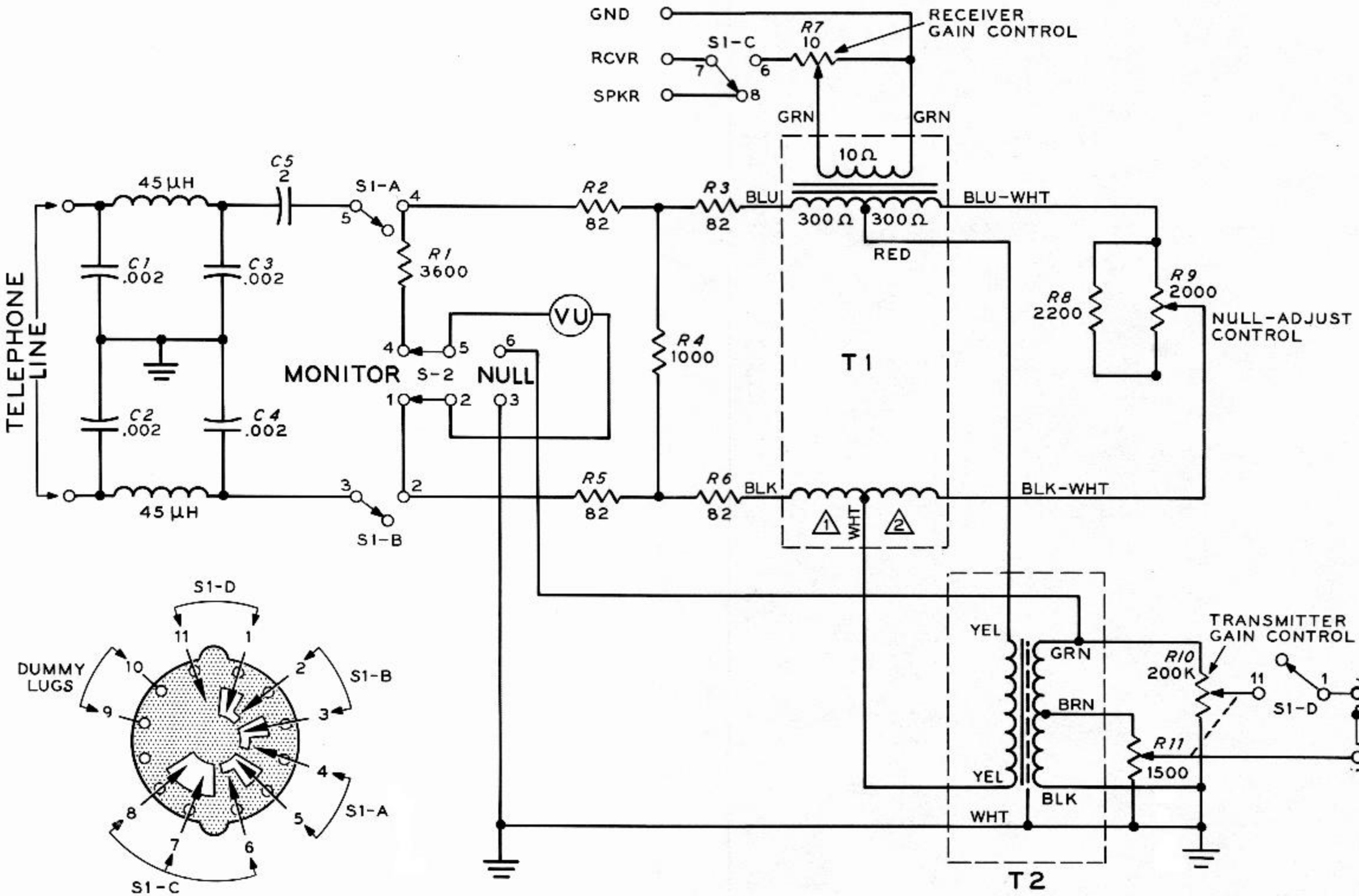


NOTES:

