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JANUARY 1977

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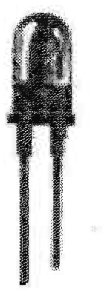

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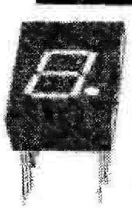

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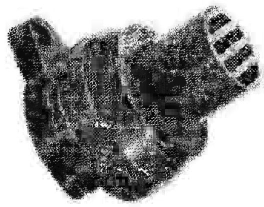

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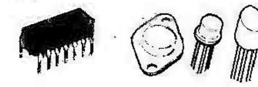

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PRACTICAL WIRELESS

VOL. 52 NO. 9
ISSUE 839
JANUARY 1977

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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6F14	·90
6F15	·75
6F18	·60
6F23	·65
6F24	·80
6F25	1·00
6F28	·74
6F32	·70
6G6G	·60
6GH8A	·80
6GK5	·75
6GU7	·90
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6J5GT	·50
6J6	·35
6J7G	·35
6JU8A	·90
6K7G	·35
6K8G	·50
6K8GT	·55
6L1	2·50
6L6GC	·70
6L7	·60
6L18	·60
6L19	2·00
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6Q7G	·50
6Q7GT	·50
6Q7(M)	·65
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6SC7GT	·75
6SG7	·50
6SH7	·55
6SJ7	·60
6SK7GT	·55
6SQ7	·60
6V6G	·30
6V6GT	·55
6X4	·45
6X5GT	·45
7B6	·80
7B7	·80
7H7	·80
7R7	2·00
7Y4	·80
7Z4	·80
8D2	·50
9D7	·70
10C2	·70
10DE7	·80
10F1	·67
10F9	·65
10F18	·65
10LD11	·75
10P13	·80
10P14	2·50
12A6	·65
12AC6	·80
12AD6	·80
12AE6	·80
12AT6	·45
12AU6	·50
12AV6	·60
12BA6	·50
12BE6	·55
12BH7	·55
12BY7	·85
12E1	3·50
12J5GT	·40
12J7GT	·70
12K5	1·50
12K7GT	·50
12K8	·75
12Q7GT	·50
12SC7	·50
12SG7	·55
12SH7	·50
12SJ7	·60
12SQ7	·80
12SR7	·75
14H7	·75
14S7	1·00
19AQ5	·65
19G6	6·50
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20D1	·70
20F2	·85
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20P1	1·00
20P3	1·00
20P4	·84
20P5	1·50
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25L6G	·70
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25Z4G	·50
25Z5	·75
25Z6G	·80
28D7	2·00
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30C15	·77
30C17	·77
30C18	1·00
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30FL13	·70
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30PL15	1·00
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35D5	·90
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35Z5GT	·80
42	1·50
43	1·25
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50CD6G	1·20
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E1148	·60
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EABC80	·40
EAC91	·55
EAF42	·70
EAF801	·75
EB34	·30
EB91	·17
EBC41	·75
EBC81	·45
EBF80	·40
EBF83	·45
EBF89	·40
EBL21	2·00
EC86	·84
EC88	·84
EC92	·55
ECC33	2·00
ECC35	2·00
ECC40	·90
ECC81	·34
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ECC84	·35
ECC85	·39
ECC86	1·25
ECC88	·51
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ECF80	·50
ECF82	·50
ECF86	·80
ECH21	2·00
ECH35	1·60
ECH42	·71
ECH81	·35
ECH83	·50
ECH84	·50
ECL80	·45
ECL82	·40
ECL83	·74
ECL84	·65
ECL85	·70
ECL86	·50
EF22	1·00
EF40	·78
EF41	·75
EF42	·90
EF73	1·75
EF80	·29
EF83	1·25
EF85	·36
EF86	·45
EF89	·32
EF91	·50
EF92	·50
EF97	·90
EF98	·90
EF183	·36
EF184	·36
EF804	1·75
EH90	·45
EL32	·60
EL34	·90
EL35	3·00
EL37	3·00
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AC166	·30
AC168	·44
AC176	·64
AC177	·32
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BA153	·18
BC107	·14
BC108	·14
BC109	·14
BC113	·30
BC115	·18
BC116	·30
BC118	·26
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OA73	·18
OA79	·11
OA81	·11
OA85	·11
OA90	·14
OA91	·11
OA95	·11
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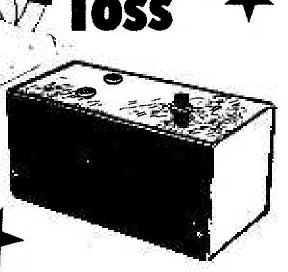

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A NEW APPROACH TO QUALITY HI-FI

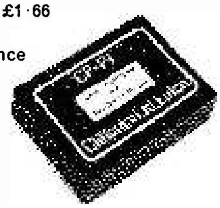
Cliffpalm Ltd. introduce a flexible range of high quality modules to enable a sophisticated hi-fi system to be built up from simple beginnings.

An initial 20W r.m.s. + 20W r.m.s. stereo with standard controls can be expanded to give a 40W + 40W system with (in addition to the normal bass, treble and balance controls) a further range comprising "rumble" and "hiss" switchable controls with a range of frequencies; and a stereo image width control.

STEREO PRE-AMP: CP-P1: PRICE £13·30
+ VAT £1·66

Specification

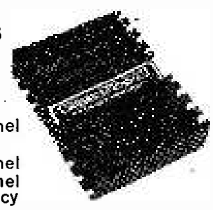
Input	Sensitivity	Signal/Noise	Impedance
Magnetic	3mV	>70dB	47KΩ
Tuner	100mV	>70dB	10KΩ
Tape	100mV	>70dB	10KΩ
Auxiliary	1–100mV	60dB–70dB	200KΩ



Magnetic i/p overload 33dB;
Distortion 0·04% at 1KHz; Output 1v r.m.s. into 10KΩ;
Supply voltage ±18v nominal;
Tone controls, Bass ±12dB at 100Hz; Treble ±12dB at 10KHz.

Description: This is a general purpose 2 channel pre-amplifier suitable for use with gramophone, tape, microphone or tuner inputs. It requires no external components other than the potentiometers for the bass, treble, balance and volume controls and the input selector switch. The unit is internally protected against accidental reversed supply connection.

AMPLIFIER: CP2-15-20 PRICE: £12·85
40W r.m.s. single + VAT £1·61
20W r.m.s. + 20W r.m.s. stereo



Specification:
Power output; 40W r.m.s. into 8Ω, 1 channel *or* 30W r.m.s. into 15Ω, 1 channel *or* 20W r.m.s. + 20W r.m.s. into 4Ω, 2 channel *or* 15W r.m.s. + 15W r.m.s. into 8Ω, 2 channel Input Sensitivity 1v r.m.s.; Frequency response 20Hz–20KHz, at –3dB; Distortion 0·04% at 15W; Supply Voltage ±18v nominal; Size 5·1×4×1·25 inches. 130×102×32mm.

Description: This module is designed to give either a 20W + 20W stereo amplifier or alternatively a 40W single channel. It has built-in protection against accidental reversed supply connection and it incorporates a thermal shut-down facility to prevent over-dissipation. No external components are required.

FUNCTION GENERATOR: CP-FG1 PRICE: £11·75
+ VAT £1·47

For those requiring a wider range of facilities, this module provides bass and treble filter controls, comprising switchable cut-off frequencies for rumble and hiss reduction. Also included is a stereo separation control. The unit is complete except for potentiometers and switches.

POWER SUPPLY: CP-PS 18/2D PRICE: £5·75
+ VAT £0·72

This is suitable for one 20W + 20W complete system. For a 40W + 40W system, two power supplies are required.

Full application notes are provided.

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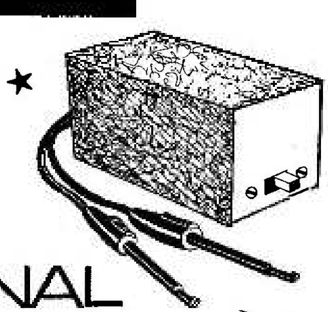

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Maximum supply voltage	15-60v
Power output for 2% THD	35 watts R.M.S.
Harmonic distortion	0·1%
Load impedance	3-8-16 ohm
Input impedance	50K ohm
Frequency response +3dB	20Hz-40KHz
Sensitivity for 25 watts O/P	280mV R.M.S.
Max. Heat sink temperature	90°C
Dimensions	102mm x 64mm x 15mm
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50 watts into 8 ohms: 0·06%
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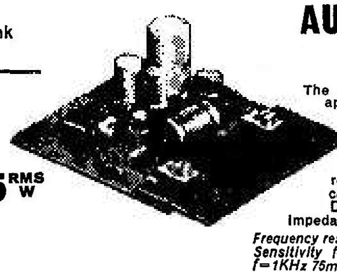

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NEW PA12 Stereo Pre-Amplifier completely redesigned for use with AL20-30 Amplifier Modules. Features include on/off volume. Balance, Bass and Treble controls. Complete with tape output.
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Input Sensitivity 300mV
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DM70	0·69	EF80	0·62	PCC84	0·84	PL504	1·40	30C15/PCF800	1·22
DY86/7	0·70	EF83	1·10	PCC85	1·02	PL508	1·73	30C17	1·29
DY802	0·53	EF85	0·70	PCC88	0·98	PL509	2·33	30C18/PCF805	1·29
EB91	0·97	EF86	1·73	PCC89	0·97	PL802	2·33	30F5/PF818	1·35
EBC81	0·89	EF89	1·73	PCC189	1·22	PY33	0·73	30FL1/PCE800	0·98
EBF80	0·63	EF91	1·35	PCF80	0·84	PY81/800	0·72	30FL2	1·02
EBF83	0·66	EF92	1·51	PCF82	1·37	PY82	0·70	30FL12	1·44
EBF89	0·50	EF95	1·63	PCF86	0·97	PY86/7	70p	30FL14	1·20
EC86	0·82	EF183	0·93	PCF200	1·50	PY88	0·84	30L1/PCC84	0·63
EC88	0·86	EF184	0·93	PCF201	1·50	PY500A	1·50	30L15/PCC805	1·35
EC90	0·94	EH90	1·22	PCF801	0·97	PY800	0·72	30L17	1·12
EC97	0·69	EL34	1·40	PCF802	1·02	PY801	0·72	30P4MR	1·63
ECC81	0·70	EL36	1·50	PCF806	0·97	U26	1·22	30P1Z/PC801	1·22
ECC82	0·70	EL84	0·70	PCH200	1·73	U191	1·17	30P19/PC802	1·06
ECC83	0·70	EL86	1·40	PCL82	0·84	U193	0·56	30PL1/PCL801	1·35
ECC84	0·63	EL95	1·02	PCL83	0·97	UBC81	0·80	30PL13/PCL800	1·47
ECC85	1·02	EM81	1·24	PCL84	0·93	UBF89	0·65	30PL14/PCL88	1·72
ECC88	1·22	EY51	0·89	PCL85	0·72	UCC85	0·66	30PL15	1·44
ECC189	0·77	EY86	0·50	PCL86	0·97	UCH81	1·73		
ECF80	0·63	EY86/87	0·70	PCL805/85	0·97	UCL82	1·02		
ECF82	0·90	EY88	0·81	PD500	2·62	UCL83	1·02		
ECF86	0·76	EZ80	0·84	PFL200	1·23	UL84	1·23		
ECH81	1·78	EZ81	0·70	PL36	1·40	UY85	0·73		
ECH83	1·06	GY501	1·73	PL81	1·23	6/30L2/ECC804	1·20		
ECH84	1·50	GZ34	1·22	PL81A	1·40	6F23/EF812	1·16		
ECL80	1·09	OC83	0·60	PL82	0·48	30C1/PCF80	0·84		
ECL82	0·69	PC86	1·40	PL83	1·73				
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DK92	1·00	EL32	0·60	PCF86	0·65	UBC81	0·50	6L6GC	0·80
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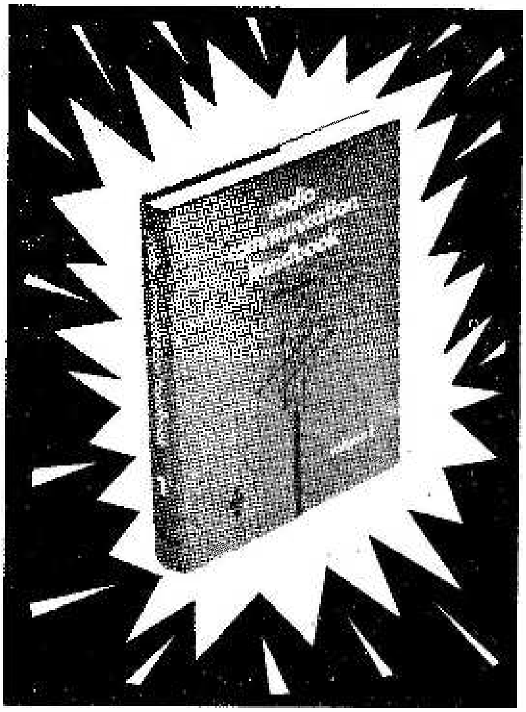

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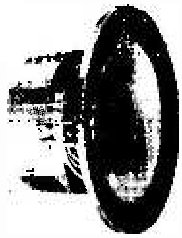

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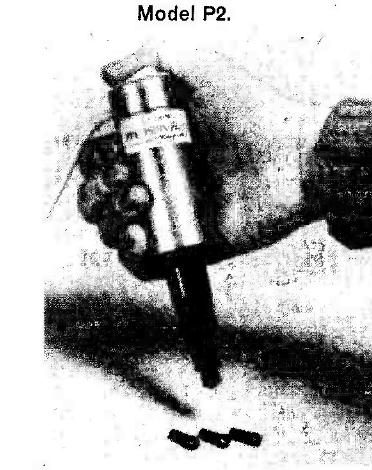

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RATION CARDS

IT is suggested that we have had an excellent supply of electronic components at extremely cheap prices, but that this will cease. Components will become that "precious" commodity just like water to the man in the desert. In the coming years prices will rise sharply and wastage will be a serious consideration for all hobbyists. Some people in the retail trade are hinting at component shortages, an event not uncommon in the professional/industrial electronics field.

Semiconductors are a good example. First there was a boom in semiconductors, and in IC's in particular. Larry Curry of SGS said at that time, "When will this bonanza cease?" But it didn't cease, and IC manufacturers, in order to keep pace with the huge and growing demand for the product, laid down more and more production lines. They ploughed huge sums of money into the business—all of it invested in plant and personnel. Then came the slump. Millions of dollars were left standing idle in the form of machinery and other capital equipment which was suddenly not needed anymore.

Today, if there is a shortage, very few manufacturers indeed are prepared to invest vast sums in capital equipment in order to meet increased demands. They did that last time—and it cost them a fortune. Today, when a demand grows, it merely means a longer and longer wait for the customer, with delivery times stretching out into months.

One professional component distributor said recently that there was a 9 month delivery on some types of capacitor. On certain other capacitors the waiting time for delivery was 18 (eighteen) months.

We cannot get round the problem by simply importing. Most countries will satisfy the demands of their own countrymen first (with the possible exception of Britain!).

German suppliers are well known for this. Certainly they will sell you components. But let there be a shortage in Germany and they will immediately switch all their production sales (including those items promised to you!) to home market sales. After all, they still get paid for their product, but by selling it at home they are helping their German manufacturing friends to complete instrumentation and equipment which is often to be exported.

So shortages are coming and many are here. Prices of those components are rising too—and will rocket up far higher before too long.

If components really do get short, and I suggest that they will, could we see the introduction of component "ration books"? During the last, war food was rationed because it was in short supply. Your ration book was stamped or a "coupon" was cut out when you'd had your share. Can the same thing happen in electronics? Will shops introduce their own rationing system?

Before you even mention Black Market (Psst—wanna buy a BC109 for a quid guv'nor?) remember that I said component prices will soar. On the Black Market the cost would be even higher.

Constructors of the future will have to think twice about exactly what they are going to build. In Practical Wireless we are running a series which uses a solderless "plug-in" breadboard to construct circuits. Because the components are plugged in they can also be unplugged afterwards and thus used again and again. So at least we are guiding the home constructor towards some saving and economy in components.

In the meantime, hang on to that "junk box". In later years the sale proceeds could see you nicely through your old age!

LIONEL E. HOWES—*Editor*

NEWS...

Careers for the future

THE theme for next year's IEETE's education conference, EASCON '77 will be career opportunities for young people as technician engineers and technicians in electrical and electronic engineering. The IEETE hope that by arranging a programme to attract careers advisers from schools and local authorities, they will play an important role in formulating and expressing the purpose of education standards the country needs.

The conference is to be a one-day event held in two separate centres. These two centres are

(1) North Staffordshire Polytechnic, Stafford, on Monday, 4th April.
(2) South Thames College, Wandsworth, on Wednesday, 6th April.

Further details may be obtained from *The Conference Secretary, IEETE, 2 Savoy Hill, London WC2R 0BS. Tel: 01-836 3357.*

Bury club

CONTINUING on the educational theme, just a short note here to inform readers in the Bury area that the local Radio Society meets every second Tuesday of each month. Meeting place is the Mosses Community Centre, Cecil Street, Bury, Lancs.

Also at the same address, and meeting every Tuesday are classes for Morse and the R.A.E. Any further information may be obtained from *The Secretary, John Clifford G4BVE, 10 Arley Avenue, Bury, Lancs.*

Tandys latest

NO doubt many readers have seen the adverts for Tandy Stores and may wish to know exactly what the stores sell. To satisfy this need, Tandy have recently launched their new 1977 Catalogue which is now available in all of their 160 outlets throughout the UK. What's more—its FREE.

Shown on the next page, this new catalogue must be one of the most comprehensive available to

NEWS... NEWS... NEWS...

the general public, and covers just about everything that is mains or battery powered, has a section for the home constructor, and

further sections of educational kits, calculators, aerials and speaker units.

Two new models that are included for the first time are the Tandy Music Centre which features an AM/FM stereo tuner, cassette deck, record deck and amplifier, and the Tandy Stereo Cassette Decks which are complete with Dolby circuitry. The Music Centre carries a price tag of £177·50, while the cassette decks range from £99·95 to £159·95.

Tandy Corporation, Bilston Road, Hollyhead Road, Wednesbury, West Midlands WS10 7JN.

HiFi in '77

THE 1977 edition of *HiFi Year Book*, now published, contains 500 pages and details of just about everything in the world of HiFi.

The book comprises 27 sections, from Amplifiers, Headphones, Surround Sound, Speakers and Receivers to Tape, Unit Audio and Pickups. Also amongst the sections is a directory listing hundreds of HiFi dealers, and additional articles on various HiFi subjects.

HiFi Year Book can be obtained from newsagents and booksellers at £3 a copy, or for £3·40, inclusive of postage and packing, from *General Sales Department, IPC Electrical-Electronic Press Ltd., Room 11, Dorset House, Stamford Street, London SE1 9LU. Telephone 01-261 8643.*

RSGB states its mind

IT has become apparent that many readers have strong feelings concerning the introduction of CB into this country. PW has been publishing many letters on this subject and we were pleased to receive a communication from the RSGB explaining their position on this rather delicate subject. We print below the complete letter received and hope that it makes the Societies position clear to our readers.

The Society is aware of the numerous items that have appeared on this subject in various journals both as correspondence and as feature articles. It is apparent that much of this material has been generated by those who will profit financially from the introduction of the facility rather than potential users.

The Society is often asked to state its policy on a citizens' band. It is somewhat difficult to offer an informed opinion on a matter concerning which nothing definite is known. Understandably no guide lines are available from the administration regarding the various possibilities and it is in this context that the following statement is made.

The matter of a citizens' band is under continual consideration by the Society's Telecoms Liaison Committee and the Council approves its present views which are:

(a) The RSGB exists to safeguard the interests of its members and of the Amateur Service in the UK. The Amateur Service is a defined service in the Radio Regulations (Geneva 1976) and is accorded world wide status in the same way as the professional services. A citizens' facility exists only where a national administration is prepared to set aside spectrum space for this use.

(b) While the RSGB may have no direct interest in a citizens' band facility by its present articles of association it must, in the interests of its members, take heed to developments likely to affect the Amateur Service.

(c) The major consideration affecting the introduction of any new facility is the ability of the administration to exercise complete and effective control. Anything less is not acceptable.

(d) The RSGB is not opposed to the introduction of a short range personal communications facility provided that its location in the spectrum and the equipment used are suitable. The 27MHz band as used in the USA and some European countries is probably one of the most unsuitable frequency bands that could be envisaged. There are three main reasons:

(i) its proximity to the amateur 28MHz band and the consequent availability of high power equipment together with the ease of illegal operation in this band,

(ii) the existence of long distance propagation during part of the sunspot cycle, and

(iii) the interference to television receivers, particularly those operating in Band 1.

Having regard to equipment now available it would appear that a vhf or uhf fm service with power limitation, crystal control and type approved apparatus could be suitable.

(e) Location of a citizens' band within an existing amateur service allocation is not acceptable to the RSGB. Further, if this facility is eventually allowed it ought to be located in a part of the spectrum remote from any amateur allocation to prevent illegal operation in an amateur band such as is now experienced in the USA.

an oscilloscope CALIBRATOR

J. THORNTON LAWRENCE (R. Tech. Eng.) GW3JGA

AN oscilloscope draws a graph of voltage against time. On some older and on most new oscilloscopes the voltage (Y axis) and the time (X axis) are calibrated in precise units of voltage and time per centimetre of deflection. The X time base can be calibrated by displaying the output of a signal generator or crystal calibrator, but the calibration of the Y amplifier and attenuator requires a square-wave generator giving a square-wave of known amplitude.

The Oscilloscope Calibrator to be described provides a square-wave of known amplitude which is switchable over the range 1mV to 5V peak-to-peak. The switching is in a 1-2-5 sequence which matches the usual oscilloscope input attenuator ranges. The square-wave output is approximately 1kHz in frequency and is also suitable for setting up the input attenuator frequency compensation and oscilloscope probe adjustments.

For uncalibrated oscilloscopes, the Calibrator will enable the Y gain to be set correctly for the range in use. The Calibrator is also useful in measuring stage gain in amplifiers and checking, by substitution, the output voltages of other equipment.

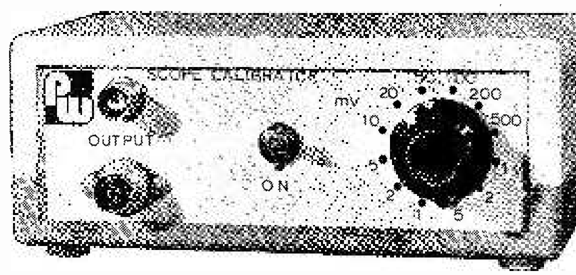
CIRCUIT

The circuit consists of a two-transistor multivibrator and a switched attenuator. The addition of a 'disconnect' diode, D2, to the standard multivibrator circuit enables a good clean square-wave output to be obtained at the collector of Tr2. PNP transistors are used to generate a conventional positive-going output waveform. The switched, two stage, attenuator provides a variable amplitude output at the BNC and Belling-Lee co-ax sockets. The complete circuit is shown in Fig. 1.

The astable multivibrator base timing components C2, R3 and C3, R4 each give a half cycle time constant of approximately 500µS and thus a square-wave output of 1mS period (1kHz frequency). The recharge of C2 is through R2 and the recharge of C3 is through R5, the 'disconnect' diode D2, allowing the collector of Tr2 to fall instantaneously to 0V when Tr2 is switched off, thus giving the clean square-wave required. A zener diode regulator is included to stabilise the supply voltage to the multivibrator.

ATTENUATOR

The output attenuator is arranged in two stages, the first section providing outputs of 5, 2 and 1V, 500, 200 and 100mV. The second section providing an attenuation of 100:1 and giving outputs of 50,



20, 10, 5, 2, and 1mV. The two sections are arranged on two 1-pole 12-way switch wafers, S2, and gives an overall range of 5V to 1mV peak-to-peak. Ideally the resistors in the attenuator should be 1% types but in the interests of economy and availability, 2% metal oxide types are used.

CONSTRUCTION

The main part of the circuit is built on a PC board, but the attenuator resistors are wired on the switch directly, as shown in Fig. 2. The PC board is mounted on the attenuator rotary switch pillars and the

★ components list

Resistors

R1 22kΩ, R2 4·7kΩ, R3 150kΩ, R4 150kΩ, R5 10kΩ — All 5% carbon film

R6 3kΩ, R7 1kΩ, R8 510Ω, R9 300Ω, R10 [illegible], R11 [illegible], R12 [illegible], R13 1kΩ — All 2% metal oxide (Doram)

VR1 1kΩ skeleton pre-set

Capacitors

C1 [illegible]µF 16V

C2 and C3 4·7nF polyester or polystyrene

Semiconductors

D1 BZY88-C5V6 (5·6V 400mW) — Tr1 BC214

D2 1N4148 — Tr2 BC214

Miscellaneous

S1, Single pole on-off miniature toggle. S2, comprising shafting unit (Doram 327-425), 2 off 1-pole 12-way wafers (327-440), 4 off spacers (327-557). BNC socket. Belling-Lee socket. Knob for S2. PCB from PW Readers PCB Services, see ad. Verobox 75-1238D from Vero Electronics Ltd., Industrial Estate, Chandlers Ford, Hants SO5 3ZR. PP6 battery (9V) and connectors.

Fig.1: Circuit diagram of the Oscilloscope Calibrator. Components mounted on the printed circuit board are shown within a dotted line. Calibration of the finished unit is effected with a single control VR1, adjacent to lead-out point F.

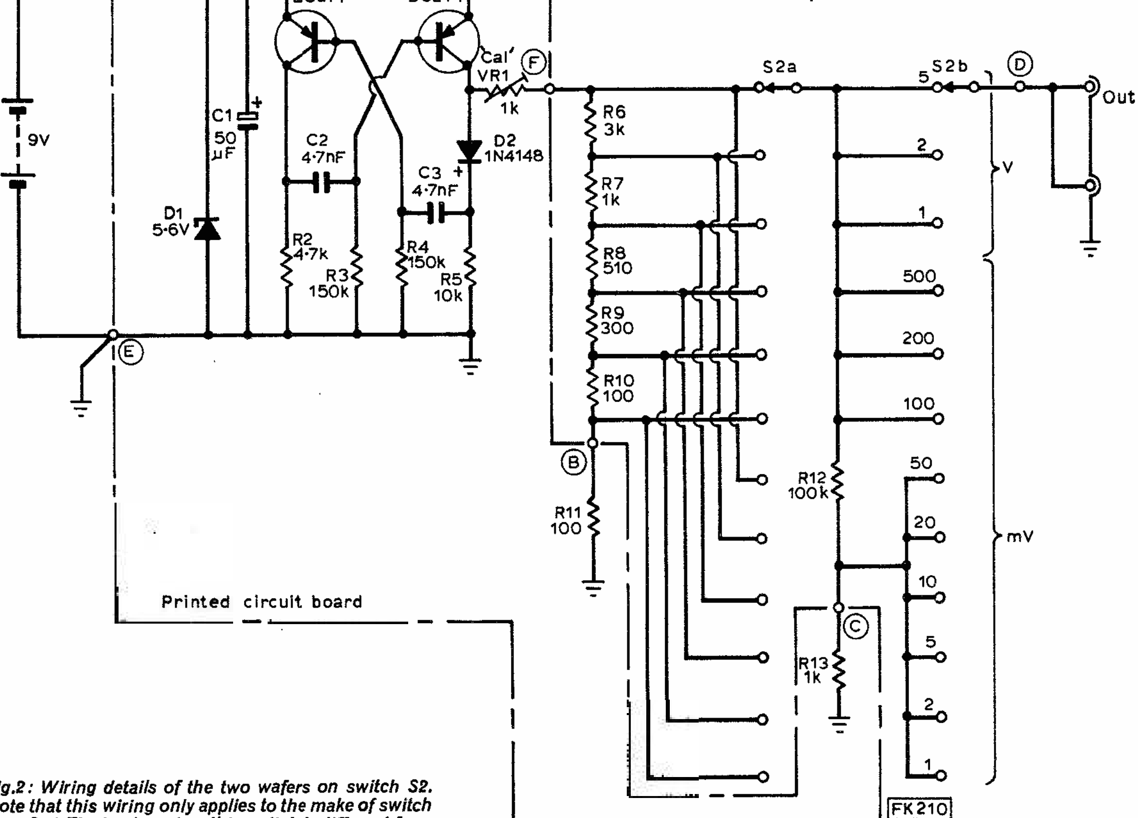
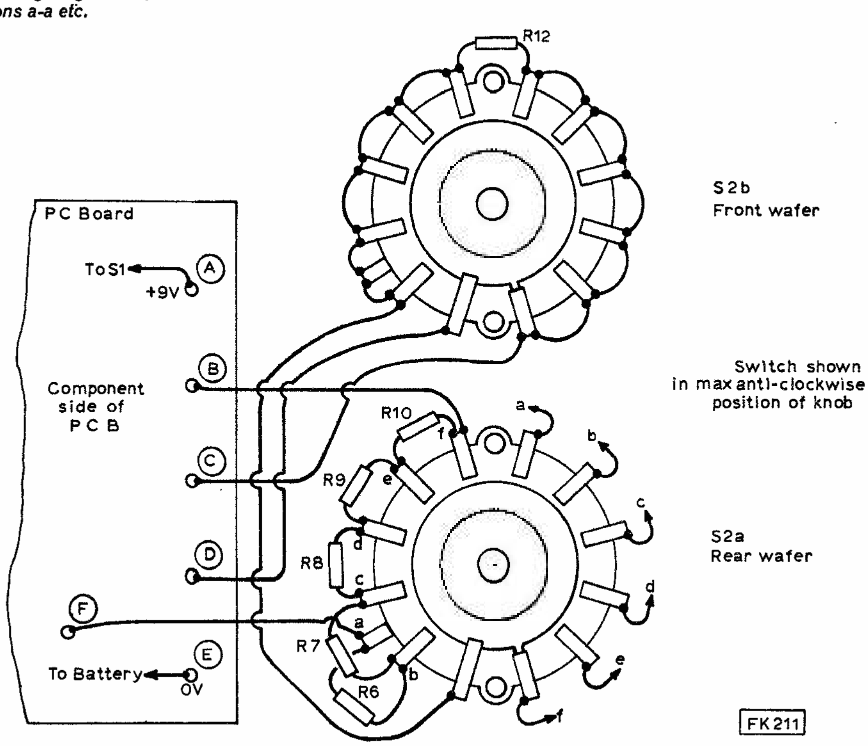


Fig.2: Wiring details of the two wafers on switch S2. Note that this wiring only applies to the make of switch specified. The tag layout on this switch is different from that on conventional 1-pole 12-way wafers which can be used provided the wiring diagram is followed. Do not forget the connections a-a etc.



