T.V. SOUND SEPARATOR

By D. S. GIBBS & I. M. SHAW* C.Eng., M.I.E.E.

THE standard of sound quality transmitted with 625-line television programmes is equal to that of the v.h.f. f.m. broadcasts and yet it is a sad fact that most TV receivers give a standard of sound reproduction little better than a transistor radio. To most of the public, cabinet styling and picture size are of paramount importance and little thought is given to the sound reproduction of the set. Consequently there is very little market for sets with good sound reproduction and those that exist are very expensive.

*Ferranti Ltd.

METHODS AVAILABLE

The ideal solution for the hi-fi enthusiast would be to feed the TV sound channel through his existing equipment. There are three possible ways this can be done:

(a) By a direct audio feed from the set via an audio isolating transformer.
(b) By building a complete TV sound tuner.
(c) By building a device to pick up the stray 6MHz radiation from the i.f. strip of the TV set.

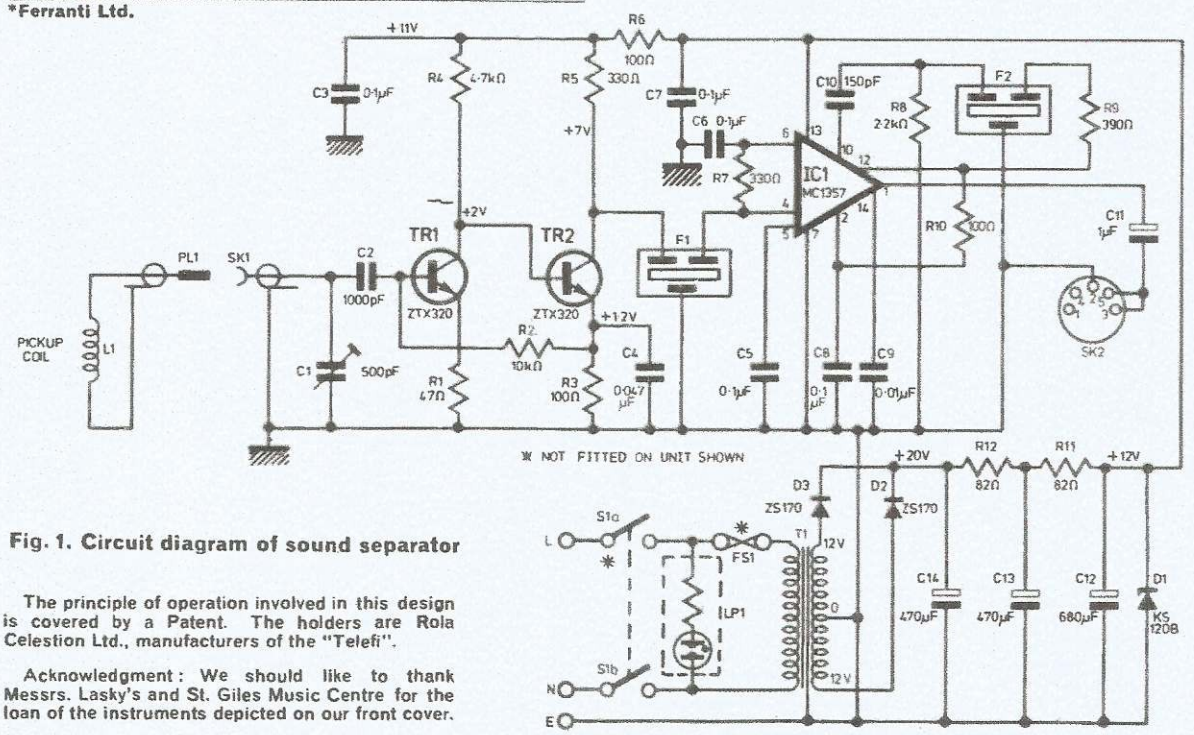
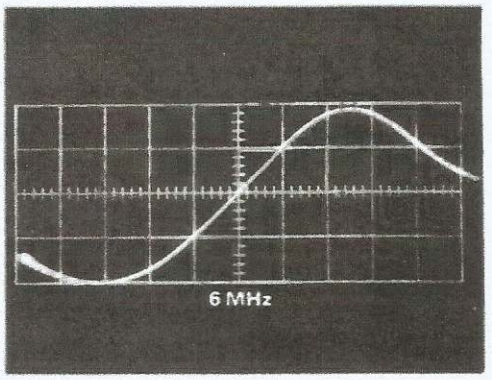


