Hardwire Receiver

Companion to the hardwire senderbug.

SYSTEM THEORY

The HWS uses a transformer to let a weakly biased transistor drive a low-impedance transmission line. A transformer steps the voltage down by ~12 dB. The hardwire receiver (HWR) uses the same transformer in reverse, recovering most of the step-down loss. Balanced transmission lets the transformer reject common-mode noise picked up along the way.

CIRCUIT FUNCTION

Balanced transmission line couples directly to 600-ohm winding of T1, loaded by R1; 10 K winding of T1 couples through C3 to input of U1, configured as an inverting amp with variable gain, determined by the ratio of R5 to the net impedance of the transformer winding loaded by R2. D1 and D2 limit U1 input voltage to ~1.2 Vp-p. D3 and D4 limit U1 output to ~1.2 Vp-p. C4 rolls off high-frequency response above a point dependent on setting of R3. Noninverting input of U1 is biased at ½ V+ by divider R3-R4.

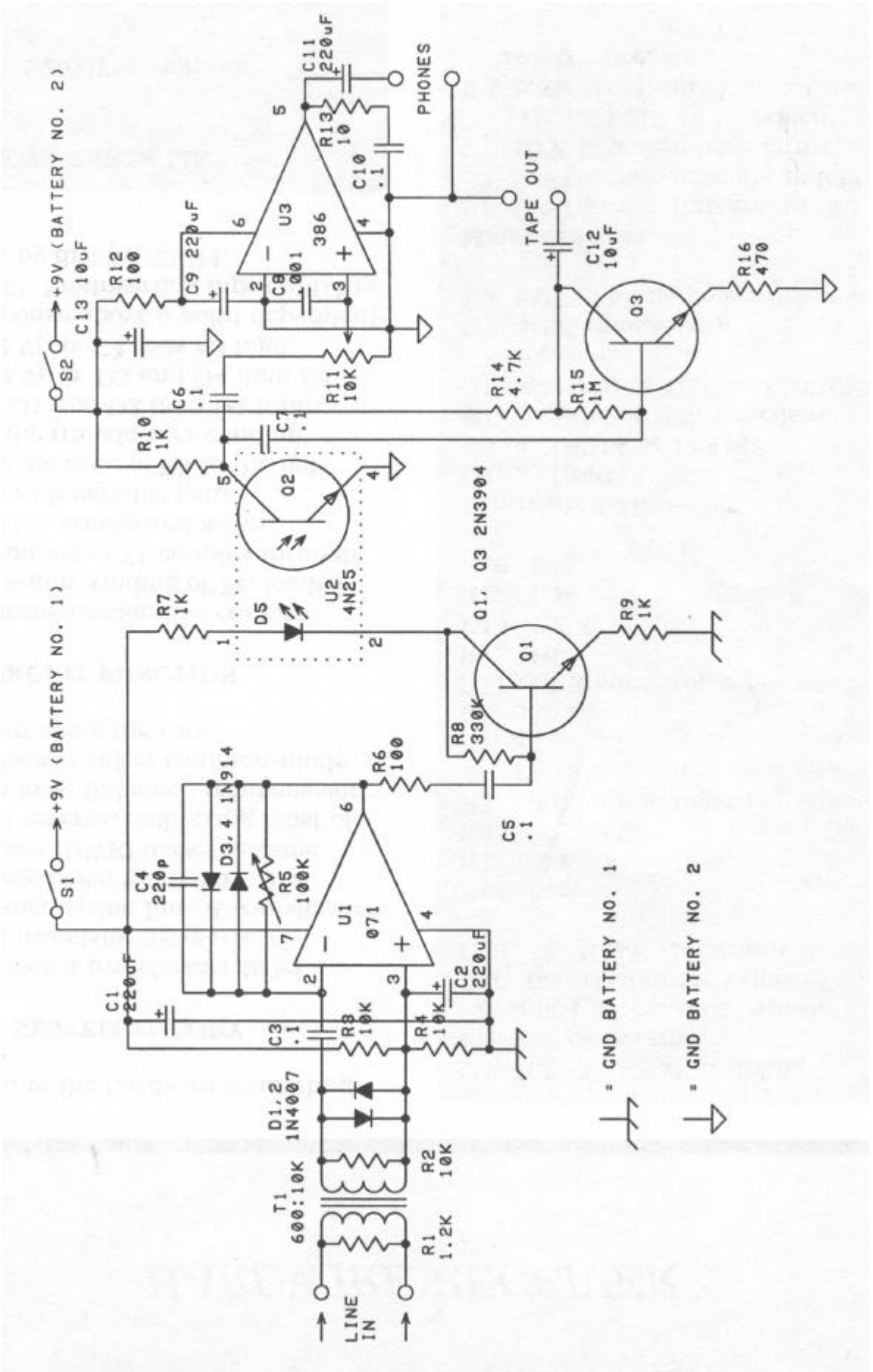
HWR PARTS LIST

Capacitors
C1, 2, 9, 11 220 µF aluminum electrolytic
C3, 5, 6, 7 0.1 µF coupling
C4 220 pF ceramic
C8 0.001 µF ceramic bypass
C10 0.1 µF ceramic bypass
C12, 13 10 µF aluminum electrolytic

