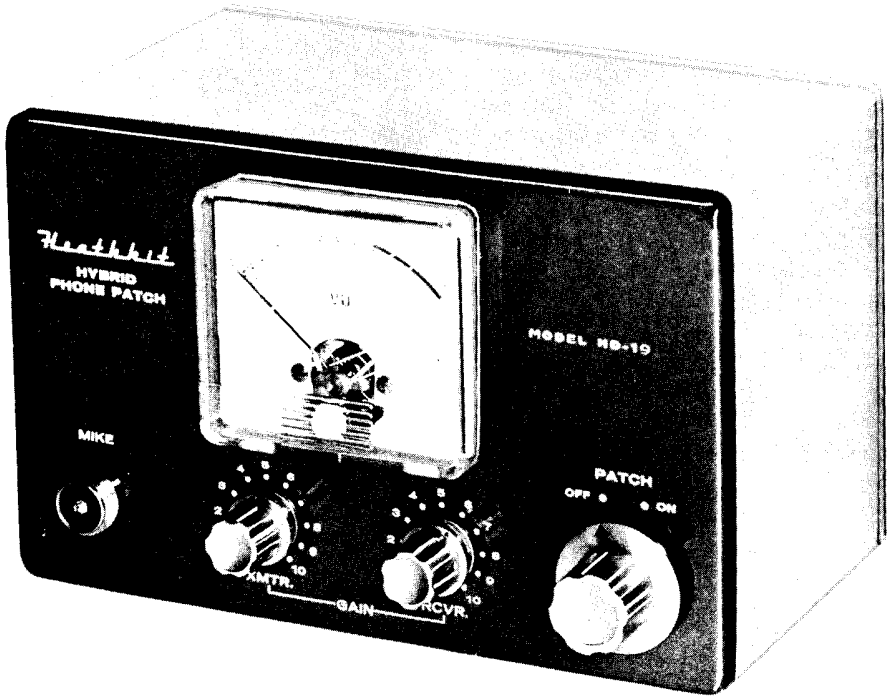
HEATHKIT HYBRID PHONE PATCH
MODEL HD-19



SPECIFICATIONS

Circuitry:	Telephone hybrid circuit to allow "VOX" or manual operation. Single switch places patch in full operation.
Telephone Line Input Impedance:	Approximately 600 Ω.
Meter:	Standard VU meter for constant output monitoring and null depth indication.
Null Depth:	At least 30 db isolation of transmit and receive circuits.
Receiver Impedance:	Effective match from 3 to 16 Ω.
Transmitter Impedance:	High Impedance output.
Power Requirements:	None.
Cabinet Size:	7 3/8" wide x 4 5/8" high x 4" deep.
Net Weight:	2 1/2 lbs.
Shipping Weight:	4 lbs.

INTRODUCTION

The HEATHKIT Hybrid Phone Patch, Model HD-19, is designed to accomplish the transfer of audio signals between telephone lines and two-way radio communication equipment with maximum performance plus ease of installation and operation. It can be used with nearly all transmitters and receivers on the market today, including transmitters employing "VOX" voice control operation.

The HD-19 employs a standard VU meter for accurate monitoring of the output to the telephone line to prevent crosstalk, and a single function ON-OFF switch accomplishes all switching for ease of operation.

The panel controls consist of a function switch (PATCH OFF-ON), transmitter gain (XMTR), receiver gain (RCVR) and a microphone connector (MIKE). The null-monitor switch (MON. NULL), microphone output (MIKE OUT.), and null adjust control (NULL ADJUST) are located on the rear chassis apron, as are the receiver and telephone connections. The null-monitor switch allows the VU meter to be used as a sensitive indicator of proper null adjustment.

With the null control properly adjusted, a minimum of 30 db isolation exists between the receiver output and transmitter input circuits of the patch, resulting in stable VOX operation. In addition, the leads to the telephone line are well filtered for RF but still maintain a high degree of audio fidelity.

In order to minimize hum, the specially designed hybrid transformer incorporates additional windings to present a balanced load to the telephone line.

