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SEPTEMBER 1972

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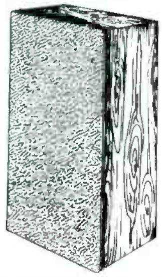

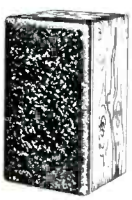

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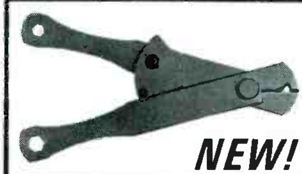

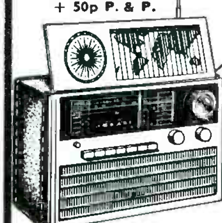

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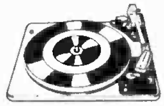

SP25 Mk. III
Deck Only

4 speed
Automatic Single Player

Lasky's price **£11·50**

Garrard SL95B Deck	...	£35·00
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SP 25 Package

SP25 Mk. III Single player	List	£15·85
AD76K stereo magnetic cartridge	List	£4·35
Lasky's teack plinth & cover	List	£4·75
Total List Price		£24·95

Package Price **£20·50**

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SHURE M44E Cartridge	List	£8·59
Lask's Base and Cover	List	£5·95
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CARRIAGE—all units
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DECK WITH PLINTH AND COVER 75p.

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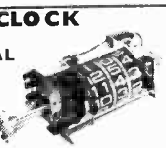
W1/700
MW/LW

Two waveband all transistor car radio that covers full Medium and Long wavebands with slide switch wave change. Large easy to grip controls. Illuminated dial with "easy to read" scale. Externally adjustable aerial trimmer. Powerful output through either one or two speakers. Operates on 12 volt D.C. Negative or positive earth. Standard size 6¼in (W) x 4¾in (D) x 2in (H). Black with chrome trim. **Complete with speaker, baffle, leads, mounting brackets.**

LASKY'S PRICE **ONLY £7·50** C & P 25p

NEW DIGITAL CLOCK

NOW WITH ILLUMINATED DIAL EXCLUSIVELY FROM LASKY'S



The clock measures 5¾ W x 2¾ H x 3in D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. ● **COMPLETE WITH KNOBS. FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER**

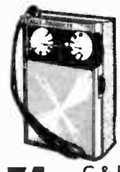
SPECIAL QUOTES FOR QUANTITIES LASKY'S PRICE **£6·75** C & P 25p

SINCLAIR PHASE LOCK LOOP STEREO FM TUNER

Incorporates varicap diodes, printed circuit, coils, squelch circuit I.C. Decoder, etc., supplied completely built and tested and ready to be mounted into any cabinet you choose. It may be used with any High Fidelity Amplifier. Power requirements 25/30V DC. Size 8¼" x 1½" x 3¾".

LIST PRICE £25·00 LASKY'S PRICE **£16·95** C & P 25p
PZ5 power supply £4·15 extra.

EAGLE AM/FM POCKET TRANSISTOR RADIO



This super compact two-band radio **ORIGINALLY COST £9·81!** The ideal pocket set for all ages. Receives all Med. wave and FM stations (local news, etc.)—separate tuning scales. Grey/chrome trim cabinet with carry strap. Excellent tone. Uses single PP3 type battery. Telescopic FM aerial. Size: 4½ x 2¾ x 1⅜in. comp. with battery and ear-piece.

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Type	Single	5	10	15
C60	28p	£1·37	£2·70	£3·99
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C120	48p	£2·35	£4·63	£6·84

Each cassette individually boxed in Philips, type plastic library.
C & P: each 7p, 5—25p, 10—40p, 20—68p.

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Leak 150 Speakers
List price £49·00 per pair
Lasky's Price **£38·95** C & P £2·00

Leak 250 Speakers
List price £63·00 per pair
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Leak 600 Speakers
List price £99·00 per pair
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BSR TAPE DECK SCOOP

BSR TD2

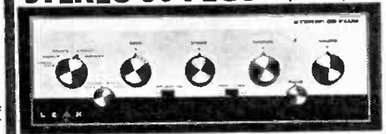
FANTASTIC VALUE. ONLY Lasky's can offer you a tape deck at such an amazing price. The BSR TD2 tape deck operates by a simple reliable mechanism using the minimum of controls.

Available with ½ track or ¼ track mono or stereo heads. Incorporates fast wind and fast rewind, records at 3¾ ips. giving up to 3 hrs playing time, takes up to 5¾in. spools. Size 13in. x 8¾in. front to rear, 2¹³⁄₁₆in. below plate, 1⅝in. above plate.

LASKY'S PRICE **£8·95** C & P

LEAK BARGAINS

STEREO 30 PLUS amplifier (cased)



List Price £62·50 PRICE **£45·00** C & P £1·00

STEREO 70 amplifier (cased)
List Price £75·00 LASKY'S PRICE **£55.00** C & P £1·00

LEAK CASES

Rosewood cases for Stereo 30 or Stereo 70.
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Teak case for Stereofetic tuner only.
List Price £7·37 LASKY'S PRICE **£2·50** C & P 35p

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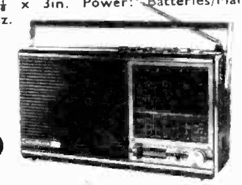
2 speed belt drive turntable comp. with plinth, cover and SHURE cartridge.
LIST PRICE £69·50
LASKY'S PRICE **£47·50** C & P £1·50

RADIO BARGAINS

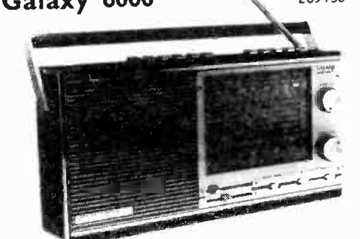
Nordmende Galaxy 4000
AM/FM/LW/SW Battery/Mains Portable Radio

Both these sets offer fantastic quality and almost unbelievable value! Each superbly finished in teak black and chrome. Covers medium, long and FM waves plus 3 band spread short wave ranges. Fitted with slider volume and tone controls. Size: 13¼ x 7¼ x 3in. Power: Batteries/Mains 220/240, 50/60Hz.



ORIGINAL LIST PRICE £49.50
LASKY'S PRICE **£39·50**
C & P 25p

Nordmende Galaxy 6000
ORIGINAL LIST PRICE £69.50



AM/FM/LW/SW Battery/Mains Portable Radio
Covers medium and long waves, FM (local) and world-wide short waves cover in 6 band ranges. Size: 16¼ x 8 x 3in. Filter switch, ext. speaker socket, tape record and record player socket. Batteries or 220/240v. Mains, 50/60Hz.

LASKY'S PRICE **£49·50** C & P 35p

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	Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23·00 +£1·50 p&p
	Total	£59·00
Available complete for only £52+£3·50 p&p		

PRICES SYSTEM 2	Viscount R101 amplifier	£22·00 +90p p&p
	2 × Duo Type III speakers	£32·00 +£3 p&p
	Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23·00 +£1·50 p&p
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14 + 14 watts r.m.s. 40 Hz to 40kHz ± 3dB. Total distortion at 10 watts at 1kHz —0·1%

This is real value for money! We have designed 2 systems and the heart of them is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For both systems we have chosen the famous Garrard SP25 Mk. III deck which comes complete with simulated teak plinth and dust cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

SPECIFICATION

14 watts per channel into 3 to 4 ohms (suitable 3-15 ohms). Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics:* Bass +12dB to —17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to —12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.)—P.U.1 and radio —65dB. P.U.2 —58dB. *Cross talk* better than —35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx. 13¾in × 9in × 3¾in.

SPEAKERS

Duo Type II

Size approx. 17in × 10¾in × 6¾in. Drive unit 13in × 8in with parasitic tweeter. Max. power 10 watts, 8 ohms. Simulated Teak cabinet. **£14 pair** + £2 p&p.

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Goods not despatched outside U.K.

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£25 *takes the wraps off* UNISOUND

a new concept in stereo

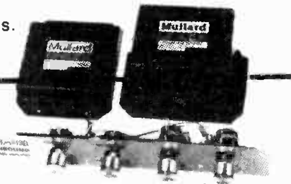
The whole system is complete *including superb cabinets in simulated teak* —just simply screw together the components and you save pounds! Amplifier is based on the famous Mullard Unilex system. Garrard 2025TC turntable complete with stereo ceramic cartridge, teak simulated plinth and tinted acrylic cover. Plus the big 13" x 8" EMI Twin-cone speakers ready for mounting in their elegant cabinets, which simply need screwing and glueing together. All glue and screws supplied.
Easy to follow step-by-step instructions guide you quickly and effortlessly to taking the wraps off truly realistic stereo sound.

RTVC

£25 complete plus £2·80 p. & p.

Diamond Stylus £1·25 extra.

Power output: 4 watts per channel into 8 ohms.
Inputs: 120 mV (for ceramic cartridges).
Stereo headphones with adaptor £4·00



UNISOUND MODULES ONLY £6.95

If you prefer, you can buy the three modules —pre-amplifier, power supply/dual power amplifier, and control panel—by themselves for only **£6·95.** P. & P. 50p extra.
No soldering, just simply screw together with screwdriver supplied. Their overall specification is the same as shown for the complete Unisound console, using the high efficient I.C. monolithic power chips to ensure very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum.

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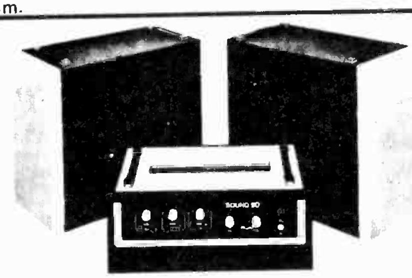
CONTROLS:—3 Volume controls. Bass control range: 13dB @ 60Hz. Treble control range ±12dB @ 15KHz. Separate ON/OFF Switch. Neon Indicator. **POWER OUTPUT:**—12 Watts R.M.S. into 3 to 4 ohms speaker.
SIGNAL/NOISE:—Better than —60dB on Inputs 3, 4 and 5 & —50db on 1 & 2.
SUPPLY:—220-250 AC Mains. **SIZE:**—12½" × 6" × 3½".



SOUND 50
50 WATT AMPLIFIER AND SPEAKER SYSTEM

Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency Response:** —3dB points 30Hz at 18KHz. **Total Distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
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To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
SPEAKERS! Size 20" × 20" × 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and Grey.

COMPLETE SYSTEM £50 Plus £6 P. & P.

Sound 50 Amp and 2 speakers or available separately.

Amplifier £28·50 plus £1·50 P. & P.
Speakers £12·50 each plus £2·25 P. & P.

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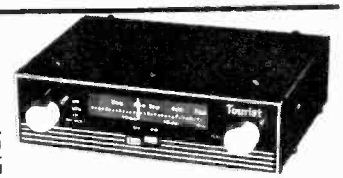
STEREO AMPLIFIER

Mullard built stereo pre-amplifier/tone control module and the highly efficient I.C. monolithic power chips ensure reliability and very low distortion at all power levels.
INPUTS:—P.U. 150mV. @ 2·2 Meg (for ceramic cartridge)
Auxiliary 100mV. @ 1 Meg (for radio, tape etc.)
OUTPUTS:—5 watts R.M.S. per channel into 8–15Ω speakers.
Switched stereo headphone socket with power correction.
CONTROLS:—Mono/stereo switch, selector switch, treble, bass, volume, balance and on/off switch. Neon Indicator.
TONE CONTROLS:—Treble ±14db @ 15KHz.
Bass ±14db @ 60Hz.
POWER BANDWIDTH:—±2db 20Hz–25KHz.

£11.50 plus P. & P. 60p.

TOURIST MK 3
CAR RADIO ALL TRANSISTOR



Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands.
R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in × 2in × 4½in deep.
Circuit diagram 13p. Free with parts. Speaker, baffle and fixing kit £1·25 extra, plus 25p p. & p. Postage free when ordered with parts.

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RTVC
See opposite page for addresses

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TESTED AND GUARANTEED PAKS

B2	4	Photo Cells, Sun Batteries. 0·3 to 0·5V. 0·5 to 2mA.	50p
B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Approx. quantity counted by weight	50p
H7	40	Wirewound Resistors. Mixed types and values.	50p
H8	4	BY127 Sil. Recs. 1000 PIV. 1 amp. plastic	50p
H9	2	OCP71 Light Sensitive Photo Transistor	50p
H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H28	20	OC200/1/2/3 PNP Silicon uncoded TO-5 can	50p
H30	20	1 Watt Zener Diodes. Mixed Voltages 6·8 – 43V.	50p
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short lead Transistors, NPN Silicon Planar types.	50p

UNMARKED UNTESTED PACKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	50p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	8	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	50p

MAKE A REV COUNTER FOR YOUR CAR

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

£1 each

OUR VERY POPULAR 3p TRANSISTORS

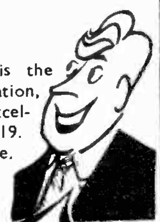
TYPE "A" PNP Silicon alloy, TO-5 can.
TYPE "B" PNP Silicon, plastic encapsulation.
TYPE "E" PNP Germanium AF or RF.
TYPE "F" NPN Silicon plastic encapsulation.

FULLY TESTED AND MARKED SEMICONDUCTORS

	£p		£p
AC107	0·15	OC140	0·15
AC126	0·15	OC170	0·23
AC127	0·17	OC171	0·23
AC128	0·15	OC200	0·25
AC176	0·20	OC201	0·25
ACY17	0·20	2G301	0·13
AF239	0·30	2G303	0·13
AF186	0·20	2N1302-3	0·15
AF139	0·30	2N1304-5	0·17
BC154	0·20	2N1306-7	0·20
BC107	0·10	2N1308-9	0·22
BC108	0·10	2N3819FET	0·40
BC109	0·10	2N4416FET	0·35
BC169	0·12	**Power Transistors**	
BF194	0·15		
BF274	0·20	OC20	0·50
BFY50	0·15	OC23	0·30
BSY25	0·13	OC25	0·25
BSY26	0·13	OC26	0·25
BSY27	0·13	OC28	0·30
BSY28	0·13	OC35	0·25
BSY29	0·13	OC36	0·37
BSY95A	0·10	AD149	0·30
OC41	0·15	AUY10	1·25
OC44	0·13	2S034	0·25
OC45	0·10	2N3055	0·50
OC71	0·10	**Diodes**	
OC72	0·10	AAY42	0·10
OC81	0·13	OA95	0·07
OC81D	0·13	OA79	0·07
OC83	0·18	OA81	0·07
OC139	0·13	IN914	0·06

F.E.T. PRICE BREAKTHROUGH!!

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 **30p each**, 10-50 **25p** each, 50+ **20p** each.



TRANSISTOR IGNITION!

AS USED BY RACING DRIVERS

NOW We introduce a Transistorised Ignition that is NOT a Kit at LESS than Kit price! The Super Spark, Mark II, is ready to go. Installation time—10 minutes. It operates on a unique and newly discovered principle that drives a standard ignition coil with a fantastic peak of 400V. The solid impact gives 45,000 Volts right to the sparking plug and gives cooler running, longer plug life, more M.P.G. and greater B.H.P. Contact breaker life is extended indefinitely and no visible burning will ever take place. The circuitry is all silicon solid state and is engineered for top dependable performance on any car with standard ignition coil. Every unit is tested before despatch and each carries a full guarantee.

Gives a full spark at up to 10,000 RPM!

Please state Positive or Negative earth on order.

Super Spark—**£9·95**
P & P 25p

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8 RELAYS FOR VARIOUS TYPES £1

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NOW ONLY 50p each
post and packing 23p.

Quantity	1–10	10-50	50+
BB105 Varicap Diodes	10p	8p	6p
OC71 or 72 Fully Tested Unmarked	5p	5p	4p
Matched Sets 1–OC44 and 2–OC45's. Per Set.	25p	20p	15p
OA47 Gold-Bonded Diodes, Marked and Tested	3p	3p	2p
1-watt Zener Diodes 7·5, 24, 27, 30, 36, 43 Volts	5p	4p	3p
10-watt Zener Diodes 5·1, 8·2, 11, 13, 16, 24, 30, 100 Volts	20p	17p	15p
Micro Switches, S/P, C/O	25p	20p	15p
1-amp Bridge Rec's 25-volt	25p	22p	20p

INTEGRATED CIRCUITS

SL403D Audio Amp.,3-Watts	1·50	1·37	1·32
709C Linear Opp. Amp.	25p	20p	15p
Gates, Factory Marked and Tested by A.E.I.	10p	9p	8p
J. K. Flip-Flops Factory, Marked and Tested by A.E.I.	20p	18p	15p
SN7490 Decade Counter	50p	45p	40p
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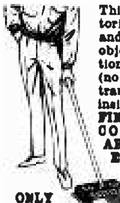
FIND BURIED TREASURE!

Transistorised Treasure Locator



This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·85** + 25p p. & p. (Sectional handle as illustrated 95p extra). Parts available separately. Made up looks worth £15!

ONLY **£2·85**

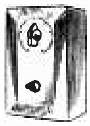
Eavesdrop on the exciting world of Aircraft Communications

V.H.F. AIRCRAFT BAND CONVERTOR

ONLY **£2·85**

Listen in to **AIRLINES, PRIVATE PLANES, JETPLANES.** *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower, Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument *can be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHATEVER NEEDED.** SEND ONLY £2·85 + 20p p. & p. for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON



Only **£2·75**

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering.
£2·75 + 25p p. & p. *Parts available separately*

BUILD 5 RADIO AND ELECTRONIC PROJECTS

only **£2·45**

Amazing Radio Construction set! Become a radio expert for £2·45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. Send £2·45 + 20p p. & p.

SHORTWAVE TRANSISTOR RADIO

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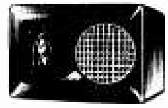
Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins. —Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4½" x 1¾" Only £2·75 + 20p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

INGENIOUS ELECTRONIC SLEEP INDUCER

ONLY **£3·25**



CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries, extremely economical. Size only 3" x 4½" x 1½"—take it anywhere. Kit includes case, nuts, wire, screws, etc. **SEND £3·25** + 25p p. & p. (parts available separately).

ELECTRONIC ORGAN

ONLY **£3·25**

Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELF CONTAINED LOUDSPEAKER.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, Simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* **ONLY £3·25** + 25p p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

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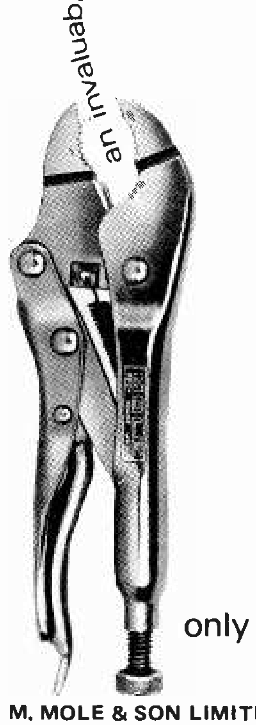
FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! £4·95 + 30p carr. etc. (High quality Danish Stethoscope headphones £2·75 extra if required.)
EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.

CONCORD ELECTRONICS LTD. (PW9U) 12 Archer Street, London, W.1. *Callers welcome 9 a.m.–5.30 p.m. Inc. Saturday*

an invaluable aid to practical wireless enthusiasts



The pocket size dimensions and versatility, of the MINI MOLE Wrench, makes it 'just the job' for intricate difficult-to-get-at components situated in awkward corners.

The steel jaws lock-on with a positive grip, and a flick of the lever releases their grip instantly.

Available from Hardware and Motor Accessory Shops.

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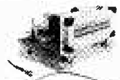
SELF GRIP WRENCH

only 80p

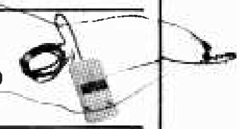
M. MOLE & SON LIMITED, NEWPORT, MON. NPT 5XZ.

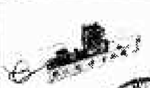


VHF/FM Tuner for 88-102 MHz. Self-powered for 200-250vac. Valves ECC85, EF89, 6BW7, ECC85, 2 diodes, metal rect. Chassis 8" × 6" × 5½". German front end. **Price £6** (40p post).

MAINS OPERATED POWER SUPPLY 12 volt 0·6Amp. Ideal for model railways but can be modified for 6v or 9v for cassette recorders, radios etc. Price list of necessary components and suggested circuit supplied each unit. Size 5½" x 2½" x 2". Moulded plastic case.

PRICE £1·25 (25p post)





STEREO AMPLIFIER 2 × 3W. Printed circuit. Valves EZ80 & 2 ECL82. Liquidated stock of well-known manufacturer. Front panel 12" × 2". Chassis 9" × 3". Controls on-off, balance, ganged vols., ganged tones; for 200-250v. a.c. Output transformers for 3-ohm speakers. With knobs. Also available for 110v. a.c. Only £6 (p. & p. 50p.) 0v. type £5 plus post.

I.C. MODULE 40p. (10p. post). Length 2½" over bracket, × 1½" over tags. With instr. diagram to build stabilised power supply, motor speed control, door buzzer, current meter, windspeed wiper speed control, saw-tooth gen, variable timer, pulse gen, width of module ⅜".

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100V at 60mA. 35p (15p).
200V at 50mA and 6·3V at 1A. 35p (15p).
220V at 50mA and 90V at 100mA. 40p (15p).
250V at 50mA and 6·3V at 1½A, 50p (20p).
22V at 1A, 6·3V at 2A and 250V at 50mA, 75p (25p).
90V at 20mA and 1·4V at 250mA, 50p (15p).
Deduct 10 per cent from total bill for more than one transformer.
100 mixed high stab. resistors up to 1M all marked 50p (10p post).
100 mixed transistors, marked type no. £2 post paid.

GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, Hants

(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240.
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HIGH POWER SPEAKER SYSTEMS

Strong leather cloth finish ¾" board, fully lagged. Fitted high efficiency 8 or 16 ohm speakers.

PRINCE. 50 watt rms. 12" twin cone. Size 24" × 16" × 12".
CONSORT. 100 watt rms. 2-12" twin cone speakers. Size 36" × 18" × 12".
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SOVEREIGN. 100 watt rms. 18" Bass, 12" Full range. Size 50" × 26" × 14".

FULL RANGE OF MICROPHONES, STANDS, ETC. ALWAYS IN STOCK

SOUND CONTROLLED AND SOUND TO LIGHT UNITS

Mid, Treble and Bass Channels, up to 1kw of lamps per channel plus override switching.

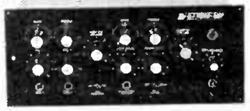
DJ30L. Sound to light. Takes output from most amplifiers. Adjustable levels.

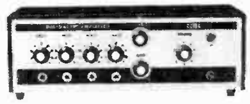
DJ40L. Sound controlled version. Built in microphone, no connections required.

ASSEMBLED DISCOTHEQUES

DISCO-MINI. Complete portable Disco with built-in full function preamplifier/mixer. For use with any power amplifier such as "Discmaster". Size 30" × 20" × 8". £98·50
DISCO-IMP. The latest addition to the Discosound Range of discotheques. Even smaller and more compact than the Disco-Mini, it contains all the necessary features for the smooth running of a mobile unit. Size 29" × 18¼" × 7". £79·00
DISCO-STANDARD. Has all the facilities of the Disco-Mini with the addition of a built-in 100 watt power amplifier making it a completely self contained disco unit. A V.U. meter gives visual indication of output levels. Size 32" × 27" × 7½". £180·00
DISCO-SUPER. A slightly larger version of the Disco-Standard. Fitted individual controls for both mic. and deck inputs plus a cross-fade for deck to deck transfer. A built in P.F.L. cueing system, mic. over-ride, also a V.U. meter gives visual indication of output levels. DJ. 30L (3000w) 3-channel psychedelic light unit is a standard fitting. Deck cut out switches are also featured for ease of cueing. Size 38" × 27" × 10". £224·00
DISCO-SUPREME. Has all the facilities of the Disco-Super plus the addition of a third turntable which can be used for Jingles or other effects without using the main deck system. Flexilights are also fitted. Size 50" × 27" × 10".
DISCO-PLINTH. Consists of 2 turntables fitted with high quality ceramic cartridges. The unit has a built in cross-fade rotary control for transferring the sound from left to right decks. The unit has no amplification built in and must be used with amplifiers such as the D.J. 105S or D.J. 70S. Size 32" × 14½" × 7" (incl. lid).

PA—DISCO AMPLIFIERS





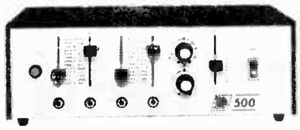
DISCO-AMP. 100 watt rms. output for 8-16 ohms, 4 channel inputs, 2-mic, 2 decks. Separate volume control plus masters. Response 30Hz –30KHz, distortion less than 1%. Treble/Bass/PFL/Mic over-ride etc. Panel size 16½" × 7".

DJ.70S MIXER/AMPLIFIER. 70 watt rms. output for 8-16 ohms. 2-mic, 2-aux/decks. Master volume/Bass/Treble. Size 15½" × 5" × 6".

DJ.105S. 30 watt rms. version. Size 11½" × 5" × 6".
DISCMASTER SLAVE AMPLIFIER. 100 watt rms. for 8-16 ohms. £55·00

NEW D.J. 500 SERIES P.A. AMPLIFIERS 50 WATT, 70 WATT & 100 WATT MODELS

This new range incorporates many features that make them ideal for the professional user, clubs, discotheques, factories etc. Fibre glass P.C. Boards are used throughout with low noise silicon transistors, high stability resistors, generously rated components and hand wired assembly to ensure reliability and quality.



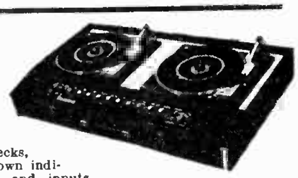
★ Exclusive "Fail Safe" Electronic Protection circuit.
★ Fault Condition warning lamp.
★ Built in bass boost below 30 Hz.
★ 4 channel mixer with slider controls.

All three amplifiers have a built in emitter follower output socket for connecting a slave amplifier to enable the power output to be increased up to 1000 watts or more if required. A matching range of slave power amplifiers and a separate matching 100v line transformer is available

SPECIFICATION

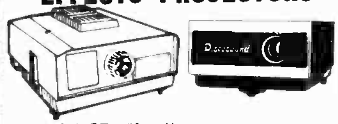
Frequency Response	50-20,000 Hz ± 3db (10dB Bass Boost at 10 Hz)		
Signal/Noise Ratio	better than —50db.		
Harmonic Distortion	less than 1%		
Speaker Impedance	8–16 ohms.		
Inputs: Mic 1 & 2	5mV at 50K ohms (50 or 600 ohm to order)		
Aux 3 & 4	100mV at 1 meg ohm.		
Size (all models)	15¼" × 5" × 6".		
Power Output: (at 8 ohms)	Model D.J.500 —	50 watts R.M.S.	£56·25
	Model D.J.700 —	70 watts R.M.S.	£67·50
	Model D.J.1000 —	100 watts R.M.S.	£79·00

DISCO MINI



Hardly larger than a suitcase yet contains all the necessary features of a high quality mobile unit. The pre-amp has separate tone controls for both mic. and decks, and each input has its own individual volume controls and inputs, plus the addition of a cross fade for deck to deck sound transfer. A built in P.F.L. system for cueing, together with mic-over-ride facility are standard on all units. Response 20-20,000 Hz. Mic. input 5mV, 50K. Output 1 volt.
McDonald M.P.60 Turntables are used with high quality ceramic cartridges, and each deck has its own individual cut out switch fitted. This unit is suitable for Discos or Clubs having a power amplifier, or for use with the 'Discmaster' 100 watt power amplifier as above. Size 32" × 20" × 8". £98·50.

EFFECTS PROJECTORS



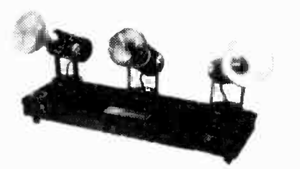
DISCO COLT. 150 watt.
LIQUIMATIC MINI, 50 watt Q1 with 6" wheel.
DISCOWHEEL, 50 watt Q1 with quick change Cassette.
GNOME 150, 150 watt Q1 with Cassette.
LIQUIMATIC, 150 watt Q1 with 6" wheel.
PLUTO TUTOR-2, 250 watt Q1 with Cassette and 6" wheel.
TUTOR-2, with Liquisplode Tank.
KALEIDOSCOPE LENS (for Tutor-2) 6" Liquid Wheel and Crystal Wheel Liquid Cassette and Moire (24 different types to choose from).
Portable Hi-Power Strobes.

YOU WILL BE SURPRISED BY THE LOW PRICES & PERFORMANCE

SDL POWER SPEAKERS

High efficiency 12" speakers. Ferrite magnets. Heavy duty voice coils and cones for Disco and Group use.
12" 50 watt rms. 8 ohm Full range.
12" 25 watt rms. 15 ohm Mid-Treble.
15" 50 watt rms. 15 ohm. Full range.
15" 100 watt rms. 15 ohm. Bass.

DISCO SPOT BANK



Designed to take three E/S Type spot or colour bulbs up to 150 watts each. The unit is of all metal construction and has one 3-pin mains input socket plus one 3-pin mains output socket for connecting more than one bank together if required. The unit can be left free-standing or wall mounted if needed. Black crackle finish gives the unit a very professional appearance.

Size 18" × 6" × 7" (excluding bulbs)

Also in stock: Ultra Violet Spot Lamps and Fluorescent Lamps, Standard and Colour Spot Lamps and Fittings. Rotating Colour Displays. Flexilights, Fibre Optics, Dimmers, Flashers Effects Foils, etc. Your enquiries invited.

MIXER UNITS

DJ.101. Battery powered, 6-channel, variable levels, 3 × 50k mic., 1 × 100mV, aux., 2 × 100mV p.u. Output 250mV.

DJ.102. Mains operated, 4-channel, variable levels. 2 × 50k mic., 2 × 100mV p.u. PFL control, master volume, mic. over-ride, output variable 0·500mV.

DISCO 40. Pre amp part of Disco amp (see above). All facilities. Output will drive up to ten 100 watt amplifiers.

Discoscene
536, Sutton Road, Southend, Essex. (0702) 611577

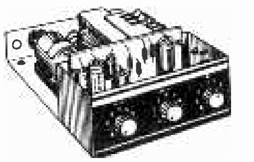
Discosound
122, Balls Pond Road, London, N.1. (01) 254 5779

Discosound (Birmingham) Ltd.
494, Bristol Road, Selly Oak, B'ham 29. (021) 472 1141

Henry's Disco
309, Edgware Road, London, W.2. (01) 723 6963

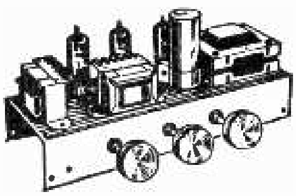
CHECK WITH YOUR NEAREST STUDIO FOR LATEST PRICES AND DETAILS (TRADE AND RETAIL SUPPLIED)

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 ohm. 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 x 6" wide x 7½" deep. AC 200/250V.
PRICE £10·50. P. & P. 25p.

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. **PRICE £8·92** P.&P. 45p.

NEW! 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 continuous (1½amp intermittent).
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¾" × 2½". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested.

PRICE £4·50 P & P 35p.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2½" × 3" approx. **25p** pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × $\frac{1}{16}$in. FIVE for **50p.** P. & P. 13p.

COILED SPRING BACK TELEPHONE CABLE. Closed approx. 10" extends to 36". 4 core or 6 core. **25p** each P. & P. 5p. 5 or more post free. LIMITED NUMBER!

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 **£1·75** P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri 200/240v. Sec. 9–0–9 at 500mA. **70p.** P. & P. 13p. Pri. 200/240v. Sec. 12–0–12 at 1 amp. **88p.** P. & P 13p. Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£1·38.** P. & P. 30p.

SPECIAL MAINS TRANSFORMER 200/240v. A.C. Input 35v at 1½ amp A.C. output overall size 2½" × 2¾" × 3" approx. Suitable drop through or vertical mounting **75p.** P. & P. 30p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY **40p.** Post 5p.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97** Carr. 50p. With stereo cartridge **£7·97** Carr. 50p.
LATEST GARRARD MODELS. S.A.E. for latest Prices!

PRECISION ENGINEERED PLINTHS
Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60 etc. or B.S.R. C109, C129, A21 etc. Choice of Black leatherette or Teak grain finish. Size 12½" x 14½" x 3¼" high (approx. 7½" high, including rigid smoked acrylic cover).
PRICE **£5·50.** P. & P. 60p.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50** P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2·50** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for **Stereo** LP. **£3.** P. & P. 10p.
LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. **£1·63** P. & P. 10p.
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·50** P. & P. 10p.

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 **£3·75** P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **£4·88** P. & P. 50p.
DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **£4·75,** P. & P. 50p.

SPECIAL OFFER!
HI-FI LOUDSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½" high x 10½" wide x 5½" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.
OUR PRICE £8.40 Carr. 65p
Cabinet Available Separately £4·50 Carr 60p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter **£6·50** Carr. 65p

LOUDSPEAKER BARGAINS
5in. 3 ohm **£1·05,** P. & P. 15p. 7 × 4in. 3 ohm **£1·15,** P. & P. 20p, 10 × 6in. 3 or 15 ohm **£1·90,** P & P. 30p, E.M.I. 8 × 5in. 3 ohm with high flux magnet **£1·62,** P. & P. 20p E.M.I. 13½ × 8in. 3 ohm with high flux ceramic magnet **£2·10** (15 ohm **£2·25**), P. & P. 30p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·20,** P. & P. 30p. E.M.I. 13 × 8in. twin cone (parasitic tweeter) 8 ohm **£2·25,** P. & P. 30p.
BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£6·25.** Guitar models: 25w. **£6·50,** 35w. **£8·50.** P. & P. 38p
E.M.I. 3½in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 or 15 ohms **93p** each. P. & P. 13p.
12in. "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling. 3, 8 or 15 ohm **£2·20,** P. & P. 30p.
35 ohm SPEAKERS 3in. only **63p** P. & P. 13p.
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" x 14$\frac{11}{16}$" x 1$\frac{1}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£5·75** each. P. & P. 25p.
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price **75p** yd. length. P. & P. 15p (min 1 yd.) S.A.E. for samples.

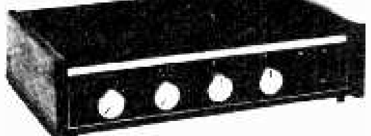
HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30-15,000Hz. Matching impedance 8-16 ohms. Easily converted for Mono. PRICE **£2·95,** P. & P. 15p.
HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **£1·05,** P. & P. 8p

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" x 1¼" x ½". Brand new complete with instructions. Price **88p.** P. & P. 13p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA. For balance or tuning. Approx. size 1" x 1" x ½" deep. Limited number. **75p.** P. & P. 10p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED FIBRE GLASS PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION

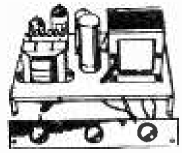
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled fibreglass printed circuit board, smart brushed anodised aluminium front panel with matching knob, 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 1M Ω. 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. x 8"d. x 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

AMPLIFIER KIT	**£10·50**	P. & P. 15p
(Magnetic input components 30p extra)		
POWER PACK KIT ..	**£3·00**	P. & P. 30p
CABINET	**£3·00**	P. & P. 30p

(Post Free if all units purchased at same time
Full after sales service

Also available ready built and tested **£21·00.** Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.

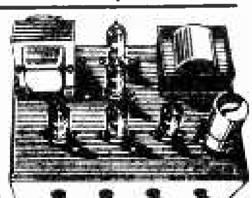
3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. x 4" d. x 4½" 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 **£4·75.** P. & P. 35p.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£3·98.** P. & P. 40p.

HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
BARGAIN PRICE **£2.75** P. & P. 35p

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 base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier Simple instruction booklet 13p (Free with parts). All parts sold separately. ONLY **£7·97** P. & P. 55p.

Open 9–5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.
170 HIGH ST., MERTON, LONDON, S.W.19 **Tel.: 01-540 3985**
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

RSC HIGH-FIDELITY STEREO *PACKAGE OFFERS*

Four fully wired units ready to 'plug in'.
★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
★ GARRARD SP25 MK III Turntable on Plinth with cover
★ GOLDRING G850 Magnetic cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units
Special Total Price **£86·95** Carr. £1·50
Terms: Deposit £11·95 and 9 monthly payments £9·37 (Total £96·28).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
★ Goldring Magnetic P.U. Cartridge.
★ Pair of Stanway II speaker units.
Special Total Price **£98·63** Carr. £1·50
Terms: Deposit £13·63 and 9 monthly payments £10·62 (Total £109·21).

ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS
Send S.A.E. for coloured brochure showing other money saving offers.

Matching as recommended for optimum performance.
Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

★ TA12 AMPLIFIER 6·5 + 6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ GOLDRING CS90 Ceramic P.U Cartridge with diamond stylus
★ PAIR OF DORCHESTER Loudspeaker Units
Special Total Price **£58·33**
Or Deposit £8·33 & 9 mthly payments £6·25 (Total £64·58). Carr. £1·25
Trans. Plastic Cover £3·15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1·25 **£51·20**
Or Deposit £7·45 and 9 monthly payments £5·58 (Total £57·67)
Trans. Plastic cover £3·15 extra.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

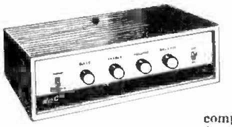
★ Moderate size only 25×14×10in. approx.
★ Response 30-20,000 c.p.s. Impedance 15 ohms
COMPLETE KIT £23 Carr. 65p
★ Performance comparable with units costing considerably more.
Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8×5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·60 and 9 monthly payments £2·47 (Total £26·83).
DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.
DORCHESTER (Illustrated) Size 16×11×9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13×8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.
STANWAY II Size 20×10½×9½in. approx. Rating 10 watts. Inc. 13×8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for illustration Carr 50p **£17·85**

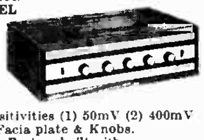
RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal facia plate and matching control knobs.



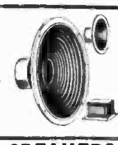
COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £14·99 or dep. £2·20 and 9 monthly payments £1·70 (Total £17·50).

R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER



FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL
Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise −70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.
COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. **£15·50** Carr. 40p. Factory built with 12 mths. guarantee **£19·50**
Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing **£23**
Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

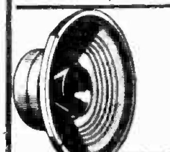


Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5·95** Carr. 30p
OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6·95** Carr. 35p

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc.
JE8 Size 16 × 11 × 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**
SE10 For outstanding results with 10in. Hi-Fi spkr. Size 24 × 15 × 10in. P'td. **£6·74**
SE8 For optimum performance with any 8in. Hi-Fi spkr. Size 22 × 15 × 9in. **£6·47**
SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter Size 25 × 16 × 10½in. **£7·87**

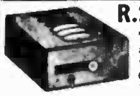
AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE.
Exceptional performance at low cost.

HF808T	8"	10W	£2·88	HF120D	12"	15W	£4·99
HF102D	10"	10W	£3·40	HF126	12"	15W	£5·75
HF120	12"	15W	£4·50	HF126D	12"	15W	£6·25

R.S.C. BATTERY/MAINS CONVERSION UNITS



TYPE BM1. An all-dry battery eliminator. Size 5½×4½×2in. approx. Completely replaces batteries supplying 1·5v and 90v. to battery radio where A.C. mains 200/250v. 50c/s is available.
COMPLETE KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

FANE 807T HIGH FIDELITY SPEAKER

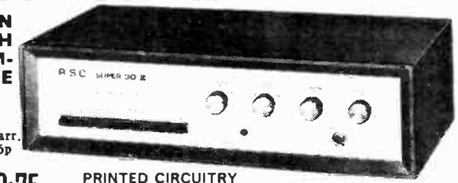
A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω.
PLEASE STATE IMPEDANCE WHEN ORDERING **£3·85**

R.S.C. TA6 6 Watt HI-FI AMPLIFIER

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9¼×2¼×5½in. Attractive brushed silver finish facia plate 10¼×3½in. and matching knobs.
Complete kit of parts with full wiring diagrams and instructions. **£7·75** Carr. 40p
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £10·95

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.
Only high grade components by leading manufacturers.
COMPLETE KIT OF PARTS **£25** Carr. 65p
Or FACTORY BUILT with 12 months guarantee. Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25.) **£33·75**
Or FACTORY BUILT in cabinet as illustrated. Dep. £7 and 9 monthly payments £3·99 (Total £42·91) **£38·75**



PRINTED CIRCUITRY
TWENTY SILICON TRANSISTORS.
FOUR DIODES,
FOUR RECTIFIERS

★ SATIN SILVER METAL FACIA with black lettering. Black edged knobs with bright silver centres.
★ PUSH-BUTTON SELECTOR SWITCHING
★ NEON INDICATOR
★ JACK SOCKET FOR HEADPHONES
★ CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.

TECHNICAL DETAILS (Applying to each channel where appropriate)
CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble and Balance. Plus Ceramic Mag P.U. Switch.
OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
HUM & NOISE —75dB Min. Vol. —65dB Full Vol. HARMONIC DISTORTION 0·1% at 1000 Hz 10 Watts
FREQUENCY RESPONSE: —3dB 7Hz to 70kHz
TREBLE CONTROL: +16dB to —12dB at 14kHz
BASS CONTROL: +17dB to —16dB at 40Hz CROSS TALK —58dB
SENSITIVITIES: Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

GROUP/DISCO UNITS PACKAGE OFFER

SEND S.A.E. FOR LEAFLET

Units listed below

100w POWER AMPLIFIER

PAIR OF HEADPHONES High quality. Matching Dynamic Moving Coil Microphone fitted to Headphones.

PAIR 50w SPEAKERS Black Rexine covered. Size approx. 18 × 18 × 8 ins. **£72·85**

Terms on Amps. Speakers and Headphone/Mike. Deposit £15 and 18 monthly payments of £3·95 (Total £86·10).

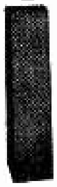
FAL

F.G.1/2A DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Ceramic Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. see illus. on left Carr. £1·25 **£67·10**

Or Dep. £13·25 and 9 mthly pymts £6·75 (Total £74) or Dep. £15 and 18 mthly paymnts £3·56 (Total £79·08).

R.S.C. COLUMN SPEAKERS



IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C48S 25-30 WATTS Fitted four 8" high flux 8 watt speakers Overall size approx. 48 × 10 × 5in. **£17·75** Terms: Dep £3 and 9 monthly payments £2 (Total £21) Carr. 50p.

TYPE C412S 50 WATTS Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 × 14 × 9in Terms: Dep. £4 and 9 monthly payments £3·37 (Total £34·33) Carr. 75p **£31**

TYPE C4100 100 WATTS Inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 × 16 × 10" Acoustically filled and pressurised. Terms: Dep. £11 and 9 mthly. pyts. £6·75 (Total £71.75). **£65** Carr. £1

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous **2 YEARS' GUARANTEE**
High flux ceramic magnets. ALL CARR. FREE

'POP' 100 18" 100 Watt 14,000 gauss 8/15Ω **£22·95** Dep: £6 and 9 mthly payments £2·20 (Total £25·80)

'POP' 60 15" 60 Watt 14,000 gauss 8/15Ω **£12·90** Dep. £3·30 and 9 monthly payments £1·30 (Total £15).

FOR BASS GUITAR, ELECT. ORGAN, ETC.

'POP' 50 12" 50 Watt 13,000 gauss 15Ω **£10·90** Dep £2 and 9 monthly payments £1·20 (Total £12·80) PAIR SUITABLE ALL PURPOSES

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output, Hum level −70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as 'mike" and Pick-up etc. to be used for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1·90. Or factory built with EL34 output valves and 12 months' guarantee for £19·75 **£15·75** Carr. 65p

TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

FANE SPEAKERS 'POP' 25/2 12 in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). **£6·75** Carr. free or Dep. £1 and 9 mthly payments 75p (Total £7·75).

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER	£34·95	PACKAGE PRICE
PR. FANE POP 25/2 25W L/SPEAKERS	£13·50	**£45** carr. £1
Terms: Deposit £6.50 and 9 monthly payments of £4.72 (Total £48.98)	£48·45	
F.A.L. PHASE 50 MK.III AMPLIFIER	£34·95	PACKAGE PRICE
PR. FANE POP 50 L/SPEAKERS	£21·80	**£52** carr. £1
Terms: Deposit £10 and 9 monthly payments of £5·25 (Total £57.25)	£56·75	
F.A.L. PHASE 50 MK.III AMPLIFIER	£34·95	PACKAGE PRICE
PAIR L12/25 25W L/S in cabinets	£23·90	**£56** carr £1·25
Terms: Deposit £10 and 9 monthly payments of £5·75 (Total £61·75)	£58·85	
F.A.L. PHASE 100 AMPLIFIER	£61·95	PACKAGE PRICE
4 FANE POP 50 L/SPEAKERS	£43·60	**£99·95** carr. £2
Terms: Deposit £15·95 and 9 monthly payments of £10·50 (Total £110·45)	£105·55	

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary.

Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2½ × 2¾ × 2¼in.

250v., 60mA, 6·3v. 2a	99p
250-0-250v., 60mA 6·3v 2a	£1·05

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·40
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier	£2·65
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·65
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	£4·95
425-0-425v. 200mA, 6·3v. 4a., 6·3v. 3a., 5v. 3a	£5·10
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	£5·50

TOP SHROUDED DROP-THRO' TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·35
250-0-250v. 100mA, 6·3v. 3·5a.	£1·55
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a.	£1·60
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·65
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier	£2·60
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·60

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 49p; 6·3v. 2a. 54p; 6·3v. 3a. 76p; 6·3v. 6a. £1·30; 12v. 1a. 55p; 12v. 3a. or 24v. 1·5a £1·35; 0-9-18v 1½a £1·10; 0-12-25-42v 2a £1·76.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 99p; 2½a. £1·10; 3a. £1·25; 5a. £1·45; 6a. £1·65; 8a. £2·00

AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v. 50-80 watts £1·10, 150 watts, £1·90 250 watts £2·75: 500 watts £5·75

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	50p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	83p
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω	£1·37
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	£1·35
Push-Pull Ultra Linear for Mullard 510, etc.	£2·20
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£1·99
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£3·30

SMOOTHING CHOKES 150mA, 7-10H. 250 Ω 70p; 100mA, 10H, 200 Ω 60p; 80mA, 10H, 350 Ω 50p; 60mA, 10H, 400 Ω 25p.

SELENIUM RECTIFIERS F. W. (Bridged) All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 25p. 2a. 35p. 3a. 50p. 4a. 65p. 6a. 80p.

CREDIT TERMS AVAILABLE ON PURCHASES OVER £8 (Kits Excepted)
INTEREST CHARGES REFUNDED ON CREDIT SALES Settled in 3 months

HIGH QUALITY LOUDSPEAKER UNITS

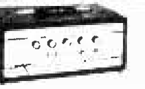
ALL TWO TONE REXINE AND VYNAIR FINISH

L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£33·50**
Or deposit £4·50 and 9 monthly payts. of £3·62. Total £37·08

L12/25 12" 25 WATT 10,000 lines 15 ohms. Carr. 50p. **£11·95**

L13 13" × 8" 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. Carr 40p **£5·25**

FAL PHASE 50 MkIII AMPLIFIER 50W



Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" × 7" × 7½" 200-250v. A.C. mains. Output 50 watts music rating. **£34·95** Carr. 75p.
Or deposit £7·25 & 9 monthly payments £3·50. Total £38·75.

R.S.C. Branches listed below open all day Sats.

