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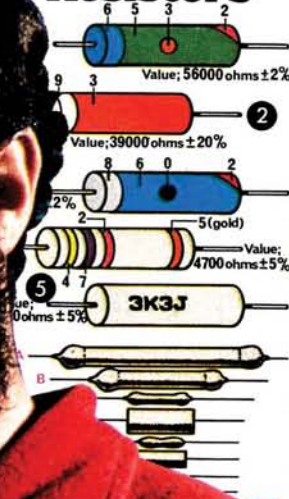
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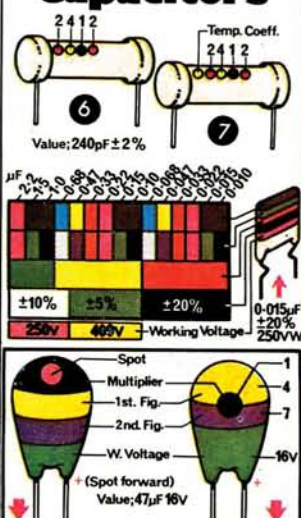
RESISTORS & CAPACITORS

0 DATACARD

Resistors



Capacitors



Multiplier	Voltage	Multiplier	Voltage
10	Blue	20	
1	Violet	3	$\times 0.01 \mu\text{F}$
6.3	Grey	3	
16	White	35	$\times 0.1 \mu\text{F}$
	Pink		

More than 10pF: $\pm 20\%$, $\pm 15\%$, $\pm 10\%$
Less than 10pF: $-0.1 \mu\text{F}$, $-0.25 \mu\text{F}$, $1 \mu\text{F}$



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System**

Pw NIMBUS

& **YAESU FT-7B REVIEW (Part 1)**
The VINTAGE YEARS OF RADIO

QUARTZ LCD 5 Function

Hours, mins, secs., month, date, auto calendar, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.
Very slim, only 6mm thick.



M1

SOLAR QUARTZ LCD 5 Function

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£8.65

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M2

QUARTZ LCD 11 Function SLIM CHRONO

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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M3

QUARTZ LCD ALARM 7 Function

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M4

MULTI ALARM 6 Digits 10 Functions

- Hours, mins., secs.
- Months, date, day.
- Basic alarm.
- Memory date alarm.
- Timer alarm with dual.
- Time and 10 country zone.
- Back-light.
- 8mm thick.

£18.65



M5

FRONT-BUTTON Alarm Chrono Dual Time

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M6

SOLAR QUARTZ LCD Chronograph with Alarm Dual Time Zone Facility

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£27.95

M7

ALARM CHRONO with 9 world time zones

- 6 digits, 5 flags.
- 6 basic functions.
- 8 further time zones.
- Count-down alarm.
- 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.

£29.65

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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M9

SEIKO Alarm Chrono

LCD, hours, mins., secs., day of week, month, day and date, 24 hour Alarm, 12 hour chronograph, 1/10th secs., and lap time. Back light, stainless steel, HARDLEX glass. List Price £130.00 METAC PRICE

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M10

SEIKO MEMORY BANK

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Metac Price **£79.50**



M11

SEIKO-STYLE Dual time-alarm Chronograph

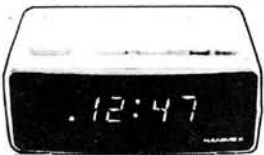
Mineral glass face. Battery hatch for DIY battery replacement. Top quality finish with fully adjustable bracelet.

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M12

HANIMEX Electronic LED Alarm Clock



Features and Specification:
Hour/minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size: 5.15" x 3.93" x 2.36" (131mm x 111mm x 60mm). Weight: 1.43 lbs (0.65 kg). AC power 220V.

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M13

HANIMEX portable LCD clock radio



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Trade enquiries: Send for a complete list of trade prices - minimum order value £100.
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M15

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Guaranteed same day despatch. **M16**

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BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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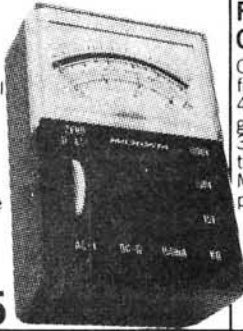
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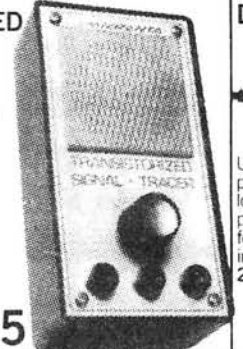
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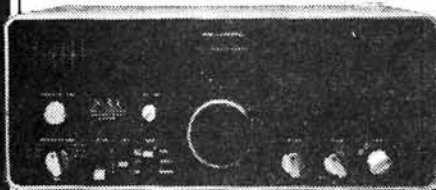
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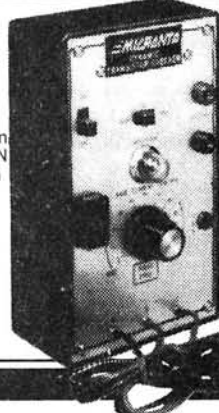
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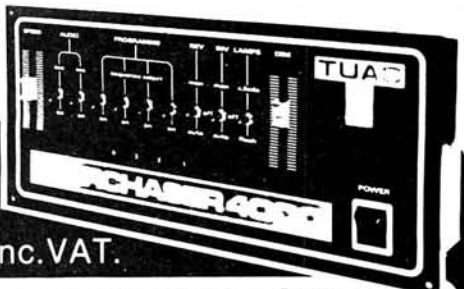


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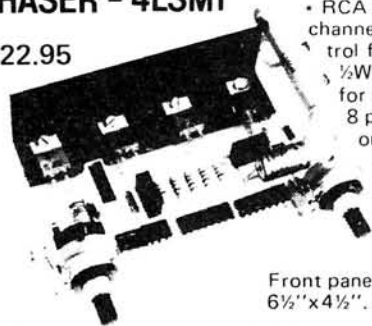
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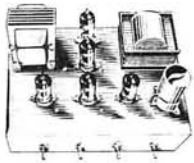
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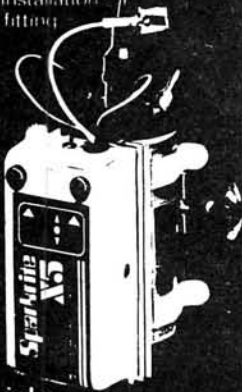
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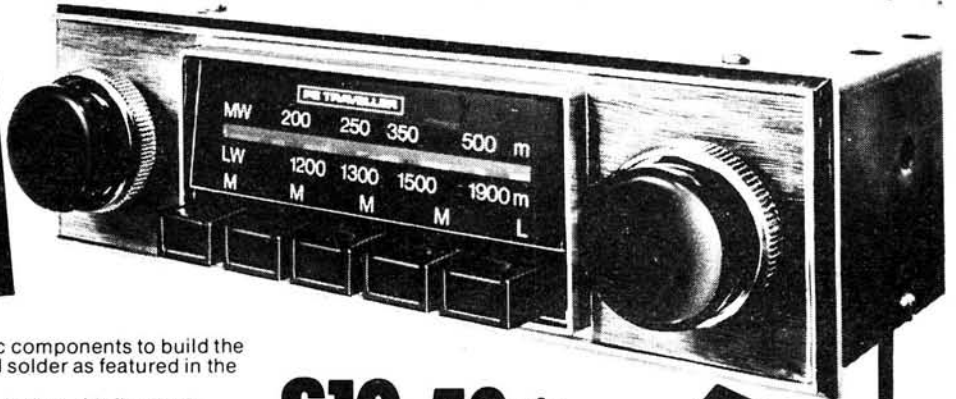
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WAVEMETER Adm pattern LF wavemeter covers 10 to 30Kc in two ranges uses two plug in coils with direct calibration, absorption type with lamp ind. Also contains Tx 1100pf tuning cond this can be rebuilt for other capacities and spacings, the two coils contain large amount of silk covered copper wire all contained in polished wood case size $12 \times 7 \times 9\frac{1}{2}$ " £10.50.