Fig. 1. Circuit diagram of sound separator

The principle of operation involved in this design is covered by a Patent. The holders are Rola Celestion Ltd., manufacturers of the "Telefi".

Acknowledgment: We should like to thank Messrs. Lasky's and St. Giles Music Centre for the loan of the instruments depicted on our front cover.



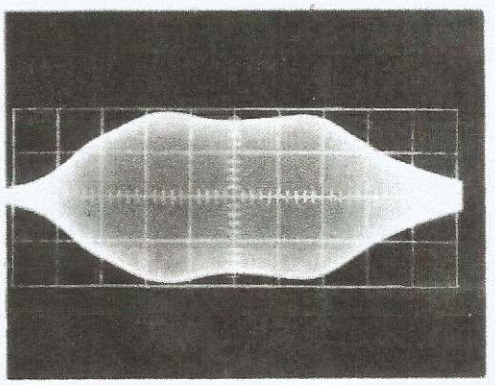


Fig. 2 (left). Response of discriminator. Horizontal scale is approximately 50kHz per division and the output has good linearity over this. (Right) Response of input stage and filter indicating a bandwidth of about 300kHz

Method (a) is probably the simplest—but as it requires modifications to the TV set it cannot be used with rented sets. Also the audio transformer must be capable of withstanding full mains voltage between its windings as there is a possibility of the chassis of the set being "live".

Method (b) is the most complex and expensive as it requires a completely separate tuner and i.f. strip. As these are already present in the TV set it seems a little wasteful to duplicate them—which leads us to method (c). This makes use of the existing tuner and i.f. strip in the TV set by picking up the stray 6MHz radiation from the sound i.f., amplifying and filtering it and then detecting it. This method requires few components, is easy to construct and align, and requires no direct connection to the TV set. Consequently this method was chosen for the unit described here.

CIRCUIT DESCRIPTION

The circuit diagram of the unit is shown in Fig. 1. The pickup coil L1 is tuned to 6MHz and is positioned on the outside of the TV set to pick up the maximum level of 6MHz radiation.

The output signal from the coil is then amplified by TR1 and TR2. These give a voltage gain of about 100 and provide a suitable output impedance to match the ceramic filter F1. This filter has a bandwidth of about 300kHz and provides the main selectivity of the unit. The output of the filter is applied to the MC1357 limiter and discriminator. This gives a high degree of limiting—thus removing noise and a.m. components—and the output of the limiter drives a quadrature detector.

An unusual feature of this circuit is the use of a ceramic filter element in the quadrature detector. The Murata CDA 6·0 MC filter is specially designed for this purpose and the associated component values have been chosen to give the best compromise between linearity and output. The use of a ceramic filter element in the discriminator means that there is virtually no alignment to do other than peak up the pickup coil—and this is very non critical in any case.

The de-emphasis time constant of 75μs is defined by the 0·01μF capacitor connected to pin 14 of the i.c.

COMPONENTS . . .