BRADFORD 10 North Parade (Half-day Wed.). Tel. 25349
BLACKPOOL (Agent) O & C Electronics 227 Church Street
BIRMINGHAM 30/31 Great Western Arcade, Tel. 021-236 1279 (Half-day Wed.).
DERBY 26 Osmaston Rd., The Spot (Half-day Wed.). Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.). Tel. 68043
EDINBURGH 101 Lothian Rd. (Half-day Wed.).
GLASGOW 326 Argyle St. (Half-day Tues.). Tel. 248 4158
HULL 91 Paragon Street (Half-day Thurs.). Tel. 20505.
LEICESTER 32 High Street (Half-day Thurs.). Tel. 56420
LEEDS 5-7 County (Mecca) Arcade, Briggate (Half-day Wed.). Tel. 28252
LIVERPOOL 73 Dale Street (Half-day Wed.). Tel. 236 3573
LONDON 238 Edgware Road, W.2. (Half-day Thurs.). Tel. 723 1629
MANCHESTER 60A Oldham Street, (Half-day Wed.). Tel. 236 2778
MIDDLESBROUGH 106 Newport Rd. (Half-day Wed.). Tel. 47096
NEWCASTLE UPON TYNE 19 Newgate Centre (Half-day Wed.). Tel. 21469
NOTTINGHAM 19/19A Market Street (Half-day Thurs.). Tel: 48068
SHEFFIELD 13 Exchange Street (Castle Market Blds.) (Half-day Thurs.). Tel. 20716
SUNDERLAND 5 Market Square Opp. W. H. Smiths

NOW TWO NEW BRANCHES

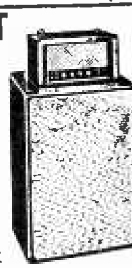
19/19A MARKET STREET
NOTTINGHAM
ALSO 5 MARKET SQUARE
SUNDERLAND
Opening late July

AND NEW MUCH LARGER PREMISES AT 101 LOTHIAN ROAD, EDINBURGH & 19 NEWGATE CENTRE, NEWCASTLE

RSC HI-FI CENTRES LTD.

MAIL ORDERS & EXPORT ENQUIRIES TO:— AUDIO HOUSE, HENCONNER LANE, LEEDS, 13. Tel: Pudsey (09735) 77631.
TERMS C.W.O. or C.O.D. No C.O.D. under £1. POSTAGE 25p EXTRA UNDER £2. 30p EXTRA OVER £2 OR AS QUOTED. TRADE SUPPLIED. S.A.E. PLEASE WITH ENQUIRIES.
SUPPLIERS TO GOVERNMENT DEPARTMENTS. EDUCATION AUTHORITIES, SCHOOLS, HOSPITALS, H.M. FORCES ETC.
MAIL ORDERS MUST NOT BE SENT TO SHOPS

RSC BASS-REGENT 50 WATT AMPLIFIER



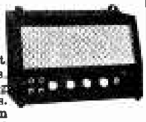
A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit optional horizontal or vertical mounting.

★ Two extra heavy duty 12in. 50w L'spkrs.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls.

Credit Terms: Deposit £15 & 9 monthly pyts of £6·25 (Total £71·25) Carr. £2 **£65** Send S.A.E. for leaflet.

RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group.



A 4 input, 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £4·30 and 9 monthly payments of £2·30 (Total £25·00). **£22·50** Carr. 65p

NEW FROM LINEAR — TWO STEREO AMPLIFIERS

Representing really exceptional value

IN ELEGANT TEAK FINISH CASES!

LINEAR 606

6+6 WATTS

Recommended Retail Price

£22·50

0-200-230-250v. 50 Hz A.C. mains operation.
Inputs for magnetic or Ceramic Pickup, Tape or Radio Tuner.

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.
Treble Control ± 12 dB at 14 KHz.
Sensitivities Mag. P.U. 3·5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K. Radio Tuner 400 m.v. into 400K ohm.
Crosstalk 53 dB.
Hum and Noise—75 dB min. vol.—65 dB max. vol.
Total Harmonic Distortion 0·1% at 1watt into 15 ohms.
Output (per channel) 6·5 watts I.H.F.M.

- ★ Individual Bass and Treble Controls.
- ★ Frequency Response ± 1½ dB 20 Hz to 65 KHz.
- ★ Outputs for Speaker impedances between 3 and 15 ohms.
- ★ Stereo/Mono Switch.
- ★ Input Selector Switch.
- ★ Solid State Circuitry.
- ★ Attractive silver finished metal facia and matching control knobs.

- ★ A modestly priced solid state unit.
- ★ The Silver Facia with black lettering enhanced by matching control knobs, provides a high standard of appearance.
- ★ Suitable for crystal Gram. Pick-up cartridges and Radio input.
- ★ A wide range of tone variation is provided by the separate Bass and Treble 'lift' and 'cut' controls.
- ★ A selector switch permits instantaneous selection of Gram. or Radio.
- ★ Speaker impedances between 3 and 15 ohms are suitable.

Wholesale and Retail enquiries to the Manufacturers

TECHNICAL DETAILS

Frequency Range 20 Hz to 20 KHz
Output (per channel) 5 watts I.H.F.M.
Bass Control ± 12 dB at 60 Hz.
Treble Control ± 14 dB. at 14 KHz.

PRINTED CIRCUIT CONSTRUCTION EMPLOYING 10 TRANSISTORS

LINEAR 505

5+5 WATTS

Recommended Retail Price

£17·50

0-200-250v. 50 Hz A.C. mains operation

ALL LINEAR AMPLIFIERS GUARANTEED FOR 12 MONTHS

LINEAR PRODUCTS LTD., Electron Works, Armley, Leeds. LS12 3SA Tel. 630126

ELECTRONIC VALVES

DY86	0.23	PC97	0.36	PY83	0.26
DY87	0.23	PCC84	0.28	PY500	0.95
EABC80	0.30	PCC89	0.43	PY800	0.32
EB91	0.09	PCC189	0.47	PY801	0.32
ECC81	0.15	PCF80	0.27	UABC80	0.30
ECC82	0.18	PCF86	0.44	UCC85	0.34
ECC83	0.24	PCF802	0.38	UCH81	0.30
ECL80	0.25	PCF806	0.56	UCL82	0.31
EF80	0.22	PCF808	0.68	UL41	0.54
EF85	0.26	PCL82	0.30	UY85	0.24
EF86	0.28	PCL83	0.55	6/30L2	0.58
EF89	0.23	PCL84	0.33	6AT6	0.18
EF91	0.12	PCL85	0.37	6AU6	0.20
EF183	0.26	PCL86	0.37	6BA6	0.20
EF184	0.28	PFL200	0.51	6BE6	0.21
EH90	0.35	PL36	0.47	6F23	0.67
EL41	0.53	PL81	0.43	12AT6	0.23
EL84	0.22	PL82	0.29	12AT7	0.15
EY51	0.30	PL83	0.31	12AU7	0.18
EY86	0.28	PL84	0.29	12AX7	[illegible]
EZ80	0.20	PL500	0.61	12BA6	0.30
EZ81	0.21	PL504	0.61	12BE6	0.30
PC86	0.45	PY81	0.23	35W4	0.23
PC88	0.45	PY82	0.24	50C5	0.32

POSTAGE: 1 VALVE 5p, EACH ADDITIONAL VALVE 1p. ORDERS OVER £5 POST FREE. CASH WITH ORDER ONLY.

Quotations for any type not listed send SAE.

NO CALLERS. ALL VALVES GUARANTEED AND INDIVIDUALLY BOXED.

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EEC Product AC/DC Converter
Input 240 volts. Output 3V, 4·5V, 6V, 7·5V, 9V, 12V d.c. Current 500mA.
Price **£4·47** postage paid

EEC Car Adaptor
Input 12 volts. Output 6V, 7·5V, 9V.
Price **£5·10** postage paid

MD 800 Sound Headphones with volume control **£3·90**
Garrard 2025 with plinth cover and cartridge **£12·30**
Shira Car Radio MW/LW—
Manual **£8·50**
Twin Speaker **£8·95**
Push Button **£10·45**
Plinth and Cover suitable for Garrard SP25, **£3·25**
Headphones DHO25, **£2·25**
Siran Battery Chargers 6V and 12V, **£2·85**
Please send 25p for postage and packing

Quality Cassettes at cheapest prices
C60 **35p** plus 5p P. & P.
C90 **47p** plus 5p P. & P.
C120 **60p** plus 5p P. & P.

Pocket Transistors
Radio AM with Battery, Magnetic Earphone and Carrying Case, **£1·95** Postage Paid.

Mixed packet of resistors 25p postage paid

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

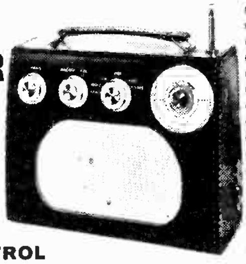
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated Telescopic Aerial, for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" × 2½" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost £8·50

P. P. & Ins. 50p

(Overseas P. & P. £1)

ROAMER EIGHT Mk I

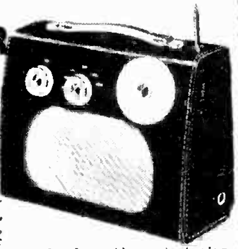


NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" × 2½" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost £6·98 P. P. & Ins. 41p.
(Overseas P. & P. £1)

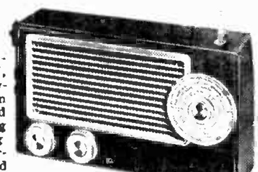
ROAMER SEVEN MK IV



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, 8" × 2½" speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

Total building costs £5·98 P. P. & Ins. 41p.
(Overseas P. & P. £1)

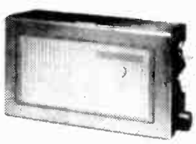
ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £3·98 P. P. & Ins. 26p
(Overseas P. & P. £1)

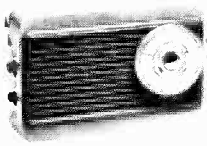
POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1¼ × 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £2·29 P. P. & Ins. 21p
(Overseas P. & P. 63p)

TRANSONA FIVE

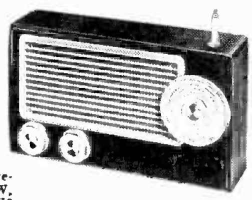


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £2·50 P. P. & Ins. 22p
(Overseas P. & P. 63p)

TRANS EIGHT



8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £4·48 P. P. & Ins. 31p
(Overseas P. & P. £1)

NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 3 inch Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ⅛" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction

All parts including Case and Plans £5·50 P. P. & Ins. 31p
(Overseas P. & P. £1)

FULL AFTER SALES SERVICE
- Callers side entrance Barratts Shoe Shop
- Open 10–1, 2.30–4.30 Mon.–Fri. 9–12 Sat.

RADIO EXCHANGE CO

61 HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £............ please send items marked

ROAMER TEN	☐	ROAMER SEVEN	☐
ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

Name ....

Address ....

.... PW45

DRILL CONTROLLER

NEW 1KW MODEL

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. **£1·50** plus 13p post and insurance. Made up model also available. **£2·25** plus 13p post & p.

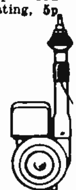
MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2¼ × 2 × 2in. **£1·50** each.

NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic push-rod suitable for operating, **5p** each, **45p** doz.

AUTO—ELECTRIC CAR AERIAL



with dashboard control switch—fully extendable to 40in. or fully retractable. Suitable for 12v. positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£5·75** plus 25p post and ins.

MAINS TRANSISTOR POWER 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: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1** plus 18p postage.

MICRO SWITCH

5 amp changeover contacts, **9p** each, **£1** doz. 15 amp Model **10p** each or **£1·05** doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **20p** each, **£1·80** for ten, your assortment.

CUADRAC. The latest thing in variable power control. This is a power thyristor with built in triggering circuit. Requires only variable control and condenser. We can offer the 400v 5 amp model with circuit at only **£1·65**.

FLEX CABLE SNIP

3-core heavy circular T.R.S. waterproof flex, ideal for running down the garden to pool or shed. 1·5mm. cores (5 amp). 100 yard coils **£4·25** plus carriage: 75p up to 200 miles; £1 300 miles; **£1·50** 500 miles.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3, Price **£1·45** each. 10 for **£13**.

12 WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price **20p** per yard.

0-8 AMMETER

2in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price **60p** each. 10 for £5·40.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ⅛in. thick. Rated at 500 MW, wire ended. **43p** with circuit. Also ORP 12 light cell **45p**.

TREASURE TRACER MARK II

Complete Kit (except wooden battens) to make the metal detector similar to the circuit in Practical Wireless August issue. **£3·95** plus 20p post and insurance.

BAKELITE INSTRUMENT CASE

Size approx. 6¼" × 3¼" × 2" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price **45p** each.

MULLARD I.F. MODULE

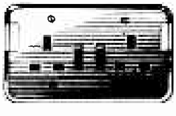
This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10·7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. **75p** each. 10 for **£6·75**. 100 for **£62·50p**. With connection dig.

STANDARD WAFER SWITCHES

Standard size 1¼" wafer—silver-plated 5·amp contact, standard ¼" spindle 2" long—with locking washer and nut.

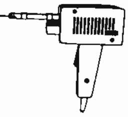
No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

13 AMP TWIN GANG SOCKETS



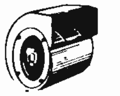
Offered at less than wholesale price your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched **20p** each, separately switched **30p** each. Separately switched and with neon on/off indicators **45p** each. Less 10% ten or more +20p postage if order under £5.

THIS MONTH'S SNIP



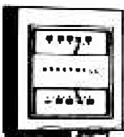
YOUR TIME is the most precious thing you have. Do you waste it waiting for the soldering iron to heat up? You can be soldering in a few seconds with the E.T.P. Solder Gun which we offer at a specially keen price. It is in fact this month's snip. A well made lightweight unit with flash lamp to illuminate the work. Has 100 watt double insulated mains Transformer and is built into a shockproof Thermo-plastic case. Suitable for 240volt, 50 c.p.s. This comes complete with 5 spare tips and is offered at a special snip price **£2·25**. plus 20p post and insurance.

CENTRIFUGAL FAN



Mains operated, turbo blower type. Pressed steel housing contains motor and impeller. Motor is 1/10th h.p. giving considerable air flow but virtually no noise. Approx. dimensions 10½ in. wide × 12 ins. dia. outlet into trunking 10½ × 4½ in. **£4·95** plus £1 post and insurance.

THERMOSTAT WITH THERMOMETER

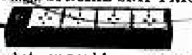


Made by Honeywell for normal air temperatures 40°-80°F. (5·25°C.). This is a precision instrument with a differential which can be adjusted to better than 1·5°F. A mercury switch breaks on temp. rise—the switch is operated by coiled bi-metal element and an adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows, thermometer above and switch setting scale below. Size approx. 3·8" × 3·2" × 1·4" deep. Can be mounted on conduit box or directly on wall. Price **£1·25** each or 10 for **£11·25**.

MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 500mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2" long × 1¼" wide × 1" high. SPECIAL SNIP PRICE **60p** each. 10 for £5·40

DISTRIBUTION PANELS



Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2·25** less plug; **£2·50** with fitted 13 amp plug; **£2·65** with fitted 15 amp plug, plus 23p P. & P.

1 HOUR MINUTE TIMER

Made by Smiths. Complete with control knob and calibrated dial. This month's special bargain at **50p**. Useful in the kitchen, office and dark-room, etc.

ELECTRIC TIME SWITCH

Made by Smiths these are A.C. mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp change-over contacts will switch circuit on or off during these periods **£2·50** post and ins., 23p. Additional time contacts **50p** pair.

3000 WATT IMMERSION HEATER

230-250 volts. Suitable all water tanks. 11" long, normal hole fixing complete with bakelite cover over connections. This is a standard Immersion Heater made by the famous Remploy Company. Price **£1·50**. Thermostat 50p extra. Post etc. 20p.

50 MICRO AMPMETER

Square, panel mounting type. £2.

MAINS OPERATED SOLENOIDS

Model 772—small but powerful 1" pull—approx. size 1½ × 1¼ × 1¼" 60p.

Model 400/1 ½" pull Size 2¼" × 2 × 1¼" **75p**.

Model TT10 1¼" pull size 3 × 2½ × 2" **£1·80** plus 20p. post and insurance.

MAINS RELAY BARGAIN

Special this month are some single, double and treble pole change-over relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Unused. Size approx. 1½" x 1". Open construction.

Single pole **25p** each 10 for **£2·25**
Treble pole **35p** each 10 for **£3·15**

CD CAR IGNITION

This system which has proved to be amazingly efficient. We offer kit of parts as P.W. Circuit **£5·95** plus 20p p. & p. Deluxe model with prepared circuit board **£6·95**. When ordering please state whether for positive or negative systems.

22 POSITION SOLENOID OPERATED STUD SWITCH

Mains operated, each current pulse to switch solenoid moves switch arm through one position on to the next contact stud—current to release solenoid brings back switch arm to position one. These are ex-equipment but in good working order. Any not so would be replaced. Price **50p** each.

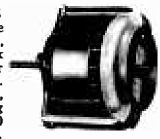
TIMED 'ON' SWITCHES

Made by Smiths for washing machines etc. Centre spindle closes double pole 15 amp switch directly it is turned. A full 360° turn or only a part turn winds the clockwork mechanism and keeps the switch closed until the spindle returns to the 'off' position. A dial therefore could be fitted to indicate hours and minutes and the switch on period could be set quite accurately. 3 models available—90 minutes. —120 minutes and 360 minutes. Price **95p** each. Metal clad pointer knob **15p**. Suitable relay to make the switch 'on' instead of 'off' **35p**.

MOTOR GENERATOR

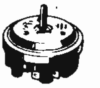
Ex Admiralty—24 volt D.C. input—240v 50 cps output. Admiralty rating 80 watt but we have tested this to 50% overload voltage regulated so suitable to operate TV or instrument. In case with metal cover—controls on front include voltmeter. Probably cost £200 each to make. Our price only **£25** each plus carriage. **£2** up to 200 miles **£4** up to 400 miles.

PAPST MOTORS



Est. 1/40th h.p. Made for 110-120 volt working, but two of these work ideally together off our standard 240 volt mains. A really beautiful motor, extremely quiet running and reversible. **£1·50** each. Postage one 23p, two 33p. 230v model **£3**.

PRESSURE SWITCH



Containing a 15 amp. change over switch operated by a diaphragm which in turn is operated by air pressure through a small metal tube. The operating pressure is adjustable but is set to operate in approx. 10 in. of water. These are quite low pressure devices and can in fact be operated simply by blowing into the inlet tube. Original use was for washing machines to turn off water when tub has reached correct level but no doubt has many other applications. **75p** each. 10 for **£6.75**.

TAPE HEADS

Miniature size, approximately ½" square by ½" long. These are double wound for stereo. Offered at a very low price of **45p** each. New and unused.

LEVER SWITCH REF. H52/4

Ideal for intercom or similar. Pressing the lever down operates 6 pairs of change-over contacts, pressing the lever up operates 4 pairs of change-over contacts. The switch is spring loaded and normally returns to the off or centre position. Size approximately 1½" long × 2½" deep × ½" thick. **40p** each.

PUSH BUTTON SWITCHES

Mains, suitable for audio or R.F. Each switch rated at 250v 15 amps. 1st (black push button) closes 2 circuits. 2nd (white push button) operates one change over. 3rd (white push button) operates one change over. 4th (white push button) opens one circuit. Note: all depressed buttons remain down until cleared by the 5th (red button). Further note:—It is a relatively easy job to alter the position of the tags thus making the switches suit your circuit. Fitted with 3 white 1 red and 1 black button. **30p** each or 10 for **£2·70**.

7 POS ROTARY MAINS SWITCH

Rated 15 amp at 230v. 4 circuits. Position A—all circuits open. Position B—circuit 1 closed. Position C—circuit closed. Position D. circuits 2, 3 & 4 closed. Position E—2 & 3 circuits closed. Position F—1, 2, 3, & 4 circuits closed. Position G—2 & 4 circuits closed. **15p** each or 10 for **£1·35**.

EDGE CONNECTORS

32 way for 2" strip boards. Gold plated contacts. 50p each or 10 for £4.50.

VEROBOARD

Offcuts—10 pieces.—·1—15 & ·2 matrix. All good useful sizes. Total not less than 150 sq.ins. Very useful for circuit building. Regular price value at least £2. Price £1 the lot.

8 AMP VARIACS

These are variable voltage transformers. British made by the famous Zenith Co. Fully enclosed for bench use and fitted with calibrated scale and control knob. Zenith Model No. 100 LM. 220-240 A.C. output 0-240volt up to 8 amps. This model is listed at nearly **£20**. We have a limited quantity only, absolutely brand new, still in makers cartons, offered to you at **£12·50** each plus **£1** carriage and insurance up to 400 miles.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 7 Park Street, Croydon CRO 1YD

Callers to: 102/3 Tamworth Road, Croydon.

-the lowest prices!

74 Series T.T.L. I.C'S DOWN AGAIN IN PRICE

Check our 74 Series List before you buy any I.C's. Our prices are the lowest possible. All devices ex-stock. Full spec. guaranteed

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP00 = SN7400	0·15	0·14	0·12
BP01 = SN7401	0·15	0·14	0·12
BP02 = SN7402	0·15	0·14	0·12
BP03 = SN7403	0·15	0·14	0·12
BP04 = SN7404	0·15	0·14	0·12
BP05 = SN7405	0·15	0·14	0·12
BP07 = SN7407	0·18	0·17	0·16
BP08 = SN7408	0·18	0·17	0·16
BP09 = SN7409	0·18	0·17	0·16
BP10 = SN7410	0·15	0·14	0·12
BP13 = SN7413	0·29	0·26	0·24
BP16 = SN7416	0·43	0·40	0·38
BP17 = SN7417	0·43	0·40	0·38
BP20 = SN7420	0·15	0·14	0·12
BP30 = SN7430	0·15	0·14	0·12
BP40 = SN7440	[illegible]	0·14	0·12
BP41 = SN7441	0·67	0·64	0·58
BP42 = SN7442	0·67	0·64	0·58
BP43 = SN7443	1·95	1·85	1·75
BP44 = SN7444	1·95	1·85	1·75
BP45 = SN7445	1·95	1·85	1·75
BP46 = SN7446	0·97	0·94	0·88
BP47 = SN7447	0·97	0·94	0·88
BP48 = SN7448	0·97	0·94	0·88
BP50 = SN7450	0·15	0·14	0·12
BP51 = SN7451	0·15	0·14	0·12
BP53 = SN7453	0·15	0·14	0·12
BP54 = SN7454	0·15	0·14	0·12
BP60 = SN7460	0·15	0·14	0·12
BP70 = SN7470	0·29	0·26	0·24
BP72 = SN7472	0·29	0·26	0·24
BP73 = SN7473	0·37	0·35	0·32
BP74 = SN7474	0·37	0·35	0·32
BP75 = SN7475	0·47	0·45	0·42
BP76 = SN7476	0·43	0·40	0·38
BP80 = SN7480	0·67	0·64	0·58
BP81 = SN7481	0·97	0·94	0·88
BP82 = SN7482	0·97	0·94	0·88
BP83 = SN7483	1·10	1·05	0·95

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP86 = SN7486	[illegible]	0·30	0·28
BP90 = SN7490	0·67	0·64	0·58
BP91 = SN7491AN	0·87	0·84	0·78
BP92 = SN7492	0·67	0·64	0·58
BP93 = SN7493	0·67	0·64	0·58
BP94 = SN7494	0·77	0·74	0·68
BP95 = SN7495	0·77	0·74	0·68
BP96 = SN7496	0·77	0·74	0·68
BP100 = SN74100	1·75	1·65	1·55
BP104 = SN74104	0·97	0·94	0·88
BP105 = SN74105	0·97	0·94	0·88
BP107 = SN74107	0·40	0·38	0·36
BP110 = SN74110	0·55	0·53	0·50
BP111 = SN74111	1·25	1·15	1·00
BP118 = SN74118	1·00	0·95	0·90
BP119 = SN74119	1·35	1·25	1·10
BP121 = SN74121	0·67	0·64	0·58
BP141 = SN74141	0·67	0·64	0·58
BP145 = SN74145	1·50	1·40	1·30
BP150 = SN74150	1·80	1·70	1·60
BP151 = SN74151	1·00	0·95	0·90
BP153 = SN74153	1·20	1·10	0·95
BP154 = SN74154	1·80	1·70	1·60
BP155 = SN74155	1·40	1·30	1·20
BP156 = SN74156	1·40	1·30	1·20
BP160 = SN74160	1·80	1·70	1·60
BP161 = SN74161	1·80	1·70	1·60
BP164 = SN74164	2·00	1·90	1·80
BP165 = SN74165	2·00	1·90	1·80
BP181 = SN74181	2·75	2·60	2·40
BP182 = SN74182	0·97	0·94	0·88
BP190 = SN74190	3·50	3·25	3·00
BP191 = SN74191	3·50	3·25	3·00
BP192 = SN74192	2·10	1·95	1·75
BP193 = SN74193	2·10	1·95	1·75
BP195 = SN74195	1·10	1·05	0·95
BP196 = SN74196	1·80	1·70	1·60
BP197 = SN74197	1·80	1·70	1·60
BP198 = SN74198	5·50	5·00	4·00
BP199 = SN74199	5·50	5·00	4·00

PRICE-MIX. Devices may be mixed to qualify for quantity prices.
PRICES for quantities in excess of 500 pieces mixed, on application.
Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

LINEAR I.C's—FULL SPEC.

Type No.	Price 1-24	25-99	100 up
BP 201C—SL201C	63p	53p	45p
BP701C—SL701C	63p	50p	45p
BP 702C—SL702C	63p	50p	45p
BP 702—72702	53p	45p	40p
BP709—72709	53p	45p	40p
BP 709P—μA709C	53p	45p	40p
BP 710—72710	53p	45p	40p
BP 711—μA711	58p	50p	45p
BP 741—72741	75p	60p	50p
μA703C—μA703C	43p	34p	27p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350	170p	158p	150p

S.G.S. EA1000 2·63

ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C's

Type No.	Price 1-24	25-99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

NUMERICAL INDICATOR TUBES

MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·70	£1·55	£1·90

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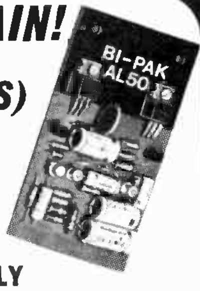

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UIC945 = 8 × μA 945	..	50p
UIC946 = 12 × μA 946	..	50p
UIC948 = 8 × μA 948	..	50p
UIC951 = 5 × μA 951	..	50p
UIC961 = 12 × μA 961	..	50p
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UIC43 = 5 × 7443N	50p
UIC44 = 5 × 7444N	50p
UIC45 = 5 × 7445N	50p
UIC46 = 5 × 7446N	50p
UIC47 = 5 × 7447N	50p
UIC48 = 5 × 7448N	50p
UIC50 = 12 × 7450N	50p
UIC51 = 12 × 7451N	50p
UIC53 = 12 × 7453N	50p
UIC54 = 12 × 7454N	50p
UIC60 = 12 × 7460N	50p
UIC70 = 8 × 7470N	50p
UIC72 = 8 × 7472N	50p
UIC73 = 8 × 7473N	50p
UIC74 = 8 × 7474N	50p
UIC75 = 8 × 7475N	50p
UIC76 = 8 × 7476N	50p
UIC80 = 5 × 7480N	50p
UIC81 = 5 × 7481N	50p
UIC82 = 5 × 7482N	50p
UIC83 = 5 × 7483N	50p
UIC86 = 5 × 7486N	50p
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Garrard 401	£26·50
Garrard Zero 100 (Auto)	£38·75
Garrard Zero 100 (Single)	£36·55
Garrard SL72B	£23·50
Garrard SL75B	£25·50
Garrard SL95B	£34·25
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Goldring GL75	£25·75
Goldring GL75/P	£34·25
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Amstrad 8000 Mk. II	£16·25
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Armstrong 521 (teak cased)	£43·95
Alpha Highgate 212	£25·00
Alpha Highgate FA300	£27·95
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Metrosound ST60	£45·95
Pioneer SA600	£58·00
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Pioneer SA800	£73·95
Pioneer SA900	£92·00
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Rogers R/brook (Chassis)	£35.00
Rogers R/brook (Cased)	£37.00
Rogers R/bourne (Chassis)	£41.95
Rogers R/bourne (Cased)	£47.50
Sinclair PRO60 2 x Z30/PZ5	£14·95
Sinclair PRO60 2 x Z30/PZ6	£17·00
Sinclair PRO60 2 x Z50/PZ8/Trans	£21·50
Sinclair AFU (Filter Unit)	£4·40
Sinclair 60S	£18·50
Sinclair 2000 Mk. II	£21·50
Sinclair 3000 Mk. II	£29·50
Wharfedale Linton	£37·50
Goodmans Max Amp	£37·95
Teleton SAQ206B	£20·50
Teleton SAQ306	£22·50

TUNERS

Please add 75p P. & P.

Amstrad Multiplex 3000	£27·95
Armstrong 523	£39·50
Armstrong 524	£30·95
Rogers Ravensbrook FET4 (Chassis)	£31·00
Rogers Ravensbrook FET4 (Cased)	£35·00
Rogers Ravenbourne FET4 (Chassis)	£43·00
Rogers Ravensbourne FET4 (Cased)	£48·00
Sinclair PRO60 (Module)	£17·95
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Philips RH690	£33·00
Leak Delta FM (Cased)	£54·75
Leak Delta AM/FM (Cased)	£64·50

TUNER/AMPLIFIERS

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Alpha Highgate 150	£44·25
Armstrong 525 (Teak cased)	£67·95
Armstrong 526 AM/FM (Teak cased)	£77·75
Leak Delta 75	£127·95
Philips RH781	£50·00
Philips RH702	£82·50
Teleton 2100	£29·95
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Rogers R/brook (Teak)	£78·50
Rogers R/brook (Chassis)	£72·75

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Shure M55E	£5·85
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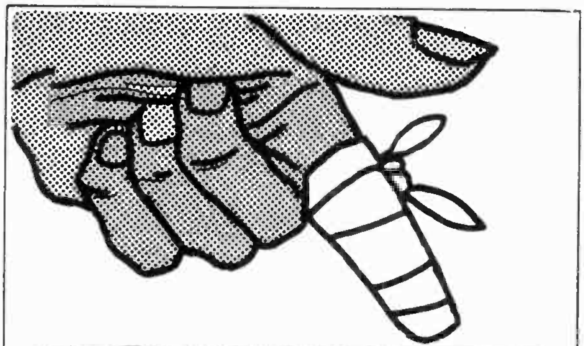

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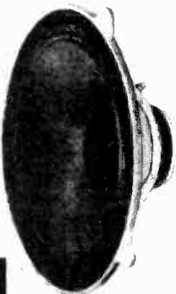

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AMSTRAD I.C. 2000	42·95	27·25
ARMSTRONG 521	59·00	44·95
DULCI 207M	32·00	19·50
FERROGRAPH F307 Mk. II (cased)	64·00	44·90
GOODMANS Maxamp	54·00	34·95
JVC NIVICO MCA 104Z	79·95	67·95
LEAK Delta 30 (cased)	65·00	47·95
LEAK Delta 70 (cased)	79·50	58·95
METROSOUND ST20E	39·50	24·95
METROSOUND ST60	70·00	46·25
PHILIPS RH591	79·00	53·95
PHILIPS RH590	52·00	35·50
PHILIPS RH580	29·00	19·95
PIONEER SA500A	45·50	29·50
PIONEER SA600	89·60	56·95
PIONEER SA800	119·85	75·95
PIONEER SA900	133·83	86·95
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RANK Rotel 210	34·90	23·95
RANK Rotel 310	47·50	31·95
RANK Rotel 610	74·50	49·50
ROGERS Ravensbourne	64·50	45·50
ROGERS Ravensbourne (cased)	69·50	49·50
ROGERS Ravensbrook Mk. II	50·50	35·95
ROGERS Ravensbrook (cased) Mk. II	55·50	39·95
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Project 60/2 x Z50/PZ8/trans	34·86	21·95
Project 605	29·95	18·90
AFU	5·98	4·50
Neoteric	61·95	42·93
3000	45·00	29·50
TELETON SAQ 206B	33·00	19·50
307	33·00	20·95
GA202 15 watt RMS P. Chan.	Spec. Price	28·50
WHARFEDALE Linton Amplifier	60·00	39·95

All take both ceramic and magnetic cartridges.

TUNERS

	Rec. Retail Price	Comet Price
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*ARMSTRONG 524 FM	40·97	30·95
ARMSTRONG M8 Decoder	9·50	6·95
*DULCI FMT.7 FM	24·43	17·50
DULCI FMT.7S Stereo	32·89	24·50
GOODMANS Stereomax	75·74	46·95
LEAK Delta FM	73·00	53·95
LEAK Delta AM/FM	87·00	65·95
PHILIPS RH 690	44·15	31·95
PIONEER TX500 AM/FM	70·93	52·50
PIONEER TX600 AM/FM	100·37	77·95
RANK ROTEL 320	53·38	38·50
RANK ROTEL 620	86·33	69·95
ROGERS Ravensbourne chassis	57·95	42·50
ROGERS Ravensbourne in teak case	62·63	47·25
ROGERS Ravensbrook chassis	42·14	30·95
ROGERS Ravensbrook (cased)	48·00	34·95
SINCLAIR 2000	45·00	32·95
SINCLAIR 3000	45·00	32·95
SINCLAIR Project 60 tuner (stereo)	25·00	16·50

All above Tuners are complete with MPX Stereo Decoder except where starred.

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
AKAI CR80T FM/AM Tuner Amplifier with built in Eight Track Tape Recorder	149·84	89·95
AKAI AA 8500	228·34	169·95
AKAI 6600	145·26	105·50
AKAI 6300	125·83	92·50
AKAI 6200	97·09	72·50
ARENA 2600	111·30	65·95
ARMSTRONG M8 Decoder	9·50	6·95
ARMSTRONG 525	90·14	67·75
ARMSTRONG 526	102·72	77·50
GOODMANS Module 80, 35w. RMS	89·02	66·95
GOODMANS Module 80 Compact	160·38	125·95
GOODMANS Module 110 FM/MW/LW/SW 100W RMS	131·22	104·95
LEAK Delta 75	160·00	127·95
MIDLAND 19/542	49·56	36·75
PHILIPS RH 790	134·00	74·95
PIONEER SX770 AM/FM	135·80	104·95
PIONEER SX440 AM/FM	101·60	78·95
ROGERS Ravensbrook Chassis	96·57	73·95
ROGERS Ravensbrook (cased)	105·35	79·95
ROTEL RX150	67·93	51·95
TANDBERG 1171 MPX	103·03	84·95
TANDBERG TR200 MPX	96·23	79·95
TELETON F2000	51·50	27·25
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95

All the above take magnetic cartridges except Teleton F2000 and 8000 which take ceramic only.

All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra.

TURNTABLES

	Rec. Retail Price	Comet Price
GARRARD SP25 Mk III	16·17	9·45
GARRARD SL65B	20·93	14·95
GARRARD SL95B	49·21	33·95
GARRARD 401	39·04	25·95
GARRARD SL72B	32·60	23·95
GARRARD Zero 100CA	57·42	39·95
GARRARD Zero 100S	52·83	37·95
GARRARD WD4 base Mk IIZ to fit Zero 100 & Zero 100S	6·55	4·95

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GARRARD AP76 with Goldring G800 — Special Price £28·75
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GARRARD AP76 with Shure M75EJ — Special Price £34·25
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GOLDRING GL75 with G800 — Special Price £36·95
THORENS 150 AB complete with TX11 cover Shure M55E cartridge — £60·46 £47·95

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Base and Cover to fit GARRARD SP25, SL55, SL65B	Spec. Price	3·60
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GARRARD AP76	28·44	17·50
GOLDRING GL69 MKII	26·86	18·50
GL69P Mk. II	35·23	25·25
GL75	39·06	26·75
GL75P	47·43	34·50
Covers for 69P and 72P	4·36	3·70
Cover for 75P Deluxe	4·88	3·95
C99—plinth and cover for G99	10·75	8·95
GOLDRING G99	27·90	19·25
GOLDRING G101P/C	27·90	20·25
GOLDRING GL72 Chassis	27·90	20·95
GOLDRING GL72P	36·27	28·95
GOLDRING GL85	61·03	46·50
GOLDRING GL85P	70·80	54·75
LEAK Delta	67·50	54·75
McDONALD MP60	14·80	9·50
610	18·79	13·95
HT70	20·68	14·75
HT70 inc. plinth and cover	29·89	22·50
Base and Cover for MP60 and 610	Spec. Price	3·95
PHILIPS 202 Electronic	64·65	48·95
PHILIPS 308 transcription unit complete with base and cover	36·55	27·25
PIONEER PL12AC with base & cover	47·15	32·95
THORENS TX25 cover	8·26	6·60
THORENS TD125	76·73	59·95
THORENS TD125AB	115·69	89·95
THORENS TD150 Mk. II	33·64	26·95
THORENS TD150A Mk. II	43·09	32·95
THORENS TD150AB Mk. II	46·63	36·95
THORENS TX11 Cover	4·13	3·50
WHARFEDALE Linton with base and cover and Shure M44-7 cartridge	34·50	25·95

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	Rec. Retail Price	Comet Price
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AUDIO TECHNICA L2 lifts	2·61	1·95
GOLDRING Lenco 75	13·51	9·30
GOLDRING Lenco L69	9·77	6·40
GOLDRING P M6 Head Shell	2·79	1·99
SME 3009 with S2 Shell	32·34	23·95
SME 3009 ME with S2 Shell	33·71	24·95
SME 3012 with S2 Shell	34·44	25·50
SME 3012 ME with S2 Shell	35·81	26·50
SME S2 headshell	2·59	1·95

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B & W DM2	60·76	49·95
B & W DM3	63·00	44·95
B. & W DM1 (pair)	75·20	57·25
CELESTION county	23·97	18·50
CELESTION Ditton 120 (pair)	56·40	39·95
CELESTION Ditton 15	37·40	26·45
CELESTION Ditton 25	65·00	44·95
CELESTION Ditton 44	54·00	38·50
CELESTION Ditton 66	99·00	70·95
FERROGRAPH S1 inc. stand	95·00	74·95
GOODMANS Havant (pair)	54·42	39·95

SPEAKERS—*continued*

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GOODMANS Minister (pair)	50·62	34·20
GOODMANS Magister	65·63	39·95
GOODMANS Double Maxim	32·07	24·75
GOODMANS Mezzo 3	35·70	22·45
GOODMANS Magnum K2	46·20	28·95
GOODMANS Dimension 8	72·44	47·50
GOODMANS DIN 20NT kit	12·19	8·95
KELETRON KN400 2-speaker System (pair)	15·86	11·95
KN600 3-speaker System (pair)	26·46	17·50
KN800 3-speaker System	15·90	10·25
KN1100 4-speaker System	20·40	13·95
KN1600 3-speaker System	25·20	15·95
KN2100 3-speaker System	30·60	20·45
LEAK 150 (pair)	49·00	35·50
LEAK 250 (pair)	63·00	45·25
LEAK 600	49·50	32·45
LINEAR 10 watt teak (pair)	Sp. Price	14·95
METROSOUND HFS 103 (pair)	29·21	21·95
METROSOUND 202	21·50	14·95
METROSOUND Duplex 15	32·00	22·95
METROSOUND Duplex 25	56·00	37·95
PHILIPS RH 402 (pair)	44·70	33·95
PHILIPS 406	34·00	25·95
PIONEER CS53	44·25	28·95
SINCLAIR Q16	8·98	6·75
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TANDBERG TAN 7	27·22	22·95
TANDBERG Tan 11 (pair)	36·94	31·20
TANDBERG Tan 12 teak (pair)	48·82	41·40
TANDBERG Tan 25 teak (pair)	66·08	56·50
TANDBERG Tan 50 teak	65·00	49·95
TELETON 8000 (pair)	21·08	11·95
THORPE Grenville TG 100 (pair)	28·95	17·95
Grenville TG 200 (pair)	41·95	25·95
Grenville TG 300 (pair)	55·95	31·95
WHARFEDALE		
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Melton Mark II	35·00	24·50
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Rosedale	65·00	44·95
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CHASSIS SPEAKERS

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GOODMANS Twin-Axiom 8	8·65	6·95
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Axiom 401	17·68	11·95
Audiom 8P	5·20	4·15
Audiom 10P	5·67	4·50
Audiom 12P	13·00	9·25
Audiom 15P	21·00	14·95
Audiom 18P	35·70	24·95
Audiom 100 40 watts DIN	12·00	8·95
ARU 172	4·50	3·20
Axent 100	6·90	4·90
Midex 650	13·59	9·50
Attenuator	3·73	2·70
Crossover Network XO/950	7·77	5·45
WHARFEDALE 8in. Bronze/RS/DD	4·50	3·40
Super 8/RS/DD	8·00	6·25
Super 10/RS/DD	13·00	9·95
WMT1 Matching Transformer	0·84	0·70

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	Rec. Retail Price	Comet Price
AUDIO TECHNICA AT66	6·47	3·60
GOLDRING G850	6·10	2·95
GOLDRING G800	12·21	4·95
GOLDRING G800E	17·67	7·95
GOLDRING G800 Super E	24·41	14·40
*GOLDRING CS90 Stereo	4·88	4·20
*GOLDRING CS91/E	7·33	6·20
EMPIRE 1000ZE/X	59·12	44·95
EMPIRE 999VE/X	42·14	32·50
EMPIRE 999TE/X	24·58	19·25
EMPIRE 999SE/X	19·90	15·25
EMPIRE 999E/X	15·57	11·70
EMPIRE 909E/X	12·12	9·25
EMPIRE 90EE/X	9·37	7·15
ORBIT Magnetic NM 22	Sp Price	2·75
ORTOFON M15E	27·60	22·75
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
SHURE M32E	10·73	6·50
SHURE M32-3	9·84	7·65
SHURE M44-G	6·30	4·95
SHURE M44-7	7·90	4·90
SHURE M-44C	7·90	4·90
SHURE M44E	8·60	5·25
SHURE M55E	9·70	5·95
SHURE M75G	14·70	8·45
SHURE M75-6	13·60	7·90
SHURE M75EJ	15·40	9·25
SHURE M75E	19·00	11·50
SHURE M75 ED	19·00	11·50
SHURE M75E/95G	20·80	12·25
SHURE V15-11	39·40	26·95
SONOTONE 9TAHC Diam/Saph.	3·75	1·45

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WB4 Base	5·60	4·70
SPC1 Cover	3·68	2·90
SPC4 Cover	4·38	3·50
Special offer of Base and Cover to fit SP25, SL55, SL65B and 3500 Special Price		3·60
WB4 base Mk IIZ to fit Zero 100 and Zero 100S	6·55	4·95
GOLDRING Plinth 75	8·37	7·00
GOLDRING Plinth 69	8·37	7·00
GOLDRING Covers for 69P and 72P	4·36	3·70
Cover for 75P De luxe	4·88	3·95
THORENS TX25 (for TD125AB)	8·26	6·60
THORENS TX11 Cover	4·13	3·50
Base and Cover for TD125	12·39	10·50
SME Plinth System 2000 with motor-board	46·20	34·50
MOTORBOARDS only	5·85	4·45
SME P1 Spacer	0·98	0·75
BLANK TAPES		
SCOTCH DYNARANGE CASSETTES		
C60	0·71	0·45
C90	0·99	0·55
C120	1·49	0·80
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1·45	0·95
C90	1·90	1·25
SCOTCH 8 Track Blank Cartridges		
40 mins	1·50	0·95
80 mins	1·80	1·10
SCOTCH LONG LIFE SPOOLED TAPES		
5" L.P. 900	1·41	0·95
5¾" L.P. 1200	1·76	1·20
7" L.P. 1800	2·52	1·70
SCOTCH DYNARANGE SPOOLED TAPES		
5¾" L.P. 1200	2·11	1·40
7" L.P. 1800	2·99	1·95

Postage—Tape, cassettes and 8T cartridges 1-9 items 5p per order. Packs of ten post free.