AMPLIFIER MODULE self contained plug in unit provides var gain up to 500 DC coupled, contains mains trans providing stab +20 & -20v supplies, good selection of 1% res, trim pots, transistors etc standard 230v/I/P £5.50.

U.H.F. RX ASS single chan crystal controlled with crystal for 243Mc/s dual conversion IFs 20.5 & 2Mc/s 11 min valves low imp O/P reqs 200v HT & 6.3 size $9 \times 4\frac{1}{2} \times 4"$ new cond £16.50.

POWER UNIT INVERTOR special purpose unit for 115v I/P contains 6 pot cores FX2240/42/43 types, 2x HV TO-3 power transis, 4x 400v 3 amp diodes, 8x BC107, 2x BFY52 (types may vary) 2x Thyristors inc 4 amp type, 3x 20mm panel fuse holders, elec conds, res, swt & zener diodes etc all in screened case size $9 \times 3\frac{1}{2} \times 4"$ with circ £4.50 or 2 for £8.

RECORDING TAPE $\frac{1}{4}$ " by Ampex 3600 ft on $10\frac{1}{2}$ " spools new £7.50.

RECEIVER UNIT small high performance Rx uses 7 min valves covers 2,5 to 20Mc/s in 3 bands as RF stage, BFO, Volt Stab. with O/P for HR or Crystal phones direct feq cal with geared drive size $5 \times 3\frac{3}{4} \times 3\frac{1}{2}"$ these req ext supplies of 180v DC HT 40Ma & 6.3v AC 1 amp supplied tested with circ & notes no ext case £25.

TRANSMITTER ASS 2/8Mc/s low power contains 500Ua meter, tuning cond, coils, swts, terminals etc complete in case with circ less valves £5.50.

MAINS TRANS 200/250v Pria Sec 340-250-0-250-340v at 210Ma LTs 6.3v at 5 amps twice & 5v Ct at 5 amps size inc term $5\frac{1}{4} \times 4\frac{3}{4} \times 6"$ these will do 700v DC at 250Ma with no LT load new boxed £9.50.

RECEIVER UNIT small battery operated covers 2 to 8Mc/s in two band 4 valve superhet plus BFO in case direct freq cal O/P for low or high res phones with circ reqs 135v HT & 1.5v DCLT £13.50.

AUDIO TEST SET CT373 bench test set comprises AF Osc 17C/S to 170Kc, AF VTVM & Distortion meter new cond further spec on request £65.

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STANDARD CELLS by Muirhead 1.01859 volts tested £5.75 H.F. RX R4187 & CONTROL BOX crystal controlled 24 chan Rx covers 2.8 to 18Mc/s intended for remote control dual conversion Rx with 2 RF stages, BFO, ML etc 15 miniature valves reqs ext supplies of 19 & 24v DC supplied with circs notes & suggested mods £25.

TAPE RECORDERS ex American services for 115v 50c/s supply 19" rack mounting uses $\frac{1}{4}"$ tape as 3 heads, 3 motors with servo controlled capstan drive speed $3\frac{3}{8}"$ takes $7\frac{1}{2}"$ spools, level meter, all controls on front panel weight about 30Kc valve amps 8 or 600 ohm O/P 600 ohm I/P £36.

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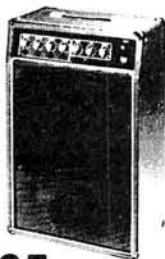
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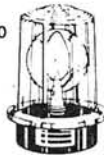
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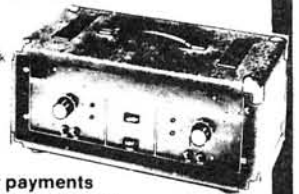


