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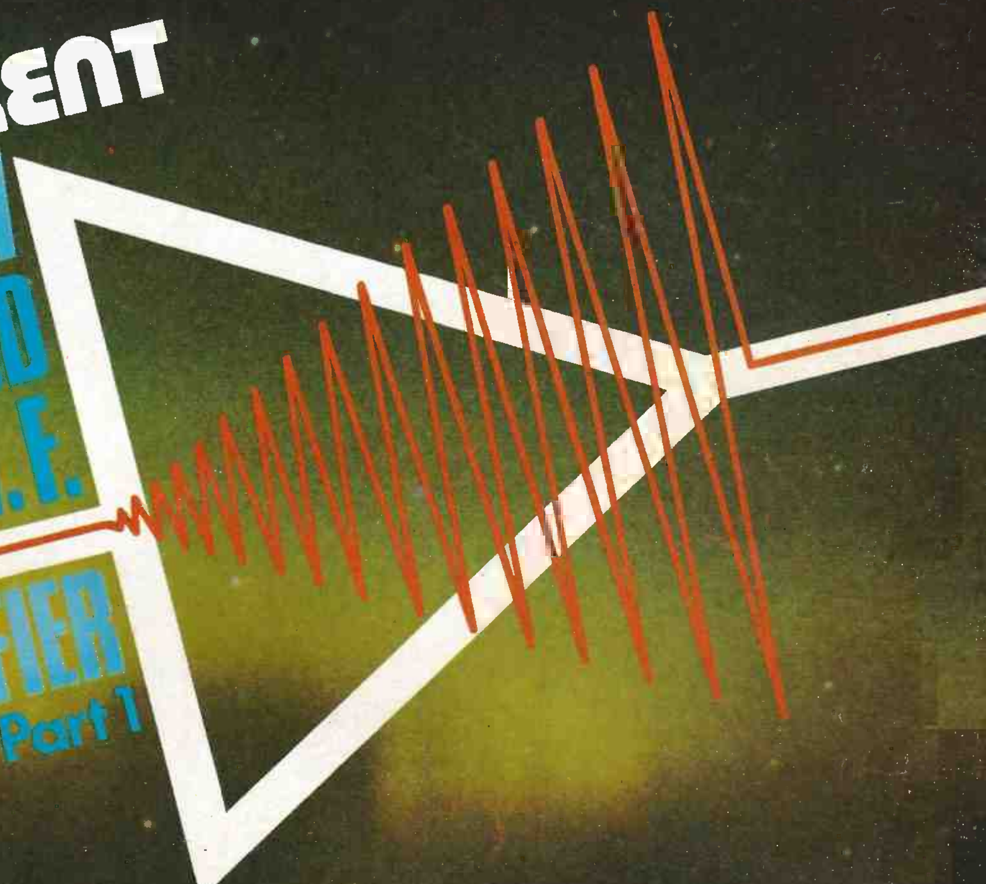

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4017	50p	4071	12p
4018	55p	4072	12p
4019	40p	4081	12p
4020	50p	4082	12p
4022	50p	4093	70p
4023	12p	4510	60p
4024	40p	4511	70p
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0·47/35V	14p	6·8/35V	14p
0·68/35V	14p	1·0/35V	14p
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BC108C	15p	BCY42	25p	BFR80	30p	IN4004	5p
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BC109C	15p	BCY58	18p	BFW60	25p	IN4006	6p
BC113	12p	BCY59	25p	BFW88	30p	IN4007	7p
BC114	15p	BCY70	15p	BFW89	30p	IN4148	4p
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BC116	15p	BCY72	15p	BFX29	25p	2N929	20p
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BC118	12p	BD121	85p	BFX38	25p	2N1302	25p
BC119	25p	BD131	35p	BFX44	35p	2N1303	30p
BC125	16p	BD132	35p	BFX48	45p	2N1305	30p
BC125B	20p	BD133	45p	BFX81	100p	2N1306	38p
BC126	20p	BD135	35p	BFX85	30p	2N1308	50p
BC134	15p	BD136	35p	BFX87	25p	2N1711	22p
BC136	16p	BD137	40p	BFX88	25p	2N2219A	25p
BC137	16p	BD139	40p	BFY10	30p	2N2483	30p
BC138	30p	BD140	40p	BFY18	100p	2N2906	16p
BC140	30p	BD144	160p	BFY19	100p	2N2907	20p
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BC158	10p	BD607	80p	BSY95	20p	2N3819	25p
BC159	10p	BD608	80p	BT100A	80p	2N3866	95p
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BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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NEWS & VIEWS

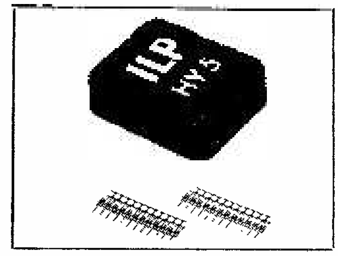
FOR OUR CONSTRUCTORS

GENERAL INTEREST

Our July issue will be published on 1 June
(for details see page 35)

The background to our cover is a picture of the Aurora Borealis as seen in Scotland during April 1978

15—240 Watts!



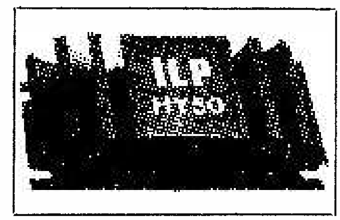
HY5
Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 47kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.
Price £6·27 + 78p VAT P&P free.



HY30
15 Watts into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board. 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω: DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.
Price £6·27 + 78p VAT P&P free.

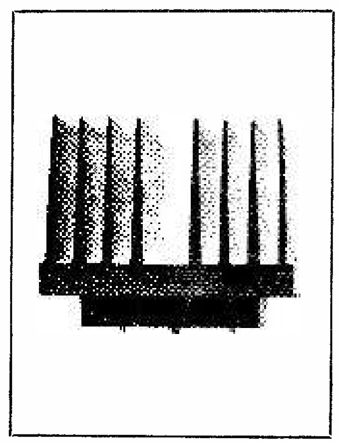
HY50
25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm
Price £8 18 + £1·02 VAT P&P free



HY120
60 Watts into 8Ω

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £19·01 + £1·52 VAT P&P free.

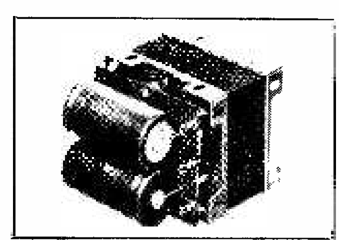
HY200
120 Watts into 8Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
SIZE 114 50 85mm
Price £27·99 + £2·24 VAT P&P free.



HY400
240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial

SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 100 85mm
Price £38·61 + £3·09 VAT P&P free.

POWER SUPPLIES

PSU36 suitable for two HY30's **£6·44** plus **81p** VAT. P/P free.
PSU50 suitable for two HY50's **£8·18** plus **£1·02** VAT. P/P free.
PSU70 suitable for two HY120's **£14·58** plus **£1·17** VAT. P/P free.
PSU90 suitable for one HY200 **£15·19** plus **£1·21** VAT. P/P free.
PSU180 **£25 42 + £2·03** VAT.
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PARTS FOR CURRENT PW PROJECTS ... FROM AMBIT INTERNATIONAL

VHF FM monitor RX: A complete kit of parts for this project, which we firmly believe will be an established "standard" for years to come. The kit includes a 5 channel switched crystal oscillator added to the board end, using diode switching. Uses cheaper 3rd OT crystals, employing original oscillator as x3 stage. Price depends on filter selected (we have various types) and whether or not chip capacitors are required. More notes on the kit from our own lab. £25-£35 kit.

VMOS POWER TRANSISTORS FOR PW WINTON £9.95 pair * 2SK133/J48

FULL KITS FOR THE PW SANDBANKS METAL LOCATOR (should be ex stock)

FULL KITS FOR THE PW DORCHESTER

Radio ICs

TDA1062	HF/VHF tunerhead	1.95
TDA1083	One chip AM/FM rx	1.95
TDA1090	One chip HiFi am/fm	3.35
TDA1220	One chip am/fm rx	1.75
HA1197W	HiFi AM tuner IC	1.40
CA3123E	AM tuner IC	1.40
TBA651	AM tuner IC	1.81
CA3089E	Famous FM IF system	1.94
CA3189E	As 3089+ deviation mute AF preamp, adj, agc	2.75
HA1137W	Improved S/N 3089	2.20
TBA120	limiting amp+detector	0.75
TBA120S	high gain	1.00
MC1350P	agc'd IF preamp	1.20
MC1330P	synch AM/video detector	1.35
KB4406	Cascode IF preamp	0.65
uA753	limiting FM preamp	1.95

Communications circuits

SD6000	DMOS RF/Mixer pair	3.75
KB4412	Bal mixers, IF+agc	2.55
KB4413	AM/SSB det. squelch,agc	2.75
KB4417	mic processor	2.55
MC3357	best thing in NBFM yet	3.12
MC1496P	popular double bal mixer	1.25

Multiplex decoders + noise blanker

MC1310P	popular PLL decoder	2.20
uA758	buffered 1310	2.20
CA3090AQ	RCA PLL decoder	3.25
HA1196	improved PLL decoder with stereo preamps	3.95
HA11223	19kHz pilot cancel, low distortion, high S/N	4.35
KB4437	as HA11223 with remote VCO kill facility	4.55
KB4438	stereo MUTING preamp for post decoder mute	2.22
KB4423	impulse noise blanker	2.53

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BF960	800MHz/2.8dB nf mosfet	1.60*
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40822	FM RF amp	0.43*
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40673	Famous MOSFET	0,55*
2SJ49/2sK133	120v/100W MOSPOWER output devices	10.50*

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	3mm	5mm	2.5x5mm
Red	0.14	0.14	0.17
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Yellow	0.18	0.15	0.20
Orange	0.22	0.29	0.24

100 off mix, 25% discount. All are AEG first grade types - absolutely no junk. 5mm clips for panel mounting 0.03 each

Misc. ICs for radio/audio applications

U237B	5 LED bargraph driver	0.80*
SAS6610	4 station touch tune IC	1.48*
SAS6710	adds 4 stations to 6610	1.48
MSM5523/4	LW,MW,SW and FM digital frequency readout plus clock, timers, stopwatch	£14 *
MSM5526	LW/MW/FM DFM with direct drive for LCD	£11 *
TCA730	DC volume control	3.50
TCA740	DC tone control	3.50
TDA1028	DC input switch	3.50
TDA1029	DC mode switch	3.50

Radio and Tuner modules

We cannot really list all the details we would like to here - but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this new range.

TERMS etc: CWO please, VAT on Ambit Items is generally 12½%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays.

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb. A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else..............

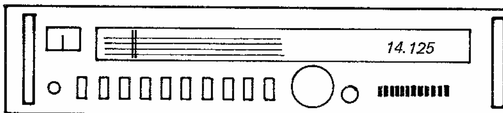
- ★ Exceptionally high performance - exceptionally straightforward assembly
- ★ Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- ★ Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- ★ Matching both the style and design concepts of the MkIII HiFi FM tuner
- ★ Hitachi VMOS power fets - characterized especially for HiFi applications
- ★ Power output readily multiplied by the addition of further MOSFETs
- ★ VU meters on the preamp - not simply dancing according to vol level
- ★ Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester·LW,MW,SW,& FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



With styling and dimensions to fit in with the rest of AMBIT's new range of tuner & audio equipment.

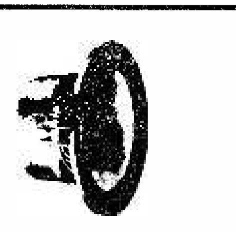
When the new range of OKI digital frequency display ICs was announced, the original prototype of the Dorchester had been made - but since so many of you wanted to use the OKI frequency counterdisplay system with the Dorchester, we quickly designed a unit to incorporate the necessary facilities. The Digital Dorchester is designed in 19 inch form, and forms a perfect match for the other units in the range. If you don't want to go to the expense of the full Ambit DFM1 module, with AM/FM/Time/Timers, then the MA1023 clock module can be used instead -

The Dorchester has been described in PW Dec., Jan. and Feb. issues - but for those of you who may have missed it - it is an All Band broadcast tuner, covering LW/MW/SW and FM stereo in 6 switched ranges. Construction is very straightforward, with all the switching being PCB mounted - and the revolutionary TDA1090 IC used for AM/FM.

The electronics for the radio section of the Dorchester remain unchanged at £33.00, with 12.5% VAT. The hardware package, of case, meter, PSU now costs £33.00 + 8% with the MA1023 available for an extra £5 only.

For the fully digital version, with Ambit DFM1, the price is £56.50 + 8% VAT.

2 Gresham Road, Brentwood, Essex.



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CSC MAX100 freq meter £75·40.
CALSCOPE oscilloscopes send sae for data or see the Calscope advert in this magazine. Super 6 £174. Super 10 £236.
COMPUTER GAMES chess challenger 10 £167. chess challenger 7 £79. checker challenger 4 £84. checker challenger 2 £50. Atari videocomputer £138. cartridges £13·45.
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(Nov. 75 article by A. C. Ainslie) *Copy of original article supplied on request*

IF Sub-Assembly (G8) **£7·65.** P&P 75p.
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All these have 230/240v 50hz
All these have 230/240v 50hz Primary

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1v	2 amp	TM 1	£1·94	40p
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6v	¾ amp	TM 3	85p	40p
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6·5v	200 mA	TM 21	£1·62	40p
6·5v-0-6·5v	100 mA	TM 21	£1·62	40p
6·5v-0-6·5v	750 mA	TM 7	£2·16	45p
6·3-0-6·3v	100 mA	TM 33	£1·62	40p
6·3v	2 amp	TM 4	£1·89	50p
8·5v	1 amp	TM 12	£1·62	40p
8·5+8·5v sep. winding	½ amp	TM 12	£1·62	40p
9v	1 amp	TM 5	£1·62	45p
9v	3½ amp	TM 11	£2·70	50p
9v	5 amp	TM 38	£3·24	60p
10v	25 amp	TM 15	£4·86	£1·25
10v-0-10v	4 amp	TM 50	£3·78	£1·25
10v-0-10v	12½ amp	TM 15	£4·86	£1·25
12v	½ amp	TM 9	£1·05	50p
13v	100 mA	TM 21	£1·62	40p
13v	¾ amp	TM 7	£2·16	50p
12v	1 amp	TM 10	£1·89	50p
12v-0-12v	50 mA	TM 19	£1·62	40p
12v-0-12v	1 amp	TM 41	£3·24	50p
15v tapped 9v	2 amp	TM 11	£2·70	50p
17v	½ amp	TM 12	£1·62	50p
18v	¾ amp	TM 13	£1·90	50p
20v	½ amp	TM 14	£1·62	50p
20v (with 6v ½ amp)	2 amp	TM 50	£3·78	£1·25
20v	6 amp	TM 46	£4·32	£1·25
20v	12½ amp	TM 15	£4·86	£1·25
20v-0-20v	6 amp	TM 15	£4·86	£1·25
24v	1½ amp	TM 16	£2·12	60p
24v	2 amp	TM 17	£2·70	60p
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40v-0-40v	2½ amp	TM 48	£5·02	£1·25
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50v	8 amp	TM 29	£11·65	£1·75
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70v	4·5 amp	TM 24	£7·02	£2·50
75v and 63v	3 amp	TM 23	£8·10	£2·00
75v	4½ amp	TM 24	£7·02	£2·50
80v tapped 70v & 75v	4 amp	TM 24	£7·02	£2·50
80v centre tapped	2½ amp	TM 48	£5·02	£1·25
100v	1 amp	TM 25	£7·02	£1·75
100v-0-100v	½ amp	TM 25	£7·02	£1·75
200v	½ amp	TM 25	£7·02	£1·75
250v-0-250v & 6·3v	50 mA	TM 36	£3·78	£1·00
000v	100 mA	TM 36	£3·78	£1·00
500v	50 mA	TM 36	£3·78	£1·00
260v	60 mA	TM 26	£3·24	£1·00
1000v	60 mA	TM 43	£6·50	£2·00
4 kv	5 mA	TM 49	£4·05	70p
5 kv	5 mA	TM 30	£7·02	£1·00
8 kv	5 mA	TM 45	£4·05	£1·00
8·5 kv	10 mA	TM 31	£10·26	£2·00

Full range of Mains to 120v Auto transformers available.

Pot Cores. We have now received our delivery of Ferrox pot cores. These are ex unused equipment. They contain the bobbins but of course these have to be wound and you would have to unwind. Three pairs available.

	Diameter	Thickness	Price	
FX 2243	4·5 cm	3·0 cm	81	
FX 2242	3·5 cm	2·3 cm	70	per pair
FX 2240	2·5 cm	1·6 cm	60	

Quantity discounts apply.

Component Panel Ref. 3055. Taken from unused P.S.U.'s, these contain 4 × 2N ·3055 power transistors with mica insulators all on heat sink and 4 variable pots, preset type with spindle locks. Real bargain at **£1·08** each.

Component Board 421. Again from unused equipment, major items on these are two power silicon transistors, Motor Rola ref. SJ 5433 mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 1008. Price **98p.**

E.H.T. Mains Transformer. With inductance control, normal primary and output voltage approx. 4kv 3mA. Voltage can be varied by applying DC to lower bobbin. Unused, ex P.S.U.'s Price **£4·32.**

Music Centre Dust Cover. Size 12″ × 10″ × 1½″ with attachments for hinging. Price **£3·95.** Callers only.

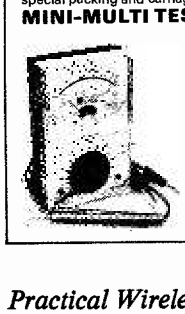
Telephone Answering Machines. Used, but apparently complete and probably in working order. However, we are allowed to supply these only for breaking up, they should be very suitable for conversion to open reel tape recorder, background music machine, echo chamber, etc. All untested but we guarantee to replace any major item in the machine should it be faulty. Machines less outer case **£7·50,** case slightly broken but substantially whole **£10·26.** Unbroken cases **£12·45,** and finally with new looking cases **£14·50.** Post **£2·50** per machine Many accessories available for these machines. Please enquire.

Wall Mounting Thermostat. The Satchwell room stat. Mains 20 amp settable over normal air temperatures between 30-80°F, suitable also for greenhouse control. Nicely finished in white enamel, Price **£3·25.**

10 r.p.m. Motor with 230v mains coil, not like the usual of these geared motors this has a good length of ¼″ shaft. Price **£2·50** + **20p.**

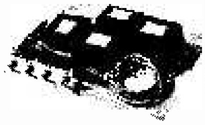
Rigonda Intermezzo 10 + 10 hi-fi amplifier with belt driven record deck with speed control and strobe check. The best hi-fi offered by Rigonda original selling price was in excess of **£125.** We have approx. 50 of these unused but with various faults. Untested, believed complete except for cartridge and speakers. Offered at **£33·50,** less than the price of the very high quality deck incorporated. If cannot collect add **£3·00** to cover the special packing and carriage charge.

MINI-MULTI TESTER

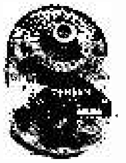


Amazing, deluxe pocket size precision moving coil instrument—jewelled bearings—1000 opv—mirrored scale.
11 instant ranges measure:—
DC volts 10, 50, 250, 1000.
AC volts 10, 50, 150, 1000.
DC amps 0-1 mA and 0-100 mA.
Continuity and resistance 0-150K Ohms.
Complete with insulated probes, leads, battery, circuit diagram and instructions.
Unbelievable value only **£6·50**+50p post and insurance.

MULLARD UNILEX



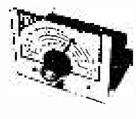
A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£15** including VAT and postage.



24 HOUR TIMERS VENNER

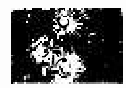
As illustrated with sun correction made for G.P.O. phone boxes used perfect **£2·95** 20 amp switching contacts.

SHORTWAVE CRYSTAL SET



Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts **£1·94**—crystal earphone **55p** including VAT and postage.

SOUND TO LIGHT UNIT



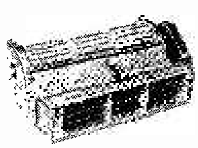
Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box ready to work. **£9·95.**

BREAKDOWN PARCEL

Four unused, made for computer units containing most useful components, and these components unlike those from most computer panels, have wire ends of usable length. The transistors for instance have leads over 1″ long—the diodes have approx. ½″ leads.

List of the major components is as follows:— 17 assorted transistors—38 assorted diodes—60 assorted resistors and condensers—4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which we made to receive these units). The price of this four unit parcel is **£1** including VAT and post (considerably less than value of the transistors or diodes alone). DON'T MISS THIS SPLENDID OFFER.

TANGENTIAL HEATER UNIT

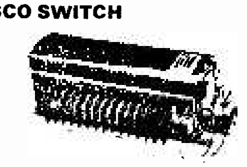


3KW MODEL
£5·95
+ £1·50 P & P

A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2 kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price **£4·95** post £1·50 control switch to give 2kw. 1kw, cold blow or off available 60 p extra.

2 k.w. model made in metal case with control switch **£12·00**

MOTORISED DISCO SWITCH

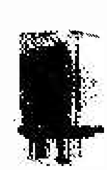


With 10 amp changeover switches. Multi adjustable switches are rated at 10 amps. This would provide a magnificent display. For mains operating. 8 switch model **£5·25.** 10 switch model **£5·75.** 12 switch model **£6·75.**

FLUORESCENT TUBE INVERTOR

For camping — car repairing — emergency lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer invertor for 21″ 13 watt miniature tube for only **£3·75** with tube and tube holders as well.

RELAYS



12 volt two 10 amp changeover plug in **95p.** 12v three 10 amp changeover plug in **£1·28.** 12v two changeover miniature wire ended **95p.** 12 volt open single screw fixing two 10 amp changeovers **85p.** 12 volt open three 10 amp changeovers **£1·25.** Latching relay mains operated 2 c/o contacts **£2·11.** Mains operated three 10 amp changeovers open type one screw fixing **£1·25.** Meny other types with different coil voltages and contact arrangements are in stock, enquiries invited.

Terms: Prices include Post & VAT. But orders under £6·00 please add 50p to offset packing. Bulk enquiries—Please Phone for Generous Discounts 688 1833.

Access and Barclycard accepted

J. BULL (ELECTRICAL) LTD

(Dept. E. E.), 103 TAMWORTH RD., CROYDON CR8 1SG

IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and It's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

FM Tuner and decoder, 2 very well made (Japan) units, nice clear dial, excellent reproduction. **£11·20** the pair.

12 Volt Heavy Duty Relay, plug in tape has three pairs of 10 amp changeover contacts. A transparent dust cover, price **£1·08** suitable 11 pin base 45.

4 Changeover Relay, upright mounting 4 sets of 10 amps changeover contacts, mains voltage coil **£1·72.**

12 Volt Pump. Designed we believe as a bilge pump, this is 12 volt AC/DC motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price **£12·50.**

High Load 24 Hour Clock Switch, made by the famous Smiths Company for normal mains but with clockwork reserve has load capacity of 80 amps at 240V 50HZ. Therefore suitable for dealing with large loads of say shop lighting, water heating, storage heaters, etc., etc. Has triggers for on and off once per 24 hours but extra triggers will be available. Price **£1·50** per pair., totally encased. Price **£9·50.**

Enclosed 24 Hour Clock with contacts for breaking 10-12 amps at 240 volts. This one has two sets of on/off per 24 hours, price **£7·00.**

Light Dimmer, our timer module with small mods makes an excellent light dimmer. Contains a 4 amp 400V SCR so it should be suitable for loads approaching 1KW. Price of module and instructions **£2·25.**

Push Pull Solenoids, mains operated solenoids which will push as well as or instead of pull. Very heavy duty, estimate this at 20lbs push or pull 1¾″ × 3¼″ 4″ made Magnetic Devices Co. **£7·50.**

Flashing Lights, chasing lights, random finishes, strobe effects etc., etc., can easily be achieved using our disco switches. These switches are ex-equipment but guaranteed perfect and supplied suitable for mains working. To get some idea of loading number, each switch is 10 amp. For the light pipe or Catherine Wheel effect order the 12 switch model with light pipe data model, inter-connecting the switches to give fastest speed. 6 Switch model **£5.** 9 Switch model **£9·75.** 12 Switch model **£6·20.**

Reed Switches, standard 60 watt glass type. Normal open contacts glass lengths 2″ diameter 3/16″. 10 for **£1,** 100 for **£6,** 1000 for **£70.**

Flat Reed Switches, for stacking, greater quantity in confined space. Price **£50p.**

Ceramic Magnets, suitable for operating Reed switches, central fixing hole, 10 for **£1.**

Music Centre Transformer 12-0·12 at 1 amp and 9 volt at ½ amp. Normal primary, uprighting, impregnated and varnished for quiet operation. Price **£3·50.**

'W' Shaped Fluorescent Tubes for porch light, box signs or where you want light evenly spaced over a confined area of approx. 10″ +10″, 30 watts made by Philips, price **£2·24.**

Extension Speakers, 8 ohm 4-5 watts handling power. We have 5 or 6 different models in stock, cheapest being the Partytime at **£3·95** each, again only really a bargain for callers as postage is £1·50 per speaker.

Auto Transformers for working American tools and equipment, completely enclosed in sheet metel case with American type flat output socket made for computer so obviously first class 500 watts. With cang handle, offered at about half price only **£15.** These may be a bit soiled but are fully guaranteed. Similar but 1000 watt for **£29·50.**

Car Starter Charge Kit. New version. We supply two 10 amp rectifiers. 250v transformer and the start charge switch with instructions, price **£9·75.** This is probably one of the most useful pieces of equipment you can have in your garage. Sooner or later you or someone will leave something on and you will have a flat battery. this starter will get you away usually in less than 5 minutes.

Resetter Counter, by Veedroot Company, 230/240V mains operated, intended for surface mounting has a fixing flange at the bottom. Price **£2·16.**

12V Drip proof Relay. Specially designed for going under the bonnet of a car, made by one of our big manufacturers, this really has a removable semi-hard rubber cover. Contacts look suitable for up to 10 amps so this could be the right one. If you are thinking about making an anti-thief device. Price **£1**+8p.

High Speed Uniselector. As many customers know, we have a very comprehensive stock of uniselectors as used in automatic telephone exchanges, light flashing device etc., etc. Just arrived however is a high speed model made by famous Plessey, this is 2 pole 32 way with make before break wipers, overall size approx. 4″ × 3″ × 2½″, price **£3·50** +28p.

Pneumatic Ram for lifting, thrusting, pulling etc., has 2¾″ travel, looks large enough to open doors, lift, staircase, ventilators, etc. Price **£7·00.**

Solder Gun Bargain. The ETP, this is 100 watt solder gun, a very well made tool with lamp to illuminate work has double insulated mains transformer and is built into the shock proof thermoplastic case. Comes complete with spare tips. Mains operated of course. Price **£4·50.**

Interested in Tape Control. American made tape punches, really beautiful units made of sophisticated parts, designed we believe to automatically operate typewriters and they can of course be used to operate other punch tape controlled machines. Reference number is NCR Class 461-2 reference 205 H8 R56. We believe these are 8 bit peper tape punches, powered from 115V 50HZ in very good condition with tape **£16·00,** carriage is £3·20.

Resettable Fuses (thermal trips). Two new types have come in, one made by ETA is a 6 amp model which is mounted through a single hole rather like a volume control. This is suitable for 250 volts AC or 24 volts DC. Price **54p. 4·5 Amp Model** made by AEG is held by two screws thus a bank of these could be mounted between metal straps. Price **54p.**

Disc Motor, mains operated. This is very thin in fact less than ½″ thick and only approx 2″ dia. Spindle revolves at 250 rpm and the spindle which is approx. 1/32″ dia. pushes through so motor could be used to drive clockwise or anti-clockwise. The spindle being a friction fit can be pushed completely out and replaced by your own spindle, a knitting needle for instance. Price only **38p.**

75 rpm Mains Induction Motor with gearbox. This motor is quite powerful and has 1½″ stack and the final 75 rpm drive shaft is 1½″ long by ⅜″ dia. The motor also has a spindle coming from the opposite end to which could be fitted another pulley. Overall size approx. 3″ × 5″ × 2½″ + spindles. Price **£3·35.**

24 Hour Motor, beautifully made by Sangamo. This is 200-240v mains driven motor with gearbox together in one housing, size approx. 1¾″ dia. by 1¾″ deep. If you are contemplating making a 24 hour switch with a lot of on/offs, then this is obviously the motor. Price **£1·89.**

SEMICONDUCTORS POTS & IRONS

SOCKETS

1611	8 pin DIL	£0·11
1612	14 pin DIL	£0·12
1613	16 pin DIL	£0·13
1614	24 pin DIL	£0·25
1615	28 pin DIL	£0·30
1616	TO18 Transistor	£0·12
1617	TU3 Transistor	£0·35
16117	TO5 Transistor	£0·12

VOLTAGE REGULATORS

Positive	
MVR7805 v.a. 7805 TO220	£0·70
MVR7812 v.a. 7812 TO220	£0·70
MVR7815 v.a. 7815 TO220	£0·70
MVR7818	
MVR7824 v.a. 7824 TO220	£0·70
Negative	
MVR7905 v.a. 7905 TO220	£0·80
MVR7912 v.a. 7912 TO220	£0·80
MVR7915 v.a. 7915 TO220	£0·80
MVR7918	
MVR7924 v.a. 7924 TO220	£0·80
v.a. 723C TO99	£0·45
72723 14 pin DN	£0·45
LM309K TO3	£1·50

ZENER DIODES

400mw *(Bzy88) DO7 Glass encapsulated.* Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v.
No. Z4 8p ea.

1w–1·5w *Plastic and metal encapsulated.* Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.
No. Z13 15p ea.

10w *Metal stud type SO10 case.* Range of voltages available, 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.
No. Z10 35p ea.

SILICON RECTIFIERS

200mA	
IS920 50v	£0·06
IS921 100v	£0·07
IS922 150v	£0·08
IS923 200v	£0·09
IS924 300v	£0·10
1 Amp	
IN4001 50v	£0·04½
IN4002 100v	£0·05
IN4003 200v	£0·06
IN4004 400v	£0·07
IN4005 600v	£0·08
IN4006 800v	£0·09
IN4007 1000v	£0·10
1·5 Amp	
IS015 50v	£0·09
IS020 100v	£0·10
IS021 200v	£0·11
IS023 400v	£0·13
IS025 600v	£0·14
IS027 800v	£0·16
IS029 1000v	£0·20
IS031 1200v	£0·25
3 Amp	
IN5400 50v	£0·14
IN5401 100v	£0·15
IN5402 200v	£0·16
IN5404 400v	£0·17
IN5406 600v	£0·21
IN5407 800v	£0·25
IN5408 1000v	£0·30
10 Amp	
IS10/50 50v	£0·19
IS10/100 100v	£0·21
IS10/200 200v	£0·23
IS10/400 400v	£0·35
IS10/600 600v	£0·42
IS10/800 800v	£0·51
IS10/1000 1000v	£0·60
IS10/1200 1200v	£0·69
30 Amp	
IS30/50 50v	£0·56
IS30/100 100v	£0·69
IS30/200 200v	£0·93
IS30/400 400v	£1·25
IS30/600 600v	£1·76
IS30/800 800v	£1·94
IS30/1000 1000v	£2·31
IS30/1200 1200v	£2·88
60 Amp	
IS70/50 50v	£0·75
IS70/100 100v	£0·84
IS70/200 200v	£1·20
IS70/400 400v	£1·75
IS70/600 600v	£2·25
IS70/800 800v	£2·50
IS70/1000 1000v	£3·00
BYX38/300 6A 300v	£0·45
BYX38/600 6A 600v	£0·60
BYX38/300 Rev 6A 300v	£0·45
BYX38/600 Rev 6A 600v	£0·60

POTENTIOMETERS

CARBON POTS (Linear Track)

Single gang with wire end terminations, 6mm × 50mm plastic shaft 10mm bushes supplied with shake proof washer & nut.
Tolerance ± 20% of resistance.

1831 1k ohms	£0·26*	1836 47kohms	£0·26*
1832 2k2ohms	£0·26*	1837 100kohms	£0·26*
1833 4k7ohms	£0·26*	1838 220kohms	£0·26*
1834 10kohms	£0·26*	1839 470kohms	£0·26*
1835 22kohms	£0·26*	1840 1 Meg	£0·26*
1841 2M2	£0·26*		

CARBON POTS (Log Track)

1842 4k7ohms	£0·26*	1846 100kohms	£0·26*
1843 10kohms	£0·26*	1847 220kohms	£0·26*
1844 22kohms	£0·26*	1848 470kohms	£0·26*
1845 47kohms	£0·26*	1849 1 Meg	£0·26*
1850 2M2	£0·26*		

DUAL CARBON POTS (Lin Track)

These high quality dual gang pots are fitted with wire end terminations and 6mm × 50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance ± 20% but matched to within 2db of each other. VC3.

1851 4k7	£0·86*	1855 100kohms	£0·86*
1852 10kohms	£0·86*	1856 220kohms	£0·86*
1853 22kohms	£0·86*	1857 470kohms	£0·86*
1854 100kohms	£0·86*	1858 1 Meg	£0·86*
1859 2M2	£0·86*		

DUAL CARBON POTS (Log Law)

1860 4k7ohms	£0·86*	1884 100kohms	£0·86*
1861 10kohms	£0·86*	1865 220kohms	£0·86*
1862 22kohms	£0·86*	1866 470kohms	£0·86*
1863 47kohms	£0·86	1867 1 Meg	£0·86*
1868 2M2	£0·86*		

SINGLE GANG SWITCHED (Lin Law)

These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1.
Switch rating 1·5amps at 250v AC.

1870 4k7ohms	£0·65*	1874 100kohms	£0·65*
1871 10kohms	£0·65*	1875 220kohms	£0·65*
1872 22kohms	£0·65*	1876 470kohms	£0·65*
1873 47kohms	£0·65*	1877 1 Meg	£0·65*
1878 2M2	£0·65*		

SWITCHED POT (Log Track)

Specification as VC2 but track having (log) law.

1879 4k7ohms	£0·65*	1833 100kohms	£0·65*
1880 10kohms	£0·65*	1884 220kohms	£0·65*
1881 22kohms	£0·65*	1885 47kohms	£0·65*
1882 47kohms	£0·65*	1886 1 Meg	£0·65*
1887 2M2	£0·65*		

DUAL GANG LOG-ANTI-LOG POT

1888 Track specification as dual gang pots VC3 but tracks mounted to log-anti-log action 100kohms **£0·75***

SPECIAL VOLUME CONTROLS

A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance ± 20% 1/8watt rating.
1889 **£0·27*** VC8

MINIATURE ROTARY VOL CONTROL

5kohms log law with on/off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.
1890 **£0·54*** VC9

WIRE WOUND POTS

A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut.
VC6

1891 10ohms	£0·80	1895 220ohms	£0·80
1892 22ohms	£0·80	1896 470ohms	£0·80
1893 47ohms	£0·80	1897 1kohms	£0·80
1894 200ohms	£0·80	1898 2k2ohms	£0·80
1899 4k7ohms	£0·80		

PRE-SET POTS HORIZONTAL MOUNTING

Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screw-driver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2·54mm. All tracks are linear law.
VC7

1801 100ohms	£0·09*	1808 22kohms	£0·09*
1802 220ohms	£0·09*	1809 47kohms	£0·09*
1803 470ohms	£0·09*	1810 100kohms	£0·09*
1804 1kohms	£0·09*	1811 220kohms	£0·09*
1806 2k2ohms	£0·09*	1812 470kohms	£0·09*
1806 4k7ohms	£0·09*	1813 1Mohms	£0·09*
1807 10kohms	£0·09*	1814 2M2ohms	£0·09*
1815 4M7ohms	£0·09*		

PRE-SET POTS VERTICAL MOUNTING

Miniature type for transistor circuits. Wiper adjustment is made by a screwdriver slot. Designed to fit 2·54mm pitch board. All tracks are linear law.
VC7

1816 100ohms	£0·09*	1823 22kohms	£0·09*
1817 220ohms	£0·09*	1824 47kohms	£0·09*
1818 470ohms	£0·09*	1825 100kohms	£0·09*
1819 1kohms	£0·09*	1826 220kohms	£0·09*
1820 2k2ohms	£0·09*	1827 470kohms	£0·09*
1821 4k7ohms	£0·09*	1828 1Megohms	£0·09
1822 10kohms	£0·09*	1829 2M2ohms	£0·09
1830 4M7ohms	£0·09*		

ANTEX IRONS

O/No. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32″ bit. **£3·80**

O/No. 1947. Replacement element for 1943 iron **£1·90**

O/No. 1944. Iron coated bit 3/32″ for 1943 iron. **£0·46**

O/No. 1945. Iron coated bit ⅛″ for 1943 iron. **£0·46**

O/No. 1946. Iron coated bit 3/16″ for 1943 iron. **£0·46**

O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. **£3·60**

O/No. 1952. Replacement element for 1948 iron. **£1·90**

O/No. 1949. Iron coated bit 3/32″ for 1948 iron. **£0·46**

O/No. 1950. Iron coated bit ⅛″ for 1948 iron. **£0·46**

O/No. 1951. Iron coated bit 3/16″ for 1948 iron. **£0·46**

O/No. 1931. Highly popular X25 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5μA and another shaft of stainless steel to ensure strength. **£3·80**

O/No. 1935. Replacement element for 1931 iron. **£1·60**

O/No. 1932. Iron coated bit ⅛″ for 1931 iron. **£0·50**

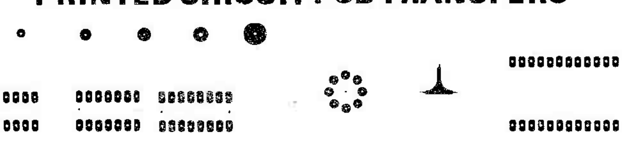
O/No. 1933. Iron coated bit 3/16″ for 1931 iron. **£0·50**

O/No. 1934. Iron coated bit 3/32″ for 1931 iron. **£0·50**

O/No. 1953. SK1 soldering kit—this kit contains 15 watt soldering iron fitted with a 3/16″ bit plus two spare bits, a reel of solder, heat-sink and a booklet 'How to solder'. In presentation display box. **£5·55**

O/No. 1939. ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring, suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. **£1·50**

PRINTED CIRCUIT PCB TRANSFERS



Draw your own boards with the new BI-PAK etch resist transfers. Lay the symbols on the board, rub over with a soft pencil. The transfer will adhere to the board. Then complete the circuit with your BI-PAK etch-resist pen.
Each pack contains 11 sheets of transfers 1 of each as shown above.
Illustrations – approx. ½ size.
O/No. TR400 @ **£1·50** p&p £0·10.

