THE OMNIVOX

THE OMNIVOX is a feature packed simple, flexible audio preamp/vox/transmitter control and phone patch unit. Integrated into this design project are the following author's dozen features:

1. 6BR6 gated beam VOX tube for positive anti-trip.
2. Automatic Level Control (ALC) of audio amplifier for uniform modulation from microphone and telephone inputs.
3. Hybrid phone patch with 6AL7-GT twin indicator tube to monitor voltage into line and ALC operation.
4. Individual phone and master gain controls.
5. Adjustable VOX Sensitivity, anti-trip and holding time controls.
7. Shaped audio band-pass from 250-3000 cps.
11. Zero audio output until control relay operates.
13. Auxiliary audio output position (with attenuated speaker output) for recorder or oscilloscope.

(continued on page 2)
The gain of the audio system is about 70 decibels, providing adequate amplification from a single 6AL7-GT tube. In addition, the "receive" (R12) serves as a gain-controlled audio amplifier, providing the load for the crystal microphone. It also acts with R4 and R6 as a voltage divider to control the amount of telephone signal fed to V1.

Preamplifier V, drives the pentode section of a 6AN8 (V5c), connected as a gain controlled audio amplifier. Inter-stage coupling capacitors C, and C6 provide low frequency attenuation. Circuit and tube capacitances coupled with C provide high frequency attenuation, resulting in the audio frequency response characteristic shown in Fig. 3.

The output circuit of V5c is composed of R9, C7, Cs, R10 and R11 in series with the load connected to the output jack (J1) and the input impedance of V5c connected through R19. When the OMNIVOX is in the "receive" (R19) energized state, the output jack (J1) is grounded through one of the normally closed contacts of R19. Thus, no audio output can appear at J1 from the speaker feeding into the microphone, even though both audio stages may be operating at full gain. The paralleled resistance of R19 and R20 is 50,000 ohms, and this, in shunt with R19, provides a load resistance of 33,000 ohms for V5c. The audio voltage developed across this load resistance is coupled to V28 to provide additional gain for the rectifier circuits of V5c, which provide a positive voltage from V28 for driving the gating tube (V1), and a negative voltage from V28 for the ALC bias on V5c.

In addition, should the positive going output of V5c exceed the 7.5 volts developed by R8 and C10 in the cathode circuit of V5c the 47,000-ohm resistance of R19 is shunted across the plate load to reduce the peak gain and provide moderate limiting action. Should greater clipping be desired, R8 can be reduced. The peak voltage at which clipping begins can be adjusted by changing the value of R19 to develop more or less DC voltage. (It is recommended that R8 be no less than 600 ohms.)

The output of V5c is coupled through C3 to V6, where it is rectified and filtered by R21, R22, and C2. The output of V6 provides a negative voltage proportional to the amplitude of the signal. The audio amplifier is shown in Fig. 1. Only two tubes are needed in the functional amplifier and control stages. In addition, a 6AL7-GT twin indicator tube provides constant monitoring of the signal applied to the telephone line when using the phone patch. The indicator tube provides an audible means for determining optimum balance of the hybrid circuit, giving a visual indication of "zero-beat" and furnishes an indication of the amount of ALC voltage developed. 

**FIG. 1. BLOCK DIAGRAM of the OMNIVOX circuit, showing audio amplifier or try, bias rectifier and indicator tube at center, V28 circuit at bottom and hybrid phone patch at lower right corner. All controls except Gain Limiting Threshold (R3), Calibration (R7) and Pitch Balance (R8) are on the front panel.**

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audio output. When this voltage is fed back through R to the grid of V, the operating point of this tube is shifted to reduce the gain of the stage. By adjusting the Gain Limiting Threshold control, the amount of audio limiting can be varied over a wide range.

The circuit is fast acting and has a control range of more than 20 decades with a normal threshold setting about 10% open, as shown in Fig. 4. The control voltage is monitored by one section of V, and provides a relative indication of the output voltage from V. Rectifier V, is driven from amplifier V through C and the VOX Sensitivity control (R). The DC output of this circuit is developed across R, and R, and charges C, to provide a positive gating voltage for control tube (V). Output from the receiver is applied to the primary of T, (continued on page 4).

