INTERCOM

A domestic intercom doesn't require a complicated circuit. The unit described here uses only a handful of components, even though an automatic gain control has been incorporated in the circuit.

This intercom was designed to meet two requirements: low cost and high performance.
To keep the cost down, the output stage is nothing more than a two-transistor class-A stage that can deliver 100 mW. To maintain good intelligibility in spite of this low power output stage, an automatic gain control is incorporated. This ensures that the output stage will nearly always be fully driven. To keep the cost of this gain control down, an OTA is used as the preamplifier – its gain is a function of a DC bias current.
Small 150 Ω loudspeakers are used both as microphone and as loudspeaker.

The circuit

Switch S1 is the master 'press-to-talk' button. When this switch is depressed, the loudspeaker in the main station (the upper loudspeaker in the diagram) is connected to the input of the amplifier. When the button is released, the other loudspeaker is connected.
Resistors R2 . . . R4 and capacitor C1 produce a smoothed DC bias voltage for the OTA. R5 and C4 are included in the input circuit to reduce clicks during switch-over from 'talk' to 'listen'; they also reduce the effect of interference pulses picked up by the (long) leads from the substation.
The output signal from the OTA is fed to the 'power' output stage T2 and T3. This stage only gives a voltage gain of a factor 2; its primary function is current gain, to drive the loudspeaker. S1 is wired in such way that the output is fed to the loudspeaker that is not being used as microphone at that moment. Understandably. . . .
The automatic gain control is derived from T1 with its associated components. This transistor is connected as a current source. The maximum current it can supply to the bias input of the OTA (pin 5) is

$$\frac{0.6\ \text{V}}{470\ \Omega} = 1.2\ \text{mA}.$$

This corresponds to a maximum gain of the OTA of 2500 ×. When the output voltage rises above a certain level, current starts to flow through D3. This raises the base voltage of T1 towards the supply level, thereby reducing the current through T1. This in turn reduces the gain of the OTA. This automatic gain control action is 'tamed' by including C5.

Installation

In most cases, the wiring to the substation can be normal two-core cable. However, if the distance is too great or if the leads run close to mains wiring it may be necessary to use single-core screened cable.
Since the output stage is running in class-A, the current consumption is too high for battery operation. It would be possible to use batteries if an on/off switch is included in the main station, but this would mean that the substation cannot initiate the conversation. For

Parts list

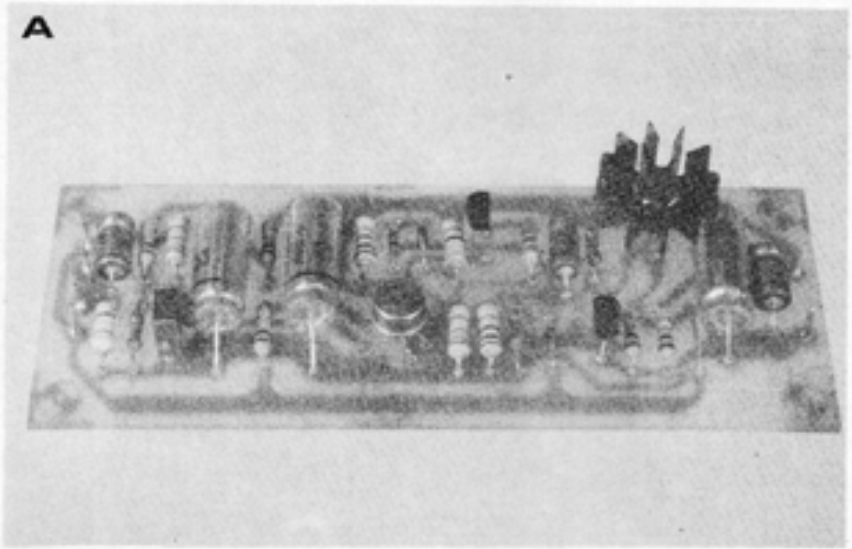
Resistors:
R1 = 47 k
R2 = 22 k
R3,R4,R6 = 10 k
R5,R10 = 1k2
R7 = 10 M
R8 = 470 Ω
R9 = 33 Ω
R11 = 1 M
R12,R13 = 2M2
R14,R15 = 1 k

Capacitors:
C1,C3 = 100 µ/16 V
C2,C5 = 10 µ/16 V
C4 = 100 n
C6 = 2µ2/16 V
C7 = 100 µ/25 V

Semiconductors:
IC1 = CA3080
T1 = BC557B,BC177B,2N1711
T2 = BC517 (darlington)
T3 = BC160,BC161,2N3553
D1 . . . D3 = DUS,1N4148

Sundries:
Cooling fin for T3
2 loudspeakers, 150 Ω/1 Watt
Switch or pushbutton, 2P2T

power supply:
Trafo 12 . . . 15 volt, 100 mA
Fuse 100 mA slow blow (and fuse holder)
Bridge rectifier B40C400
1000 µ,25 V elco