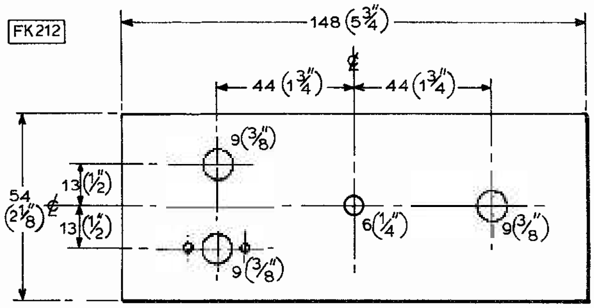


Fig.3: Suggested layout for the front panel on the Oscilloscope Calibrator.

switch itself is mounted on the front panel. The front panel drilling is shown in Fig. 3.

The Calibrator is housed in a Verobox along with the PP6 battery. The battery is held in position with a small pad of plastic foam material, cut to size.

The PC board and component layout is shown in Figs. 4/5, including the connecting wires to the remaining components and switches.

CALIBRATION

With any calibrator, there is the usual problem of its own calibration, but in this circuit it can be easily carried out using a high resistance DC voltmeter. The base and emitter of Tr1 are temporarily shorted together to stop the multivibrator running whilst leaving Tr2 conducting. With the output set to 5V and a 20kΩ/V meter (Avo 8 etc.) connected across the output, adjust VR1 to give a reading of 5V on the meter. With the short on Tr1 removed, the output will be a square-wave of amplitude 5V peak-to-peak. This completes the calibration.

ACCURACY

The accuracy of the Calibrator is dependent on a number of factors, the accuracy of the meter used for calibration, the accuracy of the attenuator resistors and the loading on the output. In order not to load the output unduly, the output of the Calibrator should not feed into an impedance of less than about 100kΩ. Providing this is observed and the setting-up is carried out carefully the output voltage inaccuracy should not exceed about ±5% of range and will probably be considerably better than this.

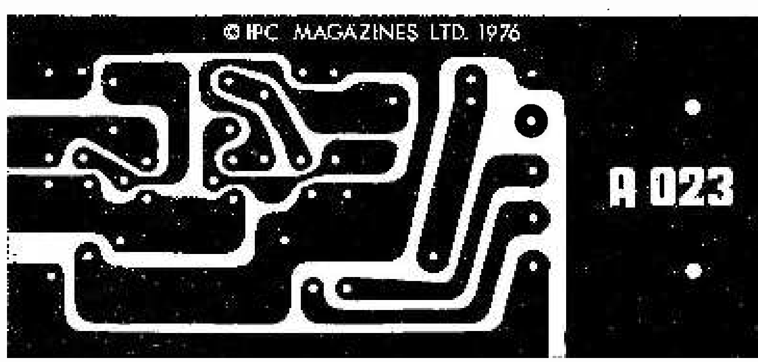
CALIBRATING A SCOPE

1. Set the oscilloscope to its most sensitive basic range, usually 10mV/cm or 100mV/cm. (If the oscilloscope has a X10 or X100 pre-amplifier, leave the setting on X1.)
2. Set the Calibrator to a range which gives about 2cm peak-to-peak display. Using the time base controls, lock the timebase to display 2 to 4 cycles.
3. Adjust the Oscilloscope SET GAIN control to give the correct amplitude of display, e.g. oscilloscope 100mV/cm, Calibrator 200mV, display 2cm p-p.

If, due to the frequency response of the oscilloscope, the top and bottom edges of the displayed square-wave are not absolutely flat, ignore any 'overshoots' and use the main horizontal portion of the displayed waveform.

4. Check the Y sensitivity of the oscilloscope at all positions of the input attenuator/gain control using a deflection of 1cm, or 2cm if greater viewing accuracy is required.
5. Adjustment of the Oscilloscope input attenuator compensation can be carried out successfully

Fig.4: The foil layout of the printed circuit board is given here full size. The centres of the fixing holes for the switch may need modifying if a switch different from that specified is used.



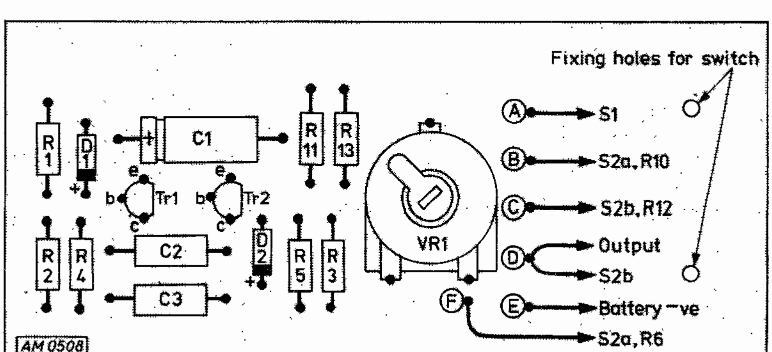
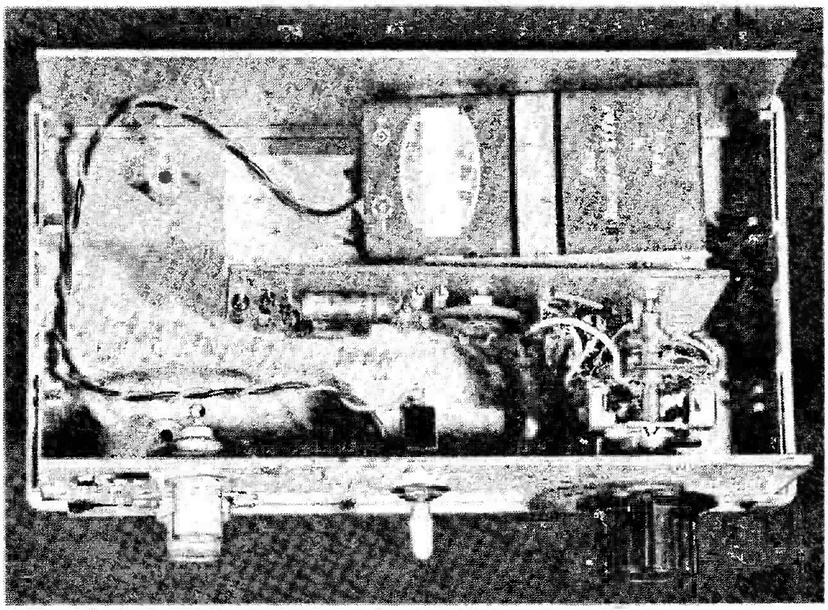


Fig.5: Layout of the components on the PCB. The output lead D should go to both sockets which are connected in parallel.



Top view of the finished Calibrator. The PCB is bolted to the switch which can be wired to the PCB before it is fixed to the front panel, leaving only the wiring to the output sockets, on-off switch and battery.

Output Setting	dB change
5V	
	8
2V	
	6
1V	
	6*
500mV	
	8*
200mV	
	6*
100mV	
	6*
50mV	
	8
20mV	
	6
10mV	
	6
5mV	
	8
2mV	
	6
1mV	

Example:— Initial setting 1V, input to amplifier for 1V output is 50mV. Gain = 6*+8*+6*+6*dB = 26dB.

using the Calibrator, but this should only be done by the method given in the maker's Service Manual.

Where the Oscilloscope does not have a calibrated Y input, the Calibrator may be connected temporarily and the oscilloscope 'Y gain' control set to give a specific deflection. The signal to be measured is then connected and its amplitude estimated against the previous deflection.

AMPLIFIER GAIN

The Calibrator can also be used for checking the approximate gain of audio and wide-band amplifiers. For this test, the oscilloscope is first connected to the Calibrator and the oscilloscope Y sensitivity set for a known deflection, e.g., 1V/cm. The oscilloscope is then connected to the output of the amplifier under test and the input of the amplifier is connected to the Calibrator.

The Calibrator output is adjusted to give the same amplitude of signal on the oscilloscope. The amplifier gain can then be estimated by noting the two output settings and adding together the individual decibel (dB) equivalents between the two settings, as shown in the table. PW

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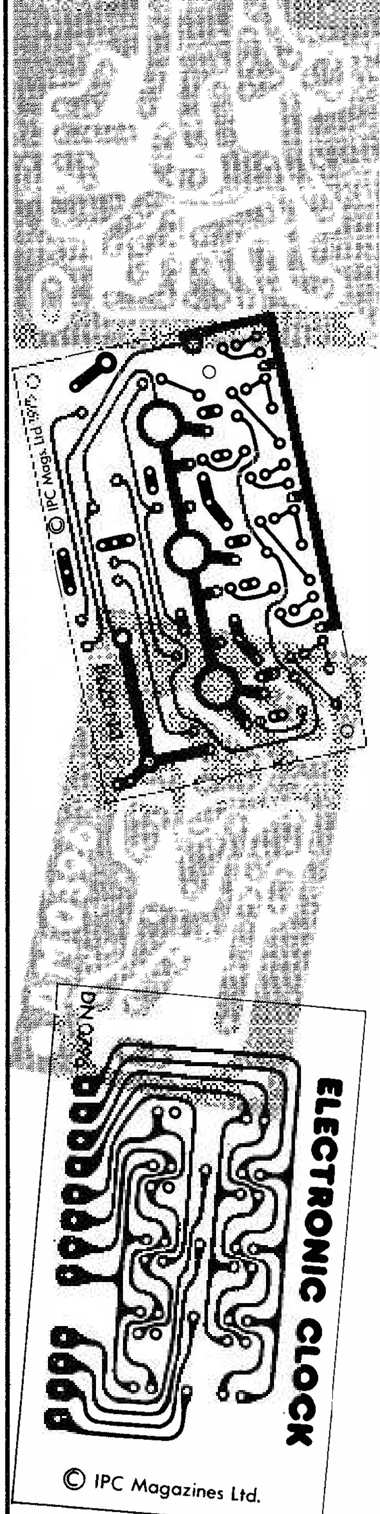

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'ICELERT' BLACK ICE WARNING

IAN HICKMAN

WITH the approach of winter and the possibility of icy roads, the author considered the advisability of fitting an alarm to his car to warn of the danger of "black ice". A thick covering of frost on the road is easy to see, but where the road is already wet before the temperature falls, the water can freeze as a transparent glaze not easily noticed, with maybe alarming results for the unwary driver.

My filing system divulged a faded photocopy showing a circuit diagram and the following notes:

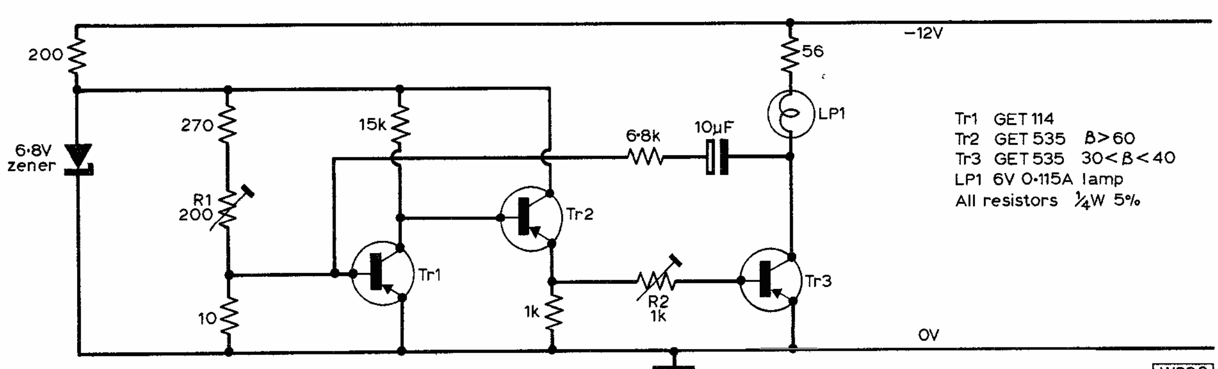
"On a windless night with a clear sky, ice can form on the road surface when the temperature 2 feet above ground level is 2°C. On a windy night with cloudy sky, ice only forms when temperature drops to 0°C. This circuit causes the lamp to start flashing when the temperature drops to 2°C, and to stay permanently lit when it drops to 0°C.

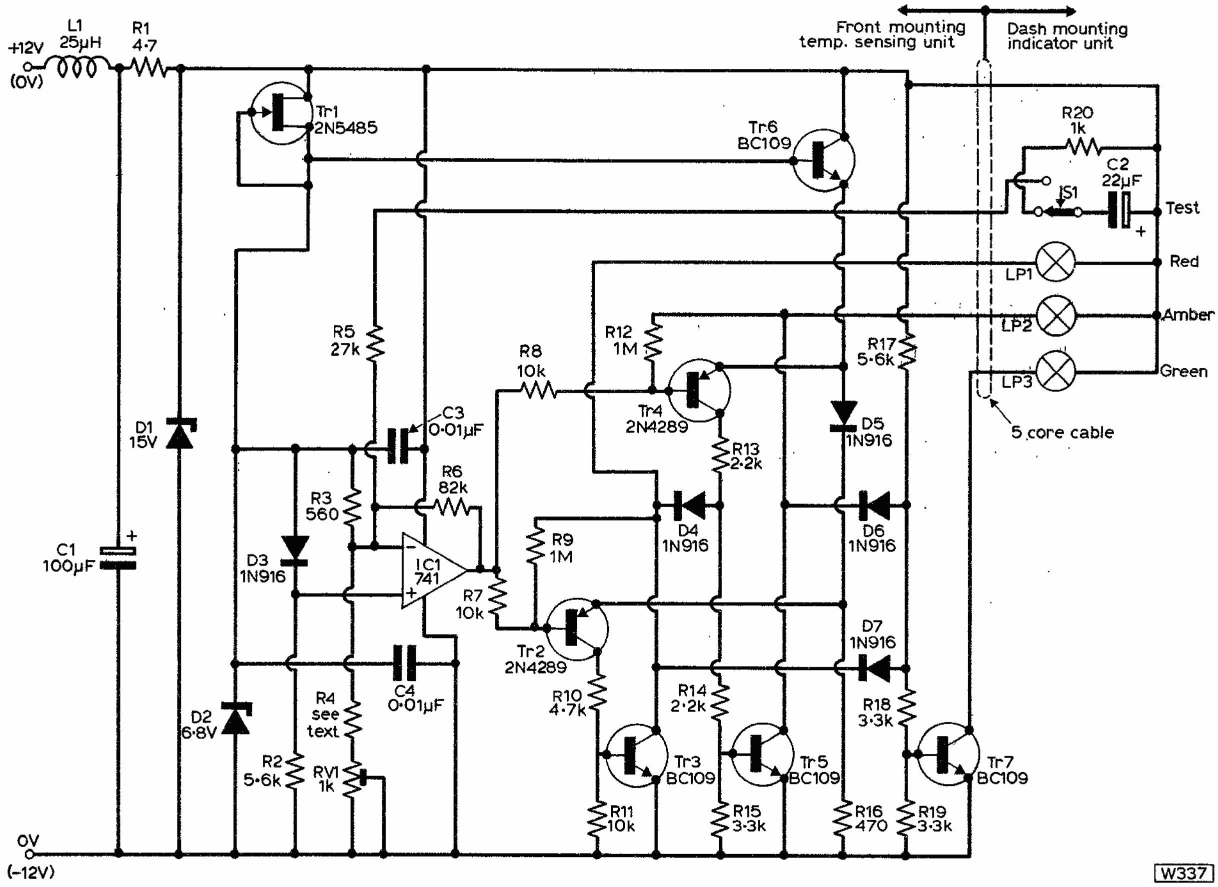
With Tr1 on a heat sink at 0°C, R1 is adjusted so that the lamp is lit but on the verge of flashing. Raise heat sink temperature to 2°C and adjust R2 so that the lamp is out but on the verge of flashing. Repeat these two adjustments as above, since the controls slightly interact.

Except for the dash mounted lamp, the circuit should be installed in a metal box forming a heat sink for Tr1 and mounted at the front of the vehicle exactly two feet from the ground. It should be mounted so that it is in a free flow of air and not likely to receive heat either conducted or radiated from the vehicle."

The circuit is reproduced as Fig. 1. Readers with the appropriate old transistors lurking in the junk box may care to experiment with it. It is an exceedingly ingenious example of what can be done with a very few components, but (although I haven't tried it out) calculations show that it is five times more sensitive to variations in the 12V supply than the circuit which forms the main subject of this article. The requirement for a heat plate capable of being set to within a degree Centigrade is also somewhat impractical.

Fig. 1. Circuit diagram of a simple alarm. Simple to make but not to calibrate.





Improved unit

The author therefore set about designing an improved ice alarm with added facilities, greater accuracy and easier to set up.

A "traffic lights" display was decided on, with a red light showing when the temperature is 0°C or lower, an amber light for temperatures up to 2°C and a green light for all higher temperatures. The green light thus acts as a pilot light indicating that the unit is switched on and a test button is provided, which simulates a temporary drop in temperature. Pressing it causes the red light to come on, then the amber and finally the green as the "temperature" rises to normal. This test operates even on a hot day, though the return to green is rapid. On a cold day it takes longer and it is just possible that if the temperature is a shade above 2°C, the amber may stay lit, as the circuit is designed with a hysteresis of a fraction of a degree.

Circuit

Figure 2 shows the circuit diagram of the improved ice alarm. The temperature sensor is D3, the voltage drop across which (due to the current via R2) is compared with the voltage across R3, both with respect to the stabilised reference point at the cathode of zener diode D2. As the slope resistance of Tr1 is typically greater than 10kΩ and that of D2 about 3Ω, variations of the 12V supply are reduced to millivolt level at the reference point and to totally negligible proportions at the input of the op amp, since D3 and R2 with R3 and R4/VR1 form a bridge circuit. The change of voltage across D3 is about 2·1 mV per degree centigrade and this change is amplified by IC1, the gain being set by R6, and R3 in parallel with R4/VR1.

Fig. 2. The circuit diagram of the up-to-date alarm. The prototype unit was built with 2N4289s for Tr2 and Tr4, as shown in the diagram. A suitable, and more readily available, alternative is the BC214L, as given in the parts list.

At summer temperatures, the drop across D3 is less than across R3, so the non-inverting input is positive with respect to the inverting input and the amplifier output is near +12V. As the voltages at the emitters of Tr4 and Tr2 are about 0·7V and 1·4V respectively negative relative to the reference point, both of these transistors are OFF and therefore Tr3 and Tr5 are likewise. Base current through R17 and R18 keeps Tr7 bottomed and the green lamp LP3 is therefore lit.

When the temperature falls to 2°C, the op amp output falls to the point where Tr4 starts to conduct, thus turning on Tr5. The amber lamp LP2 therefore lights and via D6, Tr5 removes the base current from Tr7, extinguishing the green lamp. A modest amount of positive feedback via R12 to the base of Tr4 provides about 0·2°C of hysteresis. As the temperature falls another 2°C to freezing, the op amp output falls a further 0·7V, causing Tr2 and Tr3 to turn on. This lights the red lamp LP1 and via D4 and D7 extinguishes the amber and green lamps.

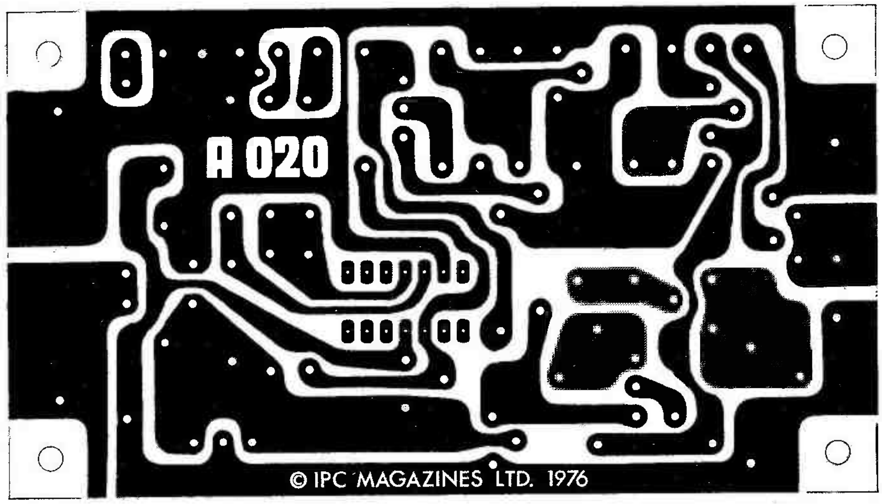
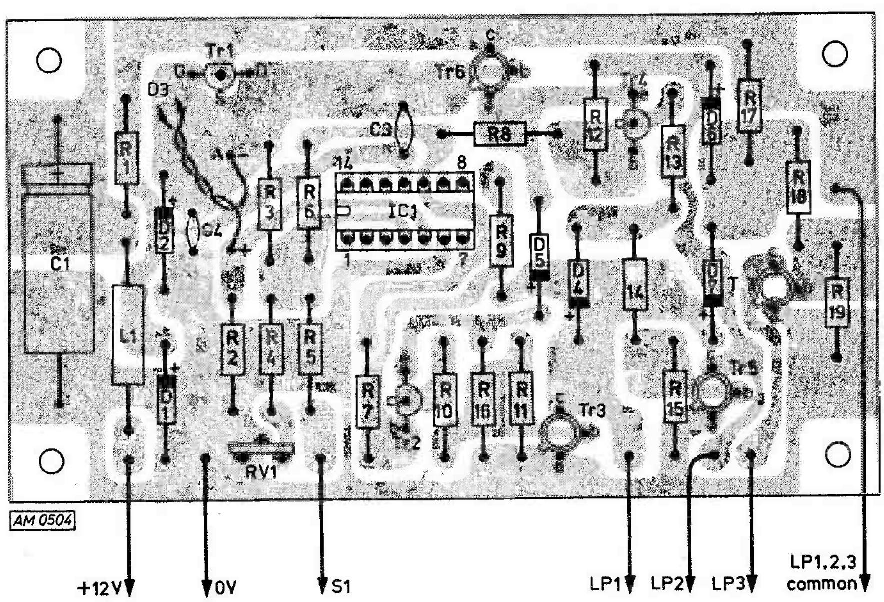


Fig. 3. The pattern on the etched board, shown full size, for the sensing/control unit. The lamp unit does not have a printed board.

Fig. 4. The component locations on the board. Note that although the IC is drawn for a 14 pin device, the 8 pin item can be used if holes at 1, 2, 7, 8, 13 and 14 are not used.



Press-button S1 provides a means of checking the operation of the circuit. When depressed, it injects a current at the junction of R3 and R4 via R5, gradually decreasing as C2 becomes charged. This has the same effect as temporarily increasing the voltage drop across D3, i.e. it simulates a temporary temperature reduction. Therefore, the red lamp will light, followed in turn by the amber lamp and finally returning to green. This not only shows that the circuit is functioning but, as explained earlier, provides a qualitative guide as to how near the temperature is to freezing.

The network L1C1R1D1 protects the circuit from disturbances on the 12V supply. Electrically, a motor car is a fairly hostile environment, with the wiring subject to "spikes" and "surges". The former are due to high rates of change of current in the inductance of the wiring and may reach several hundred volts for a few microseconds. Surges of many tens of volts, lasting for several milliseconds, are also a hazard. These are limited by R1 and D1, whilst the spikes are tamed by L1 and C1.

Construction

Most of the components are non-critical and generally similar alternatives may be used. However, it is very important that the unit's accuracy should be maintained or it could indicate no ice when ice is present. Therefore, the following components should be as listed:— Tr1, D2, R2, 3, 4, 6, D3, 5. For the same reason, the unit should be recalibrated each autumn (see next section).

★ components list

Resistors

R1	4·7Ω	R11	12kΩ
R2	5·6kΩ*	R12	1MΩ
R3	560Ω*	R13	2·2kΩ
R4	4·7k, 5·6kΩ or 6·2kΩ as required*	R14	2·2kΩ
		R15	3·3kΩ
R5	27kΩ	R16	470Ω
R6	82kΩ*	R17	5·6kΩ
R7	10kΩ	R18	3·3kΩ
R8	10kΩ	R19	3·3kΩ
R9	1MΩ	R20	1kΩ
R10	4·7kΩ		

* metal oxide

VR1 1kΩ (preferably Cermet)

Capacitors

C1 100μF, 25V
C2 22μF, 12V
C3 0·01μF, 12V disc ceramic
C4 0·01μF, 12V disc ceramic

Semiconductors

Tr1	2N5485	Tr5	BC109
Tr2	BC214L	Tr6	BC109
Tr3	BC109	Tr7	BC109
Tr4	BC214L		

D1 16V, 1W Zener e.g. 1N4745
D2 6·8V Zener, e.g. BZY88C6V8
D3 1N916
D4 1N916
D5 1N916
D6 1N916
D7 1N916
IC1 741 op. amp.

Miscellaneous

Switch, S1, single pole change-over. Lamps, LP1 to LP4 14V, 0·7W. SRBP tube for D3. Box to suit mounting position. 5 core connecting cable (or 5 separate leads) low voltage, low current. L1, 250μH suppression choke.

Before fitting the lid to the box, Red Hermetite or similar waterproof gasketing should be smeared round the lip of the lid. This material is not an adhesive and is non-setting, permitting access at a later date should this be required.

The indicator unit can be mounted at any convenient position near the dashboard. Red, amber and green L.E.Ds (each in series with a 1kΩ resistor) can be used for LP1, 2 and 3 if desired. Due to their lower light output, the indicator would then need to be mounted well within the driver's field of view.

Calibration

This should be carried out outdoors on a cold day, so that the components are at a low temperature. This will ensure that the very small influence which components other than D3 have on the accuracy is quite negligible.

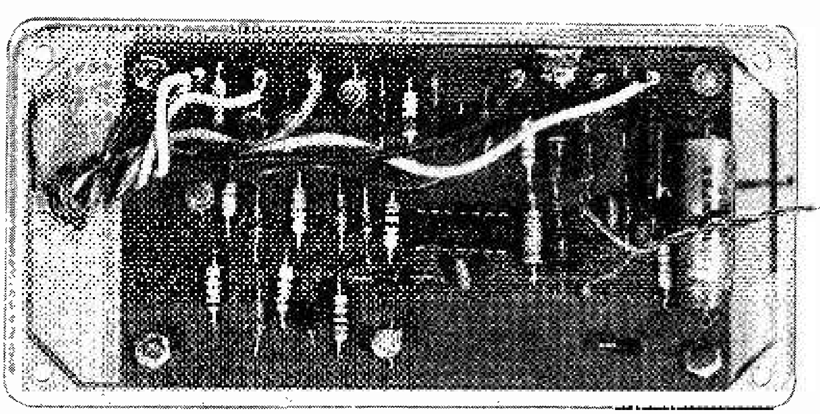
D3 is cooled to 0°C in a mixture of crushed ice in water. After stirring well with the sensor probe to ensure D3 is exactly at 0°C, adjust VR1 so that the red lamp just comes on. Remove the sensor probe and warm slightly. Check that on replacing in the ice mixture and stirring, several seconds elapse before the red lamp comes on. Readjust VR1 if necessary to achieve this.