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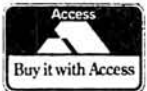
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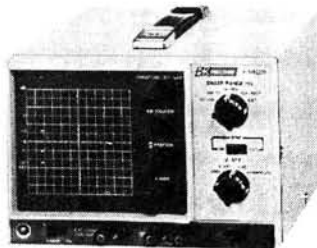
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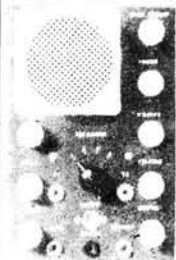
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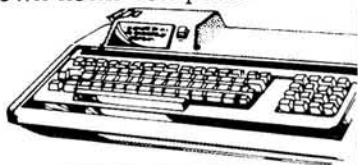
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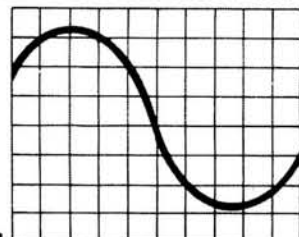
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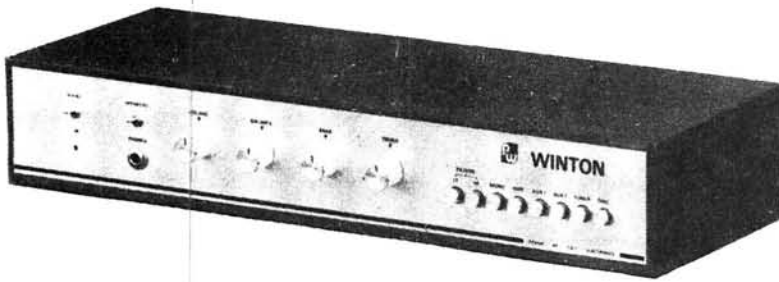
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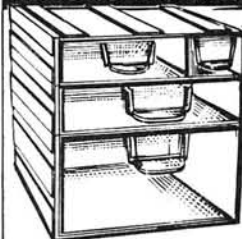
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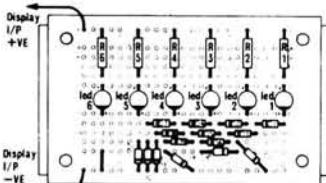
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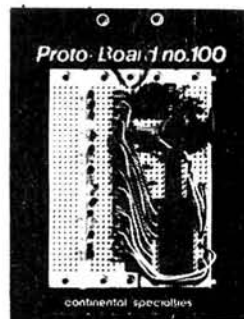
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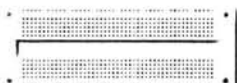
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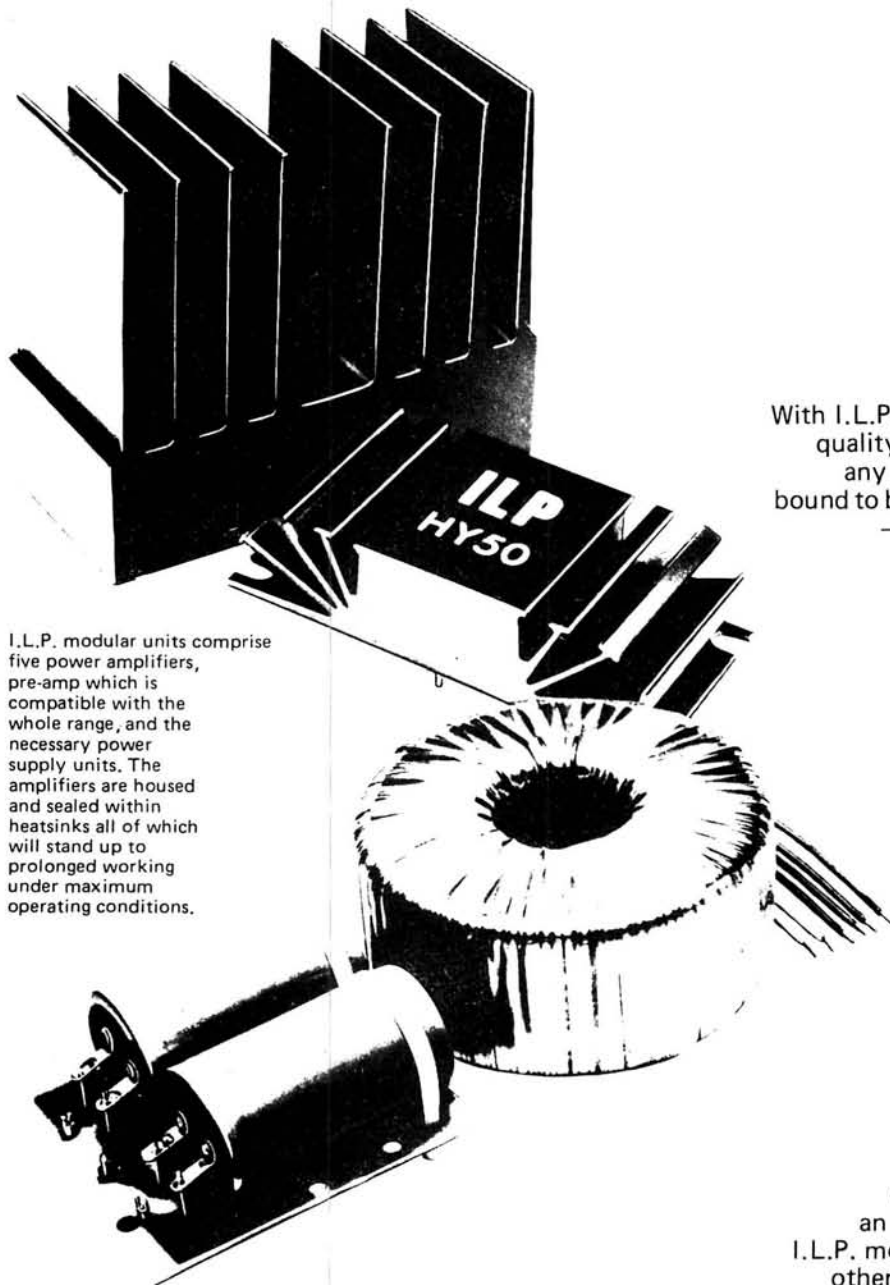
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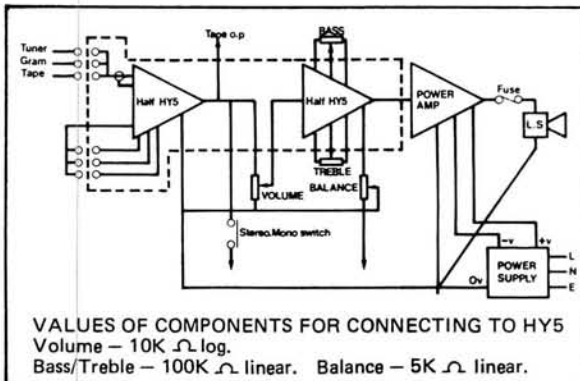
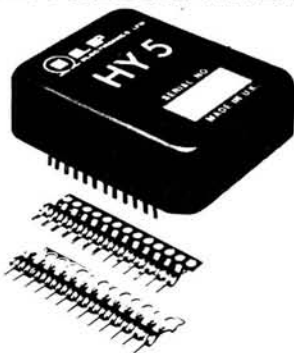
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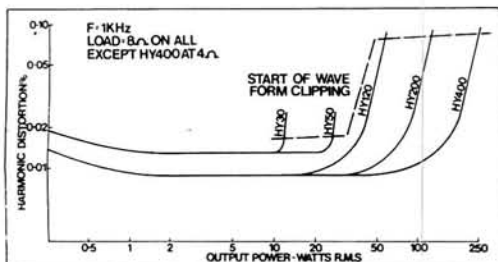
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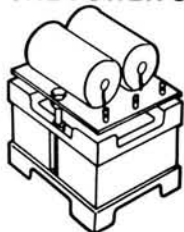
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HY120	60 W into 8 Ω	0.01%	100dB	-35 -0+ +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0+ +45	114x50x85	575	£18.44 + £2.77
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NEWS...

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The 1979 Girl Technician Engineer of the Year

The 1979 Girl Technician Engineer of the Year is Mrs Anne Cox-Horton, age 26, an Electrical Contracts Engineer from Chertsey, Surrey. At a recent ceremony in London she was presented with the prize of £250 and an inscribed rose bowl by Sir Montague Finniston, FRS, Chairman of the Committee of Inquiry into the Engineering Profession.

The Runner-up, Mrs Barbara Needham, 27, a Senior Research Engineer from Harlow, Essex, received a special award of £150.

Sponsored by The Caroline Haslett Memorial Trust and the IEETE, this Award aims to focus attention on electrical and electronic engineering as a worthwhile professional career for women.

Ann Cox-Horton is a Contracts Engineer with T. Clarke & Co. Limited, a London firm of electrical contractors. She is responsible for contracts valued at up to £1½ million, including the work of up to 50 people. Ann served her



apprenticeship on building sites, and was actually the first girl apprentice ever registered with the Joint Industry Board.

The Institution of Electrical and Electronics Technician Engineers, 2 Savoy Hill, London WC2R OBS. Tel: 01-836 3357.

Ron Ham in Video

During August 1979, BBC TV-South Today visited Chalk Pits Museum at Amberley, West Sussex.

The purpose of the visit was to record a programme commemorating the 40th anniversary of the outbreak of the second world war.

The programme centred around the Radio Workshop—a collection of antique and wartime radio equipment—run by none other than Ron Ham BRS15744, who writes the

"VHF Bands" column in *Practical Wireless*.

Our photograph shows the BBC camera crew filming at the Radio Workshop, and Ron Ham can be seen at the extreme right of the picture. The 7½ minute programme was shown on 3 September 1979.

The museum re-opens on 2 April 1980, for information on opening times contact: *Chalk Pits Museum, Houghton Bridge, Amberley, West Sussex. Tel: Bury (079 881) 370.*



Versatile Chips

Plessey Semiconductors has won an order for over half a million remote control chips from Joustra, a leading French toy manufacturer.

The i.c.s have been designed into Joustra's latest remote controlled model car which is being sold in French toy shops now.

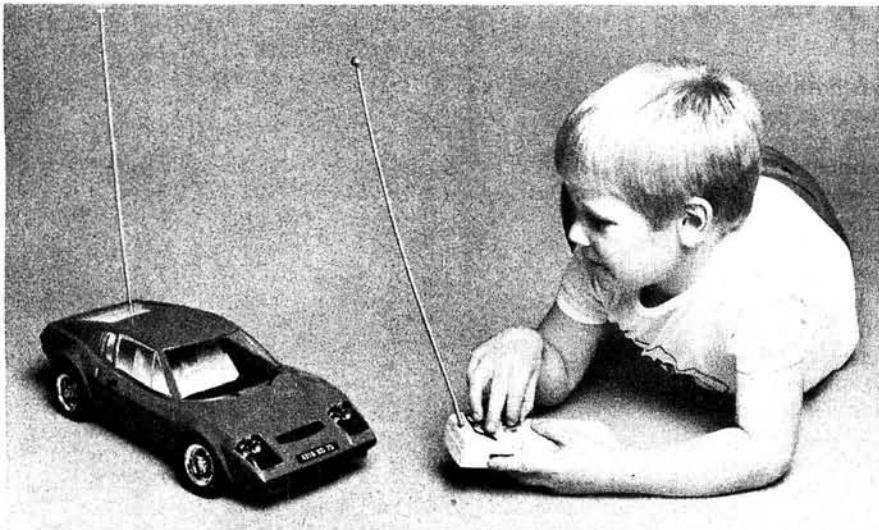
The remote control i.c.s are the SL490 transmitter and the ML928 receiver. Low current consumption on the transmitter chip ensures a long battery life. The car is controlled easily by

a miniature steering wheel on the hand-held transmitter.