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HI-FI STEREO SYSTEMS COMPLETE		
ALBA UA552	47·75	34·65
AMSTRAD Stereo 1000	48·00	33·95
BUSH A1005	69·89	53·25
DANSETTE Consort Stereo	34·43	24·95
DECCA Sound 613	Special Price	49·95
DECCA Sound 614	Special Price	52·95
DECCA Sound 1204	Special Price	70·95
DECCA Compact 2	Special Price	76·95
DECCA Compact 3	Special Price	102·35
DECCA 403	Special Price	44·75
ELIZABETHAN LZ101	58·33	41·85
FERGUSON 3425	136·35	102·75
FERGUSON 3450 with Radio	70·45	52·95
FERGUSON 3451 with Radio	96·80	75·95
FIDELITY UA2 Music Master	43·50	30·95
UA1 Music Master with Radio	100·23	69·95
Stereo Nine	38·50	23·00
GOODMANS Module 80 compact system FM/35 watts. RMS (Less L/S)	165·00	125·75
HMV 2404/5/6 with Radio	194·40	145·00
HMV 2451	115·95	89·95
HMV 2452	66·00	48·95
HMV 2450 with Stereo Radio	130·60	98·95
KB1025 with 657 speakers	48·25	37·95
KB 2250	95·50	74·95
KB 2010	73·00	56·95
MARCONI 4452	73·95	56·95
McDONALD MP60 complete with base, cover and Goldring G800 cartridge, Amstrad 2000 MP amplifier. 2 Wharfedale Denton speakers	113·96	74·25
MURPHY 902 Studio 1, AM/VHF Radio	84·50	65·95
MURPHY 903	84·42	65·95
PHILCO FORD M1500	97·96	66·75
PHILIPS 808	93·50	71·95
PHILIPS GF824	65·30	49·65
PHILIPS 825	49·50	38·95
PHILIPS 826	75·00	52·95
PHILIPS 835	69·50	49·55
PHILIPS 836	95·00	69·95
PYE Black Box unit stereo 1022	90·93	68·95
RIGONDA Party Time	27·50	21·95
STEEPLETONE stereo system	41·75	29·95

	Rec. Retail Price	Comet Price
HI-FI STEREO SYSTEMS—*continued*		
TELETON STP 8 track stereo system	57·50	38·95
TELETON R800 Tuner/Amplifier with stereo decoder. Garrard 2025 TC turntable and one pair of Teleton 8000 speakers	87·95	47·80
ULTRA 6028	58·15	44·95
ULTRA 6450	74·20	54·95
ULTRA 6454	38·85	29·95
ULTRA 6455	41·35	31·95

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TAPE RECORDERS AND TAPE DECKS		
AKAI 1720L 4-track Stereo	87·36	59·95
AKAI 4000D 4-track stereo deck	93·65	64·95
AKAI CR80D 8-track stereo tape deck	85·02	58·45
AKAI CR80 8-track stereo recorder	106·39	74·00
AKAI CR80T 8-track stereo recorder and tuner/amplifier	149·84	89·95
AKAI X200D	157·93	100·45
AKAI 1800SD	162·79	102·30
AKAI 2000SD	289·07	223·30
FERGUSON 3245 Twin track	36·70	25·95
FERGUSON 3246 4-track	42·55	30·95
FERGUSON 3247 4-track	47·95	34·95
FERGUSON 3248 4-track	53·75	39·95
FERGUSON 3252 4-track	100·52	74·95
FERGUSON 3258 4-track	72·40	53·95
FERROGRAPH 702/4 Dolby	264·38	224·50
FERROGRAPH 702H Dolby	274·95	233·95
FERROGRAPH 722/4 Dolby	301·98	255·95
FERROGRAPH 722H Dolby	312·55	264·95
FERROGRAPH 702 2-track tape deck	224·43	170·65
FERROGRAPH 704/W 4-track deck	224·43	170·65
FERROGRAPH 722	262·03	190·15
FERROGRAPH 724	262·03	190·15
GRUNDIG TK 121 twin track	56·25	39·95
GRUNDIG TK 141 4-track	62·10	44·95
GRUNDIG TK 146 4-track Auto	66·95	48·95
GRUNDIG TK 147 4-track Auto	93·05	70·95
GRUNDIG TK 148 (4-track auto 2 speed)	71·30	53·95
PHILIPS 4303 Twin-track	39·46	29·59
4307 4-track	48·65	34·95
4308 De luxe 4-track	56·85	41·45
4404 4-track stereo recorder	89·25	65·95

	Rec. Retail Price	Comet Price
TAPE RECORDERS—*continued*		
4407 4-track stereo recorder	108·50	73·95
4418 4-track stereo	189·75	139·95
4450 4-track stereo	272·50	199·95
4500 4-track stereo tape deck	124·30	91·65
TANDBERG 2000	125·61	103·95
TANDBERG 1841 4-track stereo tape deck	66·09	48·75
TANDBERG 3021X twin track stereo	104·00	80·85
TANDBERG 3041X 4-track stereo	104·00	80·85
TANDBERG 4021X twin track stereo	169·12	135·50
TANDBERG 4041X 4-track stereo	169·12	135·50
TANDBERG 6041X 4-track stereo	182·73	145·25
TANDBERG 6021X twin track stereo	182·73	145·25
TAPE RECORDERS (CASSETTES)		
AKAI GXC 40D Tape Deck	92·26	68·25
AKAI GXC 40 Recorder	111·75	83·85
APCO Batt./Mains with AM/FM Radio	35·00	22·95
BUSH Discassette DC70	20·62	15·95
BUSH TP60	28·18	15·95
BUSH TP 66 Batt./Mains	25·18	21·95
BUSH TP 70 battery/mains	28·13	21·95
CARLTONE LCR500	Sp. Price	11·95
DANSETTE DCT105	20·62	14·99
DECCA 2000 (batt./mains)	Sp. Price	22·95
DECCA CR1000 Cassette Recorder with VHF Radio	Sp. Price	32·95
EKCO 350 Bt./Mns. w. VHF/MW Radio	37·42	28·75
EKCO 351 Battery/Mains	23·23	18·45
FERGUSON 3240 with case	24·90	15·95
FERGUSON 3253	43·55	31·95
FERGUSON 3262	30·15	23·95
GRUNDIG C200 De Luxe	37·55	26·95
GRUNDIG C210 batt./mains	46·90	34·95
GRUNDIG C410	39·95	29·95
HARVARD Elite with AM/FM radio batt./mains	42·00	23·95
JVC NIVICO 9420 L/S (Stereo)	61·45	42·95
PHILIPS R.R. 692 with MW/VHF Radio and Recorder	49·95	36·55
2202	22·85	17·95
2204 battery/mains	29·10	23·85
3302	20·35	15·50
2400 stereo less L/S	66·10	51·95
PYE 9100	20·37	15·95
PYE 9116 Stereo	66·10	51·60
PYE 9118	29·11	22·95
TELETON TRC 130 with VHF/AM radio battery/mains	42·50	28·00
TC110 battery/mains	27·50	18·50

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	Rec. Retail Price	Comet Price
THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Delta 70 Amplifier, 2 Wharfedale Dovedale Speakers	229·96	167·90
PHILIPS 790 tuner/amp 20 watts RMS per channel. FM/MW/LW/SW & Stereo decoder. Electronic touch tuning. Goldring GL75 turntable on plinth with cover and G800 magnetic cartridge, fully wired. 2 Wharfedale Melton II speakers	267·79	160·90
AKAI CR80T Tuner/amp with 8-track recorder. McDONALD MP60 turntable including plinth, cover and G800 cartridge fully wired. 2 Wharfedale Linton MKII speakers	230·85	144·50
GARRARD AP76 with base cover and Shure M55E cartridge. Arena 2600 AM/FM and SW Tuner/Amp and 2 Goodmans Havant speakers	214·95	138·15
GOODMANS Module 80 Tuner/Amplifier, Garrard AP76 Turntable with Goldring G800 Cartridge and 2 Goodmans Havant Speakers	192·97	135·65
LEAK Delta 30 amp in teak case, 15 watts RMS per channel. Garrard AP76 transcription deck with plinth, cover and G800 magnetic cartridge. fully wired. 2 Ditton 15 speakers	189·36	129·60
PHILIPS RH 802 Stereo Tuner/Amp./player. 2 x 15 watts LW/MW1/MW2/SW/FM. GP400 magnetic cartridge, speakers extra	155·00	118·95
PHILIPS RH 811 System, Stereo Tuner/Amp/Cassette recorder. Complete with 2 RH411L/S.	117·00	89·95
GARRARD 2025/TC deck with plinth and cover, and Sonotone 9TAHC cartridge to suit above.	Sp. Price	12·95
LINTON System with Wharfedale Linton Amplifier, Linton Turntable with Shure M44-7 Cartridge and pair of Linton Mk. II Speakers	143·50	101·58
AMSTRAD I.C. 2000 integrated circuit 20 watts RMS into 8 ohms per channel amp. McDonald MP60 turntable with plinth cover and Goldring G800 Magnetic cart. Fully wired	114·95	74·25
AMSTRAD 8000 Mk. II Amplifier, 7 watts RMS per channel, McDonald MP60 turntable with plinth, cover and Goldring G800 Magnetic cartridge. Fully wired, and pair of Amstrad 138 13" × 8" twin cone teak finish Speakers	86·95	49·40
GOLDRING 705P Turntable, fully wired complete with Goldring 850 cartridge. Amstrad stereo 8000 amplifier and 2 Amstrad 138 13" × 8" twin cone Speakers	79·95	40·85

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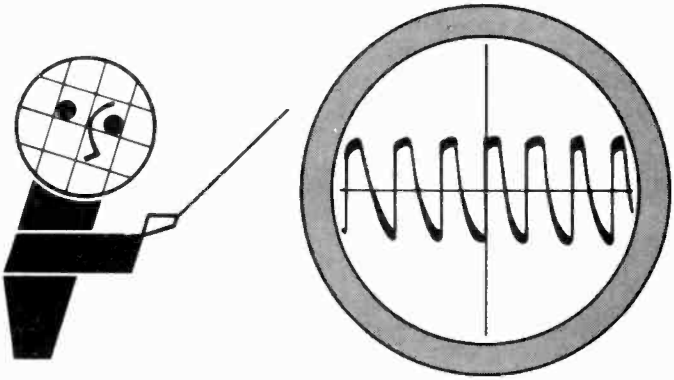

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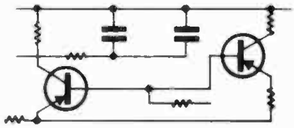

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PRACTICAL WIRELESS

VOL 48 NO 5
Issue 787

SEPTEMBER 1972

Anyone for Going Back?

ON looking at our front cover this month, readers may be forgiven for thinking that due to shortage of material we are having to ransack the archives! We hope the following words of explanation will dispel any such unworthy and infamous notions.

First of all, the response to our *Going Back* feature is large enough to indicate a real interest in the adolescence of electronics. Perhaps some people are becoming blasé about modern technological progress; perhaps the erstwhile mystery and romance has fled the scene; perhaps the pioneer days are now sufficiently remote in time to give an aura of the unknown; perhaps—but why go on?

Secondly, wireless, radio, electronics (call it what you will) is in danger of becoming taken far too seriously by the amateur, when it should be a relaxation. It *should* be fun.

We recently visited the Southampton plant of Mullard and saw how the integrated circuit designer, having determined the basic performance requirements and circuit elements, then enlists the aid of a computer with disc stores and a graphics unit. He can simulate circuits on the computer and obtain a readout of predicted performance.

Having found the optimum circuit elements, he then calls on the computer to provide cost and performance comparisons using different technologies of manufacture. The computer then takes the designer's rough IC layout and feeds in his information, using a special 'language' calls out transistor types from the computer memory store. The drawing for the mask is then generated by the computer.

To check that the circuit is correct, the engineer feeds his circuit programme into the computer, which examines the circuit and its geometry. The engineer then asks the computer to generate a control tape to reproduce the circuit on a photographically-treated glass plate reticle ten times up on final circuit size.

As a parallel operation, the computer examines the logic design of the circuit and is programmed to determine which test procedures and stimuli are wanted for the computer-testing of the complete circuit. Chips incorporating up to 6,000 transistors and all their interconnections can be designed without making a single error.

For those who boggle at such marvels, we thought it would be therapeutic to dip into the past and publish something from the days when wireless was young and unabashed. Hence the 'reproduction' crystal set. It should even please the transistor men who have been lambasting the valve lovers—after all, it *is* solidstate!

W. N. STEVENS—*Editor*

NEWS AND COMMENT

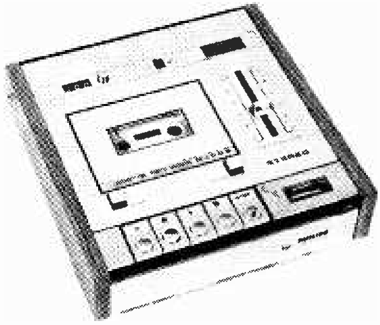
CONSTRUCTIONAL

OTHER FEATURES

THE OCTOBER ISSUE WILL BE PUBLISHED ON SEPTEMBER 1st

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

Philips Audio



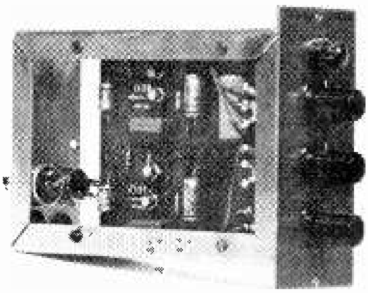
Philips announce the RH811, a tuner/amplifier/cassette recorder with built-in DNL—the first to include this feature.

The amplifier is rated at 2×10 watts (music) into 4 ohms, with a signal to noise ratio of better than 50dB. Inputs are provided for gram, microphone and external recorder. The tuner includes long, two medium, short and f.m. wavebands. Decoder and stereo signal lamp are built-in as is a.f.c. Wavebands are selected by recessed push buttons located beneath the fascia. Stations are selected through a large diameter control to the right of the fascia.

Push buttons on the top of the cabinet control the stereo cassette recorder which is linked internally for trouble-free direct recording in stereo or mono. The cassette unit incorporates automatic recording level, pause control, cassette eject control and 3 digit counter. The RH811 is finished in walnut and matt chrome and will be supplied with matching RH411 speakers. Retail price is £125.

Also announced is the N2506: a sophisticated high specification mains stereo cassette deck with built in Dynamic Noise Limiter. The DNL is Philips special electronic circuit for reducing the hiss content of a signal—especially noticeable in soft passages of music. The DNL facility is switchable. Recommended retail price £60.

Audio Modules



A new middle of the road range of audio preamplifier and mixer modules have been produced by Partridge Electronics, who until recently specialised in the manufacture of audio mixers to customers own individual requirements. They have now produced a range of units to provide a flexible and economical method of constructing small or large mixers. The majority of these are available in kit form, or fully assembled and tested. Most items use a standard panel of 16 gauge anodised aluminium, with black lettering, size 50×150m/m. A free fourteen page catalogue is available on receipt of 5p for posting and packing, on application to *Partridge Electronics, 21/25 Hart Road, Benfleet, Essex.*

Figure it out

West Hyde Developments Limited introduce a new, small $7\times9\frac{1}{2}\times3\frac{1}{4}$in. $3\frac{1}{2}$lb. calculator which multiplies and divides. The arithmetic can be mixed, i.e. $2+6-3\times5-6\div2+4\cdot5=14$. The decimal place can be set with 0 to 7 digits to the right and the machine automatically clears after the equals sign is pressed. Price is £99 for 1 off dropping to 2 at £89 and £75 for 10 off.

Features include 16 digits and a constant factor, 6 months guarantee, Pandicon display tubes (Mullard), 6 LSI chips, 1 I.C., Plug in printed circuit board, Plug in keyboard (gold plated connectors), Tobicons available on sale or return, *West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Middlesex, HA6 1NN.*

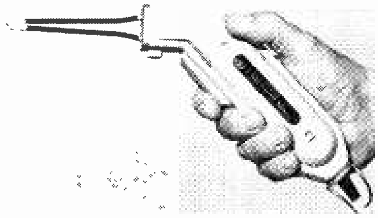
Tape Q and A

The second edition of Heinz Ritter's 120-page book, "Tape Questions & Tape Answers" is now available from the Audio/Video Tapes Division of BASF UK Ltd.

The book contains useful hints and tips on all aspects of tape recording and costs only 40p.

P.O. Box 473, Knightsbridge House, 197 Knightbridge, London, S.W.7.

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



Amtron kits

Amtron, the Italian electronics company recently sent us some samples of their range of construction kits. As yet, the company have not appointed a sole agent and all enquiries should be made to *Box 102, Advertisement Dept., Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.*

The kits are packed in "bubble packs" and contain all the components right down to the last nut and bolt and in many cases a printed circuit board.

The Twilight Switch (shown) circuit contains a photo-electric cell, two transistors, two diodes and can switch up to 1kW using a relay. The unit is activated by a wide range of light intensities and the action is reversible. It can be set to operate at pre-determined light intensities as light falls or increases, making it ideal for switching on a household light at dusk when the owners are out or away on holiday.

Power source is 220-240V a.c.

The other unit illustrated is a 27MHz Radio Control Receiver, designated UK 345. This is a superhet employing four high-gain, low-noise transistors and one detector diode. The oscillator is crystal controlled. Supply voltage is 6V and current consumption 5mA.

Primaxa gun

S. Kempner Ltd. announce their Primax and Primaxa soldering guns. Full heating is obtained six seconds after the "on" switch is depressed and twin spotlights mounted in the gun enable the user to get "a bit of light on the subject". The special alloy tip never needs retinning and the unit is guaranteed for 12 months (except tips and bulbs). Replacement tips are available for different soldering jobs and two models of gun are available: the 60W model which retails at £5·40 and the 100W model priced at £7. Postage and packing on each solder gun is 25p. Further details and soldering guns are available from *S. Kempner Limited, 421 High Road, London, N.12. Tel. 01-346 6222.*

Zeta windings

Zeta Windings Ltd. inform us that they can undertake to manufacture and design iron/ferrite cored transformers for any application that constructors may require for the development of their circuitry. They will also make them for P.W. projects and they are available by type number via: Tidman Mail Order, 236 Sandycombe Road, Richmond; H. L. Smith, 287 Edgware Road, London, W.2 or (callers only) Zeta Windings Ltd., 26 All Saints Road, London, W.11.

Other services provided by Zeta Windings are their rewinding of one-off prototype facilities on all kinds of transformers, and their rewind and prototype service which takes about 3 to 5 days.

The "voice"

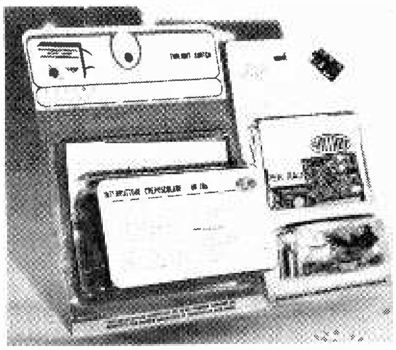
In a recent experiment, Bell Laboratories and the Western Electric Company gave a computer a "voice" so it could speak instructions helpful to production-line workers assembling complex communications equipment.

Previously, computers had been used to calculate efficient wiring instructions, and to print them in typewritten form. To get the instructions into a spoken form—so the assembler need not divert eyes or hands from the job—they were read aloud by a human announcer, and recorded, checked and corrected by technicians. Frequent changes in the complex wire lists meant frequent re-recording and re-checking.

In the recent experiment, the human steps were bypassed, and the computer made to "speak" the wiring instructions directly to an automatic recorder, which were then tested on the production line by an assembler of telephone crossbar switching equipment.

"Black ... three ... thirty-one A ... terminal strip ... four A ... valve socket," the recording said, to "tell" the assembler information about wire colour, length, and connection points. Using a cassette tape player with a foot pedal for control, she could start or stop the recorded voice during any of 58 steps involved. Assembly of each crossbar unit takes about 15 minutes.

Bell Labs engineers have been doing research on computer-generated "speech" because this is one way to make the computer respond in human terms.



Amtron Kits

Next November the British Broadcasting Corporation will be commemorating the first broadcasts, made in 1922, by the original British Broadcasting Company. We thought that readers might be interested in listening to these 50th anniversary programmes on a reproduction crystal set, typical of receivers in use in those early days.

Reproduction crystal set

R.F. GRAHAM

IN the early days of radio crystal sets were used in many homes, and this project is a reproduction of such a receiver. Variable capacitors *were* available for tuning, but their cost often resulted in some other means of tuning such as tapped coils, coils with sliding contacts bearing on the turns and swinging coils where mutual coupling (and hence the inductance and resonant frequency) could be adjusted.

In addition to the headphones, such receivers required only a few components such as terminals, a detector crystal and "catswhisker", wire to wind the coils, an insulated board or panel and a few small parts such as bolts and brackets to make a detector assembly.

The receiver shown here is something of a novelty, and sure to arouse interest when it is seen.

COILS

These are a flat type quite popular in the early days, and wound with 26 s.w.g. cotton-covered wire. Actually, any silk covered or enamelled wire, from 30 s.w.g. to 24 s.w.g., is suitable. If heavier wire is used then larger discs will be required.

Each disc is about 4in. in diameter, and can be *stout* cardboard or thin paxolin sheet. Seven slots, each about $\frac{1}{8}$in. wide, are cut about 1in. deep.

Pass the wire through two small holes, and wind in and out of each slot in turn, as winding progresses. This results in half the turns lying on one face of the disc, and half on the other face, crossing over in the slots. Each coil has about 40 turns, the wire being finally anchored through two small holes, leaving the ends long enough to reach to the terminals.

With such a circuit, the parallel capacitance is mainly due to that of the aerial and earth. As a matter of interest, "tuning" coverage was tested with a signal generator, and was 1300-1700kHz with a 25pF aerial/earth system, 850-1100kHz with 100pF, and 550-750kHz with the aerial/earth placing about 250pF across the receiver.

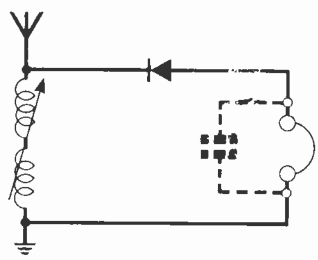
With such a receiver it was quite usual to adjust the number of turns to suit the aerial, or wavelength of local stations.

One coil is fixed on a small bracket. The other is bolted to a strip of material about 1in. long, secured to a threaded rod by lock-nuts. The rod runs in two brackets, and is rotated by a large terminal head or small knob. "Tuning" is accomplished by swinging one coil over the other thus varying the effective inductance.

The base is varnished plywood or ebonite or paxolin about 6×6in. Strips raise it about $\frac{3}{4}$in. to clear the terminals projecting underneath.

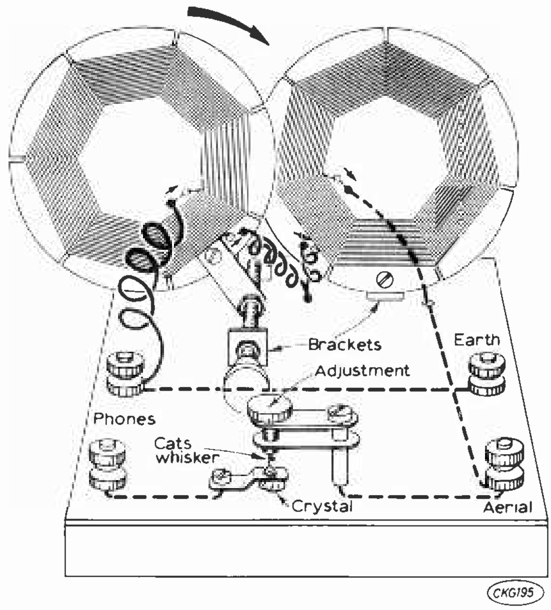
DETECTOR

A strip of brass about 1×$\frac{3}{8}$in. (from an old lamp battery) is bolted to hold the crystal firmly, a corner or point on the latter projecting up through a hole in the strip.



It could hardly be more simple! The suggested additional 'condenser' shown dotted can be about 1000pF. It will be cheaper to buy it rather than to follow the method described in the text for making a 'condenser'!

A $1\frac{1}{2}$in. bolt with spacers holds a similar strip about $1\frac{1}{4}$in. long to which the catswhisker is soldered. Above this strip is a stouter strip of metal, and a screw or terminal head runs through a threaded hole in this, or through a nut soldered to it. Turning this screw or terminal adjusts pressure of the catswhisker on the crystal.



This drawing, showing the constructional details of the crystal set, should not be difficult to follow.

The catswhisker is made by winding about $1\frac{1}{2}$in. of copper, tinned-copper or brass wire, about 34 s.w.g., on a small drill about $\frac{1}{8}$in. diameter, and then stretching the winding slightly. These bygone detectors used wonderful combinations of crystals and even gold-tipped whiskers, all of which appeared to give about the same result. There is great room for experiment here, using various kinds of wire, or soldering the crystal (use Woods metal) or packing it with metal foil. All these trials will probably give a detector of about equal efficiency to that shown, which is about the same as a modern crystal-diode, when a sensitive spot on the crystal has been found.

AERIAL AND EARTH

The aerial ought to be at least 25ft long, and preferably over 50ft. Maximum range is usually considered to be about 25 to 150 miles from a major transmitter, anything over about 50 miles generally needing some 50-100ft or so of outside aerial, 20ft or more high.

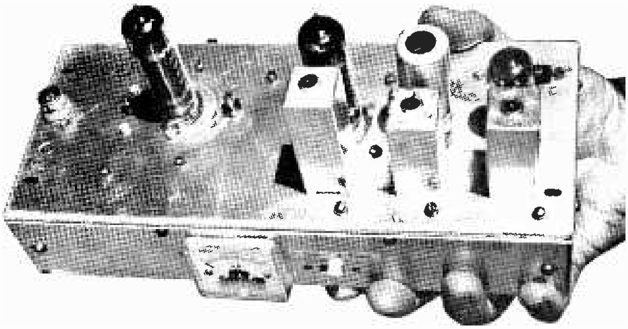
The earth lead runs to a metal spike or other earth rod in damp soil. With a 180ft aerial ample volume was obtained by the author some 25 miles from a transmitter. No earth was used but the earth is usually desirable.

The headphones ought to be good-quality, sensitive headsets of about 500Ω to 2,000Ω resistance, so as to give best volume with the rather limited output of the crystal set. Strictly speaking, a capacitor of about 1,000pF should be connected across the headphones but it was not always fitted in the early days. A description of how to make such a "telephone condenser" appeared in "Amateur Wireless" in 1922.

"The telephone condenser is made up of twenty-five small sheets of tinfoil measuring $1\frac{1}{2}$in. by $\frac{3}{4}$in. with a small strip left at one corner to make a lug. It is built up by placing the strips of tinfoil, with strips of waxed paper in between, with the lugs alternately at one end and then at the other. When the condenser has been built up the ends of the tinfoil should be carefully soldered together by means of a blob of solder, two pieces of cardboard being placed either side of the condenser and a length of linen tape wound round to keep the whole together. The condenser should then be immersed in molten paraffin and allowed to set in a solid block."

The "components list" is short and sweet! One galena crystal (ref. X6), four 4BA brass terminals, 2oz. reel of 26 s.w.g. enamelled wire and a length of 4BA brass studding, all of which are obtainable from Home Radio (Mitcham) as a "kit" for 96p which includes post and packing. ■

TRANSMITTER for 2 metres



PART 1 F. G. RAYER G3OGR

THERE is quite a lot of interest in 144MHz equipment, especially among the Amateur Class B licencees who are permitted to transmit on 144MHz and above. Apart from this, some of the advantages of the use of this band may be noted. There is considerable frequency space, the 2-metre band being 2MHz wide, from 144 to 146MHz. A large space for an aerial is not necessary, aerials for 144MHz usually being single-mast affairs resembling those used for TV purposes. Many stations use low power, in the 10 to 15 watt region, and crystal control of the transmitter is quite usual, which makes the equipment relatively simple to build and operate. There is also a very good chance of clear, solid QSO's, free of all the interference that makes 160m or 80m so uncomfortable.

The transmitter described here runs about 10 watts input, so it can be run from a power supply and modulator such as may already be in use on **a** 160m transmitter. If the inductors are made and adjusted as described, it will be found virtually impossible to make the transmitter operate **outside** the permitted band.

CIRCUIT

Fig. 1 shows the complete transmitter circuit which uses four valves. Operation of the various stages will probably be more clearly understood if they are dealt with separately.

V1 Oscillator. This is a simple crystal oscillator using a 6C4 in which L1 is tuned to the same frequency as the crystal, approximately 8MHz, and V1 cannot be made to work on any other frequency. The test point TP1 allows the grid current of V2, produced by grid rectification of r.f. from V1, to be measured, to facilitate the initial tuning of L1.

V2 Tripler. The 6BH6 receives input at 8MHz, and triples this to 24MHz, to which L2 is tuned. Point TP2 allows a meter to indicate grid current of the following stage, as an aid to the initial tuning of L2. The wrong multiple, if selected by L2, would be 16MHz or 32MHz, and these frequencies, which would result in incorrect operation cannot be tuned by L2.

V3 Tripler-Driver. This is a double beam tetrode QQVO3-10. The first section receives drive at 24MHz and triples to 72MHz, to which frequency L3 and L4 are tuned. Grid current of the following section of this valve can be monitored at TP3. L3/L4 cannot be tuned to a wrong harmonic.

The second half of V3 receives drive at 72MHz from L4, and doubles to 144MHz, to which L5 is tuned. Trimmer TC1 aids in balancing the centre-tapped circuit L5.

V4 Power Amplifier. L6 is tuned to 144MHz and grid current of the QQVO3-10 develops about 30-60V bias across R14. The switch S1a/b allows grid current to be monitored, which is essential. For grid current indications, the 5mA meter reads directly.

Cathode current for V4 flows through R19. With the meter switch in the second position, R20 is in series, and the meter reads 0-0·5V, which corresponds to a full-scale deflection of 50mA, so that the cathode current of V4 can be measured.

A separate h.t. connection is provided for V4, so that modulation can be applied for speech transmission. This type of valve does not need neutralising although acting as a straight-through 144MHz amplifier. L7 is tuned to 144MHz, and output is from the link coupling L8, TC2 allowing adjustment of loading. The transmitter will work directly into a co-axial feeder to a dipole or similar aerial.

With a 280V supply for the early stages, it was found quite easy to obtain more grid drive than was required. Running the p.a. with about 10 watts d.c. input will light a 6 watt lamp used as a dummy load very well, so a good level of efficiency is obtained.

INDUCTORS

L1 and L2 are wound on $1\frac{7}{8}\times\frac{1}{4}$in. dia. formers and L3 and L4 on a single $2\frac{3}{8}\times\frac{1}{4}$dia. former. The formers fit in $\frac{3}{4}$in. square screening cans and are mounted by 6BA bolts which pass through lugs on the cans and into tapped holes provided on the square bases of the formers. Fig. 2 shows winding details. To make L1, bare and solder 32 s.w.g. enamelled wire in the tag used for h.t. Leave $\frac{1}{2}$in. clear space, then wind on 50 turns close wound. Secure the ends with polystyrene cement or similar adhesive, clean the wire end and solder it in the A (anode) tag. The wire ends should slope down clear of the windings, and clear of the screening can.

If surplus or other formers or cans are used, these need to be long enough to avoid having the windings near the chassis or top of the can. It might also be necessary to make sure that the cores of surplus coils are suitable for the frequencies involved.

L2 is wound in the same way, and has 15 turns of 24 s.w.g. enamelled wire, close wound.

L3 and L4 each have $5\frac{3}{4}$ turns of 24 s.w.g. enamelled wire, close wound. A gap of $\frac{1}{8}$in. is left between the two coils. Begin winding at G, Fig. 2, and finish this coil at the bias circuit lead, R11. Then begin L3 at the h.t. positive end, continuing to wind in the same direction as for L4, and terminate this at end A (anode). The long former listed has soldering eyelets, and the wire ends pass down through these and soldered but not cut off. The leads emerge as in Fig. 5. They are cleaned and left long enough to reach the required points. To avoid possible short circuits pieces of sleeving are put on the pins of L1 and L2, and the wire ends of L3 and L4. For easy identification, the wire ends of the latter can

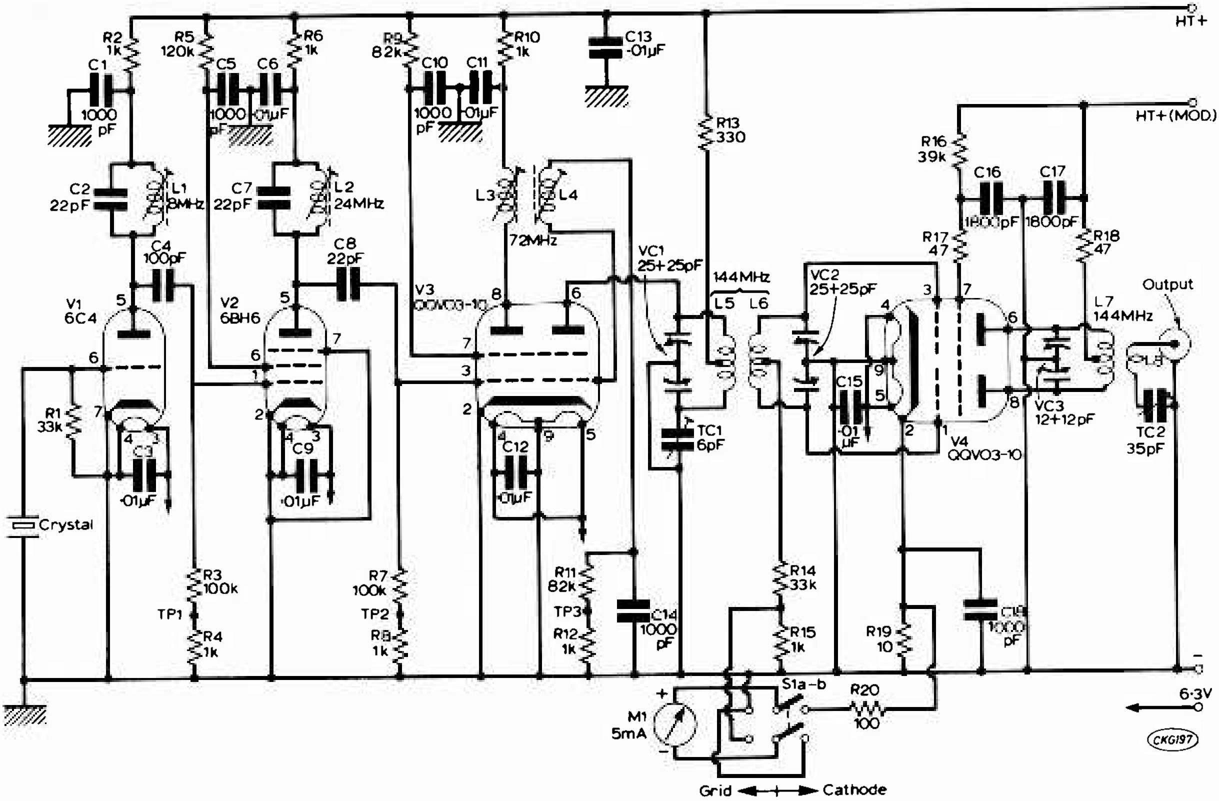


Fig. 1: Circuit of the 2-metre transmitter which uses 8MHz range crystals in the oscillator stage.

have coloured sleeving, as follows: Black—grid; Green—bias resistor; Red—h.t.; Yellow—anode.

Place each former in its can with the threaded holes matching the lugs, which are bent over. To prevent the cores moving, a piece of a thin elastic band can be put into each former, before screwing in the core.

The windings for L3 and L4 may be tuned to resonance with the cores only using stray circuit capacitances. If cores are employed, the core material must be good for 72MHz.

The 144MHz inductors are shown in Fig. 3. L5 and L6 are wound with 18 s.w.g. wire, and L7 with 16 s.w.g. wire. Sleeving should be put on the wire for L5 before winding to prevent possible contact with L6.

L5 has five turns wound on a suitable object, such as a pencil, so that its outside diameter is 0·4in. and turns are spaced to occupy 0·6in.

L6 has six turns, 0·3in. outside diameter, and is 0·7in. long. L7 is four turns, spaced to occupy 0·5in., and its outside diameter is 0·6in. L5 has a centre tap soldered on the top of the central turn, while L6 and L7 have taps on the bottom of the centre turn. The loop L8 is a single turn of 16 s.w.g. or similar wire, placed in sleeving, and with ends shaped to reach the coaxial socket and loading capacitor.

CHASSIS ASSEMBLY

The chassis and screen across V4 valveholder consists of six "universal chassis" flanged members. The top, 10×4in., is prepared for the valveholders etc. as in Fig. 4. The screened coils need four holes to clear the pins. two holes for 6BA bolts, and a central hole under L3/L4 to reach the bottom core.

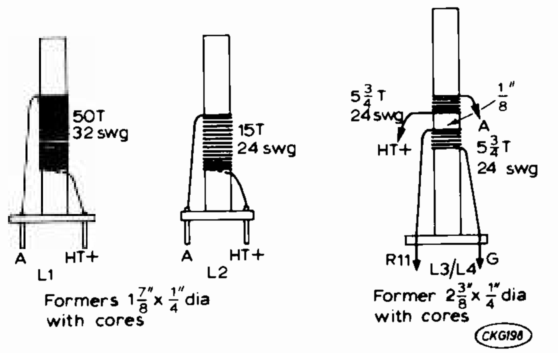


Fig. 2: Winding details of the coils for the oscillator and multiplier stages.

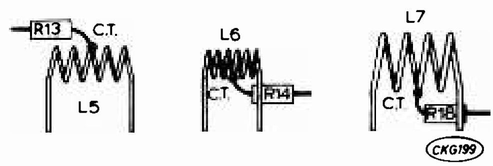


Fig. 3: Construction of the coils for the power amplifier. Put sleeving on L5 before winding.

A 4×2in. member is bolted **inside** each end flange of the top. The third 4×2in. member is cut so that it can be placed across the holder for V4 as in Fig. 5, clearing tags 4 and 5 (heater). It is bolted to the top at the valveholder.

The 10×2in. front member has the top flange cut off, and takes the meter and 2-way switch in the positions shown in Fig. 5. It is bolted to the chassis

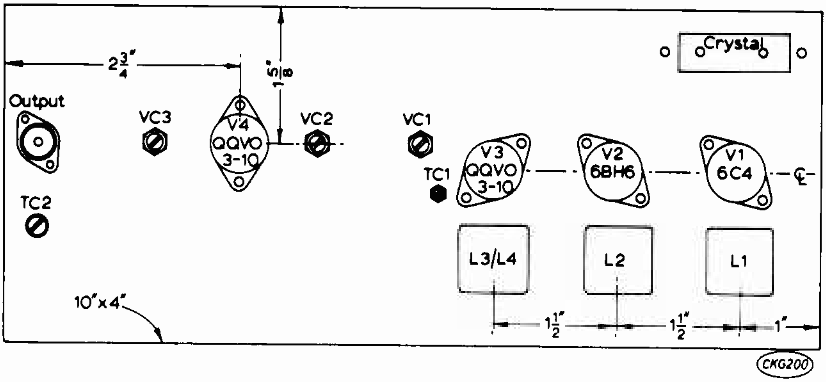


Fig. 4: Marking-out details on top of the chassis. Holes for the single tag stand-offs can be drilled as construction proceeds.

top, both ends, and the screen. The back is fitted in the same way.

It is best to prepare the front and back but leave them off until most of the wiring is completed.

WIRING

Fig. 5 shows wiring and other details. All by-pass capacitors, and particularly C10 to C19, should be connected from the various tags to adjacent chassis tags with the shortest possible leads. Resistors R13, R14 and R18 are soldered with very short leads from resistors to centre-taps, and R17 is wired directly to pin 7 of V4.

Capacitors VC1, VC2, VC3 and TC2 may be fixed by the spindle bushes, or by bolts. In either case the rotors are grounded by stout leads to near-by chassis tags. All r.f. leads in the 144MHz circuits must be stout and no longer than necessary.

Single tag stand-offs were used to provide anchor points for R2, R6, R10, etc., and also for the grid current test points TP1, TP2 and TP3.

A 4-way tag strip is bolted as shown, for flexible supply leads or a 4-way cord. This provides 6·3V, chassis or common return, h.t. positive, and modulated h.t. connections to the power supply and modulator.

CIRCUIT ADJUSTMENTS

When an indication of grid current has been obtained on the meter this can be used for all tuning adjustments. However, it is not very likely that this indication will be obtained immediately, so it is generally necessary to adjust the stages one at a time, as described below.

A 6·3V 2A supply is necessary for the heaters. A 250-300V supply at about 60mA is required for the h.t. for V1, V2 and V3, actual current depending on the voltage and adjustments. Temporarily leave h.t. to V4 (Mod.) disconnected.

Crystal. Multiplication is 3×3×2, or 18 times. Crystals in the region of 8MHz are thus necessary. To

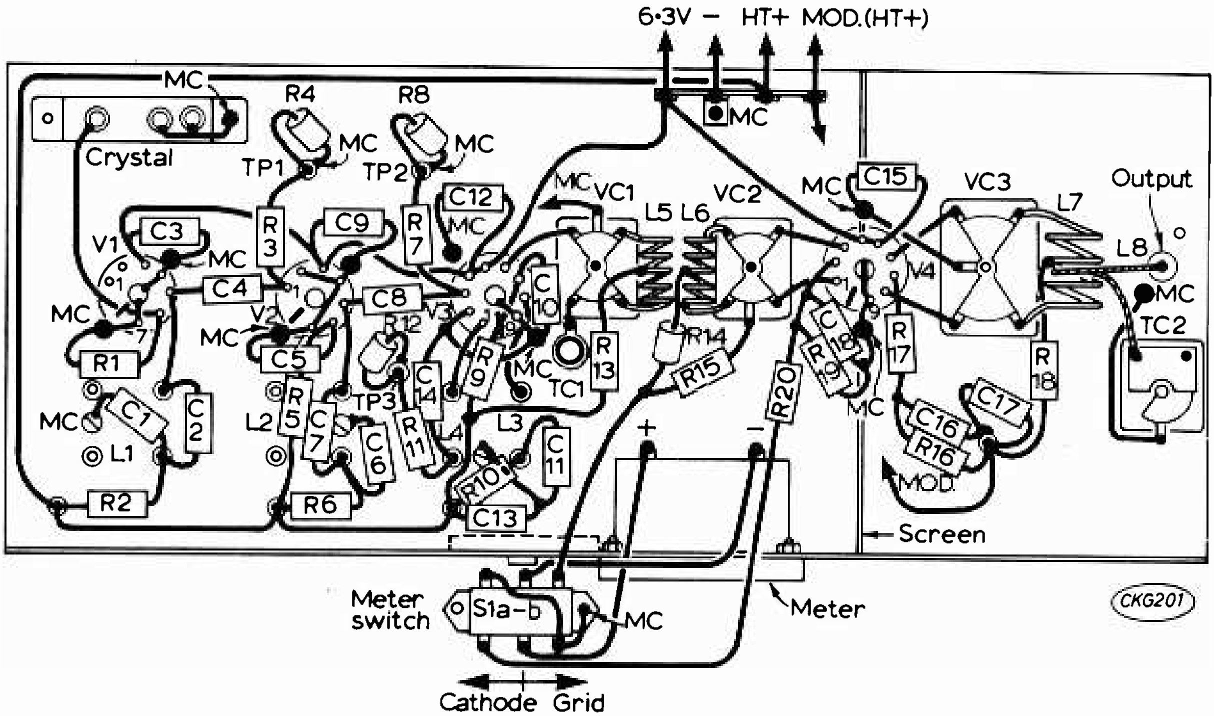


Fig. 5: Wiring underneath the chassis. Stand-off insulators are used for the test points TP1, 2, 3 and to support resistors R2, 6 and 10.

★ components list

Resistors

R1	33kΩ ½W	R8	1kΩ½W	R15	1kΩ ½W
R2	1kΩ ¼W	R9	82kΩ½W	R16	39kΩ 1W
R3	100kΩ ½W	R10	1kΩ ½W	R17	47Ω ½W
R4	1kΩ ½W	R11	82kΩ ½W	R18	47Ω ½W
R5	120kΩ ½W	R12	1kΩ ½W	R19	10Ω ½W
R6	1kΩ ½W	R13	330Ω ½W	R20	100Ω ½W
R7	100kΩ ½W	R14	33kΩ ½W		

Capacitors

C1	1000pF 350V disc	C10	1000pF 350V disc
C2	22pF SM	C11	0·01μF 350V disc
C3	0·01μF 12V disc	C12	0·01μF 12V disc
C4	100pF SM	C13	0·01μF 350V disc
C5	1000pF 350V disc	C14	1000pF 350V disc
C6	0·01μF 350V disc	C15	0·01μF 12V disc
C7	22pF SM	C16	1800pF 1kV disc
C8	22pF SM	C17	1800pF 1kV disc
C9	0·01μF 12V disc	C18	2000pF 350V disc

VC1–VC2 25+25pF butterfly capacitor (Jackson type C713 (0·015″ gap)

VC3 12+12pF butterfly capacitor (Jackson type C713 (0·045″ gap)

TC1 6pF tubular trimmer (Home Radio VC88B)

TC2 35pF pre-set air spaced

Valves

V1	6C4	V3	QQVO3–10
V2	6BH6	V4	QQVO3–10

Chassis
"Universal chassis" flanged members. 10 x 4in. type CU58A (1), 10 x 2in. type CU139 (2), 4 x 2in. type CU133 (3) (Home Radio)

Miscellaneous
M1, 5mA miniature panel meter. Valveholders B7G, skirted with screening cans (2) B9A (2). S1a–b, 2 pole 2 way slide switch. Crystal 8MHz (see text) and holder. Coil formers type CR14 (2), CR16 (1), screening cans CR15 (2), CR17 (1). Cores type CR19 (4) (Home Radio). Tag strip, stand-off insulators etc.

find the output frequency with a given crystal, multiply the crystal frequency by 18. Alternatively, to obtain a crystal to operate on a particular frequency, divide the wanted frequency by 18.

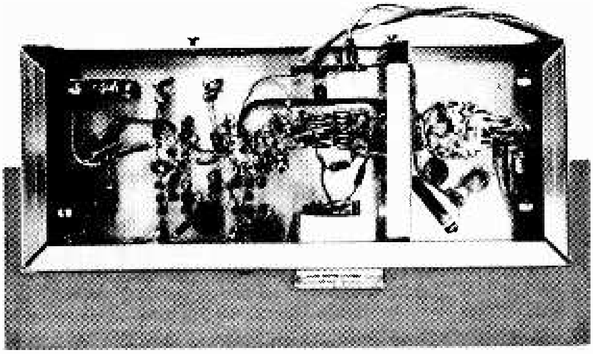
Oscillator. A suitable tool to adjust the coil cores can be made by filing flats on the end of a plastic knitting needle. Clip a multi-range meter or other suitable instrument from tag TP1 to chassis. A 5mA or similar range is suitable. Or if a voltage range is used, 1V will indicate about 1mA, and so on.

Rotate the core of L1 for nearly maximum grid current at TP1. Do not tune L1 exactly for peak current, or it will be found that the crystal oscillator will not start, when switched on. This is usual with this type of oscillator.

Tripler V2. Transfer the meter to TP2 and adjust the core of L2 for best grid current.

Tripler-Driver V3. Transfer the negative meter lead to TP3 and rotate the cores of L3 and L4 for best grid current. These are quite critical, and interact to some extent.

Power Amplifier. S1a/S1b should be set to read grid current. Slowly rotate VC1 and VC2 for best grid current. When a reading is obtained, the test-



View underneath the chassis. The vertical screen isolates the input and output circuits of the p.a.

meter can be unclipped, and cores L1 to L4 can be touched up, as necessary.

Should a peak in grid current arise with VC2 fully open, slightly stretch L6, and re-adjust VC2. On the other hand, if VC2 is fully closed, press the turns of L6 a little closer together. This also applies to L5 and L7.

Unscrew TC1, and peak grid current with VC1. Slowly screw down TC1 meanwhile re-adjusting VC1 for best grid current. This will give a peak somewhere the middle setting of TC1, but is not critical.

Final grid current can be adjusted by varying the spacing between L5 and L6, and anything around about 1·5mA is suitable.

It is best to make the first output test into a lamp load. This can be a 12V 6W bulb, connected to a co-axial plug to connect to the output socket.

Open TC2 to minimum capacity and switch the meter to read cathode current. Provide about 300V or so at the "Mod" connection. Rotate VC3 for a dip in cathode current, which should cause the bulb to light. The meter can then be returned to "Grid" and VC2 readjusted (also possibly VC1).

LOADING

The loading of V4, and thus the final current drawn when VC3 is tuned to resonance, is adjusted by rotating TC2, and if necessary moving L8 in or out of the coil L7.

Maximum listed ratings for the QQVO3-10 are 300V for anode and 175V for the screen grid, with an anode current of 76mA (d.c. input 22W), 3mA grid current, resulting in an output of about 14W. The power supply and modulator used was more suitable for about 40mA at 280-290V or an input of about 12W. Screen-grid current is about 3mA, and the meter fitted shows the total cathode current, anode current alone being a little less. If the meter is to read 0-100mA, for larger inputs, R20 should be 200Ω.

The modulator should be able to furnish at least one half of the input to V4 in watts—say 5W for 10W input to V4. A 12AX7 followed by a single 6BW6, as a Class-A modulator (as used for a 160m transmitter) was found to work well with an input of up to about 10 watts to V4.

Next month we shall describe a power supply and modulator for use with this transmitter. It can also be used as a conventional audio amplifier or as a power supply for a higher powered transmitter.

IC auto PARKING LIGHT

J. N. JONES

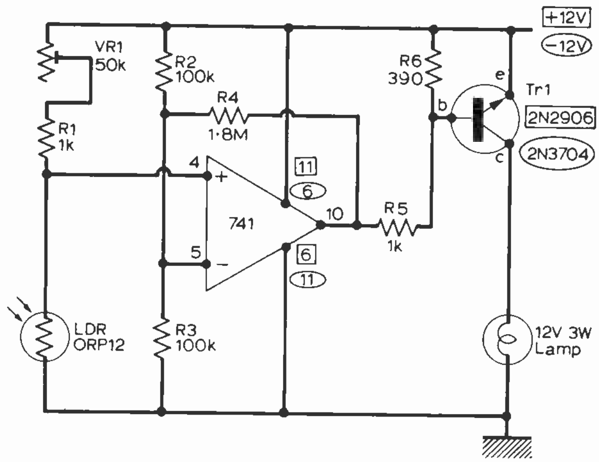


Fig. 1: The circuit for both positive and negative chassis cars. Where there is a variation, +ve details are in a squared box, −ve details in an oblong box.

ALTHOUGH the regulations regarding the lighting of cars after dark have recently been relaxed, there are many areas and situations where parking lights are still required. If your car has to display lights regularly, it is a chore having to go out to turn them on—and there is always the risk of forgetting to do this.

For quite a small cost (only about £1·25), it is a simple matter to arrange for a parking light to come on automatically when the light level falls below a certain level and to switch itself off at daybreak. This obviously conserves the battery, especially during the winter (with the long nights), the time when the battery needs to be in peak condition. Such a device is especially useful when the car is used only occasionally.

THE CIRCUIT

The circuit shown in Fig. 1 is suitable for cars with either a negative or positive chassis with appropriate modifications. The circuit makes use of an LDR (light dependent resistor) and the type 741 operational amplifier IC. The latter is an extremely useful and well protected differential amplifier which is available for as little as 34p—low enough to promote serious consideration in simple circuits such as this. The main features of the circuit are the low cost, already mentioned, and the low current drain in the standby position; in daylight the current drain is only about 2·5mA.

The positive earth circuit functions as follows: R3 and R4 fix the non-inverting input of the IC to a potential of about −6V. This is slightly modified by the positive feedback action of R5, but only by a fraction of a volt. VR1 is set so that at lighting-up time the potential of the inverting input, going negative with falling light levels, is just passing through −6V. This causes the inverting input to become negative with respect to the non-inverting input, which in turn causes the output potential to change from about −10V to about −2V. The values of R6 and R7 are selected so that when the output changes over this range, the transistor is switched from completely off to fully on, causing the bulb in the collector to light.

The purpose of the positive feedback action of R5 is to prevent possible oscillation and to ensure that the switching action is fast enough to prevent destruction of the transistor which can only handle the current in fully on or fully off states.

The negative earth circuit functions in exactly the same way but the transistor type needs to be changed and the voltages reversed.

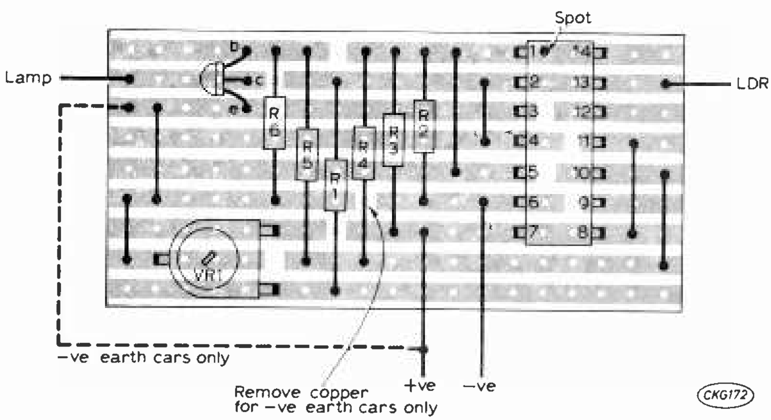


Fig. 2: Component layout on Veroboard. Note that for negative chassis cars R2 and R3 reverse notation but, as they are of the same value, no circuit changes are necessary.