This completes the calibration, as the temperature at which the amber lamp comes on is fixed by the gain of IC1 and the voltage across D5, at a little over 2°C.

Installation

The completed sensing unit, with D3 fixed at the end of a paxolin tube, mounts behind the radiator grille with the diode projecting through.

The 12V supply to the sensing unit can conveniently be picked up at the dashboard from the supply to accessories controlled by the ignition switch. For example, it can be wired in parallel with the supply to a car radio, in which case it can share the latter's line fuse.



Photograph of the inside of the author's prototype probe box. The boxes used were from Crescent Radio and were ideal for the author's Maxi, the probe box being fitted behind the grille on the off-side and the probe pointing through. Other box sizes and fixing methods may be needed for other cars.

C3 and C4 should be mounted close to IC1, though if the printed circuit board of Fig. 3 is used, this is assured anyway. A good quality low leakage capacitor should be used for C2.

The p.c. board mounts in the box with VR1 adjustable via a hole in the lower edge. This hole also acts as a breather, to prevent condensation becoming trapped within the box.

As the circuitry of the ice alarm is completely isolated from the car chassis, it is equally suitable for fitting in cars with positive or negative earth systems.

Take care to connect in the correct polarity! Reverse polarity will burn out R1, as D1 will protect the rest of the circuit by turning on in the forward direction. PW

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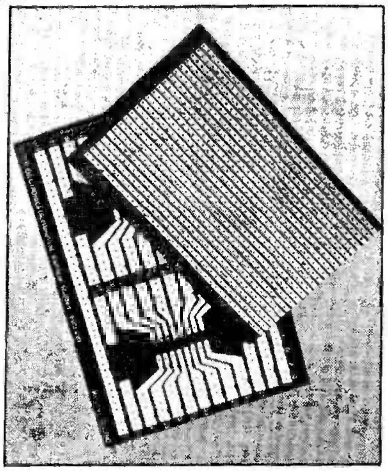

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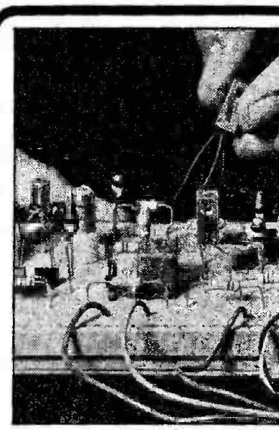

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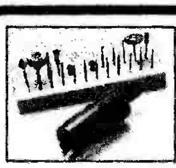

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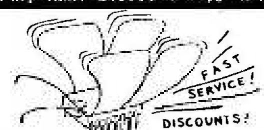

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4001	0·20	4040	1·19	4082	0·24	14506	0·57
4002	0·20	4041	0·93	4085	0·80	14507	0·60
4006	1·31	4042	0·93	4086	0·80	14508	3·08
4007	0·20	4043	1·12	4089	1·74	14510	1·51
4008	1·07	4044	1·04	4093	0·89	14511	1·74
4009	0·60	4045	1·56	4094	2·08	14512	1·03
4010	0·60	4046	1·48	4095	1·16	14514	3·47
4011	0·20	4047	1·01	4096	1·16	14515	3·47
4012	0·20	4048	0·60	4097	4·13	14516	1·51
4013	0·60	4049	0·60	4098	1·22	14517	4·02
4014	1·12	4050	0·60	4099	2·03	14518	1·39
4015	1·12	4051	1·04	40101	1·76	14519	0·57
4016	0·60	4052	1·04	40102	2·16	14520	1·39
4017	1·12	4053	1·04	40103	2·16	14521	2·77
4018	1·12	4054	1·29	40104	2·26	14522	2·15
4019	0·60	4055	1·46	40107	0·66	14526	2·15
4020	1·24	4056	1·46	40108	6·18	14527	1·76
4021	1·12	4057	29·81	40109	2·21	14528	1·22
4022	1·07	4059	6·20	40181	4·30	14529	1·72
4023	0·20	4060	1·24	40182	1·73	14530	0·95
4024	0·87	4061	25·60	40194	2·26	14531	1·74
4025	0·20	4062	10·10	40257	2·26	14532	1·39
4026	1·32	4063	1·22	4700	1·75	14534	8·15
4027	0·60	4066	0·69	7083	4·25	14536	4·00
4028	1·00	4067	1·13	14160	1·18	14537	13·17
4029	1·27	4068	0·24	14161	1·18	14539	1·24
4030	0·60	4069	0·24	14162	1·18	14541	1·62
4031	2·46	4070	0·65	14163	1·18	14543	1·82
4032	1·19	4071	0·24	14174	1·08	14549	4·10
4033	1·55	4072	0·24	14175	1·04	14552	10·50
4034	2·11	4073	0·24	14194	1·17	14553	4·66
4035	1·31	4075	0·24	14490	6·51	14554	1·67
4036	3·09	4076	1·71	14501	0·20	14555	1·01
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CHROMACHASE 4

PART 2

WILLIAM BEAN

Last month's issue covered the general outline, the circuit operation and most of the constructio
This month we complete the article by describing the Programme and Mode options and operation, the testing and, finally, offer some display ideas.

PROGRAMMES

The unit can drive lamps, or banks of lamps, in groups of four. Within that group it can energise a single lamp (called 1 for reference) a pair of lamps (either 1 and 2 or 1 and 3) or three lamps (1 and 2 and 3). No provision is made for all lamps on or for all lamps off.

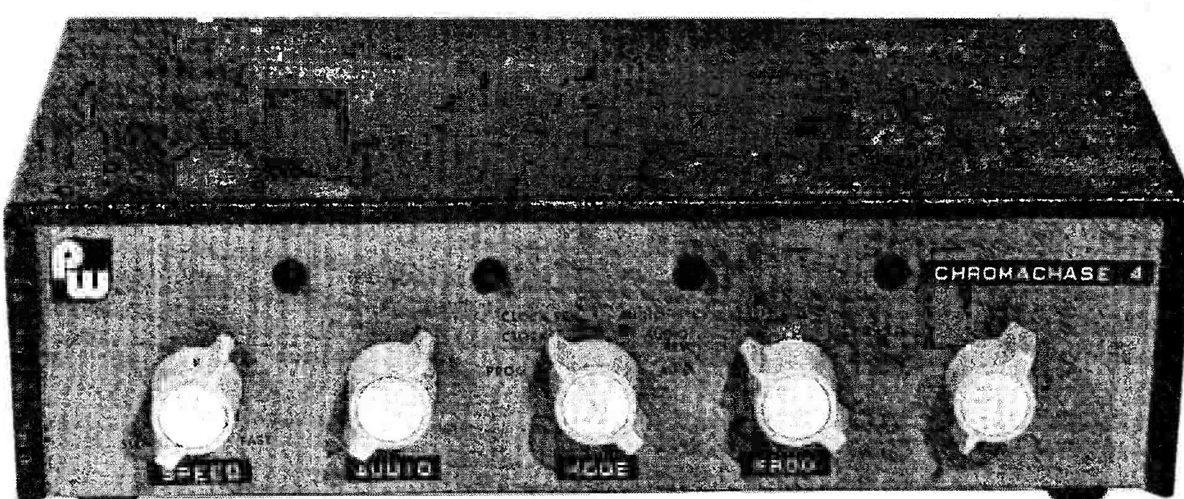
These four alternatives comprise the "Programme", and one or other of them is selected by S2a and S2b. Selection can be made at any position of the mode switch but will only be entered into the register in the "programme" position.

S2 is wired such that it puts combinations of 0V onto pins 4 and 5 of IC4. Pin 3 of IC4 is permanently connected to 0V. This ensures that at least one lamp is always on.

The conditions at the input pins 9 and 10 decide which way the register progresses and, whilst they remain constant, a pulse on pin 11 will cause it to shift in the selected direction.

As mentioned earlier, the outputs of the register are at QA, QB, QC and QD (pins 15, 14, 13 and 12) and the logic levels on those pins will progress one position in the selected direction for each clocking pulse. For instance, if 1 lamp is the selected programme, the unit will start with a logic 1 on QA and logic 0 on QB, QC and QD (i.e. 1000). At the first clock pulse on pin 11 the outputs become 0100, the second pulse gives 0010, the third 0001 whilst the fourth brings 1000 back to restart the cycle. If a reverse mode is operating the sequence would be 1000, 0001, 0010, 0100 and 1000.

Photograph of the author's unit to show the front panel lettering for the various controls and switches. Letraset was used for the small lettering and adhesive punched tape for the larger. Dry transfers of the Letraset type will last longer if sprayed with a protective covering.



MODE SELECTION

The "Mode Selection" switch, S1, can select 1 of 6 possible operating conditions. Perhaps the simplest position to start with is position 2, "Clock". Switch S1 grounds pins 9 and 10 of IC5. This prevents any audio pulses being fed to the clocking input of IC4. S1b grounds pin 1 of IC2 and thus prevents the clock pulses on pins 2 and 13 from operating the reversing sequence. The output of the internal clock, on pin 6 of IC5, is able to pass through the two gates of IC1 (pins 1/3 and 5/6) and will drive the register. S1a also grounds pins 9 and 12 of IC1 which prevents reversal of direction following IC4 reaching the ends of its cycle. Under these conditions the lamp programme will continue to cycle in the same direction.

In position 3, "Clock Reverse", the inhibits on the audio drive are still applied, as is the inhibit on pin 1 of IC1, but the inhibit on pins 9 and 12 of IC1 are removed. Now the register will progress at each pulse from the internal clock but at the end of each cycle a pulse is fed back to either pin 10 or pin 13 of IC1 which can pass through the two gates of IC2 (pins 9 or 10/8 and 5/6) and toggle IC3 which, in turn, will change the direction of IC4. The lamp sequence will now alternate, first forward then back.

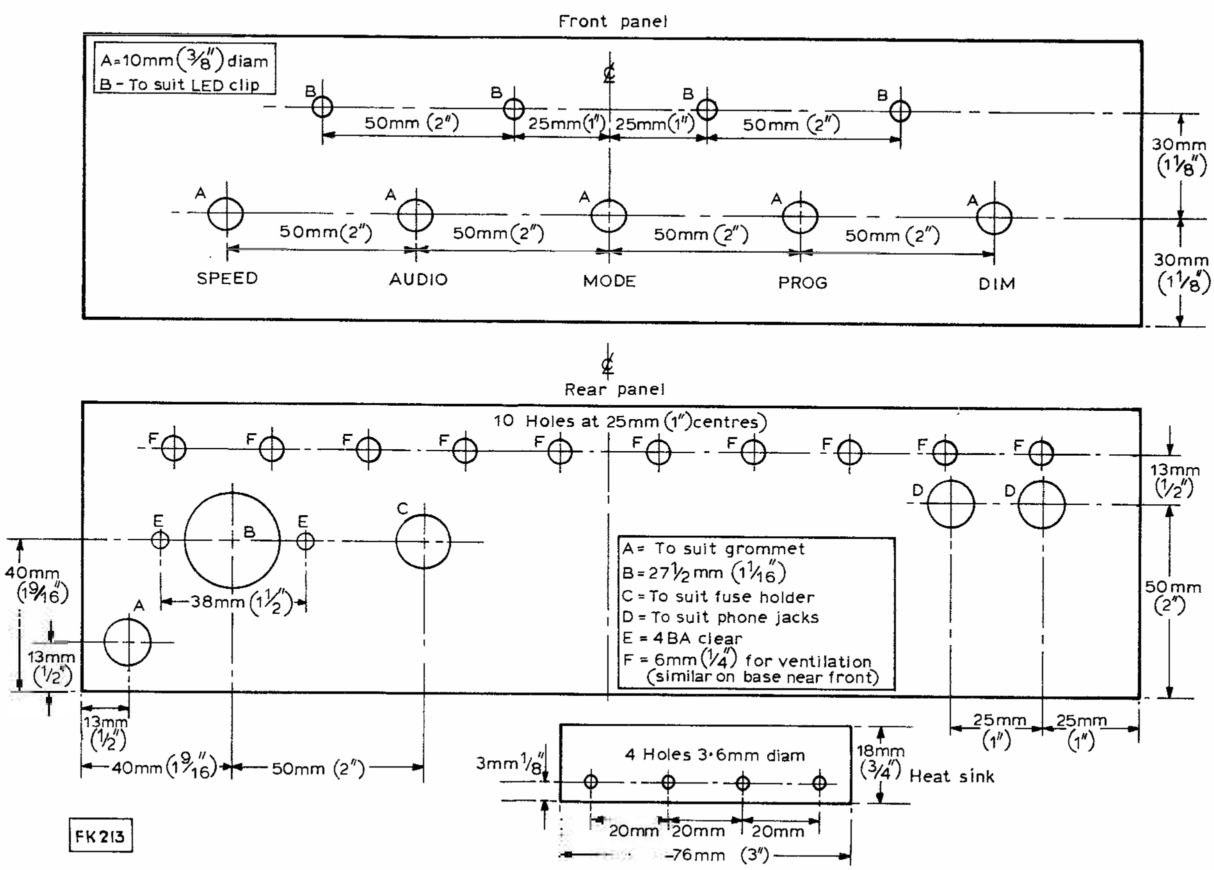
Position 4, "Audio", removes the inhibit on pins 9 and 10 of IC5 and applies it to pin 1 of IC1. This allows the output of Tr9 to drive pins 12 and 13 of IC5 and hence the clocking input of IC4. It prevents the internal clock input on pin 2 of IC1 from driving pin 5. The inhibits on pins 9 and 12 of IC1 are reapplied and the inhibit on pin 1 of IC2 remains. These prevent the reversal of IC4 as in position 2. Now each pulse from Tr9 of sufficient amplitude to trigger IC5 will cause the lamp sequence to move one position but always in the same direction.

Position 5, "Audio Reverse", maintains the inhibitions on pin 1 of IC1 and on pin 1 of IC2 but removes them from pins 9 and 12 of IC1. Thus the lamp sequence progresses one position at each audio pulse but the sequence will reverse at the end of each cycle.

In position 6, "Auto", the inhibits on pin 1 of IC1 remains and the clocking pulses for IC4 are still derived from the audio input. The inhibits on pins 9 and 12 of IC1 are reapplied, preventing the end of cycle reversing procedure but the inhibit on pin 1 of IC2 (from S1b) is removed. This allows the internal clock pulses to pass through all the gates of IC2 (pins 2/12, 11/8 and 5/6) to toggle IC3 and reverse the display direction. This can give rise to a completely random display by selecting one lamp only on the programme and adjusting the audio level and internal clock rate. Several combinations of level and rate will give the effect and its a case of "try it and see".

Position 1, "Programme", applies a 0V level to the preset and clear inputs of IC3 which conditions IC4 to accept the control levels selected by the programme switch. The programme information cannot be entered at any other position of the mode switch.

Fig.6. The drilling details for the front and rear of the case specified. Also shown is the detail for the triac heatsink.



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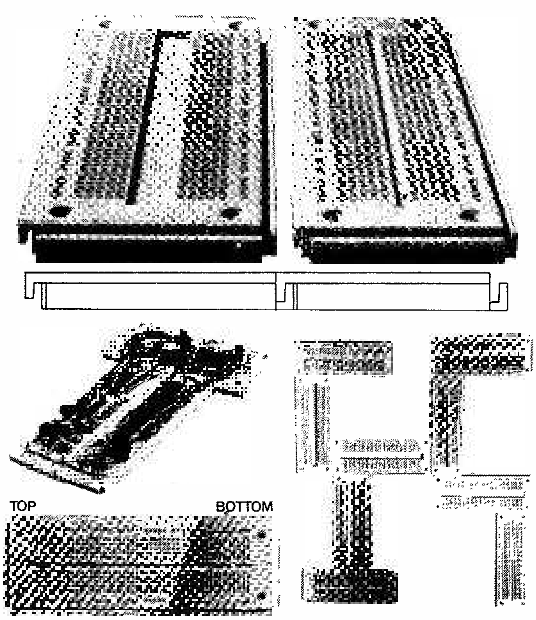

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LOCK-OUT SUPPRESSOR

It is possible that a condition could occur, particularly at switch on in a mode other than "programme", where all the outputs of IC4 are at logic 0 and this could cause a lock-out of the sequence. To overcome this effect a simple lock-out circuit, Tr10 and its associated components, has been included. If the condition did occur at any time the LEDs would all be off. This would result in no current flowing through D14 and hence no volt drop across it. This, in turn, would cut off Tr10 and the collector would fall to ground potential and, in so doing, would apply a logic 0 to the preset and clear inputs of IC3. IC3 would condition IC4 to accept the programme selected, one at least of the LEDs would light, current would flow through D14, Tr10 conducts, the preset and clear inputs of IC3 rise to 5V and the system proceeds normally.

WOUND COMPONENTS

The pulse transformers, T2, 3, 4 and 5, are wound with 28 standard wire gauge, enamelled copper wire onto a ferrite rod. No particular grade of ferrite is specified and the author has tried various without finding any significant differences. The cut rod is first covered with insulation tape and then 25 turns of wire are wound on. A second layer of tape is added, this time of double thickness. The secondary winding of 25 turns is added and a third covering of tape. The windings should go as close to the ends of the rod as practical but be spaced evenly along it.

Both ends of the first winding should be brought out at one end of the ferrite rod. The ends of the second winding should both terminate at the other end of the rod. Either winding may be used as the primary.

The suppression coil is also wound on a section of ferrite rod but consists of 20 turns of 14 standard wire gauge, enamelled copper wire. Since this item is connected to the live main it is suggested that at least 4 thicknesses of tape be used both under and over the winding. Again, wind evenly over the full length of the rod.

GENERAL ASSEMBLY

A drilling diagram is given as Fig. 6 and is suitable for the case listed. Even if the case differs from the one the author used the hole sizes and locations could still be used. On full load the Triacs get quite warm and cooling holes have been included to assist convection.

Before drilling the holes for the LEDs, check the size of the mounting washers, they do vary.

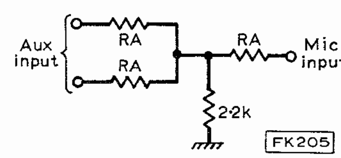
The PCB is mounted into the box on ½in x 6BA spacers but any convenient height, from ¼in to ½in will do. If screws larger than 6BA are used there may be problems with the hole sizes in the board.

The wiring to the International Octal socket used for connecting the lamps can be on any suitable pin numbering, the author used pins 7 and 8 in parallel for the neutral and pins 1, 2, 3 and 4 for the line connections.

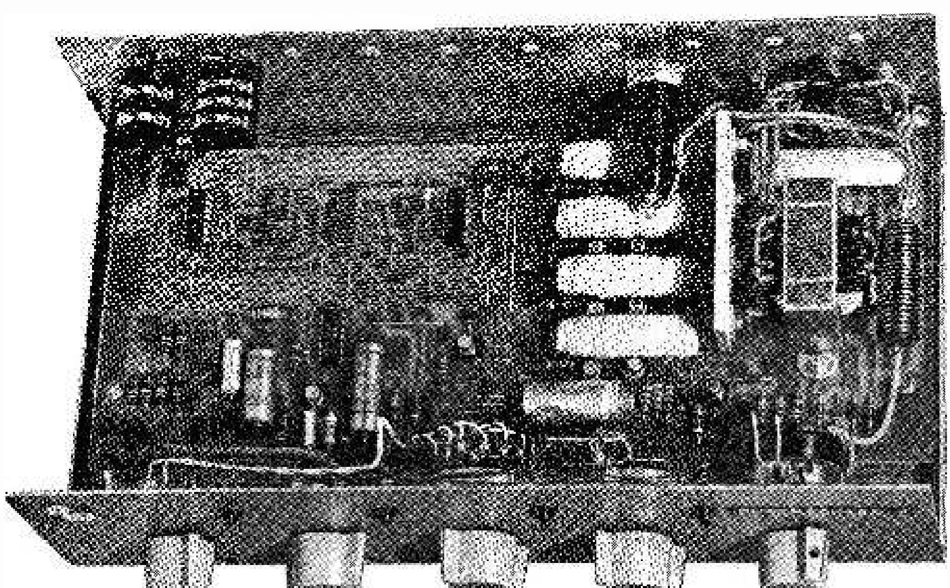
The mains into the unit is below the board and, to prevent any pulling on the connections, it is desirable to fix some form of cable retainer to the lead before the board is installed. The line input goes to S3, on the back of VR3, and it is better to wire the two switch sections in parallel, to ease the current switching problem, rather than switch both line and neutral.

The "mic" and "aux" inputs will probably require some form of attenuator network, particularly if the input is taken off the speakers or is stereo. The arrangement of a suitable network, with values of resistance for differing inputs, is given as Fig. 7. In the prototype unit the components were mounted directly onto the jack sockets. If only mono is to be used then the jack socket can be mono and one resistor can be omitted.

SENS	RA
100mV	22k
1 Volt	220k
10 Volt	2·2 Meg



▲ *Fig. 7. The values of attenuator resistors and their interconnections.*



◀ *Photograph of the inside of the prototype unit. Note that there is room to fit a standard fuse holder for 1¼" fuses. The four pulse transformers are shown as the white rectangles just to the right of the centre. The suppressor choke is to the right of the mains transformer and, in this unit, is not covered with tape.*

SAFETY NOTE

This unit will have mains potentials at various points both above and below the board. If it is required that work should be done whilst the mains is on, e.g. fault finding on the logic, it is advisable to remove the link connecting the Triac heat sink to L1. This will reduce the mains hazard above the board to the switch, the power supply transformer and L1.

No fuse is included in the lamp drive circuits since it is assumed that the mains plug will be fused. If it is not, then a fuse should be included in the unit.

TESTING AND USE

Before applying the mains, set up the following conditions: Dim Switch, S3, off: Speed Control, VR1, to maximum (fully clockwise): Mode Switch, S1, to "programme" (fully anti-clockwise): Lead from the Triac heat sink disconnected from the choke, L1: a volt meter for 5V DC connected between 0V and junction of D15 and R34 (negative to 0V).

Switch on at S3. The meter should read 5V. If it doesn't, switch off and look for faults. If it does, then proceed.

Select the various programmes and check that the LEDs give the correct indications in all positions. The display will be static in this position of S1.

Select any programme, but one lamp is probably best, and put the mode switch to position 2, "clock". The single lamp should progress along the chain. Don't be alarmed if it runs backwards, it only indicates that the toggle, IC3, has come on in the reverse mode. Check that altering the speed control alters the switching rate of the LED.

DISPLAYS

The simplest display is probably a line of four lamps. Expansion is easy, just connect further groups of four in parallel with the first and the patterns chase each other along the chain. An effective variant is to reverse half of the chain, then the lamps will meet and disappear into the centre, or start in the centre and "fall off" the ends (see Fig. 8).

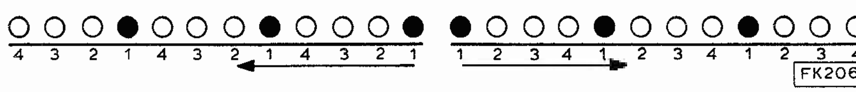
The December cover shows two blocks of four lamps arranged in two squares, each having coloured lenses in identical quarters. This has been found particularly effective and the outline dimensions are given as Fig. 9. To minimise the costs of a coloured display, ordinary pearl lamps have been used and a coloured gel has been stuck to the clear perspex front panel. A further point on economy is to use aluminium cooking foil as a reflector inside the sections. This has two advantages, first is allows lower wattage bulbs to be used with lower current consumption or more displays and, secondly, it assists heat dissipation. A word of warning on metal foil. Be very careful to leave a space around the bulb holder, the foil could slip and become lethal.

It is advisable to connect an extra socket on the display, wired in parallel with the input. This greatly assists extending the display and saves multi-sockets on the control unit.

The lamp units require 6 way cable to operate and, again to save expense, it is probably cheaper to use three core flexible mains lead, doubled up, rather than to locate 6 core cable of the right current carrying capacity. This will result in non-standard use of the core colouring scheme so, again, take care.

The bulbs used in our cover display were 60W. They were quite bright enough and even on full load the display box didn't get overheated. PW

Fig. 8. Diagramatic representation of the simplest lamp display.



Switch the mode switch to "clock reverse". The display should now reverse when it gets to the end of the line and continue to run backwards and forwards.

Switch to "audio" but without any audio input. The display should be static. Add an audio signal, if possible something with irregular loud passages, and the display should cycle in one direction. Alter the gain control and check that it affects the progression rate.

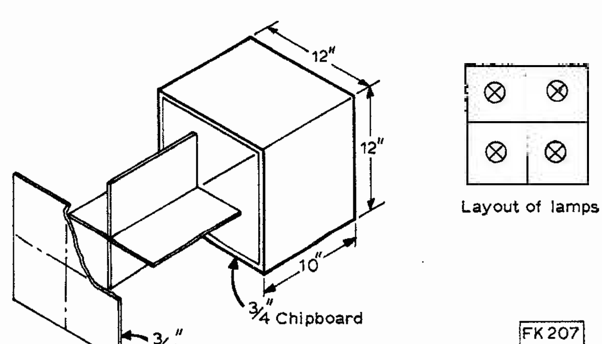
Switch to "audio reverse" and check that the display does reverse correctly.

Switch to "auto" and observe that both the audio input and the internal clock affect the display. This is more tricky and an audio input with a regular beat is probably best together with a fairly slow speed setting.

When all is correct, switch off the mains, reconnect the lead from the heat sink to L1, connect a lamp display and switch on the mains again. The lamp display should follow the patterns of the LEDs. Remember that the dimming control is at minimum immediately after switching on.

Check that the dimming control does cover the range from almost off to fully on. Check that the lamps repeat all the combinations given above.

Fig. 9. The outline dimensions of the box used in our cover display. The coloured film is not shown. If used it can be stuck to the perspex front with any suitable adhesive.



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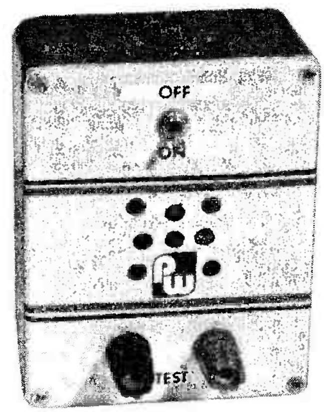

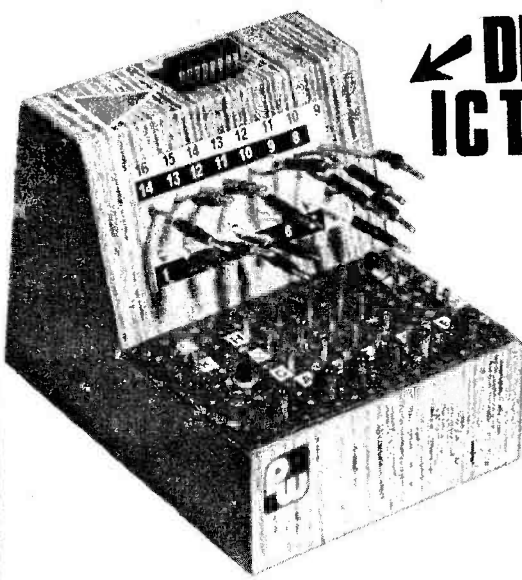

DIGITAL IC TESTER

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The PW electronic POLYPHON Part 1

M.J.HUGHES M.A., C. Eng. MIERE

MANY years ago, before the advent of juke boxes, public places of entertainment often used sophisticated coin-operated musical boxes to amuse their patrons. These instruments were called "Polyphons" and comprised a large diameter brass disc with raised studs running round concentric tracks which actuated reeds to make a musical box sound when the disc was rotated. The discs were interchangeable so one had a large number of tunes to select from. These beautiful instruments have, of course, gone out of fashion although a few still remain in good working order. Those that find their way to antique shops can fetch prices of several hundreds of pounds.

This project describes how to make a modern version of this instrument using electronics for tone generation but retaining the concept of a rotating disc to give the instrument a degree of authenticity. Instead of a brass disc we are using a circular printed circuit board having 12 concentric tracks of contacts and pick-up wires select the notes that are programmed in binary code. Apart from the fun and satisfaction in making the instrument itself, which represents a very attractive novelty in any household, there are hours of fun to be had in programming your own discs of tunes—this is simply done by cutting contacts with a knife on the standard contact discs that can be obtained from the *PW* Readers PCB Service. Later in the article we will give the "Cutting Programme" for two popular tunes.

Design Outline

The overall system is shown in block schematic form in Fig. 1. A variable frequency master oscillator drives an organ "Top Octave" tone generator which produces the twelve notes of a chromatic scale. After buffering (to convert their levels to those of standard TTL) these notes are fed to two identical circuits. Each circuit operates on one of the two notes which can be played simultaneously.

