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ANTEX TCSU1 with CTC

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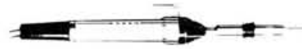
Model TCSU1 — Micro-Soldering Station

Accurate pin point temperature control between 65° and 400°C. Heating element and sensor built in tip of the iron for fast response. Interchangeable slide-on bits from 4.7mm (3/16") down to 0.5mm. Zero voltage switching, no spikes. No magnetic field, no leakage. Supplied with miniature CTC (35-40watt) iron or XTC (50watt). TCSU1 soldering station with XTC or CTC iron **£36** (6.44). Nett to industry.

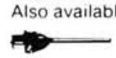
Model CTC - 24 volts Priced at **£9.75** (1.87)

Model XTC - 24 volts Priced at **£9.75** (1.87)

Model CX 17watts - 230 volts



A miniature iron with the element enclosed first in a ceramic shaft, then in stainless steel. Virtually leak-free. Only 7½" long. Fitted with a 3/32" bit **£4.20** (.98)
Range of 5 other bits available from ¼" down to 3/64"
Also available for 24volts



Spare element Model CX230E

Model X25 25watts - 230 volts

A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation. Fitted with 1/8" bit and priced at **£4.20** (.98)
Range of 4 other bits available
Also available in 24volts

Spare element Model X25/240E

Model SK3 Kit

Contains both the model CX230 soldering iron and the stand ST3. Priced at **£5.70** (1.49)
It makes an excellent present for the radio amateur or hobbyist.

Model SK4 Kit

With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£5.70** (1.49)

Model SK1

This kit contains a 15watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet "How to Solder". Priced at **£5.95** (1.53)

Model MLX 12volts

The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips. Packed in a strong plastic envelope it can be left in a car, a boat or a caravan ready for soldering in the field. Price **£4.55** (1.14)

ST3 Stand.

A strong chromium plated steel spring screwed into a plastic base of high grade insulating material provides a safe and handy receptacle for all ANTEX models soldering irons. Priced at **£1.50** (.57)

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PW580

practical WIRELESS

MAY 1980
VOLUME 56
NUMBER 5
ISSUE 879

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

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While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the Editor, *Practical Wireless*, at the above address, giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

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☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

☆ FREE THIS MONTH

PW Datacard—Component Calculator

Our June issue will be published on 2 May

(for details see page 43)

NEW

CONSTRUCTORS PACK 7

ALL THE PARTS TO BUILD THE PRACTICAL ELECTRONICS TRAVELLER CAR RADIO

* EASY TO BUILD * 5 PUSH BUTTON TUNING * MODERN STYLING DESIGN * ALL NEW UNUSED COMPONENTS * 6 WATT OUTPUT * READY ETCHED & PUNCHED P.C.B. * INCORPORATES SUPPRESSION CIRCUITS

£10.50 p&p £1.75

The pack contains all the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue.
The P.E. Traveller features pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia.
The P.E. Traveller has a 6 watts output, negative ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit.
The P.E. Traveller fits easily in or under dashboards.
Complete with instructions.

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Suitable stainless steel fully retractable locking aerial and speaker (approx 6" x 4") is available as a kit complete.
£1.95 Per Pack, p & p £1.00.
Pack 7A may only be purchased at the same time as Pack 7.
NOTE: Constructor's pack 7A sold complete with radio kit
£15.20 including p&p.

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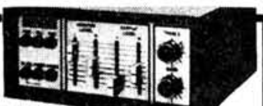
NEW 12+12 AMPLIFIER KIT

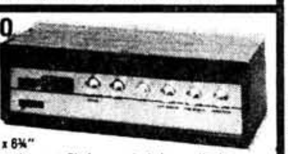


An opportunity to build your own 12 watts per channel stereo amplifier with up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit.
Size 9¼" x 8¾" x 4" approx.
NOTE: for use with 4 to 8 ohms speakers. p&p £2.55 **£13.95**

TWO WAY SPEAKER KIT To suit above amp. Comprising 2, 8" approx Phillips base unit, and 2, 3½" approx tweeters with 2 crossover capacitors **£4.95** p&p £1.65.

Available only to first time purchasers of the 12 + 12 kit.

50 WATT MONO DISCO AMP



£30.60
p&p £3.20

Size approx 13⅜" x 5¼" x 8¾"
50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

NOW AVAILABLE

30 + 30 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stero jack socket. Functions switch for mic magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30 + 30 watts RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers.
Size 14¾" x 3" x 10" approx.
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ACCESSORIES Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance. **£3.00** plus p&p £1.60

Two Way Speaker Kit Comprising of two 8" x 5" approx. 4 ohm bass and two 3½" 15 ohm mid-range tweeter with two cross-over capacitors.
Per stereo pair plus p&p £1.70 **£4.05**

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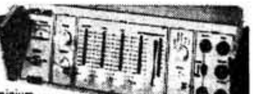

Brushed aluminium fascia and rotary controls. Size approx. 14" x 4" x 10¼".
Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

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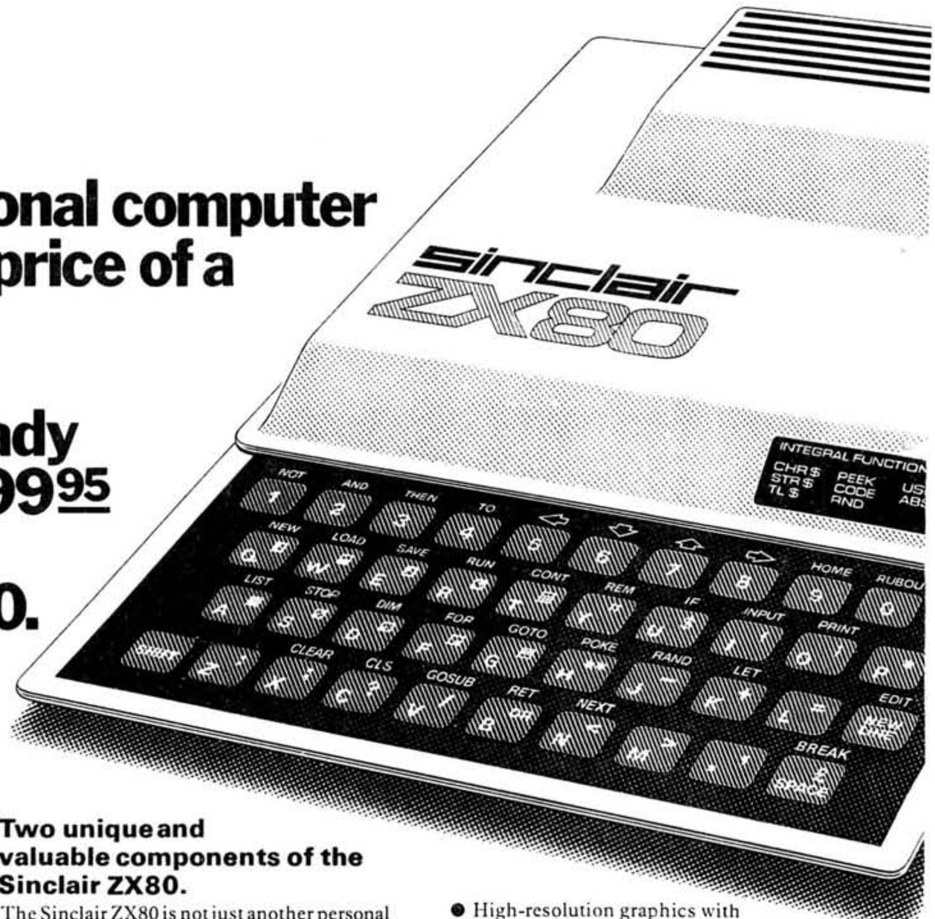


A complete personal computer for a third of the price of a bare board.

Also available ready assembled for £99.95

The Sinclair ZX80.

Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

The Sinclair ZX80 changes all that. For just £79.95 you get *everything* you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to your own cassette recorder and television; everything!

And yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers on the market at several times the price. The ZX80 is programmed in BASIC, and you could use it to do quite literally anything from playing chess to running a power station.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. Once assembled, it immediately proves what a good job you've done. Connect it to your TV set... link it to an appropriate power source*... and you're ready to go.

Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs – all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to any portable cassette recorder (to store programs) and domestic TV (to act as VDU).
- FREE course in BASIC programming and user manual.

Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion board plugs in to take up to 3K bytes extra RAM chips. (Chips also available – see coupon.)

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

Two unique and valuable components of the Sinclair ZX80.

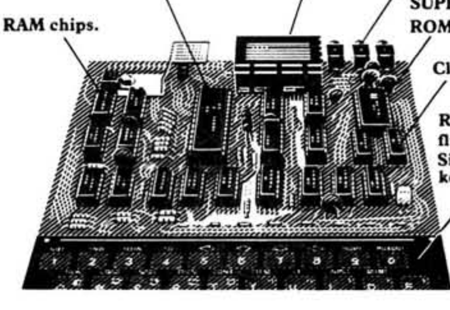
The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you – don't worry. They're all explained in the specially-written 96-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.)



plete computer kit.

Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed onto fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer, because the ZX80's brilliant design packs the RAM so much more tightly. (Key words, for instance, occupy just a single byte.)

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	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (takes up to 3K bytes).	12.00	
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	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £

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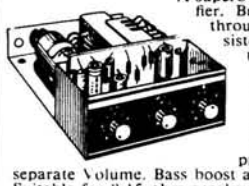
PW/5/80

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200 250V. PRICE **£18·40,** P. & P. £1·60.

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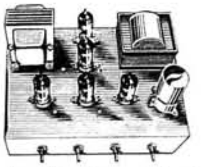

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple intruction booklet **50p** + SAE (Free with parts). **All parts sold separately.** ONLY **£18·40,** P. & P. £2.00. Also available ready built and tested **£22·50,** P. & P. £2·00.

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SIZE 1½" × 2.5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied **£7·00** plus 25p P. & P. Stereo beacon light if required **40p** extra.

Mullard LP1159 RF IF module 470kHz **£2·50** +P. & P. 22p. Full specification and connection details supplied.
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Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	**£14·95** P. & P. £1·20
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A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9½" × 2½" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£10·40** plus 90p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£2·15** + 70p P. & P. if required. Full connection details supplied.

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Guide to Broadcasting Stations

for only £2.95 (US$ 6.75)

This is the eighteenth edition of a publication which has sold over 270,000 copies. Around the world some thousands of radio stations are sending signals. If you're receiving, this standard guide will tell you who's where. And of course LW and MW allocations of November 1978 are incorporated.

The early pages contain useful information on radio receivers, aerials, propagation, signal identification and reception reports.

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Borough Green, Sevenoaks, Kent TN15 8PH

Butterworths has companies in Australia, Canada, New Zealand, South Africa and the USA, where local prices apply.

CASIO WATCHES

LATEST MODELS

DETAILS of all latest models for 1980 will be available on request all at discount prices, many with new lithium battery lasting 3-4-5 years. Please check with us first and be sure to get the 1980s model.

CASIO POCKET/CLOCK CALCULATORS

PL8 8 digit +/−/×/÷ memory √ % with constant		£8.95
CQ82 Desk calculator with clock and 4 alarms		£18.95
AQ2000 Calculator with clock, calendar & alarms		£23.95
AQ2200 As above with full month display and date calculations		P.O.A.
AQ1500 8 digit calculator, clock, calendar & stopwatch		P.O.A.
ML71 Calculator, musical, 11 tones, clock, calendar, stopwatch, alarms		£22.45
ML720 Calculator +/−/×/÷ K with memory. Plays 11 musical tones		£14.45
ML860 As above in leatherette case, 1500 hr. battery life		£14.45
MQ6 Mini-card size calc/watch, stopwatch, auto/calendar		£19.45
MQ12 Card-size calc/watch/stopwatch, calendar, month display, alarm		£19.45
QL10 Calc/watch/calendar, date calculations, 3 alarms, gas lighter		£39.95
FX81 Scientific 39 functions. Latest model with memory		£12.45
FX2600 Latest scientific slim 43 functions, 8 digit		£18.95
FX3200 As above 10 digit, 1000 hr. continuous use		£20.95
FX7100 39 function scientific with clock alarms, 1/100 sec stopwatch		P.O.A.
FX68 Mini-scientific 38 function, 8 digit, 4.7mm slim body		£18.95
FX501P Programmable 128 steps, 11 memories.	R.R.P. £64.95	£52.95
FX502P Programmable 256 steps, 22 memories.	R.R.P. £84.95	£72.95
FA1 Adaptor for 501-502 only with music synthesizer		£18.95
FX310 Ultra slim 8 digit scientific 50 functions		£16.85
FX510 Ultra slim 10 digit scientific 50 functions		£18.85

ALL OTHER CASIO CALCULATORS P.O.A.

SPECIAL OFFERS

LAMBDA latest model chronograph. Displays hour, minutes, seconds, month, date, day. Chronograph 1/100th sec. 1st, 2nd place times. *Fully adjustable* stainless steel strap, and case back with battery hatch. Slim style with night light. 1 year guarantee **£10.45**

SAXON ALARM CHRONOGRAPH Seiko style. Displays hours, minutes, seconds, am-pm and day indicator. Auto month, day, date. 24 hour alarm setting. Chronograph in 1/10th sec. 1st, 2nd place times. 12 or 24 hour display. Nightlight. 1 year guarantee. **£15.45**

TERMS OF BUSINESS: Please note all above products price includes VAT, P&P and insurance. Please send cheque P/O made payable B. Bamber Electronics. C.O.D. by phoning (0353) 860185. Callers most welcome Tues-Sat 9.30am-5.30pm. Please send 20p for all Casio details.

SPECIAL OFFERS

A.C. ADAPTOR (Battery Charger) 120V AC input, 5.8V DC at 200mA output. USA type mains plug to 3.5mm jack plug. Brand new & boxed **£1.25 Plus VAT**

A.C. ADAPTOR (Battery Charger) 117V AC input, 4.5V DC at 150mA output. USA type mains plug to 2.5mm jack plug. Brand new & boxed **£1.00 Plus VAT**

VARICAP TUNER HEADS, 4 button type, 22K res. with AFC switch & station indicator, Brand new **£2.00 Plus VAT**

SCREWS. Pack of nuts, bolts, washers, tags, self taps etc. Mixed BA & metric. Sold by weight. **£2.00 per Kilo. Plus VAT**

LOW VOLTAGE ELECTROLYTICS. Pack of mixed values & voltages. Approx. 150 items **£1.50 Plus VAT**

JAYBEAM STARBEAM UHF set top aerials. Brand new & boxed **£2.00 Plus VAT**

MODERN TELEPHONES Type 746 with dials, colour cream, used but new condition **£8.00 Plus VAT**

ERSIN MULTICORE SOLDER 3 core solder wound on a plastic reel. 20swg. Ally 60/40 tin lead. Available in 500gm reels **£5.70 Plus VAT**

CHANNEL MASTER COLOROTOR aerial rotator Model 9502. Rotation speed 1 rpm, gear ratio 3200:1,3 conductor wire for economy, pinpoint positioning to within one degree. Few only at **£45.00 PLUS VAT**

We also stock Jaybeam T.V. and Radio aerials. SAE for lists.

ISEP SLOTED HORIZONTAL RAIL available in 9 ft lengths. **£4.00 Plus VAT**

WATCH STRAPS Black stainless steel **50p** each. Black plastic **25p** each. Watch spring bars **10p** each. Discount for Quantity. **Plus VAT**

RADIOGRAM lid pumps **£1.00** each 2 for **£1.50 Plus VAT**

RIBBON CABLE 19 way decimal coded, 4 metres for **£1.25 Plus VAT**

RIBBON CABLE 10 way decimal coded, 5 metres for **£1.25 Plus VAT**

PYE TELECOM Yagi aerials. 4 element, very rugged construction, 71.1MHz (Ideal for four metres). Brand new. **£10.00 Plus VAT**

DISGUISED MOBILE AERIALS (dustbin lids). Available in mid-band & high band. Brand new. **£5.00 Plus VAT**

BYX25-1000 & BYX25R Rectifiers, 1000V 20A mounted on finned heatsink. Ex-Equip. **£1.25 Plus VAT**

BZY93C75 Diodes, 75V 20W Zener mounted on finned heatsink similar to above. Ex-Equip. **75p Plus VAT**

BUMPER 1980 CATALOGUE

A selection of items below from our 1980 catalogue, the products we stock are by Eagle, Weller, Draper, Spiralux, Knipex, Servisol, Barnard's & Babani, Newnes, Jaybeam, Vero, and others. If you send us £1.35 you will receive the catalogue plus four bi-monthly shortform catalogues to keep you up to date with prices and special offers. **Two 50p discount vouchers with this months issue.**

EAGLE MA780T Electric fully automatic 6 section retractable car aerial with built-in voltage sensor. Remote drive system makes fitting easier. Aerial length 1,000mm, below wing 220mm, lead length 9,000mm, flexible drive link 700mm. Price **£16.95 Plus VAT**

EAGLE DD7 Paging microphone, impedance 600 ohm or 50K ohms, sensitivity 2.25mV at 50K ohms, frequency response 300-9000Hz. Desk or wall mounted. Price **£14.85 Plus VAT**

EAGLE MULTIMETER EM50 50,000 opv. DC volts: 0-1200 volts, AC volts: 0-1200 volts, DC current 0-6A, Resistance 0-10 megohms. Price **£19.95 Plus VAT**

DRAPER super-chrome ¼" square drive socket sets, 38 piece, 9 AF hexagon sockets, 3 AF bi-square sockets, 11 MM hexagon sockets, 9 BA hexagon sockets, and 6 accessories. Price **£12.75 Plus VAT**

SPIRALUX metric nut spinner sets, contains 8 nut spinners 4, 4.5, 5, 5.5, 6, 7, 8, 9, 10mm. Packaged in a plastic wallet with cellulose acetate handle. Price **£7.53 Plus VAT**

WELLER TCP3 IRONS 24 *volt series*, 3 wire power units, for applications requiring earthed tip. TCP3 irons **£13.84**
PU3D power units **£24.12 Plus VAT**

WELLER instant heat guns Model No. 8100D **£13.21** each **Plus VAT**

WELLER cordless soldering irons Model No. WC100 **£25.47 Plus VAT**

JAYBEAM "STEREOBEAM" VHF/FM antennas Model SMB2, folded dipole and reflector with universal clamp. **£8.00 each**
Full range of Jaybeam aerials and accessories available. (See 1980 Catalogue).

ECA TVT78/78 semiconductor equivalent and data books. Data covering 12,000 transistors and more than 60,000 equivalents. 2 volumes for **£6.00 Zero VAT**

ORYX DE-SOLDER TOOLS model SR3A, de-soldering pump with built in safety guard. Price **£6.50 Plus VAT**

TERMS OF BUSINESS: CHEQUE OR P.O. WITH ORDER. REMEMBER PLEASE ADD **15% VAT** FOR ABOVE GOODS.
CARRIAGE: PACKING AND CARRIAGE CHARGES FOR ORDERS UNDER £5.00 NETT INVOICE VALUE 75p.
ORDERS OVER £5.00 BUT LESS THAN £20.00 50p.
ORDERS OF £20.00 CARRIAGE PAID.

B. BAMBER ELECTRONICS DEPT: P.W. 5 STATION ROAD LITTLEPORT CAMBS CB6 1QE

C.T. ELECTRONICS (ACTON) LTD.

267 & 270 ACTON LANE, LONDON W4 5DG. Telephone: 01-994 6275 *Registered in England 1179820*

9.30am-6.00pm MON-SAT CONTINUOUS

TRANSISTORS

AC128	30p	BFY51	24p
AC128/187		BU208	200p
Matched	60p	MJ2955	95p
AC187	30p	MPSA12	26p
AC188	30p	TIP29C	42p
AD149	—	TIP30C	48p
AD161/2	75p	TIP31C	49p
AF124	50p	TIP32C	53p
AF139	70p	TIP41C	88p
BC107	12p	TIP42C	90p
BC108	11p	ZTX300	15p
BC109	11p	ZTX500	15p
BC143	24p	2N2219	26p
BC147/8	9p	2N2222	18p
BC157/8	11p	2N2904	26p
BC182/4	11p	2N2906	21p
BC212/4	11p	2N3053	30p
BC547	11p	2N3054	65p
BC557	11p	2N3055	65p
BD131	42p	2N3702	—
BD132	44p	2N3704	—
BD139	42p	2N3772	160p
BD140	44p	2N3773	180p
BFR39	28p	2N3820	39p
BFR79	28p	2N3821	55p

DIODES

AA217	10p	5A 100V	80p
BB205	35p	30A 50V	225p
BY103	12p	**THYRISTORS**	
BY127	14p	TIC44	40p
BY238	40p	2N5060	40p
BY182	110p	2N5061	45p
IN4001	7p	C106B	35p
IN4004	8p	C106D	60p
IN4006	8p	2N4444	120p
IN4007	9p	10A 400V Stud	115p
IN5400	14p	*BT106	100p
IN5404	18p	**TRIACS**	
IN5407	20p	6A 400V	70p
6A-200V	25p	8A 400V	80p
10A-200V	30p	10A 400V Stud	90p
10A-400V	45p	**LEDS**	
BRIDGES		0·2 Red	13p
1A 100V	25p	0·2 Green	16p
1A 200V	30p	0·2 Yellow	23p
1A 600V	45p	0·125 Red	15p
2½A 100V	50p	0·125 Green	18p
4A 100V	70p	0·125 Yellow	25p

7400	0.12	7451	0.20	74141	0.75
7401	0.12	7453	0.20	74150	1.00
7402	0.12	7454	0.20	74151	0.70
7403	0.12	7460	0.20	74153	0.70
7404	0.20	7470	0.35	74154	1.00
7405	0.18	7472	0.30	74155	0.70
7406	0.32	7473	0.30	74156	0.85
7407	0.32	7474	0.30	74157	0.70
7408	0.20	7475	0.45	74160	0.95
7409	0.20	7476	0.35	74161	0.50
7412	0.20	7480	0.60	74162	1.00
7413	0.30	7481	1.00	74163	1.00
7414	0.70	7482	0.90	74164	1.00
7415	0.30	7483	0.80	74165	1.00
7417	0.33	7484	1.10	74166	1.00
7419	0.50	7485	0.90	74167	2.50
7420	0.10	7486	0.30	74170	2.00
7421	0.20	7489	1.60	74174	0.95
7422	0.35	7490	0.35	74175	0.80
7423	0.32	7491	0.50	74176	0.80
7425	0.30	7492	0.45	74177	0.80
7426	0.30	7493	0.40	74180	0.80
7427	0.30	7494	0.90	74181	1.85
7428	0.40	7495	0.65	74182	0.95
7430	0.18	7496	0.65	74184	1.50
7432	0.25	7497	1.90	74185	1.50
7433	0.50	74100	1.40	74188	2.50
7437	0.30	74104	0.70	74190	1.00
7438	0.30	74105	1.70	74191	1.00
7440	0.18	74107	0.30	74192	1.00
7441	0.70	74109	0.55	74193	1.00
7442	0.50	74110	0.55	74194	1.00
7443	1.30	74118	0.95	74195	0.95
7445	1.00	74119	1.30	74196	0.95
7446	1.00	74121	0.28	74197	0.80
7447	0.75	74122	0.55	74198	1.60
7448	0.75	74123	0.55	74199	1.60
7449	1.00	74125	0.50		
7450	0.20	74132	0.70		

CMOS

4000UB	0.23	4023B	0.24	4069UB	0.26
4001UB/B	0.23	4024B	0.70	4070B	0.46
4002UB/B	0.23	4025UB/B	0.26	4071B	0.26
4006B	1.04	4024B	0.44	4072B	0.26
4007UB	0.24	4028B	0.77	4073B	0.26
4008B	0.87	4029B	1.07	4075B	0.26
4011UB/B	0.26	4032B	0.89	4076B	1.17
4012UB/B	0.26	4034B	1.71	4077B	0.39
4013B	0.43	4040B	0.97	4078B	0.26
4014B	0.83	4043B	0.88	4081B	0.26
4015B	0.83	4044B	0.84	4082B	0.26
4016B	0.48	4049UB	0.50	4093B	0.80
4017B	0.79	4050B	0.43	4510B	1.01
4018B	0.83	4051B	0.82	4511B	1.25
4020B	1.11	4053B	0.82	4512B	1.25
4021B	0.90	4066B	0.55	4516B	1.01
4022B	0.82	4068B	0.26	4528B	0.80

RESISTORS

Metal Oxide 2%

TR4 (¼W)			4p
TR5 (½W)			4p
TR6 (1W)			8p
TR8 (2W)			12p

Discount on 100's/1000's

PT10/15 horiz/vert presets			10p
PT10 cermets			15p
Plessey MPD moulded track presets			15p
Bourns trimpots, all values			50p
Midget pots log/lin			30p
Double gang pots			65p
Switched pots			50p
Double gang switched			95p
1W wirewound pots	40p	1Ω to 100K	
3W wirewound pots	60p	1Ω to 100K	
5W wirewound pots	80p	1Ω to 100K	

LINEARS

CA3020	200p	TBA810	110p
CA3130	95p	TBA820	90p
CA3140	45p	*741	18p
LM301	30p	*725	200p
LM308	60p	*555	25p
LM324	53p	*747	86p
LM380	100p		
LM3900	70p	**REGS**	
MC1303	120p	7805	85p
MC1310	140p	7905	95p
MC1456	140p	7812	85p
MC1458	40p	7812	95p
SN76013N	140p	LM309	150p
SN76110	100p	LM326	150p
SN76660	60p	LM723	40p
SN76131	100p		
TAA550	40p	**ZENERS**	
TAA621	200p	400mW	
TAA700	275p	(BZY88 etc)	10p
TBA800	100p	1·3W (BZX61)	16p
		10W Studs	50p

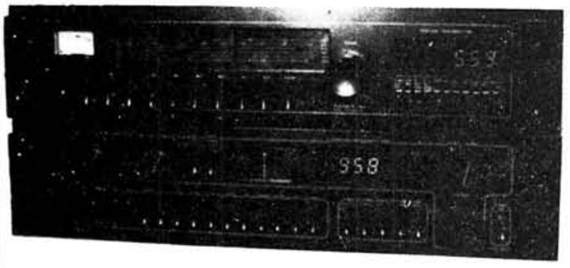
SPECIAL PURCHASES

D25 multiway connectors, brand new, with shells male or female	£1.50p each
3u Veropacks with guides and connectors	£6 each
5u Veropacks with guides and connectors	£15 each
5V 6A switched mode PSU's by Zirkon, brand new and bored	£18
4-16 volt switched mode variable PSU's by Zircon, brand new with manual	£18
Lambda 5V 3½A min. spec. PSU's, the best, brand new with manuals	£15 each

All prices NET – Add VAT at 15% MAIL ORDER minimum goods £5.00 + postage & add VAT on total

Prices may be revised without notice – Please phone for confirmation, stocks & postage.

BEWARE! RADIO ACTIVITY



The new MK III FM tuner sitting under the Dorchester multiband AM/FM tuner

Revisions to the Mark III include a centre zero tuning indicator meter and silent preset switching

New 944378-2, the last word in stereo decoders with the KB4437/4438.

Choosing the products to advertise each month can be quite a task at AMBIT, since we tend to introduce at least one new line per week. So it is nearly impossible to say all we would like in this space - other than to bring you as far up to date as possible with current events. The major medium for finding out about what we have to offer is our unique catalogue system, and we ask that you invest in a copy of parts 1,2 & 3 since many questions we are asked can be readily answered by reference to these.
Each part costs 60p, or £1.60 for all three current editions.
We are also launching a new and greatly elongated version of our PRICE LIST, which now includes a large number of quantity listings, and many items not previously listed. The new style price list is a quick reference short form to our general catalogues - available FOC with a large (A4) SAE please.

As a result of the soaring price of oil - and the subsequent huge increases in the cost of wax for Mr Tom Jackson's famous moustache, the Post Office have increased their charges (Feb. 4th). Accordingly, our standard cover charge has been increased to 35p per order (CWO).

MODULE NEWS

We are at last able to quote for quantities of our modules, following a program of standardization and revision to speed manufacture and test. The following types are the results of the standardization program:

UM1181	5 varicap MOSFET input VHF band 2 tunerhead	£12.00 inc
911225 A	High Performance FM IF system, with switched BW	£23.95 inc
911225 B	Single BW filters, single tuned detector	£14.95 inc
91072 A	DC tuned and single pole switched MW LW tuner	£14.43 inc
91072 B	As type 'A' but with either SW1 or SW2 band	£15.90 inc
92242 A	Combined LW/MW tuner, with FM IF detector section	£29.00 inc
92242 B	As 92242A but with 5-10MHz SW section	£34.00 inc

All are supplied housed in screened metal cases 97x56x24mm, with all connections along a single edge, suitable for verticle or horizontal mounting.

Previously advertized units are still available - although there may have been some price changes in the latest edition of the Price List (Date Feb.80). A separate leaflet covering the new range of modules is available from April 80, with an A4 SAE please.

COMPONENTS

DIGITAL FREQUENCY READOUTS / SYNTHESISER SYSTEMS

Ambit has the biggest range of digital frequency readout systems for various applications in Broadcast and Communications. Prices range from £18.50 for a complete AM/FM broadcast frequency display (kit of DFM2). Most are detailed in the latest catalogue.

TUNING SYNTHESIZERS are also heavily featured, and we offer our first complete system covering MW/ LW/ SW2 and FM based on Hitachi parts. The unit is retrofittable to voltage tuned radio systems - and will shortly be incorporated in a complete tuner project. Cost for the synthesiser will be circa £40
A versatile communications system based on the new Mullard 2 IC system is nearing completion, together with 16 station CMOS memory and optical shaft encoder system with fast tune facility. Synthesiser circa £70, memory £50.

NEW LINE : ALPS switches and rotary potentiometers. With a general catalogue that's over 3 inches thick, we cannot begin to offer a comprehensive list of what we can offer - but we are already stocking the keyboard switches, keyswitches, pushbutton switches etc. In particular, the pushbutton switches really put all others in the shade (schadow?) when it comes to quality and price. A special new shortform is being prepared (and may be ready when you read this). All the potentiometers and switches you could ever need from a single source. Keypad switches cost as little as 15p ea (1 off), with a range of two part caps for easy ledgending. You must see the shortform catalogue (30p) and our new pricelist for full details of this huge range of components

Latest semiconductor news:

CMOS, TTL and LPSN TTL are in stock (ask for our OSTS price leaflet). Some of the very popular types are still "difficult" but we have things like 4011s, 4017s at the time of writing.

RADIO ICs - - -interesting developments here, we now have the Hitachi HA11225 and the HA12412 ultra high specification members of the CA3089E family. The PLESSEY SL1600 range now includes the SL6600 high performance PLL NBFM IF and detector.

CA3089E	2.11	HA1197	1.61	SD6000	4.31	SL1610	1.84	SL1626	2.80
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59	SL1611	1.84	SL1630	1.86
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38	SL1612	1.84	SL1640	2.17
HA11225	2.47	TBA651	2.53	MC1350P	1.38	SL1613	2.17	SL1641	2.17
HA12412	2.81	TDA1090	3.51	KB4412	2.24	SL1620	2.50	SL6600	4.31
KB4420	1.95	TDA1220	1.61	KB4413	2.24	SL1623	2.80	SL6640	3.16
TBA120S	1.15	TDA1083	2.24	KB4417	2.53	SL1624	3.77	SL6690	3.68
KB4406	0.80	TDA1062	2.24	MC3357P	3.16	SL1625	2.50	MC1496	1.44

TRANSISTORS : New lower prices, wider range, large stocks. Also the world's lowest noise audio devices (2SC2546E and 2SA1084E) first from AMBIT of course. Power MOSFETs & all sorts of other devices. Our 3SK51 MOSFET replaces the 408XX and 40673 families.

BC237-8-9	0.092	2SC1775	0.207	2SA1084E	0.368	BF256	0.437	BFY90	1.03
BC307-8-9	0.092	2SA872A	0.207	2SC2547E	0.391	2SK55	0.368	BF224	0.253
BC413-5	0.115	2SD666A	0.345	2SA1085E	0.391	2SK168	0.402	BF274	0.207
BD414-6	0.126	2SB646A	0.345	2SK133	6.32	3SK51	0.62	BFT95	1.138
BC546-556	0.138	2SD760	0.52	2SJ48	6.32	3SK60	0.667	VN66AF	1.092
BC550-560	0.138	2SB720	0.52	2SK135	7.29	BF960	1.426	2N4427	0.977
BC639-640	0.265	2SC2546E	0.368	2SJ50	7.29	3SK48	1.426	J176	0.747

RADIO CONTROL: A special section for all RC fans. New and exciting stuff:
KB4445/KB4446 : complete 4 channel RX/TX dig.prop IC pair RF&control in one 4.75pr
MSL9362/MSL9363 : logic section of a four channel dig.prop link, with switch opt. 3.75pr
NE5044 : Signetics versatile 7 channel encoder, suitable for mixing etc. £2.14 ea
NE544 Signetics famous servo driver IC £2.07 MC3357P as used in RCME design £3.16 ea
AMBIT RCRX4 - RCME FM system compatible, complete RX kit with box/connector and AMBIT design screened front end with 27MHz ceramic filter £16.10 (kit)
XTALS: FM pairs £3.74 (no splits) TX is fund. ½ op frequency, RX 3rd OT- 455kHz
AM pairs £3.57 (no splits. Both 3rd OT types, again RX IF at 455kHz

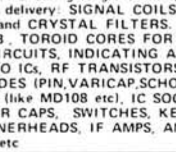
AMBIT SHOP NOW OPEN

We are gradually getting our caller sales area sorted out, with displays of the products on offer and a browsers corner to sit and study data/catalogues. Call in next time you are in the area - parking outside the door.

COMPUTER CAPABILITIES

Ambit has been keeping a low profile on the subject of the MPU and its applications. Interestingly enough, the first project we offer with MPU content does rather more in the way of processing than simply playing a daft game, or looking like an enormous calculator. Our MPU facility and expertise is now for hire on a fully commercial basis. Z80, 6800, 6809, 2650 etc.

Keyboard switch
SCK41505
typ 6m ops
23p each (1-24)



NEW LINE : DC/DC+AC converters for fluorescent displays. TOKO CPS series 12v IN, −20 and 3v AC out at 65mA. Thick film design £2.34 ea Qty. prices OA

GENERAL INFORMATION

Ambit stocks the following ranges of components for ex-stock volume delivery: SIGNAL COILS, CERAMIC, MECHANICAL and CRYSTAL FILTERS. RADIO ICs for AM/FM/SSB, TOROID CORES FOR RADIO and EMI FILTER CIRCUITS, INDICATING AND PANEL METERS, AUDIO ICs, RF TRANSISTORS, FETS, MOSFETS, DIODES (PIN,VARICAP,SCHOTTKY), PASSIVE DBMs (like MD108 etc), IC SOCKETS, LEDS, TRIMMER CAPS, SWITCHES, KEYBOARD SWITCHES, TUNERHEADS, IF AMPS, AM RADIO MODULES, etc etc

NEW LINE : DVM176 - the definitive ICM7106 LCD DVM module. 3½ digit £22.37 ea.

CM161: LCD 12/24hr alarm clock/day/date/backlight (eq.RS308-499) 7mm digits £11.44 each
CM174: LCD 12hr alarm clock/stopwatch/backlight with 30mm height digits £14.32 each

CATALOGUES 60p ea , all three for £1.60
PRICES SHOWN HERE INCLUDE VAT
POST/PACKAGE CHARGE NOW 35p

ambit
INTERNATIONAL

CWO PLEASE . Commercial MA terms on application
Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt.

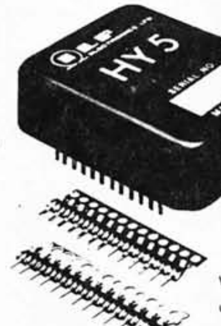
200 North Service Road, Brentwood, Essex

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

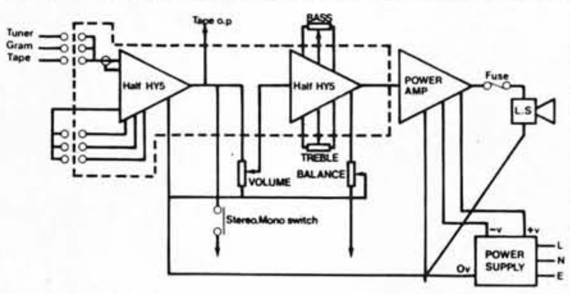
and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER



With easy to use connector.

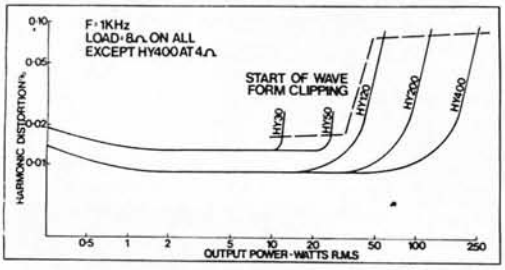


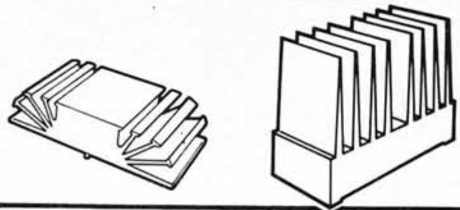
VALUES OF COMPONENTS FOR CONNECTING TO HY5
Volume – 10K Ω log.
Bass/Treble – 100K Ω linear. Balance – 5K Ω linear.

The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz–0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

£4.64 + 74p VAT

THE POWER AMPLIFIERS





Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/ Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	**£15.20** + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	**£18.44** + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	**£27.68** + £4.15

Load impedance – all models 4 - 16Ω
Input sensitivity – all models 500 mV
Input impedance – all models 100KΩ
Frequency response – all models 10Hz-45KHz –3dB

THE POWER SUPPLY UNITS *(Laminated and Toroidal)*

I.L.P. Power Supply Units are designed specifically for use with our power amplifiers and are in two basic forms – one with circuit panel mounted on conventionally styled transformer, the other with toroidal transformer, having half the weight and height of conventional laminated types.

