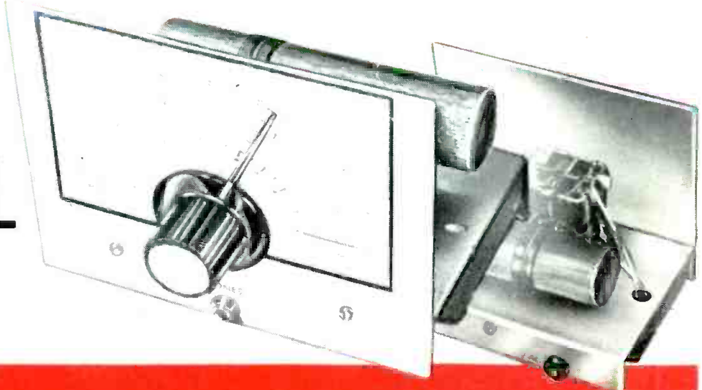
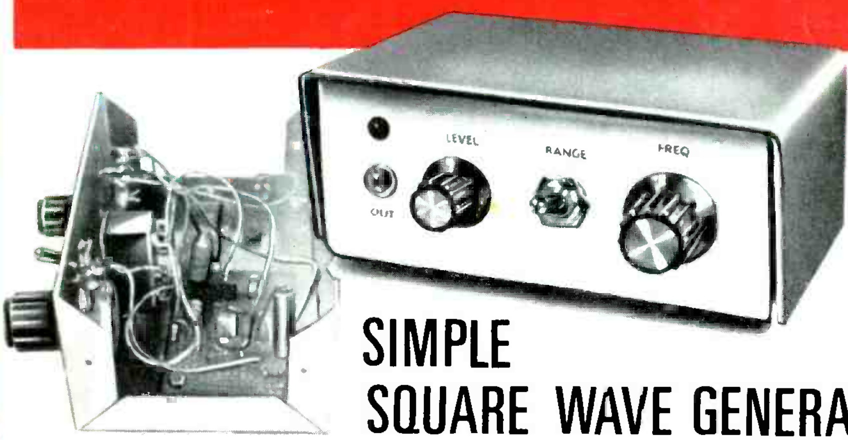
RADIO & ELECTRONICS CONSTRUCTOR

JUNE 1974

22p

SHORT WAVE CRYSTAL SET





SIMPLE SQUARE WAVE GENERATOR

ALSO FEATURED

ELECTRONIC COIN TOSSER

AMTRON

electronic kits are so versatile

There's one to suit every job—for hobbyists, teachers, technicians, 'dabblers' and experts alike. Each one comes complete with comprehensive assembly instructions and even the solder required. all inside an attractive blister pack: and prices range from £1.82 to £110
Illustrated here are just eight from the vast range of over two hundred.

Signal Injector

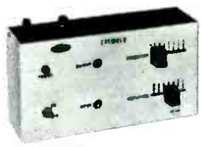
The UK 220 Signal Injector is a "must" for repairmen engaged in the repair and servicing of radio-receivers and AF amplifiers. It permits a thorough check of the various stage to the antenna coupling circuit due to the signal it delivers, which has a frequency spectrum extending from the lowest acoustic frequencies to the highest short wave band frequencies. The unit is designed to perform quickly and efficiently all the operations involved in fault tracing, and many cases that would normally call for the set to be taken back to the repair-shop can be successfully carried out on the spot.


UK 220

Specifications
Frequency: 500 Hz
Harmonics: up to approx. 30 MHz
Output voltage: 1 V peak-to-peak
Maximum voltage applicable to the probe: 500 V DC
Power supply: 1.4 V DC
Transistors: (2) BC208B

Fuzz effect

Ratings & characteristics
Power source: 115-220-240 V AC
Mains frequency: 50-60 Hz
Fuzz frequency: 3 Hz to 20 Hz
Amplifier gain: 4 dB
Input impedance: 300 kΩ
Output impedance: more than 10 kΩ
Transistors: 3-BC177 - 3-BC109c - 1-2N3819
Diodes: 1-BZY88C15 or BZY94C15, 1-BZX61C22 or BZX29C22
Bridge rectifier: BS1
Dimensions: 175 x 95 x 55 mm
Weight: 500 gr


UK 107

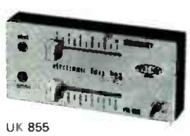

UK 875

Capacitive Discharge Electronic Ignition for Internal Combustion Engines

Specifications
Power supply: 9-15 V DC
Transistors: (2) 2N3232 or 2N3055
Diodes: (2) 1N4003
SCR: 2N4443
Bridge rectifier: WO6 420 V, 1 A

Electronic Fuzz-Box

The unit can be easily coupled between the musical instrument and the amplifier two slide-control potentiometers allow the instant adjustment of the degree of distortion and the output level. The distortion is obtained by varying the alternating feedback voltage; the lesser the feedback action, the greater the distortion.

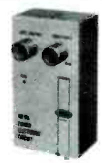

UK 855

Specifications
Power supply: 9 V DC
Current drain: 1.5 mA
Transistors: (2) BC108B

Noise reduction unit

Specification
Power supply: 12 V DC, through the output connector
Amplifier gain: 1
Input impedance: higher than 10 kΩ
Output impedance: lower than or equal to 10 kΩ
Max. permissible input signal: 2 V
Min. input signal: 50 mV
Turn-over frequency: 2 kHz
Attenuation characteristics:
Frequency: 1 kHz 2 kHz 4 kHz 8 kHz 10 kHz 20 kHz
Attenuation: 0 dB 3 dB 6 dB 12 dB 14 dB 20 dB
Transistors: (1) FET 2N3819 - (4) BC108B - (1) BC108C
Diodes: (3) 0A95
Dimensions: 108 x 77 x 50 mm


UK 127


UK 780

Electronics Unit for Metal Detector

With the help of the AMTRON UK 780 metal objects and ores can be located underground.
The sensitivity of this instrument is quite high, and certainly not inferior to that of much more expensive instruments. Its degree of stability is also quite outstanding, because of the low operating frequency of the two oscillators.
The electronic circuits consists basically of four transistors, type BC109B; the unit is powered by a 6 V battery.

Specifications
Power supply: 6 V DC
Current input: 3-4 mA
Operating frequency: 150 kHz approx.
Maximum detection depth of metal bodies of sizeable dimensions. 70 cm
Transistors: (4) BC109B
Diodes: (2) AA119

AM Tuner

The UK 520 is a fully transistorized M.W. superheterodyne AM tuner able to receive all radio-communications in the 520 to 1600 kHz frequency range. Due to its compact size and excellent electrical characteristics, the UK 520 can be used for many applications. In combination with the UK 145 AF amplifier it forms a compact, top-performance portable radio-receiver, or when fitted to a portable phonograph it forms a modern transistorized phono-radio. In combination with a tape recorder it will permit the direct recording of radio broadcasts.
The tuner can also be supplied in the UK 520 W pre-assembled version.


UK 520


UK 546

AM/FM Receiver 25 to 200 MHz

Specifications
Power supply: 9 V DC
Current drain: 4 mA
Frequency range: 25 to 200 MHz
Output sensitivity: 1 V
Transistors: (1) BF125 - (1) BC209

AMTRON UK

AMTRON UK., 4 & 7 CASTLE STREET, HASTINGS, SUSSEX TN34 3DY. Tel: (0424) 437875

ALL educational enquiries to Phillip Harris Ltd., Ludgate Hill, Birmingham. Tel: 021-236 4041

The largest selection

EX-COMPUTER BOARDS

Packed with transistors, diodes, capacitors and resistors – COMPONENT VALUE £1.50.
3 for ONLY 55p + p&p 30p

SPECIAL. As above PLUS Power Transistors ONLY 55p each + p&p 15p

STABILISED POWER MODULES
Complete with circuit diagrams etc
99p each + p&p 15p

PANOLINE BOARDS 7½ × 9" approx.
4 for 30p + p&p 20p

FIBRE-GLASS PRINTED CIRCUIT BOARDS

16½ × 4" approx. 2 for 55p

DECON-DALO 33pC Marker

Etch resistant printed circuit marker pen 90p each.

VEROBOARDS

Packs containing approx. 50 sq. ins. various sizes all 1 matric. 55p

REPANCO CHOKES & COILS

RF Chokes CH1 2.5mH 25p CH2 5.0mH 25p
CH3 7.5mH 25p CH4 10mH 25p
CH5 1.5mH 25p
Coils DRX1 Crystal set 31p; DRR2 Dual range 45p

COIL FORMERS & CORES

NORMAN ¼" Cores and Formers 7p
⅜" Cores and Formers 8p

SWITCHES

DP/DT Toggle 25p SP/ST Toggle 18p

FUSES

1¼" and 20mm. 100mA, 100mA, 250mA, 500mA, 1A, 1.5A, 2A.
QUICK-BLOW 4p each ANTI-SURGE 5p each

EARPHONES

Crystal 2.5mm plug 33p 8ohms 2.5mm plug 22p
3.5mm plug 33p 3.5mm plug 22p

DYNAMIC MICROPHONES

B1223 200 ohms plus on/off switch and 2.5mm and 3.5mm plugs £1.60

3-WAY STEREO HEADPHONE JUNCTION BOX

H1012 £1.87

2-WAY CROSSOVER NETWORK

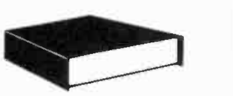
K4007 80 ohms Imp. Insertion loss 3dB. £1.21.

CAR STEREO SPEAKERS

(Angled) £3.85p per pair

BI-PAK CATALOGUE AND LISTS SEND S.A.E. AND 10p

INSTRUMENT CASES



(In 2 sections. Black Vinyl covered top and sides and bezel).

No.	Length		Width		Height	Price
BV1	8"	x	5¼"	x	2"	90p
BV2	11"	x	6"	x	3"	£1.20

ALUMINIUM BOXES

No.	Length		Width		Height	Price
BA1	5¼"	x	2¼"	x	1½"	42p
BA2	4"	x	4"	x	1½"	41p
BA3	4"	x	2½"	x	1½"	41p
BA4	5¼"	x	4"	x	1½"	47p
BA5	4"	x	2½"	x	2"	41p
BA6	3"	x	2"	x	1"	34p
BA7	7"	x	5"	x	2½"	60p
BA8	8"	x	6"	x	3"	84p
BA9	6"	x	4"	x	2"	54p

(each complete with ½" deep lid)
Please add 10p postage and packing for each box

Bib HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1.84
Chrome Finish Model 60 £1.50

Ref. 36A	Record Stylus Cleaning Kit	28p
Ref. 43	Record Care Kit	£2.35
Ref. 31	Cassette Head Cleaner	54p
Ref. 32	Tape editing Kit	£1.54
Model 9	Wire stripper cutter	83p
Ref. P	Hi-Fi Cleaner	31p
Ref. 32A	Stylus Balance	£1.36
Ref. J	Tape Head Cleaning Kit	51p
Ref. 34	Cassette Case	£1.27
Ref. 56	Hi-Fi Stereo Hints and Tips	32p

ANTEX SOLDERING IRONS

X25 25 watt £1.93 CCN 240 15 watt £2.15
Model G 18 watt £2.15 SK2 Soldering kit £2.86

STANDS
ST1 £1.21 ST2 77p

SOLDER
18SWG Multicore 7 oz 82p 22SWG 7 oz. 82p
18SWG 22 ft. 28p 22SWG Tube 22p

ANTEX BITS AND ELEMENTS

BITS No.		
102	For model CN240 ³⁄₃₂"	38p
102	For model CN240 ⅛"	38p
1100	For model CCN240 ³⁄₃₂"	38p
1101	For model CCN240 ⅛"	38p
1102	For model CCN240 ³⁄₁₆"	38p
1020	For model G240 ³⁄₃₂"	38p
1021	For model G240 ⅛"	38p
1022	For model G240 ³⁄₁₆"	38p
50	For model X25 ³⁄₃₂"	38p
51	For model X25 ⅛"	38p
52	For model X25 ³⁄₁₆"	38p

ELEMENTS
ECN 240 £1.16 ECCN 240 £1.16
EG 240 £1.16 EX 25 £1.16

LOOK FOR OUR AUDIO AND ELECTRONIC COMPONENT ADVERTISEMENTS IN 'PRACTICAL ELECTRONICS'

ALL PRICES SHOWN INCLUDE V.A.T.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx count by weight	0.55
C 2	200	Capacitors mixed values approx. count by weight	0.55
C 3	50	Precision Resistors .1%, .01% mixed values	0.55
C 4	75	⅛th W Resistors mixed preferred values	0.55
C 5	5	Pieces assorted Ferrite Rods	0.55
C 6	2	Tuning Gangs, MW/LW VHF	0.55
C 7	1	Pack Wire 50 metres assorted colours	0.55
C 8	10	Reed Switches	0.55
C 9	3	Micro Switches	0.55
C10	15	Assorted Pots and Pre-Sets	0.55
C11	5	Jack Sockets 3 × 3.5m 2 × Standard Switch Types	0.55
C12	40	Paper Condensers preferred types mixed values	0.55
C13	20	Electrolytics Trans. types	0.55
C14	1	Pack assorted Hardware – Nuts Bolts, Grommets etc.	0.55
C15	4	Mains Switches	0.55
C16	20	Assorted Tag Strips & Panels	0.55
C17	10	Assorted Control Knobs	0.55
C18	4	Rotary Wave Change Switches	0.55
C19	3	Relays 6–24V Operating	0.55
C20	4	Sheets Copper Laminate approx. 10" × 7"	0.55

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19 and C20.

PLUGS AND SOCKETS

SOCKETS

PS35	DIN 2 Pin (Speaker)	0.06
PS36	DIN 3 Pin	0.10
PS37	DIN 5 Pin 180°	0.10
PS38	DIN 5 Pin 240°	0.10
PS39	Jack 2.5mm Switched	0.09
PS40	Jack 3.5mm Switched	0.10
PS41	Jack ¼" Switched	0.17
PS42	Jack Stereo Switched	0.26
PS43	Phono Single	0.06
PS44	Phono Double	0.10
PS45	Car Aerial	0.09
PS46	Co-Axial Surface	0.09
PS47	Co-Axial Flush	0.14

INLINE SOCKETS

PS21	DIN 2 Pin (Speaker)	0.13
PS22	DIN 3 Pin	0.17
PS23	DIN 5 Pin 180°	0.17
PS24	DIN 5 Pin 240°	0.17
PS25	Jack 2.5mm Plastic	0.10
PS26	Jack 3.5mm Plastic	0.12
PS27	Jack ¼" Plastic	0.24
PS28	Jack ¼" Screened	0.28
PS29	Jack Stereo Plastic	0.22
PS30	Jack Stereo Screened	0.32
PS31	Phono Screened	0.14
PS32	Car Aerial	0.15
PS33	Co-Axial	0.17

PLUGS

PS 1	DIN 2 Pin (Speaker)	0.11
PS 2	DIN 3 Pin	0.12
PS 3	DIN 4 Pin	0.15
PS 4	DIN 5 Pin 180°	0.14
PS 5	DIN 5 Pin 240°	0.15
PS 6	DIN 6 Pin	0.15
PS 7	DIN 7 Pin	0.15
PS 8	Jack 2.5mm Screened	0.10
PS 9	Jack 3.5mm Plastic	0.09
PS10	Jack 3.5mm Screened	0.12
PS11	Jack ¼" Plastic	0.13
PS12	Jack ¼" Screened	0.18
PS13	Jack Stereo Screened	0.29
PS14	Phono	0.06
PS15	Car Aerial	0.15
PS16	Co-Axial	0.10

CABLES

CP 1	Single lapped screen	0.06
CP 2	Twin Common Screen	0.08
CP 3	Stereo Screened	0.08
CP 4	Four Core Common Screen	0.23
CP 5	Four Core individually Screened	0.30
CP 6	Microphone Fully Braided Cable	0.10
CP 7	Three core mains cable	0.07
CP 8	Twin oval mains cable	0.06
CP 9	Speaker Cable	0.04
CP10	Low Loss Co-Axial	0.10

CARBON POTENTIOMETERS

Log and Lin 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.

VC1	Single less Switch	0.14
VC2	Single D.P. Switch	0.26
VC3	Tandem Less Switch	0.44
VC4	1K Lin Less Switch	0.14
VC5	100K Log anti-Log	0.14

HORIZONTAL CARBON PRESETS

0.1 watt 0.06
100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M.

BOOK BARGAIN BUNDLE

8 Books comprising:
2 Transistor Equivalent Books.
1 Radio & Electronic Colour Code & Data Chart.
1 Radio Valve Guide PLUS
3 other Constructional books on Receivers, FM Tuners etc.
Also 1 General Constructional book.

Value £3. Our price £2.

BP1	Handbook of Transistor Equivalents and Substitutes	40p
BP2	Handbook of Radio T.V. and Industrial Tube & Valve Equivs.	40p
BP3	Handbook of Tested Transistor Circuits	40p
BP4	International Handbook of the World's Short Wave, Medium and Long Wave Radio Stations and FM/TV Listings.	35p
BP5	Handbook of Simple Transistor Circuits	35p
BP7	Radio & Electronic Colour Codes & Data Chart	15p
BP8	Sound & Loudspeaker Manual	50p
BP9	38 Practical Tested Diode Circuits for the Home Constructor	35p
BP11	Practical Transistor Novelty Circuits	40p
129	Universal Gram-Motor Speed Indicator	8p
138	How to make FM & TV Aerials, Bands 1, 2 & 3	18p
141	Radio Servicing for Amateurs	20p
146	High Fidelity Loudspeaker Enclosures	37p
156	Transistor Circuits Manual No. 1	15p
160	Coil Design & Construction Manual	30p
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175	Transistor Test Equipment and Servicing Manual	25p
176	Transistor Audio Amplifier Manual	40p
177	Modern Transistor Circuits for Beginners	40p
178	A Comprehensive Radio Valve Guide. Book 5	30p
183	How to Receive Foreign TV Programmes on your set by simple modifications	32p
185	Tested Shortwave Receiver Circuits using MAT's	30p
187	The TSL Mark '4' Valved FM Tuner and its construction	20p
198	Reactance-Frequency Chart for Audio & RF use	15p
	Resistor Colour Code Disc Calculator	10p

CARTRIDGES

ACOS	GP91 1SC	200mV at 1.2cms/sec		£1.16
	GP93 1	280mV at 1cm/sec		£1.65
	GP96 1	100mV at 1cm/sec		£2.65
TTC	J-2005	Crystal/Hi Output		95p
	J-20 10C	Crystal/Hi Output Compatible		£1.10
	J-200 CS	Stereo/Hi Output		£1.60
	J-2105	Ceramic/Med Output		£1.64

CARBON FILM RESISTORS

The E12 Range of Carbon Film Resistors, ⅓th watt available in PAKS of 50 pieces, assorted into the following groups:

R1	50 Mixed 100ohms – 820ohms		40p
R2	50 Mixed 1Kohms – 8.2Kohms		40p
R3	50 Mixed 10Kohms – 82Kohms		40p
R4	50 Mixed 100Kohms – 1Megohm		40p

THESE ARE UNBEATABLE PRICES – LESS THAN 1p EACH INC. V.A.T.!

BI-PAK SUPERIOR QUALITY LOW-NOISE CASSETTES

C60 32p C90 41p C120 52p

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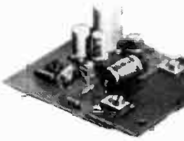
-the lowest prices!

BI-PAK QUALITY COMES TO AUDIO!

AL10 AL20 AL30
AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

PARAMETER	CONDITIONS	PERFORMANCE
HARMONIC DISTORTION	Po=3 WATTS f=1 KHz	0.25%
LOAD IMPEDANCE	—	8 – 16Ω
INPUT IMPEDANCE	f=1KHz	100 KΩ
FREQUENCY RESPONSE ±3dB	Po=2 WATTS	50 Hz – 25 KHz
SENSITIVITY for RATED O/P	Vs 25V. Rt. 8ΩF 1 KHz	75mV. RMS
DIMENSIONS	—	3" x 2½" x 1"

The above table relates to the AL10, AL20 and AL30 modules.
The following table outlines the differences in their working conditions.

PARAMETER	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL=8Ωf=1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL10	3 Watts	£2.19
AL20	5 Watts	£2.59
AL30	10 Watts	£3.01

PRE-AMPLIFIERS

PA 12 (Use with AL10 & AL20)	£4.35
PA100 (Use with AL30 & AL50)	£13.15

POWER SUPPLIES

PS12 (Use with AL10 and AL20)	88p
SPM80 (Use with AL30 and AL50)	£3.25

TRANSFORMERS

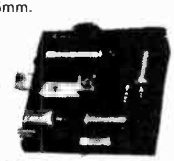
T461 (Use with AL10) p&p 15p	£1.38
T538 (Use with AL20) p&p 15p	£1.93
BMT80 (Use with AL30 & AL50) p&p 25p	£2.15

FRONT PANELS PA12 With knobs £1.00

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL10, AL20 and AL30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Cramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm x 84 mm. x 35mm.

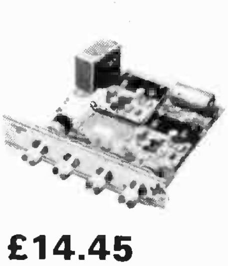
Frequency response
20 Hz–50KHz (–3dB)
Bass control
±12dB at 60Hz
Treble control
±14dB at 14 KHz
*Input 1.
Impedance 1 Meg. ohm.
Sensitivity 300 mV
†Input 2.
Impedance 30 K ohms.
Sensitivity 4 mV



EA1000 AUDIO AMP MODULE
Module Tested and Guaranteed.
Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.
SPECIAL OFFER £2

The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5.5 cm. This compact unit comes complete with on/off switch, volume control, balance, bass and treble controls. Transformer, Power supply and Power Amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interferring with the mechanism or, alternatively, into a separate cabinet.
Output power 20w peak. Freq. res. 25Hz–25kHz Harmonic distortion typically 0.25% at 1 watt Input 1 (er.) 300mV into 1M. Input 2 (Aux.) 4 mV into 30K. Bass control ±12dB at 60 Hz. Treble con. ±14dB at 14 kHz.



£14.45

NOW WE GIVE YOU
50w PEAK (25w R.M.S.) *PLUS*
THERMAL PROTECTION!

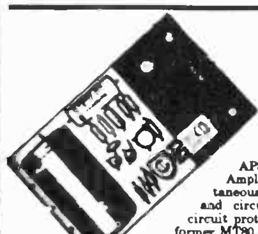
The *NEW* AL60
Hi-Fi Audio Amplifier
FOR ONLY £3.95

- Max Heat Sink temp 90°c
- Frequency Response 20Hz to 100KHz
- 0.1% Distortion
- Distortion better than 1% at 1KHz
- Supply voltage 10-35 volts
- Thermal Feedback
- Latest Design Improvements
- Load - 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm x 105mm x 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

FULLY BUILT - TESTED and GUARANTEED

STABILISED POWER MODULE SPM80



AP80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (rms) per channel, simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 62mm x 106mm x 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disco Systems, Public Address, Intercom Units etc. Handbook available 10p.

PRICE £3.25

TRANSFORMER BMT80 £2.15 p. & p. 25p.

STEREO PRE-AMPLIFIER, TYPE PA100

Built to a specification and NOT a price. and yet still the greatest value on the market. the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques.

Designed for use with the AL50 power amplifier system. this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100. which also has a STEREO/MONO switch. volume, balance and continuously variable base and treble controls.

SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0.1%
Inputs: 1. Tape Head	1.25 mV into 50KΩ
2. Radio, Tuner	35 mV into 50KΩ
3. Magnetic P.U.	1.5 mV into 50KΩ

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB, from 20Hz to 20KHz.

Base Control	± 15dB @ 20Hz	Treble Control	± 15dB @ 20KHz
Filters: Rumble (High Pass)		100Hz	
Scratch (Low Pass)		8KHz	
Signal/Noise Ratio		better than — 65dB	
Input overload	+ 26dB	Supply	+ 35 volts @ 20mA
Dimensions	292mm x 82mm x 35mm		

Price **£13.15**

SPECIAL COMPLETE KIT COMPRISING 2 AL60's, 1 SPM80, 1 BMT80 and 1 PA100 ONLY **£25.30** FREE p & p.

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AF139	30p	BCY70	13p	BF194/5	12p
AF178	30p	BCY71	12p	BF196/7	14½p
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BYX38-300	2.5	300	30p
BYX38-900	2.5	900	37p
BYX38-1200	2.5	1,200	52p
BYX49-600	2.5	600	30p
BYX49-300	2.5	300	20p
BYX49-900	2.5	900	37p
BYX48-300	6	300	27p
BYX48-600	6	600	32p
BYX48-900	6	900	40p
BYX48-1200	6	1,200	60p
BYX72-150R	10	150	26p
BYX72-300R	10	300	35p
BYX72-500R	10	500	43p
BYX42-300	10	300	40p
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*Avalanche type

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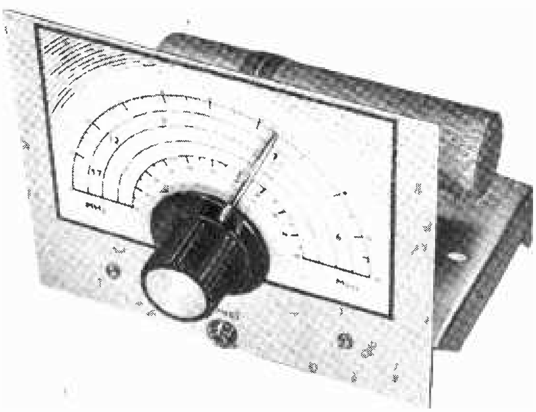
JULY ISSUE – CONTAINING ANNUAL INDEX – WILL BE PUBLISHED ON 1st JULY

SHORT WAVE



By R. A. Penfold

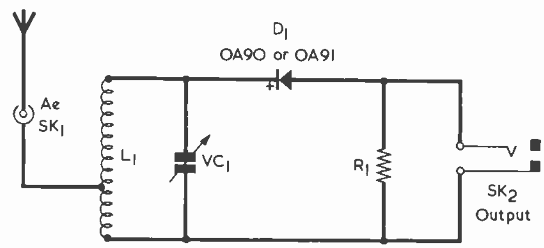


Fig. 1. The crystal receiver has an extremely simple circuit

CRYSTAL SETS HAVE PROVED TO BE VERY POPULAR OVER the years and various designs for these are still published in books and electronics magazines. These receivers employ the same basic circuits as were used in the very early crystal sets, but the old galena crystal and adjustable cat's whisker are nowadays replaced by a modern germanium diode. Most published designs are for medium and long wave reception, and they are often put forward as novelty circuits. Designs for short wave crystal sets are relatively scarce, despite the fact that such designs are capable of far superior results in comparison with their medium and long wave counterparts.