Initially we have to select the note of the octave which has to be played and this is done by using a data selector integrated circuit which is capable of selecting one of sixteen input lines by applying a 4 bit binary code to the data select inputs. Because we only need to select one of twelve signals there is some redundancy here and the four unused lines are held at a permanent 0V level. The binary codes of the 4 bit number are allocated to notes of the scale as follows:

Binary code MSB 8	4	2	LSB 1	Note selected
0	0	0	0	No note
0	0	0	1	C# (Bottom)
0	0	1	0	D
0	0	1	1	D#
0	1	0	0	E
0	1	0	1	F
0	1	1	0	F#
0	1	1	1	G
1	0	0	0	G#
1	0	0	1	A
1	0	1	0	A#
1	0	1	1	B
1	1	0	0	C (Top)
1	1	0	1	No note
1	1	1	0	No Note
1	1	1	1	No note

The binary code to select the note is carried on a set of four contacts on the rotating disc—these occur on four of the concentric tracks. If a contact to ground is present on the disc it represents logic level "0" but if one is not present it represents "1". These contacts are represented in Fig. 1 by the switches on input lines 8, 4, 2 and 1. Due to mechanical tolerances it would be impossible for the pick-

★ components list

Resistors

- R1 2·7kΩ $\frac{1}{4}$W 10%
- R2 2·7kΩ
- R3 560Ω
- R4-R15 33kΩ (12 reqd.)
- R16-R27 2·7kΩ (12 reqd.)
- R28-R39 15kΩ (12 reqd.)
- R40-R45 10kΩ (6 reqd.)
- R46 220Ω
- R47-R52 10kΩ (6 reqd.)
- R53 220Ω
- R54 4·7kΩ
- R55 10kΩ
- R56 3·3kΩ
- R57 1MΩ
- R58 330Ω
- R59 4·7kΩ
- R60 1·8kΩ
- R61 100Ω
- R62 47kΩ
- R63 4·7kΩ
- R64 10kΩ
- R65 3·3kΩ
- R66 1MΩ
- R67 330Ω
- R68 4·7kΩ
- R69 1·8kΩ
- R70 100Ω
- R71 47KΩ
- R72 100Ω
- R73 10Ω $\frac{1}{4}$W
- R74 470Ω
- R75 4·7kΩ
- R76 100kΩ
- R77 1·2kΩ
- R78 2·2kΩ
- R79 12kΩ
- R80 2·2kΩ
- VR1-VR5 5kΩ horiz. sub min. presets (5 required)
- VR6 25kΩ log (ganged with SW1)
- R7 10kΩ
- VR8 100kΩ

NOTE: Apart from R73 Sub min. resistors should be used ($\frac{1}{8}$W).

Capacitors

- C1 1,000pF (polystyrene)
- C2 0·1μF (polyester)
- C3 10μF, 12V
- C4 0·1μF (polyester)
- C5 10μF, 12V
- C6 0·047μF (polyester)
- C7 0·1μF (polyester)
- C8 0·1μF (polyester)
- C9 0·1μF (polyester)
- C10 0·047μF (polyester)
- C11 0·1μF (polyester)
- C12 0·1μF (polyester)
- C13 0·1μF (polyester)
- C14 0·047μF (polyester)
- C15 100μF, 18V
- C16 500μF, 18V
- C17 2,200μF, 18V
- C18 3,300μF, 18V
- C19 1μF (polyester)
- C20 0·22μF (polyester)

Semiconductors

- D1-D4 1N4148 (4 required)
- D5 7V, 400mW zener
- BR1, BR2, DIL 1A bridge rectifiers, type 7533 (2 required), available from Marshalls.
- Tr1-Tr14 BC148 (14 reqd.)
- Tr15 BFY51
- Tr16 BC148
- Tr17 BFY51
- IC1 NE555
- IC2 AY-1-0212
- IC3-IC4 74150 (2 required)
- IC5 7474
- IC6-IC7 7400 (2 required)
- IC8 7414
- IC9-IC10 74174 (2 reqd.)
- IC11-IC12 NE555 (2 reqd.)
- IC13 LM380
- IC14 2812 (12V regulator)
- IC15 2805 (5V regulator) Both TO220 outline
- IC16-IC17 NE555 (2 reqd.)

Miscellaneous

LS1, 8Ω loudspeaker, 5" × 2½". T1, Mains transformer, dual 12V at 1A secondaries, (Douglas type MT-71-AT). M1, low voltage, DC motor (Ripmax type EM136P, from Avicraft Ltd., 6 Chatterton Road, Bromley, Kent). PCBs, main and motor board, coded discs, (Readers PCB Service—see ad.) 1 metre of organ contact wire, (Maplin Electronic Supplies). Circuit board pins. SRBP for pick-up head. Loudspeaker grill material. 3 knobs. Grommett. Cable clamp. 8 stand-offs, 6BA × ½". DIL Sockets or Soldercon strip sockets 5 × 8 pin, 5 × 14 pin, 3 × 16 pin, 2 × 24 pin.

Aluminium turntable. Base plate. Pick-up arm. Bracket for controls. Arm support. (Any or all of these items, except the base plate, available from James & Martin Electronics Ltd., Boyers Yard, St. Albans Farm, Staines Road, Feltham, Middx.)

Perspex lid, (Visijar Laboratories Ltd., Pegasus Road, Croydon Airport, Croydon, Surrey).

Cabinet and loudspeaker panel.

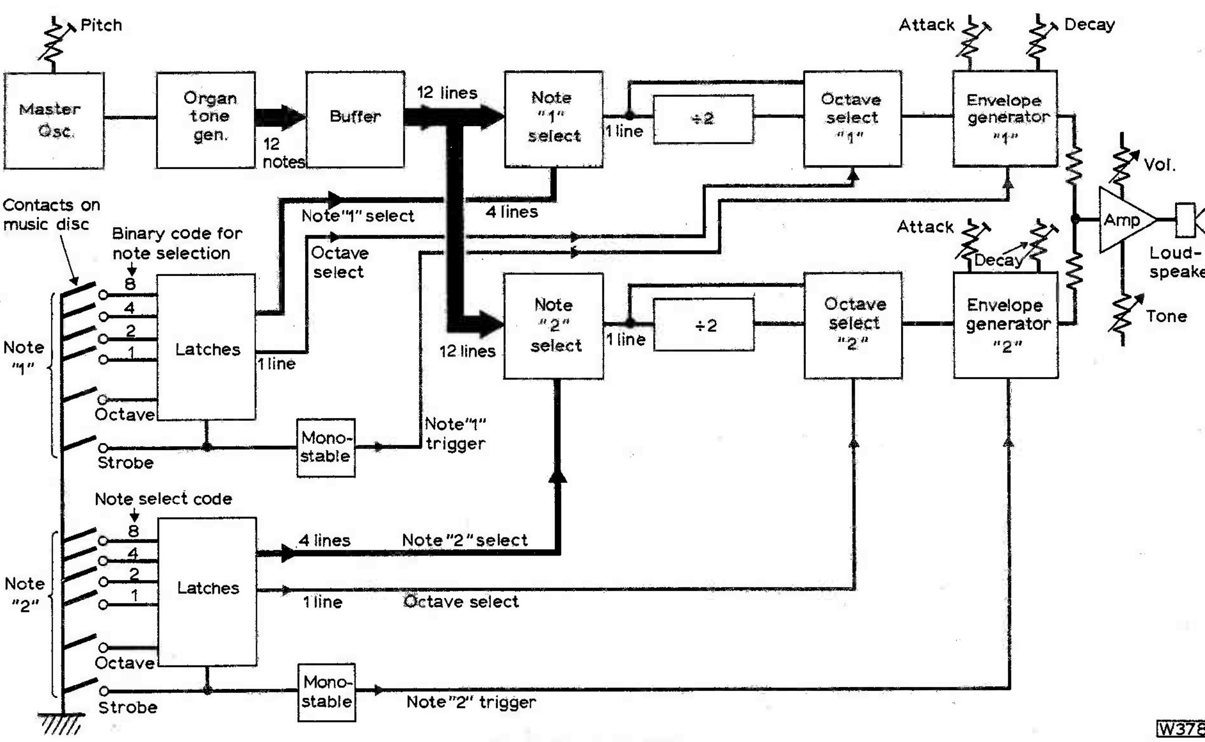


Fig. 1. Simple Block Diagram.

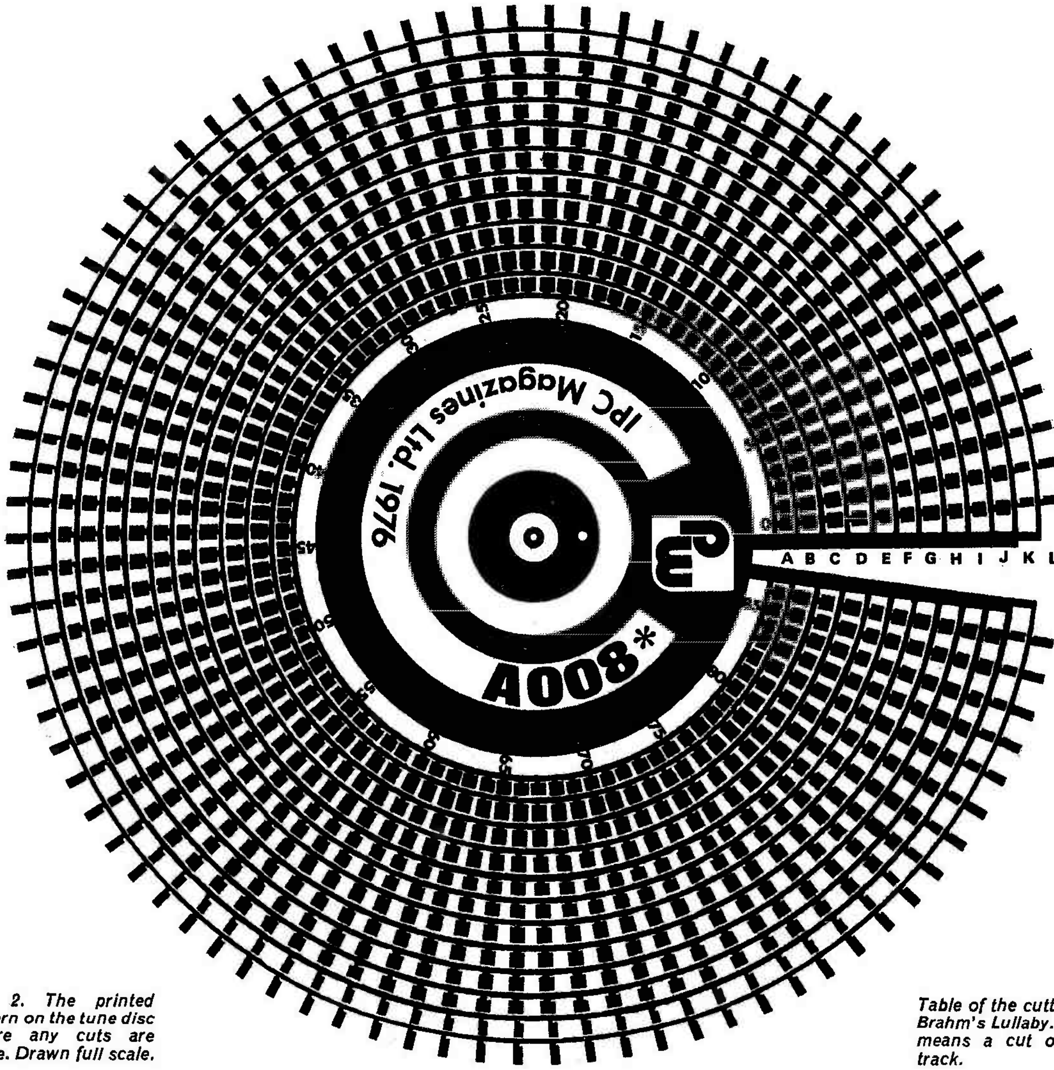


Fig. 2. The printed pattern on the tune disc before any cuts are made. Drawn full scale.

Table of the cutting for Brahm's Lullaby. An 'X' means a cut on that track.

up wires on the disc to sense the right code by taking up the prescribed condition in exact time coincidence therefore we have to use an extra contact on the disc, which is always slightly delayed after the code is set up, to tell the system to accept the code. We call this the STROBE and it is used to trigger a latch which holds the binary code until such time as it is changed. The output of this latch is fed direct to the data selector.

Having selected the right note of the octave the output signal from the data selector is split into two paths; one path goes via a binary divider which converts the note to an octave lower, the other path by-passes the divider but both meet up again in the "Octave Select" stage. Here we can determine whether we want the selected note to be in the higher or lower octave. The control signal for this also comes from a track of contacts on the disc through the latching stage. A "0" will pass the higher octave and a "1" the lower octave.

The selected note in its correct octave is now fed to the envelope generator which forms the square wave into a signal with a fairly sharp rate of attack and a long rate of decay which closely approximates to the waveform obtained from a "twanged" reed. The shape of the envelope is initiated by the same strobe signal from the disc which we have already discussed; the only difference is that we need a very short pulse in this instance and this is obtained by applying the strobe to a monostable stage.

The output from the envelope generator is the note we have selected in the form we require; it only remains to amplify it and pass it to a loudspeaker. Before doing this we have to mix it with the second note when simple chords are required.

The diagram clearly shows that this second note is generated and selected in an identical manner. This, therefore, accounts for the twelve tracks on the disc. To help our explanation we have designated numbers "1" and "2" to the two notes and when it comes to programming a tune on the disc it will be easier if you use Note "1" to select the melody line and Note "2" for any accompaniment or "counterpoint" melody.

Notes Req.			Strobe		Notes								Octave	
1	2		1	2	1				2				1	2
					8	4	2	1	8	4	2	1		
		Track →	L	K	J	I	H	G	F	E	D	C	B	A
		Contact ↓												
tE		0				×								
tE		1				×								
tG	E	2				×	×	×		×				×
,,	,,	3	×	×										
,,	G	4	×							×	×	×		×
,,	,,	5	×	×										
tE	,,	6		×		×								
tE	,,	7		×		×								
tG	E	8				×	×	×		×				×
,,	,,	9	×	×										
,,	G	10	×							×	×	×		×
,,	,,	11	×	×										
tE	,,	12		×		×								
tG	,,	13		×		×	×	×						
tC	E	14				×				×				×
,,	,,	15	×	×										
tB	,,	16		×	×		×	×						
,,	,,	17	×	×										
tA	G	18			×			×		×	×	×		×
,,	,,	19	×	×										
tA	D	20			×			×			×			×
,,	,,	21	×	×										
tG	B	22				×	×	×	×		×	×		×
,,	,,	23	×	×										
tD	,,	24		×			×							
tE	,,	25		×		×								
tF	D	26				×		×			×			×
,,	,,	27	×	×										
tD	B	28					×		×		×	×		×
,,	,,	29	×	×										
tD	,,	30		×			×							
tE	,,	31		×		×								
tF	D	32				×		×			×			×
,,	,,	33	×	×										
,,	B	34	×						×		×	×		×
,,	,,	35	×	×										
tD	,,	36		×			×							

Notes	Req.		Strobe		Notes								Octave	
1	2		1	2	1				2				1	2
					8	4	2	1	8	4	2	1		
		Track →	L	K	J	I	H	G	F	E	D	C	B	A
		Contact ↓												
tF	,,	37		×		×		×						
tB	D	38			×		×	×			×			×
tA	,,	39		×	×			×						
tG	B	40				×	×	×	×		×	×		×
,,	,,	41	×	×										
tB	G	42			×		×	×		×	×	×		×
,,	,,	43	×	×										
tC	E	44			×	×				×				×
,,	,,	45	×	×										
,,	G	46	×							×	×	×		×
,,	,,	47	×	×										
C	,,	48		×	×	×							×	
C	,,	49		×	×	×							×	
tC	F	50			×	×				×		×		×
,,	,,	51	×	×										
,,	A	52	×						×			×		×
,,	,,	63	×	×										
tA	,,	54		×	×			×						
tF	,,	55		×		×		×						
tG	E	56				×	×	×		×				×
,,	,,	57	×	×										
,,	G	58	×							×	×	×		×
,,	,,	59	×	×										
tE	C	60				×			×	×				×
C	,,	61		×	×	×							×	
tF	D	62				×		×			×			×
,,	,,	63	×	×										
tE	G	64				×				×	×	×		×
,,	,,	65	×	×										
tD	F	66					×			×		×		×
,,	,,	67	×	×										
C	E	68			×	×				×			×	×
,,	,,	69	×	×										
,,	,,	70	×	×										
,,	,,	71	×	×										
,,	,,	72	×	×										
,,	,,	73	×	×										

Tune Blanks

The design for the master disc is shown in Fig. 2. Note that initially all the contacts are linked through a narrow shoulder into their respective track busbars and that all the busbars are linked together and thence to the solid copper region in the centre of the disc. A thirteenth contact rests on this central area linking all contacts to a common ground. A contact is programmed to represent logic level "1" by cutting through the conductor at the narrow shoulder. Pull-up resistors on each of the contact wires ensure that a "1" is assumed when no contact to ground is made.

The disc is designed to rotate in a clockwise direction and you should note that the contacts on the two outer tracks are slightly narrower than the rest. These are used for the strobe signals which must occur slightly AFTER the formation of the binary codes for the notes (hence their narrowness).

The tracks are designated A (inner track) to L (outer track) and the following table shows the relationship of the tracks to the binary codes for the two notes:

TRACK	DESIGNATION		
A	Octave Select		Note 2
B	Octave Select		Note 1
C	Bit 1 (LSB)	for	Note 2
D	Bit 2		Note 2
E	Bit 4		Note 2
F	Bit 8 (MSB)		Note 2
G	Bit 1 (LSB)	for	Note 1
H	Bit 2		Note 1
I	Bit 4		Note 1
J	Bit 8 (MSB)		Note 1
K	Strobe	for	Note 2
L	Strobe	for	Note 1

If the constructor wishes to make his own discs it is important to remember that they MUST run

"True" and the centre holes must be drilled with great care. Tolerance of the positions should be within $\pm 0 \cdot 01$in. In practice we have found that plain copper left "as etched" is the best surface for the contact wires to run on.

Contact Comb

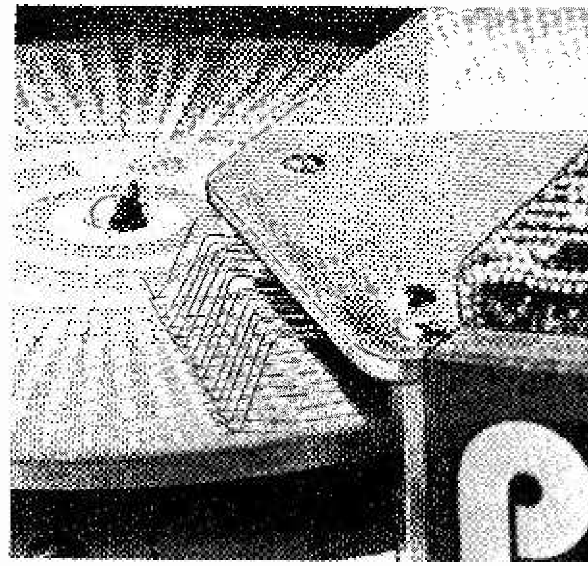
The pick-up wires have to be specially shaped with a fairly high degree of accuracy and this presents the part of the project which needs most skill and care. The material is gold-plated beryllium copper cut into lengths of approximately $2\frac{3}{4}$in.

The separation between the pick-up wires has to tally exactly with the pitch separation of the tracks on the disc which is $\frac{1}{8}$in between the 12 major contacts but the common ground pick-up is separated from the rest by $\frac{1}{4}$in. To mount the wires we suggest that you cut fine slots in a blank piece of SRBP with a fretsaw blade and drill a small hole behind each slot as shown in Fig. 3a. Next, using a pair of pliers, put a precise 90° bend about $\frac{3}{4}$in from the end of each of the contact wires. The short end is passed through the hole and the long end should pass over the slot. When all are in position another thin piece of SRBP should be glued and clamped over the top of the wires (using fast-setting epoxy resin) while at the same time ensuring that the longer ends of the wires push down slightly into the slots you have cut (see Fig. 3b). This ensures their correct position.

Use a needle file to elongate the holes in the SRBP mounting block as shown in the diagram—these are needed for adjustment later.

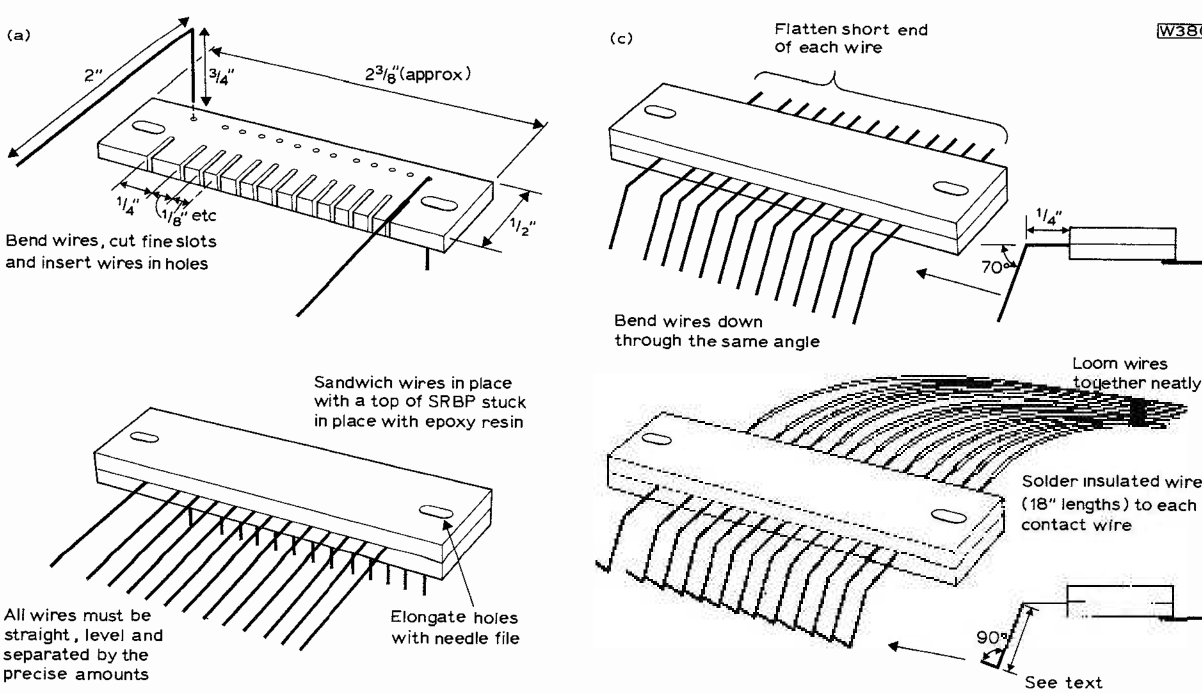
The next step is to form the contact ends. This is best done by clamping all the wires between two metal strips (Meccano strips will do) about $\frac{1}{4}$in from the front end of the SRBP mounting. Although the distance is not critical it should be exactly the same for each wire. Give a downward bend through approximately 70°, Fig. 3c, so that each wire is bent by the same amount and then remove the metal clamp.

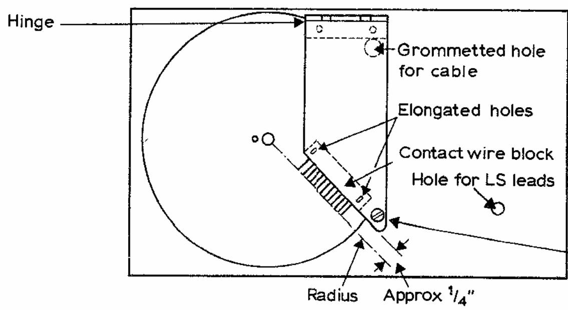
Finally replace the clamp $\frac{1}{2}$in from this bend. The actual distance will depend on the clearance

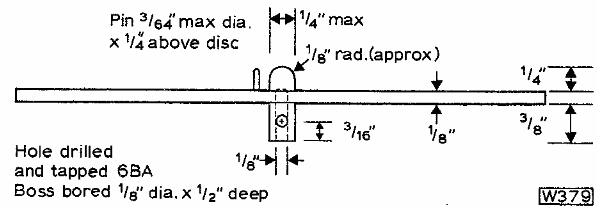


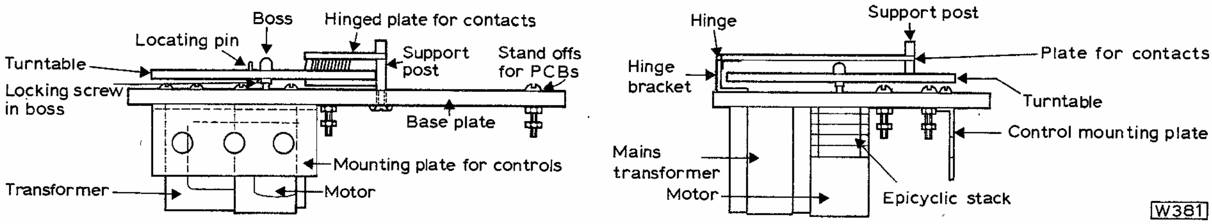
Photograph of the Contact Comb on the disc. Note that the actual connections are on a radius and that the arm is parallel to the radius

Fig. 3. The various stages involved in making the Contact Comb. Before tightening the cable ties (3d.) bend the cable along the arm.









between the top of the disc on the turntable and the height of the contact mounting block when it is assembled under the hinged arm of the deck and whatever this distance happens to be you must allow a bit more to ensure that the wires are under their own spring tension when they are pressed down on the disc. Once you are satisfied that you have the right distance the ends of all the wires should be bent upwards through 90°. The clamp can now be removed and the excess length of each wire cut off about 1/8in from the last bend.

You should now have a set of pick up wires that are all identical in length, angle and alignment. The 3/4in tail of each which protrudes through the hole you initially drilled should be flattened and an 18in length of fine flexible insulated wire should be soldered to each and these wires neatly bound together to form a flexible cable as shown in Fig. 3d.

Fig. 4. The general assembly of the major mechanical parts to the base plate.

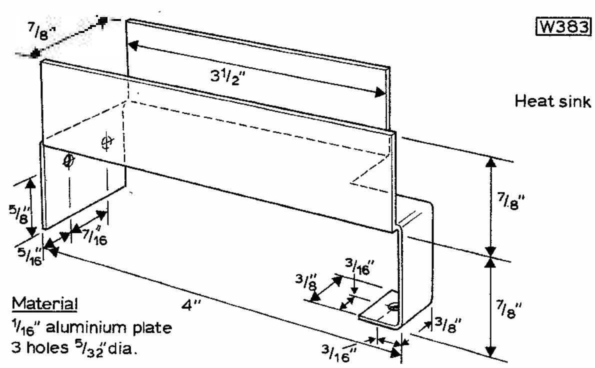


Fig. 6. Details of the Heatsink for ICs 14 and 15.

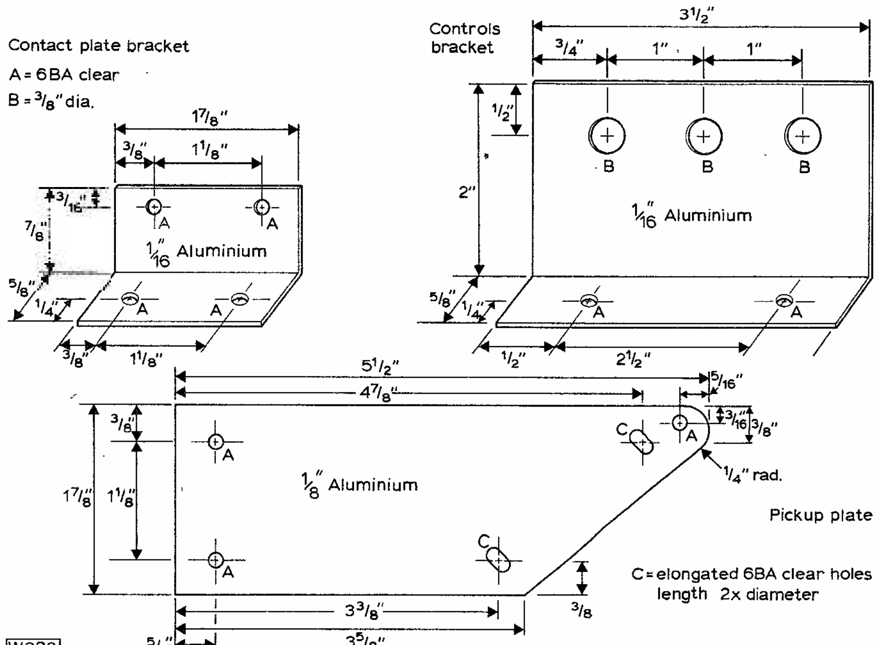


Fig. 5. The two brackets required, one for the variable controls and the other for the contact arm, and the contact arm itself as used on the prototype.