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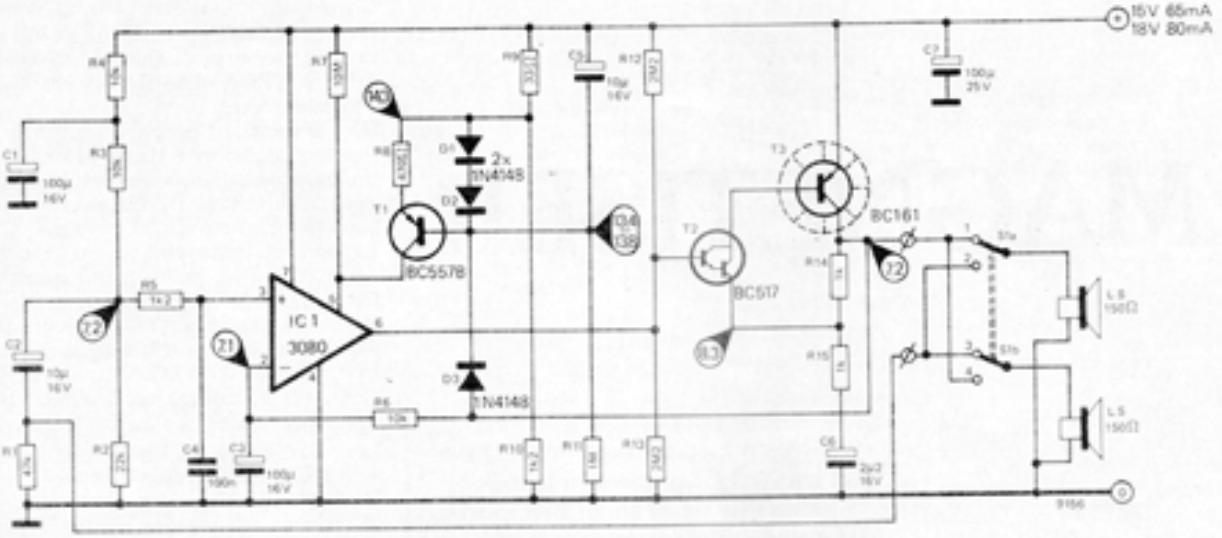

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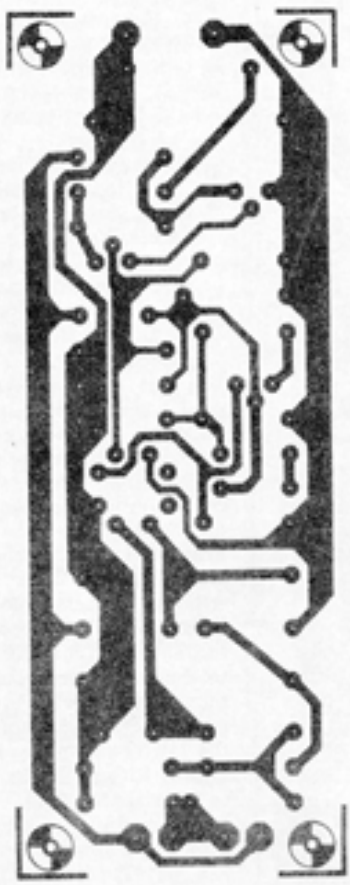

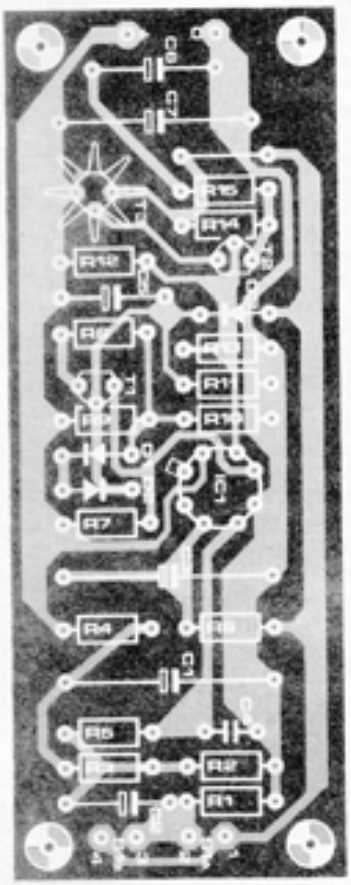

battery operation, the supply voltage can be reduced to 9 V, although this will reduce the output level.

A better solution is to use a mains-driven supply. A transformer with a 12 . . . 15 V secondary which can supply 100 mA is sufficient. Connect this to a bridge rectifier followed by a 1000 μ/25 V smoothing electrolytic.

The gain of the intercom will vary between a maximum of 5000 x and a minimum of 150 x, depending on the automatic gain control. The maximum is set by R8; increasing the value of this resistor will reduce the maximum gain. Do not decrease the value, as this can damage the IC. The minimum is set by the value of R7; this should not be altered.

S1 can be either a switch or a push-button, according to taste. In either case, it should be a break-before-make type.

Figure 1. The circuit of the intercom. T1 is the main component in the automatic gain control circuit.

Figure 2. The printed circuit board and component layout for the intercom. Switch S1 and the two loudspeakers are connected to points 1 . . . 4, as shown in the circuit diagram.

Photo. A finished unit. Note the way the cooling fin is mounted on T3. A common mistake is to mount it 'upside down', but this makes it much less effective.