
R11—1 megohm pot ("Volume Control")
R12—22,000 ohm, 1 w. res.
R13, R14—1 megohm, ½ w. res.
R15—68,000 ohm, ½ w. res.
R16—3 megohm pot ("Tone Control")
R17—2.2 megohm, ½ w. res.
R18, R20—470,000 ohm, ½ w. res.
R19, R23—100,000 ohm, ½ w. res.
R21—2700 ohm, ½ w. res.
R22—180,000 ohm, ½ w. res.
R24—33,000 ohm, 2 w. res.

C1—100 μμfd. ceramic capacitor
C2—1 μfd., 400 v. capacitor
C3, C13—.005 μfd. disc ceramic capacitor
C4, C5—.1 μfd., 400 v. capacitor
C6—100 μμfd. ceramic capacitor
C7—.001 μfd. disc ceramic capacitor
C8—250 μμfd. ceramic capacitor
C9, C12—5 μμfd. ceramic capacitor
C10—10-50 μfd. trimmer (N-750, CRL 823-BZ)
C11—150 μμfd. ceramic capacitor
C14-C15—20/20 μfd., 450 v. elec. capacitor
M1—0-1 ma. meter (Simpson 127)
SR1—Full-wave meter rectifier (bridge)
SR2, SR3—65 ma., 130 v. selenium rectifier
CH1—30 ma. filter choke
RFC1—2.5 mhy. r.f. choke, single pi
Xtal.1—See text
Xtal.2—100 kc. crystal (Bliley KV3)
RL1—S.p.d.t. relay, 117 v. coil (Advance K-1503S)

RL2—D.p.d.t. relay, 117 v. coil (Advance K-1504)
RL3—D.p.d.t. antenna relay, 117 v. coil (Advance AM type)
S1, S2—S.p.s.t. heavy-duty toggle sw., (15 amps @ 125 v.)
S3—Switchcraft "Lev-R" switch (Locking type 3001-L)
S4, S5—D.p.d.t. bat-handle toggle switch
S6, S7, S8—S.p.s.t. bat-handle toggle switch
F1—10 amp line fuse
SO1, SO2, SO3, SO4—117 volt power line socket
J1, J2, J3—Shielded input jack
J4, J5—Single-circuit phono jack
PL1—NE-2 neon lamp
T1—125-0-125 v. @ 25 ma.; 6.3 v. @ 1 amp. (Stancor PS-8416)
V1—6AL5 tube *V5—6AK6 tube*
V2—12AX7 tube
V3, V4—6C4 tube

Complete schematic of the control unit. The circuit design is adaptable to most amateur transmitters in the 100-150 watt power class.

of this magazine. When used with other rigs, individual requirements may dictate minor changes.

One relay is used for the antenna switching, transferring a single coax-fed antenna from receiver to transmitter. Additionally, three sets of normally-open, and one set of normally-closed relay contacts are used to complete transfer functions. Because of availability, a d.p.d.t. antenna relay was used, together with two miniature d.p.d.t. relays.

The receiver makes use of the normally-closed set of contacts to tie to the standby circuit of the set, disabling the receiver during periods of transmission. If, for any reason, it is desired to operate the receiver during transmitting periods, the usual receiver standby switch can be used to shunt the relay contacts as needed.

The separate v.f.o. is controlled in the "B-" return with one set of the normally-open contacts. The transmitter requires the two remaining pairs of normally-open contacts. One set completes the oscillator cathode-to-ground path during transmission. The heavy-duty contacts remaining on the antenna relay are used to complete the high-voltage power transformer primary circuit, to operate the final.

Connections are made to the antenna relay by means of chassis mounted coax fittings so that receiver, transmitter, and antenna may be fed with coax cable. Needless to say, the antenna feedline should be flat, with minimum standing wave ratio. This necessitates a well designed resonant antenna system.

The other relay contacts are attached to associated pieces of gear through cables and plugs of the *Jones* 300 series. A four-wire circuit feeds the transmitter, to control final and exciter. With reference to the schematic of the 100-watt transmitter, on page 68 of the December, 1954 issue of RADIO & TELEVISION NEWS, leads were connected paralleling the d.p.s.t. switch S_3, and brought out to the rear chassis lip to a suitable *Jones* connector. This is the only addition made to the transmitter.

The control unit circuitry discussed thus far completes the a.c. power control and distribution, as well as send-receive transfer functions. The remaining parts of the control unit are de-

voted to operational accessories which contribute to station operating ease.

A valuable receiving aid is a crystal-controlled frequency standard for receiver calibration and other frequency measurements. A 100 kc. crystal standard is included, with a 6AK6 tube in a conventional circuit. A *Bliley* KV3 crystal is used, and can be set to exact frequency by adjustment of C_{10}. Switch S_8 applies plate voltage to this oscillator when in use.