Although the Joustra car is radio controlled, the same chips are versatile enough to be used for ultrasonic, infrared or cable transmission systems.

Originally developed for TV applications, Plessey Semiconductors is currently designing these remote control chips into other systems such as moving toys, TV games and domestic appliances.

Plessey Semiconductors Ltd., Cheney Manor, Swindon, Wiltshire. Tel: (0793) 36251.



Teletext/Viewdata in Japan

Mullard Ltd. was one of four companies who took part in a two-day series of presentations of the British Teletext/Viewdata systems in Tokyo during December.

The other participants were General Instruments, Texas Instruments and VG Electronics. The Department of Industry and the Electronic Component Industry Federation were also represented.

The presentations were organised by the British Overseas Trade Board and were held at the British Export Marketing Centre. Audiences consisted of leading Japanese setmakers and broadcasting authorities.

The objective of the presentation was to underline the advantages of the Mullard Teletext/Viewdata systems, components and sub-assemblies to those Japanese setmakers who

undertake—or plan to undertake—manufacture of suitably-adapted TV receivers in the UK or Europe.

Mullard Limited, Mullard House, Torrington Place, London WC1E 7HD. Tel: 01-580 6633.

SERT has moved

Since Monday, 12 November 1979, the Society of Electronic and Radio Technicians have been established in their new premises.

The new address is: 57-61 Newington Causeway, London SE1 6BL. Tel: 01-403 2351.

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Barrie Electronics Ltd. inform us that they now stock the complete range of Vero Products. The products are on display at: 3 The Minories, London EC3N 1BJ. Tel: 01-488 3316/7/8.

SWLs & DXers get-together

A "get-together", supported by the European DX Council and organised by Northern DXers and short-wave listeners, is to take place on Saturday, 8 March 1980, starting at 2.00pm.

The venue will be the Conference Centre at the heart of the city of Durham.

Attendance is expected to be quite large and various receiver manufacturers have been invited, along with guest speakers who will give talks. The EDXC and the Handicapped Aid Programme UK will also be represented, as will certain international broadcasting stations.

A number of receivers will be on show (including the Trio R-1000) and programme schedules for the new frequency period will be available.

For further details, a "get-together" agenda and a map, contact: *The Organiser, John Shaw, 10 Poplar Lea, Brandon, Durham, Co Durham. Tel: (0385) 780743.*

Catalogues

Ace Mailtronix Ltd., the Wakefield based component supplier have recently published their latest catalogue.

The catalogue costs 30p and is supplied with a 30p voucher which is redeemable with orders over £5.00.

Available from: *Ace Mailtronix Ltd., Tootal Street, Wakefield, West Yorkshire WF1 5JR. Tel: (0924) 250375.*

Sigma Technical Press publish their latest catalogue of books, which should be of particular interest to the personal and professional computer user.

Available from: *Sigma Technical Press, 23 Dippons Mill Close, Tottenhall, Wolverhampton WV6 8HH. Tel: (0902) 763152.*

Transam Components Ltd. have recently published a new computer products catalogue containing details of their products and specialist services offered to micro-computer users in the UK.

For further information contact: *Transam Components Ltd., 12 Chapel Street, London NW1 5DH. Tel: 01-402 8137.*



NIMBUS

Modular 2m Transceiver System

(Part 1)

Michael TOOLEY BA G8CKT

&

David WHITFIELD BA MSc G8FTB

The 2 metre amateur band is popular with both class A and B licence holders and covers the frequency range from 144MHz to 146MHz. While many operators make use of high power f.m. and s.s.b. fixed station equipment in pursuit of long distance contacts, excellent results can be achieved using a low-power portable transceiver. For the energetic, operation from a mountain peak or other local "high spot" will bring considerable rewards; even under normal conditions contacts can readily be made over paths of more than 200km. The advent of 2 metre repeaters, of which there are currently a large number in service, has greatly improved the working range of portable and mobile equipment from many otherwise less than favourable sites.

The PW "Nimbus" has been developed to meet the need for a compact and versatile portable 2 metre f.m. transceiver. The basic circuit module comprises a single printed circuit board measuring only 160mm x 90mm. The single-sided board incorporates a high performance dual-conversion superhet receiver and a matching low-power transmitter. In order to allow the constructor the choice of a wide range of possible equipment configurations, the controls, changeover switching, modulator and power supplies are all external to the basic circuit module. A range of add-on modules designed to extend the performance of the basic unit will be described in later articles. These will include an alternative speech processor/modulator, a 10W power amplifier, a mains power unit, battery charger, repeater tone-burst with time-out facility and an extended multi-channel facility. The "Nimbus" can thus form the basis of a comprehensive 2 metre station which can change and grow to adapt to the individual needs of the constructor.

The design underwent many changes in the course of its evolution from rather speculative beginnings (sketches on used envelopes, beer mats, etc.), to the first QSO on the air using the prototype. Between these two extremes are hidden long periods (often well into the small hours) of paper design and bench testing. The immense satisfaction to be derived from operating a piece of equipment which has been built entirely by one's own efforts is hard to describe.

Whilst it is realised that the diecast box into which the transceiver boards fit is rather larger, to say the least, than the normal hand-held size, the dimensions were thought appropriate for two reasons. Sufficient room has been left



in the box for later additions and modifications of the basic circuitry, also the box used in the prototype is a readily obtainable item.

The constructor may, of course, feel free to use any convenient metal box provided it is rigid in construction, (no tobacco tins please!) and has sufficient internal space for the mounting of the units.

Design Philosophy

The basic transceiver module represents a compromise between cost and circuit complexity, while providing a standard of performance which should satisfy the demands of all but the most discerning amateur. The design is straightforward and conventional, using well-proven devices and techniques. It should, however, be clearly stated at the outset that *this is not a project for the novice, nor is it suitable for the newcomer to r.f. constructional practice.*

A great deal of consideration was given to the ultimate flexibility of the overall design. Indeed, from the outset it was envisaged that the basic circuit module would form the heart of a number of possible transceiver configurations. The transmitter and receiver circuits have consequently been kept entirely independent (permitting "full duplex" operation if required), and all controls and changeover switching may then be arranged to suit the particular application. The main aim was to produce a portable transceiver which could be built for about half the cost of a comparable ready-made unit. Even so, constructors should be wary of too much economy; "junk box" components should be avoided, and only new full-specification devices should be used.

System Description

The basic system comprises a number of functional modules (transmitter, modulator, etc.) which may be connected in a variety of different configurations to suit particular applications. Figure 1 shows a simple arrangement of the three basic modules in the form of a portable transceiver. This particular arrangement produces a compact unit of good performance, yet which features a current consumption which is low enough to allow portable operation from a modest battery supply (e.g., 225mAh 12.5V NiCad pack measuring approximately 25mm diameter by 70mm long).