PSU 30	±15V at 100ma to drive up to five HY5 pre-amps **£4.50** + £0.68 VAT
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PSU 70	with toroidal transformer for 1 or 2 HY120's **£13.61** + £2.04 VAT
PSU 90	with toroidal transformer for 1 HY200 **£13.61** + £2.04 VAT
PSU180	with toroidal transformer for 1 HY400 or 2 x HY200 **£23.02** + £3.45 VAT

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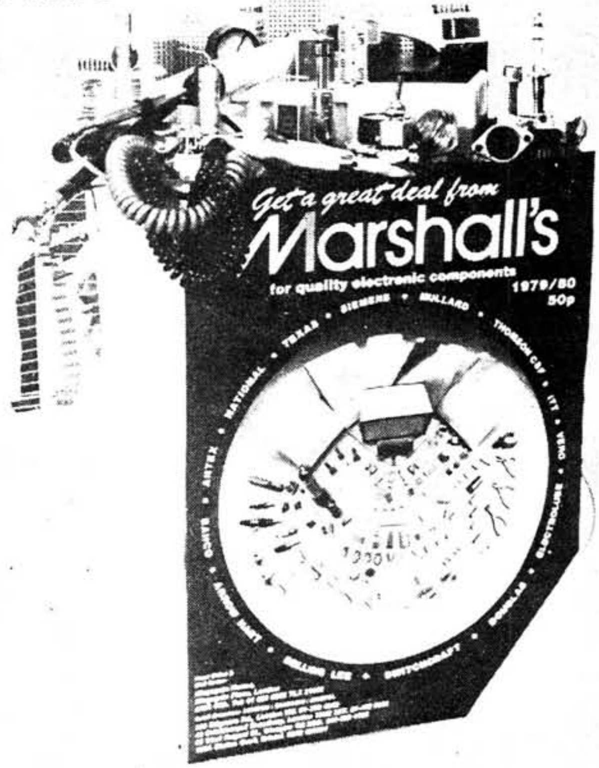

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Two further alarm systems: (i) 24 hour alarm (ii) Count down alarm (1 sec accuracy).

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7416	£0.26	7448	£0.64	7492	£0.40	74154	£0.94	74193	£0.67
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CD4012	£0.22	CD4024	£0.75	CD4041	£0.87	CD4056	£1.55	CD4520	£1.15
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CA3018	£0.75	CA3065E	£0.95	NE550	£1.09	72723	£0.52	TAA621A	£2.30
CA3020	£1.16	LM301	£0.33	NE555	£0.23	UA741C	£0.28	TAA621B	£2.88
CA3028	£0.92	LM304	£1.84	NE556	£0.69	72741	£0.27	TAA661	£1.73
CA3035	£1.61	LM308	£1.15	NE565	£1.73	741P	£0.20	TAD100	£1.50
CA3036	£1.15	LM309	£1.73	NE566	£1.73	UA7447C	£0.69	TBA540	£2.42
CA3042	£1.73	LM380	£0.98	NE567	£1.96	72747	£0.69	TBA810S	£0.86
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200 THY600ma/200v	£0.44	800 THY7A/800	£1.05
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AAZ13	£0.17	BY124	£0.25	BYZ17	£0.41	OA200	£0.09
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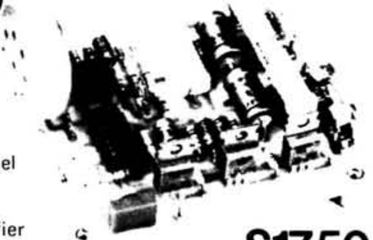

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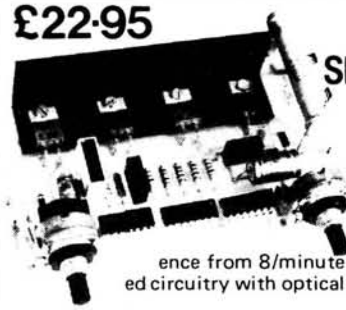

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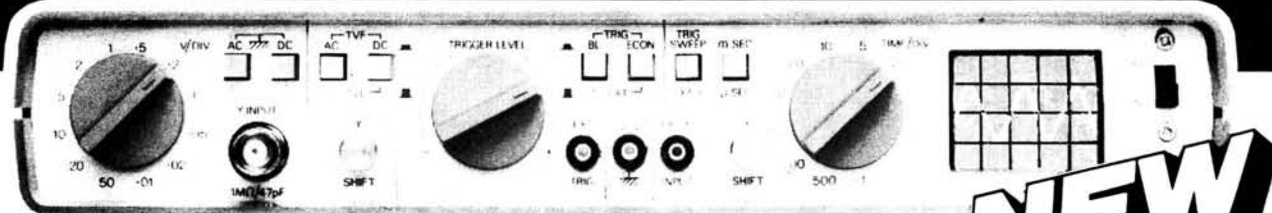

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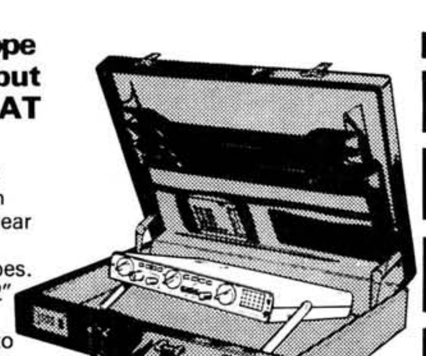

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Current Events

ONE of the problems of writing in a monthly magazine is that by the time a news item appears in print, it has become history. If, on the other hand, we try to foresee events, we invariably end up with egg on our faces, as they take an unexpected turn.

This was just what happened last November over the long-awaited announcement in Parliament on the future of Citizens' Band radio in the UK. Whilst the idea of CB was approved in principle, the Government felt it could not provide the staff needed for licensing duties in the present economic climate. The only positive step was to rule out the use of the 27MHz band adopted in most other countries where CB is legal.

The cynics have said that this announcement is just another delaying tactic, promoted by the Home Office mandarins who are against any relaxation of their tight rein on radio-communication facilities. Assuming that a reasonably simple licensing system were to be introduced, the licence fees ought to be capable of covering the administrative costs involved, but the Treasury are said to be against introducing any new taxes of this type, as a matter of principle. One major independent body has offered to take over licence issuing and control; the reaction from the Home Office has been deafening silence.

The excuse of our economic circumstances obviously has some foundation, and I'm sure that few taxpayers would normally support any increase in the number of civil servants. However, the circumstances are somewhat unusual, for the longer the delay in bringing in a legal CB system, the greater becomes the problem of illegal operation. The authorities simply do not have the resources to deal with this illegal operation, as is proved by figures quoted by the Home Secretary in December last, when he revealed that in the first eleven months of 1979, just 78 prosecutions had taken place, and a further 56 were pending. Against current unofficial estimates of up to 70 000 unlicensed CB operators in the UK, these numbers pale into insignificance.

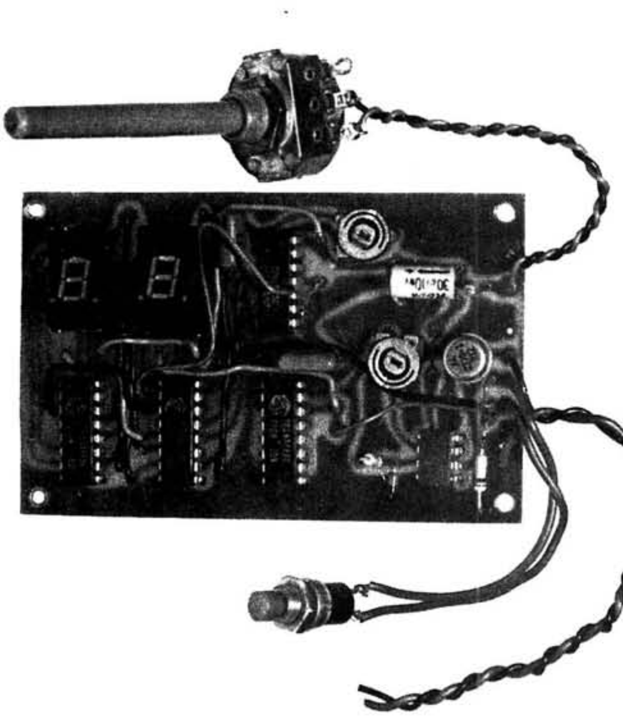
Mind you, we aren't the only country with CB problems. One of our readers in the Irish Republic, Tony Bass, recently sent a file of press cuttings on developments there. The Dublin Parliament have been debating a Bill which includes swingeing penalties for illegal CB operation. These include a fine of up to £10 000 and/or two years' imprisonment, and the National CB Council of Ireland has stated that it is prepared to go to the highest court in the land, and even to the European Court of Human Rights, to get this legislation amended.

In the UK, we are fast approaching the situation which has already come about in some other countries, where illegal operation swelled to such a volume that the authorities were forced to legalise it as an existing fact, warts and all. If you don't want this to happen here, but you do want to see a properly organised radio-communication facility for the general public, write and say so, to: The Rt Hon William Whitelaw, MP PC, The House of Commons, London SW1A 0AA. Write now—it could soon be too late!

Geoff Arnold

100 SECOND PHOTOGRAPHIC CLOCK

W. MOONEY G3VZU



Accurate timing is essential in photographic practice if consistent results are required. The clock described in the following chapters was designed to cover the enlarger exposure and print developing stages in a black and white set-up. However, the clock would also be useful for timing colour processes or taking photographs where exposure times in excess of one second are involved.

Accuracy is very good being within 1 per cent for long periods without re-calibration; but ultimately, accuracy is almost totally dependent on the human reaction time required to switch the enlarger on and off since there is no direct thyristor or relay connections contained within the enlarger, as with some other timers. However, total reaction time is seldom longer than 0·2 seconds.

The clock readout is by means of two 0·3in, 7-segment red l.e.d. displays, counting from 00–99 seconds, and can be reset to 00 at any time. The reset facility allows the usual 60 to 90 second print development to be timed without mental addition and the attendant risk of forgetting the starting time due to a distraction. Most black and white papers are not sensitive to the red light from the display, but a brightness control has been included for the sake of battery economy.

Since the CMOS i.c.s used consume negligible power, almost all the current drain is used to drive the displays which are strobed at 50Hz for further power economy. Even at maximum brightness, the current drain from a 9V supply is only about 15mA, hence considerable life can be expected from a PP9 or even a PP3 battery. A mains power supply is, therefore, probably not worthwhile. An on-off switch is provided but the clock may be left running for the duration of a printing session.

Circuitry

Since low current consumption was a primary aim and the circuitry is only required to operate at low frequency, CMOS i.c.s are used throughout except for a 741 operational amplifier in the power supply stabiliser. The complete circuit diagram of the clock is shown in Fig. 1. The l.e.d. displays are driven by a pair of cascaded CD4026 decade counter/decoder/drivers, IC3 and IC4, with reset and strobe facilities.

The first of the two counters is supplied with 1Hz pulses from the clock circuitry and these pulses are counted and displayed. On every tenth pulse a carry signal advances the 10's digit by one count. On the count of 99, the next pulse causes the display to read 00 and the count begins again.

Counting Method

The master oscillator runs at 100Hz for two reasons: (a) The use of a non-electrolytic timing capacitor is possible at this frequency, since its value is independent of the voltage and it has low leakage, a reliable timebase is assured. (b) The 100Hz signal needs to be divided down to 1Hz, and for this a CD4518 is used, which has a divide by two output producing 50Hz which, after processing, can be used to strobe the display.

The 50Hz output is used for strobing rather than the oscillator direct, the first divider of the CD4518 acting as a buffer for the oscillator. The 100Hz oscillator consists of gates A and B of IC1, a CD4011. The 1Hz pulses from IC2 pin 14 (a CD4518) are fed to IC3 pin 1 for counting.

Strobing and brightness control makes use of gate C and D of IC1. The 50Hz squarewave from IC2 pin 3 is differentiated by C2 and VR2, the brightness control, to provide positive going pulses whose duration depends on the setting of VR3. These pulses are made symmetrical by gate C of IC1. However, the output of gate C spends more of the 1/50th of a second between pulses in the high state

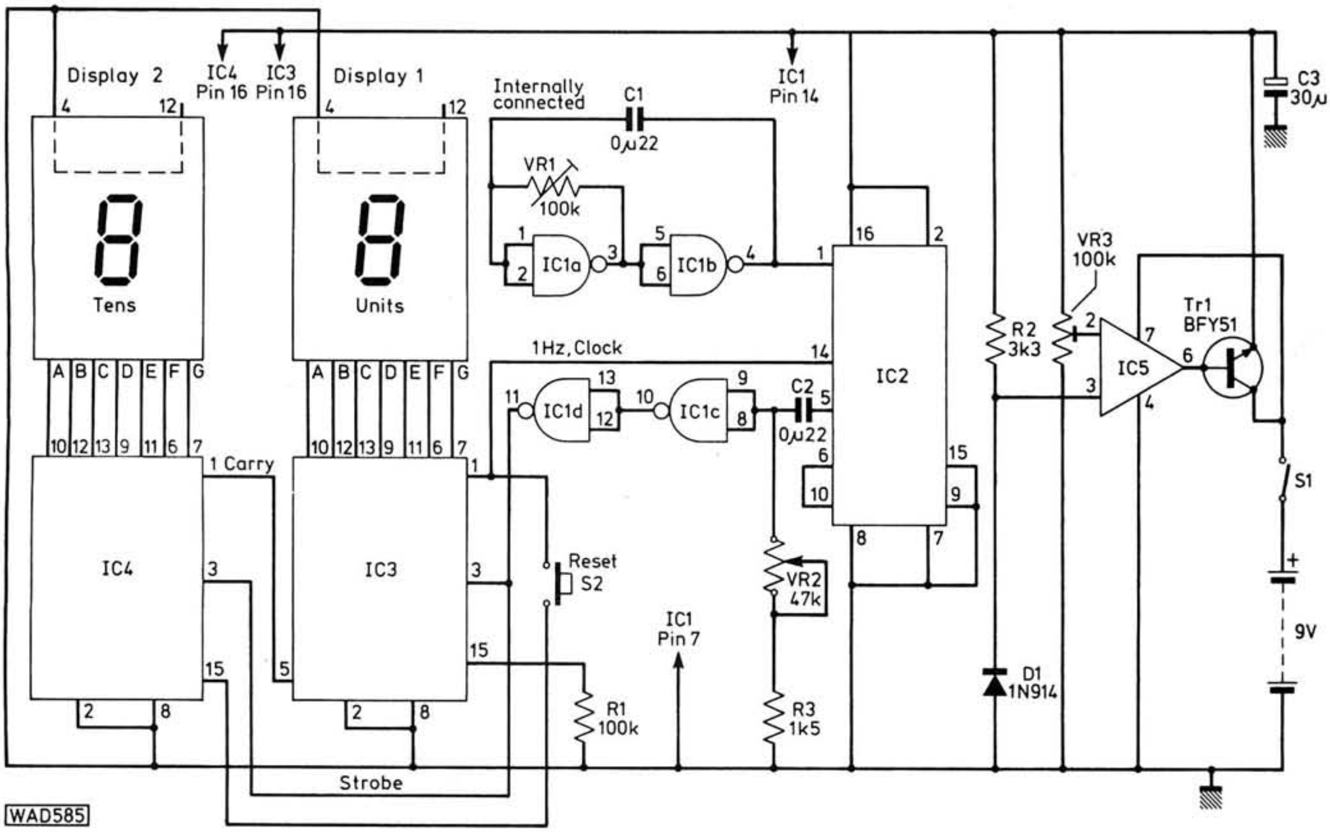


Fig. 1: The complete circuit diagram

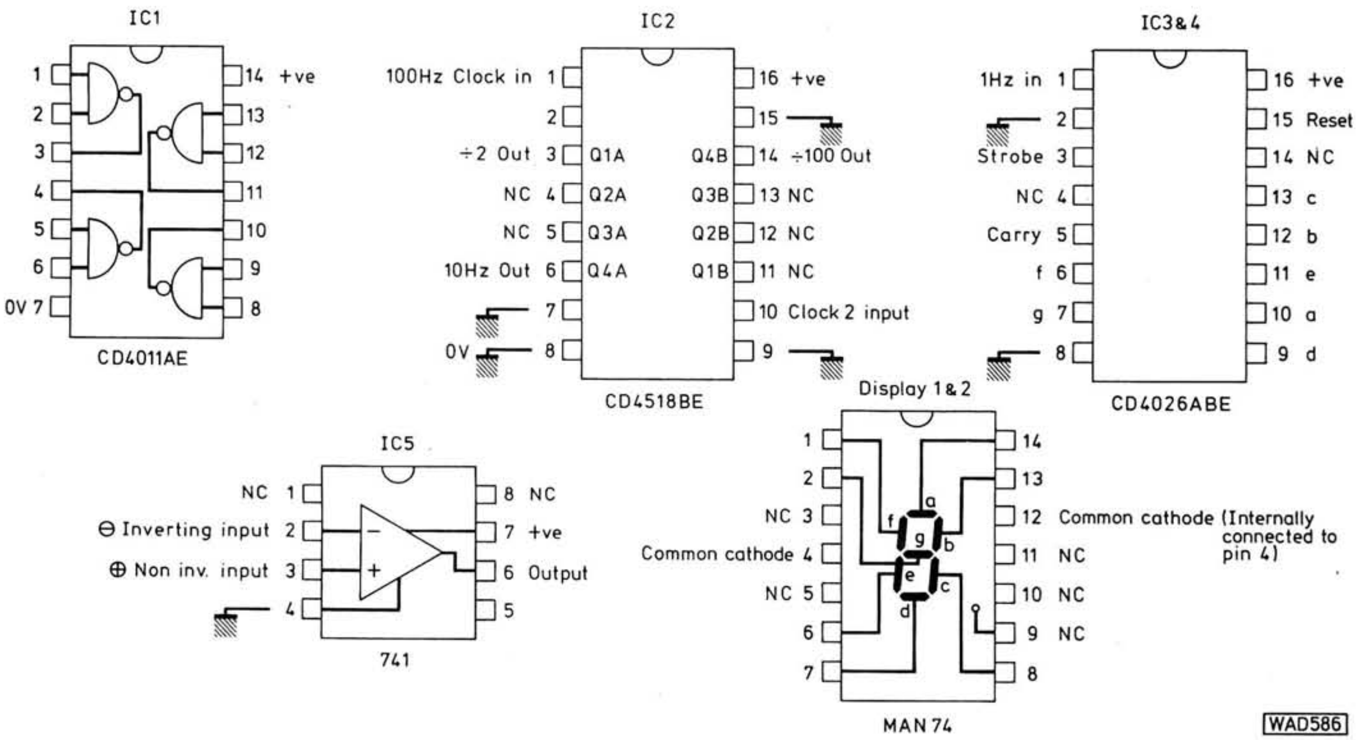


Fig. 2: Pin details of the integrated circuits and displays

and since the display is blanked when its display enabled inputs are low, the strobe pulses are first inverted by gate D of IC1 before being applied to pin 3, the "display enable" connection of the 4026 display driver.

A 5V stabilised supply is used for the circuit as this gives a reasonable display brightness and allows the use of a 9V battery until it is exhausted. Stabilisation is provided by IC5 where the reference voltage provided by a 1N914 diode is compared with the voltage from the "voltage set" potentiometer, VR3; the current output of the 741 being amplified by Tr1. The few extra components needed with this type of supply stabiliser are well justified considering the dramatic effect on the accuracy of the device.

The unstabilised clock has a frequency sensitivity of around 2 per cent per volt and a drop from 9 to 7V causes the timer to be about 4 per cent low, or 4 seconds slow over a 100 second timing period. When the stabiliser is set to 5V output the supply can drop from 9V down to about 6·4V without any change in the 5V level and a load current change of 0 to 50mA has no effect on the stabilised output voltage. Below 6·4V, the 5V supply is no longer stable and begins to drop rapidly.

Construction

The complete circuit is built on a 75 × 60mm single sided p.c.b. The track layout is shown in Fig. 2 with the component positions shown in Fig. 4. There are a number of links on the top of the board which should not be forgotten when wiring up and it is best to follow the circuit diagram when wiring up these links. The layout is not critical and Veroboard could be used although there would be many links required and the result would not be as neat as using the correctly designed board.

The two displays are mounted in sockets in order to raise them above the remaining components which are soldered directly in place. This allows the display to protrude through a suitable rectangular hole cut in the front panel of a convenient small cabinet. Many excellent boxes are currently advertised which are suitable for housing the p.c.b. and associated parts.

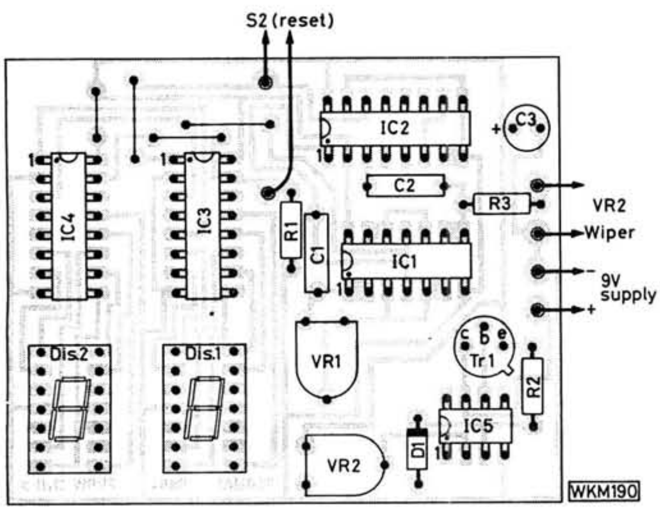


Fig. 3: Layout of the components on the p.c.b.

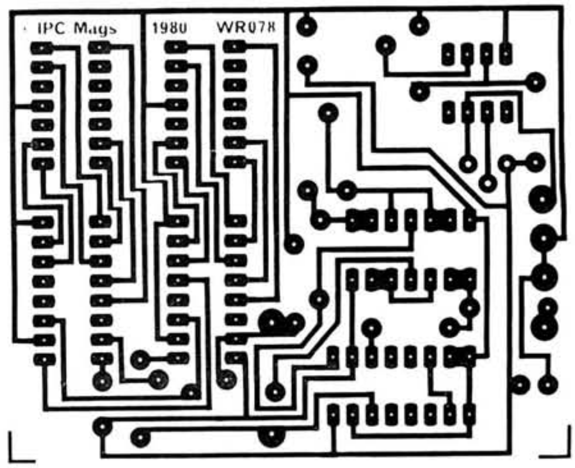


Fig. 4: The printed circuit board drawn full size

★ components

Resistors		
¼W 5%		
1·5kΩ	1	R3
3·3kΩ	1	R2
100kΩ	1	R1
Potentiometers		
Midget		
47kΩ log.	1	VR2
Miniature Preset (vertical mounting) 0·1W		
100kΩ	2	VR1, VR3
Capacitors		
Miniature Polyester		
0·22μF	2	C1, C2
10V Electrolytic		
47μF	1	C3
Semiconductors		
Diodes		
1N914	1	D1
Transistors		
BFY51	1	Tr1
Integrated Circuits		
741	1	IC5
CD4011	1	IC1
CD4026	2	IC3, IC4
CD4518	1	IC2
Displays		
MAN74 (or similar 0·3in type)	2	Display 1,2

Miscellaneous
Printed circuit board (1); Small on/off switch, S1 (1); Small push-to-make switch, S2 (1); Suitable case, battery connections and battery.

Setting Up

The wiring should first be checked visually for shorts, incorrect connections, omissions, etc. A 100mA meter should then be connected in series with the power supply and a 9V battery connected. The current should only be small if the brightness control is set to a low value. The supply voltage to the circuit, measured at Tr1 emitter, should now be set to 5V by adjusting VR2. The clock should now be set. This can be achieved by the connection of a high input impedance frequency meter to IC2 pin 4, the clock output, and adjusting VR1 to give precisely 100Hz. Alternatively, VR1 can be adjusted using a stopwatch and counting the seconds, but the previous method is to be preferred.

When the 5V supply and timer are set, the current should again be checked, and should be around 5mA with the brightness control set to minimum, rising to around 20mA at maximum brightness, with 88 being displayed.

Using The Timer

When timing an enlargement exposure, the most accurate method is to add the required exposure time to the count currently being displayed rather than resetting to 00, that is, if a 10 second exposure is required, switch the enlarger on at say 45 seconds and off again at 55 seconds. It is most convenient to set to 00 at the start of development which usually takes much longer and therefore more time is available to reset.

When the reset switch is closed, 00 will appear at the next 1 second clock pulse, therefore the reset switch will need to be kept closed for up to 1 second. ●

Reader's Letter

RSGB ID

Sir: Like many other licensed amateurs and Radio Society of Great Britain members, I can only wonder at the sheer effrontery of the RSGB setting itself up as an issuing authority for so-called "identity cards" of doubtful value.

When the idea was first announced the RSGB said it was because "over the years amateurs have sometimes been embarrassed by police and other officials asking for an explanation of mobile and portable activities."

Since last July I have been trying to find out from the RSGB just who are these "other officials"—but without success.

If the Home Secretary deemed it necessary for the holder of an amateur licence to have an identity card I feel sure that he would be the only authority to issue it, and at the same time ensure legislation for this purpose stipulating to what authorities and officers the holder was obliged to produce it.

It is not for the licensee to prove his authority to operate to anyone, and the police are no more concerned with amateur or other radio licences than they are with TV licences, planning permission, building regulations and such like.

Why anyone should be embarrassed by police interest puzzles me, as does the RSGB in thinking that their certification of licence-holdership will satisfy the police as to the operator's right to carry on with his lawful pursuit.

H. L. Millard G8LWK
Burnley
Lancs

Club News

The White Rose Radio Society G3XEP-G8LVQ, is a very active society meeting every Wednesday at 20.000hrs, and runs a competition net on about 3·75MHz every Thursday at 20.30hrs.

The society has a new, well equipped, purpose-built shack, organises c.w. and RAE classes, and for the first time this year, are expecting the examinations to be held at their premises.

Prospective members are welcome and should contact: *Hon Sec Richard Hughes G4DZI, W.R.R.S., Moortown R.U.F.C., Moss Valley, King Lane, Leeds LS17 7NT.*

Worcester & District Amateur Radio Club would also like to extend a welcome to visitors and prospective members, who are invited to attend club meetings every first Monday of the month at "The Old Pheasant", New Street, Worcester at 20.00hrs.

Further details from: *Hon Sec Mike Tittensor G4EKG, 16 Durcott Road, Evesham, Worcestershire WR11 6EQ. Tel: (0386) 41105.*

Mobile Rally

Otley Radio and Electronics Society G8JTD, G3XNO are holding "The Northern Mobile Rally 1980", at the Victoria Park Hall, Keighley on Sunday, 18 May, between 11.30 and 17.30hrs.

There will be talk-in stations on 2m f.m. S22 and 70cm f.m. SU8, also trade stands, films for the children, refreshments, bar and many other attractions.

Further details from: *Rally Manager, Jack E. Annakin G8DFZ, 25 Ashfield Place, Otley, West Yorkshire LS21 3JN.*

Livingston Hire

Although instrument hire is now widely used in the UK electronics engineering industry, not all the customers using a company like Livingston Hire come from this sector. Recently, for example, Livingston hired some equipment to the BBC for use in Ascension Island.

The equipment in question, a Solartron Model 7065 microprocessor based digital voltmeter, was needed by the BBC's Transmitter Capital Projects Department to measure the effects of rapid changes of transmitter input power on an electricity supply network.

High power short-wave transmitters present a varying load to the supply system, the load changing in sympathy with the level of programme modulation. On remote islands with relatively low capacity generating plant these load variations can lead to unacceptable voltage variations for other consumers.

The BBC's Ascension Island relay station, which broadcasts to West Africa and South America, has such transmitters installed and power is obtained from a small diesel generating station. The recent test provided valuable data for planning new transmitting stations in comparable overseas locations by establishing the limits to which voltage levels could be allowed to vary without disturbing other consumers.

Livingston Hire, Shirley House, 27 Camden Road, London NW1 9NR. Tel: 01-267 3262.

Out of Thin Air

In response to the enormous interest shown in articles on aerials and associated subjects, the staff of *Practical Wireless* have compiled an 80-page book entitled "Out of Thin Air—A Guide to Aerial Theory, Design and Propagation".

The book consists of articles extracted from *PW*, new material and a directory of aerial suppliers.

"Out of Thin Air" is available from leading newsagents, priced £1.25 or by post. See page 39 for details.

Video Disc Decision

After developing their own respective video disc systems, Matsushita and JVC have now agreed to adopt JVC's VHD (Video High Density) system with multiple function capabilities as the format upon which they will base their video disc system.

At the moment there are four systems. They are: 1. Phillips-MCA System (Optical-Tracking Pick up system); 2. RCA System (Groove-Guided Capacitance Pick up system); 3. JVC System (Electro-Tracking Capacitance Pick up system); 4. Matsushita System (Groove-Guided Pressure Pick up system).

With JVC's VHD system, video and audio information are recorded as pits on the disc's surface without grooves to guide the pick-up stylus. The information and tracking signals are simultaneously picked up as capacitance variations between the disc surface and is guided electronically to pick up the recorded signals. This feature enables the pick-up stylus to move freely over the entire surface of the disc, and permits special effects such as random access, still, slow and fast motion playback functions.

JVC (UK) Ltd., Eldonwall Trading Estate, 6/8 Priestley Way, Staples Corner, London NW2. Tel: 01-450 2621.

Try Prestel at the ME Centre

The National Microprocessor and Electronics Centre announces that it now has a fully operational Prestel system on which visitors to the centre can evaluate the advantage of such an installation to their business or home environment.

Subscribers to the service can access a large Post Office mainframe computer to obtain detailed information of a business, consumer or general leisure nature. All it takes is a specially designed television receiver, a calculator-sized remote controller and connection to a standard telephone line.

National Microprocessor and Electronics Centre, London World Trade Centre, Europe House, London E1 9AA. Tel: 01-488 2400.

WATERS & STANTON ELECTRONICS

STOP! . . .

IF YOU'RE INTERESTED IN THE R1000 READ THIS . . .

(our R1000's incorporate the latest factory mods.)

TRIO R1000 + OUR TEST CERTIFICATE

R1000 Receiver

The R1000 is reviewed this month but at the time of preparing this advertisement we have not had a chance to see the review. We have, however, extensively tested and used this receiver over a period of four months – the only way to thoroughly judge a receiver – and can honestly say that it represents excellent value for money. If, having read the review, you feel that there are any points you would like to discuss, then please feel free to telephone us.

About our company

We have been specialising in amateur radio communications receivers and transceivers for seven years now and our reputation in this field is second to none. It's fairly well known that before selling you a receiver we insist that it's thoroughly checked to ensure that it fully meets the manufacturers specification in every respect. Yes, a few do fail; after all they have travelled well over 6,000 miles from the factory! Our pre-delivery checks involve the use of some very sophisticated test equipment – this year alone we invested nearly £10,000 in updating our service department! In fact if you are calling into our premises you are welcome to see for yourself our large service department on the 1st floor above the ground floor showroom. This will assure you of the kind of back-up service you'll get from a specialist dealer like ourselves. Staffed by licensed radio amateurs, it's your assurance that equipment leaving our premises has been checked by a fellow enthusiast.

Your own test certificate

So enthusiastic are we about the R1000 receiver, that we have decided to supply a detailed test certificate with every receiver – your assurance that we have done our job with our pre-delivery checks. It also gives you the satisfaction of knowing the precise sensitivity, etc., of your receiver. It's completely free to all purchases made during April and May.

How to order

If you're unable to visit our large retail store, then simply send us a cheque or postal order for immediate despatch. For even quicker service you can telephone your Barclaycard or Access number to us for same day despatch via Securicor service. Price: **£298** inc. VAT.

WATERS & STANTON ELECTRONICS

Warren House, 18-20 Main Road, Hockley, Essex.

Telephone: 03704 6835. Telex: 897406. Hours: Monday-Saturday 9-5.30 p.m. except Wednesday 1.00 p.m.

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RADIO SPECIAL PRODUCT REPORT

TRIO

R-1000 RECEIVER

Having operated just about every type of receiver there is, from crystal sets through t.r.f.s and simple superhets to professional synthesised receivers costing a thousand pounds upwards, I have found that the modern communications receivers with switched band-pass filters for their r.f. selectivity always give the impression that they are "dead", lacking the punch of a receiver with gang-tuned or preselector-tuned front end. In *Amateur Bands* last month, Eric Dowdeswell raised this same point, saying how he felt that the comparatively broad-band filter must let through more noise than a preselector tuned "on-the-nose" for maximum signal strength.

When testing the Trio R-1000, my first reaction was that here was another receiver with no punch, and I wondered what so many radio enthusiasts were going wild about. However, as time went on, and I compared results with a more conventional set on various bands and modes, I had to admit that there was nothing I could hear on "Brand X" (which I personally rate very highly) that wasn't at least as strong and clear on the R-1000. So, I don't know why it is that I get this feeling, which applies equally to sets costing nearly ten times as much as the R-1000, and is obviously strictly subjective. Has any reader any suggestions?

Circuit Arrangements

The aerial inputs (see Specifications) are fed via a 0–60dB stepped attenuator to the front-end filters, of which there are six. The lowest has a bandwidth from 0·2—1MHz, and the remainder cover octave bands up to 30MHz. After passing through an r.f. amplifier and a buffer stage, the signals are applied to a balanced mixer, along with a signal in the range 48–78MHz, generated in the phase-lock-loop unit and tuned over a 1MHz span by the main tune control. Cascaded miniature ceramic filters centred on 48·055MHz select the appropriate product of the mixing process, which is then combined in a second balanced mixer with the output of a 47·6MHz crystal oscillator, to give the final i.f. signal at 455kHz.

This signal is fed via an active noise blanker to one of three filters, with bandwidths 2·7kHz, 6kHz and 12kHz, as selected by the MODE switch, and then passes through two i.f. amplifier stages to a diode-ring mixer for s.s.b./c.w. demodulation, and via a buffer to the a.m. detector and the a.g.c. detector. The audio outputs go to a pre-amplifier and thence to an audio output i.c. which drives the phones and top-mounted loudspeaker. Simple top-cut tone control is provided, and an output suitable for driving a tape recorder is taken off after the pre-amplifier.

★ specification

RECEIVER

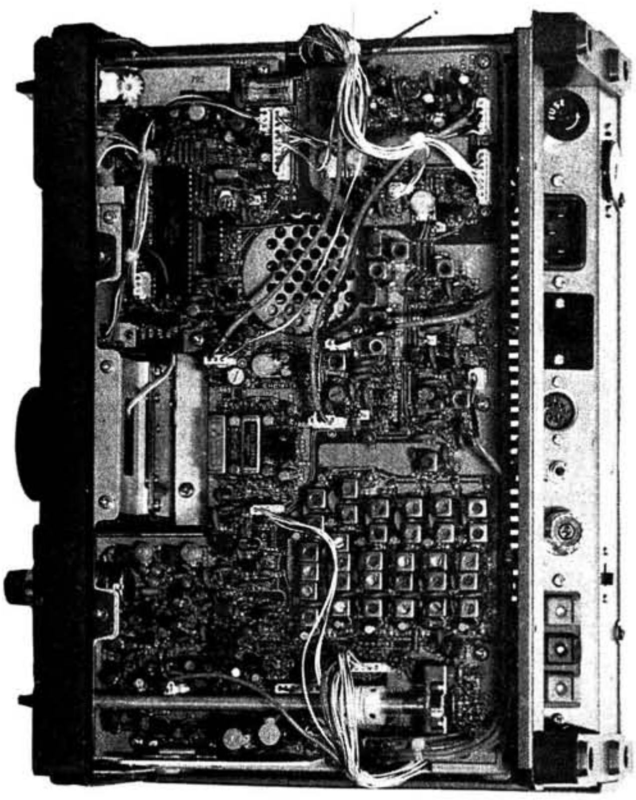
Frequency Coverage:	200kHz–30MHz in 1MHz bands
Sensitivity:	Below 2MHz; 5µV s.s.b., 50µV a.m. Above 2MHz; 0·5µV s.s.b. 5µV a.m. for 10dB S + N/N or better
Image Rejection:	Better than 60dB
IF Rejection:	Better than 70dB
Selectivity:	AM (WIDE); 12kHz at −6dB, 25kHz at −50dB AM (NARROW); 6kHz at −6dB, 18kHz at −50dB SSB/CW; 2·7kHz at −6dB, 5kHz at −60dB (also see text)
Frequency Stability:	±2kHz max. from 1 to 60 minutes after switch-on ±300Hz max. in any subsequent 30 minutes
Antenna Impedance:	Below 2MHz; 1kΩ unbalanced Above 2MHz; 50Ω or 1kΩ unbalanced (switchable)
Audio Output:	1·5W min. into 8Ω for 10% distortion
Audio Load Impedance:	4—16Ω loudspeaker or headphones 100kΩ, 30mV tape recorder
Power Requirements:	100, 120, 220, 240V 50/60Hz a.c. 12V d.c.
Dimensions:	115 x 300 x 218mm
Weight:	5·5kg

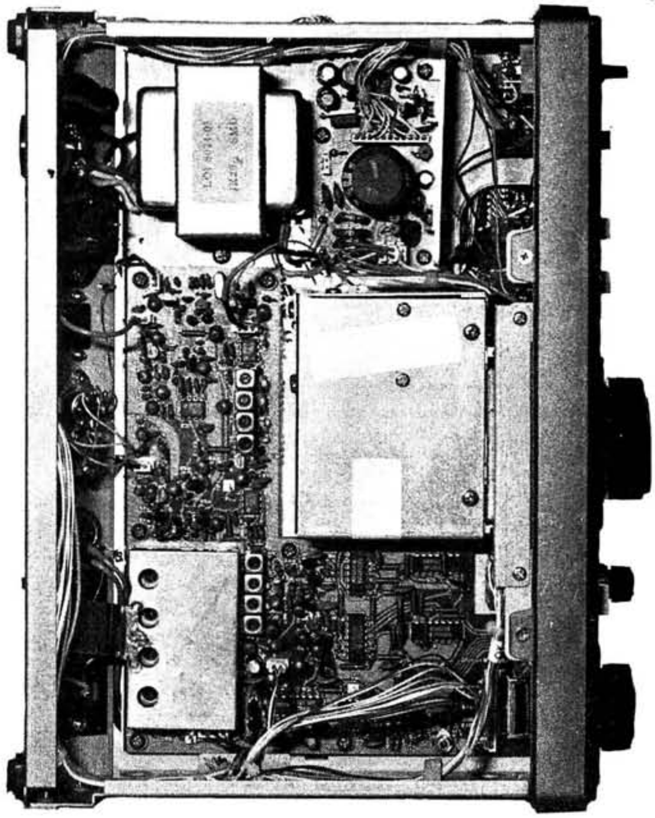
CLOCK/TIMER

Type:	Quartz
Accuracy:	±15 seconds max. per month

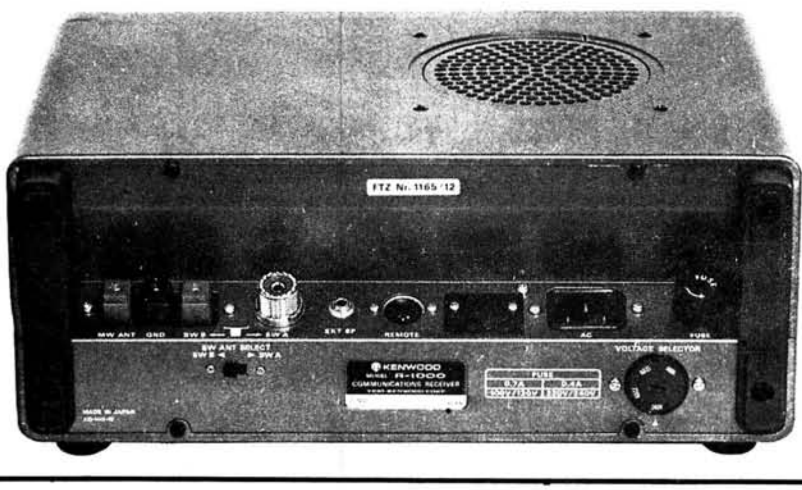
Both analogue and digital frequency readout are a feature of the R-1000. The MODE switches contain l.e.d. indicators

A top view of the receiver, showing the main board, including clock/timer. All off-board connections are made via plugs and sockets





A bottom view, showing the p.l.l. synthesiser board, v.f.o. and power supply. All p.c.b.-mounted component references are marked on the board



The rear panel is shaped so that the receiver can be placed close to a wall with the external connectors fitted

The a.g.c. detector output is amplified and applied to the r.f. amplifier and the two i.f. amplifiers. it also drives the "S" meter amplifier. An external muting input is provided for use when operating with a transmitter. This controls the r.f. amplifier, first and second mixers and i.f. amplifiers.