An additional oscillator has been included, which serves as a convenient marker oscillator. The crystal socket is mounted to the front panel so that crystals may be readily plugged in. The oscillator uses a 6C4 in a simple Pierce circuit, with S_7 as plate voltage switch to turn the marker on. This makes a convenient marker for checking transmitter frequency or band edges by plugging in appropriate crystals.

The two oscillators are coupled to the receiver side of the antenna relay to permit injection into the receiver front end.

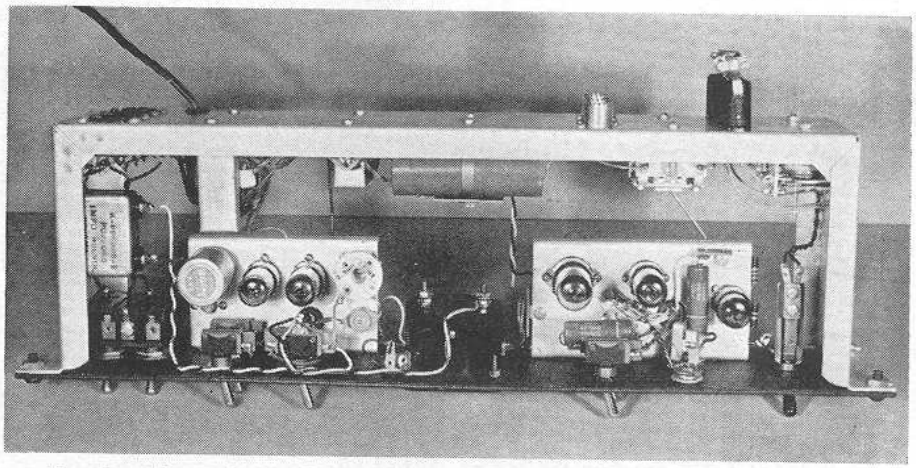
Several additional accessories are included for the transmitter. A modulation monitor is incorporated, with provision for r.f. carrier indication as well. This is based on a test monitor circuit covered by Arthur Franklin Mill in the April, 1954 issue of *"CQ"* magazine. The circuit has been modified to eliminate tuned circuits in the pickup.

Referring to the schematic, it will be seen that one half of a 6AL5 is coupled to the transmit side of the antenna relay. Rectified carrier appears across R_5, and is fed to the indicating milliammeter by means of switch S_4. One position of the switch selects the rectified carrier only, the meter then serving as an r.f. output indicator. The other switch position applies the meter to the instrument rectifier which recovers the audio from the carrier, giving a modulation indication.

It should be stated that the monitoring circuit is intended for use with 72-ohm antenna feeds, with low standing wave ratios, and powers of approximately 100-150 watts. These conditions determined the design conditions for the 6AL5 circuitry.

A note should be made in passing concerning the calibration of the r.f.-a.f. modulation monitor circuit. The audio voltage recovered will be less than the rectified carrier indication. Therefore, R_3 should be adjusted first for the audio level representing 100% carrier modulation, by comparison with the oscilloscope pattern in a conventional oscilloscope modulation measurement. The oscilloscope is needed only for the initial calibration, of course. A convenient indication can be had by setting the resistance of R_3 so that 100% modulation at the proper power level causes full scale deflection of the meter.

With S_4 thrown next to the r.f. carrier output position, R_4, should be set for the same full scale reading with carrier only applied. In future operation, it then becomes necessary only to tune and load the transmitter for full scale indication in the r.f. position, switch S_4 to the a.f. position, and modulate for 100% peaks at full scale. Because of the meter ballistics, an indication of approximately 70% of full scale will correspond to 100% modulation with voice frequencies. Additional data on the circuit adjustment can be found in the original *"CQ"* article.



Top view of control unit. Open frame chassis construction gives easy access to all components. Note layout of chassis bases, relays, and power supply, as well as the locations of the various switches. Power distribution is at left end of the unit.

The remaining accessory is similar to the familiar "Monitone" of *"ARRL Handbook"* fame. This is a most useful circuit which permits the monitoring of c.w. and phone transmissions, as well as blocking receiver audio during transmission. The only connection to the receiver is to tie the headphone output of the receiver to the input jack with a "patch cord." Phones are then plugged into the "Monitone" output jack at C_4.

The circuit is carrier-controlled by the transmitter r.f. output. Resistors R_1 and R_2 form a voltage divider feeding carrier to the remaining half of the 6AL5 for rectification. The resultant output voltage is used to key the "Monitone." Complete circuit information is to be found in any edition of the *"ARRL Handbook."* Suffice it to say that S_{5A} and S_{5B} switch the circuit from phone to c.w. monitoring positions, energizing the neon-bulb side-tone oscillator. R_{16} is the associated side-tone pitch control. R_{11} adjusts the audio level of the transmitter signal in the phones. The receiver volume control determines the audio level heard in the phones during reception. Thus the same phones position is used to monitor the transmitter as well as for normal reception. The switch S_9 applies plate voltage to the entire "Monitone" for use.