FIG. 3. COMPLETE SCHEMATIC DIAGRAM of the OMNIVOX. Only those parts which require additional identification are shown in TABLE I—PARTS LIST. Resistances are in ohms, 1/8 watt rating and ± 10 percent tolerance, unless otherwise marked. Capacitances are in microfarads (mfd), paper types of 600-volt DC rating, except where noted. Base pins of tube diagrams are numbered.

<table>
<thead>
<tr>
<th>TABLE I — PARTS LIST—OMNIVOX</th>
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<tbody>
<tr>
<td>C...33 mfd, 25-volt electrolytic.</td>
</tr>
<tr>
<td>C...10 mfd, 25-volt electrolytic.</td>
</tr>
<tr>
<td>C...10 mfd, 450-volt electrolytic.</td>
</tr>
<tr>
<td>J...Chassis type microphone jack.</td>
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<tr>
<td>J...Chassis type phone jack.</td>
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<tr>
<td>L, L...1-yh pi-wound r.f. chokes.</td>
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<tr>
<td>R...50,000-ohm potentiometer, linear topper.</td>
</tr>
<tr>
<td>R...3-degrees potentiometer, linear topper.</td>
</tr>
<tr>
<td>R...100,000-ohm potentiometer, linear topper.</td>
</tr>
<tr>
<td>R...6,000-ohm, 5-watt adjustable wire wound resistor.</td>
</tr>
<tr>
<td>R...1,000,000-ohm potentiometer, linear topper.</td>
</tr>
<tr>
<td>R...250,000-ohm potentiometer, linear topper.</td>
</tr>
<tr>
<td>R...20-ohm wire wound potentiometer.</td>
</tr>
<tr>
<td>R...SPDT relay, 5,000-ohm 8 mA coil, 8-pin actrod plug-in base (Farfall-Brunfeld ECF-11-300C DC).</td>
</tr>
<tr>
<td>S...SPDT toggle switch.</td>
</tr>
<tr>
<td>T...4-watt universal audio input transformer, 10,000-ohm primary to 3.3-ohm secondary.</td>
</tr>
<tr>
<td>T...maching transformer, 1200-ohm primary, 600-ohm secondary with precision electrical center tap.</td>
</tr>
<tr>
<td>T...maching transformer, 500-ohm primary, 4-ohm secondary.</td>
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</tbody>
</table>

*Transistor T, in the circuit’s module was obtained from a Signet Circuits 24-26 Defense Control Unit, part of the yt fast-heating oven which is available in an instrument package. Values of various resistors, etc., are of interest. It is assumed that T, is a transistor of the same type used in the OMNIVOX.*
small output transformer operated backwards), where it is stepped up and rectified by a 5N48 diode, (D.1). The voltage developed across C.4 and R.6 provides negative going pulses of voltage which are superimposed on the signal on the No. 1 grid of V. by adjusting the \( R_{LO} \) control. An additional RC filter provides a DC voltage to the deflection element of V. which is proportional to the peak audio voltage delivered by the OMMIVOX. Thus the pattern of three sections of the graph changes as more audio voltage is fed from the receiver, as shown in Fig. 5.

**HEART OF THE CONTROL SECTION**

OMMIVOX is the 6B6C6 beam tube (V.) This tube is constructed in such a way that its plate receives current only when both of the segments of the grid are cut off. Thus an anti-trip voltage at the No. 1 grid can cut off the beam and, regardless of the amount of positive voltage on the control grid, the plate cannot draw current. By this means, anti-trip action is not a matter of delicate balance between opposing voltages.

The 6B6C6 (V.) operates with nearly constant cathode current, developing 9.5 volts across R.6 and providing cut-off voltage for the second control grid. The first grid is connected to a voltage divider made up of R.6, R.8 and R.9 from plus 300 volts to ground, and is clamped at zero bias. Thus, in the absence of anti-trip voltage derived from receiver output, the input gate is open.