1. ALL RESISTANCE VALUES GIVEN IN OHM. K=1,000 OHMS.
2. ALL CAPACITOR VALUES IN µfd.

SCHEMATIC OF THE HEATHKIT® HYBRID PHONE PATCH MODEL HD-15

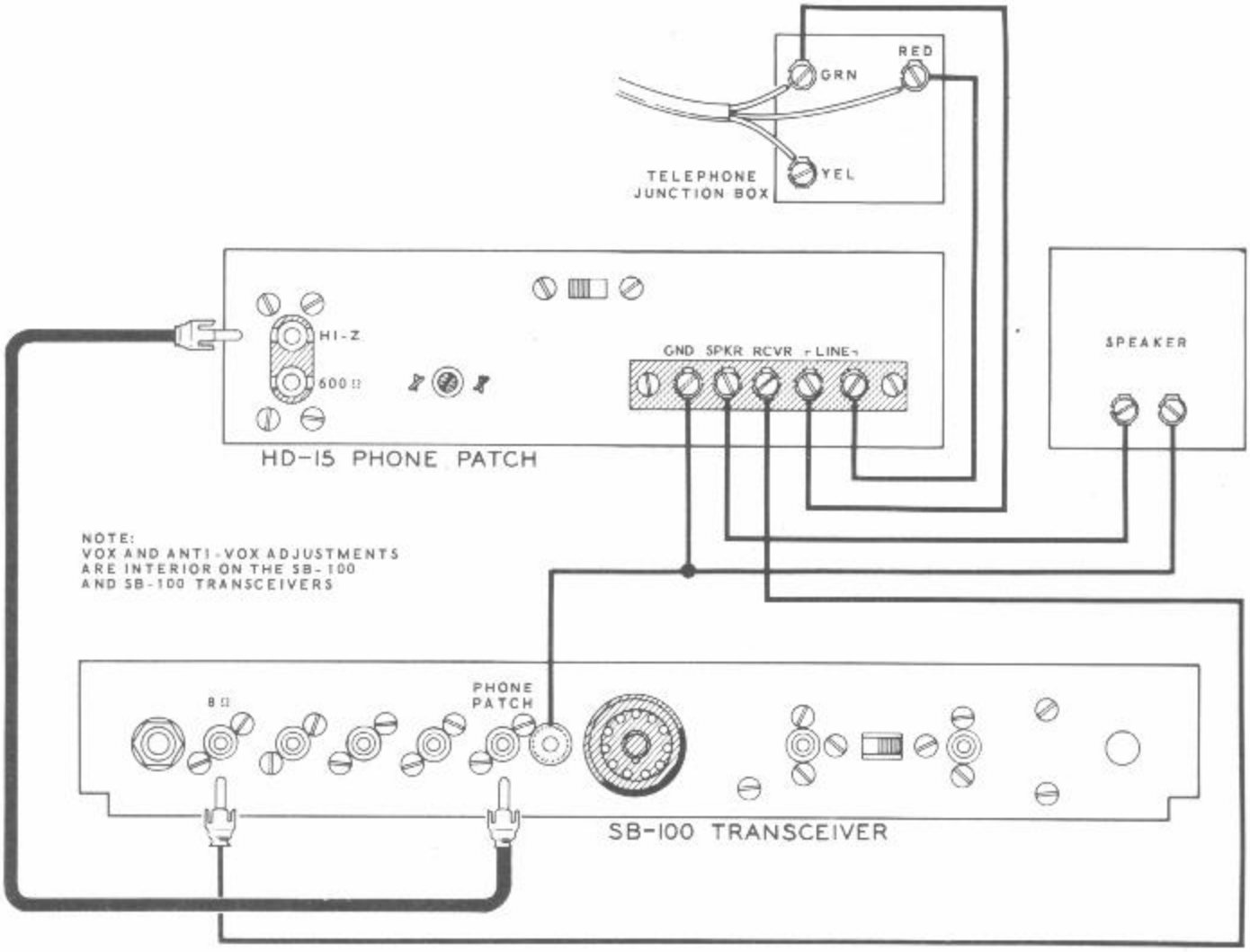

RED
GRN
YEL
TELEPHONE
JUNCTION BOX
HI-Z
600Ω
GND SPKR RCVR ⌐LINE¬
SPEAKER
HD-15 PHONE PATCH
NOTE:
VOX AND ANTI-VOX ADJUSTMENTS
ARE INTERIOR ON THE SB-100
AND SB-100 TRANSCEIVERS
8Ω
PHONE
PATCH
SB-100 TRANSCEIVER

FIGURE 2

INTRODUCTION

The Heathkit Model HD-15 Hybrid Phone Patch is used to transfer audio signals between telephone lines and two-way radio equipment. The Phone Patch combines maximum performance with ease of operation and installation. It can be used either manually or with voice-control-operated transmitters without changing any connections.

