A COMMON requirement for most intercom systems is the matching of speech transducers to the input and output impedances of the relevant amplifier stages. In the past this magazine has published designs employing balanced armature earpieces and low impedance loudspeakers as transducers, both methods involving the use of comparatively expensive matching transformers. The first of these methods suffers from volume limitations and restricted availability of suitable components. With the second method, improvement in the unit's performance, both in pick-up sensitivity and output, can be achieved by using speakers of relatively large cone diameter.

It would therefore seem that what is needed is a simple amplifier which will employ any kind of low impedance loudspeaker which can serve in the dual capacity of microphone and loudspeaker with none of the attendant cost of matching transformers in the input and output stages. This method has been adopted in the P.E. Homecom.

DIRECT COUPLING OF LOUDSPEAKERS

The relatively low input and output impedances of the power transistors used in the present circuit (see Fig. 1), a two stage amplifier of common emitter configuration, permits direct coupling to the loudspeakers. Bias current is supplied to both transistors by way of potential divider networks.

Most readers are probably aware of the principle of operation of a loudspeaker where alternating current flowing through the speech coil produces a dynamic reaction with the magnetic field provided by the permanent magnet; the cone, being connected to the coil, reproduces these electrical oscillations as sound waves. If the order of this process is reversed we then have the principle of the moving coil microphone, and it is in this capacity as induced current driver that the loudspeaker functions when spoken into.

FUNCTIONS OF SWITCHES

The circuit diagram shows the master switch S1 in its "standby" (SB) position. It can be seen that the power supply to the unit is disconnected by S1f. Station 1 loudspeaker LS1 is connected to the collector circuit of TR2. A regenerative feedback loop is provided by C2 and limiting resistor R5. The path of this loop is completed by S1c.

When Station 2 call button S3 is depressed this completes the supply line broken at S1f and the amplifier comprising TR1, TR2 now acts as a two stage phase shift oscillator producing a "call" tone at Station 1 loudspeaker.

When in response to this call, Station 1 master switch is moved to the central "Receive" (REC) position, this action disconnects the feedback line at S1c and completes the battery supply circuit via S1f, so overriding the remote call switch S3. Station 2 is now in a position to speak, the loudspeaker LS2 acting as a microphone, being connected between point "A" and TR1 base by S1d and S1e.

At the third position of the master switch—"Speak" (SPK)—the station functions are reversed by the switching of S1a, b and S1d, e. Loudspeaker LS1 is connected between points "A" and the base of TR1 by S1a and S1b; loudspeaker LS2 is connected to the collector circuit of TR2 by S1d and S1e, thus Station 1 can now speak to Station 2.

Switches S1c and S1f remain unchanged when moving from position two (REC) to three (SPK), and so the battery supply remains connected and the feedback line disconnected.

If Station 1 wishes to initiate a call, normal practice would be to go straight through to the "speak" position from "standby" and put through the oscillatory call tone by pressing S2. Then with S1 released, Station 1 is immediately on "receive" since the lever of S1 is biased to this (mid) position.

CALL TONE

If, in the final assembly, the pitch of the call tone is considered too low, this can be raised by decreasing the value of C2. A similar tailoring by "cut and try" can be exercised on R5 for increasing the call signal volume. For the loudest call R5 can be removed, but this results in the transistors being driven hard with consequent peak clipping, raucous tone and increased current consumption.

CONSTRUCTION

The first detail in order of assembly should be the circuit component board, see Fig. 2. It should be noticed from the underside view of the transistors (shown with the circuit diagram) that the base and emitter

