

SECTION 4

STUDIO LOUDSPEAKER LS5/1

General Description

Studio Loudspeaker LS5/1 is a high-grade loudspeaker designed for quality checking and it supersedes the LSU/10. The low-frequency and high-frequency units employed are of the same type as in the O.B. Loudspeaker LS3/1 described in Section 3, but the design differs in several respects. The limitations imposed on the LS3/1 by the need for easy transportability and for listening in restricted spaces do not apply to the LS5/1, and it has been possible to employ a cabinet with better acoustic properties, to separate the l.f. and h.f. units and to accommodate the loudspeaker amplifier in the same cabinet.

The LS5/1 loudspeaker consists of a Cabinet CT4/4 in which are mounted the following:

- (a) Plessey L.F. Loudspeaker, Type CP73025/12/5 and two G.E.C. H.F. Loudspeakers (G.E.C. Presence Unit Type BCS1852/T534).
- (b) Cross-over Filter FL6/2.
- (c) Mains-operated 15-watt Loudspeaker Amplifier AM8/4 which is described in Instruction S.3 Section 10.

The response at the low-frequency end of the range is similar to that of the LSU/10 but the axial frequency response is maintained substantially flat up to 13 kc/s, while the variation in response with angle is very much less.

The main considerations leading to the design of the loudspeaker are discussed in a Paper by D. E. L. Shorter (Research Department) published in *Proc. I.E.E.*, Vol. 105, Part B, No. 24, November 1958.

Loudspeaker Cabinet CT4/4

As the restrictions imposed on the design of the cabinet CT4/1 which is used in the O.B. Loudspeaker LS3/1 do not apply to the CT4/4 it has been possible to increase the dimensions of the latter to extend the low-frequency range and also to accommodate the loudspeaker amplifier; the increase in size naturally involves the use of thicker material to give the necessary rigidity. The cabinet is constructed in two portions, an upper one which is the loudspeaker cabinet proper in which the loudspeaker units and the cross-over filter are

mounted, and a lower one in the form of a pedestal which houses the loudspeaker amplifier and supports the upper one to which it is firmly fixed.

The upper portion is 2 ft 9 in. high by 17 in. wide by 19 in. deep and is constructed from $\frac{3}{4}$ -in. thick chipboard on a framework of 1-in. by 1-in. hardwood battens, and has a removable back. A small vent, $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in., is cut near the right-hand bottom corner of the front panel to resonate with the enclosed volume of air at about 30 c/s and give a slight increase in low-frequency output. The internal surfaces are lined to a depth of 4 in. to 6 in. with sound-absorbing material in the form of glass-fibre blankets folded into pads and contained in polythene bags for the top, sides and back and in a cotton bag for the bottom. These are secured in position with twine through screw eyes for easy removal to facilitate fitting and removal of the loudspeaker units and the cross-over filter. The use of polythene bags, besides making for easier handling, slightly increases the sound absorption at low frequencies, the action being similar to that of the membrane absorbers used in studio treatment. For the bottom bag, however, which is in the immediate vicinity of the vent, the use of polythene is undesirable since at high sound levels this material is liable to buzz.

An aluminium-alloy tie rod is fitted between the front and back of the upper portion to restrict the vibration of the removable rear panel.

The l.f. loudspeaker unit is mounted behind a rectangular opening 10 in. high by $7\frac{1}{2}$ in. wide as in the LS3/1, but as the LS5/1 is not intended for listening at close ranges it is permissible to mount the h.f. units above the l.f. unit, an arrangement which gives a more uniform frequency response. Under normal listening conditions the separation between sound sources is not noticeable to listeners at distances over 4 ft.

The whole of the front of the loudspeaker compartment is covered with an expanded metal grille on a wooden frame which is fixed in position by screws inserted from inside the cabinet.