CONSTRUCTION

A suggested layout on Veroboard is given in Fig. 2, with the changes from one chassis potential to another given. This circuit can be mounted anywhere in the car but the LDR has obviously got to face through the window. It should not face the parking light; if it does the unit will "oscillate" as the circuit cannot differentiate between the light it is meant to switch on and daylight! ■

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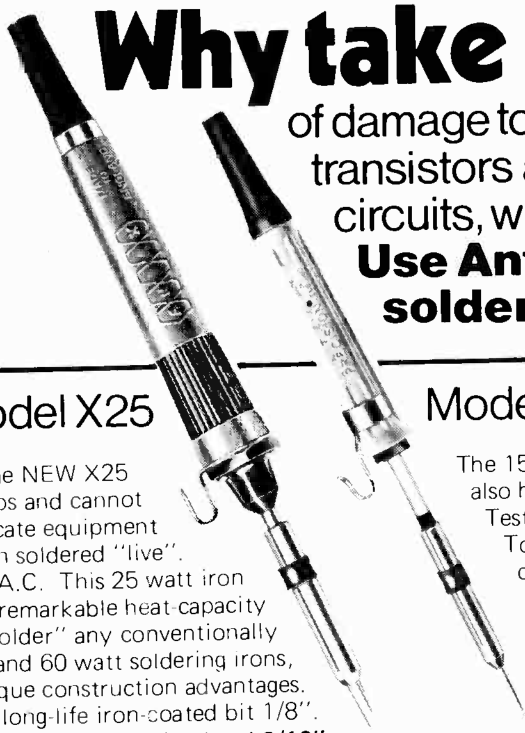

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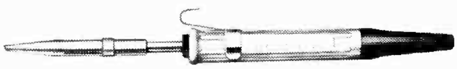

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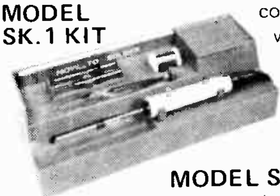

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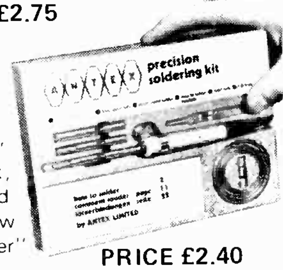

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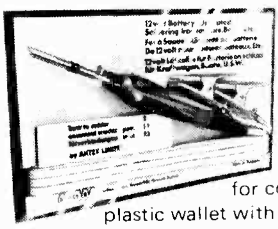

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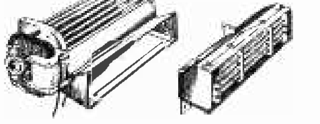

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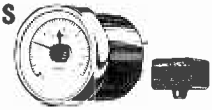

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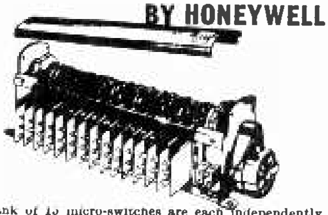

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

A good turn

With reference to the insertion in your CQ? Column June '72 you will be very pleased to know I have received a copy of the book I was looking for, "Simple Radio Circuits."

The reader who sent me this is in search of some detail concerning "Modification details of any ex-military receiver" if you could help him in this matter through your column I shall be very grateful.

The name of the writer whose request I mention is Alan Salisbury, 28 Dyke Street, Brymbo, Wrexham, N. Wales LL11-5 AH.—**J. Wheelton** *(Staffs)*.

Greek notes

With reference to W. D. Logan's letter in the May editorial; I wouldn't try to disappoint him, since I am too a vintage radio enthusiast and collector but I think that the early days of Radiotelegraphy were not so romantic and sentimental as he often dreams.

Until high frequency communications were developed, signals were pushed long distances by brute force. To generate the necessary power, great sparks buzzed, molten arcs sizzled, and mechanical alternators revved up madly to as high as 20,000 r.p.m. their rotators yearning to fly apart.

To make these rock-crushers work, an early operator had to be electrician, steeple jack, rigger, mechanic and oiler.

To turn on some arc transmitters he also had to be something of an acrobat. Trouble was when the arc chamber was filled with hydrocarbon gas—if there also was the right amount of air in the chamber, the gas blew up and the carbon was fired back to the operator.

Because receivers had little or no amplification, the operator had to develop sensitive hearing. According to the expression, a man had to crawl into the headphones in order to copy weak signals!

Stations ordinarily were hundreds of miles apart and sending had to be slow. A distant spark signal, for example, sounded like a gnat sighing through a screen and the burbly signal of a far away transmitter might be weaker than the noise, the methodically taped dihs and dahs audible only through holes in the static.

So all important was an individual's adeptness that every operator struggled to avoid ending up with the trade's own brand of punch-drunkenness, a tin ear and a glass arm.—**Chris Petsikopoulos** *(44 Atlantos str. P. Faliron, Athens, Greece)*.

CQ! G. Saunders

While reading through the C.Q. section of June *Practical Wireless* I came across a book wanted by a Mr. George W. Saunders with no address given. Could you please ask him to write to me if he is still looking for this book. The book I have is "Mullard", Circuits for Audio Amplifiers; reprinted June, 1966. Please ask him to write to the address below for details.—**E8097840 SAC Lim** *Hangar 91, RAF Brize Norton, Oxford, OX8 3LX.*

Cassette decks

With reference to the letters of V. S. Watts and A. R. Knight, I have a source of Philips type cassette mechanisms in about three different models. They are expensive (nominally £25 each) and if Mr. Watts and Mr. Knight or any others contact me I will endeavour to help them.—**S. R. Beeching** *(Consortium Engineer) (Bishop Grosseteste College Lincoln)*.

Egg-shapped

I have just recently invested in a Henry's Radio catalogue, and I note that on page 274 it says at the bottom, "Note, deliveries of speakers, particularly elliptical tapes, can sometimes be difficult." Is this a new type of tape? and are these tapes supplied on elliptical reels?

I should be interested in your comments.—**F. G. Jennings** *(Sussex)*.

[This appears to be a type error! —*Editor*]

Bang!!

Although it is too late to enter for the competition for the most interesting find made by the *PW* Treasure Tracer Mk I, I thought you might be interested to know that I found a bomb in my garden recently. The police think it is some kind of mortar bomb which has been fired but has not exploded. When I think how roughly I handled it compared with the way that the three policemen handled it I nearly died of fright.

The bomb is made by ICI and is about 9 inches long and has corroded terribly. It was buried about 2 inches in the ground and just to think that I walked over it many times a day. Apart from the mortar bomb and tail fin I also found a spent cartridge about three feet away from it.

If I had dropped this long cylindrical bomb I dread to think what would have have happened to me and my neighbour who was watching.—**N. Moyes,** *(Croydon, Surrey)*.

Equipment

Mrs. V. E. Whetstone has informed us that she has a large amount of radio and television equipment that belonged to her late husband. Items include Radio and Television Servicing volumes 1-8, numerous issues of *Practical Wireless* and *Television* dating back to the 1940s, loudspeakers, oscilloscopes, valves, tubes, transformers etc. and many items of test equipment including meters. There are many line output and e.h.t. transformers, resistors, capacitors, coils, valveholders and television i.f. panels. There is a sound measuring device together with time switches, turntable and many other items of useful equipment, including CME 2301 and CRM 172 television tubes to name but two.

If any readers are interested in making offers for any of these items (and Mrs. Whetstone has expressed a wish that she would like radio clubs to have some of the equipment) would they please phone 01-500-1513.

'Project Autumn' presentation

AT a presentation luncheon in London recently John Thornton Lawrence was presented with the *PW* Designers Trophy for 1971 by Editor Norman Stevens. The winning article "A Digital Frequency Counter/Timer" was published in *PW* from September to December 1971 and was considered by a panel of judges to be the best entry in the *PW* "Project Autumn" competition.

John's interest in radio began at school. An apprenticeship in radio engineering at an electronics factory on the inspection side gave him a good insight into multiband short wave receivers. In 1947 he switched to the radio trade as the service manager for a company specialising in radio, sound systems, disc recording and TV. At home, he designed and built a 12in. TV set together with an oscilloscope and pulse generator to align the set before regular BBC transmissions started.

In 1953 he became GW3JGA operating mainly on Top Band and 2 metres, but in 1958 as GW3JGA/T made the first GW two way television contact, with GW3FDZ/T, at a distance of 18 miles. He was a founder member of the Flintshire Radio Society and was the RSGB's Region 11 representative for a period. In 1960 he joined the Electronic Engineering Department of the University College of North Wales where he now holds the post of Senior Scientific Officer, and incidentally, founded the UCNW Amateur Radio Society whose station GW3UCB is frequently heard in contests on all bands.

John's interest in amateur TV expanded and in 1962 he completed a sequential colour system and transmitted what are believed to be the first amateur colour TV pictures in this country. With later transistorised equipment he achieved a two way TV contact with the Isle of Man at a range of 79 miles. Among other qualifications John is a Fellow of the Society of Electronic and Radio Technicians and a member of the Royal Television Society.

The pay-off! JTL (left) gets his award from WNS.

'PROJECT Autumn'

Practical Wireless Designer's Trophy 1972

To encourage new authors, entries for the 1972 Trophy will be restricted to readers who have not previously had an article published in PW. This leaves the field wide open for those wanting to try their hand at writing technical constructional articles. Contestants will not be in competition with well-known authors, only with other newcomers, so the cup can only be won by a new writer. **It Could Be You.**

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RULES

1. The winning entry will be chosen by a panel of judges from among articles published in issues of PW dated September 1972 to August 1973 inclusive. The Editor's decision on all matters arising will be final.
2. The winner of the competition will receive and retain outright the PW Designer's Trophy 1972. Other prizes will be awarded to the best runners-up. Articles will be paid for shortly after publication.
3. The competition is open only to authors who have not previously had any work published in PW.
4. Articles submitted for the competition should conform to the general style of material published in PW and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
5. Articles should, preferably, be typed using double spacing, leaving wide margins, on one side only of each sheet. Circuit diagrams and any other drawings must be separate and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Components list must also be separate and laid out to the standard PW format.
6. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Photographs may be identified by sticking a label on the reverse instead of writing on the back of the photograph itself.
7. Components used in the design must be readily available from retail sources.
8. Articles should be sent to the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. Authors will be advised as soon as possible of the acceptance or rejection of their articles. Equipment, the subject of an article, must not be sent to the Editor until advised to do so.
9. Employees and staff of PW are not eligible for entry to this competition.

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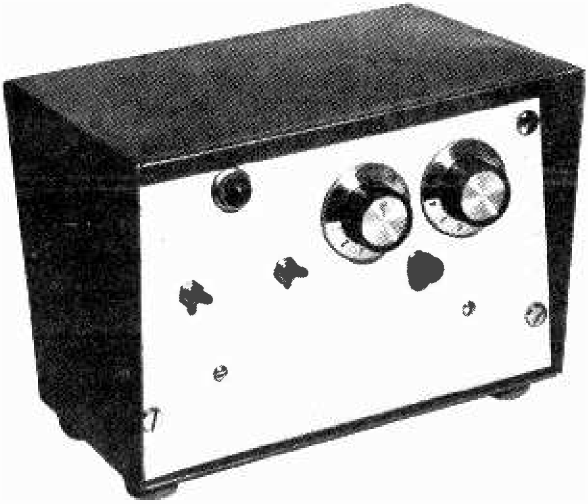


Precision ENLARGER TIMER

R.A. BOTTOMLEY

Most electronic enlarger times utilize the principle that a capacitor, when connected to a supply voltage by way of a series resistor, takes a certain time to reach a predetermined voltage. Some form of voltage level detector is then used to indicate when this level has been reached and then the capacitor is discharged in readiness for a further timing cycle. The voltage level detector can take various forms but nowadays most enlarger timers are designed around the unijunction transistor. These timers are reliable but they suffer from one or two disadvantages.

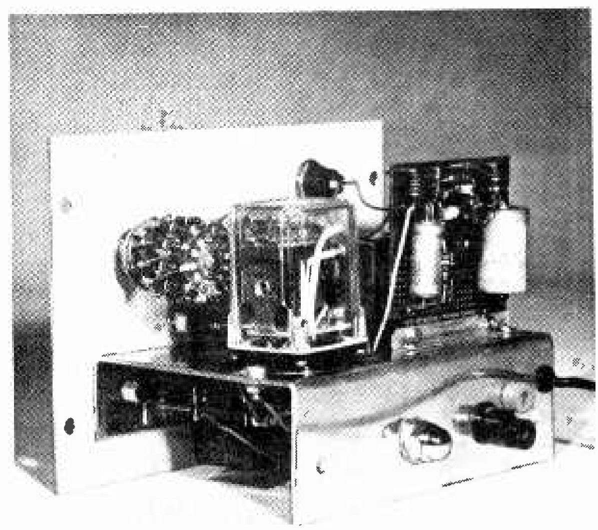
Due to the fact that the UJT requires a minimum amount of emitter current to trigger it, a limitation is imposed on the amount of resistance that can be used in the timing circuit. In order, then, to get a reasonably long time interval a large value capacitor has to be used and this is invariably of the electrolytic type which is not the most stable of components. The variable element is usually a potentiometer and this requires a hand-calibrated scale which is a drawback to those of us who lack that particular drawing skill! Even should we possess this skill there remains the difficulty of reading the scale in the subdued light of the darkroom. It was this last factor, more than any, which was mainly responsible for the present design.

Any time interval, within the range of the instrument, can be set on two decade switches by *feel;* a simple matter, akin to stopping down a lens by the feel of the click stops. Indeed the operation of the instrument has proved to be so simple that no panel marking has been considered necessary.

DESIGN CONSIDERATIONS

The use of decade switches imposes certain restrictions upon the design of the instrument. If a high degree of accuracy is to be achieved, there must be no leakage in the timing capacitor. This rules out the use of a capacitor of the electrolytic type, although a tantalum type should be better in this respect. Since a fairly large value capacitor will still be required, a low voltage polycarbonate type seems to be indicated and in the prototype a $6 \cdot 8\mu F$ component is used. This particular value was largely dictated by size and cost.

In order to obtain fairly long time intervals even with a capacitance value of this order, the resistive component of the time constant amounts to several megohms. This, as previously stated, rules out the use of a UJT and in the present design a Schmitt trigger is employed as the voltage level detector. Since this, too, would present a low resistance load to the timing circuit an f.e.t., connected as a source follower, is interposed between the timing circuit and the Schmitt trigger.

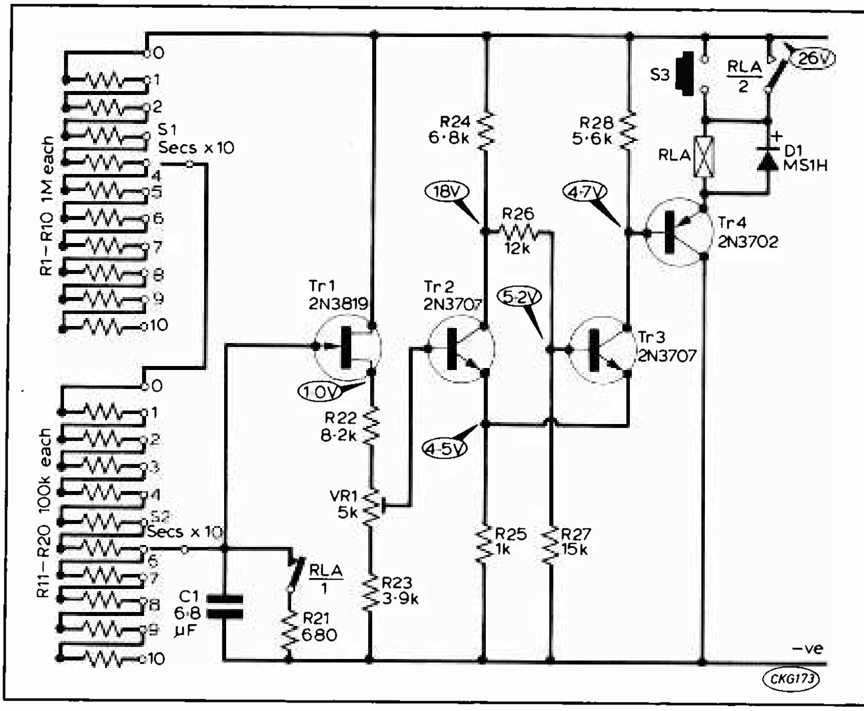


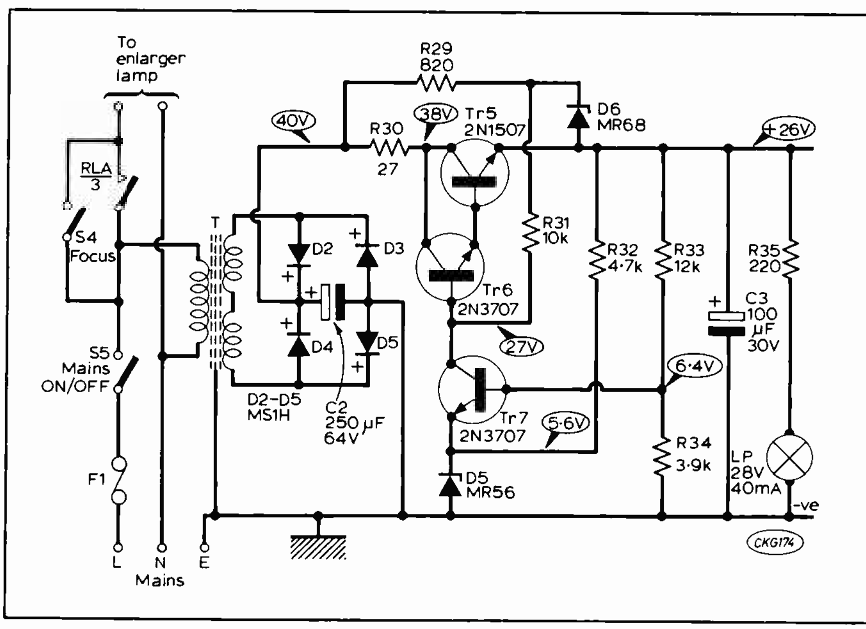
A rear view of the completed prototype.

CIRCUIT DESCRIPTION

The circuit diagram, Fig. 1, shows the state of the push-button switch and the relay contacts immediately before the timing cycle. The timing capacitor, C1, is fully discharged by relay contacts RLA/1 and the gate of Tr1 is at zero potential. Only a small voltage appears at the source due to the self-biasing effect of the small amount of drain current which flows through the resistor chain R22, VR1, R23. As a

Fig. 1: Above is the complete circuit of the timer with the power supply circuit shown below.





consequence, Tr2 is off, Tr3 is on and Tr4, which is a PNP transistor, would also be on were it not for the fact that the relay contacts RLA/2 and the push-button switch S3 are both open. When the push-button switch is actuated, Tr4 conducts, the relay coil is energized, relay contacts RLA/2 close and the relay is held on by these contacts.

Simultaneously, relay contacts RLA/1 open and allow the timing capacitor to start charging up through the series of resistors selected by the decade switches. The voltage on the gate of Tr1 then rises in an exponential manner and the voltage on the source follows in sympathy. When this voltage reaches a certain value, Tr2 goes into conduction and Tr3 switches off smartly due to the regenerative action which is a characteristic of the Schmitt trigger. Tr4 is also switched off and the relay falls out thus completing the timing cycle. During this timing cycle, relay contacts RLA/3 close, thus applying the mains supply voltage to the enlarger lamp.

In order that the timer should give consistent accuracy it is necessary that the supply voltage be held constant. Transistors Tr5, Tr6, Tr7 and their associated components form a fairly conventional stabilised power supply and the instrument is proof against mains voltage fluctuations over the range of 220 to 260V. Although Tr5 (2N1507) is operating within its rating, a small TO5 heat-sink is mounted on it for added security.

CONSTRUCTION

There is nothing critical about the layout and the constuctor is left to use his own ideas on this subject. Several prototypes have been constructed utilising various layouts and no spurious results have been encountered. The photographs show one neat layout which has become the writer's final choice. The

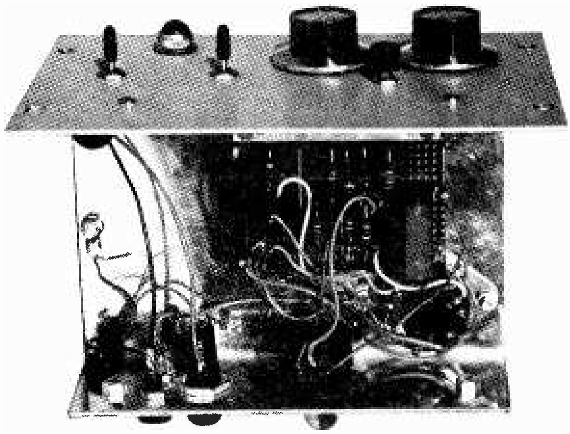
★ Specification

RANGE	0–110 seconds, in 1 second steps, selected by two decade switches.
ACCURACY	5 per cent of set time or better (see text).
"SET-ABILITY"	By feel.
STABILITY	Unaffected by mains voltage variations between 220 and 260V.
REPEAT-ABILITY	Of a very high order as there is no possibility of disturbing a moving scale.

circuit has been conveniently split into two portions and each part has been constructed on a small piece of Veroboard. The one above the chassis, along with the miniature mains transformer, comprises the regulated power supply. The one below the chassis accommodates all the components, with the exception of the relay, which go to make up the timer unit itself. These boards are fixed to the chassis by means of small angle brackets fabricated from short strips of light-guage aluminium.

The decade switches, push-button switch, focus switch (which by-passes the relay contacts RLA/3 during the composing and focussing procedure), mains on/off switch and pilot lamp are mounted on the front panel. The whole is housed in a Contil 755 instrument case which comes complete with non-slip plastic feet. As its type number suggests, this case has dimensions of 7in x 5in x 5in and completes a very neat instrument which occupies little space. The decade switches, as shown on the circuit diagram, are single-pole 11-position types but in the final prototype 2-pole 2-wafer switches are used and the decade resistors are conveniently mounted between the two wafers resulting in a neat assembly.

The relay is mounted by means of its 11-pin valveholder type base. Some comment on this relay is called for. An incandescent lamp is a very non-linear resistor and it exhibits a relatively low resistance when it is cold. Thus, when it is switched on, there is a comparatively high "in-rush" current and the contacts of the relay should be such as to cope with this heavy load. This is the reason for specifying the particular Radiospares (now R.S. Components Ltd.) heavy duty relay. The mains transformer is also Radiospares type. Before leaving the subject of the relay, however, it might be as well to remark that its rating is quoted for some hundred million operations. This would amount to an awful lot of enlargements! A lighter duty relay could be, and has been, used successfully but it is not considered to be good engineering practice.



A top view of the prototype enlarger timer.

★ components list

Resistors

R1–R10	1MΩ	R28	5·6kΩ
R11–R20	100kΩ	R29	820Ω
R21	680Ω	R30	27Ω
R22	8·2kΩ	R31	10kΩ
R23	3·9kΩ	R32	4·7kΩ
R24	6·8kΩ	R33	12kΩ
R25	1kΩ	R34	3·9kΩ
R26	12kΩ	R35	220Ω
R27	15kΩ		

All resistors ¼ watt high stability carbon film, ±5%

VR1 5kΩ preset

Capacitors

C1	6·8μF ±10% 63V polycarbonate
C2	250μF 64V electrolytic
C3	100μF 30V electrolytic

Semiconductors

Tr1	2N3819	D1	MS1H
Tr2	2N3707	D2	MS1H
Tr3	2N3707	D3	MS1H
Tr4	2N3702	D4	MS1H
Tr5	2N1507	D5	MS1H
Tr6	2N3707	D6	6·8V 5mA Zener
Tr7	2N3707	D7	5·6V 5mA Zener

Miscellaneous

RLA	Relay, Radiospares Type 34A or Omron Type MK3P
T	Radiospares miniature mains transformer, 12V type (The two 12V secondaries are connected in series)
S1, S2	1-pole, 11-way switch (but see text)
S3	1-pole push-button switch
S4, S5	1-pole mains on/off switch
F1	1A fuse-link in fuse-holder
LP	28V 40mA lamp (under-run) in pilot lamp-holder with RED bezel
	Knobs (Eagle type NK2. Graduations 0–10 at 30° intervals which match switch detent)
	TO5 Heat sink
	Instrument case

SETTING UP

The accuracy of the instrument will depend upon two factors; the tolerance of the decade resistors and the care with which VR1 is adjusted. The 5 per cent tolerance resistors should be good enough for photographic purposes but if one's pocket is deep enough or if the timer is to be used for a more exacting purpose, 2 per cent or even 1 per cent resistors could be used to improve the accuracy. The writer selected the resistors from a batch of 5 per cent carbon film resistors, using a highly accurate bridge for matching purposes.

Once the construction has been completed and the wiring checked, the instrument should be switched on. VR1 should be set with its slider at the end connected to R22 (8·2kΩ). If it is set to its other extremity the voltage at this point may never rise high enough to switch the Schmitt trigger. With the decade switches set for 1 second (x10 at 0 and x1 at 1) the push-button should be actuated and, if all is well, the relay will close and fall out again after approximately one second.

The decade switches should then be set for a period of 30 seconds (x10 at 3 and x1 at 0), the push-button should be actuated and the timing period should be measured and found to be something less than 30 seconds. If this is so, indicating correct operation, the slider of VR1 should then be moved away gradually from its end stop until a position is found where the contact closure is as near to 30 seconds as possible. Once this position has been found, the potentiometer should be left undisturbed and all the other timing periods as set on the decade switches should fall into place. ■

MOST readers will have seen and tried one of those games where you have to pass a small metal loop over a bent wire, trying to avoid touching it. When the two touch, a bell rings.

Our Buzz-Bar is similar in many ways but it has extra facilities which make it much more fun to use. The level of skill, unlike the simple version, can be varied so that children stand an equal chance with their elders. A lot of fun can be had from a project of this type and it makes an attractive side-show at a fete or bazaar—especially as it is a bit out of the ordinary.

The main difference between ours and the more conventional set-up is that the "wand" (the small metal loop) *can* touch the bar for a limited period or number of times. This allows the shape of the wire to be bent into really weird and wonderful shapes and it can be made so that a mistake-free run is virtually impossible.

We have said a limited number of times. Each time contact is made, the electronics part of the circuit adds up the total time that the two have been touching and only causes the bell to ring when a certain level has been reached. In the prototype, using the component values shown, the total time that the two are allowed to touch can be varied from about 0·1 to 1·5 secs. This time range matches pretty closely average skills encountered by the author.

Most people, including children, can manage on the 1·5 sec setting (assuming that they try hard) but, as yet, no one has managed the shape used in the prototype on the shortest time.

The skill control is infinitely variable over the whole range, from 0·1 to 1·5 secs and this control is calibrated so you can even compete against yourself, trying for a "best" result. On a sideshow, the control can be set to "easy" for children and to a shorter delay for adults, giving everyone a fair go. If you give a prize to anyone managing it and you find out you are giving too much away, the setting can be altered.

The circuit

Obviously no one would want to build in this extra sophistication if the cost was high but as you can

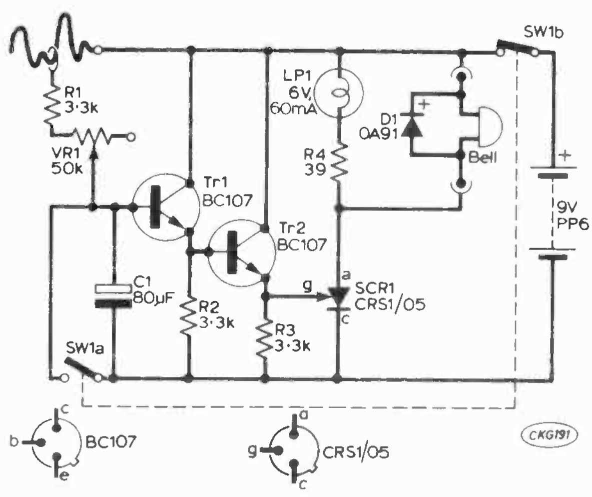


Fig. 1: The circuit of the Buzz-Bar.

see from the circuit in Fig. 1, it is very simple. Even assuming that you have to buy all the components brand new, this should set you back no more than £1. This is of course in addition to the cost of the simple unit; the costs of this with a bell, battery and a framework may come to another £1 or so.

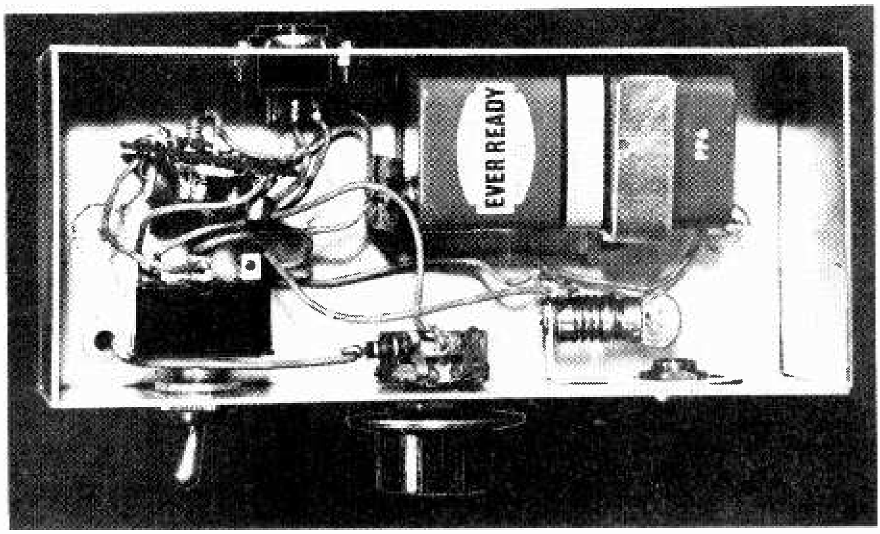
The bar itself is connected to the positive supply line with the "wand" connected via R1 and a variable part of VR1 to C1.

When the wand is touching the bar, C1 charges up through R1 and VR1. When the two are apart, C1 still holds the voltage. This is the main part of the circuit and controls the operation. When the voltage across C1 reaches a certain level, it is arranged that the bell should ring.

It is vital that we take only a tiny current from C1 otherwise it would be discharging in between "touches." In other words we want to make sure that C1 holds its charge for a reasonably long time. For this reason we connect C1 to a high impedance stage, two emitter followers connected in series. This presents a very high impedance and draws such a small current that it can be considered unimportant.

C1 must be a first class quality component, able to hold its charge properly. Electrolytics vary enormously in their leakage and a decent one must be used. All British electrolytics tried have been found to be good, something which cannot be said for many imported types.

The emitter of Tr2 is connected to the gate of an SCR. As the voltage builds up on C1, this also raises the voltage at the gate until the point is reached when the SCR switches on, causing the battery voltage to be applied across the bell. Two circuits are incorporated in conjunction with the SCR. It was found that the continual ringing of the bell was very annoying—especially indoors and for those not actually doing the test. For this reason two indicators are used—a bulb as well as the bell; the latter can be disconnected. The bulb lights up when the "error" limit has been exceeded. If this facility is not required a resistor should still be wired in its place—100Ω is about right. Since the bell is a make-and-break device the SCR will switch itself off as soon as the gate voltage falls, unless current is drawn all the time. Including this parallel resistor prevents premature switch off.



A underside view of the prototype. The various controls can be seen on the front panel. The circuit board is viewed from directly overhead. Compare this with Fig. 3.

The diode across the bell prevents the build up of large back e.m.f. voltages which might otherwise damage the SCR.

SW1 is a double pole switch. In the off position C1 is short circuited, ensuring that when the cycle starts that it is completely discharged; this short is broken when the unit is switched on.

The transistors shown are type BC107 but pretty well any silicon NPN types are suitable. In the unit shown these were later replaced by surplus devices, so salvaging good types for other uses.

★ components list

Resistors
R1 3·3kΩ
R2 3·3kΩ
R3 3·3kΩ All resistors ¼W, 5% types.
R4 39Ω
VR1 50kΩ lin. pot.

Semiconductors
Tr1 BC107—see text
Tr2 BC107—see text
SCR CRS1/05 (1amp, 50V)
D1 OA91

Miscellaneous
C1 80μF, 10V or similar, value is not critical; 6V, 60mA bulb; bulb holder; double pole toggle switch; battery clip; PP6 battery; planed timber; wire coat hanger; Veroboard; Aluminium chassis available from H. L. Smith Ltd, 287 Edgware Road, London W.2. Size: 6⅞ x 2¾ x 1⅞in, price 60p including postage.

Construction

There is nothing at all critical about the construction. In the prototype the electronic components were mounted on a small piece of Veroboard—the layout is shown in Fig. 2. No breaks are necessary in the conductor strip other than those around the mounting screw. This provides a neat and compact layout for the major components.

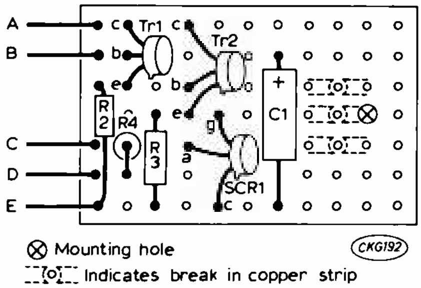


Fig. 2: The component layout on a small piece of Veroboard.

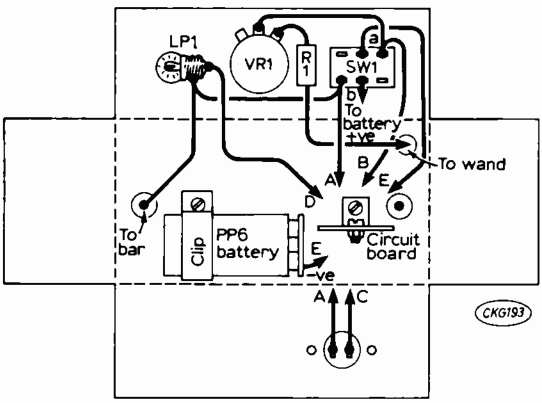


Fig. 3: The wiring diagram. The sides of the chassis have been bent out for clarity.

The prototype was built into an aluminium chassis available from the suppliers mentioned in the components list, but once again all sorts of arrangements may be used. Fig. 3 shows the wiring of the components not on the Veroboard; the wires to the board are marked A to E, matching up with the same letters in Fig. 2.

Two large holes are drilled in the top of the chassis to provide access to the bar itself. A piece of planed timber, 1in × 1in, is mounted on top of the chassis by means of two wood screws which also serve to hold the Veroboard mounting bracket and a battery retainer bracket.

The bell is mounted separately and the leads to this are connected via a plug. A DIN speaker plug and socket were used in the prototype but other types will do just as well.

One other hole is needed in the chassis; to bring the wand wire outside. This hole should be protected by a rubber grommet.

The bar

The bar itself is mounted by pushing each end through small holes drilled through the piece of timber. The holes should be quite small to make the fit tight.

Any firm wire can be used for the bar but a good source is a wire coat hanger; these are cheap and are often given away by dry cleaners. The part just below the hook, where the wires are twisted can be cut, these twisted wires will then fit nicely as a push fit into the body of a "Bic" ball-point pen

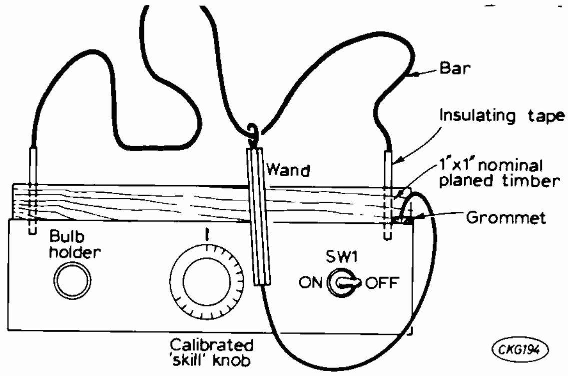


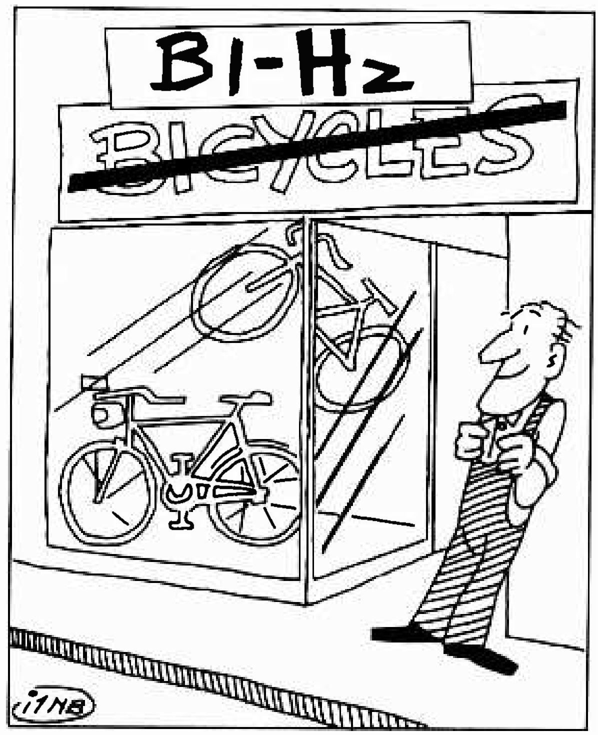
Fig. 4: Front view of the Buzz-Bar.

making a good wand. The wire should then be bent to form a tight loop.

Bands of insulating tape can be wound around the bases of both ends of the bar to prevent it ringing at the beginning and end.

Part of the fun will be bending the wire into shape. As we have said, the shape can be made virtually impossible and bends can be in three dimensions.

When someone does cause the bell to ring, the unit should be switched off. This will discharge the capacitor and allow another run to be tried. Many hours have been spent with the unit described here and although originally designed with children in mind, adults seem to monopolise it. It is only for fun but competitions and all sorts of games can be built up around it. ■

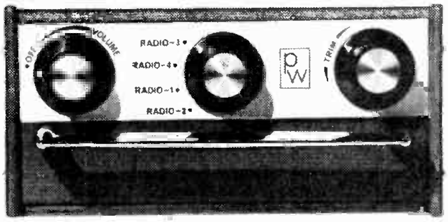


IN NEXT MONTH'S PRACTICAL WIRELESS

FREE INSIDE PRACTICAL AERIAL DATA WALL CHART

Whether your interests are short wave listening, medium wave DX'ing or listening to FM radio, you will find an aerial design on this wall chart that will improve your reception. Get rid of that odd bit of wire and use our design data to make an aerial for your favourite band. Give that stereo tuner a chance to work properly by feeding it with a solid signal from a decent aerial. Finally, medium wave DX'ers will really appreciate the data for a loop aerial that will effectively reduce that European QRM.

THE PW PRE-TUNED CAR/PORTABLE RADIO



Using just six cheap transistors, this radio provides four pre-tuned switched channels, three of which can be adjusted to stations in the medium wave band, the fourth being intended for reception of Radio 2 on long waves. In the home or garden, the internal ferrite aerial is sufficient to provide a good signal in most areas. Placed on the parcel shelf of a car it will perform well utilising the car aerial, the pre-tuned facility being especially useful in moving vehicles.

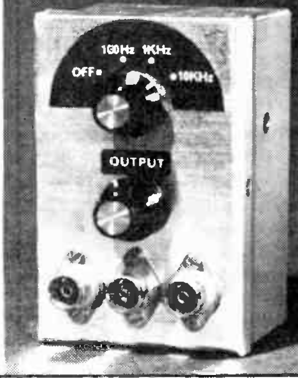
BE CERTAIN NOT TO MISS THE NEXT ISSUE PRICE 20p

THE 'logiprobe'

Have you ever built a project using digital IC's, only to find that it didn't work first time? The "Logiprobe" will enable you to see what is going on in TTL systems, giving a visual indication of the logic level at any point.

AUDIO REFERENCE SOURCE

What do you use an audio signal generator for? Certainly the full frequency range is useful but 95 per cent of the time spot frequencies are sufficient. This project describes a simple unit with square wave outputs at 100Hz, 1kHz and 10kHz with a calibrated output anywhere in the range 0·1mV to 1V. The cost is only a fraction that of a conventional design and it makes an ideal unit for those who have only occasional use for an a.f. signal source.



MANY OTHER CONSTRUCTIONAL ARTICLES PLUS ALL THE REGULAR FEATURES.

ALL IN THE OCTOBER ISSUE ON SALE 1st SEPTEMBER

WITH congested amateur and short wave bands generally, there is more and more need for really sharp selectivity, and this circuit is excellent in this respect as well as being a relatively easy and inexpensive project. Coverage is approximatly 515kHz to 30MHz in four bands, and the use of a 1·6MHz intermediate frequency gives much better freedom from second channel interference on the high frequency bands, than is obtainable with a similar circuit using 465kHz i.f. The receiver is suitable for the reception of a.m., c.w. and s.s.b. signals.

Circuit

Fig. 1 is the circuit, and five valves provide the following functions: V1, r.f. amplifier (6BH6): V2, mixer and local oscillator (ECH81): V3, beat frequency oscillator (6C4): V4, i.f. amplifier and diode demodulator (EBF89): V5, a.f. amplifier and output stage (12AT7).

Aerial, mixer and oscillator coils L1, L2 and L3 are tuned by the 3-gang capacitor VC1/VC2/VC3. For maximum possible efficiency throughout all ranges, and with any aerial, the panel aerial trimmer VC4 is provided. VC5 is a similar mixer trimmer. To avoid band switching and the attendent losses L1, L2 and L3 are miniature plug-in coils.

For exact tuning of signals in a congested band, the "microtune" capacitor VC6 is used, having a panel control. This is also very useful when keeping a difficult signal in tune, where even a small movement of the main ganged tuning capacitor may lose it. VC6 also becomes essential when receiver selectivity is at maximum, despite the reduction drive on VC1-3.

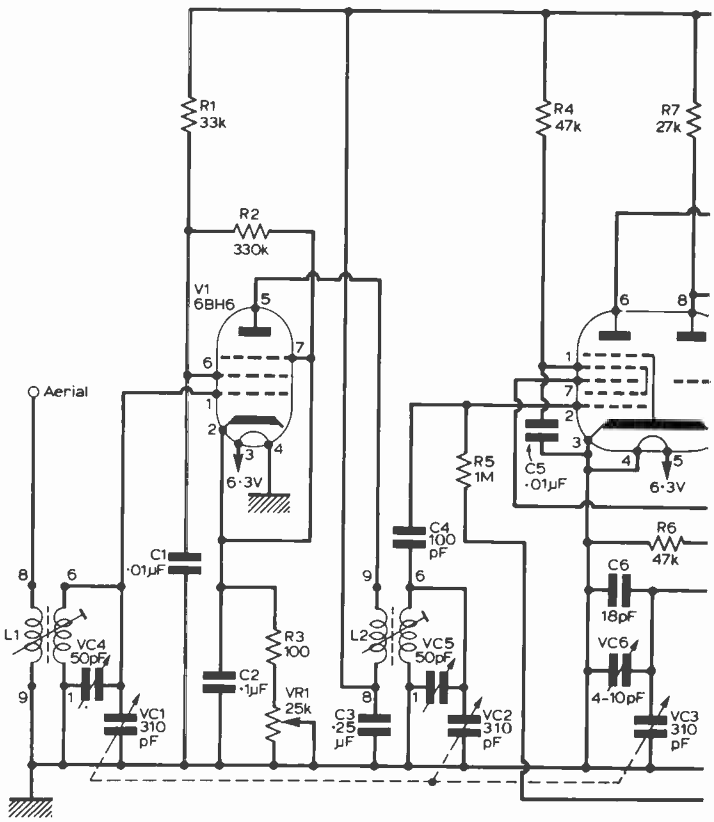
Two degrees of selectivity are provided. For normal reception S1 is closed. This gives easy tuning, and ample bandwidth for proper reception of broadcast or similar signals. With S1 open, and the crystal circuit correctly adjusted with TC1, selectivity is very much greater. Closing S2 brings in the b.f.o. necessary for c.w. and s.s.b. reception. No product type detector is included because strong s.s.b. signals can be reduced by the r.f. gain control VR1, while V3 is coupled to the grid circuit of V4 providing a suitable balance of s.s.b. signal and local carrier, so that the diode can function satisfactorily.

Fig. 1: Complete circuit of the Microtune receiver ▶

V5 is a small double triode, used as a.f. amplifier and output stage. This is economical on h.t. and heater current while giving reasonably powerful loudspeaker reception. The secondary of T1 runs to a panel socket where phones or speaker may be plugged in. T2 is a small mains transformer providing up to about 40mA h.t. and 1·5A for the heaters. HT drain is around 30mA and heater current 1·2A, thus leaving the possibility of fitting an extra i.f. stage later, or using a triode-pentode in the V5 position for greater audio output.

Chassis and cabinet

This is of novel construction, the result being inexpensive, easy to make and of quite satisfying appearance.



4-band receiver

WITH VARIABLE SELECTIVITY

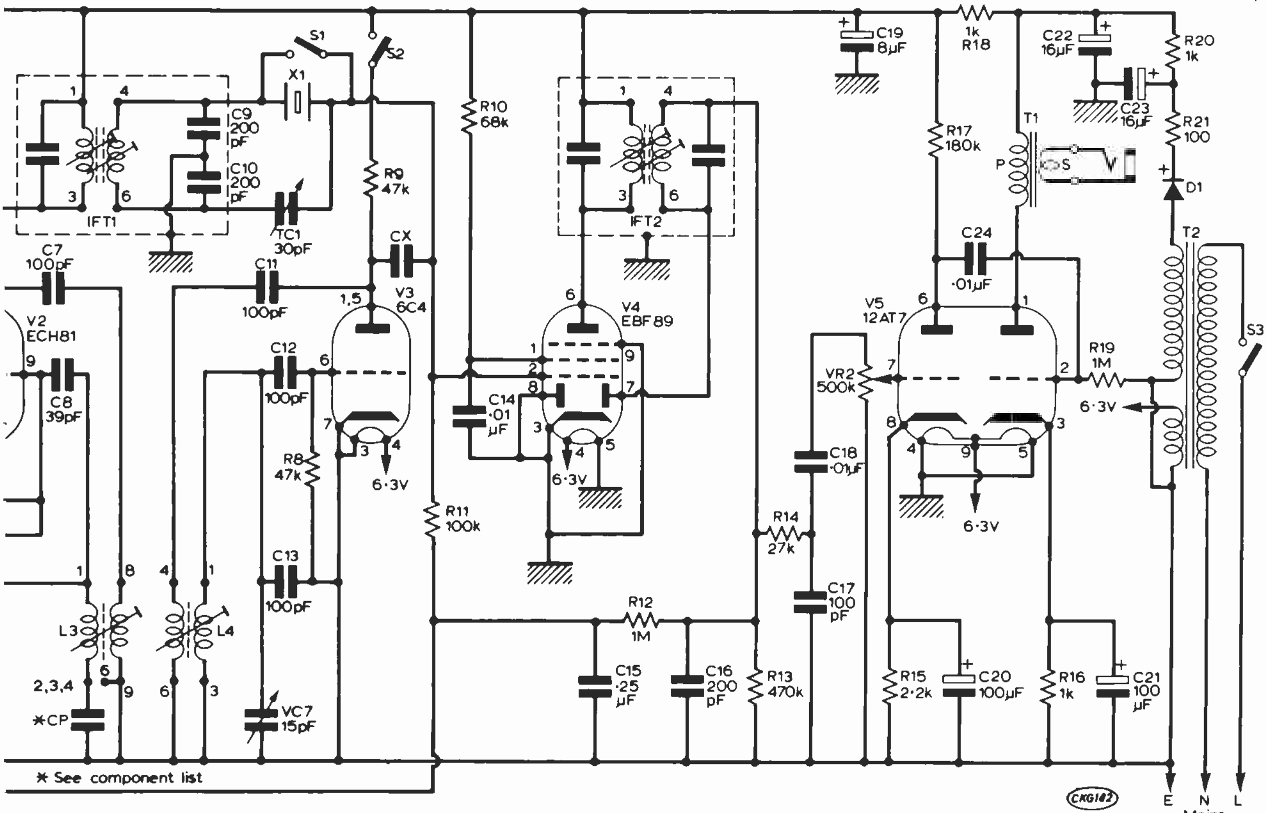
F. G. RAYER

The chassis itself consists of two 12×2in. and two 8×2in. flanged "universal chassis" members with a 12×8in. flat plate. The same screws which hold the 2in. wide members to the plate also secure two 12×4in. and two 8×4in. flanged members on top, thus forming a complete chassis/cabinet 12×8×6in. high. The final appearance of this cabinet, with the top closed by a hinged 12×8in. plate, is quite reasonable, and is obtained with the minimum amount of work.