BRIDGE RECTIFIERS

Type	Order No.	Price
SILICON 1 amp		
50V RMS	BR1/50	£0·20
100V RMS	BR1/100	£0·22
200V RMS	BR1/200	£0·25
400V RMS	BR1/400	£0·36
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100V RMS	BR2/100	£0·48
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1505	MIL5251(TIL222)	.5mm (.2)	GREEN	£0·15
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50	THY600/50	£0·22
100	THY600/100	£0·25
200	THY600/200	10·38
400	THY600/400	£0·44
1 amp TO5 Case		
50	THY1A/50	£0·28
100	THY1A/100	£0·28
200	THY1A/200	£0·32
400	THY1A/400	£0·38
600	THY1A/600	£0·45
800	THY1A/800	£0·58
3 amp TO66 Case		
50	THY3A/50	£0·28
100	THY3A/100	£0·30
200	THY3A/200	£0·33
400	THY3A/400	£0·42
600	THY3A/600	£0·50
800	THY3A/800	£0·65
5 Amp TO66 Case		
50	THY5A/50	£0·36
100	THY5A/100	£0·45
200	THY5A/200	£0·50
400	THY5A/400	£0·57
600	THY5A/600	£0·69
800	THY5A/800	£0·81
5 Amp TO220 Case		
400	THY5A/400P	£0·57
800	THY5A/600P	£0·69
800	THY5A/800P	£0·81
7 Amp TO48 Case		
50	THY7A/50	£0·48
100	THY7A/100	£0·51
200	THY7A/200	£0·57
400	THY7A/400	£0·62
600	THY7A/600	£0·78
800	THY7A/800	£0·92
10 Amp TO48 Case		
50	THY10A/50	£0·51
100	THY10A/100	£0·57
200	THY10A/200	£0·62
400	THY10A/400	£0·71
600	THY10A/600	£0·99
800	THY10A/800	£1·22
16 Amp TO48 Case		
50	THY16A/50	£0·54
100	THY16A/100	£0·58
200	THY16A/200	£0·62
400	THY16A/400	£0·77
600	THY16A/600	£0·90
800	THY16A/800	£1·39
30 Amp TO94 Case		
50	THY30A/50	£1·18
100	THY30A/100	£1·43
200	THY30A/200	£1·63
400	THY30A/400	£1·79
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Twin Oval Mains	3133	£0·09
Speaker Cable	3134	£0·07
Low Loss Co-axial Cable	3135	£0·22
15 Way Multi Coloured Ribbon Cable	3136	£0·40

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CB?

THE airing given to the Citizens Band controversy in our April issue certainly did provoke some heart-felt comments from our readers, one or two of them frankly libellous! It does seem surprising that some members of the amateur radio fraternity should express quite so forcefully the view that no-one, but no-one, who has not passed the RAE should have any right whatever to any form of personal radio communication. There must be many people who, like one of our correspondents, are interested in radio but just seem unable to pass the RAE despite repeated attempts. And there are many, many thousands who could make good use of a personal, short-range communication facility.

The choice of frequency band is obviously important. It should preferably be in a presently unused portion of the spectrum, and well away from any bands for which off-the-shelf, high-powered transmitters or amplifiers are available. These requirements both put any portion of the 2 metre band out of court. The use of v.h.f. or u.h.f. is obviously preferable, in order to limit the range achievable, but this brings us back to the question of equipment cost.

Informed sources are quoting £150 as the likely cost of a UK-produced hand-portable set. Just how many would be sold, when there are reputed to be factories in the Far East with output capacities of 25 000–50 000 CB sets per month, and FOB prices for 5 W output, 40-channel car transceivers as low as £25? Without some sort of import quota system for at least a limited period, our communications industry would suffer in the same way that our hi-fi industry already has, and our balance of trade situation be made even worse.

PW PERSONALITY

Keith Woodruff — Assistant Art Editor

After leaving grammar school, Keith began his working life as a junior in the art department of a print company. He next joined Metro-Goldwyn-Mayer Film Studios as a Set Decorator, where he stayed until the studios closed down. Keith then had an unsettled spell drifting from job to job until he joined IPC in 1973.

Having lived in Hoddesdon, Hertfordshire and commuted to London, he finds that the move to Poole has drastically cut his travelling time to work. This gives him more time with his wife and daughter, who find the move to Dorset one of the best things to have happened to them

Keith and his family are members of Poole Camera Club, with Keith and his daughter actively engaged in competitions. His other interest is gardening, growing vegetables, soft fruit and cacti in a greenhouse.

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

Catalogues

Belzer, one of Europe's leading hand tool manufacturers, have been producing high-quality tools in their West German works for almost 100 years. A selection of some 200 precision electronic tools is now available from Toolrange Ltd.

Belzer are certainly not cheap but meet the highest standards of quality and finish. The range includes, special pliers with spring-loaded handles, cutters, screwdrivers, tweezers, adjustable tools and complete tool kits.

To receive a free 32 page catalogue and price list, apply to: *Toolrange Ltd., Upton Road, Reading RG3 4JA. Tel: (0734) 29446 or 22245.*

Watford Electronics' latest catalogue contains 92 pages, packed with the most useful information for the electronics constructor. Watford also supply kits for many *PW* projects, including the *Purbeck Oscilloscope* (for details see Watford's advertisement).

The catalogue costs 50p plus 25p p&p, available from: *Watford Electronics, 33/35 Cardiff Road, Watford, Herts WD1 8ED. Tel: (0923) 40588/9.*

Marshall's latest catalogue has been expanded from 40 to 48 pages and includes many new items, such as, oscilloscopes, KIM and PET microcomputers, extended capacitor and switch ranges, more tools and a new digital multimeter.

A new feature of the catalogue is the limited line section covering obsolete items. The catalogue is available at 50p post paid or 40p to callers at their branches. *A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London NW6 4TA. Tel: 01-624 0805.*

Astra, the electronic component mail order company, inform us their latest catalogue is now available. Among the many items featured are crystals, i.c.s, resistors, capacitors and electronics books. The free catalogue is available if you send a sae to; *Astra-Pak, 92 Godstone Road, Whyteleafe, Surrey CR3 0EB.*

Teach-in

The University of Salford is again running a one-week course in July 1979 on Electronic Applications for Teachers. The aim of the course is to provide teachers who have some basic knowledge of semiconductor electronics with the opportunity to study the subject in greater depth. The material covered will be adequate for the option of the JMB 'A' level physics syllabus, or other syllabi of comparable standard. The course will be devoted primarily to the study of operational amplifier and integrated logic circuit applications, approximately half the time being spent on experimental work.

The course organiser is Dr E. A. Flinn, of the University's Department of Electrical Engineering. For further details contact: *The Administrative Assistant (Short Courses), Room 110, Registrar's Department, University of Salford, Salford M5 4WT. Tel: 061-736 5843, extension 449.*

Mobile Rallies

Otley Radio and Electronics Society (G8JTD, G3XNO) are holding "The Northern Mobile Rally 1979," at The Victoria Park Hall, Keighley on Sunday 20 May, between 11.30am and 5.30pm. There will be talk-in stations on S22 and SU8 also trade stands, films for the children, refreshments, bar and many other attractions. Further details from: *Jack E. Annakin G8DFZ, 25 Ashfield Place, Otley, West Yorkshire LS21 3JN.*

Maidstone YMCA Amateur Radio Society (G3TRF, G3YSC) Mobile Rally is to be held at the Y Sports centre, Melrose Close, Maidstone, Kent, on Sunday 27 May, 1979, commencing at 11.00am. In addition to talk-in stations using the callsign GB2YSC on 1925kHz s.s.b., 144·270MHz s.s.b., and S22 f.m., there will be bring-and-buy stalls (10% to club funds), covered trade accommodation, on-site parking, snack bar and special attractions for all the family. Further details from: *John Parker, 42 Mote Road, Maidstone, Kent. Tel: (0622) 50350.*

Getting started

A new careers publication has been issued by the Institution of Electrical and Electronic Technician Engineers (IEETE) entitled: *"Engineering a Career in the electrical and electronics industry".*

The booklet avoids excessive detail, concentrating rather on giving a general picture of the profession of electrical and electronic engineering, and the qualifications required to become a Technician Engineer, a Technician or a Chartered Engineer. The publication should be useful not only to young people considering their career, but also to those engaged in offering careers advice and guidance.

Copies are available on request from: *The Secretary, IEETE, 2 Savoy Hill, London WC2R 0BS.*

The Department of Industry has also produced a full-colour brochure entitled: *"Microelectronics—the new technology",* which should help the non-specialist to understand the basic principles of the new "silicon-chip technology". Copies of the brochure are available from: *The Electronics Applications Division, Dean Bradley House, 52 Horseferry Road, London SW1.*

Look you here

Barry College of Further Education Radio Society are holding their annual Welsh Amateur Radio, TV, Electronics and Computer Exhibition at the Barry Memorial Hall, Hoton Road, Barry, S. Glamorgan, on Sunday, 20 May, 1979, commencing at 11.00am. There will be all the usual attractions including a licensed bar. Further information from: *Reg Rowles GW4FOM, 4 Cowbridge Road West, Ely, Cardiff CF5 5BR. Tel: (0222) 565656.*

Here we are again!

Once more it's time for the RSGB Amateur Radio Exhibition, at Alexandra Palace. The two-day exhibition will be open between 10.00am and 7.30pm on Friday, 11 May, and 10.00am and 6.00pm on Saturday, 12 May, 1979.

The RSGB will occupy their largest-ever stand at the exhibition with staff and members there to answer your questions and run a talk-in station GB2AP on S22 and SU8, also listening-watch on 144·28MHz s.s.b.

Among the many features of the exhibition are stands from other amateur organisations, including RAYNET, trade exhibitors, films for the newcomer, a full range of catering amenities and a larger supply of real ale than last year at the licensed bar.

Admission will be 60p (RSGB members 50p), children under 12yrs free. Facilities for the disabled are available, plus free parking for up to 2,000 cars.

Technical staff from *Practical Wireless* will be attending the exhibition on stand N10, and look forward to meeting as many as possible of our readers.

PASSIVE 10:1 DIVIDER PROBE

FOR THE PW PURBECK

I. HICKMAN

Most readers will know that when using a multimeter to measure the voltages at various points in a circuit, account must be taken of the usually small, but none-the-less finite, current drawn by the meter. This additional circuit loading can actually change the voltage at the point of measurement by a significant amount if the source resistance is high.

Fig. 1a shows the case where the emitter and base voltages of a small signal amplifier stage are measured separately. The figures in square boxes are the voltages as measured by a 1kΩ per volt meter on the 10V range, whilst the figures without boxes are the actual voltages when the meter is not connected. The emitter voltage changes by a negligible amount, as the transistor acts as an emitter follower, i.e. a low source resistance. However, the source resistance of the base circuit is 16·6kΩ (22kΩ and 68kΩ in parallel), which is not negligibly low compared to the 10kΩ resistance of a 1kΩ per volt meter on the 10V range.

The erroneous conclusion one might draw if no allowance were made for the meter loading effect is that the transistor is cut off! The figures in round boxes are the voltages as measured on the 10V range of 120kΩ per volt meter and, as can be seen, the error due to meter loading is small. For this reason, multimeters specifically meant for electronic work (as distinct from general electrical work) have a sensitivity of at least 10kΩ per volt, commonly 20kΩ per volt and not infrequently 30kΩ per volt or even higher.

Waveforms

Exactly the same problem of the measuring instrument loading the circuit and actually changing the very voltage that one is trying to measure, can arise when using an oscilloscope.

It should be obvious that with an input resistance of 1MΩ, the oscilloscope loads the circuit under test less than a 20kΩ per volt mulitmeter (for voltage ranges up to 50 V full scale deflection).

However, the oscilloscope is specifically used for examining voltage waveforms, i.e. voltages which are changing. Therefore, we also have to consider the input capacitance of the oscilloscope and this amounts to a few tens of picofarads (pF).

Whilst this would generally cause no problems at audio frequencies, the *PW* Purbeck might be typically used to examine, say, a 1MHz square-wave. An ideal square-wave contains harmonics extending up to an infinitely high

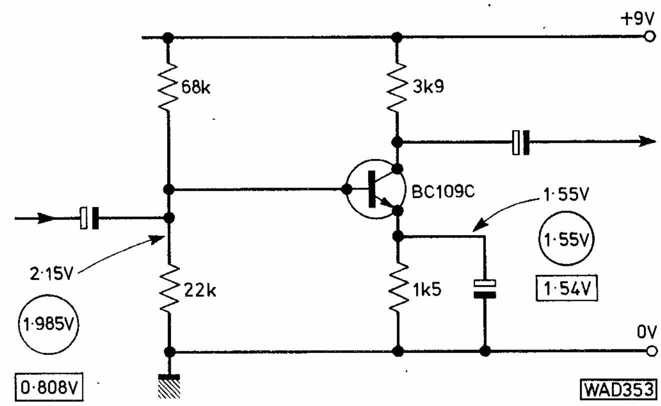
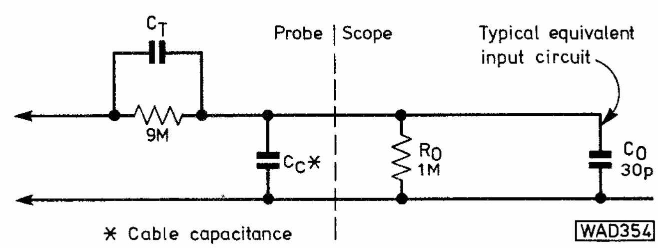


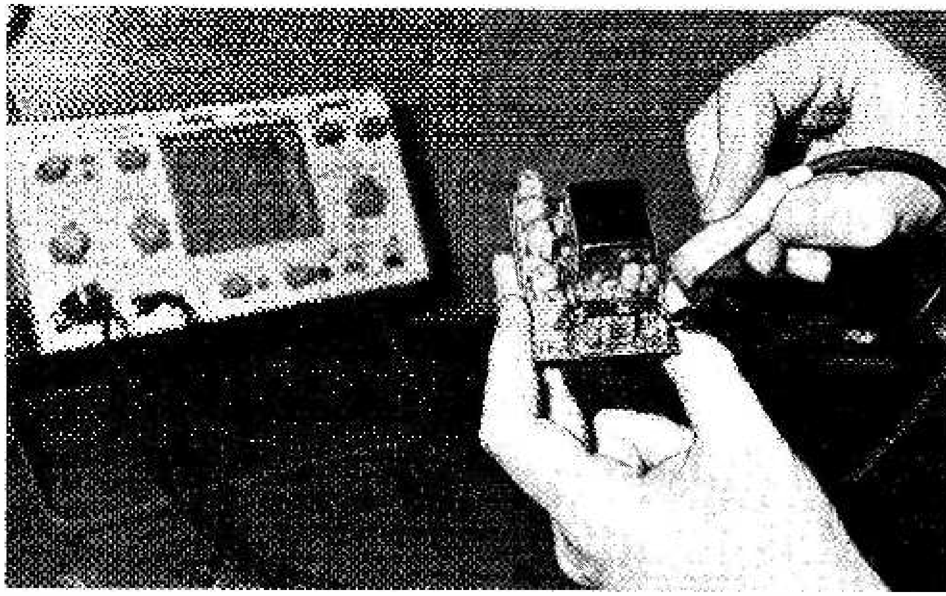
Fig. 1: (a) above, shows the effect of 20kΩ/V and 1kΩ/V meters on voltages measured. (b) below, is the circuit of a 10 : 1 probe to reduce circuit loading



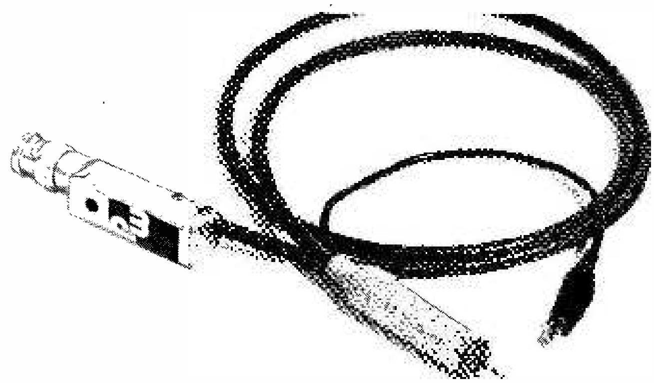
frequency and even a "practical" 1MHz square-wave will involve frequencies greater than 10MHz. Now 30pF (and the input capacitance of the *PW* Purbeck oscilloscope is of this order) has a reactance of only 500Ω at 10MHz and could thus considerably affect the waveform unless the source impedance were under 50Ω! In fact, matters are a good deal worse than this, as we have not allowed for the capacitance to ground of a lead from the test point to the oscilloscope—trying to connect the circuit under test directly to the input connector of the oscilloscope with negligible lead lengths is always tedious and often impossible. Experience dictates that for general-purpose use, a lead of two to three feet is needed, screened to avoid hum pick up when working on high impedance circuits. Even choosing a low capacitance screened lead such as 75Ω coaxial cable, we have about 20pF per foot, so that $2\frac{1}{2}$ feet of cable plus the input capacitance of the oscilloscope leaves us with a total of around 100pF. The purpose of a 10:1 divider probe is to reduce the effective input capacitance of the 'scope plus connecting lead to nearer 10pF.

★ components

[illegible] 9M [illegible] 1% ([illegible]ord)
CT 12pF ceramic 500V
CA 2–22pF trimmer (Mullard)
1 metre 75Ω "Uniradio 70" coaxial cable
50Ω BNC plug with hexagonal screw type cable clamp
Tinplate, Araldite, etc. as required



The 10:1 passive divider probe is a useful addition to the *PW* Purbeck oscilloscope. On the right it is seen being used with a Scopex 4D10 scope while the picture below shows the completed probe



Theory of Operation

Fig. 2a shows the circuit diagram of the traditional type of oscilloscope probe. The capacitance of the screened lead plus the input capacitance of the oscilloscope form one section of a capacitive potential divider. The trimmer C_T forms the other and it can be set so that the attenuation of this capacitive divider is 10:1 in volts, which is the same attenuation as provided by R_A (9MΩ) and the 1MΩ input resistance of the oscilloscope. When this condition is fulfilled, the attenuation is independent of frequency (Fig. 3a). Assuming C_E the cable plus 'scope input capacitance ($C_E = C_C + C_O$) totals 100pF, C_T should at any frequency have a reactance nine times that of C_E, i.e. will equal $\frac{1}{9}$ of C_E. If C_T is too small, high frequencies (e.g. the edges of a square-wave) will be attenuated by more than 10:1, whereas the attenuation of the steady level will still be 10:1 resulting in the waveform of Fig. 3b. Conversely if C_T is too large, the result is as in Fig. 3c. All of the above has assumed that C_E is constant and this will only be so if the input capacitance of the 'scope is the same on all ranges. This is the purpose of capacitors C3–6 in Fig. 2, p. 29 of the June 1978 issue of *PW* as they allow the input capacitance of positions 2–5 of S3B (Input Range) on the *PW* Purbeck to be set to the same value as on position 1.

The rounding or pip on the edges of a square-wave will be difficult to see on a very low frequency signal, as with the slow time-base speed needed, the square-wave will appear to settle very rapidly to the positive and negative levels. Conversely, at very high frequencies, the displayed square-wave amplitude will be affected by the capacitive divider only. The time constant CR of the oscilloscope input is 30pF × 1MΩ or 30 microseconds. Therefore, waveforms as in Fig. 3 will be seen with a square-wave input of around 1kHz.

At very high frequencies, where the length of the probe cable is an appreciable fraction of a wavelength, reflections will occur, as the cable is not terminated in its characteristic impedance of 75Ω. For this reason, commercial oscilloscope probes often incorporate a resistor of a few tens of ohms in series with the inner of the cable at one or both ends, or use a special cable with an inner made of resistance wire. Such probes are suitable for oscilloscopes with a bandwidth of 100MHz or more, but in the case of the *PW* Purbeck, a resistor is already incorporated in the input circuit of the oscilloscope, so that further resistors in the probe are unnecessary.

Fig. 2a shows C_T as a variable capacitor. However, this is mounted at the business end of the probe, where it is not very convenient to accommodate a trimmer. Therefore, a fixed capacitor is used for C_T, permitting a neat, compact design for the probe head. Adjustment is carried out by means of a trimmer mounted in a small box at the oscilloscope end of the probe. Inevitably, this means that C_E (and hence the capacitive loading of a circuit under test) is higher than with the scheme of Fig. 2a, but only slightly, and is well worth the extra convenience. With the

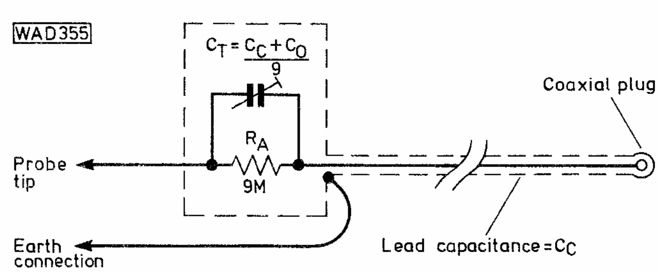
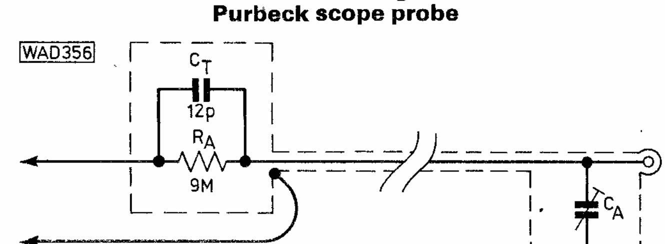


Fig. 2: (a) above shows the traditional 10:1 divider probe and (b) below the design used for the *PW* Purbeck scope probe



chosen design of Fig. 2b in use, C_A is adjusted so that $C_T = \frac{1}{9}(C_C + C_A + C_O)$, by the simple procedure of setting it to reproduce a test square-wave as in Fig. 3a rather than *b* or *c*.

Construction

This calls for the employment of a little ingenuity in the use of materials such as Araldite, tinplate (from the proverbial cocoa tin or similar), insulating tape, etc. and of tools such as tin-snips, snipe nosed pliers and the like. If you are adept at this sort of thing, construction is really straightforward and sketches of the necessary bits and pieces are given in Fig. 4.

The housing of C_A is fabricated in two parts, the body being soldered to the rear of a BNC plug and the cover fitted later when construction and testing are complete. The BNC plug used by the author had a cable clamping sleeve with hexagonal flats and the body of the C_A housing was shaped and soldered to this.

The method of fixing the 75Ω coaxial cable is crude but effective, the Araldite being essential to support the cable firmly. Araldite is also used, again as a strain-relief, at the cable entry into the probe head. The body of this is also made from tinplate and can usefully be as small as R_A and C_T will allow, bearing in mind that these should be firmly mounted and reliably insulated. The author used a long 8BA brass bolt as the probe tip. After assembly, the shank was filed smooth, the tip sharpened and then flatted and nicked as shown in Fig. 4. This enables it to be hooked on to wires, transistor or diode leads, etc. when checking through a circuit and is a very useful feature as it leaves the hands free.

The reliability of the earth wire is most important. Many commercial probes, even of the best known makes, give continual trouble due to the earth lead going open circuit. Ordinary stranded wire will not stand up to the continual flexing, so the author used black plastic covered extra-flexible wire as sold for multimeter leads and this has proved very successful. The free end is terminated in a miniature croc-clip, preferably the sort with an insulating plastic boot. It must be stressed that the 75Ω coaxial cable must have a stranded inner conductor, e.g. "Uniradio 70". Cable with a solid inner is too stiff to be convenient in use and with the flexing to which it will be subjected, the inner will certainly go open-circuit eventually.

Note that as the probe attenuates the waveform to the oscilloscope by a factor of 10, nine-tenths of the voltage applied to the probe will appear across R_A and C_T. The latter should therefore have a voltage rating adequate to cope with the highest voltage the probe may experience, say 500V working or better still, 1000V.

Setting Up The Probe

This requires a square-wave generator with an output which can be set to around 100mV peak-to-peak at a frequency of 1kHz or thereabouts. If it has accurately known output levels it can also be used for checking the oscilloscope's "Y" gain settings and the Oscilloscope Calibrator published in the January 1977 issue of *PW* is quite suitable. Alternatively, the design shown in Fig. 5 can be used. This calibrator is powered from the front panel accessory socket of the *PW* Purbeck oscilloscope itself.

Whichever source is used, connect the probe to the oscilloscope with the "Y" gain at 10mV × 0·5 and a sweep speed of 500µs per division. Apply a square-wave source and adjust "Trig Level" for a locked picture. The

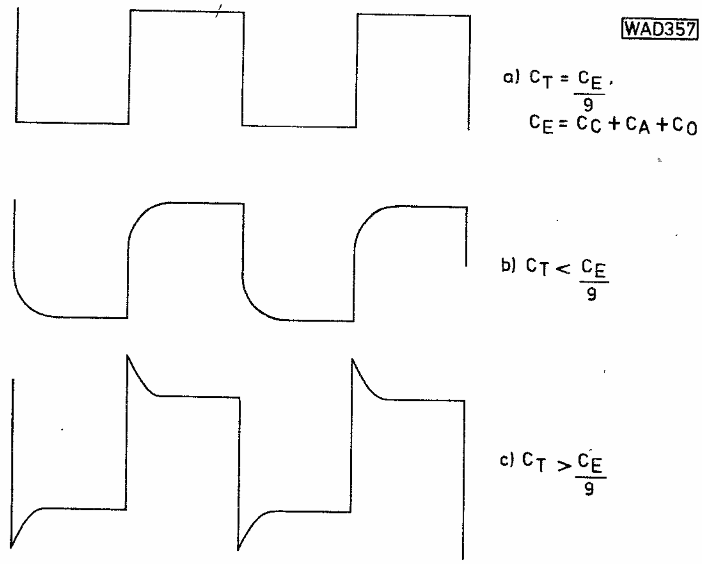


Fig. 3: The effects of misadjustment of C_T

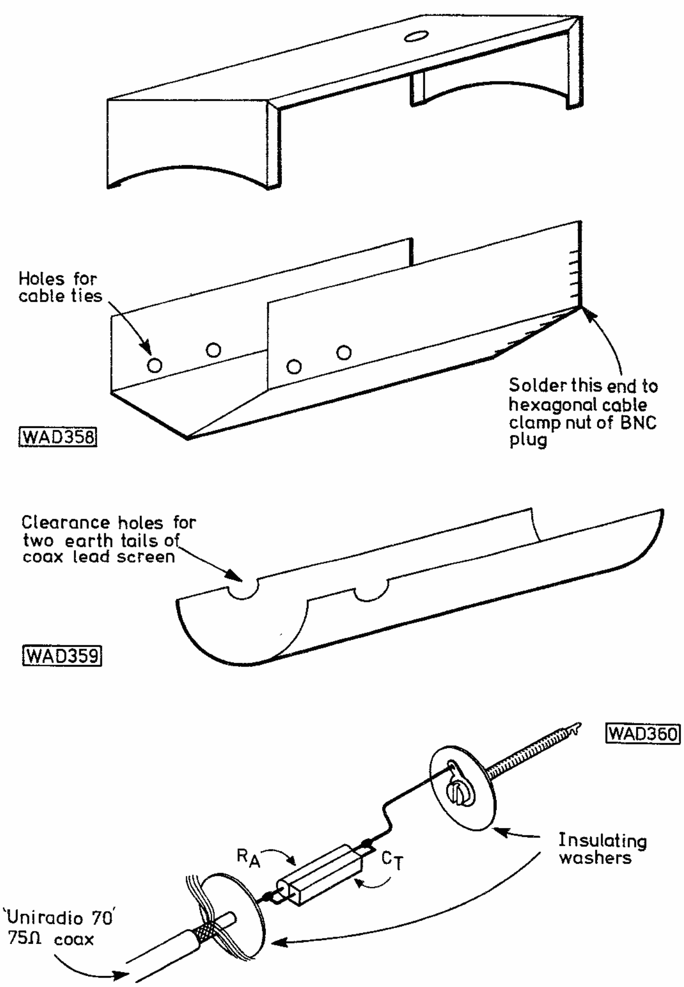
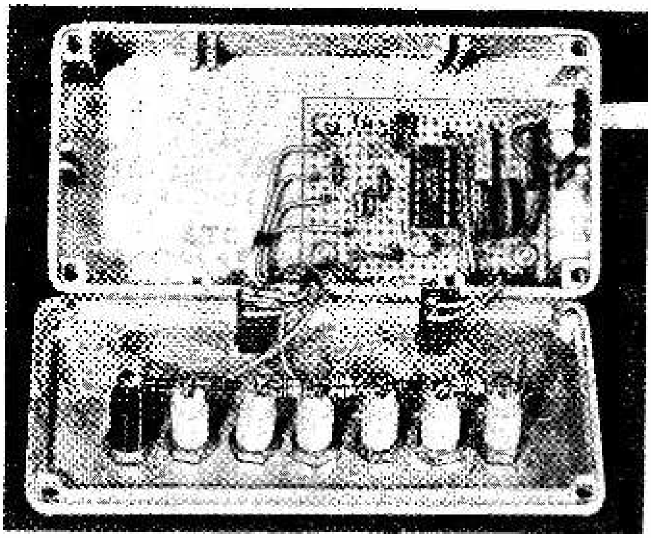


Fig. 4: The component parts of the probe housings. (Top) the housing for C_A (Centre) the half shell for the probe head, two of these are needed. (Bottom) the details of the probe head wiring

Notes. C_A mounted in housing at BNC plug end. R_A and C_T are insulated and fitted between shells which are then soldered along their seams. The screen tails are soldered to the outside of the shells. Araldite is added at both ends, the insulating washers preventing ingress. The coaxial cable is secured to the C_A housing by soldering the screen tails, wire ties through the four holes provided and also by Araldite. The inner connects to C_A at probe head and BNC plug inner at the other end



The square wave generator shown in Fig. 5 as built by the author. It is powered from the front panel auxiliary socket of the *PW* Purbeck scope

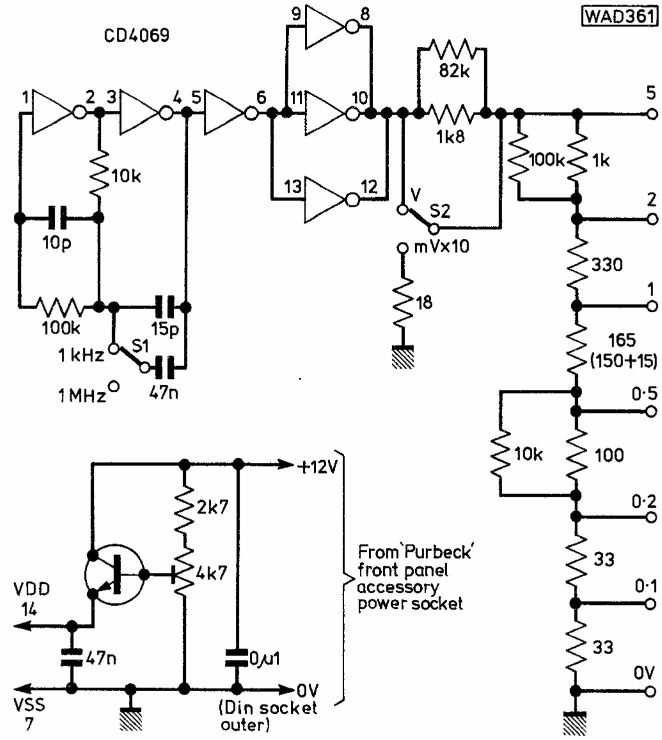


Fig. 5: The square-wave generator. With pins 1 and 14 of the CD4069 shorted and S2 set to V, adjust RV1 (4·7kΩ) for 5V output at socket 5

trace will most likely look like either *b* or *c* of Fig. 3 and the 2–22pF trimmer C_A should be adjusted to achieve the result shown in *a*. If, with C_A set to minimum capacitance, the trace still looks like *b*, the cable capacitance is too high and the length should be reduced. Conversely, if even with C_A set to maximum the trace still looks like *c*, a longer length of cable should be used or a small capacitor connected in parallel with C_A. With $2\frac{1}{2}$ feet of 75Ω "Uniradio 70" cable (about 20pF per foot) C_A should provide ample range, but to avoid disappointment it is best to try setting up the probe as above before finally making off the cable ends and Aralditing.

Note that whilst the 'scope's internal 50Hz Cal. square-wave is useful for checking time-base speeds on the lower ranges, its frequency is too low and its waveform not sufficiently square for the present purpose. Having calibrated the probe on the 10mV setting of the "Input Attenuator" S3, it can now be used to set the input trimmers on the other settings. If you recall, this job was left over in the last instalment of the *PW* Purbeck series, precisely because their purpose is to maintain a constant input capacitance as is necessary when a probe is used.

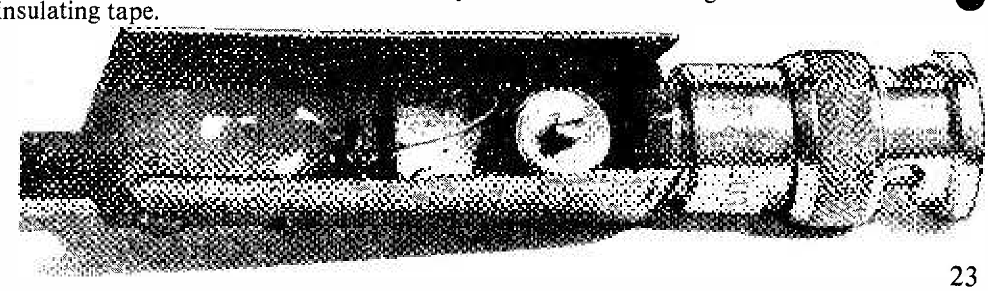
So, set "Input Attenuator" to 100mV/division and increase the square-wave amplitude to 1V peak-to-peak. Without touching C_A, set C3 (located on S3 behind the oscilloscope front panel) to obtain a trace as in Fig. 3a. Likewise, with a 5V peak-to-peak square-wave, C4 can be set up at position 3 of S3 and with the gain multiplier S301 set to "Var" and the variable gain control VR302 set for maximum gain, it will be possible to set up C5 at position 4 of S3. C6 can simply be left at midsetting as it is unlikely that a 10:1 divider probe would be used on the 100V/division setting. When calibration is complete, the cover of the C_A housing should be fitted and soldered into place. To finish off the probe body an insulating covering should be applied. A heat-shrink sleeve such as the author used is ideal, but in the absence of this a fairly neat finish can be achieved using white pvc insulating tape.

Using The Probe

The first thing you will notice when using the probe is, of course, that the oscilloscope's effective sensitivity is reduced by a factor of ten. This is why a high sensitivity in the basic oscilloscope (like the *PW* Purbeck's 5mV/cm, nearer 2mV/cm on "Var") is so desirable. The pay-off is the reduced circuit loading and you will find that in practice there are very few cases where this has to be taken into account. The most common example is the voltage across a tuned circuit. If the probe is used to measure this, there are two effects to watch for. Firstly, the capacitance of the probe will change the tuned frequency. So, if the tuned circuit is the tank coil of an oscillator, the output frequency will change, whereas if it is, for example, in an i.f. stage, the amplitude will fall, as the circuit is no longer tuned to the i.f. frequency. Secondly, the a.c. loss resistance of the probe plus 'scope (which is lower than the d.c. value of 10MΩ) will damp the tuned circuit, again causing a reduction of the observed amplitude and may even cause a lightly-coupled oscillator to stop oscillating altogether.

The technique, therefore, when examining waveforms in a tuned circuit is to restrict the probe to a low impedance tap on the coil or in the case of a Clapp or Colpitts oscillator, to connecting across the largest of the series capacitors. If all else fails, connect a 1pF capacitor in series with the probe tip (giving you a crude × 100 probe) or simply hold the probe tip near to the hot end of the coil! In virtually all cases other than tuned circuits, the probe will entirely obviate circuit loading effects. ●

Close-up view of the housing for C_A showing how the trimmer capacitor is fitted and the cable secured



student radio

C. ARUNDEL

Interesting experiments in community broadcasting are currently being conducted in three English new towns: Telford, Basildon and at Newton Aycliffe in County Durham. Further closed-circuit local broadcasting has been introduced to suburban housing developments in Greater London.

Stations operating in the medium frequency band and based at seventeen universities and colleges in the United Kingdom have broadcast successfully for several years. Indeed the oldest of these, University Radio York, recently celebrated the tenth anniversary of its first broadcast, so this would seem an appropriate time to take a look at this form of radio.

Origins

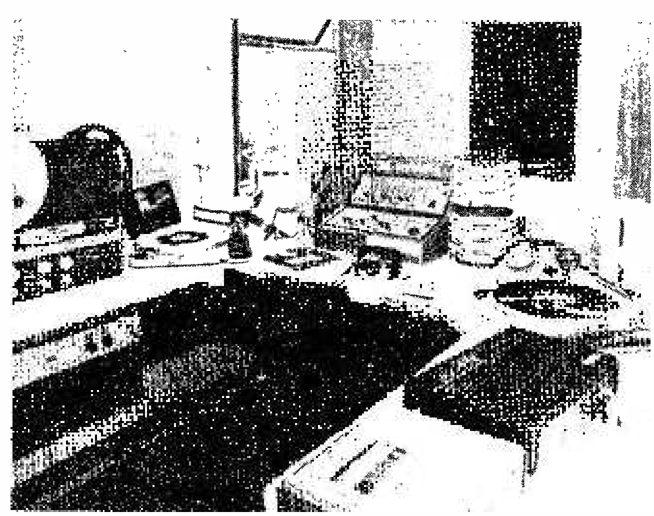
It is often surprising how widely the effects of a simple new idea are felt, and the growth of campus radio certainly seems to fall into this pattern. It has its origins in the plan of a single student, who saw the potential value of this kind of facility as a forum for information and ideas within a university community. So it was that in 1967 the administration of York University was approached in order that the response to a scheme to operate a radio station might be gauged. It is worth pointing out at this juncture that a closed-circuit TV system had operated successfully since the University's inception several years earlier. There was therefore a generally favourable response to the idea, and representations were consequently made to the Post Office asking that the project should be allowed to proceed.