Resistors

R1	47Ω	R7	330Ω
R2	10kΩ	R8	2·2kΩ
R3	100Ω	R9	390Ω
R4	4·7kΩ	R10	100Ω
R5	330Ω	R11	82Ω
R6	100Ω	R12	82Ω

0·33 watt 5% carbon film

Capacitors

C1	500pF compression trimmer
C2	1,000pF disc ceramic
C3	0·1μF 30V disc ceramic
C4	0·047μF 12V disc ceramic
C5	0·1μF 30V disc ceramic
C6	0·1μF 30V disc ceramic
C7	0·1μF 30V disc ceramic
C8	0·1μF 30V disc ceramic
C9	0·01μF HI-K tubular ceramic
C10	150pF polystyrene
C11	1μF 35V tantalum
C12	680μF 16V electrolytic
C13	470μF 25V electrolytic
C14	470μF 25V electrolytic

Filters

F1	Murata SFE 6·0 MA ceramic filter
F2	Murata CDA 6·0 MC ceramic filter

Semiconductors

TR1	ZTX320 Ferranti	D1	KS120B Ferranti
TR2	ZTX320 Ferranti	D2	ZS170 Ferranti
IC1	MC1357PQ Motorola	D3	ZS170 Ferranti

Coil

L1 Wound as described, see text

Miscellaneous

Case—West Hyde Developments, Samos size S3.
P.c.b. (Davian Electronics.)
T1—R.S. Components 12V 6VA miniature mains transformer (Doram).
NE1—R.S. Components miniature neon lamp.
DIN 5 way socket, Belling Lee coax socket, screws, spacers, grommet, connecting wire, TV 75Ω coax cable.
The printed circuit board, a kit of semiconductors, and the two ceramic filters can be obtained from Davian Electronics, PO Box 38, Oldham, Lancs., OL2 6XJ.

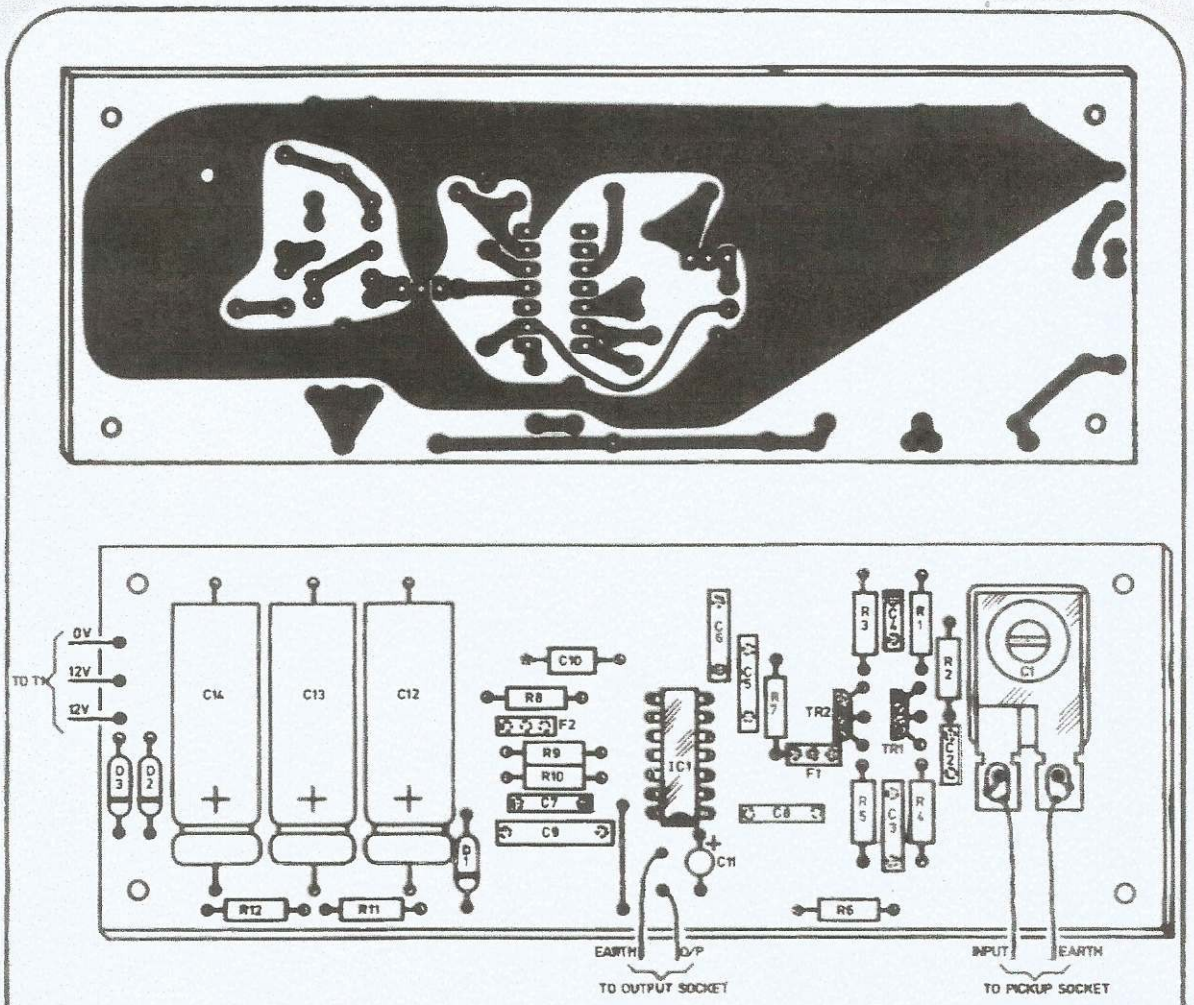
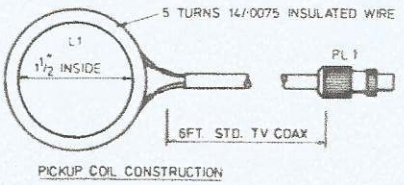


