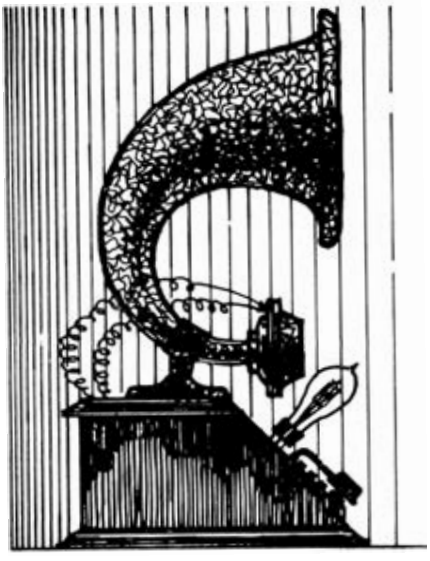
NEW HI-FI SOUND GUIDES 20p

Practical Hi-Fi guide 5

Hi-fi facts and figures • designs and data

by Clement Brown editor HI-FI SOUND magazine



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Practical Hi-Fi guide

WHAT IS HI-FI and why is its appeal so strong? How does one set about choosing equipment and ensure it is kept at peak performance? How does stereo work and what are its advantages? Will new developments affect the choice of system? Answers to such questions form the basis of these booklets. Written by Clement Brown, editor of *Hi-Fi Sound,* and closely linked with the policy of the magazine, these concise guides are of special value to the beginner but also meet the need of the more advanced amateur enthusiast for a survey of his chosen subject.

Practical Hi-Fi Guide completes this series. Earlier titles are: Introduction to Hi-Fi, All about Stereo, Planning and Buying Hi-Fi, and Using your Hi-Fi.

Haymarket Publishing Ltd, Gillow House
5 Winsley Street, London W1

Let us worry about the wow and the flutter.

The RH892 is a design for the man who doesn't want to build it himself. A sound system that gives you the sounds–beautifully–without the worry.

The deck has a low mass, low resonance tubular pick-up arm with viscous damped lifting mechanism and is fitted with a stereo ceramic pick-up head.

The amplifier delivers 2 x 12 Watts music power and is equipped with stereo balance control, switchable rumble and scratch filters and continuous treble and bass controls.

And the tuner receives LW, MW and FM. It has an FM stereo decoder, AFC for optimum reception on FM and a sensitive ferroceptor for MW and LW.

This combination unit is one of a whole spectrum of separates, planned systems, and combination units ranging up to the highest specifications to suit all tastes and pockets.

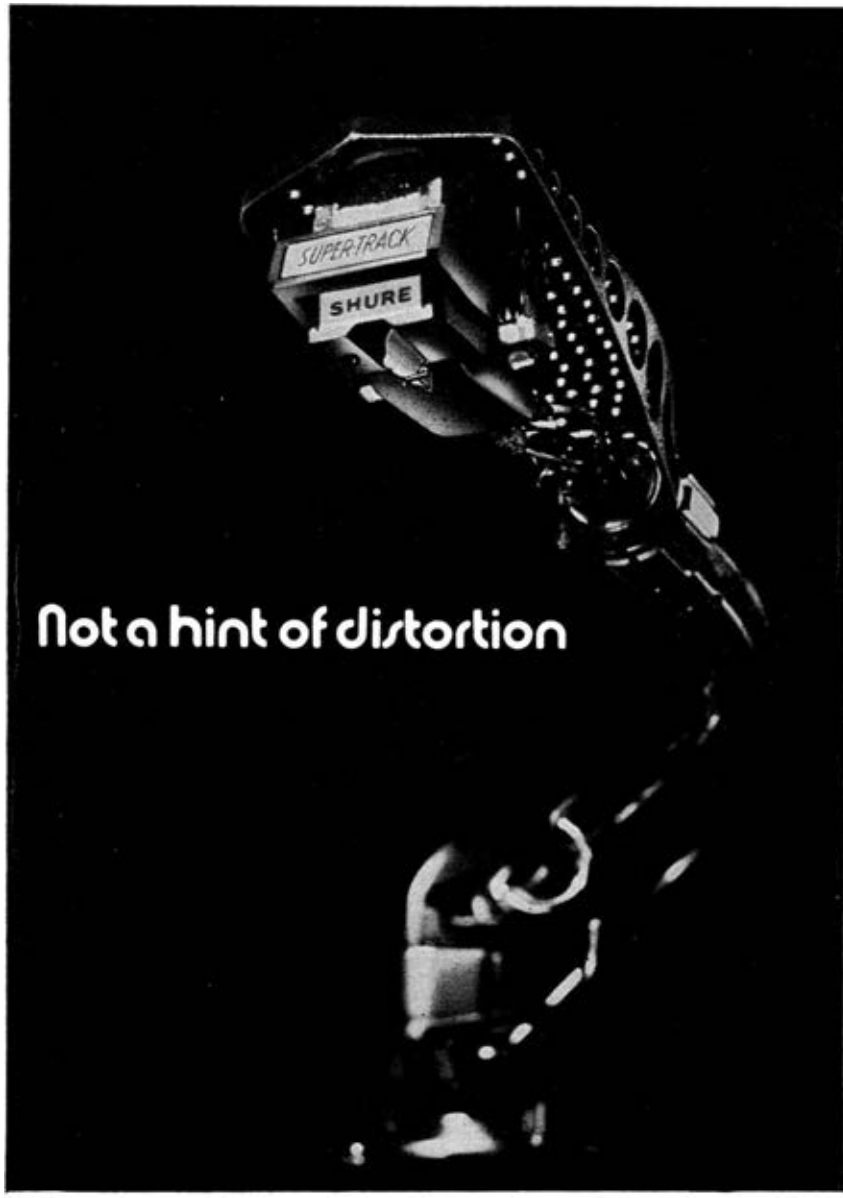
PHILIPS

AMPLIFIER
Power output (sine wave):
2 x 8 watts into 8 ohms
Music power:
2 x 12 watts into 8 ohms
Harmonic Distortion:
2% at 2 x 6 watts
Frequency range:
60-20,000 Hz ± 3dB
Tone Controls:
Bass: +14 to −18dB at 50Hz
Trebie: +12 to −13 at 10KHz
Scratch filter:
−6dB/octave
Rumble filter:
−6dB/octave
Signal to noise ratio:
>55dB
Channel separation:
>30dB at 1KHz
Input sensitivity—Tape:
230mV into 500K ohm for
8 watts output

TUNER
Wavebands:
LW 150-260KHz (2000-1154m)
MW 525-1605KHz
(511-187m)
FM 87·5-108MHz
Aerials:
Ferroceptor for MW and LW
(socket for external AM
aerial and earth)
IEC socket for FM dipole
aerial
Sensitivity:
AM 25μV for 26dB signal to
noise ratio
FM 8μV at 15KHz deviation
1·5V at 40KHz deviation
for 26dB signal to noise ratio
across 300 ohms
Selectivity:
AM 20 x for 9KHz off
resonance
FM 30 x for 300KHz off
resonance
Distortion:
<4% at 75KHz deviation
Pilot frequency
suppression:
−24dB at 19 and 38KHz
Audio response:
(with 50μ sec
40-12,500Hz ± 3dB)
de-emphasis

RECORD PLAYER
Chassis:
GC008
Turntable:
10″ diameter
Speeds:
33⅓ and 45 r.p.m.
Wow and Flutter:
>0·2%
Rumble:
−38dB(DinA)
−58dB(DinB)
Pick up:
GP213 ½″ ceramic cartridge
Stylus pressure:
2-4g (calibrated adiustment)
Dimensions:
(w × h × d overall)
21½″ × 6½ × 11¾
Weight:
21½ lbs (9·7Kg)

CONTENTS



SHURE V–15 Type II (Improved) SUPER–TRACK with bi–radial elliptical stylos (0.0002″ x 0.0007″) – 15° tracking – unique "flip–action" built–in stylus guard.

Please send me full information on the SHURE V–15 Type II. (Improved)

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Address

SHURE

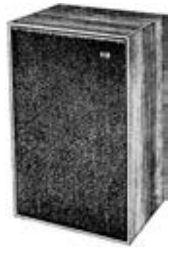
Shure Electronics Ltd.
84 Blackfriars Rd., London SE1. Tel: 01-928 3424

KEF WHITE SOUND

nothing is quite like it

The Cadenza; a new concept in bass reproduction

How the KEF Cadenza offers a higher degree of low frequency than other speakers of its size



Specification

Size	$23\frac{5}{8} \times 14\frac{1}{4} \times 11\frac{3}{4}$ in $60 \times 36 \times 30$ cm
Weight	34 lb 15.5 kg
Power Rating	25W
System Res.	Mechanical reflex 25Hz
Impedance	8 ohms
Freq. Range	30-30,000Hz
Units	BD139, B200, T27
Dividing Frequencies	45Hz, 3,500Hz
Finishes	Walnut, Teak, White
Grille Cloths	Brown, Grey, Beige
Recommended Price	£42.50

For many years, it was considered that the low frequency response of a speaker was dependent on the diameter of the diaphragm, and that a relatively compact enclosure could not achieve a satisfactory bass level without a loss of acoustic efficiency. The introduction of the KEF Cadenza showed that this need not be and that a compact speaker like the Cadenza is fully capable of producing fundamental tones down to 30Hz.

Acoustically-coupled system

The concept of bass reproduction featured in the Cadenza is based on acoustic coupling. In the Cadenza, two low-frequency radiating elements—the KEF BD139 and the B200—are acoustically-coupled to give the system an effective radiating area which is greater than that of a 12″ unit. The low frequency radiator (the BD139) is acoustically-coupled to the B200 via the pneumatic spring formed by the trapped air within the enclosure. The acoustic mass of the BD139 is critically adjusted with respect to the volume of the enclosure so that it "phase inverts" the radiation from the rear surface of the B200 diaphragm—thereby increasing the low frequency output over the range from 25-100Hz.

Inhibiting Colouration

Above 100Hz, the BD139 is acoustically decoupled from the B200 so that its output is progressively attenuated leaving the B200 as the only radiating source up to the upper crossover frequency of 3,500Hz. Over this frequency range, the BD139 acts as an acoustic barrier so preventing any sound radiating from the rear of the B200 diaphragm mixing with the directly-radiated sound and causing colouration.

A note about the B200 bass mid-range unit

The B200 has a very large magnet assembly to ensure optimum magnetic damping when used with the special bass loading system in the Cadenza. A visco-elastically damped cone minimises colouration in the critical mid-frequency band. A free air resonance of only 25Hz and a long linear suspension system ensure high power handling with low harmonic distortion.

T27 high-frequency tweeter

The T27 used in the Cadenza has an excellent transient response and wide frequency range extending at least one octave above the upper hearing limit—only 4dB down at 40kHz.

KEF exclusive 'constant impedance'

The KEF Cadenza incorporates a sophisticated 9-element two-way filter which uses close tolerance components for accurate and repeatable acoustic performance.
An exclusive KEF 'constant impedance' network incorporated in this filter keeps the system input impedance flat and resistive over the frequency range from 100 to 10,000Hz. This ensures optimum power transfer from amplifier to speaker and the non-reactive load minimises the possibility of amplifier instability.

KEF

1970

KEF Electronics Ltd

Tovil, Maidstone, Kent Tel: 0622 57258

A three waveband stereo tuner/amplifier giving 2 x 15 watts RMS, with slide-rule tuning and electronic tuning meter.
A four track, two speed stereo tape recorder with mixer-panel sliders and an irreproachable specification.
A two speed, semi-automatic turntable unit with its own arm and cartridge, bias compensation, tracking weight adjustment and strobe ring.
A pair of pressure chamber speakers, each with handling capacity of 20 watts RMS, roll-surround bass unit, robust DOME tweeter and frequency response of 45–20000Hz.
The Bang & Olufsen 1200 series. Four individualists, one family group – all bearing a unique and valuable guarantee of quality.

For further information or literature write to:
Bang & Olufsen U.K. Limited
Consumer Advisory Service
Mercia Road Gloucester
0452 31491
London Office and Showroom
70/71 Welbeck Street London W1
01-486 2144

Recommended retail prices, Teak or White finish, Beovox 2700 £63·90 (per pair), Beocord 1200 £99·50, Beogram 1200 £56·90, Beomaster 1200 £99·50. Rosewood finish a little extra.

1 FACTS AND FIGURES

SOUND WAVELENGTH

Wavelength in feet is equal to the velocity of sound in air divided by the frequency in Hertz. Velocity at 20°C is approximately 1,120ft. per second, or 341m per sec. Therefore the wavelengths at various frequencies can be obtained, as follows:

Frequency	*Wavelength*	
Hz	*ft.*	*m*
25	44·8	13·7
30	36	11·4
35	32	9·75
40	28	8.54
50	22·4	6·84
60	18	5·71
70	16	4·88
80	14	4·27
90	12·5	3·8
100	11·2	3·41
120	9	2·84
140	8	2·44
160	7	2·12
180	6·3	1·9
200	5·6	1·71
225	5·0	1·52
250	4·4	1·38
300	3·4	1·14
400	2·8	0·854
500	2·2	0·684
600	1·7	0·57
700	1·6	0·488
800	1·4	0·427
900	1·2	0·38
kHz	*in.*	*cm*
1	13	34·1
2	6·5	17·1
3	4·5	11·4
4	3·2	0·854
5	2·7	6·84
6	1·7	5·7
7	1·9	4·88
8	1·6	4·27
9	1·5	3·8
10	1·3	3·41
15	0·9	2·28
20	0·67	1·71

TAPE PLAYING TIMES

Playing times are for one track. Multiply by number of tracks for total time. For stereo, multiply by number of pairs of tracks.

Spool size	*Length of tape (feet)*			
	Standard	*Long Play*	*Double Play*	*Triple Play*
7 in. (18cm)	1,200	1,800	2,400	3,600
5¾in. (15cm)	850	1,200	1,700	2,550
5 in. (13cm)	600	900	1,200	1,800
4 in. (10cm)	300	450	600	900
3 in. (8cm)	150	210	300	450

Length of tape (feet)	*7½ips 19cm/sec* Hr. Min.	*3¾ips 9.5cm/sec* Hr. Min.	*1⅞ips 4.8cm/sec* Hr. Min.
3,600	1 35	3 12	6 24
2,400	1 5	2 9	4 18
1,800	48	1 35	3 12
1,700	45	1 30	3 1
1,200	32	1 5	2 9
900	24	48	1 35
850	22½	45	1 30
600	16	32	1 4
450	12	24	48
400	10½	21	42
300	8	16	32
210	5½	11	22
150	4	8	16

Compact Cassettes

Cassette type	*each side*
C 60	30 min.
C 90	45 min.
C120	1 hour

METRIC/BRITISH CONVERSION DATA

1 micron μ	= 0.0394 thou. (approx 0.00004in.)	1 thou. (0.001in.)	= 25.4μ
1 cm.	= 0.3937in.	1 in.	= 2.54cm.
1 metre	=39.3708in.	1 yard	= 0.914 metre
1 sq. cm.	= 0.155 sq. in.	1 sq. in.	= 6.452 sq. cm.
1 sq. metre	= 1.1967 sq. yd.	1 sq. yd.	= 0.836 sq. metre
1 cu. cm.	= 0.061 cu. in.	1 cu. in.	= 16.39 cu. cm.
1 litre	= 0.0353 cu. ft. = 1.76 pints	1 cu. ft.	= 28.3 litres
1 gm.	= 0.035 ounce	1 oz.	=28.35gm.
1 mgm.	= 0.015 grain	1 lb.	= 0.4536kg.
1 kg.	= 2.2046 lb.	1 gm.	=980.6 dynes
1 dyne	= 0.00102gm.		
1 kilowatt-hour	= 3413 B.Th.U.		

Approx. equivalents of disc sizes:

12in.	10in.	7in.
30cm.	25cm.	17.5cm.

Approx. equivalents of stylus tip radii:

0.001in.	0.0007in.	0.0005in.	0.0003in.
25μ	18μ	13μ	7μ

Metric and Decimal Equivalents of Parts of One Inch:

Inches	*mm*	*Inches*	*mm*
1/32 .031	0.793	1/2 .5	12.700
1/16 .063	1.587	9/16 .563	14.287
1/8 .125	3.175	5/8 .625	15.875
3/16 .188	4.762	11/16 .688	17.462
1/4 .25	6.350	3/4 .75	19.050
5/16 .313	7.937	13/16 .813	20.637
3/8 .375	9.525	7/8 .875	22.225
7/16 .438	11.112	15/16 .938	23.812
		1 1.0	25.399

CUBIC MEASURE

Equivalents of particular interest in speaker enclosure construction:

Cu. ft.	*Cu. in.*	*Cu. metres*
0.25	432	0.0071
0.5	864	0.0142
0.75	1,296	0.0213
1	1,728	0.0283
1.25	2,160	0.0354
1.5	2,592	0.0425
1.75	3,024	0.0496
2.0	3,456	0.0566
2.5	4,320	0.0708
2.75	4,752	0.0779
3.0	5,184	0.0850
3.5	6,048	0.0992
4.0	6,912	0.1132
5.0	8,640	0.1415
6.0	10,368	0.1700