P.E. HOMECOM

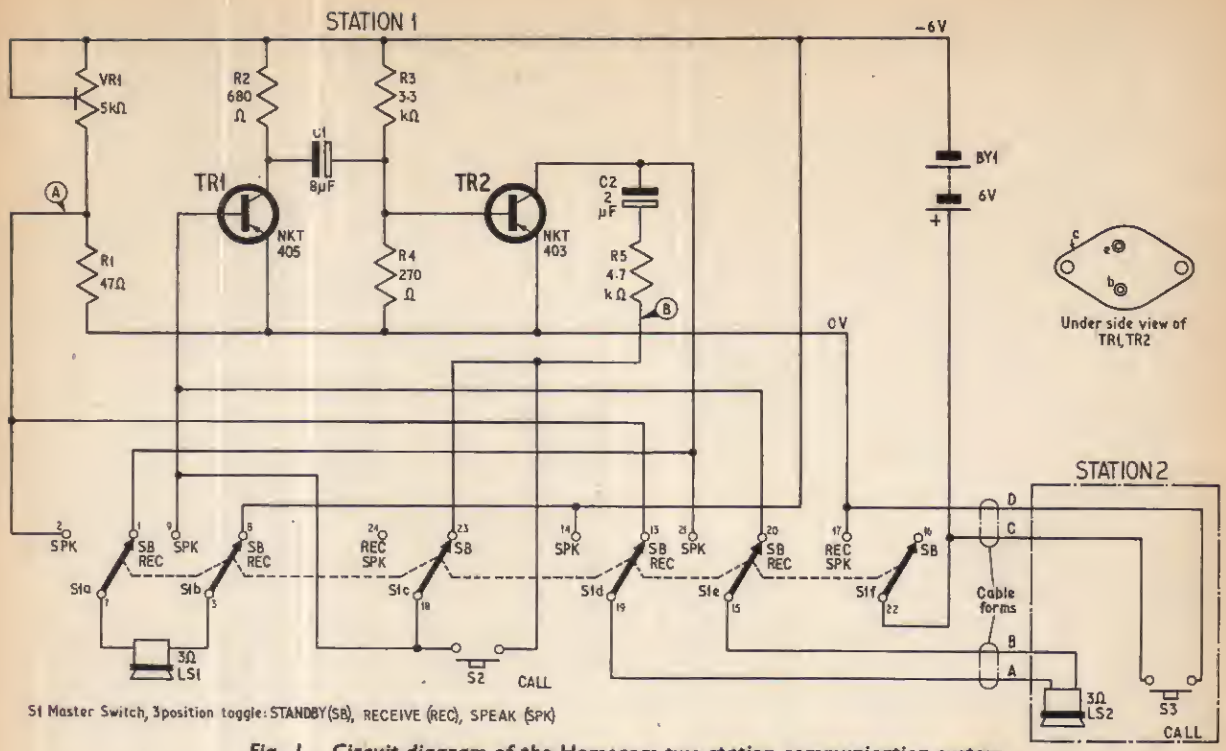


Fig. 1. Circuit diagram of the Homecom two station communication system

poles are slightly offset from centre and care should be taken in identifying these pins prior to soldering. The transistors should be mounted clear of the board as the case and collector are common and any shorting to adjacent wires might produce expensive damage. The collector connection is made by a soldering tag fitted to one fixing hole of each transistor; this is not bolted through the board. The transistors are supported by the two pins.

At this stage no flying connections are made and the completed board assembly should be placed to one side.

FRONT PANEL

The front panel is prepared from a piece of hardboard, dimensions and drilling details are given in Fig. 3. Loudspeaker and switch cut-outs are made and holes drilled for screw fixing. If loudspeaker fabric is used for covering, these holes can be easily cleared from one side of the panel.

The loudspeaker and the two switches can now be mounted, making sure that the miniature lever keyswitch S1 is positioned so that the key is up on lock or "Standby" (SB). The rear view of the switch terminals will appear as is Fig. 4. With the 12-way connecting strip screwed in position the wiring of S1 can be commenced.

Soldering to the tightly spaced tags on the master switch demands the use of an iron with a slender bit, and all connections should be made in a progressive sequence either horizontally or vertically. Random connections will probably result in insulation charring and consequent short circuits when adjacent leads are fitted.

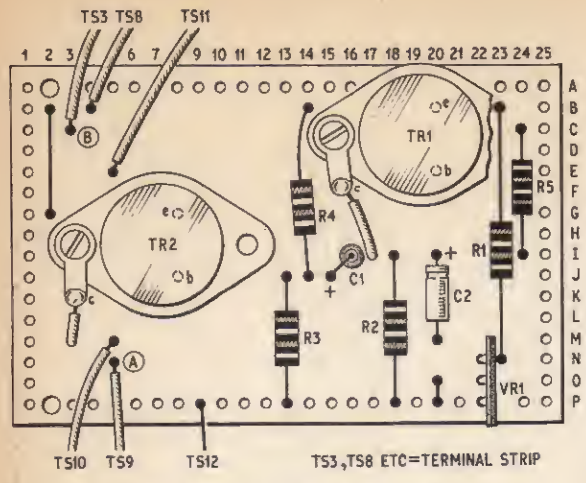
Inspection of the switch wiring (Fig. 4) will show a number of tags which are electrically common. Wire links could have been used on the switch, but it makes wiring more untidy. It is easier to make single connections at the switch tags with lengths of 1/·024 solid sleeved wire and mechanical joins at the terminal strip.