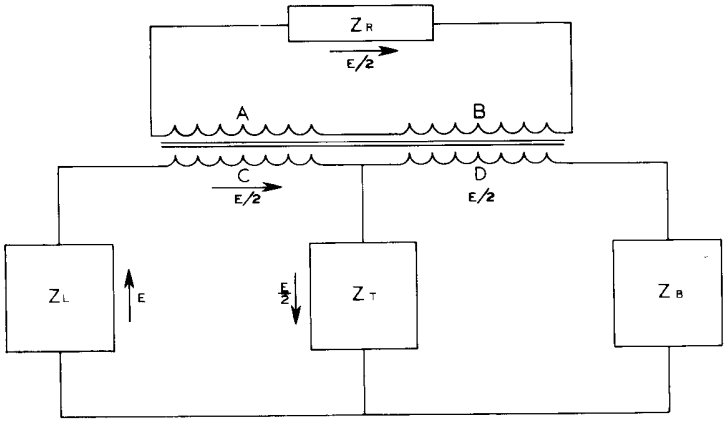
CIRCUIT DESCRIPTION

The circuit of the HEATHKIT Model HD-19 is based on the use of a special hybrid transformer. The hybrid transformer, with proper adjustment of the balancing network, will provide a high degree of isolation of the receiving circuit from the transmitting circuit. This feature is required for stable voice control VOX operation.

The operation of a hybrid transformer can best be shown by referring to Figures 1 and 2.

Figure 1 shows the patch in the transmit cycle, that is, energy from the telephone line is being routed to the transmitter. The turns ratio of the hybrid transformer is such that the impedance of windings C, D and Z_t are equal. A voltage E (representing an incoming voltage of the telephone line) impressed on the transformer will cause, at a given instant, current flow as shown by the arrows. The opposing voltage drop across winding C will equal that across Z_t. The identical winding D is linked by the same flux as winding C and will, therefore, have an induced (opposing) voltage of equal magnitude and in the same direction as winding C. The induced voltage in winding D is equal to the voltage across Z_t, and since their like polarities are connected together, no current flow will occur through Z_b. The result is that one-half of the incoming energy is available at the transmitter input and the other half is dissipated across Z_r.

Figure 1

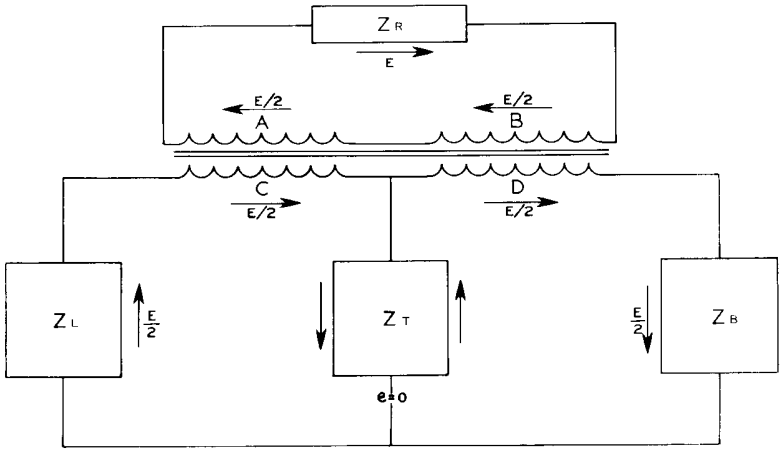


Z_l = Telephone line impedance
Z_b = Balance network
Z_l = Z_b

Windings A = B and C = D
Z_r = Receiver output impedance
Z_t = Transmitter input impedance

In Figure 2 the patch is shown in the receive cycle, where the energy from the receiver is being routed to the telephone line. A voltage E (representing a voltage from the receiver) impressed on the transformer will cause, at a given instant, current flow as shown by the arrows. Windings A and B are connected in series aiding. Since winding C equals winding D equal voltages are induced in each. The balance network is adjusted such that Z_b equals Z_l, therefore the voltage drops across Z_b and Z_l are equal. This will cause equal and opposite currents through Z_t so that there is no voltage across Z_t and no energy is fed to the transmitter input.

Figure 2



Z_l = Telephone line impedance
Z_b = Balance network
Z_l = Z_b

Windings A = B and C = D
Z_r = Receiver output impedance
Z_t = Transmitter input impedance

The turns ratio of the transformer (T1 and T2) windings are such that they properly match the speaker and transmitter input impedances to the hybrid windings of transformer T1.

The circuit incorporates a standard VU meter to allow continuous monitoring of the output to the telephone line. The VU meter is designed to read zero VU or 100% with 1.228 volts applied to the instrument and the 3.6 KΩ series resistance; this represents 4 db above 1 milliwatt in 600 Ω and is the maximum voltage allowed on telephone lines in order to avoid crosstalk between channels.