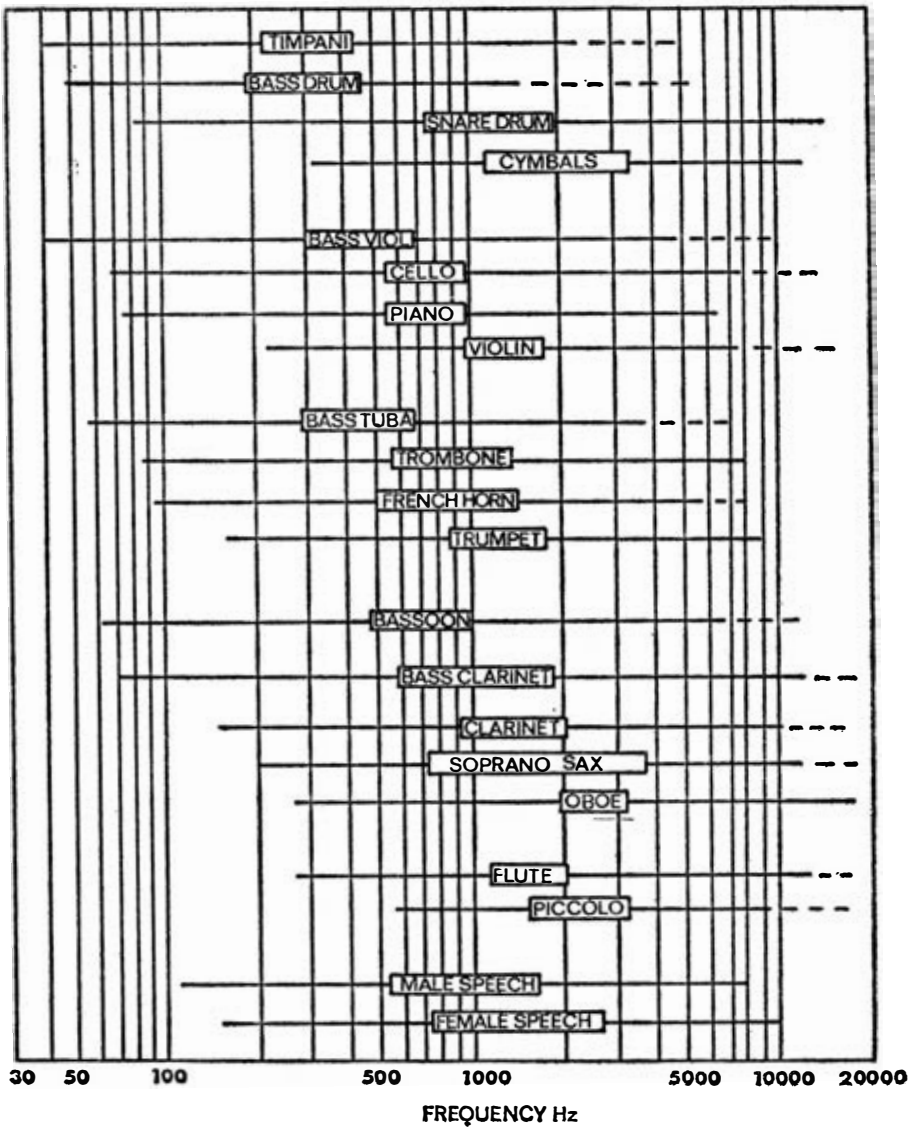
DECIBELS

Voltage or current ratio	Power ratio	dB	Voltage or current ratio	Power ratio
1·000	1·000	0	1·000	1·000
0·944	0·891	0·5	1·059	1·122
0·891	0·794	1	1·122	1·259
0·794	0·631	2	1·259	1·585
0·708	0·501	3	1·413	1·995
0·631	0·398	4	1·585	2·512
0·562	0·316	5	1·778	3·162
0·501	0·251	6	1·995	3·981
0·447	0·199	7	2·239	5·012
0·398	0·159	8	2·512	6·310
0·355	0·126	9	2·818	7·943
0·316	0·100	10	3·162	10·000
0·251	0·0631	12	3·981	15·850
0·196	0·0398	14	5·012	25·120
0·158	0·0251	16	6·310	39·810
0·126	0·0158	18	7·943	63·100
0·100	0·010	20	10·000	100·000
0·0562	0·00316	25	17·780	316·000
0·0316	0·001	30	31·620	1,000·000
0·0178	$3·162 \times 10^{-4}$	35	56·230	3,162·000
0·010	$1·000 \times 10^{-4}$	40	100·000	10,000·000
0·00562	$3·162 \times 10^{-5}$	45	177·800	31,620·000
0·00316	$1·000 \times 10^{-5}$	50	316·200	100,000·000
0·00178	$3·162 \times 10^{-6}$	55	562·300	316,200·000
0·001	$1·000 \times 10^{-6}$	60	1,000·000	1,000,000·000
$5·620 \times 10^{-4}$	$3·162 \times 10^{-7}$	65	1,778·000	$3·162 \times 10^{8}$
$3·160 \times 10^{-4}$	$1·000 \times 10^{-7}$	70	3,162·000	$1·000 \times 10^{9}$
$1·780 \times 10^{-4}$	$3·162 \times 10^{-8}$	75	5,623·000	$3·162 \times 10^{9}$
$1·000 \times 10^{-4}$	$1·000 \times 10^{-8}$	80	10,000·000	$1·000 \times 10^{8}$
$5·620 \times 10^{-5}$	$3·162 \times 10^{-9}$	85	17,780·000	$3·162 \times 10^{8}$
$3·160 \times 10^{-5}$	$1·000 \times 10^{-9}$	90	31,620·000	$1·000 \times 10^{9}$
$1·780 \times 10^{-5}$	$3·162 \times 10^{-10}$	95	56,230·000	$3·162 \times 10^{9}$
$1·000 \times 10^{-5}$	$1·000 \times 10^{-10}$	100	100,000·000	$1·000 \times 10^{10}$

ABBREVIATIONS

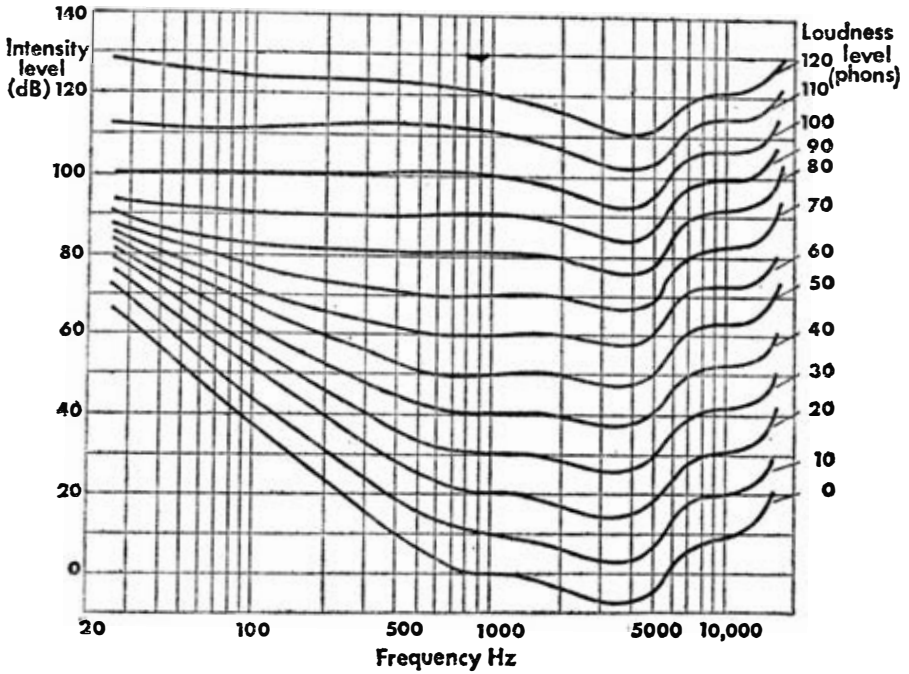
The abbreviations and units listed here are encountered in audio and radio. Many of them will be found printed in either capitals or lower case but in general the versions given are those used in *Hi-Fi Sound*.

A	Ampere (amp)
ac	Alternating current
af	Audio frequency
afc	Automatic frequency control
agc	Automatic gain control
AM	Amplitude modulation
Aux	Auxiliary
BAF	Bonded acetate fibre
BA	British Association
BS	British Standard
C	Symbol for capacitance
CCIR	International Radio Consultative Committee
cm	Centimetre
CRO	Cathode-ray oscilloscope
CRT	Cathode-ray tube
cu	Compliance unit (10^{-6}cm/dyne)
dc	Direct current
dB	Decibel
DIN	Deutscher Industrie Normen
DP	Double play (tape)
ELS	Electrostatic loudspeaker
f	Frequency
fco	Cut-off frequency
fet	Field effect transistor
FM	Frequency modulation
fsd	Full scale deflection
g	Acceleration due to gravity
gm	Grams
H	Henry (inductance)
ht	High tension
Hz	Hertz (cycles per second)
hf	High frequency
I	Symbol for current
IB	Infinite baffle
i.f.	Intermediate frequency
IM	Intermodulation distortion
ips	Inches per second (also in/sec, i/s)
k	Thousand (as in kHz)
kV	Kilovolt
kVA	Kilovolt-ampere
kW	Kilowatt
L	Symbol for inductance
lf	Low frequency
Lin	Linear
LP	Long play (tape) or long-playing disc
LS	Loudspeaker
LW	Long wave
m	Metre
mA	milliamps (also mV, millivolts; mS, milliseconds)
MHz	Megahertz (also Megohms, etc.)
mH	Millihenry
mm	Millimetre
mS	Millisecond (also mSec)
MW	Medium wave
nS	Nanosecond. One thousand millionth part of a second
OP	Output (also O/P)
pF	Picofarad. One millionth of microfarad
pot	Potentiometer
p-p	Peak to peak
PU	Pickup
Q	Q-factor (resonance)
R	Symbol for resistance
rf	Radio frequency
rpm	Revolutions per minute
rms	Root mean square
RIAA	Record Industry Association of America
sec	Second (S, also)
SW	Short wave
swg	Standard wire gauge
THD	Total harmonic distortion
thou.	Thousandths of an inch
TP	Triple play (tape)
Tr	Transistor
UHF	Ultra high frequency
VHF	Very high frequency
V	Volt
VU	Volume unit
W	Watt
wkg	Working
Xtal	Crystal
Z	Impedance
λ	Symbol for wavelength
Ω	Ohm
μ	Micron
μV	Microvolt (also μA, μF, etc.)



APPROXIMATE FREQUENCY RANGES OF INSTRUMENTS

The frequency ranges of a number of musical instruments are shown in this diagram. Male and female speech ranges are included. The range of tones in shown by the solid line and the range of overtones, including noises, by the broken line.



EQUAL-LOUDNESS CONTOURS

The diagram shows equal-loudness contours (Fletcher-Munson curves) for human hearing. Indicating the sound intensity required to produce a sensation of equal loudness at various frequencies, these are plotted for several loudness levels from very high to near-inaudibility. Although the ear responds throughout a frequency range of about 20-20,000Hz and to an intensity range of about 130dB at mid-frequencies, it is *relatively* insensitive to low and high frequencies, the effect becoming more apparent at low intensities. Note especially the low-intensity bass deficiency, a characteristic sometimes brought out in support of 'loudness' controls for sound reproduction systems.

VHF RADIO TRANSMITTING STATIONS
Radio 2, Radio 3, Radio 4

BBC FM SERVICE

Shown above is the most recent version of the map issued by the Engineering Information Department, BBC, London W1.

BBC VHF/FM TRANSMITTERS

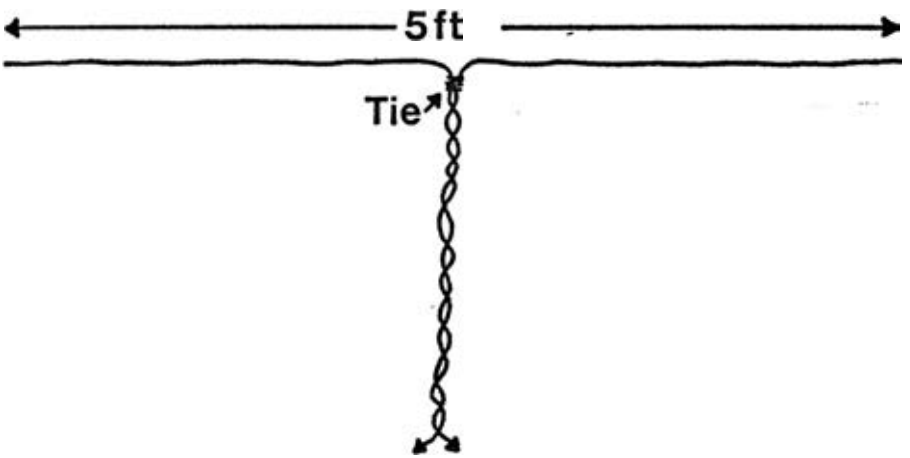
Station	*Frequencies (MHz)*		
	Radio 2	*Radio 3*	*Radio 4*
Ashkirk (Galashiels)	89.1	91.3	93.5
Blaen-plwyf (W. Wales)	88.7	90.9	93.1
Divis (Belfast)	90.1	92.3	94.5
Douglas (Isle of Man)	88.4	90.6	92.8
Dover	90.0	92.4	94.4
Fort William	89.3	91.5	93.7
Holme Moss (Manchester)	89.3	91.5	93.7
Kinlochleven	89.7	91.9	94.1
Kirk O'Shotts (S. Scotland)	89.9	92.1	94.3
Les Platons (Channel Islands)	91.1	94.45	97.1
Llanddona (Anglesey)	89.6	91.8	94.0
Llandrindod Wells	89.1	91.3	93.5
Llangollen (N.E. Wales)	88.9	91.1	93.3
Londonderry	88.3	90.55	92.7
Meldrum (Aberdeen)	88.7	90.9	93.1
North Hessary Tor (S. Devon)	88.1	90.3	92.5
Oban	88.9	91.1	93.3
Orkney	89.3	91.5	93.7
Oxford	89.5	91.7	93.9 (Mid) 95.85 (West)
Peterborough	90.1	92.3	94.5
Pontop Pike (Newcastle)	88.5	90.7	92.9
Redruth (W. Cornwall)	89.7	91.9	94.1
Rosemarkie (Moray Firth)	89.6	91.8	94.0
Rowbridge (Isle of Wight)	88.5	90.7	92.9
Sandale (Carlisle)	88.1	90.3	94.7 (North) 92.5 (Scot)
Sutton Coldfield	88.3	90.5	92.7
Talconeston (Norwich)	89.7	91.9	94.1
Thrumster (Wick)	90.1	92.3	94.5
Wenvoe (Cardiff)	89.95	96.8	94.3 (Welsh) 92.125 (West)
Wrotham (London and S.E. England)	89.1	91.3	93.5

TEMPORARY FM AERIAL

THE IMPORTANCE of the aerial for satisfactory mono and stereo FM reception has been stressed in this series of booklets. Choice of aerial depends on local reception conditions. Often a simple half-wave dipole is adequate, and it should be suitably sited and positioned broadside on to the transmitter to be received. More complex arrays, with extra reflector and director rods, are used in areas where there is difficulty in capturing an adequate signal.

A properly designed FM aerial comprises a horizontal tube in two parts, each equal to a quarter-wavelength. In practice the overall length depends to a small extent on the thickness of the tube, but this length is around 5 ft. With this in mind we can devise a very simple dipole for use where the signal is strong or as a temporary measure when it is required to obtain reception before a correctly made aerial is available.

To make the temporary dipole, take a length of lighting flex and pull apart or unravel the last $2\frac{1}{2}$ft, taping the centre as shown below. Fix the arms of the dipole to a strip of wood and use the rest of the flex as the lead to the receiver. This arrangement is similar to the wire aerials sometimes supplied with imported receivers. An even better home-made aerial can be made from two 29in. lengths of aluminium tubing with their inner ends slightly apart and with the inner and screen of coaxial cable fixed to these ends.



When choosing a permanent aerial consult a local supplier who is familiar with reception conditions and can advise on types likely to be successful.

TECHNICAL QUIZ

Are you familiar with technical terms used in audio and radio? Try this selection but resist the temptation to collect your books around you before starting. Time limit 20 mins for the average enthusiast. Answers on page 23.

1. Transducer—(a) Device that converts one form of energy to another (b) Advanced type of pickup (c) High frequency loudspeaker.
2. Dyne—(a) Electrical unit (b) Unit of force equal to a milligram (c) Unit of energy.
3. Drop-out—(a) Uncoated portion of tape (b) Momentary flaw in signal from tape due to deficiency in the tape (c) Fluctuation of signal through amplifier.
4. Clipping—(a) Tape editing process (b) Pickup fault (c) Distortion of signal waveform.
5. Solid-state—(a) Term indicating use of transistors and other semiconductor devices (b) Equipment employing printed circuits (c) Term indicating absence of wiring.
6. Compliance—(a) Stiffness (b) Springiness (c) Yield (reciprocal of stiffness).
7. Rms—(a) Recording characteristic (b) Root mean square (c) Unit of power.
8. Transient—(a) Loss of power (b) Signal of high power (c) Quick, short signal involving sudden change.
9. Reflex—(a) Hangover following cessation of signal (b) Tuned speaker enclosure with vent (c) Large speaker enclosure for units of 12in. and above
10. Efficiency—(a) Ratio of output to input energy (b) Ratio of input to output energy (c) Ratio of output power to input voltage.
11. Multiplex—(a) Conversion of stereo to mono (b) Conversion of mono to stereo (c) Stereo radio system.
12. Ohm—(a) Unit of electrical resistance or impedance (b) Unit of inductance (c) Unit of compliance.
13. Piezo-electric effect—(a) Generation of voltage by material subjected to mechanical stress (b) Amplification in a solid-state circuit (c) Reduction of power due to property of load.
14. Elliptical stylus—(a) Stylus tip with small radius across groove and large radius in contact with groove (b) Stylus tip with large radius across groove and small radius in contact with groove (c) Stylus for use on LP records only.
15. Polar response—(a) Refers to positive and negative voltages (b) Graphical representation of speaker output in various directions (c) Test result obtained at low temperature.
16. Tracing distortion—(a) Geometrical error of pickup arm (b) Distortion arising in reproduction of a disc (c) Discrepancy in amplification of a signal.
17. Fundamental—(a) Lowest note on the piano (b) Lowest note produced by a loudspeaker (c) Lowest frequency component in a complex wave.
18. Hz—(a) Unit of frequency (b) Unit of capacitance (c) Unit of power.
19. ABR—(a) Acoustic bass reflex (b) Auxiliary bass radiator (c) Axial bass reinforcement.
20. Damping factor—(a) Efficiency of damping materials in speakers (b) Ratio of speaker impedance to amplifier source impedance (c) Measure of distortion due to damping.
21. Gain—(a) Amplification factor (b) Addition of harmonics to signal during amplification (c) Property of transducers.
22. Sine Wave—(a) Complex wave (b) Distorted wave (c) Waveform of a pure tone.

23. Q—(a) Goodness factor applied to electrical or mechanical resonance (b) Quality factor for loudspeakers (c) Quiescent condition.
24. Flutter—(a) Pitch fluctuation of greater periodicity than 10Hz (b) Pitch fluctuation of lower periodicity than 10Hz (c) Random fluctuation of pitch, any frequency.
25. Heatsink—(a) Temperature-sensitive device (b) Metallic resistor (c) Metal part used to conduct heat away from transistors.

LINKS

Do you own hi-fi equipment, or have you been studying the literature before taking the plunge? Either way you may be able to link these product and speciality names and model numbers with the appropriate manufacturers. Some are very familiar, some quite tricky. Answers on page 23.

Products

1. Cadenza 2. Dynarange 3. Super-Track 4. Monitor Gold 5. BiaTron 6. Ditton 25 7. HT70 8. P6000 9. Mini-Acusta 10. PRO-4AA 11. Miracord 12. Triton 13. R50 14. Groov-Kleen 15. Delta 70 16. Flamenco 17. Havant 18. MF15 19. Ravensbrook 20. Berkeley.

Manufacturers

a. Shure b. Celestion c. Scotch d. Rogers e. Heco f. Goodmans g. Tannoy h. Teac i. Leak j. Bib k. Richard Allan l. Koss m. Wharfedale n. Telefunken o. Elac p. KEF q. Cambridge r. Heathkit s. BSR t. Ortofon.

WHO MAKES WHAT?

You know these famous names and will associate them with particular types of product. The products are listed below—not an exhaustive list but examples of items manufactured or distributed. Relate these categories to the firms. Answers opposite.

1. Micro Seiki
2. Cambridge
3. Shure
4. Sony
5. Acoustic Research (AR)
6. Sansui
7. Goodmans
8. Tandberg
9. Pioneer
10. Rogers
11. Bang & Olufsen
12. Revox
13. Metrosound
14. Decca
15. Akai

a. Amplifiers, receivers
b. Turntables
c. Pickups
d. Loudspeakers
e. Tape equipment
f. Accessories, microphones

ODD MEN OUT

Which are the two imposters in this list of product names and tradenames? Answers opposite.

1. Scaneltra
2. Dyna-Scan
3. Play-fair
4. One-Ten
5. Barmatic
6. Chilton
7. Colton
8. Ferrosonic
9. Dynastatic
10. Duette
11. Orbit
12. Elgar

ANSWERS

Quiz

1 (a). 2 (b). 3 (b). 4 (c). 5 (a). 6 (c). 7 (b). 8 (c). 9 (b). 10 (a). 11 (c). 12 (a). 13 (a). 14 (b). 15 (b). 16 (b). 17 (c). 18 (a). 19 (b). 20 (b). 21 (a). 22 (c). 23 (a). 24 (a). 25 (c).