SHORT WAVE CIRCUIT

The receiver which forms the subject of this article is a simple short wave crystal set which, although originally built for its novelty value, has proved capable of almost amazing results. In a short space of time quite an assortment of stations were received on the prototype. Broadcasts in English have been heard from B.B.C. World Service, Berlin International, Canada International, Hilversum, Moscow, Poland, Prague, Stockholm, Switzerland, and Vatican Radio. In short wave terms this is not particularly exceptional, but bearing in mind that a crystal set has no gain, and that the energy which vibrates the diaphragm in the earphone is derived from the power at the transmitter, such results become more interesting.

As the receiver is intended for broadcast band reception, a frequency range has been chosen that includes most of the short wave broadcast bands. These covered are the 19, 25, 31, 39 and 49 metre bands. Few components are used, a fact which makes the set very inexpensive and easy to construct.

Fig. 1 shows the circuit diagram of the receiver. This is quite conventional, and has the aerial coupling to a tap in the aerial coil. A commercially made plug-in coil having a separate aerial winding was originally used here, but this proved to give inferior results to the large air-spaced coil which was finally chosen. VC1 is the tuning capacitor and it consists of a 176 + 176pF 2-gang component with both sections in parallel, giving a total maximum capacitance of 352pF. D1 is the germanium diode detector, and it feeds either a crystal earphone or a pair of sensitive high impedance magnetic headphones by way of output socket SK2. The magnetic headphones should have an impedance of 4,000Ω or more. Resistor R1 provides the necessary d.c. path across the output circuit that is needed when a crystal earpiece, which has a capacitive impedance, is employed. If it is intended to use magnetic headphones all the time R1 is not required and it may be omitted.

TUNING COIL

A 4in. length of 1in. diameter wooden dowel is used as a coil former, and this may be cut from a broom handle, or similar. Make sure that the wood is completely dry before using it for its present application. Fig. 2 shows the construction of the coil and also

CRYSTAL SET

Employing a single germanium diode for detection, this receiver gives headphone reception of the more powerful transmissions over a wide range of short wave broadcast bands.

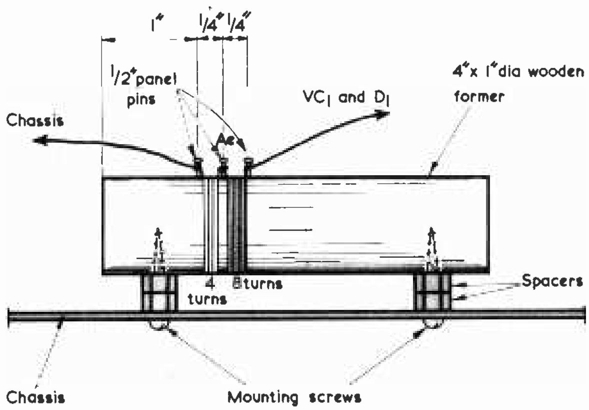
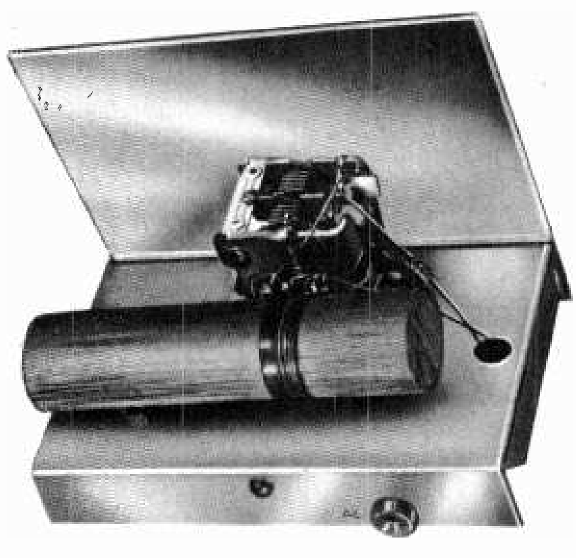


Fig. 2. Details of the coil and the manner in which it is mounted on the chassis

illustrates the method of mounting the completed coil to the chassis. Construction commences by hammering three ½in. panel pins into the former, leaving about ¼in. of each protruding. The pins are spaced about in. apart, and start about 1in. from one end of the former. The protruding sections of the pins are cleaned up with sandpaper and then tinned with a soldering iron and solder.

The coil is wound using about 4ft. of 24 s.w.g. enamelled wire. The enamel is scraped off this over a length of ½in. at a position about 3in. from one end, and this cleaned section is twisted several times around the left-hand panel pin (left-hand as seen in Fig. 2) and soldered to it. Four turns of wire are wound on the former and a ½in. length of wire is scraped clean of enamel, as before, so that it may be wrapped round and soldered to the centre panel pin. Another eight turns are then wound on the former, making certain that they are wound in the same direction as the first four. A further ½in. length of the wire is scraped free of enamel, this length is twisted around the third panel pin and the wire is then soldered to this pin. The coil is now completed, and has free lengths of 24 s.w.g. enamelled wire available at the two outside panel pins for connection, later, to the remainder of the receiver circuit.

The coil is mounted by two wood screws which pass through holes in the chassis deck (to be described next) and into the former. Spacers are placed over the wood screws between the chassis and the former, so as to hold the coil about ½in. clear of the chassis. The spacers can be any tubular objects of a suitable length and diameter, such as two or three 0BA full nuts for each screw.



Rear view of the receiver. The only components above the chassis are the coil, the tuning capacitor and the germanium diode

CHASSIS AND PANEL

The deck of the chassis is a Home Radio 'Universal Chassis' flanged single side, measuring 5in. by 3in. This has four holes cut in it as supplied, and one of these is fitted with a small grommet, as shown in Fig. 3. No use is made of the other three holes. The deck is in the centre in Fig. 3, and is viewed from the top with the flanges shown opened out for ease of presentation. The two holes in the front flange of the deck are drilled 6BA clear, as are the two matching holes in the front panel. The two are bolted together through these two sets of holes by two 6BA ¼in. bolts and nuts.

A 5 by 5in. 'Universal Chassis' plate (which actually measures 4⅞ by 4⅞ in.) is cut in two to form the front panel and the rear strut of the chassis. 4BA clear holes are drilled in this strut and the rear flange of the chassis deck, and the two parts are secured together, with the

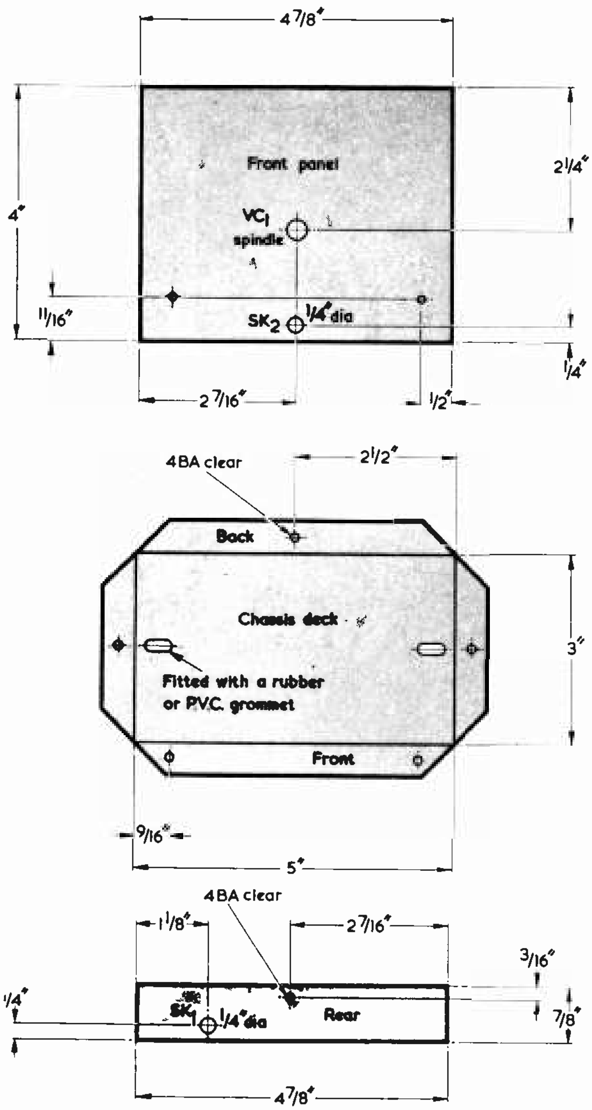


Fig. 3. Dimensions of the front panel, the chassis deck and the chassis rear

COMPONENTS

Resistor
R1 390kΩ ¼ watt 10% (see text)

Capacitor
VC1 352pF variable, 176 + 176pF 2-gang type '00' – see text (Jackson Bros.)

Diode
D1 Germanium diode type 0A90, OA91 or similar

Sockets
SK1 Wander-plug socket
SK2 3.5mm jack socket

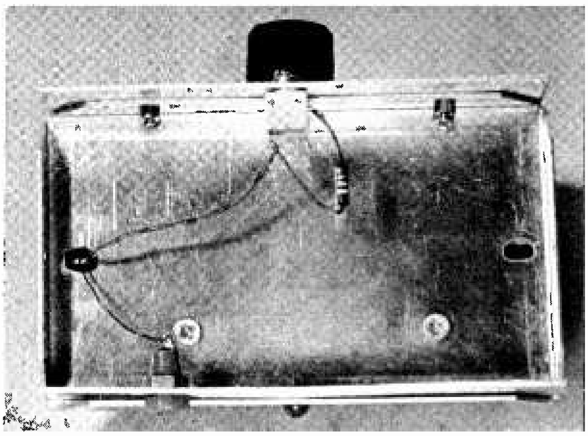
Miscellaneous
Crystal earphone or high impedance headphones
Control knob and pointer
Panel-Signs Set No. 5 (Data Publications)
'Universal Chassis' single side, 3 × 5in., Cat. No. CU145 (Home Radio)
'Universal Chassis' plate, 5 × 5in., Cat. No. CU166 (Home Radio)
24 s.w.g. enamelled wire

strut inside the rear flange, by a single ¼in. 4BA bolt. The positioning of aerial socket SK1, output jack socket SK2 and the spindle of VC1 are also shown in Fig. 3. The tuning capacitor is secured by three short 4BA screws passing, through suitably positioned holes in the front panel, into the three tapped holes in the capacitor front plate. The holes can be marked out on the front panel by initially placing a piece of paper over the capacitor front plate, marking out the tapped hole positions on this and then placing the paper on the front panel. The capacitor is mounted with its base to the left, as indicated in the photograph of the upper side of the receiver chassis. The ends of the three 4BA bolts must not pass beyond the thickness of the capacitor front plate or they will touch and damage the vanes behind. If desired, a spacing washer may be fitted over each 4BA bolt between the front panel and the capacitor front plate. Should sufficiently short 4BA bolts not be available, longer ones can be cut down. Some type 'OO' capacitors are supplied with integral trimmers. If these are present they should be fully unscrewed, to give minimum capacitance.

Finally, the coil, on its wooden former, is mounted across the chassis behind the variable capacitor.

WIRING

The wiring is very simple. Fig. 2 shows the connections to L1. A short insulated lead from the aerial socket passes through the grommet in the chassis deck to the central pin of L1. The two 24 s.w.g. enamelled wires from the end pins are shortened and cleaned as necessary and connected to VC1. The chassis connection is provided by the moving vanes tag of VC1. The two fixed vane tags of VC1 are connected together by a short length of wire and the enamelled wire lead from L1 is connected to the rear fixed vane tag. The diode connects to the forward fixed vane tag of VC1, and a short length of insulated wire is soldered to its remaining lead-out to act as an extension. The other end of this wire, shortened as necessary, connects to the output



Components below the chassis are the aerial socket, the output jack socket and the 390kΩ resistor

socket. In Fig. 1 the diode is shown with its cathode (the 'plus sign end') connected to VC1 but, in practice, it can be connected either way round in this receiver.

Resistor R1 is mounted at the jack socket tags. With standard jack sockets the chassis connection to the plug sleeve contact will be automatically provided via the mounting bush of the socket. If the particular socket employed has an insulated construction, the chassis connection to its sleeve contact may be made via a short wire connecting to a solder tag under one of the adjacent 6BA nuts.

A finishing touch is given by adding a tuning dial marked with a logging scale to the front panel and by fitting VC1 with a knob and home-made pointer. The author employed a scale taken from Panel Signs Set No. 5, this being available from the publishers of this journal. The scale can be marked up with frequencies or broadcast band positions after these have been received and identified.

OPERATION

A long wire aerial is required, and this should ideally be about 50 to 100ft. long and positioned clear of buildings, etc. An earth connection will not be needed with most aerials, and will only be of benefit if a very short aerial is used. There is only one control and that is the tuning control. As one would expect with only a single tuned circuit, the tuning is fairly broad, and a bandspread control is not necessary.

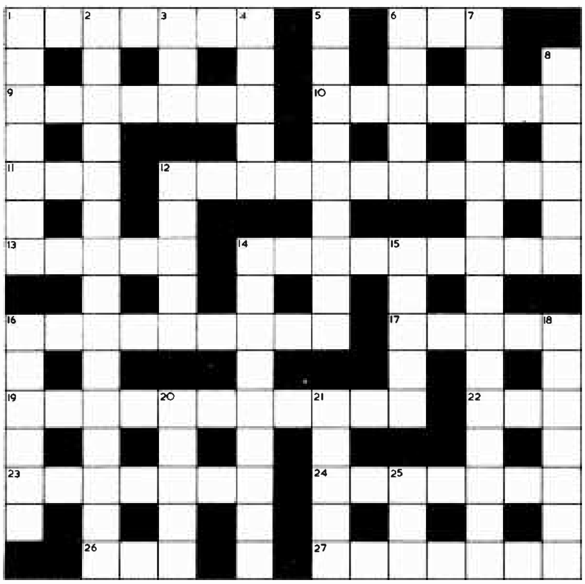
It should be found that a number of stations can be received at any time. Although subject to extreme fading, some stations should be heard very strongly for reasonable periods of time. As with any short wave receiver, the maximum range of stations received is very much dependent on prevailing conditions. In this case these include the existence of a very strong station on the band being received, which can block out weaker transmissions due to the wide bandwidth of the receiver.

To obtain best results from the receiver, the main requirements are practice and patience. ■

CONSTRUCTOR'S CROSSWORD

CLUES ACROSS

1. Electrode which allows the ingress of electrons. (7)
6. Slow and delightful initially, but gloomy when complete. (3)
9. Logic inverter. (3, 4)
10. Prescribed rule. (7)
11. Operating surface of small potentiometers. (3)
12. 12 s.w.g. and 14 s.w.g., as applied to aluminium sheet. (5, 6)
13. 50Hz circles which can cause hum. (5)
14. Circuit condition in the absence of signal. (9)
16. Space for actors left by the red and blue phosphors? (9)
17. Undesirable audio pollution. (5)
19. Simply an electro-acoustic transducer. (11)
22. Could be one result of 21 down. (3)
23. Rearranged sea port gives grass. (7)
24. Conveyed, as of modulation. (7)
26. Connection into a coil. (3)
27. Early TV device incorporating a flying spot. (7)

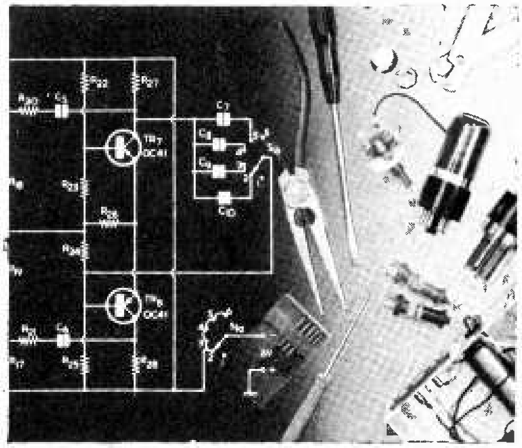


CLUES DOWN

1. Contrast this changes video amplitude. (7)
2. Upstanding Indian facility offered by the SN7400. (5-4, 6)
3. A multiplicity of eggs. (3)
4. Apply a force. (5)
5. Metal which imparts springiness to copper. (9)
6. The Greeks had a word (or letter) for this summing symbol. (5)
7. Function of the erase head. (15)
8. Applies to group of similar components within a radio. (2, 1, 3)
12. Cosmic ray particle. (5)
14. Volume listing c.w. abbreviations? (1, 4, 4)
15. Equipment for underwater listening. (5)
16. Descriptive of the electroscope leaf. (6)
18. Logic element which changes binary to BCD. (7)
20. Join valve electrodes, or components upside-down! (5)
21. Oddly enough, inductors provide these on being switched off. (5)
25. American colour TV pioneers. (1.1.1)

(Solution on page 687)

CURRENT LIMITING REGULATED POWER SUPPLY



by G. A. FRENCH

ONE OF THE MORE AGREEABLE features of semiconductor circuit design is the ease with which simple regulated supply voltage sources may be set up. Frequently, all that is required is a zener diode or a zener diode and an emitter follower. The only disadvantage with such regulated voltage sources is that, without introducing a disproportionate amount of extra components, they are not able to offer a sharply defined output current limit. This month's article in the "Suggested Circuit" series describes an unusual power supply design which offers about the same level of voltage regulation as does a zener diode and emitter follower, and which also limits output current abruptly at a predetermined level. Basically, the design requires one additional transistor and a current limiting resistance.

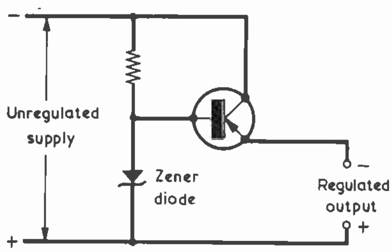


Fig. 1. A simple regulated supply incorporating a zener diode and an emitter follower

EMITTER FOLLOWER CIRCUIT

A regulating circuit incorporating a zener diode and an emitter follower is shown in Fig. 1. This circuit is frequently employed to give output load currents up to the order of several hundred milliamps, and the purpose of the emitter follower is to ensure that only the relatively low base current of the transistor is drawn from the zener diode section of the circuit. The transistor base current is provided by way of the zener diode series resistor. The regulation is not perfect and a voltage drop of the order of 0.2 to 0.4 volt can be expected at output currents around 100 to 200mA. This output drop is due to increased voltage drop in the base-emitter junction of the transistor, increased base current drawn through the zener diode series resistance, and voltage drop from the unregulated supply due to the increased current drawn from it. These last two factors take the zener diode a small way down its slope resistance characteristic, whereupon a slightly smaller voltage appears across it. Despite the small drop in output voltage at high output current, the regulating circuit of Fig. 1 is perfectly satisfactory as a supply for many items of electronic equipment.

The circuit of Fig. 1 does not provide current limiting, and a high output current can flow if the output terminals are accidentally short-circuited. This current may well damage the transistor and/or some of the components in the unregulated supply which feeds the regulator circuit. A degree of short-circuit protection can be provided by inserting a current limiting resistor between the collector of the transistor and the upper supply rail, this resistor having a value which causes the collector potential to drop to that on the transistor base when a pre-determined current is drawn from the output terminals. The current limiting offered is not, however, of a sharply defined nature and the short-circuit current which flows is approximately equal to the unregulated supply voltage divided by the current limiting resistance. This current can be considerably higher than the pre-determined current at which the transistor collector falls to base potential.

The circuit to be presented by the author is shown in Fig. 2. In this diagram it is assumed that the unregulated supply is obtained from a mains transformer and rectifier circuit. For ease of explanation let us say that the output current at which we want the circuit to limit is a little lower than 100mA. We may now consider circuit operation.

As with Fig. 1, a reference voltage is provided by a zener diode, this being ZD1 in Fig. 2. TR1 is an emitter follower but it is now connected with opposite polarity, so that its base current flows through the zener diode instead of through the zener diode series resistor. An amplified emitter current is then available for the base of TR2. If no current is drawn from the output terminals the emitter current from TR1 flows directly through the base-emitter junction of

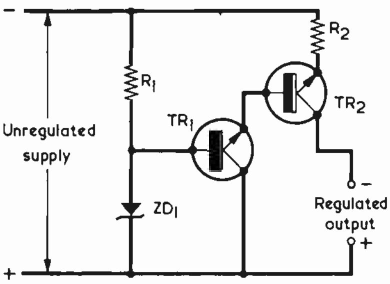


Fig. 2. This circuit gives the same level of voltage regulation as does that of Fig. 1, but it also offers sharp maximum current limiting

TR2 and then through R2 to the upper supply rail. Under these conditions the base-emitter junction of TR2 is simply being used as a forward biased diode.

Resistor R2 is the current limiting resistor and it has a value which causes 100mA to flow through it under the conditions just described. For the moment, we will make the assumption that the voltage from the unregulated supply is constant, whereupon we can say that the voltage across R2 is similarly constant. This is because it is the "constant" unregulated supply voltage minus the voltages dropped in the zener diode and the base-emitter junctions of TR1 and TR2.

The heavy base current in TR2 causes this transistor to turn hard on, and if we apply a voltmeter to the output terminals we will find that the negative output terminal carries a potential that is very close to that on TR2 emitter. If a load current of 25mA is drawn from the output terminals the potential at TR2 collector will remain at virtually the same level as it had when there was no load current, because TR2 is still fully conductive. Also, the voltage across R2 will not alter because it is still equal to the "constant" voltage from the unregulated supply minus that dropped across the zener diode and the base-emitter junctions of the two transistors. Thus, the current in R2 remains unaltered at 100mA. Previously, 100mA flowed from the emitter of TR1. The emitter current from TR1 now falls to 75mA and the remaining 25mA flows in the load. If the load current is increased to 50mA, the current from TR1 emitter becomes 50mA also; and if the load current is raised to 75mA the current from TR1 emitter drops to 25mA. This current sharing must occur because the total current which flows is limited by R2 to 100mA.

If the load current is now taken close to 100mA, very little current can flow from TR1 emitter into TR2 base, and TR2 ceases to behave as a fully turned on transistor. In consequence its collector voltage goes positive to reduce the load current to a level which enables both the load current and the current flowing into its base to add up to 100mA. Any attempts to further increase the load current will simply result in TR2 collector going further positive. If the output terminals are short-circuited the current flowing in the load will be 100mA minus the base current needed by TR2 from TR1 emitter to maintain that current.

REGULATED VOLTAGE OUTPUT

Thus, the circuit of Fig. 2 provides a regulated voltage output for all output currents up to those which approach the current limitation of 100mA imposed by the presence of R2. A consequent feature is that the design ensures that the total current drawn from the unregulated supply by the collectors of TR1 and TR2 is always maintained at 100mA, this current being drawn even at the extremes of zero output current and output short-circuit. At the start of the explanation of circuit operation we made the temporary assumption that the unregulated supply voltage is constant. Obviously, this is not true in practice, but the fact that the total current drawn by TR1 and TR2 collectors is always maintained at 100mA will ensure that the voltage from the unregulated supply is at least reasonably steady, and that it will certainly be steady enough for our present purposes. The unregulated supply voltage will, on the other hand, vary with changes in mains supply voltage. The effect on the circuit of Fig. 2 will be that if the unregulated supply voltage increases due to a rise in mains voltage, so also will the voltage across R2 and the current at which the circuit limits. Similarly, if the mains voltage falls so also will the limiting current. If the unregulated supply voltage is made to be about double the regulated voltage, approximately half the unregulated voltage will appear across R2. An increase in mains voltage of 5% will then cause the current at which output limiting takes place to increase by 10%. This would appear to be a small disadvantage when weighed against the overall simplicity of the circuit. Nevertheless, it is desirable to have the unregulated supply voltage significantly higher than the regulated voltage to minimise the effect on limiting current of mains voltage variations.

A factor which has next to be pointed out is that the current limiting which we have, up to now, considered as being provided by R2 is, in practice, given by R2 in series with the internal resistance (or regulation resistance) of the unregulated supply. However, the fixed total current drawn by the collectors of TR1 and TR2 will ensure that the unregulated supply internal resistance does not alter significantly for varying regulated output currents, whereupon the only factor which can significantly alter the current in R2 is, once again, change in mains voltage.

In a practical circuit R2 will need to be a pre-set variable component. It will be set up by connecting a current-reading meter across the output terminals (thereby simulating a short-circuit) and adjusting the value of R2 so that the meter indicates the desired output limiting current. The current in R2 will then be that output current plus the small emitter current from TR1 which is needed at TR2 base to maintain the output current.

The maximum limiting current the circuit can provide must be within the maximum collector current ratings of TR1 and TR2, and within the maximum base current rating for TR2. This last rating has to be taken into account since, in the absence of regulated output current, the full current for R2 flows directly through the base-emitter junction of TR2. This third rating will almost inevitably be smaller than the first two, whereupon it will be found necessary to employ a power transistor for TR2 which is operated well below its maximum collector current figure.

Maximum dissipation occurs in TR1 when there is zero regulated output current. If the zener diode voltage is relatively high, dissipation in TR1 can be reduced by inserting an additional resistor in its collector circuit, as shown in Fig. 3. This resistor has a value which allows several volts to appear between the collector and emitter of TR1 when the regulated output current is zero. Maximum dissipation in TR2 is given when the regulated output is short-circuited.