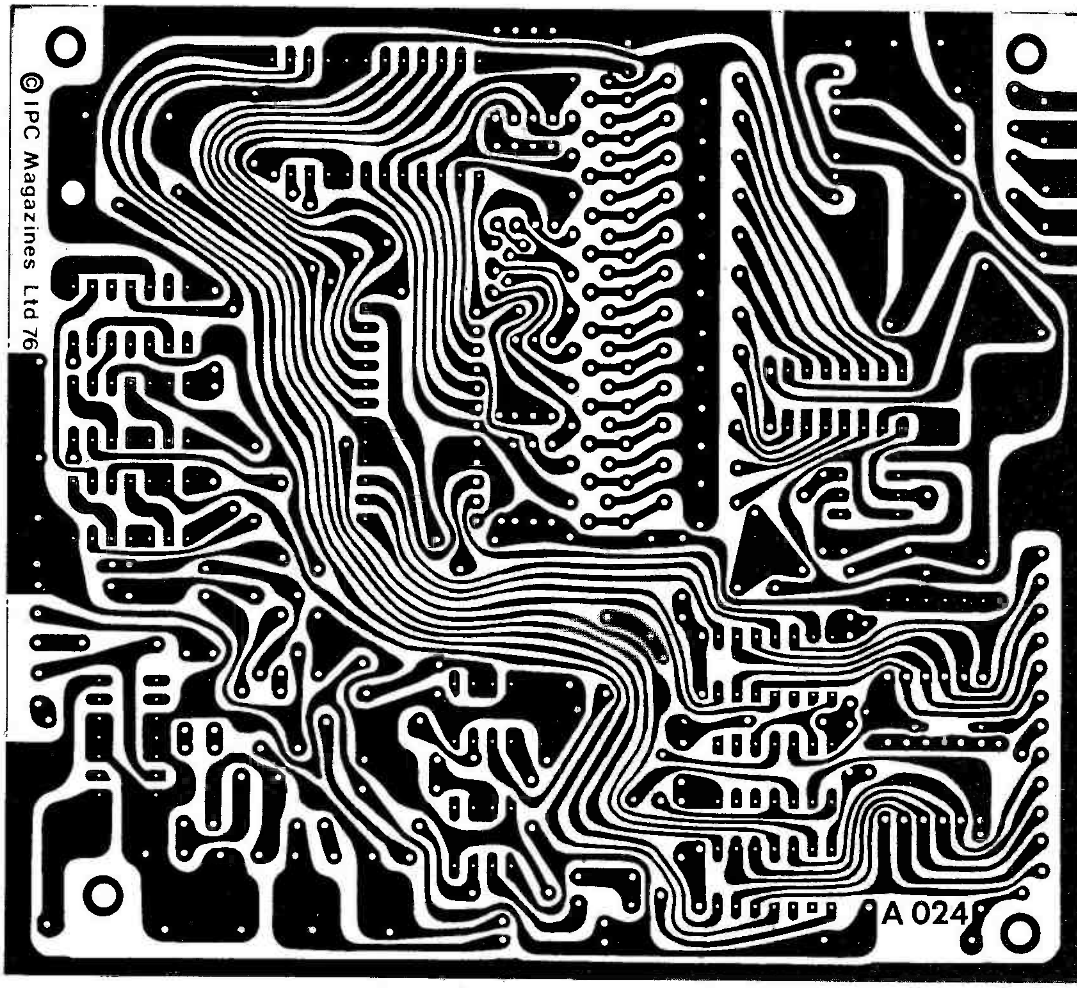


Fig. 7. The printed wiring pattern for the main electronics board, drawn full size, which will be required irrespective of the motor used.

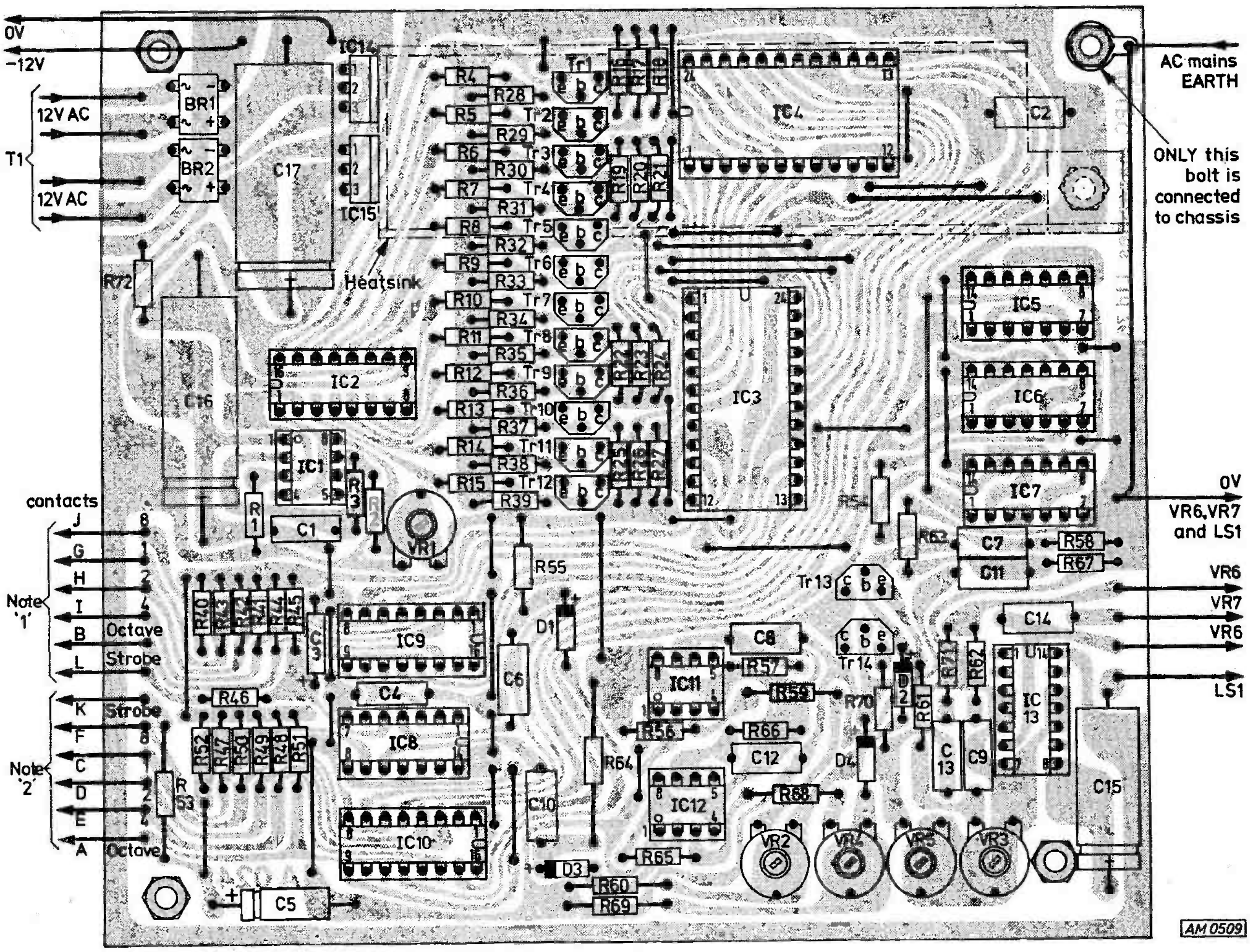
General Assembly

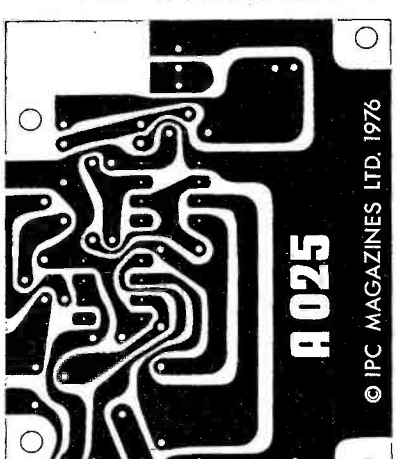
You should now concentrate on the mechanical assembly of the rest of the deck shown in the detailed drawings of Fig. 4. Note that the hinged arm is cut at an angle on its front end and this angle should be parallel to a radius from the centre of the motor shaft but set back approximately ¼in—this is to ensure that the contact points of the pick-up wires will fall EXACTLY on a radius when the block is fixed in place under it. Note also that the fixing holes for this are elongated in a direction at 90° to those in the block—again for adjustment but in the other plane (see Fig. 5). A grommetted hole is provided in the base plate near the hinge for the leads from the pick-up wires to pass through. Try assembling the mechanical parts, put an uncut disc on the turntable and then make sure you can adjust the pick-up wire block so that the wires all make contact with the twelve tracks exactly on a radius. When you are satisfied that this is possible the unit can be dismantled and all the metal parts polished and varnished prior to final assembly.

Before starting assembly of the boards it is necessary to make a heat sink for the voltage stabilisers. Details of this heat sink are given in Fig. 6. Having completed the critical mechanical assembly a start can be made on the electronics. The main board contains all the circuitry except for the manual controls and the motor speed control unit.

The wiring pattern for this board is given as Fig. 7 whilst the component positions and orientations are shown on Fig. 8. The order of assembly isn't important except, of course, the heat sink for IC14 and IC15 must be last. It is suggested that the ICs are bolted loosely to the heat sink before inserting the leads into the board holes. This will avoid deforming the leads in the event that hole positions in the board and the heat sink don't line up exactly. Don't forget to tighten the nuts after assembly and before the board is fixed into the box.

The second board holds the components required to drive the motor. This too is a printed wiring board and the track pattern is shown as Fig. 9. There are very few components on this board but capacitor C18 is large and will need to be inserted last. To conserve space, we had to remove the corner of the board to assemble the motor. A portion of the board has been left blank so that those using a similar box shape and size can do likewise. The posi-





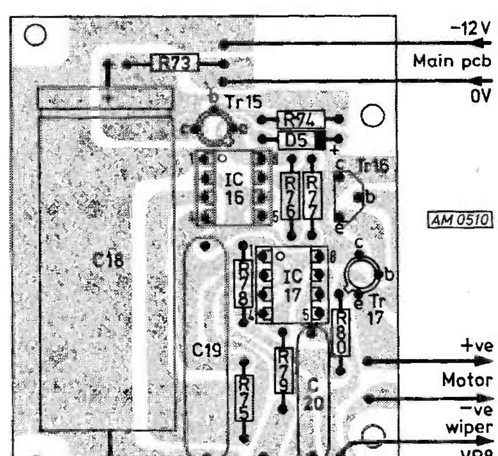


Fig. 8. The overlay for the main electronics board showing locations and orientation of the components.

Fig. 9. The wiring pattern and component overlay for the motor board. Note this circuit and board pattern are designed for the motor specified. Other motors may require other control circuitry.

tion of the components and of the section to be removed is detailed in Fig. 9.

The packing density on these boards is high and the track patterns and solder lands are close together. It is, therefore, essential to use a miniature soldering iron and care should be taken to avoid solder bridges across conductors. Equally, care must be taken when inserting retaining screws for the heat sink or for mounting the board in the case.

The two boards, the motor, the transformer and the bracket for the manual controls can be assembled on to the base board for testing but the control bracket will need to be released in order to fit the base plate into the box.

Our next issue will include the outline drawings of a suitable box and of the Perspex lid. It will also explain how to programme your own tunes. A full explanation of the functioning of the electronics will be given.

HOTLINES

Quite illogical

One of the problems with electronics is that just as you start to get really familiar with some technology or device, another generation comes in to replace it and you have to start all over again.

This could well be the case for all of us when new devices I'm hearing about come on the market. The area is logic. We all know that there are two basic states "on" and "off" or '0' and '1' etc. Just to confuse the issue, I hear that a semiconductor company is planning to introduce devices which are called "Multi-level logic". In other words many different levels of logic and not just '0' and '1'.

The first devices will handle four levels (so I'm told) which will correspond to 0, 1, 2, and 3. But already other more complex devices are in the laboratory—even though the first "simple" ones are not yet on the market! One such research is devoted to a decimal logic with ten levels.

There are, in theory, many advantages to be had from such multi-level systems which, until now, had existed only in the realms of theory. Great density for a given size chip should be one bonus to be had. If and when these devices are for sale on the hobbies market, they will offer a tremendous scope for experimentation since they will provide a flexibility which is just impossible with "ordinary" two-state logic.

Power to the people

Ever been into a shop to buy some batteries for a calculator or tape recorder? Aren't there a lot of different types about these days—all with different numbers and all 'claiming' to last longer or give better performance.

Perhaps the deciding factor of what you buy in the battery line will hinge on the success of two manufacturers; one German and the other Japanese. Both have launched a range of Lithium batteries and some amazing advantages are claimed. "High energy density" is one desirable feature attached to these components. What does it mean in real terms?—a question I put to one of these manufacturer's representatives.

The answer is that when they say "High energy density" that's exactly what they mean. In real, down-to-earth facts it means up to ten times greater than standard dry cells. One application for these batteries has already been found. They are to be used in pacemakers and in that equipment should last for some ten years before renewal is necessary. Doubtless a variation on the saying "More power to your elbow?". Speaking about batteries and power sources reminds me of a solar development which sounds interesting. An American manufacturer is to market a complete "power package". The basic kit comprises four rechargeable nickel-cadmium batteries plus a small bank of solar cells. The cells are connected up together to form a $3\frac{3}{4} \times 3\frac{3}{4}$in panel and this is used to charge the cells. In strong sunlight, the cells give 6V at some 60mA which is ample to charge up the batteries.

The price for the basic kit (in the U.S.A.) is equivalent to around £23. Dare I say they are almost certain to cell well?

Technological bloodhound

Among the newer technologies in electronics can be found the I^{2}L devices, or injection logic as they're called. They first entered the arena with no real general application although this is radically changing. The latest area into which I^{2}L has installed itself is in working with a gallium-arsenide smoke detector.

Understandably, the U.S. authorities are quite strict on reliability in such devices. For example, one authority lays down that battery-operated smoke detectors have to work for 12 consecutive calendar months. They must also have the capability of triggering a horn when light is obscured by smoke to the tune of a mere 2%. Such equipment must also be capable of giving a 7-day warning when battery power is failing past a certain point and finally should be able to sound a horn for four hours.

In the device I'm talking about (called an MCC 158) the injection logic is essentially a reliability watchdog. If the sensor is not working properly, or if there is any malfunction in the following amplifier—or when the battery gets 'low', the I^{2}L devices will sound the alarm horn intermittently.

It is interesting, too, how complexity had built up. For example MCC 158 drives a system which takes a very quick peep at the smoke for only 50 millionths of a second every five seconds—a sort of precision 'sniffing' of the atmosphere. It does seem an incredibly short time, but then I suppose it nose what it's looking for!

Marked cards

One of the problems for a forger is the watermark built into the very fabric of the paper in our currency. You cannot really change it or obliterate it without arousing suspicion and yet it must be there for the note to be valid. Again, the watermark is quite easy to detect with the naked eye simply by holding the note up to the light.

A British company has now managed to do almost the same thing but with magnetic materials. Conventional magnetic striping of cards, tickets etc is straightforward and this company has succeded in encoding the stripe with what amounts to an electronic watermark.

The process encodes small cross sectional areas of the magnetic stripe and, more importantly, in such a way that these codings cannot be altered or erased by electromagnetic influences at the surface of the stripe.

One can envisage a north pole card and a south pole card drawing their bearers closer and closer together, which may explain why many of London's computers look a little drawn!

Ginsberg

PW 'Easybuild' VIDEO-WRITER

PART 6

M.J.HUGHES M.A.,C.Eng. MIERE

This month's Section completes the design detail of the remaining circuits on the combining board D004.
It covers the Cursor Generator, the Video Mixing, the Keying Information and the Character Stepping requirements.

CURSOR GENERATION

We now turn to the Cursor Generator and Video stages shown in Fig. 26. The Cursor is used to show where on the screen the next character will appear when a key is depressed. All we need to do is indicate the position of the character cell in question. We already know that the Address Coincidence signal (generated by the Comparators) designates the position on the screen pointed to by the Address Register so this signal is obviously going to be the starting point in producing the Cursor.

It must be remembered, however, that all displays of our video data are delayed by one character cell width. To ensure that the Cursor illuminates the correct part of the screen we must also delay the Address Coincidence signal by one character cell. This is done in exactly the same way as before—by using a D Type flip flop (IC48a) triggered by $\overline{Q23}$ See Fig. 27. The delayed Address Coincidence signal appears at pin 5 provided the clear input of the flip flop (pin 1) is held at logic level "1". If we clamp this clear input to ground with S1 we will stop any output from the flip flop and this conveniently provides our "Cursor Extinguish" signal.

To make the cursor an interesting shape we AND the delayed Address Coincidence with Q21 and $\overline{Q30}$ (from IC50a) and this combination of signals produces a chequered pattern. We have chosen $\overline{Q30}$ instead of Q30 because it makes the cursor stand one row of picture points HIGHER than a character and is thus easier to see when it is being stepped "over the top" of other characters on a full screen.

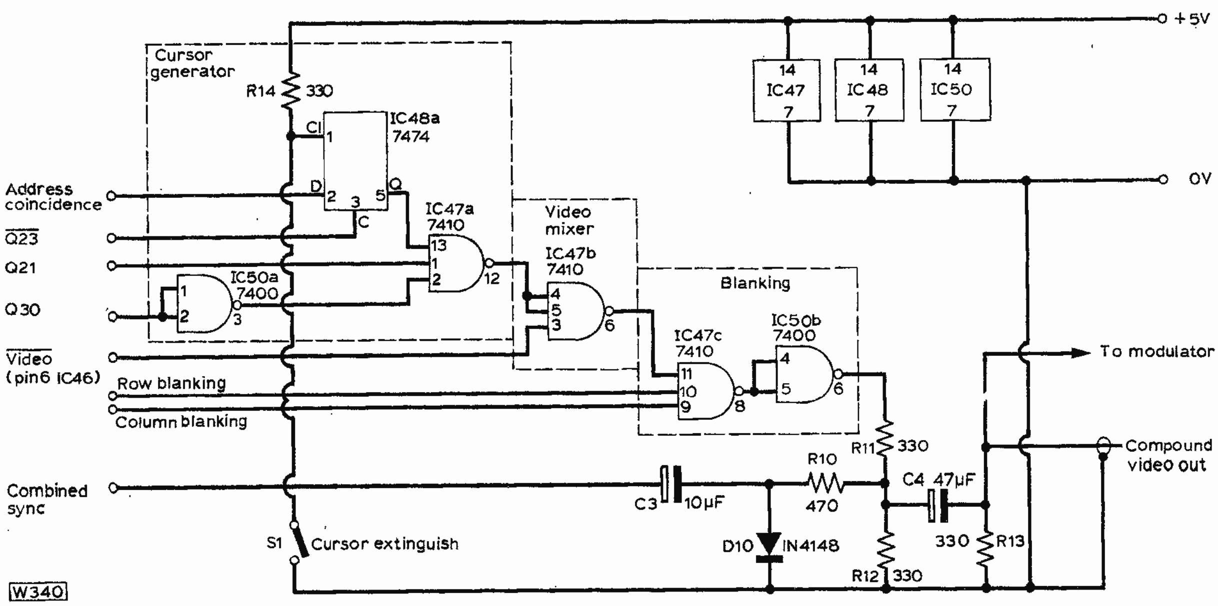
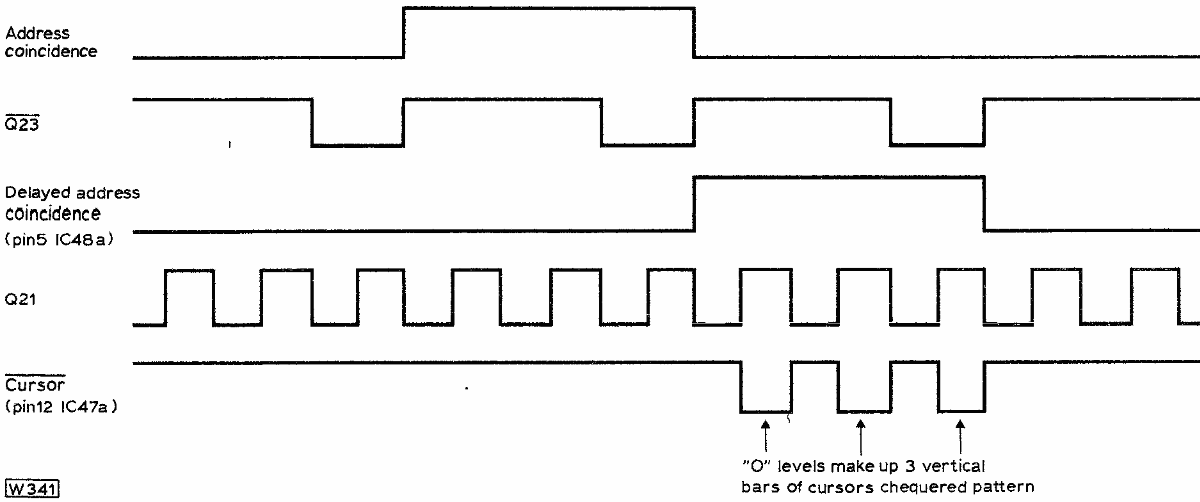


Fig. 26. The Cursor and Video Output circuitry.



VIDEO MIXING

The Cursor and Video signals are ORED together in IC47b which we have called the Video Mixer and the combined signal is fed to IC47c and IC50b where it is ANDED with the Row and Column Blanking signals. The blanking operation ensures that we have well defined margins at the top, bottom, left and right of the screen (see Fig. 28).

To complete the video stage it only remains to combine the video signal with the TV sync pulse train which was produced by the sync generator board. This is carried out by the passive resistor circuitry and the compound output is taken across R13. The video level so produced is somewhat greater than the normal 1V peak to peak but the output impedance is higher than the standard 75 ohms. When fed into a standard monitor the 75 ohms termination will drop this signal level to normal values.

Several commercial makes of video monitors as well as a Sony U Matic video cassette recorder have been driven with complete success by the output of the Video Writer. If you follow our recommendation of using the Heathkit Portable TV as a monitor this output can also be fed straight to the modification point mentioned in Part 1. For those who do not have monitors and for applications that need the output routed to several displays over a large area we suggest that a UHF modulator be used to feed into the aerial socket of any UK standard television receiver.

Fig. 27. The wave patterns required to provide the three vertical bars of the cursor. To provide the three horizontal bands the output $\overline{Q30}$ is 'anded' with this.

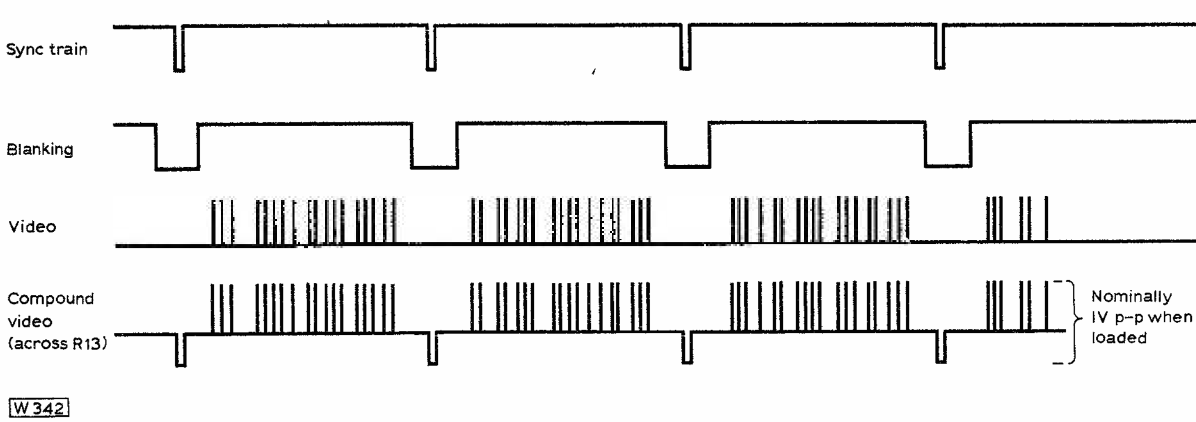
In the first prototype the video signals from C4 were fed directly to the input of a Crofton Modulator. In the second prototype a *Practical Wireless* design was used which gave a significant improvement in resolution due to its wider bandwidth capabilities.

KEYING IN INFORMATION

We must now deal with the keyboard interface and Write generator. These are shown in Fig. 29. All seven data bits and the strobe from the keyboard are required in this stage.

The seven bits are needed because we have to detect the non-writing control functions. These are Forward/Reverse, Cursor Step, Carriage Return and Line Feed. These keyboard codes are detected by ICs 51 to 54 respectively but you will also note that the Strobe signal feeds these same gates. This is necessary so that the gates do not output any signal until the keyboard data is stable. All but the Cursor Step signals are fed to the Address Registers.

Fig. 28. This drawing shows the principle of combining the Sync, Blanking and Video signals to produce the final Compound Video output.



We have to generate a $\overline{\text{Write}}$ command every time we press a "Writing" Key of the keyboard but NOT when we activate any of the above control functions. It is a fact that whenever these four codes are generated bits 4, 6 and 7 are always "1", "0" and "0" respectively and this combination does not occur for any of the codes of writing characters. We only need to detect this specific condition of bits 4, 6 and 7 to generate an inhibit signal for our $\overline{\text{Write}}$ generator.

This set of three signals is detected by IC55a and you will note that we do not wait for the Strobe in this case. This is rather important because we have to know that we have a non-writing control function BEFORE any decisions are made within the logic to generate the $\overline{\text{Write}}$ signal and the latter is carried out on receipt of the Strobe pulse's rising edge. IC55b is driven by the writing inhibit signal and when such a signal exists the strobe is blocked by the latter gate.

We need to generate our $\overline{\text{Write}}$ signal when we reach the correct address for the position on the screen in question and this is, of course, recognised by the Address Coincidence signal. We also have to make sure that the writing instruction—which makes the Read/$\overline{\text{Write}}$ input of the RAMs go to level "0"—is produced within the valid address period and it must be prevented from overlapping between two address locations. See Fig. 30.

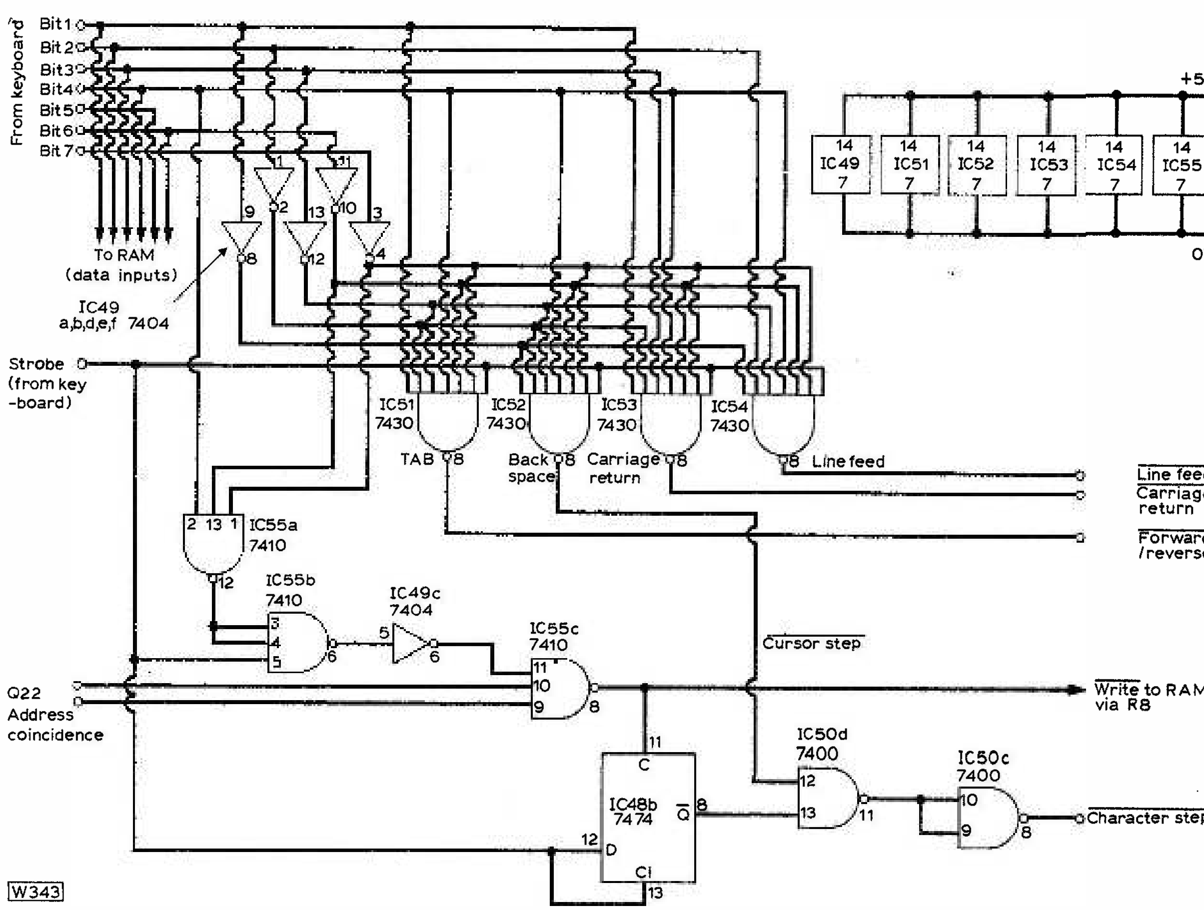
To prevent any ambiguity caused by an overlap (which could be introduced by propagation delays) we bring into play the Q22 signal which gives a pulse in the middle of a cell address and is well away from the edges (as far as time is concerned). The Strobe, Q22 and Address Coincidence are NANDED by IC55c and the output of this gate goes to "0" when all the signals are high. This gives the $\overline{\text{Write}}$ signal which is fed to all the RAMs via R8.