Lecturers currently at York remember the problems encountered in persuading the authorities of the feasibility of the project to create the first licensed radio station in England independent of the BBC. The fact that experimental local radio organised by that body was also planned at the time, may have been influential in their decision to provide a licence. University Radio York was eventually allocated the medium wave channel 998kHz 301 metres, on the understanding that the signal should be audible only at the University site. The experience gained at York was to prove useful at the University of Kent, where plans for a similar project were in preparation.

Transmitting Installation

In order to restrict the signal to the campus as required, a system of aerials known as induction loops are in use at URY and the stations which have followed. Indeed, this is the only feature of the transmission systems of campus radio to differ from local radio generally.

The signal from the transmitter is transported to each part of the campus via runs of coaxial cable terminated in a r.f. transformer. The secondary winding of this transformer is connected in parallel with a single loop aerial, composed of approximately 25 metres of insulated wire wound in a coil upon a frame and connected to a variable capacitor, so forming a parallel tuned circuit, subsequently brought to resonance at the operating frequency. (Medium wave DXers will recognise this as a further application of the popular DX reception aerial).



The on-air studio at University Radio York, showing Sony mixer and cassette decks, Thorens TD125 transcription turntables and Revox B77 tape deck

Each loop provides a high field strength of transmitted signal at short range, but signal strength is very low at distances of only a few tens of metres from the aerial, minimising the risk of off-campus radiation. The loops are then installed on the roofs of groups of buildings to be supplied with programmes.

Developments

At URY, 30 April 1969 marked the end of a period of experimentation with the first official broadcast, a programme recorded for the occasion by BBC presenter John Peel.

The development of URY has proved to be characteristic of many of the campus stations, the initial capital outlay being donated by the University or college student union, and annual grants being provided thereafter to meet running costs, though some stations have found supplementary sources of income. University Radio Bath, for example, have shown some enterprise in running their own disco which appears four nights or so every week at venues in the town. The stations are not permitted to carry advertising.

As more stations came on-air it became clear that a co-ordinating organisation was required to negotiate with the licensing body and performing rights organisations, and to act as an information exchange between stations. Consequently the National Association of Student Broadcasters was formed, and each year its annual conference is hosted by one of the member stations.

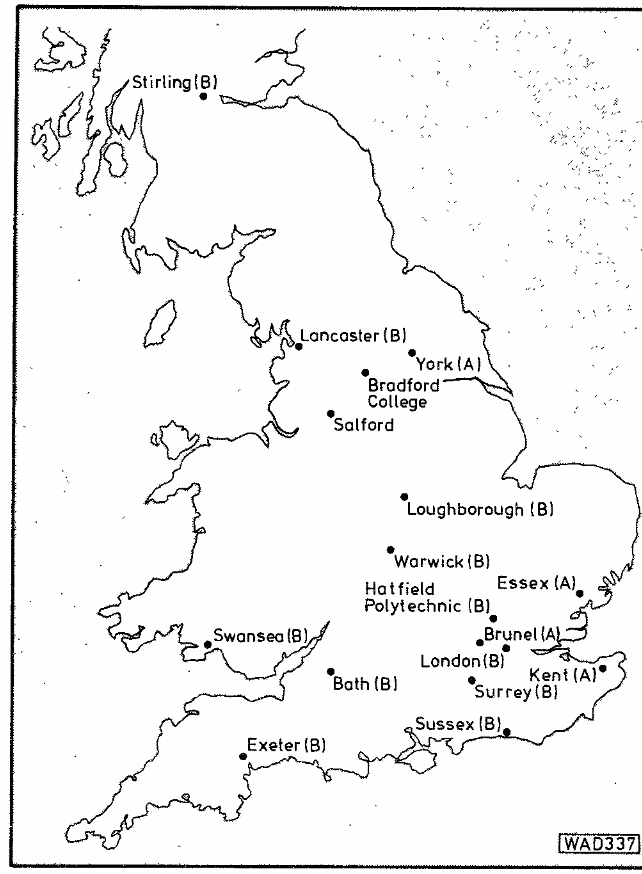
Programmes

The programme formats adopted contain music, news, "what's on" information and features; and generally, record companies are very generous in supplying a good selection of their latest material. Singles and album charts are run in conjunction with local record shops and playlists are used at many universities to ensure the music heard has a wide appeal.

Typically, a fast-moving breakfast show is broadcast daily, plus a teatime magazine programme of local news and interviews, request shows and a variety of other material until the early hours. Minority interest features are also to be heard; thus the output of UKC Radio at Kent University includes arts reviews, plays, short stories, classical music and current affairs during the 80 or so hours of their broadcasting week. Apart from programmes presented during the course of a normal week, there is often news of particular local interest, and it is on these occasions that the benefits of campus radio become clear.

Stress is placed upon putting people on the air as soon as they feel confident in the use of studio equipment. The duration of courses being as they are, roughly one-third of the personnel depart each year and the gap which they leave must be filled as soon as possible. The policy is also consistent with the concept of ease of access and a belief that the most effective way to produce competent presenters is to give them plenty of practice.

Surveys carried out by the stations have shown a demand for regular news summaries and there has therefore been a tendency to relay the hourly bulletins of Independent Radio News, by arrangement, from the v.h.f. transmissions of commercial radio. Others have formed links with the BBC; Radio Bradford college produces a weekly programme of interest to students in West Yorkshire, which is broadcast by BBC Radio Leeds, and a link has also developed between the Kent University station and BBC local radio.



Campus stations in operation at June 1978. Stations given the suffix (A) use 999kHz, 300 metres. Those given the suffix (B) use 963kHz, 312 metres. These are the post-November 1978 channels

The Future

As for the future, it seems likely that campus radio will be brought within the auspices of the IBA. What the effects of this interaction will be remain to be seen, however several stations have pointed out that if the IBA was to assume responsibility for maintenance of transmitters, as is done at present with local commerical radio, it would be possible to devote more time to the basic process of programme production.

Whatever the future holds, the fact that University radio stations not only survive on relatively small budgets but that their number increase annually suggests that small community radio stations could succeed in a wide range of other environments. It is to be hoped that the next ten years of student radio prove as interesting as the last.

LOGICAL NOUGHTS & CROSSES

J.D. MITCHELL PART 1

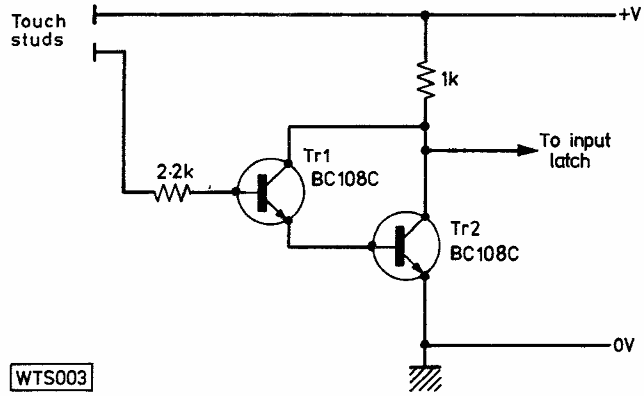


Fig. 6: The touch-switch input circuit, note this circuit is repeated nine times on the p.c.b.

Mounting the l.e.d.s

The display l.e.d.s are mounted on PCB 3 and pushed up through holes drilled in the case lid. The board is held to the lid by the 6BA bolts used as input switching studs.

The touch-switching input components are mounted on PCB 4, which is held on edge at the switch end of the case behind the corner pillars.

The power supply used in the prototype comprises of a battery-holder containing four HP11 or type C cells held two by two, and a silicon diode. The diode reduces the positive rail from 6V to protect the input latches from damage. Alternatively, any supply giving 5V at 500mA d.c. may be built in if a larger case is used.

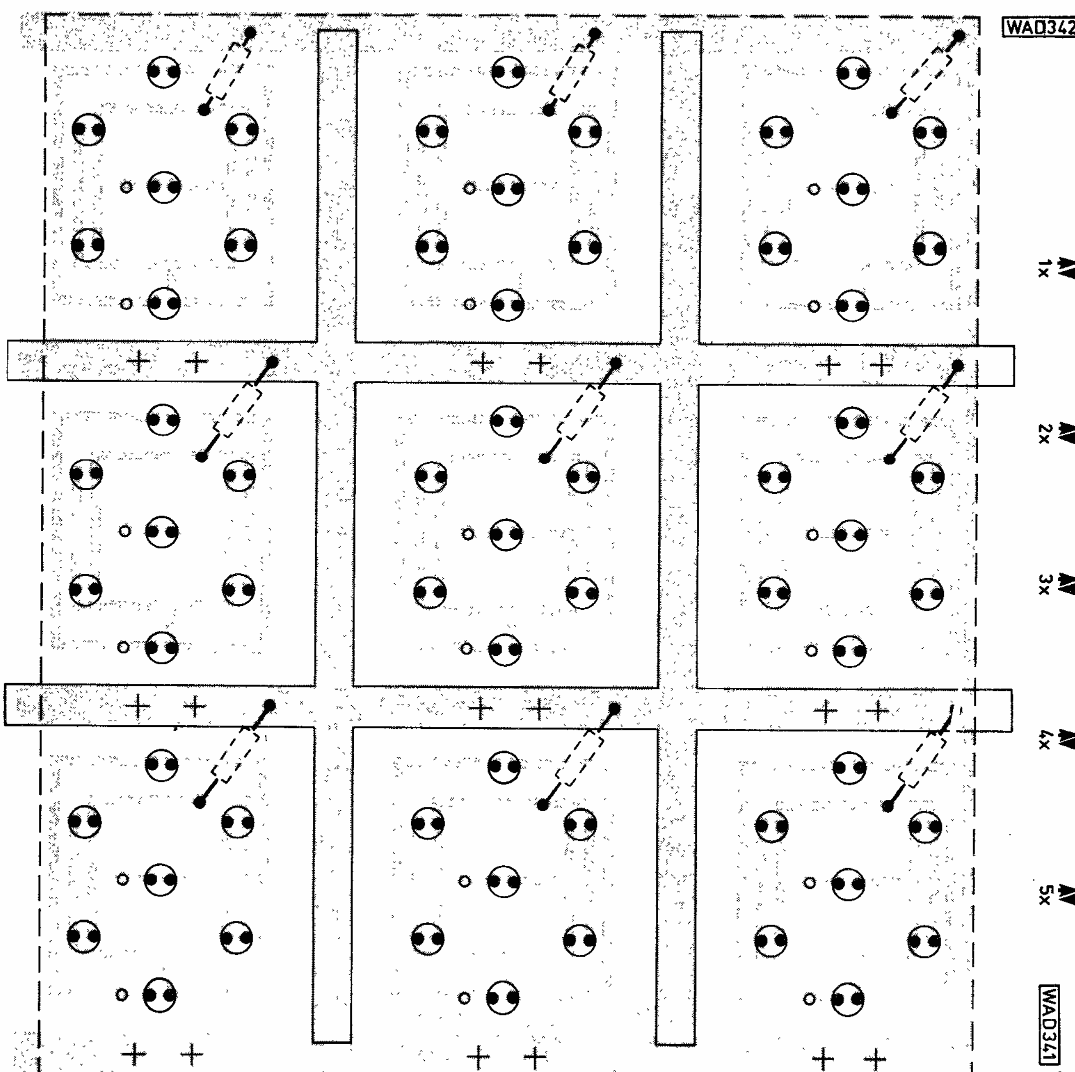


Fig. 5: Component placement layout for PCB3

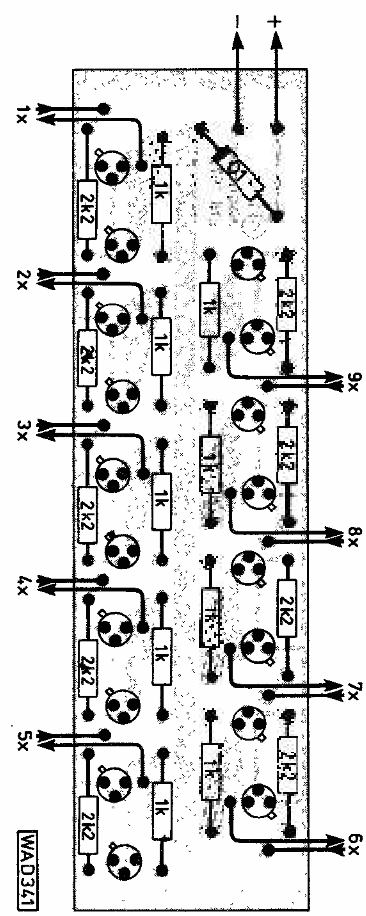


Fig. 7: Component placement layout for PCB4

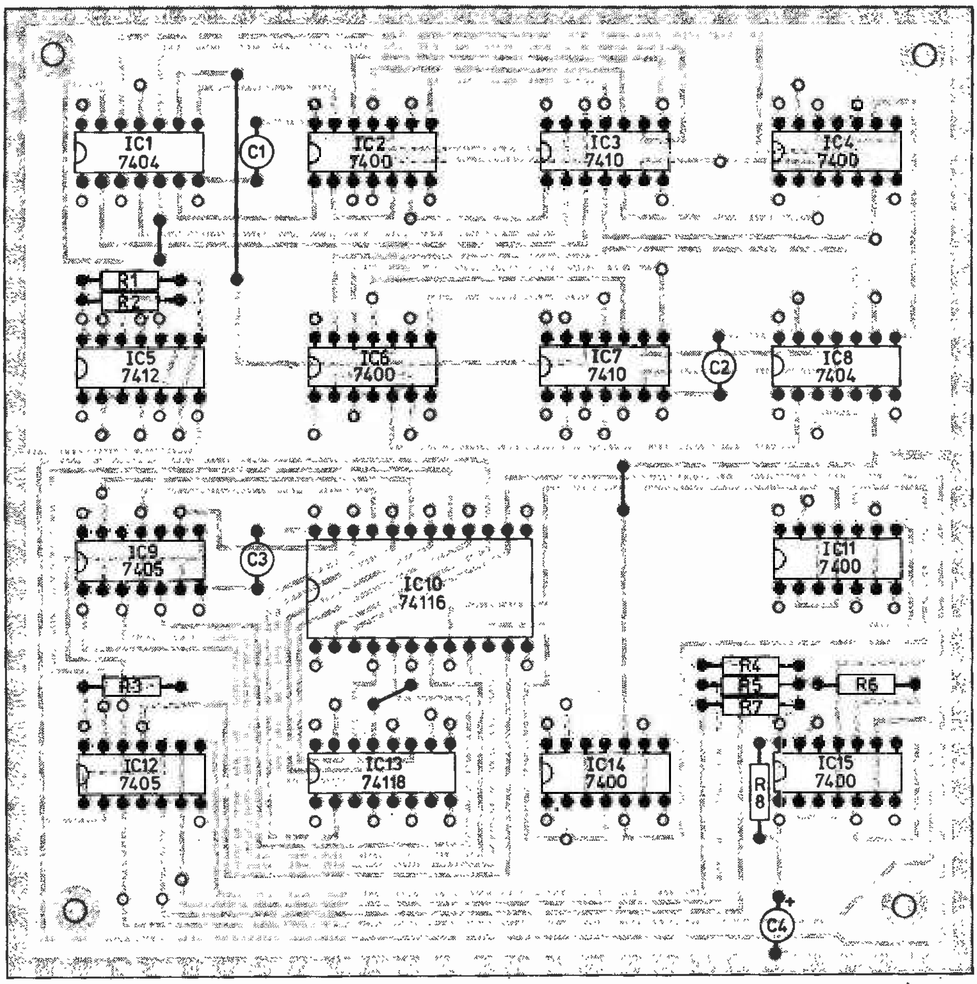


Fig. 8: Component placement layout for PCB1

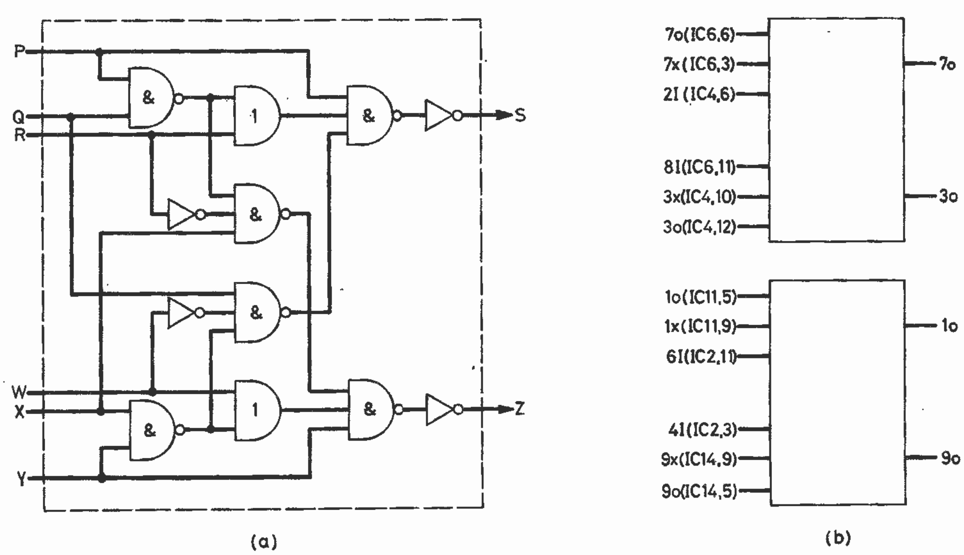
WAD344

Making the display

Display Board 3 is best constructed by inserting the l.e.d.s and initially soldering one leg only. The dropping resistors are mounted on the copper side either on pins pushed down through the board and cropped on the l.e.d. side, or by blob-soldering. Their leads should be sleeved. All connections from Board 1 are similarly made on the underside. The touch-switch screws may then be inserted in the lid and held temporarily with strips of Sellotape. Invert the lid and drop a washer over each screw as spacers. Board 3 may then be fitted, and bolted in place.

Board 4 is mounted with the component side facing into the case. The leads from Boards 1 and 3 may be soldered in with the board close to the end of the case, and then lifted back as the board is placed in the case.

It is very helpful in construction if leads between boards are colour-coded.



Truth table							
P	Q	R	W	X	Y	S	Z
1	1	1	1	1	1	1	1
1	1	1	1	1	0	1	0
1	1	1	1	0	1	1	1
1	1	1	0	1	1	1	0
1	1	1	0	1	0	0	0
1	1	1	0	0	1	0	1
1	1	0	1	1	1	0	1
1	1	0	1	1	0	0	0
1	1	0	1	0	1	0	1
1	0	1	1	1	1	1	1
1	0	1	1	1	0	1	0
1	0	1	1	0	1	1	1
1	0	1	0	1	1	1	0
1	0	1	0	1	0	1	0
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0	1	1	1	1	1	0	1
0	1	1	1	1	0	0	0
0	1	1	1	0	1	0	1
0	1	1	0	1	1	0	0
0	1	1	0	1	0	0	0
0	1	1	0	0	1	0	1
0	1	0	1	1	1	0	0
0	1	0	1	1	0	0	0
0	1	0	1	0	1	0	1

(c)

WRM112

Fig. 9: Variations on "illogical moves"

Illogical moves

The program of the basic circuit is designed to make no reply to certain "illogical" moves, those associated with the five 3-input NAND gates which enable the display inhibit. This was considered to be the logical response whereby 126 games may be won by the player.

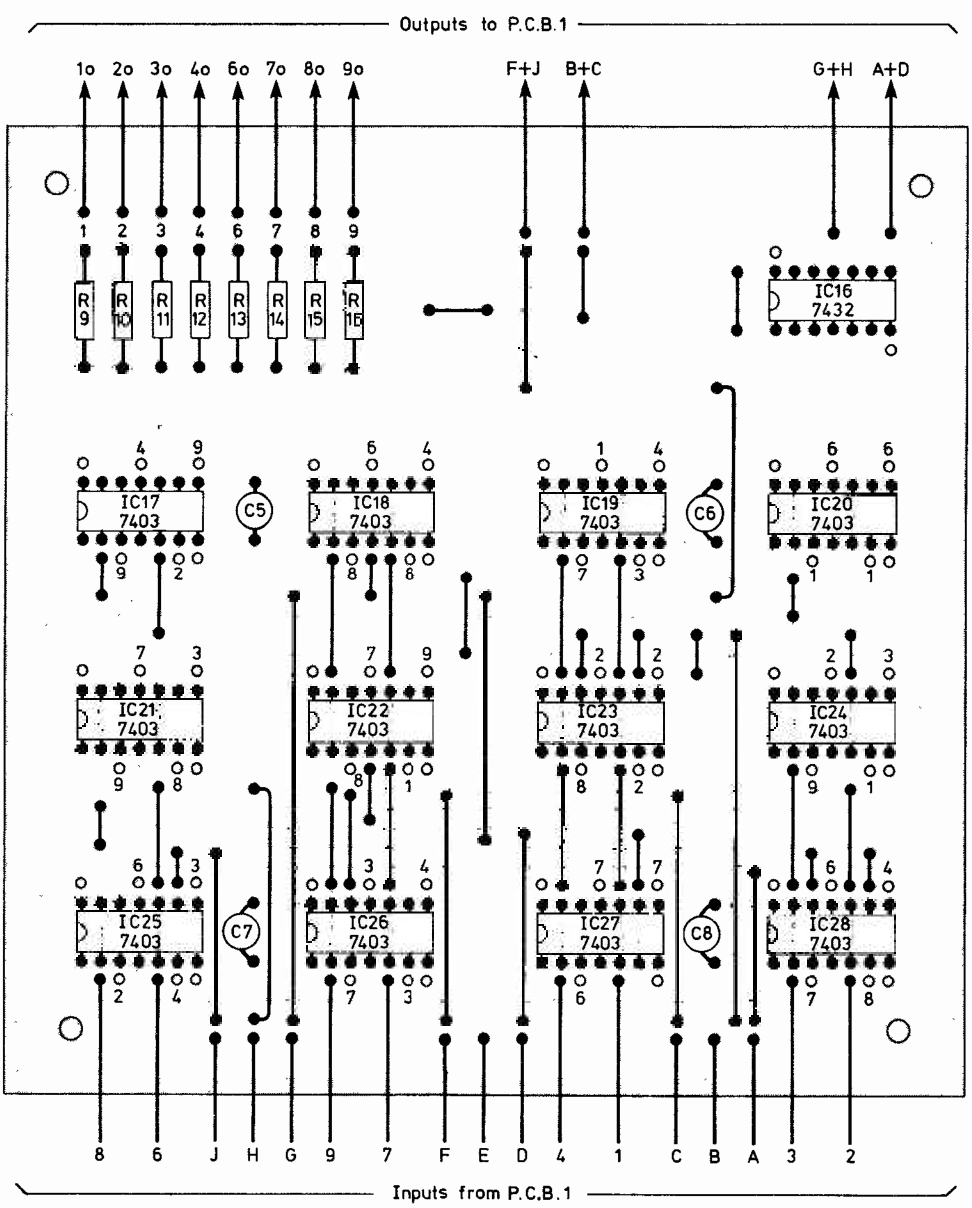
A variation to the above is possible using additional output gating as shown in Fig. 9. A reply is routed to one of the two Nought displays when such a move is made (see Truth Table). The number of games which may be won by the player is reduced to 16. Two circuits as in Fig. 9(a) are required, inputs taken from display gating on PCB 1 and outputs to the l.e.d. display as shown in Fig. 9(b).

Additional components required for the above are one SN7432 (Quad 2 i/p OR), three SN7410 (Triple 3 i/p NAND), two SN7404 (Hex. inverter) and one SN7400 (Quad 2 i/p NAND). These may be mounted on an additional board above PCB 1, but a deeper case will be needed. The track betweeen IC5·6 and 5·8 on Board 1 should be cut. R1 is replaced by a 9·1kΩ, IC5·6 is linked to IC 1·1 and R10 is replaced by a 1·5kΩ.

Construction

The case is moulded in ABS plastic, and a number of p.c.b. fixings and other extrusions have to be removed from inside the case. This is simply done using a coarse-toothed hacksaw blade, around which a piece of tape is wrapped as a grip. In order to fit the battery-holder flush to the grooved end of the base, approx. 2·5mm must be carefully removed from the inner edges of the two nearby corner pillars, through which the screw fixing is made. This may also be done with the saw blade. The batteries are fitted here to allow clearance for the switches mounted in the lid at the lower end. The diode is soldered directly to the positive terminal of the battery-holder in the prototype, but could be mounted on Board 4.

Holes in the lid for l.e.d.s and switch studs may be positioned by gumming a tracing of Fig. 5 on top. Holes for the l.e.d.s should be drilled using a 5·10mm drill; those for the studs require a 2·95mm drill. The squares on the lid may be marked out using a sharp knife and a straight edge. "Brasso" or a similar metal polish will clean up the lid after soaking off most of the paper. The lines around



WAD343

Fig. 10: Component placement layout for PCB2

the squares may then be used as guides for thin plastic strips fixed using acetone as an adhesive (hold the strips in place and lightly brush the liquid along the edges with a fine brush. The weld will be firm in about 30 seconds).

Minimising costs

In order to keep cost to a minimum, only single-sided p.c.b.s are used and i.c.s are soldered directly into the boards. PCB 1 should be constructed as shown, using Veropins at all points where connection is made to more than one other pin or to another board. After testing the completed board, remove R5 before connecting to PCB 2.

PCB 2 should be constructed as shown, using Veropins on all NAND gate outputs and where connections are made to Board 1. After checking, it may be mounted beneath Board 1 using 4BA nuts and bolts with 12mm spacers. Input leads from Board 1 may then be connected, and Board 2's outputs checked before connecting back to Board 1. Operation of the complete logic circuit may then be tested, using a probe as input and a logic probe. (A probe circuit is given in Fig. 11.)

The bolts holding the two boards together should be heads down. A blob of epoxy will then fix them to the floor of the case, in the space left by the battery-holder, which is fixed similarly.

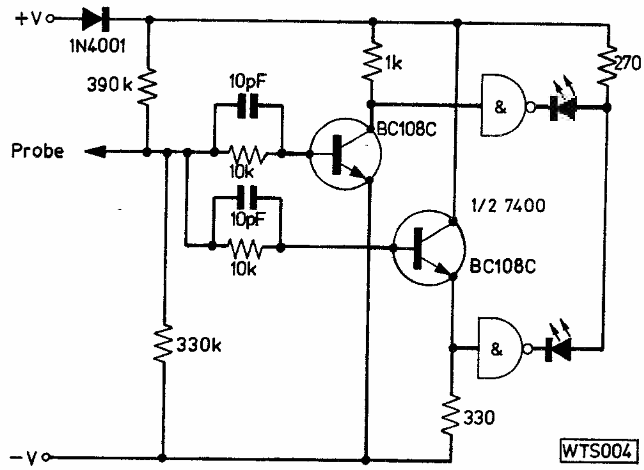
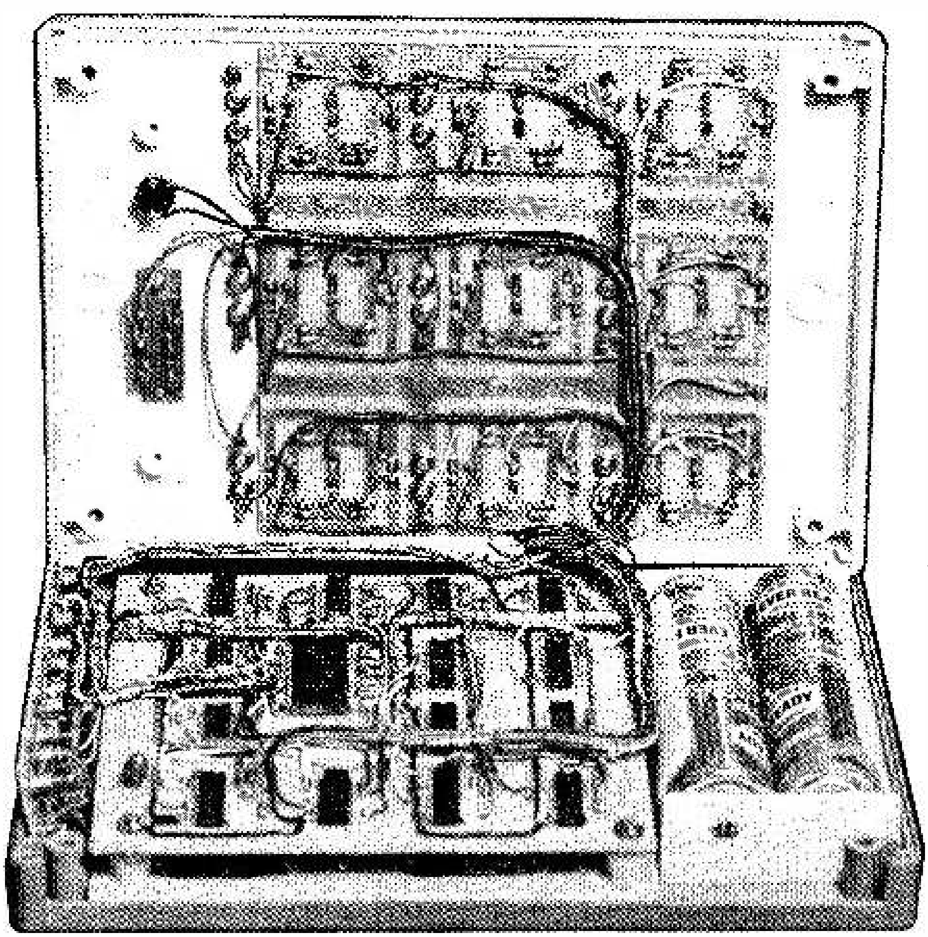


Fig. 11: The logic probe circuit diagram

An internal view of the Author's prototype



Embellishment

There are of course many extras which may be added to the basic circuit, such as a win indication, delayed replies, an external larger display, etc. Deeper cases are available in the same style for those who may need the extra space. ●

Full-size paper prints of the p.c.b. layouts are available at an inclusive price of 40p. Apply to *Practical Wireless, Westover House, West Quay Road, Poole, Dorset BH15 1JG.* Cheques and P.O.s should be payable to: *IPC Magazines Ltd.*

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

Mainline takeover

Arrow Electronics Ltd. of Leader House, Coptford Road, Brentwood, Essex, have acquired the entire stock of Mainline Electronics Ltd. previously of Windsor and Slough, Berks.

Mainline Electronics audio equipment will be available from Arrow and it is contemplated that production of the Mainline amplifiers will be continued, as it is proposed to merge these products with Arrow's existing "Leader" range of kits.

Can I Help You!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in mid-March), so, the earlier I can have details, the better.

Alan Martin

RAE Reprint

A reprint of the complete series—So You Want to Pass the RAE?—including details of the new examination format being introduced this year, is now available.

Order your copy by completing and returning the coupon on page 70.

New Portable Radiophone

Marconi Mobile Radio, a Division of Marconi Communication Systems Ltd, is now an approved supplier of equipment to the Post Office Radiophone Service and the new 'go-anywhere' telephone, the SV1320A, opens up completely new uses for the service.

With the extension of the East Pennine Radiophone Area coming into operation in the near future the SV1320A is a telephone that could be extremely attractive to new subscribers. The versatile equipment is designed to fit into the corner of a car boot with the control unit and handset easy to hand for the driver or passenger. Take the equipment out of the vehicle, a simple operation taking less than a minute, and a completely portable telephone is available to take to your weekend cottage, on the boat, fishing, into the garden or wherever you need to be contacted.

With a battery or charger unit the equipment can be used as a temporary telephone at major construction sites and office accommodation before land lines are installed. The equipment works from 12 volts or by attached battery pack, which with normal operating will last a day without recharging. *Marconi Mobile Radio, M.C.S.L., Marconi House, Chelmsford CM1 1PL. Tel: (0245) 53221.*

Hi-Fi f.m.

A new piece of equipment which greatly improves the quality of frequency modulation (f.m.) transmission has been developed in Australia.

For use with a typical £100 000 transmitter the new equipment—about the size of two cigarette packets—costs around £10.

It is the result of four years' research by Dr Keith J. Kikkert, senior lecturer in the Electrical and Electronic Engineering Department at the James Cook University of North Queensland, Townsville. Dr Kikkert, 34, was born in Amsterdam and went to Australia in 1962.

Tests of his new equipment have produced f.m. reception with a distortion factor 20 times less than the best equipment now used by large f.m. radio and t.v. stations.

Dr Kikkert said the reduction in distortion might even be much better than indicated, because there was no equipment available capable of measuring it above the "20 times" mark.

Conventional f.m. transmitters—those used in radio, television sound and microwave communication relays—generate at a high frequency. Dr Kikkert's success has been achieved by generating f.m. at a low frequency of 1MHz, which is then amplified and transmitted at 101MHz. Existing f.m. transmitters have a direct output. *Australian Information Service, Australia House, Strand, London WC2B 4LA.*

Dr Kikkert with the piece of equipment he developed

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7402	.15*	.19*	7451	.16*	.19*	74139	—	.55*	74193	1.21*	1.85*
7403	.15*	.19*	7453	.16*	—	74141	.76*	—	74194	1.21*	—
7404	.16*	.21*	7454	—*	.19*	74145	.75*	1.05*	74195	1.01*	1.05*
7405	.16*	.21*	7455	—*	.19*	74147	1.59*	—	74196	1.18*	1.05*
7406	.26*	—	7460	.16*	—	74148	1.32*	—	74197	1.18*	1.05*
7407	.26*	—	7470	.27*	—	74150	1.02*	—	74198	1.81*	—
7408	.17*	.19*	7472	.23*	—	74151	.67*	.88*	74199	1.81*	—
7409	.17*	.19*	7473	.28*	.29*	74153	.67*	.48*	74221	—	.99*
7410	.15*	.19*	7474	.28*	.29*	74154	1.21*	1.25*	74240	—	2.25*
7411	.25*	.19*	7475	.44*	.43*	74155	.67*	.78*	74241	—	2.25*
7412	.18*	.19*	7476	.30*	.29*	74156	.67	.78*	74242	—	2.25*
7413	.27*	.40*	7478	—	.29*	74157	.67*	.55*	74243	—	2.25*
7414	.71*	.79*	7482	.73*	—	74158	—	.58*	74247	—	.95
7415	—*	.19*	7483	—	.75*	74160	1.21*	.99*	74248	—	.95*
7416	.25*	—	7485	1.18*	.88*	74161	1.21*	.65*	74249	—	.95*
7417	.34*	—	7486	.25*	.29*	74162	1.21*	1.25*	74251	—	.83*
7420	.16*	.19*	7489	2.60*	—	74163	1.21*	.65*	74253	—	.99*
7421	—*	.19*	7490	.34*	.62*	74164	1.02*	1.15*	74257	—	.99
7422	—*	.19*	7491	.73*	1.05*	74165	—	.78*	74258	—	.99
7423	.25*	—	7492	.46*	.75*	74166	1.02*	—	74259	—	1.50*
7425	.25*	—	7493	.34*	.65*	74168	—	1.85*	74266	—	.35*
7426	.25*	.19*	7495	.54*	.88*	74169	—	1.85*	74273	—	2.25*
7427	.39*	.19*	7496	.67*	1.25*	74170	1.85*	1.65*	74279	—	.48*
7428	.38*	.19*	74107	.27*	.35*	74173	1.41*	.88*	74283	—	.99*
7430	.16*	.19*	74109	.44*	.35*	74174	1.01*	1.05*	74290	—	.83*
7432	.25*	.25*	74112	—	.35*	74175	.81*	1.05*	74293	—	.83*
7433	—*	.19*	74113	—	.35*	74176	1.01*	—	74295	—	1.05*
7437	.25*	.25*	74114	—	.35*	74177	1.01*	—	74298	—	1.25*
7438	.25*	.26*	74121	.27*	—	74180	1.01*	—	74365	—	.51*
7440	.17*	.19*	74122	.50*	.75*	74181	2.21*	2.99*	74366	—	.51*
7441	.70*	—	74123	.60*	.78*	74182	.81*	—	74367	—	.51*
7442	.50*	.55*	74124	—	1.25*	74184	1.81*	—	74368	—	.51*
7445	.60*	—	74125	.51*	.39*	74185	1.62*	—	74386	—	.39*
7446	.60*	—	74126	.51*	.39*	74188	2.97*	—	74670	—	1.85*
7447	.60*	.87*	74132	.72*	.65*	74189	3.17*	2.25*			
7448	.60*	.87*	74133	—	.19*	74190	1.21*	.75*			

CMOS

4000	.15*	4053	.81*
4001	.16*	4054	1.29*
4002	.16*	4056	1.46*
4006	.92*	4059	5.18*
4007	.18*	4060	1.24*
4008	.92*	4066	.48*
4009	.54*	4068	.21*
4010	.54*	4069	.21*
4011	.18*	4070	.21*
4012	.18*	4071	.21*
4013	.48*	4072	.21*
4014	.92*	4077	21*
4015	.92*	4081	.21*
4016	.43*	4082	.21*
4017	.81*	4085	.92*
4018	.92*	4086	.92*
4019	.56*	4093	.81*
4020	.92*	4099	1.81*
4021	.92*	4502	.92*
4022	.92*	4508	2.46*
4023	.18*	4510	1.07*
4024	.65*	4511	.95*
4025	.18*	4514	2.70*
4026	1.84*	4515	2.70*
4027	.51*	4516	1.07*
4028	.70*	4517	4.10*
4029	1.18*	4518	.95*
4030	.56*	4521	2.54*
4032	1.08*	4522	1.89*
4034	1.89*	4526	1.89*
4035	1.06*	4528	.92*
4040	.92*	4534	7.12*
4042	.70*	4536	3.74*
4043	.81*	4543	1.62*
4046	1.06*	4553	4.53*
4049	.43*	4566	1.51*
4050	.43*	4583	1.02*
405'	.81*	4585	1.07*
40F2	.81*		

I.C. sockets

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16 pin	.13*
18 pin	.18*
20 pin	.20*
22 pin	.24*
24 pin	.26*
28 pin	.30*
40 pin	.44*

Wire Wrap

8 pin	.23
14 pin	.34*
16 pin	.37*
18 pin	.43*
20 pin	.55*
24 pin	.60*
28 pin	.65*
36 pin	.95*
40 pin	1.05*

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2112A-2	(250ns)	2.14*	1.90*	1.78*
21L02	(350ns)	1.07*	.96*	.86*
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LM324N	.73*
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LM381N	1.73
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LM3900N	.65
LM3909N	.70*
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SN76013N	1.55
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TIL216	Red x	.20*	.18*	.16*	.14*
TIL232	Gre x	.20*	.18*	.16*	.14*

.2"		1+	10+	50+	100+
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direct use of COMMUNICATIONS SATELLITES

We have already seen great developments in satellite communications, but far more impressive systems are likely to become available during the next ten years. Initially the larger manufacturing companies will have their own earth stations which will provide them with continuous communications facilities, but hand-held personal communications sets for direct transmission to huge spacecraft are being planned for about 1990.