The current drawn by TR1 base through ZD1 is at a maximum when the regulated output current is zero and is at a minimum when the output is short-circuited. Resistor R1 should allow the flow of sufficient zener current to swamp out these changes in TR1 base current.

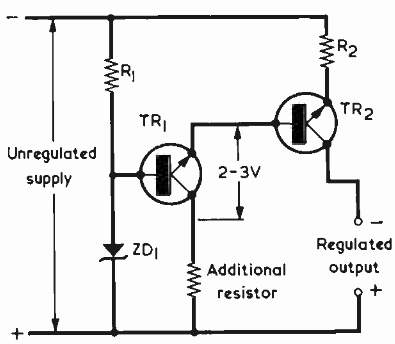


Fig. 3. Dissipation in TR1 may be reduced by inserting an additional resistor in its collector circuit

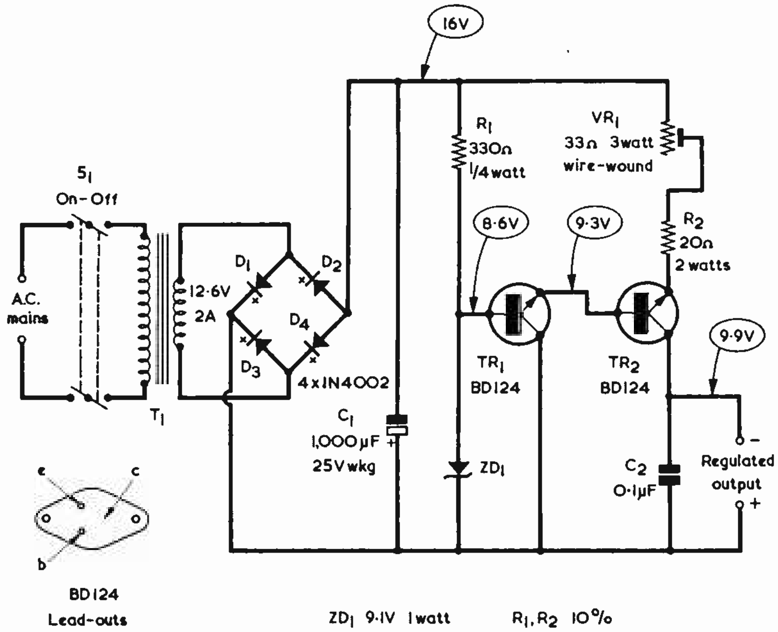


Fig. 4. A practical power supply, assembled to check the efficiency of the circuit shown in Fig. 2

PRACTICAL CIRCUIT

The author made up the practical circuit shown in Fig. 4 to check out the power supply design. In this diagram the unregulated supply comprises the components T1, D1 to D4 and C1. The 12.6 volt secondary of T1 was given by using a heater transformer having two 6.3 volt windings connected in series. In the regulating and current limiting section, R1, ZD1, TR1 and TR2 take up the same circuit positions as they had in Fig. 2. R2 of Fig. 2 now becomes R2 and VR1 in series. It was decided to make the output limiting current 150mA, whereupon a current-reading meter was connected across the regulated output terminals and VR1 adjusted to give this reading in the meter. The values of R2 and VR1 are then such that a current slightly greater than 150mA flows in them. The limiting current of 150mA will be maintained if the mains voltage remains steady, and will slightly increase or decrease if the mains voltage rises or falls. (When VR1 is being set up it should be initially adjusted to insert maximum resistance into circuit. This resistance is then reduced until the desired current reading is obtained.)

TR1 and TR2 are both silicon power transistors type BD124. These are employed well within their maximum ratings, including their maximum base current rating of 500mA. The BD124 has an hFE (at a collector current of 50mA) of 25 minimum and 60 typical. With a typical BD124, the maximum base current change at TR1 base will be of the order of 2mA, and will be 5mA with a worst-case device. The zener current flowing through R1 is 21mA, and this could be increased by reducing the value of R1, if desired, to ensure more effective swamping out of TR1 base current changes. The maximum dissipation in both TR1 and TR2 is a little less than 1.5 watts, and both transistors can be mounted on small flat heat sinks about 1¼ in. square.

It was found that the circuit exhibited slight r.f. instability at low output currents, but that this could be cleared by connecting an 0.01μF capacitor across the output terminals. The higher value 0.1μF component which is specified in Fig. 4 should, in consequence, be more than adequate to prevent this instability. C2 is not needed if, as will probably be the case, a high value electrolytic capacitor is connected across the output terminals. Should such a capacitor be fitted it must be remembered that there will be a consequent heavy surge current if the output terminals are short-circuited, this current being the discharge current of the capacitor and not due to the supply. The supply, on its own, cannot pass an output current greater than its limiting value.

Fig. 5 shows the output voltage-output current curve of the circuit of Fig. 4. For currents up to 20mA and above, the output voltage is 9.9 volts. At 130mA it drops to 9.7 volts and then to 9.6 volts at 145mA. A sudden fall in output voltage commences at around 147mA, where the voltage drops to 9.4 volts. At 150mA the output voltage is zero. The power supply offers, therefore, voltage regulation of the same order as is given by a zener diode and emitter follower circuit, together with quite abrupt current limiting.

The circuit of Fig. 4 is intended only as a guide towards the practical uses to which the basic arrangement of Fig. 2 can be put, and the constructor who understands the principles involved will be able to make up alternative supplies having different output voltage and current limiting levels. The voltages, relative to the positive supply rail, at the base and emitter of TR1 and the collector of TR2 are also given in Fig. 4, these having been measured at zero output current in the author's practical circuit (in which the zener diode employed happened to be near the lower end of its tolerance on voltage). Due to the base-emitter voltage drops in TR1 and TR2, the output voltage is 1.3 volts greater than that across the zener diode. In consequence, the zener diode employed in alternative power supplies should have a zener voltage which is 1.3 volts less than the required output voltage. ■

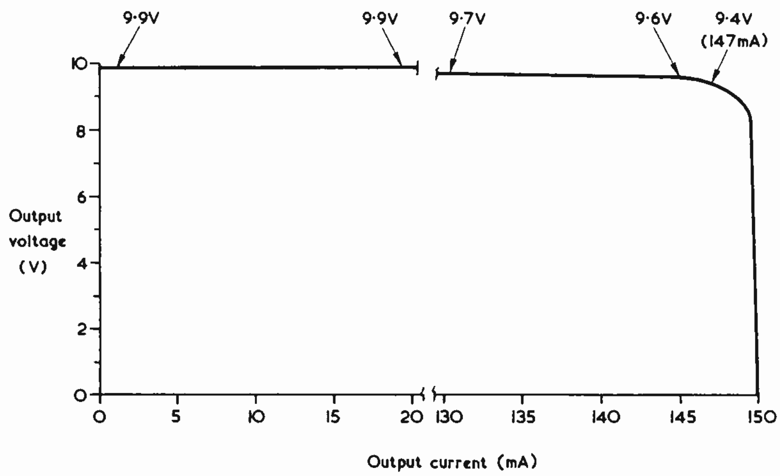


Fig. 5. Curve showing output voltage and output current in the practical power supply

RECENT PUBLICATIONS

TEST EQUIPMENT FOR THE RADIO AMATEUR. By H. L. Gibson, C. Eng., M.I.E.E., G8CGA. 136 pages, 250 x 180mm (10 x 7in.)
Published by Radio Society of Great Britain. Price £1.80.

In the introduction to this book the author makes the modest statement that its subject matter is intended to cover a range of test instruments and measurement methods sufficient for most amateur stations in the h.f. and v.h.f. bands. The reviewer feels that the book has a much wider appeal than this because, apart from two chapters on r.f. power, aerials and transmission lines, virtually all the test equipment and measurement techniques described are applicable to general electronic work.

The first chapter introduces the moving-coil multimeter, this being followed by a chapter on electronic instruments such as valve and f.e.t. voltmeters. Next to be dealt with are the dip oscillator and frequency measuring techniques, the latter including digital frequency displays employing t.t.l. and numerical indicator tubes. The fifth chapter describes r.f. power measurement and this is succeeded by chapters on noise measurement and on aerial and transmission line measurements. Chapter 8 discusses components, valves and semiconductors, whilst Chapter 9 covers signal sources and attentuators. The next chapter in the book provides details on oscilloscopes and swept-frequency measurements, and this is followed by the last chapter, which gives general reference data.

A very attractive feature of the book is that practically all the test equipment described can be home-constructed. The book is profusely illustrated with clear diagrams and photographs, and the descriptions of test equipment and principles of operation are concise and lucid. The volume will prove to be very useful to anyone who is interested in electronic measurements.

In cases of difficulty, the book may be obtained direct from Radio Society of Great Britain, Publications Dept., 35 Doughty Street, London WC1N 2AE, at the cover price of £1.80 plus 20p postage.

JAPANESE RADIO, RECORD AND TAPE PLAYER SCHEMATIC/SERVICING MANUAL. By Homer Davidson. 234 pages, 275 x 205mm. ($10\frac{3}{4}$ x $8\frac{1}{4}$in.)
Published by Foulsham-Tab Ltd. Price £1.90.

This book is in the Foulsham-Tab series having an American text with an added introductory chapter for English readers.

The first chapter of the volume proper deals with the servicing of multi-band radio receivers and amplifiers, whilst the second covers the servicing of tape players. After this the book reproduces representative manufacturers' service information, complete with full circuit diagrams, parts lists and alignment instructions, for the following equipments: Chapter 3, multi-band radios; Chapter 4, a.m.-f.m.-multiplex radios and Stereo-8 tape players (including a section on Discrete Quad); Chapter 5, automobile stereo tape players; Chapter 6, portable tape players; Chapter 7, cassette tape players; and Chapter 8, reel-to-reel tape recorder-players. An average of about seven equipments is covered in each chapter. Chapter 4 also includes a large fold-out section which allows the information given to be more clearly presented.

RTTY HANDBOOK. Edited by Wayne Green.
326 pages, 215 x 135mm. ($8\frac{1}{2}$ x $5\frac{1}{4}$in.) Published by Foulsham-Tab Ltd. Price £1.75.

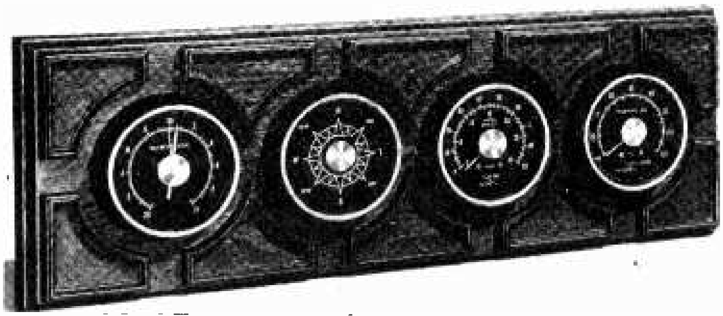
The book commences with an introduction to RTTY principles and practice and gives details of American teleprinter machines available in the amateur market. These details include full circuit diagrams. Next to be discussed are terminal units, frequency shift keying (FSK). and audio frequency shift keying (AFSK). After sections dealing with interconnections and control circuitry, reading and care of tape, and American F.C.C. regulations, there is an unusual chapter on RTTY art. This gives reproductions of pictures sent and received by teletype, the pictures being made up by the transmission of different letters or punctuation marks of varying overal density along each line. Thus, the letter 'H' produces a point of heavier density than does a full stop. The resultant picture, when viewed from a sufficient distance, has the same appearance as one formed by the dots in a newspaper photograph.

After this the book deals with means of improving reception, the use of filters and autostart circuits, and suitable accessories.

The book presents considerable detail, and the circuits published in it range from valves through transistors to integrated circuits. The keen British RTTY enthusiast should find plenty of interest in the approaches and techniques which are used by his amateur associates in the States.

NEWS . . . AND .

HEATHKIT WEATHER STATION



The Heathkit ID-1290 is one of the most sophisticated weather stations ever offered for home or office use. Now you can own the same type of weather monitoring instrumentation used by local airports and weather stations – and it's beautifully designed to suit your library, kitchen, amateur radio shack – anywhere.

You can monitor barometric pressure, wind speed, wind direction and indoor/outdoor temperature with outstanding accuracy. All readings, except barometric pressure are taken and displayed using the latest solid-state electronic circuitry via sensors mounted internally and externally. The barometer is a self-contained aneroid type. Precision meters with long scales are used for temperature and wind speed plus direction.

Temperature readout: +40° to ×120°F with 2° divisions. Front panel switch allows continuous monitoring of indoor/outdoor temperatures.

Wind speed ranges: 0–30 and 0–90 m.p.h.

All four large dial faces are mounted in an attractive simulated woodgrain cabinet and the entire panel can be used vertically or horizontally or placed on a surface using the special stand.

Wind cup, weather vane and outside temperature sensor are integrated in a weatherproof assembly which can be mounted to existing TV aerial masts.

Finally, the Heathkit 'Weather Book' will introduce you and your family to the fascinating study of weather and weather forecasting.

For 110–130 VAC mains operation. (250 VAC Transformer available as extra). Mail Order Basic price: Kit K/ID-1290 £50.05, Carriage 55p. For more information and a FREE catalogue contact – HEATH (Gloucester) LTD., Bristol Road, Gloucester GL2 6EE.

NEW MULLARD MINI-FILM

Mullard Limited announce '*Metal Film Resistors*', a new 16mm, 7-minute colour film, dealing with the manufacture of metal film linear resistors. Made by Marcus Cooper Ltd., it is available on loan from Mullard Film Library, Guild Sound & Vision, Woodston House, Oundle Road, Peterborough, Northants, PE2 9PZ.

While the resistor is the simplest of all devices, it is an essential component of every item of electronic equipment. Consequently it has been the subject of a considerable amount of research and development.

'*Metal Film Resistors*' begins with the deposition of the thin metal film on to the ceramic rod. Then follows a step-by-step description of the complete manufacturing process. This includes the mechanical cutting of the spiral track in the film to modify the resistance between the end caps to the desired value, the connecting of the leads to the end caps, the application of protective coats of lacquer and, finally, the adding of the colour-code bands.

This method of manufacture yields mass-produced resistors with tolerances of the order of 1 per cent. Another method – using a laser beam to cut the spiral track at an even greater speed is also described.

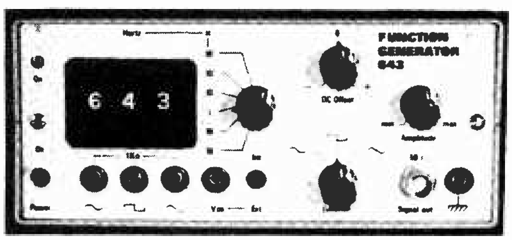
The film ends by showing finished resistors undergoing stringent quality control testing. Finally they are packed into continuous bandoliers which enable users to feed them automatically into printed circuit boards.

643 LOW COST FUNCTION GENERATOR

This instrument, from OMB Electronics of Riverside, Eynsford, Kent, puts Function Generator performance in the RC Oscillator price bracket. It features simple, accurate digital setting of frequency in the range 0.01Hz to 1MHz together with simultaneous outputs of triangle, squarewave and low distortion sinewave signals. The main output gives 10V pp at 50 Ohm output impedance and DC offset is provided.

Frequency may be accurately controlled by a low external voltage over a range exceeding 1000:1. Gated and FM operation are also available. The instrument is light, compact and is easily serviced.

The U.K. price, exclusive of VAT, is £75 and delivery is "off-the-shelf".



. . . COMMENT

'ORACLE' DATA BROADCASTING SERVICE

The Independent Broadcasting Authority welcomes the measure of agreement now achieved on a unified system of data broadcasting as the result of a joint working party with Industry and the BBC. This is expected to lead rapidly to an intensification of field testing and it seems likely that these tests will be followed by an experimental public service for broadcasting the written word over the television transmitter network of the IBA.

ORACLE is an acronym for 'Optional Reception of Announcements by Coded Line Electronics' and such a service would allow a viewer to select at will from a number of different 'pages' of information and display this information on the screen of his receiver, either against a neutral background or superimposed on his normal television picture. The viewer would thus have available a new form of information service which would be frequently up-dated and which could include accurate time checks, news flashes, weather forecasts, traffic, local and sporting news, television and radio programme information, financial news, theatre and shopping information and advertising messages and the like.

The original proposals for such an application of data information 'concealed' in short intervals of the television waveform were first made by IBA engineers at the International Broadcasting Convention in London in September 1972.

By April 1973 a closed circuit demonstration of the 50-page ORACLE magazine had been given and during that month regular ORACLE transmissions commenced from Crystal Palace. These included frequent test transmissions of the full 50-page magazine with immediate 'live' editing, using the IBA's exclusive computer-based system. Transmissions from Crystal Palace were demonstrated in public at a Conversazione of the Institution of Electrical Engineers in June 1973 at the Royal Festival Hall.

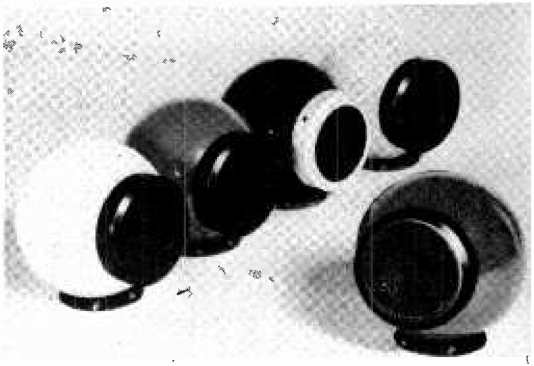
These regular ORACLE transmissions were the first of their type, anywhere in the world, to be field tested on an operational broadcast service.

ELVASTON CASTLE MOBILE RALLY

This year the Nunsfield House Community Association Amateur Radio Group will be holding their fifth amateur radio mobile rally in the grounds of Elvaston Castle near Derby. The Group aim is to provide a family day out that is of interest to the general public as well as to the radio amateur.

Elvaston Castle is situated on the B5010 which is 5 miles south east of Derby, just off the A6 between Derby and Loughborough.

AUDIO 'HI-BALL' 750 SPEAKERS

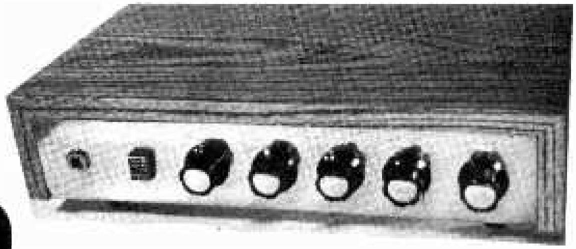


The Hi-Ball modular speaker system represents a breakthrough in Hi-Fidelity sound reproduction. The attractive speakers, with cabinet material of glass, are sold exclusively in the UK by QAS of Wollaton Road, Beeston, Nottingham, NG9 2PB.

Quadrophony is already on the way to becoming the norm in the Hi-Fi world, the two extra speakers improving the ambiophonic sound. The placement of four speakers in a room is however difficult aesthetically, if optimum accoustic requirements are to be met. The Hi-Ball 750 overcomes this problem of conventionally shaped speakers because, when mounted on the CG2 corner bracket, it nestles neatly in the four ceiling corners of the room. It provides the benefits of large speaker sound without taking up valuable space and, in the colours available, can make an interesting visual focal point.

"Then we tried planning. My husband made a baby alarm, but it didn't work!"

6 + 6 STEREO AMPLIFIER



Part 2

By A. P. Roberts

This concluding article in our 2-part series deals with the construction and setting-up of this attractive fully solid-state stereo amplifier.

POWER SUPPLY ASSEMBLY

THE MAINS TRANSFORMER SPECIFIED IN THE COMPONENTS List, which was given last month, has a 9–0–9 volt secondary rated at 1 amp. In the author's case it was found possible to modify this transformer so that the bridge rectifier and smoothing capacitor, C17, could be mounted on its tags. The finished assembly then takes up the appearance illustrated in Fig. 4.

As received, the transformer had the secondary centre-tap connected to tag 2 and the two outside ends of the secondary connected to tags 1 and 3. No connection was made to tag 4. The two wires from the secondary winding which pass to tag 2 are carefully removed from this tag. Their ends are then soldered together, taped up and moved out of the way so that they cannot touch any other wire or tag. The lead from the secondary winding which went to tag 1 is then removed from that tag and is soldered to tag 2. Since tags 1 and 4 now have no connections from the transformer windings, they are free to act as anchor tags for the rectified output from the bridge rectifier and to take the two 2,500μF capacitors which, in parallel, make up C17. Note that the negative output at tag 1 connects to a solder tag secured under the adjacent mounting nut for T1. As with all parts and assemblies mounted on the chassis deck, the mounting bolt heads are below the chassis.

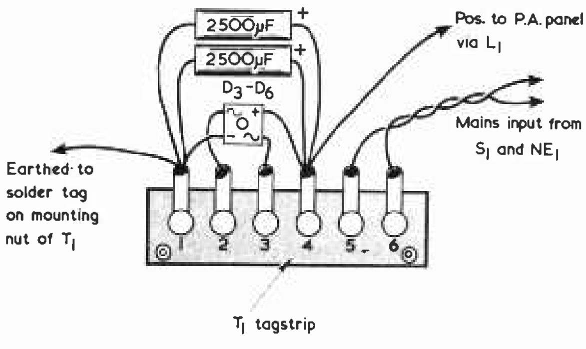


Fig. 4. The bridge rectifier and reservoir capacitor (given by two capacitors in parallel) are mounted direct to the mains transformer tags

It must be pointed out that there is a slight possibility that some transformers may have a different tag layout to that employed by the author. Because of this, it is important to check that the outside ends of the secondary are initially connected to tags 1 and 3. The main essential is to ensure that the power supply, as finally assembled, follows the circuit of Fig. 2, which was published in last month's issue. Readers who feel uncertain about modifying the transformer secondary connections could fit a small tagstrip with two insulated tags on the chassis deck alongside the transformer. This tagstrip could take the connections to C17 and the rectified output from the bridge rectifier. The a.c. input to the rectifier is then taken from the existing tags which couple to the outside ends of the transformer secondary.

As was mentioned last month, the smoothing choke L1 is home-made and has an unusual design which nevertheless functions adequately in practice. The choke is wound on a piece of ¼ in. diameter ferrite rod which is 1¾ in. long. The 1¾ in. length has to be broken from a longer rod, and it may be noted here that 3½ in. lengths of ¼ in. rod are available from Henry's Radio Ltd. The shorter length is obtained by cutting a V-shaped groove with a small file in the rod at the point where it is to be

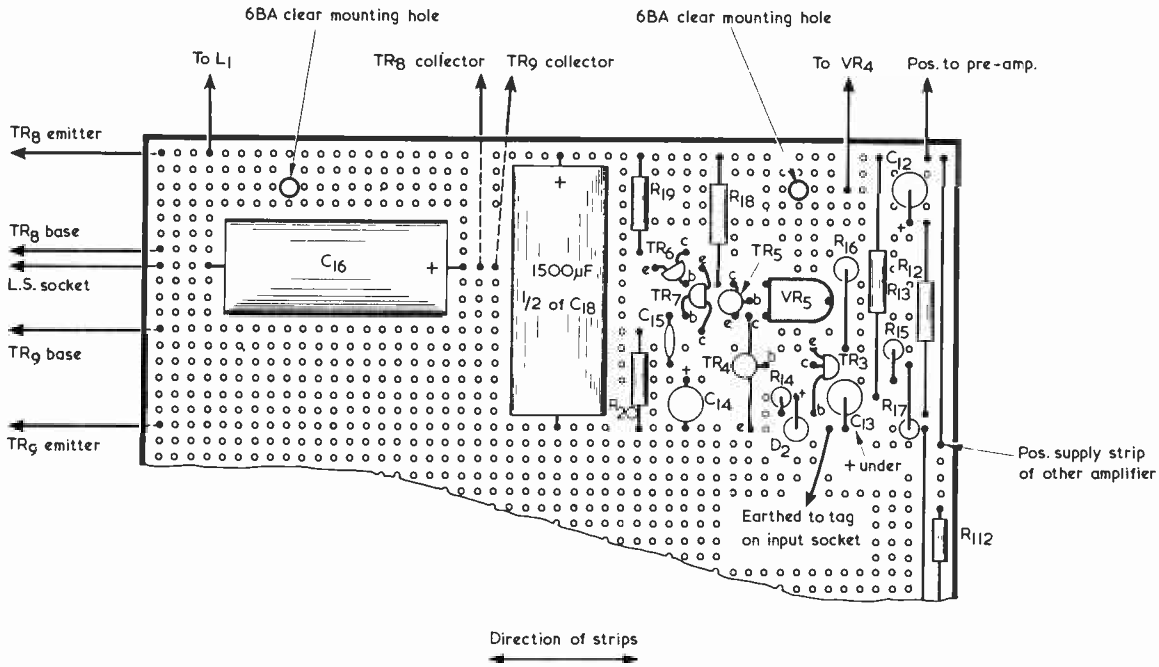


Fig. 5. The power amplifiers for both channels are assembled on a single Veroboard panel. The layout of one of the amplifiers is shown here

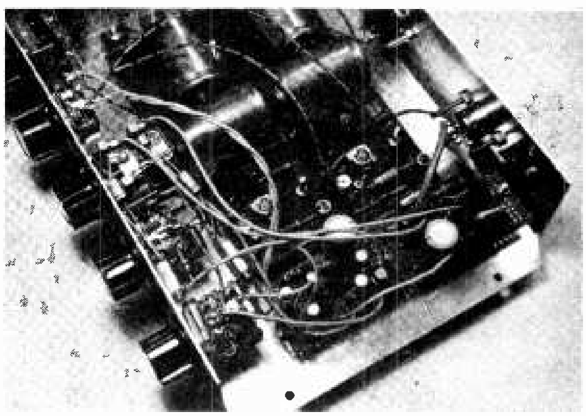
broken. The rod is then given a sharp tap with a small hammer on this groove, whereupon it should break fairly evenly into two.