CONTINUOUS WRITE

There is frequently a requirement to carry out a rapid "ERASE" of all data in the memory. It would be possible to do this by using the spacer bar to type through every one of the 512 character positions—thus writing a "space" code in to every memory location. This would be a very time consuming and tedious job and the circuit enables a very rapid erase by using the "Continuous Write" button (S3). When this button is depressed a logical "0" is forced on to the $\overline{\text{Write}}$ inputs of the RAM chips and puts them into a permanent Writing state. This overrides the normal $\overline{\text{Write}}$ input signal (hence the reason for R8 which prevents shorting the output of its driving gates to ground when S3 is pressed).

Continuous writing means, in effect, that whatever data is being applied to the Data Input pins of the

Fig. 29. The Keyboard Interface circuitry for detecting the non-writing control codes and for generating the writing signal when necessary.



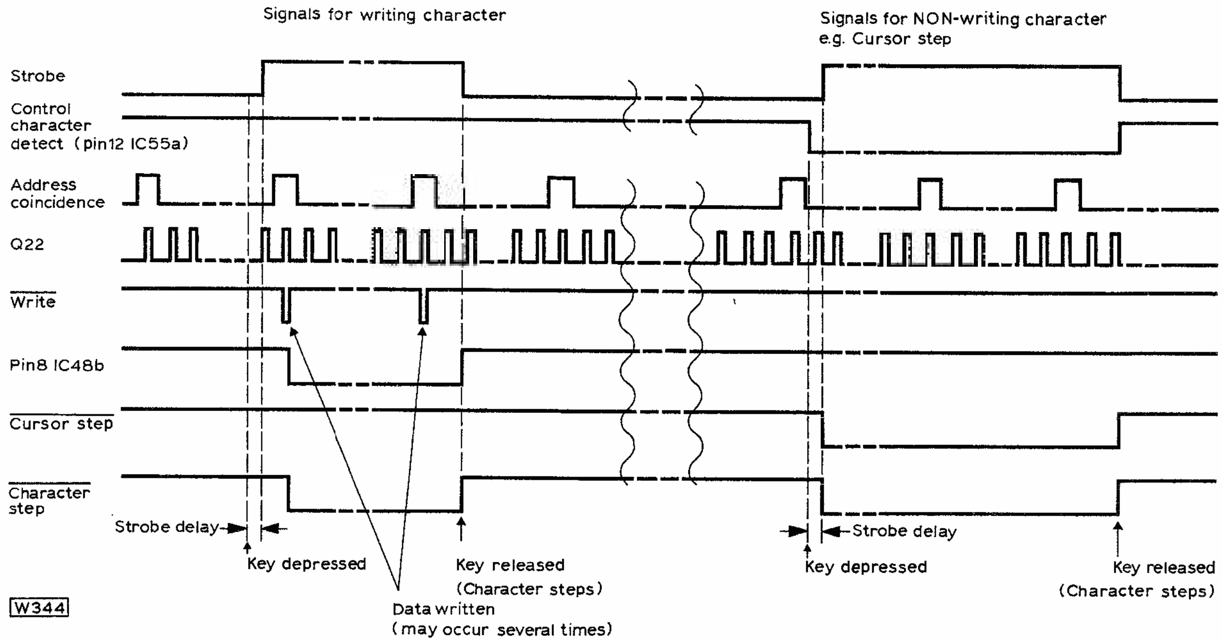


Fig. 30. The major waveforms used to generate the Write and Character Step signals. The time axis is not to scale but note that it is Q22 that occurs within Address Coincidence which gives the Write signal. The Strobe and Control Character Detect signals are asynchronous (i.e. are generated by manual operation of the keyboard). The fact that several Write pulses occur during a key depression does not matter. It simply means that the same data is rewritten into the same address location.

RAMs is written into EVERY memory location in one single Addressing scan (i.e. within the time of a single TV Field). The screen is "Filled" with 512 repeats of the single character that was selected. For erase purposes one would, in practice, depress the spacer bar key and while it is depressed give a quick touch to the "Continuous Write" button. The result is a screen full of spaces or, in other words, a blank screen.

Alternatively it is possible to select any other character, or symbol, and fill the screen in a similar manner. This is a useful facility if the unit is to be used for display advertising when a patterned background might be required.

CHARACTER STEP

There is only one more signal to account for; this is Character Step which, if you remember, increments the Column Address Register each time a writing key or Cursor Step is depressed. It is important that the register is not incremented during a writing pulse otherwise we would get double characters on the display; we also have to make sure that it is not incremented by any of the control functions (with the exception of Cursor Step).

The D Type flip flop (IC48b) ensures that these conditions are fulfilled for writing codes and the Cursor Step signal is ORED with this in IC50d. The inverted character step command is then available at the output of IC50c from where it is fed to the input of the Column Address Register.

KEYBOARD VARIANTS

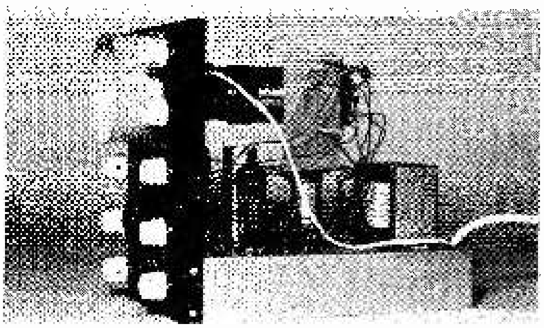
It is assumed that the keyboard unit will provide positive logic output signals for the seven data bits (i.e. +5V signals to represent "1" and near OV for "0" and that the strobe signal is activated a millisecond or two after the data has been set up. The Strobe must also go from OV to +5V after this delay period.

It is understood that there are a number of "surplus" keyboards on the market which will be perfectly adequate for this project but there may be one or two variants in their output parameters. It would be impossible to cover all eventualities within the printed circuit of our keyboard interface so it is recommended that modifications to the output signals from the keyboard unit to bring them into line with the input requirements of the keyboard interface should be carried out on an extra board.

The modifications required for one such keyboard unit will be described later together with an alternative method of entering data for those who do not wish to purchase a keyboard. PW

There have been some errors on the PCBs reported to us. Although these errors were incorporated into our prototype it performed all the functions we required of it. For completeness the amendments should be added. Details are:
1. Board DOO2, IC10, pins 10 and 11 should be connected (as Fig. 13).
2. Board DOO3, IC37, pin 4 should be connected to pins 8, 9, 10 and 15 (as Fig. 21).
3. Board DOO3, IC35, pin 11 should be linked to IC34 pin 3.

In our next issue, available early January, we will cover the General Assembly of the boards and the keyboard into a suitable case and will describe the modifications required to use another keyboard.



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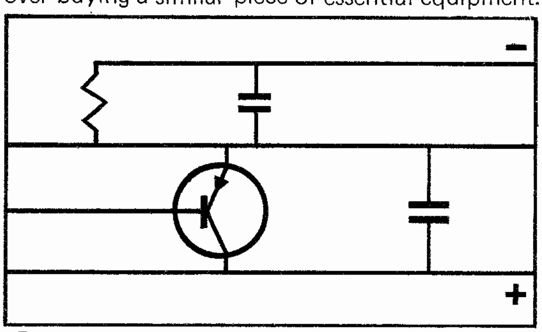

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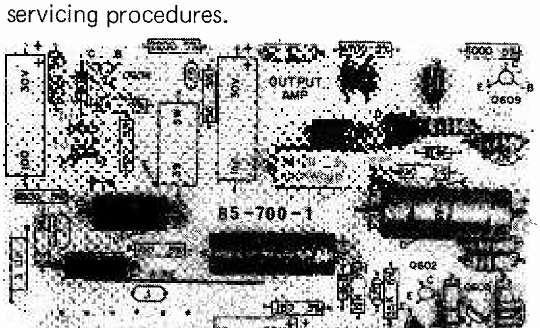

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WB 17

S-DeCnology

DAVID GIBSON

THIS MONTH

'Christmas Pudding Saver'

IT is rumoured that many a Christmas pudding suffered an undignified fate in certain unspecified workhouses—but at least they were cooked. This Christmas, as those in the past, will find many a pudding ruined and there is a common cause. A saucepan is usually half-filled with water. The pudding, in its basin, is then put into the water and the pan is heated until the water boils. The water is then left to simmer i.e. just boiling, for a period of hours depending upon the size of the Christmas pudding undergoing the cooking.

The 'common cause' referred to earlier is that of inadvertently letting the pan boil dry with a resulting burnt and ruined pudding—and possibly a saucepan also.

This months S-DeC project is a little more complex than the Guardian Angel shown in the last issue, but only by virtue of using a few more components. Exactly the same principles apply—simply plug the components into the S-DeC holes shown on the circuit diagram (duplicated on the layout diagram), and you should have no problems.

Too little water

The circuit basically senses when there is too little water in the saucepan. If this happens, an alarm is triggered. In this circuit, in the interests of simplicity, a lamp flashes repeatedly. A further reason for using a lamp is that the lamp bulb used for the last project may also be used for this one—as can all three transistors. The only additional components are two 10μF capacitors, 5 resistors and a potentiometer.

Although the application suggested here is topically seasonal, other applications are suggested later on.

The circuit comprises a free running multivibrator (transistors Tr1 and Tr2) which feeds a lamp driving transistor Tr3 via the 4·7kΩ resistor.

The multivibrator, when it is running, will provide a series of pulses at Tr2 collector. However, notice the dotted lines marked "probe" which plug into S-DeC holes 14 and 19.

The probe consists of two conductors separated by a small gap. Two bare wires about half an inch long and ¼in. apart will work for a prototype, or perhaps two adjacent tracks on a printed circuit board.

Driving pulses

If one ignores the potentiometer for a moment, a break in the base circuit of Tr2 caused by the probe will allow the multivibrator circuit to function and produce the driving pulses at Tr2 collector. These in turn will pulse Tr3 on and off which in its turn causes the lamp to pulsate.

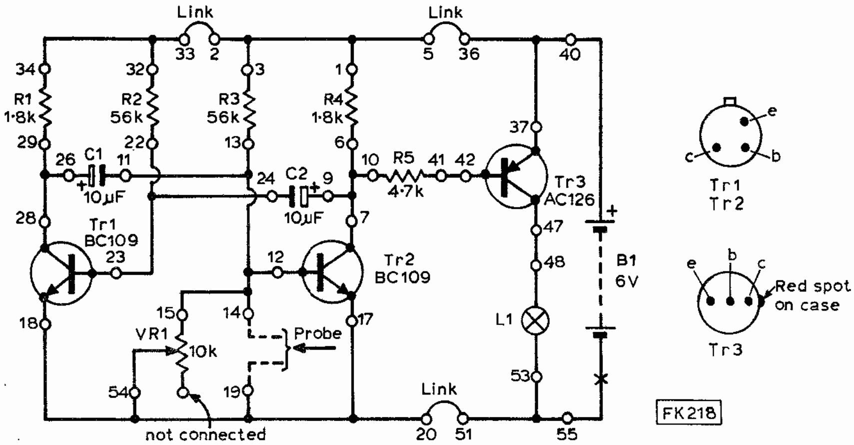
If we now dip the ends of our probe into a fluid such as water, then the base of Tr2 will be grounded by the resistance of the water. Because the resistance is low, it will stop the Tr1/Tr2 multivibrator from pulsing and thus the lamp will stay out.

The Christmas Pudding saver can now be appre-

you will need . . . . .

R1	1·8kΩ	C2	10μF 12V
R2	56kΩ	Tr1	BC109
R3	56kΩ	Tr2	BC109
R4	1·8kΩ	Tr3	AC126
R5	4.7kΩ		
VR1	10kΩ lin. pot.	L1	6V 60—100mA cycle bulb
C1	10μF 12V	B1	6V or 9V battery

One S-DeC, materials for probe, and wire for links.



Circuit diagram of the Christmas Pudding Saver, the second project in the S-DeC series. Components used last month can be used again in addition to a few extra ones.

ciated. The probe is simply lowered into the saucepan until the probe ends are about half an inch from the bottom of the pan. The probe could be clipped onto the side of the saucepan—perhaps using a ballpoint pen clip arrangement. When there is water in the saucepan, the alarm lamp will stay extinguished. Immediately the water boils down to less than half an inch the multivibrator will start to function and its pulses will flash the alarm lamp.

Correct polarity

Note that Tr1 and Tr2 are both silicon transistors of the n-p-n type. But Tr3 is a p-n-p transistor and hence it is wired up with its emitter going to the positive rail and not the negative rail like Tr1/Tr2.

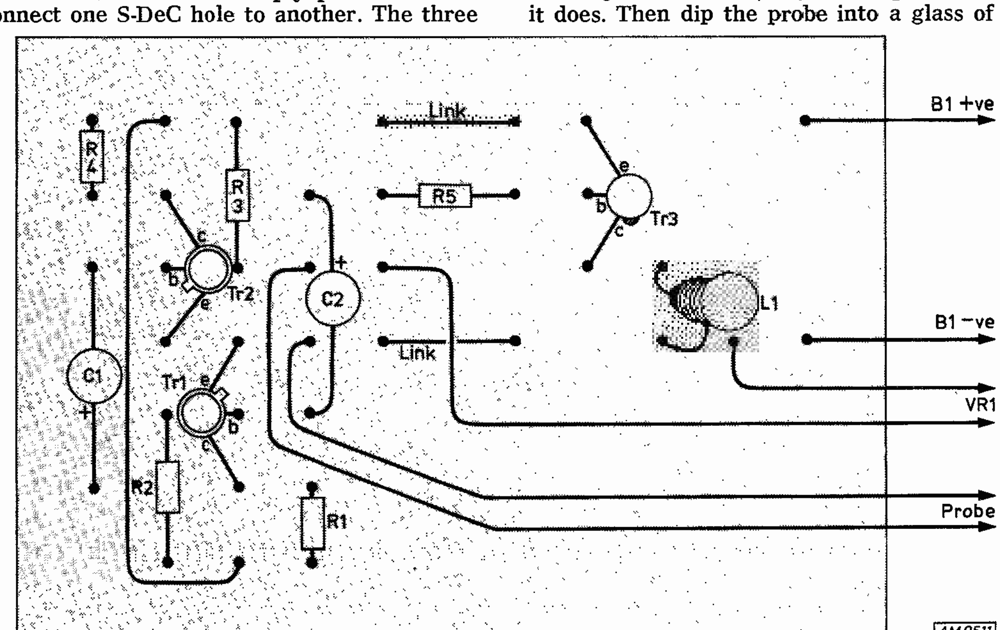
Another important point is the polarity of the two capacitors. They must be connected the right way round i.e. the positive leads being plugged into S-DeC holes 26 and 9 respectively.

Referring to the circuit diagram, there are three link wires shown. These are simply pieces of wire which connect one S-DeC hole to another. The three links are shown in thick lines and connect hole 33 to 2, 5 to hole 36, and hole 20 to hole 51 respectively. The best wire to use for the S-Dec is solid-cored wire which can be inserted and withdrawn many times. The manufacturers do market a little packet of links which comprise a connecting wire with a tiny plug at each end.

The potentiometer has three connections but only two are used; the centre tag and the left hand one viewed from the rear of the component. This variable resistor was included because it allows adjustment of threshold sensitivity at which the multivibrator will function. This is useful since different fluids will have different resistances (no—you can't use it as a wetness measuring device!).

Setting up

In setting up the Christmas Pudding Saver, simply plug in the battery to holes 40 (positive) and 55 (negative). The lamp should immediately start flashing. If it doesn't, adjust the potentiometer until it does. Then dip the probe into a glass of water. If



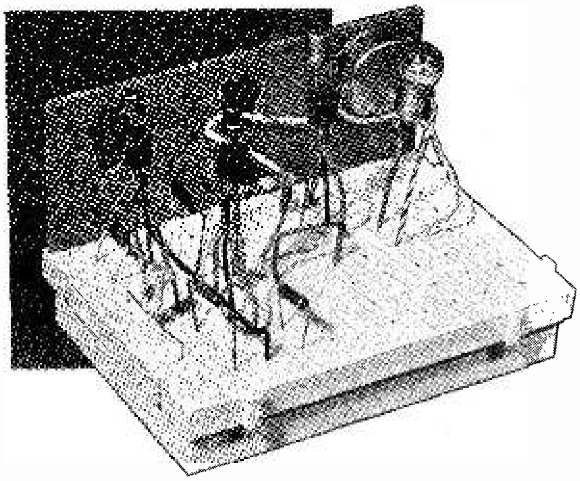
Full size drawing of the S-DeC giving the exact location of the components with respect to the numbered holes. As can be seen, three link wires are required, to enable the circuit to function.

the lamp does not go out, carefully adjust the potentiometer until it does. Now withdraw the probe and check that the lamp immediately commences flashing. If not, readjust the variable resistor slightly and the safety of your Christmas Pudding is assured!

A last point about the circuit. Do not use a battery voltage greater than 9V and don't use a bulb which has a current rating greater than 100mA.

Alternative uses

Now that the basic circuit has been explained, many readers will think of other applications. Basically, the circuit will sense when water drops below a certain preset level. Thus enthusiastic gardeners might use it to monitor the level in the water butt. Again, and in more festive spirit, it would make an excellent Pubometer. The probe could be housed in a ballpoint pen (suitably converted) which could clip onto the side of one beer glass at the local—clip it next to your thumb on the left of the handle. When your beer is getting low and you put your glass down, the lamp will start to flash showing that you're ready to be bought another drink!



Rear view photograph of the completed Christmas Pudding Saver. The front panel is optional and provides a useful method of mounting the potentiometer.

Lastly, since the probe is essentially a kind of wet/damp sensor, it might be possible to bury the probe in a plant pot. When water is needed the lamp will flash.

Future projects

Having built the first two projects in this series you will appreciate just how easy it is to plug in components and get a circuit working. The same components will crop up again in other circuits in the series so all the projects are economical to build.

Next months circuit is truly an international/multi-functional project. It can be used as a police car wailer, a wind speed indicator, and . . . . well, buy *Practical Wireless* next month and find out!

Vagaries of VHF (Contd.)

Ron HAM F.R.A.S.*

OCTOBER

ALTHOUGH the author checks a number of specific radio frequencies at regular intervals each day, there are events which pass by unrecorded. **Your** reports are vital so that between us we can compile an account of unusual propagation which will be useful to the scientists of the future. It is always good to receive readers reports, even more so when no major disturbance has occurred during the period under review.

SOLAR ACTIVITY

Commander Henry Hatfield, (Sevenoaks, Kent. Gen. Sec. Brit. Astro. Assoc.) recorded several bursts of radio noise from the sun during the early morning of October 2nd before the author's radio telescopes began their routine observation. The solar activity on October 3rd was confined to a single burst at 136MHz, while on days 11, 12 and 13 several bursts of noise were recorded, by the author, at both 95 and 136MHz.

Ionospheric disturbances were reported by the BBC World Service in the early hours of both the 7th and 8th and during the afternoon of the 10th. **Robin Bellerby** G3ZYE (Linfield Sx) noted the short skip "opening" on 10m which appeared to have an umbrella effect, because when Constance Hall G8LY changed the direction of her beam aerial it made little difference to the strength of incoming signals. 10m was open again toward Europe and the Middle East during the late morning of the 17th and at 1215GMT a strong signal was pounding into

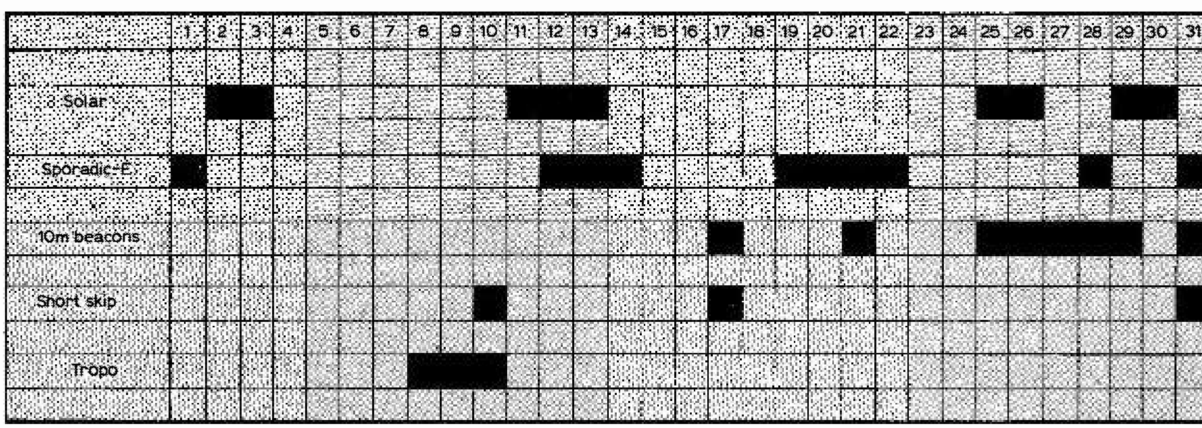


Fig.1: The black squares indicate days of activity affecting transmissions on the 10m and VHF bands.

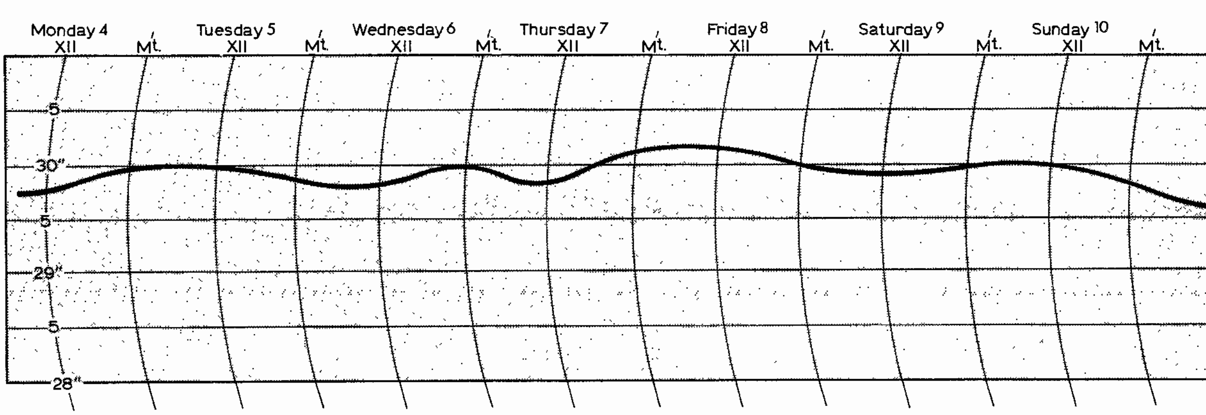


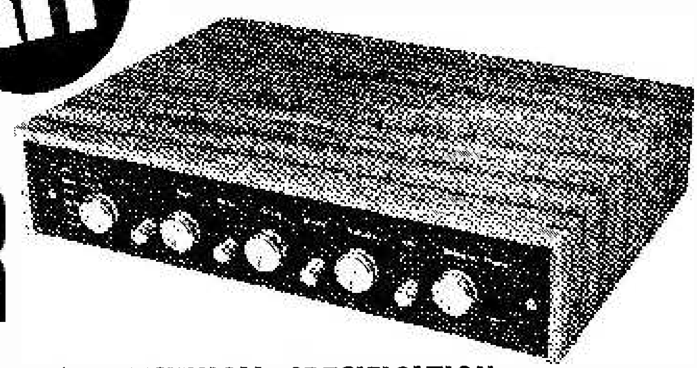
Fig.2: Barograph chart covering the period 4 to 10th October. On the 8th and 9th VHF signals were received from the Continent.

SPECIAL PRODUCT REPORT

RT-VC

KIT

30+30W AMPLIFIER



Having had one of the original ready-built Viscount amplifiers (14+14W) for a number of years and not having experienced any problems with it I was delighted to have the chance to assemble the kit for the latest in the line. This model is rated at 30+30W RMS output and is the only one of the range to have been made available as a kit. The facilities are the same as the Viscount IV. The purpose of this review is to assess the suitability of the kit for the constructor rather than to check out all the electrical specifications.

RT-VC consider that the constructor needs to be experienced to complete this kit successfully and I agree with them. A wrong connection could prove very expensive! Naturally RT-VC's caution is aimed at reducing the very high cost of after-sales servicing. Considering the excellent constructional and data sheet supplied with the kit the average constructor should have no difficulty in completing the amplifier satisfactorily. If, on receiving the kit, you feel that you are not up to building it then RT-VC will refund the full purchase money if the kit is returned untouched.

TECHNICAL SPECIFICATION

All silicon transistor stereo amplifiers using 20 transistors and 4 diodes.
Controls:—Pushbuttons for On-Off, Stereo-Mono, Scratch Filter, and RIAA-Flat Equalisation. Rotary selector for input facilities Magnetic or Crystal cartridge, Tape, Tuner, Microphone and Auxiliary. Individual controls for Treble, Bass, Balance and Volume. Neon power-on indicator. Tape Recorder Output provided.
Frequency Response:—25Hz to 25kHz plus-minus 1dB.
Distortion:—Less than 0·2% at 10W each channel operating in turn at 1kHz.
Power Output:—30W RMS per channel into 8Ω speakers or 20W RMS into 15Ω speakers.
Two auxiliary switched mains sockets (2-pin).
Size:—381mm long × 250mm deep × 75mm high. (15¼ × 10 × 3in.).

Brief specification of the 30+30W stereo amplifier which can be assembled from the kit. The facilities are the same as on the Viscount IV amplifier. 30W speakers in chassis form are available from RTVC at £20 + £2·50 p/p each.

GETTING DOWN TO IT

There are only around twenty parts to check on opening the kit plus the usual nuts, bolts, etc. The most important item is the fully assembled and tested control unit which is really the whole amplifier except for the power supply, DIN sockets and cabinet! There are four pre-set pots on the unit which must not be touched. Incidentally, there are two speaker leads and an input lead supplied with the kit which is very thoughtful indeed. The 'experienced' constructor can be assumed to have the necessary few tools already plus a soldering iron.

The assembly instructions are very detailed indeed especially when one considers the line drawings and photographs supplied. I reckon that RT-VC's 'experienced' constructor ought to be able to do the job from these alone! After following the 36 steps outlined you will be ready to take in the copious notes on the testing, checking and installation of the amplifier.

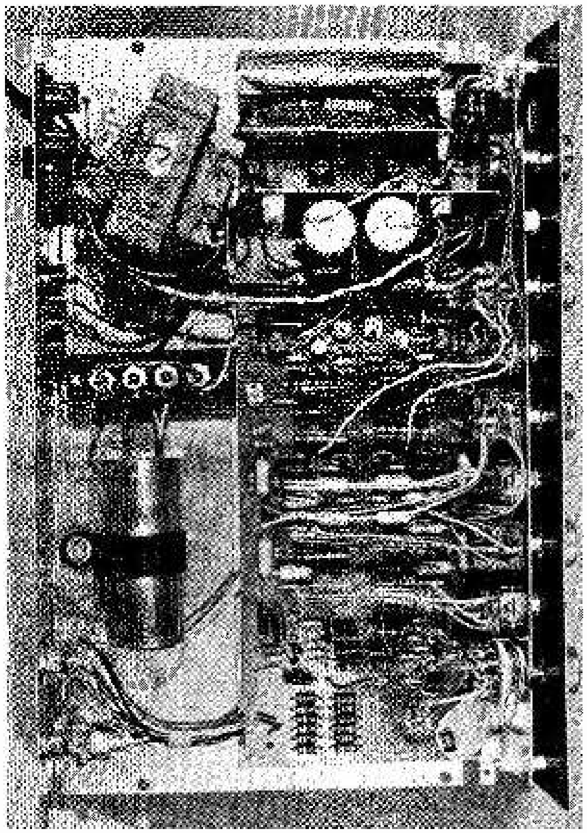
CONSTRUCTIONAL NOTES

Construction took about four hours and no particular difficulties were encountered. The drawing of the paxolin panel for the power rectifiers can't make up its mind as to the hole sizes required but the answer is obvious on looking at the rectifiers. The mains transformer is supplied bolted to the chassis but ensure that the fixing bolts are really tight.