Since the second grid is cut off, no plate current flows until audio voltage is applied to Vs which provides a positive gating bias at the 6B6C6's second grid. This gating plate current flows in the 6B6C6 causing R.1, to draw a D.C. current from Vs, to provide the speaker and close the external VOX control circuit on terminals 7 and 8.

Bias remains on the second control grid of Vs as long as there is sufficient positive voltage across C. The **Hold control (R.7)** adjusts the discharge time of Co. Space charge effects in V. further modify the discharge characteristics so that the components specified give a range of Hold from one second to continuously on. In the Manual position of S., the cutoff bias for the second gating grid is removed and closes R.8.

**THE PATTERN SECTION**

OMMIVOX is a hybrid circuit made up of a pair of transformers, a balancing network, cou-

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**Fig. 3.** Audio frequency response characteristics of the preamplifier. Curves show change in output level at constant input level with different values of ALC bias. When converted to decibel scale and normalized, all three curves nearly coincide. This indicates that the bandwidth remains constant over wide gain variations.

**Fig. 4.** Graph showing range of control provided by ALC system over range of zero threshold voltage, to full threshold voltage.

**Fig. 5.** Pattern shown on 6AL7-GT indicator tube (V.) with left-hand pattern changing at slow rate with variations in ALC bias. Maximum phone line level of 0.77 volt is shown in pattern view at right.
plugging capacitors and a pi-section RF filter for the phone extension line. In the OFF position of S6, the patch is off and is completely out of the circuit (with the exception of the RF filter which is left in at all times). In the AUX position of S6, the receiver output is switched to the Receiver Output jack (J). Simultaneously a 30 ohm resistor is connected in series with the speaker voice coil to attenuate the audio output about 10 decibels.

In the PATCH position of S6, the hybrid transformers are connected to the telephone line through low-leakage paper coupling capacitors (C1 and C2). In addition, while the speaker remains attenuated, a Tee network is connected between the receiver output and the primary of T3, which couples audio from the receiver to the telephone line. Earlier, it was explained that the 6AL7 (V3) was driven by a negative voltage proportional to the peak receiver output voltage. In the PATCH-ON position of S6, Rs (in the Tee networks) can be adjusted so that the maximum audio voltage supplied to the 'phone line is equal to the maximum allowable line voltage (usually about 0.77 volts) for a specific amount of pattern compression on V3. The escutcheon plate shown in Fig. 6 is marked for this purpose. Once this calibration has been accomplished, the 6AL7-GT eye tube monitor provides a direct means for checking the audio level to the line. This makes it possible for the operator to adjust the station receiver audio output to the proper patch operating level.

The Balance control (R10) is used to adjust the current flow through the two sections of the primary of T3 due to the presence of voltage across the secondary of T3, so that receiver output is not coupled through T3 to the audio amplifier section of OMNIVOX. To adjust R10, the patch is switched on (after you have dialed an understanding friend on the land line) and the Phone Gain control (R6) is opened to impress voltage from the secondary of T2 on V8. Receiver output is being fed into T3 in this case and the circuit may tend to oscillate unless the Sensitivity control (R9) is at minimum gain.

With the Threshold control (R9) about mid-point, the Patch Balance control (R10) may be adjusted slowly until the ALC monitoring section of V1, indicating the amount of audio voltage out of V8, shows zero output voltage. The Master Gain control (R5) may be opened further to increase the system gain for more precise balance. Although this adjustment is quite sensitive, the visual indication provided by V8 makes this a simple operation. Following the balancing of the hybrid circuit, the calibration of phone line voltage versus V8 pattern compression should be rechecked.

The OMNIVOX may now be operated from the phone line by adjusting the Master Gain, Phone Gain (R3), and Sensitivity controls (R4) appropriately. Slight compression of gain by ALC action from the voice input on the line should be indicated by V1. When the microphone in the telephone is providing the audio signal, the ALC will reduce the gain of V1 (depending on the setting of the Threshold control) so that the audio output is not excessive even though the output from the handset is many times greater than the usual 'phone line signal. Note that the reduced speaker output in the Patch-ON position of S6 helps prevent audio feedback from the speaker to the telephone microphone. Changing S6 from 'Patch-ON' to 'On' will reduce this action.