A tight-fitting grommet is placed over each end of the rod to prevent the winding slipping over the edges. 10 yards of 24 s.w.g. enamelled copper wire are then scramble-wound onto the rod. Several layers of insulating tape can be used to prevent the coil from unwinding. The choke is then glued to the chassis so that the rod is vertical, using a powerful adhesive such as Araldite. It is positioned between the remaining power supply wiring and the set of output transistors nearer the rear of the chassis. One end of the 24 s.w.g. wire, suitably tinned, may be used for connecting the choke to the positive end of C17. A lead from the power amplifier panel connects to the other end of the choke wire, and the soldered joint is covered with sleeving.

The 3-core mains input lead passes through a grommet in the rear panel and its earth wire is soldered to the chassis tag under T1 mounting nut. The live and neutral wires pass on to switch S1. Two leads from the remaining tags of S1 couple to the neon assembly NE1, and then pass to tags 5 and 6 of the transformer.

POWER AMPLIFIER

The power amplifier is assembled on a panel of 0.1 in. matrix Veroboard measuring 3¾ by 5 in. This is a standard size. The copper strips should run along the 5 in. length. Fig. 5 shows the component layout for one of the two power amplifiers. The other amplifier is virtually identical and is assembled on the lower half of the board. The only difference is at the extreme right-hand side of the panel, where the wires linking over the power supply necessitate R112 being one hole to the right of the corresponding position of R12. The top copper strip in Fig. 5 carries the positive supply from L1, and this is linked over to the strip immediately below the earthed strip to which are connected R17, C13, D2, etc. The lower strip with the positive supply takes the upper connections of R119, R118, etc., and the wiring for the other power amplifier then proceeds down in the same way as that for the power amplifier shown. The upper amplifier provides a positive supply for the pre-amplifier, and such an outlet is not needed from the



A close-up view of the pre-amplifier and tone control boards, and of the wiring to the tone control potentiometer

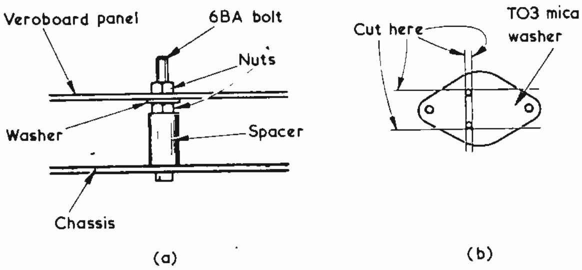


Fig. 6 (a) Illustrating the manner in which the Veroboard panels are spaced off from the chassis deck
(b) Two TO3 mica washers are cut as shown here to provide insulating washers for the output transistors

lower amplifier. The lower amplifier takes its negative supply connection via the link wire from the holes to the right of R17 body. Two 6BA clear mounting holes are required in the lower amplifier section, and these have the same relative positions as those in the upper amplifier section, i.e. one hole is above C116 and the other is between R118 and C112. The mounting holes should be lightly countersunk on the copper side to ensure that the mounting bolts do not make contact with the adjacent copper strips.

There is only one break in the copper strips for each amplifier. This is made between the two points of connection for the speaker coupling capacitors C16 and C116.

The method of mounting the power amplifier Veroboard panel is shown in Fig. 6(a). This mounting method is used also with the pre-amplifier and tone control boards. The washer must be made of an insulating material. The panels are spaced off from the chassis by about ⅜ in.

Although the output transistors are used well within their maximum ratings, they are nevertheless given a substantial amount of heatsinking by being bolted to the chassis deck. The appropriate holes are shown in Fig. 3 (published last month). They are mounted with their lead-outs pointing away from the mains transformer end of the chassis, as is evident in the photograph of the chassis interior. Each output transistor has a metal pad which should face the chassis and which is in contact with the collector lead-out of the device. This metal pad must be insulated from the chassis. The author could not find a source of supply for mica insulating washers to suit this type of transistor, but it was found possible to make up two suitable washers from a T03 type washer, this being cut as shown in Fig. 6(b). The mounting bolt for each output transistor passes through the original TO3 mounting hole of the cut out mica section. A ½ in. 6BA bolt is required for each transistor and there is no need to provide an insulating bush. To be entirely safe, the insulation between the collector lead-out and chassis of each transistor should be checked with an ohmmeter after it has been mounted.

The resistors R21 and R121 are mounted at the headphone jack tags. These resistors can be seen in the photographs of the chassis interior. The free ends of the resistors couple to the appropriate speaker socket tags. The speaker sockets employed by the author were 3-way DIN types. These may be wired in any way favoured by the constructor such that one terminal connects to chassis and the other to C16 or C116 as applicable.

TONE CONTROLS

The wiring of the tone control section is split into two parts. Some components are mounted on the small Veroboard panel shown in Fig. 7, whilst the others are wired to the tone controls themselves.

The Veroboard panel of Fig. 7 is of 0.1 in. matrix and has 12 by 21 holes. It contains wiring for both channels in addition to the common components R9 and C9. There are no breaks in the copper strips. A positive supply is obtained from D1, which is mounted on the pre-amplifier panel. The tone control panel is secured to the chassis with a 6BA bolt and nut, using the same spacing-off method as was employed with the power amplifier board.

The wiring at the tone control potentiometers is illustrated in Fig. 8. This shows only one channel, the wiring being identical for the rear sections, VR102, VR103 and VR101, of the dual-gang potentiometers. Also shown are the connections to the balance control, VR4. Mounting components on the potentiometers helps to reduce the amount of interwiring required, but there is still a fair amount of this to be carried out. Interconnections are made using 7/076 or 14/076 stranded insulated wire, and are kept as short as possible.

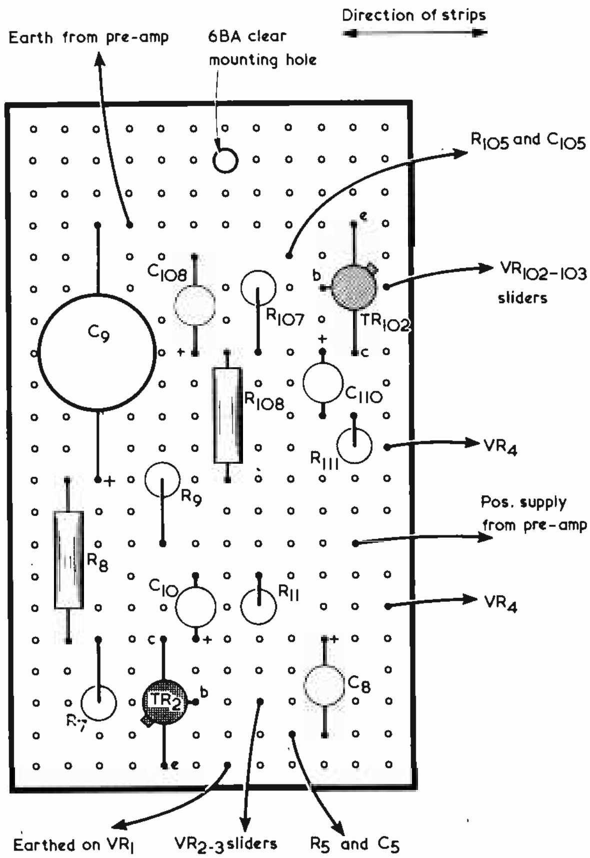


Fig. 7. Component side of the Veroboard holding the tone control stage components

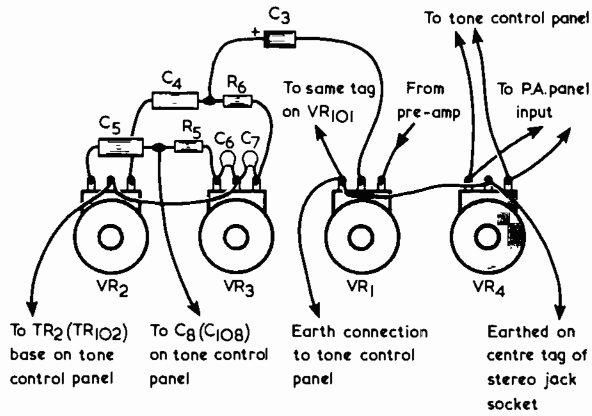


Fig. 8. The remaining tone control components are wired directly to the potentiometers. This diagram illustrates the wiring for one channel

PRE-AMPLIFIER

The pre-amplifiers for both channels are assembled in their entirety on a further piece of 0.1 in. Veroboard, as shown in Fig. 9. This has 13 by 22 holes. Like the tone control panel it has the copper strips running across its width, and it employs the same method of mounting to the chassis. There are no breaks in the copper strips. The board holds components for both channels and, since the inputs are at high impedance, the leads from the input socket to C1 and C101 are screened. The braiding of the two leads is connected to chassis at the input DIN socket, which is viewed from the rear in the inset in Fig. 9. The external wiring to the input socket must, of course, also be screened.

TESTING AND ADJUSTMENT

When constructional work is complete, and the wiring has been carefully checked, the amplifier is ready for initial testing. the two 5kΩ pre-set potentiometers, VR5 and VR105, should be adjusted for minimum resistance between the base and collector of TR5 and TR105. This is the fully anti-clockwise setting. A current reading meter set at a high current range is inserted in the positive supply lead between C17 and L1 and the unit is turned on. If all is well, the meter should indicate a standing current of around 20 to 30mA, whereupon the meter current range can be reduced to enable clear readings of up to 100mA to be obtained. VR5 is then slowly adjusted in the clockwise direction. After it has been rotated through approximately 30 to 45 degrees the current reading in the meter should begin to increase. VR5 is then adjusted to a point at which the meter reading is approximately 15mA higher than the original reading. VR105 is next similarly adjusted for a 15mA increase in the meter reading. The amplifier is switched off, the meter is removed and L1 is reconnected to C17. It is merely necessary to plug in a pair of speakers or headphones, and an input from a record deck or tuner, to check the performance of the completed amplifier.

With the more sensitive types of headphone it may be found beneficial to increase the value of R21 and R121 so as to give a lower level headphone signal.

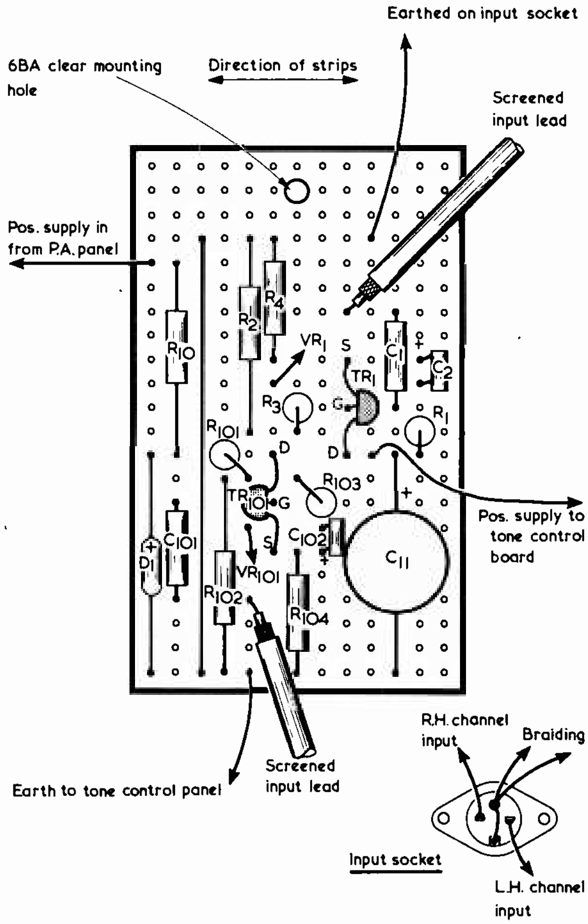
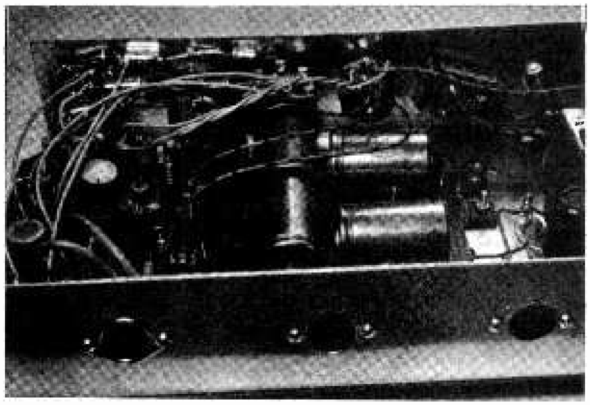


Fig. 9. The components on the pre-amplifier board



A view from the rear of the amplifier. This also shows the wiring to the front panel controls

CASE

The completed amplifier can be quite readily fitted with an outer casing. This can consist of a top and two side panels cut out from ½ in. chipboard. The two side panels are 6¼ by 2½ ins., and the top is 11 by 6¼ ins. The side panels are glued to the 6¼ in. edges of the top panel in the manner illustrated in Fig. 10, and any general purpose adhesive may be used here. The casing is covered with a plastic veneer, a sticky-backed imitation teak material being used with the prototype.

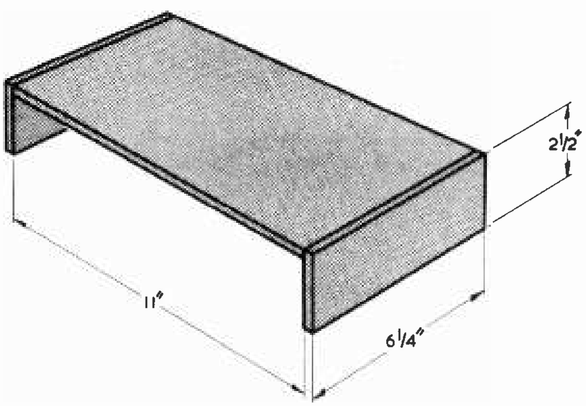


Fig. 10. Assembly of the amplifier casing

When the outer casing is completed, it is fastened to the chassis by four wood screws, these passing through holes in the chassis as indicated in Fig. 3.

The mains transformer is 2 in. high, which is the same as the height of the chassis. It is possible that the soldered joints on the tagstrip on the top of the transformer may rise above the 2 in. level. Should this occur it is necessary to chisel out a small groove on the inside surface of the casing top panel to give clearance for these soldered connections and enable the casing to fit properly.

The final task consists of fitting four rubber feet to the amplifier. These may be mounted at holes drilled in the chassis deck, as was discussed in Part 1 of this article. ■

(Concluded)

ADD–ON CONTROLS

By R. L. Shaw

It is not unusual for the home-constructor to be faced at some time with the situation in which he requires to couple a crystal or ceramic pick-up to an a.f. amplifier which gives a flat response and has no tone controls. This can occur if, for instance, the amplifier has an overall feedback loop which is not frequency selective. It is, however, quite an easy matter to fit treble cut and bass cut tone controls between the pick-up and the input to the amplifier, the only requirement being that the amplifier has an input resistance of 1MΩ or more.

The tone control circuit can also be incorporated in a new amplifier which it is intended to construct.

EQUIVALENT CIRCUIT

A crystal or ceramic pick-up can be looked upon as being a voltage generator in series with a capacitance, as shown in the equivalent circuit of Fig. 1. This capacitance is, typically, of the order of 500 to 1,000pF. The tone control circuit, which appears in Fig. 2, takes advantage of this effective series capacitance.

In Fig. 2, VR1 is the bass cut control. When it is set up so that it inserts maximum resistance into circuit it has negligible effect on the frequency response of the pick-up. If, on the other hand, it is set up to insert minimum resistance it causes the 220kΩ resistor, R1, to be connected directly across the input from the pick-up. The effective series capacitance in the pick-up exhibits an increasing reactance as frequency decreases. In

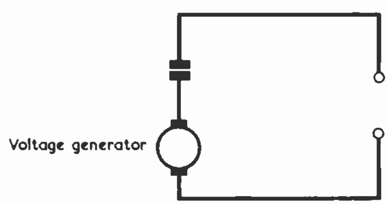


Fig. 1. The equivalent circuit for a crystal or ceramic pick-up.

TONE

Treble cut and bass cut tone controls can be readily added at an amplifier input coupled to a crystal or ceramic pick-up.

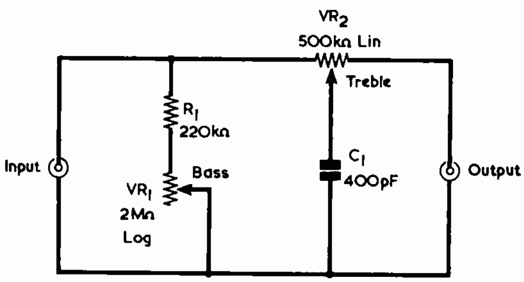


Fig. 2. The tone control circuit. The pick-up connects to its input, and its output couples to the a.f. amplifier.

consequence a significant proportion of the lower audio frequencies is built up across this capacitance and a smaller proportion appears across R1. The attenuating effect increases as frequency decreases, thereby giving a smooth bass cut. Intermediate settings of VR1 produce corresponding levels of cut.

Treble out is provided by VR2. When the slider of this potentiometer is at the input end of the track, capacitor C1 is connected across the internal capacitance of the pick-up and has no effect on pick-up response. When VR2 slider is at the output end of its track, this track and C1 form a potential divider for audio frequencies. Since the reactance of C1 reduces as frequency increases there is an attenuation of the higher frequencies appearing across this capacitor, the attenuation increasing with frequency. In consequence, the circuit provides treble cut. Lower degrees of treble cut are produced at intermediate settings of VR2 slider.

COMPONENT VALUES

The component values shown in Fig. 2 should be suitable for most, if not all, crystal and ceramic pick-ups. A heavier degree of bass cut can, if desired, be given by reducing the value of R1, the minimum figure here being around 100kΩ. Alternatively, the bass cut can be reduced by increasing the value of R1. The treble cut can be modified by using different values of capacitor in the C1 position. The cut is increased if a larger capacit-

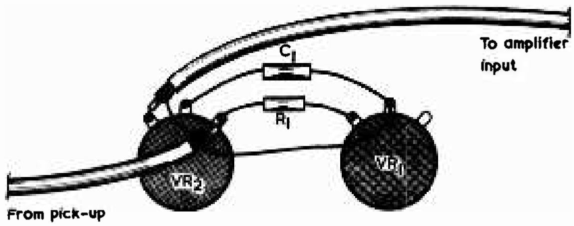


Fig. 3. The circuit is wired up in the manner shown here. This ensures that VR1 is connected in the correct way for smooth control of bass cut.

ance is employed and reduced when a smaller value is used.

The circuit can be fitted to a stereo amplifier input by using two-gang potentiometers and a further resistor and capacitor in the R1 and C1 positions for the second channel.

VR1 gives smooth control if it is connected such that it inserts increasing resistance as its spindle is turned clockwise. The tone control circuit may then be wired up as illustrated in Fig. 3, which shows the potentiometers from the rear. Both potentiometers give maximum cut when their spindles are fully anti-clockwise and minimum cut when their spindles are fully clockwise. This mode of operation appears to be satisfying subjectively.

The tone control circuit may be housed in a small box. If this is made of metal, it should be earthed to the centre tag of VR1.

The presence of VR2 causes a small loss in signal input, but this should not be significant with amplifiers having input resistances of 1MΩ or more. If the amplifier has an input resistance of less than 1MΩ an extra series resistor should be fitted after VR2, as in Fig. 4. The extra resistor requires a value which, when

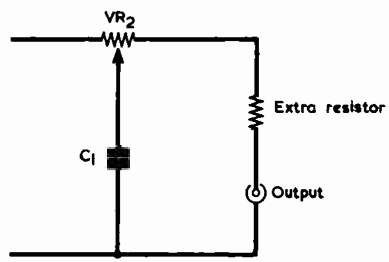
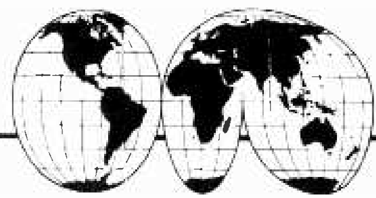


Fig. 4. An extra series resistor is added if the amplifier input resistance is lower than 1MΩ.

added to the amplifier input resistance, gives a total of 1MΩ or more. The loss in signal strength resulting from the extra resistor will be high if the amplifier has a very low input resistance, but such an amplifier would not, in any event, normally be expected to work with a crystal or ceramic pick-up. ■

SHORT WAVE NEWS



FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT   *Frequencies* = kHz

It is generally recognised that the shortwave broadcast bands listening fraternity is divided into two main streams. On the one hand we have the short wave listener who, generally speaking, listens to programme content usually from stations operating on the 6 to 21MHz bands. On the other hand, we have the Dxer who is interested in receiving transmissions from low powered broadcast stations most of which are equipped with an omnidirectional aerial system and which operate in the 60 and 90 metre bands.

It is probably true that more ink has been spilt on the subject of 60 metre band affairs than any other broadcast band frequency allocation. However, the 90 metre band about which much less has been written, can also offer some very interesting transmissions when conditions allow.

For successful operation over the 90 metre band the first requirement in very practical terms is that the operator should have the good fortune to reside in a rural or semi-rural area where man-made local QRM is largely absent. Trying to operate over the band in an urban area these days is almost impossible.

Other requirements, of course, are a first class aerial system designed for maximum efficiency over the LF bands, a good earth system, a sensitive and selective receiver together with all the other requirements of a good short wave listening station.

A quiet local background is essential for operation over the LF bands if one is to succeed in combating the commercial QRM which abounds over these portions of the dial. It is bad enough coping with the latter form of interference let alone having a man-made layer of QRM superimposed.

The results of a very recent 90 metre band survey conducted when conditions were far from good, will provide readers with some information on the current activity.

90 METRE BAND

● **CHINA**

3200 PLA Fukien at 1808 with YL and OM alternate in Chinese dialect.

3400 PLA Fukien at 1831, YL with harangue in Chinese dialect.

3450 Radio Peking at 2220, OM in Chinese through utility QRM.

● **NIGERIA**

3204 Ibadan at 2212 with programme of Jim Reeves records, announcements in vernacular.

● **LIBERIA**

3227 Radio St. ELWA at 2208, OM in African dialect through utility QRM.

● **IRAQ**

3240 Baghdad at 1804 with programme of Arabic music, YL announcer.

● **SOUTH AFRICA**

3250 SABC Johannesburg at 2203, English ballads and announcements.

● **INDIA**

3295 AIR Delhi at 1820, OM with local song, local music. Off without National Anthem at 1830.

● **KASHMIR**

3382 Azad Kashmir at 1832 with local music, sign-off with choral music 1834. Following day on a measured **3378** at 1755 and still there at 1840 with Asian-type music programme. Obviously varies frequency from day to day.

● **GHANA**

3350 Ejura at 1935, OM in vernacular then into pops European-style.

● **ANGOLA**

3375 CR6RZ Em. Official at 1914, OM in Portuguese with sports commentary.

● **MALAWI**

3380 Blantyre at 2107, English pops and announcements.

● **GUATEMALA**

3380 TGCH R. Chortis, at 0102 uith OM in Spanish then YL's in duet followed by piano music.

● **UNIDENTIFIED**

3399.5 at 1820, OM with Asian-type song, YL announcer.

The above results were gathered over a single weekend, the location being very much a rural one, deep in the heart of Suffolk.

By the time this appears in print, the 90 metre band should have come to life and, on a good evening, one should be able to log many African stations and also, with some luck, an Angolan or a Mozambique transmitter. Listen particularly on **3331** for Moroni in the

Comoro Islands which tends to come in around 1830, build up to a peak at 1900 or so and then fairly rapidly decline in signal strength such that, by 1930 it has faded out completely.

CURRENT SCHEDULES

● ISRAEL
The External Service for Europe and North America, in English from Jerusalem, is currently as follows – from 0500 to 0515 on **7395, 9009, 10250, 11700, 11745, 11960, 15100** and **17690.** From 1130 to 1200 on **9009, 9495, 10250, 15100, 15130** and **17690.** From 2000 to 2045 on **7395, 9009, 9450, 9495, 9625, 9785, 10250, 11960, 12000, 15100** and **15245.**

● INDONESIA
"The Voice of Indonesia", Jakarta, has an External Service in English as follows – to Southeast Asia and the Pacific from 0900 to 0930 on **6045** and **11790;** from 1100 to 1200 to Australia, New Zealand and the Pacific on **11790** and from 2330 to 2400 to Malaysia, Singapore, Southeast Asia and the Pacific, also on **11790.**

● YUGOSLAVIA
"Radio Belgrade" operates an External Service in English to Europe, the Middle East and Africa, as follows – from 1530 to 1600 on **9620, 11735** and on **15240;** from 1830 to 1900 and from 2000 to 2030 on **6100, 7240** and on **9620.** From 2200 to 2215 in English to Europe and North America over the latter mentioned three channels.

● SWITZERLAND
The Swiss Broadcasting Corporation has omni-directional transmissions in English to European area on **3985, 6165** and **9535** from 0700 to 0730, 1100 to 1130, 1315 to 1345, 1530 to 1600 and from 2100 to 2130.

● VATICAN CITY
Vatican Radio has a daily afternoon news bulletin in English to Europe from 1450 to 1505 on **6190, 7250, 9645** and **11740.**

● SAUDI ARABIA
The Home Service from Riyad, in Arabic, can be heard from 1900 to 2300 on **5390, 6005, 6080, 7110, 7195, 7220** and on **11950.**

● SOMALI REPUBLIC
"Voice of the Somali Democratic Republic", Mogadishu, in an External Services schedule features an English transmission from 1200 to 1215 on **6095, 7120** and on **9585.** These frequencies are also those of the Home Service.

● SYRIA
The "Syrian Arab Republic Radio from Damascus" has an English transmission from 2030 to 2200 on **9655** in the Western/Turkish programme.

● JAPAN
Radio Japan, Tokyo, is currently operating a European Service in English from 0800 to 0830 on **17710** and **17825,** and from 1830 to 1900 on **9700** and on **11960.**

AROUND THE DIAL
Some of the more interesting transmissions heard on the higher frequency bands of late have been —

● CUBA
Radio Havana at 2025 on **15140** with news of events in Latin America, in English, by alternate YL and OM announcers.

● CHILE
R.N. de Chile can be heard on **15150** from around 2230. Logged by us recently at 2243, identification in Spanish after two deep-toned chimes then into Arabic with frequent references to Alliende and Santiago. According to the published schedule, should have been in English at this time, obviously erratic.