On removing the control unit from the chassis before beginning work note how it is fitted. It will go back the same way. A piece of cardboard is called for under the control unit but do not be tempted to make it bigger than the size given or it will obstruct the ventilation lourves in the bottom of the chassis. The input and speaker sockets are retained with washers (having internal teeth) and these are best fitted by going round and round the circle of teeth with the edge of the blade of a large screwdriver, pressing down until the socket is secured. Ensure each socket is orientated correctly.

Perhaps I was unlucky with my kit but the two spacers for the front panel were of different lengths so one had to be filed down until they were the same. The hole in the panel for the neon lamp was enlarged to take the lamp since it was found impossible to push the lamp back, as suggested by the instructions. Work from the back of the panel to avoid scratching the front.

The instructions call for the cutting away of a small area of the inside top of the cabinet to clear the mains transformer. This was an annoying task, having completed the amplifier and being impatient to try it out! A wax candle was rubbed



View underneath the finished amplifier. The single PCB carries the two channels from pre-amplifiers to the power amplifier stages and is supplied in the kit ready wired and tested. Little remains but to connect the PCB lead-out wires to the DIN sockets and power supply mounted on the chassis.

over the top of the transformer, the cabinet replaced and pressed down round the transformer which left a clear outline on the inside of the cabinet. A slightly larger area was then cut away with a chisel to a depth of about ⅛in. Having done all this it was suddenly realised that a couple of washers between the chassis and the cabinet at each fixing screw hole would have done the job just as well! The bottom edge of the panel projects down slightly but is still held in its slot in the cabinet.

Back to the wiring and note that in Fig. 1 of the instructions the arrows pointing to the two pink wires are slightly displaced downwards. The wires go to the mains sockets as will be apparent when following the written instructions.

CONCLUSIONS

For a stereo amplifier providing 30+30W output this kit is very cheap indeed and no-one who has ever handled a soldering iron need be afraid of tackling this project. The circuit diagram is excellent except that there are no values on it! It is a good exercise to put them on after the amplifier is completed, just for reference purposes. It was good to note that RF suppression components are fitted to the input transistors which should prevent the pick-up of signals from broadcast stations, taxi services and the like.

On connecting the amplifier to the existing domestic radio equipment it worked satisfactorily on all functions but since the existing speakers are rated at only 20W the temptation to 'turn up the wick' was firmly resisted! On the old 14 + 14W amplifier that was a small amount of cross-over distortion at low volume levels but this is noticeably absent in the new amplifier.

The complete kit costs £29 inc. VAT plus £2·10 for post and packing. **Mail Orders** only to RTVC Ltd., 21c High Street, Acton, London W3 6NG. **Personal shoppers** to 323 Edgware Road, London W2 (Half day Thursdays).

VAGARIES OF VHF—*continued from page 781*

southern England from the beacon station in Cyprus, 5B4CY on 28·180MHz. This beacon was heard again at 0930 on the 21st, early on the 25th and at lunchtime when there was deep fading.

Reference to Fig. 1 will show that the Cyprus beacon was heard for seven days between 21 and 31st. On each day at 0915 a signal varying between S2 and S9 was heard and on the 26th it was again audible at midday and during the afternoon. On the 31st this beacon was heard at 0830 and by 0930 many SSB signals on 10m were copied including G, 4Z4, CT, I, ZS2 and F.

SPORADIC-E

One cannot expect much disturbance to radio signals from sporadic-E during the autumn and winter months so it is worth making a special note that strong and frequent bursts of signal were received from the R1 television system (49·75MHz) during the early mornings on the 8 days indicated in Fig. 1. Periodically, strong bursts of signal were heard simultaneously from East European broadcast stations operating in the 4m band.

TROPOSPHERIC

There was little hope of VHF DX when large areas of low atmospheric pressure accompanied the badly needed rain which came between late September and the time of this report, Oct 22. However, there was a slight "lift" between midday on the 8th and midnight on the 10th which coincided with a rise, to above 30·0in and then a fall in pressure, Fig. 2. At midday on both the 8th and 9th the author heard strong signals from Continental broadcast stations between 95 and 100MHz, while **Steve Whitt** G8KDL (London) also keeping an eye on the barometer, noticed that when the 2m band opened up towards the Midlands and Wales on the 10th the "DX" signals were subject to fading and at times this was very rapid. Steve is keen on VHF propagation and is equipped to receive Band 1 TV, Band 2 FM, 2m amateur signals and Band 3 TV, a good way of checking for both sporadic-E and tropo disturbances because that lot covers from 40 to 200MHz!

Thanks also to **Joosa Berden,** G3RND for a copy of his barograph chart (same as Fig. 2) showing the sharp fall on the 10th and his report that conditions were good on both 2m and 70cm around 0800 on that day. Joose, who has a good location on the Isle of Wight, has found that UHF is open longer and more often than 2m. His letter also contains details of his equipment and other observations which we will use at a later date.

**Faraday, Greyfriars, Storrington, Sussex RH20 4HE.*

Readers experiencing unusual reception of stations on the VHF/UHF bands of the nature described by Ron Ham in the first two articles are invited to send brief reports to him at the above address. NOT to the Editorial offices!

If there is sufficient response a regular feature could be compiled for inclusion in PW—Editor.

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

MORE than one reader has asked for my views on repeaters in the amateur bands. Obviously there are those that like 'em and those that don't! I don't! and I never have done. I do not consider them to be amateur radio as I understand it and I am quite convinced that they have been foisted upon the amateur community by outside interests. The results can be seen in the avalanche of costly black boxes now available to the repeater enthusiasts. Many of these sets contravene the terms of the amateur transmitting licence which requires that a station shall be able to receive as well as to transmit on a particular frequency. With a separation of 600kHz between transmit and receive frequencies needed for repeater operation the manufacturers are not going to fit crystals to receive on every transmit frequency. So to hell with the regulations here!

Incidentally, if a foreign amateur visits my shack he cannot operate my station without the prior permission of the Home Office, yet foreign amateur stations can and do access our unattended repeaters! Doesn't make sense, does it?

Steve Larkins of Wellingborough has modified his Pye superhet sufficiently to copy SSB and make some good catches on 20m. He and a number of others are studying for the RAE under G8LII so good luck to you all. **John Higginbotham** keeps the flag flying in Holyhead and although only 16 seems to have got himself a BRS number from the RSGB, or rather RS36901 to be exact. What's happened to the "British" part of British Receiving Station? Are we suddenly ashamed of the "British" part or is it too long for the RSGB's new data processor? John had a CR70A but is now looking for something a bit more advanced. Apart from the fact that John is on a full time electronics course at Bangor Tech he is studying for his RAE and having a go at the code as well! If you don't manage to send in any logs OM, we'll understand!

More on **Geoff Watts,** composer of DX News Sheet, mentioned all too briefly last month. He is in a bad way physically, attributable in some part to the amount of work Geoff has put in on the News Sheet since 1962. He can still supply copies of his excellent prefix/country/zone list which is as up-to-date as any such list can be. It runs to 15 pages and is available from Geoff for 35p at 62 Belmore Road, Norwich NR7 0PU. The least we can do to help is to ensure that we each have a copy of this valuable listing. Overseas readers need to send $1 or five IRC's.

Brian Le Lievre residing in Guernsey has a collection of sets including an Eddystone 840C, Yaesu FR50, Mohican, SW717 and has now acquired an RG39 thought to be circa 1941 but I think it may be quite a bit earlier than this. Any info would be appreciated. The set has six bands covering 95kHz to 26MHz and seven valves. **Paul Barker** has moved into a new QTH but is still in Sunderland but already feels that it is a better site even before he gets his aerials up again. At present a short whip has to suffice but nevertheless he has copied SSTV from several countries including the US.

Steve Cottis A8961 is back again bemoaning the fact that his local code class has collapsed due to lack of support. His hopes for a local RAE course have also gone the same way. Keep your pecker up OM and suggest you flog on by yourself until something gets organised. Steve finds 80m beginning to open up for the winter season and mentions the improved conditions on 10m during the RSGB's 21/28MHz contest. Was it really conditions, I wonder, or just the sudden extra activity! The latter, I suspect.

From Dublin an interesting letter from **Andrew Grendon** who has got the amateur radio bug after reading this feature and wonders where to start. A good question! Well, there is nothing like the RSGB's *Guide to Amateur Radio* at £1·17 inc. from 35 Doughty Street, London WC1N 2AE to get on with, coupled with a good second-hand communications receiver to get the feel of the bands. I don't usually advise beginners to build their own SW sets until they have had some experience otherwise they finish up floundering around, unable to find the bands and condemning all and sundry connected with amateur radio!

Having had many such letters in recent times, asking for information on amateur radio, I have now prepared a standard letter of reply, ready for the future. Typing out a lengthy and detailed answer each time gets a bit tiring. Such a letter, however, is very important indeed and may well determine whether the enquirer takes up amateur radio or not!

ON THE AIR

Steve Budd A8713 of Worthing also comments on the way that bands seem to improve when there is a contest on and mentions 10m in particular. As I have said before, if people would only send a CQ more often on seemingly dead bands, instead of waiting for someone else to take the initiative, a lot more activity would be generated.

Further to my very terse reference last month to the death of HZ1AB I understand that it was the result of a helicopter crash in Saudi Arabia. When I used to be flying around from ST2 land he could often be heard on the aeronautical frequencies with his Convair aircraft that he flew around for the Aramco oil company.

Log Extracts (All SSB)

S. Budd: — 80m A9XBD IT9PUG LX1JAN WA6EGL/VQ9 (Chagos) VS6DO 6W8DY 9L1NP **40m** IT9FTT VK3HW ZB2CF **20m** HM9A WA6EGL/VQ9 **15m** AP2AL EA9FN KZ5RL VP2KAA VP2KF VP8HA WA6EGL/VQ9 (again!) VU2BX YN1RWG 9J2WR **10m** EL2T TU2FW ZE1BL 6W8FP 9G1LZ

P. Barker:—20m SSTV EA2JO 17LKF K4ZRD OH5RM VO1BL W1BGW W1VRK WA2DWE W2HKW W4LZZ YU1NWJ YU2CB 9G1JX **20m** EL2EK HZ1TA OE5GML/YK UF6FCO

S. Cottis:—80m EA6DA FP8DX EP2NC DU9FB SV0WZ (Rhodes) WB4ZKG/KC6 VS5MC **15m** AP2SA VQ9HCS VU2LQA 9J2WR ZS1HS **10m** 9J2WR

S. Larkins:—20m DU9FB OY8KH JW7FDI (Svalbard) OA2DX VK1AOP ZL3GG.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Derek Bell

THIS month's column has more of an overseas look than has been evident for some time. The first letter comes from a DXer who is in the happy position of not only listening to the DX but in going to the stations rather than having them come to him! He is **D. Simpson** who is chief cook on the tanker "British Pioneer" one of the BP fleet. D.S. has written while on a trip in the Malacca Straits, Sumatra area and posted the letter in Kure, Japan. Dare I say it, a veritable Cook's tour! (sorry).

The set that our friend runs is a Vega Selena hung on the end of a long wire and he comments that the Philippines and Indonesia offer many stations that we in the UK can never hope to hear, and that it is nice to be able to hear Radio Australia on the 19 and 25m bands all through the day. The full log is as follows:-

Radio Kuwait on 9555 at 1730
Radio Free Europe on 15145 at 1715
Vatican Radio on 15165 at 1500
Radio Belgrade on 15240 at 1530

D.S. would also like to know how to enter the world of the licensed amateur and to this end I would suggest that the best thing to do would be to write to the Radio Society of Great Britain, 35 Doughty St., London W1 and get the Guide to Amateur Radio for £1·17 which explains all.

While still in the mysterious East let us turn to **Robert Leo** of Malacca, West Malaysia. It seems that even in this part of the world there are problems caused by competing stations. Robert reports that Radio Veritas on 11725 is hampered by the Madagascar relay of the Radio Nederland broadcasts on 11740. If anyone pulls in the Radio Veritas overseas service, and I must admit it is not often reported, the address is Radio Veritas Overseas Service, PO Box 939, Manila, Philippines.

This station is an evangelical service and I can find out nothing of the power of its transmitters only that they are listed as using 15345. However, to return to Robert's letter, he uses an Aiwa 7PR930 set with internal aerial and logs the following:—

Radio Nederland (Madagascar Relay) on 11740 at 1400
Radio Australia on 9670 at 1200
FEBA Seychelles on 15190 at 0700
Radio Japan on 11875 at 1115
Radio Kuwait on 15345 at 0530
Radio Veritas on 11725 at 1400

Bear in mind that Malaysia is Greenwich time plus seven hours and that for anyone here in the UK these are the times that apply since Robert has quoted in GMT. In fact Radio Australia would not be heard at 1200 here while for Robert it would be 1900 Malaysian time.

Station news this month is provided by **Robin Bayley** of Albrighton which brings us back to these wintery shores. Robin has recently constructed a short wave set from the pages of PW and it seems that hooked on to the end of the ever-popular long wire aerial it pulls some very interesting signals. Robin confirms our Malaysian friend's logging of Radio Veritas on 11725 and adds the following frequencies. 0100 to 0200 on 15280, 1400 to 1500 on 9610 and 11725. Signals sucked in by the PW set include

9570 Radio Australia at 0645
9710 Radio Nederland, Bonaire at 0800
9860 Radio Pekin at 1600
9910 AIR Delhi at 2100

It seems, according to Robin, that the Danish Short Wave Club PO Box 50 DK 2560 Alburstoland, Denmark has published its Tropical Bands Survey, for five IRCs.

Ken Smith from Ross-on-Wye has been keeping a keen eye on the Voice of America Broadcasts and can give the available channels for any hour of the day and night. His picture postcards are a delight on these gloomy days! However, what has puzzled

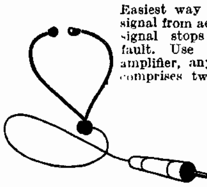
DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **£3·45 including post & VAT.** Made up model **£1·00** extra.

MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·50** VAT & Postage 50p.

RADIO STETHOSCOPE



Easiest way to fault find, traces signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, **£2·95**, twin stetho-set instead of earpiece. £1·00 VAT and postage incl.

MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for **£1·00**, VAT and post paid.

MOTORISED DISCO SWITCHES

With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating **£4·25** post & VAT Paid. Ditto 9 switch **£4·95** Post & VAT Paid. **DITTO BUT 12 SWITCH £5 75** POST & VAT PAID.

AMMETERS

Ideal for chargers etc. 2" sq. full vision 0·8 amp **95p.** 1½" *round* 0·2 amp **55p,** 0·3 amp **65p.** 0·4 amp **75p.** Post & VAT 25p each.

MAINS OPERATED SOLENOIDS

Model 772—small but powerful 1in. pull—approx. size 1½ × 1½ × 1½in., **£1·00**
Model 4001/—½in. pull. Size 2⅝ × 2 × 14in. **£1·50**
Model TT1—1½in. pull. Size 3 × 2½ × 2in. **£2·50**
Prices include VAT & postage.

SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. **£7·95** plus **95p** VAT & Postage

RELAY BARGAIN

Type 600 relay with twin 500 ohm coils which may be joined in series or parallel thus relay will operate off voltages between 5 and 30 volts DC. Price **44p** each, 10 for **£4** post and VAT paid.

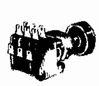
BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3¾" × 6¼" × 2" with leads and prod. **£4·50** post & VAT paid.

BATTERY CHARGER

Famous Atlas in metal case with meter, output lead terminated by crocodile clips. For 6 or 12V charging simply by changing plug on front panel. Ready built new and still **£2·95** plus £1 Post & VAT

HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH



1-2-3 Bank, each Bank consisting of the changeover micro switch rated at 10 amps 250 volts. Through panel fixing by 2 lock nuts complete with black 1" diameter knob. Prices:—1 bank **40p**—2 bank **55p**—3 bank **70p.**

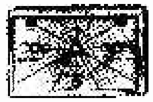
MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Celestion speakers normally £8. This should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£16·50** including VAT and postage.

TANGENTIAL HEATER UNIT

This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. **£5·83** plus VAT & post £1. 2kW Model as above except 2kW **£4·25** plus VAT & post 75p. Don't miss this. Control Switch **44p.** P. & P. 40p.

ISA ELECTRICAL PROGRAMMER



Learn in your sleep; Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·95**, VAT & Postage 60p, or with glass front, chrome bezel, **£1·50** extra.

ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C. Special snip this month **£2·50**, post and VAT paid.

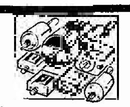
SMITHS CENTRAL HEATING CONTROLLER

Price **£7·50** including VAT and postage.

RANDALL CENTRAL HEATING CONTROLLER

Price **£6·50** including VAT and postage.

8 POWERFUL BATTERY MOTORS



For models. Meccano's, drills, remote control models, planes, boats, etc., etc. **£2·00.**

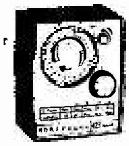
ROTARY PUMP

Self priming, portable fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertilizer, chemicals, anything liquid. Hose connectors each end. **£2·00** Post Paid.

MAINS RELAYS

With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment **60p** each. 10 for **£5** post and VAT paid.

HORSTMANN 24-HOUR TIME SWITCH



With 6 position programmer. When fitted to hot water systems this could programme as follows:

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3in × 3in × 2in deep. Price **£5·50.** 80p Post and VAT. as illustrated but less case

SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands. Kit contains chassis front panel and all the parts **£1·90**—crystal earphone **55p** including VAT and postage.

PAPST MOTOR

West German make, these fine motors are noted for their performance and reliability. Special features are the rotating heavy outer which acts as a flywheel to eliminate wow and flutter and switchable reversing.
We have four types in stock, all 1350 revs., including starting capacitor.
(1) Reference No. KLZ 20.50-4, 230 volts 50HZ, price **£5·50**
(2) Reference No. KLZ 32.50-4, 230 volts 50HZ, price **£6·50**
(3) Reference same as above, 115 volts 50HZ, price **£2·50**
(4) Reference same as above, 110 volts 60Hz, price **£2·50**
Post and VAT 80p each extra.

PANEL METER SNIP

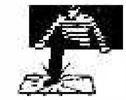
Japan made 2" × 1½" full vision flush mounting, 100μA f.s.d.—scale engraved DB easily changeable as perspex cover simply clips on. A real snip **£1·75** post and VAT paid, or 10 for **£15** post and VAT paid.

TERMS: Where order is under £5 please add 40p surcharge to offset packing expenses

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 103 TAMWORTH ROAD, CROYDON CR9 1SG.

SWITCH TRIGGER MATS



So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in × 18in **£2·33.** Post & VAT 60p.
13in × 10in **£1·85.** Post & VAT 50p.

MAINS TRANSFORMERS

All standard 230-250 volt primaries

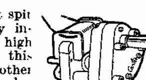
			£ p
2·4v	.. .. ..	5 amp	1·05
6·3v	.. .. ..	2 amp	1·57
6·3v	.. .. ..	3 amp	2·19
9v	.. .. ..	1 amp	1·19
9v	.. .. ..	3·5 amp ..	3·13
12v	.. .. ..	1½ amp ..	1·85
12v	.. .. ..	1 amp	1·25
6·5v-0·6·5v	.. ..	1 amp	1·85
18v	.. .. ..	1 amp	1·85
24v	.. .. ..	2 amp	2·82
24v	.. .. ..	3 amp	4·75
12·0-12v	.. ..	50mA ..	1·56
6·0-6v	.. .. ..	50mA ..	1·56
8·0-8v	.. .. ..	½amp	1·85
25v	.. .. ..	1½ amps ..	2·44
50v	2 amp & 6·3v	1 amp	5·63
60v	5 amp & 5v	1 amp	9·35
27v	.. .. ..	8 amp	5·63
30v	.. .. ..	37 amp ..	27·50
80v tapped 75v & 70v		4 amp	6·87
250v-60mA & 6·3v	..	1·5 amps ..	2·19
275-0-275v at 90mA & 6·4v		3 amps ..	2·82
EHT Transformer 5000v 23mA	.. .. ..	(Intermittent)	6·87
Charger Transformers			
6v and 12v	.. ..	2 amps ..	1·87
6v and 12v	.. ..	3 amps ..	2·82
6v and 12v	.. ..	5 amps ..	4·25

Add 30p per £1 to cover postage and VAT

MULTI SPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is ¼ in. diameter and approximately 1 in long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia × 5 in. long. Price **£2·00** including Post & VAT.

SPIT MOTOR WITH CARTER GEAR BOX



Probably one of the best spit motors made. Originally intended to be used in very high priced cookers however this can be put to plenty of other uses, for instance your garden barbeque or to drive a tumbler for stone polishing; in fact, there are no ends to its uses. Normal mains operation. **£3·25** including POST & VAT.

MAINS TRANSISTOR PACK

Designed to operate transistor sets and ampliers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·90** including post and VAT.

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied

Model 1153 500mW power output **£1·50** including Post & VAT.
Model 1172 1W, power output **£1·85** including Post & VAT.
Model EP9000 4 watt power output **£2·90** including Post & VAT.
EP 9001 twin channel or stereo pre-amp. **£2·90** including Post & VAT.

28 RPM GEARED MAINS MOTOR

This is a substantial motor (1" stack induction type) quite powerful definitely large enough to drive a rotating display or a tumbler for polishing stone etc. Approximate overall size 4" × 3½" × 2¼" these are ex-unused equipment, carrying our normal ex-equipment guarantees. PRICE **£2·95** POST and VAT PAID.

TELESCOPIC AERIALS

for portable car radio or transmitter. Chrome plated—six sections, extending from 7½ to 47in. **50p** + 15p. Post & VAT. KNUCKLED MODEL FOR F.M. **80p** + 17p Post and VAT.

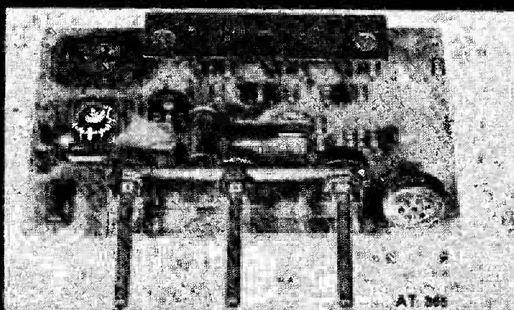
CENTRIFUGAL BLOWER

Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4¼" × 4¾" × 4". When mounted by flange, air is blown into the equipment but to suck it out, mount from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering, etc. etc. A real bargain at **£3·30.** 60p post & VAT.

JOSTY KIT

Announcement

Electronic Construction Kits for 1976/77



		£
AF 25	Mixer	2·50
AF 30	Pre-amplifier	2·30
AF 300	3 Watt audio amplifier	6·10
AF 310·3	Power amplifier	5·90
AF 340	40 watt AF power amplifier	8·95
AF 380	2 Watt IC universal amplifier	3·25
AT 5	Automatic light control	3·10
AT 30	Photo-cell amplifier	5·25
AT 50	Triac AC regulator up to 440W	3·70
AT 56	Triac AC regulator up to 2200W	5·55
AT 320	All-round AC/DC regulator	10·75
AT 325	Interval and flasher unit	7·20
AT 347	Electronic Roulette	8·75
AT 365	Light show	17·00
AT 405	Low-cost light/heat control	2·75
AT 460	Monolite	10·80
AT 465	Superlite	17·10
AT 466	Strobolite	20·45
AT 468	Quadrolite	19·45
GP 304	Main circuit unit	4·55
GP 310	Hi-Fi pre-amplifier	24·60
GP 340	Hi-Fi pre-amplifier	29·10
GU 330	Guitar tremolo	5·65
HF 61	Diode medium wave reciever	4·30
HF 65	FM transmitter/Signal Test Generator	2·50
HF 305	Amateur band 2 metre VHF 144 MHZ converter	6·70
HF 310	FM tuner	11·50
HF 325·2	FM tuner module	19·85
HF 330	Stereo decoder	6·70
HF 375	Mini FM receiver	2·95
HF 385	VHF/UHF aerial amplifier	5·80
HF 395	Aerial amplifier AM-FM	1·50
LF 380	4d-stereo	8·45
MI 310	Stereo VU module	4·30
MI 350	S-meter module/amplifier	2·95
MI 360	Multivibrator/signal generator	1·40
MI 390	Dial module (meter not included)	2·55
MI 391	VU module (meter not included)	1·60
MI 392	Balance module (meter not included)	2·10
MI 393	Tuning module (meter not included)	2·60
MI 402	Semi-conductor tester for diodes/transistors	4·50
NT 300	Power pack (transformer not included)	10·15
NT 305	Voltage converter	4·40
NT 311	Voltage converter	2·80
NT 315	Power pack	8·75
NT 330	Power pack	4·70
NT 400	Power Supply (transformer not included)	17·15
NT 410	Power supply	4·50
NT 415	Power supply (transformer not included)	8·45

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P.O. Box 68, Middlesborough,
Cleveland, TS1 5DG

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ADDRESS ....
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AMBIT international (dept 85)

The Dynamic Twosome: Signalmaster/Audiomaster

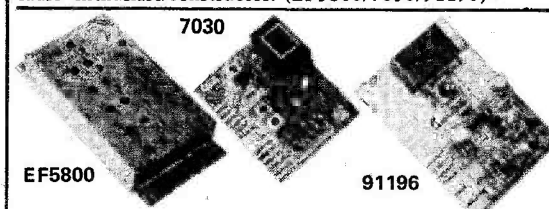
After long and thorough deliberation, we are proud to announce a new unit from Larsholt - the Audiomaster. As ever, the instructions are designed to lead the unwary- and the inexperienced- through point-to-point steps that culminate in a professionally styled and finished amplifier to complement the Signalmaster FM tuner. Price £79.00

Power: 25+25W RMS
THD: Less than 0.3%
Dynamic range: an exceptional 80dB
(Signalmaster shown on top of the Audiomaster)

The Signalmaster Mk.8 is equally simple to assemble, and results reflect the superb Scandinavian styling and careful electronic engineering. £85.00.

International Mk.2: A choice of tuners for the more experinced constructors.

A chassis, cabinet and front panel designed to be used with a variety of electronics inside. The standard set, with the Larsholt 7253 varicap FM tunerset, plus all necessary parts to complete costs £65.00. Alternative modules for the signal processing stages are available for the more advanced F.M. radio enthusiast/constructor. (EF5800/7030/91196)



From left to right, the EF5800 6 circuit varicap FM tunerhead. Two MOS RF stages, both with AGC control, and an ultra stable oscillator. Next the 7030 Linear Phase 10.7MHz IF. Distortion 0.08%, muting, AGC, meter, auto stereo switch outputs. Finally the new 91196 mpx decoder and combined birdy filter. Mono THD 0.05%, stereo sep. 55dB at 1kHz, 42dB at 10kHz - the best decoder module yet.
EF5800.....£14.50 7030.....£10.95 91196.....£12.99 (Built).
Overall performance of the three modules when correctly assembled:- 30dB S/N at 0.85uV input. 60dB at 5uV. THD 0.09%. AFC holds THD below 0.2% over 400kHz if required. AGC effective over a 90dB range. Image rejection -90dB. Noise floor -73dB.

Components: Coils, ICs Filters, etc.

Radio ICs: (and modules)		Coils and filters:-	
CA3089E/HA1137W FM	1.94	AM IFTs TOKO	
CA3090AQ mpx	3.75	YRC5/YHCS types(10mm)	0.30
MC1310/KB4400 mpx	2.20	7MC5 types (7mm)	0.30
HA1196 mpx	4.20	FM IFTs:-	
HA1197 AM radio	1.40	KAC5/KALS types(10mm)	0.33
TBA120AS FM IF	1.00	94A types (10mm)	0.30
TBA651 AM radio	1.81	AM filters:-	
uA720/CA3123E AM rad	1.40	CFT types ceramic (455)	0.55
LM380N 2W Audio	1.00	CFU type ceramic (470)	0.60
TBA810AS 7W Audio	1.09	5FD470 types (470)	0.75
TCA940 10W Audio	1.80	FM filters:-	
TDA2020 20W Audio	2.99	CFS/SFE ceramic (10.7)	0.50
LM381N stereo preamp	1.81	SFE6MA (TV sound)	0.80
LM3900 Quad amp	0.68	3132 linear phase	2.25
78M12-20-24 volt reg	ea:1.20*	MPX 19&38kHz notch	
NE550A variable reg	0.80*	BLR3107 (4k7 imp)	1.75
TAA550B varicap reg 32v	0.50*	BLR2007 (3k3 imp)	1.75
NE560/2B PLL IC	ea:2.50	23 or 36mH chokes	0.33
NE561B PLL IC	3.50	Tunerheads: (& tunersets)	
NE565A/567V PLL	ea:2.50	EF5600 5 gang varicap	12.80
810k kit for TBA810 amp	2.75	EC3302 3 gang varicap	5.50
2020k kit for 2020 amp	9.35	8319 (Larsholt)	12.00
92310 kit for mpx decoder	5.35	7252 tunerset complete	26.00
7020 kit for 3089 FM IF	6.65	7253 stereo tunerset	26.00
971197 kit for varicap AM radio tuner	9.65	Standard transistors also kept in stock - see lists for further detail and price information.	
7700 built TV sound tuner	27.00		

Terms: Vat extra, 12.5% unless marked *, which is 8%, all complete tuners require £3.00 for packing and carriage. The standard P&P rate remains at 22p per order. Catalogue 40p.
Phone (0277) 216029 (After 3pm please). SAE for free price lists.