The three basic circuit modules are arranged physically as two single-sided p.c.b.s, the main board containing the

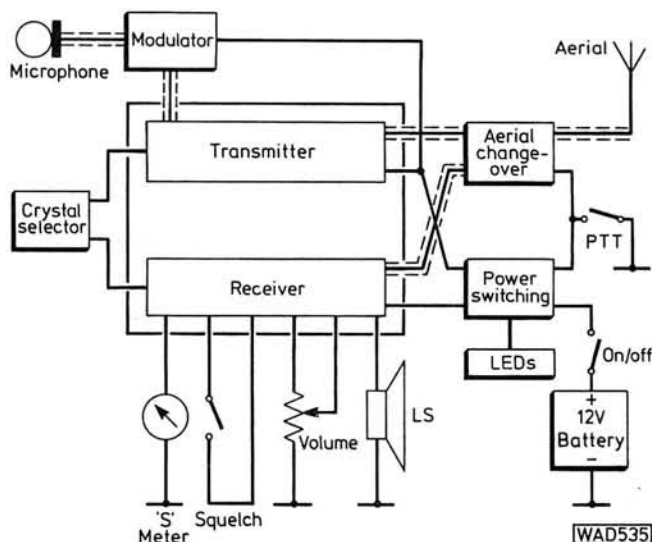


Fig. 1: System block diagram for a portable v.h.f. f.m. transceiver

transmitter and receiver modules. Although these are on the same board, they are totally isolated functionally, but for the use of a common earth plane. The second board contains the modulator and this arrangement will be seen in future articles as capable of providing the maximum flexibility without undue proliferation of boards.

A functional block diagram for the transmitter module is shown in Figure 2. A low frequency (18MHz) fundamental crystal oscillator is used to define the transmitter output frequency. The fundamental signal is then passed to the phase modulator circuit before being successively applied to three cascaded frequency doubler stages. The output from the final doubler is thus at eight times the fundamental frequency, and this is used to drive the output amplifier stage. The overall design features bandpass coupling throughout which achieves a low harmonic content in the output. The alignment procedure is simple with test points provided for each stage; the only test equipment necessary for alignment of the transmitter being a simple d.c. voltmeter.

The receiver module features a conventional high performance dual-conversion superhet arrangement as shown in Figure 3. The signal frequency is applied via the r.f. amplifier stage to the input of the first mixer. The local oscillator drive is derived, by way of a frequency tripler,

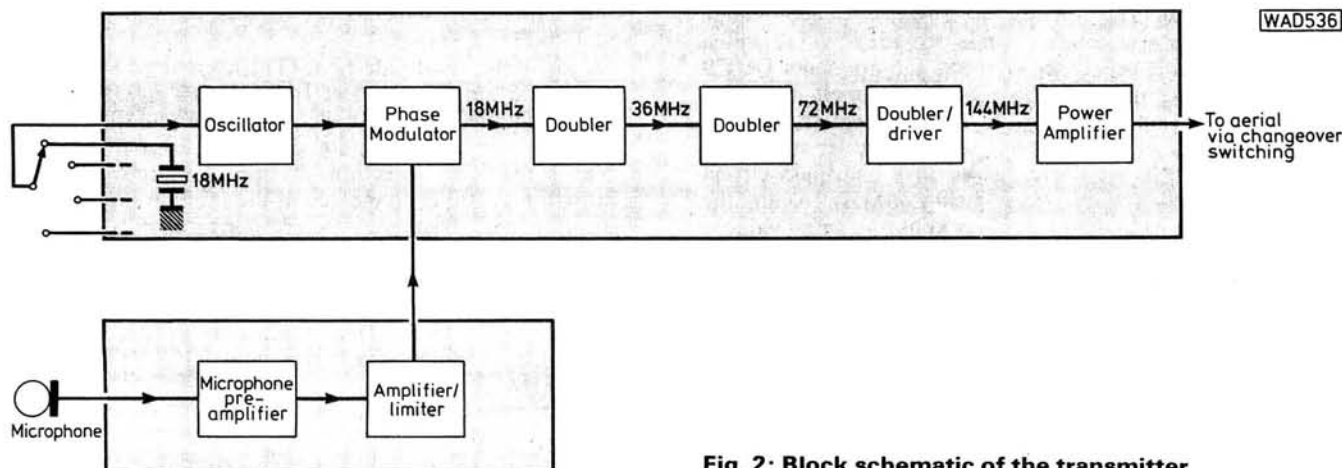


Fig. 2: Block schematic of the transmitter

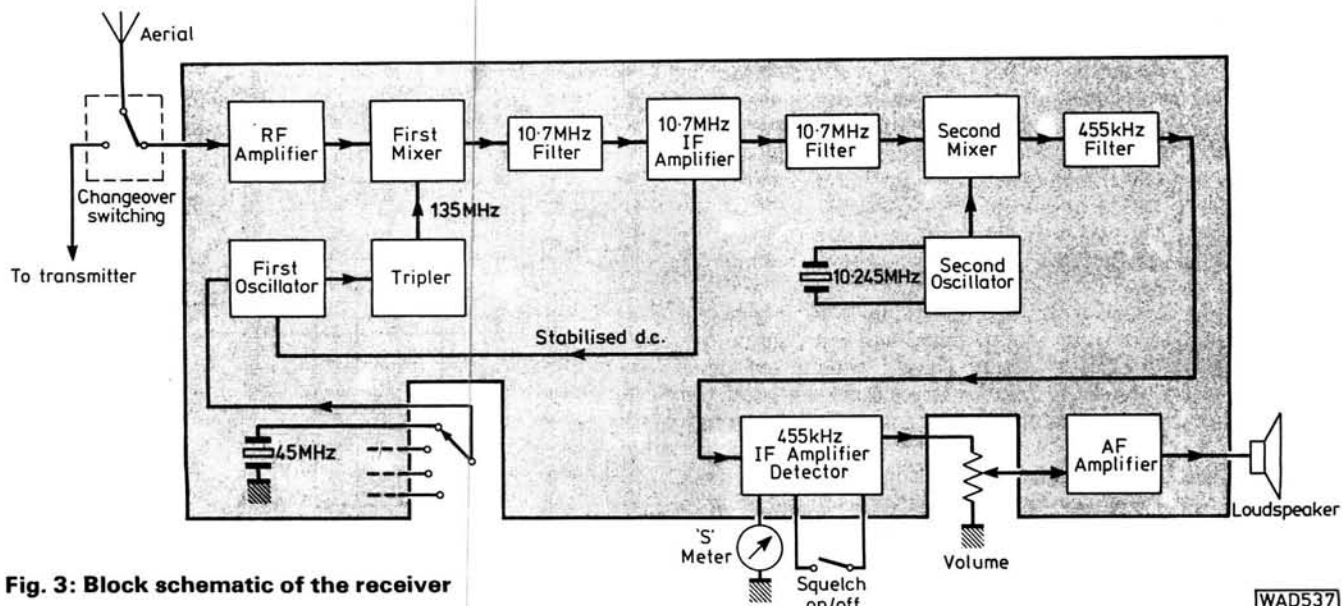


Fig. 3: Block schematic of the receiver

WAD537

from the first oscillator working at 45MHz. The 10.7MHz output from the first mixer is filtered to remove the unwanted mixer products, and then amplified before being applied to the second mixer. The output from the second mixer is at 455kHz and this signal is further amplified before being demodulated. The combined second i.f. amplifier and demodulator stage also provides the 'S' meter and audio squelch facilities. Final audio amplification is provided by an i.c. power amplifier. The use of high gain i.c. amplifiers, with their associated i.f. filters, ensures that the alignment of the receiver is a very straightforward task, with a minimum of preset adjustments.

The modulator is arranged as a separate unit to allow the user a choice of speech processing and other associated facilities (e.g., VOX, ALC, toneburst, etc.). The basic modulator features a variable gain microphone pre-amplifier to allow a variety of microphones to be used. After amplification, the signal is subject to peak limiting to prevent over-deviation on speech peaks, the output being adjusted in level to set the maximum transmitter deviation.