In addition to analogue indication of frequency by means of a back-lit dial, a bright blue fluorescent display gives digital readout to the nearest kilohertz. The digital display can also be switched to indicate time, driven from an internal quartz clock, and to show start and stop times for the timer, which will turn both the receiver and an external circuit on and off once in each 24-hour period. The dial lights and digital display can be dimmed for night-time use.

Operating Impressions

Station-getting ability has been largely covered in the introduction, with the exception of selectivity. The s.s.b./c.w. filter (2·7kHz at the −6dB points) is good, and is fine for picking out sideband signals in the amateur bands. The AM WIDE bandwidth of 12kHz, on the other hand, is simply too wide to separate broadcast stations with 9kHz spacing. We understand from Lowe Electronics, who supplied the review receiver, that it is a simple matter to alter the wiring so that the 6kHz filter is used for AM WIDE, and the 2·7kHz filter for AM NARROW. We did not test this modification, but it would certainly be worth trying for the broadcast band DXer.

The a.g.c. decay time constant on the review receiver was far too long on the a.m. mode, but we gather that this has been altered to a more realistic value in subsequent production. The attenuator provided (20dB steps from 0dB to 60dB) is of rather limited use, and very, very few stations are strong enough to allow use of the 60dB position.

It is a pity that, in common with so many other modern receivers, the R-1000 does not have a manual r.f. gain control. If you are listening to a strong c.w. station, the a.g.c. lifts the gain in the signal spaces, giving a rather unpleasant ear-bashing effect as the noise rises just before key-down. If, in these circumstances, you bring in attenuation, the receiver noise comes up and produces a general mushy signal. It is so much nicer to be able to turn back an r.f./i.f. gain control to lose both that mush and the thumping effect. I know it's not the easiest job in the world to design an efficient manual r.f./i.f. gain control circuit, but it adds a lot to the operating facilities. What about it, you receiver manufacturers?

There are just two tuning controls on the R-1000: a thirty-position switch selecting MHz bands and a 45mm diameter knob controlling the v.f.o. This has no flywheel action, but rapid tuning across the band is aided by a finger-recess in the front of the knob. No fine tuning control is provided, but tuning presents no difficulty, even when resolving s.s.b. stations. Tuning rate averages 50kHz per revolution, and the analogue dial can be adjusted to line up with the digital readout. Lighting of that dial and of the "S" meter scale is good, though under some daylight condition the contrast of the meter scale (which, like the tuning dial, is back-lit) improves with the lights dimmed, because the scale-plate is reflective.

No opportunity occurred to test the operation of the noise-blanker, but these circuits tend to be pretty subjective in their efficiency any way.

The arrangement of the external connections on the back panel is an outstanding feature of this receiver, as it allows the set to be operated on its back, or hard up against a wall, yet with all the plugs and sockets tucked neatly away out of sight. From the rear view shown in our photographs, you will see that our review receiver has an FTZ number. This means that it is type-approved by the Federal German authorities, and as a result has no 12V d.c. power supply facility, since their regulations forbid dual input arrangements. A 12V connector is fitted on UK market receivers, and this, together with their small size, makes them ideal for mobile operation. For anyone who might be interested in using an R-1000 on a small boat, or anywhere else with a 24V d.c. supply, Lowe Electronics tell us that they can supply receivers fitted with a regulator allowing operation on d.c. supplies of 11–28V, at no additional cost.

Accessories supplied with each receiver include an operating manual, power cable, five metres of aerial wire, plugs for the external loudspeaker and remote control sockets, and a spare fuse.

The operating manual is multi-lingual (English, German, French and Spanish) and provides comprehensive installation and operation instructions for the receiver, clock and timer. The only obvious omission from an operating point of view was the external circuit connections required to mute the receiver.

A block diagram plus full circuits of the receiver are the only servicing information provided, but a full service manual is available as a separate publication.

Price

The Trio R-1000 is available for around £300, including VAT.

The R-1000 receiver reviewed was kindly loaned by Lowe Electronics Ltd., Chesterfield Road, Matlock, Derbyshire, telephone 0629 2817 or 2430, and we would like to thank them for their invaluable assistance in this respect.

HI-FI GLOSSARY

6

Gordon J KING

R

REFLEX LOUDSPEAKER

One way of achieving the required "baffling" of a speaker unit (see under *Infinite Baffle* in Part 4), while utilising the low frequencies radiated from the rear of the cone to aid those radiated directly from the front, is to mount the bass unit on the front panel of an enclosure whose resonance is critically engineered to relate to the fundamental low-frequency resonance of the unit itself. Towards the bottom of the front panel, beneath the bass unit, lies an aperture which is called a *vent* or *port*.

This causes the enclosure to behave after the style of a Helmholtz resonator. By virtue of its volume and vent dimensions, the enclosure is tuned to proximity of the fundamental resonance of the bass unit. When this happens, the air pressure in the enclosure rises which acoustically damps the unit's resonance. At frequencies below the unit's resonance the cone is coupled to the mass of air in the vent, while at frequencies above resonance the "stiffness" of the air in the enclosure is coupled to the cone, owing to the high mass reactance of the air in the vent.

The net result is that two "resonances" occur at frequencies below and above the vent frequency, as shown in Fig. 26, but they are tamed by judicious acoustical damping inside the enclosure and sometimes by the application of acoustical resistance to the vent itself (see under *Acoustical Resistance Unit* in Part 1). A great attribute of the enclosure is that while the vent is active, the air in it moves in phase with that moved by the front of the cone so that the low-frequency radiation is augmented while the unit remains desirably damped. This type of speaker system, therefore, is more efficient than the infinite baffle or acoustical suspension type at low frequencies, but usually has the disadvantage of being larger. For proper performance the vent area and enclosure volume need to be carefully "matched" to the resonance characteristics of the bass driver.

To get the technique to work more faithfully with smaller enclosures the vent extends into the enclosure from the aperture as a tunnel or duct, as shown in Fig. 27.

RIAA

This stands for the Record Industry Association of America and refers to disc recording and replay characteristics (e.g., replay equalisation). The term is dealt with fully in Part 3 under *Equalisation*.

RINGING

Electronic circuits and "mechanical" devices, notably *transducers* such as loudspeakers, microphones and pickups, which are subject to *resonances* tend to produce a *damped oscillation* when triggered by a *transient*. This is colloquially known as ringing. It is an undesirable effect in hi-fi, since the resulting oscillation can colour the reproduction.

The oscillograms in Fig. 28 give some illustrations of the effect as observed on the screen of an oscilloscope. The upper trace at (a) shows the squarewave output from a hi-fi amplifier when loaded across pure resistance. There is

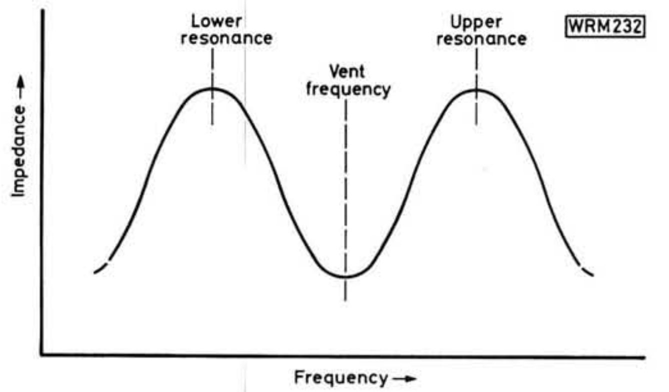


Fig. 26: Resonance characteristics of bass reflex loudspeaker system. The peaks are tamed by acoustical damping (see text)

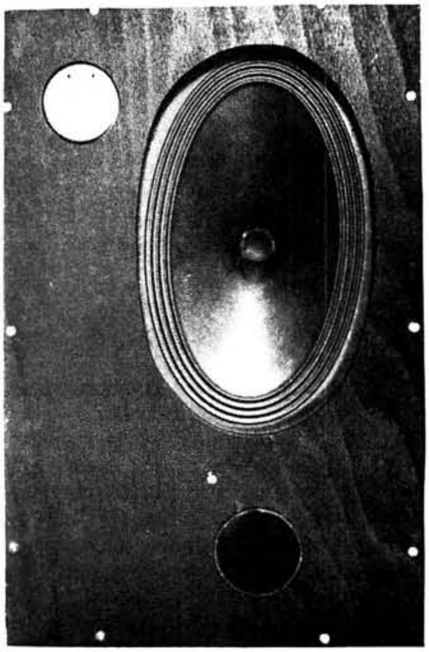
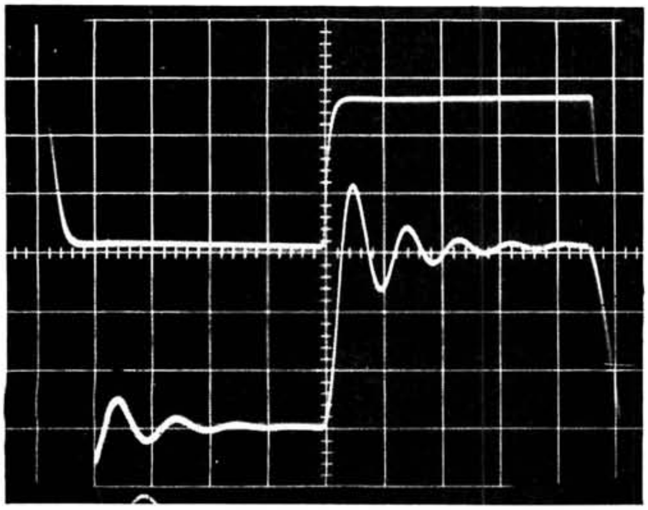
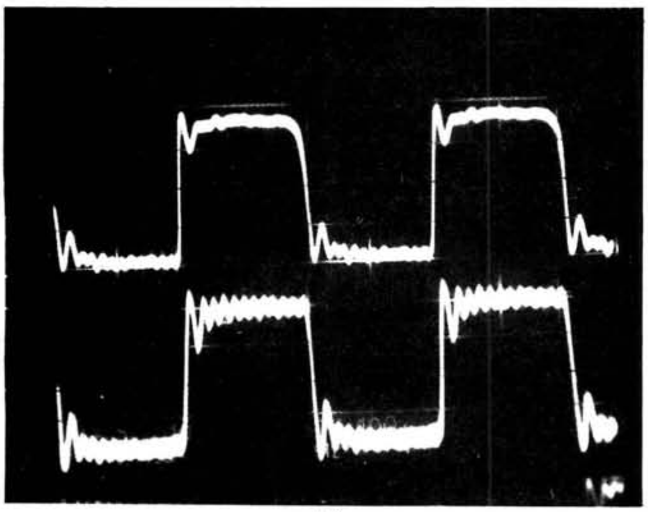


Fig. 27: The bass reflex principle is sometimes applied to smaller enclosures by extending the aperture into the enclosure by a tunnel or duct as shown ▶

HI-FI GLOSSARY



(a)



(b)

Fig. 28: Squarewave oscillograms showing ringing (a) upper trace squarewave output of hi-fi amplifier driving a resistive load which is free from ringing; lower trace when same amplifier driving into a capacitive reactance load (each horizontal division corresponds to 10μs). (b) Ringing from pickup cartridge playing a squarewave test record, upper trace left channel and lower trace right channel

no ringing here. The lower trace shows how ringing can develop when the output is loaded into capacitive reactance, such as might be reflected by a real loudspeaker. Here each full cycle of oscillation lasts about 10μs, which corresponds to a frequency of 100kHz.

The squarewaves at (b) are from a pickup cartridge playing a 1kHz squarewave test record at 2·2cm/s modulation depth, the upper display from the left channel and the lower from the right channel. Each cycle of ring here has a period of about 45μs, which corresponds to a resonance of about 22·2kHz.

With transducers the mechanical part of the resonance results from the interaction of mass and compliance, the ringing frequency increasing with decreasing mass or compliance according to

$$\frac{1}{2\pi\sqrt{MC}}$$

where M is the mass in kg and C the compliance in metre/newton (m/N).

The electrical resonance results from the interaction of inductance and capacitance according to

$$\frac{1}{2\pi\sqrt{LC}}$$

where L is the inductance in henries and C the capacitance in farads.

A common pickup resonance stems from the inductance of the transducer element and the capacitance of the screened connecting cable in shunt with the input capacitance of the amplifier. For example, if the inductance is, say, 500mH and the total capacitance 200pF, then the resonance frequency is

$$\frac{1}{6{\cdot}28\sqrt{500 \times 10^{-3} \times 200 \times 10^{-12}}}$$

or just under 16kHz, which is an undesirably low frequency.

RISE-TIME

This refers to the time it takes an amplifier or electronic circuit to respond to a step-wave input. The step-wave at the output takes a finite time to arrive at its 100 per cent amplitude value, and the rise-time is measured between the 10 and 90 per cent amplitude points, as shown in Fig. 29.

The rise-time is related to the upper-frequency response of the network or amplifier in terms of:

$$f_{-3dB} = \frac{0{\cdot}35}{RT}$$

where f_{-3dB} is the upper-frequency where the response is 3dB down from the middle-frequency response (e.g., the half-power point) and RT the rise-time.

For example, if the −3dB point of an amplifier occurs at, say, 22kHz then the rise-time is $1{\cdot}59 \times 10^{-5}$ seconds,

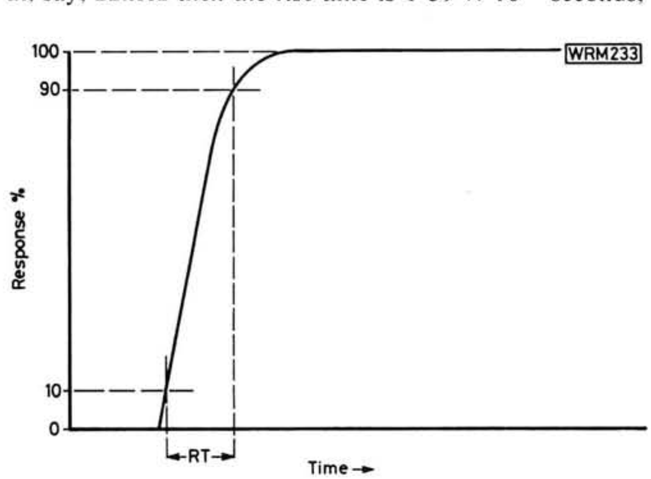


Fig. 29: Illustration of rise-time (see text)

HI-FI GLOSSARY

or 15·9μs. Conversely, an amplifier boasting a 2μs rise-time will have an upper-frequency response to the −3dB point of 175kHz. These functions apply most accurately when the upper-frequency roll-off is of a gaussian nature (e.g., as produced by a simple single-pole filter action). Rise-time should not be confused with time constant.

S

SELECTIVITY

This commonly refers to the sharpness of tuning and hence the discrimination provided by the tuning against unwanted side frequencies. Selectivity of an f.m. receiver, for example, is commonly measured by the application of two signals, an unmodulated one at the wanted frequency and a modulated one representing an unwanted signal. The level of the wanted signal is often set to 100μV, and the frequency of the unwanted signal 200 and/or 400kHz away from the wanted signal to which the receiver is accurately tuned. The level of the unwanted signal is then increased until it causes a 30dB signal/interference ratio on the tuned, wanted signal. The level of signal where this happens in dB with reference to the 100μV signal is an *IHF* (see Part 3) measure of selectivity—the higher the dB value, the sharper the selectivity. Latter-day f.m. receivers of the hi-fi type have a selectivity of 60dB or more (some as high as 80dB), but with f.m. the sharper the selectivity above a certain value, the higher the audio distortion owing to restriction of the upper-order f.m. sidebands.

SIDE-THRUST (CORRECTION)

Owing to the geometry of a pivoted pickup arm required to defeat lateral tracking error (see under *Offset Angle and Overhang* in Part 5) an unwanted lateral force is imparted on the arm which causes it to develop an inward (towards the centre of the record) torque. This stems partly from the overhang and the friction of the stylus/groove interface. The result is that the stylus suspension is subjected to a bias which can impair the absolute tracking ability (see later) and the inter-channel separation balance. This is countered by the application of an opposite torque provided on the arm by a dangling weight (gravity), small magnet (Decca) or a spring. The scheme is to adjust the side-thrust correction for the best tracking in combination with the tracking force using a special test record.

As the required correction is a function of friction it is related not only to the tracking force (see under *Playing Weight* in Part 5) but also to the contour and hence surface area of the stylus tip. Because the interface friction is continuously varying with modulation level, the adjustment can never be absolute (also see under *Anti-Skating* in Part 1).

SIGNAL/NOISE (S/N) RATIO

This is a dB measure between a wanted signal of stated reference level and the *noise floor* measured when the signal is removed and the input and output loading of the device under test unchanged. The latest *IHF* reference output for amplifiers is 1W into 8 ohms, which is 2·828V across 8 ohms. This output is achieved from an input of 500mV applied to a high-level source or with 5mV to the pickup input source, in either case the volume control is adjusted for the 1W output. When the input signal is removed the appropriate input is loaded in a manner to simulate the actual source which would normally be applied.

S/N ratio is another expression of *dynamic range* (Part 3); that is, the dynamic capability of the device between the maximum output and the *noise floor*.

SLOPE (RATE OF ROLL-OFF)

Following a filter action the response falls and eventually reaches an ultimate slope or rate of roll-off. This is commonly expressed in dB per octave. For example, a simple single-pole filter of quasi-gaussian nature has an ultimate 6dB/octave rate of roll-off; a two-pole filter 12dB/octave; a three-pole filter 18dB/octave, and so forth. The faster the rate of roll-off, the greater the tendency for ringing (see under *Ringing* above).

T

TOTAL HARMONIC DISTORTION (THD)

Owing to non-linearity, a pure tone applied to the input of an amplifier will give rise to the fundamental plus harmonics at the output. However, because most hi-fi amplifiers are remarkably linear in this sense, the harmonics are of very low relative amplitude. The spectrogram in Fig. 30 shows the fundamental and harmonic output of a hi-fi amplifier. The fundamental is 1kHz and is referred to 0dB at the top horizontal line of the scale. The 2nd harmonic is 70dB below this, the 3rd 84dB, the 4th 83dB and the 5th 86dB. The THD is the vector sum of all the harmonics resolved as a voltage with respect to the voltage of the fundamental, commonly expressed as a percentage. The THD shown in Fig. 30 is thus around 0·03 per cent.

To avoid such calculations, a distortion factor meter is often used for simple measurement whereby the fundamental is merely notched out so that only the harmonics and noise remain. The voltage of the sum of these spurious signals is then referred to the voltage of the notched-out fundamental (the datum established before the notching!) and the read-out given in direct percentage. This is sometimes incorrectly called THD; but it is more accurately *distortion factor* because it includes the noise in the measurement bandwidth as well as the harmonics.

HI-FI GLOSSARY

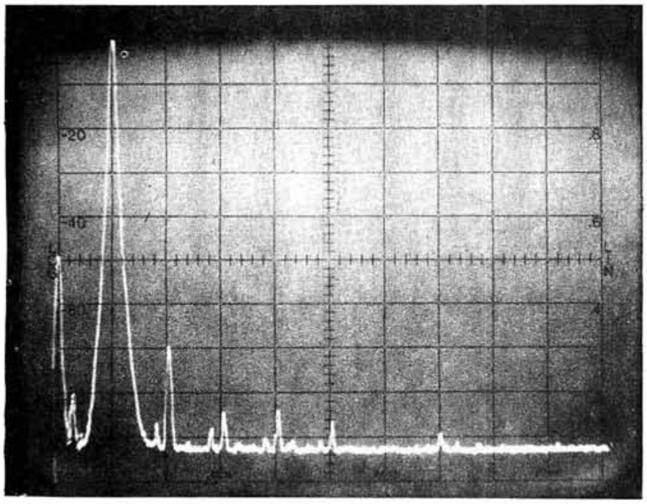
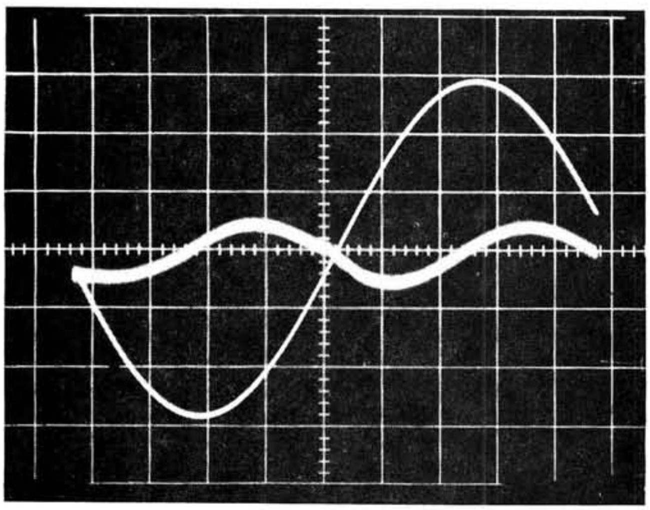
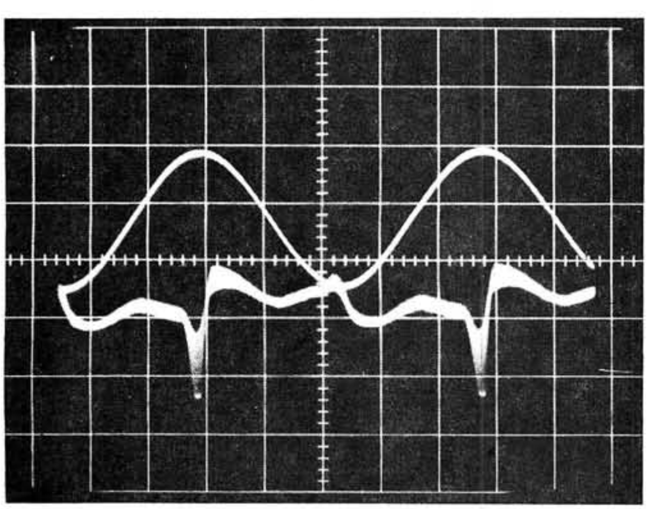


Fig. 30: Spectrogram of harmonic distortion. Scale 1kHz/div. horizontally and 10dB/div. vertically



(a)



(b)

Fig. 31: Distortion factor oscillograms (see text for details)

The oscillograms in Fig. 31 show on one trace the actual output signal before notching and, on the other trace, an amplified version of the distortion factor. At (a) the residual is essentially 2nd harmonic corresponding to around 0·03 per cent (the *PW* Winton amplifier, in fact!), while at (b) the residual is composed of a multiplicity of odd-harmonics which are less palatable than simple harmonic distortion.

Inharmonious distortion products are also created by the interaction of two or more signals in a non-linear input/output situation. This is called *intermodulation distortion,* typical products from two driving signals of, say, 15 and 16kHz being $16 - 15 = 1$kHz (2nd-order), $(2 \times 15) - 16 = 14$kHz and $(2 \times 16) - 15 = 17$kHz (both of these 3rd-order).

TRANSIENT INTERMODULATION DISTORTION (TID)

Amplifiers employing *negative feedback,* as do all hi-fi designs, rely on the distortion at the output being reduced by the input receiving, along with the actual input signal, a proportion of the output signal. This feedback signal arrives back at the input as an inverted form of the actual input signal, the two signals being "mixed" at the input coupling. This results in partial cancellation, so that the gain of the amplifier is reduced in proportion to the amount of feedback applied. It also results in cancellation of distortion components and widens the small-signal bandwidth.

Now, the speed at which the output signal can get back to the input depends on the high-frequency capability of the output transistors (and hence on their speed of operation). If a fast transient is applied to the input which is faster than the speed at which the output transistors can operate, then the feedback will be late in turning down the gain of the amplifier. This can result in severe overload and in some cases "blocking" of the amplifier while the transient is passing which will, of course, produce very disconcerting distortion. The effect has been termed transient intermodulation distortion.

Latter-day hi-fi amplifier designers avoid this by using suitably fast output transistors and by ensuring by pre-filtering that a transient faster than the output transistors can never reach the input of the power amplifier and cause the trouble. In reality, though, programme signal transients are automatically limited by the nature of the source, anyway; but by using very fast test transients, which are not really related to real music signal, it is often possible to produce TID.

TIP MASS (EFFECTIVE)

This refers to the effective inertia at the tip of a pickup stylus as accelerated by the groove modulation. It takes account not only of the mass of the tip itself but also of the "levered-down" mass of the moving element as the result of the cantilever (see under *Cantilever* in Part 2).

The effective tip mass of state-of-art cartridges lies in the region of 50mg, but even this is not particularly small when considered in terms of the astonishingly high acceleration to which the stylus can be subjected by high-level, high-frequency groove modulation. For example, at

HI-FI GLOSSARY

a recorded velocity of 30cm/s and a frequency of 8kHz, the stylus is required to accelerate at around 1500g!

The effective tip mass thus determines the upper-frequency tracking ability of the cartridge (see below).

TRACKING ABILITY

Sometimes called "trackability" (after Shure), this indicates the accuracy with which a pickup cartridge will track a recorded groove of both high amplitude and high velocity. A pickup which is capable of tracking such modulation faithfully at a small playing weight would be said to have a "high trackability" owing to a low mechanical impedance at the stylus tip (also see under *Compliance* in Part 2).

TRACKING FORCE

This is a more accurate term for "playing weight" (see under *Playing Weight* in Part 5).

TRANSIENT RESPONSE

This is effectively any deviation at the output of a device from a transient type signal or step-wave applied to the input. A typical response error is ringing, already defined in this part.

TURNOVER FREQUENCY

This is basically the frequency at which the output response of a transducer or amplifier changes from the "flat" owing to a filter action.

TWEETER

A speaker unit which is designed to handle the upper frequencies of music.

V

VERTICAL TRACKING ANGLE

This refers to the vertical stylus movement path with respect to the real vertical of a stereo pickup cartridge. The angle is often 15 degrees forward, though is likely to differ with some cartridges, and relates to the nature of record cut. For the least distortion the vertical tracking angle should correlate to that of the record, and special test records are available for determining the angle by distortion measurement.

W

WOOFER

A speaker unit which is designed to handle the lower frequencies of music. A unit specifically designed to handle the middle frequencies is sometimes called a "*squawker*". A *frequency-divider* network is employed in a multi-unit speaker system to direct the appropriate ranges of frequencies to the woofer, squawker and tweeter.

WOW AND FLUTTER

Wow is a waver of pitch caused by uneven operation of a turntable or tape machine transport at frequencies below about 10Hz. Flutter is the effect at frequencies above 10Hz. The two together are commonly measured as an integrated percentage, often through a *weighting network* which takes account of the subjective (annoyance) aspects of the fluctuations. At DIN peak weighted percentages below about 0·1 per cent the effect is indiscernible. Recent research, however, has revealed that intermodulation products can be generated by the pitch fluctuations and impair the reproduction in subtle ways. Modern hi-fi equipment has wow and flutter values right down to 0·05 per cent or less.

Index of Partly Defined Jargon

Damped oscillation
Distortion factor
Dynamic range
Frequency divider
Intermodulation distortion
Noise floor
Negative feedback
Port
Resonance
Squawker
Transducer
Transient
Vent

END OF SERIES

Model Radio Control

Part 6

THE PW FM-80 SYSTEM

J. BURCHELL & W.S. POEL

Whilst dry batteries provide a cheap initial means of powering a radio control system the longer term economics dictate the use of some form of rechargeable batteries.

For model aircraft applications Nickel-Cadmium cells (NiCad) are widely used as they offer a reasonable power to weight and size ratio. For boat use, where weight is not of such great importance sealed lead-acid cells are often used.

Lead-acid cells can be charged quite easily using a constant voltage supply, but NiCads must be charged from a constant current source if maximum efficiency and a long working life is to be realised.

A simple constant current charger is easily built by the home constructor and the unit described in this article will allow a wide range of NiCad cells to be charged.

Operation

The basis of the circuit is a 5V regulator i.c. which is connected so that all the charging current to the battery passes through it. The common terminal is strapped to the charger output terminal so that the regulator maintains its constant output voltage (5V) across the series output resistor. This keeps the output current constant, at a value given by $I_{out} = 5 \div R$ (amps).

The actual output current is varied by changing the series output resistor and in this unit a rotary switch performs this function.

Table 1

Current (mA)	Resistance (Ω)	Switch position
—	—	Off
15	330	1
30	180	2
60	82	3
100	47	4
250	22	5
500	10	6

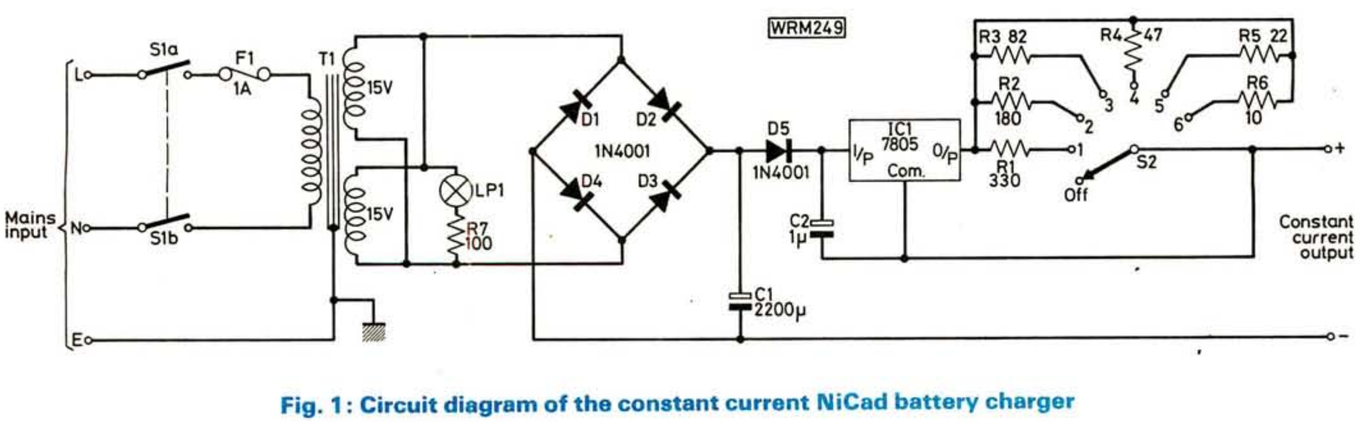
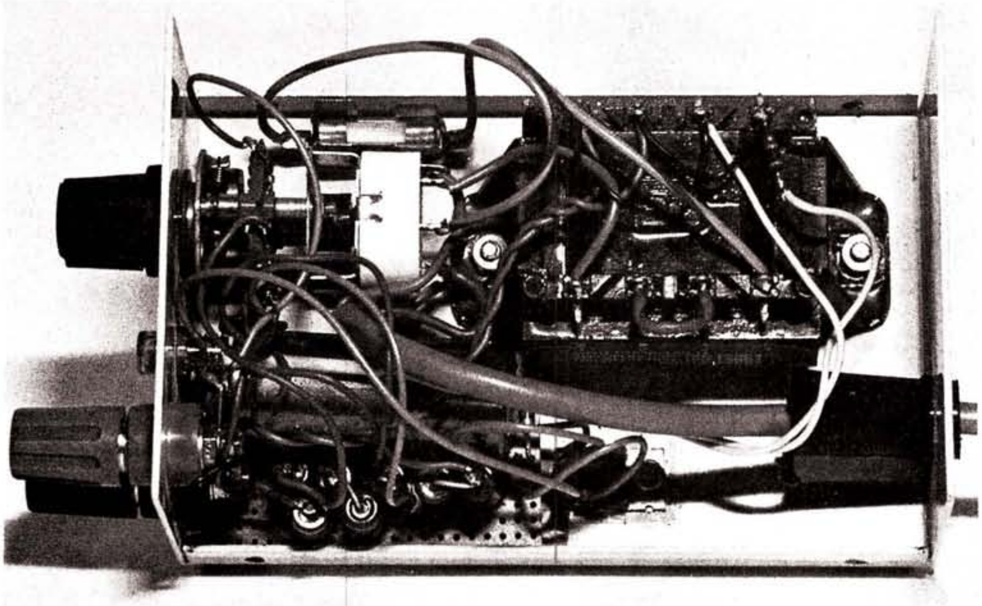


Fig. 1: Circuit diagram of the constant current NiCad battery charger



This picture shows the inside of the prototype NiCad charger. The layout is not critical and the more adventurous constructor could combine the charger shown here with the servo tester to be described in Part 7

Construction

The charger can be built in any suitable case but it should be noted that IC1 must be bolted to a suitable heatsink if the case is not metal. The resistors and diodes can be mounted on a small piece of Veroboard. No layout is given for this as the circuit is so simple that the constructor should have no difficulties in working out a layout to suit the components he uses.

★ components

Resistors		
¼W carbon		
100Ω	1	R7
2W 5% carbon film		
22Ω	1	R5
47Ω	1	R4
82Ω	1	R3
180Ω	1	R2
330Ω	1	R1
2·5W wirewound		
10Ω	1	R6
Capacitors		
Tantalum bead		
1μF (35V)	1	C2
Electrolytic		
2200μF (25V)	1	C1
Semiconductors		
Diodes		
1N4001	5	D1,2,3,4,5
Integrated Circuits		
7805 regulator	1	IC1

Miscellaneous

Transformer 15V 6VA; Metal case 135 × 80 × 55m; Fuse and fuse holder; Veroboard; Rotary switch 1p 12w with mains switch; Knob; 4mm insulated terminals Red (1), Black (1); 14V panel indicator.

Using the charger

NiCad cells object strongly to being short-circuited or discharged below a certain voltage and therefore it is important to ensure that you do not leave equipment powered by NiCads switched on for long periods. To obtain maximum life from the cells some makers recommend discharging the cells to a given voltage before charging and then constant current charging for a fixed time period.

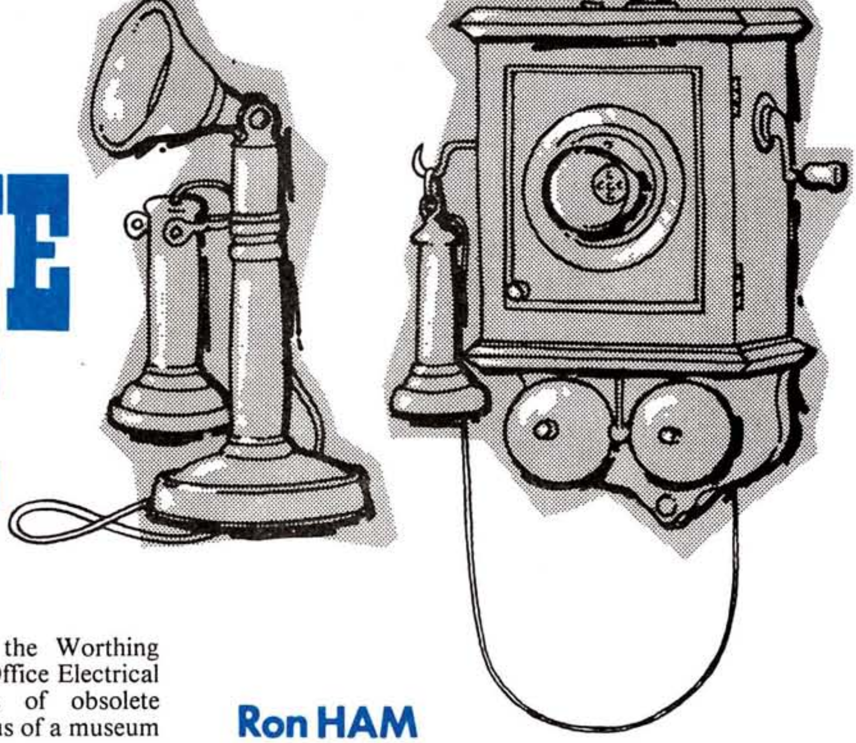
However, as NiCads can be charged for well over twice the theoretical time, it simplifies the charging procedure if the cells are placed on charge immediately after use and given a charge based on the assumption that they are discharged down to the endpoint voltage.