MOUNTING THE COMPONENT BOARD

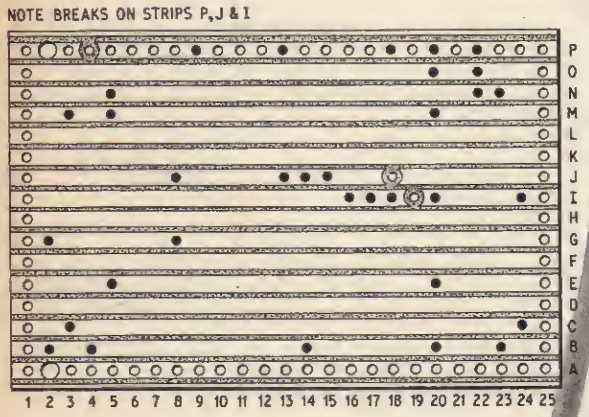
The component board is mounted on a piece of angle aluminium using nylon nuts and bolts or bushes in the fixing, and the whole is attached to the front panel, see Fig. 4. The complete assembly is now integral to this panel which facilitates any later servicing, as the unit can be readily withdrawn from its press-fit attachment to the recessed main housing. See Fig. 5.

With the front panel conveniently held in a vice, flying leads to the circuit component board can be

By G.M. Harvey



(a) Arrangement of components



(b) Underside view of board

Fig. 2. Circuit component board. Note the three breaks which have to be made in the copper strips

COMPONENTS . . .

Resistors
R1 47Ω
R2 680Ω
R3 3·3kΩ
R4 270Ω
R5 4·7kΩ
All 10%, ¼W carbon

Capacitors
C1 8μF elect. 15V
C2 2μF elect. 15V

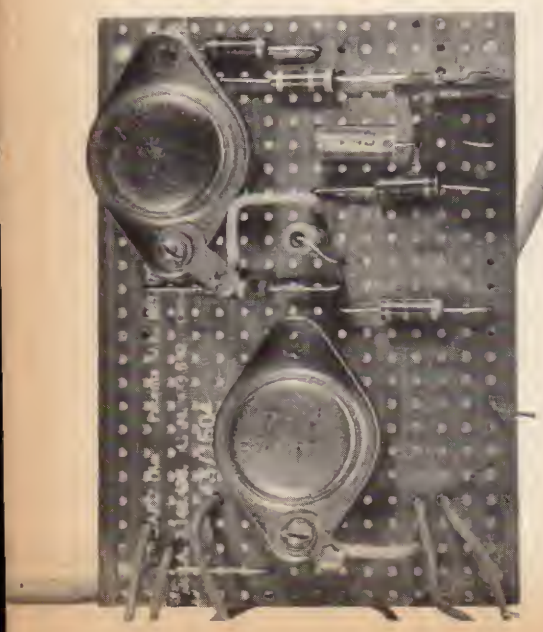
Potentiometer
VR1 5kΩ linear skeleton preset

Transistors
TR1 NKT405 } (Newmarket)
TR2 NKT403 }

Switches
S1 Miniature lever key switch 4CL/4CN (Keyswitch) (Home Radio)
S2, 3 Miniature push-to-make s.p.s.t. (Home Radio) (2 off)

Loudspeakers
LS1, 2 3Ω, permanent magnet, 5in dia. (see text)
BY1 6V battery—2 × 3V twin cell batteries (800 type Ever Ready)

Miscellaneous
Terminal strip, 12 way
Terminal strip, 4 way
Veroboard 3¾in × 2½in
Solder tags.
Hardboard for front panel (2 off)
Material for cases. Aluminium strip
Tygan or speaker grille
Length of cable as required; 4-core, or 2 × 2-core mains flex