In the receiver shown, it was decided to cover the front with a sheet of $\frac{1}{16}$in. paxolin, held in place with component fixing nuts. Sides are cut from 3-ply wood and varnished. These are $8\frac{1}{4}\times6\frac{1}{2}$in. to give a little overlap at top, bottom and front. The sides are held with chrome headed 4BA screws run through the holes which will be found in the flanged members. A lid to match is also cut from plywood.

The best way to facilitate construction is first to bolt together the 12×2in. and 8×2in. members, placing the end flanges of the 12×2in. members *outside* the 8×2in. members. Check for squareness, put the 12×8in. plate on, and drill three holes along each 12in. edge, and two on each 8in. edge, about $1\frac{1}{2}$in. from the corners.

Drill through the chassis flanges to match, so that these can be bolted to the 12×8in. flat plate. Assemble the 12×4in. and 8×4in. members to match, put the plate on these, and drill the flanges. The whole can then be bolted together, though construction is easier if the 12×4in. back member is left off until later. In any case, drill and punch holes for the components as in Fig. 2 before assembly, and punch holes for the panel controls, as in Fig. 3.



before screwing on the 12×2in. front runner.

Mark out and drill the 12×4in. front member before finally screwing it in place.

If an overall panel of thin paxolin or other material is to be fitted, mark it now by holding it in position and scribing through the existing holes with a sharply pointed tool. Holes will then match up correctly.

Above the chassis

Holes are drilled near T1 and T2 so that adequately insulated leads can pass down through the chassis. Fit valve and coil holders with tags as in Fig. 3, including soldering tags under the nuts. Drilling positions for L4 and the i.f.t.s can be found by pressing paper on the pins, holding this on the chassis, and marking through with a sharp point. A central hole is necessary to allow adjustment of the cores. It is as well to put pieces of insulated sleeving on the pins.

The front is carefuly marked with the height of the ganged capacitor spindle, so that the drive can be fitted, and the spindle should line up exactly with this. Solder insulated leads to the tags of VC1, VC2 and VC3 and pass them down through holes, before bolting the capacitor in place.

There is some latitude in the choice of VC6, and a component with a maximum value between 4pF and 10pF is most suitable. If VC6 is too small, it may give adequate tuning near the h.f. end of a band, but not near the l.f. band end. The capacitor should be smooth and electrically silent in action. Cheap surplus capacitors in good condition may be used by removing some plates.

In a similar way, though 15pF is shown for VC7, values of from about 10pF to 25pF are possible.

Below the chassis

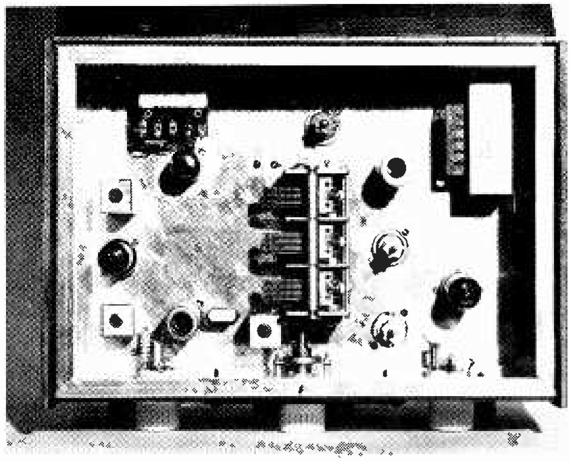
All connections etc. are shown in Fig. 3. Capacitors VC4 and VC5 need not be 50pF, but values of about 25pF to 50pF are most suitable. VC4 is on a bracket cut from scrap metal, and operated by a ¼in. insulated or metal shaft and coupling.

The aerial socket is an insulated type and the adjacent terminal on the back runner is for earth.

The contact-cooled rectifier is bolted flat on the chassis side, and all burrs should be removed from the associated holes after drilling. Capacitors C22 and C23 are a double unit in Fig. 3, but separate capacitors give the same result. Tag strips are used to support various items and connections.

In general, run heater and h.t. leads against the chassis. Leads to r.f. and other circuits should be clear of the metal chassis. It is useful to employ differently coloured wires or sleeving, such as red for h.t. positive, blue for heaters, etc.

The leads to VR2 run along the side of the chassis as shown. All leads should be reasonably short and direct, especially those of grid and anode circuits, which should be well separated from each other. Leads run from the primary of the output transformer T1 to C22 positive, and pin 1 of V5. Leads from the secondary run against the chassis to the miniature output jack. The transformer is intended for a 3 ohm or similar speaker, which should be in a cabinet or fixed to a baffle board. Put extra sleeving over the primary leads of the mains transformer and bring them down to the "neutral" tag N, and to S3. Connect S3 back to the tag L of the tag strip. Run a 3-core flexible cord from the tag strip, brown to L,



View into top of cabinet. Compare with Fig. 2, right.

blue to N, and green-yellow to E (metal chassis). Connect the cores correctly to a 3-pin plug fitted with a 3A fuse.

The 6·3V secondary leads pass through a hole, and are taken to MC and pin 4 of V1, Fig. 3. The h.t. leads go to MC and rectifier negative.

Modifying IFT 1

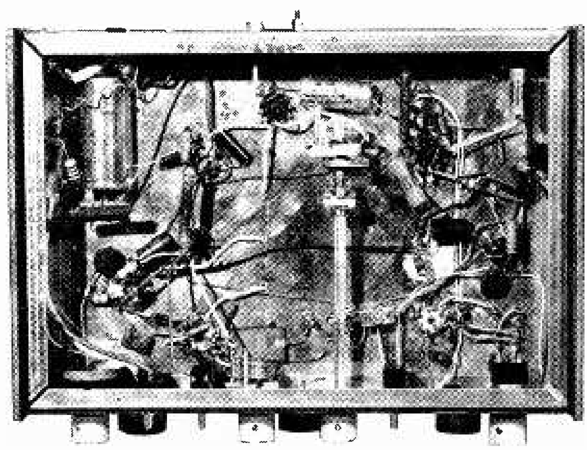
If wished, the receiver can be tested by fitting i.f.t.1 as supplied, omitting TC1 and the crystal, and wiring pin 4 to pin 2 on V4. However, i.f.t. has to be modified, to secure a balanced output circuit, when fitting the crystal.

Straighten the screening can tags and remove the can. 100pF capacitors are internally fitted between pins 1 and 3, and between pins 4 and 6. Cut the leads of the capacitor between pins 4 and 6, and remove it. Replace the can and bend over the tags.

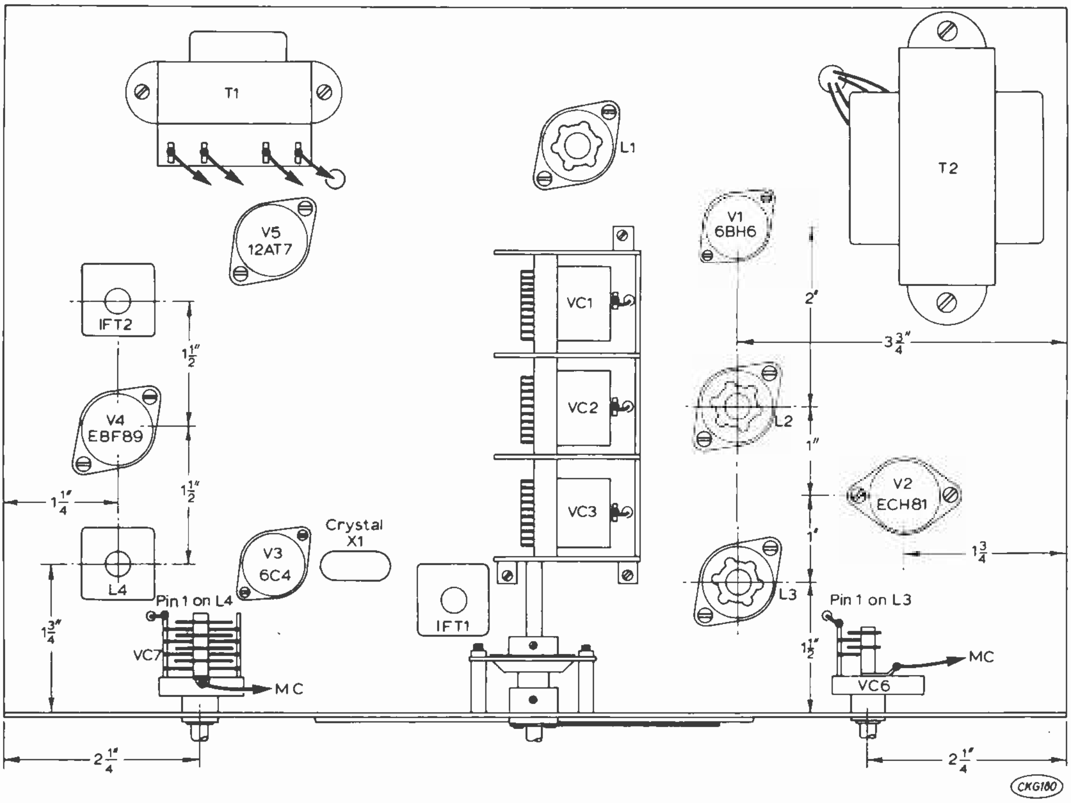
The i.f.t. is fitted as in Fig. 3, and C9 and C10 (each 200pF) are soldered from MC to pins 4 and 6, as shown. The receiver can be tested in this form without TC1 and the crystal.

Crystal filter

The i.f.t.s are intended for 1·6MHz, but have some range of adjustment, so that it is not essential that

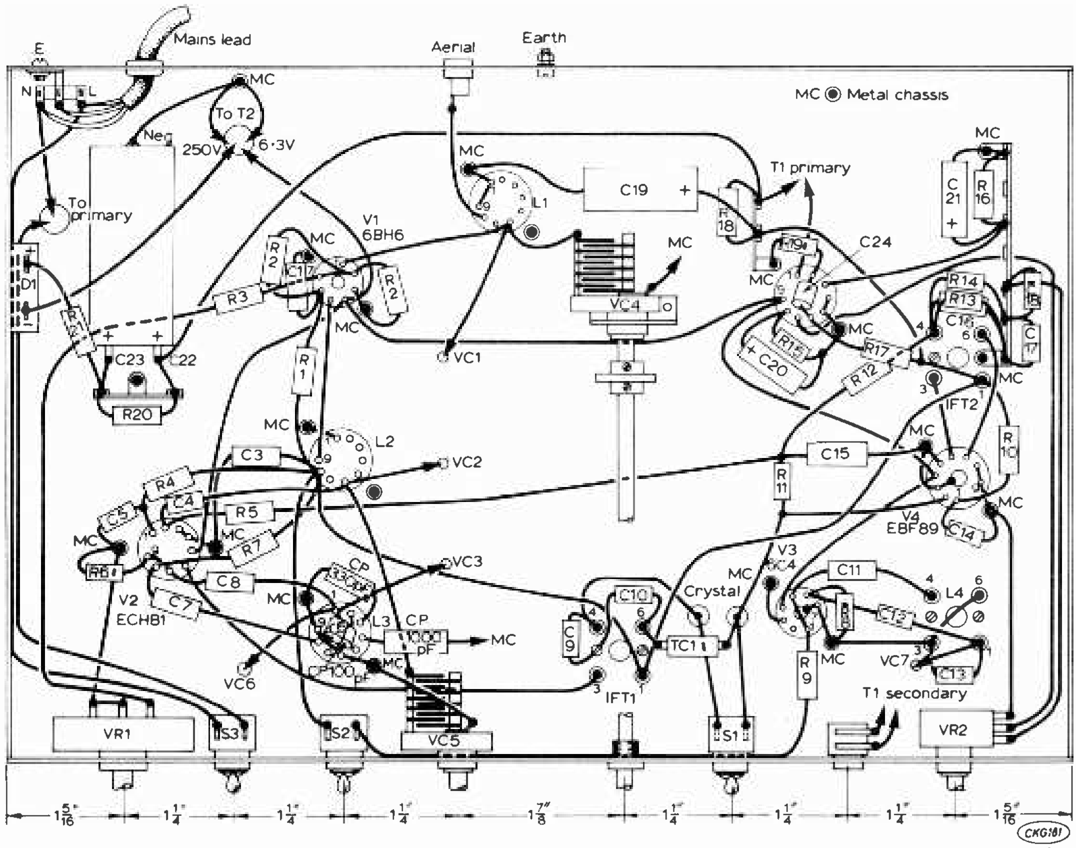


This view may help when wiring underneath the chassis from Fig. 3, right.



▲ *Fig. 2: Layout of components mounted on top of the chassis.*

▼ *Fig. 3: All wiring is shown in this under chassis diagram.*



the crystal be exactly this frequency. But to avoid the possibility that the i.f.t.'s cannot be adjusted to the crystal frequency, the latter ought if possible to be in the 1575-1625kHz range. In some commercial equipment, where an interfering transmission may fall around 1·6MHz, it is usual to fit a 1·6MHz wave-trap in the aerial circuit. In the receiver described, no trouble of this kind was encountered.

Adjustments to the crystal filter are best carried out with a signal generator, or, if this is not available, by tuning in a strong, stable signal, such as a BBC transmission on medium waves.

With S1 open and TC1 about half closed tune slowly through a *strong* signal, to locate the crystal resonance. It will probably be found that the response of the i.f.t.'s gives strong reception over a few degrees of the tuning scale. Near this, one side or the other, the crystal resonance point should be heard. This may be quite weak if far from the i.f.t.'s in frequency, but should be very sharp, having a peak covering only a small part of a degree on the scale.

If this peak is not found, close S1, move all the i.f. cores a little one way, and search for it again. If it is still not found, repeat, moving the cores the other way.

When a signal can be tuned in on the crystal resonant point, adjust all the i.f.t. cores to this, using a proper core adjusting tool. This should give an enormous increase in sensitivity and signal input should be reduced, or VR1 turned back. A high resistance voltmeter may be clipped across C14 (negative to chassis) and adjustments made to secure *maximum* voltage, as this is more accurate than adjusting by ear.

TC1 should then be adjusted to balance stray capacitance. This is easy with a signal generator, but can be done without it.

Tune slowly through a stable transmission, carefully noting volume (or preferably the voltmeter reading). It will probably be found that there is a dip in volume one side the signal, and a less selective response the other side. Adjust TC1 a little at a time, noting how this changes. When TC1 is adjusted too far, the dip or notch will move to the other side of the signal, and the less selective response will appear on the opposite side of the signal to that originally. The best setting for TC1 is midway between these two situations. Tuning should then be extremely sharp, while music will sound very muffled, due to sideband clipping.

This type of crystal filter can be used with a variable capacitor instead of TC1, with panel control, but this has to be completely insulated from the chassis and panel. A variable control allows the filter rejection notch mentioned to be moved across the pass-band of the i.f. amplifier, reducing or eliminating an interfering carrier.

With VC7 half open tune in accurately an a.m. transmission, close S2, and rotate the core of L4 until a strong heterodyne is heard. Set the core in the zero beat position and seal. Moving the core either way from this position causes a tone which rises in frequency. Rotating VC7 from the central position has the same result.

Cx is an extremely small coupling capacitance, and it may be found that the lead from R11 to pin 2, V4, is near enough to C11 to provide this. If not, run an insulated wire from pin 5, V3, near this lead.

If the coupling of V3 is too great, weak signals will be lost. If, on the other hand, coupling is very small,

★ components list

Resistors

R1 33kΩ 1W	R8 47kΩ ¼W	R15 2·2kΩ ½W
R2 330kΩ 1W	R9 47kΩ 1W	R16 1kΩ ½W
R3 100Ω ½W	R10 68kΩ ½W	R17 180kΩ ½W
R4 47kΩ 1W	R11 100kΩ ¼W	R18 1kΩ 1W
R5 1MΩ ¼W	R12 1MΩ ¼W	R19 1MΩ ¼W
R6 47kΩ ¼W	R13 470kΩ ¼W	R20 1kΩ 2W
R7 27kΩ 1W	R14 27kΩ ¼W	R21 100Ω 1W

VR1 25kΩ pot. linear. VR2 500kΩ pot. log.

Capacitors

C1 0·01μF 350V	C13 100pF SM
C2 0·1μF 150V	C14 0·01μF 350V
C3 0·25μF 350V	C15 0·25μF 150V
C4 100pF SM	C16 200pF
C5 0·01pF 350V	C17 100pF
C6 18pF SM	C18 0·01μF 150V
C7 100pF SM	C19 8μF 450V
C8 39pF SM	C20 100μF 6V
C9 200pF 5%SM	C21 100μF 6V
C10 200pF 5% SM	C22 16μF 450V
C11 100pF SM	C23 16μF 450V
C12 100pF SM	C24 0·01μF 350V

Padding capacitors: Range 2, 100pF SM: Range 3, 330pF SM: Range 4, 1000pF SM.

VC1-2-3 3 x 310pF gang (Jackson—E type)
VC4 50pF variable (type C804)
VC5 50pF variable (type C804)
VC6 5pF variable (type C804)
VC7 15pF variable (type C804)

TC1 30pF compression trimmer

Valves

V1 6BH6	V4 EBF89
V2 ECH81	V5 12AT7
V3 6C4	

Inductors

L1 Miniature plug-in, valve type (Denco "Blue").
L2 Miniature plug-in, valve type (Denco "Yellow").
L3 Miniature plug-in, valve type (Denco "White").
(Frequency ranges as in text)
L4 BFO coil (Denco BFO2/1·6)
IFT1/2 IF Transformers (Denco IFT16)

Metalwork

"Universal chassis" flanged sides: 12 x 4in. (2), 12 x 2in. (2), 8 x 4in. (2), 8 x 2in. (2), panels 12 x 8in. (2) (Home Radio).

Miscellaneous

T1, Valve output transformer (Home Radio TO43). T2, Mains transformer, 250V 40mA, 6·3V 1·5A. (Home Radio TM24A). X1, crystal 1·6MHz, type HC6U, and holder (Senator Crystals). D1, contact cooled rectifier, 250V 50mA. Valveholders, B7G (2, with screening cans), B9A (3). Dial and drive (Jackson 4103/A), coupling (Jackson 5610). On/off toggle switches (3). Headphone socket. Polystyrene rod and panel bush. Knobs.

s.s.b. signals, even when resolved, will sound like very much over-modulated a.m. However, VR1 allows signals to be reduced, so Cx is not critical.

When receiving s.s.b., turn VC7 one way or the other, as needed to resolve the signal. The a.f. gain (VR2) should usually be well advanced, while strong signals have to be reduced at the demodulator diode by turning back VR1. With correct adjustment, the circuit gives very good results in s.s.b.

CW is dealt with in a similar manner, VC7 adjusting the beat-frequency note. Switch S2 is off for a.m. reception, and VC7 is inoperative.

It will be seen that strong injection from V3 will create an a.g.c. voltage, reducing gain, but this was not found too important, using minimum coupling, as explained. This effect can if wished be overcome by switching the a.g.c. out for c.w. and s.s.b. reception.

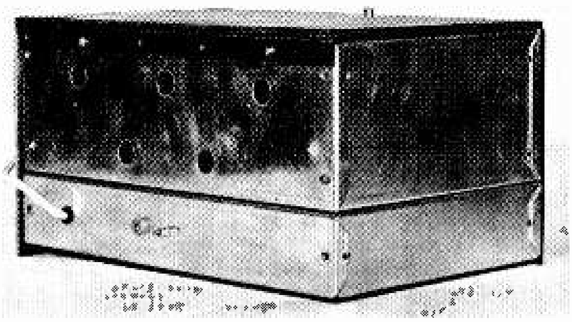
Band coverage

Coils are inserted in a set of three for each band, and the ranges are approximately as follows:

Range 2. 515-1545kHz.
Range 3. 1·67-5·3MHz.
Range 4. 5·0-15·0MHz.
Range 5. 11·0-30·0MHz.

Range 2 gives m.w. coverage, and may not be required. Range 3 includes the two l.f. amateur bands 80 and 160m, and many other transmissions. Range 4 covers most general s.w. broadcasts, with Range 5 taking over for the h.f. bands.

Coverage is adjusted by closing VC1-3, and adjusting the core of L3 for the l.f. band end. To simplify adjustment, C6 is fixed, and no adjustment is made at the h.f. end of the bands. If this is required, replace C6 by a 30pF trimmer.



This not very inspiring view of the back of the receiver shows how the flanged "universal chassis" members are bolted together with a flat plate in between, forming the top of the chassis.

Tune in a signal near the h.f. end of the band (VC1-3 open) and peak VC4 and VC5 for best volume. Tune towards the l.f. end of the band, adjusting the cores of L1 and L2 to give best volume. When the cores of L1 and L2 are correctly adjusted, little movement of VC4 and VC5 will be required. However, some adjustment of these controls will improve weak signals. No efficiency is lost if both VC4 and VC5 can be peaked with any set of coils, and are not then fully open or fully closed. The core adjustments are thus not too critical.

L1 and L2 are separated and partially screened by the can on V1, and by the ganged capacitor. With some aerials it may be found that VC1 becomes regenerative at maximum setting of VR1 at some frequencies, and this effect can be used to boost sensitivity. ■

CHARLES MOLLOY

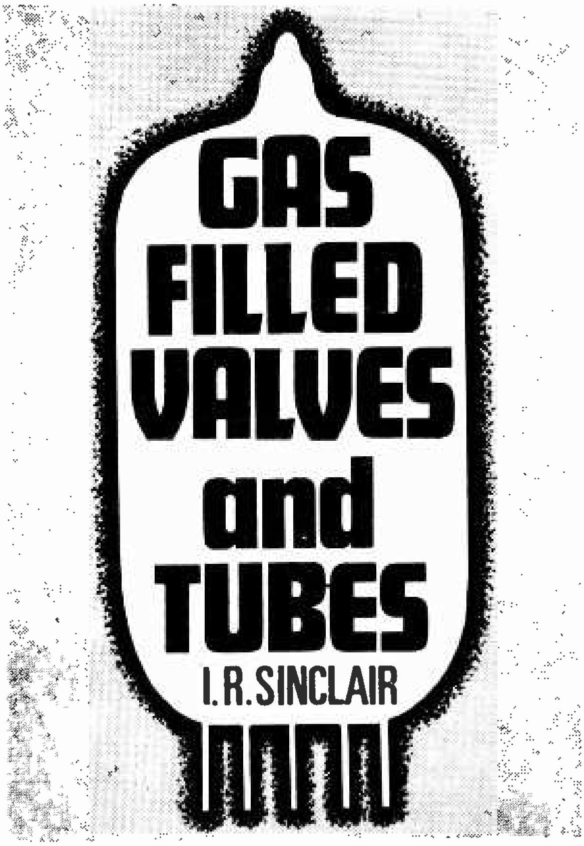
THE Medium Wave Column

PROPAGATION over the long sea path between the UK and the northern part of South America is often good during the late summer. From midnight until sunrise is the time to search for medium wave stations from this area and many Latin Americans can be heard, Venezuelans being particularly prominent. Listen for Radio Giradot, Maracay on 650kHz; Radio Rumbos, Caracas on 670kHz; Radio Caracas 750kHz; Radio Puerto la Cruz 760kHz; Radio Margarita, La Asuncion 1020kHz; Radio Zulia, Maracaibo 1080kHz; Radio Carupano 1110kHz; Ordas del Lago, Maracaibo 1120kHz; Radio Tiempo, Caracas 1200kHz; Radio Valera 1230kHz.

Medium wave broadcasters in the Caribbean area are capable of being logged in the UK at this time of year. The most conspicuous is PJB on 800kHz which is a 525kW outlet of Trans World Radio, located on the island of Bonaire in the Netherlands West Indies. This station broadcasts religious programmes in English and other languages and it also relays Radio Nederland. Other English speaking transmissions to look for are from Georgetown, Guyana on 760kHz; Radio Belize on 834kHz; Radio Caribbean in St Lucia in the Windward Islands 840kHz; Radio Victoria, Arubia, NWI on 925kHz; ZDK St Johns, Antigua on 1100kHz.

DX'ers generally find it useful to have a list of known broadcasting stations arranged in order of frequency. J. S. Smith of Enfield, Middlesex; S. F. Hannaford, Plymouth and David Cotterall, Helensburgh, Scotland have enquired about published lists of medium wave stations. "Guide to Broadcasting Stations" Butterworth Press is on sale in many bookshops at 50p. It covers all medium wave stations in the European area and North Africa plus a number of the more powerful ones from North and South America and it should be of value to the newcomer to the band. For the serious DX'er there is the World Radio-TV Handbook published in Denmark and distributed in this country by Fountain Press. It costs £2·80 but in addition to comprehensive lists of the medium wave stations in the different continents it contains detailed information, by country, of radio stations and broadcasting organisations in every country in the world. For the specialist there is "Broadcasting Stations of the World, Part 2" produced by the Foreign Broadcasting Information Service of the United States Government. All known stations outside the United States in the range 150kHz to 26MHz are listed. The current edition, can be obtained for $2, post paid, by writing to the Superintendant of Documents, Government Printing Office, Washington, DC 20402, USA quoting catalogue number PX EX 7.9.971 Part 2.

Please send logs and information about the medium waves to the author at 132 Segars Lane, Southport PR8 3JG.



IN AN AGE of semiconductors, the continued and increasing use of valves may seem curious, the use of gas-filled valves even more so. The facts are that semiconductors have by no means completely conquered the electronics market; there are still useful jobs for which valves are either more suitable or considerably cheaper, and there are some jobs for which only gas-filled valves are suitable at all.

The conventional hard (meaning evacuated) valve uses a cathode, heated by a wire filament, as its source of electrons which will then travel from the cathode to any positive electrode in the valve. The current which can be drawn depends on the rate at which the cathode can emit electrons and the field which the anode can create to attract them. There is little difficulty in creating high fields, an anode at a higher voltage or placed nearer the cathode will ensure higher fields, but there is a limit to the current which can be taken from a cathode of any given area, and there is also a limit to the field strength which can be applied to the usual oxide cathode without pulling the coating off the nickel tube which supports it.

The effect of gas

Before we can understand the effect of gas in a valve, we have to understand the way in which a gas behaves at low pressure. Gases, like other materials, are made up of atoms which are usually grouped together as molecules. Air, for example, is mainly a mixture of two gases, oxygen and nitrogen, and each of these gases consists of molecules of two atoms each. Carbon dioxide, another gas present in air, consists of molecules containing three atoms, one of carbon and two of oxygen. The important difference which distinguishes gases from liquids and solids is that gas molecules are spaced well apart; the average spacing at normal pressure is about 300 times the diameter of the molecules, so that the molecules are fairly free to move about and exert force (noticeable as pressure) on the walls of the container. If a small amount of gas is allowed to enter a large evacuated container, the distance between the molecules increases and the gas fills the container; we say that the gas has expanded. If we compress a gas to fill a small container, the spacing between the molecules decreases; we can decrease it so much for some gases that they turn into liquids. The laws connecting the pressure and volume of a gas were discovered by *Boyle* some 300 years ago, but it was only in the middle of the last century that it was discovered that gases at low pressures conducted electricity.

Electricity is conducted when charged particles move in a substance. In metals, the free electrons are the charged particles, in liquids, mainly solutions of certain materials in water, conduction takes place by positive and negative particles together. These particles are termed **Ions**; they are charged fragments of atoms which have been split by the action of dissolving the solid in water. In gases, we have molecules moving at high speeds around 500m per second at normal room pressure and temperature) and colliding with each other violently, but all this movement does not cause conduction because the particles are not charged. We can make charged particles of the molecules only by the violent means of splitting the molecules into atoms and the atoms into charged ions, as in the case of liquid conductors. We can do this by hitting the molecules so hard that they separate into atoms and the atoms lose one or more of the electrons which surround the central portion. We are then left with large positive ions and negative electrons. Note that these positive ions have a real independent existence, and can be collected, they must not be confused with semiconductor holes, which, though just as "real" in the sense of having measurable mass, velocity and charge, cannot be separated from the crystal lattice of the semiconductor.

Ionisation

The splitting up, or ionisation, of the atoms of a gas can be carried out by any form of energy sufficient in size. Early workers with static electricity had noticed their capacitors rapidly discharging when they were held near a flame; the heat was producing some ions which were then attracted to the negative end of the capacitor while electrons, usually attached to atoms, arrived at the positive end. Ultra-violet light is another source of the energy needed to ionise a gas; Heinrich Hertz had noticed in his pioneer work on radio transmission and reception that a spark passed more easily between two electrodes at a given voltage if they were illuminated. The application of heat also causes ionisation; a hot ionised gas is called a "plasma" and conducts well enough to be used as a conductor at temperatures where metals would melt. Since heating a gas is simply a method of making the molecules move faster, we might expect that any method of making the molecules move faster might also cause the gas to become ionised if we apply enough energy.

If gases are so easily ionised, why do they not conduct electricity well? The answer is that ions in a gas cannot move easily to the anode or cathode, whichever is attracting them. Imagine a gas confined between two electrodes (Fig. 1) and one atom ionised. Clearly the positive ion will be attracted directly to the negative electrode and the negative ion to the

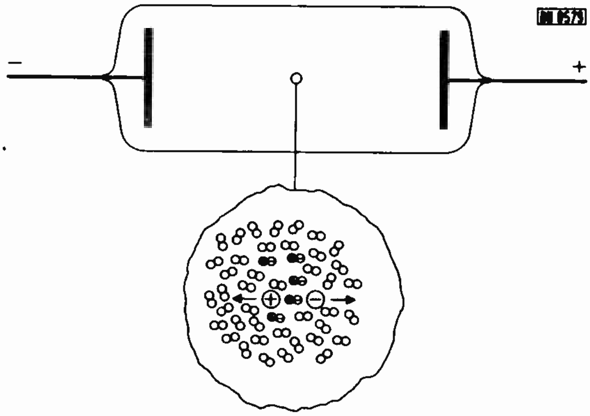


Fig. 1 : The electrodes attract the ions but other atoms hinder this movement. The shape, size and spacing of atoms can be measured to a considerable degree of accuracy.

positive electrode; the forces act in straight lines from electrode to ion. It is, however, impossible for the ions to move in straight lines without colliding with other atoms, and it is the process of making collisions which accounts for the odd behaviour of gases. If the forces acting on the ions in our example are not very great, then the ions may rebound into each other and recombine, or they may slowly make their way, with many collisions, to the electrodes. The current in the second case will be so small that only electrostatic instruments will detect it. If we increase the voltage between the electrodes, still keeping the gas at normal pressure, then the forces on the ions will be greater and so the collisions will be more violent. Eventually, as we raise the voltage, the collisions may become so violent that new ions are created on each collision. When this happens, the number of ions available to carry the current increases enormously, and the current is large. We see a spark pass when this happens. If the voltage supply is well regulated, a continuous spark will pass; if, as is usually the case, the voltage drops when the spark passes, the ions are collected by the electrodes leaving no more available until the voltage rises high enough again to start more ionisation by collision, so that sparking is intermittent.

Reducing pressure

When we reduce the pressure of a gas, we are separating the atoms so that there are fewer collisions. Note that "fewer" still means many millions of collisions per second, even for currents of a few nanoamps. If we create a pair of ions in a gas at low pressure (about one ten thousandths of the normal atmospheric pressure) they will move very much further before colliding with atoms. Since a steady force of attraction between ion and electrode causes the ion to accelerate steadily, the ion can be travelling at a very high speed when it eventually hits another atom and it is very much more likely that it will cause the atom to ionise. If the pressure is low enough, each ion is capable of creating another ion pair at each collision, so that the number of ions formed rises extremely rapidly. This sort of thing is called a "chain reaction" (Fig. 2) and it causes the gas to become a good conductor very rapidly. There are several important points about this chain reaction. It takes place only in a range of pressures; at high pressures the molecules are too close to allow the ions to reach a speed fast enough for ionisation by collision. Only if the voltage is made very high, about 30kV per inch gap between the electrodes, will ionisation take place to allow sparking. If the pressure is very low it may be possible for an ion to travel, on average, all the way from one electrode to the other without hitting another particle, in which case the current is only that carried by the original ions and is very low. Only in the range of pressures between these extremes can ionisation be reliably produced with low voltages (of the order of 150-300V) but high currents.

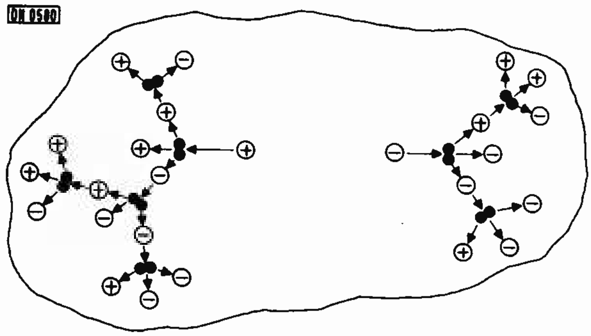


Fig. 2: A chain reaction occurs when ions can move far enough to accelerate to high speeds; when collision occurs more ions are produced.

The voltage used is also critical. Below a voltage called the "striking voltage," no ionisation takes place to a sufficient extent to cause noticeable currents because the voltage cannot give any ions which are formed enough speed to ionise other atoms by collision. The value of this striking voltage depends on the gas used, its pressure, and the materials used for the anode and cathode.

When current is flowing and the gas is already ionised, the voltage drop between anode and cathode is smaller than the striking voltage, and is called the "running voltage." Most of the voltage drop takes place near the cathode, as this is where most of the collisions take place due to electrons leaving the cathode. This region is visible because the excess ions recombine, causing light to be emitted. The value of the running voltage is also dependent on the gas used, its pressure and on the anode and cathode materials. In the running condition, the gas discharge behaves as a *negative resistor*, meaning

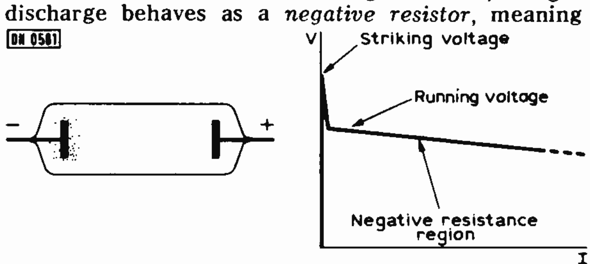


Fig. 3: A gas discharge appears around the cathode at fairly low pressures (about one millionth of atmospheric pressure). On the right is shown the characteristic for a gas tube.

that the voltage between the electrodes *decreases* as the current increases see Fig. 3. Contrast the behaviour of a normal resistor, where the voltage drop increases as the current through it is increased.

Armed now with some knowledge of the complex processes which take place in a gas at low pressure, let us now see how these processes can be used.

Gas filled rectifiers

An ideal rectifier should have a very small forward voltage drop when conducting, a very high reverse resistance, the ability to withstand high reverse voltages and the ability to pass high forward currents. For low voltages, semiconductors which answer this specification fairly well have been available for some time and have superceded the diode valves formerly used. Problems arise, however, when voltages of several kV and currents of several amps are required, as they often are in a transmitter. Connecting semiconductor rectifiers in series is not always suitable (it is difficult to ensure that the same voltage appears across each rectifier) and can be expensive when really high voltages are used. Valve rectifiers using oxide cathodes can be used up to a few kV, but the high electric field causes the oxide to peel off at higher voltages. Valves using thoriated tungsten filaments can be used, but the currents available are restricted, since these filaments are not such efficient producers of electrons as oxide cathodes. The solution, which has been used for many years, is the gas-filled rectifier.

If a rectifier contains some gas, then the electrons which are emitted cause ionisation of this gas, and a low anode-to-cathode voltage will be able to cause conduction. The resistance of the valve is very low, a combination of the resistance of the leads and the resistance of the gas, and the *slope resistance* is negative, as previously explained.

Since electrons are provided in large numbers by the cathode the running voltage is very low, but when the voltage reverses, electrons are no longer emitted from the cathode and the gas will ionise only if the voltage between the anode and the cathode exceeds the striking voltage. By making the pressure of the gas low enough, this striking voltage can be made almost as high as we like so that a gas rectifier can be used up to very large values of peak reverse voltage, several hundred kV. The valve-makers' problem is to make the pressure of gas constant despite the absorption of gas by the anode and the emission of other gases by the cathode. If the design of the rectifier is such that these problems are overcome, then the gas rectifier is reliable and long-lived. Note the difference between this case and that of the hard valve rectifier which has become gassy through leakage or overheating. Here there is no control of gas type or pressure, and the valve fails when the striking voltage is less than the back reverse voltage. In commercially made gas rectifiers, the gases commonly used are *Mercury-Vapour* for the smaller types, and *Xenon* for the larger varieties.

Some precautions are needed when using gas rectifiers. When mercury vapour rectifiers are in use, the temperature of the valve must be allowed to come up to full operating temperature before high voltages are applied. This is because the mercury is in the liquid state at room temperatures and has a very low pressure at such temperature. If high voltages are applied in these conditions, there is a risk of sparking between anode and cathode, or at least of a very high resistance discharge. Either way, the resulting dissipation can be very destructive to the cathode, and dangerous to the operator if the valve should fracture, as mercury-vapour is poisonous. Most mercury-vapour rectifier circuits incorporate some sort of automatic delayed switching to ensure that the heaters have been on for at least one minute before the anode volts are switched on. Such a circuit is shown in Fig. 4.

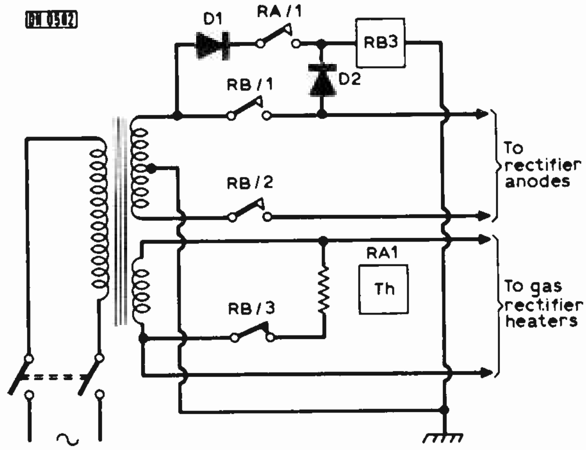


Fig. 4: A delayed switching circuit for gas filled rectifiers. The thermal relay in the heater circuit ensures that there is a delay before the h.t. is applied.

Voltage stabilisers

Another use of gas-filled valves is bound up with the stability of the running voltage. We have said earlier that, as current through a gas-filled rectifier increases, the voltage across the valve decreases. This change of voltage with current is small, and, with suitable choice of materials for anode, cathode, and gas, can be made very small. This is the essence of a voltage stabiliser, that a voltage should be unchanged while current varies.

The circuit of Fig. 5 is a simple stabiliser. When

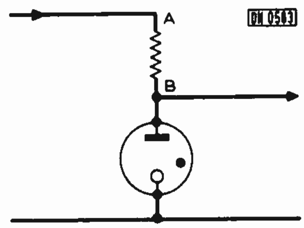


Fig. 5: A simple voltage stabiliser circuit.

voltage is applied at point A and raised until it equals the striking voltage of the gas, current will flow in the valve, and the voltage at B will be the running voltage. As the voltage at A is raised, the current through the resistor and the valve increases, but the voltage at B remains almost constant. If current is taken from B, it is taken at the expense of the current in the valve. If the current taken at B is greater than the current which was flowing in the valve, then the gas discharge will cease and the voltage at B will no longer be stabilised. The actual value of the running voltage, as said before, depends on the gas, and the materials used for anode and cathode; standard values obtainable with well-tried combinations of materials are 45V, 70V, 85V, 105V, and 150V. By more careful choice of materials, the change of voltage for a given change of current can be made smaller than normal, and the change of running voltage with temperature change can also be made very small. Such carefully designed valves are known as *voltage reference valves*, and can be used, not in the simple circuit of Fig. 5, but in more complex stabiliser circuits such as that of Fig. 6, where the current through the reference valve is fairly constant.

Normally, the voltage difference between striking and running is fairly large, so that a 105V stabiliser needs about 150V to strike, and the voltage required for striking becomes higher when the valve is in darkness. The reason for this is that light provides enough energy to cause some ionisation in the gas, and so provide the conditions for easier striking. When light is excluded, the voltage must be raised to help start ionisation off from the very few ion

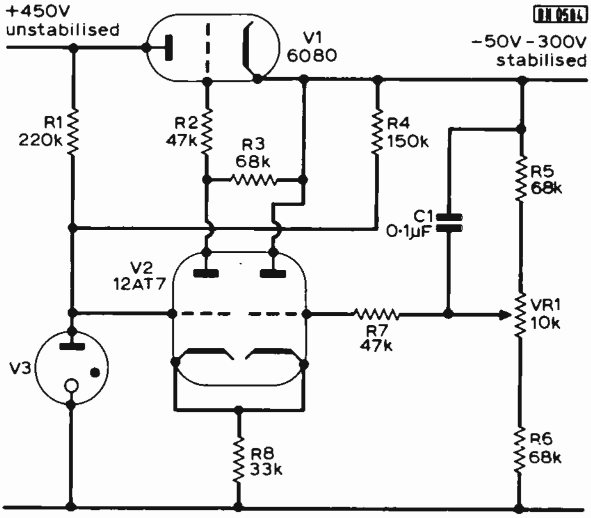


Fig. 6: A complex stabilised power supply.

pairs produced solely as a result of the temperature of the gas. To avoid the difference in striking voltages with light, which can be troublesome in reference tubes, the gas in the valve is often made slightly radioactive. The ions produced by radioactive disintegration then start off the ionisation in the valve, so that the striking voltage is much less dependent on the effect of light.

Neon lamps

Small neon lamps are commonly used as indicators of voltages greater than their striking voltage. Such lamps are used with a large resistance, in the order of 500kΩ, in series so that the running current is extremely low. There are, however, other uses. Since a neon is a gas-filled tube, the running voltage is fairly constant, and neons can be used as stabilisers for circuits which take low currents and for which a large degree of stabilisation is not necessary. For this purpose, neons have to be separated from the

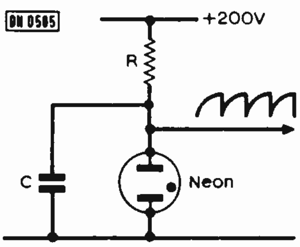


Fig. 7: A simple sawtooth generator. The capacitor must have low leakage and should not be an electrolytic.

series resistor which is built into the base of many types, or neons without a resistor purchased.

There is usually a large voltage gap between striking voltage and running voltage, and this can be

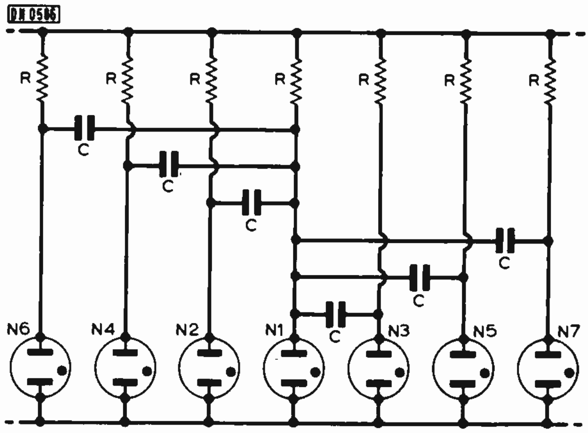


Fig. 8: A random flasher circuit. R can be between 220kΩ and 2·2MΩ and C between 0·1µF and 1µF (low leakage types must be used).

used in sawtooth circuits of the type in Fig. 7. Such signals are used as wide-range frequency sources, or as time delays where high accuracy is not needed. One amusing circuit based on neons is the random flasher of Fig. 8. When the supply is connected, one neon will inevitably strike before any other. The drop in voltage caused by the change from striking voltage to running voltage is communicated to all the others by the capacitors, and delays the rise of volts across all the other neons. The next neon to strike will have the effect of extinguishing the first and also of delaying the firing of the others yet again. The neons will then wink in random order as long as voltage is applied. This can be used as a decoration, but has serious uses when a large number of neons are used, as it can generate random numbers—the **ERNIE** principle is based on such a scheme for selecting Premium Bond winning numbers.

TO BE CONTINUED

CQ! CQ! CQ! CQ! CQ!

ISSUES WANTED

...The issue containing details of the 6V car radio.—P. J. Day, 43 Highgate Lane, Farnborough, Hants.
...The issue containing details of the Treasure Tracer.—C. Weaver, 30 Cherry Garden Road, Canterbury, Kent.
...The June issue containing the Electronic Ignition System —S. Bennion, 312 Warrington Road, Galzenbury, Nr. Warrington, Lancs.
...Jan., June, Aug. and Sept. 1970.—P. D. Williams, 52 Acacia Road, Sutherland, N.S.W. 2232, Australia.
...The issues containing Parts 1 and 2 of Transistor Circuitry for Beginners.—P. M. Bontomme, 26 Greencroft Gardens, Reading, Berkshire.
...The issue containing the Treasure Tracer.—M. A. Branford, Flat "C", The Clint, 4 Parade, Chudleigh, South Devon.
...October and November 1971 P.W.—R. Burke, 62 Garner Road, Walthamstow, London, E.17.
...The issues of P.W. containing the three transistor amplifier Take 20 project.—P. Mieszkowsk, 25 Kingsway, Wembley, Middlesex.
...June 1964 P.W.—H. Hallybone, 7 Sauncy Avenue, Harpenden, Herts.
...September-December 1961 issues of P.W.—R. B. Howard, 3 St. George's Place, Macclesfield, Cheshire.
...July 1971.—D. C. Dick, 97 Curtis Avenue, Kings Park, Glasgow, S.4.
...July 1968 P.W.—P. J. Chapman, 90 Melody Road, Wandsworth, London, S.W.18.
...Fault-finding chart No. 1 issued April 1968.—H. Symonds, 16 Newhaven Street, Piallea 4655, Queensland, Australia.
...April 1969 and subsequent copies of the P.W. Double-12 amplifier.—K. Stean, 101 Atherley Road, Shirley, Southampton, Hants.
...The issue of P.W. containing the 7MHz Transceiver.—P. Matlock, 60 Down[illegible] Avenue, Whitstable, Kent.
...February 1971 issue of P.W.—Mrs. M. M. Buckner, 13 Tankerton Road, Tankerto[illegible] Whitstable, Kent.
...The issue containing the Treasure Tracer.—R. Birkby, 1 Gloucester Place, Haughton Road, Darlington, Co. Durham.

JUNK? what junk?

MORAG GREER

THIS XYL *never* complains about the junk in her husband's shack, for the simple reason that he might one day take the notion to have a prowl round *her* shack and decide that *it* is full of junk which rightfully should be gracing the local rubbish tip.

I must admit that my husband's obsession has added somewhat to my vast store of bits of half-digested knowledge, useful or otherwise. Prior to my marriage six years ago I knew nothing about wireless beyond how to switch the set on and off, find a suitable station, and adjust the volume. An aesthetically satisfying array of lit valves might very well have been left-overs from last year's Christmas tree, and I wouldn't have recognised a silicon epitaxial planar transistor if one had jumped up and yelled, *'Boo!'* I still wouldn't, but I read it in an advertisement and it sounds fascinating. Anything to do with transistorised planarians, I wonder?

"No, it isn't!" shouts a voice through the intercom connecting the two shacks. *"And how about making some coffee?"* This, despite the fact that his junk resides in the kitchen while mine is in a bedroom.

I comply with his request and brew the coffee while watching his usual antics as he tangles himself in various cables and wishes desperately that he could get a third hand for Christmas or increase the length of his arm because the part he wants is just out of reach and where the hell is the soldering bo . . . Aaah! *"Found it, darling?"*

Having consoled him with coffee and a kiss, I leave him muttering about microhenrys and picofarads. I sometimes have nightmares about poor Messrs. Henry, Faraday, Volta and all the others, wandering around in that maze of liquorice-allsort components.