● FINLAND
OIX8 Pori heard at 1815 when OM and YL presented a programme about Finnish cultural life and the native cinema, on **11755.**

● SOUTH KOREA
Suwon may be heard with a programme directed to Europe in the early mornings. Logged at **0628** when in French on **15335,** English programme and identification at 0630, local music, announcements then YL with news of South Korea. The transmission is subject to the attentions of a jammer.

● SAUDI ARABIA
Jeddah can now be heard on a measured **6006,** logged here at 1751 with Arabic music, YL with songs, local announcements.

● TURKEY
Ankara Police operate a transmitter which varies slightly in frequency around **6340** and which can be heard around 1800. Entered in the log here on **6339.5** at 1759 with a programme of Turkish songs and music.

● INDIA
AIR Delhi presents very interesting programmes about Indian life and affairs. Listen on **11620** from 1800. "India My Home", "Womens World" and "Oil, Food and India" have been some of the programmes enjoyed of late.

QSX
For the Dxer we offer the following – although rather late in the season!

● INDONESIA
RRI Banda Acheh on **4954.5** at 2324, OM with Muslim chants, announcements at 2328 then series of 7 chimes Interval Signal repeated many times until further announcements at 2330.

● THAILAND
Bangkok on **4830** at 2337 with OM in Thai till 2343 then military music to 2345 when YL in Thai.

I have been asked to state that a certain number of vacancies for membership exist in the British Association of Dxers. Applicants must be active Dxers and are required to report results on a regular basis, 'sleeping' members are not required.

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SIM
SQUAR
GENE

By A.

Incorporating a s cuit, this squar offers outputs u peak at frequen 2C

A SQUARE WAVE GENERATOR IS A VERY USEFUL PIECE OF test equipment, especially when used in conjunction with an oscilloscope. This combination can be employed for testing audio amplifiers for high frequency performance, the correct functioning of tone controls, and transient response. The generator can also be used as a general purpose test oscillator on its own.

The generator described in this article has a frequency coverage of approximately 200Hz to 20kHz in two ranges. Only one active component is used, this being an inexpensive integrated circuit operational amplifier. The output amplitude is variable from zero to 1 volt peak-to-peak. The unit is battery operated, and is contained on a home-made aluminium case measuring approximately 5 by 2 by 3½ in.

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	3.9kΩ (see text)
R2	68kΩ
R3	68kΩ
R4	1.5kΩ
R5	68kΩ
R6	820Ω
VR1	25kΩ linear
VR2	5kΩ log, with switch S2

Capacitors

C1	0.47μF, plastic foil
C2	5.6pF, ceramic
C3	0.0022μF, plastic foil
C4	0.022μF, plastic foil
C5	10μF electrolytic, 10 V.Wkg.

Semiconductors

IC1	748 (d.i.l. 14 or 8 pin)
LED1	TIL209
D1	OA200
D2	OA200

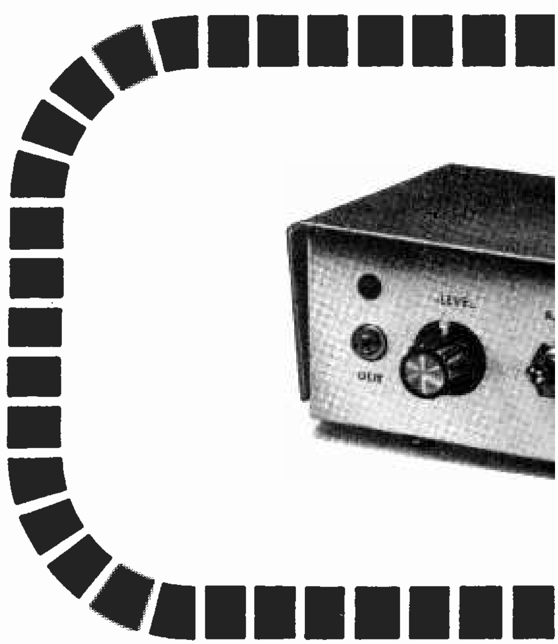
Switches

S1	s.p.d.t. toggle
S2	s.p.s.t., part of VR2

Socket

SK1	2.5mm jack socket

Miscellaneous
PP3 battery (Ever Ready)
Battery connector
2 control knobs
Perforated board, 0.1in. matrix
4 rubber feet
18 s.w.g. aluminium sheet



PLE
: WAVE
RATOR

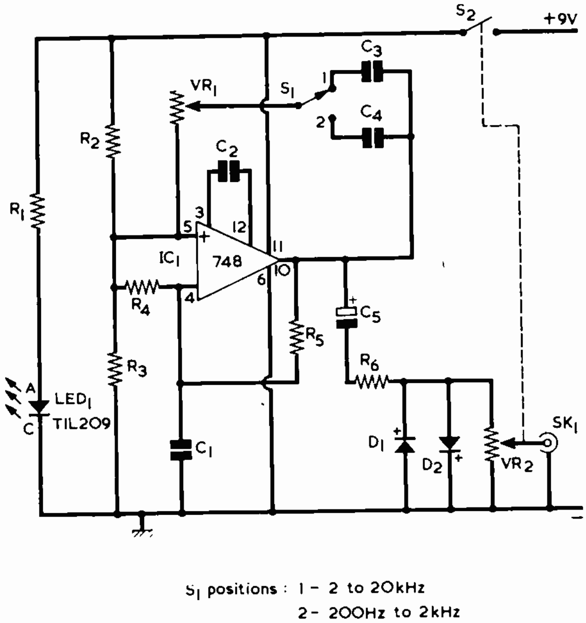
Roberts

**gle integrated cir-
wave generator
to 1 volt peak-to-
ɜs from 200Hz to
Hz.**

CIRCUIT OPERATION

The circuit diagram of the square wave generator is shown in Fig. 1. The 748 integrated circuit is normally intended to operate from a centre tapped supply giving potentials of about 12 to 15 volts positive and negative of the centre tap. With some loss of performance, however, the 748 can be operated on a very much lower supply potential. In Fig. 1, it is run from a 9 volt supply, with R2 and R3 forming a centre tap between the supply rails. R4 and R5 provide the normal biasing components for the i.c., and set its direct voltage gain.

The junction of R2 and R3 does not provide a bypassed centre tap, and voltages may be fed in here via VR1. If C1 were not in circuit the a.c. gain offered by



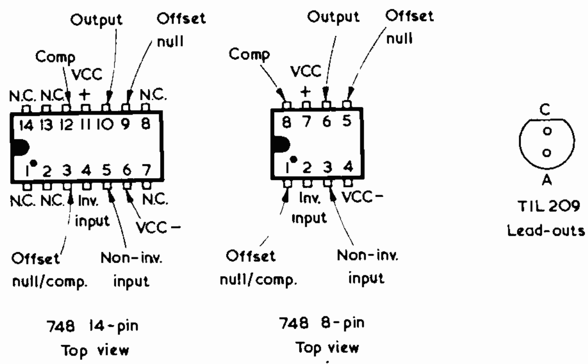


Fig. 1. The circuit of the square wave generator. The pin numbering in the circuit diagram corresponds with the 14-pin version of the 748

the i.c. would be low, as the inverting and non-inverting inputs are connected together by R4. But with C1 in circuit there is no a.c. feedback, and the a.c. gain of the device then becomes equivalent to its open loop gain, which is many thousands of times.

Positive feedback is provided via either C3 or C4, according to the position of range switch S1, and VR1. As the gain of the i.c. is so high there is violent oscillation due to the feedback, and a waveform that is almost a square wave is produced. This has, however, a small spike on its leading edge. The spike is removed by feeding the output of the integrated circuit by way of C5 and R6 to the simple clipping circuit given by D1 and D2. These are silicon diodes and they clip the signal at about 0.5 volt positive and negative of the negative supply rail, giving a good square wave of about 1 volt peak-to-peak. VR2 is the output level control, and it is ganged with on-off switch S2.

VR1 varies the time constant of the feedback, and performs as a fine frequency control. When C3 is in circuit the range offered by VR1 is approximately 2 to 20kHz. If C4 is switched in, the range is 200Hz to 2kHz. When VR1 inserts minimum resistance the mark-space ratio of the square wave is almost exactly 1:1. The ratio deteriorates slightly as the slider of VR1 is moved along the track.

C2 is the frequency compensation capacitor and is required by the i.c. for stable operation. LED1 is a light-emitting diode and is fed via the current limiting resistor, R1. The l.e.d. functions merely to indicate when the generator is switched on and, with the value specified for R1, gives a glow which is just visible. The total current drawn from the 9 volt supply is approximately 3.5mA. If desired, the glow given by the l.e.d. may be increased in intensity by reducing the value of R1, but this will cause increased current drain from the battery. R1 may be made 1.5kΩ, whereupon the l.e.d. draws about 5mA from the battery, or 750Ω, with a consequent current in the l.e.d. of around 10mA. However, it will probably be found that the value of 3.9kΩ specified for R1 gives an adequate glow, without the consumption of excessive battery current. R1 should not be given a value lower than 750Ω.

The 748 type integrated circuit can be obtained from Trampus Electronics, P.O. Box 29, 48 Holland Pines, Bracknell, Berks. RG12 4UY. Most of the components are mounted on a plain perforated Paxolin panel, without copper strips, of 0.1in. matrix. Perforated boards having an 0.1in. matrix are listed by R.S. Components, and can be obtained from retailers of R.S. Components parts. The l.e.d. type TIL209 is available from Henry's Radio Ltd. A suitable panel mounting for this can be given by a small grommet in which the l.e.d. body is placed.

THE CASE

The case is home-made from 18 s.w.g. aluminium and details are shown in Fig. 2. The three ½ in. flanges on the front panel are bent down, away from the reader. The two holes marked 'A' are drilled 6BA clearance whilst the holes marked 'B' are drilled tapping size to take self-tapping screws. The front panel is secured to the base at the two holes 'A' on the base, these also being 6BA clear, with the flange of the front panel being below the base. The two ½ in. flanges on the base then point upwards. The back is secured to the base in the same way as the front panel, and the four holes marked 'C' are similarly 6BA clearance. The flange of

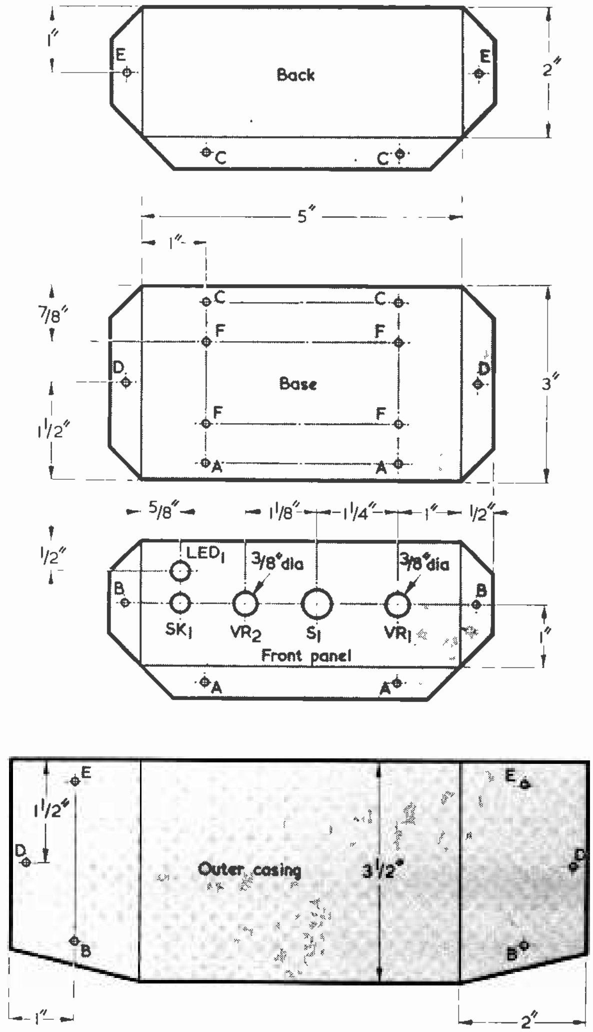


Fig. 2. Dimensions of the sections which form the chassis and outer casing. Details of bending and assembly are given in the text

the back is below the base. The two 2in. side flanges of the back point inwards. Holes 'D' and 'E' in the base and back are drilled tapping size for self-tapping screws. The 6BA bolts and nuts which secure the back and the front panel to the base have the bolt heads under the base.

The four holes 'F' in the base take the bolts of four small rubber feet, with the bolt heads being below the base. One of these bolts, and its nut, will be under the component board when this is fitted later. It must project upwards by little more than the thickness of its nut to ensure that it does not foul the underside of the board or short-circuit against the wiring. The diameter of holes 'F' depend upon the bolts required by the particular rubber feet employed. Two further 6BA clear holes are required in the base to take the Component board. These are marked out with the aid of the component board itself.

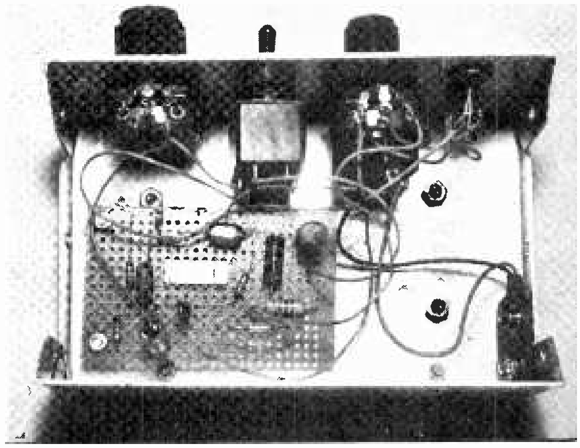
The holes in the front panel for the LED1 housing, SK1 and S1 have diameters suitable for the particular components fitted in these positions.

Also shown in Fig. 2 is the outer casing. The two sides of this casing are bent down, and it will be seen that the casing then fits over the assembled base, front panel and back, with a ½ in. forward overhang at the top of the front panel. To take up discrepancies due to metal thickness, etc., it will be helpful to dimension the casing so that it fits snugly over the other parts after these have been cut out and assembled. Holes 'B', 'D' and 'E' on the casing are drilled clearance size for self-tapping screws, and allow the casing to be secured by self-tapping screws which pass into the similarly lettered holes in the front panel, base and back. To ensure good alignment, some constructors may prefer to drill holes 'B', 'D' and 'E' in the casing first, and then use these to mark out the positions of the corresponding tapping-size holes in the front panel, base and back.

The front panel, base and back of the author's unit were finished, on the outside, with two coats of ivory paint. The outer casing was given two coats of matt black paint, and the overall effect of these contrasting colours gives the completed unit a very pleasing appearance. As a final touch, the author added suitable legends to the front panel after the generator had been assembled, these being taken from 'Panel Signs' Set No. 4. ('Panel Signs' are available from the publishers of this journal.) The legends chosen were 'FREQ', above the knob for VR1; 'RANGE', above S1; 'LEVEL', above the knob for VR2; and 'OUT', below SK1.

COMPONENT BOARD

As was mentioned earlier, most of the components are mounted on a perforated Paxolin board without copper strips, and having an 0.1in. matrix. This has 25 holes by 16 holes and is cut from a larger piece using a small hacksaw. The board is shown, viewed from the component side, in Fig. 3. Before wiring, the two 6BA clear mounting holes should be drilled out. The corresponding holes in the aluminium base may then be marked up and drilled out also. The board takes up the position indicated in the photographs of the interior of the unit, with its two mounting holes at the right of the chassis assembly, as viewed from the front.



Despite its small size, there is no crowding of components inside the generator

Fig. 3 shows the 14 pin d.i.l. version of the 748. The 8 pin d.i.l. version may also be used without any change in wiring layout. As is evident from the insets in Fig. 1, the 8 pin i.c. has virtually the same pin layout as the 14 pin device, the exception being that pins 1, 2, 7, 8, 13 and 14 are, in effect, absent.

The i.c. is fitted to the perforated board in the position shown in Fig. 3. If the 14 pin i.c. is used, the pins which have connections made to them are bent outwards at 90° on the reverse side of the board. Pins to which no connections are made are bent inwards. With the 8 pin i.c. all leads are bent outwards. Take great care whilst bending, and whilst subsequently soldering to the pins, as these are fragile and can be easily broken or shifted out of position.

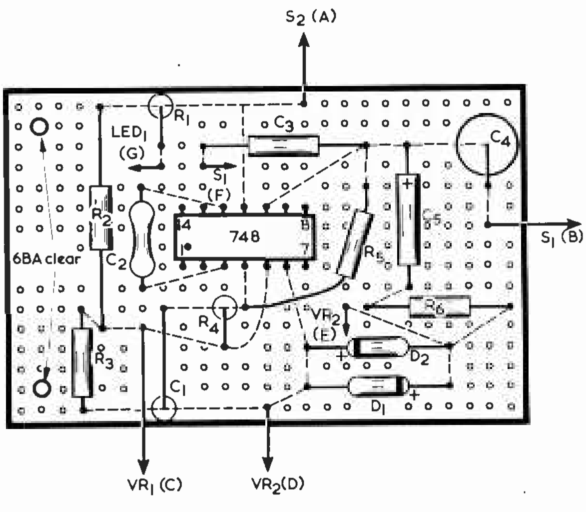
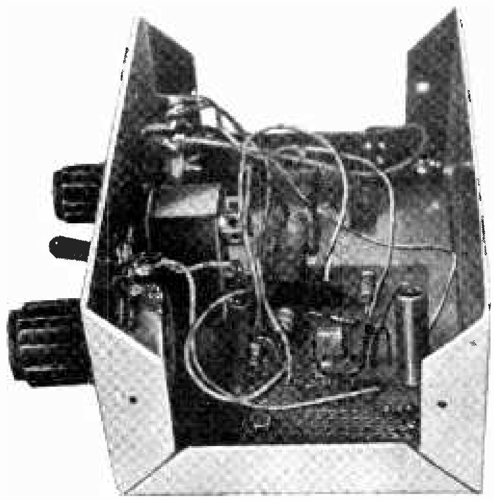


Fig. 3. Wiring and layout of parts on the perforated component board



A view of the interior from one side

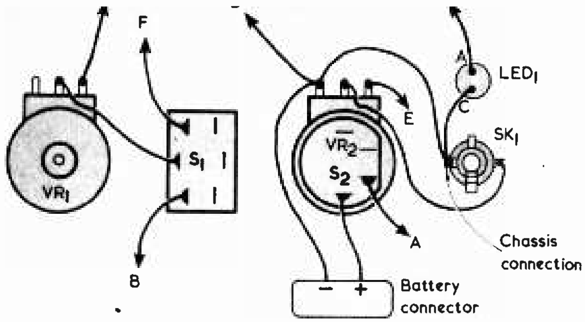
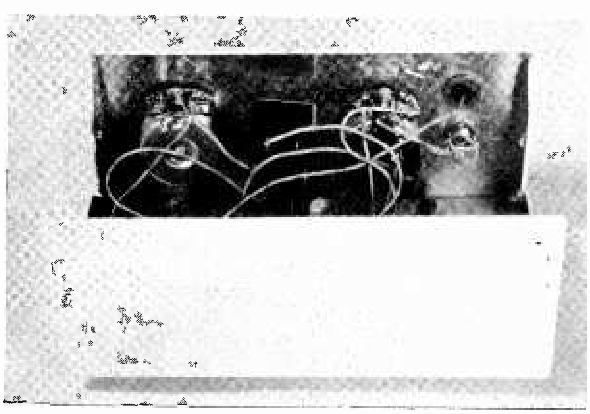


Fig. 4. Circuit wiring behind the front panel

The remaining components are next mounted, as indicated in Fig. 3. Their lead-outs are bent over at right angles under the board, cut to length and then connected up as shown by the broken lines. If necessary, short lengths of tinned copper wire may be employed in instances where component lead-outs are not sufficiently long. Note that flexible insulated wires leave the board for connection to S1, S2, VR1, VR2 and LED1.

Fig. 4 shows the wiring behind the front panel, including the connections to the flexible insulated leads from the component board. These leads should be shortened as required before they are soldered to the front panel components. The negative supply connection to the chassis is made via the contact of SK1 which connects to the jack plug sleeve. It may be found helpful, here, to identify the tags of the jack socket with the aid of an ohmmeter or continuity tester. If the jack socket has an insulated construction which does not provide an automatic connection to chassis via its mounting bush, the chassis connection may be made to a solder tag secured under the nut of the adjacent 6BA bolt and nut which hold the base and front panel together. LED1 must, of course, be connected with correct polarity or it will fail to light up.

The component board is fitted to the base by means of two 6BA bolts and nuts, with spacers between the base and the board. The spacers should be ¼ to ½ in. in length and must ensure that there is no risk of short-circuit between the board wiring and the surface of the base or the nut under the board which secures one of the rubber feet. The battery is positioned vertically on the left-hand side of the chassis assembly, as viewed from the front, and is held in place when the outer casing is screwed in position. A small piece of foam rubber or plastic glued to the underside of the casing top holds the battery securely.



The wiring to the front panel components

TESTING AND USE

The completed unit, after a visual check for correct wiring, is ready for testing, this being carried out preferably with the aid of an oscilloscope. If there is any tendency for the circuit to be unstable on the higher frequency range, a resistor can be inserted in series with C1, to give the modified circuit shown in Fig. 5. Should it be required, this resistor will need to be around $1k\Omega$, and its exact value can be found by experiment. The value should be as low as is possible without the instability appearing.

The rise time of the output waveform can be shortened somewhat by reducing the value of C2. However, the value of this capacitor can only be lowered by a small amount since, if it is reduced too much, the circuit will oscillate at a radio frequency. The minimum acceptable value will vary between one i.c. and another, and can only be found by experiment.

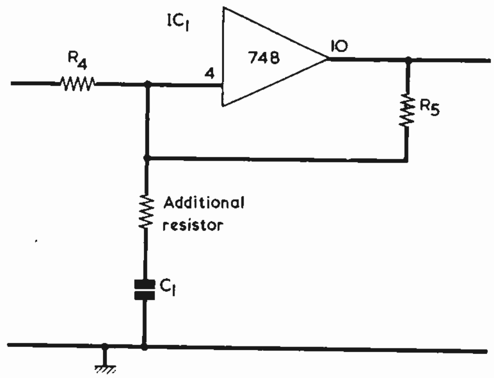


Fig. 5. It may be necessary to add an additional resistor between C1 and R4, as shown here

In conjunction with an oscilloscope, the generator can be used for testing the upper frequency response of audio amplifiers. A square wave consists of a fundamental sine wave at the square wave frequency with, theoretically, an infinite range of harmonics. In practice it is not possible to obtain all the harmonics but, providing the harmonics up to a few hundred kHz are present, the waveform will be satisfactory for testing audio circuits. The output of an audio circuit having a good frequency response will be the same as the input square wave.

If a square wave is fed into an audio amplifier having its tone controls in the central 'flat' positions, and an oscilloscope is used to monitor the output of the amplifier, a trace which looks basically like that of Fig. 6 (a) will probably be produced. The leading edges are curved due to the attenuation of the higher frequency harmonics by the amplifier. The less rounding there is of the leading edges, then the better the high frequency response of the amplifier.

The effectiveness of tone controls can be quickly tested with the square wave generator and oscilloscope. For instance, if the tone controls are set for maximum treble cut and bass boost the harmonics will be greatly attenuated, and an output waveform approaching a sine wave can be obtained.

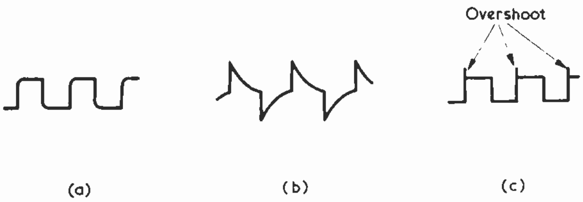
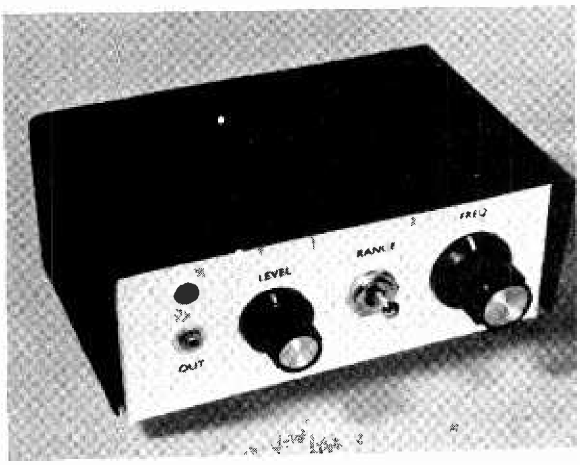


Fig. 6 (a) A typical amplifier output waveform. The rounding on the leading edges indicates reduced high frequency response
(b) A waveform resulting from high treble boost and bass cut
(c) An amplifier with poor transient response may give overshoot on one or both leading edges of the square wave

With the controls set for maximum treble boost and bass cut, the square wave fundamental is attenuated and the harmonics boosted, giving a waveform of the type shown in Fig. 6(b). A suitable square wave frequency for these tests is 1kHz.



The completed square wave generator has a very neat and professional appearance

Some amplifiers have a tendency towards momentary instability when an input with a fast rise time, such as a square wave, is applied, this being especially true when the amplifier is given treble boost. If this effect is present it will produce a trace like that of Fig. 6(c), in which there is overshoot after one of the leading edges. This test gives a measure of the ability of the amplifier to handle transient signals.

As a final point, the square wave generator will run at frequencies outside the range of the circuit as described here by raising or lowering the values of the capacitors in the C3 and C4 positions. However, the frequency response of the 748 is not really adequate enough to produce a good square wave at frequencies much above 20kHz. For oscillation at frequencies below 200Hz the value of bypass capacitor C1 must be increased proportionately. It should, for instance, be 1μF for a minimum square wave frequency of 100Hz, and 4.7μF for a minimum square wave frequency of 20Hz. ■

ELECTRONIC COIN

By S. L. Martin

DECISIONS, DECISIONS, LIFE IS FULL OF DECISIONS. HOW helpful it can be, therefore, to have access to an electronic device which sorts out all the answers for you. Present any problem to the gadget described in this article and it will tell you 'Yes' or 'No' without fuss, delay or ambiguity.