The charging rate for the cells in your battery pack will be specified by the supplier and this should be adhered to if maximum life is to be achieved. The cost of NiCad battery packs is high and careful charging will ensure that your bank balance stays reasonably healthy as well.

Part 7 will describe a simple servo test unit.

A licence is required to operate radio control equipment. This costs £2.80 for five years. Application forms are available from: The Home Office, Radio Regulatory Dept., Waterloo Bridge House, Waterloo Road, London SE1 8UA

A LANDLINE MUSEUM



Ron HAM

Over the past ten years, members of the Worthing Associate Section of the Institute of Post Office Electrical Engineers, have collected many items of obsolete telephone equipment. These form the nucleus of a museum at Worthing's Swandean exchange.

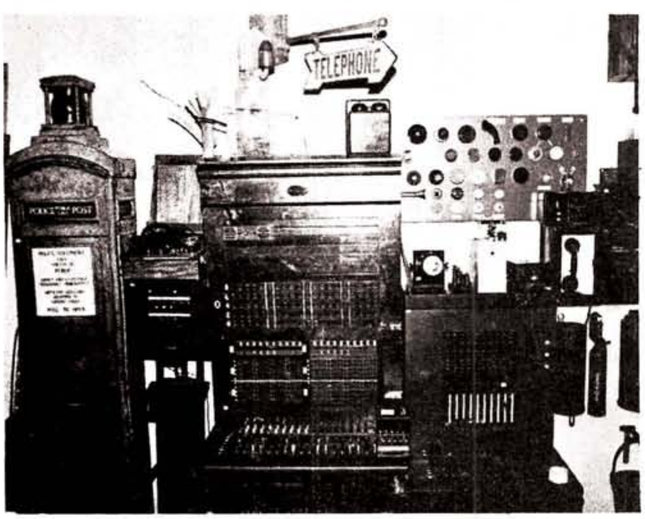
As I opened the door the chatter of the relays and selectors of a 1938 automatic switching unit heralded the fact that this is a working museum. This became even more obvious when I noticed the wide variety of household telephones connected through it. Among these instruments I could see a 1902 Magneto phone, made in Coventry by the Consolidated Telephone Company, and a 1920s "Candlestick" phone mounted on a "walligraph", just as in the American movies. Examples of the polished wooden-cased wall phones, a robust call-box unit of the mid-1930s complete with the famous buttons A and B and samples of the first telephones with the combined handset (HMT) used in the 1930s and 40s, firstly with a separate bell and later with an internal bell, were also in evidence.

The museum was set up by Alec Bonsall, Chairman of the Worthing Associate Section, David Rudram, Peter Russell and Fred Stanford. Fred describes himself as "the scrounger" because, like the others, he has gone to great lengths to rescue much of the equipment on display.

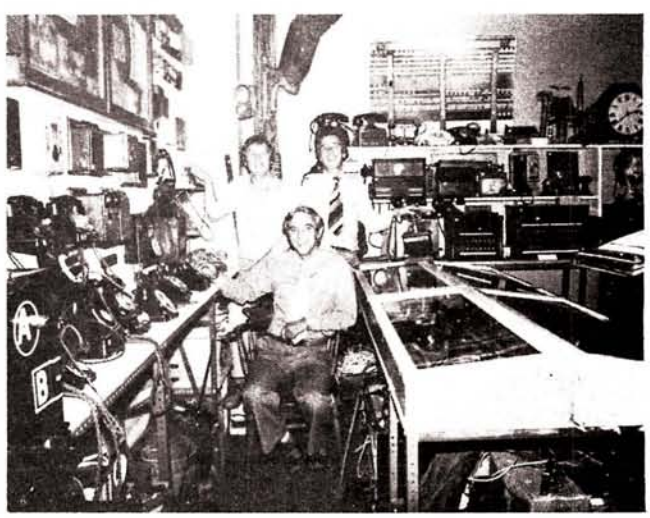
The 14ft high ceiling allowed them to instal the upper parts of telegraph poles showing the "maypole" and ring type methods of cable distribution, the steps and arms of a route pole complete with the appropriate insulators for carrying uninsulated line wires. One prominent exhibit, at the top of one pole is a life-like model of an engineer, dressed in overalls and rubber boots with a leather safety belt, tool bag and linesman's telephone.

Wartime Service

During WW-2 a special connecting box was fitted, about 1·6m a.g.l., on some poles so that members of the Royal Observer Corps could hastily couple equipment to the line if the need arose. Displayed alongside this box is a typical emergency telephone unit, housed in a polished wooden box, complete with its own power supply and ringing generator and wired, so that it could work on all Post Office systems.



The Metropolitan Police telephone box among a selection of switchboards



Alec Bonsall (right), Fred Stanford (left), Dave Rudram (seated in a Post Office foreman's chair)

While Alec demonstrated an early scrambler system, Dave showed how an emergency call was received in a blue, 1940s, Metropolitan police box, which stands majestically in the museum complete with its roof-top, amber, emergency light.

Among the rarer items is a section of lead sheathed, multi-way, cable from the National Telegraph Company days of before 1912, an Austrian telephone unit with glass bell-gongs, a special pair of scissors for cutting entangled kite strings away from the lines, fire buckets with George V labels, and a combined, front and rear, oil lamp from a Post Office cable jointer's hand-cart.

While I was comparing bits of coaxial and submarine cables with a section of modern wave-guide, Fred drew my attention to a super-sensitive galvanometer, made by Sullivans circa 1900, with a f.s.d. of a few micro-amps and a 1934 audio noise generator and receiver, for testing transmission lines. Like several others in the collection these two instruments are beautifully manufactured and their brass and glass is a sheer joy to look at.

When I left the museum there was no doubt in my mind that with the overwhelming enthusiasm of Alec, Dave, Fred, Peter and others of the section, this already magnificent collection is only the beginning of a project which will eventually show the complete technical history of the telephone service. ●

KINDLY NOTE!

PW "Trent" 150W Amplifier, June and Aug. 1979

In Part 1 of the article (June 1979), the base and collector connections to Tr3 (Fig. 7) were incorrectly labelled; the centre lead wire should have been marked "c" and that nearest VR1, "b". Constructors should also note that the device used for Tr3 should be contained in a TO126 package—should this not be so, it is possible that the transistor appears correctly fitted but is, in fact, wrongly configured electrically.

In Part 2 (Aug. 1979), the BD135 has been drawn with its base and collector reversed; its base should be connected to pin 6 of the 723 regulator and its collector to +Vcc.

Battery Eliminator, March 1980

The electrolytic capacitor, C1 is shown reversed in the wiring diagram. The circuit diagram is correct.

Noise Blanker, September 1979

R3 in the circuit diagram should be connected between the junction of C4/5 and the negative supply rail. The p.c.b. is correct. The i.c. is available from Ambit International.

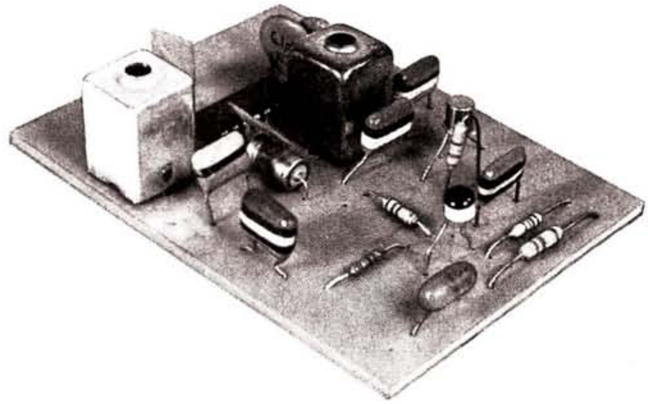
Radio Control—Electronic Speed Controller, March 1980

The capacitor shown alongside VR2 in the p.c.b. component placement drawing (Fig. 3) should be labelled C6 (not C3). The manufacturers of the output devices have decided to renumber them and they are now called L149 instead of TDA1490. Ambit International should have these in stock by now.

The circuit diagram of the servo unit (Feb. 1980) shows R1 and C2 in series but shorted out. These two components should be in parallel between Pin 2 and 0 volts. The p.c.b. is correct.

ADD-ON N.B.F.M. DEMODULATOR

R.A.PENFOLD



Narrow band frequency modulation (n.b.f.m.) and phase modulation (p.m.) now seem to be the established forms of modulation for local activity on the 2 metre amateur band and are also used by many amateurs for DX working. There are definite advantages with these modulation systems when compared to forms of amplitude modulation (a.m. c.w. and s.s.b.), such as freedom from TV interference and similar problems and the relative simplicity of generating these types of signal. When demodulated properly, these forms of transmission also have good immunity to pulse interference and mobile QSB flutter, which makes them the obvious choice for the mobile operator.

The main disadvantage of n.b.f.m. and p.m. for many people is simply that their receiving equipment is not designed to demodulate this type of signal. Most of the older v.h.f. equipment still in use today was designed for a.m. operation and the same is also true of the commercial radio telephone equipment which is often adapted for 2 metre amateur use. In the author's case, 2 metre band reception is by means of a converter and a s.w. receiver. This is quite a popular method of reception, but virtually no s.w. sets have an f.m. discriminator (including the author's receiver).

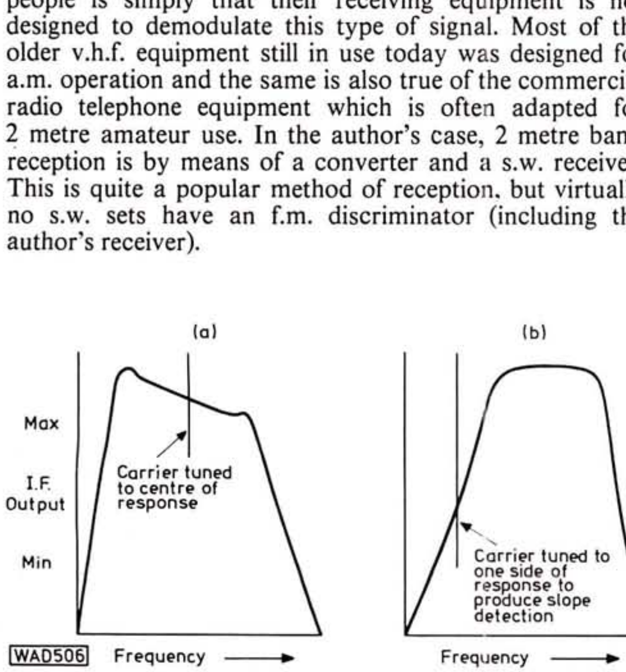


Fig. 1: Typical i.f. response curves

Principle

Phase modulation and n.b.f.m. reception requires an i.f. response of the type shown in Figure 1(a). The selectivity is provided by the i.f. filters in the usual way and the linear sloping response within the passband is provided by a special type of demodulator. The response of an a.m. receiver is usually something like that shown in Figure 1(b), and this can be used for n.b.f.m. and p.m. reception by tuning the carrier slightly away from the centre of the response. As the carrier and subsequently the i.f. deviates up and down in frequency, the slope of the skirt selectivity produces a varying output voltage; this is, of course, the required audio signal.

One drawback of this system is that the f.m. or p.m. signal occupies only a small part of the i.f. passband, which is obviously less than ideal. Another problem is that the signal is being demodulated on a slope which is far from linear with a consequent high level of distortion present in the audio output. Also, there is usually very little latitude in the setting of the tuning control which makes tuning to a station rather critical and difficult.

Circuit

The obvious answer to the problem is to modify the receiver by adding a n.b.f.m. demodulator and it is such a unit which forms the subject of this article. The circuit diagram of the unit appears in Figure 3 and as will be apparent from this, the unit employs standard readily available components.

The demodulator is of the quadrature type, and is based on IC1. This is a Texas SN76660N device which also contains a high gain limiting amplifier and a d.c. volume control circuit as well as the quadrature detector. The d.c. volume control function is not used here, and the appropriate pin of the i.c. (pin 5) is therefore left unconnected. This i.c. is primarily designed for use as a wideband f.m. demodulator in TV receiver sound channels or in high quality f.m. broadcast receivers, but it works perfectly well as a n.b.f.m. discriminator. Coil L1 is the quadrature coil and this is the primary winding of an ordinary 470kHz i.f. transformer. In a wideband application the i.c. would normally be used at a frequency of 6MHz or 10·7MHz and the fact that it is working at a far lower frequency here automatically reduces the bandwidth of the demodulator so that it provides a good output level and signal-to-noise ratio from a n.b.f.m. signal.

Although L1 has a nominal operating frequency of 470kHz it can be adjusted to suit any i.f. in the standard 455 to 470kHz range. The tap on the primary of L1 and the secondary winding are of no consequence in this application and they are left unused. Capacitor C8 is used to "roll off" the upper frequency response of the audio output signal and this gives an improved signal-to-noise ratio.

Tr1 is a JUGFET source follower stage which is used to provide buffering at the input. Capacitor C2 provides input d.c. blocking and R1 is the gate bias resistor. In the original circuit the discrete i.f. stage using Tr2 was omitted and the right hand end of C3 connected to pin 14 of IC1. A 6·8kΩ resistor was connected between pins 13 and 14 of the i.c. to provide the necessary d.c. path between these two points. The circuit was then fed from the collector terminal of the first i.f. transistor of the receiver and on a few stations this arrangement worked very well.

However, on many stations the audio output was extremely distorted and this was obviously due to the first i.f. filter of the receiver (a 7kHz mechanical filter) providing an inadequate bandwidth. On a.m. a lack of i.f. bandwidth results in a loss of high frequency response, but on f.m. the situation is completely different. The modulation frequency determines how fast the carrier frequency varies about its nominal figure. The bandwidth is dependent upon the amplitude of the modulating signal. Thus transmissions which used only a low level of modulation could be received perfectly well, whereas those using a high level of deviation produced a clipped audio signal as the carrier went outside the passband of the receiver for much of the time. In fact some stations (particularly mobile ones) used such a high level of deviation that the resultant audio signal was virtually unintelligible. Some stations which produced an 'S' meter reading of about 9 when unmodulated went down to about strength 1 or 2 when modulated!

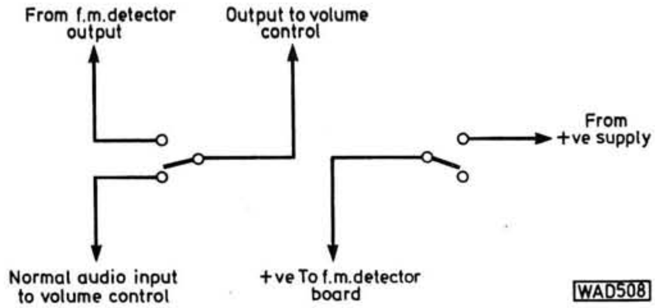


Fig. 2: Required switching arrangements

It was therefore necessary to add the extra i.f. amplifier stage so that the signal could be extracted from earlier in the receiver and was not then subjected to the constraints of the first i.f. filter, thus providing the necessary wide bandwidth.

Of course, if the unit is used with a receiver having a fairly wide bandwidth ahead of the first i.f. amplifier stage, perfectly satisfactory results should be obtained using the simplified circuit described above.

Construction

The unit is assembled on a printed circuit board and full details of this are provided in Figure 4. Although this is designed for the circuit of Figure 3, it could be readily adapted to take the simplified version of the unit. The board can be mounted in any convenient place on the receiver chassis and if the set is a negative earth type, the negative supply rail connection can be obtained via the mounting bolts, but if the receiver has a positive earth rail it will be necessary to mount the board in a way which insulates it from the chassis.

An on/off switch and audio changeover switch will be required and this can be accomplished using a d.p.d.t. switch as shown in Figure 2. The QR666 receiver has a suitable switch already installed (this being intended to switch an optional f.m. broadcast tuner in an out of

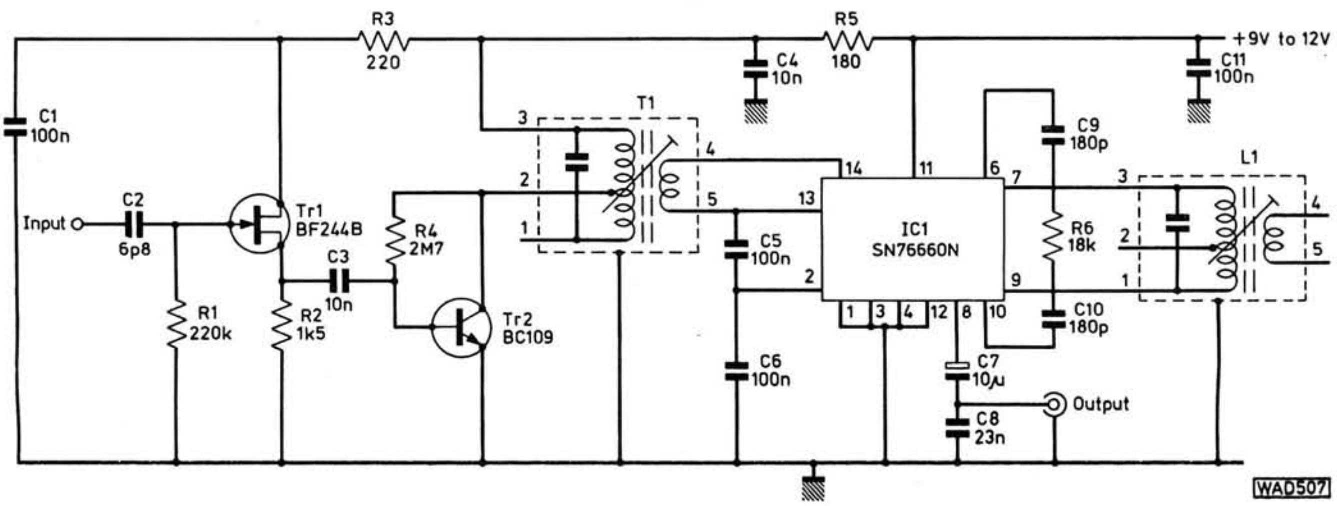


Fig. 3: Circuit diagram of n.b.f.m. demodulator

★ components

Resistors
¼W 5% tolerance

180Ω	1	R5
220Ω	1	R3
1·5kΩ	1	R2
18kΩ	1	R6
220kΩ	1	R1
2·7MΩ	1	R4

Semiconductors
Transistors

BC109	1	Tr2
BF244B	1	Tr1

Integrated circuits

SN76660N	1	IC1

Capacitors
Ceramic

6·8pF	1	C2
180pF	2	C9,10
10nF	1	C3
33nF	1	C8
100nF	5	C1,4,5,6,11

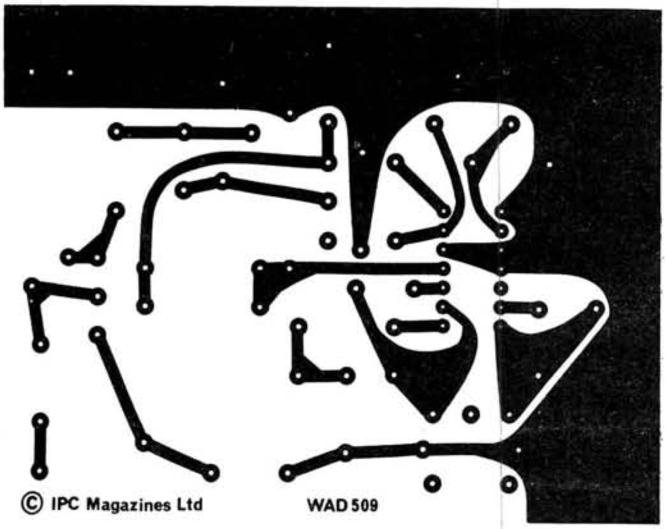
10V electrolytic

10µF	1	C7

Inductors

Denco IFT14/470kHz	1	L1
Denco IFT13/470kHz	1	T1

Miscellaneous
Min. d.p.d.t. switch; printed circuit board.



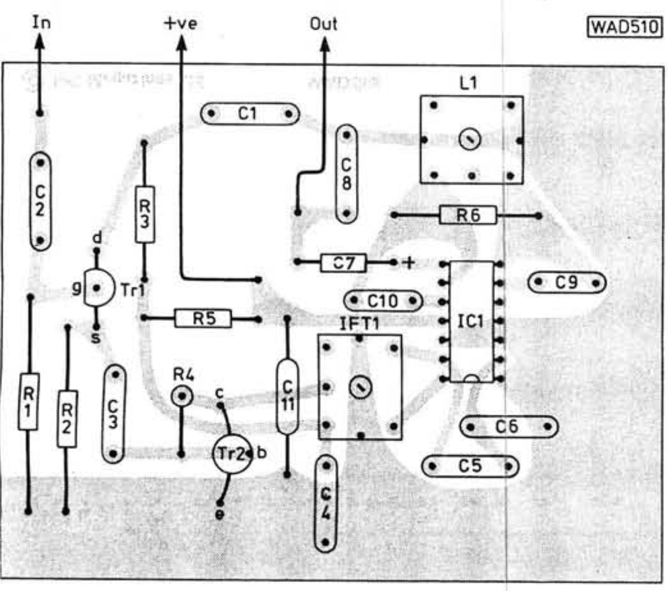


Fig. 4: The p.c. board layout reproduced full size

circuit), but in most cases, with other receivers, it will be necessary to add a switch in some convenient position on the front panel.

The input lead should be no longer than absolutely necessary and connects to either the drain, collector, or anode of the mixer, whichever is appropriate to the type of device used in the main receiver. The unit requires a supply voltage of 9 to 12 volts, and the current consumption is about 15 to 20mA. The audio output level depends upon the amount of deviation of the received transmission of course, but this is usually something in the region of 300mV peak-to-peak and is from a source impedance of 2·6kΩ. If preferred, the unit can be built as a self-contained external unit, feeding either high impedance headphones or an amplifier and speaker, (an LM380N i.c. amplifier is suitable). Inexperienced constructors should *not* try to build the unit into expensive equipment unless they are able to obtain help and advice from someone who is suitably competent.

Adjustment

Start with the set in the a.m. mode, find a 2 metre f.m. transmission and tune the carrier to the centre of the receiver's passband. With the set switched to the f.m. mode there should be an audio output, although it will probably be rather weak, distorted and noisy at this stage. The core of T1 is adjusted for minimum background noise. A proper trimming tool must be used such as the Denco TT5 when adjusting the core of T1 and L1 as use of the incorrect tool will damage this type of tuning core.

The core of L1 is adjusted for maximum audio output; the setting of this core is not particularly critical as the demodulator has a fairly wide bandwidth. With L1 adjusted correctly there should be about half the supply rail potential at pin 8 of the i.c. and "rocking" the core should result in a rise and fall in this voltage. There will be a fairly high background noise level when the receiver is not tuned to a station, but the noise should subside in the presence of a reasonably strong carrier. ●

NEXT MONTH IN...

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DON'T 'TIME-OUT'...

BUILD OUR VHF/UHF REPEATER STATION TIMERS

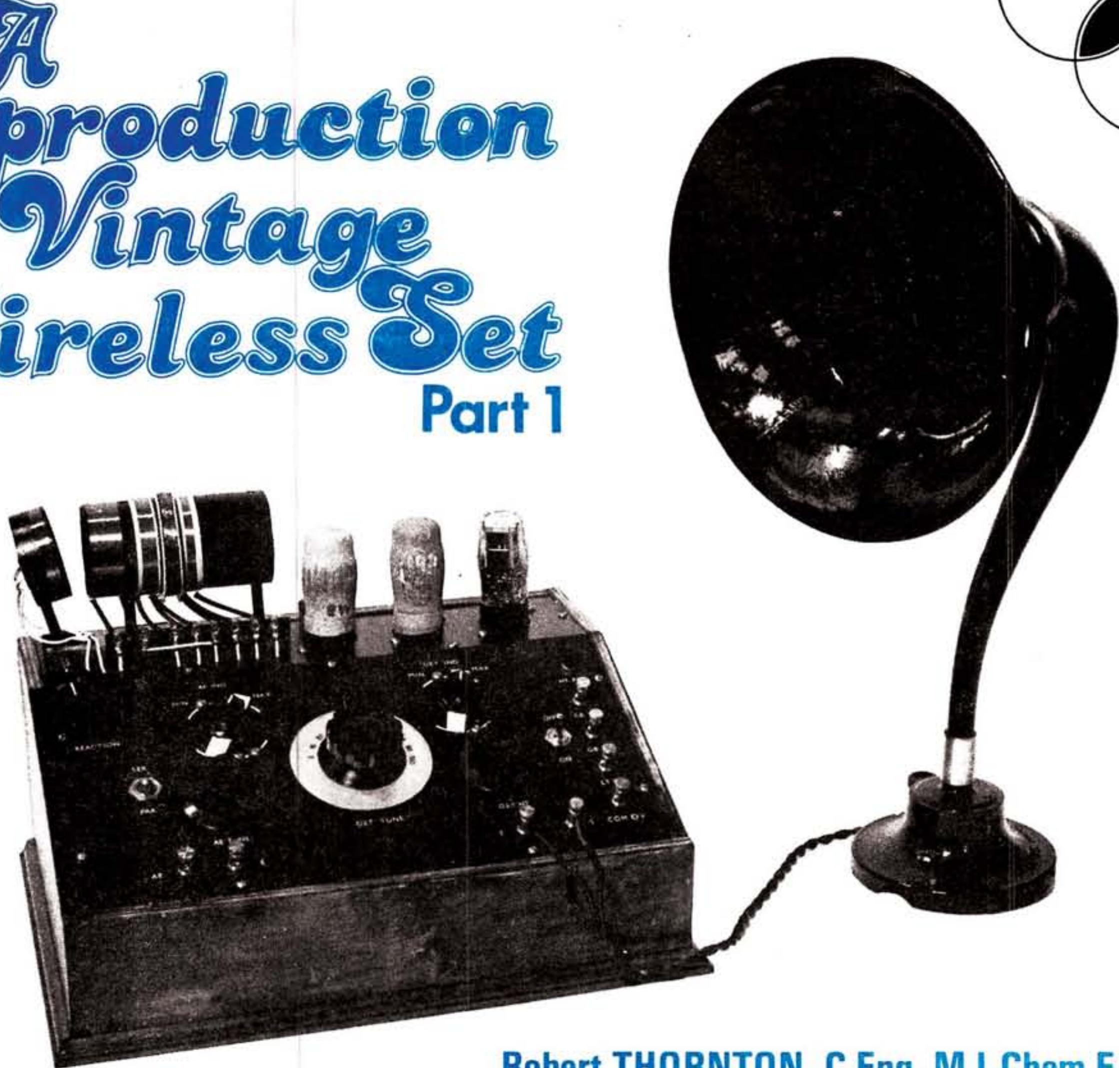
If you work mobile stations through the local repeater and find it difficult to count to sixty while trying to remember the callsign of the station and find something worth saying then this project is for you. An audible warning is given one, two or three minutes after you have started your over

ACOUSTIC FLASH TRIGGER

This device enables anyone interested in photography to take pictures of the most difficult of things—objects in rapid motion. The unit makes use of the shock wave produced for triggering purposes, complete with an inbuilt delay system for timing the camera

A Reproduction Vintage Wireless Set

Part 1



Robert THORNTON, C Eng, M I Chem E

On 20 June 1920, sixty years ago this year, Dame Nellie Melba sang into the microphone of a radio transmitter at the Chelmsford works of the Marconi Company. So dawned the era of entertainment broadcasting in this country. Recently there has been renewed interest in radio equipment of these early days.

The receiver described in this article is constructed in the style of an instrument built around 1923–25, yet it uses readily available components.

Obviously for this reason the receiver cannot be an exact replica of any earlier set, but as far as possible the circuits used (taken from "*The Radio Experimenter's Handbook*," 1922), the style of construction and the method of operation have been retained. It is what is known as a panel receiver, in which the valves and other components are mounted on a panel and exposed to view. This manner of assembly lasted until about 1925, after which all the "works" tended to disappear into cabinets.

It is interesting that the constructor tackling this project today faces many of the same problems as his 1923 counterpart: components which cannot be easily bought have to be made or improvised.

This is a battery-operated, three-valve receiver with reaction. The complete circuit is show in Fig. 1. The tuned circuits are an early form of band-pass arrangement. Aerial tuning is accomplished by L1a–b, L2 and VC1. Switch S1 provides either parallel or series tuning, and S2 selects tappings on the inductance. VC1 is a 1000pF variable capacitor and consists of a standard two gang 500pF tuning capacitor with the gangs wired in parallel. L2 provides coupling to the grid circuit of the detector valve V1. This is tuned by L5, L6, and VC2, and is a leaky grid detector. Switch S3 selects the waveband (long or medium) covered. The grid leak resistor R1 is mounted between terminals on the panel to facilitate easy adjustment.

Reaction

Reaction is provided by a "swinging coil". Part of the residual r.f. output from V1 is coupled back to the input by means of the reaction coils L3 and L4. By varying the distance between L3 and L5 the degree of coupling and hence the amount of reaction can be controlled. This detector arrangement was referred to in 1922 as the "Autodyne" circuit.

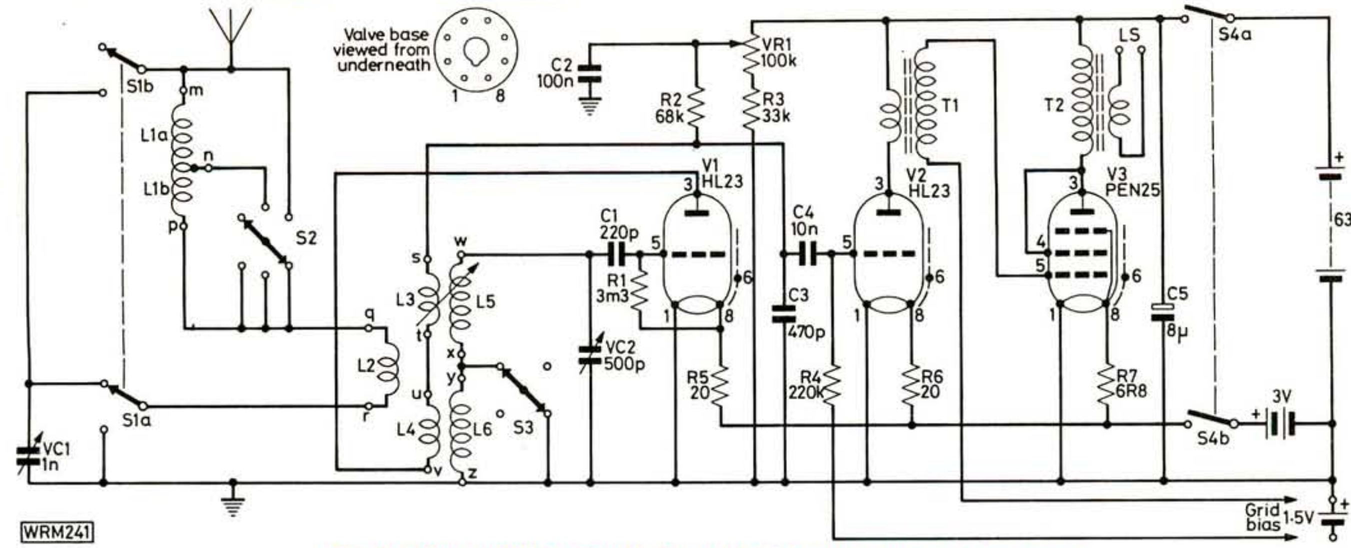


Fig. 1: The complete circuit diagram of the vintage valve receiver

To ensure success of this circuit the anode voltage on V1 must be carefully controlled. In early receivers this was achieved by having multiple tappings on the high tension battery. This is not convenient here, so as an alternative the potentiometer VR1 in conjunction with R3 is used to adjust the voltage. Capacitor C2 is used as a decoupling component.

The audio output from V1 is developed across the anode load R2, and is resistance-capacity coupled to the grid of V2 by means of C4, with unwanted r.f. being shunted to earth by C3. V2 is part of a conventional a.f. amplification stage, which is transformer coupled by T1 to the output valve V3. This arrangement of R–C and inductive coupling was common in sets of the early 1920's, as it gave a high overall gain with little tendency to howl or oscillate uncontrollably.

Intervalve transformers are unobtainable now, but a miniature 20–0–20 volt mains transformer was found to be an excellent substitute, giving a step-up ratio of 6:1. The output of V3 appears across the primary of the loudspeaker transformer T2. These transformers are still available, although another mains transformer with a turns ratio of about 60:1 could be used (for a 3–8Ω speaker).

Capacitor C5 provides a low impedance path to earth for any unwanted a.f. signals appearing on the h.t. line. The 1922 circuit used a large paper capacitor, but a more modern electrolytic component suits the purpose admirably.

High tension batteries are of course out of the question nowadays. The power supply is obtained from seven 9 volt transistor batteries wired in series. The total h.t. current is about 3mA, so the drain on the batteries is not great.

The valves specified are 2-volt filament types. Ideally a 2 volt accumulator should be used to power them, but these are no longer easily obtainable, so a 3 volt torch battery is used instead with dropper resistors R5, R6 and R7 in the filament circuits. The grids of the a.f. valves will generally require a negative bias potential to make them operate over a linear portion of their characteristics. This is provided by a 1·5 volt grid bias battery. In fact, owing to the rather low h.t. used it was found that V2 did not require any bias, and so the grid leak R4 could be returned directly to the earth line. However, if different valves or h.t. voltages are used, this will not necessarily be the case, and bias supply points for V2 and V3 are provided on the panel.

Some experiment will do no harm here, but the grids should be biased as negatively as possible (consistent with obtaining good amplification and no distortion) in order to minimise h.t. current.

★ components

Resistors		
½W 10% carbon composition		
6·8Ω	1	R7
10Ω	4	R5a,5b,6a,6b (see text)
33kΩ	1	R3
68kΩ	1	R2
220kΩ	1	R4
3·3MΩ	1	R1 (see text)
Potentiometers		
100kΩ (lin.)	1	VR1
Valves		
HL23	2	V1, V2
PEN25	1	V3 (see text)
Switches		
Toggle d.p.d.t.	2	S1,4
Open stud	2	S2,3 (see text)

Capacitors		
Mica		
220pF	1	C1
Ceramic		
470pF	1	C3
10nF	1	C4
Paper 150V		
0·1µF	1	C2
Electrolytic		
8µF (150V)	1	C5
Variable		
500pF	1	VC2
1000pF	1	VC1 (2 × 500pF)

Miscellaneous

Intervalve transformer (see text) T1; Output transformer (see text) T2; Mazda Octal valvebases (3); Horn loudspeaker; Screw terminals (11); 32 s.w.g. enamelled copper wire (2 oz); Black "Formica"; wood; screws, etc.

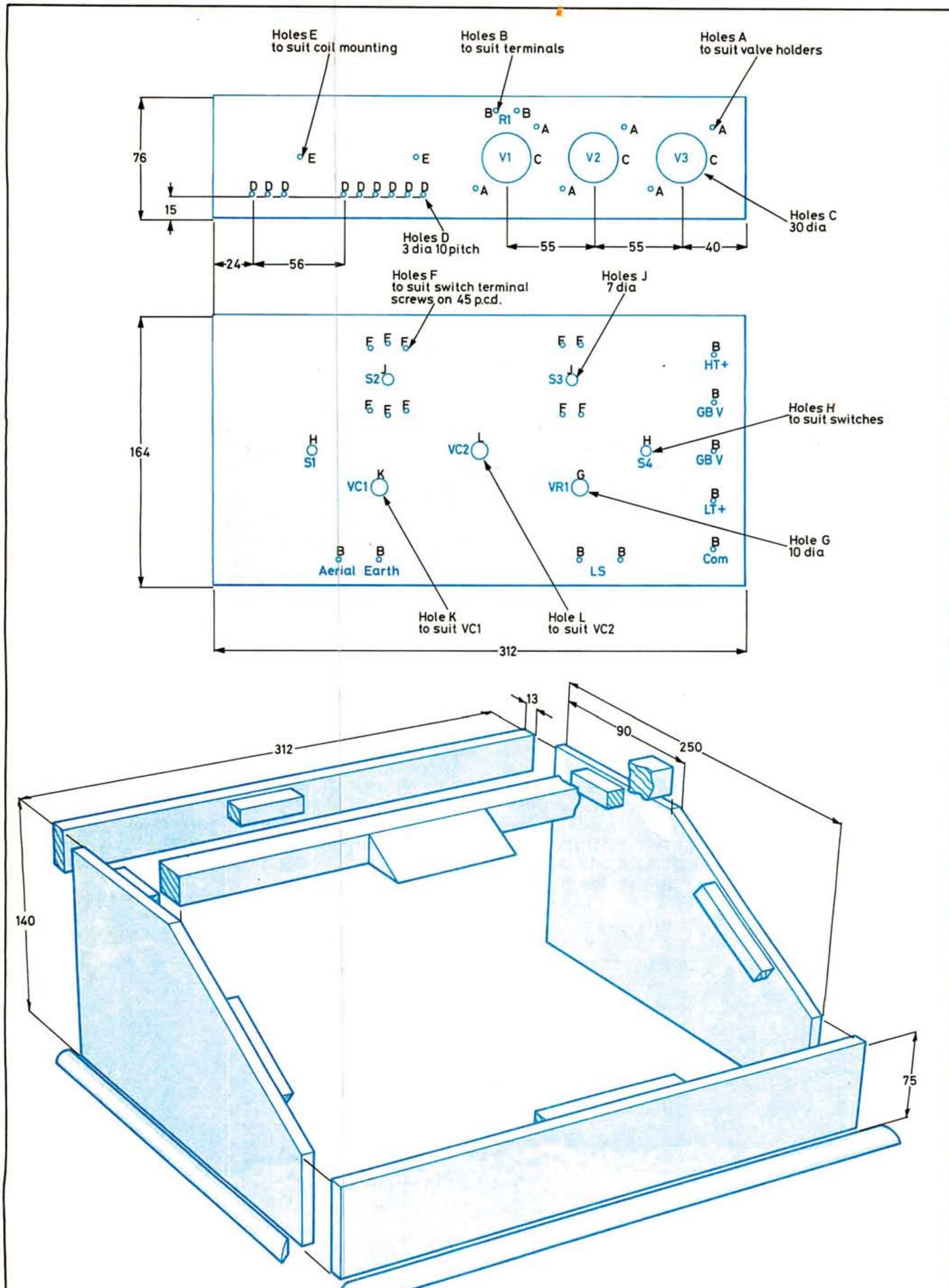


Fig. 2: Details of the construction of the cabinet and front panels

Valves and Alternatives

Obtaining suitable valves may prove to be one of the more difficult parts of this project. The constructor of 1923 would have used bright emitter triodes, but these are museum pieces now. Dull emitter valves with similar characteristics are employed here. Those specified by the author (and many others) are currently obtainable from several advertisers in *Practical Wireless,* but are presumably not available in unlimited quantities. V1 and V2 are small signal general purpose triodes, HL23. They are not really suitable for output purposes, so a PEN25 valve was used in this position. This is in fact a pentode, but is connected as a triode.