Fig. 3. P.c.b. and component mounting details

Fig. 4. Details of the pick-up coil L1



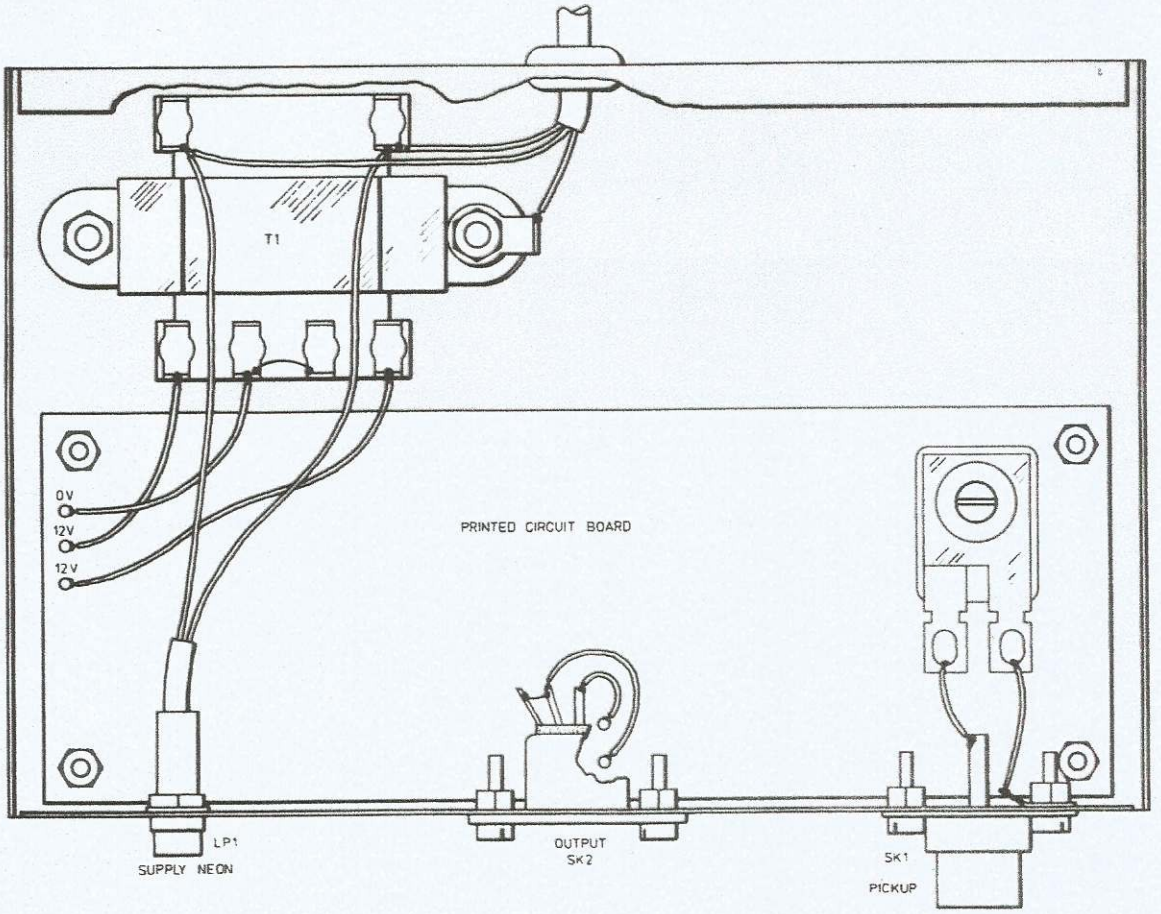


Fig. 5. Assembly details of sound separator

CONSTRUCTION

Most of the components are mounted on the printed circuit board shown in Fig. 3. If you decide to make your own board the copper pattern shown should be followed carefully or stability problems may arise. Do not use Veroboard.

The assembled printed circuit board is a complete module and can be incorporated into your hi-fi system if desired. Alternatively it can be built up as a separate unit as shown in the illustrations.

The prototype unit was built into a West Hyde Developments' Samos case size S3. An assembly diagram for this is given in Fig. 5.

On the latest R.S. Components' 6VA miniature mains transformers the screen tag is at the bottom and it will be necessary to connect a wire to this tag before the transformer is mounted in the box, as this tag is inaccessible afterwards. The assembled printed circuit board is mounted on four $\frac{3}{8}$in (9·525mm) spacers, and after this has been fixed in place the coax. socket, DIN socket and the neon lamp can be inserted and the unit wired up.

No mains switch or fuse have been included as many amplifiers have a switched mains output to power auxiliary equipment, but these can easily be added by the constructor if desired.

PICK-UP COIL