In my own shack I am faced with nothing more frightening than a typewriter, a small sheaf of completed manuscript on the right, and a whacking great pile of unsullied, virginal white paper on the left. I have only one problem: that of intelligently and successfully transferring the reams of paper from left to right via the typewriter. My husband maintains that the simple and logical solution would be to shift it straight into the wastepaper basket.

I really can't imagine why Wireless Widows let themselves get into such a situation in the first place. They don't know what they're missing. Listening to shortwave radio can be, among other things, very entertaining, but even more so is watching *one's husband* listening to shortwave radio.

Having finished my "scribbling" for the evening, I make the cocoa, which comes very shortly after the coffee. I hand his mug to him, then retreat to a safe distance, that is, a distance at which I can watch yet not be *seen* to be watching.

There he sits with the earphones on his head, and the oddest expressions darting across his face. His lips purse, his beard wiggles, his eyebrows flit up and down like a couple of frenzied pussmoths. A calm swig of cocoa erupts into an unexplained gale of choking laughter, he scribbles something on a pad and mumbles a few indistinguishable words. I say, *"Yes, dear,"* just in case they were intended for me. When he stands up suddenly to reach for his list of call signs he unknowingly pulls the jack-plug out and has a silent fit, trying to discover what has gone wrong with his beloved B40. Finally he finds the plug dangling around his knees, thrusts it back in, and performs a magnificent impromptu Indian war-dance because, during his frantic fiddling with the controls, he turned the volume full on and now doesn't know which to do first—turn down the volume, tear the headset off, pull the jack-plug out again, or simply collapse in a twitching heap on the floor!

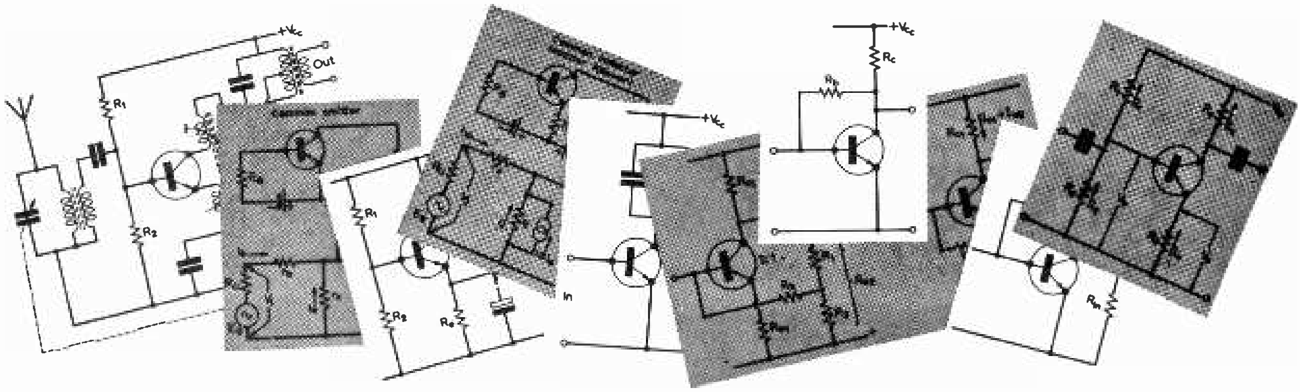
Oh, yes, ladies. Shortwave radio can be fun.

Then there's the *"helping husband in the shack"* act. Any XYL can do this, no previous experience required.

When he has spent half an hour searching for a certain component which he "had in his hand not two minutes ago", and it's the only one of that kind that he has, and the shops are closed so he can't get another till Monday; that is the moment at which the loving, devoted and helpful XYL enters the hallowed precincts and retrieves said component from floor/tobacco tin/inside of radio chassis/shirt pocket/hip pocket/coffee mug. The XYL then places the component quietly, unobtrusively and without comment, on the bench and beats a strategic retreat.

She is also handy for testing electrolytic capacitors, to see if they are safe or not. *"Just touch this, darling, and tell me what you feel."* Or for holding a tiny part in a restricted space while the expert solders blindly. And heaven help her if she is weak-willed enough to allow the "slight warmth" at her finger-tips to force her to relinquish her grip, thereby breaking the delicate joint.

Painful? I wouldn't ever want to do away with the radio shack. It keeps him quiet for hours, so what are a few burnt fingers? ■



TRANSISTOR CIRCUITRY for beginners

PART 10

H.W. HELLYER & MICHAEL HOLLIER

Matching

It is no great hardship to answer letters that begin: "Thank you for your series of articles . . ." and go on to pose a query. More difficult, if only because one is obliged to clench one's teeth and answer as objectively as possible, when someone with an opinion to air uses a criticism of the previous text as an excuse to ride his own hobbyhorse. But, answered they must be, so let's begin with the pleasant task of selecting a letter from Mr. Edward Tarrant of Rochester, as representative of one body of readers, who ask questions on matching.

It has been said that audio engineers would be out of a job if their customers understood the simple rules of matching. They have been expounded before in these pages. In Part 4, for example, dealing with Buffer Amplifiers, I took some trouble to explain some of the difficulties and expound the basic "rule of ten".

To come back to our correspondent: he says that his trouble is one of adding together 'bits of circuits.' He has made up the Fig. 4 complementary pair of the 'Experimenter's Circuit Supplement' of PW January, 1972 and obtained highly satisfactory results and now wants to add the active tone control circuit, Fig. 102, Page 131 of the Mullard 'Transistor Audio and Radio Circuits', but is worried because the output impedance of the latter is only 180Ω. 'Can one follow it with a common-base stage?' he asks.

Well, yes, one can—but why should we go to that trouble? Input impedances of the PW circuits are in the region of 30,000Ω and over. Just as the amplifiers we have described, and have built for this article, sport a low output and high input impedance. That, Mr.T. is the whole point. Basically, one can match a low impedance output into a high impedance input of the succeeding section of equipment without too much bother.

There are exceptions, true; no use sticking the very low Z of the mains supply into the very high Z of your crystal microphone socket unless you want your tape recorder to go up in smoke. But, if it is millivolts to millivolts, i.e., small signal handling devices, then the 'rule of ten' can be invoked more often than not. This is to say that an output will safely match into an input which has an impedance of ten times or more than itself. So our 10kΩ output wants to 'see' at least 100kΩ. And, in Mr. Tarrant's case, 180Ω is very well catered for by upwards of 30kΩ.

It is not, repeat NOT, a matching rule that like equals like—that a 5kΩ output has to be matched into a 5kΩ input. If you stop and think about it, those conditions will cut the available voltage exactly in half. And, as one of the ideas behind this series was to produce those handy buffer-links that allow us to squeeze the utmost from a source that may be delivering barely enough output, then you can see what a mistake such 'exact' matching would be.

To take a practical example: loudspeaker matching. An amplifier is rated at X watts into 8Ω. So it wants to 'see' an 8Ω nominal load to produce that power. But take a close look at an output circuit and you will see that its actual impedance is more like a fraction of an ohm. In fact, one of the designer's aims is to get it as low as possible to derive the greatest power and efficiency.

So to repeat: match up! And if, like Mr. Tarrant, you are 72 years old, then I salute you, and hope that I shall still be enjoying the thrills of construction when my three-score years and ten have been rung up!

Adding stages

So, for that matter, does Mike, who has been sweating away over a tepid soldering iron, producing a direct-coupled circuit to illustrate this month's argument. He has a little farther to go to reach the Biblical milestone, but, wise beyond his years, suggests we explain at this stage what we are getting at. 'You know, I know, and perhaps the Editor may know,' he says, but the series of articles has entered its decade and we are still scratching around at fundamentals, so let's explain why!

It is possible to take someone else's evolved circuit and build around it, taking for granted the basic design work, and come up with a beautiful piece of electronic wizardry that all your friends will admire.

This is, fundamentally, what our other typical correspondent, Mr. E. F. Good, from Malvern, has complained about. In Part 7 of this series we described the Darlington Pair transistor, and gave some of the calculations from which it was derived. This, we thought, was a legitimate demonstration of the evolution of transistor circuitry, from which the beginner could see where the application of the rules we had laid down might be leading him. The insertion was a legitimate 'leader'—but Mr. Good took exception to it.

'You do let your enthusiasm carry you away,' he complained. The only place where he would be likely to use it would be as part of the triples of a power amplifier. In other positions, a pair of opposite conductivity would be more suitable and would cost only a little more. 'A manufacturer's economics are different.'

Well, of course, Mr. G., but give us credit for some insight: we are coming to the complementary pair. All in good time. This series is for the beginner, which your letter shows you not to be. Palpably, for you complain that our circuit that was intended to get the best from a crystal microphone could have been better served by a j.f.e.t.

That is true, but, I beg leave to argue, irrelevant. Until we have got the hang of simple circuitry, there is no point in progressing to more sophisticated devices. Much of the rest of this long letter, picking out points from preceding articles—in no sequential manner, either—has been dealt with in Part 9. Some wrongly captioned drawings have been explained. Some omitted references (for simplicity) have been taken up, and there is one formula in which no account was taken of r_e, because we did not at that point want to confuse beginners: we have since dealt with that subject.

Mr. Good ends his letter with the statement: '. . . instructing beginners is the most responsible job one can undertake, and should be performed with the greatest possible care.'

Agreed, Sir, so without more ado we shall go on to discuss the biasing of BC109 transistors, with particular reference to the modifications necessary in our thinking when we add two stages together.

Coupling up

It is possible, in theory, to cascade similar circuits like erected chains of dominoes. But if we do, taking no account of voltage swings, etc., our amplifying edifice is likely to fall down. When this series was being discussed, the Editor wanted us to call it 'Building Bricks', and this example is a case in point. We must consider the composite circuit, the two transistor unit, when we add one stage to another.

Take Fig. 52. Here, we have Tr1 operating as a collector follower, capacitively coupled via C_c to the second transistor, Tr2, working as an emitter follower. Bias for Tr1 is provided by a conventional potential divider, R1 and R2.

The input signal is coupled to base of Tr1 by C_{in}. A measure of gain may be expected from this stage in its collector follower mode. The emitter resistance R_{e1} is bypassed by C_e and the amplified signal at the collector of Tr1 is capacitively coupled to the base of the following stage. All very good, except that, as some of our corespondents have been quick to point out, the output impedance is higher than would be desirable. So, adopting Mr. Tarrant's suggestion, almost, we use another stage between our Tr1 and whatever we are feeding.

This time, we are not interested so much in the gain—we've got that—but must preserve what we have got and present a low output impedance. So the second stage is operating at slightly less than unity gain in its emitter follower mode, but it does give us a low output impedance. The output voltage is developed across R_{e2} and is coupled to the following stages via C_{out}. The snag? The circuit, as given, is wasteful of components. It is a general rule that extra components in any circuit are extra possible sources of trouble: noise, instability, excessive current drain. So we shall proceed to whittle down the circuit.

To begin with, there is an alternative way of biasing Tr2. Readers of the previous articles will have no trouble in following the train of thought. We have already dealt with the collector follower and the emitter follower circuits. From the information given in past articles, the 'circuit' of Fig. 52 could be derived without much trouble.

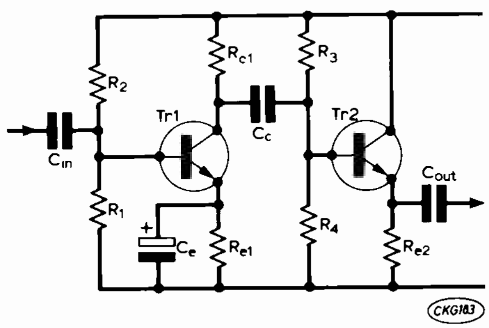


Fig. 52: Two stages already considered, a common emitter (collector follower) stage with an emitter follower stage added to it. The object being to produce a low impedance output while preserving the gain. This method of adding stages is wasteful of components.

Our alternative method is to remove bias resistors R3 and R4 and the coupling capacitor, C_c. We now couple direct: that is to say, the collector of the first stage is taken directly to the base of the second. The result is that the base bias for Tr2 can now be derived from the collector of Tr1. Hence the term 'directly coupled.'

Operating conditions

Calculating the operating conditions is a matter of logical progression, as before. We start with Tr2. We know the transistor characteristics—we have dealt with the BC109 before. We know the supply voltage and the 'rail' voltage, V_{cc}, which we shall adjust to 8 volts by manipulation of the series resistor. R_{dec}, through which all the current in the circuit flows, Fig. 53.

The things we do not yet know, and which we shall have to define, are the load at the output and the drive voltage at the input.

Remembering what we have said about matching already, we shall define the 'worst case' load. If we decide that the maximum r.m.s. output voltage we require is, say, 200mV (0·2V), and that the *minimum* impedance into which our circuit can feed is 5kΩ, we have some more guidelines to follow. Next thing we want to know is the peak voltage—remember, it is the voltage swing that gives us the operating voltages, i.e., defines our limits.

Here, we have 0·2V×1·414 (Peak=r.m.s.×√2)=0·2828V peak.

For a 300mV r.m.s. output, we shall need 0·3×1·414=0·4242V peak, and this is the value we shall choose.

To calculate the current which will be driven into our minimum load of 5kΩ, we divide our peak voltage by the load impedance,

$$\frac{0{\cdot}4242}{5000} = \frac{4242}{50} \simeq 82\mu A$$

To allow for a safe margin, we should operate Tr2 at an emitter current of five times or more than this. A convenient emitter current to use in calculations would be 1mA.

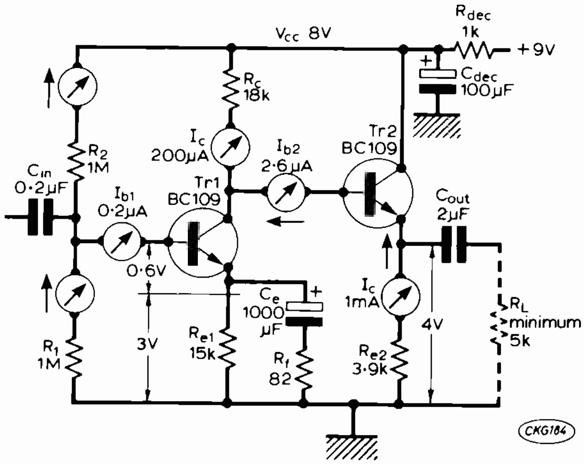


Fig. 53: A practical direct-coupled circuit. Linearity is good and distortion very low.

Operating Tr2 at an emitter current of 1mA and with an emitter voltage of 4V (half V_{cc}, which is 8V), giving us a swing of 8V, peak-to-peak, again a good margin of safety is obtained.

Using Ohms Law, we calculate the value of R_{e2}.

$$R = \frac{V}{I} \text{ or } \frac{4V}{1mA} = \frac{4000}{1} = 4{,}000\Omega$$

The nearest preferred value of resistor will be 3·9kΩ.

From the graphs

Turning now to the base conditions of Tr2. We have already said that bias is derived from the collector of Tr1 (see Fig. 53). We know that a silicon transistor such as the BC109, when forward biased, will have a voltage of 0·6V developed across the base-emitter junction. If we add this to the emitter voltage of Tr2, we get an expected base voltage of 4·6V, and so can say that the collector voltage of Tr1 will be the same, since the two transistors are directly coupled.

To calculate the base current of Tr2, we need to refer to the graphs which have previously been published, remembering that $I_b = \dfrac{I_c}{h_{FE}}$

We know that, for a BC109, the h_{FE} (d.c. current gain) at a collector current of 1mA is 380. We know the collector current, and can now say:

$$I_b = \frac{1mA}{380} = \frac{100\mu A}{38} = 2{\cdot}6\mu A$$

The collector current of Tr1 should be four or five times greater than this. To get a more satisfactory h_{fe} (a.c. current gain), we shall choose a collector current for the first transistor of 200µA. Again, plenty in hand. In comparison with the base current of Tr2, this collector current of Tr1 is very large, and the effect of I_{b2} on the load of Tr1 can be ignored in our calculations.

$$\text{This load, } R_c = \frac{V_{cc} - V_{c1}}{I_{c1}} \text{ or}$$

$$R_c = \frac{8{-}4{\cdot}6V}{200\ (\mu A)} = \frac{3{\cdot}4}{200\ (\mu A)} = \frac{34{,}000}{2} = 17{,}000\Omega$$

The nearest preferred value is 18kΩ.

Emitter voltage

Referring back to Part 9, a table was given to show the effects of a spread of emitter current, resulting from changes in H_{FE} and V_{BE}, for alternative supply voltages. From this, we can say that to get good stability with our given circuit we need an emitter voltage somewhere around 3V for Tr1, if we use potential divider biasing, as here.

If Tr1 is to operate with an I_c of 200µA, we know that the emitter current will only be a little less than this. We shall ignore the effect of the relatively small base current for this calculation. (This is no trick of convenience, as one accusing reader expressed it! Simply that if we wasted our time calculating to the minutest figure, the resultant resistor values would not be available. The variations due to these current differences come within the preferred value 'spread' of resistors we propose to use.)

So, if you will grant us this much dispensation, ignoring I_{b1}, we will calculate R_{e1} as

$$\frac{V_{e1}}{I_c} = \frac{3V}{200\mu A} = \frac{3 \times 10^6}{200} = 15k\Omega$$

a preferred value of resistor.

Voltage gain

The d.c. voltage gain, A_v, of Tr1, ignoring the effect of re, the internal emitter resistance (if Mr. Good will allow us to do so!), can be calculated from the collector load resistance divided by the unbypassed emitter resistance. That is,

$$A_v = \frac{18{,}000}{15{,}000} = 1{\cdot}2$$

From a knowledge of the d.c. current gain of Tr1, which is operating at a collector current of 200µA, we can calculate the true base current of the transistor. h_{FE} of a BC109 at a collector current of 200µA is typically 280.

$$I_{b1} = \frac{I_{c1}}{h_{FE1}} = \frac{200\mu A}{280}$$

which works out to approximately 0·7µA.

The emitter voltage of Tr1 has already been worked out: the base-emitter voltage will be 0·6V, as explained before; we shall aim at a current through the potential divider network, R1, R2, of five times the base current of Tr1.

Calculating R1, the lower resistor, this equals:

$$\frac{V_{b1}}{5 \times I_{b1}} = \frac{3{\cdot}6v}{3{\cdot}5\mu A} = \frac{36 \times 10^6}{35} = 1{\cdot}03M\Omega$$

And again, the nearest preferred value will be chosen, 1MΩ.

The current flowing through R2 is the base current of Tr1 as well as this base current multiplied by five, which we decided as our desirable current through the potential divider. In other words, $6 \times I_b$.

$$\text{So, R2} = \frac{V_{cc} - V_{b1}}{6 \times I_{b1}} = \frac{8 - 3{\cdot}6V}{4{\cdot}2\mu A}$$

again working out approximately to 1MΩ.

Input resistance

In this context, we refer to transistor input resistance, which, in the case of the input resistance to the base of Tr1 is the effective emitter resistance of the transistor plus the effect of the unbypassed resistor.

Calculating first the internal emitter resistance of Tr1, we have the formula:

$$re = \frac{25}{I_c\,(mA)} = \frac{25}{0{\cdot}2} = 125\Omega$$

R_{in}, ignoring R1 and R2, is equal to the effective emitter resistance plus the internal emitter resistance, multiplied by the a.c. current gain, $(R_{eff} + r_e) \times h_{fe}$.

Let's backtrack. Referring to Fig. 53, we bypass R_{e1} with a whacking great capacitor. Now, the stage gain is going to be determined by $\frac{R_{c}}{re}$. We can't do much about R_e without mucking up the d.c. conditions (to quote verbatim from Mike's notes). If we want to modify the stage gain, therefore, we have to find an alternative way of doing it, and the solution is as shown in the drawing, a resistor, R_f, in series with a large value of capacitor, C_e, both across the emitter resistor, R_{e1}.

Now we find that R_f cannot affect the d.c. conditions. The amount of feedback in the circuit will depend on the sum of the feedback resistor, R_f, and the internal emitter resistance of the transistor, r_e. We have already agreed that re is 125Ω. If we make R_f 82Ω, the total emitter resistance (as far as a.c. is concerned) will be 82+125=207Ω.

Our stage gain will be controlled by the formula:

$$Av = \frac{R_c}{R_f + re} = \frac{18{,}000}{207} = 87$$

Reverting to the point where we backtracked and putting in our value of feedback resistor for the effective emitter resistance, we get an input resistance of $R_{in} = 207 \times 360$ (the h_{fe} from the curves for the BC109) = 74520.

Having got the input resistance of the transistor settled. we can calculate the input resistance of the stage, which, you may remember, is obtained from the following formula:

$$\frac{1}{R_{IN}} = \frac{1}{R_{in}} + \frac{1}{R1} + \frac{1}{R2} = \frac{1}{74{\cdot}5k\Omega} + \frac{1}{1M\Omega} + \frac{1}{1M\Omega} = 65{\cdot}2k\Omega$$

Gain control

We can see that the gain of the circuit is obtained by altering the feedback resistor but this also affects the input resistance. Work out a few alternatives for yourself. When you do so, one fact will strike you: that is the major controlling factor of R1 and R2. We have already seen that there are decided limits to the amount of juggling that can be done, so in the next article we shall dispense with this pair of resistors altogether and show how the bias for the base of the first transistor can be derived from a single resistor fed from another part of the circuit.

Results

The final circuit, built up on 0·15in. matrix Veroboard gave us a measured gain of 90 (calculated 87), the input resistance was higher than calculated, and the output resistance when the circuit was fed from a low impedance source was approximately 522Ω. The output, measured and viewed on the oscilloscope, was 300mV.

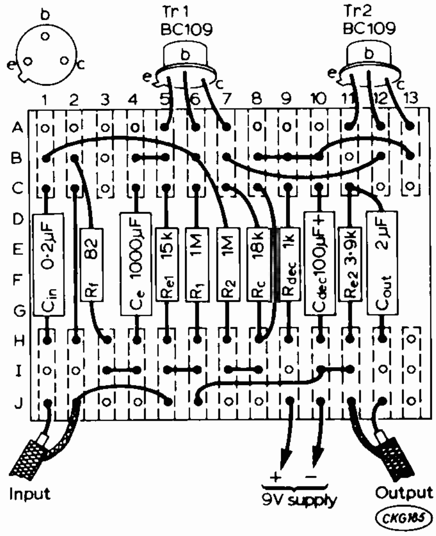


Fig. 54: Suggested layout of Fig. 53, on a 0·15in. matrix Veroboard.

Power supply details are as before, calculating R_{dec} to drop 1V from the sum of the various currents we have already considered, and decoupling with a large electrolytic to prevent the audio signals from modulating the supply. Coupling components are chosen from experience rather than calculated in exact detail. An input coupling capacitor could be 0·2μF and for an output coupling capacitor, 2μF might be chosen.

TO BE CONTINUED

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C	1/2W	5%	4·7-10M	E24	1·2	1	0·9
C	1W	5%	4·7-10M	E12	2·5	2	1·9
MO	1/2W	2%	10-1M	E24	4	3	2 nett
WW	1W	10% +1/20 Ω	0·22-3·9	E12	7	7	6
WW	3W	5%	1Ω-10K	E12	7	7	6
WW	7W	5%	1Ω-10K	E12	9	9	8

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Values:
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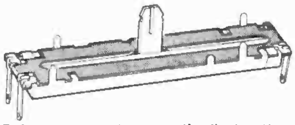

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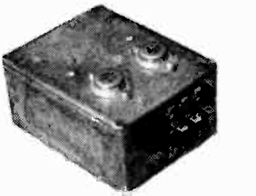

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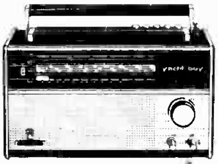

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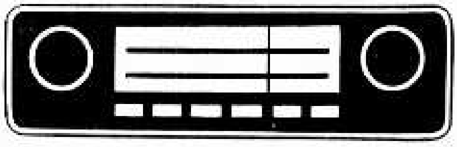
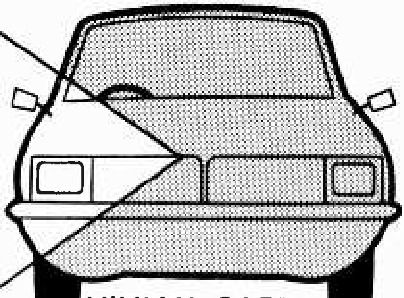
CAR RADIO INSTALLATION





VIVIAN CAPEL

PART 2

THE main source of engine interference is, as we have said before, the distributor. Suppression is achieved by inserting resistance in the central high-tension lead from the coil. Modern British cars already have this fitted, often it takes the form of a resistive carbon brush for the rotor contact. No additional suppression should be fitted. In the case of older cars, and some of foreign manufacture, a suppressor should be fitted as a routine job when installing the car radio. A value of 10kΩ is suitable which can be of the screw-in or cut-lead type, whichever is the most convenient.

The coil

The next point to consider is the ignition coil. This can generate interference which can be suppressed by fitting a 2μF capacitor. This should be of the metal-cased type, the case being secured to the car bodywork as near to the coil as possible. The capacitor lead, which must be kept as short as possible, must be connected to the low-tension lead coming from the ignition switch.

One type of capacitor-suppressor which is specially suited for this application, is the co-axial type. This is similar to the lead-through capacitors often found in television tuner-units. The metal case is clamped to the car bodywork, or better still the metal case of the coil, one connection is taken to the ignition switch-lead and the other to the coil. Thus the low-tension supply to the coil passes through the capacitor casing which thereby forms an effective barrier to interference pulses. The two capacitor leads must be kept as far apart as possible to prevent any inductive coupling to bypass the capacitor.

Dynamo suppression

Next, comes the dynamo. Again, interference can arise from this component, and a metal-cased ordinary or co-axial capacitor suppressor of 0·5μF should be used. What has been said about earthing the case and keeping leads short applies here too. Two leads come from the dynamo, one is the field-coil connection and the other is the output lead. On no account should the suppressor be connected to the field terminal as actual damage could result. One method of identification as to which is which, is that the field coils carry much less current than the output lead from the armature and so is wired with much thinner wire. The suppressor then, must be wired to the thick-wire connection.

We have described the three suppression points which should be attended to as a matter of routine on every car-radio installation. In most cases it will be found that interference is down to a very low level and the installation can be considered successfully completed. There are though the stubborn cases, and we will now see what can be done to silence these.

Stubborn cases

It may be that you are fitting a radio in a second-hand car that previously had a radio which was removed by the previous owner. Do not assume that the three points we have described were properly suppressed, check each one. Some garage mechanics have a habit of disconnecting or removing suppressors when looking for faults. In most cases the aerial will have been left on the car and of course this will be used in the new installation. As the majority of faults are attributable to the aerial, always check it in case of persistent interference. Check that the circuit from the aerial-rod to the radio-plug is continuous with a meter or other type of circuit tester. Check that the screening goes all the way and that there is no break or badly made join. Check that there is no leakage between the aerial and screen, and that the screen is a dead short to the bodywork.

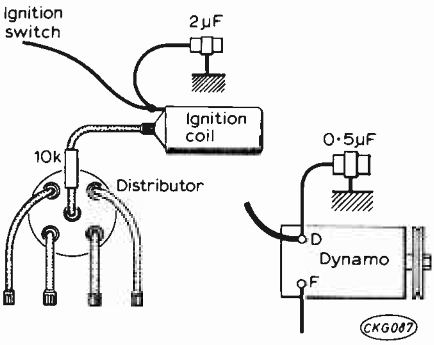


Fig. 2: Three routine suppression points for all radio installations.

Check that the part of the body that the aerial is mounted on and therefore the part that the screen is earthed to, is in fact in good electrical contact with the main bodywork. Sometimes new wings are fitted that are primed with undercoat before being bolted into place, and therefore make poor electrical contact. Lastly, check that all sections of a telescopic aerial are in good contact with each other. Oxidization sometimes prevents this and the bottom section is 'on its own' with poor, if any, contact with those above it, thus resulting in a short aerial length, poor signal pickup and degraded signal/noise ratio.

If interference persists we must look elsewhere for the trouble. Cases have been known where after the most careful and extensive suppression the trouble has remained, and the cause has been traced to a burnt and pitted rotor-arm. It is worth replacing it if in doubt. Similarly the high-tension terminals in the rotor head may be worth checking and cleaning up.

If all is in order here, the plug leads may be radiating. A set of 5kΩ resistive suppressors can be fitted, one in each plug lead, as near to the distributor as possible. It may even need a second set wired close to the plugs. Some makers use resistance wire for the plug leads and if this is the case (as can be checked with the meter) no further resistance will be of much help. Actually these resistive leads are better than wired-in suppressors, because the resistance is distributed along the complete length. Special h.f. filters may prove the answer.

It is assumed that the plugs themselves are in good condition, and of course these should be replaced at the stipulated intervals in the interests of petrol economy and engine performance. Old and worn plugs can cause interference, so if yours are due for a change, try a new set before getting too involved in suppression methods.

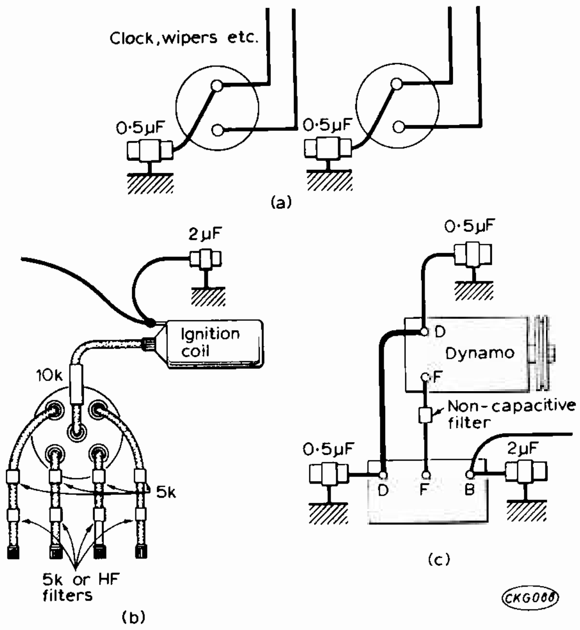


Fig. 3: All possible suppression points. Rarely necessary except in stubborn cases or FM radios.

Other interference

Any interference that yet remains will very likely be due to causes other than the high-tension ignition circuit, if all the measures here described have been taken.

This can be ascertained by revving up the engine and then switching off the ignition. Any interference arising from the ignition circuits whether low or high-tension will immediately cease. Any noise that continues as the engine slows down and stops must therefore be due to the dynamo or voltage-regulator. If it is still the ignition circuit that is giving the trouble, about the only thing left is inductive coupling between the l.t. ignition circuit and radio leads. One possibility that has been known, is coupling between the car wiring to the ignition-switch and the radio loudspeaker leads. Moving the latter may improve things, but in stubborn cases it sometimes pays to rewire the speaker with screened-cable. Some radios already have screened loudspeaker wire fitted by the makers, but often the screening is earthed to some point inside the metal case of the radio. Thus if any r.f. interference pulses are picked up by the screen they will be conducted inside the radio, and possibly affect the r.f. circuits. A worthwhile move is to disconnect the internal earth and to earth the screening to some external point on the case.

If in fact, the engine rev test eliminates the ignition circuits, we can absolve the dynamo if it is properly suppressed as we have described. This leaves the voltage regulator. It is usually easy to tell if interference is coming from this source because the sound has quite a distinctive character. It has what can best be described as a chattering sound, and it seems to affect the long-waves more than the medium waves.

Suppression will usually be effected by the connection of a 2μF capacitor to the regulator terminal that goes to the battery. Do not connect it to the one that goes to the dynamo field coil.

If the main engine interference has been suppressed, as indeed it should be after the measures we have described, there may be a residual noise, especially with installations that have the aerial mounted at the front of the car. We have seen that this is more probable than those with rear mounted aerials, but in some cases the level may be higher than it should be. One possible reason for this is that the bonnet is not earthed electrically to the rest of the car. Thus its shielding effect is poor and the aerial is exposed to direct radiation from the engine. A couple of jumpers of copper braiding should be connected across the hinges to provide a low-resistance earth-path.

There are other causes of radio interference besides the engine and its necessary subsidiaries. A common one is the ticking of the electric-clock and the whine of windscreen-wipers. Fortunately, the cause is self-evident, and all that needs to be done is to fit a suppressor to the offending item. A metal-cased 0·5μF should suffice as long as it is fitted as close to the accessory as possible with the shortest leads to it and to earth.

There is one final source of interference which has nothing to do with the car's electrical system, and this is static. It is easily identified because it is not present when the car is stationary, even though the engine is running, and it is present when the car is coasting with the engine switched off.

Although thus easy to recognise, it is not so easy to find the precise cause and effect a cure. It is generated by some part that is in poor electrical contact with the rest of the bodywork, and the problem is to find out which one. A common cause is the tyres; friction builds up an appreciable charge which then leaks through various paths producing the interference.

One possible cure, is the dangling-chain which a

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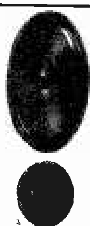

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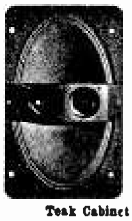

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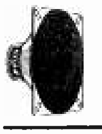

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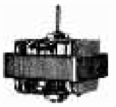

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3Q4	50
3Q5	50
3S4	35
3V4	48
5R4GY	75
5U4G	35
5V4G	45
5Y3GT	40
5Z4G	40
6/30L2	80
6A7	75
6A8G	40
6AK5	35
6AM5	35
6AM6	33
6AQ5	38
6AS7G	85
6AT6	35
6AU6	25
6B4G	£1·00
6B8G	25
6BA6	25
6BE6	30
6BH6	75
6BJ6	50
6BQ7A	45
6BR7	90
6BR8	70
6BS7	£1·30
6BW6	85
6BW7	30
6C4	33
6C5G	35
6C6	25
6CD6G	£1·25
6CH6	60
6CW4	65
6D6	35
6E5	60
6F1	70
6F5G	90
6F6G	35
6F8G	50
6F11	40
6F13	45
6F14	70
6F23	85
6F24	75
6F25	£1·00
6F28	65
6F32	25
6G6	25
6H6	28
6J5M	50
6J5G	20
6J5GT	30
6J6	20
6J7M	45
6J7G	30
6J7GT	45
6K6GT	60
6K7M	35
6K7G	35
6K7GT	35
6K8M	60
6K8G	40
6K8GT	50
6K25	75
6L6G	50
6L18	45
6Q7G	40
6Q7GT	48
6SA7M	40
6SC7M	75
6SG7M	40
6SH7M	40
6SJ7GT	30
6SK7GT	40
6SL7GT	35
6SN7GT	35
6SQ7GT	40
6U4GT	65
6U5G	40
6V6M	60
6V6G	30
6V6GT	40
6X4	35
6X5G	40
6X5GT	40
7B6	70
7B7	50
7C5	£1·13
7C6	75
7D5	60
7H7	50
7R7	75
7S7	£2·25
7Y4	65
9BW6	60
10C2	63
10F1	75
10F3	90
10F9	60
10F18	50
10LD11	65
10P13	60
11E3	£4·00
12AT6	30
12AT7	35
12AU6	35
12AU7	30
12AX7	30
12BA6	40
12BE6	40
12C8GT	35
12E1	£2·20
12J5GT	30
12J7GT	50
12K7GT	40
12K8GT	50
12Q7GT	40
12SA7GT	50
12SG7	35
12SH7	35
12SJ7	40
12SK7	50
12SR7	40
14H7	50
19AQ5	50
20D1	50
20F2	70
20L1	£1·10
20P4	£1·10
20P5	£1·20
25A6	85
25L6GT	50
25Y5	65
25Z4	30
25Z5GT	55
25Z6	65
30C1	30
30C15	80
30C17	90
30C18	80
30F5	85
30FL1	75
30FL12	£1·20
30FL14	85
30L15	85
30L17	80
30P4	£1·12
30P12	80
30P19	85
30PL1	75
30PL13	93
30PL14	90
35A5	75
35L6	50
35W4	35
35Z3	70
35Z4GT	60
35Z5	50
37	40
42	50
50B5	50
50C5	50
50CD6G	£1·20
50L6GT	55
75	50
78	45
80	55
85A2	50
150B2	60
150C4	60
801	60
807	50
813USA	£3·75
866A	75
954	60
1625	55
4022AR	£5·50
5763	70
7193	30
7475	50
A61	48
ATP4	45
ATP5	60
ATP7	60
AU2	£4·00
AU5	75
AZ1	55
AZ31	55
CBL31	£1·00
CCH35	75
CL33	£1·30
CY30	63
CY31	48
DAC32	50
DAF91	30
DAF96	45
DCC90	£1·35
DF33	55
DF70	45
DF91	30
DF92	20
DF96	45
DH3·91	£7·00
DH77	35
DK32	45
DK91	40
DK92	55
DK96	50
DL66	£1·25
DL92	35
DL93	40
DL94	48
DL95	50
DL96	45
DM70	45
DY86	33
DY87	33
E88CC	65
EA50	20
EABC80	35
EAF42	55
EB91	20
EBC33	50
EBC41	55
EBC90	35
EBF80	40
EBF83	40
EBF89	30
EBL1	£1·00
EBL21	60
EBL31	£1·50
EC90	33
ECC81	35
ECC82	30
ECC83	30
ECC84	30
ECC85	40
ECC88	40
ECH21	63
ECH35	£1·00
ECH42	75
ECH81	30
ECH83	45
ECL80	45
ECL82	35
ECL83	70
ECL86	40
ECLL800	£1·65
EF9	75
EF37A	£1·20
EF39	50
EF41	65
EF50	25
EF80	25
EF85	35
EF86	30
EF89	28
EF91	33
EF92	35
EF98	75
EF183	30
EF184	35
EL32	50
EL33	£1·25
EL34	50
EL41	60
EL42	65
EL84	25
EL95	35
ELL80	£1·00
EM80	45
EM81	60
EM84	35
EY51	40
EY86	40
EZ35	40
EZ40	50
EZ41	50
EZ80	27
EZ81	29
GY501	80
GZ30	40
GZ32	48
GZ34	60
HN309	£1·50
KT36	£1·00
KT61	£1·25
KT66	£2·05
KT81	£1·75
KT81(7C5)	£1·13
KT88	£2·00
KTW61	£1·00
KTZ41	50
ML4	88
ML6	40
MSP4	50
MU14	75
MX40	63
N78	£1·50
N108	£1·50
OA2	38
OC3	38
OZ4	40
PC86	60
PC88	60
PC97	50
PCC84	40
PCC89	50
PCC189	55
PCF80	30
PCF82	35
PCF84	60
PCF86	60
PCF801	50
PCF802	50
PCF805	80
PCF806	70
PCF808	85
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PCL83	65
PCL84	45
PCL85	40
PCL86	45
PD500	£1·30
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PENB4	£1·00
PEN45	75
PEN46	40
PL36	55
PL81	50
PL82	45
PL83	45
PL84	40
PL500	80
PL504	80
PL508	90
PL509	£1·10
PL802	95
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PX25	£2·50
PY33	63
PY81	30
PY82	35
PY83	38
PY500	£1·00
PY800	40
PY801	50
R2	75
R19	50
S130	£1·75
SP4	50
SP41	60
SP61	75
STV280/80	£10·00
SU25	£1·00
SU2150	75
T41	£1·00
TDD4	60
U10	75
U14	75
U19	£3·00
U25	80
U26	80
U78	35
U191	75
U251	80
U301	63
U403	60
U404	60
U801	£1·18
UABC80	40
UAF42	55
UBC41	50
UBC81	40
UBF80	40
UBF89	35
UCC84	43
UCC85	40
UCF80	55
UCH42	70
UCH81	40
UCL82	35
UCL83	60
UF41	60
UF89	40
UL41	65
UL84	40
UM80	30
UU6	£1·75
UU7	£1·75
UU8	£1·75
UU9	50
UY21	50
UY41	48
UY85	40
VMP4G	85
VP4B	£1·25
VR105/30	38
VR150/30	35
VU111	75
VU120	£1·00
VU508	£3·00
W81M	63
Y63	50

Transistors

Type	Price
1N914	07
1S113	25
1S202	23
2G302	22
2G371	22
2N404	20
2N697	15
2N706	10
2N1132	25
2N1305	22
2N2147	75
2N2160	60
2N2218	20
2N2219	20
2N2369A	15
2N2444	£1·91
2N2646	45
2N2904	20
2N2926	10
2N3055	75
2N3702	10
2N3819	35
2N4289	15
AAZ12	30
AC126	20
AC127	25
AC128	20
ACY20	20
ACY39	50
AD140	50
AD149	50
AD161	87
AF115	25
AF117	25
ASY26	25
BC107	10
BC108	10
BC109	10
BC169C	15
BF898	28
BFY50	22
BFY51	20
BY100	15
BZY88	15
CRS1·40	47
DD003	15
GET102	30
GET882	25
GJ7M	87
KS100A	20
MJE520	87
MJE2955	£1·37
MJE3055	87
NKT212	27
NKT214	15
NKT223	33
NKT251	24
NKT713	25
OA70	10
OA71	10
OA81	08
OA85	12
OA91	07
OA211	30
OAZ201	50
OAZ207	47
OAZ210	32
OAZ222	45
OAZ224	45
OAZ241	22
OAZ242	23
OAZ246	23
OC35	50
OC44	17
OC45	12
OC57	60
OC58	60
OC59	65
OC71	12
OC72	20
OC81	20
OC81D	20
OC82	25
OC82D	20
OC84	25
OC170	25
OC171	30
OC200	40
OCP71	97
ORP12	50
ZS170	10
ZS178	P on A
ZTX107	15
ZTX108	12
ZTX300	12
ZTX304	25
ZTX500	16
ZTX503	17
ZTX531	25

Integrated Circuits

Type	Price
7400	20
7401	20
7402	20
7403	20
7404	20
7405	20
7406	30
7407	30
7408	20
7409	45
7410	20
7411	23
7412	42
7413	30
7416	30
7417	30
7420	20
7422	48
7423	48
7425	48
7427	42
7428	50
7430	20
7432	42
7433	70
7437	65
7438	65
7440	20
7441AN	75
7442	75
7450	20
7451	20
7453	20
7454	20
7460	20
7470	30
7472	30
7473	40
7474	40
7475	55
7476	45
7480	80
7482	87
7483	£1·00
7484	90
7486	45
7490	75
7491AN	£1·00
7492	75
7493	75
7494	80
7495	80
7496	£1·00
7497	£6·25
74100	£2·50
74107	50
74110	80
74111	£1·45
74118	£1·00
74119	£1·90
74121	60
74122	£1·35
74123	£2·70
74141	£1·00
74145	£1·50
74150	£3·35
74151	£1·10
74154	£2·00
74155	£1·55
74156	£1·55
74157	£1·80
74170	£4·10
74174	£2·00
74175	£1·35
74176	£1·60
74190	£1·95
74191	£1·95
74192	£2·00
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74198	£4·60
74199	£4·60

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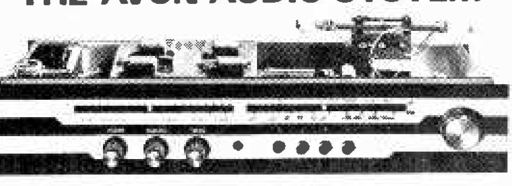
THE AVON AUDIO SYSTEM



This uncabineted system is ideal as an economical replacement for an outdated chassis. The Stereo Tuner Amplifier with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection. 10 watts total output. Frequency response 25-18000 Hz.

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G3UBO & G3MME

While the Yaesu Musen FRdx400 receiver is just about the best you can get in the Amateur Band line, the price of £160 is beyond a lot of pockets, so to cater for the lower-priced field, we very proudly introduce the Yaesu Musen FR-50B at a very incredible £52. In spite of this rock bottom price, the FR-50B is a very good Amateur Band receiver indeed and provides a high degree of sensitivity, selectivity and stability. Basically, it is a double conversion receiver covering 80 to 10m with a VFO for the first oscillator and a crystal controlled second oscillator. Being double conversion (5173.9 kHz and 455 kHz) explains the incredibly good image rejection figure of better than 50 db. When it comes to sensitivity, the 6BZ6 r.f. amplifier ensures 0.5 microvolt for 10 db S/N ratio. Selectivity is achieved by two ceramic transducer filter elements which give a nose band width of 3·6 kHZ at 6bd and a skirt band width of 10 kHz at 50 db. These figures are extremely good for equipment in this price class (even for equipment costing much more!). A high order of stability is achieved by a stabilized transistor VFO and VFO buffer amplifier. Other nic eties of design built in are:—
100 kHz calibrator, speaker, geared VFO drive, "S" meter, product detector.

Frequency range:	Amateur Bands 80-10 plus WWV.
Sensitivity:	Better than ½ microvolt for 10 db S/N ratio in the SSB mode.
Selectivity:	3·6 kHz—6db 10 kHz—50db
Image rejection:	50 db or more.
Audio:	1·5W 4/600 ohm output. Built-in speaker.
Power:	240 v.a.c.
Size:	13" wide, 6" high, 10½" deep.
Weight:	17½ lb
Controls:	BFO, monitor agc slow/fast/off, noise limiter on/off, calibrator on/off, mode switch, AF gain, RF gain, band switch, main tuning, preselector, zero set (for calibration), "S" meter zero (on rear panel).
Valves:	12AT7 crystal calibrator, 6BZ6 r.f. amp., 12AT7 first mixer 2SC373 VFO, 2SC372 VFO buffer, 6CB6 1st IF amp./2nd mixer, 2SC372 2nd oscillator, 6BA6 2nd IF amp., 6BA6 3rd IF amp., 1S1007 AM detector, 6BE6 product detector, 1S1941 noise limiter 6BA6 BFO, 6BM8 Audio.

The above is just a sample of our wide range of Amateur Radio equipment—we stock everything from aerials to 'Z' matches for the Amateur Radio enthusiast. Please note, though, that we dont' handle domestic equipment, Hi-fi, small components, surplus junk—just good quality equipment for the Amateur Radio Enthusiast.
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few years ago was widely used to prevent travel sickness. It discharges to ground any static that may be built up by the tyres or by the movement of the car body. This can be quite effective in the latter case but not so much in the former because of the rather long path from tyres to the chain. The most effective cure for tyre static is to provide a conductive path from the tyre tread to the car body. Painting the inside wall of the tyres with a conductive paint such as lead paint, or a rubber conductive paint, should do the trick. It is not necessary to paint the whole of the wall, several wide strips will do, providing they are taken from the wheel rims to the tread.

It may be that the wheels themselves are not in good contact with the body due to the wheel bearings. Packing them with graphite grease should make them conductive. Alternatively, special springs that are made for the purpose can be fitted inside the hub-caps. These form a bridge between hub-cap and axle.

In the case of the rear wheels it could be found that the back axle is not in electrical contact with the body, and if this is so it will be necessary to fit a copper-braid jumper from axle to body; the top bolts of the differential housing should prove a convenient anchoring point.

Other parts of the body or engine components can cause static through poor earthing, although it is usually the larger parts. Exhaust systems are a possibility and also the steering column.

From all this it may well be assumed that installing a car radio and suppressing all interference is a major job and one that is not to be lightly undertaken. This is not actually so, rarely will all the measures here described be found necessary, in the majority of cases the three routine suppressors we have before described will be sufficient. However, the stubborn ones do sometimes crop up, and it is hoped that in such an eventuality these tips will prove helpful.

It should be noted though, that f.m. car radios are more troublesome in the matter of car interference than a.m. All the suppression measures here described, except for static, should be carried out as routine when installing one. In addition to these an extra 0·5μF suppressor should be connected to the voltage-regulator, this time to the D terminal, and also a special non-capacitive suppressor to the F or DF terminals. As stated before, an ordinary capacitive suppressor must not be connected to the field-coil circuit.

The resistive suppressors used for plug suppression will probably not be sufficient, and special h.f. filters may have to be used instead. ■

TOP BAND CONVERTER. August 1972
Figure 1. Pin 8 on L2 should be connected to chassis and not to the junction of C2/C3. The wiring in Fig. 2 should be amended accordingly.

TAKE 20. August 1972
VR1 is given as 5kΩ in the circuit and 10kΩ in the components list. Either will work but the circuit is correct and in preference VR1 should be 5kΩ.

Electronotes..