Links

1p. 2c. 3a. 4g. 5h. 6b. 7s. 8e. 9n. 10l. 11o. 12m. 13q. 14j. 15i. 16k. 17f. 18t. 19d. 20r.

Who Makes What?

1b,c,f. 2a,d. 3a,c,f. 4a,b,c,d,e,f. 5a,b,c,d,f. 6a,b,c,d,e,f. 7a,d,e,f. 8a,d,e,f. 9a,b,c,d,e,f. 10a,d. 11a,b,c,d,e,f. 12a,e,f. 13a,b,c,d,e,f. 14a,c,d,f. 15a,b,c,d,e,f.

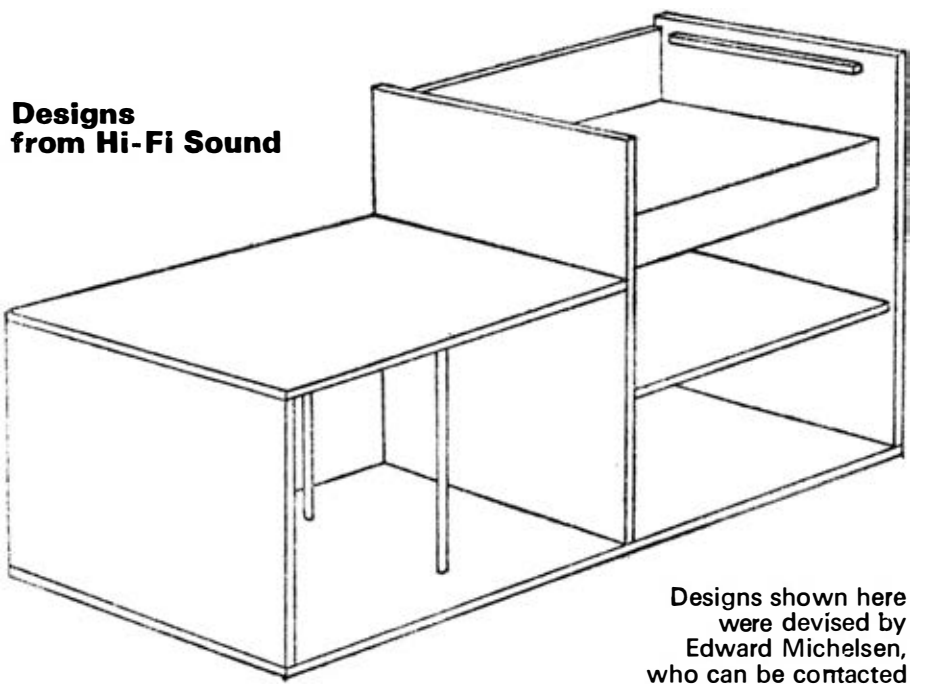
Odd Men Out

5.Barmatic 8. Ferrosonic

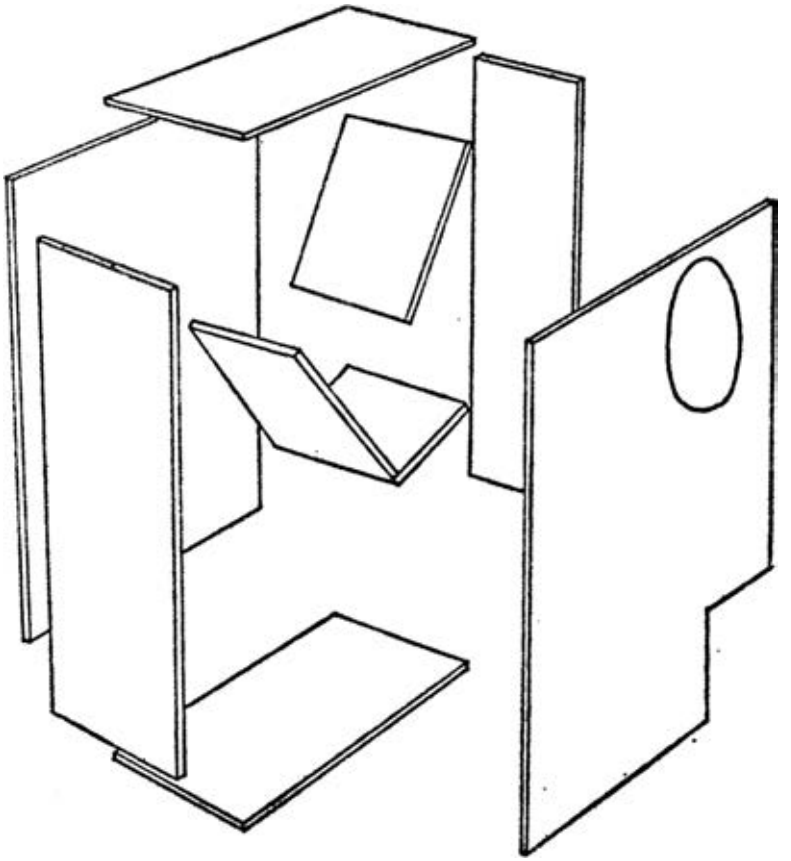
2 PRACTICAL HI-FI

THESE THREE simple designs first appeared in *Hi-Fi Sound Annual '71* but will be new to many readers. First is a 'split-level' equipment cabinet the construction of which will be apparent to any handyman. Suggested dimensions: 36in. long by 16in. deep by 20in. high at the equipment end. Height of record storage section 15in. There is space for popular players such as Connoisseur and Thorens TD150, and the constructor can devise a lift-off Perspex cover or a hinged lid. Popular small amplifiers and tuners (Trio, Rogers, Alba, Rotel, etc.) can be accommodated on the shelf and base. Otherwise adjust dimensions as required. Use veneered chipboard and ensure the turntable board is sufficiently thick and rigid.

Designs from Hi-Fi Sound

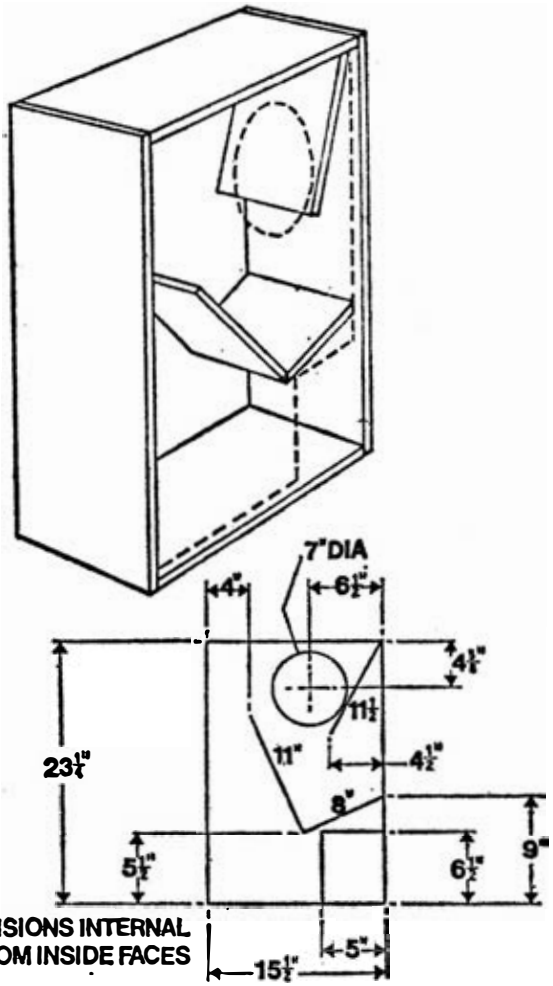


Designs shown here were devised by Edward Michelsen, who can be contacted at 494 New Cross Road, London SE14.

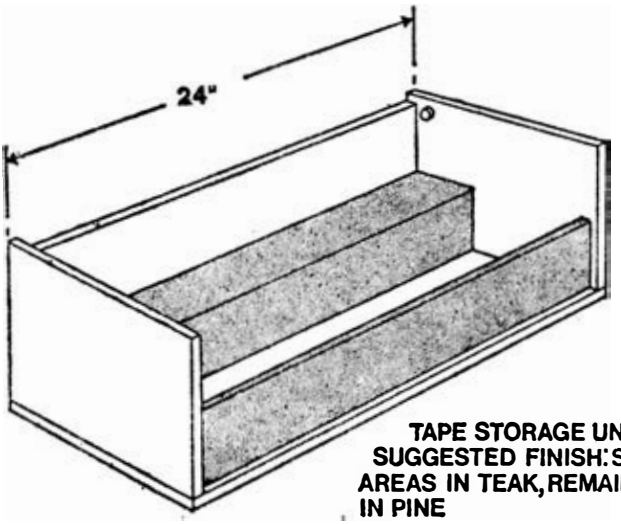


Low-cost enclosure

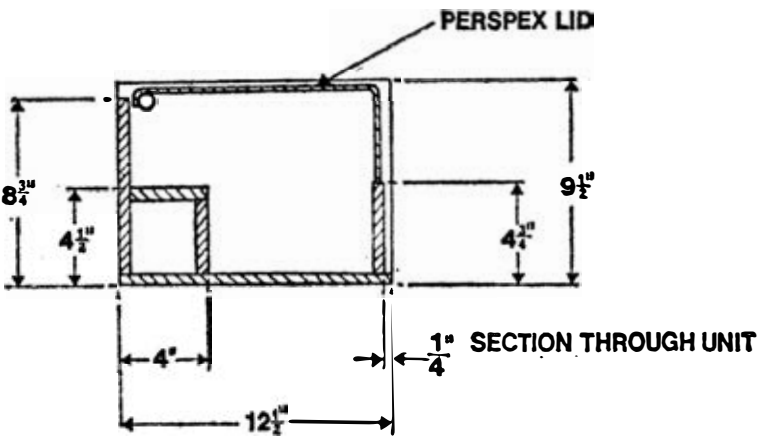
This small 'folded-column' speaker enclosure should be constructed from 9mm plywood. Suitable drive units are Richard Allan CG8T, Elac 8N/185 with KEF T15, or the Goodmans 8in. wide-range. Note the port at the bottom corner, front. Drive unit is mounted from the front. The enclosure can stand on the floor with the port at the bottom, or horizontally on short legs. The design is appropriate to 'budget stereo' outfits since the efficiency is above average and drive power requirements are modest. Bass extends to about 60Hz. Dimensions overleaf.



Dimensions of low-cost enclosure shown on previous page.



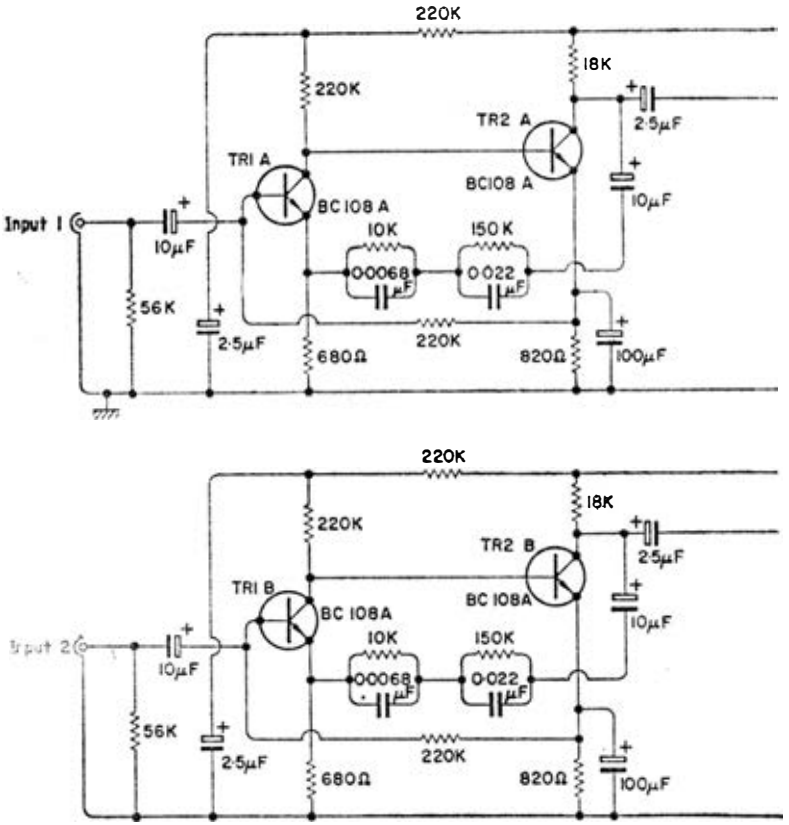
TAPE STORAGE UNIT
SUGGESTED FINISH: SHADED AREAS IN TEAK, REMAINDER IN PINE



SECTION THROUGH UNIT

Storage unit

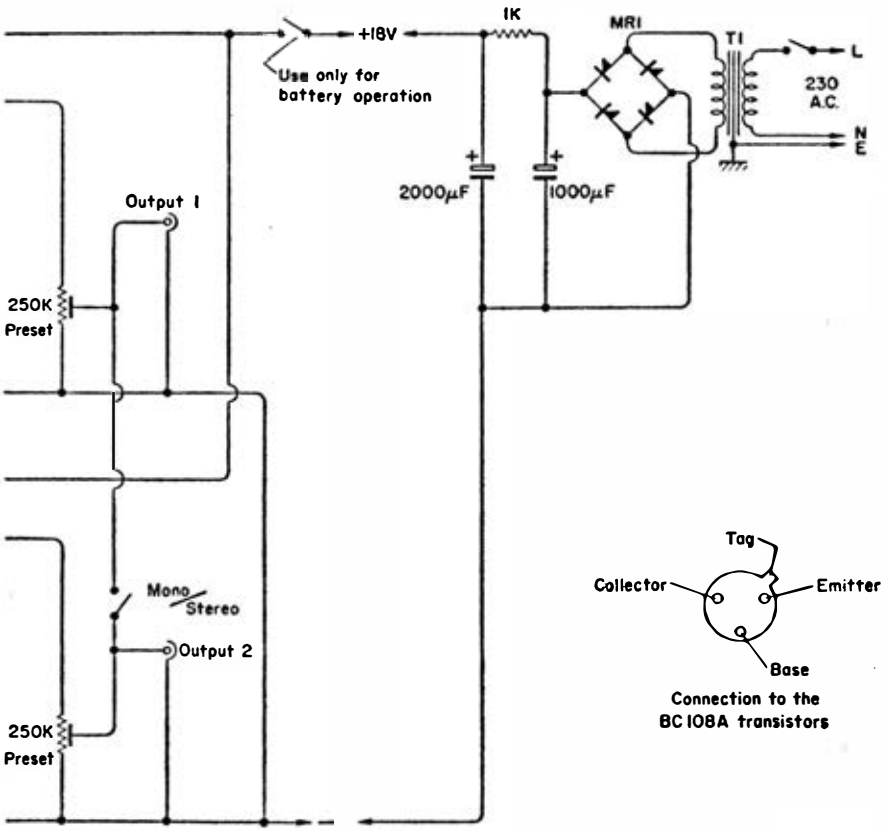
This tape storage unit accommodates 7in. spools in their boxes and is so arranged that 3in. and 4in. sizes also can be ranged along the back. The cover could be of Perspex or wood.



PICKUP PREAMPLIFIER

Most modern amplifiers accept the low outputs from magnetic cartridges. However, if a magnetic cartridge is to be connected to a low-sensitivity amplifier that lacks proper facilities and was not designed to accept such cartridges, it is necessary to use a preamplifier. This has two functions: it boosts the very small pickup signal voltage to a figure suitable for the amplifier input, and it provides the standard response equalisation which has to be applied to the signal before this is passed on to circuits having a linear frequency response.

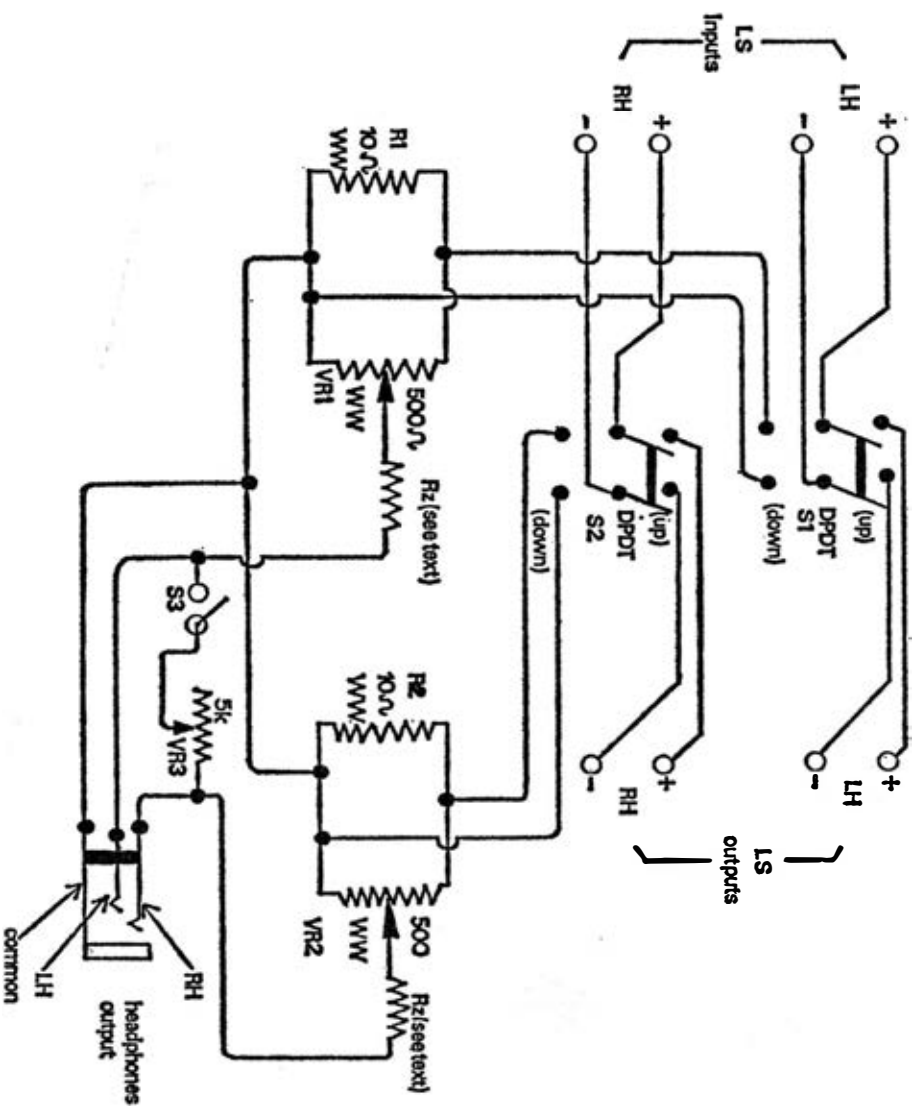
The stereo preamp shown here, devised by F. C. Judd and first described in the magazine (November 1968), has a sensitivity of about 3mV for 75mV output. Cartridges with nominal outputs of up to 6mV (at 5cms/ec) may be used and the preamp output will be correspondingly higher. A stereo/mono switch is included but can be omitted if the main amplifier has such a control. Components can be mounted on small assembly boards and must be in a screening housing, preferably a die-cast box (consult radio components suppliers). Phono plugs and sockets are suggested for inputs and output. Supply voltage must be nominally 18V from batteries (simplest and cheapest) or via the mains section which is included in the circuit. Voltage must not fall below about 16V. Keep mains wires as far as possible from signal wires.