The pick-up coil L1 consists of five turns of ordinary connecting wire (14/·0076 insulated wire was used in the prototype) wound around a 1·5in (38·1mm) diameter former. The coil thus formed is soldered to the end of a length of standard Band I/III TV coaxial cable, and the whole assembly is then bound with p.v.c. insulating tape so that the coil and its connections are completely covered. The coax. cable forms part of the tuning capacitance of the coil but the length is not critical and anything up to about 10ft (3·048m) should be satisfactory. A 6ft (1·8288m) length was used with the prototype unit (Fig. 4).

ALIGNMENT

Before switching on check the circuit carefully for errors and make sure that all the semiconductors are connected the right way round.

Connect the output of the unit to an amplifier and switch on. You will probably hear a selection of foreign stations at first but when the pickup coil is placed near to the TV set the TV sound channel should be heard. Move the pick-up coil around over the outside of the TV set until the position giving minimum background noise is found. Then adjust

C1 for best sensitivity and seal it with a blob of adhesive. Once the optimum position for the pick-up coil has been found it can be fixed in position with adhesive tape.

It it is found impossible to pick up a signal of sufficient strength outside the set, the pick-up coil can be placed inside—near to one of the 6MHz sound i.f. coils. However if this is done great care must be taken to make sure that the pickup coil is very thoroughly insulated—so that there is no possibility of it touching any part of the set. Also make sure that the chassis of the set is connected to the neutral side of the mains supply.