(continued on page 6)
OMNIVOX (continued from page 5)

"Aux." provides an immediate disconnect between the phone line and the patch circuit without a blast from the speaker. When running a phone patch through the OMNIVOX, the positive gating action of the VOX control tube and the easy shift from automatic to manual control, provide sufficient flexibility to meet the variety of operating conditions and degree of familiarity with patch procedures likely to be encountered.

The 6AL7-GT monitoring indicator is also useful for frequency checking and zero-beat to net or roundtable frequencies. Since the indicator is DC-coupled to the 1N48 anti-trip diode, and the time constant of the filter is relatively short, the compressed pattern opens abruptly as zero-beat is approached between the received signal and the beating signal from a transmitter VFO, crystal calibrator, or inter-polation oscillator.

It is possible to see the beat note down to about 2 cps with this system (this is usually close enough for most tuning). In order to use this feature on SSB it may be necessary to insert some carrier while setting the transmitter on frequency. For DXB (used by the author), or for AM, carrier is readily available at the operating frequency.

CONSTRUCTION of the author's model OMNIVOX was accomplished in an 8 x 12 x 5-inch chassis.

The pictures of the completed unit on pages 2, 5 and 6 show most of the pertinent constructional details. A smaller chassis size could be used if smaller parts than those from the author's junk box are available.

Controls which may be used during normal operation were mounted on the front side of the chassis in the locations shown in the drilling diagram, Fig. 7. The four control tubes (V1 to V4) were mounted internally on a small sub-chassis bracket running parallel to the front panel. Fabrication details of this bracket are shown in Fig. 8. The 6AL7-GT indicator tube (V5) is mounted on another bracket made from 1/8-inch thick sheet aluminum, located so that the tube protrudes through the 1/4-inch diameter hole in the chassis front (and panel, too).

An 8-terminal barrier strip for external signal connections, the Gain Limiting Threshold (Rg), Patch Balance (Rg) and Calibrate (Rg) controls, the Receiver Output (J.), and Audio Output (Jx) jacks, and control relay (R.), are mounted on the top side of the chassis. Power for the heater and plate power come from a dc supply.

Almost all wiring is run with insulated hookup wire. Leads from J1 to R2, R3 to the control grid of V5, and to the Phone Gain control (Rg) are run with shielded single conductor wire. Small parts are mounted on lugs of components that connect with, and on terminal strips.

TESTING THE OMNIVOX, when completed consists of connecting it to a power supply furnishing 300 volts DC at 40 milliamperes, and 6.3 volts at 2 amperes. The audio section should be checked out first, and then bias voltage measurements in the ALC circuit are taken to check its operation.

The VOX circuit should then be tested, and calibration of the indicator eye tube is completed. Instructions for adjusting the various controls have been given heretofore in the description of the OMNIVOX circuits, and will not be repeated here. Balancing and testing of the Phone Patch circuit should be done last after the other adjustments have been completed.

Finally the chassis cover plate is mounted, with proper spacing for knobs and the OMNIVOX is installed in the proper space in the station. The package has been designed so that it can be set up, or on top of, a receiver, speech amplifier, etc. Or, it can be stood on end and mounted to the operating desk. If the latter position is chosen, vent holes should be drilled in the chassis sides which form the bottom and sides of the box that also should be secured to the bottom side.

Operation of OMNIVOX is pretty much automatic once the Microphone Gain, Telephone Gain, and VOX Sensitivity controls have been set. The Anti-Trip control should be adjusted so that speaker noise does not actuate the VOX circuit. The Hold Time control should be set to individual tastes, with sufficient hold in time so that R5 remains closed between spoken sentences.

Portions of the OMNIVOX circuitry may easily be adapted to existing transmitter audio equipment, if desired. The audio gain-controlled amplifier, with its speech frequency range emphasis, and the VOX circuits too, are superior to similar circuits found in some commercial transmitters.