Components

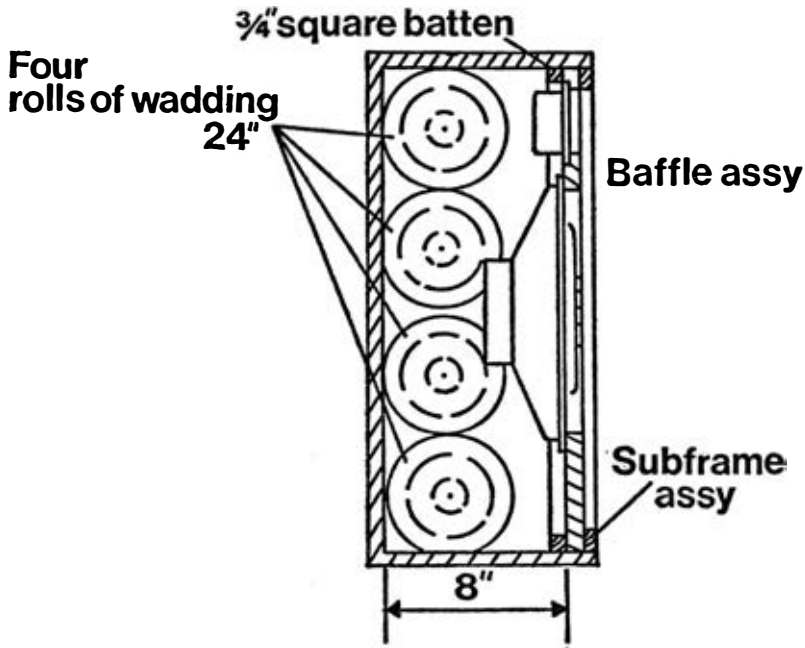
Transistors (4)	Mullard BC108A
Resistors	All ½W 20%
Electrolytics	Min. 25V wkg.
Preset controls	250k miniature
Toggle switch (1)	On/off
Slide switch (1)	Mono/stereo
Twin phono sockets (2)	
Transformer	230-24012/V Henrys Radio PS12/1
Bridge rectifier	Henrys Radio 1H3 or equivalent

SPEAKER/PHONES BOX

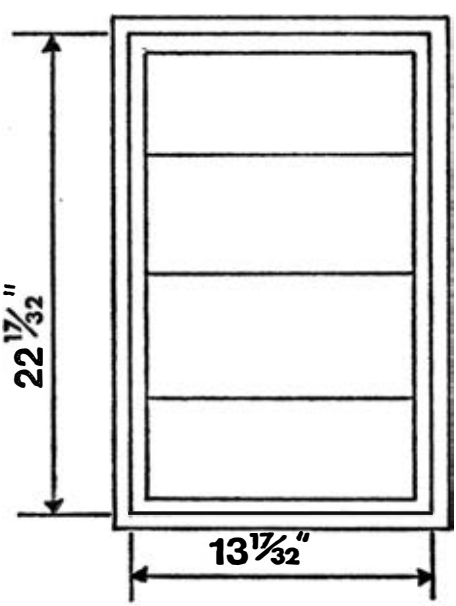


This loudspeaker/phones selector ensures the amplifier is not left unloaded. The circuit provides the necessary switching and when in the 'phones position the amplifier sees 10-ohm resistors in parallel with 500-ohm volume controls for the headphones. VR3 is a 'blend' control. Rz should be 100 ohms for 'phones up to 200 ohms impedance; 470 ohms for 'phones of 200-600 ohms; and 1k for those above 600 ohms. Very many headsets are in the lowest of these ranges. R1 and R2 should be at least 10W rating—more if the amplifier is of higher power. VR3 is a linear law variable resistor. Assemble the parts in a wooden box.

MANUFACTURERS' SPEAKER DESIGNS

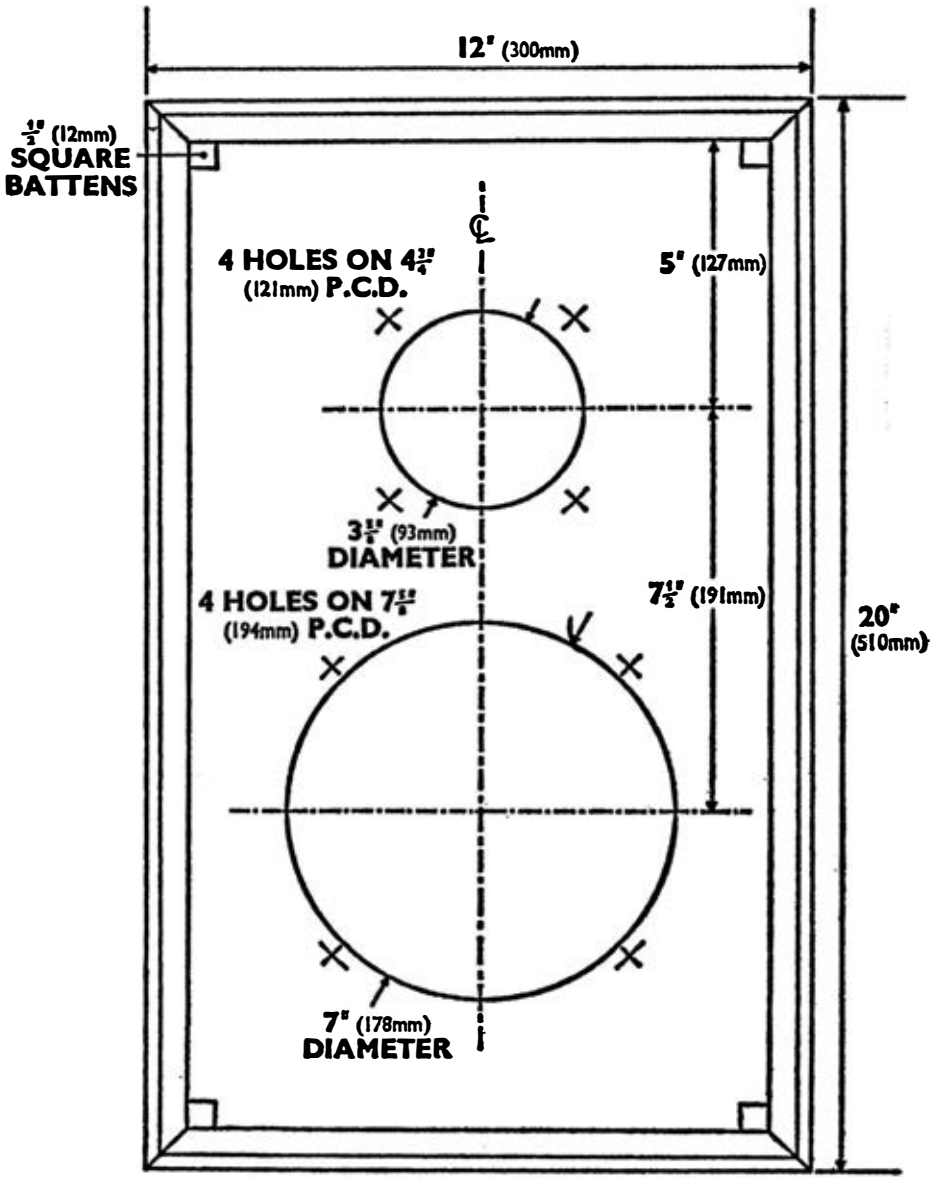


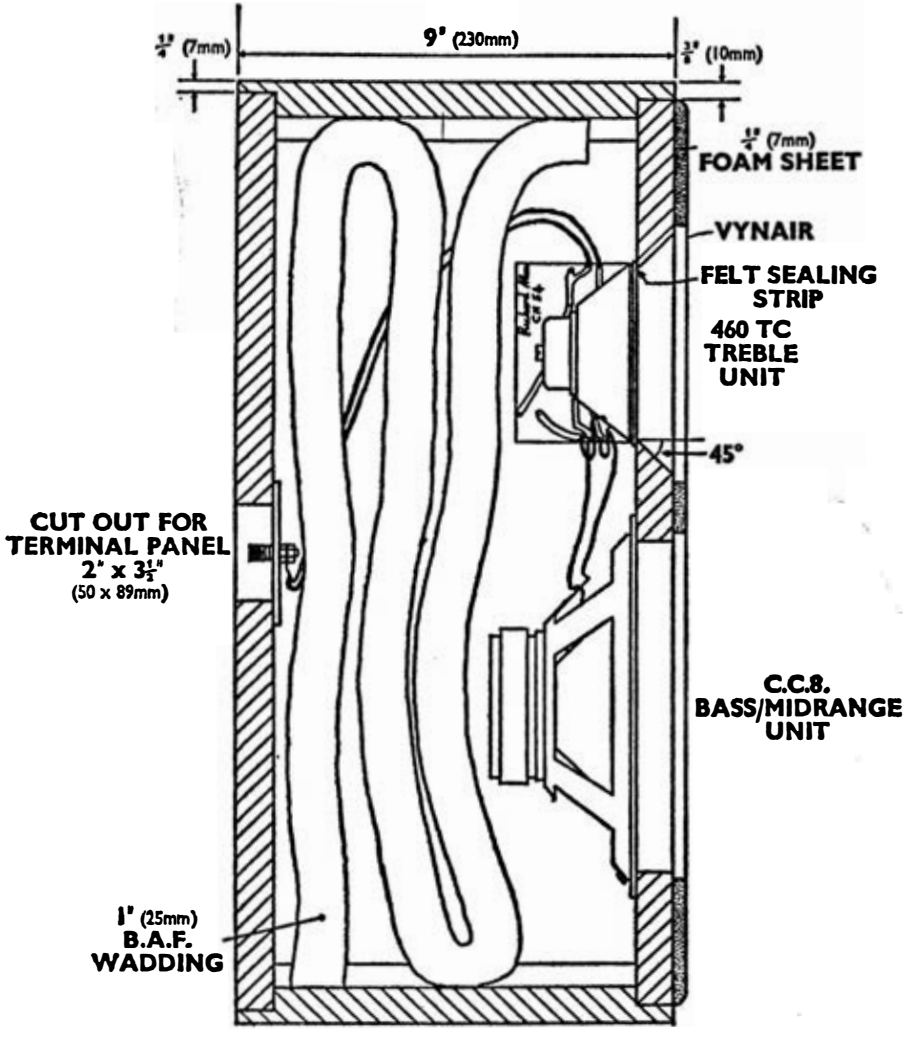
Kefkit 2



Details from typical enclosure design. The kit is intended for installation in a total enclosure having internal volume of 1 to 2.5 cu. ft. Within this range the bass performance will improve as volume is increased (i.e. as system resonance is lowered). Chipboard or plywood ¾in. minimum. BAF wadding is used for sound-absorbent treatment. KEF literature covers construction, grille, phasing of units, etc.

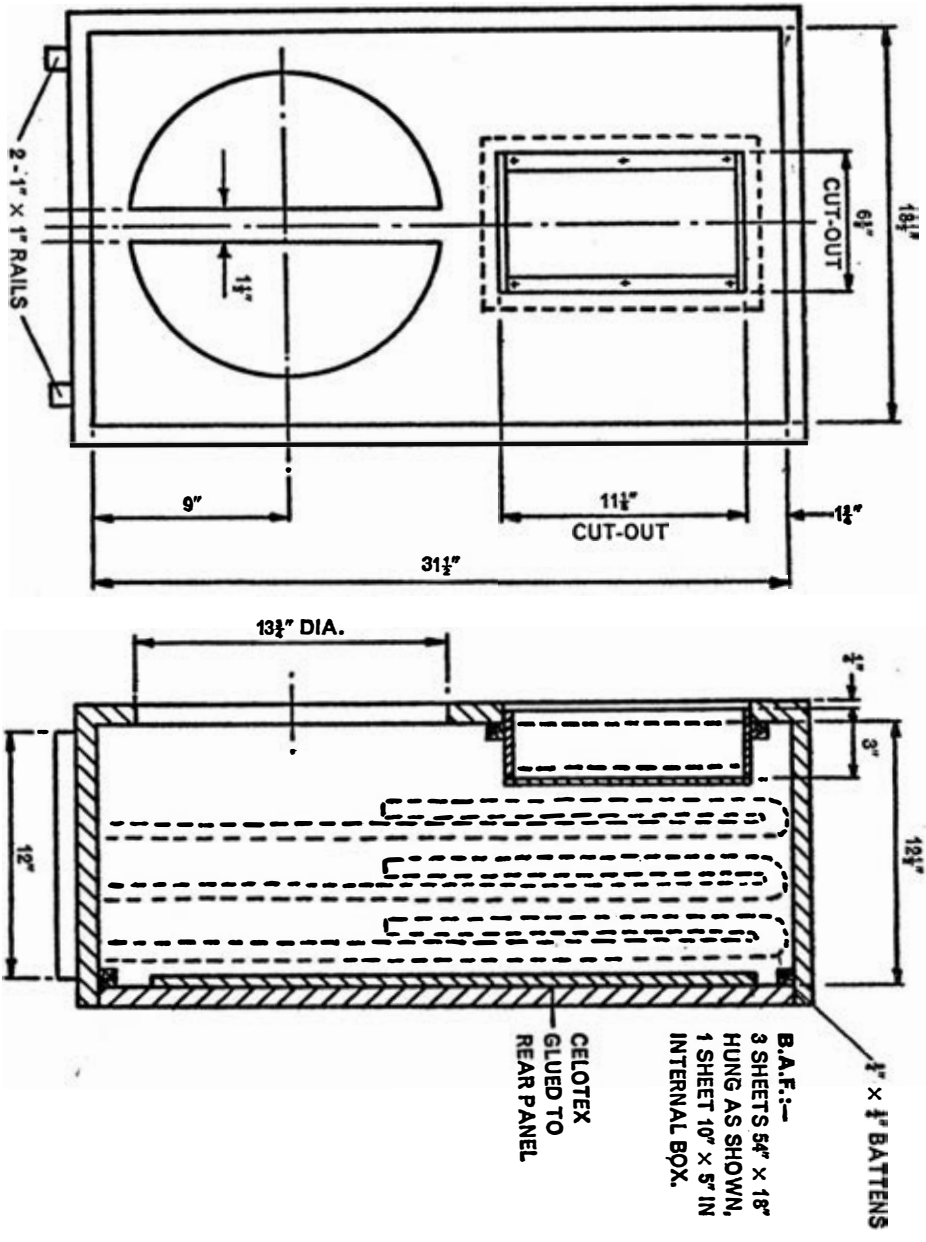
Several specialist speaker manufacturers issue design information of this kind, usually in leaflet form and free of charge. The designs may be for specified drive units sold separately or for kits of units. Other extracts from firms' literature are offered in the following pages. Those intending to tackle such projects should of course obtain full details from the manufacturers. See page 50 for notes on services provided.


12" (300mm)
½" (12mm)
SQUARE
BATTENS
4 HOLES ON 4¾"
(121mm) P.C.D.
5" (127mm)
3⅝" (93mm)
DIAMETER
4 HOLES ON 7⅜"
(194mm) P.C.D.
7½" (191mm)
20"
(510mm)
7" (178mm)
DIAMETER



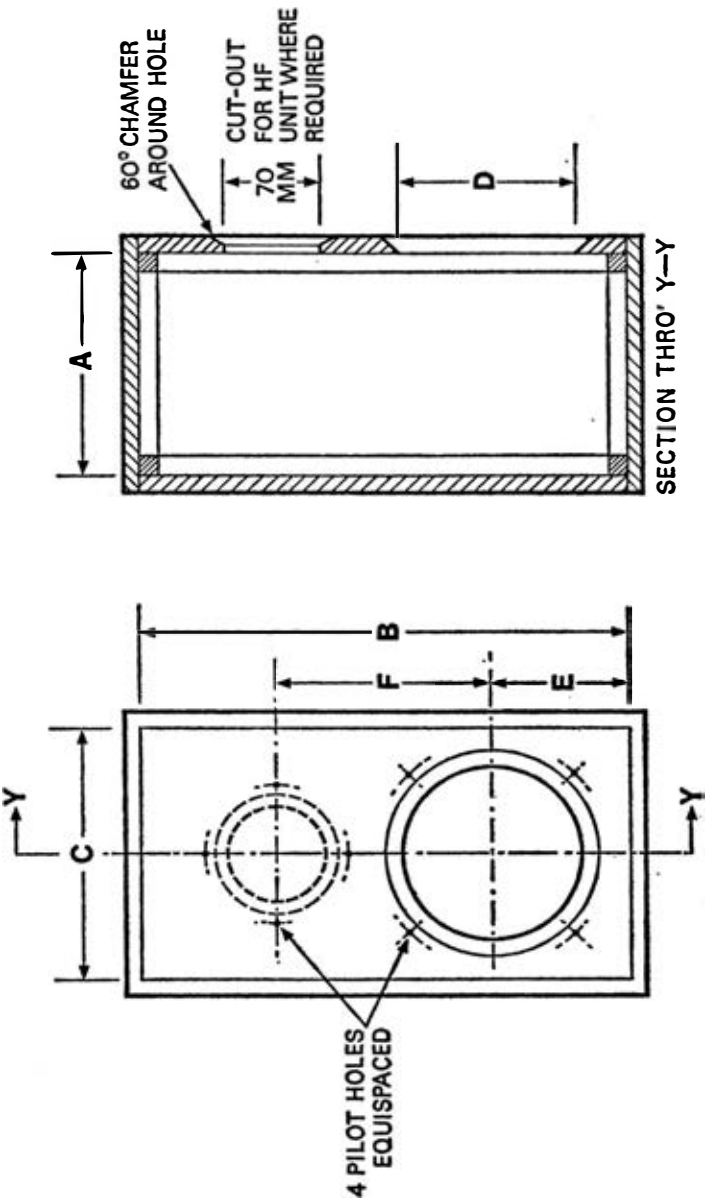
Richard Allan Twin Assembly

For their Twin Assembly (8in. bass unit plus tweeter and crossover kit) Richard Allan recommend a total-enclosure design of compact type as shown above and opposite. Recommended material is ¾in. chipboard and information given on the data sheet covers construction details, the grille, finishes and adhesives. Units are CG8 bass/mid-range and 460TC treble unit. A similar sheet deals with the Triple Assembly (three drive units with crossover).



Richard Allan Sarabande

A leaflet includes an enclosure design similar to that used for the Sarabande system, which incorporates a 15in. bass unit and a mid-range and tweeter module. Note that the module is housed in an internal box to isolate it from the bass unit's rear radiation.



Goodmans Twin Axiom 8

Shown here is the enclosure for this 8in. double-diaphragm unit. Similar enclosures are advocated for other Goodmans drive units and the details are given on a series of leaflets, the appropriate dimensions appearing on each. For the 8in. unit the dimensions are: A, 9in. B, 20in. C, 11in. D and E, $6\frac{11}{16}$in. A loose filling of 2in. glass fibre wadding is suggested.

BUILDING A KIT

HEATHKITS EXEMPLIFY the organised DIY approach, suited to keen amateurs who lack previous experience and do not feel qualified to follow a basic design, shop for components and undertake the engineering that would be required without a prepared kit to speed the work. A kit of this kind contains everything that is needed—components, prepared chassis, printed-wiring boards, sundries—and all steps in construction, test and adjustment are explained in appropriate order. The Heathkit catalogue lists all manner of equipments including amplifiers, tuners, receivers, speakers and test instruments.

With kit assembly planned in this way it is reasonable to say that an elaborate project presents no more real difficulty than a simple design such as a small amplifier with fewer components. There are of course more steps to follow and more things to check, and therefore the time taken is greater. But the more elaborate assemblies rarely take more than a few weekends of concentrated effort. If problems arise despite the measures taken to anticipate and prevent them, the constructor can call on the manufacturer's technical service.