Construction

As previously mentioned, a panel space of 3½" was available, so a standard rack panel of this size was used for construction. A *Bud* CB-1371 dish type chassis is attached to the rear of the panel to form the basic chassis assembly, of open frame construction. Two small aluminum bases measuring 4½" x 2½" in size, with a 1" lip folded along the longer dimension, attach to the front panel as support shelves for the tubes and associated components. One shelf accommodates the two oscillators as well as parts of the modulation monitor. The other shelf is used for the "Monitone" circuit.

Reference to the accompanying photographs will indicate the parts layout and method used for construction to those interested in making a similar control unit. Viewed from the front,

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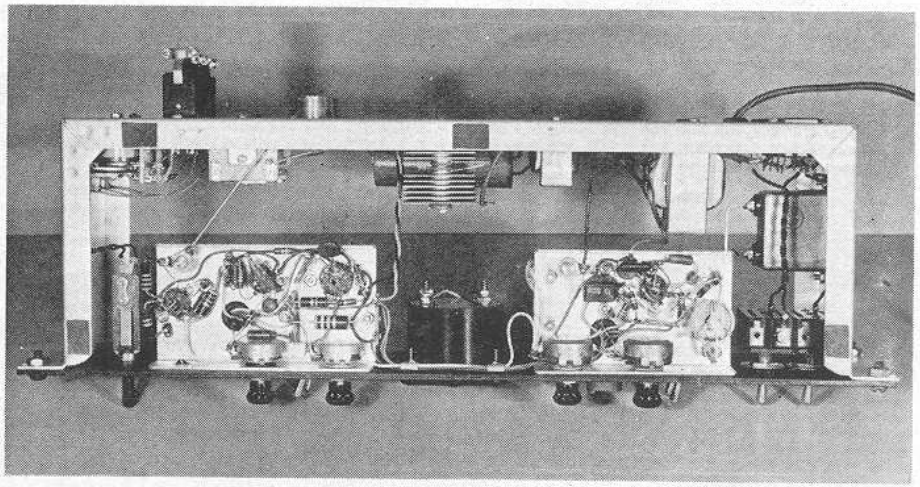
Bottom view of control unit, showing two small chassis bases attached to the front panel, as well as general component placement. Jones plugs are used to connect the relays to the transmitter, v.f.o., and receiver comprising entire ham station.



Amateur Control Unit

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the two primary power switches are attached at the extreme left end of the panel. The four power outlets, fuse, and power cord mount directly behind, on the chassis.

A two-inch square milliammeter mounts at the center of the panel. The toggle switches S_7, S_8, and S_9, and marker oscillator crystal socket fill the panel space between meter and power switches on the left. The calibration resistors, R_3 and R_4 are attached below the marker crystal socket. It might be wise to use locking shaft type controls here so that settings will not be inadvertently disturbed once calibration is completed.

The send-receive switch, S_3, mounts at the extreme right end of the panel. Controls for the "Monitone," including the input and output audio jacks, S_5, S_6, R_{11}, and R_{16} occupy the space left. This completes the front panel.

The relays are attached to the rear chassis deck, taking up the space behind the "Monitone" shelf. Included are the *Jones* connections for the leads to the equipment involved. Space behind the meter and oscillator shelf is used for the power pack for the accessories, with these parts attached along the chassis deck mounting surface.

Once completed, the top and bottom sides of the assembly are covered with perforated metal or screen to preclude possibilities of accidental contact with voltage points. This is especially important in view of the a.c. distribution within the chassis, and the open frame construction style.

The completed control unit is fastened below the receiver on the operating desk. A simple plywood shelf can be used to advantage in this case, to support the receiver and provide, simultaneously, a housing for the control. Other installation possibilities will suggest themselves to constructors in adapting the unit to particular installations.

Operation of the control is practically self-evident. All power switches on equipment are left on, with switching of power done at the control unit.

It will be seen that the functions of a.c. distribution and switching for the entire station, complete receive-transmit change over, a 100 kc. crystal calibrator, marker oscillator, r.f. carrier output indicator, modulation monitor, and "Monitone" c.w. and phone monitoring facilities have been included in one compact control unit. As such, the assembly is worthy of space on any ham station operating table for use with transmitters in the 100-watt class. The operating conveniences gained by the addition of the control unit to the station will be very readily appreciated, particularly after a few hours operation with the unit. The advantage of the accessories, plus centralized control of all equipment, are obvious to all hams.

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