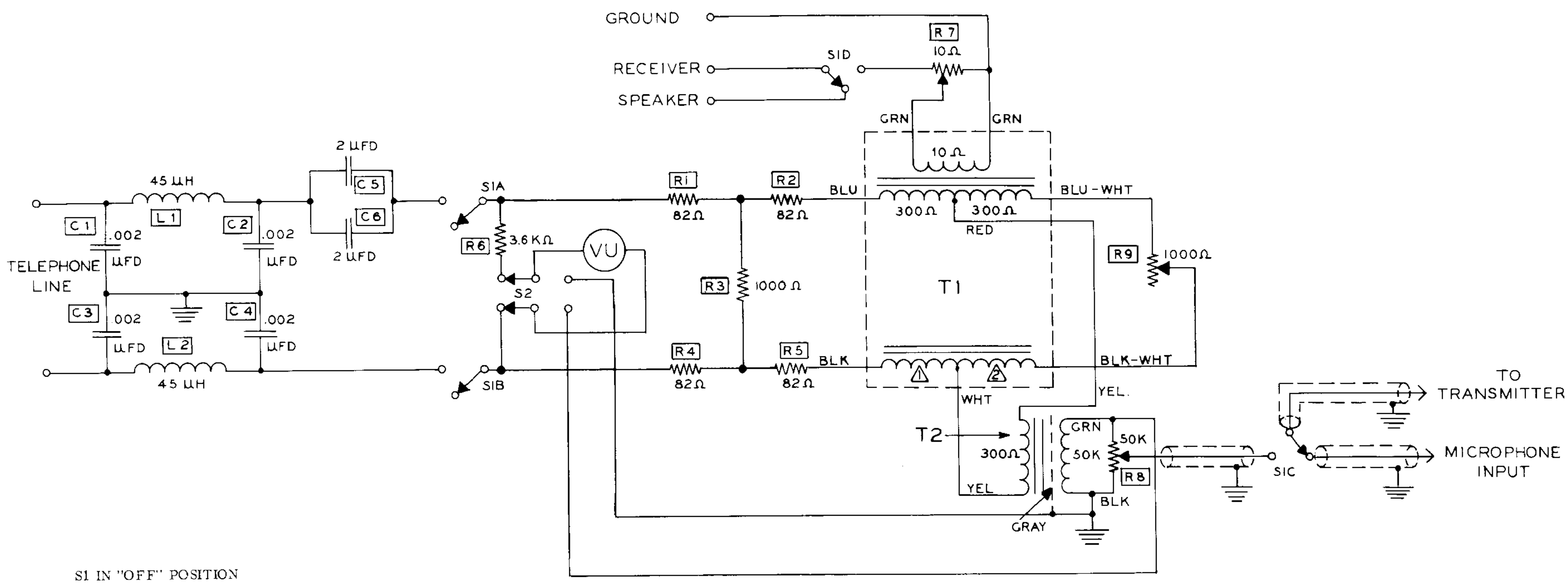
A null-monitor switch S_2 is provided on the rear apron so that the VU meter can be used as a null indicator when adjusting the balance network. When the switch is in the NULL position, the meter resistor (R6) is out of the circuit in order to increase the sensitivity of the meter.

The telephone line connections to the phone patch are filtered by a balanced pi network. This is to prevent RF from entering the phone lines and/or the transmitter audio circuits. The short, low impedance speaker leads, which are not susceptible to RF pickup, are not by-passed in order to preserve the audio quality. All other leads are shielded against RF.

Since the impedance of telephone lines vary greatly from installation to installation, it is necessary to isolate the line impedance so that a simple balance network will provide a sufficient null at every installation. This is accomplished by connecting the telephone line to the patch through an H pad (formed by R_1, R_2, R_3, R_4 and R_5) with an iterative impedance of 600 Ω resistive. The pad forces the line impedance to appear as approximately 600 Ω resistance, thus allowing the impedance of the balance control (R9) to equal the line impedance and provide a deep null.

In order to provide a balanced load to the telephone line, which is an important feature in minimizing hum, the hybrid transformer incorporates additional windings and the resistive pad is made in the "H" form.

The telephone line is also connected to the patch through two capacitors (C5 and C6) in parallel, giving a total capacitance of 4 μfd. These capacitors block the DC voltage of the telephone line, but allow the audio frequencies to pass. The large value of capacitance has very little reactance at audio frequencies, thus allowing the patch to maintain good audio quality.



S1 IN "OFF" POSITION

S2 IN "MON" POSITION

WINDINGS 1 AND 2 FOR LINE BALANCE ONLY

1 AND 2 300 OHMS EACH

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