The pedestal on which the loudspeaker compartment is mounted and which houses the loudspeaker amplifier consists of a rectangular com-

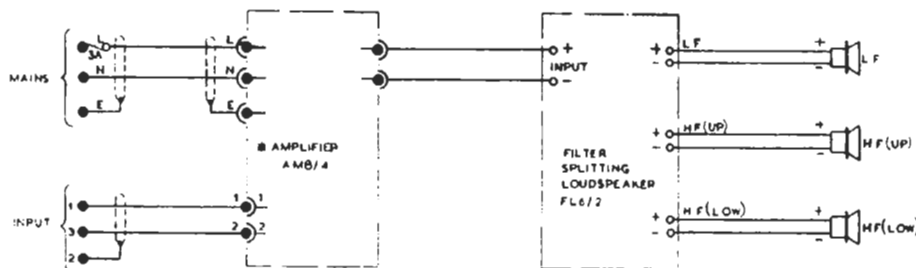
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partment with overall dimensions of 10½ in. wide by 13 in. deep by 9½ in. high supported by four outward sloping legs, giving a total height of 16 in. Large cut-outs in the back and two sides and the base give access to the amplifier and provide ventilation. The pedestal, which has an open top, is screwed to the bottom of the loudspeaker compartment to which a sheet of asbestos, 11 in. by 8 in. by ¼ in. thick, is glued, to give protection from the heat dissipated by the amplifier. Two steel mounting bars supported on rubber grommets are fitted along the bottom of the pedestal compartment for mounting the amplifier.

In the design of the cabinet and in the mounting of equipment care has been taken to prevent the occurrence of unwanted vibrations and rattles as far as possible, but it is essential that all fixing screws, etc., should be kept quite tight if this object is to be achieved.

the centre portions of both diaphragm and plate are slightly conical in shape. Slots in the front plate at a tangent to the cone-shaped centre portions provide an outlet for the sound. Because of the low overall diameter of 2½ in. the unit is less directional at high frequencies than a conventional cone or single horn radiator.

Two h.f. units, selected as a matched pair and tested against a standard unit, are used to increase the power-handling capacity of the system, but as the spectral distribution of energy in normal programme material falls off towards the upper end of the frequency range, it has been found unnecessary to employ both units at the highest frequencies. Accordingly, one of the units is made inoperative at the upper end of the frequency range, the input to the other being correspondingly increased by a top-lift circuit in the loudspeaker amplifier to preserve uniform response; this



THE AMB/4 CIRCUIT INCLUDES A SWITCHABLE EQUALISER FOR CORRECTION OF THE FREQUENCY CHARACTERISTICS OF THE H.F. UNITS

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FIG. 4.1. STUDIO LOUSPEAKER LS5/1: CIRCUIT
DRAWING No. EA 10845

L.F. and H.F. Loudspeaker Units

These units are of the same type as those used in the LS3/1. The l.f. unit, which has a 15-in. cone and an axial frequency range extending to about 4 kc/s without the cross-over filter, is mounted behind a rectangular opening 10 in. high by 7½ in. wide as in the LS3/1. This gives a less directional system in the horizontal plane than with a circular opening by reducing slightly the axial response at the upper end of the range and raising the response at oblique angles in the horizontal plane.

The two h.f. units are used as direct radiators without horns, and are of the moving-coil type with a plastic-impregnated fabric diaphragm which moves as a whole up to at least 10 kc/s. A thin metal plate is fitted in front of the diaphragm and

arrangement avoids unwanted directional effects in the vertical plane at high frequencies which result when both units are used. As used in the LS5/1 the axial frequency range extends from about 1.5 kc/s to 13 kc/s.

L.F. Unit

- Flux density: 12,000 gauss
- D.C. resistance: 11-13.4 ohms
- Fundamental resonance of unit unmounted:
25 ± 5 c/s

H.F. Units

- D.C. resistance: 11-12.5 ohms each
- Fundamental resonance: 1.6 kc/s
- Impedance at resonance: 45 ohms each approx.

Cross-over Filter FL6/2

The cross-over filter FL6/2 is mounted on one side of the loudspeaker compartment near the h.f. units. It has three separate outputs which are wired to the three loudspeaker units as shown in Figs. 4.1 and 4.2, the upper and lower h.f. units being marked *Up* and *Low* respectively. Separate outputs are provided for the two h.f. units to enable the inductor L4 to be introduced in the output to the upper unit to attenuate the output at the upper end of the frequency range; as already indicated, this improves the directional characteristics in the vertical plane.

adjusted accordingly to maintain the correct frequency characteristic. The output in all cases is taken from Tap 8.