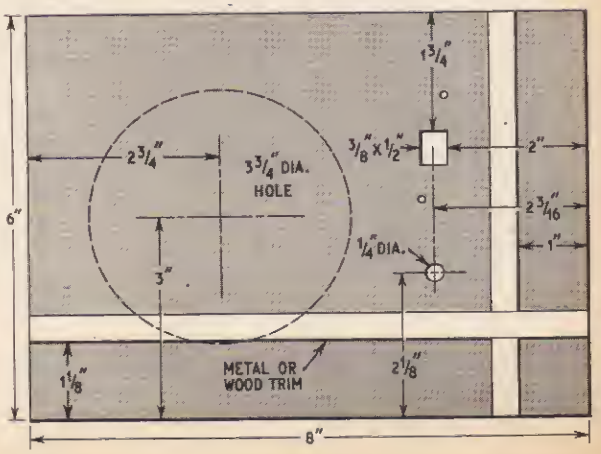


Fig. 3. Front panel cutting and drilling details. Suitable material is ⅛in hardboard

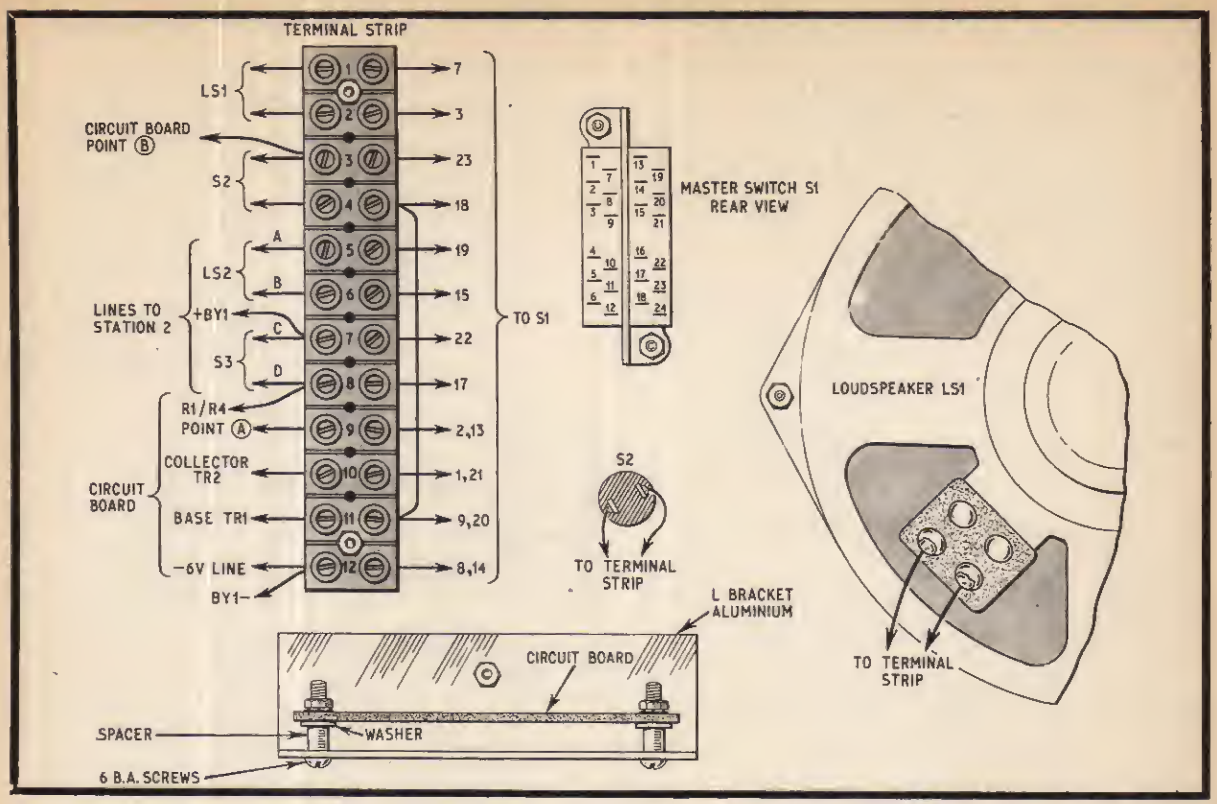
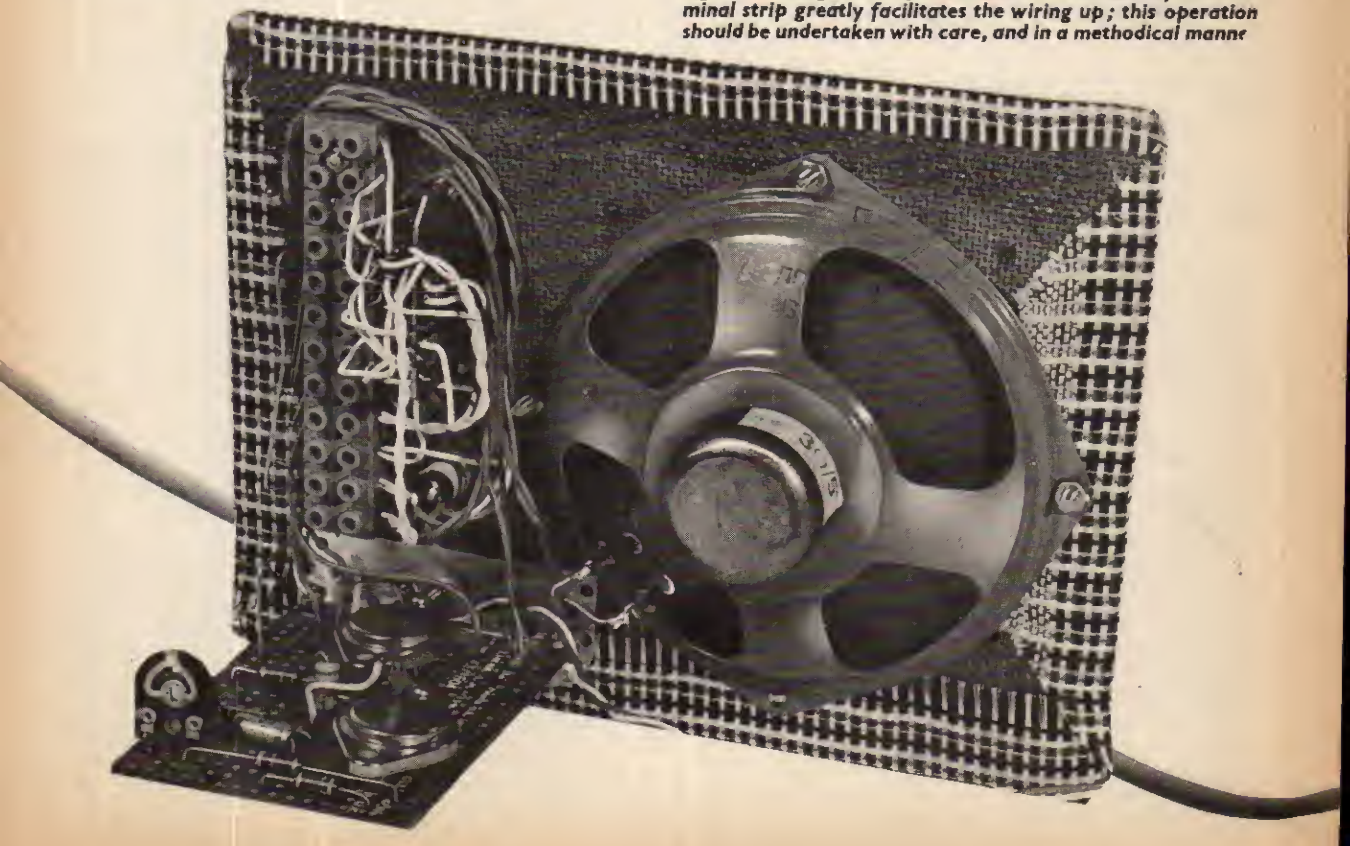
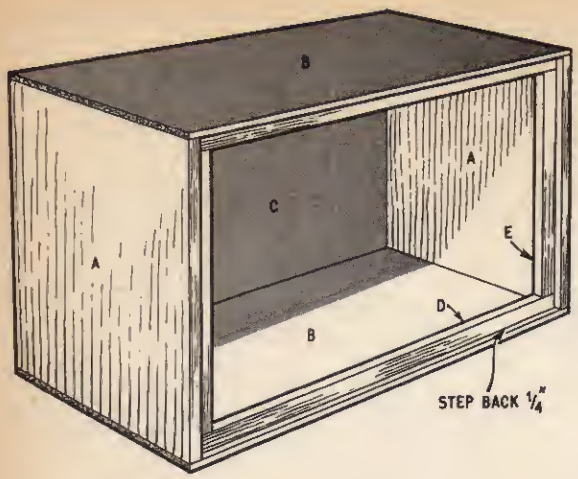