A built-in standard VU meter provides accurate monitoring of the Phone Patch output to prevent crosstalk on the telephone lines. The VU meter also permits a convenient check for null depth. Maximum null depth produces maximum isolation between the telephone line and station equipment, and best operation with voice control circuits. A specially designed hybrid transformer, with an additional winding for proper matching to the telephone line, is used to minimize hum.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

The numbers in parentheses are keyed to the numbers on the Parts Pictorial.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS - 1/2 Watt		
(1) 1-118	4	82 Ω (gray-red-black)
1-9	1	1000 Ω (brown-black-red)
1-44	1	2200 Ω (red-red-red)
1-82	1	3600 Ω (orange-blue-red)
CAPACITORS-CONTROLS		
(2) 21-36	4	.002 μfd disc capacitor
(3) 27-21	1	2 μfd resin capacitor
(4) 11-64	1	10 Ω control
(5) 10-52	1	2000 Ω tab mount control
(6) 12-68	1	200KΩ-1500 Ω dual tandem control
CHOKE-TRANSFORMERS-SWITCHES		
(7) 45-2	2	45 μh RF choke
(8) 51-129	1	Input transformer
51-130	1	Hybrid line transformer
(9) 60-2	1	DPDT slide switch
63-426	1	2-position rotary switch
TERMINAL STRIPS-SOCKETS-PLUG		
(10) 431-16	1	2-lug terminal strip
(11) 431-10	1	3-lug terminal strip
(12) 431-5	1	4-lug terminal strip
(13) 431-17	1	5-lug screw-type terminal strip
(14) 434-82	1	Double phono socket
(15) 438-4	2	Phono plug

PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE		
(16) 250-89	3	6-32 x 3/8" screw
(17) 250-56	11	6-32 x 1/4" screw
(18) 250-8	4	#6 x 3/8" sheet metal screw
(19) 250-93	3	8-32 setscrew
(20) 252-3	12	6-32 nut
(21) 252-7	3	Control nut
(22) 253-10	3	Control flat washer
(23) 254-1	14	#6 lockwasher
(24) 254-4	2	Control lockwasher
(25) 259-1	1	#6 solder lug
(26) 259-10	1	Control solder lug
MISCELLANEOUS		
261-4	4	Rubber feet
90-M319P252P253	1	Chassis
90-M320F	1	Cabinet
343-6	1	Length shielded cable
344-50	1	Length hookup wire
407-111	1	VU meter
462-191	3	Knob
490-5	1	Nut starter
490-6	1	Allen wrench
331-6		Solder
597-308	1	Kit Builders Guide
	1	Identification label
595-771	1	Manual

( ) Remove 1/4" of insulation from the other wire at this end and connect it to lug 1 of meter K (S-1).

( ) Cut the hybrid line transformer (#51-130) leads to the following lengths. Measure each lead from the point at which it leaves the transformer.

LEAD COLOR	LENGTH
Both green	4-3/4"
Blue-white	3-3/4"
Black-white	3-3/4"
White	3-3/4"
Red	2-3/4"
Blue	2-3/4"
Black	2-3/4"

( ) Remove 1/4" of insulation from the end of each transformer lead. Then melt a small amount of solder on each bared lead end to hold the wire strands together.

( ) Mount the line transformer at G with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts. Position the transformer as shown in Pictorial 3. Be sure there are no wires pinched under the transformer.

Connect the line transformer leads as follows:

LEAD COLOR	CONNECT TO
( ) Black	lug 1 of terminal strip H (S-2).
( ) Blue	lug 2 of terminal strip H (S-2).
( ) White	lug 3 of terminal strip H (S-2).
( ) Red	lug 4 of terminal strip H (S-2).
( ) Either green	lug 2 of control M (S-1).
( ) Other green	lug 3 of control M (S-2).
( ) Blue-white	lug 1 of control C (S-2).
( ) Black-white	lug 2 of control C (S-1).

( ) Connect a 3600 Ω (orange-blue-red) resistor from lug 4 of switch L (S-2) to lug 4 of switch B (S-1). Position this resistor so that its leads do not touch the transformer case.

( ) Connect a 2-3/4" wire from lug 2 of switch L (S-2) to lug 1 of switch B (S-1).