Resistors
R1 1.2 K
R2, 3, 4 10 K
R5 100 K audio-taper pot w/switch
R6, 12 100
R7, 9, 10 1 K
R8 330 K
R11 10 K audio-taper pot w/switch
R13 10
R14 4.7 K
R15 1 M
R16 470

Semiconductors
D1, 2 1N4007
D3, 4 1N914 or 1N4148
Q1, 3 2N3904 NPN transistor
U1 MAX410 or TL071 or LT1097 op amp
U2 4N25 optoisolator
U3 LM386 audio power driver

Miscellaneous
S1 SPST switch (integral to R5)
S2 SPST switch (integral to R11)
T1 10 K:600 ohm transformer (Mouser p/n 42TL019 or equivalent)
9 V batteries, printed circuit board, solder, wire, etc.


+9V (BATTERY NO. 2)
+9V (BATTERY NO. 1)
S1
S2
C1 220uF
C2 220uF
C3 .1
C4 220p
C5 .1
C6 .1
C7 .1
C8 .001
C9 220uF
C10 .1
C11 220uF
C12 10uF
C13 10uF
R1 1.2K
R2 10K
R3 10K
R4 10K
R5 100K
R6 100
R7 1K
R8 330K
R9 1K
R10 1K
R11 10K
R12 100
R13 10
R14 4.7K
R15 1M
R16 470
D1,2 1N4007
D3,4 1N914
D5
T1 600:10K
U1 071
U2 4N25
U3 386
Q1, Q3 2N3904
Q1
Q2
Q3
LINE IN
PHONES
TAPE OUT
= GND BATTERY NO. 1
= GND BATTERY NO. 2

U1 output couples though R6 and C5 to base of Q1, configured by R7, R8, and R9 as a driver for D5, an LED integral to optoisolator U2.

C1 and C2 decouple the first supply.

Phototransistor Q2 is integral to U2, biased by R10. Q2 output is taken off the collector and couples through C6 to volume-control pot R11, whose wiper couples to noninverting input of U3. C8 shunts RF at U3 input; R13 and C10 form the standard snubber. Audio couples through C11 to headphone output.

Q2 output also couples though C7 to base of Q3 configured by R14, R15, and R16 as a common-emitter amplifier with gain of 10. Output is taken off the collector. Signal couples through C12 to tape output.

R11, C9, and C13 decouple the second supply.

DETAILS

Given two independent supplies, both S1 and S2 must be ON for the unit to work. R5 controls preamp gain, R11 controls headphone volume.

The 600-ohm balanced line has another name: telephone line. It conducts line-level audio many miles with trivial loss. In fact, any unshielded, twisted pair of 20- to 30-gauge copper wire will serve as transmission line. This includes the ubiquitous spare pair in the telco trunk. With careful shopping a mile of 24-gauge twisted-pair cable can be had for less than four bills.

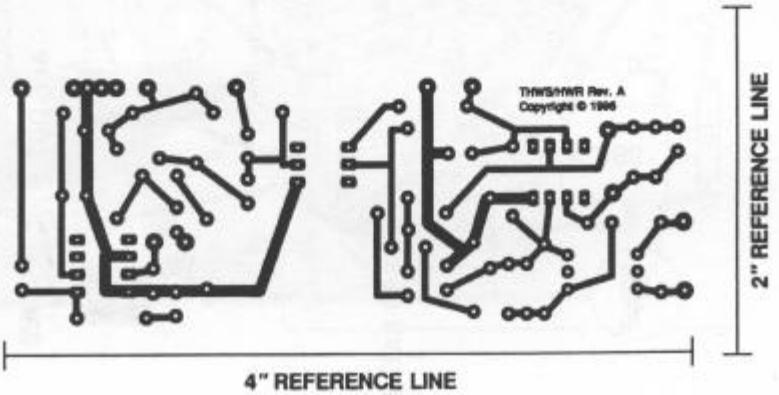
The HWS is a lot more versatile than the board-mounted mike implies. The mike could mount in a hose or a corner; become part of a spike setup, etc. The system also has nonsurveillance uses. The HWS's low current drain suits it to hardwired listening posts at tactical points on vast stretches of land. Its tremendous sensitivity invites use as an area-coverage mike, as in a corner boundary.