Transmitter

The transmitter is shown in Figure 4. Transistor Tr1 operates as a conventional Colpitts oscillator with frequency determining crystals and trimmers selected by S1b. The d.c. supply to the oscillator stage is stabilised against supply variations by means of a simple Zener diode regulator, D1. Phase modulation is provided by Tr2 which acts as a variable reactance element. Components L1/C9 and L2/C12 form a bandpass coupled tuned circuit at 18MHz. The coupling capacitor, C10, is kept small so as to ensure purity of the input to the first doubler stage, Tr3 output of which is similarly passed to a bandpass circuit with the selected frequency now being 36MHz. Again, the value of coupling capacitor, C17, is kept to a small value.

Transistor Tr4 is the second doubler with an output at 72MHz which is selected by L5/C21 and L6/C24, the final doubler, Tr5, providing an output on 144MHz. The collector of Tr5 is tapped into the tuned circuit, L7/C35, in order to ensure a good impedance match and also to maintain a relatively high 'Q' factor in the bandpass coupled circuit.

The final stage is a low-power amplifier operating with both input and output at 144MHz. The emitter of Tr6 is

returned directly to the earth rail rather than via the resistor and capacitor arrangement associated with the earlier doubler stages; this helps to reduce the impedance of the emitter connection and facilitates heat sinking. The combination of L10/TC6/TC7 tunes to 144MHz, TC6/TC7 being adjustable in order to provide correct matching of the antenna load impedance. The r.f. output level is detected by D2 and a d.c. output is available at TP6 for alignment purposes and for continuous r.f. output indication where desired.

Alignment of the multiplier stages is facilitated by means of test points TP1 to TP4 where the emitter current of successive stages may be monitored and TP5, which allows for measurement of the collector current (either directly or by calculation involving the voltage drop across R22), and hence d.c. input power to the final stage.

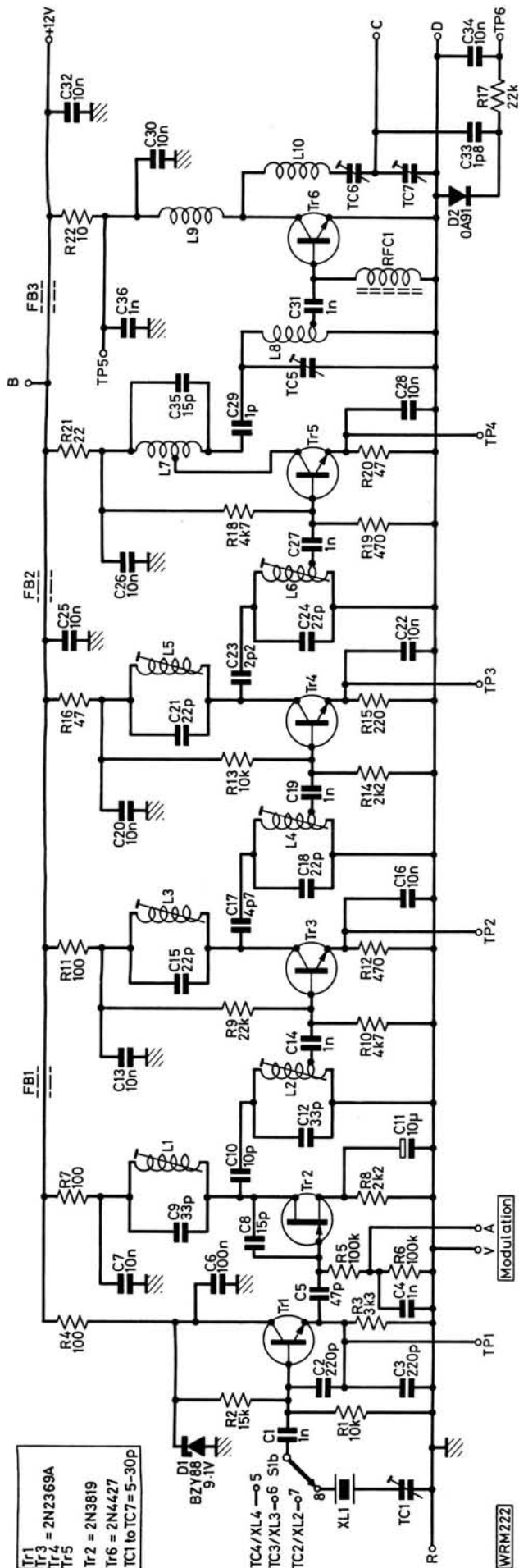
Receiver

The receiver circuit is shown in Figures 5(a) and 5(b). The double superhet receiver necessitates the use of two mixers and associated crystal-controlled first and second oscillators. The high first intermediate frequency (10.7MHz) ensures good image channel rejection whilst the low second intermediate frequency (455kHz) permits the use of low cost ceramic filters in order to achieve the desired selectivity (approximately 12kHz at the -6dB points). Integrated circuits are used in both the 10.7MHz and 455kHz i.f. stages.

A low noise dual-gate f.e.t. (Tr100) is used for the first stage of r.f. amplification at 144MHz, giving about 20dB of gain coupled with excellent cross-modulation performance. A second dual-gate device is used for the first mixer stage with injection at approximately 135MHz. Transistor Tr102 is connected in the familiar Colpitts configuration with frequency determining crystals and their associated trimmers selected by S1a (this is ganged with the transmitter crystal switch S1b). Tuned circuit L102, C108 and associated stray capacitance tune the collector circuit of Tr102 to 45MHz. Transistor Tr103 operates in common base mode as a tripler with L103/TC106 tuned to 135MHz.

To improve efficiency, a small amount of forward bias is applied to the stage by means of the potential divider formed by R112 and R113. The 7.8V regulated supply for

★ specifications



GENERAL

- Frequency range:** 144–146MHz
- Number of channels:** 4
- Modulation:** F3 (phase modulation)
- Supply:** 12V nominal (8 × U7 cells or equivalent)
- Supply current:** 75mA (receive)
150mA (transmit)
- Battery life:** approx. 10 hrs (intermittent usage, 2:1 receive/transmit ratio)
- Dimensions:** 220 × 145 × 55mm
- Weight:** 1kg with batteries

TRANSMITTER

- Input power:** 800mW (d.c. into final stage)
- Output power:** 500mW (r.f.)
- Output impedance:** 50Ω
- Deviation sensitivity:** 4.5kHz for 150mV 1kHz test-tone (measured at final output)
- Frequency stability:** ±0.001% or better
- Spurious radiation:** less than 10μW or better than -50dB relative to 144MHz output
- Crystal frequency:** 18MHz
- Frequency multiplication:** ×8
- Crystal trimming range:** ±10kHz (measured at final output)

RECEIVER

- Intermediate frequencies:** 10.7MHz and 455kHz
- Sensitivity:** 1.5μV for 20dB quieting
- Selectivity:** ±6kHz (-6dB)
±15kHz (-40dB)
- Audio output power:** 1W into 8Ω at 1kHz
- Frequency stability:** ±0.002% or better
- Crystal frequency:** 44MHz (overtone)
- Crystal trimming range:** ±15kHz at 144MHz
- Input impedance:** 50Ω

MODULATOR

- Sensitivity:** 2mV r.m.s. at 1kHz for onset of clipping (mic. gain set to max.)
- Input impedance:** 10kΩ
- Frequency response:** 120Hz to 3.5kHz (-3dB)
- Maximum output:** 400mV r.m.s. (for 11.5kHz frequency deviation at 144MHz)
- Deviation:** 4.5kHz nominal (adjustable from 0 to 11.5kHz)

▲ Fig. 4: Transmitter module circuit diagram

★ components

TRANSMITTER

Resistors

$\frac{1}{4}$ W 5% carbon

10 Ω	1	R22
22 Ω	1	R21
47 Ω	2	R16, 20
100 Ω	3	R4, 7, 11
220 Ω	1	R15
470 Ω	2	R12, 19
2.2k Ω	2	R8, 14
3.3k Ω	1	R3
4.7k Ω	2	R10, 18
10k Ω	2	R1, 13
15k Ω	1	R2
22k Ω	2	R9, 17
100k Ω	2	R5, 6

Semiconductors

Transistors

2N2369A	4	Tr1, 3, 4, 5
2N3819	1	Tr2
2N4427	1	Tr6

Diodes

BZY88C9V1	1	D1
OA91	1	D2

Miscellaneous

4.8mm coil formers Type 722/1 (8); tuning slugs Type 4 (6); coil former bases (8); screening cans Type 10 (8); anti-parasitic beads (3); HC25/U crystal sockets (4); RFC1 see text.