This completes the construction of your HD-15 Phone Patch. Be sure all connections are securely soldered. Shake out all wire clippings and solder splashes.

INITIAL TEST

Check the resistance between the rear apron terminal strip and the chassis with all leads disconnected from the Phone Patch. Any deviations from the values listed in the Resistance Table indicate possible sources of trouble. Check any circuit where an erroneous reading is obtained.

RESISTANCE TABLE

FUNCTION SWITCH	LINE	LINE	GND	SPKR	RCVR
OFF	Infinity	Infinity	0	Infinity	Infinity
ON	Infinity	Infinity	0	Infinity	*1 to 10 Ω

*Depending on RCVR GAIN control setting.

INSTALLATION

NOTE: To prevent the telephone ringing voltage from damaging the VU meter, be sure the Function switch is turned to OFF before connecting any leads to the Phone Patch.

Refer to Figures 1 and 2 for the following steps.

NOTE: Due to the differences in equipment, we have selected the Heathkit SB-400 Transmitter, SB-300 Receiver, and SB-100 Transceiver as typical units. While the connections to your equipment may not be exactly the same, the basic principles will apply. Use the phono plugs and shielded audio cable supplied where necessary. See Figure 3 for phono plug installation.

( ) Connect the station speaker leads to the SPKR and GND terminals of the Phone Patch.

( ) Connect the speaker output of the receiver or transceiver to the RCVR and GND terminals of the Phone Patch. If voice control is used and no anti-vox output is provided on the receiver, connect the VOX anti-trip circuit to the RCVR and GND terminals on the Phone Patch.

When using the Phone Patch with a transceiver, the transceiver internal anti-trip gain control must be adjusted.

NOTE: The GND terminal on the Phone Patch must be connected to the receiver ground terminal, if no other ground path exists.

( ) Connect the two LINE terminals on the Phone Patch to the red and green terminals in the telephone terminal box. Polarity is not important.

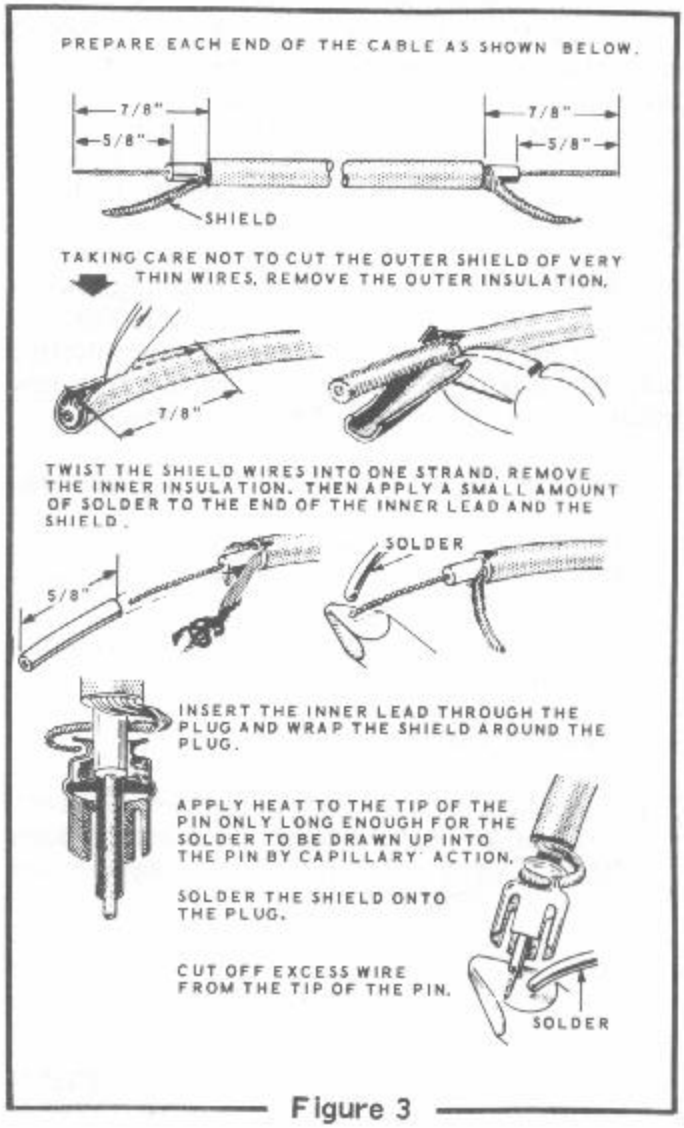


Figure 3

( ) Connect either the HI-Z or 600 Ω Phone Patch output to the transmitter input. The impedance of the transmitter input circuit will determine which Phone Patch input to use.