There are many other valves which will work in this circuit. Virtually any battery-operated triodes or pentodes connected as triodes may be used, though valves in the output position should be capable of passing at least 3mA of anode current. The other point to watch is the filament voltage and current. If the current drawn is too high, torch batteries will not suffice and other arrangements will have to be made. Filament resistors must be changed to suit. The HL23 valves consume 0·05A filament current; the PEN25 takes 0·15A.

Valves from the B7G 1·4 volt range may also be tried (connected as triodes) with a single cell for the filament supply. For a complete list of all the possibilities the constructor should consult a book such as "*Radio Valve Data,*" Book 1 (W. J. May, Bernards Radio Manuals) available in most reference libraries.

Constructional Details

The first job is to construct the case and panels for mounting the components. The appearance of the receiver is important—many early sets had superb cases—so some effort here will be well worth while. The general idea will be seen from the photograph, and an exploded view of the assembly is shown in Fig. 2.

The dimensions may of course be varied to suit the components used and the constructor's taste; those given were found convenient by the author.

The sides and front of the case may be made from 8mm plywood, pinned and glued together. The panels would have been ebonite in 1923; today dead black Formica makes an excellent substitute. The panels are fastened using chromium plated round headed screws and suitably positioned wooden blocks glued to the inside of the case.

The layout of the panels is shown in Fig. 2. The variable capacitors VC1 and VC2 may be attached directly to the panel with short bolts, and the potentiometer VR1 uses its own fixing nut. The terminals should be large brass types, although an insulated terminal may be used for HT+. S1 and S4 are of the toggle variety; these are not strictly "period" but the author's attempt to make knife switches was singularly unsuccessful!

Stud Switches

A characteristic feature of many of these panel radios was the multiple way switches used to select tappings on the inductances. These usually consisted of a wiper moving over a series of brass studs set in the ebonite panel. The idea is copied here, and Fig. 3 shows the construction of switches S2 and S3. Brass 4BA bolts form the studs. The wiper was a strip of printed circuit board 10mm wide by 50mm long: this has just the right amount of spring, and can be glued to a suitable knob with Araldite.

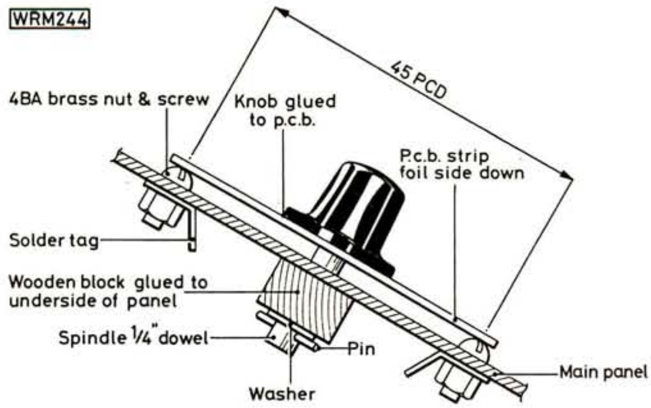
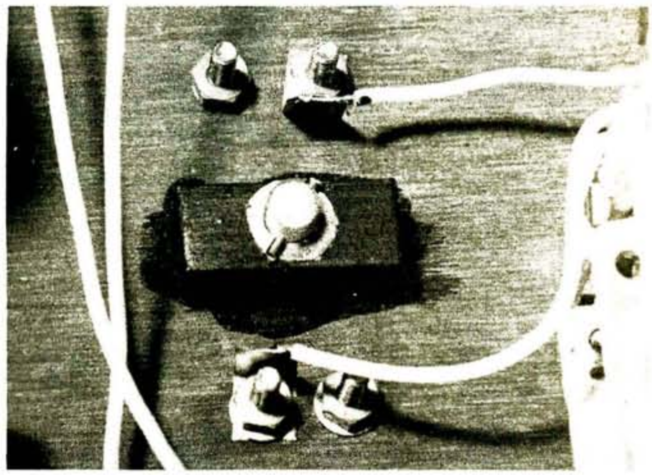


Fig. 3: Constructional details of the stud switches. Further details can be seen in the photograph below



Valve Holders

The valves specified require Mazda Octal valve holders, and these are virtually unobtainable now (B7G holders for the 1·4 volt range of valves can still be purchased). The author resorted to making his own, and Fig. 4 shows how this was done.

Very accurate drilling is required, and the best way to achieve this is to make a template. Prepare a "pancake" about 10mm thick of an epoxy resin based filler (such as is used for filling dents in car bodies) and while it is still soft press the valve base into it to leave deep impressions of the

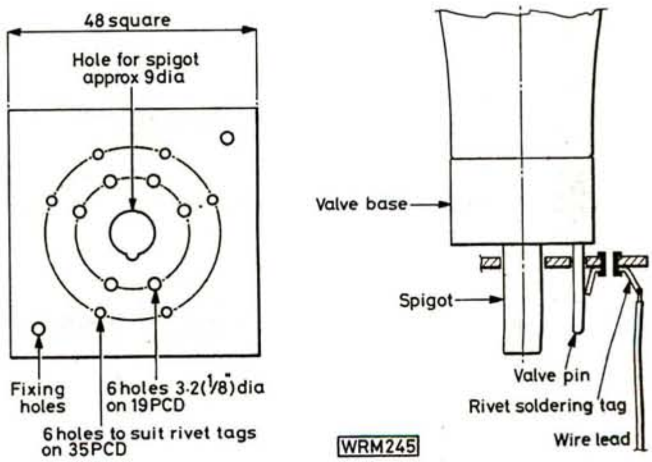
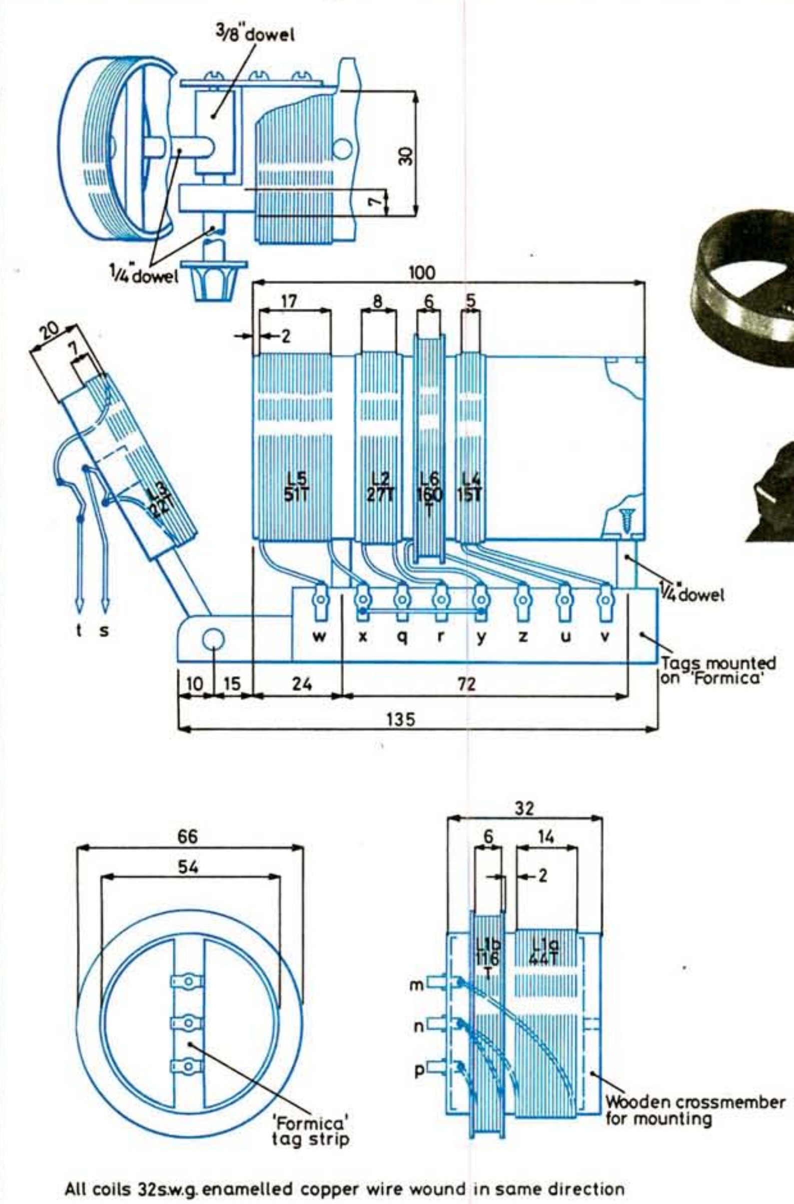


Fig. 4: Method used to make Mazda Octal valve holders



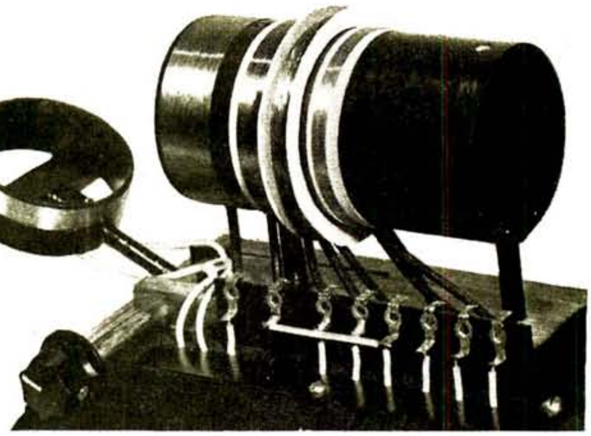
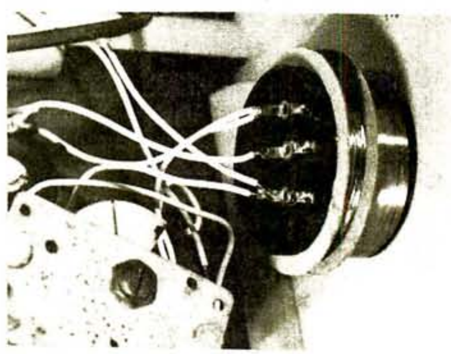


Fig. 5: Coil winding details. The main tuning coil with the swinging reaction coil is shown above with L1 shown below



WRM243

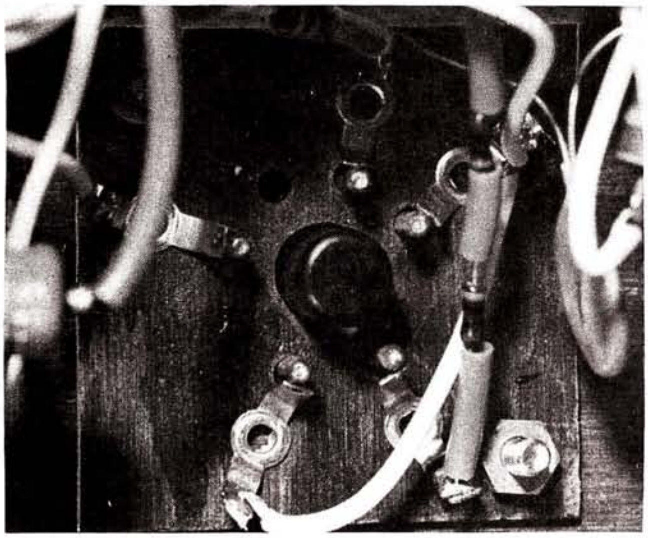
pins and central spigot. When the filler is hard, sand it down so that the impressions make holes right through, and use this as a template and guide for drilling. Electrical contact is made with rivet soldering tags set up to bear against the sides of the valve pins. Provided the tags and pins are clean, no trouble should be experienced with intermittent contacts.

Coil Winding Details

The coils for the set must, of course, be hand wound. Although this may look a difficult job, it is much easier to do than to describe. The two parts of coil L1 are wound on a 54mm diameter cardboard former. This was actually a stout cardboard tube of the type used to contain rolled documents. Cut the tube carefully to size, and glue in the mounting bracket and tags using Araldite as shown in Fig. 5. Glue on the two annular cardboard cheeks which contain L1b spaced 6mm apart. Paint the former inside and out with matt black paint. L1a consists of 44 turns of 32 s.w.g. enamelled copper wire close wound in a single layer over a distance of about 14mm. Anchor the beginning and end of the winding by passing the wire through pin holes in the former. Coil L1b consists of 116 turns also of 32 s.w.g. enamelled wire wound at random between the cheeks on the former. Slip lengths of sleeving over the wire ends and solder to the tags as shown (having first scraped off the enamel insulation).

Coils L2, L4, L5 and L6 are all wound in the same direction on the same former, also of 54mm diameter, according to the details given in Fig. 5. Again, paint the former before winding the coils.

These are mounted on the top panel in full view, so some care in the construction pays dividends, both in the appearance and the performance of the set. All the windings are of 32 s.w.g. enamelled wire. Notice that sections L2, L4 and L6 are wound on collars that slide along the former (for later adjustment). The best way to do this is to wrap several layers of paper around a length of the same tube from which the former was cut. Then carefully glue a strip of thin card about 3mm wider than the winding to form a collar fitting tightly over the paper layers. The

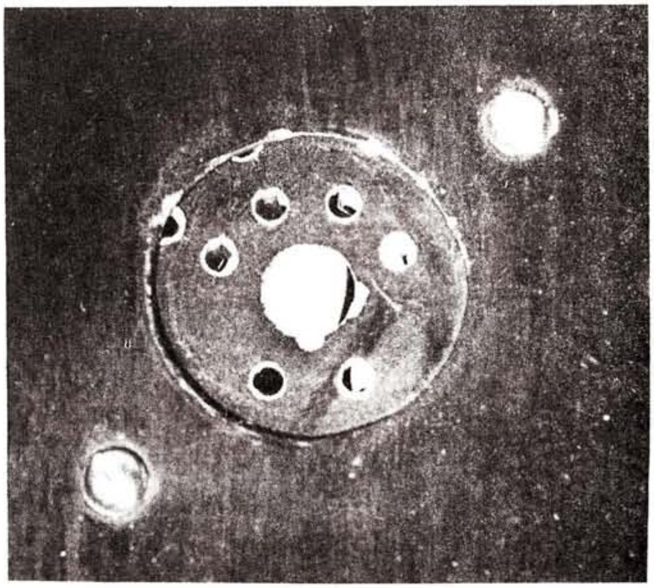


coil may then be wound on to the collar, anchoring the turns with a dab of quick drying varnish. Gently ease the collar with its coil off the tube, and anchor the ends of the winding more firmly by passing the wire through pin holes in the edge of the collar. The whole should now slide easily on to the former. Coil L2 consists of 27 turns in a single layer; coil L4 has 15 turns also in a single layer, and L6 consists of 160 turns random wound between two cheeks spaced 6mm apart. L5 is 51 turns in a single layer wound directly on to the former as close to the end as possible.

The swinging coil L3 is wound on a separate section of the former and has 22 turns of 32 s.w.g. wire in a single layer close to the end of the former. This coil turns through an arc to bring it either close to L5 or far away with its axis at right angles to the tuning coil.

The method of mounting the coils is shown in Fig. 7a and also in the photograph. Sleeve all the wire ends and allow some free play before soldering to the tags. The detail in Fig. 5 shows how the swinging coil is arranged.

It is most important that the coils are all wound in the same direction. The letters m–z on the windings correspond with those on the circuit diagram.



These two pictures show the valve holders. On the left is the underpanel details showing the riveted solder tags used as pin connections. If you are lucky and persistent you might be able to locate genuine Mazda Octal bases in an old junk set or even in the stock of some suppliers

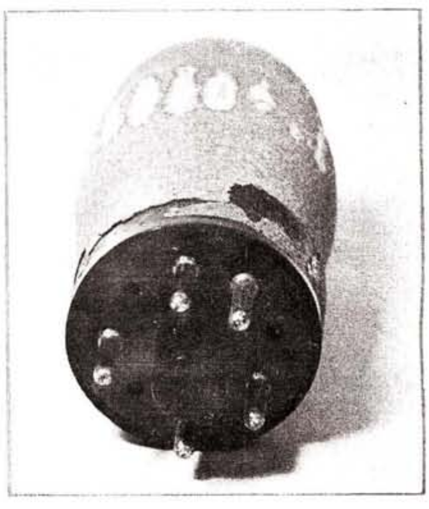
Wiring Up

If the highest degree of authenticity for the style of construction is to be maintained the set should be wired with thick bare copper wires, all running neatly parallel or making right-angled bends. Unfortunately, modern components do not lend themselves to this form of construction, and the author resorted to using much more conventional (though still old-fashioned) stranded PVC insulated wire and tag strips where necessary.

Layout is not critical, and may be adjusted to suit the components used. Notice that R5 and R6 are 20Ω resistors each being made-up of two 10Ω 5% resistors wired in series. Connection to the coils L2–6 are made through 3mm holes drilled in the top panel.

Next Month

Part 2 will cover the remaining details of construction of this interesting project and give information on alignment and operation.



PRODUCTION LINES

alan martin

Powered Breadboard Kit

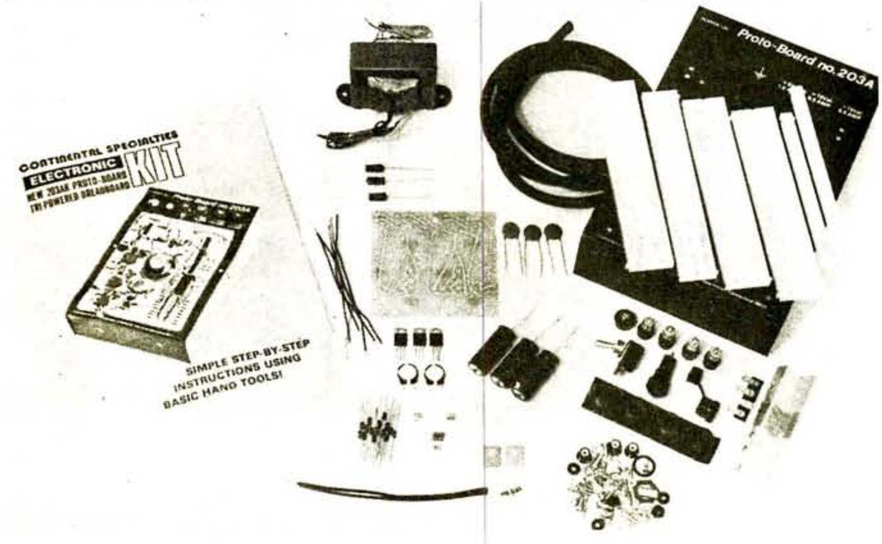
CSC has recently introduced a kit containing all the components needed to make a solderless breadboard unit containing three regulated d.c. power supplies. The new Proto-Board PB203AK is equally suited to use as a teaching aid in electronics education or as a design and prototyping tool for hobbyists and professional users alike.

The kit comes complete with all the electronic components, case and breadboard modules, as well as nuts, bolts, connecting wire and solder. The assembly instructions are clearly arranged, step-by-step, without any assumptions about the constructor's past experience.

The finished Proto-Board incorporates three large breadboards plus four long busbars and one shorter one, giving a constructional area sufficient for 24 i.c.s in 14-pin packages. In addition, terminal posts allow connection to earth and to the +5V. 1A and ±15V, 0·5A power supplies. The power supplies are independent and fully regulated, and the ±15V supply can be adjusted over the range 7-18V.

The PB-203AK is supplied with a robust earthed metal case measuring 248 × 168 × 83mm, is designed for operation from a normal a.c. mains supply and costs £69.57 inclusive of VAT and P&P.

Available from: *Continental Specialties Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ. Tel: (0799) 21682.*



Latest from Trio

Rumours have been flying around lately, that Trio are about to launch a new transceiver. They are, its the TR-9000 a multi-mode, compact 2 metre transceiver with a wide range of accessories.

The outstanding array of functions include: multi-band operation, f.m./u.s.b./l.s.b./c.w. there are two f.m. modes, FM1 for mobile operation and FM2 for precise tuning; five channel memory selector, with memory insert and recall switches; v.f.o. shift switch which selects either of the two built-in v.f.o.s; automatic signal scanner and hold switches; r.f. gain and RIT control; noise-blanker switch, squelch/FS control, the FS position allows free scanning in the f.m. mode; TX offset facility for repeater operation; tone switch which activates the accurate 1750Hz repeater access tone oscillator; S and r.f. meter; search/D. step switch and main tuning knob which controls the digital synthesiser, the frequency steps changing automatically according to mode in use or position of digital step switch, also incorporated is a linear power module M57713 as the final power amplifier. Externally a new hand microphone with up/down switching is included.

At a VAT inclusive price in the region of £365, the TR-9000 will be obtainable from:

Lowe Electronics Ltd., Bentley Bridge, Chesterfield Road, Matlock, Derbyshire. Tel: (0629) 2430 or 2817.

Practical Wireless hope to produce a "Radio Special Product Review" on the TR-9000 in the very near future.

Crystal Oscillators

Meon Electronics Limited have announced the appointment of FieldTech as their sole UK distributors for their range of crystal oscillators.

Meon Electronics, a relatively new manufacturer of crystal oscillators, have established themselves in the market by a reputation of producing high quality components at very competitive prices. For example, their FMC 300T (TTL) series covers a frequency range of 500kHz to 14MHz with a calibration accuracy of ±50ppm, an ageing rate of only 10ppm per year, and a temperature coefficient of 1ppm/°C. This series is offered at a unit price of under £6 with very substantial discounts for o.e.m. quantities.

Information about Meon crystal oscillators is now available from: *FieldTech Limited, Components Division, Heathrow Airport–London, Hounslow, Middx TW6 3AF. Tel: 01-759 2811.*

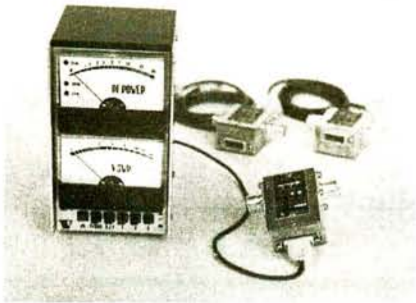
VSWR/Power Meter

A combined v.s.w.r. and power meter offering direct reading of both functions without interpolation is available from Zycomm Electronics Limited.

In operation, the unit is autoranging for power output, covering 20W to 2kW in three ranges for 1·8–30MHz and 50–150MHz, and 2W to 200W for the 430–470MHz range, v.s.w.r. from 1:1 to infinity can be measured.

Separate sensing heads are supplied to cover each frequency range, and these can be connected at any position in the feed line—including the mast head for precise radiated power indication. Press switches on the front panel allow the selection of the appropriate head, and the display of forward and reverse power as either peak or r.m.s. readings.

The electronic comparator included in the unit allows constant readout of



v.s.w.r. irrespective of power variation, i.e. gives true indication during speech on s.s.b.

A 240V, 50Hz supply is required for operation and the unit is priced at £99.00 plus VAT.

Available from: *Zycomm Electronics Ltd., 47, 49 & 51 Pentrich Road, Ripley, Derbys DE5 3DS. Tel: (0773) 44281.*

New Digital Display for the FRG 7

The unit is a compact, self-contained true frequency meter, which has been especially developed for the Yaesu-Musen FRG-7 communications receiver as an add-on unit, the original analogue facility remaining unchanged.

The counter produces a 3 digit display to an accuracy of 1kHz. The design is entirely based on CMOS logic i.c.s which are assembled on double-sided fibreglass boards to professional standards.

The display on the MGC7 is non-multiplexed to avoid problems with r.f.i. from the high peak currents that occur with multiplexed displays. The displays themselves and the display filters have been carefully selected for good contrast and maximum readability.

The "update" rate of the display is set internally to 3 "updates" per second and is blanked completely if the receiver is tuned below "000" or above "999".

The unit is complete with all fitting instructions and MG Communications Ltd. products are fully guaranteed for one year, including all parts and labour.

The unit is realistically priced at £49.00 including VAT, plus £1.00 P&P, and is available from: *Amateur Radio Exchange, 2 Northfields Road, Ealing, London W13 9SY. Tel: 01-579 5311.*

If you please

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

Portable PSU

A self-contained 12V, 60Ah power supply unit TP2 Mk1V which has the advantage of being recharged either from 240V a.c. 50Hz mains or from a 12V d.c. source such as a car, is available from Lab-Craft Limited. Applications include the provision of power, on sites remote from mains supplies, for inverter driven fluorescent lighting fittings and battery-powered hand tools, mobile rigs, etc.

The unit is supplied complete with an electronically regulated battery charger which automatically cuts out when the battery terminal voltage reaches approximately 14·5V, indicating full charge. Excessive battery gassing, caused through overcharging, is eliminated by this arrangement and a state-of-charge indicator shows when the battery requires a prolonged charge (under 10V white sector); is below full charge (10 to 13V green sector); or is fully charged (13 to 15V red sector). The typical charging current for a fully discharged battery is between 3 to 4A and a 60Ah battery should completely charge from the mains in 36 hours.

A thermal cut-out is fitted which temporarily switches off the charge if the unit overheats due to poor ventilation or if the battery heats up excessively due to shorted cells, damaged plates, etc. The unit has been designed and tested to BS3456.

The TP2 Mk1V is supplied complete with detachable carrying handle and can be fitted with any suitable 12V car battery not exceeding 280 × 175 × 205mm high (not supplied). The case is constructed in two robust acid-resistant polyethylene mouldings, with battery ventilation holes in the lid, and the dimensions are 420 × 198 × 285mm high (approx.).

Costing £52 plus VAT, the TP2 Mk1V is obtainable from motor factors, etc. Further details are available from: *Lab-Craft Limited, Church Road, Harold Wood, Romford, Essex RM3 0HT. Tel: (04023) 49320.*

Interesting Pair

Telecommunications Accessories Ltd. (formerly Antenna Specialists UK Ltd.) have recently introduced two new products which should be of particular interest to the amateur radio enthusiast.

First, the CS100 a compact loudspeaker unit specifically designed for mobile radio applications.

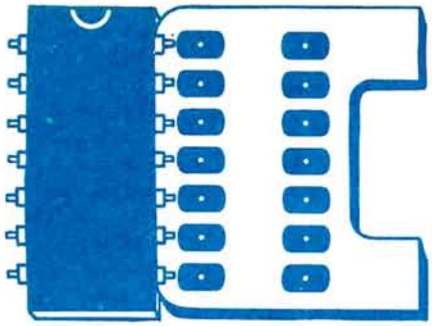
The carefully shaped response curve has steep below 500Hz and above 3·5kHz to reduce out of speech band noise. The small size (68 × 68 × 43mm) and adjustable bracket allows mounting on the dashboard of most vehicles and cost is in the region of £9.00.

Second, the TAS.1001 a coaxial changeover switch, designed to allow the operator to change from one antenna to another.

Switch operation is by a 12V relay and the unit has a loss of less than 1dB over the frequency range 0–500MHz and retails at approx. £20.00.

For availability details of both items contact: *Telecommunications Accessories Ltd., Thame Industrial Estate, Bandet Way, Thame, Oxon OX9 3SS. Tel: (084 421) 3621/2/3.*

The CS100 compact loudspeaker



OF THE MONTH

Brian DANCE M.Sc

RCA CA3280 VARIABLE OP. AMP

At first glance, the RCA CA3280 device appears merely to contain two operational amplifiers within a 16 pin dual-in-line package. First impressions, as always, can obviously be misleading—the particular and interesting feature of this i.c. is that its transconductance is arranged to be *programmable* by means of a current fed into a separate input connection.

The term "transconductance" or "mutual conductance" (g_m) was widely used in the days of the thermionic valve but has fallen nowadays rather into disuse. Broadly defined as the change in output current resulting from a change in input voltage, it was usually expressed in ma/V or in "milli-mhos" and was the designer's guide to the voltage gain that could be obtained from a particular valve.

Conductance is, of course, the reciprocal of resistance and it was this fact that led to someone spelling "ohm" backwards in deriving a name for its principal unit. Now, to ruin the essential simplicity of this arrangement, the mho has been axed in the new fervour for international rationalisation and today we have the "siemen" as the SI (Systeme Internationale) unit of conductance (Symbol: S, µS, MS, mS etc., not to be confused with the symbol for seconds, s!).

The transconductance of the CA3280 can be set anywhere in a range of values by a suitable choice of the programming current. The gain is proportional to the transconductance and therefore the gain of a CA3280 circuit can be easily changed by varying the programming current.

The CA3280 is certainly much more than two independent amplifiers in a single package. For example, all of the characteristics of the two separate amplifiers in each device are matched to within ±5% and internal current-driven linearisation diodes reduce the external input current. In addition, the emitters of the differential amplifier stage are brought out to external pins so that the device can be used in emitter-coupled dual differential amplifier applications.

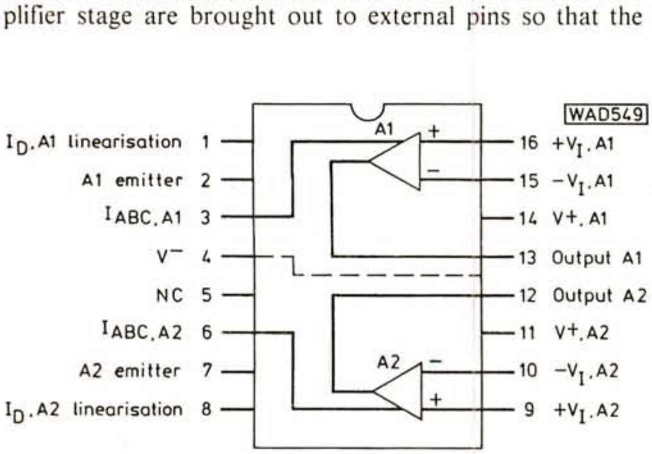


Fig. 1: Internal circuit and pin connections

The CA3280G is a new device with a specified operating temperature range of 0–70°C and a more expensive CA3280AG device is also available if a wider temperature range is required. The suffix "G" indicates "gold chip" hermetic sealing.

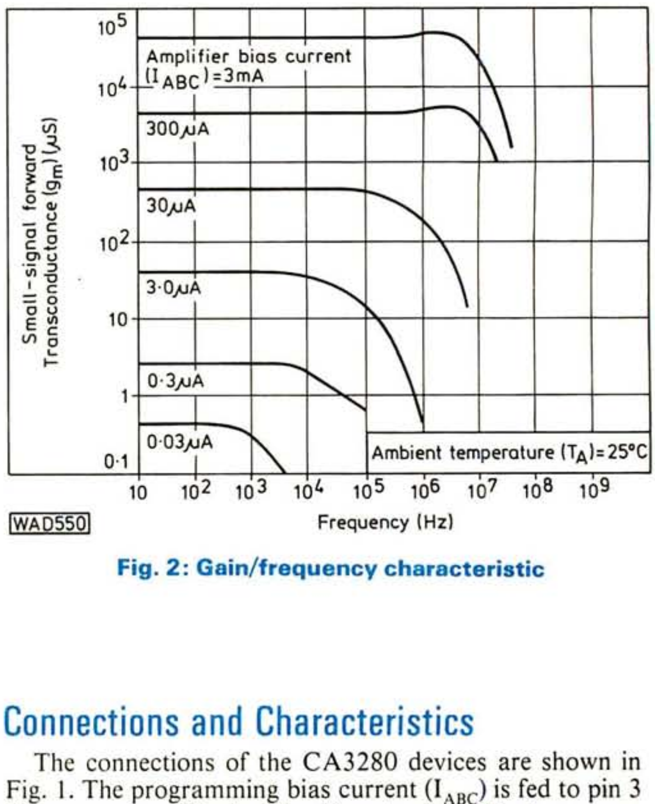


Fig. 2: Gain/frequency characteristic

Connections and Characteristics

The connections of the CA3280 devices are shown in Fig. 1. The programming bias current (I_{ABC}) is fed to pin 3 (the upper amplifier in Fig. 1) or to pin 6 (the lower amplifier). Each has the normal differential input: pins 15 and 16 for the upper amplifier; pins 9 and 10 for the lower one.

The maximum voltage that may be applied between the positive supply at pin 14 and the negative line (pin 4) is 36V, but it is wise to use a maximum of about 30V rather than to risk momentarily exceeding the absolute maximum permissible voltage (36V) and possibly destroying the device. Maximum internal power dissipation is 750mW total and should not exceed 600mW in either amplifier. At temperatures above 55°C these values must be linearly derated at a rate of 6·67mW/°C.

The input offset voltage is not more than 3mV at 25°C and does not exceed 4mV over the complete temperature range for values of I_{ABC} between 10µA and 1mA; typically, it is 0·7mV. The input bias current has a maximum value of 8µA when I_{ABC} is 500µA—the voltage gain (without feedback) is typically 100 000. The typical resistance is 63MΩ.

The CA3280 has built-in short circuit protection—the output can be shorted to ground or to either supply rail for an indefinite period without suffering any damage. The bandwidth is quoted as being 9MHz with a 1mA programming current and a 100Ω load; the noise level is very low (for the more technically minded it is typically $8nV(Hz)^{-\frac{1}{2}}$ at 1kHz).

The relationship between the transconductance of a typical CA3280 amplifier, frequency and input bias current is depicted in Fig. 2. Each curve shows the result obtained for each different value of input bias current, for a programming current of 3mA. It can be seen that as the input bias current is increased from 30nA to 3mA, the transconductance increases from less than 1μS to about 50mS and the frequency response from less than 1kHz to over 1MHz.

Varying the programming current also results in a wide-ranging variation in the current which the device draws from the power supply. If an amplifier with a relatively low transconductance (and gain) is required, a small programming current is used and the supply current drawn will thus be small. As shown in Fig. 3, the supply current can be less than 1μA, but even at high values of I_{ABC} increases only to a few milliamps. The programming current affects not only the gain, but also the output and input currents.

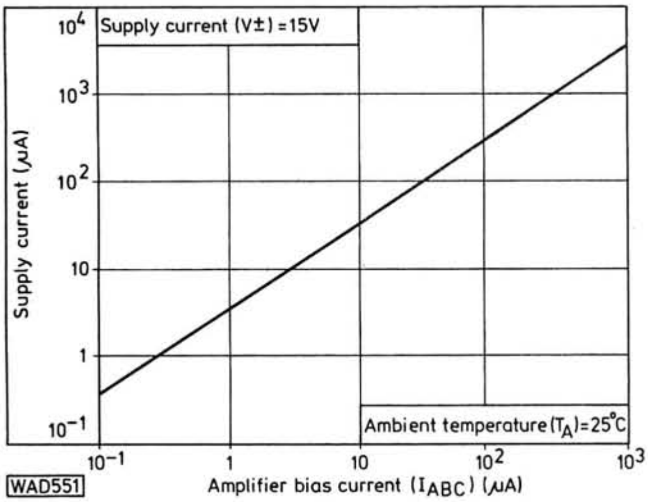


Fig. 3: Supply current as a function of amplifier bias current

Applications

The CA3280 can be employed in a wide variety of voltage-controlled oscillators whose frequency can be electrically controlled, in voltage-controlled amplifiers of variable gain and also in voltage-controlled filters, etc. The device also has applications in audio preamplifiers, triangle-sine convertors, function generators, demodulators and in more complex instrumentation circuitry.

The CA3280 has been developed from an earlier RCA device (type CA3080) and has many advantages over the earlier version. Although the CA3280 differs from a conventional op. amp. in many ways, there are similarities and this new product can be used by experienced circuit designers in a wide variety of original applications.

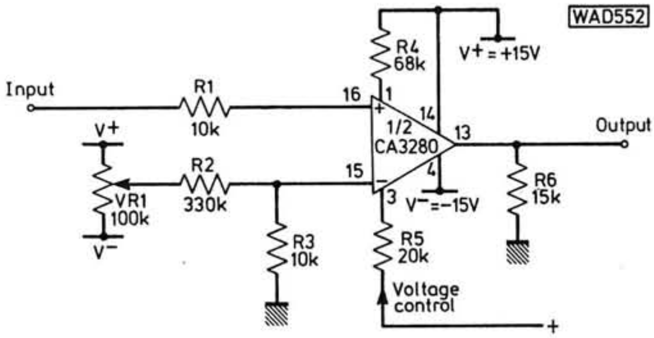


Fig. 4: Typical gain control circuit

Gain Control

A typical gain control circuit using the CA3280 is shown in Fig. 4; only one of the two amplifiers is used and so the other is available for use in another part of the circuit. An alternating input signal with a peak-to-peak voltage of the order of 10V is fed through the current limiting resistor R1 to the input at pin 16. This resistor changes the voltage signal into a current signal.

The gain of the circuit may be controlled in two ways. Potentiometer VR1 may be used to control the input bias current to pin 15 or, alternatively, the programming current to pin 3 may be used to control the gain. In the latter case, the lower end of the current limiting resistor R5 may be returned to a source of fixed voltage via another potentiometer. Note that the use of a linear-track potentiometer for this function is not very satisfactory, since a disproportionately large change of I_{ABC} will occur at one end of its travel—using a potentiometer with a logarithmic track will result in much more progressive gain control.