A receiver (tuner-amplifier) is among the more complex projects for the good reason that it combines all the functions in one unit that a constructor might otherwise tackle as separate parts—with a rest in between! Heathkit AR-2000 FM/AM stereo receiver is chosen for mention here since it is a representative but fairly elaborate example—an up-to-date design in which some modern electronic devices and techniques are put to good use. It incorporates 44 transistors, 37 diodes and three integrated circuits, and most of the components are to be mounted on four printed-circuit boards which are linked by colour-coded wiring assemblies to reduce the possibility of wiring errors.

Some features are as follows. An input level control for each channel is provided for disc and tape sources; push-button switches are provided for many of the controls; a single control with flywheel action tunes both FM and AM; a panel meter is used for tuning, and on FM this is arranged to give centre-zero tuning on the station. For FM a pre-assembled tuning unit uses an rf field effect transistor 'to provide high sensitivity and low cross modulation with no overloading on strong local stations', and the i.f. section employs integrated circuits and ceramic filters for optimum performance. The FM multiplex circuit also uses an integrated circuit in conjunction with pre-aligned coils.

Power amplifier circuits have overload protection to make the receiver virtually short-circuit proof. Dc supplies from power section to various circuit sections are zener-diode regulated where required. All stages in construction, adjustment, operation, etc. are explained in a manual (126 pages plus circuit schematics) features of which are shown here. Heathkit estimate the building time as about 20-25 hours. First, here are extracts from the AR-2000 specification.

AMPLIFIER

Output power, rms continuous per channel	18 watts, 4 ohms 20 watts, 8 ohms 15 watts, 16 ohms
Output power, dynamic (music power) per channel	30 watts

Power Bandwidth for constant 0.25% THD	10Hz to 30kHz
Frequency response ref. 1 watt	10Hz to 30kHz ± 1dB 8Hz to 60kHz ± 3dB
Harmonic distortion	Less than 0.25% from 8Hz to 20kHz, 20 watts
Intermodulation distortion, 60Hz and 6kHz mixed 4 :1	Less than 0.25%, 20W
Damping factor	Greater than 50dB
Input sensitivity	PU1 2.8mV, overload 130mV. PU2 200mV at 1Mohm, overload 2V. Tape 200mV, overload 5V.
Hum and noise	Phono −65dB ref. 10mV. Volume at min. −90dB
Output impedance range	4 to 16 ohms

FM SECTION—Stereo

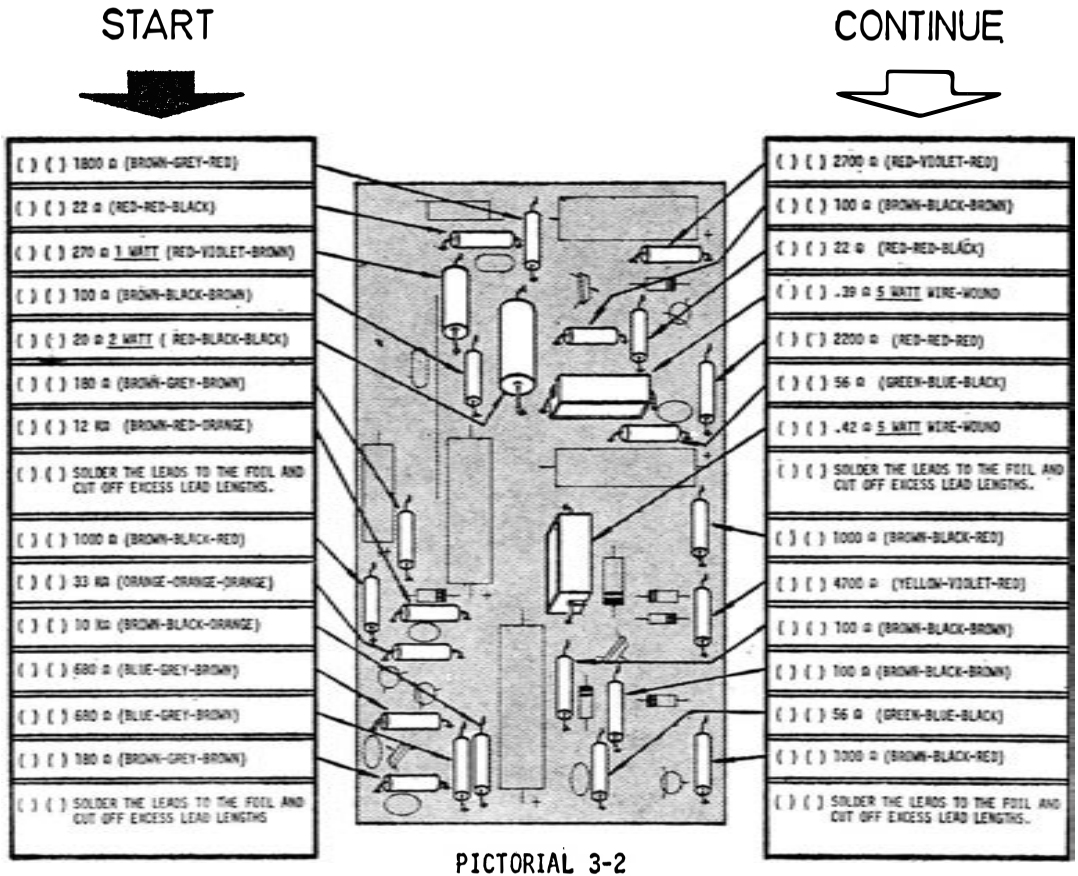
Channel separation	37dB at 1,000Hz 30dB at 80Hz 25dB at 10kHz
Frequency response	20-15,000Hz ± 1.4dB
Harmonic distortion	Better than 1% at 1kHz ref. 100% mod.
19 and 38kHz suppression	Better than —50dB ref. 100% mod.
Tuning range	88-108MHz
Antenna	Balanced for external 300-ohm aerial and 75-ohm coaxial
Sensitivity, mono	2μV (IHF)

AM SECTION

Tuning range	LW 150-350kHz MW 530-1,580 kHz SW 5.8-11.5MHz
Antenna	Long wire, 25 ft. min.
Harmonic distortion	Less than 3% ref. 1mV input, 1kHz, 30% mod.

Particular attention is given to fault-finding. Possible causes of faults are suggested in tables dealing with amplifier and power supply circuits, stereo and mono FM circuits, AM circuits, etc. Here are a few examples.

Condition	*Area of difficulty*	*Possible cause*
Receiver completely dead	Power supply circuit	1. Blow fuses 2. Open circuit supply wiring or on-off switch
Dial lamps on, but no sound	Power supply circuit	1. Diode D1, D2, D3,D4 2. Diode bridge D5 3. Diode bridge D6
	Speaker switch	1. Speaker switch in off position 2. Speaker wiring
Right channel dead, left channel OK	Power amplifier, right channel circuit Input or control amplifier circuits, right channel circuits	Refer to stage-by-stage tests on p.102



PICTORIAL 3-2

PROCEED TO PICTORIAL 3-3

Example of the step-by-step instructions in the Heathkit AR-2000 construction manual. This is from the section dealing with the amplifier circuit boards.

Distorted output from both channels in all 8-station switch positions	Power supply circuit Power amplifier circuit Input or control amplifier circuits	Low voltages Check voltages at dc fuse points and input amplifier circuit
Hum with no signal in all 8-station switch positions	Power supply	Capacitors C802, C803. C1 or C5
High frequency oscillation from left channel output	Power amplifier left channel circuit	1. Loose connection L601L or C625 2. Capacitor C611 or C625 3. Resistor R657
Little or no separation of stereo signals	Multiplex circuits	1. IC300 2. R303 SEP ADJ or R304
Stereo reproduction garbled or distorted	Multiplex circuits	1. Multiplex adjustments 2. IC300
Distortion on strong stations	FM tuner unit or FM circuits	1. AGC wiring 2. Q200, D200, D201 or D202 open 3. C207 open
Hum on FM reception	Power supply	Capacitors C3 or C4 open

SCIENCE AND SOLDER

VERY MANY people think they know how to solder: far fewer make a sound job of even the simplest tasks with a soldering iron. Indeed, some of the smallest joints—terminals on wires and joins to the pins in fiddly DIN plugs—receive the messiest treatment. As with many minor accomplishments and a few major ones, practice makes perfect.

It is of course possible to assemble audio systems using prepared leads and plugs, so that no soldering is necessary to get everything working. But additions may be made in the future, or it may be necessary to make good some broken joints, and therefore it is worth mastering the skills of soldering. Those intending to assemble electronic kits should give the matter special attention, gathering together the few essential aids and developing some expertise before getting down to serious work, which will involve making anything from a dozen to a hundred or more soldered joints. Apart from audio, there are plenty of jobs around the home for which a soldering tool is useful.

Basically simple though it is, soldering depends on science. It depends on a correctly prepared solder, a flux, and a soldering tool of the right type and at the right temperature, as well as properly prepared work. A wildly wrong temperature prevents efficient soldering, and so does dirt on the parts to be joined. And it is essential to understand that soldering does not involve melting solder around a joint in order to cover it. A badly prepared joint with solder over and around it is likely to be a dud sooner or later.

Soldering is akin to alloying, in that the solder applied to the workpieces combines to some extent with the metals—usually copper in electrical work. To make the ideal mechanical and electrical joint that this implies, first ensure that the surfaces are clean—free from dirt and oxide film. However, the oxide starts to develop again as soon as heat is applied by the soldering tool; hence the use of a flux in the interest of oxide control.

For audio and small electrical work use solder in 'wire' form containing several cores of resin flux (e.g. Multicore solder, available in 22 and 18 swg in handy dispensers), commonly with a 60/40 tin-lead composition. It is pointless to use any other kind of solder for small electrical joints. For larger-scale tinning the techniques are somewhat different.

Bit for the job

Perhaps it is hardly necessary to remark that a dreadnought iron, suitable for repairing a leaky kettle, is of no use for work on a printed-circuit board. It may be less obvious to the newcomer that there is some merit in choosing a tool with a bit size to match the jobs most often undertaken, or that bits of all shapes and sizes are available (angled and curved shapes included). In general the soldering tools most often purchased for small electrical work have bit widths of $\frac{1}{8}$- $\frac{3}{16}$in. One look at the array of closely spaced pins in an audio plug will show the wisdom of choosing carefully.

When choosing, remember that the tool should be rated for your supply voltage. Be as precise as possible about this, for it is necessary to be sure that the temperature reached will cause free flow of solder yet not be such as to overheat and burn the flux. As for the bit size, consider whether there will be enough work to justify a miniature soldering tool with interchangeable, push-on bits. This facility enables you to ensure the bit is compatible with the work, while an over-large bit may cause burning or generally 'get in the way'.

Those who do a great deal of soldering sometimes favour a soldering 'gun', a rapid-action tool that heats in a few seconds and cools almost as quickly. This kind of device is fairly costly and also rather heavy—factors to be set against the impressively quick action. It has the advantage that it can be placed

on its side on the work-bench without any special safety precaution, whereas an ordinary tool should have a metal stand—even if you make it yourself. Whatever the model chosen, an important feature is the bit material—high conductivity copper or alloy. There may be special coatings to reduce pitting and scaling. Some tools are produced with iron-coated bits (thus justifying use of the name 'soldering iron') to which is applied an anti-rust cadmium coating.

When starting with a new soldering tool (or bit), tin the tip with a little solder. Switch on and hold the solder to the tip as it heats, promoting a tinned area and at the same time preventing an oxide film. After this, and at all times when doing soldering work, remove surplus solder on a wiping pad. Apply a trace of solder to the tip between jobs that are being done in succession, and above all keep the bit clean.

Other aids to soldering are small tweezers, small pointed pliers, a razor blade and a tool for stripping the insulation from wires. This latter item can be side-cutters, which will in any case be needed for audio and electrical jobs, or a special wire-stripping tool. The razor blade will be useful for trimming odd ends of insulation and for stripping off the outer coverings of mains cables and coaxials. Avoid damage to inner insulations and do not nick conductors.

It is difficult to keep some small components still while work proceeds, and all too easy to burn one's fingers if one tries to push the work into convenient positions. So another aid is a simple clamp or wedging device to hold cables, plugs, etc. A couple of small pieces of wood and a rubber band will form jaws that stop the work moving about. If a vice is used, its jaws should be covered with cardboard or cork to avoid damaging delicate items.

Making a joint

When making a joint—a wire to be joined to a tag, for instance—first tin the tip of the tool. Then place the tip on the joint so that enough heat is transferred. Without delay apply the resin-cored solder to the joint so that solder flows quickly and freely. Remove the tool without disturbing the work, and the solder will quickly harden. Do *not* apply the solder to the tool and expect a joint to be made, and do not transfer blobs of solder on the tip. Repeat: the solder is applied to the heated work, not to the bit.

With many small audio jobs it is desirable to tin the work with a trace of solder before actually bringing the two parts together to make the joint. The above rule applies. For example, if wire ends are to be fitted to closely spaced terminals, it is helpful first to twist the wire strands and tin them. Hold the bit against the wire and immediately apply to the work a very little solder, which will flow and produce what amounts to a solid wire, free from straggly strands. Tin the terminal as well. Where the design of components permits, make a mechanical join by hooking the end of the wire on the terminal or tag before doing the soldering.

With all such work, whether or not pre-tinning is necessary, the solder should flow easily and the result should look even and shiny. If it looks very rough the joint is probably ineffective. Do not try to reheat it and use yet more solder: this will be of no help if dirt was the cause of lack of bonding. Instead, take the joint apart and clean the parts before trying again. Of course, it is best to prepare work rather than waste time rectifying errors. Clean greasy surfaces with methylated spirit and prepare doubtful-looking tags by lightly scraping them with fine glasspaper or a small file as appropriate.

Fitting Plugs

Typical jobs for the equipment user include the tinning of wire ends to prevent unravelling when they are clamped under screw-heads; resoldering of

terminals on wires in the pickup headshell lest they come off at an inopportune moment (which is bound to be when you are in a hurry to try a new cartridge); and the fitting of the familiar phono plug to a coaxial lead. This last seems to irritate some users who make a particularly messy job of it, perhaps because soldering the screen to the outside of the bright-finished cap is not as easy as it looks. First clean and tin a spot on the cap.

Prepare the inner conductor to length, and unravel and twist the screen braid; then prepare both by tinning their ends. Then push the wire down the plug pin until it just shows beyond the end. Next—and be quick lest the insulation is affected—place the end of your solder on the protruding end and apply the hot bit. Check that the solder has run inside the end of the plug pin, then tidy up. Touch the twisted and tinned outer braid to the prepared spot on the cap and make this joint.

DIN plugs may have terminal pins on which the wire ends are to be laid for soldering, or the pins may have holes in them intended for insertion of the wires. In either case tin both the wire ends and the pins before making the joints, as this will avoid bad connections and frayed tempers. After completing all joins, inspect closely to see whether any blobs or strands have appeared —these could bridge terminals and cause a mysterious fault condition. The previously mentioned clamp is essential for work on small plugs; otherwise you will find yourself chasing plug and cable around the table-top while you try to apply the solder. A rough-surfaced work-area is also helpful—try a length of corrugated packing material.

Kit-builders should take note of any recommendations provided by suppliers concerning soldering methods and preparation of components, especially where printed-wiring boards are involved. In the absence of information on minor points, remember to inspect and prepare small components. Cut the wire ends of resistors, etc to length and then lightly clean them. Tinning is desirable in some cases, but apply heat for the absolute minimum time needed to produce a trace of solder. Be particularly careful with transistors and diodes, first checking instructions about the use of heatsink devices to prevent damage to the components.

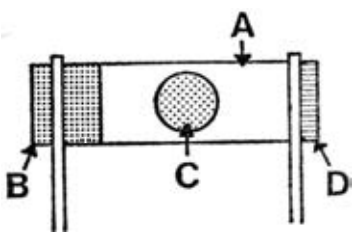
COLOUR CODES

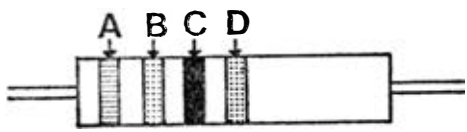
RESISTORS CARRY a colour code to indicate their value. This may take the forms shown below. Colour A gives the first significant figure of the resistor's value, colour B gives the second figure, and colour C gives the number of noughts following the figures. Colour D indicates the tolerance (percentage of the nominal value) but if no colour is marked it can be assumed that the tolerance is ±20%. The standard coding scheme is shown in the Table.

Capacitors are sometimes colour-coded in a similar way. Coloured dots may be used. Reading from left to right, the first two dots give the figures and the third dot the number of noughts following the figures. If there are two rows of dots, the top row gives the figures and the bottom row the number of noughts. If tolerance and voltage ratings are coded, these are read from right to left. Values of capacitors are given in picofarads and of resistors in ohms.

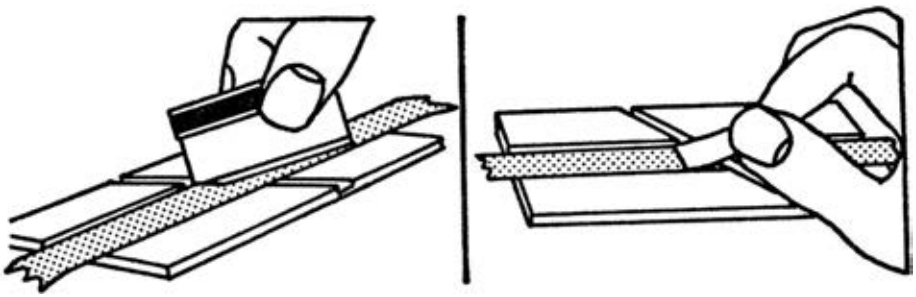
COLOUR CODE FOR RESISTORS AND CAPACITORS

		Resistors	*Capacitors*	
Colour	*Figure*	*Tolerance*	*Tolerance*	*Rating, V*
Black	0	—	—	—
Brown	1	—	±1%	100
Red	2	—	±2%	200
Orange	3	—	±3%	300
Yellow	4	—	±4%	400
Green	5	—	±5%	500
Blue	6	—	±6%	600
Purple	7	—	±7%	700
Grey	8	—	±8%	800
White	9	—	±9%	900
Gold	—	±5%	±5%	1,000
Silver	—	±10%	±10%	2,000
None	—	±20%	±20%	500

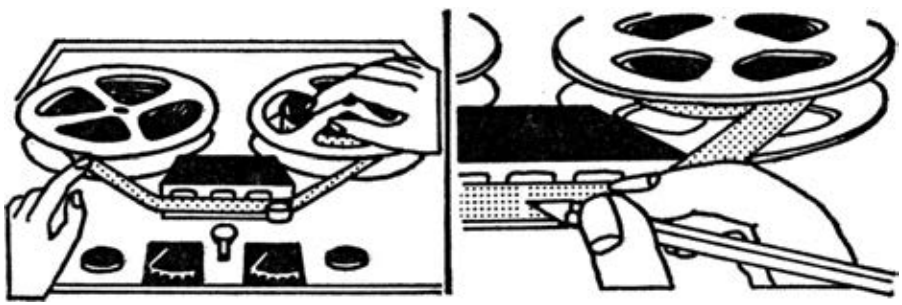




EDITING TAPES



A block is used to hold the tape in position for cutting and joining. At its simplest the block has a 45° slot to guide the blade when the cut is made. There may also be a 90° slot. The cut ends are butted together (right) when the jointing tape is applied to the tape's uncoated side.