NULL ADJUSTMENT

This Null Adjustment only needs to be made if the Phone Patch is to be used with voice control operation. Once the NULL control is adjusted, its setting need not be changed unless you change the setting of the RCVR GAIN control on the Phone Patch. You do not need to make this adjustment if the Phone Patch is to be used with manual control only.

NOTE: Never try to make the null adjustment without actually placing a phone call. The impedance of a dead line, obtained when dialing only one digit, is different from the line impedance when a completed call is made.

( ) Set the Phone Patch controls as follows:

NULL-MONITOR switch - NULL.
NULL-ADJUST control - Full counterclockwise.
TRANS GAIN control - Full counterclockwise.
RCVR GAIN control - 7.
Function switch - OFF.

( ) Tune in a strong heterodyne note of about 800 cps on the receiver. This can be done by beating a crystal calibrator against the receiver BFO.

( ) Call a friend on the phone. Someone on a different line is best. Explain to your friend that there will be a strong tone in the telephone receiver, that he should keep the phone away from his ear, and that he can hang up when the tone stops.

( ) Leave your telephone handset off the hook, and turn the Phone Patch Function switch to ON.

( ) Advance the receiver AF Gain control until the VU meter on the Phone Patch indicates zero VU or 100%.

( ) Adjust the NULL-ADJUST control for a minimum VU meter indication, -20 or less. This dip should occur with about one-half rotation of the NULL-ADJUST control.

( ) Turn the Function switch to OFF and hang up the telephone handset.

( ) Place the NULL-MONITOR switch in the MONITOR position.

This completes the Null Adjustment of the Phone Patch.

OPERATION

The Phone Patch can be left connected at all times. When the Function switch is in the OFF position, it is isolated from the telephone line.

PLACING A PHONE PATCH CALL

( ) Be sure the Function switch is turned to OFF and dial the desired phone number.

( ) When the called party answers, explain the procedure for speaking over a phone patch. Then turn the Function switch to ON.

( ) Adjust the TRANS GAIN control to provide the desired moduation level, and adjust the RCVR GAIN to the desired listening level. See the Note below for the RCVR GAIN adjustment. It is not necessary to change the AF Gain controls on the Receiver and Transmitter.

( ) It is not necessary to switch the Phone Patch when changing from transmit to receive. The operator can use the telephone handset for a microphone and headset. When the Phone Patch call is completed, always turn the Function switch to OFF.

NOTE: When the NULL-MONITOR switch is in the MONITOR position, the VU meter indicates the listening level on the telephone lines. The telephone industry permits peaks up to zero VU. In testing the Phone Patch we have found that this level was much in excess of a comfortable listening level. The exact level will have to be arrived at by experimentation, however -10 VU seems to be satisfactory in most cases. NEVER PERMIT THE LEVEL TO EXCEED ZERO VU, AS IT MAY CAUSE CROSSTALK BETWEEN TELEPHONE CHANNELS.

IN CASE OF DIFFICULTY

NOTE: Refer to the Kit Builders Guide for Service and Warranty information.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Soldering section of the Kit Builders Guide.

3. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

5. Lack of transmitter gain will result if the meter switch is left in the NULL position. Always operate the Phone Patch with the NULL-MONITOR switch in the MONITOR position.

6. Difficulty in obtaining a deep null may be caused by failure to make a complete phone call. Dialing one digit will not give a correct null. An actual call must be placed.

7. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

SPECIFICATIONS

Circuit	Telephone hybrid circuit. Allows voice control or manual operation. Single switch places unit in full operation.
Telephone Line Input Impedance	Approximately 600 Ω.
Meter	Standard VU meter for constant output monitoring and null depth indiciation.
Null Depth	At least 30 db isolation between transmit and receive circuits.
Receiver Impedance	Effective match from 3 to 16 Ω.
Transmitter Impedance	600 Ω or high impedance output.
Cabinet Size	9-1/4" long x 3-5/8" wide x 2-5/8" high.
Net Weight	2-1/2 lbs.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

The circuit of the Phone Patch is based on the use of special hybrid transformer T1. The hybrid transformer, with proper adjustment of the Null-Adjust control, will provide a high degree of isolation between the receiving and transmitting circuits. This feature is required for stable voice control operation.