It should also be noted that the absolute maximum value of the current through the internal linearisation diodes is 5mA, and the current to pin 3 should therefore be limited to a value somewhat less than this.

Function Generator

As an alternative to the single-chip design featured elsewhere in this issue, the circuit shown in Fig. 5 is that of a function generator which simultaneously generates triangular and squarewave outputs of the same frequency. A particular feature of this circuit is the extremely wide frequency range available—from about 2Hz to 1MHz. The range of frequencies covered by the setting potentiometer VR1 can be modified by changing the two resistors in series with this component. The small capacitor VC1 trims the shape of the waveform at high frequencies and VR2 can be used to alter the mean output voltage. The signals from each output are passed through 10kΩ resistors so that any current taken will not have much effect on the operation of the circuit.

If a sinewave output is also required, the triangular output may be fed into the triangle-sine converter shown in Fig. 6, which uses the two amplifiers of another CA3280. If necessary, the input signal amplitude should be attenuated so as to provide a peak-to-peak input voltage of about 170mV at pin 16. The sinewave output has a total harmonic distortion of approximately 0·37%.

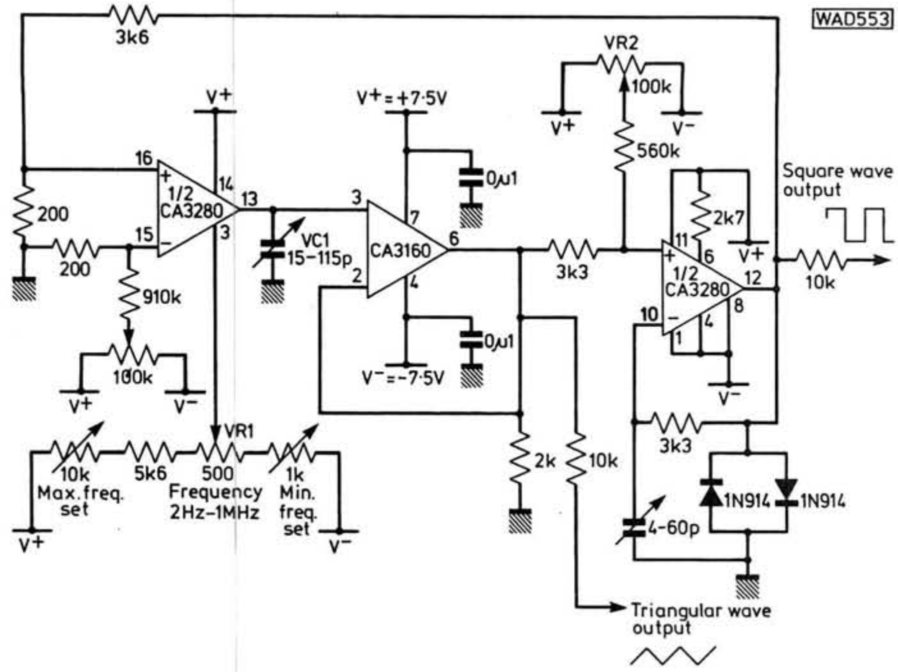


Fig. 5: Function generator circuit

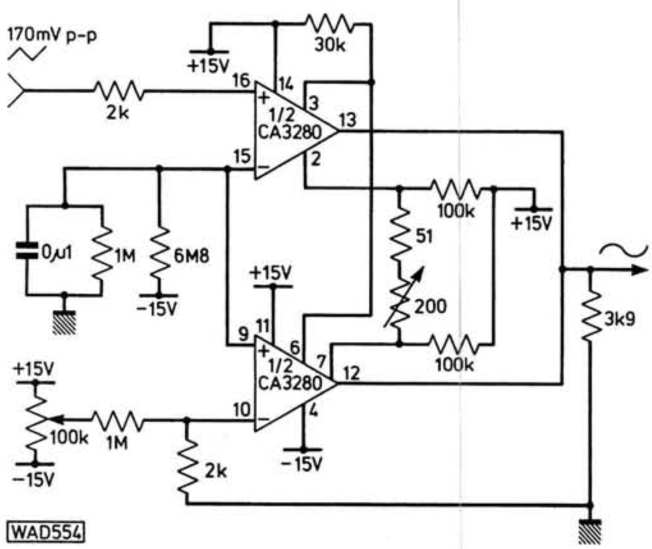


Fig. 6: Triangle-sine converter

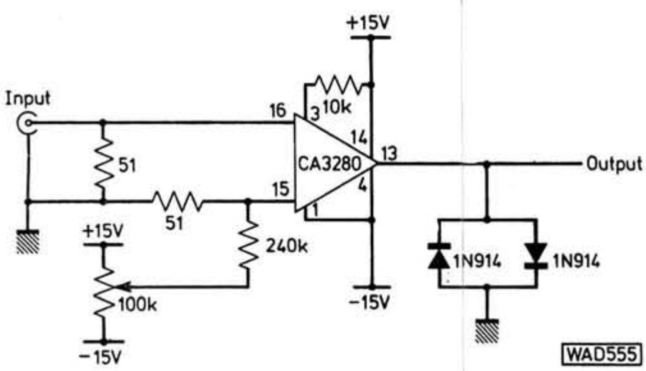


Fig. 7: Fast comparator circuit

Comparators

The programming facility of a CA3280 amplifier enables it to be used either as a very fast comparator (Fig. 7) or as a much slower comparator (Fig. 8). The Fig. 7 circuit shows delay times of less than 80ns using a 3mA programming current through a 10kΩ resistor, whereas the circuit of Fig. 8 uses the much larger value of 3·6MΩ from a supply of only +5V. The delay time of the Fig. 8 circuit is about 120µs—the Fig. 7 circuit requires a few extra components.

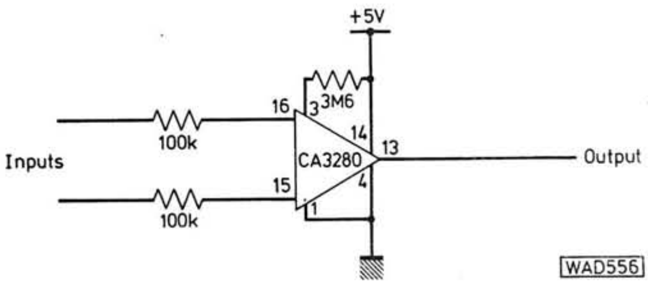


Fig. 8: Slow comparator circuit

Conclusion

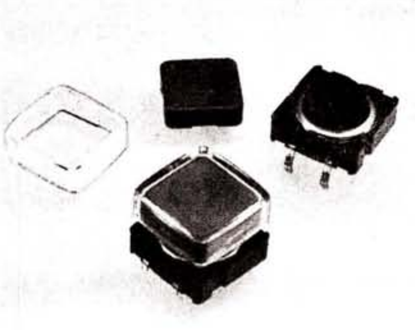
The programmable feature of this i.c. enables the user to choose (more or less!) the particular parameters that he requires in his amplifiers. It is thus of tremendous assistance to the circuit designer.

The CA3280 is available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN. ●

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

ALPS from Ambit

Armon Products Ltd. of Wembley (UK importers for ALPS), have recently concluded a distributive agreement with Ambit International for a range of products, including the broad range of ALPS switches, various moving coil meters from Hung Chang of Korea, and Faital loudspeakers of Italy.



This agreement has occurred at a time when ALPS are rapidly expanding their range of small keyboard switches to cope with the increasing demand from industrial and consumer manufacturers—now that the m.p.u. is at last finding widespread acceptance in a wide variety of manufactured goods. Ambit will be stocking various types, including the KHC/SCM series miniature disc switches (see photograph), and the SUT series pushbutton switch system, intended for right angle mounting on a p.c.b.

Please note! Ambit International have moved, their new address is: *200 North Service Road, Brentwood, Essex CM14 4SG. Tel: (0277) 230909.*

Videotone Slash Prices

In an aggressive change in marketing policy, Videotone have decided to open a Direct-Selling Showroom in South London and cease selling through its normal retail outlets. Videotone believe they are the first major Hi-Fi company to enter the direct-selling market which has proved so successful for other consumer products.

The showroom has full demonstration facilities with competitive products for comparison and qualified staff are always on hand to give advise.

This policy change has allowed Videotone to introduce some incredible price reductions, some products have been reduced by as much as 50% of the r.r.p. Other services include an extra 10% on their own brands if they are out of stock at the time of ordering, for hobbyists there is a facility that allows them to buy prototypes and surplus goods at exceptionally keen prices.

The showrooms, at the address below, opened on 1 February 1980 and I understand from Videotone that business has been brisk, to say the least.

Videotone Ltd., 98 Crofton Park Road, London SE4. Tel: 01-690 8511.

Marconi and Chips

An outstanding feature of the "Challenge of the Chip" exhibition, at London's Science Museum, is a large realistic model of an advanced fighter plane of the future, demonstrating the role of the microprocessor "chip" in aviation. The exhibit has been contributed by *Marconi Avionics Limited,* the GEC-Marconi Electronics company which leads the world in aviation electronics.

The unique audio visual presentation makes use of the same techniques as those used in the company's head-up displays. The head-up display, an export-winning British innovation, is an instrument not unlike a sophisticated gunsight, which presents to a pilot, in his forward view, an image of symbols representing the readings of his instruments. Using the same optical principles and involving a ten foot long half-silvered mirror mounted beneath the model plane, a vivid account is presented to the onlooker of the vital tasks performed by microprocessors in modern civil and military aircraft.

The exhibit clearly demonstrates the kinds of tasks which avionic systems carry out and also explains how these tasks are performed and where the equipment is located in an aircraft. Systems for civil airliners, maritime patrol aircraft and combat planes are vividly explained.

Diary Date

Practical Wireless will once again be exhibiting at the RSGBs' 1980 Alexandra Palace Exhibition.

The two day exhibition will be open to the public on Friday, 9 May and Saturday, 10 May 1980.

We look forward to meeting our many friends and readers at the exhibition. Further details next month.

Flat Panel Display

Bowmar Instrument announce that Optotek Ltd. of Canada, for whom they are the sole UK representatives, have recently developed a miniature l.e.d. which can be fabricated to form a "flat panel" screen as an alternative to more conventional displays, such as, electromechanical dials and cathode ray tubes.

The 100 × 75mm screen incorporates more than 49 000 l.e.d.s (each only 0·008in in diameter), giving a resolution of 64 lines per inch.

The display device, which is currently being evaluated by the USAF Flight Dynamics Laboratory, is intended as a replacement for the mixture of dials and c.r.t. displays at present to be found in aircraft cockpits.

The computer-controlled display is designed to provide the pilot with flight advisory information on various subsystems, at the flip of a switch, the data being depicted on the screen in numbers, letters or symbols.

It seems, the trouble with c.r.t. displays is that they are too large and failure prone, should they fail, the display can suddenly and completely disappear, whilst the flat panel undergoes a kind of graceful degradation. In other words, if several hundreds of thousands of l.e.d.s should fail, the display could still be read. Another very important factor is reliability, it is estimated that the mean time between failure of a flat panel is 20 times longer than that of the average c.r.t. display.

Bowmar Instrument Ltd., 45 High Street, Weybridge, Surrey.

New Lithium Batteries

Ray-O-Vac is now producing a range of lithium batteries for watches, calculators and other electronic uses.

The main advantages of these non-aqueous lithium-manganese dioxide batteries is greater capacity, longer shelf life, lower cost—particularly in view of rising silver prices—and low-leakage coupled with the fact that should the battery leak it is non-corrosive. One lithium replaces two 1·5V silver-oxide batteries.

These batteries will be introduced onto the UK market during 1980.

Ray-O-Vac, Station Approach, St Mary Cray, Orpington, Kent BR5 2ND. Tel: (0689) 70516/7/8.

NIMBUS

Modular 2m Transceiver System (Part 3)

Michael TOOLEY BA G8CKT
&
David WHITFIELD BA MSc G8FTB

The construction of the modules will now be complete and should be mounted in the case, with all internal connections to plugs and sockets, etc., soldered up. Checks should now be made again for short-circuits and if all is satisfactory, then the batteries or power supply may be connected.

Alignment of the transceiver is relatively straightforward provided that the following instructions are closely followed. While it is quite natural to want to get the unit functioning on the air as quickly as possible, time invested in the alignment procedure will bring dividends later on. Indeed, the achievement of the design specifications depends largely on the accuracy of alignment; furthermore, gross misalignment of the transceiver is capable of producing signals on unwanted frequencies outside the amateur band! The following items are essential for carrying out the alignment procedure:

1. A d.c. multirange meter for initial checks and to facilitate adjustments using the test points provided.
2. A 6V 60mA light bulb to serve as a dummy load and to provide visual indication of output power.
3. A 144MHz signal source consisting of either a stable signal generator or a low power transmitter strip operated into a dummy load.
4. Suitable trimming tools. These should preferably be nylon with non-ferrous blades. Particular care must be taken when adjusting the ferrite dust cores since they are fragile and easily damaged. In some cases the core may become locked inside the former in which case it will be necessary to replace the entire coil assembly!
5. A wavemeter to check that the final output is within the amateur band and that no spurious signals are radiated. The wavemeter should be accurately calibrated and give indications from at least 70MHz to 300MHz.

The following items of test gear, although not essential, will be very useful in the alignment process:

1. A grid dip oscillator for use over the range 18 to 150MHz.
2. A sensitive v.h.f. power meter with a non-reactive 50Ω load.
3. An electronic voltmeter with an r.f. probe.
4. A v.h.f. digital frequency meter.

Transmitter Alignment

Select S20 on the crystal switch, S1, and insert an 18·1875MHz crystal in the appropriate holder. Connect a 6V 60mA bulb to the aerial socket using a short length of 50Ω coaxial cable terminated in a PL259 plug. Insert a d.c. milliammeter in the positive supply lead, switch to transmit (either by bridging the p.t.t. contacts on the microphone socket or by wiring a miniature toggle switch across the p.t.t. rail), and observe the supply current. This should be less than 160mA, typically 100mA. If this is not the case carefully check the circuit and wiring for errors.

Connect the negative lead of a d.c. voltmeter to chassis and with the positive lead measure the d.c. voltage at TP1 which should be approximately 2·25V and should fall very slightly when the crystal is removed from its socket. If this is not the case then the crystal oscillator is not functioning and it will be necessary to check the circuit around Tr1 and S1 for faults. Having established that the crystal oscillator is operating and if a sensitive digital frequency meter with a high input impedance is available, the trimmer capacitor, TC1, may be adjusted until the meter reads 18·1875MHz exactly. If an r.f. probe is available the signal voltage at TP1 can be checked and should be approximately 400mV r.m.s.

Transfer the meter to TP2 whose reading should be approximately 1V. Carefully tune first L1 and then L2 for maximum indication. It will be necessary to repeat this operation several times since there may be some slight interaction between L1 and L2. This increase in voltage at TP2 will, in any event, be small (around 0·1V). Transfer the meter to TP3 and similarly adjust first L3 and then L4 for maximum indication. It will again be necessary to repeat the operation several times to allow for interaction between the two coupled circuits. An increase of around 0·25V should be observed when L3 and L4 have been correctly tuned.

Transfer the meter to TP4 adjusting first L5 and then L6 for maximum indication. Again, repeat the adjustment several times to obtain the largest possible d.c. voltage. The increase, from around 0·5 to 1·5V, should be even more marked at this test point. Set the meter to a higher range (20 to 30V full scale), and transfer it to TP5. The reading should be approximately 12V. Carefully tune first L7, then L8 and then TC5 for minimum. This procedure will have to be repeated several times for optimum results.

In particular, it may be necessary to experiment with different settings for TC5 and then adjust L7 and L8. When the adjustment is complete the voltage at TP5 will have fallen by about 0·5V. As an alternative it is possible to carry out the adjustment of L7, L8 and TC5, by tuning for maximum voltage drop across R22. This method provides a proportionately larger voltage change and is therefore more appropriate for voltmeters having a limited resolution.

Finally, transfer the meter to TP6. Adjust first TC6 and then TC7 for maximum indication (approximately 1V). This should coincide with maximum output from the light bulb, which should be glowing at a reasonable level of brilliance. Replace the light bulb with a properly matched 50Ω load consisting of two ½W 100Ω carbon film resistors

Table 1. Transmitter test voltages

D.C. Voltages at Test Points

	Crystal Out	Crystal In
TP1	2·23	2·27
TP2	1·05	1·1
TP3	0·95	1·25
TP4	0·42	1·5
TP5	12·0	11·3
TP6	0	1·2

R.F. Voltages (Measured with an r.f. probe)

Tr2	drain	200mV r.m.s.
Tr3	collector	1·2V r.m.s.
Tr4	collector	3·5V r.m.s.
Tr5	collector	4·0V r.m.s.
Tr6	collector	5·5V r.m.s.
Point C	(across load)	5·0V r.m.s.

connected in parallel with their leads cut very short and soldered in place of the light bulb. Alternatively, a well matched aerial system can be used but not an indoor whip aerial! Now repeat the adjustment of TC6 and TC7 for a maximum indication at TP6.

Check the output frequency with a wavemeter (or grid dip oscillator) by holding the wavemeter close to the dummy load. Alternatively, if insufficient signal is obtained, the wavemeter may be coupled to the end of L10 adjacent to TC6. In either case check that the r.f. output is within the band 144–146MHz and that no spurious signals are present. With all but the most sensitive of wavemeters and provided that the alignment procedure has been carried out correctly, spurious signals such as the second harmonic of the output on 228MHz, should be undetectable.

If a v.h.f. digital frequency meter is available, check the final output and adjust TC1 to give an output frequency of 145·500MHz. At this point the other crystals may be inserted in their respective sockets and the corresponding trimmers adjusted to produce output signals precisely on the designated channels.

Having completed the overall transmitter alignment procedure, it is a very useful and interesting exercise to determine the d.c. input power to the final amplifier stage. Poor alignment usually results in reduced d.c. power input and thus measurement of this power can serve as a useful indication of the effectiveness of the alignment process. The procedure is to carefully measure the d.c. supply voltage and the voltage at TP5. The following example then shows how the d.c. input power may be determined from these two measurements.

Assume, for example, that the supply is precisely 12 volts, and that the voltage at TP5 is 11·2V. The difference is thus 0·8 volts. This means the voltage drop across R22 is 0·8V, and consequently the current flowing is 0·8 ÷ 10A or 80mA. The d.c. input power is the product of the d.c. collector voltage and current; in this case 0·08 × 11·2 = 0·896W or 896mW.

The light bulb used earlier represents a somewhat reactive load at 144MHz and thus should not be treated as an accurate indicator of r.f. output power. Rather, it should be used to provide a rough and ready visual indication of relative transmitter output. Meaningful measurements of r.f. output power require the use of properly calibrated v.h.f. wattmeters with non-reactive loads.

Receiver Alignment

When the transmitter alignment has been completed, remove the link, if used, from across the p.t.t. line and check that the relay drops out. Insert a d.c. milliammeter in the positive supply lead and check that the current is approximately 75mA, but if the supply current is widely different, check for wiring errors. If an "S" meter has been incorporated, observe the indication produced. Alternatively, connect a d.c. milliammeter using the 1mA or 500μA range in series with a 4·7kΩ resistor to point L on the printed circuit board. The indication should be approximately 150μA, but if the reading is widely different, check the wiring around IC101. Increase the volume control level and check that a reasonable level of noise is produced by the loudspeaker. If there is no discernible change check the wiring around IC102, IC101 and VR102.

Set the core of L105 to approximately mid-position and, with no receive crystal inserted, adjust L104 for minimum reading on the "S" meter. (This may also correspond with a slight increase in noise from the loudspeaker.) The reading should fall to less than 50μA (or approximately S1) with L104 correctly adjusted. Now select S20 on the crystal switch, S1, and insert a 44·9333MHz crystal in the appropriate holder. Connect the negative lead of the d.c. voltmeter to chassis and the positive lead via a 47kΩ resistor to the emitter of Tr102 where a reading of approximately 0·4V should be obtained.

Tune L102 for maximum indication when an increase of about 0·05V should be obtained. Transfer the voltmeter and series resistor to the source of Tr101 where a reading of approximately 0·6V should be obtained. Tune TC106 and L103 for minimum indication, when a reduction of about 0·15V should be obtained. Some experimentation may be necessary with the settings of TC106 and L103, and it may be convenient to vary TC106 for minimum indication at several different positions of L103. The combination that produces the greatest reduction can then be accurately located.

Using a local signal source on 145·500MHz, adjust the crystal trimmer, TC102, for maximum indication on the

Table 2. Receiver d.c. test voltages

IC100	IC101	IC102
1. 1·3	1. 2·1	2. 0
2. 1·3	2. 2·1	8. 6·0
3. 2·6	3. 2·1	14. 12·0
4. 0	4. 0	
5. 2·3	5. 0	
6. 8·0	(squelch off)	
7. 2·1	6. 7·6	
8. 9·6	7. 7·0	
	8. 5·6	
	9. 5·8	
	10. 5·8	
	11. 10·7	
	12. 3·3	
	13. 0·3	
	14. 0	
	15. 8·1	
	16. 0·3	

Tr100	Tr101	Tr102	Tr103	Tr104	Tr105
S 1·4	S 0·68	c 8·0	c 8·0	S 2·4	c 10·7
G1 0	G1 0	b 1·7	b 2·4	G 0	b 4·9
G2 5·0	G2 0·62	e 5·0	e 4·6	D 10·4	e 5·6
D 11·0	D 10·0				

"S" meter. If necessary, increase or decrease the coupling between the signal source and the transceiver in order to provide a suitable deflection on the "S" meter. Trimmer TC107 may also be adjusted, if necessary, for maximum indication. Reduce the coupling between the signal source and transceiver in order to produce a reading of about 100μA (S2 to S3), and then adjust first TC101 and then TC100 for maximum "S" meter indication. It may be necessary to again reduce the coupling during this adjustment.

Remove the signal source, turn up the volume control and adjust L104 for maximum noise. This will not quite coincide exactly with minimum "S" meter indication. Connect an aerial to the transceiver and wait until a reasonably strong signal at constant strength is heard, then peak TC106, TC101 and TC100 for maximum "S" meter reading and then carefully adjust L105 for the best received audio quality. This will occur quite sharply in the centre of the adjustment range and will produce a very noticeable change in speech quality.

The adjustment of L105 may be repeated on several signals, each time tuning for optimum audio quality. It should be noted that, when a signal is off-channel, i.e., a few kilohertz above or below the correct frequency, noticeable distortion will occur and it is therefore important that one should not rely on the accuracy of the first signal that is heard! If, however, the transmitting station has a digital frequency meter and can measure his frequency accurately, then the adjustment of both TC102 and L105 can, of course, be finalised. Crystals for the other three channels can then be fitted and their respective trimmers, TC103 to TC105, can be similarly adjusted.

Adjustment Of The Modulator

Before attempting to adjust the modulator it is essential to ensure that the transmitter is functioning correctly and in particular, that the transmit frequency is correct. Set VR200 and VR201 to mid-position and enlist the help of a nearby amateur station. VR201 should be adjusted for the correct deviation, approximately 4·5kHz, and this should be reasonably apparent to the experienced listener. If the deviation is too low the recovered audio will lack punch, but if it is too high noticeable distortion may be present. If a deviation meter is available this should, of course, be used in the setting up process.

Now adjust VR200 so that the deviation produced is reasonably constant regardless of the speech level or the proximity of the microphone to the operator's mouth! If VR200 is set too high, the audio will sound harsh and unpleasant, though it may well give good results under noisy or weak signal conditions. If VR200 is set too low, then there will be a fairly wide variation in the audio level and only "close talking" will give satisfactory results. If possible, repeat the tests with several stations in order to obtain a concensus of results.

Crystals

The choice of crystals is a matter of individual preference which will largely be dictated by the current usage of f.m. channels in the area. In any choice of frequencies, however, it is a good plan to include the designated f.m. calling channel, S20, and at least one of the popular simplex working frequencies, e.g., S21, S22 or S23. If there is a local repeater within range, it is well worth adding this to the coverage of the Nimbus since it is likely to provide a nucleus of activity even when there is little else on the simplex frequencies.

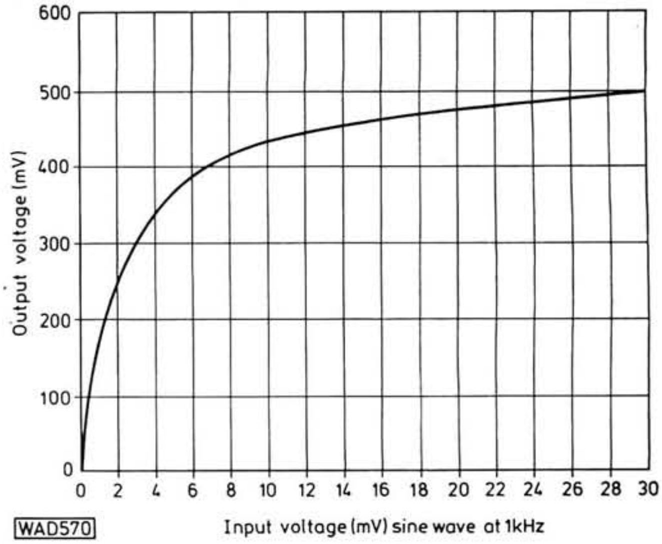


Fig. 16: Limiting characteristics of the modulator VR200 and VR201 set to maximum

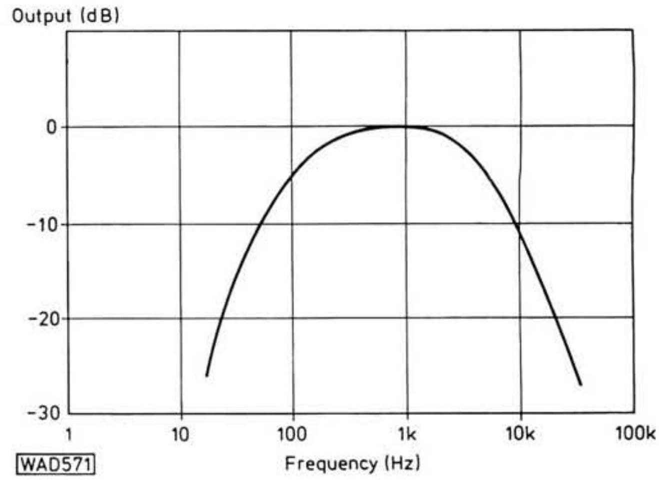


Fig. 17: Frequency response of the modulator

Most of the commonly available 18MHz transmit and 44MHz receive crystals intended for fitting to Japanese transceivers will operate satisfactorily in the Nimbus. These crystals are usually available in a wide range of frequencies by return of post from several sources. Alternatively, a number of firms will grind crystals to given specifications at quite reasonable charges. The delivery time for this service is usually about 4 to 8 weeks, but most manufacturers will provide an express service at an extra charge.

It is important to note that the crystals used in the transmitter are fundamental types, whilst those in the receiver are overtone types. It is also possible to use fundamental mode crystals in the 15MHz range in the receiver; however, these are not readily available and are therefore likely to be more expensive than the 44MHz overtone types.

Alternative PA Transistors

The nominal 0·5W r.f. output provided by the final amplifier stage of the Nimbus transmitter represents a

Table 3. Transmitter crystal frequency chart

	Channel Number	Frequency (MHz)	Crystal (MHz)
Repeater	R0	145·600	44·9667
	R1	145·625	44·9750
	R2	145·650	44·9833
	R3	145·675	44·9917
	R4	145·700	45·0000
	R5	145·725	45·0083
	R6	145·750	45·0167
	R7	145·775	45·0250
	R8	145·800	45·0333
Simplex	S16	145·400	44·9000
	S17	145·425	44·9083
	S18	145·450	44·9167
	S19	145·475	44·9250
	S20	145·500	44·9333
	S21	145·525	44·9417
	S22	145·550	44·9500
	S23	145·575	44·9583

$$\text{Crystal frequency (MHz)} = \frac{\text{signal frequency (MHz)}}{8}$$

Table 4. Receiver crystal frequency chart

	Channel Number	Frequency (MHz)	Crystal (MHz)
Repeater	R0	145·000	18·1250
	R1	145·025	18·1281
	R2	145·050	18·1312
	R3	145·075	18·1344
	R4	145·100	18·1375
	R5	145·125	18·1406
	R6	145·150	18·1437
	R7	145·175	18·1469
	R8	145·200	18·1500
Simplex	S16	145·400	18·1750
	S17	145·425	18·1781
	S18	145·450	18·1812
	S19	145·475	18·1844
	S20	145·500	18·1875
	S21	145·525	18·1906
	S22	145·550	18·1938
	S23	145·575	18·1969

$$\text{Crystal frequency (MHz)} = \frac{\text{Signal frequency (MHz)} - 10{\cdot}7}{3}$$

compromise between power output and battery economy. For some applications a higher power output would be desirable, but this can only be achieved at the expense of a corresponding increase in battery consumption. The 2N4427 transistor was chosen for the p.a. stage since it proved to be stable under all conditions and was also a low cost device, being available at less than £1. Constructors may, however, wish to experiment with higher gain devices such as the 40290, BLY33 or 2N3553.

There are, unfortunately, several pitfalls to be avoided. Firstly, any increase in output power can only be achieved at the expense of extra battery consumption and consequently reduced battery life. Secondly, these transistors tend to have high values of f_T (transition frequency), and this can lead to stability problems unless special precautions are observed.

Great care is necessary in the alignment process and in particular, it is essential to check that the p.a. does not become self-oscillating under driven conditions. The use of very short transistor connections is essential. The 2N3866 is a good replacement for the 2N4427 and can be used as a direct substitute with little adjustment needed to the p.a. tuning.

Aerials

Always use the very best aerial system that you can. This is important because the gain offered by any aerial system affects the performance of both the transmitter and the receiver. It is far better to instal a co-linear aerial with a gain of about 6dB, than to add a p.a. running 2W output into an existing quarter-wave ground plane. Not only will the co-linear provide an increase in effective radiated power but it will also provide an extra 6dB gain on receive and give a noticeably stronger received signal.

For portable applications a quarter-wave whip, approximately 490mm long, soldered to the centre pin of a PL259 plug will be quite adequate. Alternatively, one of the commercially available flexible helical whips may be used. These come ready terminated with a suitable plug and the PL259 version should be specified when ordering.

A beam, or Yagi aerial can be employed in fixed station applications where the directional characteristics of such an aerial can be useful in providing increased coverage in a particular direction, with the further refinement of adding a remotely controlled aerial rotator. Fixed station aerials should be sited outdoors well clear of local obstructions and furthermore, to minimise interference, they should be located at some distance from existing TV and f.m. aerials.

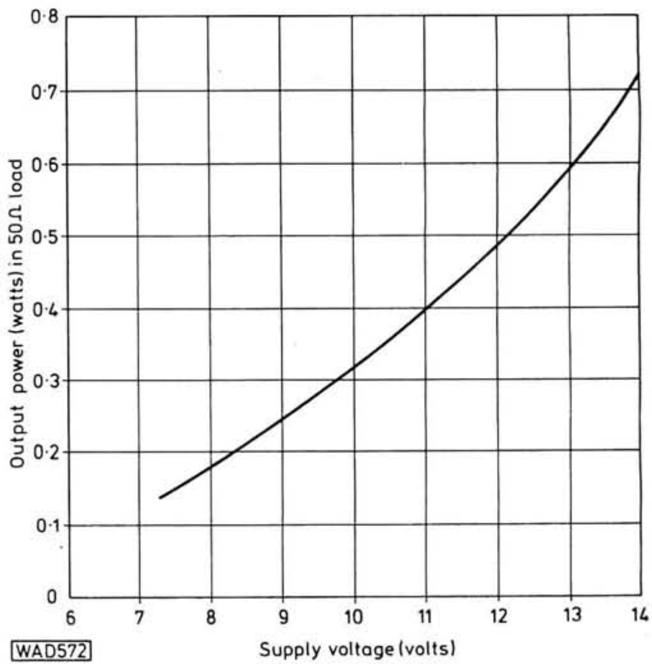


Fig. 18: Variation of output power with supply voltage using a 2N4427 final

Polarisation should be vertical as this has become the accepted standard for two metre f.m. operation. Where a long cable run is necessary, only low loss 50Ω coaxial feeder should be used; suitable cables being Uniradio 67 or RG 213/U.

Low Power Operating Technique

Operating with low power f.m. equipment requires quite a different technique than would, for example, be appropriate for high power s.s.b. Skill and perseverance are nevertheless still required and competence in operating technique can usually only be acquired as a direct result of experience on the air.

The peculiarities of low power operating will soon become evident, requiring usually a clear channel and, just because you don't hear anyone on the frequency, this does not mean that it is clear at the other man's location! Also, do not be downhearted by an apparently poor signal report. If the other man is running 100W output and you are hearing him at 5 and 9 plus, it is very likely that you will only get a report of strength 5. What is important is that you are readable!

The real advantage of the Nimbus lies in its ability to go anywhere. It can, for example, be packed in a rucksack and carried up a mountain, tucked away in the glove compartment of the car to provide some good company on a long journey, or even stowed away in a suitcase for that package tour abroad.

Most constructors will want to continue with further work and tailor the Nimbus to suit their own particular needs. Further articles in this series will describe a variety of add-on modules to extend the performance of the basic transceiver module. This, therefore, is just a starting point—the rest is up to you! ●

Readers who intend to operate the *PW* Nimbus should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

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ON THE AIR

by Eric Dowdeswell G4AR

My monthly mail nearly always includes a letter from a relatively older reader of *PW* who has spotted this column and then decided to take up amateur radio again after a lapse of many years. Often it is connected with a wish to take up a past hobby again as retirement approaches. Frequently an old valved receiver has been resurrected from shed or attic and put back into service.

The immediate reaction and source of inspiration of the letter to me is: "Where have the amateur stations gone to?" The answer, of course, is that amateurs today invariably use single sideband (s.s.b.) on telephony instead of what was then called a.m., or amplitude modulation. In fact, s.s.b. is only another form of amplitude modulation, though not every amateur realises this. To resolve s.s.b. we have to replace the missing carrier by generating a local one in the receiver, normally done by switching on the beat frequency oscillator (b.f.o.) and adjusting it very carefully for correct sounding speech.

Normally our old friend would not have done this unless he wanted to listen to c.w., or Morse code transmissions. In the better communications receiver of today the b.f.o. may be replaced by a carrier insertion oscillator (c.i.o.), using a couple of crystals, obviating the need for any tricky adjustments of the b.f.o.

Once the need for the b.f.o. is explained all is fairly plain sailing although the lack of adequate i.f. selectivity is usually the next complaint. This can be remedied by replacing the first i.f. transformer by a mechanical or crystal filter unit of the required bandwidth.

It is worth mentioning here that in a commercial transceiver the audio bandwidth is usually carefully matched to the i.f. filter bandwidth. If, for example, the audio is deliberately attenuated below 300Hz and above 3kHz then the nominal bandwidth of the filter will be 2·7kHz, hence the seemingly strange bandwidths of some i.f. filters in the literature on the subject. Ideally the filter's bandwidth should be 2·7kHz at the normal point of measurement at −6dB down and at −60dB down, in other words vertically straight sides. In practice there is always a flare out towards the bottom, which may be several kilohertz wide, thus decreasing the effective selectivity. This is particularly noticeable in ceramic i.f. filters which may specify "2·7kHz bandwidth" but this does not indicate the flare or skirt at the bottom of the curve. Generally speaking only mechanical or crystal filters are capable of giving the right bandwidth characteristics.

It is sometimes suggested to me that an audio filter be fitted to the receiver to overcome the lack of selectivity in older sets, but this is a fallacy. The increased selectivity must come as early as possible in the stage line-up, usually after the first mixer, that is at the input to the first i.f. amplifier stage. Subsequent i.f. stages using conventional *LC* circuits or ceramic filters will increase the i.f gain but will not affect the i.f. bandwidth determined by the crystal or mechanical filter.

Audio filters can be used to tailor the audio signal as already mentioned, to cut off below 300Hz and above 3kHz, or if made very narrow indeed, of the order of 80 to 100Hz, they can be used when copying c.w. Such a filter is essential for copying weak c.w. signals in a mess of QRM, providing however that one's own receiver does not drift in the process and that the other station's signal also does not drift! If they both drift at the same rate in the same direction, all is well! This is where too much audio selectivity can be a liability.

Here and There

Good news from **Richard Barker** (Canterbury, Kent) who got a credit in both parts of the December RAE and is now G8UUK and active on 2m, with an IC240, where he has found a very warm welcome. Congrats Richard and hope you will get on with the code while you are at it. Incidentally, Richard says the *PW* RAE Reprint was very helpful in explaining in English the contents of the *Radio Amateurs' Exam Manual!*

It is only fit and proper that I should mention that certain of *PW*'s staff also sat and passed the last RAE. So congratulations all round and hope we shall know their calls very soon so that we can look for them on the air. *(See Leader page for details—Ed.).*

John Timms of Barking, Essex, decided it was time to write in after being a regular reader of the column for some time. He has an FRG-7 and is rather keen to start copying RTTY on it when he has got the necessary accessories. Just to show that he takes this listening business seriously John has bought a 1000 of the *PW* QSL cards! Being in a flat is a problem also but he is managing with a Joystick and a.t.u. Since getting a Kenwood R820 receiver from Father Christmas, **Mark Smith** (Sutton Coldfield) has moved on from the ranks of the beginners and started to copy some decent DX he tells me, mainly on the 15 and 20m bands.

I got a right rocket from **Gordon Stevens,** of Hampton, Middx, for omitting an important part of the QTH of

Chris Mousley in the March issue of *PW*, who was seeking info on the 1155B receiver. It should have been *"Fleet*, Aldershot, Hants" and in consequence Gordon went on a 70-mile wild goose chase round Aldershot trying to find Chris! Anyway I hope Chris has now got the info from Gordon and my apologies all round!

In Leeds, Yorks, **Basil Woodcock** has very wisely been altering the lengths of his aerials to make them resonant on the amateur bands instead of the broadcast bands! The main improvement has been to the North American stations on 20m, using a 66ft wire and a.t.u. to his SRX-30 with which he is "very satisfied", although he hopes in due course to go on to something like the R1000 when he has seen some reports on it. He comments on getting signals even when the aerial is disconnected from the a.t.u., but as the latter is not screened and he used ordinary twin flex between it and the set, this is only to be expected. It is always preferable to put the a.t.u. in a metal box and to use coaxial cable to couple it to the receiver as a matter of good practice.