Write to: 37a High Street Brentwood, Essex : CM14 4RH

ON THE AIR

Ken is the fact that a new service has popped up on the VOA scene. This is not in the printed schedule and is on 18MHz and available occasionally as late as 2100. As I said before, gloomy days are with us and to this end Ken notes that the best frequency reception of the VOA breakfast show is 6MHz while the National Public Radio is best on 11MHz around 2130.

It's an ill wind—etc" they say, and for **John Mcleod** the strike by the school cleaners has meant that the hours wasted in school have been put to better use DXing, with the result that he can report the signals from the Kalamabad transmitters of Radio Teheran with 100 and 350kW on 15315 and 9022 respectively. It might be a good thing however to use some of the time to listen to foreign language broadcasts in order to keep up with one's French or German! The last item this month is my very best wishes for Christmas and the New Year and may Santa bring that expensive piece of equipment that you have long been hinting at. So I will wish 73s to you and yours.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy

A NEW transmitter of Radio Gambia, located at Bouto, is now on 648kHz with a power of 20kW and is on the air during the evening until midnight. This is the unidentified station reported by **F. A. Ainslie** of Hartlepool who used a homebrew receiver and medium wave loop to pull in a programme in English and an African dialect with either Western or African style music. Local time was announced in GMT. Some difficulty with reception was experienced owing to QRM from BBC Radio 3 on 647kHz. According to the World Radio and TV Handbook 1976 Radio Gambia planned for a new medium wave station at Bouto to come into service during 1976 as a replacement for the short wave outlet on 4820kHz.

When FM broadcasting was first introduced it was thought that broadcasting on the medium waves would decline. This has not happened. New stations are continually appearing, both in the third world where transistor portables find a ready market and in the Western world where the medium waves are more readily received on car radios than FM broadcasts.

One recent addition to the band for the DXer to look for is Gafsa in Tunisia which is on 584kHz with a power of 350kW and could easily be mistaken for the 1200kW Riyadh in Saudi Arabia which is on 587kHz. Another newcomer is Bukavu in Zaire which is reported to be on 800kHz with high power with sign-off at 2100.

Several readers have asked about the mechanics of MWDX. Propagation of radio waves in the medium and long wavebands during the hours of daylight is by means of the ground wave. Rays travelling upwards from the transmitter are absorbed by the D layer which is the lowest part of the ionosphere, located some 80km above the earth's surface. The range of the ground wave is rather limited since the signal is attenuated by the earth's surface. At sunset the D layer disappears and rays travelling upwards can now reach higher into the ionosphere where they are refracted and returned to the earth, with little attenuation, at considerable distance from the transmitter. This is the mechanism that permits continental signals to appear on domestic radios after dark and long distance DX to be heard in the UK from North and South America, Africa and a large part of Asia.

The medium wave DXer in the UK who wants to hear Canada or the United States will have to wait for some five to six hours after sunset until the path across the Atlantic is in darkness and skywave propagation becomes possible. In summer this will occur an hour before sunrise and in winter Canada will appear at 2200 and USA an hour later, when conditions are favourable. Newcomers to the band should be careful if they hear North American style programming earlier in the evening as it unlikely to be direct trans-Atlantic reception and may well come from one of the AFN outlets in West Germany.

Robin Beyley reports again from Kingswood School near Wolverhampton. Using his Regentone DM2 he pulled-in Trans World Radio Bonaire on 800kHz, CJON on 930, WINS 1010 and WBZ in Boston on 1030. Robin reports that the Voice of Cyprus is on 755kHz in English from 0330 to 0600. The Voice of Cyprus, according to Sweden Calling DXers, is located at Anamur in Turkey and broadcasts multilingual programmes to Cyprus. It is also on the air between 1400 and 1600 and part of this transmission might be audible in the UK in midwinter.

A good log of Latin American DX comes from Preston in Lancashire where **Derek Taylor** uses a Realistic DX160 receiver and a medium wave loop. Stations heard include Radio Aeropuerto in Maiquetia, Venezuela, on 910kHz; Radio Eco in Cali, Colombia, on 940; Radio Jornal do Brasil in Rio de Janeiro also on 940; Radio Margarita in Las Asuncion on 1020, Radio Litoral on 1130 and Radio Puerto Cabello on 1290. The last three are in Venezuela and all were heard between midnight and 0400 GMT. The long sea path between the UK and the Atlantic coast of South America favours propagation on the medium waves and Latin Americans are often prominent on nights when North American DX is poor. Channels normally occupied by high power stations in Canada and the USA can yield some surprising DX on these occasions. Portuguese is the language of Brazil and Spanish the language of Colombia, Venezuela, Uruguay and Argentina.

Derek mentions the night programme from Athens on 1385kHz which identifies with "Radiophonikos Stathmos Athenon." It is audible after midnight when Radio Centro Madrid and Bernburg, East

ON THE AIR

Germany have cleared the frequency. Athens does verify. Derek has logged the YENED (Greek Armed Forces) outlet in Athens on 593kHz and he asks if the 4kW YENED station at Pyrgos in the Western Peleponese is still on 1349kHz? Pyrgos is listed as having a night programme from 2300 to 0300 with announcements in English. Has anyone heard it recently?

The mystery surrounding the Libyan broadcasts on 1570kHz now appears to be solved. The programme comes from the Deutsche Welle relay in Malta which is used by the Maltese Government after the DW transmissions finish at 2130. From 2130 until 2245 there is the Voice of Malta in Arabic and from 2245 to 0030 the Arabic Service from Radio Tripoli. Sharjah is on 1575 with 5kW from 0230 until 2000 and it can be heard in the UK.

BROADCAST BANDS
Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD. **Medium Wave** Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS
Logs covering any amateur band/s in band/alphabetical order by the end of the month to **Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.**

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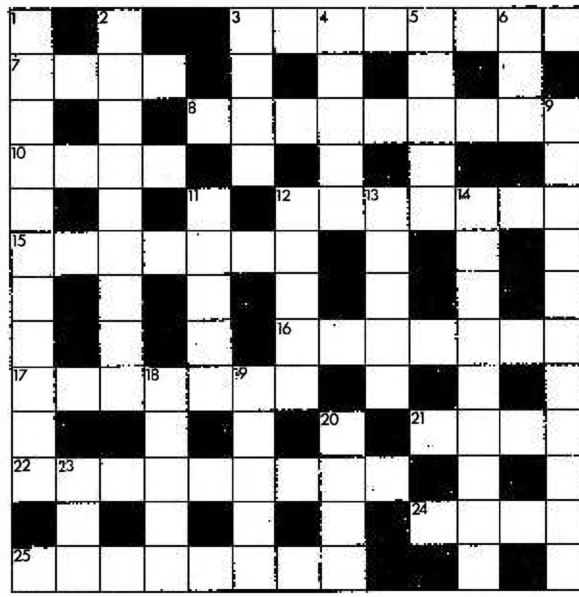
PW TECHNICROSS PUZZLE No.17



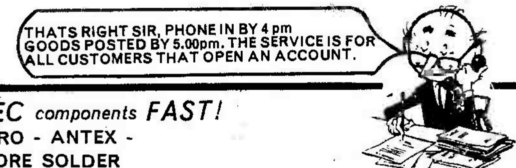
ACROSS

3 What you hold against the bridge tester? (8)
7 Essential part in retro leads? (4)
8 Non-conductors on the defensive? (9)
10 About a hooter with a hood? (4)
12 Banish radio leaving the motorway? (4, 3)
15 Chemical drier that's broadcast on a city? (3-4)
16 Ring five relay changes and sleep on! (7)
17 Implement for cutting our a wavelength? (7)
21 Ham said to get him on a hook-up? (4)
22 Revolver that holds the record? (4-5)
24 Arc he volted round a shorted motor? (4)
25 Interrupter of your old car radio? (8)

DOWN

1 Wire to get your teeth into—and part with this tool! (5, 3, 3,)
2 Many stations to pick up on it? (4, 5)
3 Five-line system for music? (4)
4 L.P. I.O.U. from a broken French soldier (5)
5 Take someone else's partner for a dance! (3, 2)
6 The right pitch from the start (3)
9 No-risk radio component with release mechanism (6, 5)
11 Knaves who support damaged motors? (5)
12 Chuck to operate the switch? (5)
13 Dog with extremes of radio and receiver terminals! (5)
14 Halt Gus on distortion attack? (9)
18 He eats to the sound of jazz, girl! (5)
19 Divided one component? (5)
20 Correct arc for smooth music? (4)
23 Smith's short way in the studio? (3)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH



TRANSISTORS

AC125	20p
126	20p
127	20p
128	20p
151	35p
153	35p
176	20p
187	20p
188	20p
AD149	68p
161	42p
162	42p
MCH/PR	1·04p
AF116	24p
117	24p
124	30p
186	50p
239	46p
AU113	1·50p*
BAX12	10p
13	7p
BC107	11p
107A	12p
107B	13p
108	10p
CIL108	6p
BC108B	11p
108C	12p
109	11p
109B	12p
109C	13p
117	18p*
136	16p*
142	24p
143	24p
147A	9p*
147B	10p*
148	9p*
148B	10p*
149	10p*
149B	11p*
149C	11p*
153	18p*
154	18p*
157B	12p*
158A	12p*
159A	12p*
172A	15p*
173B	16p*
177	17p
177B	18p
178B	18p
179B	19p
182B	10p*
182L	11p*
183B	10p*
183L	10p*
184B	12p*
BC184L	11p*
186	25p
187	26p
204A	16p*
204B	16p*
209B	13p*
212A	13p*
212L	15p*
213B	12p*
214	15p*
214L	17p*
237A	16p*
238A	15p*
261A	16p
262A	19p
267A	14p

BC268B	13p
269	13p
287	20p
300	35p
301	34p
303	35p
327	20p*
328	18p*
338	16p*
340	15p*
461	35p
557	15p*
BCY70	15p
71	18p
72	14p
BD123	90p
124	90p
131	36p
132	38p
139	54p*
140	58p*
155	75p*
BDY20	80p
BF115	22p
158	20p*
166	38p
167	21p
173	20p
178	24p
179	25p
183	34p
184	25p
185	28p
194	10p*
195	10p*
196	12p*
197	12p*
199	15p*
200	38p
BFW10	68p
11	68p
BFX29	26p
30	25p
40	28p
84	22p
88	22p
BFY50	17p
51	16p
52	18p
BSX20	19p
BY126	12p
164	40p
ME0401	18p*
0402	18p*
0411	18p*
0412	19p*
0413	15p*
0414	15p*
ME0461	21p*
0462	21p*
0463	19p*
0475	30p*
0491	19p*
0492	19p*
0493	16p*
4001	10p*
4101	11p*
MJE340	56p*
MPF102	32p*
OA5	60p
10	37p
47	9p
81	15p
90	5p
91	4p
95	5p

200	6p
202	7p
OC35	80p
44	30p
45	27p
71	25p
72	27p
74	25p
81	24p
82	25p
ORP12	65p
TIP29A	47p*
30A	56p*
31A	57p
32A	67p
33A	94p
34A	1·13p
41A	67p
42A	80p
TIS43	35p
ZTX109	14p*
300	13p*
301	13p*
302	18p*
500	15p*
502	18p*
504	25p*
530	23p*
IN914	5p
IN4001	5p
4002	6p
4003	7p
4004	8p
4005	9p
4006	10p
4007	11p
4148	5p
5401	15p
5404	21p
2N708	20p
1613	20p
1711	20p
2102	50p
2219	20p
2222	20p
2646	40p
29260	13p*
2926G	15p*
3053	18p
3055	60p
3643	17p*
3646	13p*
3702	11p*
3703	10p*
3704	13p*
3705	10p*
2N3707	12p*
3708	12p*
3709	10p*
3710	11p*
3711	11p*
3819E	25p*
3820	45p*
3823E	25p*
4036	34p
4058	13p*
4059	10p*
4061	12p*
4124	20p*
4126	30p*
5298	48p
5457	30p*
5458	30p*
5459	38p*

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1/63	5p*	250/12	10p*
1/75	5p*	250/50	18p*
2·2/25	5p*	330/16	15p*
2·2/63	5p*	470/6V3	10p*
2·5/64	5p*	470/10	12p*
4·7/16	4p*	470/16	15p*
4·7/40	5p*	470/25	19p*
4·7/63	5p*	680/25	25p*
6·8/25	5p*	1000/16	25p*
6·8/40	5p*	1000/50	40p*
8/70	6p*	1500/25	35p*
10/16	4p*	2200/25	60p*
10/25	5p*	2500/15	45p*
10/35	6p*	5000/12	45p*
10/64	6p*	**Poly. R/Load 100VDC values in Mfd**	
20/70	5p*		
22/6V3	5p*		
22/16	6p*	·001	5p*
25/25	6p*	·0022	5p*
33/50	8p*	·0047	5p*
47/6V3	5p*	·0068	5p*
47/10	5p*	·01	5p*
47/16	5p*	·015	6p*
47/25	6p*	·022	6p*
50/10	5p*	·033	6p*
50/15	5p*	·047	6p*
100/18	6p*	·068	6p*
100/25	6p*	·1	6p*
100/35	9p*	·15	7p*
100/50	11p*	·22	8p*
150/35	11p*	·33	10p*
220/16	11p*	·47	15p*
220/25	12p*		

TANTALUM BEAD

·47 MFD 35V	10p*
·15 MFD 35V	10p*
1 MFD 35V	10p*
10 MFD 10V	10p*
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5K, 10K, 25K, 50K 100K, 250K, 500K. 1M, 2M, 25p* EACH

PRESET

MIN & SUB-MIN
100 Ω, 220 Ω, 470 Ω, 1K 2K2, 4K7 10K, 20K, 50K, 100K, 250K, 470K, 1M, 2M2, 8p* EACH

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Spare Element	1·35p
Bits 2, 3, 4, 5, 6, 102, 103, 106	·46p
15W MODEL CCN	3·45p
Element	1·75p
Bits 1100, 1101, 1102,	46p
1106	72p
ST3 Stand	1·40p

BREAD-BOARDS. S-DEC 1·98p
T-DEC 3-63p μ-DEC 'A' 3·99p

VERO 0·1 Matrix		3·75" × 5"	51p
2·5" × 1"	12p	2·5" × 5"	46p
2·5" × 3·75"	38p	4·7" × 17·9"	2·34p
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POST & PACKING 25p PER ORDER. VAT PLEASE ADD TO TOTAL *12½% REST 8%

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RESISTORS 1½p* each

½ WATT E12 (5%)
1 ohm–10m ohm

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LED Til 209/0·125 0·2"

Red	20p	20p
Grn	20p	29p

Clips for above 1p.

THYRISTORS

60V 1A	20p
600V 1A	60p TAG 1 600
700V 1A	1·20 BT106
400V 4A	58p C106D1
500V 6½A	1·25 BT109

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7400	15p	7440	18p
1	20p	1	85p
2	18p	2	68p
3	18p	3	1·00p
4	23p	4	1·00p
5	23p	5	90p
6	40p	6	1·00p
7	40p	7	98p
8	24p	8	98p
9	23p	7450	18p
7410	18p	3	18p
1	24p	4	18p
2	25p	7460	18p
3	38p	7470	32p
4	72p	2	30p
6	36p	3	30p
7	36p	4	35p
7420	18p	5	49p
1	26p	6	32p
2	22p	7480	48p
3	34p	3	1·00p
5	34p	4	1·20p
6	36p	5	1·30p
7	32p	6	43p
8	30p	7	1·65p
7430	18p	9	3·30p
2	28p	7490(A)	55p
3	33p	1	75p
8	30p	2	55p

3	55p
4	85p
5	74p
6	90p
74107	30p
74121	38p
74123	49p
74141	80p
74174	1·20p
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4002	19p	4024	75p
4006	1·45p	4025	19p
4007	19p	4026	1·96p
4008	1·49p	4027	78p
4009	58p	4028	1·31p
4010	58p	4029	1·95p
4011	19p	4030	61p
4012	19p	4040	1·21p
4013	45p	4042	1·14p
4014	1·42p	4043	1·44p
4015	1·16p	4049	52p
4016	52p	4050	54p
4017	1·12p	4511	1·94p
4018	1·81p	4518	1·87p
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4020	1·63p	4901	37p
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14 pin	15p
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100V 3A	15p
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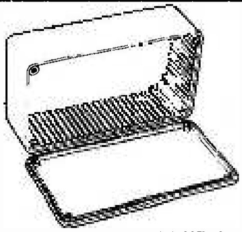

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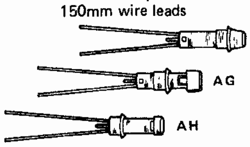

Red, Amber, Clear, Opal 19p each
Green 28p each

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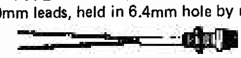

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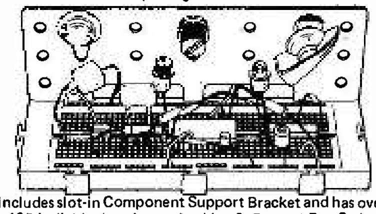

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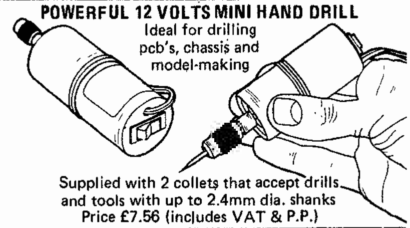

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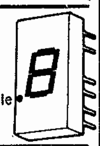

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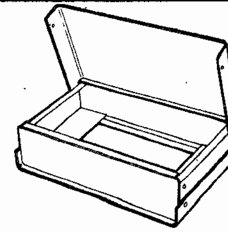

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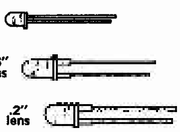

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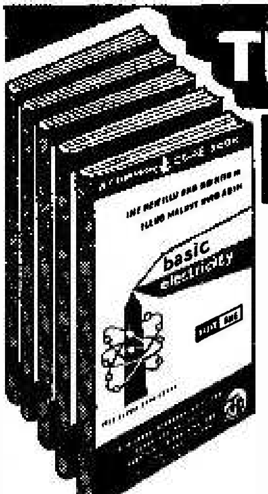

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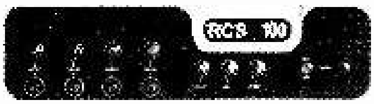

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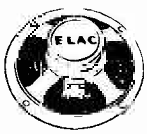

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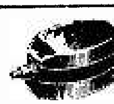

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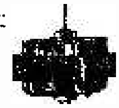

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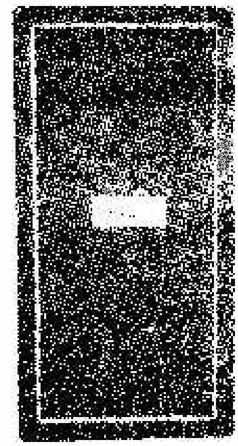

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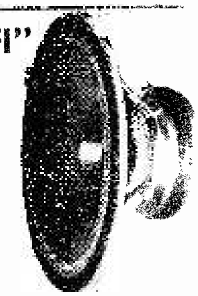

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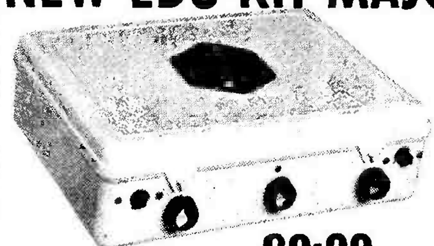

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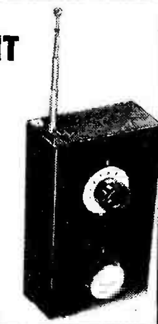

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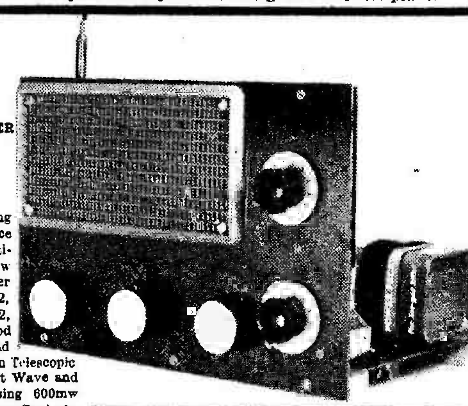

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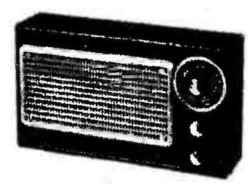

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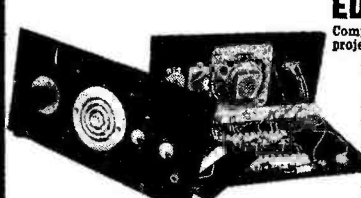

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7425	0·30
7427	0·48
7428	0·53
7430	0·16
7432	0·37
7433	0·49
7437	0·35
7438	0·35
7440	0·16
7441	0·76
7442	0·65
7445	1·50
7446	2·56
7447	0·81
7448	0·81
7450	0·85
7451	0·16
7453	0·18
7454	0·18
7460	0·18
7470	0·32
7472	0·26
7473	0·30
7474	0·32
7475	0·47
7476	0·36
7480	0·55
7481	1·26
7482	0·75
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7485	1·25
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AC142	0·18	BD238	0·60*	OC70	0·10
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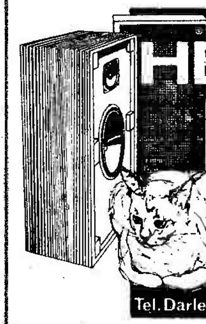

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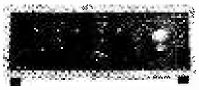

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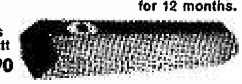

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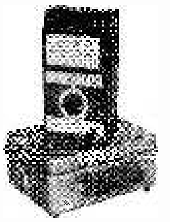
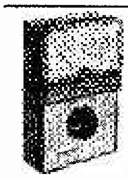


TYPE	U4312	U4313	U4315
Sensitivity D.C.	667 o.p.v.	20,000 o.p.v.	20,000 o.p.v.
Sensitivity A.C.	667 o.p.v.	2,000 o.p.v.	2,000 o.p.v.
D.C. Current	300 μA-6A	60μA-1·5A	50μA-2·5A
A.C. Current	1·5mA-6A	0·6mA-1·5A	0·5mA-2·5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
Resistance	0·02-3kΩ	1K-1M	300Ω-500kΩ
Capacity	—	0·5μF	0·5μF
Accuracy	1% D.C., 1·5% A.C.	1·5% D.C., 2·5% A.C.	2·5% D.C., 4% A.C.
Price complete with pressed steel carrying case and test leads.	£14·50	£17·50	£14·95

TYPES U4313 AND U4313 ARE PROVIDED WITH ANTI-PARALLAX MIRROR SCALES

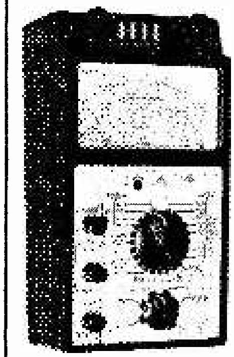


TYPE U4324

D.C. Current:	0·06-0·6-60-600mA-3A
A.C. Current	0·3-3-30-300mA-3A
D.C. Voltage:	0·6-1·2-3-12-30-60-120-600-1200V
A.C. Voltage:	3-6-15-60-150-300-600-900V
Resistance:	500Ω-5-50-500kΩ
Accuracy:	D.C. 2·5%; A.C. 4% (of F.S.D.)

PRICE complete with test leads and fibreboard storage case **£14·50**

TYPF U4341



Sensitivity: 16700Ω/V D.C., 330Ω/V A.C.
Ranges:
D.C. current: 0·06–0·6–6–60–600mA
A.C. current 0·3–3–30–300mA
D.C. Voltage: 0·3–1·5–6–30–60–150–300–900V
A.C. Voltage: 1·5–7·5–30–150–300–750V
Resistance: 2–20–200kΩ-2MΩ
Transistor collector cut-off current 60μA
Transistor D.C. current gain in two ranges 10–350
Accuracy: 2·5% D.C.
4·0% A.C.
5% D.C. current gain
Power supplies: 4·5V battery (Eveready 1289)

Complete with steel carrying case, test lead, battery and instruction manual **£14·50**

NO OVERLOAD PROTECTION IS INCORPORATED IN THESE INSTRUMENTS

THE ABOVE PRICES ARE EXCLUSIVE OF VAT (at present 8%) HANDLING AND POSTAGE CHARGES £1·25 PER INSTRUMENT

OUR NEW 1976/1977 **CATALOGUE** IS NOW READY AND WILL BE SENT ON RECEIPT OF REMITTANCE FOR £0·30

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Audio Amplifier Module. Mullard LP1173. Output nominal 10 watt. Supply voltage +24vt. With data and circuit **£2·30**.

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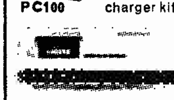

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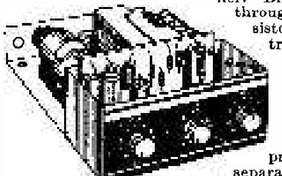
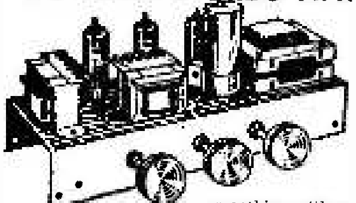
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £13·75. P. & P. £1·00.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:- 2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. £12·40. P. & P. £1·30.

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A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel size approx. 9¼" × 2⅜" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £7·50 plus 50p P & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at £1·50 + 40p P & P if required. Full connection details supplied.

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BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £2 90 P. & P. 90p.

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Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2·35. P. & P. 90p.
Pri. 200/240V Sec. 23V at 1·5amp, 6V at ·6 amp, 8V at 50mA. £2·00 + 65p P. & P.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load.
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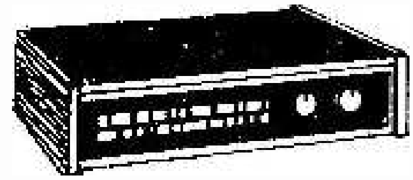
QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE £6·20, P. & P. 90p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £7·30, P. & P. £1.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER



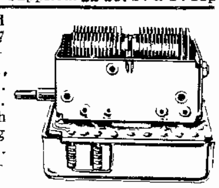
Enjoy fabulous stereo radio at this low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-gain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12¼" wide × 8" deep by 2¼" high. Supplied ready built, fully tested and fully guaranteed. A/C Mains 200/240V (not available in kit form).

SPECIAL OFFER £22·50 + £1·40 p. & p.

SPECIAL OFFERS

Mullard LP1159 R.F.–I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2¾" × 1½" × ½" 7·6 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25. P. & P. 12p



Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10·7 M/Hz I.F. output. 7·8 Volt + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only £3·15 + P. & P. 35p.

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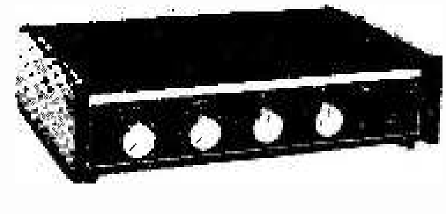
Also similar but without cueing lever or bias compensator. ONLY £11·00 + £1·40 P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2½"h.

Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£13·50	P. & P. 65p
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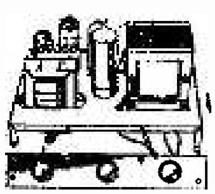
POWER PACK KIT	£4·85	P. & P. 85p
CABINET	£4·85	P. & P. 85p

SPECIAL OFFER—only £22·50 if all 3 items ordered at one time plus £1 p. & p.

Full after sales service

Also available ready built and tested £29·25. P. & P. £1.

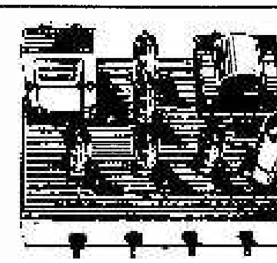
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7¼"w. × 4"d. × 4¾"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £7·80. P. & P. £1·00.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc £7·00 P. & P. £1·00.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts)' **All parts sold separately.** ONLY £11·25 P. & P. £1·35. Also available ready built and tested £15 20 P. & P. £1·35.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" × 1½" × ½". Brand new complete with instructions. Price £1·60 P.& P. 15p.

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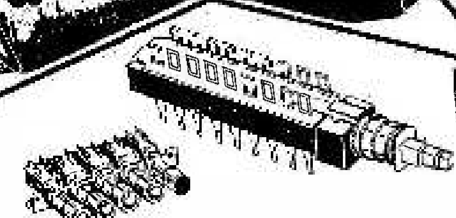

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