With many machines it is possible to see the replay head by removing the cover fitted over the head assembly. Then the tape is moved to and fro until the point required for editing has been located by listening. Make a mark on the tape to indicate where the cut has to be made. Practice ensures that very close editing can be achieved One can soon become expert at joining tapes so that there is no significant break in the magnetic coating running past the heads A well-made join is mechanically strong and will pass the heads silently. The narrow tape in Philips-type cassettes can be pulled out and taken through an editing block of the kind that has been produced for the purpose. Manufacturers supplying editing materials also market ranges of accessories of interest to tape recording enthusiasts—head cleaning aids, spools, containers, auto-stop foil, coloured tapes and so on.

3 MISCELLANY

SOME MANUFACTURERS make only aids for the tape enthusiast, and some specialise in record maintenance. Others make a bit of everything. The following list is not claimed to be comprehensive but it includes the best known manufacturers as well as some less familar suppliers. A simple code is used for three categories of accessories:

> **A—Disc,** including cleaning aids, stylus checks, storage, turntable maintenance, setting-up devices, controls.
> **B—Tape,** including recorder maintenance, tape editing, cassette accessories, labelling aids, storage.
> **C—Miscellaneous,** including preamplifiers, connecting leads, power units, headphone connecting devices.

Acos. Cosmocord Ltd, Waltham Cross, Herts. **A**
Audio Packs Ltd, 206-210 Ilderton Road, London SE15. **C**
Bib Sales Division, Multicore Solders Ltd, Hemel Hempstead, Herts. **A,B,C**
Black Knight Rumblecure, Bank Top, Currier Lane, Ashton-under-Lyne, Lancs. **A,C**
Burne-Jones & Co. Ltd, 18 Brunswick Road, Sutton, Surrey. **A**
Clendisc (Mail Order) Ltd, 7 Trinity Court, Grays Inn Road, London, WC1. **A**
Colton Musonic Ltd, 34-8 Verulam Road, St. Albans, Herts. **A,B**
Decca Special Products, Ingate Place, Queenstown Road, London SW8. **A**
Eagle International, Precision Centre, Heather Park Drive, Wembley, Middlesex HAO 1SU. **A,B,C**
EMI Tape Ltd, Hayes, Middlesex. **B**
Ferrograph Co. Ltd, The Hyde, Edgware Road, Colindale, London NW9 **B**
Goldring Mfg. Co. (GB) Ltd, 10 Bayford Street, London E8 3SE. **A,C**
Grundig (Great Britain) Ltd, Newlands Park, London SE26. **B,C**
Howland-West Ltd, 3-5 Eden Grove, London N7. **A,C**
Koss TMD Ltd, 11 Redvers Road, London N22. **C**
Metrosound Mfg. Co. Ltd, Audio Works, Cartersfield Road, Waltham Abbey, Essex. **A,B,C**
Micro Seiki. B. H. Morris & Co Ltd, 84-88 Nelson Street, London E1. **A,C**
Osmabet Ltd, 46 Kenilworth Road, Edgware, Middlesex. **B**
Philips Electrical Ltd, Century House, Shaftesbury Avenue, London WC2. **B,C**
Schweizer. Highgate Acoustics, 184-8 Great Portland Street, London W1. **A,B**
Scotch. 3M Co, 3M House, Wigmore Street, London W1. **B**
Selecta (London), Selecta House, 50 Southwark Bridge Road, London SE1. **A,B**
Tandberg. Farnell-Tandberg, 81 Kirkstall Road, Leeds LS3 1HR. **C**
Transcriptors Ltd, 2 Theobald Street, Boreham Wood, Herts. **A**
WAL. A.C. Farnell (Leeds) Ltd, 81 Kirkstall Road, Leeds LS3 1HR. **B**
C. E. Watts Ltd, Darby House, Sunbury-on-Thames, Middlesex. **A**
Weircliffe. Amos of Exeter Ltd, Exwick, Exeter. **B**

HI-FI PERFORMANCE CHECK-LIST

THESE NOTES bring together a selection of facts and figures that were explained with more qualification earlier in this series of Guides. The purpose of summarising such points at this stage is to give a handy reference to some important features of performance of high quality systems and components—a memory-jogger for those interested in technical aspects of the subject.

The lack of a generally acceptable definition of 'hi-fi' has not proved to be a very serious matter in practice; and lack of general agreement about high fidelity performance standards has not prevented steady improvement in the design and manufacture of high-grade equipment (it could be argued that the reverse is the case). However, all this does mean that many figures, though based on experience and respectable methods of measurement, are quoted without reference to agreed standards. Those quoted here are middle-of-the-road figures of merit the implications of which should be investigated by technically inquisitive readers, who should also remember that a false impression can be gained by attaching too much importance to isolated technical points.

General

1. Although there are built-in limitations on dynamic range due to programmes, hi-fi systems and conditions of use, a figure of around 55-60dB is sometimes practicable and can be borne in mind as a desirable range. Wide dynamic range implies low noise levels in working conditions. Noise arises at all stages —in the programme material, in the equipment, as a background to domestic sound reproduction—and the general aim is to seek the best possible signal-to-noise ratio.

2. Sound reproduction is subject to distortions of various kinds which, like noise, arise at all stages in transmission of the original sound to the listener. The general aim is to find ways to reduce them. The most readily measurable (and therefore most widely quoted) effects are those due to electronic parts of the system, and they are usually smaller than effects due to transducers (pickups, speakers), especially distortions of a mechanical nature. Harmonic, intermodulation and transient distortions are among those encountered, and the first of these may range from less than 0.1% to upwards of 2% depending on what is responsible for the effect. Disturbances in pitch of the sound also arise.

3. Frequency response is a range of frequencies associated with information about the departure from linearity (expressed in dB), but a 'frequency range' is a statement of frequency coverage without qualification. A general aim is to obtain a wide *and* smooth response embracing all audio frequencies. Smoothnesss is more important than small extensions at the ends of the range but a 20-18,000Hz coverage is a not unreasonable requirement where high-grade systems are concerned. Since satisfactory response is most readily obtained with the electronic units, interest in improving the smoothness of response centres on the transducers.

Pickups, turntables

It is here especially that we have to take one feature with another. By isolating, say, response or tracking weight ot (even worse) tip mass or compliance, we learn very little. Reduction of tracking weight has of course been a feature of pickup development, but it is not difficult to find a pickup that is claimed to work at fairly low pressure, has a good (on paper) response and high compliance yet sounds rough and fails to track cleanly.

The kind of combination we require is good tracking ability at low tracking weight with smooth response and low distortion. Since the most important

features are not fully revealed in the spec and only show up in the right kind of tests, it is difficult to set out figures in an orderly fashion. However, figures for a high quality cartridge are along these lines:

Output about 5mV per channel at 5cm/sec.
Response 20-18,000Hz ±1.5dB.
Tracking weight about 1-1¼gm. in suitable arm.
Channel separation at least 20dB at 1kHz.
Stylus, elliptical, radii about 0.0007 × 0.0002in.

Second harmonic distortion figures of several per cent can be expected; intermodulation should not exceed 1% by currently popular test methods; a vertical tracking angle of 15° is a design objective, as is an effective tip mass in the 1 milligram region.

It is assumed that the pickup is set up for optimum tracking using a dynamic test, and also that the arm will provide the right working conditions for the cartridge. The lowest possible pivot frictions, low inertia, good adjustability and bias correction facilities are outstanding requirements for the arm.

The least possible background noise (rumble and hum) and pitch fluctuation (wow and flutter) are expected from a turntable for hi-fi. The annoyance value of rumble depends on conditions of use and the amount of noise will often depend on details of installation, but an unweighted S/N of about —45dB is typical of stark figures for good turntables. Combined wow and flutter around 0.1% is not unusual.

Amplifiers

Understandably, output power is isolated from other matters by prospective users, but the only figure of merit is the power (rms-based, continuous rating) that is adequate for individual conditions of use, the general aim being to provide enough for all likely eventualities—and a little more besides. It is hardly likely to be less than 10W per channel, and it may be 50W or more. Popular ratings are somewhere in between.

Power bandwidth may appeal as a goodness-factor provided other factors are not overlooked; the behaviour of the amplifier with realistic load conditions also is important. A power bandwidth to -3dB points (i.e. where power falls to half that available at 1kHz) of 20-25,000Hz is typical.

Frequency response (a low-power measurement) is typically 10-50,000Hz ±1dB.

Distortion is (or should be) linked to power—for example, total harmonic distortion 0.1% at 1kHz and at full rated output.

S/N ratios at least as good as -60dB are expected, and that applying to the magnetic pickup is particularly important (-65dB has been achieved with medium-priced modern amplifiers).

Overload margin at this same input is of special interest: a margin of about 25dB (e.g. a 2mV input overloading at 35mV) is poor, a margin of 35dB is adequate in that it covers signal peaks commonly encountered, and a better figure is desirable.

Stability, adequate damping factor and accuracy of response equalisation at the magnetic pickup input are among performance features about which inquiry should be made (see test reports).

Loudspeakers

Published specifications convey only a small amount of really useful information but test reports can augment this, principally by throwing more light on the loudspeaker's accuracy as a reproducer of signals applied to it. Distortion, impedance characteristics and response traces are among the reported results.

A frequency range of 40-18,000Hz is not unusual for a medium-sized loudspeaker system of popular type and price; an extension in the bass would be expected from a good, big and probably expensive system. A response trace would show the departures from linearity in this range, and a fall of 5dB at the hf end is typical. Accompanying polar responses are useful because they show the sound dispersion pattern, bearing on the speaker's qualities in establishing (when in pairs) the stereo image.

Harmonic distortion figures reported for hi-fi speakers are in the approximate range 1 to 10% and much depends on inputs and the frequencies at which tests are applied.

Curves of impedance v. frequency are often very uneven, showing variations from below the nominal impedance to a figure several times the nominal. A general aim is a smooth characteristic with minimum fluctuation, and the emergence of such a curve will provide evidence that the speaker is able to accept power easily—i.e. how easy it is to drive from particular amplifiers. Bear in mind that acceptance of power involves any crossover filter circuits as well as the drive units. Generally, the nominal impedance quoted in a specification applies at one or a few frequencies only.

It is not possible to be specific about power ratings but it should be understood that the speaker system should handle enough power (that is, accept it without obvious distress) to suit the conditions of use. There is no question of exact matching of speaker and amplifier ratings, but the figures—such as they are—should be used as a guide. Avoidance of extremes is the main requirement. Various methods are used in the industry to obtain the figures found in specifications.

Typical efficiency figures for loudspeaker systems are 1 to 5%, but this is of little concern to the user, who rightly concentrates on other matters. There is no particularly favourable figure; some of the best systems are very inefficient (as measured) though not necessarily judged subjectively as difficult to drive.

DIY HI-FI

THERE ARE nearly as many motives for do-it-yourself as there are handy hi-fi enthusiasts. Obviously economy is at the top of the list. The amateur on a low budget may wish to summon up all his skills in order to make a start on something that he fears will otherwise stay beyond his reach. Then there are such factors as craftsmanship, pride of possession and the satisfaction that results from a properly completed piece of work.

Again, some people have a technical interest in their subject and like meeting the challenge of, say, kit construction or—more basic—interpreting a specification and shaping working equipment. For them the hobby promises many rewards, though the work of construction, rather than the sound, is often the work of construction, rather than the sound, is often the complete justification for becoming involved.

Then there is the particularly interesting possibility of using the DIY approach to reach higher standards, not to make economies. In other works, a high standard of performance, possibly out of the question at normal retail prices, may be attempted without any thought for extreme economy. For example, some enthusiasts working on budgets of medium size (£100-150) have achieved a standard associated with a higher outlay, largely through cabinet construction but also by brushing up their electronics.

Disc equipment offers little scope—apart from the supporting woodwork. If the keen enthusiast is equipped to make a turntable or pickup arm he is not only one of a tiny minority but also is hardly in need of any encouragement from us. There are of course the excellent BD1 turntable kit of Sugdens (Connoisseur) and the Valek turntables and these will surely be found in very many systems in future. Tape equipment, with its mechanical complexity and requirements for reliability, is even more firmly beyond consideration, though we cannot resist the comment that a simple, robust tape deck in kit form, basically semi-professional but devoid of frills and gadgets, would be a welcome addition to practical hi-fi.

Readers sometimes ask about the performance obtained from kit amplifiers and other electronic units. How do they compare with factory-made equivalents? The answer is that the performance is the same provided instructions are followed in every detail. That is certainly true of the products of Heath (Gloucester) Ltd, makers of Heathkits. They prepare their stage-by-stage instruction manuals with great care, expecting no technical knowledge of the purchasers, and provide solutions to problems—mostly 'accidents'—which may arise. Kit amplifiers are sometimes similar mechanically to ready-made units, and simply broken down into kit form.

The savings made through construction of the better kits, though seldom spectacular, are considered worth while by many people who wish to smooth the way to an acceptable standard, well clear of the hi-fi fringe area. There are some surprisingly cheap kits about but *Hi-Fi Sound* does not advise on them. They may provide fun for the experimenter, and to some extent they have educational value, but in many cases the results are poor and the instructions difficult to follow or even incomplete.

Working from diagrams and components lists, without benefit of a prepared kit of parts, is attractive to the keen enthusiast who, while lacking technical training, is ready to study background information, check data and go to some trouble to get things right. If this approach appeals, it is necessary to look out for designs published by large components manufacturers.

Many popular designs have come from Mullard. This company's book, *Transistor Audio and Radio Circuits* (£1.50), has not appeared in a revised edition (it was first published in 1969) but may be found in some technical bookshops. A wide variety of circuits, from high quality amplifiers to portable radios, is presented in detail and a chapter is devoted to test equipment. Chapter headings show the coverage: silicon and germanium transistors; basic hf circuits; basic af circuits; radiograms, record players and portable radios; tape recorders; car radios; high quality audio equipment; high quality FM tuners; and test equipment. As always, enthusiasts' questions are answered by post by Mullard Ltd, Mullard House, Torrington Place, London WC1.

At one time there was a 5s booklet of Ferranti designs, *High Fidelity Audio Designs,* based on the use of this company's silicon devices and other components. The units made to these designs, though bulky, were of good quality and made a favourable impression when demonstrated at exhibitions. However, publication was in 1967 and Ferranti consider that the designs have become a little outmoded, and at present they advocate a more modern amplifier design for which their own applications engineers were responsible—the PE Gemini. Power amplifier and control unit are separate. and the amplifier is rated at 30W into 8 ohms and 20W into 15 ohms. The usual inputs and other facilities are provided by the control unit. Articles describing the design have been reprinted in booklet form and copies can be obtained at 55p post-free from Ferranti Ltd, Gem Mill, Chadderton, Oldham, Lancs.

To most amateurs, DIY means woodworking skill—or more probably,

chipboard-working! Some hobbyists make cabinets or wall furniture to take hi-fi plus other possessions. Still more make speaker enclosures, for it is in this particular area that considerable savings are possible. As we point out in another article, it is *essential*—and not just preferable—to work to a design that is intended for the chosen speaker drive units. Enclosure plus drive units form a working system. Our surveys have shown what is possible and gave many instances of manufacturers' technical service involving construction leaflets, drawings, accessories and advice. A brief round-up is included in this booklet.

Here are typical examples: a simple and cheap bookshelf speaker can be made around an 8in. Richard Allan twin-cone unit; a two-unit compact system can be made with Wharfedale's Unit 3 kit; Goodmans offer several possibilities; free-standing multi-unit systems can employ units by KEF, Wharfedale and others; large corner systems with sand-filled panels are much cheaper to make than to buy; column speakers using concrete drainpipes are economical, and so are built-in enclosures of brick. There are dozens more.

SPEAKER MANUFACTURERS' SERVICES

ADVISORY SERVICES have been offered by loudspeaker manufacturers ever since the audio components industry began to assume importance. Even if they had not originally intended to enter into correspondence with individuals on technical matters, the need for such a service would have been forced upon them as soon as they marketed separate components and thus attracted the attention of the do-it-yourself amateur.

A successful speaker is a complete, working system—one like the factory-made models consisting of one or more drive units, any necessary auxiliary components, and an enclosure. The enclosure and its contents are matched in certain ways, involving requirements which are simply not appreciated by some amateurs who take drive units of unknown properties and mount them in often unsuitable cabinets.

Speaker manufacturers, knowing that so many hi-fi enthusiasts have an eye for economy and good value as well as a liking for experiment and the simpler types of construction work, market kits and separate units, adding a backing-up service with the aim of ensuring the products are properly used. For instance, the manufacturer may make available drawings, provide lists of drive units which make up into systems at several price levels, explain the need for crossover filters, and so on.

In fact, most advisory services are firmly based on semi-technical literature such as enclosure drawings and dimensions of various degrees of complication and illustrating different principles of acoustic loading—total enclosure, vented box, folded horn. These will have been designed in the factory for specific drive units, and there is no guarantee that acceptable results will be obtained by amateurs who insist on departing from the specification. Choose your design, follow the instructions and don't make modifications without the approval of the manufacturer. And please don't write to *Hi-Fi Sound* for support in experimental schemes: we shall be obliged to refer you to the makers of the components. It is simply not possible to predict the results of connecting brands X, Y and Z together with the aid of a home-made crossover.

Those who are interested in making speakers should decide whose products they favour, and then write for information. This is usually supplied free. The

literature requested should cover: drive unit specifications and price list (and crossover details if relevant) together with recommended enclosure designs and construction notes, which are in many cases in separate leaflet form. Typically, a small bookshelf speaker with bass unit and tweeter can be made for little more than half the cost of the factory-made counterpart. Construction of a more ambitious free-standing system, with perhaps three units with crossovers, can be undertaken with savings of about the same order. A few enthusiasts may seek details of crossover filter (network) design, but it is more usual to employ a ready-made crossover unit—not an unduly expensive item. Obviously the main savings are in the cabinet work.

A few manufacturers use solid hardwood for their factory-made loudspeakers—costly though this is—and may approve of the amateur doing the same. Again, high quality blockboard or plywood may be suggested. However, most designs call for chipboard, which should be a high-grade, dense particle board—not the softer, flaky kind. Some amateurs buy plain chipboard and apply the veneer but it is more usual to choose veneered boards, sawing as required and finishing the edges with veneer strip.

Internal treatments are specified for damping purposes and there may be special arrangements to impede the formation of standing waves in enclosures. Materials in common use include bonded acetate fibre wadding, felt, glass fibre and waste textiles. Ask the manufacturer concerning sources of supply. Do not experiment with pulp egg-trays, foam rubber or other odds and ends: most of them are useless. Keep closely to instructions concerning sealing at corners and the fit of baffle or removable enclosure back. Foam plastics strip (draught excluder) makes a good gasket. Tygan and Vynair are popular grille cloths. Some other materials are too fluffy and affect frequency response of the finished speaker.

The following notes give examples of the kind of service offered by speaker firms. It is not a complete listing, and study of *Hi-Fi Sound* will reveal from time to time new firms which are entering the field or established ones which introduce new ideas to interest the economy-conscious enthusiast.

RICHARD ALLAN

A cabinet construction leaflet includes dimensioned drawings of enclosures for the firm's drive units. One of the simplest and least expensive bookshelf speakers obtainable is based on the 8in. CG8 or CG8T. More elaborate multi-unit systems also can be attempted. To promote interest in the DIY aspect, Richard Allan now supply units and crossovers in kit form—the Twin Assembly and other models. Purchasers receive a grille-cloth sample card and then order the material they require. The appropriate piece of material is sent without further charge. Many amateur enthusiasts have remarked on this firm's helpful attitude. Address: Richard Allan Radio, Bradford Road, Gomersal, Cleckheaton, Yorks.