In European homes the greatest impact of satellite communications occurs when a television signal is relayed from another continent. All such very long distance television links are made using satellites in geosynchronous orbit some 36 000km above the equator; such satellites orbit the earth once every 24 hours and hence remain above the same point of the earth at all times. However, television relays account for only about 2 per cent of the total use of communications satellites, the greatest demand being for ordinary telephone conversations by businessmen, together with high-speed data transmissions.

At the present time, communications satellites are used mainly for intercontinental communications by means of the INTELSAT spacecraft, although maritime and military satellite communications are also of vital importance. Very rapid developments are taking place; the European Space Agency recently launched the OTS2 vehicle which will be a forerunner of the first European satellite to carry telephone and television signals on a commercial basis across Europe.

Satellites are presently handling rather more intercontinental telephone traffic than sub-oceanic cables. The American Federal Communications Commission is apparently delaying the production and laying of a new TAT-7 transatlantic telephone cable whose 4000 telephone circuits would provide a more equally balanced capacity between cables and satellites. Cables are more expensive than satellites, but have a much longer life than the typical seven years design life of a satellite.

The INTELSAT spacecraft provide first class communications facilities over the largest distances, but involve the use of extremely expensive earth stations with parabolic reflectors of some 30 metres diameter; all points of these huge reflectors should be positioned with an accuracy of about 1 millimetre and retain this accuracy even in a high wind. Such stations became available in the mid-1960s at a cost in the order of £5 million. Some smaller, more economical earth stations with 10 metre diameter aerial reflectors are used in low density traffic areas for international communications where maximum bandwidth is not required.

The era of satellite broadcasting of television and radio programmes is now commencing. Aerials with reflector diameters of some 5 metres can be used in earth stations costing some £30 000, for receiving television signals from a geosynchronous satellite and relaying them to a whole community of users. Smaller aerials (perhaps 1 metre in diameter) can be used with more economical receivers costing no more than a few hundred pounds, to provide television signals to individual homes in out-of-the-way places. Higher power satellite transmitters combined with very high gain satellite aerials make such economical earth stations possible for reception only, without facilities for transmitting to the satellite.

Eventually very large aerial structures will be assembled in space and, when used with far more powerful satellite transmitters, are expected to make possible the use of small hand-held transmitters for direct communications with the satellite by about 1990. The earth station reflectors may be about 100mm diameter and the total cost of the hand-held equipment about £10 on present day values. One of the advantages will be that you will eventually be able to telephone almost any person via a satellite by merely dialling his number; it will not be necessary to know whether he is working at his office, on a visit to another company, at his home, at his club or even taking a bath—although some protection of his privacy may be necessary.

One can even imagine a wrist radio communications system in the next century. Enormous satellite aerials with very high power transmitters will be required for such a system. However, it is claimed that the cost of such systems will be surprisingly low owing to the enormous amount of telephone traffic they would handle. It seems likely that the cost of a call over a distance of 3000km will be similar to that of a call to a person a few doors away in the same street. Competing with such telephone systems will be electronic letter facsimile transmission systems, which will (hopefully!) ensure the fast delivery of letters across intercontinental distances even if messages cannot be immediately delivered.

SBS

In the more immediate future, a series of satellites will be launched in 1981 by a consortium known as SBS (Satellite Business Systems), which will provide US businessmen with direct access to the satellites for communications purposes through small company-owned unattended earth stations using 5 or 7 metre diameter aerial reflectors. One can imagine such dish reflectors being as commonplace as our present-day television aerials.

The Hughes Aircraft Company of California has been awarded a $63 million contract by SBS for the construction of three domestic satellites for the direct transmission of voice, facsimile (printed matter), video, high-speed computer data and tele-conferencing pictures for US business and government agencies.

The SBS system will be the first US domestic commercial communications satellite system to use the higher frequency "K" Band (12 and 14GHz; that is, 12 000 and 14 000MHz). This high frequency system will enable earth stations to be located in urban areas without causing interference to terrestrial systems or to other spacecraft, whilst small and relatively inexpensive earth stations can be used at such frequencies.

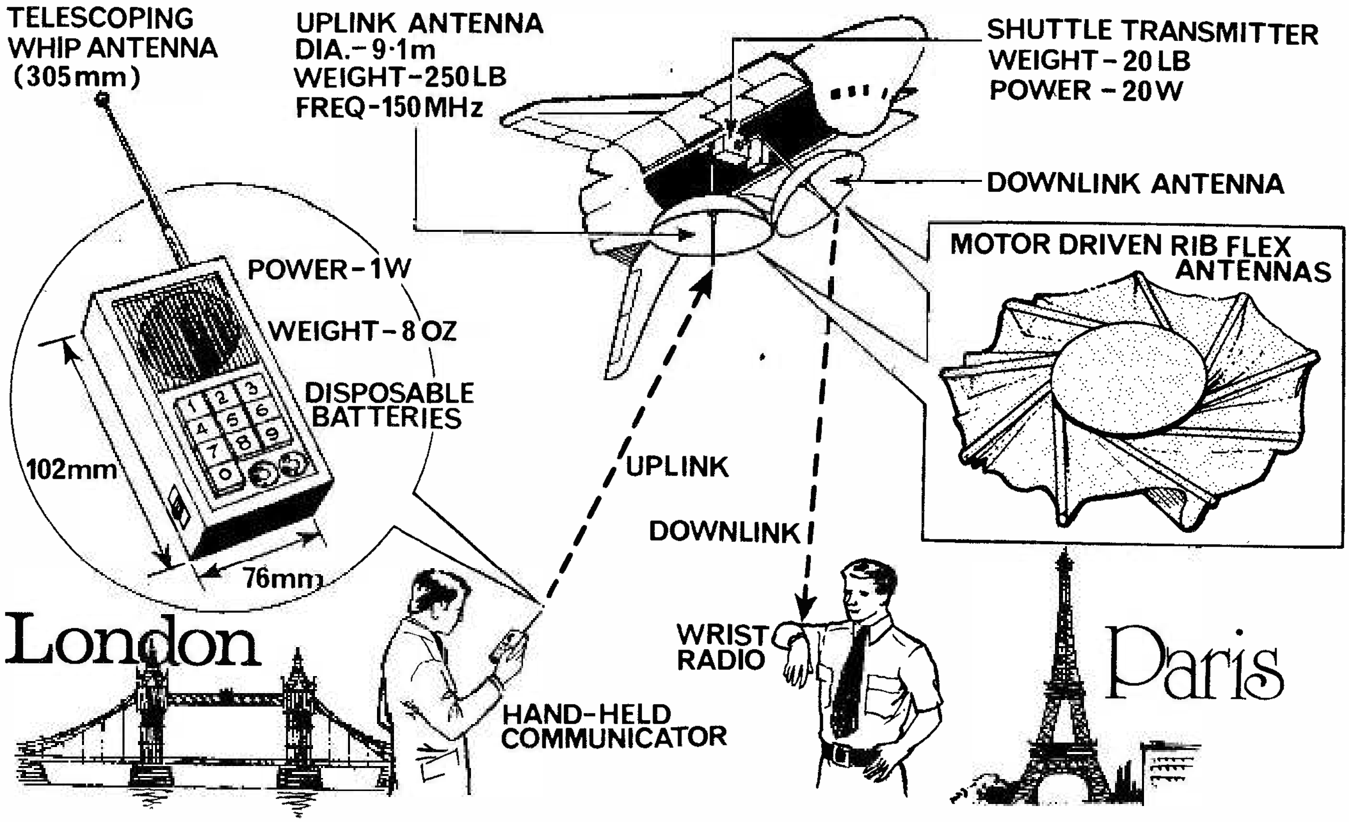

Fig. 1: A concept of how we may be able to communicate in the future by a personal satellite link

The SBS satellite system will cover all of the 48 contiguous states of the USA. The beam transmitted from the spacecraft will be electronically shaped so that the strongest signals are sent to the more densely populated east-central and west coast regions of the US, where SBS will install 5 metre diameter aerial reflectors on users' premises. In the remainder of the US the signals will be somewhat weaker, so 7 metre diameter aerials will probably be employed.

Perhaps the most interesting feature of the SBS satellites is the use of a telescoping solar panel system. During the launch phase, the cylindrical solar panels are closed over one another to keep the satellite as compact as possible, but the panels will be deployed in space to provide the relatively high power level of about 914W. The spacecraft will be spin stabilised, so each part of the solar panel array comes into full sunlight in turn. It is intended that the SBS satellites will be launched by the Space Shuttle, since this type of launch will be much less costly than rocket launching. A SBS satellite will be able to sit upright in the cargo bay of the Shuttle vehicle with its aerial folded; this saves Shuttle charges, since the charge is more or less proportional to the payload bay length employed in the launch.

The travelling wave tubes in the SBS satellite transmitter will be able to provide an output power of 20W; this is higher than the more usual 5 or 6W in satellite transmitters. Ten channels, each 43MHz wide, will be available. Time Division Multiple Access (TDMA) will be used to provide the maximum signal-carrying capacity.

The specially shaped beam for providing maximum signal strength in the most heavily populated areas will be created by a 1·83 metre reflector with two reflecting surfaces. The front horizontal grid reflector is essentially transparent to vertically polarised r.f. signals bounced off the rear reflector. Superimposition of the reflectors in a single aperture allows both of them to share structural support and have the maximum possible diameter. The two reflectors are offset from each other with a corresponding offset of their focal planes so that two separate feed arrays for transmit and receive can be employed without any mutual interference. It is expected that a minimum signal strength of 43·7dBW will be provided over the primary eastern coverage zone of the USA.

The SBS spacecraft are 2·16 metres in diameter by 6·6 metres in height when the solar panels are fully deployed. Each will weigh some 1057kg at launch, but after the apogee engine has been fired to place the craft in its correct geosynchronous orbit, the weight will be 555kg. Design life is seven years.

Conclusions

Satellite communications are going to have an even larger impact on our lives in the future and will greatly facilitate business communications. It is interesting to note that it has been reported that the US has been using a "Pyramider" satellite communications link to enable their foreign agents to transmit short bursts of secret coded information via the satellite to their National Security Agency. Apparently Soviet agents in Mexico have purchased details of the system and former employees of a US satellite manufacturer have been charged with security offences. Presumably the US National Security Agency is rapidly searching for a replacement for their previous link. It is understood that the National Security Agency is interested in spread-spectrum links of very wide bandwidths (even up to 5GHz), since signals of such extremely wide bandwidths are very difficult to detect when transmitted at fairly low power, even with the most sophisticated receivers.

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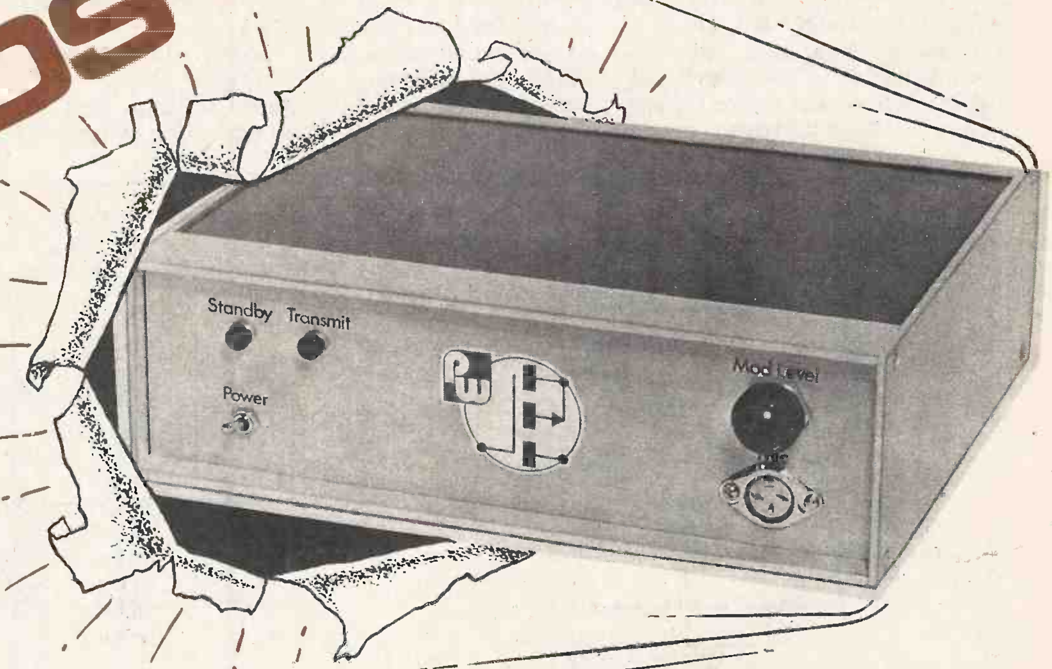

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SPECIAL PRODUCT REPORT

YAESU FRG~7 RECEIVER

JUMBO Wall Clock

There have been many published designs for digital clocks, but these have almost all been for a digit height of less than 25mm. By using an array of discrete l.e.d.s, this clock has digits 64mm ($2\frac{1}{2}$in) high, and is ideal for use in shops, offices, kitchens, etc.

The circuit is based on the General Instrument Microelectronics clock chip AY-5-1224A, which utilises *p*-channel m.o.s. technology. Although not one of the most recent clock chips, it nevertheless incorporates a wide range of features, not all of which are used in this particular application. By the use of multiplexing techniques, a 16-pin dual-in-line package can be used. A non-multiplexed device offering similar facilities would require a 40-pin package.

Multiplexing

The time division multiplexing technique, whereby several separate signals are passed in turn via one connection, is now widely used, particularly in digital displays and in calculator or typewriter keyboards. For the benefit of readers not familiar with the principle, a brief explanation may not be out of place. This will be based on the 7-segment, common-cathode l.e.d. displays used in this clock.

In Fig. 1(a), we show the schematic arrangement of one 7-segment display digit, with segments conventionally identified. Each digit requires eight external connections, so four digits connected in the normal way would require

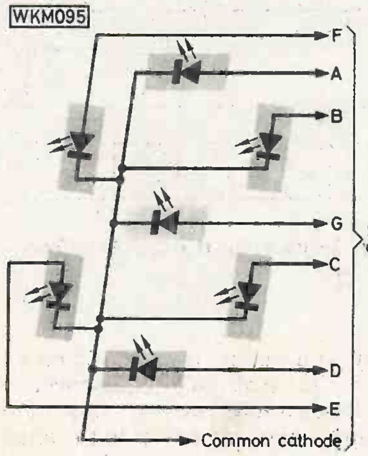


Fig. 1(a): Schematic arrangement of a l.e.d. 7-segment display digit

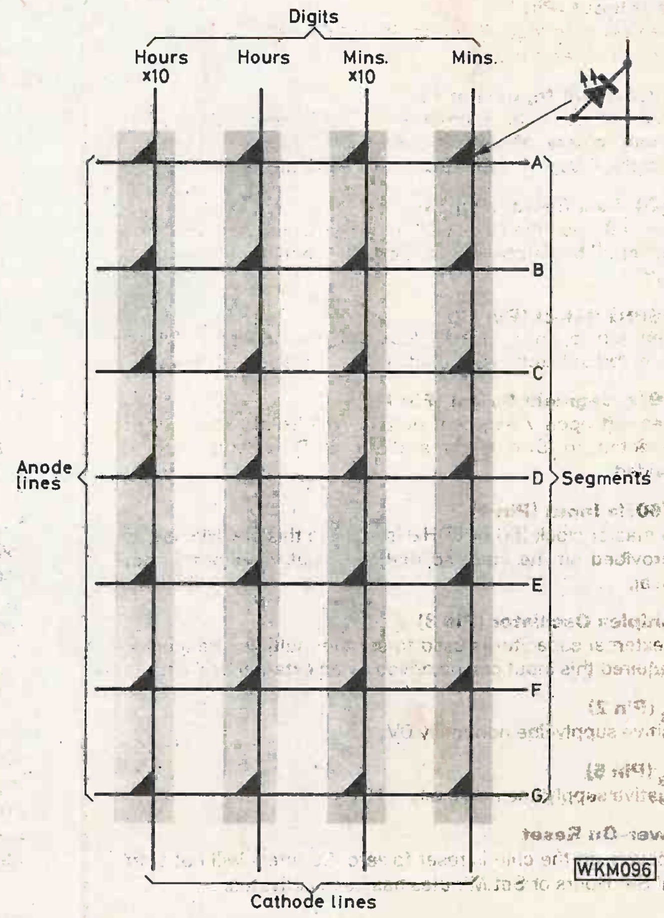


Fig. 1(b): A 4-digit, 7-segment display considered as a matrix for multiplex driving

Table 1—Pin Functions

Pins 1 and 11 to 16 are multifunction. During multiplex times 1 to 4 they function as data outputs, either 7-segment code or BCD according to the display mode selected. During multiplex time 5 (Strobe) they function as inputs.

Segment Outputs A-G (Pins 1 and 11 to 16)
In 7-segment mode the digits are multiplexed out on to these pins. Normally the outputs are at logic *0* (positive to display).

BCD Outputs 2^0—2^3 (Pins 1, 16, 15, 14)
In BCD mode the digits are multiplexed on to these pins in BCD code. Normally the outputs are at logic *0* (positive), i.e. code 0=*0000*.

Multiplex Outputs 1-4 (Pins 10, 9, 8, 7)
These pins are successively switched to logic *0* to select appropriate digit display. A fifth multiplex time (Strobe) is used to enable the control inputs. The multiplex rate is 1/20th the multiplex clock frequency.

Strobe Output (Pin 6)
This pin is used to enable the control input lines; it goes to logic *0* to enable.

Set Hours Input (Pin 1)
When taken to logic *0* during Strobe time this input causes the hours counter to advance at the rate of 1 hour per second.

Set Min Input (Pin 16)
When taken to logic *0* during Strobe time this input causes the minutes counter to advance at the rate of 1 minute per second and the hours counter to advance at the rate of 1 hour per minute.

Reset Input (Pin 15)
When taken to logic *0* during Strobe time this input causes the clock to reset to zero.

Complement Input (Pin 14)
When left open the segments and BCD outputs will have normal polarity. When connected to Strobe output via a diode the 7-segment and BCD output will be inverted.

12/24 Hour Select (Pin 13)
When left open the clock will run in the 12 hour mode, when connected to Strobe via a diode 24 hour operation will result.

50/60Hz Select (Pin 12)
When left open a 50Hz clock will be accepted. When connected to Strobe via a diode 60Hz operation will result.

BCD/7-Segment Select (Pin 11)
When left open 7-segment outputs will be provided, when connected to Strobe via a diode BCD outputs will be provided.

50/60Hz Input (Pin 4)
The master clock (50 or 60Hz) is input to this pin. Hysteresis is provided on the input so that the input waveform is not critical.

Multiplex Oscillator (Pin 3)
An external capacitor is used to set the multiplex frequency. If required this input can be driven by an external oscillator.

V_{SS} (Pin 2)
Positive supply line nominally 0V.

V_{GG} (Pin 5)
Negative supply line nominally −15V.

Power-On Reset
At power-on the chip is reset to zero. Counters will not start until Set Hours or Set Minutes has been activated.

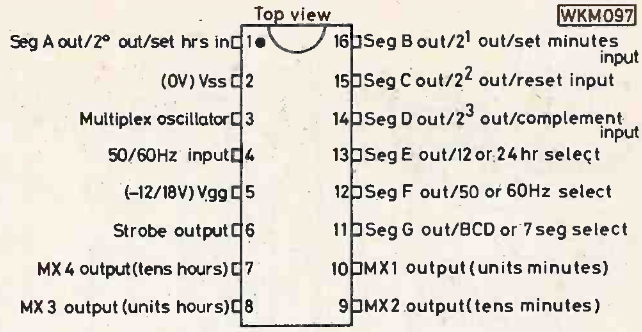


Fig. 2: Pin configuration of the GIM AY-5-1224A clock chip

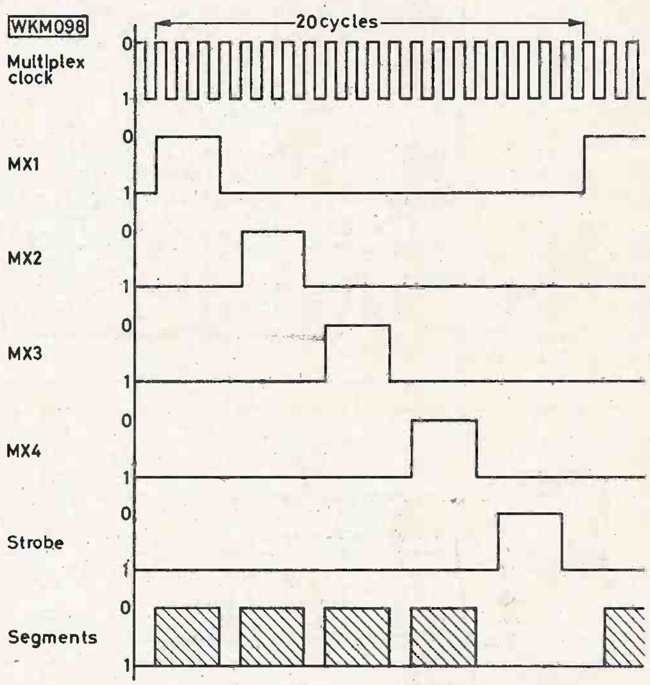


Fig. 3: Timing diagram for the AY-5-1224A

32 connections. By connecting the 28 segments in a matrix, as shown in Fig. 1(b), only 11 connections are needed—almost a three-to-one saving. Any individual segment can be lit up by applying power to the anode and cathode lines across whose intersection that segment is connected. In practice, the cathode (digit) lines are scanned in turn, the appropriate pattern of anode (segment) lines being connected in each case to light up the required digit. Persistence of vision will cause the digits to appear to be continuously illuminated if the scanning frequency is sufficiently high.

The AY-5-1224A

In the AY-5-1224A, the multiplex principle is extended still further, and allows several of the pins to be used for inputs and outputs in turn. In Fig. 2, we show the pin configuration of the device, with the various input and output functions identified. A more comprehensive description of these functions is given in Table 1.

The Timing Diagram (Fig. 3) shows how the display digits are scanned in turn by the MX (Multiplex) outputs going to logic *0*. Note that in this device, the *1* logic level is

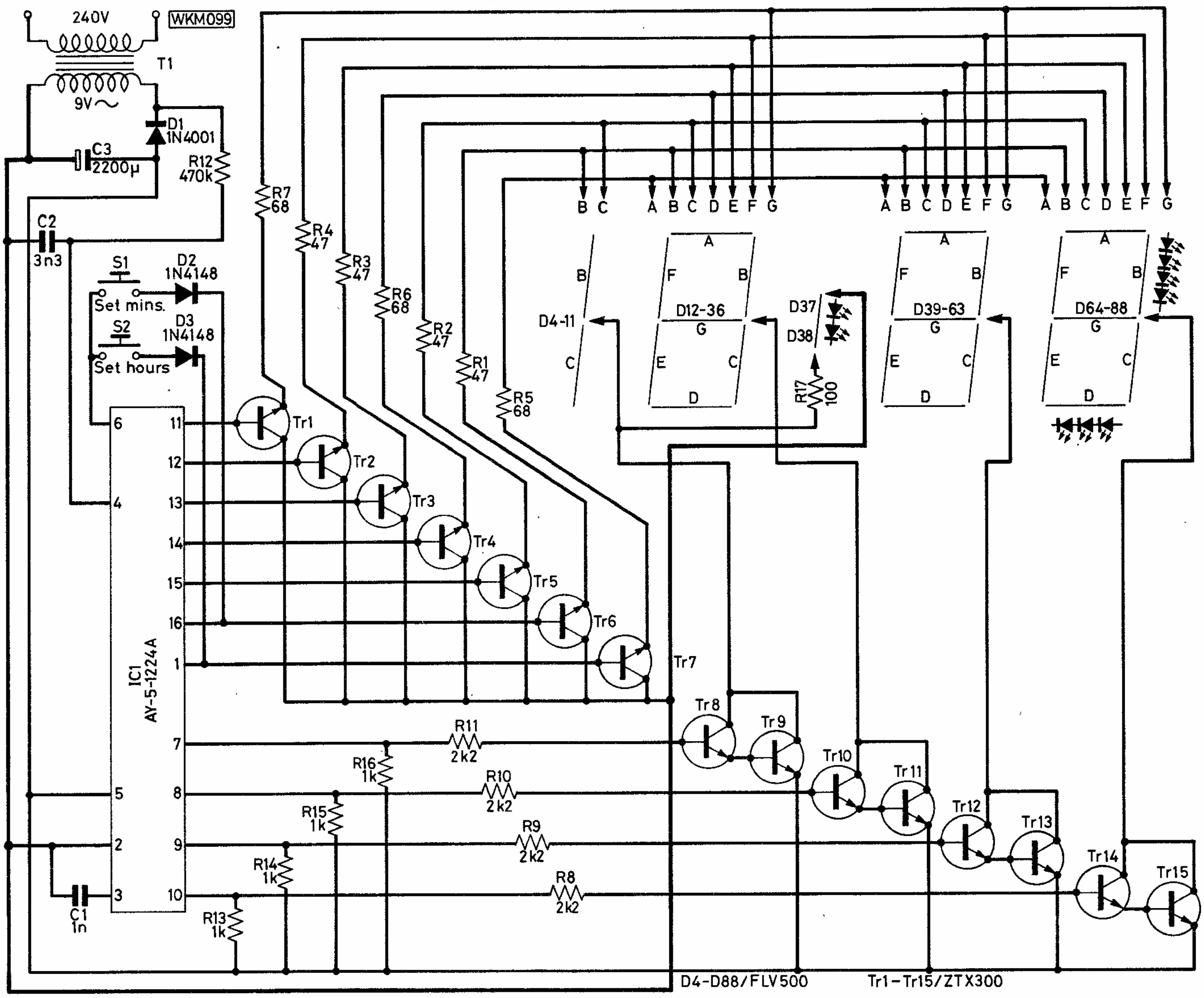
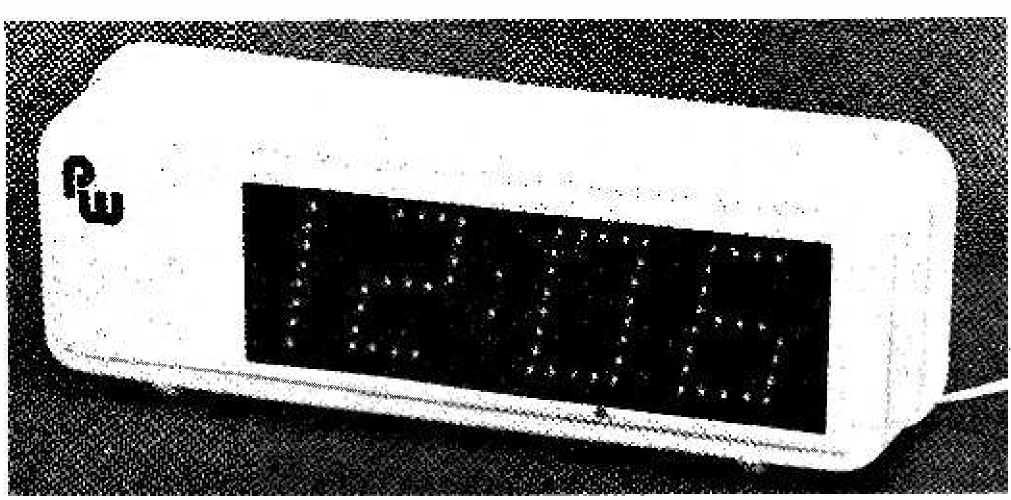


Fig. 4: Complete circuit diagram of the Jumbo Wall Clock



a negative voltage, approaching the V_{GG} supply rail. The input/output pins become inputs during the period that the Strobe output goes to logic *0*.

Circuit Description

The complete circuit diagram of the clock is shown in Fig. 4. Transformer T1 has a nominal 9 volt secondary, and the rectified and smoothed d.c. output across C3 will be around 13 volts. A sample of the 50Hz a.c. supply is taken from T1 secondary via R12, and after shaping by C2, is fed to pin 4 on IC1 as the Master Clock. The frequency of the on-chip Multiplex Clock is set by C1, and will be about 6·7kHz.

The 7-segment outputs are applied to transistors Tr1–7, which drive the l.e.d. arrays via limiting resistors R1–7. Each horizontal segment uses three series-connected l.e.d.s, and each vertical segment uses four. The values selected for the limiting resistors compensate for the resulting difference in voltage drop across each segment, and give an even overall brightness to the display.

The four Multiplex outputs are applied to Darlington pairs Tr8/9, 10/11, 12/13 and 14/15, and control the "Tens of hours", "Hours", "Tens of minutes" and "Minutes" digits respectively. Only two vertical segments are required for the "Tens of hours" digit, since this can only be a blank or a "1". This form of display is known in instrumentation circles as a $3\frac{1}{2}$-digit display, meaning that there are three full digits, each capable of displaying "0" to "9", and one half digit, capable of displaying only a blank or a "1".

The colon separating the hours and minutes digits comprises two l.e.d.s, and is scanned at the same time as the "Tens of hours" digit. The cathode end of the colon pair is fed via limiting resistor R17 directly from the 0V line.

Construction

All the components, apart from the mains transformer and the time-setting switches, S1 and 2, are mounted on a single p.c.b., greatly simplifying construction. In the display window area, all the wire links and resistor R18 are mounted on the foil side (underside) of the board, to preserve a clean frontal appearance. The power supply reservoir capacitor C3 is also mounted on the foil side, because there is insufficient room for it between the p.c.b. and the case front.

Being an m.o.s. device, IC1 should be left in its static protection pack until it is actually to be fitted to the board.

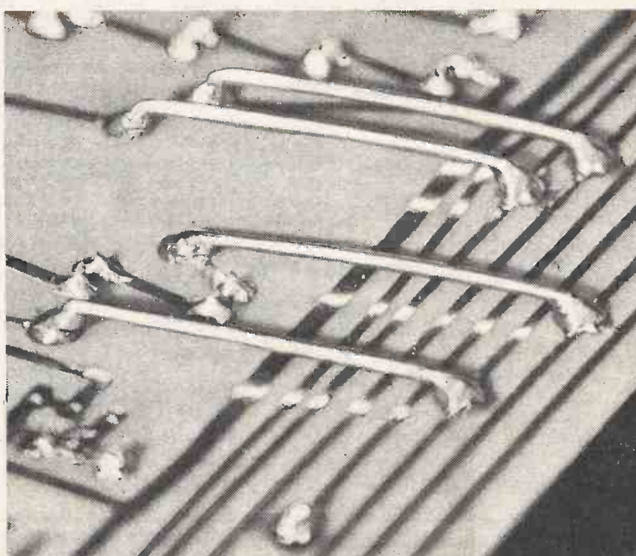
The first step in construction is to fit the wire links. Take the length of 20 s.w.g. tinned copper wire, secure one end in a vice, hold the other end with pliers and stretch slightly. This will remove all kinks, etc., and make the wire easier to cut and bend. Cut 21 lengths, each 45mm long, and bend both ends, allowing 26mm between bends. Because these links are fitted on the foil side of the board, they must be spaced off to avoid short-circuits to other tracks. It is easier to achieve this spacing if the bends are made curved rather than sharp, as shown in the photograph. A bend of some 2-3mm radius is about right. Place the links in the foil side of the board as shown in Fig. 6, solder both ends and trim the protruding wire ends flush with the plain (top) side of the p.c.b. The plain side of the board should then be sprayed with a light coat of matt black paint, to provide maximum display contrast in high ambient light levels.