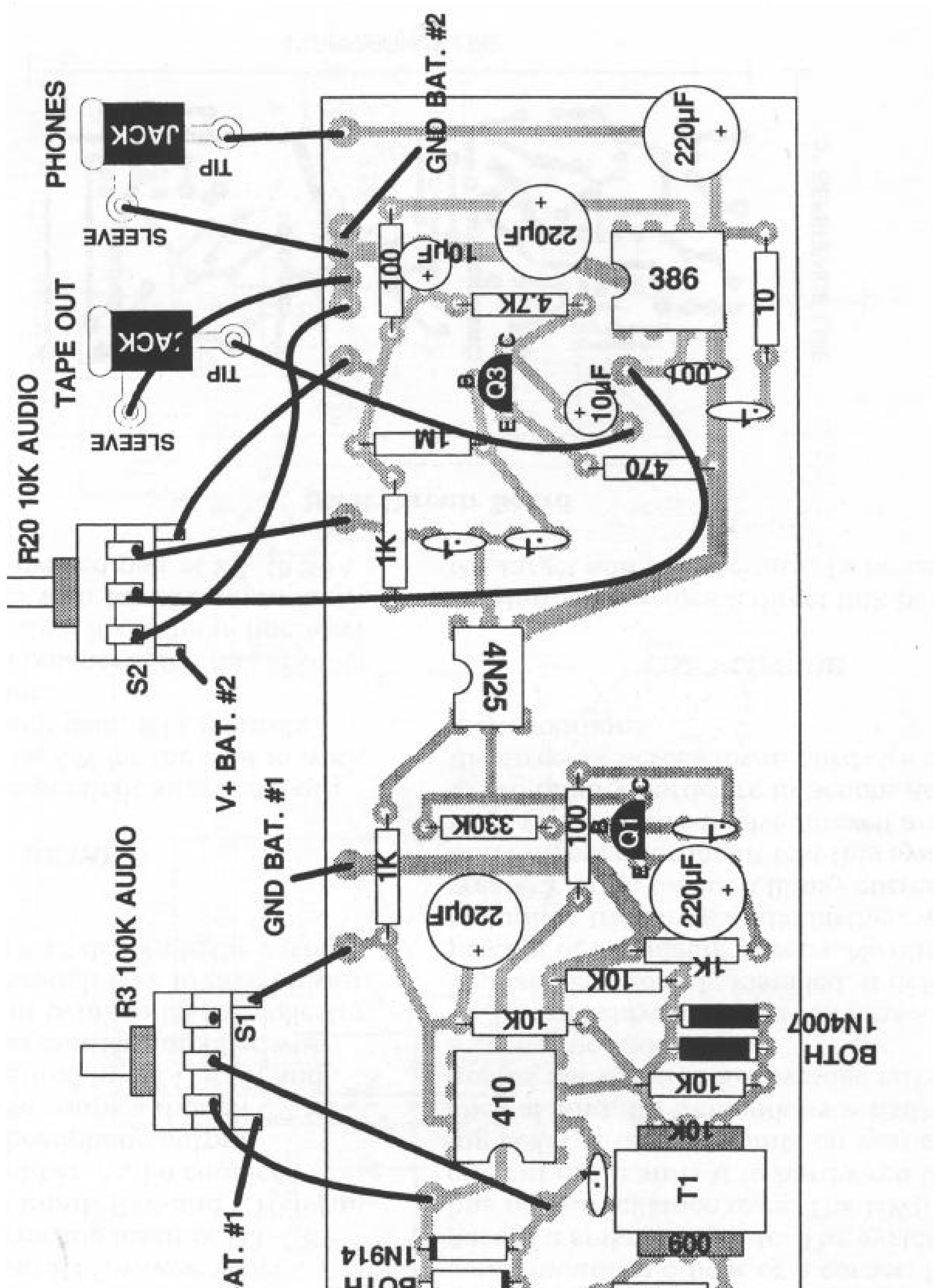
Inexplicably, hardwire remains a well-kept secret. Properly installed, it defeats 99 percent of debugging sweeps. No other technique transmits audio farther, with greater clarity, on such flimsy current. The budding operator might test this system with a mile of wire to give himself an earful of pro-quality hardware in action. Across the street or across town, hardwire makes a great solution.

THE FLIPSIDE

Hardwire creates a direct link between the target and the operator. To be caught

HWR Circuit Board




PHONES
TAPE OUT
JACK
TIP
SLEEVE
GND BAT. #2
R20 10K AUDIO
S2
V+ BAT. #2
GND BAT. #1
R3 100K AUDIO
S1
V+ BAT. #1
LINE IN
BOTH 1N914
BOTH 1N4007
220µF
10µF
100
4.7K
386
10
Q3
1M
470
1K
4N25
330K
Q1
10K
410
T1
600
1.2K
220p