Regular writer **Pete Lucas** (Aberystwyth, Dyfed) has been having trouble with his AR88 on the power supply side. Considering the likely age of such sets it is generally a good idea to replace all the electrolytics at least, and the mass of by-pass capacitors as well if one has the patience. Anyway, all is well again and at the moment Pete is using a dipole at 40ft on the 10m band at, it seems, a very desirable QTH, less than a 100 yards from the sea! Pete is also installing his R209 in his car to do some DXing from the tops of the "local mountains" some 2500ft above sea level!

Quite a few of you are quite keen on playing with old radios that seem to come within the "vintage" bracket so you may like to know about a magazine *Sounds Vintage* that deals with the whole field of radio and gramophones of those days, edited by ex-*PW* staff Norman Stevens and Colin Riches. If interested write to the subscription department at 28 Chestwood Close, Billericay, Essex.

John Dainty of West Wickham, Kent, reports the loss of his FRG-7 and a tape recorder in a burglary, but it was not long before he was able to get another FRG-7 secondhand. He is thinking of a transceiver very soon in anticipation of passing the RAE, and a KW2000 tops the list of likelies. One moan John has about the construction articles in *PW* is the lack of information on the suppliers of components, especially people like *RS Components* who only supply through dealers. It certainly isn't everyone who happens to know this.

Paul Burgess (Lowestoft, Suffolk) is very enthusiastic about his CR150 receiver, to back up his old AR3, and is hearing plenty of DX now with a long wire and a.t.u. A proper log is promised for next month. From Tetbury, Glos, **Jim Rowland** expresses some doubts as to the value of the logs sent in by readers mainly because it seems to be just a matter of listening to some powerful Euro station working the DX and finding the DX itself in between. This is so, of course, and if the DX has really been heard then all well and good. Not much we can criticise about that but the point is that one must make sure the DX has really been heard before it is logged.

DXing Corner

In spite of intense activity on the air these days, **Paul Barker** G4HPS (Sunderland) still finds time to send in a long and interesting letter. He has a Trio TS-180 transceiver and a Ten-Tec Argonaut for QRP work. A fine lad Paul, because he sticks to c.w. on 10, 15 and 20m, only using the microphone for a few local ragchews. His aerial is an 18AVT trapped vertical which has enabled him to contact CP5NK, CX5RV (old friend G5RV, no less!), HH2VP (QSL N4XR), KL7DM, VP2SAX and VU2DX on 20m c.w. On 15m he keyed with FY7BF, OY7GP (using the QRP rig), WA7CWM in Nevada, 3A2ZZ and 8R1J. A good one on 10m was J7DBB in Dominica with a rare state in KA0ERR on Nebraska, and 8P6JD in Barbados.

Dave Coggins in Knutsford, Cheshire, has had a couple of letters from *PW* readers asking general questions on amateur radio whom Dave has been pleased to help. Dave's FRG-7 and 66ft inverted-Vee plus a 33ft wire, both into an a.t.u. have been busy on all bands from 10 to 160m. On the last-named he has been copying the W's but on 40m was annoyed to miss getting FK8CR and ZK1DK into the log, mainly because of the heavy Euro QRM. Dave is one of those listeners who is very keen to stick to the rules and doesn't log a choice bit of DX until he is sure he has actually heard it himself. He says that FK8CR is reported to be on 80m around 1900–2000 hours at the DX end of the band, with AP2KS active between 3790 and 3798kHz.

Putting Dave's DX in order it was DU1DBT, FK8CR and OK3TAB/D2A on the 28MHz band, TU2GA, YB0ADW and YB0ACL on 15m and XT2AB, ZF1MA and 7Z2AP on 20m. LU8DSS and TG8IA appeared on 40m with TI2VVR and VK2AVA on 80m, the latter around 3680kHz at about 1900 hours.

Sad news, I'm afraid, from **Dennis Sheppard** (Sheerness, Kent) who is "throwing up amateur radio" because of all the local electrical interference he is getting which has even caused damage to his RTTY printer. I have pointed out that he should regard this as a challenge and get on and cure the QRM either at source or by means of filters at his own mains input. I hope that after Dennis has been "off the air" for a while he will return refreshed and ready for the battle! But don't just give up, OM! Some RTTY copied by Dennis before going QRT included HP1XAW, K7NTV, VE2ESV, WA9UXP on the 28MHz band, JA1JDD, OX3FG, PY2YFG, VE7DQA, ZS1XR and 5N0SID on 21MHz and FP8DF, HL9UN, PT2WS, VK3IZ and XT2AZ caught on 14MHz, which ain't bad going for RTTY!

Last missive this month is from **Bill Rendell** of Truro, Cornwall, who had to contend with 126-mile-an-hour winds a while back that even the counterweight at the far end of the long wire couldn't cope with, with the inevitable result. Sticking to his AR3 plus preselector and a.t.u., Bill got VK3XI and ZL4BO on 7MHz, C5AAP, FP8HL, VE3BVD/ST2, ZF1MA and 3D6DW (QSL G4AVA) on 20m, and C5ABK, C6ACY, YC1BSA, 3D6BP and 6W8AR logged on 15m.

Club-land

Every Tuesday sees the **Liverpool & District ARS** hard at it in the Conservative Rooms, Church Road, Wavertree, from 8pm, with G8CFM running a quiz show on April 8 and no less than old friend Dud G6CJ giving his famous lecture on aerials through the medium of an RSGB film, on April 15. The 22nd deals with constructional matters, with the history of German amateur radio recounted by DJ0PC/G4IHS on the 29th. Every Thursday night at 8.30pm, G3AHD puts out slow Morse on 144·250MHz and, of course, everyone interested is welcome to join in. Further info from: Al Neilson G4CVZ, 78 Ackers Hall Avenue, Liverpool L14 2EA or try 051-220 5470.

A fair wodge of Morse practice is also handled by G3ASR club station of the **Edgware & District RS** on both 160 and 2m, from four to sixteen w.p.m. The club meets at Watling Community Centre, 145 Orange Hill

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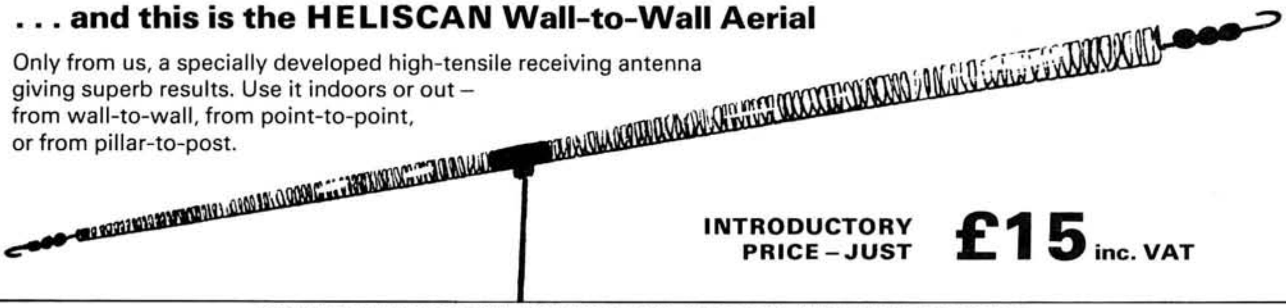

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Road, Burnt Oak, Edgware, on second and fourth Thursdays at 8pm, with visitors being especially welcome. That's nice! If interested you could do worse than contact Howard Drury G4HMD, 39 Wemborough Road, Stanmore, Middx. I note from the society's newsletter *Edgware Ham News* that average attendance last year was 18½. Nasty!

If you live around Lincoln why not contact Mike Wells G8PNU, 4 Horner Close, Brant Road, Lincoln, who will tell you all about the **Lincoln SW Club** that meets 8pm second and fourth Wednesdays at the Lincoln Corporation Social Club, Waterside South, or ring 0522 721277.

The Wirral area of Merseyside seems to be well stocked with clubs, you lucky people. First there is the fairly new **Wirral & District AR Club** meeting on the second and fourth Wednesdays at the West Kirby Sports Complex. Events for the coming year range from contest operation information, through films and talks to a lecture and demo on radio-controlled powerboats. Contact: Ian Brooks G8PMW, 59 Mosslands Drive, Wallasey L45 8PF. Then there's the **Wirral ARS** of which another old friend, G2AMV, is El Presidente and lately became Executive Vice-President of the RSGB. They meet at the Sports Centre, Grange Road West, Birkenhead, on the first and third Wednesdays at 7.45pm, where on April 2 NFD equipment plans will be (were?) laid. The 18th is annual dinner/dance night. So write to Public Relations Officer (nice!), Gordon Lee G3UJX, 30 Manor Drive, Upton (Wirral?), or ring 677 3826. The bi-monthly newsletter of this club is a good read with well-balanced amounts of club and member info and technical stuff.

Since the much-lamented death of G4EMN there is little news emanating from the **Bournemouth RS.** Latest "newsletter" might be very newsy for members but completely uninformative to an outsider or anyone wanting to join the club. I know the club has a large membership but it is not wise to get too complacent about new members wishing to join. The secretary's QTH, at least, would be helpful.

The **West of Scotland RS** meets every Friday evening at 22 Robertson Street, Glasgow G2, with club station GM4AGG active on h.f. and v.h.f. bands. Fortnightly films, talks, etc., are interspersed with chat nights with everybody welcome, says Sec Ian McGarvie, 3 Kelso Avenue, Paisley PA2 9JE. **West Kent ARS** meets alternate Tuesdays at the Adult Education Centre, Monson Road, Tunbridge Wells, with April 25 being AGM night. Contact: Sec Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks. Tel: 0732 56708 for latest info on meetings. **St Helens & District AR Club** is fairly new and meets every Wednesday at YWCA HQ, 107 Corporation Street, St Helens. Get there at 7.45pm for the Morse practice if you are on your way to a G4 ticket. A "warm welcome is extended to visitors" says sec Paul Gaskell G8PQD, 131 Greenfield Road, St Helens, Lancs WA10 6SH or try 25472.

Lastly a new QTH for the **North Bristol AR Club** which is the Self-Help Enterprise, Braemar Crescent, Northville, Bristol 7, with meetings Fridays at 7.30pm. Further detailed info from: G. Taylor G2HDG, 66 Burley Crescent, Downend, Bristol BS16 5PW.

I need hardly remind you of the **Northern Radio Societies Association** get-together at Belle Vue, Manchester on Sunday, April 27, doors opening at 11am. Attractions include inter-club quiz, construction contest, RSGB bookstall, grand raffle, Morse code challenge and a teletext display and Home Office exhibit. Talk-in facilities on f.m. via GB4NRS and G8NRS/A on 145·55 and 433·20MHz.

A reminder, as usual, to get copy to me by the 15th of the month. Those writing for the first time will find my full QTH in the box in this *On the Air* feature. Write to me direct and not via the magazine.

WARC 79

My comment in the March column on the effects of WARC 1979 on the c.w. qualifications got things rather back to front. The c.w. requirement will apply only to bands below 30MHz. 70MHz and 50MHz would therefore escape it. Sorry for the confusion.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

If you listen on 927kHz at 2343, other than on a Monday, you will hear Brussels signing off. After the final announcement the interval signal comes on and in the background you will hear Big Ben and then: "This is the BBC World Service." Tuning notes then become dominant and when the Brussels carrier finally goes off a few minutes later, the BBC World Service disappears too. What have we been listening to?

Luxembourg Effect

It is cross-modulation, which causes the programme from a strong station to be impressed on the carrier of another station, that enables the BBC WS to appear on 927kHz. Cross-modulation usually occurs inside the receiver as a result of overloading it with a strong signal, but in the case of 927kHz it is not the receiver. I have heard the effect on several sets and the cross-modulation seems to be happening in the ionosphere. This phenomenon was first observed in the 1930s when Radio Luxembourg's English programme was on the long waves. It could be heard as a background to a number of other stations, so it became known as the Luxembourg Effect. Since it can be observed on several medium- and long-wave stations it is important that the DXer should be able to recognise it, otherwise he may spend a lot of time chasing after non-existent DX.

If two stations are really transmitting on the same frequency then there will be a beat which may be audible but will be visible on the "S" meter. It is caused by the slight difference in frequency between the carriers of the two stations, which may only be a few hertz, but is enough to produce the beat. It can be very useful. If you are listening to WINS New York on 1010kHz, for example, and there is a flutter on the "S" meter then stay on the channel as WINS may fade and CFRB in Toronto may become dominant in its place. I had an experience like this some years ago when listening to WCFL Chicago on 1000kHz, when the cause of the beat turned out to be KOMO, which is in Seattle on the West Coast of the United States.

On the other hand, cross-modulation, no matter how it occurs, will not produce a beat since there is only one carrier. It is only the programme from the BBC World Service, presumably from 648kHz, that is superimposed on the 927kHz carrier so there cannot be a beat, or sub-audio heterodyne as some people call it.

Realistic DX160 Receiver

Regular readers will remember the latest version of this receiver which has a ferrite-rod aerial for use on the medium and long waves. The windings on the ferrite rod replace the aerial tuning inductors fitted to earlier models, and if the ferrite-rod aerial is disconnected then the receiver will not work. If, however, the ferrite aerial is left untouched, it will mask the null of any loop that might be connected to the receiver. In short, you cannot use a loop with this version of the DX160.

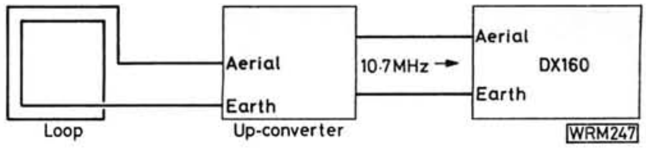
Of course, you could remove the internal aerial and fit aerial coils in its place, thus restoring the receiver to its original state. This requires some experimenting and technical know-how and if it is done to a new receiver then the guarantee would undoubtedly become void. Understandably, DXers shrink from this solution.

Two readers have succeeded in getting round the problem. **David Hyams** says: "Place a loop aerial near to the receiver and earth the loop windings. This can give good results so long as you are careful not to go near a part of the band with high-power transmitters." The transfer of signal is by induction from the loop to ferrite-rod aerial and no direct connection between loop and receiver is necessary. The loop is peaked up by its tuning control as usual. This method is useful if you want to boost the strength of a weak station but it cannot be used to null-out QRM.

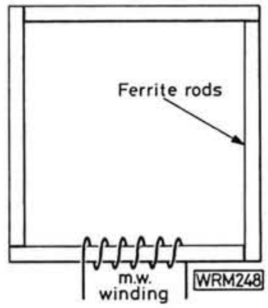
Up-Converter

Reader **K. Lewis** of Pensilva, in Cornwall, found another solution. He purchased an up-converter, which tunes across the medium waves and gives an output of 10·7MHz which is fed to the aerial and earth sockets of the DX160, and the latter is tuned to approximately 10·7MHz to a spot clear of any strong stations. A loop is then connected to the up-converter and the problem is solved. Fig. 1 shows the arrangement. What has been done is to convert the receiver into a double superhet on the medium wave with a first i.f. of 10·7MHz. The source of his particular unit has unfortunately since dried up, but the idea can no doubt be adapted for use with any others which might become available.

It is a great pity that the manufacturers of the DX160 decided to fit a ferrite-rod aerial, since earlier versions of this receiver gave good results when used with a m.w. loop aerial. If you are purchasing a receiver either new or second-hand and you want to use a m.w. loop then make sure it does not have an internal aerial. It is easy to check. There should be little or no signal pick-up on the medium wave unless an aerial is connected. If there is, then the receiver cannot be used with a loop.



▲ Fig. 1



◀ Fig. 2

Fig. 1: Arrangement of loop aerial and up-converter for use with the DX160

Fig. 2: The ferrite-rod loop aerial suggested by George Horvarth

Ferrite-Rod Aerials

"Would a loop made of ferrite rods give better results than an ordinary straight rod?" enquires **George Horvarth** of Mablethorpe, who enclosed a drawing (Fig. 2) to show what he has in mind.

My guess is that as the loop would form a closed magnetic circuit there would be little or no pick-up by the winding, but it would be interesting to hear from anyone who tries it out. Ferrite material incidentally, is an insulator! Try an ohmmeter across the ends of a ferrite rod and you will see what I mean.

There is an optimum ratio of length to diameter of approx. 25:1 for a ferrite rod for use as an aerial, which precludes making a bundle of rods with a winding placed round the bundle. I made a ferrite-rod aerial with two 200mm rods of 16mm diameter which are inserted end-to-end inside a 250mm length of Paxolin tube. This gives an effective 400mm rod with an l/r ratio of 25 and it performs very well with a winding of 150 turns on the tube. It was described in more detail in the July 1978 edition of this column, but briefly it has a coupling winding of 10 turns and the tuning capacitor has a value of 330pF.

Readers' Letters

The term "homebrew" is referred to by **Bradley Wilson** of Bristol, who has been misled by it. It means simply "home-made" and is part of the jargon used by Radio Amateurs. Coupling by induction from loop to portable has been mentioned many times in this column and also in my article on loops in the November 1979 *PW*. AFN (American Forces' Network) broadcast from a chain of low-power stations on 1143kHz. All sites are in West Germany and you probably heard one of them.

DX Heard

A really interesting log of first-class DX comes from K. Lewis using his Realistic DX160, up-converter and 36 inch loop. Among the more interesting were WMDD 1480kHz in Fajardo, Puerto Rico in Spanish at 0205, Radio Vision, Caracas, Venezuela on 950 at 0130, Radio Globo in Rio de Janeiro on 1220 at 0135, Radio Montecarlo in Montevideo, Uruguay on 930 at 0200, Radio Colosal, Neiva, Colombia on 1005 at 0130 and Radio St Vincent (705 Radio) on approx. 703kHz at 0205.

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

This month we will start off with readers' letters as a number of them contain problems that should be of general interest. The first is from **B. Woodcock** of Leeds, who has an SRX-30 receiver and wants to know if there is a unit that could be fitted between aerial and receiver that would boost weak signals. He does not want to interfere internally with the SRX-30. Yes, there is, and it is called a preselector.

Preselectors

A preselector is a tuned amplifier which is really no more than the r.f. stage of a receiver, fitted into a metal box. It should not be confused with a pre-amplifier which is untuned and amplifies everything in the spectrum. The preselector amplifies only the station it is tuned to, and it has a tuning control in order to do this.

Occasionally I use a Codar PR30 preselector with the BRT400. It is valve operated and consists of a metal box with input and output sockets, a tuning control with a large-skirted knob marked 0 to 100, a switch to cover 1·5 to 30MHz in three bands, and a gain control with on/off switch. The unit, which has its own power supply, is plugged into the mains.

It is easy to use a preselector. First of all you tune in the station on the main receiver. Then you peak-up the signal with the preselector tuning control, and finally you adjust the preselector gain for a satisfactory signal. It is at this point that snags are encountered. If there is too much gain from the preselector, which is likely to occur if it is used on a crowded band, then you may overload the receiver, which will cross-modulate and may even produce spurious signals in protest. A preselector amplifies noise as well as stations. A weak station with a noisy background will become a strong signal with a lot of noise, and it may be more difficult to listen to than the original.

Best results are obtained from a preselector when the receiver does not have an r.f. stage of its own. Image rejection will be improved and there will be a useful increase in sensitivity. The preselector is less valuable when used with a powerful receiver, but it is none-the-less a useful piece of ancillary equipment for DXing provided it is used with discretion.

Codar also produced the PR40 which was a transistorised model. The firm no longer make preselectors, though both models can be obtained secondhand. Be careful with the PR30 as there is a version of it that does not have its own power supply as it was intended to be powered from a valved receiver. Currently, Technical Associates make a preselector Type 2 for the s.w.l. and details of it are available from Stephens-James Ltd., 47 Warrington Road, Leigh, Lancs WN7 3EA. Details of other preselectors in use by readers would be welcome.

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.

B40 Receiver Handbook

This handbook is no longer available from the Ministry of Defence, though the one for the B41 receiver can still be obtained for £11! Many thanks to A. R. Hardstone and P. Wixon for updating the information supplied by Peter le Quesne of Dunedin in the November 1979 *PW*.

Callsigns

"How can I identify stations by their callsigns?" asks **D. Burgess** (Alton, Hants). Very difficult, since broadcasting stations on the short waves scarcely ever use callsigns and I'm not sure if they are still issued in some countries. It is the prefix that identifies the country and these are fixed by international agreement. For example, mine is G8BUS and the G shows that it is issued in the UK. Similarly with F for France and W for the United States. A list of prefixes can be found in many amateur publications but it is of very little value to the broadcast band DXer or s.w.l.

Logbooks

Reader **Tim Barrow** (Freeland, Oxfordshire) would like to know what should go into a logbook. Unlike a reception report, a logbook is not concerned with programme details. It is a record of stations heard and reception conditions. My logbook has seven vertical columns which are titled: Date; Time; kHz; Log (Log scale reading); Item (what was heard); SIO; Station (if identified). It is up to the individual to decide what is best for him, but columns noting the date when the reception reports went out and when the QSL was received, are suggestions.

Radio Free Granada

Dean Bayliss is puzzled by this station as it has been quoted as being on 15 045, 15 105 and 15 115kHz and he wonders if I could give the exact frequency. All of them could have been correct! Unlike broadcasters on other bands, those on the short waves are constantly changing frequency. The majority find it necessary to change four times a year, in March, May, September and November,

A recent QSL from Radio Australia

because of seasonal changes in propagation. As a result, smaller stations have a period of adjustment after a major shuffle around as they look for a slot among the big broadcasters.

A list of short-wave stations in frequency order represents something quite different from a similar list covering the medium waves where it gives a picture that is static over the years. The international s.w. list gives frequencies that are normally used by the stations at some time of the year and it is only from DX programmes such as Sweden Calling DXers or from the *World Radio and TV Handbook* Newsletter that the DXer can keep up with the ever-changing scene.

DX Heard and News

Jim Edwards (Wigan) has been active on the Tropical Bands with his FRG-7, a.t.u. and 100ft long wire. He reports hearing Radio Nepal on 3425kHz at 1545, Kurseoung on 3355kHz at 1555 (both on the 90m band) and Delhi on 3925kHz at 1610 on the 75m band, all logged during December. On the international bands Jim heard Radio New Zealand on 15 345kHz at 0435 and Radio Nacional Colombia on 15 335 at 0300. Radio Nepal on 3425 was also picked up by **Bryan Robertson** (Oxford) using his Realistic DX300 and 60ft long wire. Reception was at 0020 with Indian-style programming. RNZ was logged this time on 17 860 in the 16m band at 0505 but with heavy QRM.

"Is it possible to hear Antarctica on the short waves?" asks **David Hyams** of Finchley. According to a report over Sweden Calling DXers, Radio Nacional Arcangel San Gabriel at Esperanza Base in the Argentine sector of Antarctica is on 6030kHz from midnight until 0200. Programming is in Spanish and the address for reports is: LRA36, Base Ejercito Esperanza, Apartado Postal 9411, Antartida Argentina.

Radio Andorra is mentioned by **Roy Patrick** (Derby) who reports that it is on 6215kHz from 1930 to 2100 daily in English. **Brian O'Flynn** (Cork) used a Pye domestic receiver and a 90ft long wire to pull in Radio Bangladesh on 21 670kHz at 1259 and Radio Zambia on 9580kHz at 1515. Reader **G. W. Barber** would like to contact any DXer living in his part of the country. Replies to: No 1 Alcaig, Conon Bridge, Ross-shire IV7 8HS. **Graeme Stevenson** (Dunblane) heard FEBA Seychelles on 11 860 at 1640, details of receiver not given. Sorry Graeme but I do not have the information you ask about amateur band receivers, I suggest you write to Eric Dowdeswell.

A concluding note about Radio Australia comes from **G. E. W. Hewlett** who is a monitor to Radio Australia. He says this station has now disbanded its Listeners' Club and the policy of sending out QSL cards will also go except possibly for one designated month a year.

VHF Bands

by Ron Ham BRS15744

The popular saying: "As one door closes, another opens," certainly applies to the world of v.h.f. because, at present, the 6m band is closed, the sun is active again after a two month lull, and many readers are watching out for some early sporadic-E disturbances.

Aurora

About half-way through the auroral event on January 27, **Alan Baker** G4GNX, Newhaven, heard London stations working GM, LA and SM, and **John Branegan** GM4IHJ, Saline, Fife, who monitored between 1511 and 2110, heard stations in EI, G, GM, PE1, LA and SM on 2m, along with signals from the v.h.f. beacons in Germany DL0PR, Northern Ireland GB3GI and television pictures on Channels E2 and E4. Between 1725 and 2000 on the 28th, John received auroral signals from a Polish broadcast station around 69MHz, 2m signals from EI, G, GM and ON and very good signals from DL0PR and the beacons in Cornwall GB3CTC and Wrotham GB3VHF. For about two minutes at 2029 on the 29th, he received an exceptionally strong auroral picture on E2 from Norway, Steigen, and later, around 0230 on the 30th, Alan Baker heard tone-A c.w. signals on 20m, none of which is surprising in view of the solar activity which began on January 27.

Solar

At 1025 on September 15, **Cmdr Henry Hatfield,** Sevenoaks, recorded the radio noise at 136MHz from a solar event (VHF Bands, *PW* December 1979), which he also photographed through his spectrohelioscope (Fig. 3). At 1151 on January 27 Henry recorded what he thought was just another burst of radio noise at 136MHz. Unfortunately, the overcast sky prevented him from using the spectrohelioscope, but it is now known that on both these occasions, large X-ray bursts occurred on the sun and were recorded by the two satellites used by the Space Environment Service Centre, Boulder, Colorado, USA. Neither Henry nor I recorded any significant radio noise from the sun, at our observational frequencies, from 18 November 1979 until January 27 when a lengthy period of solar activity began. Although we both recorded slight noise and a few bursts between the 27th and 31st, the main event commenced on February 1, with a mild noise storm which lasted until the 5th. On the 8th, a few tiny bursts heralded an intense noise storm which ended on the 14th. **John Smith,** Rudgwick, Sussex, said that it was the strongest noise storm he had recorded for some years. The solar noise was very intense on the 11th, 12th and 13th (Fig. 4), during which time Henry recorded some activity at 1296MHz, and I heard solar noise at 50MHz on the 10th, 12th and 13th and at 28MHz, on the 12th. Henry observed seven sunspot groups on the 10th,

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The new digital flight scan receiver from Regency of America is a stunning improvement on any other air band monitor receiver. Utilising its own micro computer system to control an advanced synthesiser, the flight scan allows you to monitor any air band frequency in the range 108-136 MHz and to store up to 16 channels which can then be scanned continuously. Other features include fast keyboard entry of frequency, full band search facilities, channel lockout and much more. For the last word in air band monitors contact us today. Also available – M100 digital FM scanner covering 30-50 MHz, 144-174 MHz and 430-512 MHz.

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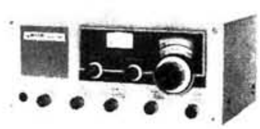
SRX30



The SRX·30 represents a new step forward for the keen short wave listener or the radio amateur who needs to tune frequencies outside the amateur bands.
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The SRX-30 is housed in a rugged metal case and operates from 240V ac mains or 12V dc supply. Reception modes are USB/LSB/AM/CW to cater for all HF operation and the receiver is equally at home on VHF using an external convertor.
This receiver combines small size, accurate readout, ease of use, all mode operation, mains/battery power supply and excellent performance at a remarkably low price.
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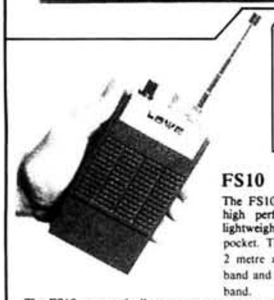
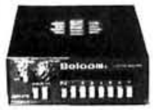


FS10

The FS10 VHF FM monitor receiver is a high performance unit in such a small lightweight package that it will fit into a pocket. The receiver can be aligned for the 2 metre amateur band or the VHF marine band and provides top performance on either band.
The FS10 automatically scans up to ten crystal controlled channels, stopping on any channel where a signal is present. Manual selection of any channel is also provided. Complete with rechargeable battery pack, charger and personal earphone with provision for external antenna.
Price **£82·00,** including V.A.T., crystals extra. (Fitted ten channels **£109·25,** including V.A.T.) Carriage £1·50.



AMR217B

The AMR217B VHF FM monitor is an outstanding receiver suitable for either the 2 metre amateur band or the VHF marine FM band and can be supplied for either band on request. The AMR217B has an eight channel scanning facility and can also accommodate up to ten additional switched channels to extend its versatility even further. The receiver is extremely sensitive and is one of the best monitor receivers available to either the amateur or professional user. It is completely self-contained with a built-in speaker and operates from 240V AC mains or 12V DC supplies. A matching mobile moant is supplied to allow easy installation in boat or car.
price £120·75, including V.A.T. (fitted 8 crystals). Carriage £1·50.

SR9

The SR9 represents the finest value for money ever offered in the FM monitor receiver market. Available in two versions to suit the 2 metre amateur band or the VHF marine FM band the SR9 gives fully tunable coverage of either band and also incorporates the facility for installing optional crystals which will provide up to eleven fixed channels for the most popular frequencies.
The SR9 is completely self-contained with built-in speaker and requires only 12V DC at around 200 mA to operate. **Mounting hardware is provided for easy installation anywhere.**
Price **£46·00,** including V.A.T. Carriage £1·50.

AP12

The AP12 is a 12 channel crystal controlled airband monitor receiver covering a frequency range from 108 to 136 MHz which utilises a micro-computer which automatically peaks the R.F. oscillator and mixer stages in accordance with the crystal frequency in use. This means that you can install crystals for any frequency in the entire band without any drop in performance. Supplied complete with rechargeable battery pack, charger and personal earphone.
Price £89·70, including V.A.T. Fitted 12 channels: £118·45, including V.A.T. Carriage £1·50.

R512

The R512 airband receiver is a high performance unit which automatically scans up to eight crystal controlled channels. The receiver will stop on any channel on which there is a transmission, stepping on again at the end of transmission. You may lock the receiver onto any channel of your choice for continuous monitoring and if any channel should be more or less permanently occupied you may also lock out the channel to permit scanning of other channels. These facilities are available on any or all channels.
Covering the full band from 108-136 MHz, the R512 is completely self-contained including built-in speaker and is supplied with mains and 12V DC power leads, whip antenna, mobile mounting bracket and personal earphone.
Price including five fitted channels is **£138·00,** including V.A.T. Carriage £1·50.

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Fig. 3: The solar event photographed by Cmdr Henry Hatfield on 15 September 1979

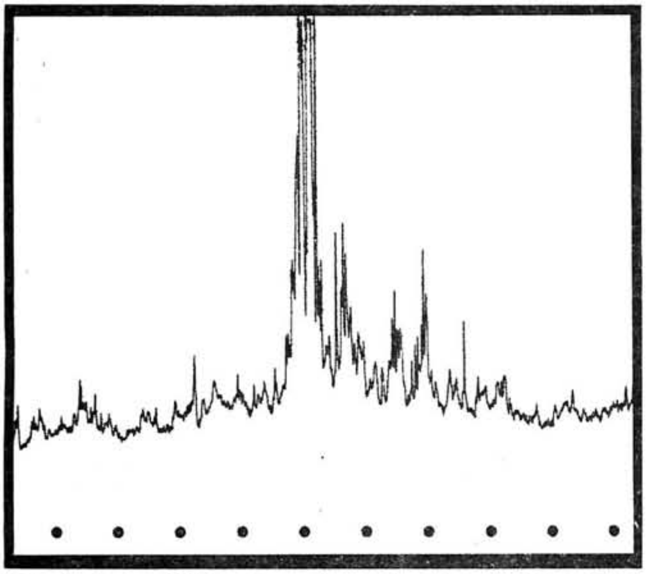


Fig. 4: One of the many large bursts of radio noise recorded by the author at 143MHz during the solar storm of 13 February 1980

one of which, around CMP, had a very large spot in the group. **Ted Waring,** Bristol, counted 29 sunspots on January 22, 25 on the 24th, 19 on the 28th, 16 on the 30th, 45 on February 1 and 4, and 37 on the 11th.

The 10m Band

After that special solar burst on January 27, it was not surprising that the BBC World Service announced, during the early hours of the 30th, that ionospheric disturbances had interfered with their signal paths for the previous few days. "Recently, whilst in QSO with John W2BLQ, on 10m s.s.b.," writes **Colin Phillips** G3RLA, Wirral, on January 21, "He invited me to try out my FT-901DM on the Metroplex f.m. repeater. The unit is carrier-accessible on both 2m and 10m, the 10m input being on 29·540MHz and the output 100kHz higher on 29·640MHz. We were immediately successful and had an interesting QSO." Colin also heard signals from 2m mobiles in the immediate access area of New Jersey, working across to Europe and South Africa via the repeater. Later, Colin had a QSO with WA2USS who confirmed the contact with a Metroplex QSL card (Fig. 5) which shows the address of the ACA if any readers require more gen.

On most days between January 21 and February 17, the band was open with the familiar pattern of strong signals from Russia in the early mornings. By midday, signals from the north-American continent were equally strong. I heard several JAs around 0930 on January 24, 30 and February 4, 6, 8, 14, 15 and 17. 7X2LS was predominant among the strong signals around this time on the 30th, and Russian and Japanese stations were at equal strength, 55, when they were in QSO on February 1. On the 4th, the band was like a madhouse, with many stations active and a very strong JA working a very strong GW. At 1008 on January 25, there was a hefty signal from VK4NLL calling SV and TA stations for a QSO.

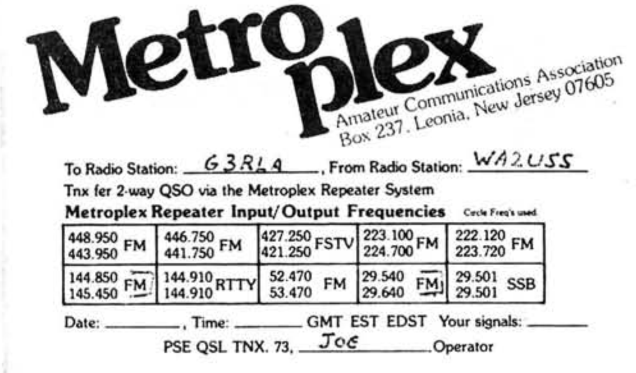
Although Ted Waring is still hearing Canadian DX on 10m he has not heard any signals from the Ottawa beacon, VE3TEN, since a regular daily spell between January 20 and 25. I heard signals from the beacons in Bahrain A9XC, Cyprus 5B4CY and Germany DK0TE and DL0IGI, on each of the 28 days between January 21 and February 17, while the beacon signals in Bermuda VP9BA and Florida N4RD were heard on only five and eight days respectively. **Harold Brodribb,** St. Leonards-on-Sea, noted strong harmonics from lower frequency broadcast stations between 28 and 31MHz on January 17, 18, 30 and February 3, 4, 6, 8 and 9. Among them were signals from Alma Ata (identified by Harold, VHF Bands, *PW* February 1980) and several stations using the Russian language.

Slow Scan TV

"Many SSTV stations continue to take advantage of the good conditions on the 10m band," writes **Sam Faulkner,** Burton-on-Trent, "and although my monitoring periods have only been between 1700 and 1800 and part of the weekends, prefixes from W1 to W0 are in the log". On January 19, Sam received pictures from VE3JW, WB0RL2 and W4DWB; 20th K5KQG, WD0ADZ and WB0QCD; 23rd WD9HWG and WB0KFB; 25th WD0ADZ. Between 1430 and 1600 on the 27th, Sam had a good haul; K3EGK, N3TV, WD0ADZ, WA4UUV, WB2SBN, WA1YNR and W5ZR. On February 2 he saw KA4H, K4FJK, N3TV and WD0ADZ, 3rd I7PQD, K8CHW, WA2YJD, WB4GHA and W8KZM, and on the 4th, Mel Shavelson W6VLH (Mel was the executive producer of the "Best Sellers" series *Ike* shown on ITV recently) and W1SE, the advertising manager for the American magazine QST.

DXTV

It will be a long time before that big tropospheric opening of late November, 1979, is forgotten. It was so extensive that many more v.h.f. enthusiasts realised that simply anything can happen when such a disturbance is in progress. During the event, **Richard Lambley** G8LAM, London, was called by his neighbour, Hugh Williams, who uses a Sony TV



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PSE QSL TNX. 73, Joe Operator

Fig. 5: The QSL card received by Colin Phillips for a QSO through the 10m repeater in New Jersey

receiver and a large, rotatable Fuba aerial, to see a strong picture from Kiel on channel 35, and during a programme junction the station put up a caption (Fig. 6), apologising for the prevailing interference and asking for the viewers' understanding. Richard's quick action in photographing this caption has enabled me to place on record that interference of this nature cuts both ways. This caption may well have been used again during the period of January 28 and 29, because another tropospheric disturbance was affecting the v.h.f. and u.h.f. bands.

At 1934 on the 28th, **Ken Smith** BRS20001, Horsham, watched a news programme from the French u.h.f. television service and noted the moderate to severe patterning on our own signals. For most of the 28th and 29th, I received pictures from the IBA transmitter at Lichfield on channel 8 with a dipole aerial, always a good v.h.f. path indicator toward the north for me. At 0016 on the 29th, I watched a picture caption *News of Wales* from Wenvoe, again with a dipole, on channel 44, followed by a clock with BBC Wales CYMRU and close down. At 0919, there were strong u.h.f. TV signals from many parts of the UK and at 0930, Ken Smith saw another French TV caption, *TDF ANTENNE 2* from one of their stations using channel 21. **Martin Liezers** GW8RKB, University College of Swansea, using a JVC 3040 receiver and a dipole cut to 55MHz, has, since early January, sometimes seen pictures from Russia and Scandinavia in Band I and is no doubt looking forward to the 1980 sporadic-E season.