★ components

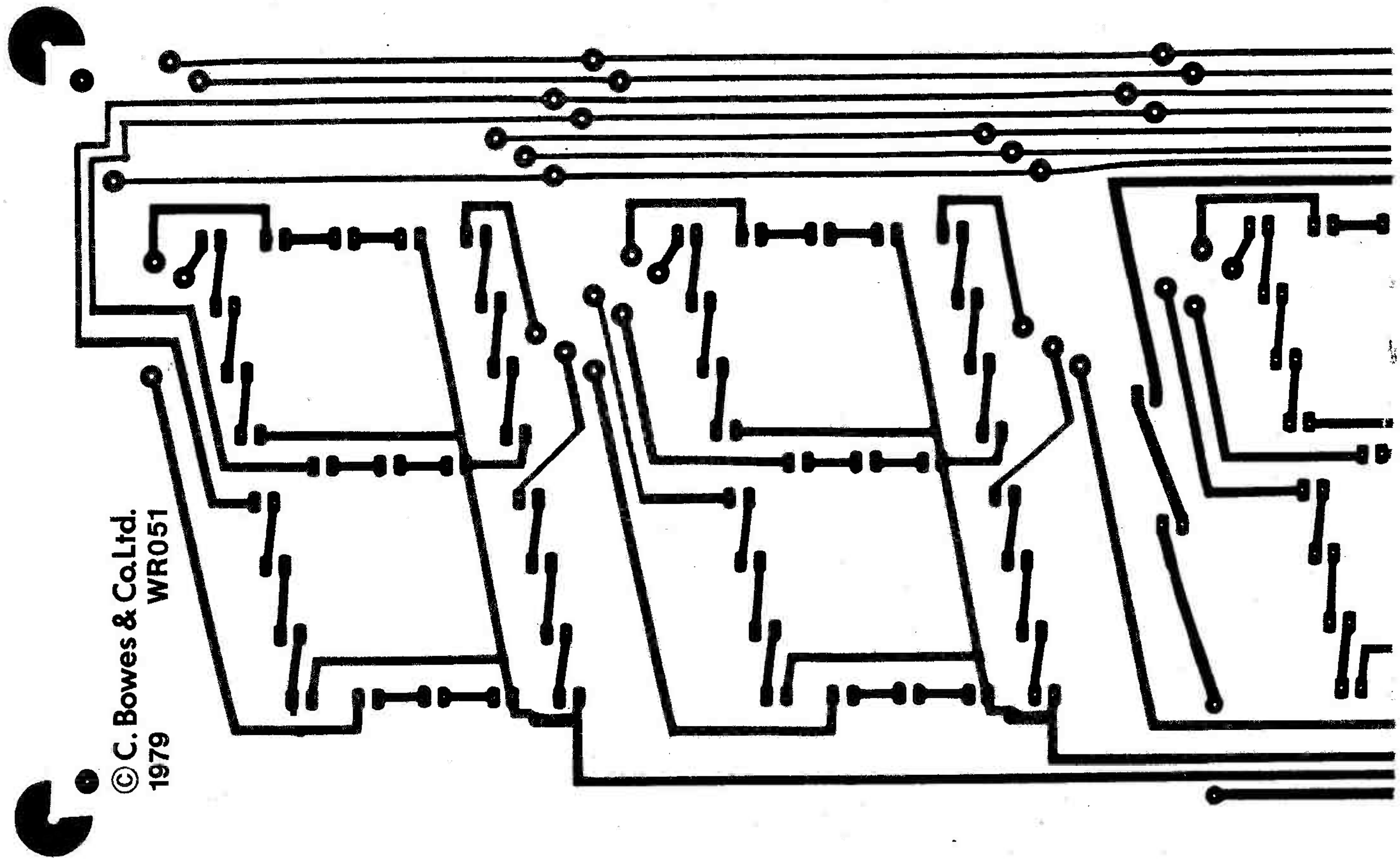
Resistors		
½W 5%		
47Ω	4	R1–4
68Ω	3	R5–7
100Ω	1	R17
1kΩ	4	R13–16
2·2kΩ	4	R8–11
470kΩ	1	R12
Capacitors		
Polystyrene 160V		
1nF	1	C1
3·3nF	1	C2
Electrolytic Axial leads		
2200µF 40V		
Semiconductors		
Integrated circuit		
AY-5-1224A	1	IC1
Transistors		
ZTX300	15	Tr1–15
Diodes		
1N4001	1	D1
1N4148	2	D2, 3
FLV110	85	D4–88 (0·2in red l.e.d.s)

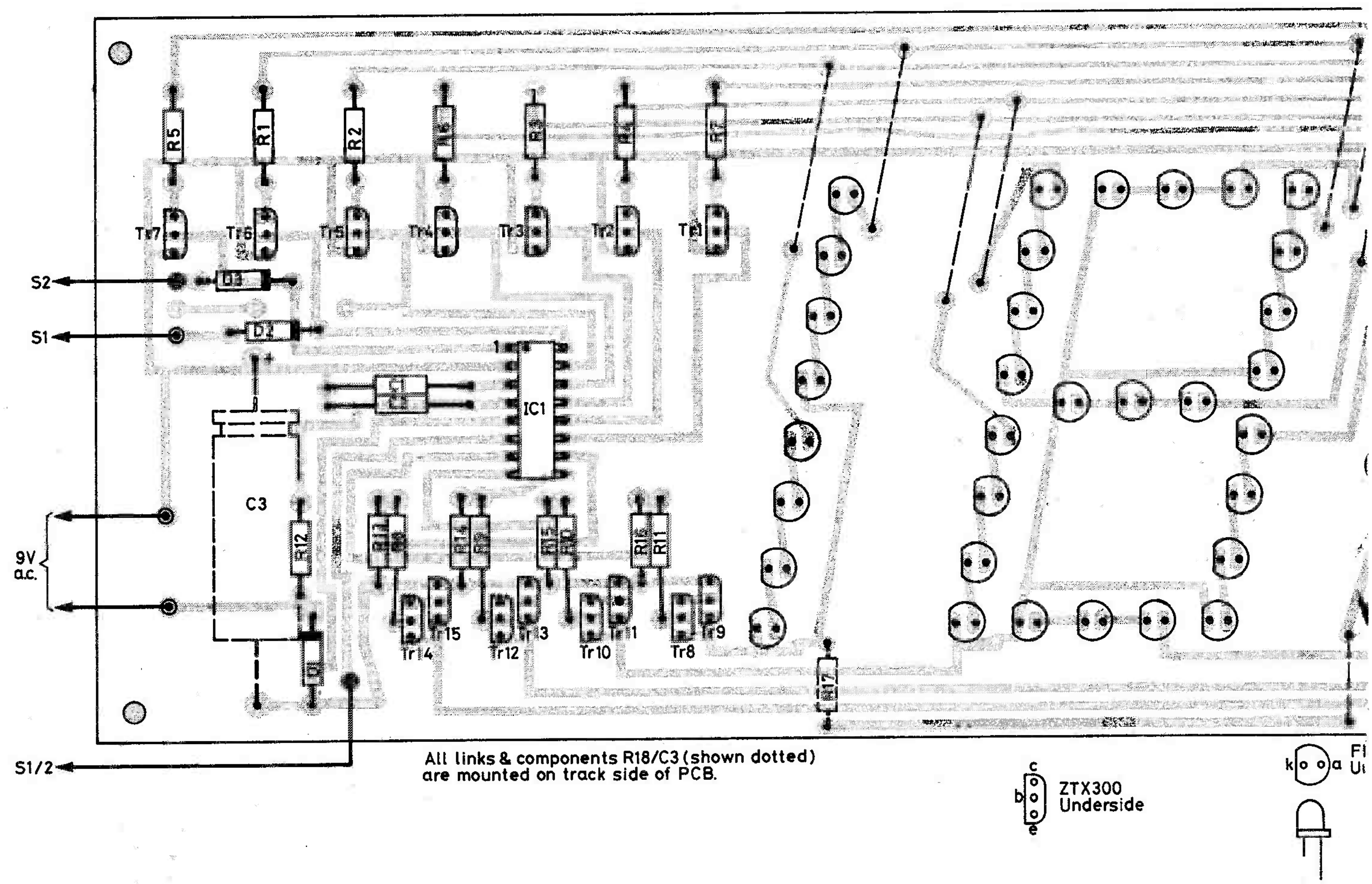
Miscellaneous

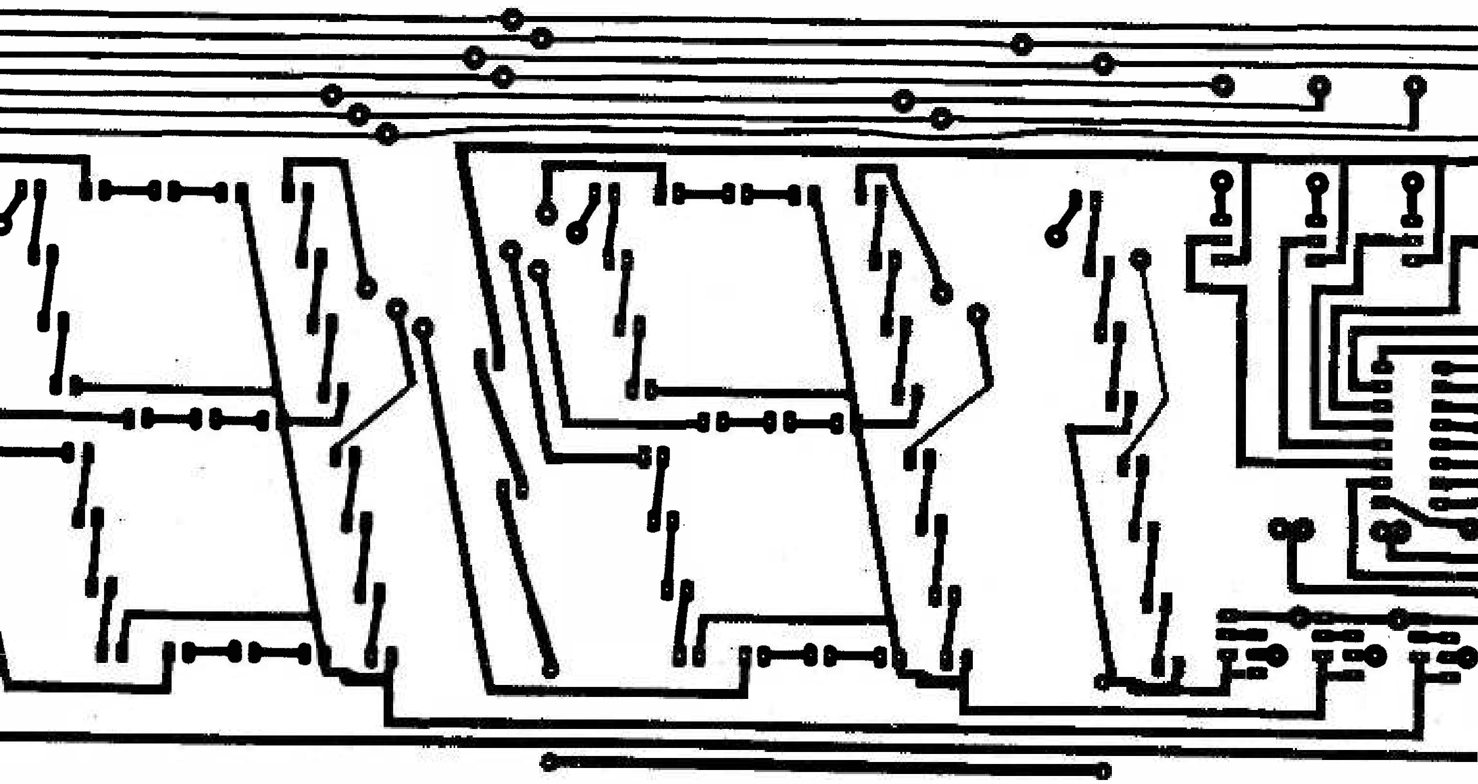
T1 9V 0·75A secondary.
S1, S2 Min. push-button, s.p. push-to-make.
Printed circuit board Ref. WR051*
Case, Perspex window and p.c.b. mounting pillars.*
16-pin d.i.l. socket for IC1.
1 metre 20 s.w.g. tinned copper wire.
*Available from C. Bowes & Co. Ltd. (see Advertisers' Index).

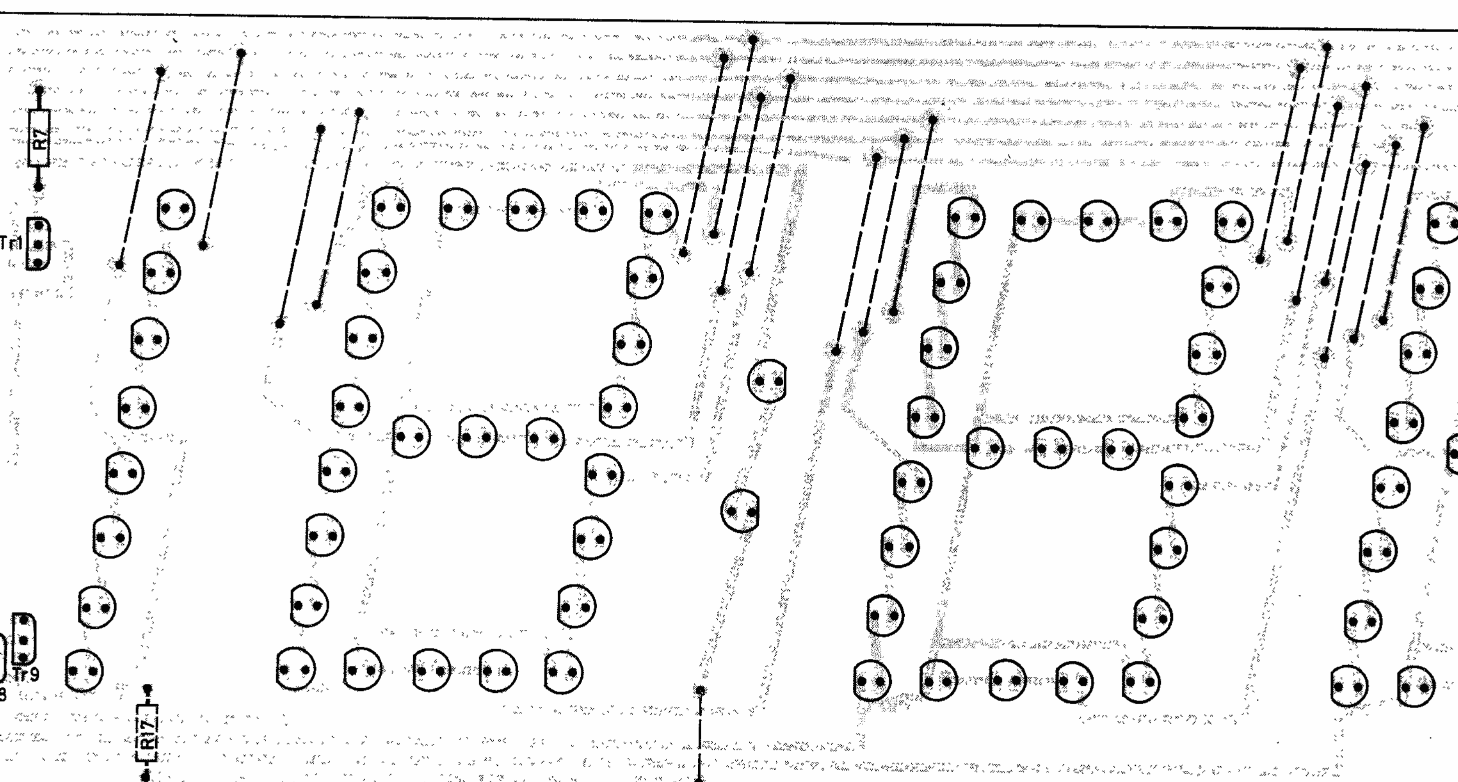


This photograph shows the way in which the 20 s.w.g. wire links are made to stand clear of the board by the radiused bends to the legs at each end

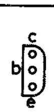

© C. Bowes & Co.Ltd. 1979
WR051

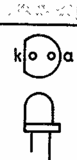

R5
R1
R2
R6
R3
R4
R7
Tr7
Tr6
Tr5
Tr4
Tr3
Tr2
Tr1
S2
D3
S1
D2
IC1
C1
C2
C3
R12
R13
R14
R15
R16
R8
R9
R10
R11
Tr14
Tr15
Tr12
Tr13
Tr10
Tr11
Tr8
Tr9
9V a.c.
D1
R17
S1/2
All links & components R18/C3 (shown dotted) are mounted on track side of PCB.
c
b
e
ZTX300 Underside
k
a





shown dotted)
CB.





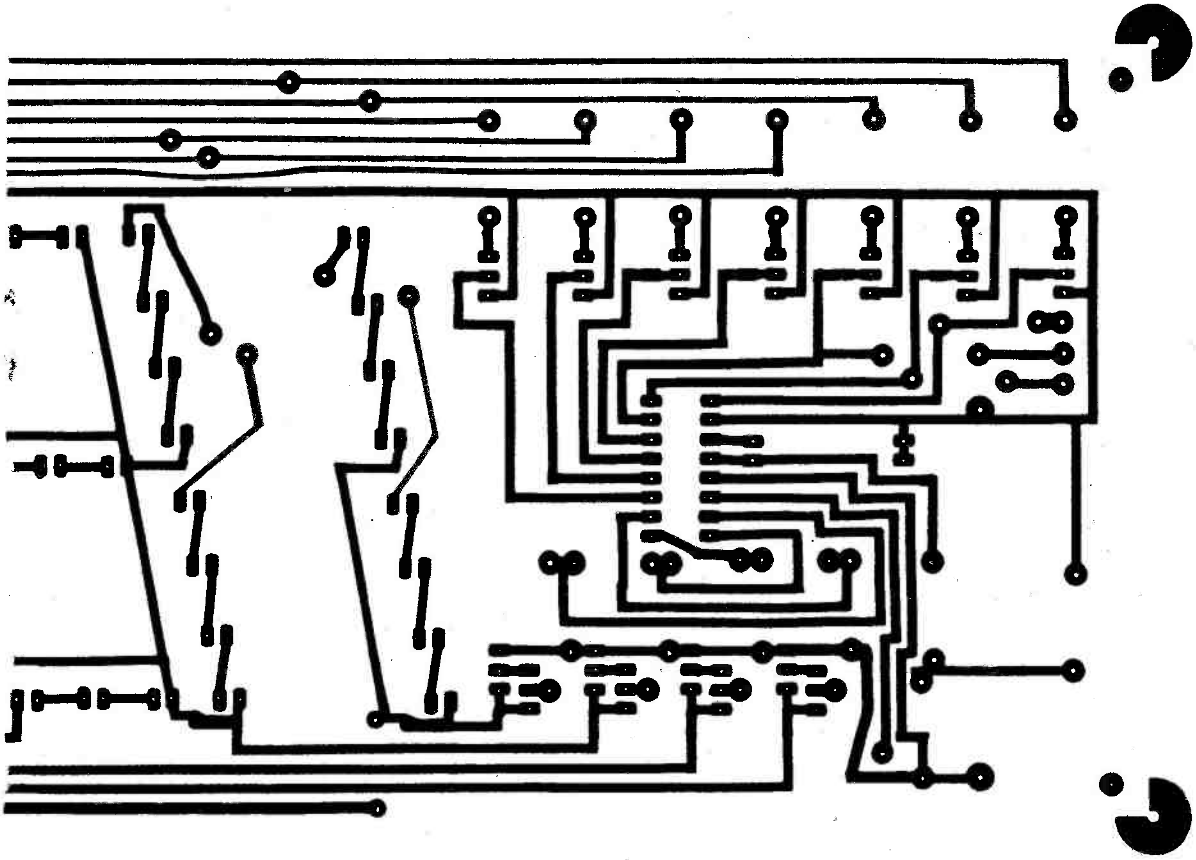


Fig. 5: The p.c.b. track pattern, shown full size

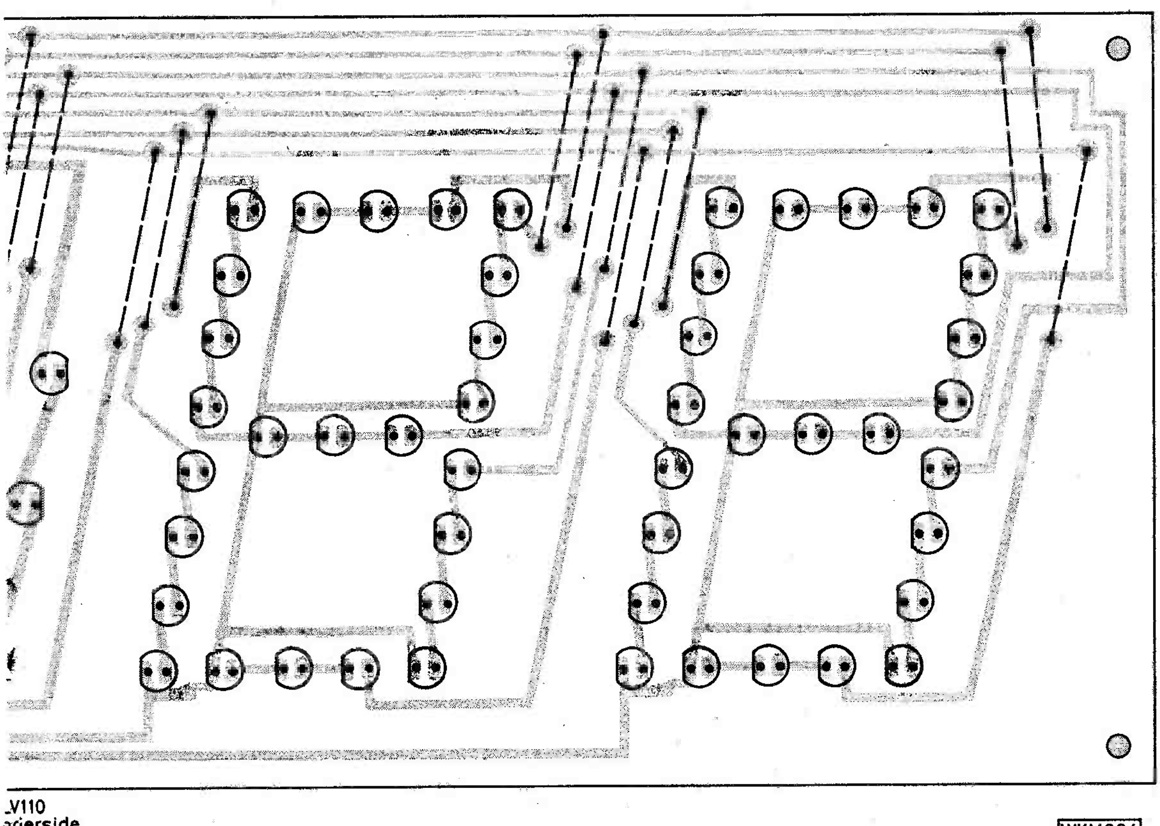
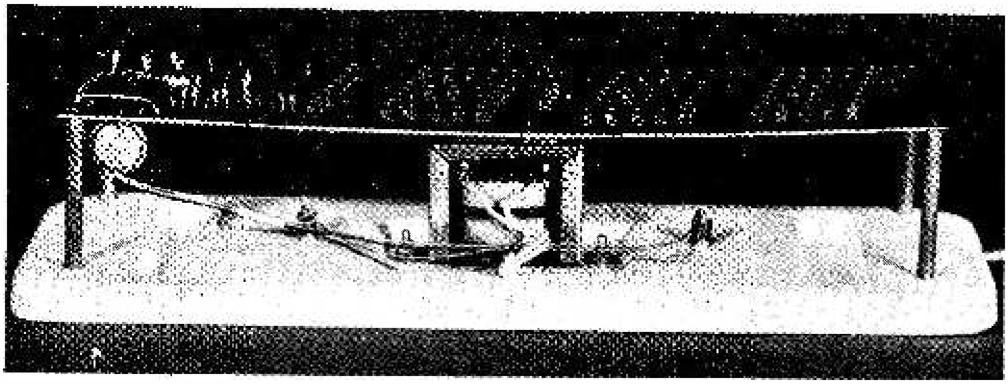


Fig. 6: Component layout and off-board connections



An internal view of the clock, showing the two time-setting switches and the mains transformer mounted on the rear panel

Insert all resistors, diodes, transistors and capacitors (except C3), and the i.c. socket, taking care to check that the semiconductors are fitted the right way round. Solder all the leads and trim the ends close to the p.c.b.

Next insert the l.e.d.s, noting that these are polarised, and should be fitted with the longest lead (the opposite side to the flat on the l.e.d. body) on the side facing away from the transistor, **except** for the two l.e.d.s forming the colon, which face the opposite way.

The l.e.d.s are easily damaged by excessive heat during soldering, and it is best to solder just one leg of each l.e.d. first, and then allow them to cool. Check that all l.e.d.s are in line and flat against the p.c.b., and then solder the second leg and trim off the excess wire ends.

Fit and solder five 300mm lengths of thin, pvc-covered wire to the p.c.b. in the positions shown in Fig. 6. Insert IC1 in its socket (**check correct orientation**). Fit C3 on the foil side of the board, noting that the negative end faces the edge of the board. After pushing the capacitor flush against the underside of the p.c.b., bend the wires over flat against the top side of the board before cutting, so as to create a mechanical fixing. Solder the leads on the foil side.

The four p.c.b. mounting pillars are made from 6mm diameter rod, and drilled 2·4mm to about 12mm deep at each end to take self-tapping screws. If the l.e.d.s and case mentioned in the components list have been used, the pillars will need to be 57mm long. If other types are used, the length will have to be adjusted to suit.

The transformer and switches are mounted on the back of the case, as shown in the photograph, and wired as shown in Figs. 4 and 6. Note that S2 (Set Hours) is on the left-hand side, behind the hours digits. The mains lead should be terminated in a fused clock connector or plug, fitted with a 1 amp fuse.

Testing

When connected to a mains supply, the display should show three zeros and light the colon. On pressing a button at the rear of the case the appropriate digits should change, enabling the time to be set correctly.

Experience has shown that any l.e.d.s damaged internally through soldering are likely to fail during the first 24 hours of operation. It is therefore advisable to run the clock for two days out of the case.

When satisfied with the operation of the clock, the remainder of the case may be assembled. The red Perspex window should be glued into the case front with Evostik (use sparingly to avoid spoiling the finished appearance), and the case fixed together either by means of self-tapping screws or Evostik.

Fault Finding

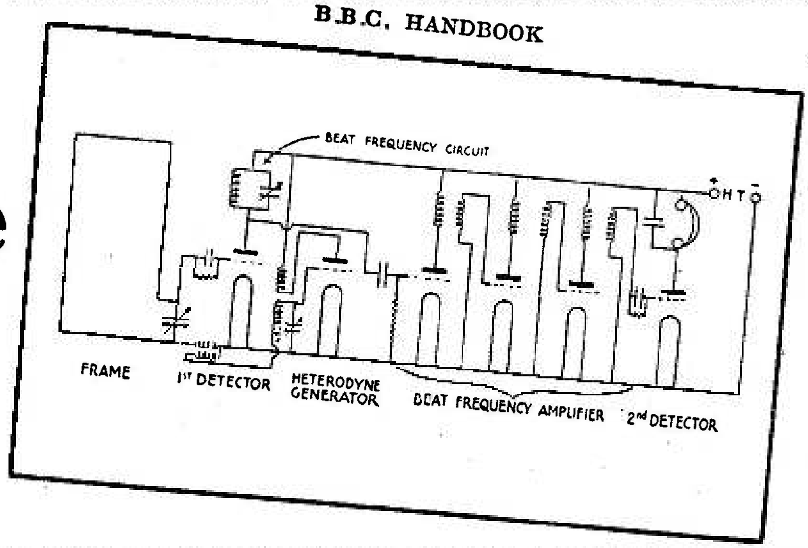
If a single segment of the display fails to light when power is first applied, it is probable that one l.e.d. has been damaged when soldering. To locate the faulty l.e.d., select a number by means of the rear buttons, when it is known that the particular segment should be illuminated, and carefully short out each individual l.e.d. in that segment. The l.e.d. which, when shorted, lights the remainder, is the faulty one. Switch off the power and replace the faulty l.e.d.

If the same segment on each digit is off, check the resistor feeding the line, and the soldering of the associated transistor connections. If one digit is out completely, make the same checks on the resistors and transistor pairs at the bottom of the board.

Noise

In common with all other multiplexed displays, it will be found that severe interference is caused to radio reception in the immediate vicinity of the clock. This interference is radiated from the display wiring, and it is not really practicable to suppress it. It will be found, however, that the noise disappears when the radio receiver is moved more than about a metre from the clock, and it should not normally prove a problem.

A Glance into the Past



Chas. E. MILLER

I recently acquired a copy of the BBC Handbook for 1928. It's a slim, but quite weighty volume of 384 pages, handsomely bound in dark red. Surprisingly, it contains a large number of advertisements, and at this distance in time these are arguably of at least as much interest as the text! For instance, on pages 2 and 3 we find a double-spread for Mr C. S. Dunham, late radio engineer to the Marconi Scientific Inst. Co., and a member of the BBC since its conception. (A somewhat doubtful word to employ in connection with that august organisation, I would have thought!), who has now set up in business as a manufacturer of high-class receivers. The two-valve loudspeaker set has a performance equal to many three-valve sets, at half the price and half the maintenance costs. Tuning is by a single dial with a small knob to vary reception power to individual requirements. Coils are entirely dispensed with. The larger C.S.D. 51D three-valver has a handsome cabinet fitted with a lock and key! It is a beautiful piece of furniture worthy of the most exclusive (but not presumably the most affluent) home, and is secured by a down payment of 35s 6d, and 25s monthly. Should you doubt any of the claims made, sworn statements are available for only 2d postage.

Passing on, Messrs Igranic Electric Co. Ltd. modestly announce their Neutrosonic Seven Radio Receiver, with the words: Igranic Radio Devices put life into a circuit — life in the zest and virility they give to results — life in the extraordinary length of time they continue to give such complete satisfaction. But what's this on page 17? An appeal To The Women Of Britain, no less, by a firm which has an enormous range of sizes, shapes, and designs. Of lampshades, I hasten to add. Hailwood & Ackroyd Ltd. (Morley, Nr. Leeds), enjoin the ladies to make their homes a Heaven on Earth for their menfolk by the use of their glassware. Zest, virility, and Mutual Pleasure! They certainly don't write advertisements like that any more. It makes one yearn for those far-off days when people thought a double-entendre was French for a pair of earphones.

Origins

Ah well, on to the text. In an article entitled "BBC — the old Regime" we learn that the original British Broadcasting Company was set up in a remarkably short space of time — talks started in May, 1922, and the Company was registered on 15 December of that year. However, stations in London, Birmingham, and Manchester were commissioned on 15 November, and Newcastle had programmes from the following Christmas Eve. Thus, by the end of the year the BBC was able to claim that 40 per cent of the population were in "crystal range" of a transmitter. By the Autumn of 1925 this figure had increased to nearly 80 per cent.

In June, 1927, there were 2 299 822 licences in force for reception, which wasn't bad growth from virtually a standing start less than five years previously. Curiously enough the BBC now wished to dismantle the local stations in favour of "regional" broadcasting, not without some opposition from listeners, particularly in Birmingham, where the old 5IT transmitter in Summer Lane had already been closed down and replaced, in part, by the new high power experimental station 5GB at Daventry. High power in this instance meant 30kW; not a lot by today's standards, but vastly greater than the other stations then operating. 2LO, for example, was the next in line with 3kW, while most of the others had no more than 200 watts (0·2kW). In the light of this it is really surprising that so many people could expect to get good results on the insensitive receivers then in common use, albeit with very largely no choice of programmes.

With a glance forward to the independent radio network set up in the 70s, we find that it more closely mirrors the old British Broadcasting Company's chain of stations than does the latter day BBC's own local radio. La plus ça change, etc . . . Returning to the lack of choice in the 20s, however, it is refreshing to find that the handbook contains a list of all the major European radio stations as well as the domestic ones, for what was quaintly termed "reachers out", or long-distance listeners. There is even a reference to broadcasting in the United States — " . . . many of (the stations) giving regular transmissions of fair to excellent quality . . ." There were, incidentally, 50 stations in Chicago alone, so choice would not seem to have been any problem!

Programmes

Browsing along, in an article entitled "Topical Addresses", we discover that the Instant TV Pundit of today is merely a descendant of an older breed: ". . . the 9.20 space on Monday evening is still vacant on the morning of the same day, and somebody on the staff of the BBC is wondering whether it would not be possible to shift the centenary of Dante or King Charles the Martyr on the strength of some historical quibble, and make it, rather abruptly, that very Monday as ever is, and by the same token telephone to Professor Asterisk Space, the celebrated Italian authority, and get him to broadcast at 9.20." It appears that one talk broadcast from London was criticised in listeners' letters because it was (a) biased towards Communism, (b) Fascist propaganda, (c) anti-clerical, (d) sectarian propaganda, (e) frivolous, (f) over-intellectual. We are not told who made the broadcast in question, or what was its burden, but one hopes that the luckless author could shrug off the reaction with the time-honoured "Ah well, you can't please 'em all!"

A large section of the book is devoted to explaining how the programmes were produced, and fascinating reading it is. However, perhaps we should now confine ourselves to the technical matter, which is truly comprehensive, starting with an historical survey of "Wireless", and going on to detailed discussion of the BBC transmitters, with circuits of amplifiers and oscillators, and of other radio stations, such as that used for transatlantic telephones. This latter worked on about 5000 metres (60kHz) using single-side-band! At least there shouldn't have been too much difficulty in keeping the local b.f.o. on tune at that frequency.

Equipment

Moving on to receivers, there are details of many types of set, from the simplest crystal to a superhet, with two stages of "h.f. magnification". The listener is warned against wearing headphones whilst making adjustments to mains-powered high tension supplies, because of the danger of electric shock. It was remarked that "modern headphones are much improved acoustically, but whether sufficient attention has been given to the response/frequency curve in every case is open to question. No doubt the necessity for a low price is responsible . . ." Neither could the moving-iron type of loudspeaker boast of really good reproduction, but in America the moving-coil speaker had already become widely used. Interspersed into the pages of this particular section are the numerous advertisements of the loudspeaker manufacturers. The Celestion C.12 could be had in oak for £7 5s, or in mahogany for an extra 5 shillings; but "this is but one of the 1927–28 Celestions, which range in price from £5 10s to £25.(!) They all definitely improve with age." Perhaps they matured, like wine. No doubt if anyone discovers one which had been laid down in a cellar back in 1928, it will by now out-perform anything the hi-fi merchants can offer!

And so to aerials. Once again the advice given to listeners is applicable to all sorts of receivers and reception conditions. In general they were urged to use the maximum length of wire allowed by the receiving licence — 100ft, and no doubt they needed to if they wished to hear a 200 watt transmitter at any distance with a crystal set. The earth, too, was important, the recommended method of ensuring good results was to bury a 3 feet square plate in damp ground, with the lead-in wire soldered to several points along its top edge, with a ". . . small wooden cover over the joint, so that it may be inspected from time to time." This section ends, incongruously, with a picture of four aristocrats playing a hand of Bridge, which was being broadcast! There is no sign of a commentator, so perhaps the listener heard only the player's voices, plus the occasional soft thud of a well-shod foot impinging on a partner's shin!

From then on, most of the text is devoted to the do-it-yourself enthusiasts of the day, with articles by outside contributors on subjects such as "Hints for the Novice", and "The Home Constructor Scores", followed by 12 Don'ts for Listeners (e.g. DON'T forget that it is impossible practically to get true reproduction when receiving in the "silent point". How about that?), a glossary of technical terms. In this latter are some terms which are surprisingly familiar, such as, KiloHertz, Push-pull Amplification, and Cathode Ray Oscillograph.

In a limited space it is clearly impossible to do full justice to a book which is rich in interest, so here are just three more samples.

The Ormond 5-valve Portable advertised on page 306 is ". . . ideal for indoor and outdoor use . . . and will render perfect reproduction under average conditions from a main BBC station within about 30 to 40 miles, and about 400 miles of Daventry." Price, ready for immediate use, £24 10s — but then comes the sting in the tail. Marconi Royalty, extra, was no less than £3 2s 6d, or just over 12½%. No doubt this caused as much displeasure as does VAT today! On the very last page is an ad. for the British Radio Corporation, of Weybridge. It can't be the same one owned by Thorn, can it? Anyway, their speciality of the day was a High Frequency Combination Transformer, 200–2000 metres, which sounds as though it was intended to convert ordinary t.r.f. sets into superhets, although only hinted at by the reference to a high value of intermediate frequency. A somewhat strange reticence compared with

continued on page 59

Ideas DEPARTMENT

Some original circuit ideas provided by our readers. These designs have not been proved by us, and we cannot therefore guarantee their effectiveness. They should at least provide a basis for experimentation.

Why not send us your idea? If it is published, you will receive payment according to its merits. Articles submitted should follow the usual style of PW in circuit diagrams and the use of abbreviations. Diagrams should be clearly drawn on separate sheets, not included in the text.

Each idea should be accompanied by a declaration that it is the original work of the person submitting it, and that it has not been accepted for publication elsewhere.

REMOTE AERIAL PRE-AMP SUPPLY

There have been several published designs for remote (mast-head) aerial pre-amplifiers, but these have generally been battery powered, or fed via a separate supply cable. It is very convenient, and not difficult, to supply power via the signal coaxial cable, using the circuitry shown here to draw power from the associated tuner.

In Fig. 1, C1 isolates the d.c. supply from the pre-amp output, and L1 prevents the r.f. output from being shunted away via the pre-amp power supply circuits. Resistor R_x is

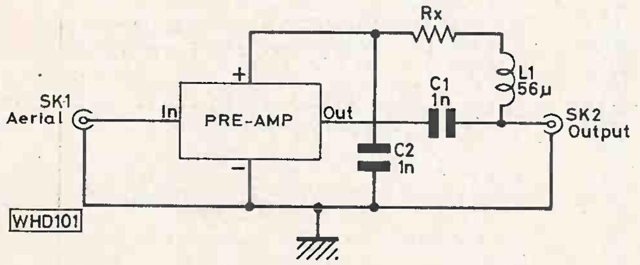


Fig. 1

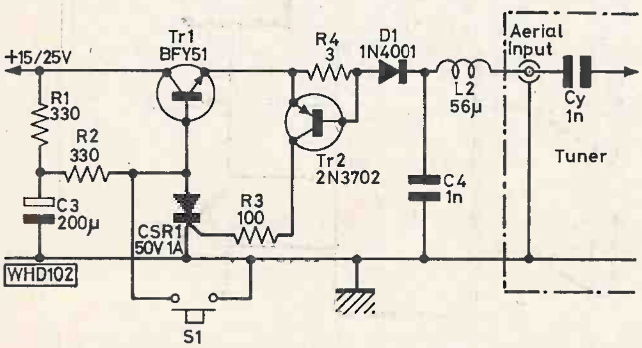


Fig. 2

chosen to reduce the supply voltage to the required value at the rated current consumption of the pre-amplifier, and also provides supply decoupling in conjunction with C2.

To prevent damage to the tuner's power supply, in the event of a short-circuit on the aerial downlead, some sort of overload protection is necessary. The circuit of Fig. 2 is fed from the power supply reservoir capacitor, which will often have around +15/25V on it. The series pass transistor Tr1 acts as the control element of the overload protection circuit, and also provides electronic smoothing by the action of R1, C3, R2. When an excessive current is drawn, the voltage drop across R4 will rise above about 0·6V, turning on Tr2, whose collector current triggers CSR1. When CSR1 conducts, it removes the base drive from Tr1 and so shuts off the d.c. supply to the tuner aerial socket via D1 and L2. The supply is restored by pressing S1, the "Reset" button. Diode D1 protects Tr1 from high reverse emitter-base voltages which can occur at switch-off if there is a large-value capacitor in the aerial pre-amplifier. Decoupling is provided by L2 and C4. Capacitor C_y must be added to the tuner input circuit if the latter is not a d.c. open circuit.

The output voltage of the protection circuit will be about 1·5V less than the tuner supply voltage, due to the voltage dropped across Tr1, R4 and D1. With the value shown for R4, shutdown will occur at a load current of about 200mA. If some other value is required (dictated by the maximum safe additional current which can be drawn from the tuner power supply), the value of R4 can be calculated from the formula:

$$R4 = 0{\cdot}6/I_c$$

where R4 is in **ohms** and I_c is in **amps.**

The inductors L1 and L2 should be mounted as close as possible to the coaxial sockets, and may be made by winding about five turns of enamelled copper wire onto a ferrite bead. Other than this, the circuit layout is in no way critical.

P. J. H. Fox
Oxford

THE PW 'TRENT' 150W BROADBAND H.F. LINEAR AMPLIFIER

PART ONE

This article describes the theoretical and practical considerations necessary to construct a push-pull 150 watt, solid state linear r.f. power amplifier. The unit, which provides a 15dB gain, is primarily intended for use with s.s.b. transmitters, and employs broadband technology, covering the range 2–28MHz. Operation is from a 13·8V d.c. source and the full output is achieved for only 3 watts excitation. Intermodulation products, measured at 28MHz for 150 watts p.e.p. are better than −30dB.

The amplifier, which is fairly simple to construct, uses two TRW power transistors type PT9784/A and a BD135. A schematic diagram is given in Fig. 1. Readily-available European components were a prerequisite design consideration.

Design Criteria

In a push-pull configuration the transistor input or output impedances are in series, making the required transformation ratio one-quarter of that required for parallel operation. This method has been chosen to improve even-harmonic suppression and to simplify the matching problems due to very low input and output transistor impedances.

The circuit calculation was made in the following order:

1. Choice of the input and output transformer ratio.
2. Choice of transformer type.
3. Estimation of the transformer volumes.
4. Calculation of the transformer compensation.
5. Calculation of the input network between the input transformer and the transistors to match the two input impedances to 3Ω and to stabilise the gain/frequency characteristic.

A detailed analysis of the theoretical parameters will be given later for those wishing to study the technology. However, this should not deter the amateur from constructing the module, which requires only a little care and common sense in order to make it work.