In the low-pass filter for the l.f. loudspeaker unit the resistor R1 shunted by the inductor L2 corrects, at the cost of some mid-band loss, for the rising frequency characteristic of the l.f. unit between 100 c/s and 1 kc/s, and the rejector circuit L5 C6 reduces the output of this unit in the 2.2-kc/s region to avoid interference effects in the cross-over region. L3 and C5 in series with R2, which is adjusted on test, correct the shape of the frequency characteristic between 300 c/s and 500 c/s.

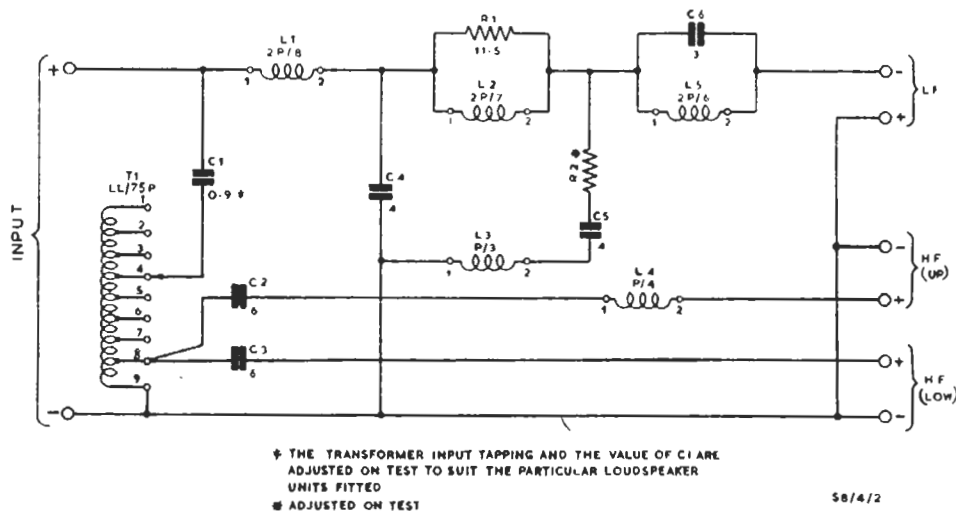


FIG. 4.2. CROSS-OVER FILTER FL6/2: CIRCUIT
DRAWING NO. EA 10835

A flexible lead is wired to the input tags of the filter and run to the amplifier compartment where it terminates on a 2-pin socket for connection to the output of the amplifier.

As the output impedance of the loudspeaker amplifier is low a constant-resistance cross-over network is unnecessary and the high-pass and low-pass filters are connected in parallel across the input and work independently of each other with negligible interaction.

The input transformer for the high-pass filter is used as a combined choke and auto-transformer, and is tapped to provide initial adjustment of the signal level to the h.f. units according to the relative sensitivity of the particular h.f. and l.f. units with which it is used. Any change in input tapping alters the shunt inductance in the cross-over network; the value of C1 has therefore to be

Provision is made for adjusting the shape of the frequency characteristic above 3 kc/s by an electrical network included in the loudspeaker amplifier which gives a peak of about 4 dB at 10 kc/s in the frequency characteristic of the amplifier. (See Instruction S.3, Section 10.)

When the input to the high-pass filter is connected to Tap 4 of the transformer via C1 the value of C1 is normally 0.9 μF. The voltages appearing at the terminals marked *L.F.*, *H.F. (Up)* and *H.F. (Low)* are then equal at about 1.75 kc/s when the low-pass filter is loaded with 15 ohms to represent the input impedance of the l.f. unit and each of the h.f. outputs is loaded with 12 ohms. Under these conditions the voltage loss introduced by the filter at the cross-over frequency is about 18 dB relative to the input voltage to the filter, and the low-pass filter gives a loss of about 30 dB

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at 2 kc/s and the high-pass filter a loss of about 30 dB at 1.2 kc/s. The acoustic cross-over frequency, i.e., the frequency at which equal sound pressures are produced on the loudspeaker axis by the l.f. and h.f. units respectively, is about 1.7 kc/s.