Capacitors

Ceramic

1pF	1	C29
1.8pF	1	C33
2.2pF	1	C23
4.7pF	1	C17
10pF	1	C10
15pF	2	C8, 35
22pF	4	C15, 18, 21, 24
33pF	2	C9, 12
47pF	1	C5
220pF	2	C2, 3
1nF	7	C1, 4, 14, 19, 27, 31, 36
10nF	11	C7, 13, 16, 20, 22, 25, 26, 28, 30, 32, 34
100nF	1	C6

Tantalum bead 25V

10 μ F	1	C11
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Ceramic trimmers, miniature

5-30pF	7	TC1, 2, 3, 4, 5, 6, 7
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MODULATOR

Resistors

$\frac{1}{4}$ W 5% carbon

220 Ω	1	R205
1k Ω	1	R207
3.3k Ω	2	R201, 202
10k Ω	3	R200, 203, 204
22k Ω	1	R206

Potentiometers

Min. preset (vertical mounting) 0.1W

10k Ω lin.	1	VR201
1M Ω lin.	1	VR200

Capacitors

Ceramic

10nF	1	C205
47nF	1	C204
100nF	1	C200

Electrolytic 16V

1 μ F	1	C203
2.2 μ F	1	C202
47 μ F	1	C201

Semiconductors

Diodes

1N914	2	D200, 201
-------	---	-----------

Integrated circuits

741	2	IC200, 201
-----	---	------------

GENERAL ASSEMBLY

Resistors

$\frac{1}{4}$ W 5% carbon

1k Ω	2	R300, 301
-------------	---	-----------

Potentiometers

47k Ω log.	1	VR102/S2 (d.p. switch)
-------------------	---	------------------------

Semiconductors

Light emitting diodes

0.2in red	1	D300
0.2in green	1	D301

Switches

Rotary 3p4w	1	S1
Min. s.p.s.t.	2	S100, 300

Sockets

DIN 5 pin	1	SK1
270 $^{\circ}$		
SO239 u.h.f.	1	SK2

Relay

2p changeover	1	RL1 (RS349-658)
min. p.c.b.		

Miscellaneous

HP7 cells (8); battery holder, 4-cell, press stud connections (2); 10k Ω dynamic microphone with p.t.t. switch (1); 222 x 146 x 55mm diecast box (1); transceiver p.c.b. (1); modulator p.c.b. (1); knobs (2).

RECEIVER

Resistors

$\frac{1}{4}$ W 5% carbon

47 Ω	1	R124
100 Ω	1	R114
220 Ω	4	R100, 103, 109, 111
390 Ω	1	R115
470 Ω	3	R107, 121, 129
680 Ω	1	R122
1k Ω	1	R106
1.5k Ω	1	R133
2.2k Ω	2	R117, 120
3.3k Ω	1	R116
4.7k Ω	3	R128, 131, 132
10k Ω	2	R113, 123
12k Ω	3	R125, 126, 127
47k Ω	4	R101, 102, 108, 130
100k Ω	5	R104, 105, 112, 118, 119

Potentiometers

Miniature preset (vertical mounting) 0-1W

10k Ω	1	VR101
47k Ω	1	VR100

Capacitors

Ceramic

10pF	2	C108, 109
22pF	1	C106
47pF	4	C102, 107, 117, 141
100pF	2	C118, 127
220pF	1	C119
1nF	2	C105, 137
2.2nF	1	C136
4.7nF	1	C133
10nF	21	C100, 101, 103, 104, 110, 111, 112, 113, 114, 115, 116, 121, 122, 123, 124, 125, 126, 128, 131, 134, 138

Electrolytic 16V

1 μ F	1	C135
2.2 μ F	1	C130
10 μ F	2	C132, 139
47 μ F	1	C129
470 μ F	1	C140

Ceramic trimmers, miniature

5-30pF	8	TC100, 101, 102, 103, 104, 105, 106, 107
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Semiconductors

Transistors

40673	2	Tr100, 101
2N2369A	2	Tr102, 103
2N3819	1	Tr104
BC458	1	Tr105

Integrated circuits

μ A753	1	IC100
CA3189E	1	IC101
LM380N	1	IC102

Crystal filters

CFU455H or	1	FL102 (see text)
CFU455F		
CFS10-7	2	FL100, 101
(150)		

(NB. These two items must be ordered together.)

Crystal

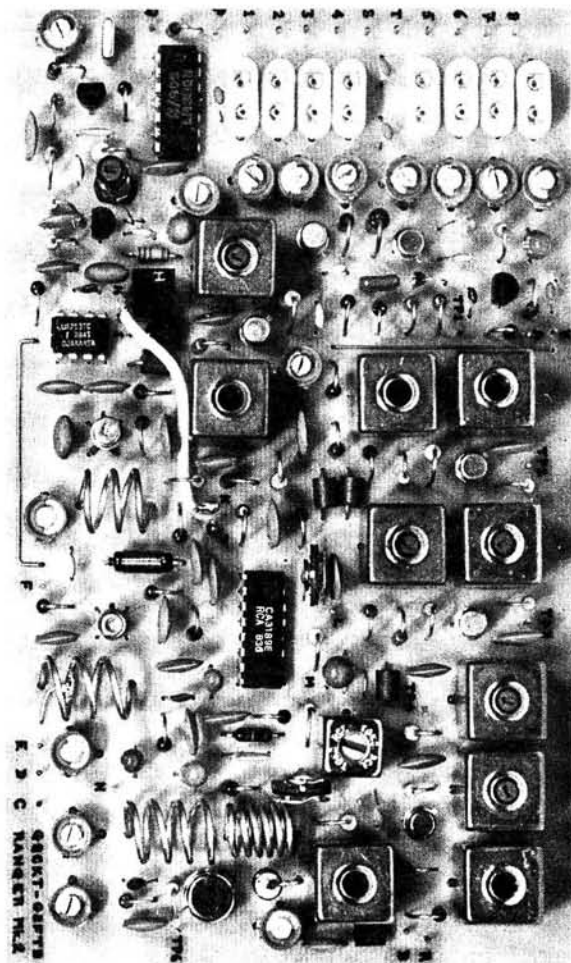
10.245MHz	1	X104
wire ended		

Coils

YRCS 11098	1	L105
AC2 (Toko)		
RFC 100	1	see text

Miscellaneous

4.8mm coil formers Type 722/1 (3); coil former bases (2); tuning slugs Type 4 (2); screening cans Type 10 (2); anti-parasitic ferrite beads (3); HC25U crystal sockets (4); 8 Ω loudspeaker (1); 500 μ A signal strength meter (for test purposes) (1).