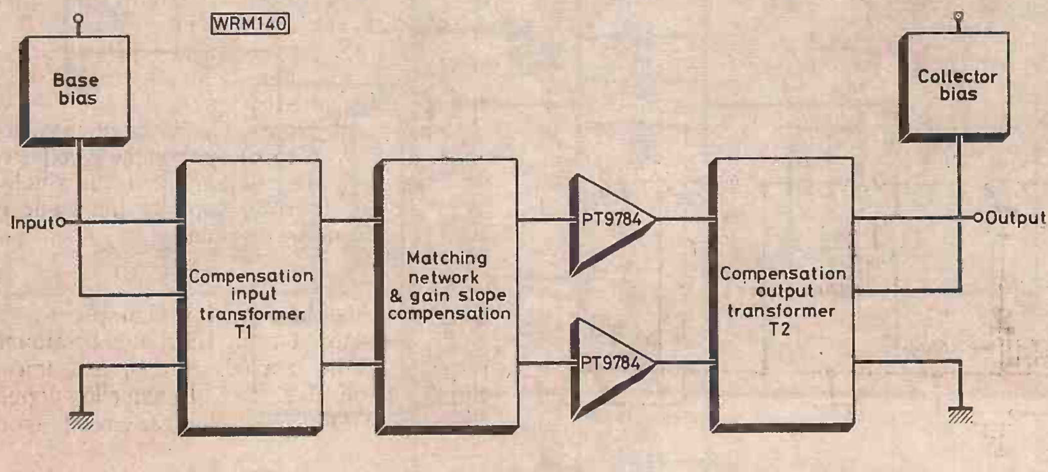
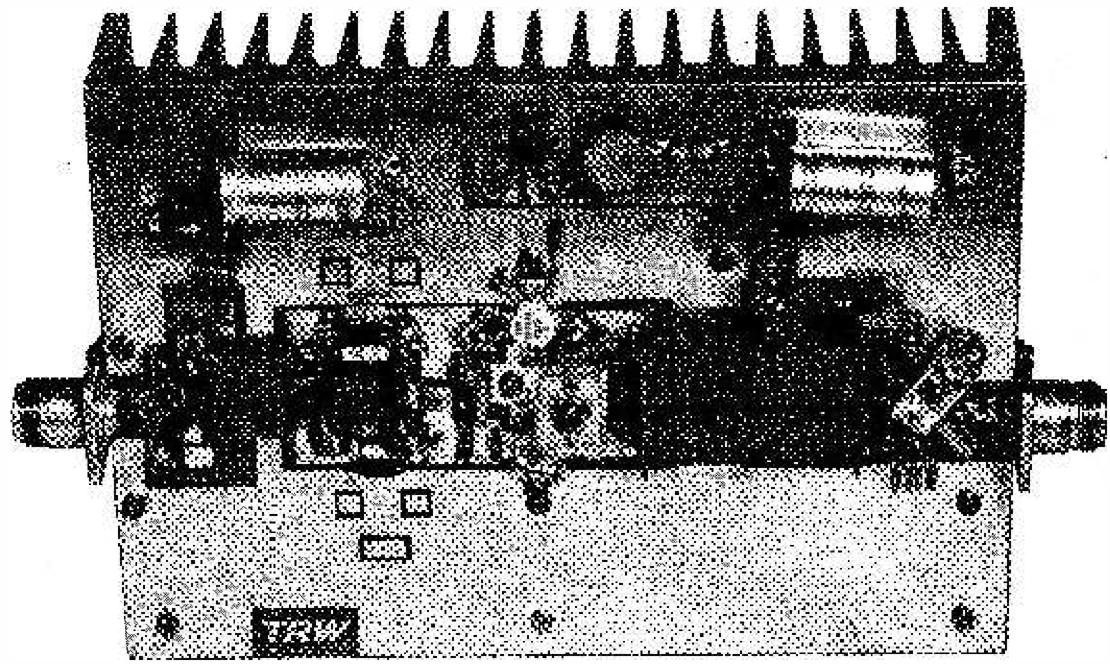


Fig. 1: Block diagram of the amplifier



The complete circuit is shown in Fig. 2 and the p.c.b. and component locations in Figs. 6 and 7. On-the-top assembly is employed throughout and the heatsink should be drilled and countersunk to permit the power transistors to seat properly on the p.c.b. The mica chip capacitor and the transformers should be the first devices to be fixed to the board. *Note that one of the transformer end-pieces forms the centre-tap in each case.*

When the transformers for the prototype were built, some difficulty was experienced in locating brass tubing of the prescribed dimensions. It is possible that copper would suffice, but the original development module called for brass, so a supply was ultimately found, and appears in the components list. Several other devices could possibly be substituted, but those listed are those currently working in the prototype.

Output Circuit

The equivalent r.f. output circuit is given in Fig. 3. Resistor AA, capacitor AA and inductor BB form the equivalent circuit to 2 × Z_{OUT} in series. Capacitor CC, capacitor EE and inductor FF are the transformer h.f. compensation. The transformer itself is a black box, described by its S-parameters.

Optimisation of the compensation elements was carried out with the aid of a computer and the maximum output v.s.w.r. is lower than 1·6:1.

Input Circuit

The equivalent r.f. input circuit is shown in Fig. 4. Here IMP JJ represents the two transistor input impedances in

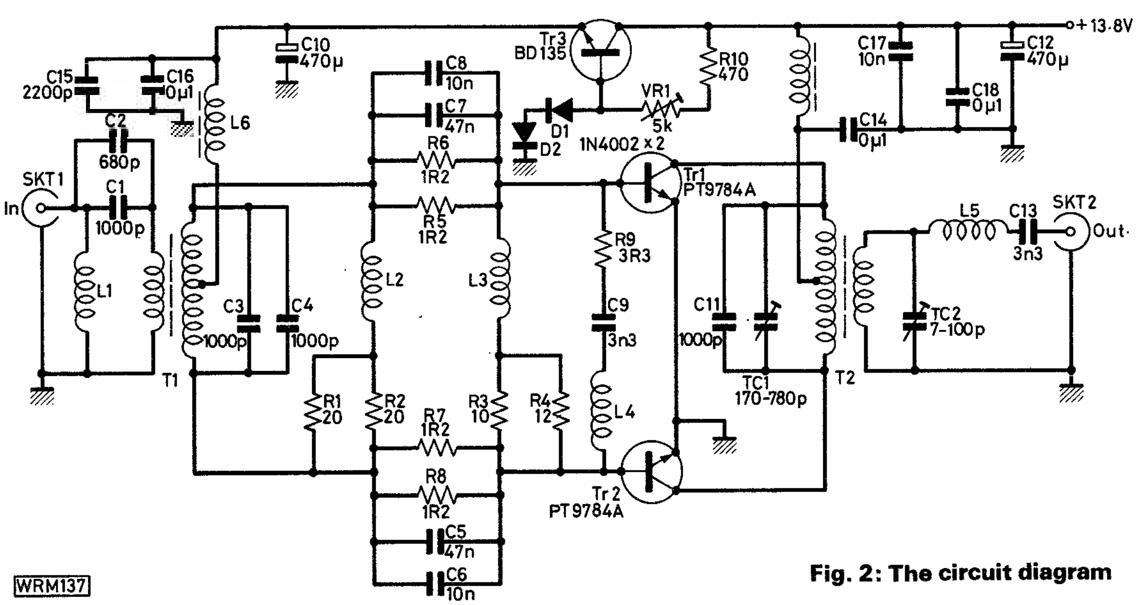


Fig. 2: The circuit diagram

Elements		Calc. value	Empirical value
CC	Cap (pF)	1474	1000+100/700 ✱
EE	Cap(pF)	136	20/100 ✱
FF	Ind. (nH)	256	90
	Cap (pF)	2993	4700

✱ Variable capacitor

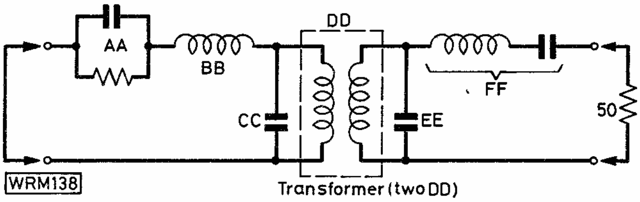


Fig. 3: Equivalent output circuit

Elements		Calc. value	Empirical value
AA	Ind. (nH)	5732	4000
BB	Cap(pF)	1294	1680
DD	Cap(pF)	1146	2000
EE	Res (Ω)	13·4	10
	Ind. (nH)	189	200
FF	Res. (Ω)	1·3	1·2
	Cap. (pF)	33350	57000
GG	Res (Ω)	7·2	5·5
	Ind (nH)	93·3	95
HH	Res(Ω)	6·8	4·3
	Ind (nH)	31·5	45
	Cap(pF)	3040	3300

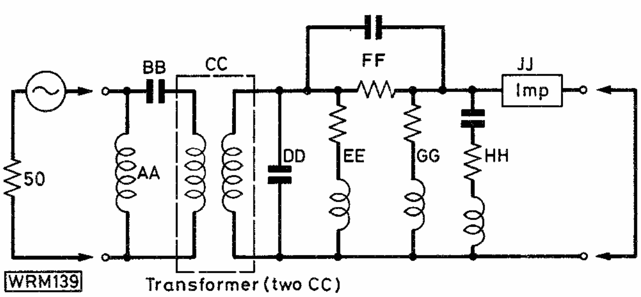


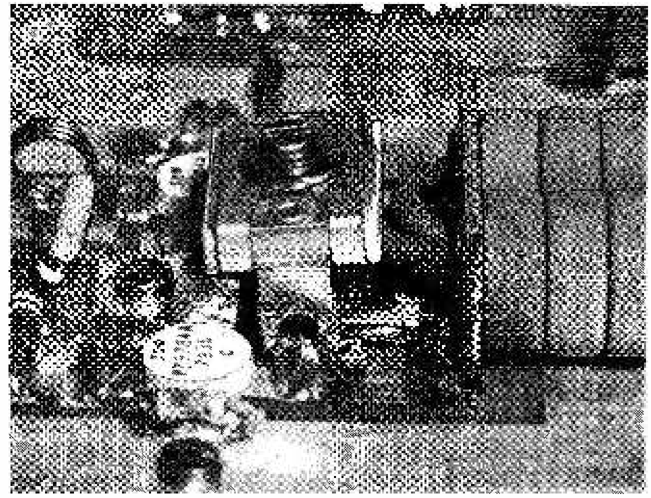
Fig. 4: Equivalent input circuit

series. Inductor AA and capacitor BB are for low-frequency transformer compensation and capacitor DD forms the high-frequency compensation.

Circuits EE, FF, GG and HH have two functions, namely to form a selective attenuator with 3Ω input impedance to stabilise the gain/frequency characteristic and to match the two transistor input impedances (which are in series) to 3Ω with the minimum of loss at the highest frequency. Again a computer program was employed to arrive at the final figures and the maximum v.s.w.r. is lower than 1·6:1.

Bias Circuit

Naturally, the two power transistors heat during operation, although this effect is reduced if the duty cycle



The mica chip capacitor can be seen between the trimmer and the end of the transformer. Note also the fins of the power transistor

is low—as in the case of c.w. or s.s.b. Never-the-less, a thermally-compensated bias current must be arranged. In this instance an emitter-follower circuit is used producing a low output resistance, in which the base voltage is fixed by a thermally-variable component—diode D2. This is fixed to the heatsink in a manner which ensures good heat transfer to take place. The method used in this project was to shape the adjacent fin on one of the power transistors into a bracket with which to secure the diode. A detailed illustration is given in Fig. 5. The diode D1 is needed to compensate the V_{BE} of the transistor.

A more sophisticated circuit could have been evolved but this is quite adequate for the purpose. Potentiometer VR1 is used to adjust the current through the diodes by changing the voltage across them.

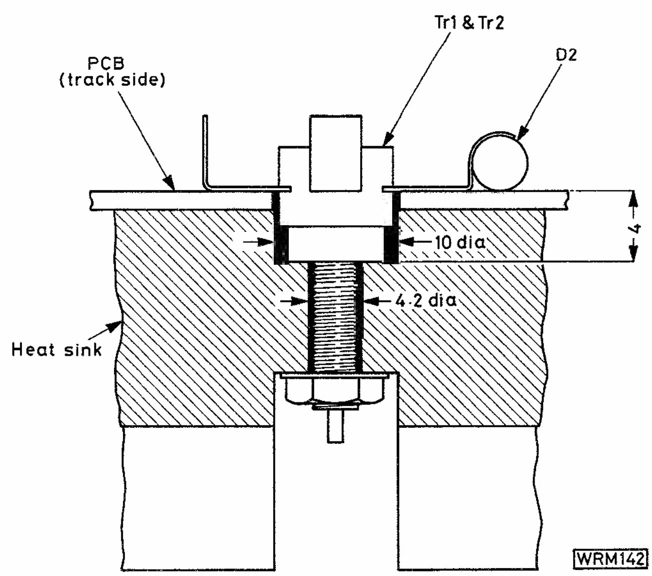


Fig. 5: Fixing diode D2 and mounting the power transistors

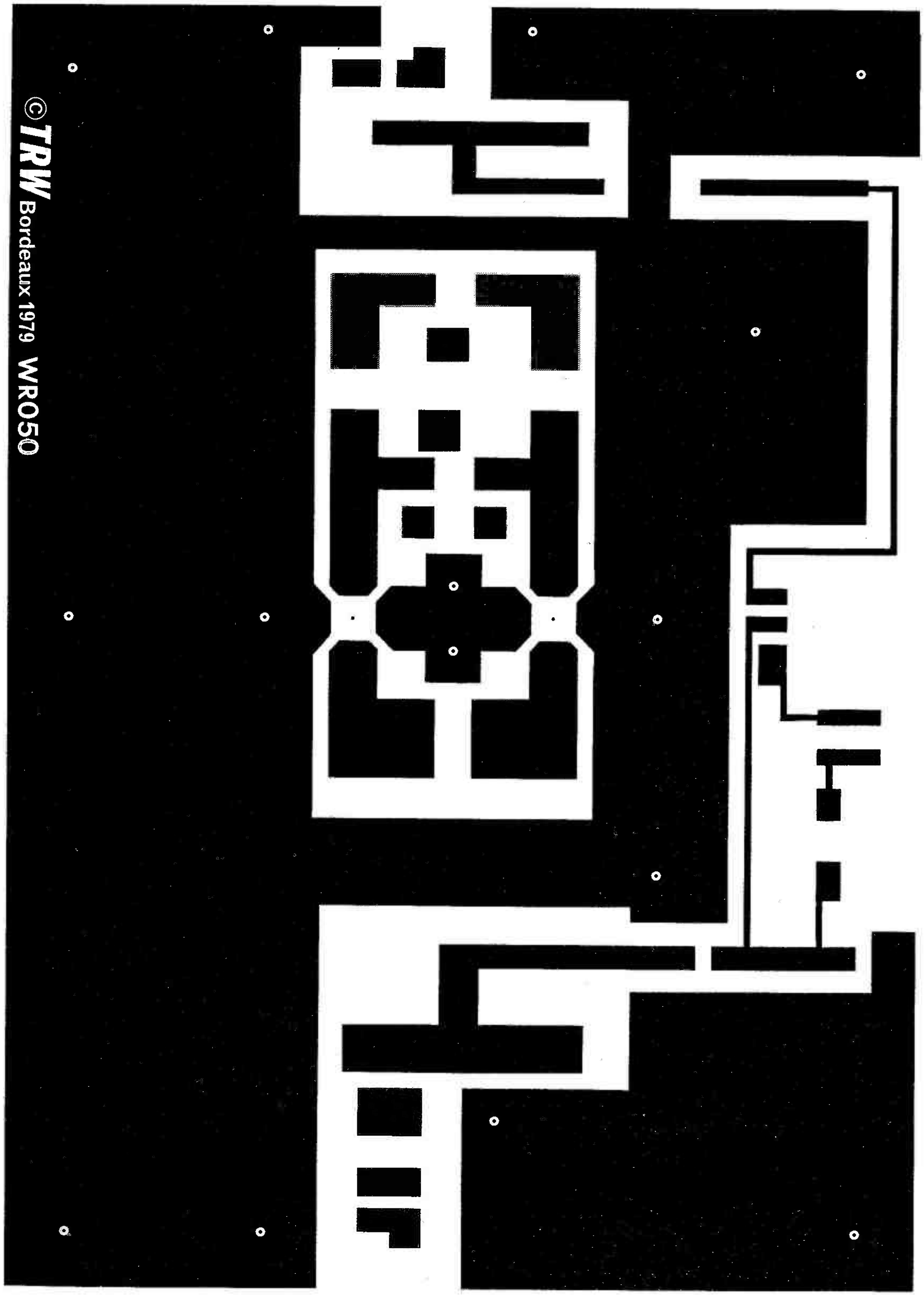


Fig. 6: Printed circuit board pattern

WRM136

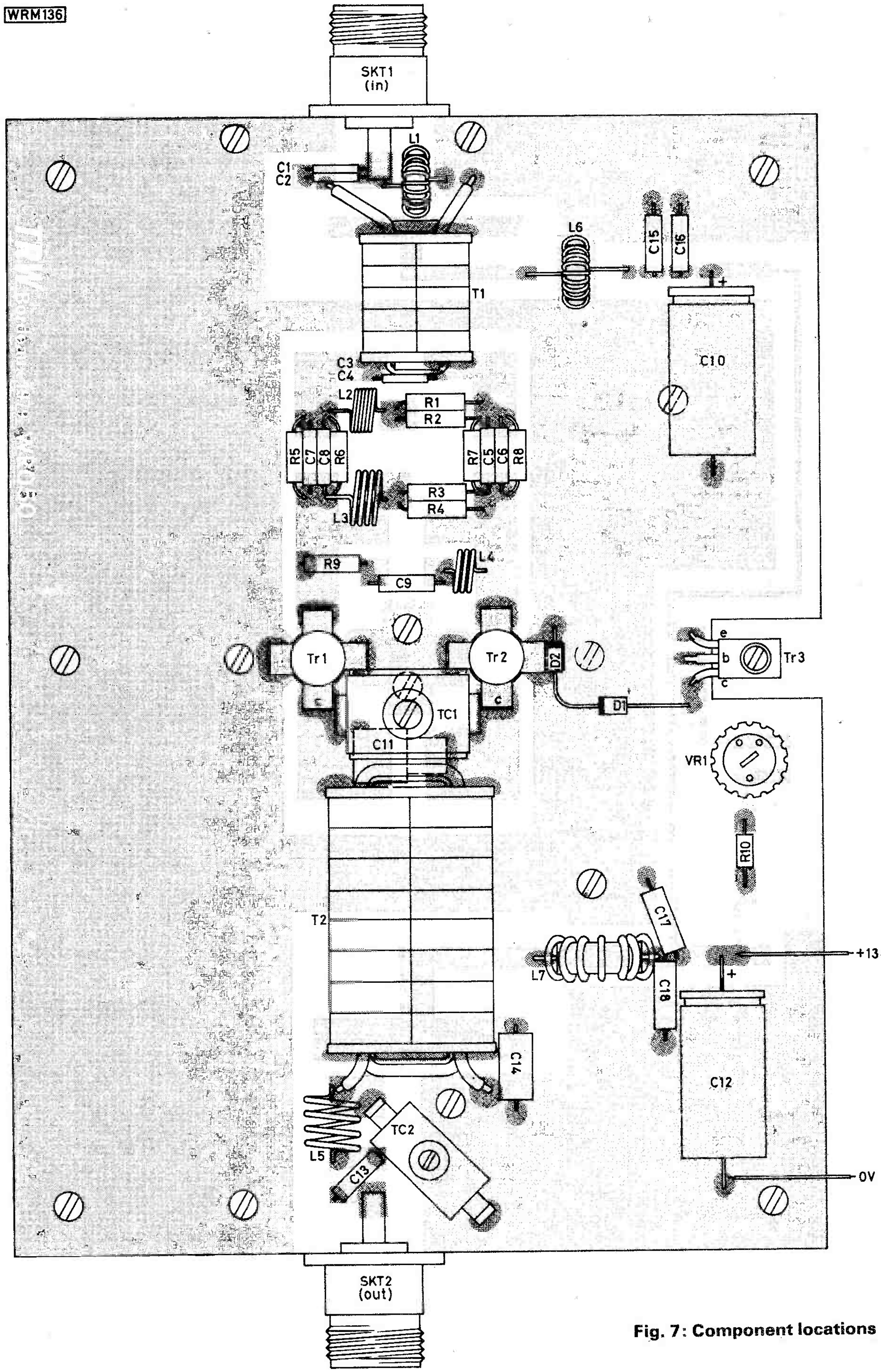
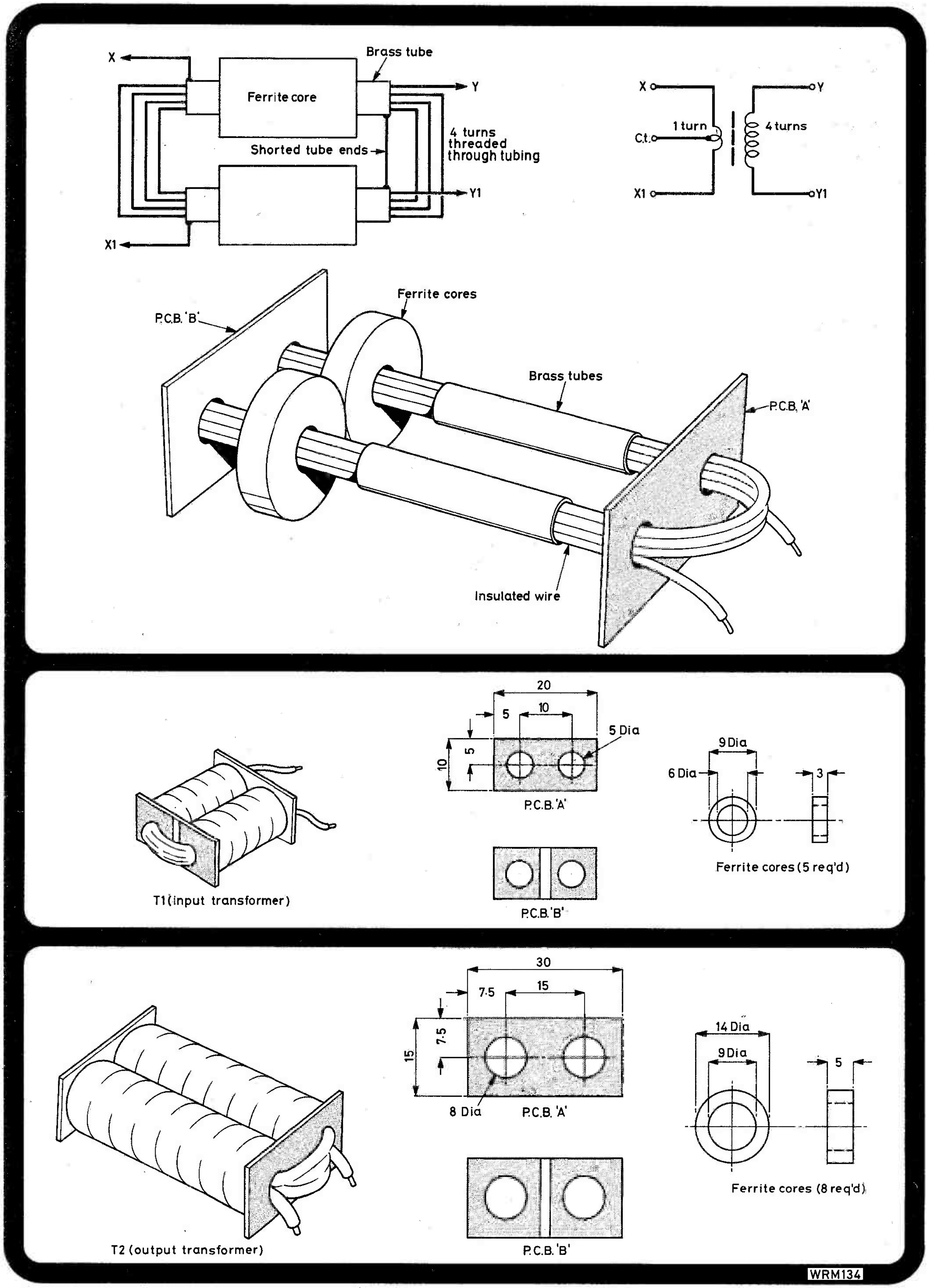


Fig. 7: Component locations


X
Brass tube
Ferrite core
Y
4 turns
threaded
through tubing
Shorted tube ends
Y1
X1
X
Y
1 turn
4 turns
C.t.
X1
Y1
Ferrite cores
P.C.B. 'B'
Brass tubes
P.C.B. 'A'
Insulated wire
20
5
10
5 Dia
5
10
P.C.B. 'A'
9 Dia
6 Dia
3
Ferrite cores (5 req'd)
T1 (input transformer)
P.C.B. 'B'
30
7·5
15
7·5
15
8 Dia
P.C.B. 'A'
14 Dia
9 Dia
5
Ferrite cores (8 req'd)
P.C.B. 'B'
T2 (output transformer)
WRM134

★ components

Resistors

½W 10% metal oxide

1·2Ω	4	R5, 6, 7, 8
470Ω	1	R10

½W 5% carbon composition

3·3Ω	1	R9
10Ω	1	R3
12Ω	1	R4
20Ω	2	R1, 2

Potentiometers

Horizontal mounting, cermet, enclosed pre-set

5kΩ	1	VR1

Capacitors

Miniature dipped-case polyester

2·2nF	1	C15
3·3nF	2	C9, 13
10nF	2	C6, 8
47nF	2	C5, 7

Miniature ceramic disc

680pF	1	C2
1nF	3	C1, 3, 4
10nF	1	C17

Monolithic ceramic

0·1µF	3	C14, 16, 18

Mica chip

1nF*	1	C11

Tubular electrolytic. Axial leads

470µF 25V	2	C10, 12

Trimmers

Arco compression type

7–100pF*	1	TC2 (Arco 423)
170–780pF*	1	TC1 (Arco 469)

Semiconductors

Transistors

PT9784/A*	2	Tr1, 2
BD135	1	Tr3

Diodes

1N4002	2	D1, 2

Coils

L1 15 turns 0·5mm enamelled copper wire on *RTC 4322–020–97170 toroid

L2 6 turns 8mm inside diameter of 0·8mm enamelled copper wire

L3 6 turns 8mm inside diameter of 1mm enamelled copper wire

L4 4 turns 8mm inside diameter of 0·6–0·8mm enamelled copper wire 6mm long

L5 4 turns 10mm inside diameter of 0·8–1·4mm enamelled copper wire 9mm long

L6 25 turns 0·5mm enamelled copper wire on *RTC 4322–020–97170 toroid

L7 10 turns 1·5mm enamelled copper wire on *RTC 4322–020–97180 toroid

Transformers

T1—Primary

*2 × 5 ferrite cores 9 × 6 × 3mm $\mu_r = 120$, material 4C6 RTC reference 4322–020–97170 on 2 brass tubes 5mm o.d., 22mm long, with 10 × 20mm piece of copper-clad board at each end—see text.

T1—Secondary

4 turns of 0·5mm² insulated wire, wound through the 2 brass tubes.

T2—Primary

*2 × 8 ferrite cores 14 × 9 × 5mm $\mu_r = 120$, material 4C6, RTC reference 4322–020–97180 on 2 brass tubes 8mm o.d., 49mm long with a 15 × 30mm piece of copper-clad board at each end—see text.

T2—Secondary

4 turns of 1·8mm² insulated wire, wound through the 2 brass tubes.

Miscellaneous

Printed circuit board (C. Bowes & Co.)
Heatsink*. Coaxial sockets (2)

Component Sources

The specialised components marked with an asterisk are available from R. B. Knight, 28 Lynwood Drive, Wimborne, Dorset. Tel: (0202) 888426. These include the RTC ferrites used for the transformers and coils L1, L6 and L7. In addition, suitable brass tubing for T1 and T2 can also be obtained from this source.

Making the Transformers (Fig. 8)

By careful reference to the drawings one should be able to reproduce the transformers with a high degree of accuracy. Note the end pieces (which are made from small rectangles of single-sided copper-clad board) very carefully. One has a narrow strip of copper removed to form two distinct and separate islands. The other joins the two brass tubes and when fixed to the main p.c.b. forms the centre-tap connection.

Only the dimensions, wire gauges and—most important—the toroids specified must be used. The transformer assemblies should be fitted to the p.c.b. before the windings of insulated wire are inserted into the tubes, otherwise heat generated during the soldering process may destroy the sleeving.

The heatsink used to accommodate the prototype can be seen to be quite substantial—around 0·5°C/W. However, the power amplifier could well be reduced in size and mounted within existing equipment, say on a metal

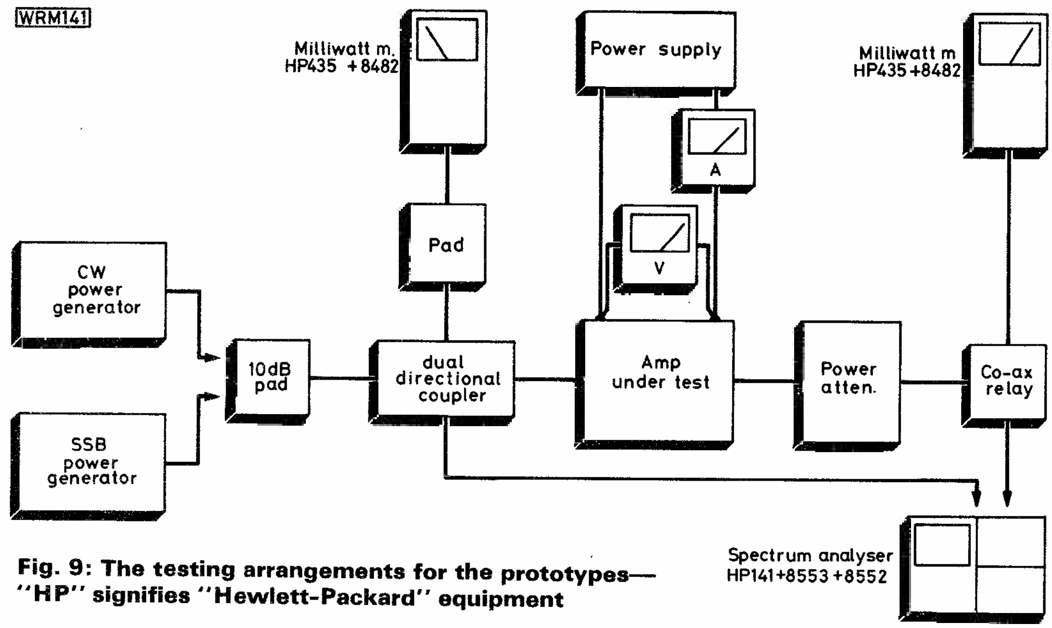


Fig. 9: The testing arrangements for the prototypes—"HP" signifies "Hewlett-Packard" equipment

back-plate. In this case, additional heatsinking could be provided on the outside.

If the method of mounting the power transistors used in the prototype is used, it will be necessary to put a small, flat-bottomed countersink in the heatsink to settle the devices properly (Fig. 5). Great care should be taken to ensure maximum heat transfer by making the stud holes only just large enough for the thread to pass through. Do not chamfer, but de-burr with Emery cloth. Apply a smear of thermal grease and tighten—firmly, but not so as to stretch the studding. (About 10lb. inches torque, for the perfectionist.)

Finally, note that in some areas continuity of the earth plane sections of the p.c.b. is effected by the fixings to the heatsink. If other arrangements of the amplifier are envisaged, it may be necessary to take this into account.

Setting up the Amplifier

The technology employed in this project means that a minimum of adjustment is required to achieve acceptable performance. If you are fortunate enough to have access to a spectrum analyser, all the better. A description of the original test arrangements is given in Fig. 9.

In its quiescent state, the module will only draw a few hundred milliamps—typically 200. This is set by the potentiometer VR1. It is a good idea to initially apply a very low level of r.f., which is increased gradually whilst carefully observing the current consumption. Judicious peaking of the trimmers should be all that is necessary to produce the required output.

KINDLY NOTE!

PW "Soundlite", March 1979
On Fig. 5, electrolytic capacitor labelled C18 adjacent to D12 should be C13. On Fig. 6 the labels on the Bass and Treble switches should be transposed.

Car Test Probe, May 1979
The three l.e.d.s (D2, 3, 4) are shown connected the wrong way round in the circuit diagram. They are correctly shown in the component drawing.

THE PW 'WINTON' Stereo Amplifier

Part 4

E.A.RULE

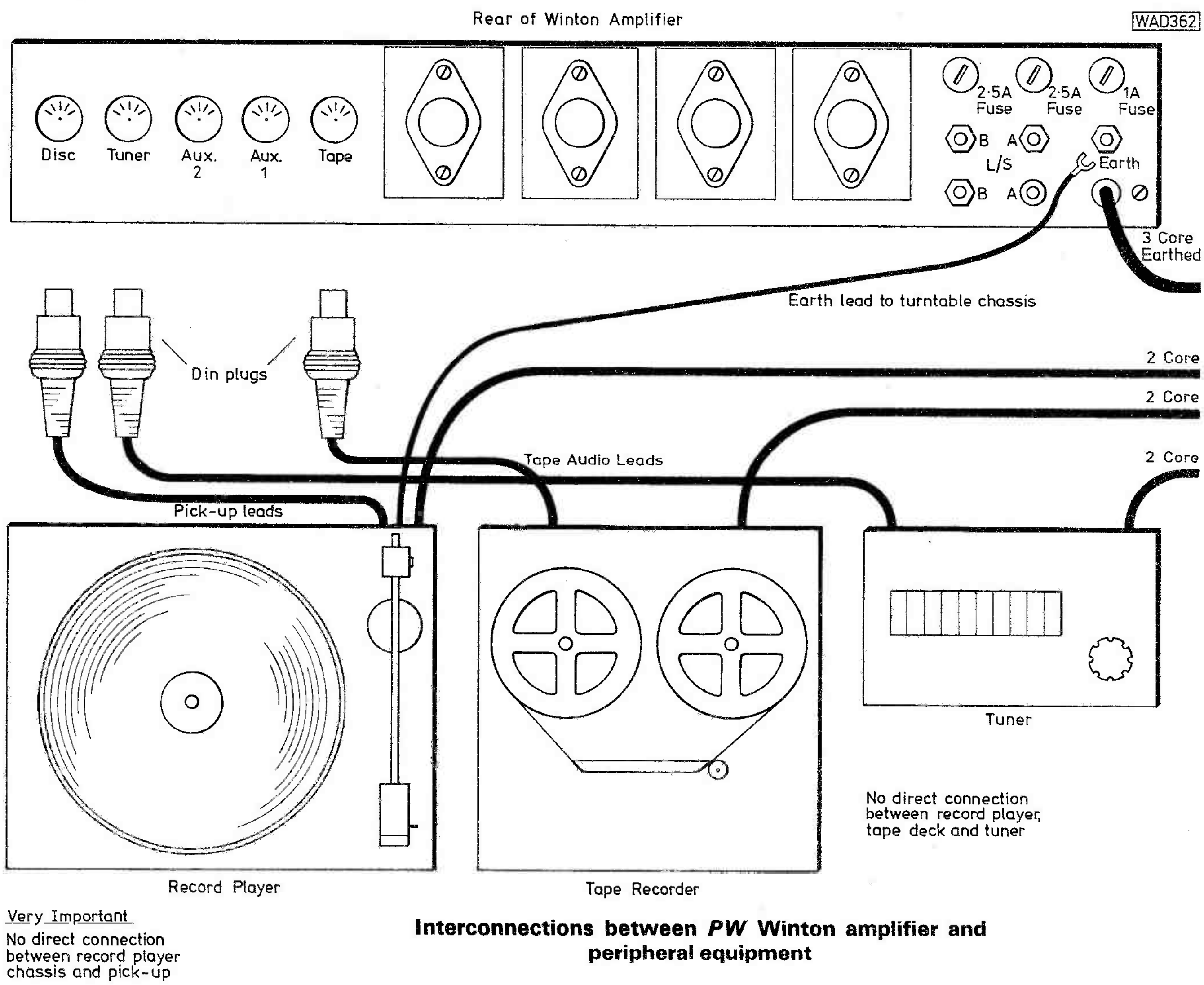
The manner in which the peripheral components of a hi-fi system are connected to the main amplifier is very important, especially if low noise and hum are required. One extra earth connection can lead to horrible hum problems through earth loops.

The drawing (Fig. 19) shows how the connections should be made between the *PW* Winton amplifier and the tape, record deck and tuner unit.

Three minor errors occurred in the metalwork drawings in the April issue. Fig. 13 which shows the mounting details of the power transistors has the chassis upside down and inside out. The right-angle fold should be at the bottom and folded away from the heat sink.

Fig. 14 the main chassis drawing has the mains transformer fixing holes shown at 75mm from the back edge of the chassis. The entire group of holes for this component should be centred at 75mm from the front edge.

Fig. 15 has the chassis front shown upside down, with the bottom fold at the top.



Interconnections between *PW* Winton amplifier and peripheral equipment

OF THE MONTH 76

Brian DANCE M.Sc

FAIRCHILD μA78HG REGULATOR

Most of the currently available voltage regulators will provide only a small output current of the order of 100mA to 1A. Greater current demands require the use of a low current regulator with a series-pass transistor in a more complex circuit or a number of low current regulators.

Most regulator devices have a fixed output voltage. Although variation is possible by suitable circuit techniques, it is not generally convenient to purchase just one type of fixed voltage device and expect to be able to use it to provide a specific voltage range.

The new Fairchild μA78HG 5A regulator with variable output voltage can provide the answer to the problem of obtaining high output currents from simple circuitry over the wide operating output range of 5V to 20V.

The μA78HG

The μA78HG is encapsulated in an hermetically sealed metal package like that of TO-3 transistors, but has the four connections shown in Fig. 1 instead of the normal three leads of a TO-3 device. The case must be bolted to a suitable heat sink where the internal power dissipation is appreciable. The letter "H" in the type number of this device signifies that it is a "hybrid" component which unlike monolithic integrated circuits contains several silicon chips joined together internally.

The μA78HG can be used in the simple circuit of Fig. 2. The internal circuitry of the device maintains the "control" pin at +5V relative to the "common" pin. It is recommended that the value of the current in R2 should be 1mA, so R2 should normally have a value of 5 kilohm.

The value used for R1 determines the output voltage. This output voltage, V_o, is given by the equation:

$$V_o = 5 \times (1 + R1/R2)$$

Thus if R1 has a value of 5kΩ, the output voltage will be 10V, whilst R1 should be 15kΩ for a 20V regulated output.

For a variable output voltage, R1 should be replaced with a suitable potentiometer.

Drop-out Voltage

It must be emphasised that this type of regulator cannot supply a greater output voltage than the applied input voltage; indeed, the output will always be somewhat less than the input. As the input voltage is decreased, a point is reached at which the regulator circuit "drops out" and ceases to function. The drop-out voltage is the difference between the input and output voltages when the regulator ceases to function.

The drop-out voltage of the μA78HG is typically 2·6 volts at 3 amps output, and 3 volts at 5 amps output. Thus one should always ensure that the input voltage to the circuit is at least 3·5 volts above the maximum output voltage required. However, the input voltage must never be allowed to exceed 25 volts, even for an instant, or the regulator device may be damaged.

The μA78HG contains an internal circuit to prevent damage when the output voltage is accidentally shorted to ground. This internal circuit limits the output current to approximately 7 amps under such conditions. In addition, the device incorporates "safe operating area" protection which ensures that the power transistors in the device are kept within the safe operating area of their current/voltage characteristic. Any tendency to go outside this safe operating area will result in the device being shut down with little output current until the condition is cleared.