S. GINSBERG

ONE of the problems (in certain applications) of using a standard typewriter keyboard to put characters or letters into a computer, is that you are stuck with exactly those characters. Thus a capital letter A is always exactly the same shape, thickness, height etc. It will be the same no matter who presses the key. It would be very useful if one could write, just as with an "ordinary" pen, and have the resultant "shapes" stored. These could be called up onto a visual display unit (v.d.u.) at will and could be transmitted to remote v.d.u.'s at another location. No longer would we be restricted to characters and numbers, and we could, if we wished, send a circuit diagram. It would be possible to send a signature which could be checked and verified by, say, a bank or security personnel.

Well, it can be done. As far as the "sender" is concerned he/she merely writes on a special tablet with an electronic pen. The method has been developed by the Siemens laboratories in Munich. Any handwritten marks may be displayed immediately on a large cathode ray tube or stored in the computer, or transmitted to another computer or v.d.u.

The special writing tablet is a sheet of piezoceramic material. Ultrasonic pulses at about 500Hz are applied to two edges of the plate which are at right angles to each other. The result is that a wave front is generated from each of the two edges. These fronts travel across the plate but remain parallel to their edge of origin.

The pen doesn't write by pressure. It acts as a capacitive probe which reacts with these voltage fronts travelling across the piezoceramic at constant speed. Electronic circuitry interprets the pen's position in relation to the x-y axis formed by the wave fronts. The position of the pen is converted into signals used for the v.d.u. and computer.

Lasers are back in the news again. RCA has built a laser beam image reproducer. It is reckoned to produce film copies of TV pictures with a sharpness improvement of some forty times. The system has a line resolution of something like 20,000 lines. This is a considerable improvement over earlier RCA systems which had resolutions of 6,000 lines.

The other laser story comes from the Mecca of electronic innovation—Bell Laboratories in the U.S. Here, miniature gas lasers have been made which are only two inches long and 0·02in. in diameter. Operating at 6328 Angstroms, the first successful model employed helium-neon discharge. Using glass capillary tubing with a 430μm bore, gains of 2·7dBm were obtained.

TAKE 20

JULIAN ANDERSON

No. 40 CRYSTAL MIKE PREAMP

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

THERE is nothing much wrong with crystal microphones that a decent preamp will not cure. They are not as good as decent moving coil or ribbon types but it needs a discerning listener to notice the difference with one proviso: that the mike is properly matched to a high impedance source. Crystal microphones have got a bad name mostly because they are more often than not fed directly into a simple transistor amplifier with an input impedance of perhaps 10kΩ providing a very bad mismatch. To get the best out of these inexpensive mikes, they must be connected to a really high impedance—at least half a megohm.

Figure 1 shows the circuit which comprises two sections. Tr1 and the associated components give the high input impedance as they are connected as a common-collector (or emitter-follower) stage. The input impedance to such a stage is roughly equal to the emitter resistor multiplied by the gain of the transistor and so we shall find that the input impedance is about 1MΩ which will provide a very decent match to the crystal. Since we are dealing in high impedances we only require a low value coupling capacitor to d.c. block the input, in the circuit this is C1, a 0·1μF capacitor. The base bias for this stage is provided by R1.

The output of this stage will show no voltage amplification, in fact as far as voltage is concerned the output will be marginally less than the input. The transistor has used up its gain in converting the impedance, not in amplifying the signal in the conventional sense. The output from a crystal mike will vary with the type but for our purposes we shall take it as being 1mV. So we shall still be getting only a small output across the emitter resistor R2. To bring this up to a usable level to feed an amplifier we have to amplify the signal further. C2 d.c. blocks the output from Tr1 and this feeds to a series resistor. The function of this resistor is fairly complex but if it is omitted the signal will become distorted, the value is not critical but it will be found to lie around the level of that shown, 3·3kΩ.

This resistor connects directly to the base of the conventional common-emitter amplifier Tr2 which, like Tr1, is a BC109. If this has a gain of 300 the output will be about 300mV, enough to drive pretty well any transistor amplifier. R4 provides the base bias and R5 acts as the collector load and the output is taken from the collector via the capacitor C3. C4 decouples the supply line. The version shown is for a negative earth type circuit but, if it is needed for a positive earth amplifier, all that is necessary is to change the transistors to 2N3702 types and reverse the polarity of the electrolytics. The gain may be slightly less but it should still be more than adequate.

As the input is a high impedance it is important that the input is screened. Crystal microphones are usually provided with a screened wire lead, the screening itself should go to the negative line (or positive line if that version is built). The output impedance is about 10kΩ and although this is much lower than the input, a screened wire should still be used between it and the amplifier if it is more than a few inches long.

A suggested layout on a small piece of Veroboard is shown in Fig. 2 but building the circuit up on tagboard is just as good. ■

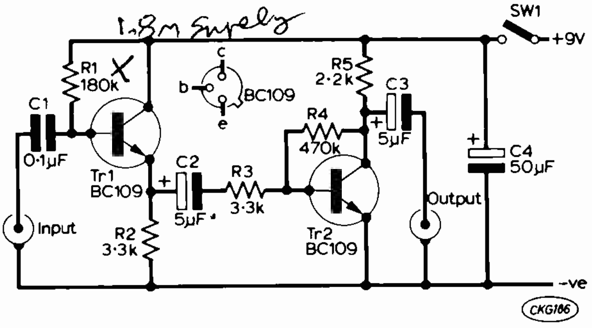

Fig. 1: The circuit of the crystal mike preamp.

★ components list

R1	180kΩ 5%, ¼W	1p
R2	3·3kΩ 5%, ¼W	1p
R3	3·3kΩ 5%, ¼W	1p
R4	470kΩ 5%, ¼W	1p
R5	2·2kΩ 5%, ¼W	1p
C1	0·1μF mylar or ceramic	4p
C2	5μF 10V minimum	4p
C3	5μF 10V minimum	4p
C4	50μF 10V minimum	4p
Tr1	BC109	10p
Tr2	BC109	10p
SW1	On-off switch	7p
		48p

Prices are those recently advertised and may have changed. No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

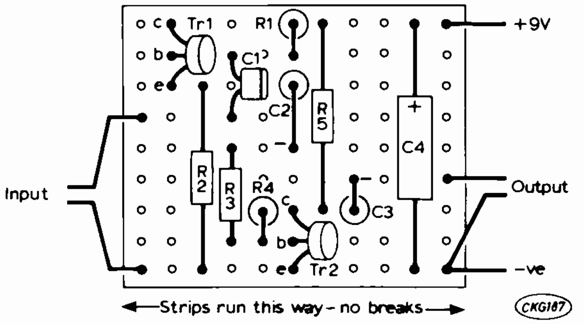

Fig. 2: A suggested component layout.

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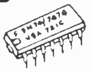
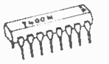
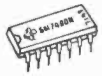

Type	1/11 p	12/24 p	25/99 p
SN7400	0·20	0·18	0·16
SN7401	0·20	0·18	0·16
SN7402	0·20	0·18	0·16
SN7403	0·20	0·18	0·16
SN7404	0·20	0·18	0·16
SN7405	0·20	0·18	0·16
SN7406	0·30	0·27	0·25
SN7407	0·30	0·27	0·25
SN7408	0·20	0·19	0·18
SN7409	0·45	0·42	0·35
SN7410	0·20	0·18	0·16
SN7411	0·23	0·22	0·20
SN7412	0·42	0·40	0·35
SN7413	0·30	0·27	0·25
SN7416	0·30	0·27	0·25
SN7417	0·30	0·27	0·25
SN7420	0·20	0·18	0·16
SN7422	0·48	0·44	0·40
SN7423	0·48	0·44	0·40
SN7425	0·48	0·40	0·35
SN7427	0·42	0·39	0·35
SN7428	0·50	0·45	0·42
SN7430	0·20	0·18	0·16
SN7432	0·42	0·39	0·35
SN7433	0·70	0·61	0·44
SN7437	0·65	0·60	0·50
SN7438	0·65	0·60	0·50
SN7440	0·20	0·18	0·16
SN7441AN	0·75	0·72	0·70
SN7442	0·75	0·72	0·70
SN7443	1·00	0·95	0·90
SN7445	2·00	1·75	1·60
SN7446	2·00	1·75	1·60
SN7447	1·75	1·60	1·45
SN7448	1·75	1·60	1·45

Type	1/11 p	12/24 p	25/99 p
SN7450	0·20	0·18	0·16
SN7451	0·20	0·18	0·16
SN7453	0·20	0·18	0·16
SN7454	0·20	0·18	0·16
SN7460	0·20	0·18	0·16
SN7470	0·30	0·27	0·25
SN7472	0·30	0·27	0·25
SN7473	0·40	0·37	0·35
SN7474	0·40	0·37	0·35
SN7475	0·55	0·52	0·50
SN7476	0·45	0·42	0·39
SN7480	0·80	0·75	0·67
SN7481	1·25	1·15	1·10
SN7482	0·87	0·80	0·70
SN7483	1·00	0·90	0·85
SN7484	0·90	0·85	0·80
SN7486	0·45	0·41	0·38
SN7490	0·75	0·70	0·65
SN7491AN	1·00	0·95	0·90
SN7492	0·75	0·70	0·65
SN7493	0·75	0·70	0·65
SN7494	0·80	0·75	0·70
SN7495	0·80	0·75	0·70
SN7496	1·00	0·97	0·95
SN7497	6·25	5·50	5·00
SN74100	2·50	2·30	2·00
SN74104	1·45	1·35	1·20
SN74105	1·45	1·35	1·20
SN74107	0·50	0·45	0·40
SN74110	0·80	0·70	0·60
SN74118	1·00	0·95	0·90
SN74119	1·90	1·78	1·65
SN74121	0·60	0·55	0·50
SN74122	1·35	1·25	1·10
SN74123	2·70	2·55	2·47
SN74141	1·00	0·95	0·90

Type	1/11 p	12/24 p	25/99 p
SN74145	1·50	1·40	1·30
SN74150	3·35	2·95	2·15
SN74151	1·10	0·95	0·90
SN74153	1·35	1·27	1·20
SN74154	2·00	1·75	1·55
SN74155	1·55	1·47	1·35
SN74156	1·55	1·47	1·35
SN74157	1·80	1·70	1·50
SN74160	2·60	2·40	2·25
SN74161	2·60	2·40	2·25
SN74162	3·40	3·25	2·70
SN74163	3·40	3·25	2·70
SN74164	2·75	2·30	2·10
SN74165	4·00	3·50	3·00
SN74166	4·00	3·50	3·00
SN74167	6·25	5·60	5·10
SN74170	4·10	3·55	3·05
SN74174	2·00	1·75	1·80
SN74175	1·35	1·27	1·15
SN74176	1·60	1·35	1·20
SN74177	1·60	1·35	1·20
SN74180	1·55	1·30	1·20
SN74181	7·00	6·00	5·50
SN74182	2·00	1·80	1·60
SN74184	2·40	2·00	1·80
SN74185A	2·40	2·00	1·80
SN74190	1·95	1·85	1·75
SN74191	1·95	1·85	1·75
SN74192	2·00	1·90	1·80
SN74193	2·00	1·90	1·80
SN74194	2·50	2·25	1·90
SN74195	1·85	1·70	1·60
SN74196	1·50	1·40	1·30
SN74197	1·50	1·40	1·30
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SN74199	4·60	3·70	3·35

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IN4003	200	8
IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
1·5 amp miniature		
PL4001	50	8
PL4002	100	9
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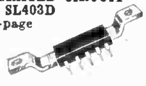

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SC40B	200	90p
SC40D	400	£1·00
SC40E	500	£1·20
10 AMP RANGE (TO48)		
SC45A	100	95p
SC45B	200	£1·00
SC45D	400	£1·25
SC45E	500	£1·45
15 AMP RANGE (TO48)		
SC50A	100	£1·25
SC50B	200	£1·35
SC50D	400	£1·65
SC50E	500	£1·85

DIAC D32 25p

TRIACS—
Additional Types

40430	(TO66)	85p
40669	(Plastic)	£1·00
40486	(TO5)	80p

3 Amp T048

15 Amp T048

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Type	Volts P.I.V.	Price 1-11
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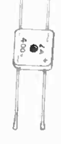
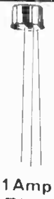
BO5/05	50	20p
BO5/10	100	25p
ONE AMP ¼ × ⅜ H TUBULAR		
B1/05	50	25p
B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
TWO AMPS ¼ H × ¼ L × 5/16		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
FOUR AMPS ¼H × ½L × 1/16		
B4/100	100	60p
B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
B4/800	800	£1·00
SIX AMPS ¼H × ½L × 1/16		
B6/100	100	70p
B6/200	200	75p
B6/400	400	90p
B6/600	600	£1·00


SILICON CONTROLLED RECTIFIERS

Type	Volts P.I.V.	Price 1-11
ONE AMP		
CRS 1/05	50	25p
CRS 1/10	100	30p
CRS 1/20	200	30p
CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (TO48)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
SIXTEEN AMP		
SCR 16/100	100	65p
SCR 16/200	200	70p
SCR 16/400	400	80p
SCR 16/600	600	£1·00



1 Amp T05

3 Amp T048

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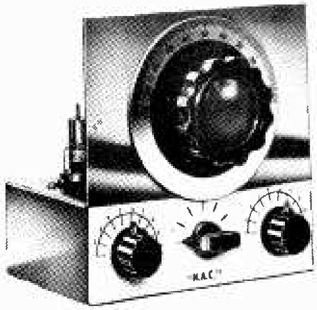

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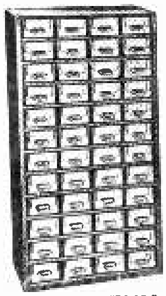

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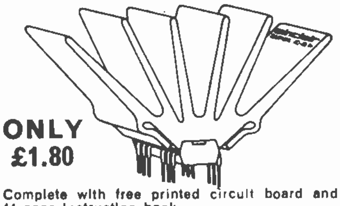

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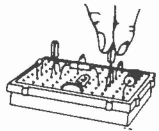

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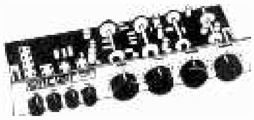

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

ONE of the many problems faced by the newcomer to the hobby of Shortwave Listening is the bewildering number of abbreviations which are used by more experienced listeners. Contrary to rumour these abbreviations are not used solely to confuse the uninitiated. Every branch of science and technology has its own set of abbreviations and jargon and Shortwave Listening is no exception to this.

To assist the uninitiated I will explain the meanings of some of the more common abbreviations which may be used on this page from time to time.

anncr	Announcer.
Ant	Antenna, aerial.
BC	Broadcast or Broadcasting.
condx	Conditions (propagation).
DX	Long distance reception.
GMT	Greenwich Mean Time.
hrd	heard
Hz	Hertz, measurement of frequency equivalent to one cycle per second.
ID, Ident	Identification.
IRC	International Reply Coupon, sent to help a station with return postage.
kHz	1,000Hz.
LA	Latin American.
MHz	1,000,000Hz.
Mx	Music.
NA	North America.
Nx	News.
QSL	Card sent by a station verifying reception.
rcvd	Received.
Rx	Receiver.
SA	South America.
Sce	Service (Home Sce., Overseas Sce., etc.).
Sched	Schedule.
s/off	Sign off.
s/on	Sign on.
SW	Shortwave.
SWL	Shortwave Listener.
TNX	Thanks.
Tx	Transmitter.
Wrp	Weather report.
Wx	Weather.
Xmsn	Transmission.
Xtal	Crystal.
//	Parallel transmission.

Adrian R. Pell has compiled the schedule of Radio Bangladesh which reads as follows:—

Address: Broadcasting House, 20 Green Road, Dacca.

Stations:

kHz.	m.	kHz.	m.
9690	30·96	15335	19·56
11620	25·82	15520	19·32
11650	25·75	17925	16·74

Programmes in English (Overseas Service):

0230 - 0300 GMT on 9690 and 15520 kHz.
1230 - 1300 GMT on 11620 and 17925 kHz.
1715 - 1800 GMT on 11650 kHz.
Listeners' Letterbox: Saturday at 1230, Sunday at 1715, Wednesday at 1230 and 1715.

Adrian also sent in the following log using his VEF 204 receiver:

7210 *ICRC, Geneva* via SBC at 1705.
9745 *R. Baghdad,* Iraq, s/on at 1930.
11650 *R. Bangladesh* at 1740.
11930 *VOA, Okinawa,* s/on at 2200.
11955 *FEBA, Seychelles* at 1730.
15335 *R. Bangladesh* in Bengali at 1430.
15520 *R. Pakistan* at 2050.
17705 *VOA Monrovia,* s/off at 0830.

Ian Howes of Lowestoft has used his R209 Mk. II receiver and TV antenna to log the following stations:

3265 *R.TV Congolaise,* local Mx. at 2015.
3380 *Malawi BC,* local language at 2020.
4800 *R. Lara, Venezuela,* Spanish at 2345.
4880 *Kinshasa, Congo* local Mx. at 2315.
4940 *Abidjan, Ivory Coast,* local Mx. at 2320.
15245 *R. Australia,* ID in English at 2100.
15300 *HCJB, Quito,* Ecuador at 2030.
15345 *TWR, Bonaire* in Spanish at 2328.

R. Cooper of Foulden, near Thetford used his Philips 6 valve domestic recevier and a Bush 4 valve domestic to log the following stations:

11750 *HCJB, Quito,* Ecuador, English at 0830.
11915 *BBC, Cyprus* relay in English at 1645.
15020 *R. Hanoi* with Nx. in French at 1830.
15620 *WINB,* Red Lion at 2120.
15795 *R. Nacional,* Brazil, Mx. at 2010.
21500 *RSA, South Africa,* Nx. in English at 1000.

Richard Witney of Braintree is only 14 years old and is to be congratulated for sending in the following log:

6185 *Radio Norway,* Oslo at 1825.
7135 *TWR,* Monte Carlo at 1930.
9625 *Radio Sweden* in English at 1100.
9915 *AIR, Delhi* in English at 2100.
11725 *Radio Bucharest,* Rumania at 1515.
11910 *Bangkok, Thailand* at 1150.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz ● Times in GMT

NOT a very good month for listening between 1·8 and 30MHz, especially up the h.f. end. It seems that the summer evenings haven't lost their knack of making 20 metres the main dx band and logs indicate that most s.w.l's. appreciated this fact.

David Knott (Middlesborough) enquires about DD3FK. Anyone know if DD works wonders in any other country?

Hands up if you live anywhere near Newtown in Montgomeryshire. Now hands down and get a pen! Seems that there's a newly-formed Amateur Radio Club which welcomes prospective members. All queries to: R. Litten, 512 Maesyrhandir, Newtown, Montgomeryshire.

Hot tip from **Ian Hotchkiss** (Hatfield) that there is an interesting net on Sundays on about 14300kHz (his dial not very accurate) at 1600 hrs. How's about a quick QRX next Sunday?

Sam Elsdon (Halesowen) has been doing strange things with a 500μA meter, diode and l.s. output terminals. (Never mind, the wounds will soon heal). Sam describes his antenna as "310ft. wire arranged in a sort of tapered square spiral in the loft". He asks, "Is there a name for that?" Well is there? Anyone care to suggest something? Gear, besides the above mentioned "thing" in the loft is, a CR70A and PR40. The 21MHz log for s.s.b. reads: CR3MD, CT1EAL, CT2AZ, F6VAA, FL8MM, JA1LCG, JW7FD, LU5AJ, OD5BA, PY2BC, PY7BF, TN8AU, VP8MM, W7GRH, YV4AGP, 4X4NX, 6W8AL, 9Q5DF.

Big round of applause for **Stephen Worral** (Stafford). He dared to listen on four metres. Two receivers are in use (anyone tried ham stereo transmissions yet?)—a B44 and FR-DX-400, the latter covering all amateur bands from 160 to 2 metres inclusive. (Cor! Think of winding the front-end coils by hand). Antenna for 70MHz is a four-over-four in the loft. Signals on 4 metres heard from G2FOS, G3LR, G3OJ, G3ANH, G3AOO, G3CDM/P, G3FBW/P, G3JFO, G3JHM/A, G3JUB, G3JXN, G3KSU/P, G3KTH/P, G3LUP/P, G3MWQ, G3NAS, G3NEO, G3OCC, G3OHC, G3OHH, G3OQT, G3OWW, G3PXP, G3RCQ/P, G3TQF, G3TVW, G3UGN, G3VPF/P, G3VPS/P, G3WCS, G3WXI, G3YBY, G4AGO, G4ALE, G4AYU, G5DF, GI3GLT, GW3ABR/P, GW3ITZ/P, GW3NWR/P, GW3OXD/P, GW3UCB/P, GW3XFY/M So who says there's nothing on 4 metres?

Up (or should that be down?) on 14MHz, Steve's log reads: CP1KRT, HP9AHD, JA1AEA, JA1AGH, JA3BQF, JA6LAE, KP9AID, KR6DO, 44 VK stations (Wow!), VQ9R, XT2AF, ZL1AFO, ZL1BER, ZL1BHB, all s.s.b. with the same gear except antenna; 75ft. end fed at 20ft.

Alan Smith (Nelson) says he will continue to burn the midnight oil. Also committed to this awful pledge is a 680X and a 100ft. length of wire in the loft. Late night oil burnings to date raised 20 metre smoke signals from: CN8HD, CR4BS, CT1QN, EA3JE, EA6BH, EL2CB, EP2TW, HK4BNC, HK5AZA, HP9JW, IT9SPI, JA6GBB, JX2HK, JY9VO, KZ5SD, PY8ZAA, PZ1DR, VE1YW, VK2AVA, VK3BCM, VK4SD, VP1BH, YS1MAX, YV5AK, ZD3M, 4X4VB, 5B4CDN, 5W1AU, 6Y5SR, 9K2AL, 9X5VA, 9Y4T. A quick singe on 15 metres brought in: AP2DU, EA7GF, JA6WAS, JH1DBU, JH1LZW, KV4FY, K9QFR, OD5CS, SV0WZ, SV0WP, VQ9R, VQ9MC, W9MEL, ZD8FM, ZB2A, ZD3M, 4X4BL, 9K2AL, 9X5VA all s.s.b.

Roger Hunt lives in a road I can't pronounce in Carmarthen. Listening utensil is a CR70A plus PR30. Antenna is a 190ft. long wire, end fed. Happenings on 28MHz include: CR6OZ, PY2DVM, ZS6UR, 9J2DT, 9Q5SF. Down on the dreaded forty, where brave receivers cringe, signals were logged from: PY7BBD, PY8YT, TR8VE, ZD8TS, 4U1ITU, 5Z4LW, 9G1DY. I wouldn't mind living in a road I couldn't pronounce just to hear things like that on 7MHz.

A self-confessed agent of **Charles Molloy** has written in! (Gad, these Medium wave devils are everywhere!) Gorgeous gear includes a FR-DX-400 with an 80 metre inverted V (wot, no dx loop wound on broom handles?). Said agent has purged his soul by listening on 3·5MHz to: CP1DN, CP6FG, CR4BS, CX2AX, KP4AST, KP4AN, KV4FZ, OY7JO, OY9LV, PY1HA, PY2ERS, PY3ABH, PY5CDZ, PY6SL, PY7BFN, VE1WV, VE2AL, VE3PT, VO1CQ, ZD8CS, ZD8RR, ZL4KF, 4X4UF, 3A2EE, 5R8AZ. Even 7MHz produced: ZL4KF, VK2AVA, YN9MQ and 9Q5BG. On two metres using a 6-ele homebrew and the same receiver: G4ART, G8AVH/P, G4BBH, G4BEL, G8BXX, G8CGG, G8CKC, G8DYX, G8FAB, G3ZVC. Name of the convert is **W. Waldron** (Cwmbran). Welcome home, brother Bill.

Alan Harper (Manchester) has a VEF204 receiver (I thought it was a new prefix for Rockall). Being b.f.o.-less, he uses a second receiver to get a beat note. Careful adjustment gave readable s.s.b. signals from CR6EM, EA5KR, HC1JB, HP1GS, KV4AD, PY2FCD, W8GL, ZF1WE, 4X4HT, 5N2ABG, 8P6DV, 9H1CV.

Ian Leslie (Mold) says that there are probably better logs about than his. Well, how does the one you didn't send in compare? Gear is an R107 and an end fed of unspecified length which bagged: CO2FA, CT1ZE, EA5IW, EP2MJ, JA2PJC, JX2AK, KV4AV, KZ5NG, M1B, OD5FA, PY4BSX, PY8BX, PZ1AX, TI2GI, VE0NEC/MM, VE1KG, VE2ACP, VE6BB, VK2SG, VK5SV, VK6FP, VK7TR, VK9KA, WA1NGK/P/TF, YN1FI, YN1RSJ, YV1OJ, ZD3D, ZD7CE, ZP5KA, ZD3HT, 4S7AB, 4U1ITU, 4X4HT, 5Z4GG.

August is one of the busiest months in amateur radio. Six mobile rallies and three contests with another two early in September. Contests are: August 5-6, WAE c.w.; 12, 4 metre contest (worth a listen); 20, two metre s.s.b. contest; September 2-3, v.h.f. NFD; 2-3, IARU v.h.f. event; 3, qualifying round of the DF contest at Rugby.

Logs, in alphabetical order please, to arrive by the 15th of the month to:
12 Cross Way, Harpenden, Herts.

EXPERIMENTERS CORNER

FULL WAVE POWER CONTROL CIRCUIT

L. MacNAMARA

A NUMBER of designs have been featured in past issues of Practical Wireless illustrating how s.c.r's (silicon controlled rectifiers) may be used to control such things as the speed of an electric motor and, although these devices worked perfectly well for their intended use, their versatility was limited when applied to light dimming control. In this particular application the s.c.r. has an obvious drawback in that it conducts only on one half cycle of the mains a.c. and the resulting 25Hz frequency appears as a flickering on the bulb, especially when run at low intensities. The obvious method to overcome this difficulty is to use a related device, the TRIAC, which conducts in both directions and the present article illustrates how a very simple and inexpensive power control unit may be assembled from a mere handful of components.

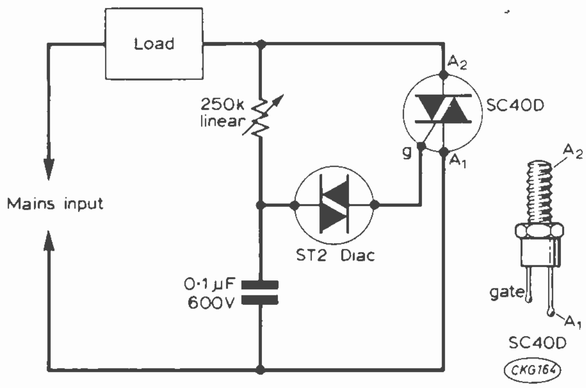


Fig. 1: Full wave power control circuit using a minimum of components.

At the heart of the unit is a G.E. D45D TRIAC (SC40D) which can effectively handle up to 6A at 240V. Basically it can be considered as consisting of two SCR's connected in inverse parallel either of which can be triggered by a pulse applied at the gate. If the time at which this pulse is applied can be varied complete control of the power entering the TRIAC can be effected and this can be realised by a simple resistance/capacity variable phase shift network. An ST2 DIAC, which conducts when the voltage across it reaches about 20V of either polarity, acts as the trigger link between the TRIAC and the phase shift circuit. Fig. 1 shows how such a circuit can be designed using a minimum of components. However due to the sudden switching of the TRIAC from the "off" to the "on" state r.f. interference is produced and this can be a nuisance if the device is operated in the vicinity of radio or TV set. A simple inductance/capacity circuit was therefore incorporated to reduce the interference to a minimum and the prototype was constructed along the lines of Fig. 2. The complete unit was mounted in a plastic box with an ordinary 13A 3-pin socket attached. In addition a 5A fuse was incorporated in the plug to prevent the TRIAC being damaged should excessive current be drawn. ■

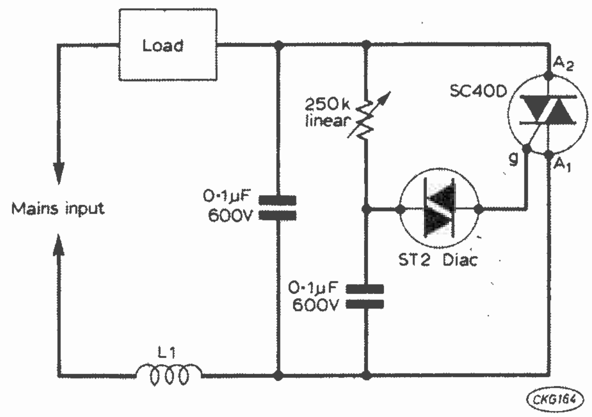


Fig. 2: The same circuit with r.f. suppression. L1 must be capable of handling 5A.

'SCOPE TRIGGER UNIT

P. ROUSE

MANY government surplus oscilloscopes are of extremely high quality and well worth preserving, but sometimes they require an external trigger signal to produce a visible time base. The unit described below produces such a signal and also synchronises the oscilloscope input waveforms to the timebase frequency thus providing a very stable display for accurate measurements. It consists of an astable multivibrator or square wave generator which is coupled to the trigger input on the oscilloscope by a small step-up pulse transformer. The circuit diagram is shown in Fig. 1 and its operation is briefly described.

The multivibrator produces square waves of either polarity at either collector but Tr2 is used because the frequency can be varied over a small range by

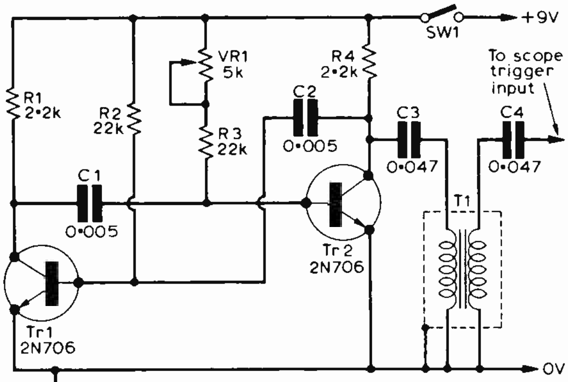


Fig. 1: The circuit of the trigger unit.

★ components list

Resistors:
R1 2·2kΩ
R2 22kΩ
R3 22kΩ
R4 2·2kΩ
all 10% ¼ watt

Capacitors:
C1 0·005μF
C2 0·005μF
C3 0·047μF
C4 0·047μF

Transistors:
Tr1 2N706
Tr2 2N706

Miscellaneous:
VR1/SW1, 5kΩ potentiometer with switch; T1, miniature i.f. coil 0·7cm. x 0·7cm. x 1cm; tag strip 2½in x 1½in; screened box 3in. x 2in x ¾in; battery PP9; wire; 3 x 6BA nuts and bolts ½in long.

adjusting VR1. With the components specified, this range is from 5300Hz to 6500Hz which is quite adequate for synchronisation purposes. The waveform at this collector is shown in Fig. 2. The amplitude is only 8 volts and this must be increased to about 16 volts to trigger most of these old oscilloscopes. Furthermore, a fast pulse rise time is also required. In order to satisfy these two requirements a step-up differentiating pulse transformer must be used. This has the added advantage of producing both positive and negative voltage spikes thus allowing positive and negative triggering. The waveform between C4 and earth is shown in Fig. 3.

Differentiating pulse transformers should have very low leakage inductance and high permeability at their operating frequency. Consequently, a miniature ferrite i.f. transformer is ideally suitable but a Mullard ferrite pot core can be used. The i.f. transformer must be rewound in order to give the correct turns ratio and a diagram of the type used is shown in Fig. 4.

The i.f. transformer must be carefully dismantled and its windings removed. It is then rewound as follows. Firstly 100 turns of fine enamelled wire are wound onto the ferrite bobbin and the ends are soldered on to the lead-through pins in the plastic base. With thin enamel wire such as this, the heat of the soldering iron is sufficient to remove the enamel for easy tinning. Secondly 200 turns of the same gauge wire are wound on to the bobbin and the ends are soldered to the pins as before. The i.f. transformer is then reassembled.

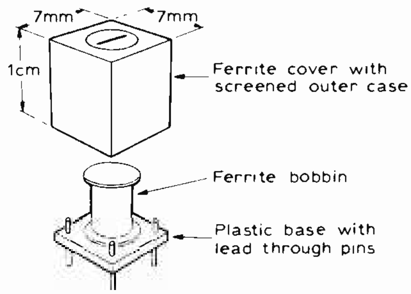


Fig. 4: Construction of the pulse transformer.

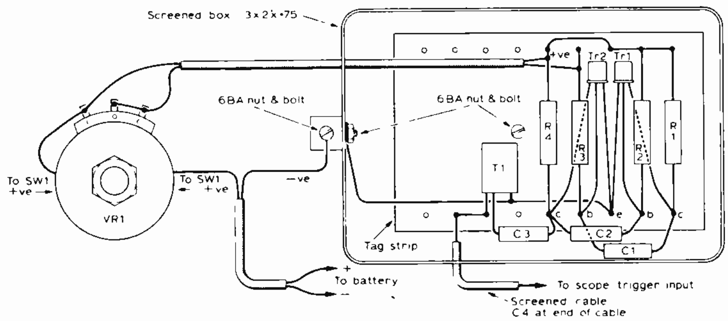
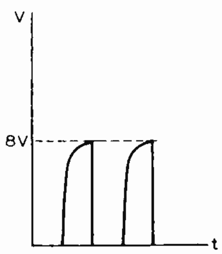


Fig. 5: A suggested component layout.



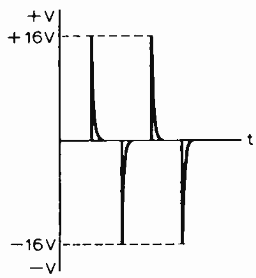
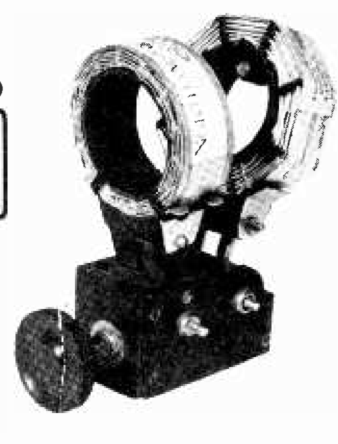


Fig. 2: (left) Waveform at the collector of Tr2.
Fig. 3: (right) Waveform at C4.

The circuit is wired up on a small piece of tag strip and mounted in an old tobacco tin for screening purposes. The switch on the back of the variable resistor VR1 is used as SW1 and the whole unit is small enough to be mounted inside the oscilloscope if required, in which case a hole of diameter ⅜in should be drilled in the front panel to hold VR1 and SW1. A 9 volt battery is used to provide power supplies and this voltage ensures that the transistors operate well within their limits thus providing good operational reliability. A diagram of the assembly is shown in Fig. 5. ■

GOING BACK...

1970 60 50 40 30 20



COLIN RICHES
ARTHUR DOW

MR W. W. Pickard from Lowestoft, Suffolk, tells us he still has an "Osram Music Magnet" with 2 volt valves and the old springy "Benjamin" bakelite valve holders, the set is in near perfect condition. He also has quite a lot of 2-volt valves, all sorts, given to him recently by a local dealer, and two old sets, one of which is a Gecophone, and the other he thinks a "Marconi". He says if any readers happen to be in Lowestoft at any time, they are welcome to see this ancient equipment and valves, if they will call at his business address, 192 London Road South, Lowestoft—an outfitters shop. Phone 5675 (closed Thursday).

He can go back to 1923, and had a 3-valve wireless set with plug-in coils then, and remembers well the first broadcast from 5XX Daventry. He remembers he had at that time an Amplion "Dragon" oak-horn loudspeaker—the price was 5 guineas in those days!

★ ★ ★

Mr. S. D. Smith, 292 Whitton Avenue East, Greenford writes "The article "Going Back" prompts me to write down a few memories of my first home built wireless receiving sets. I used a similar device to the buzzer "thing" shown recently in "Going Back" to find a sensitive spot on the galena crystal. My buzzer was coupled inductively however and had no A or E terminals. Bypassing the galena, bornite Zincite etc., etc., we come to my first valve set. This was built on the bottom of a cut down wooden box from the grocers. A, E and phone terminals were P.O. type with steel wood screws for fixing. The valve holders were bought as separate sockets which were screwed separately into the box. The coils were 45 and 30 turns hank wound round the first three fingers and tied with thread. The aerial coil was clamped between two strips of wood by a centre screw which fixed it to the box. The reaction coil was tied to the end of a lath about 15in. long. The pivot screw (with washers) passing through a cotton reel fixed the assembly to the box above the aerial coil. A similar piece of wood was attached to the condenser. thus providing both slow motion and anticapacity control. One needed to be quite a good oarsman to avoid catching a crab! The condenser was straight line capacity and bunched the stations at the bottom end.

The phones were Sterling from the first World War for which I paid 2/6d. The valve I remember best had a horizontal assembly. It started to go blue above about 20V h.t. and was at that time treasured and only brought out for special occasions! My only measuring instrument was an old Post Office galvo and a few resistances (resistors had not been invented). This was "calibrated" against new h.t. and g.b. batteries. All readings were strictly comparative. This instrument was almost indestructible and could be reversed on overload without ill effect. Once it was connected momentarily to the a.c. mains when on the 120V d.c. range. The only result was a slight demagnetisation, easily corrected by moving the paper "calibrations". The original variable grid leak consisted of a short length of glass tube, two corks, a bit of brass wire and burnt sugar. The degree of burning determined the resistance range—more or less. As I had no megohm meter I had to "suck it and see"!

I heard KDKA New York on two successive mornings at about 1.30 a.m. (My mother gave me a tongue lashing for my bleary eyes and threatened to smash up the gear.) It was many years before I heard America again and never since on medium wave. This experience made me very cynical about the "low loss" components which proliferated later and the degradation of the once honourable term High Fidelity. This was commented upon in the Marconi Book of Wireless (1936).

Memory ranges over unit sets, the Popular Wireless Combination Set which, after various mods. finished up with more SP and DP knife switches than a power house. It was more effective as an exercise in ingenuity and oneupmanship than a wireless set, but fun for all that. The Transatlantic Five with plug in McMichael r.f. transformers which never crossed the Atlantic for me, but which did give me a little ephemoral notoriety when I broadcast to all who cared to listen the results of the first election won by Labour. An early three gang neutrodyne I never did succeed in aligning and reverted to a separate aerial condenser, the old Transatlantic Five arrangement.

Later things became much more commercial and stereotyped so I will conclude with a two valve circuit which gave me a lot of fun for several years. In its final form it had a Ferranti choke and transformer and a BTH moving coil speaker, the latter replacing the Amplion horn, simple moving iron and the Blue Spot balanced armature speakers which served in turn. No screening was used and with all those fields and triode valves you may be able to imagine the stabilising devices that were tried out! Just before it was scrapped I found that reaction was very smooth and the set quite sensitive if r.f. instability was induced over the whole wave band and the reaction coil used back to front. I did not recognise the possibilities of N.F.B. and thought no more about it for years. Hilversum and Paris came in well on L.S., i.e. speech clearly readable in any part of a normally quiet room. Brussels was somewhat weaker but it was only about 100 watts at that time, if my memory is not at fault. It wasn't one of the giants anyway.

I wonder how it would work now? Pentodes, ferrite aerials screened coils and valves, reaction to the first anode and three tuned circuits. Perhaps I'll try it one day if I can find a parafeed 3-1 valve transformer. The AF 5 *was* a bit bulky.

As an after thought—how many remember the very formal announcement --- "Hallo, Hallo, Hallo, this is 2LO calling; this is the London Station of the British Broadcasting Company calling. You will now hear the news, copyright by Reuter, Press Association, Exchange Telegraph and Central News"?

Marconi Kemp Stamp

On September 13th the Post Office will issue a set of four commemorative stamps. One of these, valued 7½p, commemorates the 75th Anniversary of the first wireless transmissions across water. These tests were carried out by Marconi and Kemp from Lavernock Point, near Barry, to Flatholm Island in the Bristol Channel and Brean Down in Somerset.

The Barry College of Further Education Radio Society commemorates these tests annually by operating amateur radio stations from these historic locations. The Society was responsible for suggesting to the Post Office the issue of this stamp, and are justifiably proud of their association with its issue.

In connection with this issue, they are making available a special commemorative first day cover service from Flatholm Island. For the first time the

The design on the envelope in blue and red.

Post Office has granted a postmark from Flatholm Island. The special postmark will include their callsign GB3BCT (Bristol Channel Tests)—the callsign to be used by their station operating from the island on the 13th September. The first day cover is an embossed design showing the location of the three historic sites.

This unique combination should be of great interest to radio enthusiasts and philatelists alike and the Society will provide the special commemorative envelope, the 7½p Marconi stamp, address and post from Flatholm Island on the first day of issue for . . . 20p.

Remittance should be made by crossed postal order or cheque. All monies should be made payable to BARRY COLLEGE F.E.R.S.

Names and addresses should be printed clearly, and orders should be forwarded to:

The Secretary,
Barry College of Further Education Radio Society,
Colcot Road,
Barry, Glamorgan.

to arrive not later than 11th September, 1972

Vintage Records

Once again we ask readers to let us know the titles and labels of any pre-1930 78's they may have as we have received a number of queries asking the whereabouts of such records.

In addition, if anyone has any gen or pictures of "talking machines" cylinder or disc, we would be glad to hear from them as we are considering writing a feature on this subject in a future "Going Back."

Vintage CQ CQ CQ

EQUIPMENT FOR DISPOSAL

...photographs and constructional details of the "All Concert de luxe" receiver by Percy W. Harris, about 1924 also two Scott-Taggart books. Offers to—A. E. Robinson, 34 Haddon Way, Carlyon Bay, St. Austell, Cornwall.

...3 volumes of Harmsworth Wireless Encyclopedia in good clean condition. Together with other items. Sae for details please—F. L. Harris, 80 Queens Walk, Ashford, Middlesex, TW15 3JB.

...Buzzer Wavemeter similar to the one in your column a short time ago, various wirewound, pancake and plug-in coils by Igranic and others, Ferranti and Formo Intervalve transformers and chokes, filament rheostats, ebonite panels etc. and several examples of single and multiple variable condensers by Ormond and Newey. These later being mechanical curiosities in their own right—and mostly brand new. I think there are a couple of complete (?) receivers somewhere in the attics but have not yet come across them. Any offers—J. C. Priest, 21 Levens Grove, Blackpool, Lancs. FY1 5LA.

..."Wireless Telegraphy and Telephony; Charles R. Gibson: Seeley Service, 1914. "The Armstrong Super Regenerator Circuit; George J.ELT2. Radio Directory and Publishing Co. New York, 1922. "The Art and Science of the Gramophone" Gaydon 1928.—V. C. Calver, 11 Robin Dene, Manor Road, Brighton, BN2 5EX.

INFORMATION WANTED

...any gen on Marconiphone V2 receiver type R.B.I.A.M3 Inst. No. S/A 1725. Inside the lid is a Post Office stamp reading "Type approved by the Post Master General P.O. Regd. No. 2001".—A. P. Linsell, 7 Canewdon Hall Close, Canewdon, Rochford, Essex.

...Info on Gecophone 3 valve (Det & 2 l.f.). This is a finely made set with ebonite covered coils loading coil and reaction. Loading coil marked 1250, BC1347 other coil 300, BC1360. But think that these coils are interchangeable. One was used as reaction to the other. In between the two coils is a disc of aluminium which can be slid in and out presumably for adjustment of reaction. Lovely rheostats controlling valve filaments, also neat little cylindrical aerial coupling condenser, made in brass. Marconi 2 valve set. Good slow motion condenser gear. This receiver is marked

"Marconiphone Receiver Type 22 Inst. No. S.C.2661". Unfortunately I have only one coil, longwave, 1000–2200 metres. This is a black ebonite cylinder enclosing coil and beautiful little reaction coil (adjustable from dial on front) marked "Aerial reaction unit, Marconiphone Pat. No. 217042". I would be very pleased to hear of a medium wave coil, 200–500 metres. It clips on to a base with four clips. The two valves fit into one holder mounted on sponge rubber.—W. W. Pickard, 333 Long Road, Lowestoft, Suffolk.

EQUIPMENT WANTED

...receiver, separate speaker or valves from the 1920's or earlier.—Gunnar Carlstrom, S-540 50 Moholm, Sweden. (Radio Amateur SM6KT).

...bright emitter valves or dull emitter with exhaust pips on top. Also horn to fit diaphragm-type speaker, and pre-1920 components.—P. Beckley, 14 Beechdale Road, Newport, Monmouthshire, NPT 8AE.

"J. S. T."

In the article last month on John Scott-Taggart the call-sign of his amateur radio station shown on page 321 should have been LU (later LUX). The receiver illustrated on page 322 was the ST400, not the ST300.

BRAND NEW GUARANTEED

SEMICONDUCTORS & COMPONENTS

SOLE AGENTS FOR SOLID STATES DEVICES INC., (U.S.A.), IN U.K.