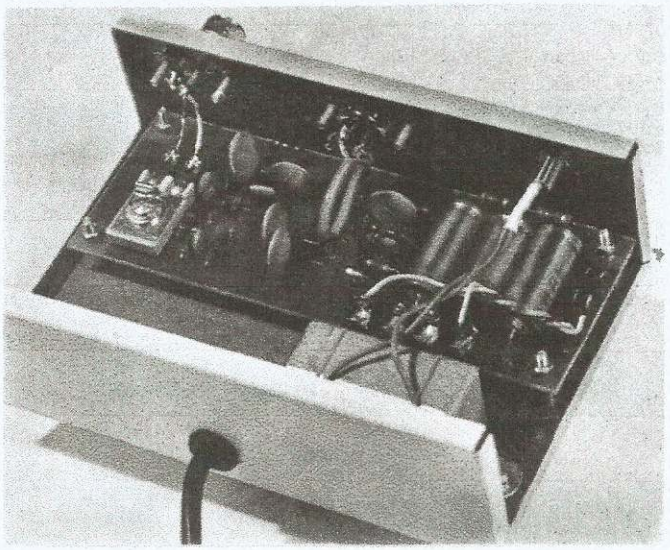
This unit has been tested with a Marconi colour TV (T.C.E. 3000 chassis), a Decca colour TV and a Ferguson 3816 portable black and white TV, and in each case it was possible to obtain satisfactory performance with the pick-up coil on the outside of the set.

USING THE TUNER

It is subjectively rather strange to hear the sound coming from a different direction to the picture—so it will usually be necessary to move one of the loudspeakers so that it is close to the TV set. This should not cause any problems with black and white sets, but colour sets are very sensitive to external magnetic fields and if a loudspeaker is placed too close some interesting effects on the picture may be obtained! In practice it will usually be sufficient to place the loudspeaker a few feet to one side or behind a colour TV.

If a buzz is noticed on the output of the tuner this could be either intercarrier buzz from the TV set or an earth loop. It should be possible to remove the former by a slight adjustment to the tuning or contrast controls of the TV set. An earth loop will be present if both the unit and the amplifier are separately earthed and the cure is to disconnect one of the earths. It is probably best to disconnect the earth to the tuner unit so that it is then earthed via the amplifier.

This unit will not operate with 405-line receivers as these do not have a 6MHz sound i.f.. Also overseas readers should note that in many countries a sound i.f. of 4·5 or 5·5MHz is used. It should be possible to modify the unit to operate at these frequencies by using the appropriate ceramic filters but the necessary experimental work must be left to the constructor. ★



BOOK REVIEWS

IC OP. AMP. COOKBOOK

By Walter G. Jung
Published by Prentice/Hall International
Clothbound. Price £6·60

OF operational amplifiers appearing in this magazine the 741 must surely be the most familiar. We have seen it in electronic music circuits, ramp generators, filters, integrators, differentiators etc. To many this "gain packet" is still a mystery. It has the qualities of a super-transistor but at high frequencies cannot hold a candle to its forebear. Of course, this criticism does not apply to the whole op. amp. family.

Obviously then, although the 741 can provide a fantastic range of audio and d.c. application it still has its limitations.

It follows, that to make the best use of these now standard design tools, one must understand the language of manufacturers' literature for selection and know the basic rules for design.

The book is arranged in three parts: Part I introduces op. amp. basics and the evolution of general purpose and specialised groups. Operating procedures and precautions in use completes this section. Part II covers practical circuit applications: signal generators, regulators, signal processors and audio designs. Some of the more unusual op. amps. are examined at length.

Part III consists of two appendixes of manufacturers' data.

Following the tradition of all good cookbooks this does not stint on the recipes as there are over 250 practical circuit applications.

In all, an instructive reference to anyone interested in op. amp. design techniques.

G.G.