Thermal Considerations

The μA78HG also has internal circuitry which prevents damage to the device by overheating, such as when an inadequate heatsink is fitted. Never-the-less, it is advisable to operate the device so that it does not become too hot, since high temperature operation tends to reduce the life by a factor of about two for each 10°C rise.

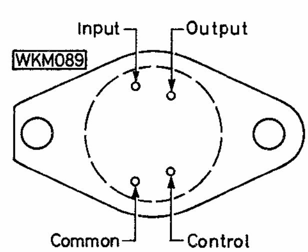


Fig. 1: The μA78HG package and connections

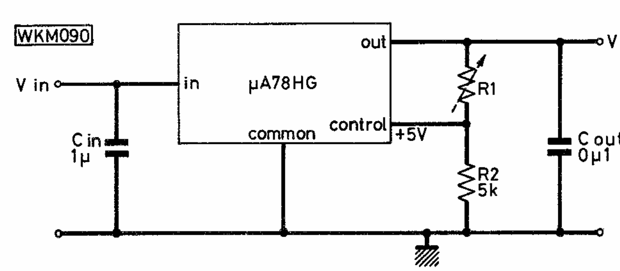


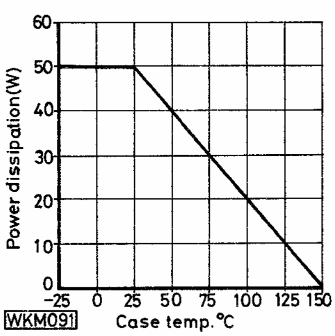
Fig. 2: A simple circuit using the μA78HG

The maximum permissible dissipation in the µA78HG is 50W, but this applies only when the case temperature is 25°C. At higher case temperatures the internal dissipation must be de-rated according to the graph shown in Fig. 3.

The size of the heatsink required depends on the internal thermal dissipation which in turn depends on the input voltage, output voltage and output current. The quiescent current is only 10mA, so the dissipation it produces is fairly small. The internal dissipation in watts will therefore be approximately equal to the output current multiplied by the difference between the input and output voltages.

To obtain an output voltage which can be varied over a wide range, a fairly high input voltage is necessary and the internal dissipation will be large if the output current is large. This requires a large heatsink. However, to maintain a fixed output voltage, the input voltage can be set at about 3·5 volts above this output voltage and the heat dissipated in the regulator device will then be much reduced.

The maximum value of the thermal resistance of the heatsink required may be estimated in the following way. The difference between the case temperature of the µA78HG (from Fig. 3) and the maximum room temperature is divided by the internal dissipation in watts. About 0·2°C/W is then deducted from the result to allow a safety factor.



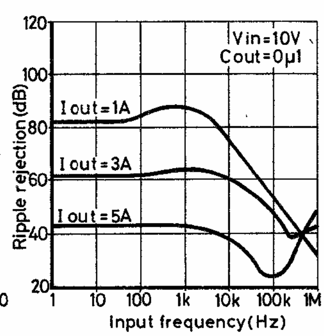


Fig. 3 (left): Maximum internal power dissipation in the µA78HG. Fig. 4 (right): Ripple rejection provided by the µA78HG

The µA78HG contains a beryllium oxide substrate for efficient heat transfer. This material is extremely toxic, so it is very important to note that one must never cut open the case of this device. If one were to saw through the beryllium oxide, the toxic particles could enter the lungs.

Performance

The line and load regulation are respectively the variation of the output voltage with the input voltage and with the output current; their values do not exceed 1% of the output voltage of the µA78HG.

The rejection of unwanted noise and ripple on the input power supply is quite high, as shown in Fig. 4 at various frequencies. The output noise voltage is typically 50µV r.m.s. The output capacitor shown in Fig. 2 improves the transient response, whilst the input capacitor should be used if the regulator is located more than a short distance from the power supply reservoir capacitor. Solid tantalum capacitors are recommended for use in Fig. 2.

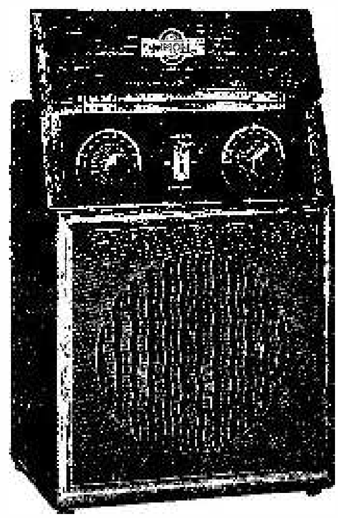
The µA78HG is available from Arrow Electronics Limited, Coptfold Road, Brentwood CM14 4BN. ●

A GLANCE INTO THE PAST

continued from page 45

The ORMOND

5 VALVE PORTABLE SET



This set is ideal for in-door and outdoor use. It is contained in a Handsome Mahogany Cabinet, is extremely simple to control, and will render perfect reproduction under average conditions from a main B.B.C. Station within about 30 to 40 miles, and about 400 miles of Daventry.

A simple switch gives choice of short and long wavebands. Entirely self-contained and is fitted with a Celestion Loud Speaker. Complete with all Accessories and ready for immediate use.

Price . . . £24 10 0

Marconi Royalty extra £3 2 6

BAKELITE MOULDINGS

Quotations given for Bakelite Mouldings of every description, for which enquiries—large and small—are invited.

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In addition to the 5 valve Portable Set, Ormond Manufacture 2 and 3 valve Sets. Also, Condensers—Logarithmic S.L.F., Square Law, 2, 3 and 4 Gang Models, etc., etc.

199-205 PENTONVILLE ROAD, KING'S CROSS, LONDON, N.1

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FACTORIES: WHISKIN ST. & HARDWICK ST., CLERKENWELL, E.C.1

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the hyperbole used by other firms, but perhaps explained by their not wishing to frighten-off timid constructors!

Censorship

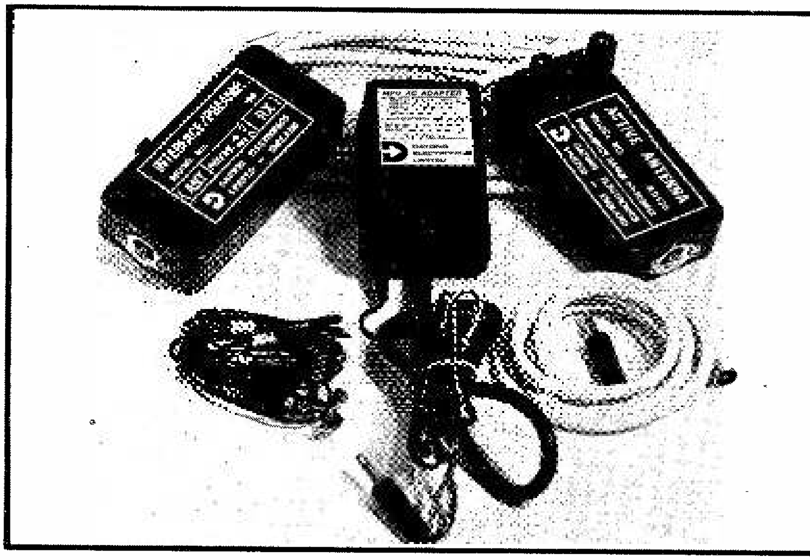
Lastly, now that permissiveness reigns, let us see what Sir John Reith wrote in 1928 about censorship: "The peculiar nature of Broadcasting . . . inevitably transfers the choice . . . from the listener himself to the broadcaster. The theatre manager, the editor, the preacher, deal each with his *own* public rather than with *the* public, and the . . . subject and opinions likely to be expressed is established by their assembling and buying. To impose limits upon the freedom of such publicists, therefore, is sheer censorship, to be justified or not as such. But the broadcaster's censorship, if it be fair to call it so, has a different basis. He has not to consider the willing but the *unwilling* audience, the people who if the matter were, say, performed in a hall would not be there. And he has further to consider that even for the same people, matter entirely proper in a hall or a newspaper may be in bad taste or even frankly objectionable in a family group. This is not Philistinism but common-sense." I don't think one needs to be too much of a Mary Whitehouse to concur with this statement, or even to wish that certain television producers would take note of it! ●

Our grateful thanks to the BBC for permission to reproduce the illustrations in this article

SPECIAL PRODUCT REPORT

DATONG ELECTRONICS LIMITED

ACTIVE ANTENNA MODEL AD170



For those enthusiasts who enjoy the l.f. and h.f. bands an efficient antenna is a fundamental necessity and whilst many may dream about three-element beams on 120ft. towers, few will be fortunate enough to be able to obtain one. Some, such as those living in flats, may well be denied any outside wires at all and this group in particular should reap the greatest benefit from an active antenna.

The Datong AD170 Active Antenna is a matched set of modules which, when assembled, exhibits some of the characteristics of a full size half-wave dipole. The kit consists of a short wire dipole, each leg being connected to a high-impedance differential input amplifier whose output is arranged to match a low impedance feeder which carries the signals to the receiver. Some signal amplification is also achieved within this module.

A second "interface" unit mixes d.c. power with the r.f. output signal, which is fed via coaxial cable to the antenna module. Its power input is filtered to avoid interference pick-up and is also protected against a polarity reversal.

The Datong units are designed for indoor use and may be installed almost anywhere, an ideal position being the loft or similar high siting. Try to avoid places likely to be influenced by electrical noises, such as may be experienced from fluorescent lights. Remember also that water tanks, over-flow pipes and so on will also affect the performance of any antenna.

The two wires from the head amplifier are stretched out and the ends attached to convenient fixing points (rafters, etc.) by non-conductive material—string, for example. For this purpose, two loops are provided. Optimum orientation of the dipole will depend on many factors, such as distance from the transmitter, mode of propagation, transmitter polarisation, time of day and operation frequency, so some experimentation is necessary. Vertical or near-vertical mounting is recommended for frequencies above 10MHz. This will give omnidirectional reception of ground waves (e.g. from l.f. stations) and of low-angle sky waves from DX stations. Reception of high-angle sky waves from medium distance stations will be relatively poor, however.

Horizontal mounting gives almost omni-directional reception of high-angle sky waves and directional reception of low-angle sky waves. In the latter case, maximum response will be obtained when the line of the dipole wires is perpendicular to the line between antenna and transmitter. Null responses occur in directions along the line of the wires and can be used to reduce local interference.

continued on page 62

★ specification

Frequency range: 60kHz–70MHz
Output impedance: 50Ω
Differential voltage gain of amplifier: Unity
Recommended dipole length: 3m overall
Third order intermodulation products: typically −90dB relative to two output signals of 100mV e.m.f. (Equivalent to 100mV p.d. at the differential inputs)
Second order intermodulation products: typically −80dB relative to two output signals of 50mV e.m.f. (Equivalent to 50mV p.d. at the differential inputs)
Current consumption: 80mA
Supply voltage: 12V d.c. nominal
The Datong AD170 is supplied as a package containing the active aerial, the interface unit, 2 × 1·5m antenna wires, 1 × 4m jumper cable and a 3·5mm jack plug. The mains power unit shown in the photograph is an optional extra.
Price: Antenna £33·19 incl. VAT
Power Supply £6·19 incl. VAT
Both units (inclusive price) £37·13 incl. VAT

Datong Electronics Ltd, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE Tel: 0532-552461

PRODUCTION LINES
alan martin

If you please

Would readers kindly mention "Production Lines", when applying to manufacturers or suppliers featured on this page.

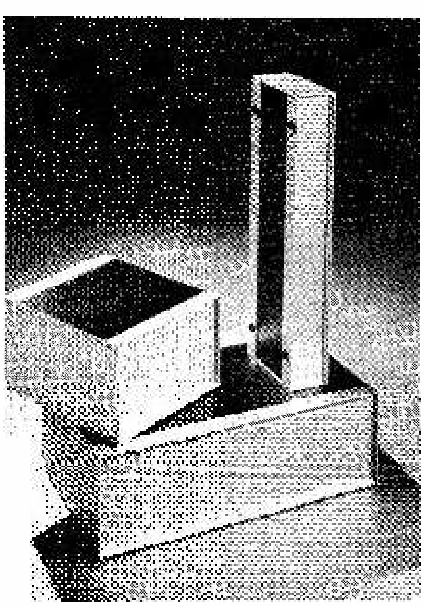
Classic case

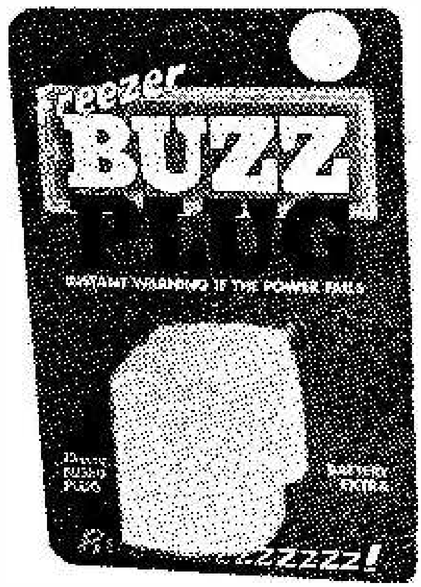
West Hyde Developments have recently introduced a new, versatile series of 45 different cases called the "Contil Classic II."

The main design feature of the cases is the extruded rail, which for the new Classic II has been extensively modified, giving much greater flexibility in use: The slot for the front and back panels is now stepped to give a choice of three different panel thicknesses and to allow for an added translucent panel. The screw groove has been altered to prevent thread stripping and more slots are provided for mounting a chassis or p.c.b. horizontally or vertically.

The case sizes have been carefully chosen to accept single or double Eurocards, which will fit horizontally across the "T" slots or slide vertically behind the front or back panels.

The Contil Classic II is available in three widths, five heights and three depths and held in stock as component parts. For further information contact: *West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET. Tel: (0296) 20441/5*





Safety buzzer

Those who have ever had a freezer full of food ruined because the power to the unit has been accidentally switched off, or a fuse has blown, will be well aware of the value of the Buzz Plug recently introduced by Videotime Products.

Wired like an ordinary plug and looking not much larger, the Buzz Plug may be fitted as a direct replacement for a standard plug.

The slightly thicker top contains the circuit which continuously monitors the mains supply. Should the power fail the plug produces a loud instantaneous warning which will persist until some action is taken.

The plug is powered by a single inexpensive battery which will give up to 48 hours warning. Typical applications include use with freezers, fridges, incubators and equipment which must run constantly or would require recalibration. The RRP is £5·95, and is available from: *Videotime Products, 56 Queens Road, Basingstoke, Hants. Tel: (0256) 56417.*

Simple wrapper

OK's new WSU-30M is about the size of a small screwdriver, but performs the complete wire-wrapping function. At one end it has a bit for making wire-wrapped terminal connections, in the middle a "no-nick" wire stripper and, at the other end, an unwrapping bit.

Designed for use with AWG30 (0·25mm) wire and 0·025in (0·63mm) square terminal posts, the all-metal tool produces a modified wrap which has a small amount of insulated wire around the terminal, in addition to the bare wire, to improve vibration resistance. The connection, which takes only seconds to make, is considerably stronger than solder, has excellent conductivity characteristics but can be quickly "undone" if necessary.

The WSU-30M is available at a VAT and carriage inclusive price of £5·64 from: *OK Machine & Tool (UK) Ltd., 48a The Avenue, Southampton, Hants SO1 2SY. Tel: (0703) 38966/7.*

PRODUCTION LINES

alan martin

A better 555

Rapid Recall Ltd. are now distributing to retailers the ICM7555 and 7556 timers, which provide a significantly improved performance over the standard SE/NE555/6 and 355 timers and are direct replacements for these devices in most applications.

The devices are manufactured by Intersil using a low-power CMOS process and will provide time delays from a few microseconds to several hours.

Operating from any d.c. power source within the range of 2V to 18V, and consuming only 80μA (typical), the ICM7555 or the ICM7556 (160μA) can be used without the special decoupling arrangements which are mandatory with standard 555 devices. This is because the 7555/6 creates switching spikes on the power rail of only 2 or 3mA compared with 200 to 300mA with standard devices. Also, because the CMOS comparators on the chip possess a very high impedance, control voltage decoupling capacitors are unnecessary. Therefore, in many applications the two or three capacitors needed with the 555/6 are not needed with the 7555/6.

For details of availability and price contact: *Watford Electronics, 33/35 Cardiff Road, Watford, Herts. Tel: (0923) 40588/9.*

Display bezel

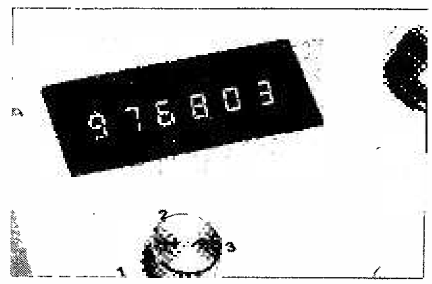
Newly-available from Vero Electronics, is a moulded "display bezel AB064" in two sizes to attractively frame and highlight a display and at the same time cover unsightly tool marks around a panel cut-out.

Designed to fit into a single rectangular cut-out, the bezel is positioned in the cut-out by four removable location pegs, and firmly secured by two moulded-in screwed studs which also secure the display mounting board on spacers provided.

A choice of lenses are offered—neutral, red and clear, polarised or unpolarised and a full range of compatible mounting boards for both l.e.d. and l.c.d. displays is available.

Prices range from £1·50, for a 4-digit bezel with clear lens, to £2·65 for a 6-digit bezel with coloured lens.

Further details from: *Vero Electronics Ltd., Industrial Estate, Chandler's Ford, Eastleigh, Hants SO5 3ZR. Tel: (04215) 69911.*



DATONG ACTIVE ANTENNA

continued from page 60

The AD170 has a frequency range of 60kHz to 70MHz. On "medium" and "long" waves there are many strong stations which call for a very good intermodulation performance from a unit such as this. At −80dB on second-order products and −90dB on third-order products the Datong antenna fulfils this requirement admirably.

The interface unit previously referred to contains a switchable amplifier of 12dB gain which will help compensate for the poorer h.f. performance of some older receivers, but is not essential if the unit is to be used with more modern equipment. It is, however, very convenient to have a couple of S-points extra gain available when required to winkle out that elusive DX station.

On test, the AD170 gave very impressive results. It should be fully-understood, however, that the level of signal at the receiver will only compare with that from a full-size dipole at frequencies of about 16MHz, appearing to be about one S-point better at 30MHz.

Below 16MHz the "gain" relative to a full-size resonant half-wave dipole falls at approximately 6dB per octave and at 2MHz will be three S-points down on a 75 metre passive dipole. However, this may not be as dramatic as may first appear, because at 2MHz the level of signal received on a full-sized dipole is considerable, as is the noise level. The active antenna worked quite satisfactorily at these frequencies and its all-important signal-to-noise ratio was at worst equal to and in many cases better than the full-size dipole against which comparisons were made.

Peter Preston

ON THE AIR

by Eric Dowdeswell G4AR

An oft-repeated complaint by readers of this column concerns interference on the amateur bands, generally between amateur stations, but frequently from other services. It is often assumed that the amateur bands are exclusive allocations, but a look at the allotments will show that sharing with other services is not uncommon. The 80m band is a typical example.

Such QRM can be the making or breaking of a newcomer to the amateur bands, especially if the equipment in use is relatively simple or unsuitable, which is frequently the case. I would say from my correspondence that about 50 per cent of budding amateurs buy equipment on the strength of ads in the popular press, instead of seeking advice from those having some experience of amateur radio.

All too often, sums of well over £100 are spent on receivers claimed to be able to "get the world", on a telescopic aerial! "Listen to the amateurs" they say, about a receiver that does not have a b.f.o., when the vast majority of amateurs today use single-sideband on our h.f. bands, necessitating the use of a b.f.o. "Eavesdrop on the aircraft bands, the police, the taxis etc.," is quite common, all of which is illegal in this country, but it sounds good in advertising.

So my advice must be to contact another person before buying a receiver for use either on the amateur bands or for general s.w. listening. Avoid also the sets that claim to cover the long-wave band through to the v.h.f. or even u.h.f. bands! There are few, if any, sets that can do this efficiently over such a wide range of frequencies. Get a good communications set for the h.f. bands and use its facilities in conjunction with a converter for the v.h.f. and u.h.f. bands. There must be another amateur not too far away, or a radio club of some kind, where you can seek advice on buying a set. An intelligent look at the advertising in magazines devoted to amateur radio is as good a start as any.

A good secondhand receiver is not to be despised, can be quite cheap, and can always be sold or swopped for another set if it is not up to expectations. Old valved sets, especially those with i.f. filters intended for use on s.s.b., can frequently out-perform many solid-state receivers under the conditions of interference that prevail on some amateur bands. They are virtually free of the bugbear of most transistorised sets, cross-modulation, where signals which are on adjacent channels, or even far apart in terms of frequency, inter-modulate giving the effect of interference on the desired signal. It is frequently almost impossible to convince a listener that the interfering station is not on an adjacent channel! Turning down the r.f. gain can usually prove the point.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

What's on the Bands

From Marple, near Stockport, **John** and **Steven Goodier** used their FRG-7 and 30ft wire to log J6LFU, a new prefix for St. Lucia, previously VP2L, plus suffix. On 20m s.s.b. FW0TT on Wallis Is. was a good find as well as JX9WT, much nearer home on Jan Mayen but still quite rare. S8AAT is another unusual prefix, this time for the Transkei while D68AD in the Comoro Is. is not heard all that often.

School work doesn't prevent **Ian Marquis** BRS41426 in Leigh-on-Sea, Essex, from digging out some goodies with his FRG-7, such as EA8CR and VO1HP on 160m c.w., FP8, HR3, TI5, 6W8 and 9K2 on 80m s.s.b. in spite of the rising sunspot number, or is it? **David Palmer** writes for the first time from Stowmarket, Suffolk, with a goodly selection of DX heard on his Trio JR310 with indoor dipoles for 10, 15 and 20m, and a 100ft wire for the l.f. bands, plus an a.t.u. I have suggested that David tries the wire on the h.f. bands, too, if he hasn't already done so. He found 10m quite good with prefixes like C5, DU1, HH2, H44, J28 and 6W8. David's two precepts for good DX are, getting on at the right time, and skill in operating the receiver. *D'accord!*

Finally, some more grist for the June DX mill, says **Bill Rendell** in Truro, Cornwall. He's been trying his h.f. dipoles as centre-fed "T"s on 80m using an a.t.u., as well as on the design frequencies of 20 and 15m. Bill's still hankering after a new set to replace his beloved Heathkit AR3, but so far an AR88 in the pipeline has been vetoed by the XYL! The QTH of AA6AA turned out to be Los Angeles much to Bill's disappointment as did KG4W in Virginia. However, he did manage three ZLs on the same band, 80m, while on 20m VK2AGT on Lord Howe Is. was some compensation. VP8SO seems to be a new one on from Signy Is. with QSLs via G3KTJ, S79MC is still a mystery to Bill, and me, so if anyone can enlighten us please do so. Could it be old timer VS5MC?

The Month's Mail

Andrew Smith in Glasgow admits to being just a beginner but is lucky to be off the mark with an FRG-7 and Joystick aerial and a.t.u. He thought of contacting someone else in his area who might also just be starting, but my advice in such a case is to find the local radio society or group and get among the experienced amateurs and listeners who will be only too willing to assist. G4HWB hides the identity of **Mike Stollov** of Blackley, near Manchester, who complains that although modern technology has given him colour TV and non-stick frying pans it hasn't indicated how he can pay for all the modern amateur radio gear!

However, he has an FRG-7, and being keen on c.w. he ought not to have much trouble getting hold of one of the older c.w. rigs such as the LG300 for next to nothing. Another recruit from the BC bands is **Martin Gill** (Kirkby Lonsdale, Cumbria) who has been active on 10, 15 and 20m with a Barlow-Wadley XCR30 and logged 67 countries in four months. **David Wyatt** a 14-year-old from Oswestry, Salop, is starting to copy c.w. on his BC348 and queries a few prefixes. I can only advise, as I do most months, buying Geoff Watt's prefix list for the grand sum of 45p from 62 Belmore Road, Norwich. His weekly news sheet is also good value for those keen on keeping up with the latest DX news.

A note of warning for owners of Realistic DX160 receivers comes from **D. Dempster** of Birmingham, who points out that the set's on-off switch only cuts the internal low-voltage supply and not the mains supply in the conventional manner. The set is therefore always live, which could be dangerous if one is poking around inside believing the mains is switched off. **W. Semmens,** writing from Penzance, Cornwall, says that he is handicapped but very keen to take up amateur radio, if he had a receiver, so if anyone in his area can help with a secondhand set at a reasonable price please let me know.

The above note on the DX160 should be of interest to **P. C. Hawkes** who uses his with a 100ft wire. A beginner of only a few months, P.C.H. has been disappointed at not finding a radio amateur's map of the world at his local bookshops. Only source for these are the RSGB and *Short Wave Magazine,* and to be of any use such maps must be on a great-circle projection which gives true direction, so important when used with rotary beams. Incidentally P.C.H. sold part of a stamp collection to take up our hobby, but I can assure him he will never be disappointed with his choice.

After five years of studying electronics **Phil Charlesworth,** now BRS41107, in Southport, went to a mobile rally with G8EFQ and fell for amateur radio. He passed the RAE last December and is going all out on his code before getting his G4+3. He even threatens to send in some c.w. logs! **Alan Billington** is very lucky indeed, as his Dad is teaching him the code and he sits the RAE in May, Alan, that is! He is only 16 and has a Lafayette HA350 plus 80ft aerial and homebrew a.t.u. Alan is BRS40845 and wonders if there are any other SWLs in Morecambe, Lancs.

John Cassidy of Shanklin, IOW, is 13 and recently bought a five-valve set from AH Supplies of Sheffield, and wonders if any reader has a circuit diagram. He'd also like to get hold of a pair of 4kΩ headphones (so would I!) at a reasonable price. John lives at 15 Sibden Road if anyone can help. Some comments on the National DR2800 mentioned in the April column, from **John Gomer** (Colchester). He had one but swopped it for a Hammarlund SP600JX which sounds like a good swop to me. He heard subsequently that the 2800 was traded for a VW Beetle! John is dedicating a couple of nights a week for RAE study so good luck OM.

News from the Clubs

Editor of *SWM,* G3KFE, will be talking to the **West Kent ARS** on making homebrew equipment on Friday May 25 at the Adult Education Centre, Monson Road, Tunbridge Wells where meetings are held fortnightly. Alternate Tuesdays for informal meetings, Morse practice and chat at the Drill Hall, Victoria Road. **Bury RS** (G3BRS) will benefit from a chat on modifying Pye gear by G8EUM on May 8 at Mosses Centre, Cecil St., Bury, and every Tuesday evening. Contact: G4GSY at 7 Rothbury Close, Ainsworth Road, Bury, or ring 061-761 5083.

Stevenage & District ARS normally meet first and third Thursdays but contact Trevor G8KMV, 11 The Dell, Stevenage for details of the 2m DF Hunt on May 10, or ring 0438 54689. An anonymous secretary has sent details of the **Loughor Amateur Radio & Electronics Club** operating near Swansea. Only formed late last year the club is looking for more members so ring said Sec on 0792 893392.

A little detective work on the **Crawley ARC** (W. Sussex) Newsletter reveals that it meets on the last Wednesday of the month with informal gatherings at a member's QTH on the second Wednesday. Formal meetings at Trinity United Reformed Church Hall, Ifield Drive, Ifield but write to "Dot and Vernon" G3MER and G3MSK respectively for details of club activity, at 16 Newmarket Road, Crawley, W. Sussex.

Don't forget, letters and logs by 15th of the month and don't miss the RSGB's Exhibition at Alexandra Palace on May 11 and 12.

Log Extracts

M. Gill:—20m HS1WR VU2JNA VP2LFZ TU2HS **15m** ZP5LN HC7DR **10m** FM7WY ZP5CDE YS9RE

R. Bell:—20m HC9CB HP7OP VP2MFO YA3DM YB6IB **15m** TR8AC **10m** CX8CN JR2LDM

W. Rendell:—80m CO2JA CT2SH (QSL W3HNK) HR0QL KG4W PJ2FR VP2SK XE1OW YV5ANS ZL2BT/ZL4AP **20m** C5AAL CT2YB HS1ABD TU2AE VK2AGT (Lord Howe Is.) VK7AE VP2MF VP8SO **15m** CT2CP C6ANU D4CBS HK3AXT J3AAE S79MC TG5WQ

D. Palmer:—15m C5ABK J28AY VQ9MR YB0WR **10m** C5AAP HH2PW HR0QL H44JD J28AG TA1MB VS6EZ YB0TZ YS9RVE 6W8DY 7Z2AP

J. & S. Goodier:—20m FW0TT JX9WT J6LFU KA1MI S8AAT 5U7AG **15m** D68AD VP2AC 9Y4TRV **10m** C5AAP ZE2JK

I. Marquis:—80m CT2SH VE3BWK/4U **20m** VP8SO ZD7PL 4S7DJ 5U7AG **15m** FC9VN FG7AX HR0QL VP2LFZ 6W8DY

All above loggings were on s.s.b.

MEDIUM WAVE DX

by Charles Molloy G8BUS

While tuning round the medium waves recently, I was intrigued by the number of 1kHz heterodynes that could be heard. A quick check brought a surprising total of 33, some quite strong, which indicates in each case there was a station still working on the old pre-Geneva frequency, 1kHz below the correct channel. If two stations are operating 1kHz apart then they will interfere with each other, and the difference in frequency between them will appear as a 1kHz audio tone at the loudspeaker.

A note over Sweden Calling DXers shed some light on the problem when it was stated that a number of countries have not (yet?) adopted the Geneva plan. Algeria, Iraq, Jordan, Lebanon, Libya and Tunisia it was claimed had not changed over at all, while several others in the same area have altered only a few of their transmitters. Algeria is still on 251kHz on the long-waves, while 520kHz now appears to be an out-of-band frequency at the l.f. end of the medium waves, inhabited by low-power Austrian and German stations.

Heterodynes and DXing

Although a heterodyne is usually associated with a frequency difference between two signals that is at least great enough to generate an audible note, it is possible to have a sub-audio heterodyne. These are called "beats". A beat is generated when two stations, nominally on the same frequency, are separated by only a few hertz, which is usually the case when two signals are not synchronised. This is of particular interest to the DXer, as the beat will show up on the "S" meter. Even a weak station swamped by a much stronger one on the same channel will produce a beat strong enough to be indicated on the "S" meter and thus reveal its presence to the DXer. If you come across such a beat then stay on the frequency for a few minutes. DX on the medium waves is usually subjected to slow cyclic fading, so the strong station may fade and the weak one may increase in strength and even become dominant for a short while. I have often picked up interesting DX just by sitting on a channel that has a strong signal with a beat.

West African DX

Sunset along the West African coast occurs at much the same hour as in the UK, which makes this part of the world attractive to anyone who would like to DX during a summer's evening. Since the DX is coming from the south and any interference will most likely be from other directions, a loop will be useful in getting rid of unwanted co-channel interference.

Radio Las Palmas in the Canary Islands is now conspicuous, in Spanish, on 1008kHz after Lopik in Holland signs-off. The Radio Naçional España outlet in Tenerife can be heard with the call "Centro Emisor del Atlantico" on 621kHz, but there will be QRM from Batra in Egypt which a loop should be able to deal with. Brussels, which is on the same frequency, signs-off at 2245. Radio Dakar in Senegal shares 765kHz with Sottens in Switzerland and it is often heard in the UK with African music and French announcements. Conakry in Guinea is a regular on 1404kHz with the call "La voix de la Revolution," and it is difficult to miss it after 2300 when the France Cultur network on the same channel goes off for the night. Bissau, located in Guinea-Bissau, is now on 1071kHz and the time to look for this one is after 2100 when the France Inter network closes down.

World Radio and TV Handbook

The 1979 edition of this handbook is now available and it contains the latest changes on the medium and long waves. As well as listing the stations authorised under the Geneva Plan, it also indicates those that are not yet on the air, or are operating with less than maximum power. This is the only up-to-date list of medium- and long-wave stations that is available at the time of writing. The *WRTVH* contains all sorts of information that is useful to the DXer including station addresses, schedules, and details of interval signals from broadcasters in every country in the world, and it covers the long, medium, short, v.h.f. and TV bands. The 1979 edition costs £8.50. It is published by Billboard, distributed in the UK by Argus Books, 14 St James Rd, Watford, Herts and it can be ordered through bookshops.

WARC 1979

These initials stand for the World Administrative Radio Conference, which is due to be held in Geneva in September this year. This conference is concerned with the allocation of frequencies to different users, and when I wrote about its possible effects on s.w. broadcasting last month, it did not occur to me that the conference would concern itself with the medium waves. There is, however, a proposal to the conference from the US Government, that the medium waves should be extended to 1860kHz in Region 2, which covers North, Central and South America.

Radio amateurs will be far from happy at the prospect of having broadcasting in the lower 60kHz of the 160m band, and one can only hope that this part of the proposal is not implemented. The US intention is to use the extended part of the band to provide another 14 channels which would be occupied by 700 low-power local stations. Each would become what is known as a graveyard channel, like 1230, 1240, 1340, 1480 and 1490kHz are at the moment. These frequencies are the resting place for hundreds of stations with powers of 500 watts or less, some of which operate during the daytime only.

It is hard to predict what DXing among these new channels would be like, but experience of existing graveyarders indicates that some interesting and unpredictable results can be expected.

Readers' Letters

"Perhaps the internal ferrite rod interferes," writes **D. R. A. Lowe** from Lichfield, who has been trying to use a m.w. loop with a Philips 543A receiver. He found that the loop exhibited no directional properties. Yes, this is what is wrong. The receiver is picking up signals from the internal ferrite rod aerial at the same time that the loop is trying to null-out this signal. You should only connect a loop to a receiver that does not have an internal aerial, and preferably a receiver that is well screened in a metal cabinet, so that the receiver wiring does not act as an aerial. It is easy to test the receiver. Unplug the loop and the receiver should now be dead.

A similar problem comes from **Roy Haynes** who has been trying a loop with his Realistic DX160 and cannot get directional reception. Unplug the loop and see if the receiver still picks up the station you are trying to null-out. If it does then the loop is OK and it is the receiver that is causing the problem. Some versions of the DX160 are fitted with a ferrite rod aerial for m.w. reception, and this will have to be disconnected before a loop can be used with it. The ferrite rod should be fitted at the back, externally to the metal cabinet.

Chris Constantinides would like to listen to any of the Greek medium-wave stations and wonders if he should swap his DX160 for a better receiver. A more selective receiver will not help Chris, as the interference you are experiencing comes from stations operating on the same frequency as the signals you are trying to pick up. Try a m.w. loop along with your DX160, making sure that the latter does not have an aerial of its own. Don't be optimistic about obtaining regular reception from Greece on the m.w.s as there is a lot of co-channel interference to overcome.

Athens is now on 729kHz and signs-off at 2300. The power is 150kW but there is high-power interference from Egypt, USSR and Finland, and also from stations in East Germany and Spain. Similarly with the main Yened outlet which is on 981kHz with 200kW, there is QRM from Algeria, Bulgaria, Cyprus and Sweden. The best time to listen to the Eastern Mediterranean is from 0400 onwards when, owing to the different time zones, stations in that area are signing-on while those further west are still off for the night.

DX Heard

Using a DX160, 90ft long wire, a.t.u. and pre-amp **K. Lewis** (Pensilva, Cornwall) pulled in Radio Margarita, Venezuela on 1020kHz, WINS New York on 1010, Radio Coro Venezuela on 1210 and Radio Paradise, St Kitts 1265, all heard between 0145 and 0330 in mid-March. Listen at this time of the year for North America and the Caribbean during the hour before sunrise. Reception is often good and QRM is light.

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

A three-transistor receiver is in use at Fareham by **Simon Pegler,** who finds he gets improved reception if he unplugs the aerial from the receiver and runs the aerial lead close to a piece of wire which is plugged into the aerial socket. Similar results would be obtained by fitting a low-value fixed capacitor in series with the aerial. **Peter Simms** has a similar problem with his 9-valve, semi-vintage domestic receiver, which he uses with a 40ft inverted "L" aerial. This set-up works well on some bands but not on others: "It picks up very little and selectivity becomes poor. This does not happen if I use short lengths of wire . . ."

It is possible to electrically shorten an aerial by inserting a capacitor between the aerial and the receiver. A variable capacitor with a maximum value of about 50pF will do the trick on the main short-wave bands. This dodge is as old as radio itself and it was once the subject of a patent held, I believe, by Scott Taggart who designed the famous ST series of receivers. A long aerial picks up a lot of signal which is useful when you are listening to a weak station, but it can cause receiver overloading with strong signals, as well as damping the receiver input tuned circuits as in the two cases quoted above. A capacitor in series with the aerial will be found beneficial with many sets.

Tropical Bands

Some very good DX has been reported on the Tropical Bands recently. **Bob Bell** (Blyth) used an FRG-7, a.t.u. and a vertical aerial to pull in Radio Nepal at Katmandu on 3425kHz in the 90m band at 0030, Radio Bolivar Venezuela 4770kHz (60m) at 0100, Radio Tallin in English on 4860 at 0105, Radio Naçional Luanda 4820 at 0120, Dacca in Bangladesh 4790 at 2050, Radio RSA 4875 at 2350 with sign-off, Gansu in China on 4865 at 2155 in Chinese with jamming, an unidentified station in Arabic on 4845 at 2215, Alma Ata on 5035 at 2205 in Chinese, and Ashkhabad on 4895 at 2350.

From Pensilva in Cornwall, **K. Lewis** reports hearing Radio Guatapuri in Colombia on 4817kHz at 0535 and Radio Garoua in Cameroon on 5010 at 1840 in English, the receiver being a DX160. **Peter Ramsey** (Ayrshire) used an AR88 and a loft aerial to pull in Radio Singapore on 5010 at 0315, Tegucigalpa Honduras on 4820 at 0330 and Lagos, Nigeria on 4990 at 0440. **David Wyatt** (BC348) heard Radio Reloj in Costa Rica on 4832 at 0755, Nouakchott in Mauretania on 4845 at 2305, Cotonou Benin on 4870 at 0550, Radio Rumbos (Villa de Cora) in Venezuela on 4970 at 0625, Radio Colosal (Neiva) Colombia on 4945 plus two he could not identify—Radio Superas on 4879 (R. Super at Medellin Colombia is on 4870) and Radio Cosanti on 4950 (anyone any ideas?).