At 2030 on January 26, **Andrew Rogers,** Bristol, watched a car review programme on channel E2, immediately after installing a new 3-element wideband aerial for Band I. "The signal was present for about half-an-hour," writes Andrew, "and became super strong for the caption about the Peugeot 505SR". During the early evening of January 17, Sam Faulkner received pictures from Sweden on E2 accompanied by a weaker news programme on R1, and at 1245 on the 23rd, he logged the RS-KH test card from Czechoslovakia.

While watching some pictures on R1 and reading my morning mail, around 0930 on February 4, I thought it worth pointing out to new TV DXers the closeness in frequency of the E2 and R1 vision channels, 48·25 and 49·75MHz respectively. JA2TTO has sent John Branegan photographs of Chinese television with captions, and John has reciprocated with photographs of European test cards, so let us hope that this typical amateur co-operation will help us identify the signals from China if they appear to us on R1. John is keeping a watch on Band I for television pictures from both Australia: channel 0, 46·25MHz; channel 1, 57·25MHz and channel 2, 64·25MHz; and China: channel R1 and channel "X" 57·75MHz.

Sporadic-E Television

John received pictures from Hungary, R1, between 1845 and 2200 on January 17, France F2 and F4, negative pictures, and Norway from 1450 to 1842 on the 21st, and West Germany, E2, periodically between 1820 and 2050 on the 26th, 30th and 31st.

Tropospheric

The atmospheric pressure, measured on my barograph, rose sharply from a low of 29·6in at midday on January 24 to 30·0in at noon on the 25th, 30·2in at noon on the 26th, and reached its peak of 30·4in at midday on the 27th. By 1800 on the 27th it began to fall just as sharply, and by midday on the 31st there was a big storm and a low of 29·0in. It's very rarely that a high fails to produce some v.h.f. DX and, true to form, at 0953 on the 27th, signals from the Bristol Channel repeater GB3BC, R6, were opening the squelch on my TM56-B receiver and were consistently strong until the opening ended late on the 29th. From early morning on the 28th to mid-evening on the 29th, I received signals from the 2m repeaters in Birmingham GB3BM and Kent GB3KR. Most stations working through the repeaters were talking about the DX and the good conditions. One amateur, working through the Hampshire repeater GB3SN, R5, referred to it as pandemonium as one repeater interfered with another on the same channel.

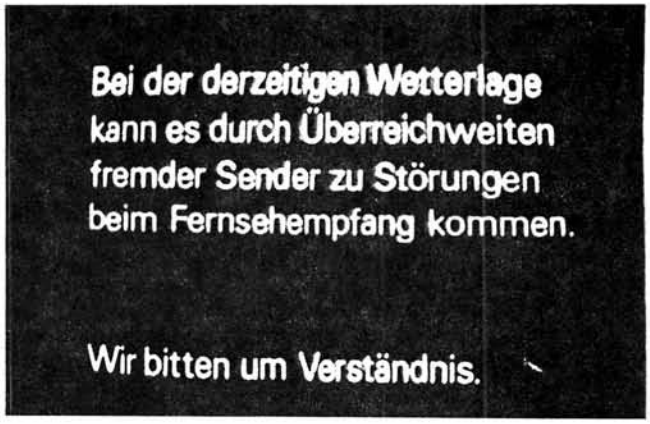

Fig. 6: Interference apology caption received from Kiel on Channel 35 by Hugh Williams

Alan Baker reported signals on all channels, R0 to R6, and while mobile on the 28th he worked two GWs and stations in Cornwall and Devonshire via the Brighton repeater GB3SR, R3. He also heard the Paris beacon FX0THF, at 569.

The Cornish 2m beacon GB3CTC was heard at 599 in Brighton during the event, and between 1755 and 1817 on the 29th, **Brian Houghton** G4BCO, Hastings, worked DC5KV, ON1AGO and PA0CML on 70cm. At 1935, Alan worked F1FBE near the Spanish border via the Brighton repeater, which is possibly the repeater's best DX so far. Later he heard ON0UR on R3, worked DK2GS/M via DB0UT on R7, and was called by LX1XJ via the Geneva repeater and a QSO was established. Around 0150 on the 29th a 5-way QSO took place between GW3EHN, G8JIM (Stratford), G3OEM (Brighton) with no aerial, G8SHM (Saffron Walden) and G4GNX (Newhaven) through the Brighton repeater. G4GNX also worked ON5BG and ON1EG via the Belgian repeater ON0WV, R2, and G8TXG through the Malvern Hills repeater GB3MH, R3.

Both Ken Smith and I heard French broadcast stations, frequently as strong as the BBC signals, in Band II, on the 28th and 29th. Although conditions were not so good for the RSGB's 432MHz fixed station contest on February 3, **George Grzebieniak** RS41733, London, heard GJ4ICD, G4BEL (Cambridge) and a few stations in Suffolk, all at good strength. George is now concentrating his efforts on 70cm because he only requires three more counties for his RSGB 70cm award. Around 2200 on February 8 and 1000 on the 9th, Harold Brodribb, using a Bush VHF80, heard several French f.m. stations in Band II, a brief lift which coincided, as usual, with a slight drop in atmospheric pressure.

News Items

Congratulations to **Laurence Hatfield,** aged 14, Sevenoaks, who, along with three other lads at Worth School, Sussex, passed the RAE and will soon be sporting their G8 callsigns.

Congratulations also to **Griffith Rockwood** G3JGR, on his election as chairman of the Mid-Sussex Amateur Radio Society. The retiring chairman, **Eric Letts** G3RXJ, served in this capacity for many years and is now concentrating his efforts on the Society's u.h.f. gear for their field day station.

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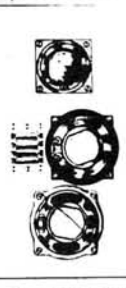

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7413	30p	74122	48p
7414	60p	74123	48p
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7417	27p	74126	60p
7420	17p	74128	75p
7421	40p	74132	75p
7422	22p	74136	60p
7423	34p	74141	70p
7425	30p	74142	200p
7426	40p	74145	90p
7427	34p	74147	190p
7428	36p	74148	150p
7430	17p	74150	100p
7432	30p	74151A	70p
7433	40p	74153	70p
7437	35p	74154	100p
7438	35p	74155	90p
7440	17p	74156	90p
7441	70p	74157	70p
7442A	60p	74159	190p
7443	112p	74160	100p
7444	112p	74161	100p
7445	100p	74162	100p
7446A	93p	74163	100p
7447A	70p	74164	100p
7448	80p	74165	130p
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74LS138	60p
74LS139	60p
74LS151	100p
74LS153	60p
74LS157	60p
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74LS161	100p
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74LS164	120p
74LS165	80p
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74LS174	110p
74LS175	110p
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74LS192	140p
74LS193	140p
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74LS241	175p
74LS242	175p
74LS243	175p
74LS244	195p
74LS245	260p
74LS251	200p
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4022	100p
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4024	50p
4025	20p
4026	130p
4027	50p
4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
4034	200p
4035	110p
4040	100p
4041	80p
4042	80p
4043	90p
4044	90p
4046	110p
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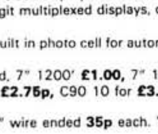

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500V: 10 **40p;** 47 **68p; 250V:** 100 **65p; 63V:** 0·47, 1·0, 1·5, 2·2, 3·3, 4·7, 6·8, **8p;** 10, 15, 22 **10p;** 32, 47, 50 **12p;** 63, 100, **27p; 50V:** 1·0 **7p;** 50, 100, 220 **25p;** 470 **32p;** 1000 **60p; 40V:** 22, 33μF **8p;** 100 **12p;** 2200, 3300 **85p;** 4700 **98p; 35V:** 10, 33 **7p;** 330, 470 **32p; 25V:** 10, 22, 47, 80, 100 **8p;** 160, 220, 250 **15p;** 470 **25p;** 640 **25p;** 1000 **27p;** 1500 **40p;** 2200 **52p;** 3300 **77p;** 4700 **85p; 16V:** 10, 40, 47 **7p;** 100, 125 **8p;** 220, 330 **14p;** 470 **20p;** 1000, 1500 **30p;** 2200 **36p; 10V:** 100 **6p.**
TAG-END TYPE 450V: 100μF **180p; 70V:** 4700 **165p; 64V:** 3300 **150p;** 2500 **110p; 50V:** 3300 **136p;** 2200 **99p; 40V:** 15,000 **399p;** 4700 **130p;** 4000 **92p;** 3300 **98p;** 2500 **85p;** 2200 **85p;** 2000+2000 **120p; 30V:** 4700 **90p; 25V:** 6400 **120p;** 4700 **100p;** 3300 **85p;** 2200 **60p.**

TANTALUM BEAD CAPACITORS
35V: 0·1μF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2μF, 3·3, 4·7, 6·8. **25V:** 1·5, 10. **20V:** 1·5μ. **16V:** 10μF **13p** each.
16V: 15μ, 22 **25p;** 47, 100 **50p;** 220 **70p; 10V:** 15μ, 22, 33 **20p;** 100 **35p; 6V:** 47μ, 68, 100 **30p; 3V:** 100 **20p.**

POLYESTER (MYLAR) CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01μF **6p**
0·015, 0·02, 0·03, 0·04, 0·05, 0·056μF **7p**
0·1μF **8p,** 0·2 **10p.** **50V:** 0·47μF **12p**

CERAMIC CAPACITORS 50V
Range: 0·5pF to 10nF **4p**
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POLYSTYRENE CAPACITORS:
10pF to 1nF, **6p.** 1·5nF to 47nF **10p.**

RESISTORS–5% carbon, High Stab. Miniature, Low Noise

	Range	Val.	1-99	100+
¼	2Ω2-4M7	E24	2p	1p
0.5W	2Ω2-4M7	E12	2p	1p
1W	2Ω2-10M	E12	5p	3p
2% Metal Film	10Ω-1M		6p	4p
1% 0·5W	51Ω-1M	E24	10p	8p

N.B. 100+ price applies to Resistors of each type not mixed values.

VEROBOARD

Pitch	0·1 (copper clad)	0·15 (copper clad)	0·1 (plain)	0·15 (plain)
2½ × 3¾	46p	39p	31p	24p
2½ × 5	55p	50p	—	31p
3¾" × 3¾"	55p	50p	—	—
3¾ × 5	62p	67p	50p	43p
3¾ × 17	218p	180p	141p	120
4¾ × 17	280p	—	—	183p

Pkt of 36 pins	40p	VQ Board	129p
Spot face cutter	105p	DIP Board	290p
Pin insertion tool	140p	Veroblock	324p

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP 9·5" × 8·5"
6 × 6	75p	90p	80p
6 × 12	130p	175p	

FERRIC CHLORIDE
1lb **95p** - 35p p&p

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100 pins **50p;** 500 pins **£2.00**

EURO BREAD-BOARD 530p

DALO ETCH RESIST PEN 75p

VERO WIRING PEN + spool **325p**

DIL SOCKETS

	Low profile	Wire wrap
8 pin	10p	25p
14 pin	12p	35p
16 pin	13p	46p
18 pin	16p	52p
20 pin	22p	65p
22 pin	25p	70p
24 pin	36p	78p
28 pin	39p	85p
36 pin	—	105p
40 pin	50p	109p

EDGE CONNECTORS

		1	·156
2	10 way	—	85p
2	15 way	—	99p
2	18 way	115p	120p
2	22 way	130p	135p
2	25 way	149p	160p
2	30 way	170p	—
2	36 way	194p	—
2	40 way	210p	—
2	43 way	232p	—

DENCO COILS
Dual Purpose 'DP' VALVE TYPE
Ranges: 1-5 Bl. Yl. Rd. Wht. **92p**
6-7 B, Y, R **82p**
1-5 Green **100p**
'T'-type* (Transistor Tuning).
Ranges: 1-5 Bl. Yl. Rd. Wht. **105p**

B9A Valve Base	29p
RDT2	98p
RFC 5 chokes	104p
RFC 7(19mH)	120p
1FT 13/14/15/16 17	110p
1FT 18/1·6	104p
1FT 18/465	114p
TOC1	110p
MW 5FR	112p
MW/LW 5FR	120p

JACKSONS VARIABLE CAPS.

Dielectric 100/300pF	175p
500pF	225p
6:1 Ball Drive 4511/DAF	125p
Dial Drive 4103 6:1/36:1	650p
Drum 54mm	30p
0·1-365pF	275p
00 2 365pF	325p
00-2-500pF	525p
0 2 365pF with slow motion Drive	395p
00 208/176	325p
" " with slow motion drive	395p
C804: 5pF; 10 25pF	195p
50pF	195p
100; 150pF	275p
'L' 3 - 310pF	595p
00-3 - 25pF	490p

POTENTIOMETERS (AB or EGEN)
Carbon Track, 0·25W Log & 0·5W Linear Values. Rotary Type.

470Ω, 680Ω 1K, 2K (Lin only) Single	27p
5KΩ to 2MΩ Single gang	29p
5KΩ to 2MΩ Single with D/P switch	69p
5KΩ to 2MΩ Dual gang	88p

SLIDER POTENTIOMETERS
0·25W log and linear values 60mm track

5KΩ 500KΩ Single gang	60p
10KΩ 500KΩ Dual gang	80p
Self-Stick graduated Alum. Bezels	30p

PRESET POTENTIOMETERS

0·1W 50Ω-2·2M Mini. Vert. & Horiz.	7p
0·25W 100Ω-3·3MΩ Horiz. larger	10p
0·25W 250Ω-4·7MΩ Vert.	10p

OPTO ELECTRONICS

LEDs plus clip	
TIL209 Red	13
TIL211 Grn	18
TIL212 Yel	18
.2" Red	15
.2" Grn, Yel	18
Square LED, Red Grn, Yel	36
7 Seg. Displays Red	
.3" C Cath	99
.3" C Anod	99
.5" C Cath	115
.5" C Anod	115
.6" C Cath	180
.8" Green 275	
Burgraph 10 seg.	225p
3½ LCD	875
4 LCD	975
OCP71	120
ORP12	63
2N5777	45
Infra Red Emit. LD271	40
TIL32 Detector	58
SFH205	98
TIL78	70

CRYSTALS

100KHz	385
455KHz	385
1MHz	323
1.008M	323
1.6MHz	395

TRANSISTORS

	p
AC125	35
AC126	25
AC127	20
AC128	22
AC141	24
AC142	24
AC176	25
ACY17	60
ACY18	60
ACY19	60
ACY20	53
ACY21	50
ACY22	60
ACY28	60
ACY39	80
AD149	70
AD161	42
AD162	42
AF114	60
AF115	60
AF116	70
AF117	75
AF118	40
AF139	75
AF178	70
BC107	12
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	35
BC142	30
BC143	30
BC147	9
BC147B	10
BC148	8
BC148B	10
BC148C	10
BC149	9
BC149C	10
BC153	27
BC154	27
BC157	10
BC158	11
BC159	11
BC160	42
BC167A	11
BC168C	12
BC169C	10
BC170	18
BC172	11
BC173	12
BC177	18
BC178	16
BC179	18
BC181	20
BC182	10
BC183	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	28
BC212	9
BC212L	11
BC213	10
BC213L	12
BC214	10
BC214L	13
BC236	10
BC237	10
BC307B	20
BC308B	20
BC327	15
BC328	15

	p
BC338	12
BC441	27
BC461	27
BC477	35
BC516	48
BC517	48
BC547	10
BC548	10
BC549C	10
BC557	15
BC558	10
BC559	10
BCY70	18
BCY71	20
BCY72	20
BD131	42
BD132	42
BD133	50
BD135	30
BD136	30
BD137	30
BD138	35
BD139	40
BD140	30
BD144	198
BD145	198
BD205	110
BD214	115
BD245	50
BD378	70
BD434	32
BD517	70
BD695A	85
BD696A	85
BDY56	170
BF115	34
BF167	30
BF180	38
BF194	12
BF195	12
BF196	12
BF197	14
BF198	18
BF199	18
BF200	32
BF224	24
BF244	29
BF245	24
BF244B	30
BF256	45
BF257	30
BF258	30
BF259	30
BF274	18
BF336	35
BF594	35
BF595	35
BFR39	25
BFR40	25
BFR41	24
BFR79	24
BFR80	24
BFR81	21
BFR98	105
BFX29	28
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY50	21
BFY51	21
BFY52	21
BFY56	32
BFY64	40
BFY81	99
BRY39	39

	p
BSX20	20
BSY95A	18
BU105	105
BU205	125
BU208	225
E421	158
MD8001	179
MJ491	175
MJ2955	105
MJE340	54
MJE370	58
MJE371	60
MJE2955	105
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	15
MPSA06	25
MPSA12	22
MPSA55	22
MPSA56	22
MPSU06	50
MPSU56	60
OC26	170
OC28	120
OC35	125
OC36	130
OC41	125
OC42	48
OC43	55
OC44	55
OC45	30
OC70	35
OC71	28
OC72	35
OC74	50
OC76	45
OC81	35
OC82	50
OC83	48
OC84	45
OC140	110
OC170	85
OC171	45
OC200	48
TIP29	31
TIP29C	60
TIP30	32
TIP30C	43
TIP31A	38
TIP31C	50
TIP32A	40
TIP32C	55
TIP33A	54
TIP33C	70
TIP34A	63
TIP34C	75
TIP35A	135
TIP35C	165
TIP36A	145
TIP36C	185
TIP41A	50
TIP41B	55
TIP42A	64
TIP42B	
TIP120	70
TIP121	90
TIP142	190
TIP147	195
TIP2955	60
TIP3055	48
TIS43	30
TIS44	45
TIS45	45

	p
TIS88A	35
TIS90	20
TIS91	24
ZTX107	11
ZTX108	11
ZTX109	11
ZTX300	13
ZTX301	15
ZTX302	20
ZTX303	25
ZTX304	17
ZTX314	24
ZTX326	45
ZTX341	20
ZTX500	15
ZTX501	15
ZTX502	17
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
40311	60
40313	125
40315	55
40316	85
40361	42
40362	48
40408	70
40411	280
40467	95
40468	60
40594	90
40595	98
40603	90
40673	68
2N697	25
2N698	40
2N699	30
2N706A	19
2N708	19
2N918	33
2N1131	22
2N1132	22
2N1303	50
2N1304	50
2N1305	35
2N1671B	215
2N2219A	22
2N2220A	26
2N2221A	23
2N2222A	20
2N2369A	15
2N2646	48
2N2904	24
2N2905A	22
2N2906	22
2N2907A	22
2N2926G	10
2N3053	19
2N3054	55
2N3055	48
2N3442	140
2N3663	14
2N3702	10
2N3703	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	11
2N3709	[illegible]
2N3710	10
2N3711	10
2N3822	130
2N3771	233
2N3772	195
2N3773	288

	p
2N3819	22
2N3820	45
2N3823	70
2N3866	90
2N3903	20
2N3904	18
2N3905	18
2N3906	17
2N4037	52
2N4058	17
2N4061	17
2N4062	17
2N4427	75
2N4859	65
2N4871	50
2N5172	25
2N5179	60
2N5191	70
2N5305	40
2N5457	32
2N5458	32
2N5485	35
2N5642	750
2N5777	45
2N6027	40
3N128	112
3N140	112

74LS

LS00, LS01, LS02, LS03, LS04, LS05, LS08, LS09, LS10, LS11, LS12, LS13, LS14, LS15, LS20, LS21, LS22, LS26, LS27, LS28, LS30, LS32, LS33, LS37, LS38, LS40, LS42, LS47, LS51, LS54, LS55, LS73, LS74, LS75, LS76, LS78, LS83, LS85, LS86, LS90, LS91, LS92, LS93, LS95, LS96, LS107, LS109

LS112, LS113, LS114, LS122, LS123, LS124, LS125, LS126, LS132, LS136, LS138, LS139, LS151, LS153, LS155, LS157, LS158, LS160, LS161, LS162, LS163, LS164, LS165, LS166, LS168, LS169, LS170, LS173, LS174, LS175, LS181, LS183, LS191, LS192, LS193, LS194, LS195, LS196, LS197, LS200, LS221, LS240, LS243, LS244, LS245, LS251, LS253, LS257, LS258, LS259, LS261, LS266, LS273, LS279, LS280, LS283, LS290, LS293, LS295, LS298, LS299, LS323, LS365, LS366, LS367, LS368, LS373, LS375, LS374, LS377, LS378, LS379, LS384, LS390, LS393, LS395

74LS398, 74LS399, 74LS447, 74LS490, 74LS668, 74LS670, 74LS673, 74LS674

VOLTAGE REGULATORS

1A -ve 5V, 12V, 15, 18, 24V	65p
1A ve	85p
100mA -ve 5V, 6, 8, 12, 15V	30p
100mA -ve	65p
LM309K	135p
LM317K	350p
LM323K	635p
LM723	38p
78H05	595
TBA625B	80

BRIDGE RECTIFIERS

1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	48
2A/400V	53
2A/600V	65
4A/100V	72
4A/800V	120
6A/100V	73
6A/400V	90
BY164	58
VM18 DIL	48

SCRs THYRISTORS

0.8/200V	35
5A/100V	32
5A/400V	39
5A/600V	43
8A/300V	48
8A/600V	85
12A/300V	59
12A/800V	150
15/700V	195
BT106	150
C106D	38
TIC44	22
2N4444	140

TRIACS

3A/100V	48
3A/400V	50
8A/100V	54
8A/400V	64
8A/800V	108
12A/100V	60
12A/400V	70
12A/800V	130
16A/100V	95
16A/400V	105
25A/400V	160
25A/800V	250
T2800D	120

DIAC
ST2 **25p**

LINEAR IC's

702	75
709C 8 pin	35
710•	67
723 14 pin	39
741 8 pin	17
747C 14 pin	78
748C 8 pin	36
753 8 pin	150
810	159
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	315
AY-1-5050	190
AY-1-5051	145
AY-1-6721/6	195
AY-3-1270	840
AY-3-8500	390
AY-3-8910	875
AY-5-1224A	260
AY-5-1230	450
AY-5-1315	560
AY-5-1317A	630
AY-5-3500	510
AY-5-3507A	450
AY-5-4007D	638
AY-5-8100	735
CA3011	110
CA3014	157
CA3018	68
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	71
CA3048	214
CA3059	170
CA3075	213
CA3080E	65
CA3081	190
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	85
CA3140	48
ICL7106	795
ICL7107	975
ICL8038CC	340
ICM7205	1150
ICM7215	1025
ICM7216A	1950
ICM7216B	1950
ICM7216C	1950
ICM7217A	790
ICM7555	89
LD130	452
LF365	98

LM10	350
LM301A	23
LM308T	70
LM311H	80
LM318H	205
LM324A	45
LM339	70
LM348	90
LM349	125
LM379	375
LM380	80
LM381N	145
LM381AN	248
LM382	125
LM386	99
LM387	150
LM389	93
LM733	125
LM1458	40
LM3900	60
LM3909N	70
LM3911	125
LM3914	240
LM13600	135
M252AA	625
M253AA	795
MC1303	88
MC1304P	260
MC1310P	150
MC1312PQ	195
MC1495	350
MC1496L	92
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MC1710	79
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MC3360P	120
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MC3405	150
MFC6040	97
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MM57160	620
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NE566	160
NE567V	170
NE570	395
NE571	420
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SN76033N	195
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SN76227N	95
SN76477	200
SN76660	120
SP8629	299
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TAA661A	155
TAA960	320
TAD100	159
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TBA540	220
TBA550Q	330
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COMPUTER IC'S

2102-2	115
2111	195
2112	110
2112-2N	250

2114	435
2708	675
4116 16K	1025
4047	750
6502	995
74S00	60
74S04	73
74S132	00
74S138	250
74S158	00
74S188	185
74S189	158
74S194	00
74S195	00
74S241	195
74S262	895
74S287	325
74S288	210
74S470	325
74S472	1150
74S475	825
81LS95	125
81LS96	125
81LS97	137
AY-5-2376	980
CP1610	920
MC1488	85
TMS2716	1650
TMS4035	250
TMS4039	250
MC1489	90
MK4027 4K	325
MK4118	2099
Z80 CPU2 5	990
Z80 4M	1099
Z80 P10	660
Z80 CTC	595

VDU IC'S

AY-3-1015	550
AY-5-1013	450
RO-3-2513	650
SFF96364E	1050
SFC71301	820
SFS80102	205
SN74265	63
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SN74S262	895
SN75450	120
SN75451	70
SN75452	70
SN75454	225
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TTL 74 (TEXAS)

7400, 7401, 7402

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BY127	12
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0A70	12
0A79	12
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0A85	14
0A90	7
0A91	7
0A95	8
0A200	9
0A202	8
1N914	4
1N916	5
1N4001/2	5
1N4003/4	5
1N4005/6	6
1N4007	7
1N4148	4
3A/100V	18
3A/400V	20
3A/600V	27
3A/1000V	30

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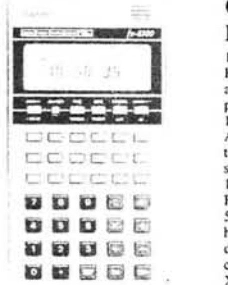

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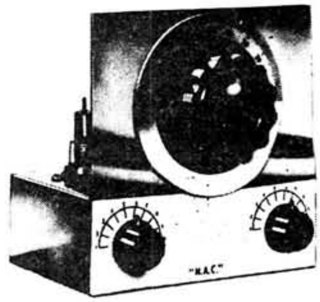

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Very slim, only 6mm thick.

M1

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M2

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ALARM CHRONO with 9 world time zones

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- 6 basic functions.
- 8 further time zones.
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- Stop-watch to 12 hours 59·9 secs. in 1/10 sec. steps.
- Split and timing modes.
- Alarm.
- 9 mm thick.
- Back-light.
- Fully adjustable bracelet.

£19.95 **M8**

SOLAR QUARTZ LCD Chronograph

Powered from solar panel with battery back-up. 6 digit, 11 functions. Hours, mins., secs., day, date, day of week. 1/100th, 1/10th, secs., 10X secs., mins. Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet. Metac Price

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METAC PRICE

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Calendar watch M354 Hours, mins., secs. Month, day, date in 12 or 24 hour format all indicated continuously. Monthly calendar display month, year and all dates for any selected month over 80 year period. Memory bank function. Any desired dates up to 11 can be stored in advanced. 2 year battery life. Water resistant.

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Metac Price **£69.95** **M11**

SEIKO CHRONOGRAPH

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M13

CASIO F-200 Sports Chrono

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M24 SAME DAY DESPATCH.

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M15

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COMPONENT CALCULATOR

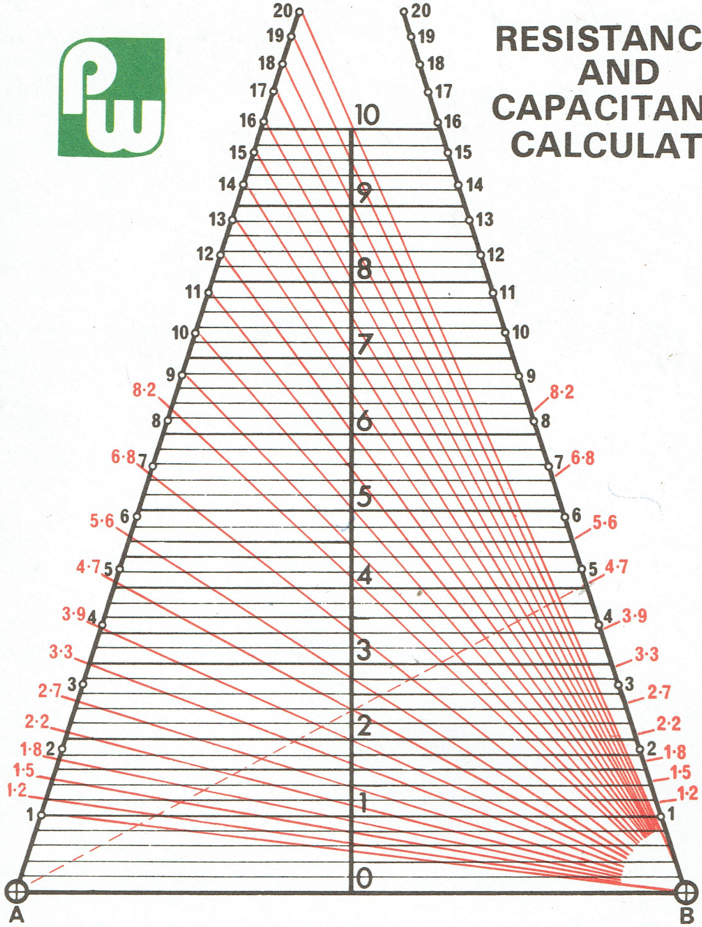
DATACARD

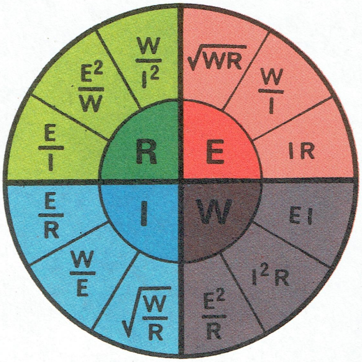
This nomograph simplifies the calculation of parallel resistors or series capacitors. Place a straight edge between point A and the point on the right-hand scale corresponding to the value of one of the resistors or capacitors. Note where this line crosses the red line corresponding to the value of the second component. Transfer this point across to the centre scale and read off the resulting value of the combination. Note must be made of the value of the multipliers of each component to ensure that the correct multiplier is used for the answer.

The example on the Calculator shows the resultant value of two resistors of 6·8kΩ and 4·7kΩ in parallel. The line from datum point A to 4·7 on the right hand scale crosses the red line from 6·8 on the left hand scale at a point corresponding to 2·8 on the centre scale. Combined value of resistors is 2·8kΩ.

With higher values of resistor it may be necessary to divide both values by a factor in order to bring them on to the scales. For example, 180000Ω (180kΩ) and 68000Ω (68kΩ) may be divided by 10000 to give 18 and 6·8 on the scales. The answer from the centre scales is then multiplied by 10000.

RESISTANCE AND CAPACITANCE CALCULATOR

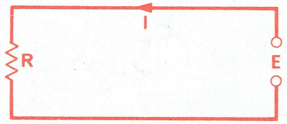




FORMULA WHEEL

DC CIRCUITS

In an electrical circuit carrying direct current (DC) the current I will be directly proportional to the applied voltage E, provided that the resistance R of the circuit remains constant.



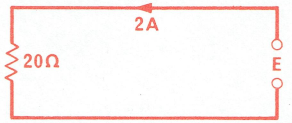
This may be expressed as:—

$$I = \frac{E}{R} \text{ thus } E = IR \text{ and } R = \frac{E}{I}$$

the current being expressed in AMPERES, the applied voltage in VOLTS and the circuit resistance in OHMS.
In such a circuit the power being dissipated W is proportional to the square of the current flowing since if the applied voltage is doubled then the current in the circuit will also be doubled (from the formula above). Thus:—

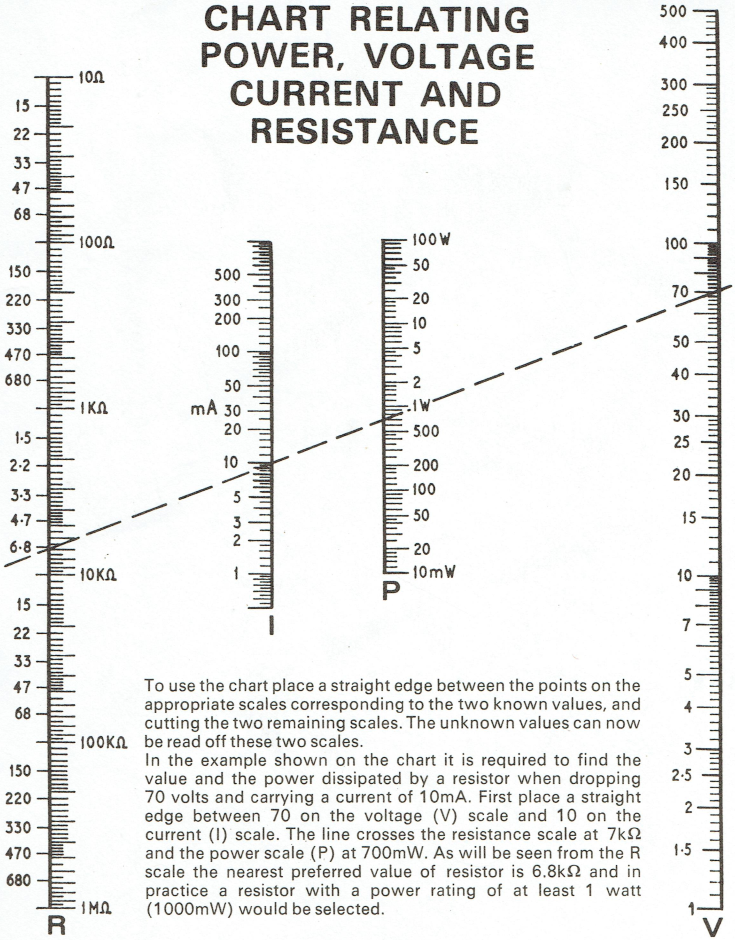
$$W = EI \text{ or } \frac{E^2}{R} \text{ or } I^2R$$

the unit of power being expressed in WATTS.



For example, if a resistor of 20 ohms (R) is carrying a current of 2 amperes (I) the formula to find the wattage being dissipated by the resistor (W) can be seen to be I^2R (from the W quadrant of the Wheel) = 4 x 20 = 80 watts.
Any one of the four values can be determined by using the Formula Wheel to find the appropriate formula, given two of the remaining three values.

CHART RELATING POWER, VOLTAGE CURRENT AND RESISTANCE



To use the chart place a straight edge between the points on the appropriate scales corresponding to the two known values, and cutting the two remaining scales. The unknown values can now be read off these two scales.

In the example shown on the chart it is required to find the value and the power dissipated by a resistor when dropping 70 volts and carrying a current of 10mA. First place a straight edge between 70 on the voltage (V) scale and 10 on the current (I) scale. The line crosses the resistance scale at 7kΩ and the power scale (P) at 700mW. As will be seen from the R scale the nearest preferred value of resistor is 6.8kΩ and in practice a resistor with a power rating of at least 1 watt (1000mW) would be selected.

MULTIPLIERS

Frequently the values of current, resistance etc. are found to be either much smaller or much larger than the basic units used in the above formulae, namely volts, amperes, ohms and watts, and due allowance must be made to ensure that the correct value, in basic units, is entered in the formulae.

Some common values that may be encountered in electronics and their conversion to basic units:—

Current:

1 milliampere (mA) $= \frac{1}{1000}$ A or 10^{-3}A

1 microampere (μA) $= \frac{1}{1000000}$ A or 10^{-6}A

Resistance:

1 kilohm (kΩ) $=$ 1000Ω or 10^3Ω

1 megohm (MΩ) $=$ 1000000Ω or 10^6Ω

Voltage:

1 kilovolt (kV) $=$ 1000V or 10^3V

1 millivolt (mV) $= \frac{1}{1000}$ V or 10^{-3}V

1 microvolt (μV) $= \frac{1}{1000000}$ V or 10^{-6}V

Power:

1 megawatt (MW) $=$ 1000000W or 10^6W

1 kilowatt (kW) $=$ 1000W or 10^3W

1 milliwatt (mW) $= \frac{1}{1000}$ W or 10^{-3}W

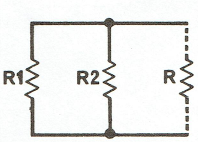
Example:— Suppose that it is required to find the voltage drop across a resistor of 10kΩ which is carrying a current of 250μA. Converting to basic units 10kΩ becomes 10000Ω and 250μA becomes $\frac{250}{1000000}$A.

From the Formula Wheel E = IR so:—

$$E = IR = \frac{250}{1000000} \times 10000 = 2{\cdot}5 \text{ (V)}$$

RESISTOR AND CAPACITOR CALCULATOR

Not infrequently a resistor is needed having a value that does not correspond to any value in the preferred range of resistors. While the required value may fall within, say, the 10% tolerance range of a preferred value resistor it is not generally feasible to run through a batch of such resistors in order to find one of the precise value required. Such odd value resistors may be used in attenuators, meter multipliers or special bias circuits. The value can often be arrived at by using one of two methods, resistors in series or resistors in parallel. Since the series method merely entails adding the individual values, R1 + R2. . . etc. no further explanation is necessary. When the resistors are connected in parallel the formula $\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$ etc. is used. The Calculator on this Datacard gives the resultant value of two resistors in parallel without recourse to a formula.



$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$$

or

$$R = \frac{R1 \times R2}{R1 + R2}$$

It is advisable to have a rough idea of the value to be expected from two resistors connected in parallel, if only to check that the Calculator is being used correctly. If the resistors are roughly similar in value their paralleled resistance will be around half the value of one of them. At the other extreme, if one resistor is relatively low in value then a high value resistor in parallel with it will have very little effect. By this means a resistor slightly higher than the required value can be brought down by paralleling it with a resistor several times its own value.

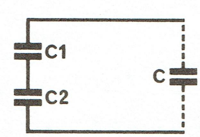
If resistors having, say, 5% tolerance limits are used in parallel then the resulting value will also be subject to a 5% tolerance.

Where a close tolerance is specified for a resistor it is important to use a type of resistor that is capable of maintaining its value inside the tolerance limits. Composition resistors are poor from the stability aspect and should not be used in critical circuits.

Metal oxide and carbon film resistors are preferable to composition ones, having good long term stability as well as a low temperature coefficient over a wide range of temperatures. They should also be used where a low noise level is important such as in audio circuits.

The usual tolerance limits commonly available for these high stability resistors are 1% and 2%.

With capacitors in series the same type of formula holds as was used for resistors in parallel, namely $\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2}$ etc. so the Calculator can also be used to find the equivalent value of two capacitors in series. This value will always be less than the value of either capacitor.



$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2}$$

or

$$C = \frac{C1 \times C2}{C1 + C2}$$

If three resistors are connected in parallel, or three capacitors in series, the Calculator can be used to find their equivalent value. First find the resultant value of any two as previously described and then use this with the value of the third resistor or capacitor in a similar calculation again. This method may be used for any number of resistors in parallel or capacitors in series.

In the case of two capacitors in series the lower working voltage of the two should be taken as the maximum working voltage across the pair.