The operation of a hybrid transformer is shown in Figures 4 and 5. Refer to the Schematic Diagram (fold-out from Page 15) while reading this Description.

Figure 4 shows the Phone 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. If voltage E (representing an incoming voltage of the telephone line) is impressed on the transformer, it will at a given instant, cause current to flow as shown by the arrows. The opposing voltage drop across winding C will equal that across winding Z_T. Identical winding D is linked by the same flux as winding C; therefore it will have an induced (opposing) voltage of equal

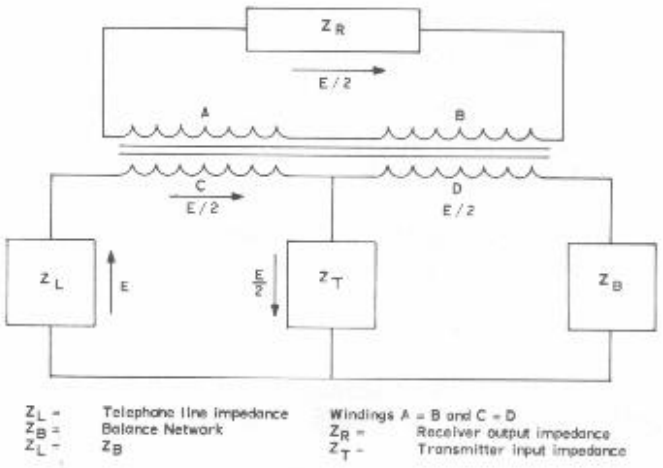


Figure 4

magnitude and in the same direction as winding C. The induced voltage in winding D is equal to the voltage across winding 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.

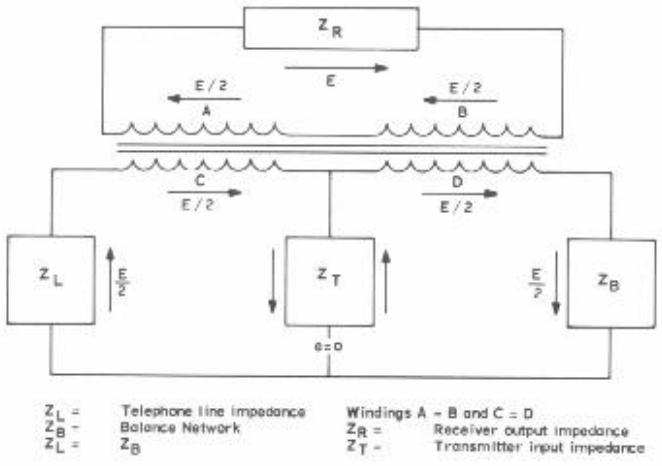


Figure 5

In Figure 5, the Phone Patch is shown in the receive cycle, with the signal from the receiver routed to the telephone line. If voltage E (representing a voltage from the receiver) is impressed on the transformer, it will, at a given instant, cause current to flow as shown by the arrows. Windings A and B are connected in series aiding.

Equal voltages are induced in each winding, since winding C equals winding D. The balance network is adjusted so 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 there is no voltage across Z_T and no energy is fed to the transmitter input.

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

A standard VU meter is used to continuously monitor the output to the telephone line. The VU meter is designed to read zero VU with 1.228 volts AC at 1000 cps applied across the instrument and the 3600 Ω series resistance. This represents 4 db above 1 milliwatt in 600 Ω, and is the maximum voltage allowed on telephone lines to avoid crosstalk between channels.