DXers who have not tried the Tropical Bands should study the above carefully as it is representative of what can be heard. Listen after dark during the summer for African stations and throughout the night for Latin Americans.

"Long Live Short-Wave"

This is the title of an album (12 inch LP) issued by the well-known songwriter and record producer Mitch Murray. Mitch, who is a keen DXer himself, is the narrator who in the space of an hour, guides the listener through just about every aspect of DXing. One advantage of this type of presentation is that the audience can actually hear what it is all about, whether it is a signal from a satellite, WWVH in Hawaii, or QRM such as facsimile or Teletype. Station announcements and interval signals from a number of stations, some everyday and some exotic, are presented and I must admit there were a couple that were new to me. A few words from Henry Hatch of the BBC World Radio Club are included.

The album, which is advertised on page 159 of the 1979 *World Radio and TV Handbook* is accompanied by an explanatory booklet. It is available from Trans-Island Productions, PO Box 24, Douglas, Isle of Man, either as a record or cassette for £3.50, post paid. It should provide a

novel introduction to the hobby for the newcomer as well as being of interest to many old hands like myself.

Frequency Standard and Time Signal Stations

Fourteen-year-old David Wyatt (Oswestry) got hold of a BC348 surplus receiver which was made in 1942, and is the type that was used in the wartime Flying Fortress. When used with a 90ft long wire, it pulled in IBF in Turin, Italy on 5MHz at 0700 with identification in Italian and English plus IBF in Morse, VNG Lyndhurst, Australia on 12MHz at 0915 and WWV Fort Collins USA on 10MHz at 0955. David finds these frequency standard stations useful to check the calibration of his receiver. This is, of course, one of the reasons why these stations are on the air. Others that are logged now and again (I nearly said from time to time) are Podebrady, Czechoslovakia 3170kHz, BPV Shanghai and JJY Tokyo on 10MHz, CHU in Ottawa on 14 670kHz, RWM Moscow and WWVH Hawaii on 15MHz.

Readers' Letters

Fourteen-year-old **Alistair Dupres** (Cardiff) has made a good start with DXing by logging Radio Japan on 15 195kHz at 2200, using his Vega Selena MB 210/2 with telescopic aerial; their address is 2-2-1 Jinnan, Shibuya-Ku, Tokyo. Alistair asks: "what is a QSL card?" A QSL card is a colourful picture postcard, or a card with an artistic design, that a station will send to a listener in return for a reception report. See the front cover of the August 1978 issue of *PW* and my article on QSLs in the same issue. The card will usually have the station callsign or slogan printed on it together with the verification details that will confirm that the DXer actually heard the station.

A Hitachi Radio Cassette Type TRK5320E with telescopic aerial is in use by **P. W. Oliver** of Paisley, who wonders if he would get improved reception by joining an additional aerial to the telescopic one. I would not recommend it as you may get overloading. A series capacitor will help, but I like the method suggested by Mitch Murray in *Long Live Short-Wave,* which is to wrap a piece of insulated wire round the whip aerial without making direct contact with it. Then join your aerial to one end of this piece of wire, the degree of coupling being adjusted by altering the number of turns.

"What is a mechanical filter?" asks **Michael Welsh,** who is thinking of investing in a Collins R390A which possesses "mechanical intermediate frequency filters for selectivity." It is an electromechanical device which replaces an i.f. transformer. It will give results equal to, if not better than a crystal filter, and its main advantage is the steep sides of the reponse curve. A mechanical filter should not be confused with a ceramic filter which gives results similar to an i.f. transformer. Since the ceramic filter does not require adjustment it has advantages from the manufacturer's viewpoint and they are now widely used for domestic receivers.

Ian McLean has a Pye Cambridge R35 and he wonders if anyone could put an age to it. Replies direct to Ian at 46 Golf Drive, Port Glasgow, Scotland. Used with a PR40 preselector and 50ft long wire this receiver pulled in Radio Australia on 17 785kHz at 0306 and Radio Pakistan in English on 17 890 at 0245, both in the 16m band. **Derek Vivian** would like to contact any reader who has fitted an "S" meter to the CR100 and his address is 9 Dymock House, 19 Malden Rd, Wallington, Surrey.

Radio Tinian crops up again with a suggestion from **Dr S. K. Kellet Smith** (Guernsey) that this station might be located on an island called Tinian in the Marianas Group in the SW Pacific (Micronesia). This would really be DX! Unfortunately, broadcasting in this area (according to the *WRTVH*) is on the medium waves and v.h.f., neither of them being likely to be heard in the UK. Dr Kellet Smith, who is now retired, has a Sanyo RP990 with telescopic aerial which pulled in Australia on 11 855kHz after midnight for him. Receiver trouble is being experienced by 15-year-old **Julien Smith** who has a Philips 341A which has blown a valve and also a new replacement. Julien lives at 48 Seafield Close, Seaford, Sussex, and help from anyone in his area would be appreciated as he is currently "off the air". **Neil Devlin** writes from Dundee to say that his Ferguson 5-valve domestic receiver and 60ft long wire pulled in Vietnam on 12 035 at 2115, Iran on 9022 at 1705 (out-of-band) and Radio Yugoslavia on 9620 at 2202 and Radio Australia on 6005 at 1705.

by Ron Ham BRS15744

I always enjoy attending the RSGB's annual VHF Convention and this year's event, held on March 10, at the Winning Post Hotel, Whitton, was no exception mainly because it is a wonderful opportunity to meet many of our readers and to feel the pulse of the current v.h.f. affairs.

Sudden Ionospheric Disturbance

Soon after I arrived at Whitton, **Mark Deutsch** G3VJG, told me about the Sudden Ionospheric Disturbance which occurred between 1035 and 1142 on March 9. Shortly afterwards I met **Charlie Newton** G2FKZ, with the same news and **Cmdr Henry Hatfield,** Sevenoaks, who was not a bit surprised because, at that time, he recorded solar radio noise at both 136 and 1296MHz. Another old friend, **Harry Gratton** G6GN, up for the day from Bristol, knew something had happened because 10m conditions were extra good at midday. At 1215 he worked VK2QL on c.w. and as late as 1400 he heard a VK in QSO with a GW on the key.

Aurora

The Convention was a mine of information and during the afternoon lecture session, Charlie Newton explained, with illustrations, how the equipment aboard SkyLab improved our knowledge of the sun's coronal holes, great solar filaments that unwind like a knotted rope, and the occurrence of auroral events. "Information is vital," said Charlie, "I often have a thousand observers on the air throughout Europe during an event," and he told **Angus McKenzie** G3OSS, London, who recently achieved a tone-A contact with a GM on 70cm, that auroral contacts on the u.h.f.s and microwaves should be attempted. Many of the pundits were expecting an aurora after the previous day's s.i.d., and soon after I arrived home from Whitton, **Alan Baker** G4GNX, Newhaven, phoned around 2300, saying that signals on 20m had gone auroral. By midnight, **John Cooper** G8NGO, Cowfold, had received a GM and **Roy Bannister** G4GPX, Lancing, almost completed a

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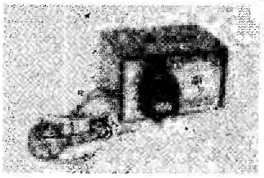

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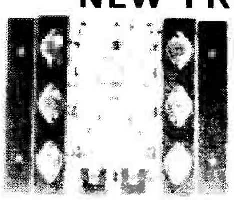

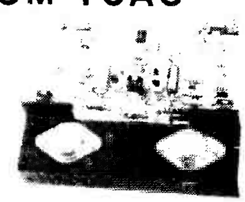

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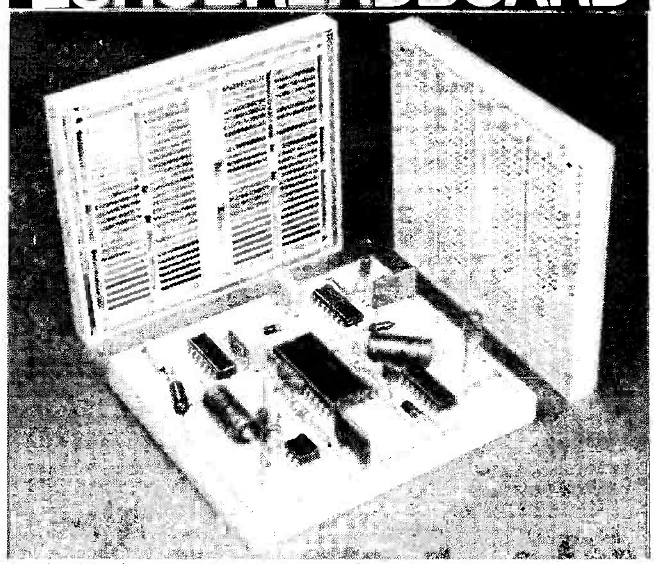

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Please make cheque/P.O.'s payable to David George Sales tone-A QSO with a GM on 2m. SM4IVE told **John Branegan** GM8OXQ, Saline, Fife, that an aurora manifested east of northern Sweden around 1925 on February 24, and John saw the effect of a weak aurora on Band I television on the 26th. Between 1900 and 2200 on the 21st, John received auroral signals from the 2m beacons in Germany DL0PR, Cornwall GB3CTC, Northern Ireland GB3GI and from three amateur stations in Scotland.

Solar

There is little doubt that the February aurorae were caused by the solar activity which was recorded by **Robin Knight,** South East Essex Astronomical Society on 60MHz, Henry Hatfield on 136MHz, **John Smith,** Rudgwick, Sussex, on 142MHz, and myself on 146MHz, between the 19th and 23rd. Also on the 23rd, Henry, using his spectrohelioscope, saw a sunspot group nearing the western limb. Alan Baker visited Henry on the 25th and saw a prominence, several sunspots and a cloud of gas through Henry's machine. At 1052 on March 1, Henry located a bright area and a prominence just inside the east limb which may well have caused the solar radio noise recorded earlier by himself and John Branegan.

Satellites

I chatted to **Ron Broadbent** G3AAJ, Secretary/editor of AMSAT-UK at the Convention, and he sent me a copy of their journal, *OSCAR News,* in which I am delighted to read that Britain's first Amateur Radio Spacecraft is in the pipeline and will be built at the University of Surrey. Ron is going to update us on all future developments. *(Full details were given in "News" in our last issue. Ed.)*

On March 4, John Branegan received a QSL card from W3JPT, Washington, DC, confirming his best OSCAR-8J DX to date. John raises an interesting point in his letter, "The intense high pressure to the east side of the UK on February 25 and 26 had a marked effect on satellite results, creating a barrier which slowly moved south-south-east. It was not possible to put a 2m signal into a satellite through this barrier when the satellite's elevation was below 25°." (My barograph recorded 30·75in at that time.)

Several stations have given John propagation data by coming back to his OSCAR-Mode J CQs, in particular the 11 QSOs with each of VE2LI Montreal, WA3ZHW Pennsylvania and WB2OXJ New Jersey.

The 10 Metre Band

Harold Brodribb, St Leonards-On-Sea, writes: "Now that 10m is so brilliant and the Russian stations so numerous, we have a new field to hunt in." Harold has far too many American and Russian stations for a detailed report, which shows that his AR88 and loft-mounted, inverted "V" dipole are going well. Harry Gratton has been concentrating on 10m and in just two weeks has worked 60 JAs on the key. Between February 20 and March 18, I heard signals almost daily from the International Beacon Project stations in Bahrain A9XC, Cyprus 5B4CY, Germany DL0IGI, and periodically at midday, Bermuda VP9BA.

DX TV

Both **Ian Rennison,** Horsham, and myself noticed frequent short bursts of signals on Channel R1, 49·75MHz during the early mornings. Around 0956 on

February 26, I received an unidentifiable picture, with vertical bars, on R1 and at 0900 on March 6 there were bursts of test card. **Ian Roberts,** Glenstantia, Rep. South Africa, says that conditions for DXTV were good on March 3 and writes: "The spectrum was literally jammed at the low-frequency end and the only pictures I could make out in detail were on R2 at 1609 GMT and later in the evening from 2053 to 2200, local time, Channel E2, Kenya." At 2300 Ian could still hear video signals above the receiver noise on Channels E2, R1 and IA. At the suggestion of young **Stuart Hardy,** Loudham, Notts, I wrote to Granada Television, Manchester, to find out more about the Granada caption that several of us saw during a Band I sporadic-E disturbance last year. In reply, one of our readers, **Arthur Brennan** G2AUC, of their engineering department said: "I can confirm that it was a Granada Television International caption which you saw. We do export to all European Countries and during sporadic-E we do have reports of our own station at Winter Hill, Lancashire, being received in Holland, Sweden and Norway". Arthur also expressed his interest in the "Five Metre Story" (*PW* March 78), because he and GW2CPU listened to the Snowdon tests, in 1932, with a super-regen receiver situated 800ft a.s.l. some 10 miles inland from Aberystwyth.

From Western Australia, **Anthony Mann** writes: "I spent February 10 and 11 modifying a valved TV set for 405 lines, just in time to lock B1 video, 45·0MHz, on the 12th, and B1 was in again on the 14th, 16th, 17th, 20th and 21st. Without doubt February 21 was the best B1 opening so far. Next day was completely different, absolutely dead, as is often the case with enhanced F2 conditions the day before." Anthony also heard B1 sound, 41·5MHz, briefly on March 8, 9 and 10 and signals from China on R1, on February 14 and March 2.

Tropospheric

Anthony Mann tells me that on December 29, 1978, a two-way QSO on 1296MHz established a new world record between VK6KZ, 160km west of Albany, across the Great Australian Bight to VK5MC, 70km west of Mt Gambier. Our congratulations to the participants.

Although the atmospheric pressure rose from 29·1in at midday on February 13 to a record of 30·75in on the 25th, the v.h.f.s did not open as much as we hoped. However, some DX was about and on the 19th, **David Wakefield** G8RVK, Worthing, worked ON1YW and ON4VN; on the 20th, G3CHN, south Devon and at 1815 on the 26th, GU3KFT. David has a Mizuho SB-2M portable rig and a 10 watt linear on loan from **Mitch Tribe** G8PMT, and has worked G, GJ, GU, GW, F and ON and had QSOs in 13 different QRA locator squares including ZM, YJ and YK. On the 21st, a newly licensed husband and wife team, **John** G8RZP and **Jackie** G8RZO, **Brakespeare,** Slough, worked into Belgium and Holland on 2m s.s.b. During the evening of the 25th, Alan Baker worked F1ANH and ON5UN on s.s.b., ON6CP on c.w. and F1FJT through the Brighton repeater GB3SR, R3. At the Convention, Randam Electronics displayed a massive, eye catching, 21ft long, 2m Yagi, French made by Tonna, which, along with their 70cm beams were selling well. Harry Gratton uses one of these beams and is delighted with its performance. During one of the Convention lectures, **Ray Flavell** G3LTP, talked about the mechanics of tropospheric openings and explained how to use the data published in the RSGB's VHF Manual. He also emphasised the importance of getting the "upper air data" when obtaining daily met. information which is available from many sources.

144/432MHz Contest

Although conditions were generally poor for the RSGB's 144/432MHz and SWL Contest held on March 3 and 4, Alan Baker worked four French stations, one ON, one GW and a GJ on 2m s.s.b., and **David Wakefield,** a first timer, made 30 QSOs including 2 Fs and 1 GW. The multi-operators of the Hastings Electronics and Radio Club, G6HH/P, made 496 QSOs during the event with a best DX of 620km into France.

St Dunstan's Weekend

Among the guests at the AGM of the St Dunstan's Amateur Radio Society held at Ian Fraser House, Ovingdean, Nr Brighton, on February 24, were Alan Baker, President of the Brighton and District Radio Society, **Barry Cook** G4BWJ, Royal Naval Amateur Radio Society, **Eric Letts,** Chairman of the Mid-Sussex Amateur Radio Society and **John O'Houlihan** G4BLJ and **Len Wooller** G9GEZ, of the Post Office Radio Division. After the official business a talk was given by **Louis Varney** G5RV, and during the weekend the St Dunstaners contacted several Ws on 10m and many locals on 2m through the Brighton repeater.

Raynet

On March 1, several of our readers took part in an East Sussex Raynet exercise designed to assist the Red Cross ambulance service if the need arose. The group covered a wide area from Worthing along the south coast to Eastbourne and inland to Crowborough, with **Dermot Cronin** G3GRO, on the Royal Sovereign Light as a relay station. Many Sussex Raynet members were again on exercise on March 11 when they operated throughout Sussex in conjunction with the County Emergency Planning Officer, using 80m and 2m, s.s.b. and f.m.

Amateur Co-operation

On February 25, F1FJT of Radio Club de Normandie wanted to contact **Geoff Ellis** G3LFZ of the Southdown Amateur Radio Society, so Alan Baker, who worked the Frenchman, called Geoff on the land line and they were soon in QSO. During the evening of March 9, Alan heard G5BYU/M on 2m s.s.b. in Haywards Heath and G3IIR, in London, calling each other in order to arrange a meeting at the VHF Convention the following day. By breaking in, Alan linked the two stations together.

Sporadic-E

I was fortunate to be chairman for the Convention lectures given by Charlie Newton, Ray Flavell and **Professor Martin Harrison** G3USF, who began by playing tape recordings of music from Budapest, and an Italian commercial heard around 70MHz during a sporadic-E disturbance last summer. Martin explained some of the theories about sporadic-E, and emphasised that it was an erratic phenomenon occurring annually between May and August and most likely to affect the 2m band in the late afternoon.

The VHF Convention

During the morning I met my two opposite numbers, **Graham Knight** and **Norman Fitch,** the v.h.f. columnists for *Radio Communication* and *Short Wave Magazine,* who, like myself were surveying the trade stands which were laden with components especially for the home constructor. Among the trade exhibitors, who were all most helpful, were Messrs Burns, Cambrian, C and C, Display, Garex, Heller, J.M.G., Modular and S.G.S. Electronics, J Birkett, Catronics, Crayford, Hamvel, Packer, South Midlands Communications, SOTA, S.W. Webb, Wood and Douglas, Amateur Radio Technical Service and Amateur Radio Exchange. At the end of the day Westlake Electronics told me that they had their usual run on coaxial cables, and John Fisher Electronics sold a lot of finishing materials, such as knobs, pilot lampholders and bits for making p.c. boards. The RSGB's bookstall and Bring and Buy sale were well supported and **Mike Dormer** G3DAH, and his lady assistants at the reception desk, were kept very busy as approximately 800 visitors arrived for the convention.

VHF PERSONALITY

THE RENNISON BROTHERS

by RON HAM

A variety of receivers belonging to radio enthusiasts, David and Ian Rennison, are installed in their respective bedrooms at their parents' home in Horsham, Sussex.

David, an 18-year-old trainee electrician, caught the bug for radio from his elder brother Ian and Ian's friend, Chris Otley G4CYA, some six years ago when the Rennisons lived in Sheffield. Ian, a 28-year-old bank employee, recalls that he began around the age of 14, when Chris and he listened to the medium waves on an old valved set which, after taking some 30 minutes to warm up, gave about 30 minutes good service before developing a loud squeal.

Ian's first communications receiver was a Codar 70A which he used to take around to Chris's home, in a shopping bag, because, with a bigger garden, Chris had a larger aerial and more signals were heard. David, a member of the Horsham Amateur Radio Club, is more inclined toward amateur radio than Ian whose main interests are medium wave DX, Band II broadcast listening and v.h.f. television DXing.

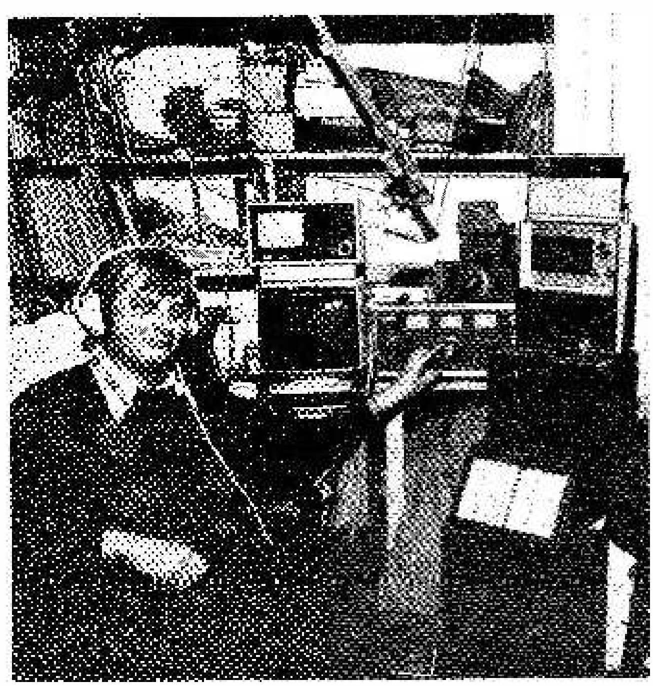
Both David and Ian use Trio 9R59 communications receivers with Codar preselectors. David uses an NR56 v.h.f. receiver for the 2m repeaters and a dual-gate MOSFET converter for general coverage of the 2m band, while Ian uses a Aiwa 5080A, with its wide bandspread for the f.m. stations in Band II, and a JVC 3040 UKC receiver for the European TV Channels, E2-4 and 5-12.

Both brothers have sound recording facilities and use sundry home-constructed items, such as aerial tuning units and crystal calibrators, and, in the large loft of the Rennison home, David has a Slim Jim, a 5/8 groundplane and a home-brew 2m beam, while Ian has a dipole for Band I and a Yagi for Band III.

David is also keen on motor car engineering, while, over the years, Ian has built a large collection of pop records. As a regular reader of *Practical Wireless,* Ian makes frequent contributions to the columns of Charles Molloy and myself.

Although living under the same roof, their mutual interest in radio is separated by the different wavebands which suit the needs of Ian, the BCL and David, the SWL.

David Rennison operating his Trio receiver



Ian Rennison with his DX TV gear

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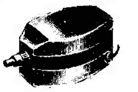

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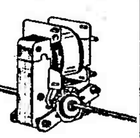

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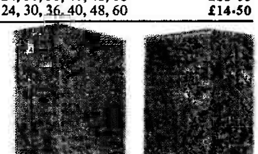

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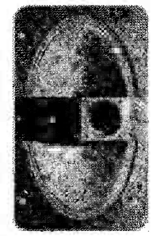

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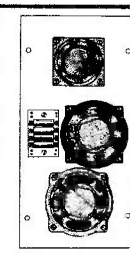

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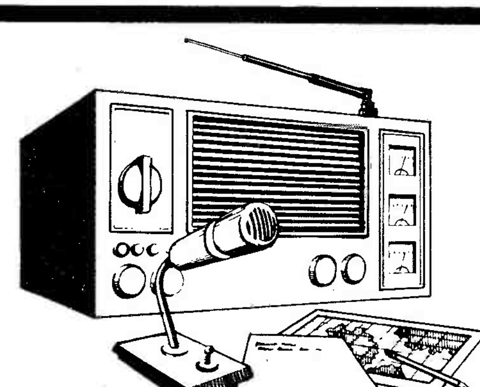

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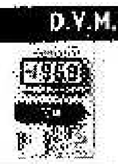

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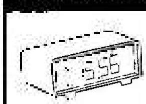

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51	5·0	10·66	1·43
117	6·0	12·06	1·57
88	8·0	16·15	1·77
89	10·0	18·63	1·99
90	12	20·70	2·11
91	15	23·72	2·25
92	20	31·81	OA

50 VOLT RANGE
Pri 220/240v Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V & 25V-0-25V.

Ref	Amps	VAT Inc.	P & P
102	0·5	3·68	0·84
103	1·0	4·94	1·04
104	2·0	7·73	1·23
105	3·0	9·24	1·43
106	4·0	12·32	1·62
107	6·0	16·26	1·77
118	8·0	21·88	2·25
119	10·0	26·98	OA
109	12	31·21	OA

60 VOLT RANGE
Pri 220/240V Sec 0-24-30-40-48-60V Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V, or 30V-0-30V.

Ref	Amps	VAT Inc.	P & P VAT Inc.
124	0·5	4·19	1·04
126	1·0	6·38	1·04
127	2·0	8·21	1·23
125	3·0	11·88	1·43
123	4·0	13·52	1·99
40	5·0	17·11	1·99
120	6·0	19·50	1·99
121	8·0	27·60	OA
122	10·0	31·91	OA
189	12·0	36·78	OA

MAINS ISOLATORS (SCREENED)
Pri 120/240V SEC 120/240V CT

Ref	VA (Watts)	VAT Inc.	P & P
*07	20	4·75	0·85
149	60	7·24	1·04
150	100	8·23	1·23
151	200	12·05	1·62
152	250	14·34	1·99
153	350	17·74	1·99
154	500	22·11	2·32
155	750	31·38	OA
156	1000	40·18	OA
157	1500	55·49	OA
158	2000	66·75	OA
159	3000	93·59	OA

Pri 0-220-240V. Sec 115 or 240V. State secondary volts required.

AUTO TRANSFORMERS

Ref	VA		VAT Inc.	P & P VAT Inc.
113	15		2·68	0·77
64	75		4·33	1·04
4	150	115 to 240	5·78	1·04
69	250	or	7·60	1·23
67	500	240 to 115	11·87	1·77
84	1K		20·26	2·25
93	1·5K		25·14	OA
95	2K		37·61	OA
73	3K		63·95	OA
80s	4K		83·01	OA
57s	5K		96·66	OA

HIGH VOLTAGE ISOLATORS
Pri 200/220V or 400/440V. Sec 110/120V CT or 200/240CT

Va	Ref	VAT Inc.	P & P
60	243	7·24	1·43
350	247	17·74	1·99
1000	250	45·10	OA

CASED AUTO TRANSFORMERS
240V cable in 115V USA flat pin outlet

VA	Net	VAT Inc.	P & P VAT Inc.	Ref
20	5·95	6·43	1·04	56W
75	7·73	8·35	1·23	64W
150	10·01	10·81	1·23	4W
200	9·92	12·01	1·57	65W
250	12·17	13·15	1·57	69W
500	19·17	20·70	1·77	67W
1K	27·88	30·11	OA	84W
1·5K	26·02	35·48	OA	93W
2K	49·97	53·97	OA	95W

SEND 15p FOR CATALOGUE

SCREENED MINIATURES

Ref	mA	Volts	VAT Inc.	P & P VAT Inc.
238	200	3-0-3	2·78	0·59
212	1A, 1A	0-6, 0-6	3·08	0·84
13	100	9-0-9	2·31	0·41
235	330, 330	0-9, 0-9	2·15	0·41
207	500, 500	0-8-9, 0-8-9	2·99	0·77
208	1A, 1A	0-8-9, 0-8-9	3·81	0·84
236	200, 200	0-15, 0-15	2·15	0·41
214	300, 300	0-20, 0-20	3·02	0·84
221	700 (DC)	20-12-0-12-20	3·68	0·84
206	1A, 1A	0-15-20-0-15-20	5·00	1·04
203	500, 500	0-15-27-0-15-27	4·31	1·04
204	1A, 1A	0-15-27-0-15-27	6·52	1·04
239	50	12-0-12	2·78	0·41

TEST METERS

	Net	VAT Inc.
AVO 8 MK5	88·10	95·15
AVO 71	36·00	38·88
AVO 73	48·70	52·60
AVO MM5	32·95	35·59
Wee Megger	74·25	80·19
EM272	57·80	62·42
DA116 digital	108·90	117·61

	Net	VAT Inc.
AVO TT169 in circuit Transistor Tester	39·53	42·69
Meggar BM7 battery		
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Ref	VAT Inc.	P & P VAT Inc.
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4A	20·27	1·99
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172	1A	3·20	0·84
173	2A	3·88	0·84
174	3A	4·05	0·93
175	4A	6·19	1·04

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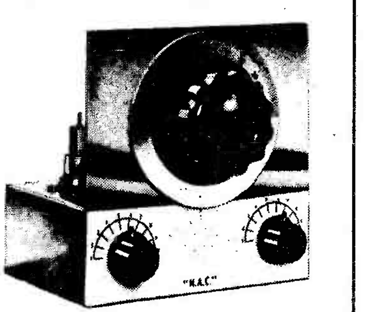

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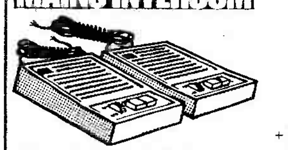

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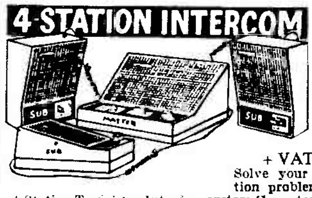

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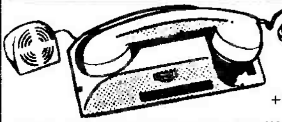

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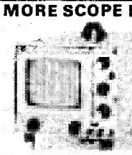

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4027	**325p**	Z80	**1150p**

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AC117*	35
AC125*	20
AC126*	20
AC127*	20
AC128*	20
AC141*	24
AC141K*	38
AC142*	24
AC142K*	38
AC176*	22
AC187*	22
AC188*	22
ACY17*	35
ACY18	40
ACY19	40
ACY20	40
ACY21*	35
ACY22*	40
ACY28*	40
ACY39	78
AD149*	70
AD161*	42
AD162*	42
AF106	50
AF114*	40
AF115*	40
AF116*	40
AF117*	40
AF118*	65
AF121*	48
AF124*	55
AF125*	35
AF126*	50
AF127*	35
AF139*	35
AF178*	70
AF180*	70
AF239*	42
AFZ12	126
ASY26*	40
ASY27*	45
ASY50*	95
ASY76*	95
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BC108*	9
BC108B*	10
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BC114	20
BC115	20
BC116	20
BC117	20
BC118	20
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BC134	20
BC135	20
BC136	18
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BC140*	35
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2N6109	50
3N128*	112
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Matched Pair 20p extra

TRIMMERS mini
2·5pF; 3-10pF;
3-30pF; 10-40pF **22p**
5-25pF; 65pF 88pF **30p**

COMPRESSION
3-40pF; 10-80pF **30p**
25-200pF **33p**
100-500pF **45p**

AUDIBLE Warning
Buzzers 6V or 12V **65p***

RF CHOKES 1µF, 4·7, 10, 22, 47, 100, 220, 470, 750, 1mH, 2·5, 5, 10mH **35p.** 35mH, 100mH **60p.**

CRYSTALS*

100kHz	**385p**
455kHz	**385p**
1MHz	**323p**
1·80MHz	**385p**
1·6MHz	**395p**
3·2768MHz	**323p**
4·032MHz	**323p**
4·433619M	**135p**
5·0MHz	**355p**
8·083333M	**275p**
18MHz	**395p**
27·648MHz	**350p**

TRANSFORMERS* (mains Prim. 220-240V)
6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 100mA **95p.**

8VA type: 6V-·5A 6V-·5A; 9V-·4A 9V-·4A; 12V-·3A 12V-·3A; 15V-·25A 15V-·25A **195p.**

12VA: 4·5-1·3A 4·5V-1·3A; 6V-12A 6V-1·2A 12V-5A 12V-5A; 15V-·4A 15V-·4A 20V-·3A 20V-·3A **220p** (20p p&p)

24VA: 6V-1·5A 6V-1·5A; 9V-1·2A 9V-1·2A; 12V-1A 12V-1A; 15-·8A 15-·8A; 20V-·6A 20V-·6A **290p** (45p p&p)

50VA: 6V-4A 6V-4A; 9V-2·5A 9V-2·5A; 12V-2A 12V-2A; 15V-1·5A 15V-1·5A; 20V-1·2A 20V-1·2A; 25V-1A 25V-1A; 30V-·8A 30V-·8A **350p** (50p p&p)

100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2·5A 20V-2·5A; 30V-1·5A 30V-1·5A; 40V-1·25A 40V-1·25A; 50V-1A 50V-1A **650p** (60p p&p)

(N.B. P&P charge to be added above our normal postal charge.)

DENCO COILS
Dual Purpose 'DP'
VALVE TYPE
Ranges: 1-5 Bl. Yl. Rd. Wht. **86p**
6-7 B, Y, R **76p**
1-5 Green **92p**
'T'-type (Transistor Tuning).
Ranges: 1-5 Bl. Yl. Rd. Wht. **93p**

B9A Valve Base	**25p**
RDT2	**92p**
RFC 5 chokes	**91p**
RFC 7(19mH)	**96p**
1FT 13/14/15/16 17	**85p**
1FT 18/1·6	**92p**
1FT 18/465	**104p**
TOC1	**86p**
MW 5FR	**82p**
MW/LW 5FR	**103p**

LINEAR IC'S

702*	75	ICM7555*	89	NE566*	160
709C 8 pin*	35	LD130*	452	NE567V*	170
710*	67	LF365*	98	NE570	395
723* 14 pin	45	LM301A*	30	NE571*	420
741* 8 pin	18	LM308T*	110	RC4136D*	120
747C 14 pin*	78	LM311H*	120	SAD1024*	1450
748C 8 pin*	36	LM318H*	205	SG3402*	295
753 8 pin*	150	LM324A*	68	SN76003N	170
810*	159	LM339	70	SN76013N	140
AY-1-0212	580	LM348*	90	SN7601B*	148
AY-1-1313A*	660	LM349*	125	SN76023N	140
AY-1-1320	315	LM379*	375	SN76033N	175
AY-1-5050	180	LM380	80	SN76115N	215
AY-1-5051	145	LM381N	145	SN76131*	110
AY-1-6721/6	195	LM381AN	248	SN76227N	115
AY-3-1015*	560	LM382	125	SN76477*	225
AY-3-8500*	390	LM733*	125	SN76660	90
AY-5-1013*	450	LM1458*	50	TAA621AX1	250
AY-5-1224A*	260	LM3900*	60	TAA661A	155
AY-5-1230*	450	LM3909N*	70	TAD100	159
AY-5-1315	560	LM3911*	125	TBA120S	70
AY-5-1317A	630	M252AA*	750	TBA540	220
AY-5-3500*	510	M253AA*	795	TBA550Q	330
AY-5-8100*	735	MC1303	88	TBA641-A12/ BX1 or BX11	250
CA3012*	150	MC1304P	260	TBA651	180
CA3014*	137	MC1310P	150	TBA800	90
CA3018*	68	MC1312PQ	195	TBA810S	95
CA3020	170	MC1458*	50	TBA820	70
CA3023	170	MC1495*	350	TBA920Q	260
CA3028A*	80	MC1496L*	92	TCA965*	120
CA3035	240	MC1710	79	TDA1004*	290
CA3036	110	MC3340P*	120	TDA1008*	310
CA3043	190	MC3360P	120	TDA1022	575
CA3045*	140	MC3401	52	TDA2020	320
CA3046*	71	MC3403*	135	TL061C*	76
CA3048	210	MFC6040*	97	TLO62CP*	125
CA3075	175	MK50253*	650	TLO64CN*	199
CA3080E*	70	MK50362*	650	TLO71CP*	76
CA3081*	190	MK50398*	635	TLO72CP*	125
CA3089E	210	MM5303*	635	TLO74CN*	199
CA3090AQ	398	MM5307*	1275	TLO81CP*	48
CA3123	200	MM57160*	620	TLO82CP*	96
CA3130*	85	NE543K*	210	TLO83CP*	105
CA3140*	70	NE544*	185	TLO84CP*	130
ICL7106*	795*	NE555*	22	UAA170	198
ICL7107*	975	NE556DB*	60	UAA180	198
ICL8038CC*	340	NE560*	325	ZN414	90
ICM7205*	1150	NE561*	395	ZN424E	130
ICM7215*	1050	NE562B*	410	ZN425E*	415
ICM7217*	790	NE564*	425	ZN1034*	200
		NE565A*	120		

TTL 74* (TEXAS)

7400	11	7475	38	74153	64	74265	63
7401	11	7476	36	74154	96	74273	320
7402	11	7480	48	74155	53	74278	240
7403	12	7481	86	74156	80	74279	119
7404	12	7482	69	74157	65	74283	173
7405	18	7483	72	74159	185	74284	385
7406	28	7484	95	74160	82	74285	395
7407	38	7485	75	74161	92	74290	125
7408	17	7486	31	74162	92	74293	125
7409	17	7489	140	74163	92	74297	236
7410	11	7490	30	74164	105	74283	173
7411	20	7491	75	74165	105	74284	385
7412	17	7492	38	74166	140	74285	395
7413	30	7493	32	74167	200	74290	125
7414	45	7494	78	74170	185	74293	125
7416	30	7495	65	74172	625	74297	236
7417	30	7496	57	74173	120	74298	185
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7438	33	74120	115	74190	95		
7440	15	74121	25	74191	95		
7441	74	74122	46	74192	98		
7442	68	74123	48	74193	98		
7443	115	74125	38	74194	98		
7444	112	74126	57	74195	98		
7445	94	74128	74	74196	93		
7446	94	74132	73	74197	80		
7447	57	74136	65	74198	150		
7448	56	74141	56	74199	150		
7450	17	74142	209	74221	132		
7451	17	74143	314	74246	204		
7453	17	74144	314	74247	204		
7454	17	74145	65	74248	240		
7460	17	74147	175	74249	204		
7470	28	74148	109	74251	125		
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CMOS*

4000	15	4021	95	4072	21	4507	55
4001	15	4022	85	4073	21	4508	298
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4006	93	4024	66	4076	85	4511	150
4007	18	4025	19	4077	40	4512	98
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4010	38	4028	81	4082	21	4515	299
4011	18	4029	99	4085	74	4516	120
4012	18	4030	58	4086	73	4517	382
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		4040	105	4161	109	4530	85
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		4055	128	4433	995	4559	375
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		4060	115	4451	295	4566	155
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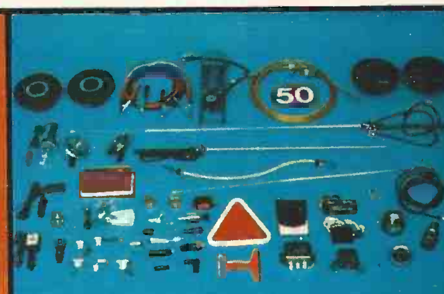

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