BAKER

This company has long been known for its 12in. and 15in. drive units, for which it provides an information service complete with enclosure data. The basis of a speaker, in 'modular' form, is another, more recent product. This assembly comprises bass and treble units with crossover, all mounted on a flat baffle, ready for building into an enclosure. Inquiries to: Baker Reproducers Ltd, Bensham Manor Road Passage, Thornton Heath, Surrey.

CELESTION

Many successful speaker systems have been assembled with this company's drive units and, in particular, the HF1300 Mk 2, one of the best known of all tweeters. The CO3K crossover unit has often been included. Queries are dealt with at: Rola Celestion Ltd, Ditton Works, Foxhall Road, Ipswich, Suffolk.

EMI

A brochure describes an extensive series of matched loudspeaker sets which, in general, take the form of a bass driver with associated hf units and crossover. Each specification includes a note on the recommended enclosure design and choice of materials. Simple kit assemblies have recently been introduced, ranging from a bookshelf design at £5.80 to £29.50 for a large free-standing model. Further information from EMI Sound Products Ltd, Hayes, Middlesex.

GOODMANS

This company's free brochure and data sheets describe a variety of drive units and some multi-unit systems, and associated with the specifications are dimensions and other details of suitable enclosures. It has been the policy of the company for some time now to list addresses of cabinet-makers able to supply approved types of enclosures to those who decide that they will not after all undertake construction work. For the brochure write to Goodmans Loudspeakers, Downley Road, Havant, Hants.

KEF

This manufacturer has recently introduced Kefkits—several assemblies of drive unit, crossover, etc at different levels of cost and elaboration. These are counterparts of familiar KEF speaker systems and are known as Kefkits 2, 3 and 4. Otherwise one can assemble systems from individual units which, together with sundries, are shown on a complete price list. This company is well known for its rectangular bass driver, which has a specially strengthened plastics diaphragm and which is currently found in speaker systems of various makes, both British and foreign.

For some time now KEF have brought together their DIY designs in a small booklet which also contains general information on methods and materials for those taking the plunge with separately purchased drive units rather than kits. Known as *Enclosure Designs* and now available in an updated edition, the publication covers the mounting of units in a wall as well as systems corresponding to such well known models as Celeste, Concord, Concerto and Chorale. This is one of the 'standard works' of the DIY literature and in itself acts as a reminder not to experiment with hardware and designs of unknown qualities. Address: KEF Electronics Ltd, Tovil, Maidstone, Kent.

LOWTHER

The name Lowther is firmly linked with horn speaker systems of high efficiency employing the PM series of drive units. Folded horns, though fairly complex, can be built by amateur constructors who can bring patience and some skill to the task, and Lowther will advise on technical matters. Inquiries about the choice of design and the supply of drawings, as well as questions of details arising subsequently, will be answered. The first practical step is to obtain a blueprint of the chosen design and this is supplied at 50p—Acousta, Mini-Acousta or Dual-Postion Acousta. Lowther are prepared to check constructors' work if it is taken to them by appointment. Another Lowther service is

the updating of PM-series drivers with new diaphragms, etc. Address: Lowther Mfg. Co, St. Mark's Road, Bromley, Kent.

TANNOY

One of the very few firms making a dual concentric drive unit, Tannoy supply a leaflet which includes enclosure dimensions. Vented and total-enclosure cabinets are possibilities, and the Monitor Gold, in 12in. and 15in. versions, is the latest model driver. For details write to Tannoy Products Ltd, West Norwood, London SE27.

WB

Designs made available to amateur constructors are to some extent similar to those used by the firm for factory-made models. A number of moderately priced drive units as well as crossover networks are available. Both cone and pressure-type tweeters are made. Specifications from Whiteley Electrical Radio Ltd, Mansfield, Notts.

WHARFEDALE

Those planning speaker systems should write for the cabinet construction sheet, drive unit specifications and price list. Several systems, ranging from simple one-unit arrangements to three-way reproducers, can be constructed. Wharfedale introduced the popular Unit 3 kit some time ago and since then have added Unit 4 and Unit 5, which yield larger systems at higher cost. The company has long been known for its advisory service covering aspects of do-it-yourself work. Rank Wharfedale Ltd, Idle, Bradford, Yorks.

MISCELLANEOUS

There are several other firms offering a service which may range from the sale of drive units and the provision of advice to the marketing of kits. For instance, Peerless speaker kits marketed by P. F. & A. R. Helme, Summerbridge, Harrogate, Yorks include the 20-2, which comprises bass unit, tweeter, crossover, gasket, fixing brackets and sundries. The Decca Kelly kit consists of an enclosure with recommended bass unit, ribbon hf unit and acoustic lens. The cabinets sell at £21 a pair and the address is Decca Special Products, Ingate Place, Queenstown Road, London SW8.

Details of a concrete column, originally a Wharfedale speciality, are available from Eaton Audio Fitments, Leopold Street, Long Eaton, Nottingham. Pioneer kits are marketed by Shriro UK Ltd, 42 Russell Square, London WC1. Another helpful firm is Nichols Acoustical Fitments, Church Street, Bubwith, Yorks.

OTHER ADDRESSES

Henry's Radio, 303 Edgware Road, London W2.
Jason Electronic Design Ltd. 15-17 Queen Street, Arundel, Sussex.
Mainline Electronics Ltd, Thames Avenue, Windsor, Berks.
Sinclair Radionics Ltd, 22 Newmarket Road, Cambridge.

RECORDS FOR HI-FI

THIS SELECTION of stereo records, most of them of recent issue, exhibits characteristics of interest to hi-fi enthusiasts, especially users of systems of the highest quality. The discs mentioned are at various prices, from full price (over £2) to 'budget' (under £1), and nearly all have been the subjects of reviews in *Hi-Fi Sound*. Recommendations, which may aid those building up collections, are based on samples accepted for review and cannot take into account variations in production and pressing faults, etc encountered by purchasers. Items marked *are considered to be particularly good of their kind. For technical gradings and comments on recording quality, see the magazine.

Mozart: Serenades and Divertimenti for Wind Instruments—complete. Philips 6799003, boxed.
Verdi: *Don Carlo.* HMV Angel SLS956, boxed.
Brahms: Symphony No. 2. Alto Rhapsody. HMV ASD2746.
*Vaughan Williams: A London Symphony. HMV ASD2740.
Verdi: *Macbeth.* Decca SET510-2, boxed.
Purcell: *Dido and Aeneas.* Philips 6500131.
Ravel: *La Valse, Bolero,* etc. Decca PFS4226.
Bach: Harpsichord Concertos. HMV ASD2713.
The Virginalists—harpsichord and organ recital. RCA LSB4038.
Martinu: Symphony No. 6.Vorisék: Symphony in D. Unicorn RHS309.
Chopin recital by Daniel Adni. HMV HQS1251.
Beethoven Piano Concerto No. 1. Philips 6500179.
Richard Strauss: Symphony for Wind Instruments, etc. Philips 6500097.
*Welcome the New Year—Vienna Philharmonic concert. Decca SXL6526.
*Eric Coates: Three Elizabeths, Miniature Suite, etc. EMI TWO361.
Janacék: Sinfonietta. *Taras Bulba.* DGG 2330075.
Mahler: Symphony No. 1 in D. HMV ASD2722.
Mahler: *Lieder eines fahrenden Gesellen. Kindertotenlieder.* Philips 6500100.
Lionel Rogg at the Festival Hall: organ recital. HMV CSD3659.
*Poulenc, Ravel, Françaix: Melos Ensemble. HMV ASD2506.
Britten: Piano Concerto. Violin Concerto. Decca SXL6512.
Janacék: Sinfonietta. Lutoslawski: Concerto for Orchestra. HMV ASD 2652.
*Hindemith: Organ Sonatas. Argo ZRG663.
Tales of Beatrix Potter—ballet. HMV CSD3690.
Britten: Serenade. *Les Illuminations.* HMV CSD3684.
Fauré: Piano Quartet No. 1, etc. HMV HQS1245.
*The Bach Family. Philips 6709004, boxed.
*Schubert, Schumann. Lieder recital. Decca SXL6506.
Dvořák: Serenade for Wind Instruments. Gounod: Petite Symphonie. Philips 6500163.
Wagner: *Das Rheingold.* Decca SET482, boxed.
Brahms: Symphony No. 3 in F. Tragic Overture. HMV ASD2660.
Brass Now and Then. Decca SDD274.
Dvořák: Symphony No. 7 in D minor. Decca SDD260.
*Mozart: Serenade No. 1 in D, K100, etc. Decca SXL6499.
*Contrasts, the lighter Elgar. HMV ASD2638.
Vaughan Williams: Sinfonia Antartica. HMV ASD2631.
Mahler: Symphony No. 6. Decca SET469-70.
Massenet: *Le Cid, Scènes Pittoresques.* EMI TWO350.

Carnival. Manuel and Music of the Mountains. EMI TWO337.
The Very Original Brasso Band. EMI TWO362.
Baker Street Philharmonic. Orchestra and Moog. Pye NSPL28131.
The Time has Come. Anne Briggs. CBS 64612.
I Love Paris. Accordions. EMI TWO353.
Patchwork. Bobbie Gentry. Capitol EST494.
The Dark Island. Jimmy Blue, Scottish Band. CBS 52821.
McGuinness Flint. Capitol EAST22625.
The Cordovox Magic of Valentino. EMI TWO316.
Tomorrow Is So Far Away. Design. Epic 64653.
Wout Steenhuis meets The Wedgwoods. Starline SRS5110.
The Hollies. Stop, Stop, Stop! Starline SRS5088.
Mark Almond. Harvest SHSP 4011.
Folk Philosophy. Scottish Folk Group Championship. Talisman STAL5019.

BUDGET

When buying budget-class records it should be remembered that many offer programmes comprising items drawn from different sources, recorded at various times. Thus variations in recording quality through the programme may be apparent. The 'budget' range also include mono recordings that have been 'electronically reprocessed to give a stereo effect' (the current euphemism) but in fact it is not possible to convert mono recording into stereo. If the stereo is questionable, the quality may still be pleasing. The following sell at 99p.

Dvořák: Slavonic Dances. Bartók: Rumanian Dances. Decca Eclipse ECS632.
Tchaikovsky sampler. Philips 6833032.
The World of the Baroque. Decca SPA129.
Brahms: Symphony No. 2. Decca Eclipse ECS596.
Vivaldi: The Four Seasons. Decca SPA201.
Elgar: Enigma Variations. Brahms: Haydn Variations. Decca SPA121.
Handel: Water Music. Royal Fireworks Music. Decca SPA120.
Danse Macabre. Saint-Saëns, Arnold, Mussorgsky, Dukas, etc. Decca SPA175.
The World of the Academy. Vol. 1. Decca SPA/A 101. Vol. 2. Decca SPA/A 163.
The Phase 4 World of Los Muchucambos. Decca SPA144.

CASSETTES

Music cassettes have been subject to considerable variations in technical quality, and few can be said to approach the standard of good discs, even on the basis of subjective assessment. Only Decca-group music cassettes, most of them engineered for replay using Dolby B noise-reduction, have been reviewed in the magazine. Here are a few examples from the better releases.

Welcome the New Year. Vienna Philharmonic concert. SXC6526.
Vivaldi: The Four Seasons. ZRC654
The World of the Academy. CSP/A 101.
The Phase 4 World of Foreign Film Themes. CSP161.
Rossini: String Sonatas. ZRC506.
Mozart: Piano Concertos Nos. 8 and 9. SXC6259.
Astromusical Odyssey. PFC4208.
Mussorgsky: Pictures at an Exhibition. SXC6328.
Jacques Loussier's Play Bach No. 3. SKC5024.
Stravinsky: Petrushka. PFC4207.
Tchaikovsky: Serenade. Souvenir de Florence. ZRC584.

QUESTIONS AND ANSWERS

THESE ARE edited versions of readers' questions received by *Hi-Fi Sound*. In a few instances the scope of the Q&A has been adjusted to make the subject of wider interest. The Q&A service is for readers of the magazine only, and details concerning its use appear in each issue.

? I like the idea of unit audio to replace my stereogram, which in any case must go before long. Some of the unit schemes look very glamorous but I fear that such an arrangement put into effect by an amateur may look untidy. And are the various connections a problem?

You may of course be thinking of unit audio at what is sometimes called the 'mid-fi' level, or of genuine high fidelity, which is most often in unit form. At all quality levels there are some very pleasing designs and they can be assembled into neat systems; and it is not difficult to make an improvement over the stereogram standard! One feature alone—the use of separate speakers—virtually guarantees more accurate stereophony, though sound quality depends on various, more complex matters. This same feature often leads to the accusation of untidiness, but there is no reason why you should expect to sit and contemplate messy wiring while you listen to the music. In fact a shelf-mounted system, or units on furniture, can look tidy and attractive. The nature of the interconnections—screened cable for inputs, flex for the speakers—has been explained in this series (in the fourth Guide, particularly) and you can arrange to connect everything together quickly and easily with prepared leads if you wish to avoid any effort in that direction.

? Can you provide recommendations for a light battery and mains cassette recorder for mobile use that also has facilities for replay of music cassettes through my domestic system, which includes Sansui, Garrard and Shure equipment? Not sure of prices—possibly £50 or so.

Sorry, but portable cassette recorders are well outside the scope of a hi-fi magazine. There are various Japanese machines that seem to suit many people, also some British models and the Philips range. Many have an output of some kind that may permit replay through other equipment. Be prepared for noisy results, and note that for good quality on music you would have to spend more. Some of the more costly units have noise-reduction systems—but they are not portables.

? Several friends have audio systems and I am thinking of following their example and buying some equipment. Theirs seems quite satisfactory but sometimes affected by background noise from records or radio. Is it possible to fit additional devices to reduce such effects, and where are they to be connected?

Without a great deal of information it is not possible to say how the noises arise. In record reproduction there may be emphasis of noise that starts from the records but is made noticeable by peakiness in equipment performance (i.e ideal performance and conditions would not cause the emphasis) or specific disc faults may be present. We are assuming a mid-range noise, but there is also the much lower rumble noise attributable to turntables.

You do not have to suffer these disadvantages: care over equipment selection is the first requirement, and smoothness allied to important features of

hi-fi performance will set you on the right lines. Hiss on radio reproduction is most likely due to an inadequate aerial, and the penalty for carelessness here is a poor signal-to-noise ratio. It is not possible to fit additional devices, though some amplifiers have filters on them. Attend to basics first, and then the need for filters will seem less vital.

? I use a Nikko 1200 amplifier, Thorens/SME disc equipment and large Wharfedale speakers. Next move may be the addition of a Tandberg 3000X tape record/replay unit, or possibly the latest Sony, but I am wondering about the apparent discrepancy in matching and the possibility of overload or even damage.

The combination should work satisfactorily. In some cases a tape unit's line outputs may be high and cause some overload effects (not damage) and need attenuation, as we have pointed out, but this is unlikely to happen here. As for the signal input side, the use of radio and other sources should prove straightforward, and you will be able to record from microphone directly into the recorder or, if necessary, via the amplifier.

? I realise that one can probably reach a conclusion about minimum hi-fi standards by studying the subject. But is it reasonable to reach a similar conclusion by allowing price to be the guide? At least I can claim to have looked at prices a great deal, and I have the impression that the 'real thing' starts at around £100 and that there is little point in exceeding twice that figure for the average room.

We think price is some sort of guide if you are first seeking a general impression before going into more detail. A certain amount of study of the subject (test reports, etc.) brings more knowledge, though, and leads more surely to an understanding about which items come closest to being tailor-made for your requirements. These are the products you would select for a hearing. Nowadays the supply of goods at a discount tends to complicate the issue—at least you must make allowance for it and decide which kind of supplier you favour.

But we agree that 'fringe' hi-fi starts at around £100, very approximately, assuming normal retail prices and record-playing only. Then comes a medium range up to some figure in excess of £200. We do *not* agree with your last comment: it is absolutely and demonstrably wrong, as further study should reveal. Eventually one reaches a standard where tiny improvements cost a lot—but that is up in the £500-plus region where the most advanced types of equipment are candidates. In that area, one loudspeaker may cost as much as a complete 'budget' system.

A final point: a quest for minimum standards is not particularly rewarding. Hi-fi is all about seeking higher standards, although everyone has a maximum to which he can aspire!

? A colleague with a keen interest in audio and some practical experience insists on the superiority of tape and urges me to avoid discs when I start assembling my equipment. His next purchase will be a cassette machine. I'm not very impressed with his present £110 conventional recorder, which seems to lack range and is anything but a sparkling performer. What do you think?

It's a big subject, part of which has been covered in this series of Guides. Tape recording *can* be better than anything else—if you go to an appropriately high standard of machinery and do not seek great economy in tape. Obviously tape is what starts things off in the studio—it has to be good. At home, the

enthusiast can obtain great pleasure from tape recording, especially if his interests extend beyond the simple enjoyment of sitting down to enjoy music. It depends on what you want to do. Quality costs a deal of money; disc reproduction at its best is outstandingly good, and tape has to be used at fairly high speed under very good conditions to rival the disc's range and sparkle.

When we investigate the true tape enthusiast's understanding of all this we often find he is not aware of the advances made in disc reproduction, especially if he has a hobbyists' approach to the subject. If you are not impressed with the present recorder it seems unlikely that you will amend your views when you hear a cassette machine. But the special-quality cassette units (with Dolby B) are coming along nicely and may interest you if you are planning at that price level. For any tape unit expect to pay at least as much as you would for a top-class turntable and pickup—and probably more.

? I have grasped your comments on power output related to room size and it was consideration of this which led to my original choice of a Leak 30 used with a GL75 and Stanton 500 cartridge and a pair of Richard Allan compact speakers in a room about 16 × 12 ft. But the noise level is not really satisfactory and I often have to bring the volume to more than half-way on the control. Presumably I need yet more output and must therefore change?

We think the power rating is adequate for the conditions of use. A change for the sake of more power would hardly be a priority. Consider instead whether your amplifier is being driven to anything like full power—it seems very unlikely from what you say. The volume control serves as a fair indicator of input to the amplifier: if there is not enough signal (e.g. from the pickup) you cannot develop the expected power. But in this instance we suspect the cartridge does provide enough for the amplifier. If so, the amplifier is either faulty or has insufficient sensitivity and should therefore be checked to show whether it is up to specification.

? I use a Japanese amplifier (details enclosed), with a magnetic cartridge, and get interference on the mains when appliances in the house are in operation—refrigerator, heaters, and so forth. I sometimes fear for the safety of the speakers when switch bangs are at their worst. What is the cure?

There is not usually a very simple cure for this kind of mains-borne interference. Trouble arises from lack of adequate filtering on the power supply section of the amplifier or receiver. If operating on a domestic ring main, try using a different mains socket. Try removing the amplifier earth from the mains circuit, if you are using one, and instead try a low-impedance outside earth. Sometimes local suppression of switches, etc may help; otherwise consult the amplifier manufacturer about the problem of amplifier filtering—we cannot provide details of anything we can be sure will work in your condtions.

? Breakthrough always occurred with my equipment (circuit enclosed) even before I fitted a FM tuner. By shorting each base to earth in the preamp and tone stages I found the point at which all signals disappeared, and this seemed to be the base of the BC169 in the tone control. I disconnected the base and inserted in series a 10k resistor with a 100pF from base to earth, reducing the breakthrough. Please suggest further ideas.