It is important that the loudspeaker units are correctly phased by connecting the leads between them and the filter to the appropriate terminals, red wires being connected to positive terminals and black wires to negative terminals. The polarity markings on the l.f. and h.f. units follow opposite

the output plug to which the filter input lead is connected. Access to the valves is obtained through the cut-out on the right-hand side by removing the valve shield, which is done by removing the rear fixing screw only and slackening the front screw, the front fixing hole being slotted. An input jack is fitted to the front of the amplifier and connected in parallel with the input socket, but is not accessible when the amplifier is fitted in the pedestal compartment.

A 20-ft mains connecting lead and a 20-ft input lead are provided as part of the LS5/1.

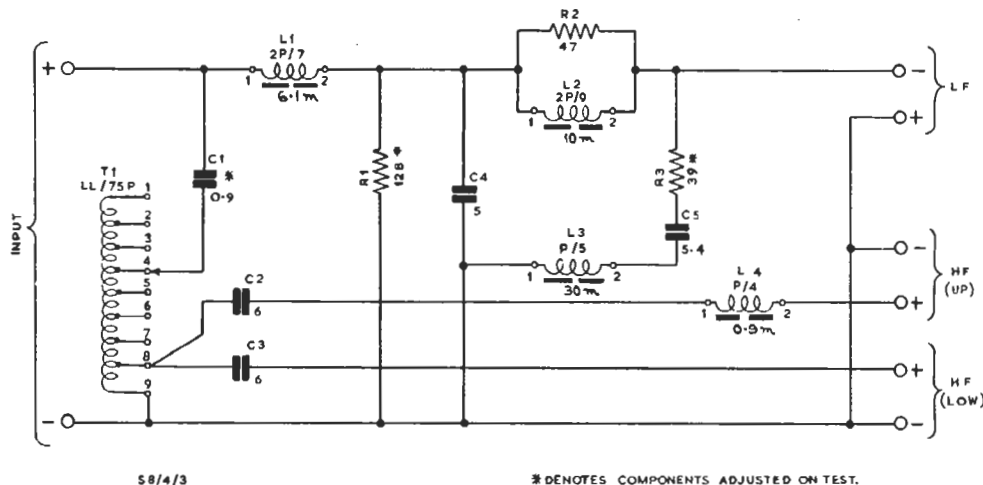


FIG. 4.3. CROSS-OVER FILTER FL6/4: CIRCUIT
 DRAWING NO. EA 11339

conventions but this disparity is taken into account in the cross-over network.

Loudspeaker Amplifier AM8/4

The amplifier used in the LS5/1 is described in Instruction S.3, Section 10. It should be noted that the amplifier incorporates a correction circuit to compensate for the changeover from two h.f. units to one at the high frequencies. (Provision is made for switching out this equaliser when the amplifier is used for other purposes.) The amplifier chassis is bolted to the two mounting bars which are supported on rubber grommets on the bottom of the pedestal compartment.

The cut-out in the right-hand side of the pedestal compartment gives access to the gain control and fuses, that in the left-hand side gives access to the input socket and the one in the back gives access to the mains switch and mains input socket and to

Maintenance

Should it become necessary to change either the l.f. loudspeaker unit or an h.f. unit the whole loudspeaker should be returned to Equipment Department as the overall performance is closely adjusted on initial test.

Loudspeaker LS5/1A

In later models of the LS5/1 the Plessey l.f. loudspeaker has been replaced by a Goodmans loudspeaker Type C129B/15PR/15 ohm, and such models are coded LS5/1A.

The characteristics of the Goodmans loudspeaker are slightly different from those of the Plessey unit, and in order to give the same overall performance the combined equaliser and cross-over filter FL6/2 has been replaced by the FL6/4 which has the modified circuit shown in Fig. 4.3.

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