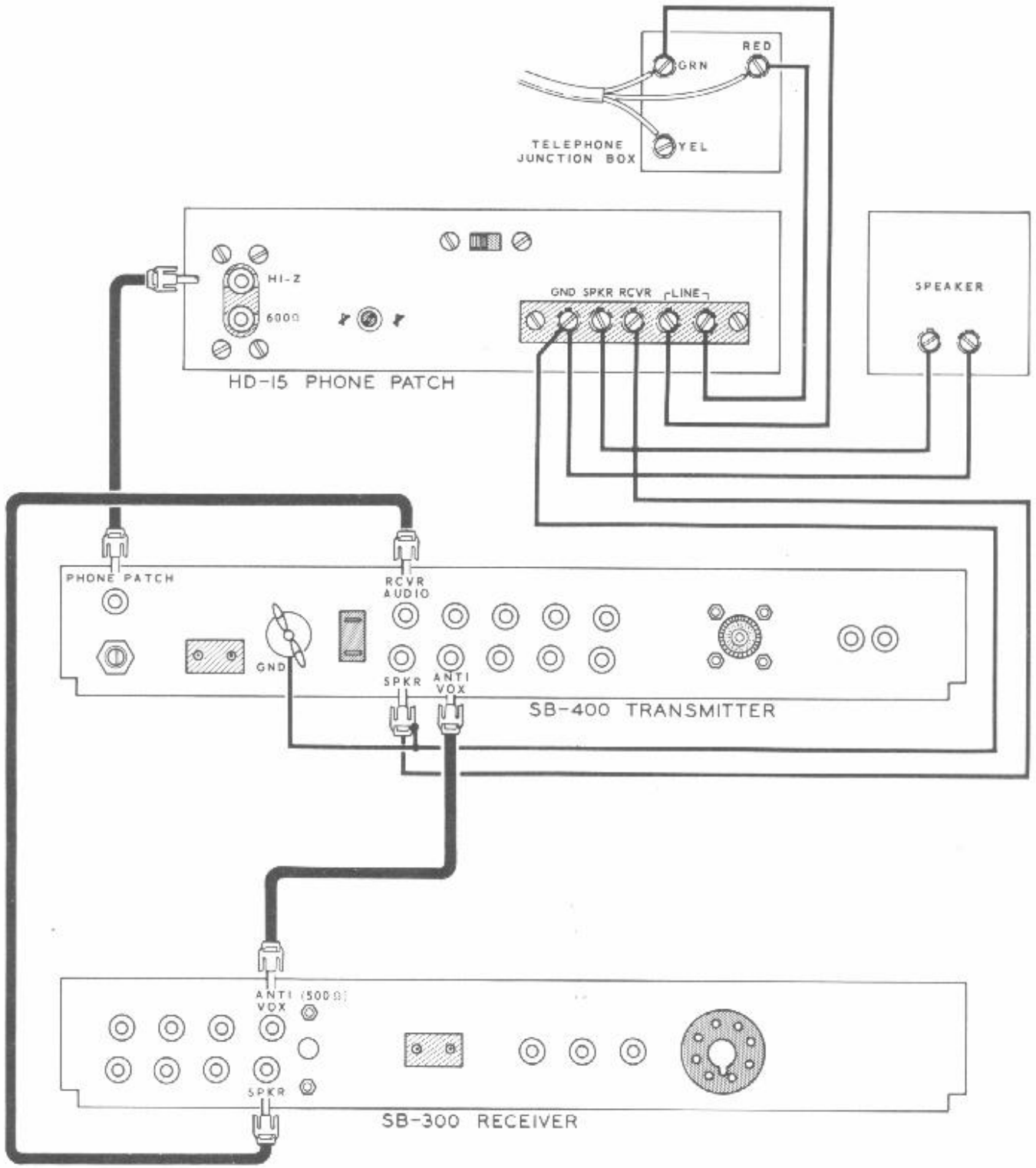
A Null-Monitor switch, S2, is provided on the rear apron so the VU meter can be used as a null indicator when adjusting the balance network. In the Null position of S2, the meter resistor (R1) is switched out of the circuit to increase the sensitivity of the meter.

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.

Since the impedance of telephone lines vary greatly from installation to installation, it is necessary to isolate the line impedance so a simple balance network will provide a sufficient null at every installation. This is accomplished by connecting the telephone line to the Phone Patch through an H pad. This H pad, which is formed by resistors R2, R3, R4, R5, and R6 has an impedance of 600 Ω. The pad forces the line impedance to appear as approximately a 600 Ω resistance. This allows the impedance of the Null Adjust control, R9 with resistor R8, 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 Phone Patch through capacitor C5. This capacitor blocks the DC voltage of the telephone line but allows the audio frequencies to pass. The large value of capacitance has very little reactance at audio frequencies, thus allowing the Phone Patch to maintain good audio quality.


RED
GRN
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600Ω
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SPEAKER
HD-15 PHONE PATCH
PHONE PATCH
RCVR
AUDIO
GND
SPKR
ANTI
VOX
SB-400 TRANSMITTER
ANTI
VOX
(500Ω)
SPKR
SB-300 RECEIVER

FIGURE 1