If you are an amateur station by incorporating the complete OMNI-VOX, or portions of the circuit, into your equipment.
VERSATILE POWER-CONTROL BOX

Few amateur stations today have equipment permanently wired to power lines through disconnect switches; rather, the trend toward tabletop units with simple power cord connections has sometimes brought about a tangle of extension cords and cube taps, necessary to connect a receiver, moderate power transmitter, and accessory equipment to the power line. A useful accessory to lessen the power-line haywire may be easily constructed in the form of an AC outlet box—shown in the accompanying illustrations. The mechanical design can be tailored to fit individual installations. The box shown in use at W9GFS was intended for mounting on the side of a desk. A different layout would permit other mounting positions.

THE SCHEMATIC DIAGRAM, Fig. 1, shows the outlets split into groups: (1) those that remain on as long as the box is plugged in, intended for a desk lamp and clock; and (2) those controlled by a main switch (S) and intended for the receiver, transmitter, and accessories. A fuse is included in the circuit for all of the outlets.

The input plug and all of the outlets but one are mounted on the rear of the box, since constant accessibility is not necessary. One outlet in the group not controlled by the switch is mounted on the front to allow ready accessibility for a soldering gun. The neon lamp on the front of the box indicates when the switched group of outlets are on. The switch allows all station units to be turned on or off without the use of the switches on the individual units. The switch on the model shown requires a key to turn it on; this prevents children from energizing the equipment. A conventional wall-switch has which the same dimensions may be substituted.

All of the outlets used are of the polarized type, and care should be taken in connecting the plugs on the attachment cord to preserve the polarity relationship. If the box will be used within reach of a ground, a 3-wire safety type plug should be used to ground the box.

This control box usually will handle transmitters rated at up to 200 watts input. Higher power transmitters, especially those in the kilowatt class, should be powered from a separate circuit. However, all station equipment except a large transmitter can be controlled by the power control box. Devote one or two evenings to eliminating your line cord haywire by constructing this handy box.

![Diagram of Power-Control Box](image)
A New Feature —

MEET OUR AMATEUR TUBE DISTRIBUTORS —

Uncle Dave Marks, W2APF (center), visited the amateur radio station at Vatican City, HV1CN, on a trip to Europe recently. At left is Dr. Loris Castaldi, I1CL, who acted as interpreter and, at right, Domenico Petti, Chief Operator and Custodian of HV1CN.

W2APF is widely known as the operator of UNCLEDAVE'S Radio Shack in Albany, New York. During several foreign and globe-girdling tours, Dave has met thousands of radio amateurs, and may well have set a record for this feat.

CAPACITORS FOR HAMS — General Electric’s new line of “application rated” Service-Designed Alumalytic® capacitors will replace more than 1,200 different types with only 275 twist-prong and tubular types. Amateurs will find them ideal for replacement, or for new home-built equipment. Ask for them at your G-E Tube distributor.

W4PFQ — Allen (All P. Haase, needed a combination audio preamplifier, with automatic gain control, voice-controlled break-in circuit, and phone patch. The result, after many hours of construction and testing, is the OMNIVOX described in this issue on pages 1 to 6. Al’s fine station is shown on page 7. The transmitter is completely home constructed, including the exciter unit at the right.

MEET OUR AUTHORS —

W9GFS — Philip E. Hatfield, found a solution to the usual tangle of power cords and cube taps in the neat power control box for his station described on page 7.

Phil’s previous contributions to G-E HAM NEWS have been the GADGET RACK and accessories in the September-October, 1958 issue; and “OPERATING G-E Hi-Fi TUBES AS MODULATORS” in the January-February, 1960 issue.

Vocationally, W9GFS is a technical data engineer with G.E.’s Receiving Tube Department here in Owensboro. He has authored several articles for QST, Electronics World, and other publications.

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W4PFQ is Manager of Advanced Development Engineering for General Electric’s Receiving Tube Department in Owensboro. He and his staff are busily engaged in developing exotic new thermionic devices like TIMMS circuits, the tiny high-temperature, radiation-resistant packaged electronics circuits described on page 2 of the July-August, 1959 issue.