Fig. 4. Wiring details for Station 1. The use of the terminal strip greatly facilitates the wiring up; this operation should be undertaken with care, and in a methodical manner





A = 5" X 6" X 3/8" WOOD (2 OFF)
B = 8 3/4" X 5" X 1/8" HARDBOARD (2 OFF)
C = 8 3/4" X 6 1/4" X 1/8" HARDBOARD
D = 3/8" X 1/4" X 8" WOOD FILLET (2 OFF)
E = 3/8" X 1/4" X 5 1/4" WOOD FILLET (2 OFF)

Fig. 5. Construction details for the Homecom housing. Note that the case for Station 2 can be of less depth than stated above if desired. Four screws secure the front panel

connected. At this point it is as well to make sure that the retaining screws of the terminal block are making clean connections to the wire and not the sleeving.

THE CASE

A suitable housing for both units is a wooden or metal case of internal dimensions 8in × 6in × 5in. This provides ample room for the two twin cell 3V batteries (connected in series) immediately behind the loudspeaker in Station 1.

Aluminium strip can be used for front panel embellishment, and provides a good base for Letraset marking of switch functions. This embellishment also allows a distinction to be introduced between the frontal appearance of Station 1 and Station 2.

As Station 2 contains only the press switch S2 and a loudspeaker LS2 the disposition and mounting of these components should duplicate Station 1, that is, if the loudspeakers used are of equal diameter. The depth of the case could however be reduced to about 2½in if desired. Wiring details are given in Fig. 6.

A small hole should be drilled in the back panel of each case for feeding out the interstation cables.

LOUDSPEAKERS

Almost any low (3–15 ohm) impedance loudspeaker of various cone diameter may be usefully employed. Of course, it follows that input and output sensitivities will be a function of the loudspeaker diameter. It should be noted that loudspeakers of differing impedances were not tried, but in view of the swamping value of VR1 such unbalances should not upset the preliminary sensitising of the circuit.

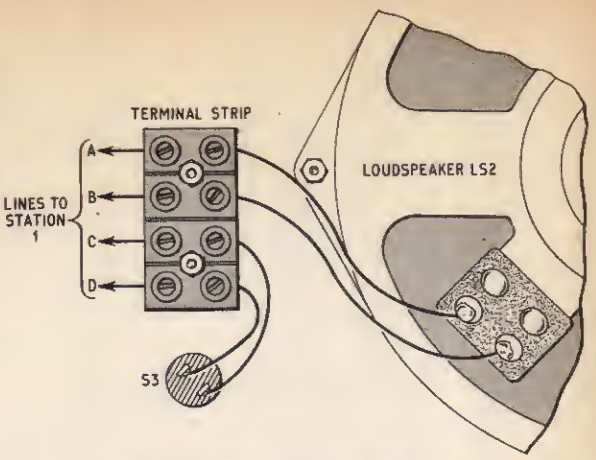


Fig. 6. Wiring details for Station 2

INTERSTATION CONNECTIONS

Two twin lengths of 2A flex can be used for interstation connections. In the prototype 3 ohm 5in loudspeakers were employed, with a four-way standard screened cable between stations. As the input impedance is low such screening was found to be completely unnecessary. Satisfactory operation was achieved with a 60ft length of cable between stations.

It should be borne in mind that 3 ohm transducers in the output stage will contribute to a greater collector dissipation, however this is well contained in the unsinked assembly of TR2. Higher impedance loudspeakers whilst providing better power transfer have the advantage of overcoming the power lost in the interconnecting line resistance.

SENSITIVITY ADJUSTMENT

In the preliminary setting up of the Homecom, the required cable length should be maintained *in situ*. With power connected VR1 potentiometer should be reduced from its maximum value until the "microphone" loudspeaker becomes alive—which will be prefaced by a rushing noise in the output loudspeaker. In this adjustment both stations should be reasonably separated to prevent acoustic feedback.

The optimum loudspeaker sensitivities will depend on the speech coil impedances employed and interstation line length, but this adjustment of VR1 should be carefully carried out both for best possible transmission and reception. ★