You should certainly try filters at the preamp input transistors. Connect the 100pF in this case direct between base and emitter at the transistor base. In severe cases it is sometimes necessary to use screened cable for the speaker leads, since when the signal field is very high it can get into the early stages via the nfb circuit and speaker leads, the latter than acting as 'aerials'.

? I receive BBC-3 FM stereo on my HMV Stereomaster 2402. I use a J-Beam FM—two coupled by 75-ohm harness vertically spaced 6 ft. apart, the height of the aerial being about 17 ft. Are these spaced correctly and is it asking too much to attempt to receive stereo from the continent? Is the tuner capable of this?

Frankly, the nature of the FM front-end in your equipment is incompatible with distant-station reception. It is possible that under particularly good tropospheric propagation conditions you will be able to tune one or two Continental stations. The spacing of the two arrays is tied into the nature of the impedance coupling from their dipoles. Altering the spacing could diminish the feeder signal rather than increase it. But you should use a tuner to match your requirements!

? I have purchased the Rogers Ravensbrook and a pair of Dovedale speakers and expect to add a Connoisseur BD2 player. Meanwhile for my Goldring 800E cartridge I wish to use the Garrard 3000 I have had for some time fitted with a ceramic cartridge. Is all this in order?

Yes, except for the bit about the Garrard, which is not at all suitable for the new cartridge and in any case has no place in a hi-fi system such as you describe. Complete the outfit with the new player as soon as possible. You have not mentioned the room size in relation to power requirements: we trust you are satisfied that the rating is adequate for the conditions of use.

? I have a Nikko amplifier with tape head input of 1.9mV and auxiliary 200mV, and a Sony TC800 I wish to connect via the Nikko (they say use the monitor jack output, which is 0.775V, load 10k). Which input do I use. With tape head it does not work properly, or should I use the aux. or tuner—and will overload cause damage?

You cannot use the tape head input on your amplifier for replay of the Sony recorder. The machine has a high output signal so use the tuner or auxiliary inputs on the amplifier. You will not damage the amplifier with the signal from the recorder, but if you find you are getting distortion, which is not very likely, you may have to reduce the signal level from the tape recorder—a point that was covered in the last booklet, *Using your Hi-Fi*. There is no reason why you should not try it all out before worrying about alterations.

? have purchased a Quad 33/303 and a GL75 with M55E. Temporarily I have borrowed cheap speakers, and on listening with the bass +2, treble –1 and volume 3, the sound seems all right but after a while I feel there is a pressure on my ears, causing discomfort. Is it due to harmonic production of the speakers or hum, as I have not yet connected the equipment to earth?

From this description we have no idea what the trouble may be. You have not mentioned the make or type of speakers, and in any case it is pointless to make judgments based on the use of cheap temporary speakers. It would be necessary to hear the effect to pass a reliable opinion—but we are not surprised there is distortion if the speakers are really cheap.

? I wish to link an Akai 4000D to my Cambridge P40. Cambridge say put it through the aux. input and use a resistor to drop the signal—they first told me to use 10kohms. Akai output is 1.28V at 1.5k, line, and the P40 takes 50mV, 100k. How can I arrange matching?

There is no question of the recorder not working with the P40, and this is not a matter of matching in the strict sense. All that is needed is to get a suitable signal voltage to the P40 aux. socket as suggested by the firm. The 50mV mentioned is a nominal figure, and the P40 will handle more signal than that. If the set-up works with a resistor recommended by Cambridge then there will be no trouble from overload. You have not made your latest move clear in your letter.

? I use a B&O 2000 tape recorder for professional multi-recording using the sound-on-sound system. The machine is ageing and the noise build-up is becoming more noticeable after about the fourth or fifth track. The new B&O range looks impressive but so do Revox. The literature does not deal with this aspect of tape recording and your opinion would be appreciated.

It is doubtful, even with a Revox or any other top-grade tape recorder, that you would be able to maintain a reasonably low noise level after five successive re-recording stages. Tests have shown that with a top-grade half-track recorder having an initial signal-to-noise performance of around –60dB, the best possible signal-to-noise obtainable after three or four re-recordings is around —30dB.

This assumes all auxiliary equipment to have a signal-to-noise performance of at least —60dB as well. Short of buying a professional multi-track recorder, the Revox would be about the best you could use.

? Is there any disadvantage in a compact system in which the turntable is combined with the amplifier? I see there is a new Hacker model. Something of this sort would be convenient in my room, placed on a side-board with the speakers on shelf and window ledge.

There is no disadvantage provided the amplifier is a good one. Apart from the Hacker there is a cabinet model by Dynatron which includes the Lenco GL75. We tested its amplifier SA90 some time ago (it is sold as a separate unit also) and considered it good value. The GL75 also features in a new outfit from Rank-Bush-Murphy. The Japanese makers also favour integrated systems. We suppose one reason we do not see more of this type of system is that the combination denies the customer the wide choice of turntables he would normally have. However, the numbers of such systems will increase, no doubt, and this will be acceptable as long as quality is good and the user chooses his own speakers.

? There seem to be fewer turntables with the 78rpm speed, and those that have (Garrard, for example) provide only a small range of speed adjustment. Have manufacturers forgotten the very many collectors of 78's? Why don't they add 78rpm to all their principal models?

Why on earth should they? The additional speed and a range of adjustment add to costs, and for most people the facility is redundant. We simply do not agree that there are 'very many' collectors of 78's using hi-fi equipment. There are some—a very small minority—and we sympathise with them, for we know that 78's can give a lot of pleasure. But it is not surprising that designers are settling for two speeds. Let us remind you of one important

factor: development in the interests of better performance has led to wider use of belt drive, which on simple mechanisms does not lend itself to three-speed operation.

However, 78rpm still turns up on some models, and the Lenco range of hi-fi turntables gives continuously variable speed—a nice feature for 78 devotees since the speed can be set above 80rpm!

Incidentally, sometimes readers remind us of the other side of this story, pointing out that they do not really need 45rpm. For many of them the ideal would be a fixed-speed 33rpm turntable of very high quality.

? I seldom see references to 45 rpm records in the technical press. I realise they are not very hi-fi but I sometimes play them on my system and find this acceptable. Are there any special points to remember and can I damage my pickup?

As you say, they are not very hi-fi. That is why you seldom see references to them. No, you will not damage your equipment—but mind your ears! There are no special requirements for playing these discs: in the case of hi-fi systems, treat them like LPs, but you may have to experiment with the tone controls because the balances tend to be unpredictable.

It is rather tedious to play 45s on a manual unit. Some hi-fi owners with a lot of 45s buy a separate, cheap record changer with appropriate cheap magnetic cartridge, plugging this pop groove-grinder into the hi-fi system when needed.

We are not forgetting that some people have those 7-inch EP discs that have reached the market from time to time. Some of these were of passable quality. Rather like playing a small LP.

? How does one go about choosing speakers? I find the prospect rather bewildering, although I know how much I can spend—about £80 a pair.

As long as you are not expecting us to choose them for you we are happy to comment. We agree that speakers are numerous so that it is simply not realistic to hear more than a selection of possible candidates. It helps that you have fixed the budget. While you are narrowing the field you can go to some extent on reputation and popularity (don't buy on hearsay) and it is useful to read the more objective of the published test reports. Get down to a short-list and hear these. If you can find a retailer who will let you try one or two models in your home, so much the better. You will need time to reach a decision, though. Some speakers may impress you, yet be suited to only occasional use. But if long-term serious listening is the aim you must take time to decide whether or not the sound is tiring to the ears. By the time you have run through favourite records on quiet evenings you will know all about it.

? I have 12in. Wharfedales already in use and formerly partnered these with the same firm's 5in. tweeters. Recently I was given a couple of German hf units and I also have in mind the KEF units. Could the Elac units (details enclosed) come in as mid-range, and in that case what about the crossovers—and have you any circuits I can use? IB loading was formerly used, but could I use reflex enclosures and what would the dimensions be?

You appear to be asking us to design your speakers for you, and we regret we do not offer that service. We suspect you have been collecting recipes for some unpredictable and probably unsatisfactory speaker systems, but some experiment will not do any harm. However, the original Wharfedale

combination was a satisfactory one, and you could check with that manufacturer the advisability of using reflex enclosures. We advise readers generally to follow manufacturer's instructions concerning the use of drive units and crossovers, since they often develop their own designs and offer specific advice on application. For inexperienced amateurs, kits of units are best.

FM RADIO

For satisfactory VHF/FM radio reception, mono or stereo, use a correctly designed dipole aerial, appropriately mounted and aligned (in the loft, for instance, or outside the house if necessary). Most of the complaints about FM reception arise from aerial deficiencies—cast-off TV aerials. bits of wire and so on. For information on aerials suited to local conditions consult local components suppliers, not *Hi-Fi Sound*. For information on service areas consult the BBC. Frequencies of FM transmissions are shown in *Radio Times*.

DO'S AND DON'TS

DO use the best turntable and arm you can afford. The better the disc equipment the better the cartridge, and the better the sound.

DO take the size of room into account in your planning. The larger the room, the greater the power likely to be needed. This means speakers with adequate handling capability as well as an adequately rated amplifier.

DO plan carefully—and *do* wait until your budget is a match for your ambitions.

DO hear a few loudspeakers in your range (the right price, size, impedance). If possible hear your final choice at home before deciding.

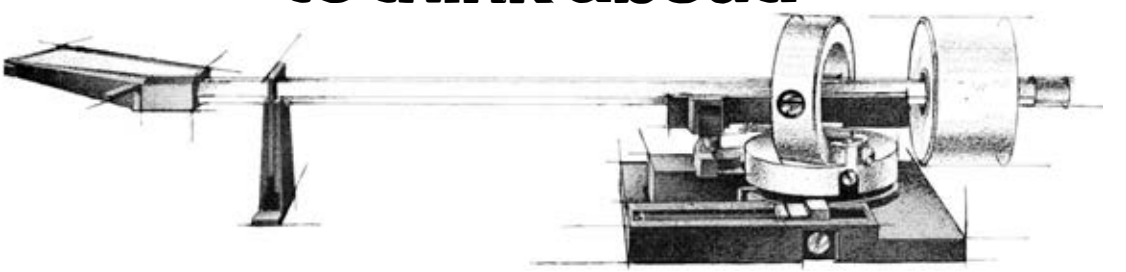
DON'T install pickups or cartridges by guesswork. Follow instructions and use appropriate setting-up checks.

DON'T expect hi-fi from an underpowered system in a large room.

DON'T make records damp in an attempt to clean them and don't apply cleaning preparations. A trace of humidity may be needed to relax static charges. It is only too easy to cause noise instead of cure it, so don't be *too* enthusiastic about record cleaning.

DON'T forget (despite earlier comments) that hi-fi stereo starts on the record or in the broadcast. Poor programme material means poor performance. Hi-fi is like a computer: feed garbage in and you get garbage out.

The Garrard AP76 transcription quality deck gives you a good deal to think about:



Forget the price for a moment, look at the features. □ Offers automatic play (start, stop and return) of single records at 33⅓, 45 and 78 rpm. □ Tab controls for viscous damped cue and pause, start/stop, manual/auto. □ Hexagonal, low resonance, aluminium pickup arm. □ Resiliently mounted counterbalance weight. □ Stylus force adjustment, calibrated 0 to 5 grams. □ Bias compensation calibrated for spherical and elliptical styli. □ Combined record speed and size selector. □ Slide-in cartridge carrier. □ 11½ inch non-magnetic turntable driven by 4-pole induction motor. □ Performance: wow and flutter better than 0.10% rms. Rumble (relative to 1.4 cm/sec at 100Hz) better than −49dB. This performance betters DIN 45-500 Hi-Fi standard. □ Black and silver finish as standard. Wooden base and rigid plastic cover available.

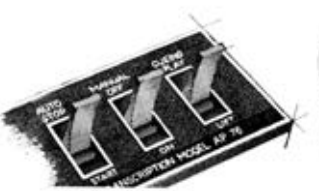
These are hard facts (and compare them with what the competition offers). Add in true quality engineering and the reliability based on 50 years' leadership in record players.

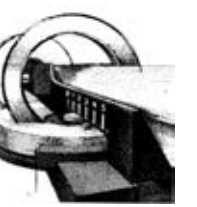
Now look at the price – recommended at £27.85. Fully £10 cheaper than the good competitive decks having the same features. Only Garrard can do it – by long experience and their comprehensive production programme across a whole range of quality players.

At £27.85 the AP76 gives you transcription quality. Write for full details of this and other Garrard decks – or ask your Hi-Fi dealer for a demonstration.

Garrard
A PLESSEY QUALITY PRODUCT

Garrard, Newcastle Street, Swindon, Wiltshire.





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Sound like the pro you'd be if you were recording for money instead of love.

If you're serious about tape, the TEAC 3300 is a tape deck you can take seriously.

It'll accept 10½-inch reels, like a professional deck, for up to 6 hours of recorded material. And it has professional features you won't find on any other tape deck for the price.

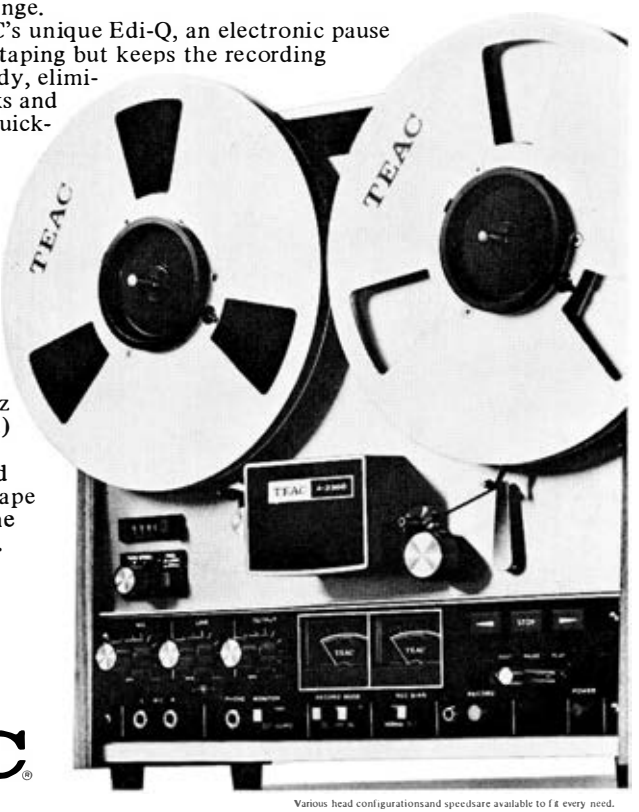
Like the new Front Panel Bias Switch for the proper selection of bias current and recording equalization for either conventional tapes or the new low noise/high output tapes.

And expanded scale professional-type VU meters for each channel. The wide excursion scales simplify recording at higher (up to 6dB) signal levels, a must when using the new tapes, assuring better signal-to-noise ratio and an expanded dynamic range.

Another is TEAC's unique Edi-Q, an electronic pause control; it interrupts taping but keeps the recording amplifiers on and ready, eliminating recording clicks and tape bounce during quick-start operation.

Of course the 3300 has the kind of professional specs you'd expect from TEAC (after all, we make the professional systems too) — S/N: 58dB, wow and flutter: 0.06% and frequency response: 25–24,000Hz ±3dB; 30–20,000Hz) at 7½ ips.

Before you spend your money on any tape deck, spend some time with the TEAC 3300. At your dealer's.



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PACKAGE DEALS

Plinths, covers, made up connectors included. Ready to operate Packages marked "R" include stereo radio.

		R.R.P. £	Package price £
●	B.S.R. changer; HL. SA707 amp; 2 PF8-S.L.S.		**52·00**
R	Garrard SP25; Sonotone 9TAHC; Teleton R8000	96·25	**55·00**
●	SP25; 9TAHC; LL NOVA amp.; 2 K.F. PF8-S.L.S.	79·25	**59·95**
R	Garrard 2025TC; Teleton F2000 & 2 SA1003 L.S.	82·38	**60·00**
●	SP25; Goldring G800; Tripletone GEMINI; 2 K.F. PF8-S	92·10	**69·95**
●	Metrosound 8-track cartridge player; 2 PF8-S L.S.	82·70	**72·00**
●	Toshiba cassette recorder; Teleton SAQ206B & 2 SA1003	103·50	**89·90**
●	SP25; G800; Sansui AU100; 2 Mordaunt-Short 07 L.S.	144·85	**109·00**
●	SP25; G800; Lux 707 amp.; 2 LNB PARALAB L.S.	148·35	**111·00**
●	SP25; G800; Alpha 400 amp.; 2 Celestion DITTON 120	139·55	**115·50**
R	SP25; G800; Sansui 200; 2 K.F. PF8-S	138·08	**123·00**
●	SP25; G800; Trio KA2002; 2 Wharfedale TRITON	149·60	**123·50**
●	SP25; G800; Trio KA2000A; 2 Celestion DITTON 15	154·79	**128·50**
R	SP25; G800; Teleton TFS50; 2 Wharfedale ASTON	170·50	**129·00**
●	Connoisseur BD2; G800; Ferrograph F307; 2 KEF CHORALE	187·57	**156·50**
●	JP601; Goldring 800E; Scott 299-F/13; 2 KEF CADENZA	253·71	**198·50**
R	Goldring GL75PC; G800E; Leak DELTA 30+FM+2 200L.S.	251·30	**198·50**
●	GL75PC; G800E; Trio KA4002; 2 Mordaunt-Short 700	288·65	**237·50**
●	BD2; G800; Nikko TRM-120 amp.; 2 Goodmans MAGISTER	274·19	**249·00**
R	BD2; G800; Sansui 600L; 2 KEF CADENZA	330·15	**285·00**

KIT PACKAGE DEALS

Plinths, covers & cabinets not included unless stated

		R.R.P. £	Package Price £
●	Mullard UNILEX; BD1 kit; SAU2 arm; 9TAHC; 2 Goodmans 8 in. L.S.	53·37	**48·80**
●	Peak Sound stereo amp. modules with cabinet kit; BD1kit; SAU2; G800; 2 EMI $13\frac{1}{2} \times 8$in. L.S. + tweeters	87·13	**71·50**
●	Sinclair STEREO 60; PZ5; 2 Z30; BD1 Kit; SAU2; G800; 2 KEF KIT 4.	99·58	**85·00**

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The AR-2050 Tuner/Amplifier provides 40 watts output power rms at a distortion level of less than 0.8% - and receives FM stereo plus Long, Medium & Short wavebands with unrivalled audio response.

The Garrard AP76 deck with its Shure cartridge is of the same superb quality.

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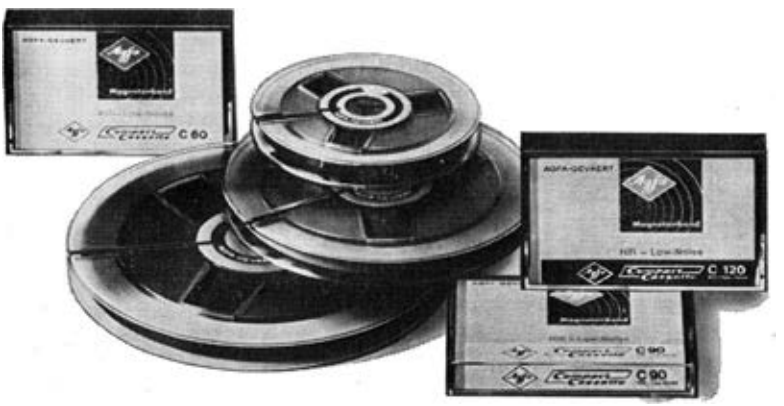

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