To be a little more serious, what the device actually consists of is a circuit which offers one of two random outputs, and a similar service would be given by tossing a coin. Nevertheless, the unit is amusing and instructive, and it can be made up in an attractive form which will intrigue and impress your friends.

CIRCUIT

The circuit of the Electronic Coin-Tosser appears in Fig. 1, which shows a simple 50:50 multivibrator with a few additional components. The collector loads are light-emitting diodes with series resistors, these being LED1 and R1 for transistor TR1, and LED2 and R7 for transistor TR2. The cross-coupling capacitors are C1 and C2, whilst the base feed resistors are R2 and R6. Normally, R2 and R6 would be returned directly to the positive supply rail, but in this instance they are both coupled to the positive rail via R4.

Two components not encountered in a normal multivibrator are R3 and R5. The only effect these have on multivibrator operation is to increase the discharge rate of C1 and C2, and thereby raise the multivibrator frequency.

The multivibrator is symmetric, with R1 equal to R7, R2 equal to R6, R3 equal to R5 and C1 equal to C2. R4 enters the discharge path for C2 when TR1 is turned off during the multivibrator cycle, and it similarly enters the discharge path for C1 when TR2 is turned off during the cycle. Frequency of oscillation is of the order of 7.5kHz.

The unit is switched on by closing S2, and the multivibrator at once commences to run. LED1 is illuminated when TR1 is turned on and LED2 is illuminated when TR2 is turned on. The visible effect is that both diodes light up with equal brightness.

A decision is obtained by pressing push-button S1, whereupon the circuit changes from a multivibrator to a flip-flop. Whichever transistor was turned on at the instant of closing S1 remains turned on, and the other transistor stays turned off. In consequence, either the 'Yes' or the 'No' light-emitting diode remains lit on its own. It is a matter of pure chance as to which of the two transistors is turned on at the instant of closing S1, and

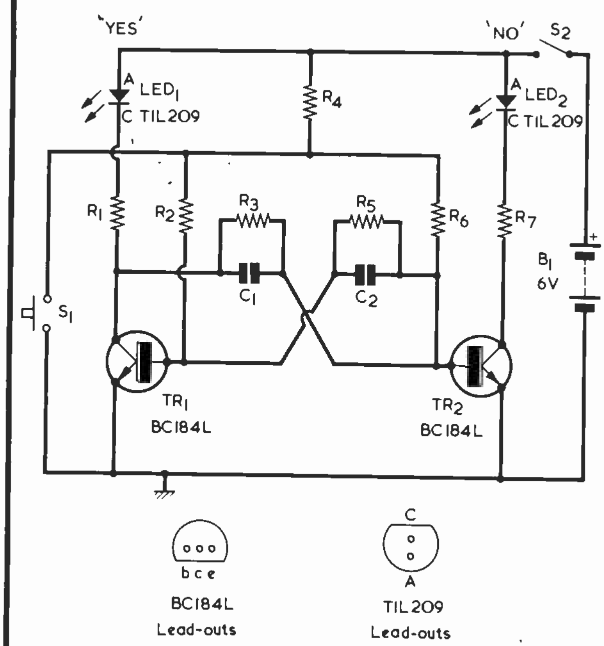


Fig. 1. The circuit of the Electronic Coin-Tosser is basically a 50:50 multivibrator

COMPONENTS

Resistors
(All ¼ watt)

R1	220Ω 1%
R2	10kΩ 1%
R3	15kΩ 1%
R4	2.2kΩ 5%
R5	15kΩ 1%
R6	10kΩ 1%
R7	220Ω 1%

Capacitors

C1	0.01μF 1%, silvered mica (see text)
C2	0.01μF 1%, silvered mica (see text)

Semiconductors

TR1	BC184L
TR2	BC184L
LED1	TIL209
LED2	TIL209

Switches

S1	Push-button, press to close
S2	S.P.S.T. toggle

Battery

B1	6 volt battery

TOSSER

so the circuit offers a fully random illumination of the diodes.

Closing S1 brings the upper ends of R2 and R6 down to chassis potential, and the circuit then effectively becomes that shown in Fig. 2. This is a perfectly stable flip-flop because the collector voltage of the transistor that is conductive is about 0.2 to 0.3 volt above chassis potential, causing the base of the opposite transistor to be well below the 0.6 volt level it needs to become turned on. Even C1 and C2 are not out of place in a flip-flop circuit; in a normal flip-flop they would be the speed-up capacitors.

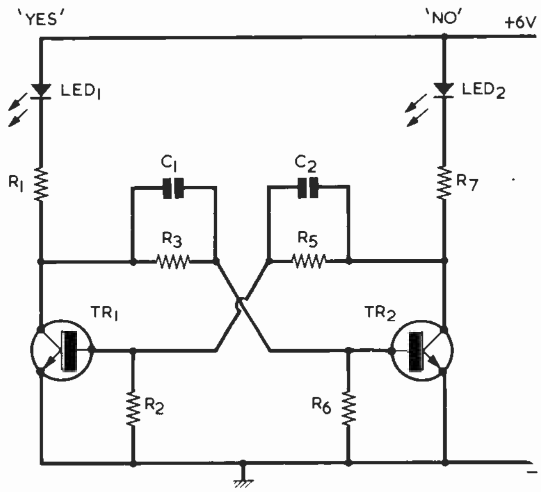


Fig. 2. The circuit changes effectively to this form when S1 is pressed

50:50 OPERATION

To obtain an unbiased selection of the 'Yes' and 'No' light-emitting diodes on pressing S1, it is necessary for the multivibrator to have a true 50:50 waveform. The author achieved a nearly 50:50 waveform by selecting 1% resistors and capacitors for all the circuit positions which could affect the length of each half of the multivibrator cycle. A check for 50:50 operation is obtained by connecting a moving-coil voltmeter switched to read low voltages across the two collectors, as in Fig. 3. S1 is kept open for this check. If both transistors are turned on for exactly the same period in the multivibrator cycle then the voltmeter will indicate zero volts. At first, the author's unit caused a reading of about 0.1 volt to be given across the two collectors, whereupon he tried the effect of changing over C1 and C2. The voltage across the collectors then became much lower, and the voltmeter indicated a voltage of less than 0.025 volt. Obviously, the two capacitors used by the author had slightly different values within their tolerance. It was felt that the low voltage now given was good enough and a subsequent run of 600 operations yielded 301 'Yes' answers and 299 'No' answers, which indicates a good circuit balance.

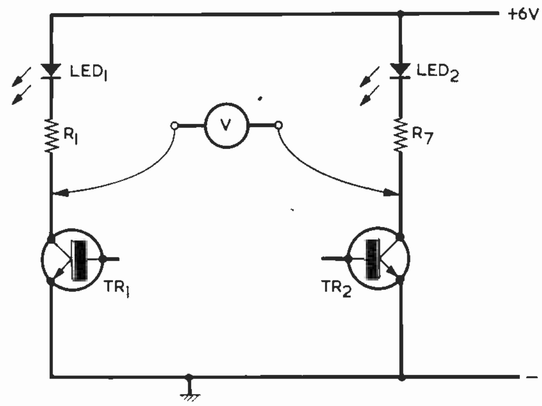


Fig. 3. Checking for circuit symmetry. Voltmeter polarity is unimportant as the desired voltage reading is zero

It is appreciated that testing for circuit balance by checking the voltage across the collectors assumes equal forward voltage drops in the light-emitting diodes and equal values in R1 and R7. However, discrepancies here are likely to be small when compared with possible build-ups of tolerances in all the remaining components.

It will be evident that, despite the use of 1% components, there may still be a necessity to slightly trim the circuit after it has been built to obtain a truly random output. Adding small capacitors across C1 or C2 as required until the voltmeter across the collectors reads zero represents a useful practical method of obtaining balance. In this respect some constructors may prefer to fit wider tolerance capacitors for C1 and C2, and then pad one or other of these up with further capacitance, as required, until the zero collector-to-collector voltage reading is obtained.

The device can be assembled in a small case with S1, S2 and the two light-emitting diodes on the front panel. Current consumption from the 6 volt battery is approximately 20mA both when S1 is open and when it is closed. Do not use a battery voltage greater than 6 volts as this will cause the maximum reverse base-emitter voltage rating of the transistors to be exceeded, whereupon one or both base-emitter junctions could zener and give asymmetric operation.

Finally, don't be surprised if you get short runs of 'Yes' or 'No' answers as S1 is pressed successively. You'd get the same sort of runs if you tossed a coin. ■

New Products

STANDARD RANGE OF SOLDERING BITS

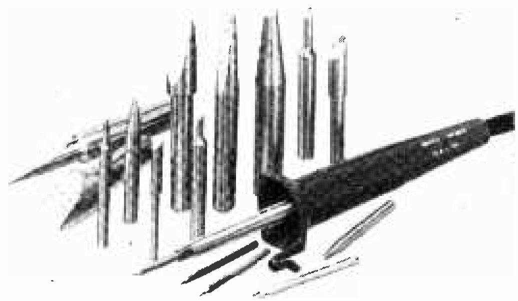
Adcola Products Ltd. of Gauden Road, London SW4 6LH is launching an extensive range of almost 100 different soldering bit designs as a standard, off-the-shelf service to industry.

The range has been developed to meet the requirements of production engineers in the electronics and electrical industries, and includes both copper and iron plated long life bits in a variety of popular shapes – standard, taper, and reduced chisel, 80° PCB, conical and screwdriver.

In addition to soldering bits for Adcola's own tools, the new range has been extended to cover other manufacturers' soldering irons to allow for the purchase of a total supply of soldering bits from a single source.

All Adcola soldering bits are manufactured from high grade copper, chromium plated overall except for the immediate soldering face. The chromium plating deposit minimises the possibility of seizure in the instrument holder and assists in preventing solder run-back.

Long life bits are iron plated to a thickness of approx 5.7 mil which extends their useful working life to more than ten times that of an equivalent conventional copper bit. Other advantages include the elimination of soldering bit face filing and the provision of similar heat transfer characteristics.



Shank diameter, varying from $\frac{1}{8}$ in – 3.2mm to $\frac{1}{2}$ in – 12.7 mm, measurements are used throughout Adcola specifications to classify and identify size and type of instrument for which the relevant bits are suitable, and all bit lengths have been temperature corrected to provide maximum thermal output when used with an Adcola soldering instrument.

HIGH-PRECISION TRIMMER CAPACITOR

A new type of miniature trimmer capacitor claimed to give an outstandingly linear response (better than 2%, with no local reversals of capacitance) is announced by Jackson Brothers (London) Ltd., Croydon CR9 4DG, England.

The Trimline capacitor is a tubular design (see photograph) measuring 18 mm long by 5 mm diameter. Its constant length simplifies layout planning. Minimum capacitance is below 0.5 pF and maximum above 5 pF. Adjustment is by screwdriver slot, with ten turns between minimum and maximum to permit very fine setting. Main applications will be in professional telecommunications equipment operating at UHF and microwave frequencies.

Unlike most tubular trimmers, the Trimline employs air as the dielectric, and the moving element does not rotate. This avoids the eccentricity and deviations from linear response associated with designs based on a rotating piston. Here the stationary element is a small piston and the moving element is a coaxial cylindrical sleeve. Both are made of silver-plated brass. The sleeve is moved axially by a lead-screw engaging a threaded collet inside it; it is precisely located and guided by a fixed outer glass sleeve, and by two lugs in its tail which run in fixed longitudinal slots.

At both ends of the travel a slipping-clutch mechanism – a patented feature – prevents accidental damage being caused by over-adjustment. And at maximum capacitance an insulating (PTFE) end-stop prevents electrical shorting.

Electrical losses are low (Q factor greater than 1000 at 20 MHz), and the capacitor has an expected life of over 10,000 adjustment cycles.

H.T. Switching Delay Circuit

An inexpensive delay circuit for amateur transmitter use.

By P. Manners

VALVES MAY HAVE FADED FROM THE CURRENT SCENE BUT they still have plenty of applications, even if these differ considerably from those for which they were originally designed! The television booster diode type PY81 can, for instance, be an excellent choice for the provision of an h.t. switching delay in high power amateur transmitters. Because the cathode of a PY81 runs at around 3 to 4kV positive of its heater in its normal TV application, it has a high level of spacing between the heater and cathode, and this results in its taking a relatively long time to rise to emitting temperature when it is switched on from cold. It can be made to take an even longer time if it is run at a heater voltage lower than its rated 17 volts, a fact which is used to advantage in the circuit described here.

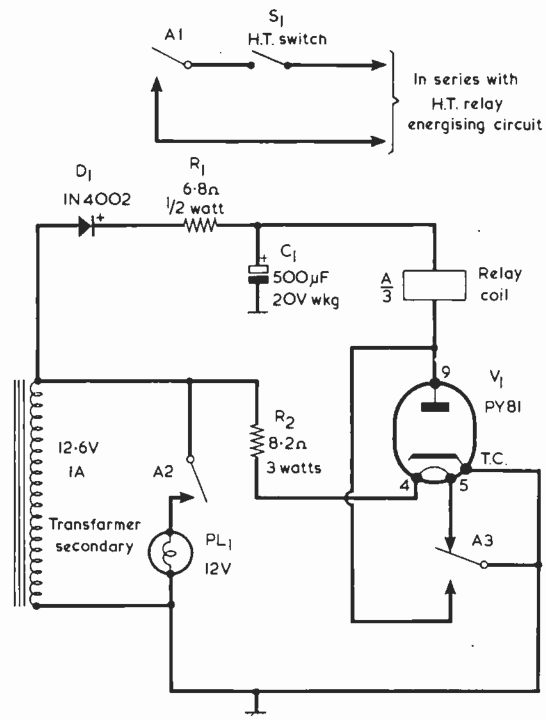
The PY81 is, of course, a currently available valve. In many cases, it should be possible to obtain one from an old discarded TV set, whereupon it is not even necessary to buy a new valve.

CIRCUIT DIAGRAM

The circuit of the h.t. time delay unit appears in the accompanying diagram. Here, the only power requirement is a 12.6 volt 1 amp secondary winding on a mains transformer. If necessary, this may be provided by two 6.3 volt windings in series.

When the transmitter is switched on from cold, its heater circuits are turned on as, also, are any lower voltage h.t. supplies which do not require a time delay. The high voltage h.t. circuits which require a delay cannot come into operation until both the h.t. switch, S1, and the relay contacts, A1, are closed. Even if S1 is closed the relay contacts are still open, preventing the appearance of the high voltage h.t.

A heater supply is applied from the 12.6 volt transformer winding via R2 to the heater of the PY81. At the same time, a rectified voltage of about 17 volts is available across the 500μF electrolytic capacitor, C1. The cathode of the PY81 gradually warms up and, after a relatively long period, reaches emitting temperature. Anode current passes through the relay coil and, when this current is sufficient to operate the relay, causes the relay contacts to change over to their energised positions. Contacts A1 close the h.t. supply circuit. If S1 is already closed the h.t. supply will then be turned on. If S1 is open, the closure of contacts A1 ensure that h.t. is available whenever S1 is closed. Relay contacts A2 couple the 12.6 volt secondary winding to a 12 volt pilot lamp, which then lights up to indicate that the high voltage h.t. supply is available. Contacts A3 disconnect the heater of the PY81 from the 12.6 volt winding and apply the lower supply rail to the relay coil, thereby holding it latched on. The heater of the PY81 cools, ready for the next operation.



An inexpensive time delay circuit for transmitter high voltage h.t. supplies

The relay employed should be capable of energising at around 8 volts and should have a coil resistance of about 300Ω or more. The author used a P.O. 3000 type with a coil resistance of 600Ω. The relay contacts A1 complete the energising circuit to the main h.t. relay in the transmitter.

The delay time when switching from cold was 90 seconds, but this will vary slightly with different PY81's. Quicker or slower times may be obtained by using different values of resistance for R2. The valve takes around 10 minutes to cool off sufficiently to give the full time delay again after it has operated. ■

HALF-VOLTAGE POWER DISSIPATION

By F. L. Smith

A quick look at a dictum which we rather tend to take for granted.

A TRANSISTOR IS VERY FREQUENTLY CONNECTED IN grounded emitter with a resistive collector load, as illustrated in Fig. 1. If the collector current is likely to be fairly high we have to pay attention to the power which will be dissipated in the transistor, whereupon we frequently work to the rule that maximum power is dissipated in the transistor when the voltage across it (i.e. across its emitter and collector) is equal to half the supply voltage.

The power dissipated in the transistor is then the same as that dissipated in the collector load. It is a simple matter to calculate the power dissipated in the load, and this is given by V squared divided by the load resistance, where V is half the supply voltage. We can then say that under worst case conditions, when half the supply voltage appears across the transistor, the dissipation in the transistor will be equal to that figure.

But is it really true that maximum dissipation occurs in the transistor when half the supply voltage appears across it? It is possible to prove this fact mathematically, but it is easier to examine the situation with the aid of a practical example.

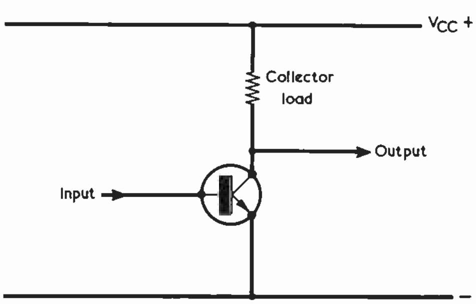


Fig. 1. A typical transistor circuit.

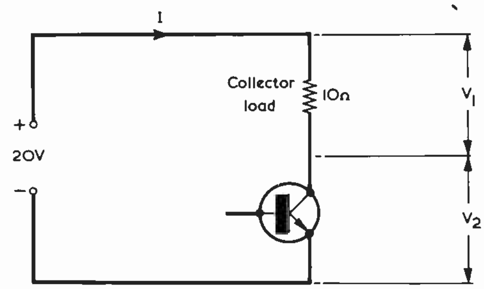


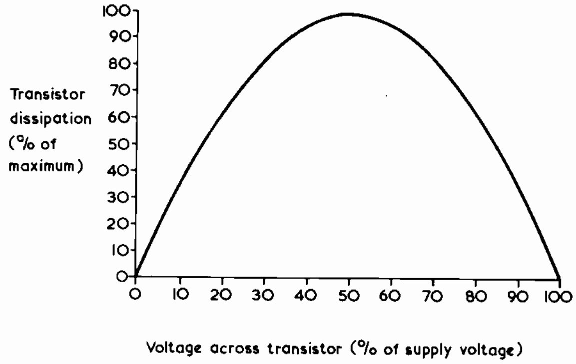
Fig. 2. A circuit which enables transistor dissipation to be evaluated in terms of the voltage across it.

PRACTICAL CIRCUIT

Fig. 2 shows a practical circuit in which the transistor has a 10Ω collector load resistor and the supply voltage is 20 volts. The voltage across the resistor is V1 volts and that across the transistor is V2 volts. The current flowing through the load resistor has, of course, the same value as that flowing between the collector and emitter of the transistor. We shall call the current I amps.

We can start by biasing the transistor such that 10 volts is dropped across it. Since the supply voltage is 20 volts, this means that 10 volts is also dropped across the resistor. A voltage of 10 volts across a resistance of 10Ω results in a current of 1 amp and so, under this condition, the value of I is 1 amp. Next, let's bias the transistor so that 9 volts appears across it. There must now be 11 volts across the load resistor, and 11 volts across 10Ω produces a current of 1.1 amps. So the current in both the resistor and the transistor is 1.1 amps. If we have 7 volts across the transistor there is 13 volts across the load resistor and the current becomes 1.3 amps.

Fig. 3. General curve for transistor dissipation against percentage of supply voltage across it.



Similar results are given when the voltage across the transistor is greater than 10 volts. If it is, say, 11 volts then there is 9 volts across the load resistor and the current becomes 0.9 amp. A voltage of 13 volts across the transistor results in 7 volts across the load resistor and a current of 0.7 amp.

TABLE

V2 – Voltage Across Transistor (volts)	*I – Current In Transistor (amps)*	*Transistor Dissipation (watts)*
0.3	1.97	0.591
0.5	1.95	0.975
1	1.9	1.9
3	1.7	5.1
5	1.5	7.5
7	1.3	9.1
9	1.1	9.9
10	1	10
11	0.9	9.9
13	0.7	9.1
15	0.5	7.5
17	0.3	5.1
19	0.1	1.9
19.5	0.05	0.975
19.7	0.03	0.591

The accompanying table shows current values for different voltages, V2, across the transistor, together with the corresponding values of I. The power dissipated in the transistor is equal to V2 multiplied by I, and the corresponding power figures are given in the third column of the table. A quick glance at this shows that the power dissipated in the transistor is, indeed, at its greatest when half the supply voltage appears across the transistor. The table takes the voltage across the transistor down to 0.3 volt and up to 19.7 volts, where the dissipation in both cases is slightly less than 0.6 watt only. A curve showing the dissipations at the various voltages appears in Fig. 3.

The table demonstrates quite definitely that the greatest dissipation in the transistor is given when half the supply voltage appears across it. It also illustrates that, if we wish to use a transistor as a switch, we should arrange matters such that the transistor is cut off when it is in the 'open' condition and is fully bottomed when it is in the 'closed' condition, with a quick transition through the high dissipation half voltage state when changing from one condition to the other.

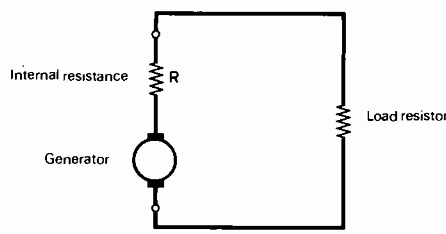


Fig. 4. Maximum power in the load resistor is given when its value is equal to the internal resistance of the generator.

As a final bonus we can see that, when we *want* to dissipate maximum power, say in a load resistor, we can take advantage of this half voltage situation. If, as in Fig. 4, a generator with internal resistance R is connected to a load resistor, maximum power is dissipated in the load resistor when its value is equal to the internal resistance, R, of the generator. This must be so because the voltage dropped across the load resistor is then equal to the voltage dropped across the internal resistance of the generator. ■

SOLUTION

Across: 1, Cathode. 6, Sad. 9, NOT Gate. 10, Regimen. 11, Rim. 12, Metal Gauges. 13, Loops. 14, Quiescent. 16, Greenroom. 17, Noise. 19, Loudspeaker. 22, Arc. 23, Esparto. 24, Carried. 26, Tap. 27, Scanner.

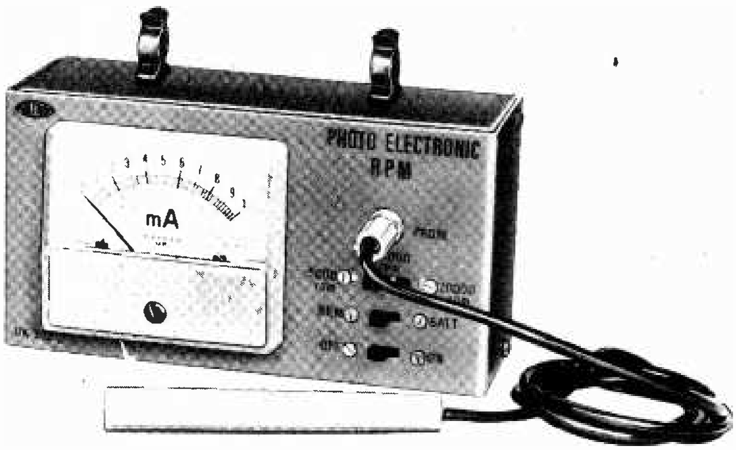
Down: 1, Control. 2, Totem-Pole Output. 3, Ova. 4, Exert. 5, Beryllium. 6, Sigma. 7, Demagnetization. 8, In A Set. 12, Meson. 14, Q Code Book. 15, Sonar. 16, Golden. 18, Encoder. 20, Strap. 21, Kicks. 25, R.C.A

Listening to Oscar

In the diagram on page 490 of the March issue, the coaxial matching section between the two dipoles should be shown as 70Ω. The Constructional Details on page 491 should be altered accordingly.

TRADE REVIEW . . . .

PHOTO-ELECTRONIC REVOLUTION COUNTER



A highly accurate, versatile instrument for measuring the speed of revolution of bodies, even when driven by extremely small powers. The instrument is not affected by the angular velocity of the rotating object because it is not mechanically connected to it.

The accuracy of the UK 832 Photo-electronic Revolution Counter is extremely high: the value shown on the scale depends exclusively on the frequency of alternation from right to snade which falls on the window of the measuring probe. The scales are designed for rotational speeds up to 20,000 r.p.m.

The accuracy of the instrument is independent of the voltage of the battery to a very wide extent: the battery charge can be checked at any time by means of a selector switch.

Specification

Power Supply	9 V flat battery	Photo-electric probe with FPT 100 photo-transistor	
Measurement scales:	3, of which 1 up to 5,000 r.p.m. f.s., 1 up to 10,000 r.p.m. f. s., and 1 up to 20,000 r.p.m. f.s.	Instrument:	moving coil milliammeter, 1,000Ω/V sensitivity, 1.5% accuracy
Controls:	master switch, battery check selector switch, measurement range selector switch.	Photo transistor:	(1) FTP 100
		Transistors:	(6) BC108B
		Zener:	BZY88C5V1
		Dimensions:	145 × 60 × 95 mm

Enquiries to: Amtron UK, 4&7 Castle Street, Hastings, Sussex TN34 3DY

FUSING WITH RESISTORS

By C. T. Watson

How to provide long-term circuit protection without fuses.

THERE ARE A NUMBER OF ELECTRONIC CIRCUITS IN which it is possible for current consumption to increase by a level of around 100% under fault conditions and where, in consequence, a fuse does not always provide effective protection. There is, however, a circuit protection technique employed in commercial television receiver design which can be similarly used by the home-constructor who is prepared to experiment a little. The technique consists of fitting series resistors which are run just below their maximum power rating and which then, under fault conditions, break the circuit due to the increased heat they dissipate.