RETURN OF POST SERVICE

TRANSISTORS

				2N4931	2.70	AF116	0.25	BC307	0.09	BF271	0.21
				2N5172	0.09	AF117	0.20	BC307A	0.09	BF272	0.53
2G301	0.15	2N2924	0.12	2N5174	0.22	AF118	0.50	BC307VI	0.09	BF273	0.25
2G302	0.15	2N2925	0.12	2N5175	0.26	AF121	0.22	BC308	0.08	BF274	0.28
2G303	0.25	2N2926		2N5176	0.32	AF124	0.24	BC308A	0.08	BF457	0.46
2G306	0.30	Green	0.10	2N5245	0.43	AF125	0.20	BC308B	0.08	BF458	0.57
2G309	0.30	Yellow	0.10	2N5190	0.92	AF126	0.20	BC309	0.09	BF459	0.57
2G344A	0.25	Orange	0.15	2N5191	0.96	AF127	0.20	BC309A	0.09	BFS21	2.10
2G345B	0.25	2N3053	0.15	2N5192	1.24	AF139	0.33	BC309B	0.09	BFS21A	2.30
2G371	0.15	2N3054	0.47	2N5193	1.01	AF170	0.25	BC313	0.30	BFS28	0.92
2G374	0.15	2N3054	0.47	2N5194	1.10	AF172	0.25	BC327	0.21	BFS61	0.27
2G381	0.25	2N3055	0.60	2N5195	1.46	AF178	0.55	BC328	0.19	BFS98	0.30
2G417	0.20	2N3390	0.20	2N5245	0.43	AF179	0.65	BC337	0.17	BFW10	0.61
2N109	0.49	2N3391	0.20	2N5457	0.35	AF180	0.50	BC338	0.17	BFW11	0.61
2N174	1.40	2N3391A	0.22	2N5458	0.33	AF186	0.40	BCY30	0.35	BFW15	0.35
2N176	0.75	2N3392	0.13	2N5459	0.33	AF200	0.35	BCY31	0.40	BFX13	0.23
2N274	0.75	2N3393	0.12	3N128	0.63	AF239	0.36	BCY32	0.60	BFX29	0.25
2N335	0.75	2N3394	0.12	3N138	1.37	AF240	0.63	BCY32	0.50	BFX30	0.25
2N351	0.95	2N3402	0.17	3N199	1.36	AF279	0.47	BCY33	0.30	BFX37	0.33
2N376	1.00	2N3403	0.19	3N140	0.76	AF280	0.47	BCY34	0.35	BFX44	0.33
2N384	0.93	2N3404	0.24	3N141	0.69	AFY42	0.65	BCY38	0.40	BFX63	2.48
2N388A	0.40	2N3405	0.27	3N142	0.54	AF211	0.55	BCY39	0.80	BFX68	0.30
2N404	0.23	2N3414	0.10	3N143	0.64	AL102	0.75	BCY40	0.50	BFX84	0.24
2N404	0.23	2N3415	0.10	3N152	0.79	AL103	0.70	BCY42	0.15	BFX85	0.29
2N456	0.75	2N3416	0.15	3N153	0.74	ASY26	0.25	BCY43	0.15	BFX86	0.24
2N456A	0.75	2N3417	0.21	3N154	0.74	ASY27	0.30	BCY58	0.18	BFX87	0.27
2N457A	0.80	2N3570	1.25	3N159	1.00	ASY28	0.25	BCY59	0.19	BFX88	0.25
2N491	3.25	2N3571	1.12	3N187	1.30	ASY29	0.30	BCY66	0.58	BFX89	0.45
2N584	0.26	2N3572	0.97	3N200	2.07	ASY50	0.20	BCY67	0.82	BFY10	0.35
2N591	0.34	2N3702	0.11	3N201	1.05	ASY55	0.35	BCY70	0.17	BFY11	0.45
2N696	0.15	2N3703	0.10			ASZ21	0.55	BCY71	0.22	BFY17	0.90
2N697	0.15	2N3704	0.11			AU103	1.25	BCY72	0.10	BFY18	0.35
2N698	0.25	2N3705	0.10			BC107	0.12	BCY87	3.47	BFY19	0.35
2N699	0.29	2N3706	0.90			BC108	0.11	BCY88	2.40	BFY20	0.50
2N706	0.10	2N3707	0.11			BC109	0.12	BCY89	0.80	BFY29	0.40
2N706A	0.12	2N3708	0.70			BC113	0.13	BCZ10	0.35	BFY37	0.20
2N708	0.13	2N3709	0.90			BC114	0.12	BCZ11	0.50	BFY41	0.43
2N709	0.38	2N3710	0.90	40050	0.50	BC115	0.15	BD115	0.75	BFY43	0.65
2N711	0.30	2N3711	0.90	40251	0.58	BC116	0.15	BD116	0.75	BFY50	0.16
2N718	0.21	2N3712	0.95	40309	0.26	BC116A	0.18	BD121	0.75	BFY51	0.16
2N718A	0.30	2N3713	1.08	40310	0.37	BC117	0.21	BD123	0.82	VFY52	0.16
2N720	0.50	2N3714	1.15	40360	0.35	BC118	0.11	BD124	0.60	BFY53	0.15
2N721	0.55	2N3715	1.23	40361	0.37	BC119	0.27	BD130	0.50	BFY56	0.34
2N914	0.15	2N3716	1.30	40362	0.40	BC121	0.20	BD131	0.75	BFY64	0.41
2N916	0.17	2N3773	2.40	43063	0.61	BC123	0.25	BD132	0.75	BFY75	0.40
2N918	0.30	2N3774	3.33	40389	0.37	BC125	0.15	BD135	0.38	BFY76	0.22
2N919	0.20	2N3775	4.19	40394	0.58	BC126	0.20	BD136	0.44	BFY77	0.24
2N929	0.14	2N3776	5.95	40395	0.50	BC132	0.30	BD137	0.47	BFY78	0.36
2N930	0.14	2N3777	4.84	40406	0.40	BC134	0.11	BD138	0.55	BFY90	0.55
2N1090	0.30	2N3778	2.25	40407	0.31	BC135	0.11	BD139	0.62	BRY39	0.38
2N1091	0.32	2N3779	3.15	40408	0.41	BC136	0.15	BD140	0.73	BSX19	0.13
2N1131	0.20	2N3780	4.50	40409	0.49	BC137	0.15	BDY10	1.25	BSX20	0.14
2N1132	0.20	2N3781	3.67	40410	0.53	BC138	0.24	BDY11	1.50	BSX21	0.20
2N1184	1.27	2N3782	3.87	40411	1.40	BC140	0.30	BDY17	1.50	BSX26	0.34
2N1302	0.16	2N3789	1.76	40467A	0.57	BC141	0.34	BDY18	1.75	BSX27	0.34
2N1303	0.16	2N3790	1.90	40468A	0.35	BC142	0.18	BDY19	1.97	BSX28	0.25
2N1304	0.20	2N3791	2.06	40600	0.57	BC143	0.21	BDY20	1.00	BSX29	0.43
2N1305	0.20	2N3792	2.20	40601	0.55	BC144	0.24	BDY38	0.65	BSX30	0.68
2N1306	0.22	2N3794	0.10	40602	0.40	BC145	0.21	BDY60	0.90	BSX59	0.78
2N1307	0.22	2N3819	0.28	40603	0.49	BC147	0.10	BDY61	0.85	BSX60	0.54
2N1308	0.25	2N3820	0.49	40604	0.45	BC148	0.09	BDY62	0.75	BSX61	0.42
2N1309	0.25	2N2923	0.62	40636	0.33	BC149	0.11	BF115	0.25	BSX76	0.15
2N1483	0.90	2N3824	0.75	40673	0.60	BC153	0.10	BF117	0.45	BSX77	0.20
2N1507	0.30	2N3826	0.23	AC107	0.35	BC154	0.11	BF119	0.58	ASX78	0.25
2N1613	0.20	2N3854	0.16	AC113	0.16	BC157	0.09	BF121	0.25	BSW70	0.28
2N1613	0.38	2N3854A	0.16	AC115	0.16	BC158	0.10	BF123	0.27	BSY24	0.20
2N1637	0.36	2N3855	0.16	AC117	0.20	BC159	0.10	BF125	0.25	BSY25	0.20
2N1638	0.32	2N3855A	0.16	AC121	0.11	BC160	0.11	BF127	0.27	BSY26	0.20
2N1671	1.00	2N3856	0.16	AC126	0.20	BC167B	0.11	BF152	0.20	BSY27	0.15
2N1701	1.10	2N3856A	0.16	AC127	0.20	BC168B	0.10	BF153	0.29	BSY28	0.15
2N1702	2.15	2N3858	0.16	AC128	0.20	BC168C	0.10	BF154	0.16	BSY38	0.15
2N1711	0.17	2N3858A	0.16	AC141K	0.30	BC169B	0.11	BF158	0.23	BSY39	0.15
2N1893	0.34	2N3859	0.16	AC142K	0.25	BC169C	0.11	BF159	0.27	BSY51	0.25
2N2102	0.30	2N3859A	0.16	AC151V	0.12	BC170	0.11	BF160	0.23	BSY52	0.25
2N2147	0.70	2N3860	0.16	AC152V	0.15	BC171	0.13	BF161	0.35	BSY53	0.25
2N2148	0.60	2N3866	0.70	AC153	0.19	BC172	0.11	BF163	0.20	BSY54	0.30
2N2192	0.40	2N3877	0.25	AC153K	0.22	BC182	0.10	BF166	0.35	BSY56	0.79
2N2192A	0.40	2N3877A	0.26	AC154	0.20	BC182L	0.10	BF167	0.18	BSY65	0.15
2N2193	0.58	2N3878	1.22	AC176	0.16	BC183	0.09	BF173	0.19	BSY78	0.40
2N2193A	0.61	2N3879	1.91	AC176K	0.17	BC183L	0.09	BF177	0.25	BSY79	0.40
2N2194	0.27	2N3900	0.20	AC187K	0.17	BC184	0.11	BF178	0.31	BSY790	0.45
2N2194A	0.30	2N3900A	0.21	AC188K	0.23	BC184L	0.11	BF179	0.38	BSY95A	0.09
2N2195	0.37	2N3901	0.32	ACY17	0.25	BC186	0.25	BF180	0.35	BU104	1.42
2N2195A	0.18	2N3903	0.22	ACY18	0.15	BC187	0.25	BF181	0.34	BU105	2.25
2N2218A	0.18	2N3904	0.22	ACY19	0.20	BC204	0.11	BF182	0.40	C111	0.53
2N2219	0.20	2N3905	0.21	ACY20	0.20	BC205	0.10	BF183	0.40	C407	0.18
2N2219A	0.20	2N3906	0.22	ACY21	0.18	BC206	0.10	BF184	0.17	C424	0.15
2N2220	0.20	2N4036	0.40	ACY22	0.13	BC207	0.10	BF185	0.17	C425	0.36
2N2221	0.20	2N4037	0.35	ACY28	0.18	BC208	0.09	BF194	0.14	C426	0.25
2N2221A	0.22	2N4058	0.12	ACY30	0.42	BC209	0.10	BF195	0.15	C428	0.25
2N2222	0.20	2N3059	0.90	ACY39	0.55	BC211	0.30	BF196	0.15	C444	0.26
2N2222A	0.32	2N4060	0.11	ACY40	0.17	BC212K	0.10	BF197	0.15	D40N3	0.62
2N2368	0.11	2N4061	0.11	ACY41	0.17	BC212L	0.12	BF198	0.18	GET111	0.45
2N2369	0.12	2N4062	0.11	ACY44	0.31	BC214L	0.14	BF199	0.18	GET113	0.25
2N2369A	0.17	2N4302	0.25	AD136V	0.84	BC236	0.16	BF200	0.40	GET114	0.20
2N2646	0.45	2N4303	0.32	AD140	0.50	BC237	0.08	BF224J	0.17	GLT115	0.50
2N2647	1.20	2N4913	0.80	AD140	0.55	BC238	0.08	BF225J	0.19	GET119	0.35
2N2711	0.12	2N4914	0.87	AD142	0.50	BC239	0.08	BF257	0.22	GET120	0.40
2N2712	0.12	2N4915	0.95	AD143	0.45	BC251	0.20	BF238	0.22	GET535	0.20
2N2713	0.17	2N4916	0.11	AD149V	0.58	BC252	0.18	BF244	0.16		
2N2714	0.17	2N4917	0.17	AD149V	1.23	BC253	0.23	BF245	0.33	GET536	0.20
2N2904	0.18	2N4918	0.50	AD150	0.55	BC257	0.08	BF246	0.43	GET538	0.20
2N2904A	0.29	2N4919	0.53	AD161	0.33	BC258	0.08	BF247	0.49	GET873	0.15
2N2905	0.26	2N4920	0.60	AD162	0.36	BC259	0.11	BF254	0.14	GET880	0.35
2N2905A	0.28	2N4921	0.50	AD161 }		BC261	0.20	BF255	0.15	GET883	0.20
2N2906	0.18	2N4922	0.55	AD162 } PR	0.60	BC262	0.18				
2N2906A	0.23	2N4923	0.60	ADZ11	1.50	BC263	0.23	BF257	0.41	GET887	0.20
2N2907	0.18	2N4926	0.90	ADZ12	1.75	BC300	0.42	BF258	0.46	GET890	0.35
		2N4927	1.00	AF106	0.24	BC301	0.34	BF259	0.48	GET895	0.25
2N2907A	0.26	2N4928	1.30	AF109R	0.35	BC302	0.27	BF261	0.23	MA8001	0.16
2N2913	0.75	2N4929	2.23	AF114	0.25	BC303	0.54	BF264	1.45	MA8002	0.47
2N2923	0.12	2N4930	2.25	AF115	0.25	BC304	0.43	BF270	0.25	MA8003	0.47

Post & Packing 13p per order. Europe 25p. Commonwealth (Air) 65p (MIN.) Matching charge (audio transistors onl) 15p. extra per pair. Prices subject to alteration without prior notice.

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	1–24 £p	25+ £p		1–24 £p	25+ £p		1–24 £p	25+ £p
SN7400	0.20	0.18	SN7428	0.71	0.62	SN7460	0.20	0.18
SN7401	0.20	0.18	SN7430	0.20	0.18	SN7470	0.38	0.34
SN7402	0.20	0.18	SN7432	0.48	0.42	SN7472	0.36	0.31
SN7403	0.20	0.18	SN7433	0.71	0.62	SN7473	0.45	0.39
SN7404	0.22	0.20	SN7437	0.52	0.45	SN7474	0.45	0.39
SN7405	0.22	0.20	SN7438	0.52	0.45	SN7475	0.60	0.55
SN7406	0.56	0.50	SN7439	0.52	0.45	SN7476	0.47	0.42
SN7407	0.56	0.50	SN7440	0.20	0.18	SN7480	0.70	0.65
SN7408	0.22	0.20	SN7441AN	0.80	0.77	SN7481	1.45	1.27
SN7409	0.22	0.20	SN7442	1.04	0.88	SN7482	1.26	1.00
SN7410	0.20	0.18	SN7443	1.04	0.88	SN7483	1.30	1.05
SN7411	0.22	0.20	SN7444	1.04	0.88	SN7484	1.10	1.00
SN7412	0.48	0.42	SN7445	1.85	1.70	SN7485	2.50	2.30
SN7413	0.35	0.32	SN7446	1.30	1.20	SN7486	0.45	0.40
SN7416	0.45	0.40	SN7447	1.30	1.20	SN7488	12.40	11.80
SN7417	0.45	0.40	SN7448	1.04	0.92	SN7489	4.97	4.40
SN7420	0.20	0.18	SN7449	Price to be		SN7490	0.80	0.75
SN7421	0.22	0.20		announced shortly		SN7491	1.20	1.00
SN7422	0.48	0.42	SN7450	0.20	0.18	SN7492	0.80	0.75
SN7423	0.52	0.45	SN7451	0.20	0.18	SN7493	0.80	0.75
SN7425	0.48	0.42	SN7452	0.20	0.18	SN7494	0.85	0.79
SN7426	0.32	0.28	SN7453	0.20	0.18	SN7495	0.85	0.79
SN7427	0.48	0.42	SN7454	0.20	0.18	SN7496	1.00	0.90

SUB-MIN ELECTROLYTIC

Axial lead — 6p each

Values: (μF/V); 0·64/64; 1/40; 1·6/25; 2·5/16; 2·2/63; 4/10; 4/40; 6·4/6·4; 6·4/25; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/10.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	8p	9p	10p	11p	12p	15p	20p	—
3A	15p	17p	20p	22½p	25p	27p	30p	35p
6A	—	—	25p	30p	32½p	35p	—	—
10A	30p	35p	40p	47p	56p	66p	75p	—
15A	36p	45p	48p	55p	65p	75p	87p	—
35A	70p	80p	90p	£1·00	£1·40	£1·70	£2·75	—

1 amp and 3 amp are plastic encapsulation.

DIODES & RECTIFIERS

IN34A	10p	AA119	7p	BAX16	12½p	FST3/4	22½p
IN914	7p	AA129	15p	BAY18	17½p	OA5	17p
IN916	7p	AAZ13	12p	BAY31	7p	OA10	20p
IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
IS940	5p	BA154	12p	BYZ12	30p	OA202	10p
		BAX13	5p	BYZ13	25p	TIV307	50p

OPTOELECTRONICS

MINITRON 3015F 7-SEGMENT INDICATOR (16 PIN DIL) £2·00
May be driven by SN7447

GNP-7AH COLD CATHODE TUBE SIDE VIEWING. 0-9 and TWO DECIMAL POINTS. May be driven by SN7441AN. 75p

TIL 209 LIGHT EMITTING DIODE. Made by TEXAS INST. (Red). 35p

B9900 PHOTORESISTOR 38p

VEROBOARD

	0.15 Matrix	0.1 Matrix
2½ × 3¾in	17p	23p
2½ × 5in	25p	25p
3¾ × 3¾in	25p	25p
3¾ × 5in	30p	29p
5 × 17in (Plain)	82p	—

Vero Pins (Bag of 36) 20p
Vero Cutter 45p
Pin insertion Tools (·1 and ·15 matrix) at 55p.

"SCORPIO" CAP DISCHARGE IGNITION SYSTEM
(As published in P.E. Nov. '71). Complete kit £10·00
P. & P. 50p.

RESISTORS

Carbon Film

⅛ watt 5%, 1p. — ⅛W, 1W & 2W E12 Series
¼ watt 5%, 1p
½ watt 5%, 1½p
½ watt 2%, M/O 4p
1 watt 10%, 2½p — ⅛W & ¼W E24 Series.
2 watt 10%, 5p

SLIDE POTENTIOMETERS

58 mm, TRACK
SINGLE GANGED. LOG or LIN 1k to 1M. 40p each.
TWIN GANGED. LOG or LIN 1k to 500k 60p each

MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047	3p each
0·068, 0·10	4p each
0·15, 0·22, 0·33	5p each
0·47	9p
0·68	11p
1μF	14p
1·5μF	21p
2.2μF	25p

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only), 7p
5 watt 5% (up to 8·2k Ω only), 9p
10 watt 5% (up to 26k Ω only), 10p

POTENTIOMETERS

Carbon:
Log. or Lin., less switch, 10p
Log. or Lin., with switch, 25p
Wire-wound Pots (3W), 38p
Twin Ganged Stereo Pots, Log. or Lin. 40p.

PRESETS (CARBON)

0·1 Watt	6p	VERTICAL
0·2 Watt	6p	OR
0·3 Watt	7½p	HORIZONTAL

P.W. Digital Clock
Complete Kit (less box) as in April '72 issue.
£20·50 (inc. P. & P.)

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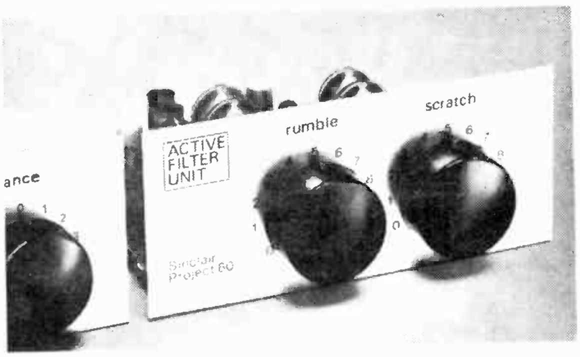
Sinclair Project 60



Active Filter Unit

(A.F.U.)

Built and tested
post free
£5.98

The value of an efficient filtering system cannot be over emphasized in these days of very high quality reproduction since there are so often occasions where its use can mean the difference between comfortable and uncomfortable listening. On the low pass side the Sinclair A.F.U. will effectively reduce hiss from radio or tape, cut out heterodyne whistles on A.M. reception, greatly reduce record surface noise and other imperfections; on the high-pass side it will cut out motor rumble and other spurious low frequency intrusion. The unit is for use between pre-amp (including tape pre-amps) and power amplifiers, and operates in two sections, both stereo. The cut-off frequencies are continuously variable, and since attenuation in the rejection band is rapid (12dB/octave) there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is as easy to mount as the stereo 60 pre-amp/control unit which it matches in styling, along with the Stereo FM Tuner.

SPECIFICATIONS

The A.F.U. employs two Sallen and Key type active filter stages, one rumble (high pass) and one scratch (low pass). The two stages use complementary transistors to minimise distortion.

Supply voltage: 15 to 35 volts. Current 3mA maximum.

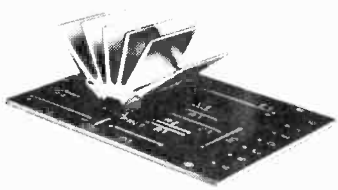
Gain at 1kHz: Filters flat 0.98 (—0.2 dB)

HF cut off: (—3dB) variable from 28 kHz to 5 kHz at 12 dB/octave.

LF cut off: (—3dB) variable from 25Hz to 100Hz at 12dB/octave.

Distortion: at 1kHz (35 volt supply) 0.02% at rated output.

Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC. make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω. **Frequency Response:** 5Hz to 100KHz±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0·1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22×45×28mm including pins and heat sink..

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.
£2.98 Post free

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

Everything you need to assemble a superb 30 watt high fidelity stereo amplifier without having to solder.

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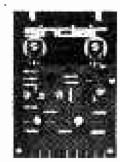
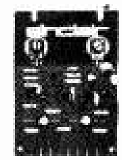
Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

the world's most advanced high fidelity modules

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual **Z.30 £4.48** **Z.50 £5.48**



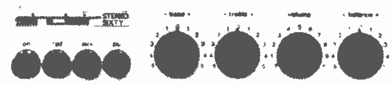


The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).*** **— Power Outputs:**
Z.30 15 watts R.M.S. into 8 ohms using 35 volts : 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency response: 30 to 300,000Hz ± 1dB. **Distortion:** 0.02% into 8 ohms. **Signal to noise ratio:** better than 70dB unweighted. **Input sensitivity:** 250mV into 100 Kohms (for 15w into 8Ω). For speakers from 3 to 15 ohms impedance. **Size:** 14 x 80 x 57mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**



Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u 3mV correct to R.I.A.A. curve ±1dB 20 to 25,000 Hz. Ceramic p.u – up to 3mV Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE +12 to —12dB at 10KHz BASS +12 to —12dB at 100Hz **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C **Tuning range:** 87.5 to 108MHz **Sensitivity:** 7μV for lock-in over full deviation **Squelch level:** Typically 20μV **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB) **Total harmonic distortion:** 0.15% for 30% modulation **Stereo decoder operating level:** 2μV **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum **Operating voltage:** 25–30VDC. **Indicators:** Stereo on ; tuning **Size:** 93 x 40 x 207mm

Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**

Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc.	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control, etc	**£9.45**
12W RMS continuous sine wave stereo amp for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. **(£5.98)** may be added as required.

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Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

SINCLAIR RADIONICS, ST IVES, HUNTINGDONSHIRE PE17 4HJ

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WEYRAD

COILS & TRANSFORMERS FOR CONSTRUCTORS

Special versions of our P50 Series are now available for AF117 or OC45 Transistors. They can be used in the standard superhet circuit with slight changes in component values.

Oscillator Coil	P50/1AC (For OC45)	P50/1AC (For AF117)	33p
1st I.F. Transformer	P50/2CC (For OC45)	P51/1 (For AF117)	36p
2nd I.F. Transformer	P50/2CC (For OC45)	P51/2 (For AF117)	36p
3rd I.F. Transformer	P50/3CC (For OC45)	P50/3V (For AF117)	36p

Rod Aerial	RA2W	72p
Driver Transformer	LFDT4/1	58p
Output Transformer	OPT1	58p
Printed Circuit	PCA1	58p

I.F. TRANSFORMERS FOR "PRACTICAL WIRELESS" CIRCUITS

Components for several receivers are available, including the following for the "Clubman".

T41/1E	1st I.F. Transformer	39p
T41/2E	2nd I.F. Transformer	39p
T41/3T	3rd I.F. Transformer	57p
T41/3T	B.F.O. Coil	57p

Details of these and our other components are given in an illustrated folder which will be supplied on request with postage please.

WEYRAD (ELECTRONICS) LIMITED
SCHOOL STREET, WEYMOUTH, DORSET

NEW-from partridge

SIZE: 6 inches (153mm) x 5¼ inches (133mm) x 3 inches (76mm)

FINISH: Gold Stove Enamel Metal Case with Fascia Off White on Maroon

JOYMATCH 111A—versatile Pi circuit. Matches most antennae, including JOYSTICK VFA, to your Communications Receiver. 1·6 to 32 MHz continuous coverage. **£11·00** (+30p p/p)

JOYMATCH 111A—FOR TRANSMITTING: High peak, harmonic free, excellent SWR obtainable on 6 bands 160 thru 10, when used with JOYSTICK VFA. Handles up to 300W P.E.P. (P.A. input) at LOW "Z" out.

PARTRIDGE PACKAGE DEAL

TRIO 9R59DS (with mechanical filter)	£57·50	delivered
TRIO Matching SP5D speaker (optional)	£4·38	,,
JOYMATCH 111 or 111A	£11·00	,,
Matching JOYSTICK VFA (1972 model) when ordered with above	FREE	,,
COMPLETE HIGH PERFORMANCE RECEIVING STATION	£72·88	,,

Send 3p stamp for full details and illustrated description of ALL PARTRIDGE SPACE AGE PRODUCTS for improved reception and transmission to:—

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C.O.D. orders accepted by phone

GEIGER COUNTERS

(FOR MAINS OR PORTABLE BATTERY USE)

Latest Home Office release and probably the last, of this well known Contamination Meter No. 1, this very useful Instrument is used for the measurement of Radio-Activity. Indicated on an Internal Meter scaled 0·1 to 10 milli Rontgens/Hour, a socket is also provided for additional sound Monitoring on Headphones. This Instrument is housed in a Strong light Alloy Case, placed in a carrying Haversack with shoulder strap. Containing Cable and Hand held Probe, Instruction Card, plus the latest plug in Vibrator Power Unit, which uses current small Transistor Radio Batteries (4 Mallory Long Life RM12 or 4 EverReady H.P.7 or equivalent makes).
For Mobile use anywhere. (Cost Gov. approx. £70 each). Supplied Brand New in Carton only **£5·50** carr. 50p. An additional plug in Power Unit for Laboratory use, operating from 100–120 volts or 200–250 volts A.C. Mains is available. Supplied Brand New in Carton only **£2·50** post 25p. Headphones (not necessary) if required £1·50. A few Geiger Counters as above but not boxed in cardboard cartons, available at only £4·50.

Meter Dose Rate Portable Trainer NO. 1
This was used to train in the use of Geiger Counters. A very compact selfcontained Geiger Counter, being very sensitive. Radiation indicated on Internal Meter scaled 0 to 3 Rontgens /Hour × 10–4. Unit contained in Waterproof Alloy Case, which is hand held. Uses Internal Batteries (4 EverReady B105 and I U2 or equivalent makes) Not Supplied. These have had little or practically no use, supplied as New in Cartons. Few only **£3·50** carr. 50p.

Due to Warehouse clearance, we have for disposal few only Trans-Receivers No. 62 MK2. Made by Pye for the Navy and Army. Using a total of 11 Valves, 1 RF and 2 I.F. stages, A.V.C., BFO, covering 1·5 mc/s to 10 mc/s (approx 200 to 30 metres) in two switched Bands. Can be used on RT or CW M.O. or Crystal. A very good Internal ATU made of a rotating Silver wire coil. Tuneable over the complete range, suitable for Aerials 4ft to 100ft. Internal P.U. for 12 volt DC. A meter is fitted for checking voltages A.V.C. etc. Housed in a Metal Waterproof Case approx size 18" × 10½" × 12½". Supplied in very good condition with Headphones & Mike two spare Valves, circuit boxed, only at **£12·50**. Carr. £1. Air Tested £1 extra. A few Grade 2 sets **£9·50**. Carr. £1, Air Tested £1 extra. **CRYSTAL CALIBRATOR No. 10.** Range [illegible] to 10 mc/s, up to 30 mc/s on Harmonics. Size 7" × 7½" × 4", Power 300 volts HT, 12 volts L.T. The Calibrator can plug into a Power Socket on the 62 Trans-Receiver which it was normally used with. Supplied in Good used condition with circuit £2·50 Post 50p or **Brand New in Carton** with operating Manual & Circuit Connectors per set **£5·00**. Post 50p.

JOHNS RADIO Dept. D, 424 Bradford Road, Batley, Yorks. *Phone Morley 69696*

SEW PANEL METERS

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● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK
● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

TYPE SW.100
100 x 80 mm.

		20V. D.C.	£3·10
50µA	£3·60	50V. D.C.	£3·10
50-0-50µA	£3·45	300V. D.C.	£3·10
100µA	£3·45	1 amp. D.C.	£3·10
100-0-100µA	£3·35	5 amp D.C.	£3·10
500µA	£3·20	300V. A.C.	£3·10
1mA	£3·10	VU Meter	£3·75

BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts

50µA	£3·20		
50-0-50µA	£3·10	50V. D.C.	£2·60
100µA	£3·10	300V. D.C.	£2·60
100-0-100µA	£3·00	1 amp. D.C.	£2·60
500µA	£2·75	5 amp. D.C.	£2·60
1mA	£2·60	300V. A.C.	£2·60
20V. D.C.	£2·20	VU Meter	£3·37

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in. × 4¼in. fronts.

		50mA	£2·80
		100mA	£2·80
		500mA	£2·80
		1 amp.	£2·80
		5 amp.	£2·80
		15 amp.	£2·80
		30 amp.	£2·90
		20V. D.C.	£2·80
		50V. D.C.	£2·80
50µA	£3·60	150V. D.C.	£2·80
50-0-50µA	£3·10	300V. D.C.	£2·80
100µA	£3·10	15V. A.C.	£2·80
100-0-100µA	£3·00	300V. A.C.	£2·80
200µA	£3·00	8 Meter 1mA	£2·87
500µA	£2·90	VU Meter	£3·60
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1mA	£2·80	5 amp. A.C.*	£2·80
1-0-1mA	£2·80	10 amp. A.C.*	£2·80
5mA	£2·80	20 amp. A.C.*	£2·80
10mA	£2·80	30 amp. A.C.*	£2·80

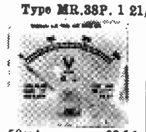
Type MR.52P. 2½in. square fronts.

50µA	£3·10	10V. D.C.	£2·00
50-0-50µA	£2·60	20V. D.C.	£2·00
100µA	£2·60	50V. D.C.	£2·00
100-0-100µA	£2·50	300V. D.C.	£2·00
500µA	£2·30	15V. A.C.	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	8 Meter 1mA	£2·10
10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3½in. × 3¼in. fronts.

50µA	£3·37	10V. D.C.	£2·20
50-0-50µA	£2·75	20V. D.C.	£2·20
100µA	£2·75	50V. D.C.	£2·20
100-0-100µA	£2·65	150V. D.C.	£2·20
200µA	£2·65	300V. D.C.	£2·20
500µA	£2·40	15V. A.C.	£2·30
500-0-500µA	£2·20	50V. A.C.	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	8 Meter 1mA	£2·37
100mA	£2·20	VU Meter	£3·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
50 amp.	£2·50	20 amp. A.C.*	£2·20
5V. D.C.	£2·20	30 amp. A.C.*	£2·20

Type MR.38P. 1 21/32in. square fronts.



		200mA	£1·60
		300mA	£1·60
		500mA	£1·60
		750mA	£1·60
		1 amp.	£1·60
		2 amp.	£1·60
		5 amp.	£1·60
		10 amp.	£1·60
50µA	£2·10	3V. D.C.	£1·60
50-0-50µA	£1·90	10V. D.C.	£1·60
100µA	£1·90	15V. D.C.	£1·60
100-0-100µA	£1·75	20V. D.C.	£1·60
200µA	£1·75	100V. D.C.	£1·60
500µA	£1·65	150V. D.C.	£1·60
500-0-500µA	£1·60	300V. D.C.	£1·60
1mA	£1·60	500V. D.C.	£1·60
1-0-1mA	£1·60	750V. D.C.	£1·60
2mA	£1·60	15V. A.C.	£1·70
5mA	£1·60	50V. A.C.	£1·70
10mA	£1·60	150V. A.C.	£1·70
20mA	£1·60	300V. A.C.	£1·70
50mA	£1·60	500V. A.C.	£1·70
100mA	£1·60	8 Meter 1mA	£1·70
150mA	£1·60	VU Meter	£2·10

Type MR.45P. 2in. square fronts.

50µA	£2·25	5 amp.	£1·70
50-0-50µA	£2·10	10V. D.C.	£1·50
100µA	£2·10	20V. D.C.	£1·50
100-0-100µA	£1·87	50V. D.C.	£1·50
200µA	£1·87	300V. D.C.	£1·50
500µA	£1·75	15V. A.C.	£1·80
500-0-500µA	£1·70	300V. A.C.	£1·80
1mA	£1·70	8 Meter 1mA	£1·85
5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp.	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METER

Type MR.65. 3½in. square fronts.

		1 amp.	£1·95
		2 amp.	£1·95
		5 amp.	£1·95
		15 amp.	£1·95
		30 amp.	£1·95
		50 amp.	£1·95
		5V. D.C.	£1·95
		10V. D.C.	£1·95
		20V. D.C.	£1·95
		50V. D.C.	£1·95
		150V. D.C.	£1·95
25µA	£3·50	300V. D.C.	£1·95
50µA	£2·75	30V. A.C.*	£1·95
50-0-50µA	£2·35	50V. A.C.*	£1·95
100µA	£2·35	150V. A.C.*	£1·95
100-0-100µA	£2·25	300V. A.C.*	£1·95
500µA	£2·20	500mA A.C.*	£1·95
1mA	£1·95	1 amp. A.C.*	£1·95
1-0-1mA	£1·95	5 amp. A.C.*	£1·95
5mA	£1·95	10 amp. A.C.*	£1·95
10mA	£1·95	20 amp. A.C.*	£1·95
50mA	£1·95	30 amp. A.C.*	£1·95
100mA	£1·95	50 amp. A.C.	£1·95
500mA	£1·95	VU Meter	£3·10

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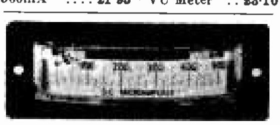
Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50µA	£5·00	20V d.c.	£4·80
100µA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c.	£4·40
50-0-50µA	£4·65		
1-0-1mA	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c.	£4·65
10V. d.c.	£4·40		



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Type PE.70. 3 17/32in. × 1 15/32in. × 2¼in. deep

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50-0-50µA	£3·00	1mA	£2·45
100µA	£3·00	300V. A.C.	£2·45
100-0-100µA	£2·90		
200µA	£2·90	VU Meter	£3·40

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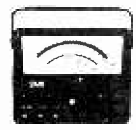
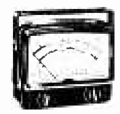


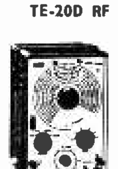


TMK LAB TESTER. 100,000 O.P.V. 6½in-Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100µA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6¾in. × 3¼in. **£18·90.** P. & P. 25p

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. **£17·50.** Carr. 37½p.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions **£15.** Carr. 37½p. Size 140 × 215 × 170 mm.

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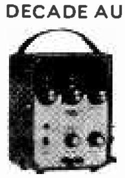
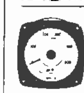


New high quality portable instrument. Sine 1 Hz to 100 kHz. Square 20 Hz to 20 kHz. Output max +10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm × 150mm × 120mm.
Price **£27·50.** Carr. 25p

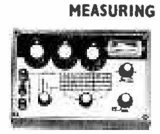


240° Wide Angle 1mA Meters

MW1-6 60mm square	£3·97½
MW1-8 80mm square	£4·97½

P. & P. extra

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω–11·1 meg Ω 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges 2 = %C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7¼ × 5 × ¾in. £20. P. & P. 25p

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20,000 O.P.V.
Overload protection
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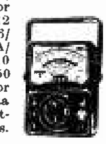
10/50/250/1000 VAC.
50uA/250mA. 20K/2 megohm. −5 to +62db.
£4·97. P. & P. 15p.

ModelS-100TRMULTIMETER/TRANSISTOR TESTER. 100,000o.p.v. mirror scale/overload protection. 0/·12/·6/3/12/30/120/600 VDC. 0/6/30/120/600 VAC. 0/12/600µA/12/300mA/12 AMP DC. 0/10 K/1MEG/100MEG. −20to+50 db. 0·01–·2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. **£13·50.** P/P 25p.



MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25 100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. **£8·87½.** Post paid.

MODEL 5025 57 Ranges, Giant 5¼in. Meter, Polarity Reverse Switch.
Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50IA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. **£12·50.** P. & P. 17½p.

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Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100 wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case.
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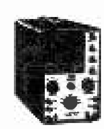

3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps –800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. **£40·00.** Carr. 50p.

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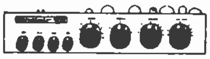

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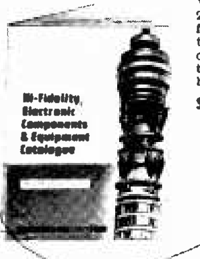

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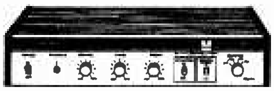
TELETON SAQ-206B STEREO AMPLIFIER



Latest exciting release. Brand new model. 6 + 6 watts rms. Inputs for mag, xtal, aux tape. Volume, bass, treble, sliding balance, scratch filter and loudness controls.
OUR PRICE £19·50 Carr. 37p.

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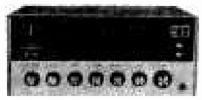
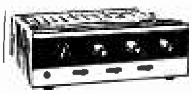


Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO, AVC, ANL, 'S' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 x 266 x 150 mm. Complete with instructions and circuit. £28·50. Carr. 50p

LAFAYETTE LA. 324 STEREO AMPLIFIER



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Compares with amplifiers up to £40.
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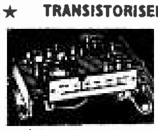

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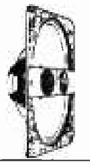

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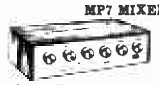

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" × 5" × 3". Inputs Mics: 3 × 3mV 50K; 2 × 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
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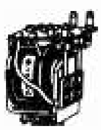

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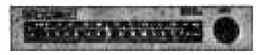

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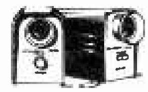

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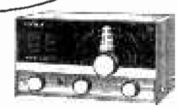

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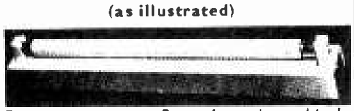

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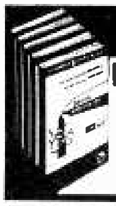

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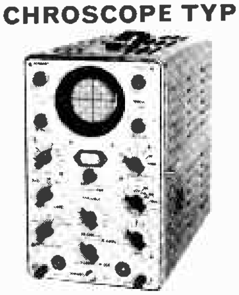
30PL14	0.90	7199	0.80	EBF83	0.40	ECL83	0.70
35A3	0.55	7360	2.00	EBF89	0.30	ECL84	0.55
35A5	0.75	7586	1.25	EBL31	1·50	ECL85	0.55
35B5	0.65	7895	1.25	EC53	0.50	ECL86	0.40
35C5	0.50	9002	0.40	EC86	0.60	ECLL800	2·00
35D5	0.75	A2293	2.00	EC88	0.60	EF40	0.50
35L6GT	0.50	AZ1	0.55	EC90	0.33	EF41	0.65
35W4	0.35	AZ31	0.55	EC92	0.35	EF42	0.70
35Z3	0.70	CBL1	0.90	EC93	0.55	EF80	0.25
35Z4G	0.35	CBL31	1.00	ECC35	1.00	EF83	0.55
35Z5GT	0.60	CY31	0.35	ECC40	0.65	EF85	0.35
50A5	0.75	DAF96	0.45	ECC81	0.35	EF86	0.30
50B5	0.50	DF96	0.45	ECC82	0.30		

EF89	0.28	GY501	0.80	PF86	0.65	U201	0.35
EF91	0.33	GZ30	0.40	PF818	0.85	U281	0.40
EF92	0.35	GZ31	0.35	PFL200	0.65	U282	0.40
EF95	0.35	GZ32	0.48	PL33	0.35	U301	0.40
EF97	0.65	GZ33	0.70	PL36	0.55	U403	0.60
EP98	0.65	GZ34	0.60	PL81	0.50	U404	0.60
EF183	0.30	HABC80	0.45	PL82	0.45	U801	0.80
EF184	0.35	HK90	0.40	PL83	0.45	UABC80	0.40
EF804	1.25	KT66	2.20	PL84	0.40	UAF41	0.50
EK90	0.30	N78	1.50	PL302	0.85	UAF42	0.55
EL34	0.50	PABC80	0.40	PL504	0.80	UB41	0·60
EL36	0.50	PC86	0.60	PL508	0.90	UBC41	0.50
EL37	1.60	PC88	0.60	PL509	1.10	UBC81	0.40
EL41	0.60	PC92	0.05	PL801	0.80	UBF80	0.40
EL81	0.55	PC97	0.50	PL802	0·95	UBF89	0.35
EL83	0.42	PC900	0.48	PM84	0.60	UBL1	0.60
EL84	0.25	PABC80	0·40	PY31	0.30	UBL21	0.65
EL85	0.43	PCC84	0.40	PY33	0.63	UC92	0.40
EL86	0.40	PCC85	0.40	PY80	0.40	UCC85	0.40
EL90	0.38	PCC88	0.55	PY81	0.30	UCF80	0.55
EL95	0.35	PCC89	0.55	PY82	0.35	UCH21	0.60
EL821	0.60	PCC189	0.55	PY83	0.38	UCH42	0.70
EL822	1.30	PCC805	0.85	PY88	0.40	UCH81	0.40
ELL80	0.75	PCC806	0.80	PY500	1.00	UCL81	0.60
EM34	1.00	PCF80	0.30	PY800	0.40	UCL82	0.35
EM71	0.80	PCF82	0.35	PY801	0.50	UCL83	0.60
EM80	0.45	PCF84	0.60	PZ30	0.35	UF9	0·60
EM81	0.60	PCF86	0.60	QQVO2-6	2.25	UF11	0·50
EM83	0.50	PCF87	0.90	QQVO3-10	1.25	UF41	0.60
EM84	0.35	PCF801	0.50	QQV03-20A	5.25	UF42	0.60
EM85	1.00	PCF802	0.50	QQV06-40A	5.50	UF43	0.60
EM87	0.70	PCF805	0.80	TT22	3.20	UF80	0.35
EN91	0.88	PCF806	0.70	U18/20	0.75	UF85	0.40
EY51	0.40	PCF808	0.85	U25	0.80	UF89	0.40
EY80	0.55	PCH200	0.70	U26	0.80	UL84	0.40
EY81	0.40	PCL81	0.50	U31	0.60	UM84	0.25
EY83	0.55	PCL82	0.35	U37	2.10	UY1N	0.50
EY86	0.40	PCL83	0.65	U52	0.35	UY11	1.00
EY87	0.43	PCL84	0.45	U76	0.35	UY41	0.48
EY88	0.43	PCL85	0.40	U78	0.35	UY82	0.50
EZ40	0.50	PCL86	0.45	U191	0.75	UY85	0.40
EZ41	0.50	PCL88	0.90			W729	0.75
EZ80	0.27	PCL800	0.93			Z759	3·00
EZ81	0.29	PCL801	0.75			Z803U	1.20
GT1C	3.00	PD500	1.30				

TRANSISTORS

2N696	0.17	AC127	0.20	BD123	0.80
2N697	0.17	AC128	0.15	BD131	0.85
2N698	0.80	AC132	0.35	BD132	0.85
2N705	0.70	AC153	0.20	BF115	0.20
2N706	0.10	AC154	0.15	BF167	0.18
2N708	0.15	AC157	0.20	BF173	0.20
2N753	0.25	AC169	0.10	BF179	0.30
2N929	0.22	AC176	0.25	BF180	0.35
2N930	0.25	AC187	0.30	BF181	0.25
2N987	0.80	AC188	0.30	BF184	0.25
2N1131	0.25	ACY17	0.275	BF185	0.20
2N1132	0.25	ACY18	0.20	BF194	0.15
2N1184	1.25	ACY19	0.25	BF195	0.15
2N1301	0.40	ACY20	0.20	BF196	0.20
2N1302	0.75	ACY21	0.20	BF197	0.20
2N1304	0.25	ACY22	0.15	BF200	0.35
2N1305	0.25	AD140	0.50	BFW87	0.25
2N1306	0.25	AD149	0.50	BFW88	0.23
2N1307	0.30	AD161	0.35	BFW89	0.20
2N1308	0.25	AD162	0.35	BFW91	0.20
2N1309	0.30	ADZ11	1.25	BFX88	0.25
2N1613	0.22	ADZ12	1.25	BFY17	0.40
2N1711	0.25	AF114	0.20	BFY19	0.60
2N1756	0.75	AF115	0.20	BFY50	0.25
2N2147	0.75	AF116	0.20	BFY51	0.20
2N2160	0.65	AF117	0.20	BFY52	0.25
2N2217	0.30	AF118	0.45	BSY26	0.20
2N2218	0.30	AF125	0.25	BSY27	0.20
2N2219	0.35	AF127	0.20	BSY28	0.20
2N2369A	0.20	AF180	0.35	BSY65	0.20
2N2477	0.65	AF181	0.35	BSY95A	0.15
2N2646	0.60	AF186	0.40	OC16	0.50
2N2905	0.35	AF239	0.40	OC22	0.50
2N2923	0.15	AFZ11	0.45	OC23	0.60
2N2924	0.15	ASY26	0.25	OC24	0.60
2N2926	0.125	ASY27	0.30	OC25	0.35
2N3053	0.25	ASY28	0.25	OC26	0.25
2N3054	0.60	ASY29	0.30	OC28	0.60
2N3055	0.75	ASY54	0.25	OC29	0.60
2N3133	0.30	ASZ15	0.70	OC30	0.75
2N3134	0.30	ASZ16	0.70	OC35	0.50
2N3391	0.20	ASZ17	0.75	OC36	0.60
2N3392	0.15	ASZ18	0.75	OC42	0.20
2N3393	0.15	ASZ20	0.25	OC44	0.20
2N3394	0.15	ASZ21	0.40	OC45	0.15
2N3395	0.20	BC107	0.125	OC70	0.10
2N3402	0.15	BC108	0.125	OC71	0.12
2N3403	0.15	BC109	0.125	OC72	0.25
2N3404	0.35	BC113	0.25	OC73	0.30
2N3414	0.20	BC118	0.30	OC75	0.20
2N3415	0.15	BC134	0.30	OC76	0.20
2N3416	0.25	BC147	0.175	OC78	0.25
2N3417	0.25	BC148	0.15	OC78D	0.20
2N3702	0.12	BC149	0.15	OC81	0.25
2N3703	0.12	BC152	0.15	OC81D	0.15
2N3704	0.17	BC158	0.15	OC83	0.20
2N3707	0.15	BC175	0.20	OC139	0.30
2N3709	0.12	BC186	0.25	OC140	0.35
2N3710	0.12	BCY30	0.25	OC141	0.60
2N3819	0.35	BCY31	0.40	OC170	0.25
2N3906	0.20	BCY33	0.25	OC171	0.25
2S702	0.50	BCY34	0.30	OC200	0.30
2S746	0.25	BCY72	0.20	OC201	0.60
AC113	0.15	BCZ10	0.30	OC202	0.65
AC125	0.30	BCZ11	0.40	OC203	0.40
AC126	0.20	BD121	0.65	OC204	0.40

SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2-5-10-30-100-300-1000-3000 µsec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1-5-20-100 µ sec.
Amplitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE £39.00. Packing and carriage 1.50

INTEGRATED CIRCUITS

TAA263 Direct coupled 3-stage amplifier up to 600kc. Supply voltage 6-8V output 10mW TO72 outline . . . . . 0·75
TAA293. Medium frequency amplifier up to 600kc. Supply voltage 6V. output 10mW TO74 outline . . . . . 0·95
TAA320. MOST stage followed by a bi-polar stage Gate-to-source voltage 9-14V. Power dissipation 200mW. TO18 outline . . . . 0·65
TAA570. Four-stage limiter-amplifier with F.M. quadrator detector and remote D.C. volume control facility. Nominal supply voltage 12V. TO74 outline . . . . . 0·95
TAD100. AM receiver circuit containing all active components (except output stage) required to build a complete receiver . . £1·95
SL403D PLESSEY 3-Watts Audio Amplifier £1·50
SL432A PLESSEY, limiting I.F. Amplifier and F.M. discriminator . . . . £0·75

OUR NEW 1971/1972 CATALOGUE IS NOW READY AND AVAILABLE FREE OF CHARGE. PLEASE SEND QUARTO STAMPED AND ADDRESSED ENVELOPE FOR THIS VALUABLE SOURCE OF REFERENCE LISTING MANY THOUSAND TYPES OF VALVES, SEMICONDUCTORS, TUBES, ETC.

MULTIMETERS

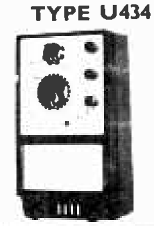
WITH TAUT BAND SUSPENSION MOVEMENT

TYPE U4312

Low sensitivity (667 ohms per volt), 1% accuracy DC and 1·5% AC. 9 DC current ranges 300µA to 6A. 8 AC current ranges (1·5mA to 6A). 9 AC/DC voltage ranges 0·3-900V. Resistance 0·2-30K. £9·75

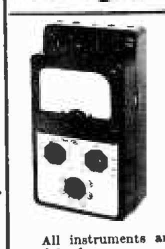
TYPE U4313. High sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC. Accuracy 1·5% DC and 2·5% AC. 8 DC current ranges 60µA to 1·5A. 6 AC current ranges 0·60mA to 1·5A. 9 AC and DC Voltage ranges 1·5 to 500V. Resistance ranges 0·5-500 Kohms. £10·50

TYPE U4341 MULTIMETER AND TRANSISTOR TESTER



With taut band suspension movement.
8-DC voltage ranges 0·3-900V
6-AC voltage ranges 1.5-750V
5-DC current ranges 0·06-600mA
4-AC current ranges 0·3-300mA
4-resistance ranges 0·5-500 Kohms
Transistor cut-off current 60µA max
Transistor DC current gain 10-350
Sensitivity: 16700 Ω/V DC; 3300 Ω/V AC PRICE £10·50

TYPE U435



With taut band suspension movement.
Sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC.
7 DC current ranges 50µA to 2·5A.
5 AC current ranges 5mA to 2·5A.
7 AC/DC Voltage ranges 2·5 to 1000V.
3 Resistance ranges 0–300 Kohms.
Capacity range 0·5µF. £9·00

All instruments are supplied with steel carrying case and leads.
No protection is incorporated. As the movement can withstand overloads up to 100 times, only basic precautions should be taken to prevent damage through misuse

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