RESISTOR PROTECTION

The circuit approach is illustrated in Fig. 1, in which the resistor giving protection also acts as a standard supply decoupling component. The wattage dissipated in the resistor can be calculated from $P=I^2R$ where P is power in watts, I is current in amps and R is resistance in ohms. (If the normal current consumption of the circuit being protected is 50mA (=0.05 amp) and the value of the resistor is 100Ω then the power dissipation is 0.05 squared times 100, or 0.25 watt. A 100Ω resistor which would normally run just perceptibly warm may be employed in the circuit and its temperature will rise when the current flowing through it increases due to a fault condition. Typically, the resistor required in the example just given will be rated (in the home-constructor market) at ¼ watt but, as is explained shortly, this point cannot always be relied upon.

The resistor is wired into circuit in the manner shown in Fig. 2. It is soldered to the *undersides* of two horizontal tags, using ordinary 60/40 solder. The connection points should be fairly close to the body of the resistor.

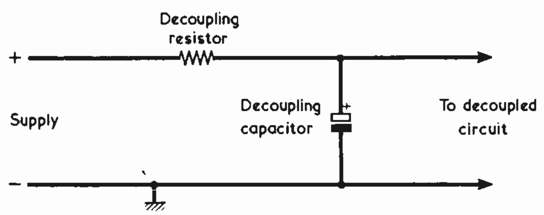


Fig. 1. A standard supply decoupling resistor may also be used to break the circuit when there is excessive current flow. It is assumed here that the non-earthy supply rail is positive

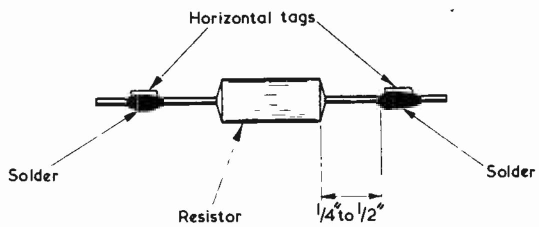


Fig. 2. The resistor lead-outs are soldered to the undersides of two horizontal tags. When the resistor dissipates excessive heat the solder melts, and the resistor drops off the two tags

The functioning of the protection device thus set up is quite simple. If due to a fault condition there is an excessive current flow in the resistor, its temperature will increase. Should the increase in temperature be sufficient, the solder at its connections will then melt, whereupon the resistor will simply drop off the two tags and break the circuit.

Resistors sold by home-constructor suppliers are usually rated at the maximum wattage they can safely withstand, but this is not always the case. In consequence, the home-constructor has to experiment a little with resistors of different nominal wattage ratings until he finds one which exhibits the required temperature rise in practice when the fault current flows. This may entail the loss of one or two resistors during the experiments, but the constructor can at least console himself with the fact that he is only repeating the process which is carried out in the laboratories of the receiver designers who use resistors in this way!

High stability resistors will give best results at the lower wattage ratings, as they are more liable to maintain their resistance values with temperature increase. Where the resistor has a high dissipation, excellent results will be given with wire-wound resistors.

The solder which secures the resistor lead-outs to the tag undersides should be applied sparingly as, otherwise, the resistor will be required to heat a large thermal mass of solder before it falls off. Finally, the resistor should be spaced away from printed circuit board surfaces and similar forms of insulation by around ½in. or so, to prevent the heat it generates in normal service from overheating the adjacent insulation. ■

In your workshop

This month Dick and Smithy take another look at transistor monochrome TV design, and they investigate the functioning of a solid state vertical timebase which is employed in a number of current television receivers.

SMITHY ADDED UP THE COLUMN OF figures a second time.

The total came to the same as at his first attempt and he gave a sigh of relief. For once, the Workshop was luxuriating in an atmosphere of peace and serenity.

Smithy had had a tiresome afternoon. Shortly after lunch-time the stock of sets in for repair had been completely cleared up, and he had immediately seized the opportunity this gave of catching up on his backlog of neglected paperwork. Stacking up the papers on his bench he had cheerfully commenced what he fondly imagined would be an uninterrupted period in which he could, at long last, finally get up to date.

But he had failed to take into account the reactions of his assistant to an enforced period of inactivity. After the last receiver had been triumphantly carried over to the 'Repaired' racks, Dick had slouched miserably on his stool, gazing vacantly at the switched off test equipment on his bench. He had then started to whistle quietly, producing a composition which, entirely devoid of any recognisable rhythm or melody, wandered aimlessly from one note to the next and which apparently made itself up as it went along. After about a quarter of an hour, and much to Smithy's relief, the whistle gradually faded out. But it was followed by a musical *blowing* effect which was just, agonisingly, higher than the minimum level of Smithy's audible perception. This unaccustomed exercise must have upset the balance of Dick's salivary processes because it suddenly ceased and was succeeded by a series of noisy clearings of his throat.

VERTICAL TIMEBASE

It was when Dick was on the point of clearing his throat for the twelfth time that the Serviceman had finally exploded. Recalling thankfully that he had not yet sorted out a batch of recently received service manuals, he had presented these to his assistant with stern orders to study them in silence. Thus it was that Smithy was now able to sort out his figures, and the silence of the Workshop was broken only by the faint rustle of the service manual leaves as these were turned by his assistant. Gratefully, Smithy surrendered himself to his two-dimensional world of accounts and invoices.

The tranquility prevailed, punctuated only by the turning of service sheet pages by Smithy's assistant. Then, ominously, this sound ceased.

"Smithy!"

The silence returned.

"Smithy?"

The Workshop remained still.

"*Smithy!*"

The Serviceman looked round tentatively.

"Were you calling me?"

"I've been calling you for *ages*."

"What's the trouble?"

"I've got a monochrome TV circuit in this manual here," pronounced Dick, "in which the a.f. output stage feeds direct into the vertical deflection coils!"

"You've got *what?*" queried Smithy unbelievingly. "This I must see for myself."

The Serviceman rose from his stool and walked over to Dick's bench. His assistant indicated a section of the overall receiver circuit in the manual in front of him. (Fig. 1).

"There you are," said Dick. "This set's got a Class B audio output stage, and it's coupling direct into the vertical deflection coils!"

"You great twit," snorted Smithy, as he glanced at the circuit. "That's not the audio output stage at all. The two output transistors in that circuit are part of the vertical timebase."

"Well," retorted Dick indignantly, "why do they look as though they're in a Class B audio output stage, then?"

"Why shouldn't they? As it happens, smoe transistor TV sets do have vertical output circuits which are fairly similar to Class B a.f. output stages, but this particular receiver isn't one of them. Although the output section of the timebase circuit you've got there bears a superficial resemblance to an a.f. output stage, it works in quite a different manner. In this circuit, one driver and output transistor turn on during the flyback period, whilst the other driver and output transistor turn on during the scan period."

Dick gazed down at the circuit with an utter lack of comprehension.

"It's got *me* beat at any rate," he pronounced. "Could you tell me how it works, Smithy?"

"I *am* trying," said Smithy meaningly, "to get some paperwork done."

"Oh, come on," coaxed Dick. "It won't take you more than a few minutes to explain a simple circuit like this to me. You always put things so concisely."

Smithy looked uncertainly at the papers on his bench.

"A chap who's as clued-up as you are," cajoled Dick, "could deal with a thing like this in no time at all."

"Oh, all right then," said Smithy

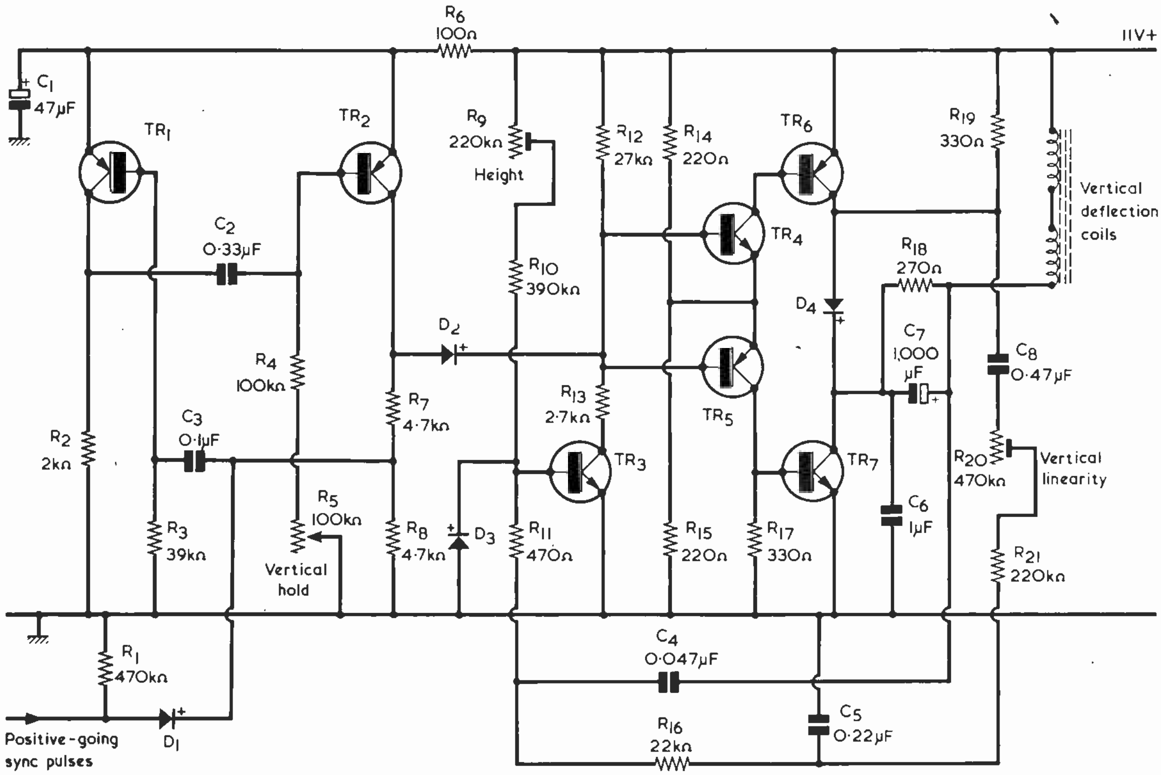


Fig. 1. A transistor vertical, or frame, timebase. This is a slightly simplified version of the vertical timebase employed in the I.T.T. Consumer Products monochrome television chassis type VC300

unwillingly. "But, if we're going to look at this vertical timebase, we can't just start at the two output transistors. We've got to commence with the multivibrator section at the left-hand side and work our way from that along to the right."

"Fair enough," replied Dick, settling himself comfortably. "Let's start with the multivibrator bit. I suppose that that's the circuit around TR1 and TR2." (Fig. 2.)

"It is," confirmed Smithy. "Like most multivibrators, this one is pretty easy to understand. One important point, though, is that in this particular vertical timebase the multivibrator isn't called upon to produce a saw-tooth, as would usually be the case, say, with one of the old valve vertical timebases. What this multivibrator has to do is to generate a positive pulse during the flyback period. Hang on a tick while I bring my stool over."

Smithy hurried over to his bench and returned with the stool. He had already forgotten about his paperwork.

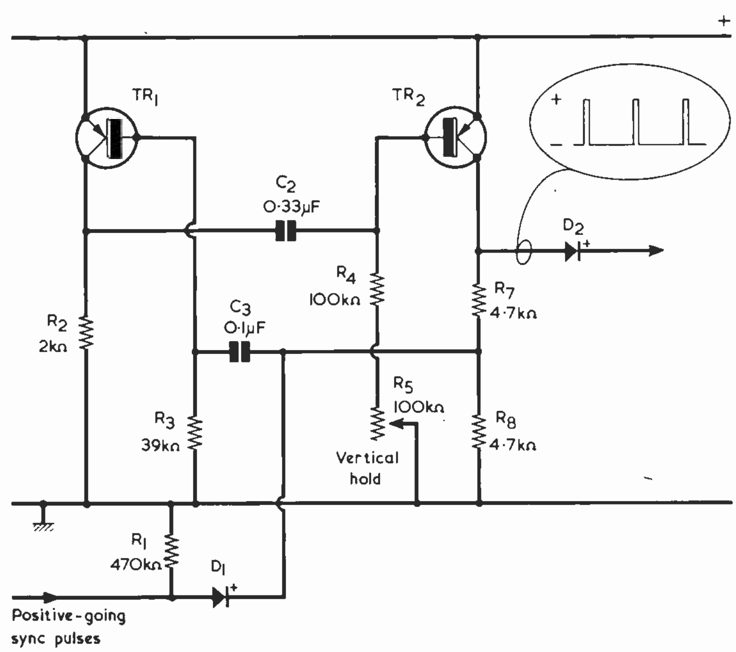


Fig. 2. The function of the multivibrator section of the timebase is to produce a positive-going pulse during flyback

VERTICAL MULTIVIBRATOR

"Now," resumed Smithy briskly, as he sat down on his stool, "this multivibrator is synchronised by positive-going vertical, or frame, sync pulses, and the function of these is to end the scan period and initiate flyback. TR1 is the transistor which is turned on, and TR2 is the transistor which is turned off, during the scan period. The vertical sync pulse is fed in via D1 and C3 to the base of TR1 ,and it turns TR1 off. TR1 collector then goes rapidly negative, taking TR2 base negative by way of C2, whereupon TR2 turns on. Yet get the usual multivibrator changeover action, and it ends with TR1 being turned fully off and TR2 being turned fully on. The time during which TR1 is turned off is equal to the time needed for C3 to discharge into R3. In this circuit C3 also discharges via the relatively low value resistor R7. C3 soon discharges sufficiently for TR1 to turn on again, and we get the second multivibrator changeover, which concludes with TR1 turned on and TR2 turned off. The period over which TR2 is turned off depends upon the time needed for C2 to discharge into R4 and R5 in series."

"C2," commented Dick musingly, "is larger than C3. Also, R4 and R5 in series are a lot larger than R3. This will mean that TR2 is turned off, during the multivibrator cycle, for a much longer time than TR1 is turned off."

"That's right," confirmed Smithy. "The longer time during which TR2 is turned off corresponds to the vertical scan period, and the short time when TR1 is turned off corresponds to the vertical flyback period. The length of time during which TR2 is turned off, and hence the frequency of the multivibrator, is controllable by the vertical hold control, R5. This control is adjusted such that, in the absence of vertical sync pulses, the multivibrator runs just a little more slowly than field frequency. When the sync pulses are applied they then trigger the multivibrator into its flyback period a little earlier than would happen if it were free-running. That's how you get sync, of course."

"Just a minute," interrupted Dick. "What's this business about field frequency?"

"Two interlaced fields," explained Smithy, "make up a picture. In TV the field frequency is 50Hz and the vertical timebase is made to run at this frequency by the vertical sync pulses."

"Fair enough," grunted Dick. "Is there anything more we need to know about the multivibrator?"

"Not really," said Smithy. "We've established that the flyback period corresponds to TR1 being turned off. When TR1 is turned off, TR2 is turned on. During the flyback periods, then, TR2 draws collector current through R7 and R8 and produces the positive-going pulses which, as I said earlier, are all that are required from the multivibrator in this timebase."

Smithy paused for a moment to collect his thoughts.

"Now," he resumed, "you must next look back at the complete timebase circuit for a moment, and take a butcher's at the two output transistors, TR6 and TR7, which you mistakenly assumed to be the output transistors of a Class B audio output stage, together with their driver transistors, TR4 and TR5. If you examine the manner in which TR4 and TR5 are wired up, you'll see that there's no resemblance to a Class B output stage at all."

"How come?"

"Because," said Smithy, "the biasing is different. To start off with, it so happens that TR4 and TR5 are silicon devices as, incidentally, are all the other transistors and the diodes in the timebase. Now, the emitters of TR4 and TR5 are joined together, and they connect to the junction of the two bias resistors R14 and R15. The bases of TR4 and TR5 are also joined together, and these connect to the junction of R12 and R13. As you know, a silicon transistor cannot become conductive until its base is taken above the emitter by about 0.6 volt in the forward direction. Thus, TR4 cannot conduct until its base is taken 0.6 volt positive of its emitter, whilst TR5 cannot conduct until its base is taken 0.6 volt *negative* of its emitter."

"I suppose," said Dick slowly, "this means that if TR4 base is taken positive, so as to make this transistor conductive, the base-emitter junction of TR5 becomes reverse biased. And that the opposite will happen if TR5 base is taken negative in order to make TR5 conduct."

"You've got it," confirmed Smithy. "The result of the common emitter and base connections is that it's impossible to have TR4 and TR5 both turned on at the same time. If TR4 is made conductive only TR4, and in consequence TR6, can pass current, whilst TR5 and TR7 are cut off. Similarly, when TR5 and TR7 are turned on, TR4 and TR6 are cut off."

"I can understand now what you meant when you said that this part of the circuit doesn't work in the same way as an audio Class B output stage."

"Well," remarked Smithy cheerfully, "that's something achieved, at any rate. Having seen that only one driver and output transistor pair can be turned on at any one time, we can now return to timebase functioning. Let's start the next part of our examination at an instant during the vertical scan period when the spot on the tube screen has been deflected nearly all the way down to the bottom of the picture. As you'll see more clearly in a few minutes' time, the current flowing through the deflection coils which produces this scan is provided by TR7. Both TR4 and TR6 are turned off."

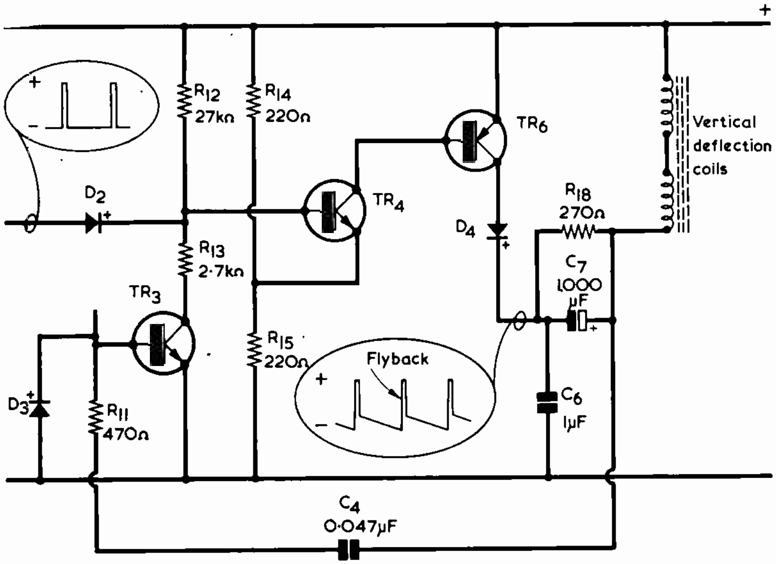


Fig. 3. The positive-going pulse turns on TR4 and TR6, thereby allowing the vertical deflection coils to go through flyback. Also, capacitor C4 becomes charged

Smithy indicated the section of the timebase circuit incorporating these last two transistors. (Fig. 3.)

"The next thing that happens," he resumed, "is that the vertical sync pulse comes along and initiates flyback in the timebase. The multivibrator given by TR1 and TR2 changes over, and TR2 passes a positive-going pulse to the bases of TR4 and TR5 via diode D2. This pulse cuts off TR5 and TR7 and turns TR4 and TR6 hard on. The current flow in the vertical deflection coils then ceases abruptly. Now, perhaps, *you* can tell me what happens next."

Dick stroked his chin reflectively.

"Well," he remarked tentatively, "if the vertical deflection coils behave in the same way as the line output transformer winding in a line timebase, they'll produce a sudden high back-e.m.f. which will cause the lower end of the coils to go violently positive."

"Good, good," commented Smithy approvingly. "The magnetic field in the vertical deflection coils collapses abruptly due to the cessation of current from TR7 and, as you say, the lower end of the deflector coils goes violently positive. The positive excursion occurs at the ringing frequency of the coils, and in the present circuit the ringing frequency is controlled by the inductance of the coils and C6, this capacitor being included to tune the coils during the flyback period. The voltage on the lower end of the coils goes violently positive until it reaches a peak, after which it proceeds, still at the ringing frequency, to return in a negative-going direction. The voltage continues to go negative until it is suddenly brought to a stop, at a potential just below that of the upper supply rail, by the hard-on transistor TR6 and the diode D4. Due to the tuning provided by C6, the positive half-cycle at ringing frequency which has just taken place will have conveniently occupied a comfortable proportion of the vertical blanking period."

"This is interesting," pronounced Dick. "Go on, Smithy!"

"We must next," stated Smithy, "look at capacitor C4. Just before the onset of flyback, this capacitor had only a low voltage across its plates. After the flyback has been initiated and the half-cycle at ringing frequency is over, C4 becomes charged such that its right-hand plate has the same potential as that which is now given at the lower end of the vertical deflection coils. During the charging process the left-hand plate of C4 was prevented from going more than about 0.6 volt positive of chassis potential because of the presence of diode D3. So C4 is now charged up to a voltage which is slightly lower than the supply voltage. Okay?"

"Definitely," said Dick eagerly. "What happens next?"

SCAN PERIOD

"What happens next," repeated Smithy, "is that the multivibrator changes back to its previous state, thereby starting the scan period, and the positive pulse fed to the bases of TR4 and TR5 comes to an end. TR4

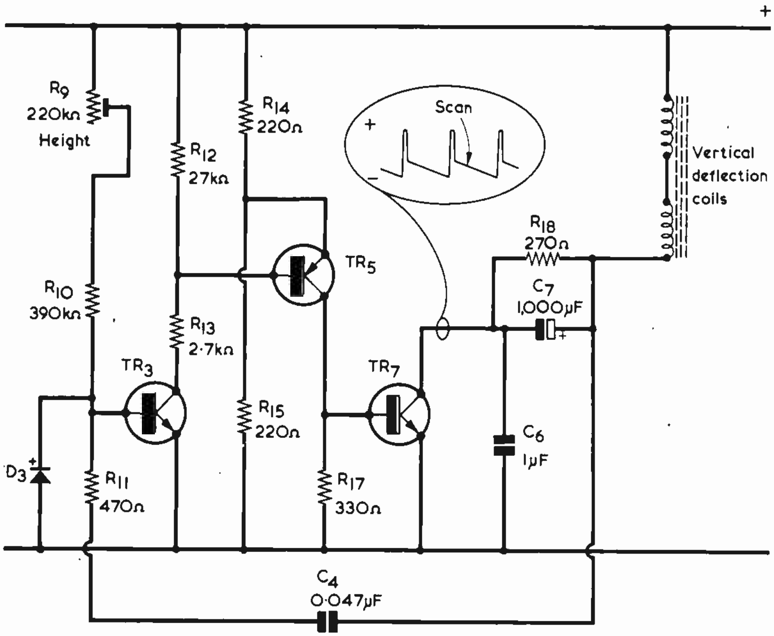


Fig. 4. TR3, TR5, and TR7 form a high gain amplifier during the scan period, the rate of change of output voltage at TR7 collector being controlled by the discharge of C4 into TR3 base circuit

and, in consequence, TR6 now become cut off, and TR5 and TR7 are turned on. As a result there is a 3-transistor amplifier given by TR3, TR5 and TR7. So we must next concentrate on this part of the overall circuit." (Fig. 4.)

"Those three transistors," remarked Dick thoughtfully, "are all connected as common emitter amplifiers. This means that each will give an amplified signal at its collector which is 180 degrees out of phase with that at its base."

"That's correct," confirmed Smithy. "And the result is that when the base of TR3 goes positive, the output at TR7 collector goes negative. Now, there are two resistors coupling the base of TR3 to the positive supply line, these being the potentiometer R9 and the fixed resistor R10. If C4 were not in circuit, R9 and R10 would rapidly draw the base of TR3 positive, whereupon the collector of TR7 would just as rapidly go fully negative. However, the presence of C4 in the circuit slows things up a bit."

"How's that?"

"We know," said Smithy in reply, "that at the start of the scan period C4 is charged nearly to the full supply potential. As soon as the base of TR3 goes positive, because of the current flowing through R9 and R10, the collector of TR7 goes negative. This causes both plates of C4 to go negative as well, whereupon the voltage on the left-hand plate of C4 causes a current to flow to TR3 base which very nearly cancels out the current from R9 and R10. What happens as a result is that TR7 collector goes negative at what is relatively a very slow rate, the speed at which it goes negative being governed by the rate of discharge of C4 into the base circuit of TR3. The slow negative-going progress of TR7 collector provides the scan period of the vertical timebase cycle, and it is quite linear because of the overall negative feedback that is provided by C4 itself."

Dick looked at the circuit and scratched his head.

"I'm a bit puzzled here," he remarked. "Didn't you say just now that C6 tunes the deflection coils so that a half-cycle at the ringing frequency fits nicely into the vertical blanking period?"

"I did."

"What does C6 do during the scan period?"

"Very little," said Smithy. "Its value is too small for it to have much effect at the slow change in output voltage which is given during the scan period."

"But," protested Dick, "C6 is a big fat 1μF capacitor. At the same time, you're telling me that the delaying factor during the scan period is provided by C4, and C4 is only a measly 0.047μF."

"Ah yes," stated Smithy. "But what you must take into account is that C6 is merely returned to chassis, whereas C4 is returned to the input of the high gain amplifier given by TR3, TR5 and TR7. The result is that a tiny discharge current from C4 at TR3 base corresponds to a very large current change at TR7 collector. Because of this, the effective capacitance of C4, so far as slowing down the negative-going progress of TR7 collector is concerned, is its actual value multiplied by the gain of the amplifier. Get it?"

"Yes, I think so," said Dick, frowning. "Let's see now! There will be quite heavy current changes at TR7 collector, but these will be controlled by current changes in the order of tens of microamps only at TR3 base. So the heavy output current changes are controlled by quite small discharge currents from C4, and these permit the use of a low value capacitor in this position."

"That's right," agreed Smithy. "The whole circuit is, in fact, very similar to an op-amp ramp generator having capacitance between the output and the inverting input. Now, the rate of change of current at TR3 base during the scan period can be controlled by R9, because this component controls the current from the positive supply rail which is counteracted by the discharge current from C4. As a result, R9 controls the extent by which the collector of TR7 can go negative during the scan period before this period is brought to an end by the sync pulse, and it therefore controls the height of the picture reproduced on the tube screen. So we've now got the vertical timebase safely launched into its scan period, with the collector of TR7 going slowly negative and with TR3, TR5 and TR7 acting as a high gain amplifier. All we need do to complete our examination of the timebase is to carry on up to the next flyback period. When the flyback period starts, the multivibrator given by TR1 and TR2 again changes state and it once more produces its positive pulse. As before, this turns off TR5 and TR7, whereupon the amplifier given by TR3, TR5 and TR7 ceases to exist. Also, TR4 and TR6 are turned on, and the deflection coils again go through their half-cycle at ringing frequency. And, finally, C4 becomes charged up once more. It can charge up quite quickly during flyback because it is now behaving as a normal 0.047μF capacitor, and not as an 0.047μF capacitor whose effective value is multiplied by an amplifier."

"I see," remarked Dick, "that there is a further negative feedback loop, this being provided by the components in the linearity control circuit."

"It's necessary to provide the second flyback loop," stated Smithy, "to give a manual control of vertical linearity. The linearity control is R20, and it appears in a frequency selective circuit which irons out any bumps still left in the scan waveform. It will also help to keep the gain of the amplifier given by TR3, TR5 and TR7 at a reasonably fixed level despite spread in these transistors. At the slow speed at which vertical scan takes place it is really quite difficult to maintain linearity over all the scan without extensive use of negative feedback."

"That circuit," remarked Dick with a chuckle, "is certainly a far cry from the old valve vertical timebases."

"It is that," agreed Smithy. "For a start, the inductance of the vertical deflection coils is a lot lower than that of the deflection coils which are used in a valve circuit. In a valve circuit, also, there would be a vertical output pentode feeding the deflection coils by way of a vertical transformer. Here, the coils are coupled directly to the output transistor circuit."

ALTERNATIVE MULTIVIBRATOR

Smithy turned, and caught sight of the neglected papers strewn over his bench.

"Blow me," he snorted, "I've never met anyone like you for needlessly taking up my time. Well, I can't stay nattering with you all afternoon, and I must get back to my own bench now."

But Dick had caught sight of a circuit in another of the service manuals in front of him.

"Here's the same sort of vertical timebase again," he remarked. "But this time there's quite a different sort of multivibrator in it."

Smithy glanced quickly at the circuit indicated by his assistant.

"Yes," he agreed hurriedly. "The main part of that timebase does work in the same basic way as does the timebase incorporating TR3 to TR7 which we've just looked at."

He rose from his stool.

"Couldn't you," asked Dick carelessly, "just give me the gen on the multivibrator part of this second timebase?"

"I could not," retorted Smithy. "I've lost enough time talking to you as it is."

"But," wheedled Dick, "you know how really clued-up you are about these things. A few words from you are all I need for full enlightenment!"

Smithy gazed sternly at his assistant.

"If it wasn't for the fact," he stated resolutely, "that I know myself to be quite immune to flattery, I would strongly suspect you of attempting to flannel me."

Dick turned on an expression of ineffable innocence towards the Serviceman.

"Why, Smithy," he stated in a hurt tone, "nothing could be further from the truth. All I'm after is a quick rundown on the way this different multivibrator works."

"Very well, then," said Smithy, as

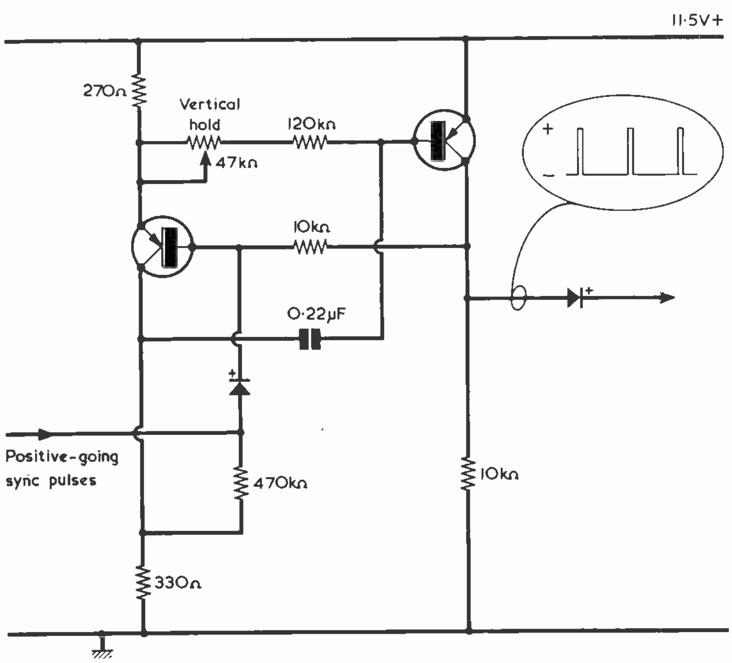


Fig. 5. A vertical timebase basically similar to that shown in Fig. 1 is employed in the Thorn Consumer Electronics 1590–1591 Series of portable monochrome receivers. with the exception that a somewhat different multivibrator circuit, shown here, is incorporated. As in Fig. 1, this multivibrator similarly produces positive-going pulses during flyback

he resumed his seat. "But it *will* have to be quick. All we need to do this time is to look at the multivibrator on its own."

Smithy pulled the new service manual circuit towards him and pointed at the multivibrator section of the vertical timebase. (Fig. 5.)

"Although it's a bit unusual at first sight," he went on, "this multivibrator is just as easy to understand as the previous one. Once more we can start at a point just before the end of the scan period, whereupon we'll find that the left-hand transistor is on and the right-hand transistor is off. A positive-going vertical sync pulse is then applied via the left-hand diode to the base of the left-hand transistor, and it turns this transistor off. Its collector goes rapidly negative, taking the base of the right-hand transistor negative via the 0.22μF capacitor, and thereby turning the right-hand transistor on. This produces the required positive-going pulse at its collector. The 0.22μF capacitor soon becomes fully charged by way of the 330Ω resistor, after which the negative voltage on the base of the right-hand transistor relative to its emitter begins to fall. The collector starts to go negative. As soon as the collector voltage of the right-hand transistor goes sufficiently negative to allow base current to flow in the left-hand transistor the latter starts to turn on. Its collector goes positive, taking the base of the right-hand transistor positive as well by way of the 0.22μF capacitor."

"The right-hand transistor," chimed in Dick, "will then turn fully off and its collector load will take the base of the left-hand transistor negative by way of the 10kΩ resistor between them."

"That's the size of it," concurred Smithy. "In other words, you get the cumulative amplification which is given in all multivibrators at change-over. The positive pulse from the multivibrator ceases and we are now in the scan period with the base of the right-hand transistor held well beyond cut off by the charged 0.22μF capacitor. This capacitor has to discharge into the much higher resistance which is offered by the 120kΩ fixed resistor and the 47kΩ potentiometer before the scan period comes to an end. The length of the scan period can be controlled by the 47kΩ pot, which then becomes the vertical hold control."

PAPERWORK RESUMED

"Blimey, that *was* quick," exclaimed Dick, surprised. "And there isn't anything very complicated in that multivibrator at all."

"There isn't," confirmed Smithy. "Basically, it does just the same as the other multivibrator did, which consists of producing short positive pulses corresponding to vertical flyback."

Resolutely, the Serviceman rose once more.

"And that," he stated positively, "is the end of today's impromptu technical sesh. Can I now rely on you to keep quiet for the rest of the afternoon so that I can concentrate on clearing up my outstanding paperwork?"

"I shall," returned Dick obligingly, "be as quiet as the grave."

And so, much to Smithy's amazement, he was.

■

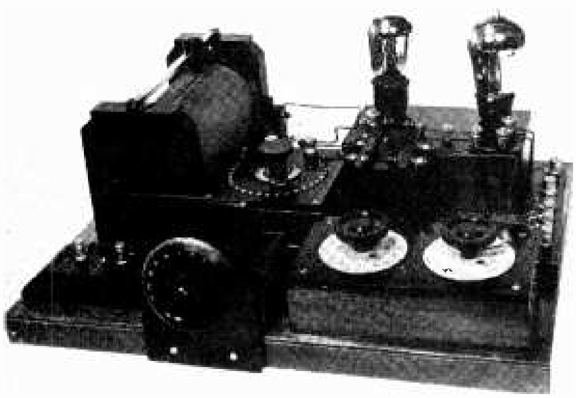
VINTAGE RADIO REPRODUCTION

By H. Ross McDonald

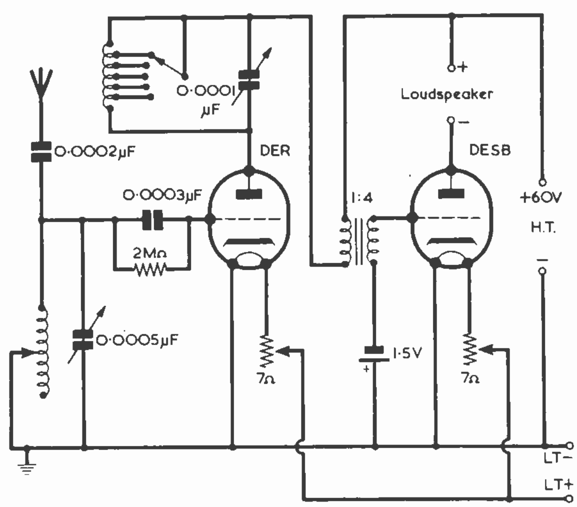
Turning back the pages to half a century ago.

THE PHOTOGRAPH SHOWS A RADIO RECEIVER WHICH sets out to be a faithful reproduction of a 1922–24 home-construction design. As can be seen from the circuit diagram the set is an O-V-1; that is to say, it has no r.f. stage, a valve detector and a single a.f. amplifier valve.

All the components used, including even the 'Glazite' connecting wire, are of authentic 1922–24 manufacture. The slider tuned inductor came from an old 1923 crystal set, and only the brass woodscrews and wooden bases are contemporary.



A reproduction of a home-constructor receiver design of the early 1920's. All the components were manufactured in that period.



The circuit of the receiver. Both valves have series filament rheostats and the output valve is biased by a 1.5 volt cell.

The valves and other components have been collected over a period of time, and it was decided by way of amusement to assemble them into a working model.

The set tunes between 240 and 700 metres. If it is fitted with bright or dull emitter valves it can drive a moving-iron horn loudspeaker with reasonable volume. It is, of course, very unstable when later valves, such as the HL2 or LP2, are fitted. The valves shown in the photograph are early dull emitter types. ■

Radio Topics

By Recorder

CURRENT SENSING RELAY

The first of my photographs this month depicts a somewhat unusual relay. It is, in fact, one of a range of current sensing relays now available from FR Electronics Limited, Wimborne, Dorset, BH21 2BJ.

The FR current sensing relays incorporate a dry reed switch as a monitoring device. The units are designed such that the switch closes when a pre-determined current flows in the sensing coil, this being connected in series with the circuit being monitored. The units can be used either to sense an overload current or to ensure that a minimum current level is flowing.

Response time is of the order of 1 millisecond or less, whereupon spurious operation by short duration surge currents is avoided. Trip ratings are in the range from 20mA up to 120 amps. The relay in the photograph is one of the heavier current units, and it can be seen that the sensing coil consists of a single turn of thick metal strip between the two terminals. The dry reed switch is inserted in the hole just visible on the right hand surface of the insulated mounting.

Current sensing relay manufactured by FR Electronics Limited. The unit shown here is intended to monitor heavy currents, and the energising coil has 1 turn only

MAGNETIC INVISIBILITY

If a submarine is to function effectively it must be 'magnetically invisible'. That is to say, it must be magnetically neutral to any form of magnetic detection including that employed in magnetic mines. This state of affairs is achieved by supplying power to coils distributed about the vessel to counteract its effect on the earth's magnetic field.

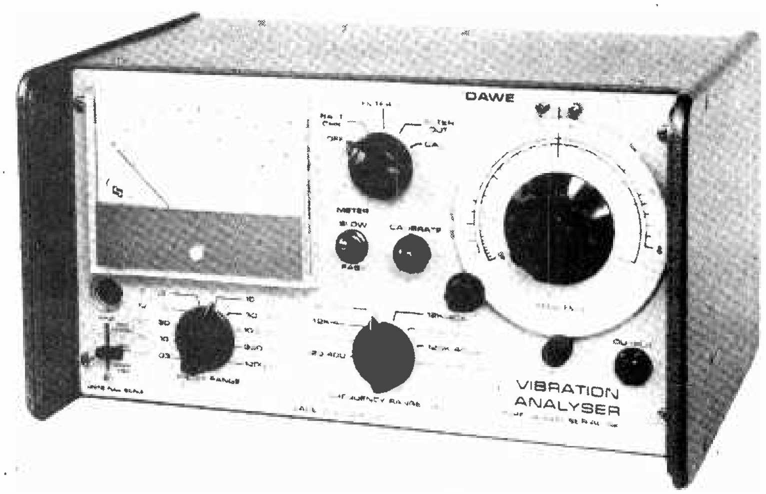
Sweden's latest three submarines are to be fitted with very advanced automatic degaussing equipment in order to achieve magnetic invisibility, this being supplied by Marconi Radar Systems Limited, a GEC-Marconi Electronics Company. The three submarines are of the Type A14 Nacken class, and the equipment to be installed is designed for small vessels where space is at a premium. The systems will operate at very low noise levels and will be screened against radio frequency interference.

In the Marconi installation the currents in the neutralising coils are automatically and continually varied to maintain the vessel in a degaussed condition, regardless of how the submarine moves in the water or changes its global position. Operation is computer controlled, with a manual control mode available for emergency conditions.

VIBRATION ANALYSER

The second photograph gives a striking illustration of the way in which electronics is nowadays applied to industrial engineering problems. The instrument shown is the Dawe Instruments Vibration Analyser Type 1461 BV and it is designed to measure the mechanical vibration of machinery. This is a very useful facility because the onset of breakdown in machinery is frequently heralded by excessive vibration.

The input for the instrument is obtained from a velocity pick-up mounted on the machine being monitored. This input is applied, inside the instrument, to a continuously variable narrow band filter ranging from 120 cycles to 1,200 kilocycles per minute. The output of the filter is fed to a meter circuit offering a sensitivity from 0.01



The Dawe Instruments Vibration Analyser Type 1461BV. This has its own battery and is capable of measuring the velocity of machine vibration over a very wide range of frequencies

in. to 300 in. per second in 10 ranges. Wear in rotational machinery is directly related to velocity of vibration, so that it is customary to use this parameter as an indication of change in machine condition. The Vibration Analyser allows individual vibration frequencies to be measured separately in a complex machine having parts rotating at various speeds. Alternatively, the filter can be switched out and the overall vibration level determined. The instrument can also be switched to measure acceleration or displacement.

The analysed vibration waveform is available at an output jack, and this can be fed to an oscilloscope, a recorder or headphones. It may also be used to trigger a stroboscope for the visual inspection of moving parts.

The Vibration Analyser Type 1461 BV is self-contained with its own internal battery. Further details can be obtained from Dawe Instruments Limited, Concord Road, Western Avenue, London, W3 0SD.

ENERGY CONSERVATION

As I write these notes we are embarked on an energy crisis which, to say the least, is anything but funny.

It occurs to me that we could, at a small capital investment per building, find a peripheral source of energy which could offer quite a useful alleviation of the situation. The wind is free and there is plenty of it for everybody. Wind-driven generators are not a new idea and have been used in the past, particularly overseas, for the production of electricity and the pumping of water at isolated homesteads and villages. Why not take advantage of modern technology and employ wind-driven generators in our own urban communities?

Most of you will know the sort of generator that I'm referring to, having either seen one directly or on the films or TV. They consist of rotatable metal-vaned windmills with a flat vane at the rear to direct the windmill blades towards the oncoming wind. The windmill blades either drive the generator directly or via suitable gearing.

What I visualise is a small wind-driven generator, on any building capable of supporting it, in which the generator is a simple alternator having slip-rings instead of the more complicated commutator employed in d.c. dynamos. The alternating voltage from the alternator can be very economically rectified by a silicon bridge rectifier and the resultant direct voltage used to charge a lead-acid or nickel-cadmium storage battery. The bridge rectifier will automatically prevent current flowing from the battery to the alternator when wind force is low, and the only cut-out required would be one which turned off the charging current when battery voltage approached the over-charging level. The requisite circuitry could all be solid state, the single mechanical item being the alternator itself. The battery would be used to power the lighting in the building.

The electric mains supply would still be piped into buildings having wind-driven generators, but it would be primarily used for heating. On periods of low wind energy the mains could also be used for charging the battery. The efficiency of such a charging circuit would not be much less than would occur if the mains supply were fed direct to the lighting system.

Naturally, the lighting wiring in the building would be at the relatively low battery voltage, but this raises no insurmountable snags. Domestic entertainment items, such as television sets or hi-fi units, could run either from the mains or from the battery. Indeed, 12 volt monochrome television receivers are already with us.

To sum up the situation, the whole lighting for the building could, hopefully, be obtained free from the wind. In practice, there would be periods of low wind activity when all the lighting load would be met by the mains supply. Nevertheless, suitably designed wind-driven generator installations in sufficient numbers throughout the country could result in a significant reduction in electricity demands and would employ design techniques that are currently viable. A final advantage of the idea is that consumers would be financially attracted towards installing such generators because of the consequent saving in payments for public mains electricity and because of the non-cessation of lighting during power cuts. ■

"Must get the electrician to repair this — we can't afford to keep losing customers this way!"

MAINS CURRENT MEASUREMENTS

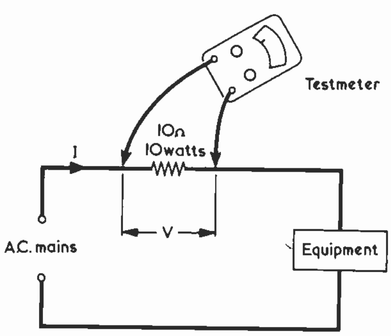
By S. L. Stevens

How to measure mains current consumption with inexpensive multi-testmeters.

IT IS SOMETIMES DESIRABLE TO MEASURE the current drawn from the a.c. mains by an item of electronic equipment. Unfortunately, whilst most of the lower cost multi-testmeters that are currently available have a.c. voltage ranges, they do not have a.c. current ranges which would enable such a current measurement to be carried out.

SERIES RESISTOR

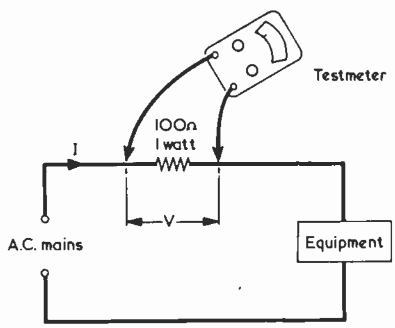
The problem may be overcome by inserting a low value resistor in series with the equipment being checked and then measuring the alternating voltage dropped across this. In Fig. 1, for instance, a 10Ω resistor is so inserted, and the testmeter, switched to an a.c. volts range, measures the voltage across this. There is a simple direct relationship between the voltage dropped across the resistor and the current which flows through it. If the voltage dropped across the resistor is 5 volts then, from the Ohm's Law relationship, I = E/R, the current is 5 divided by 10, or 0.5 amp.



$I = \frac{V}{10}$

Fig. 1. A suitable circuit for checking mains currents from 0.1 to 1 amp

It is permissible to insert a 100Ω resistor, as in Fig. 2, if the current consumption of the equipment is less than 0.1 amp. A current of 0.05 amp through 100Ω corresponds to 5 volts.



$I = \frac{V}{100}$

Fig. 2. A higher value series resistor may be employed if the current lies between 0.01 and 0.1 amp

The maximum voltage which should be permitted to appear across the series resistor is, in general, 10 volts. If higher voltages are dropped across the resistor the supply voltage for the equipment whose current consumption is being checked falls to too low a value. Not only may the equipment draw an excessively lower current than normal, but its functioning may be modified by the presence of the series resistance, whereupon the readings obtained become unreliable. A current reading obtained with the aid of a series resistor should not be considered accurate unless the equipment performs in its normal manner whilst the series resistance is in circuit.

In a few instances it is possible that the equipment may draw a current in excess of 1 amp. In this case the series resistance may be 1Ω, whereupon the voltage dropped across it is equal to the current in amps which flows through it. The use of the 1Ω resistor is only practicable for currents up to 3 amps, at which the dissipation in the resistor is just short of 10 watts.

WATTAGE RATINGS

To sum up, the series resistor can be 1Ω for mains currents of 1 to 3 amps, 10Ω for mains currents of 0.1 to 1 amp, and 100Ω for mains currents of 0.01 to 0.1 amp. With the 1Ω resistor the current in amps is equal to the voltage across the resistor; with the 10Ω resistor the current in amps is equal to the voltage divided by 10; and with the 100Ω resistor the current in amps is equal to the voltage divided by 100. These are easy relationships to remember.

The maximum power dissipated in the 1Ω and 10Ω resistors is 10 watts. Ten watt resistors in these values are a little difficult to obtain from the usual home-constructor component supply sources and it will probably be necessary to use two or more lower wattage resistors in a parallel, a series, or a series-parallel arrangement. Two 20Ω 5 watt resistors in parallel will, for example, give the 10Ω 10 watt resistor. An 18Ω and a 22Ω resistor connected in parallel will give a value sufficiently near to 10Ω for the present application. The maximum dissipation in the 100Ω resistor is only 1 watt, and no supply problems arise here. In general, there is little point in employing close tolerance resistors, and 5% resistors should be quite adequate. Mains current measurements are not usually required to a high level of accuracy. ■

Trade News . . .

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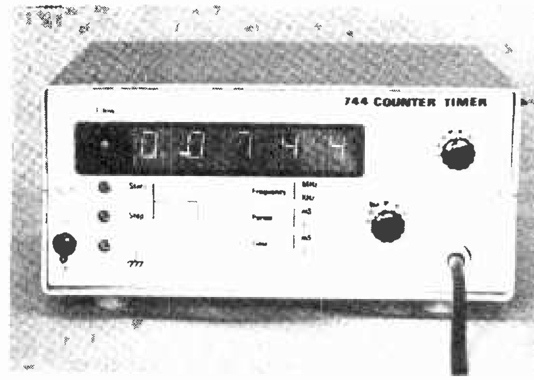

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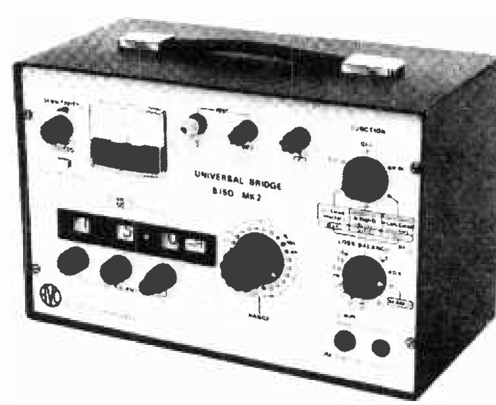
Details from Avo Ltd., Avocet House, Archcliffe Road, Dover, Kent.



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(Continued on page 705)

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(Continued from page 703)

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(Continued on page 707)

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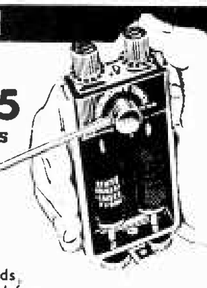

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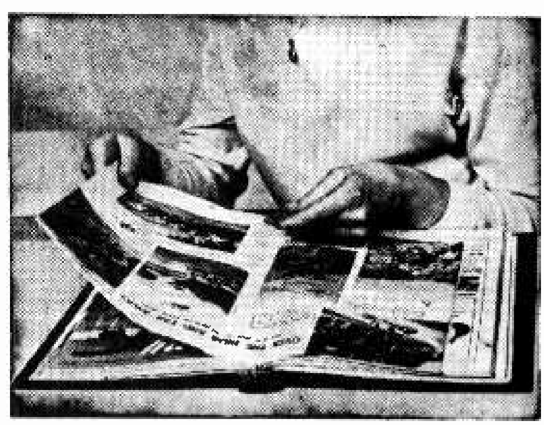

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(Continued from page 705)

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The Table lists vision and sound carrier frequencies for television transmissions in Band V (u.h.f. and 625 lines). This completes the information which commenced in Data Sheet No. 86.

Band V			Band V		
Channel	Vision Carrier (MHz)	Sound Carrier (MHz)	Channel	Vision Carrier (MHz)	Sound Carrier (MHz)
39	615.25	621.25	54	735.25	741.25
40	623.25	629.25	55	743.25	749.25
41	631.25	637.25	56	751.25	757.25
42	639.25	645.25	57	759.25	765.25
43	647.25	653.25	58	767.25	773.25
44	655.25	661.25	59	775.25	781.25
45	663.25	669.25	60	783.25	789.25
46	671.25	677.25	61	791.25	797.25
47	679.25	685.25	62	799.25	805.25
48	687.25	693.25	63	807.25	813.25
49	695.25	701.25	64	815.25	821.25
50	703.25	709.25	65	823.25	829.25
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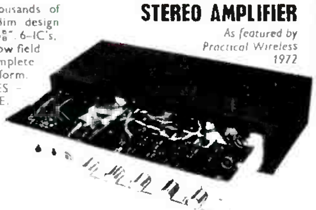

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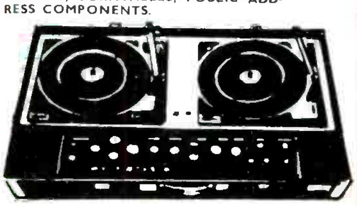

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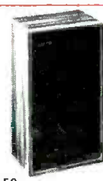

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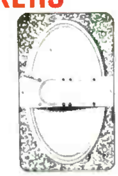

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