The completed printed circuit board for the Nimbus transceiver

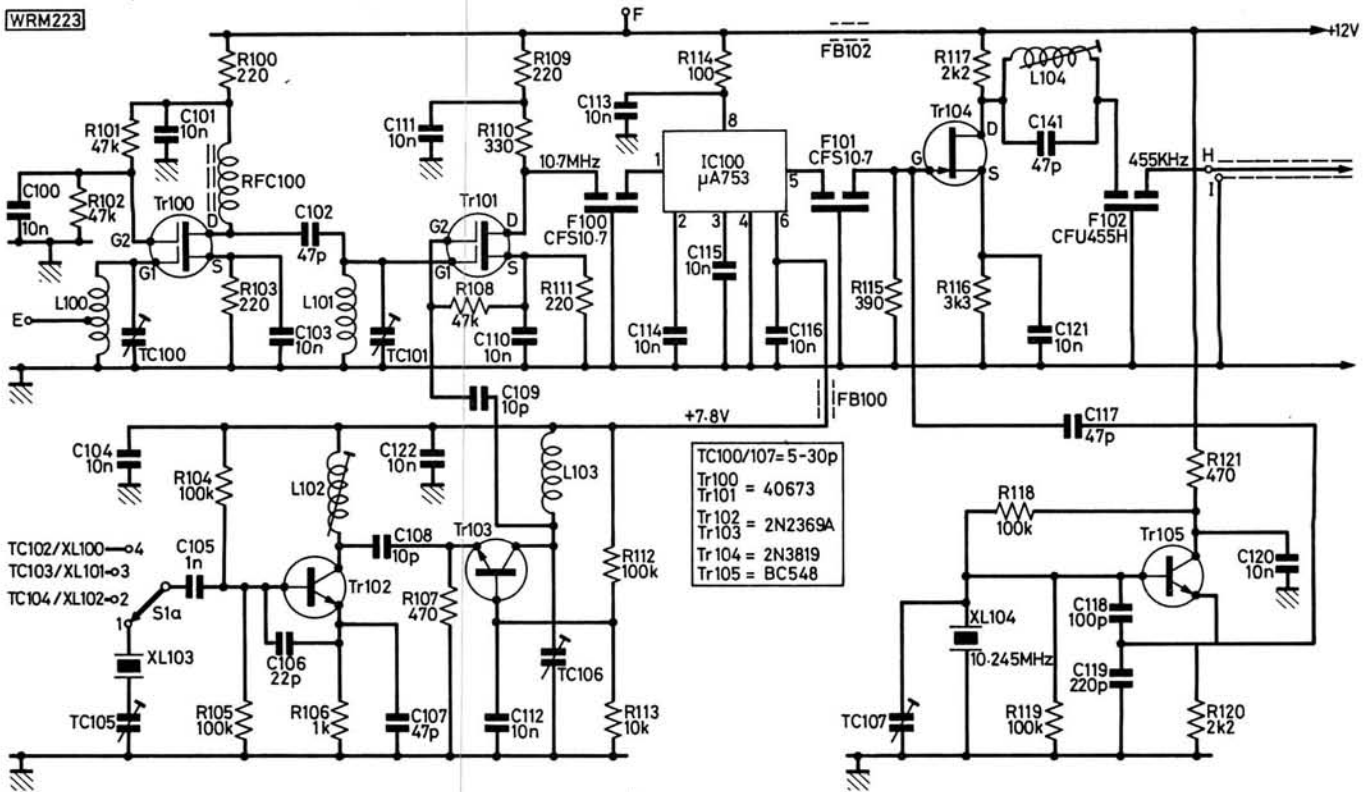


Fig. 5(a): Receiver module circuit diagram Section 1

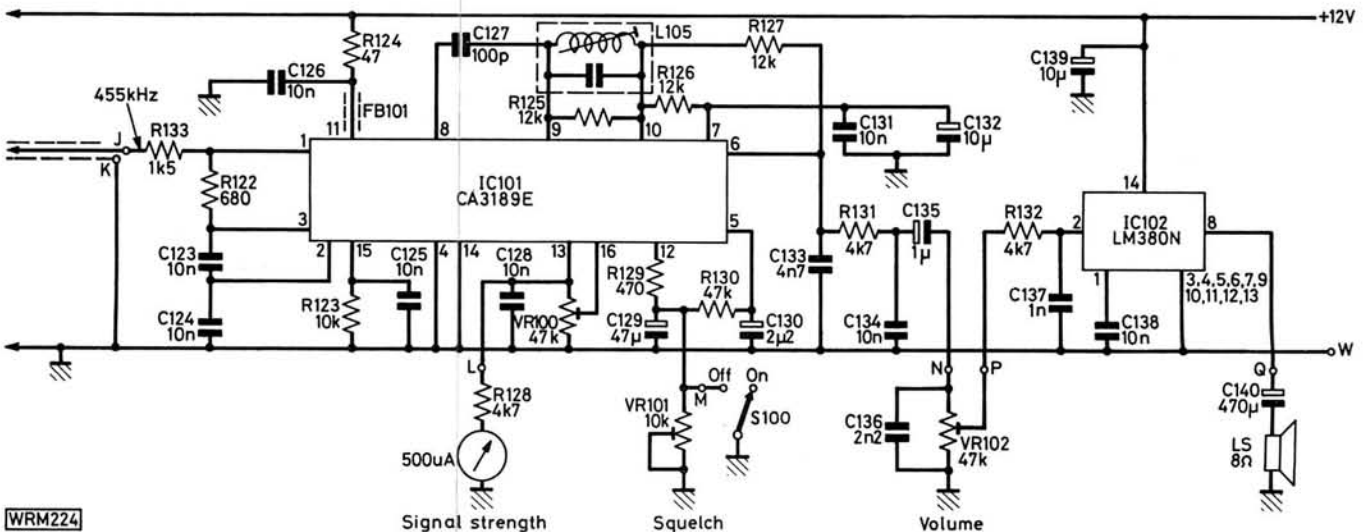


Fig. 5(b): Receiver module circuit diagram Section 2

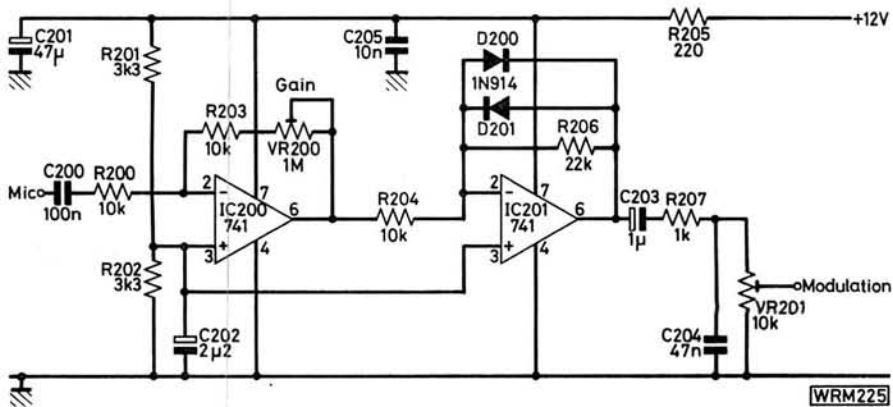


Fig. 6: Basic modulator circuit diagram

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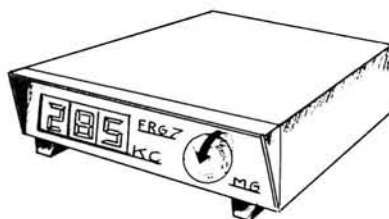
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the first oscillator and tripler is derived from IC100, which also acts as a fixed "gain block" at 10.7MHz. Ceramic filters provide "roofing" selectivity (150kHz bandwidth) and are used as the coupling elements at the input and output of IC100. A JUFET is used as the second mixer with injection at 10.245MHz derived from the second crystal oscillator, Tr105. Tuned circuit L104/C141 is a parallel resonant trap which helps to reduce the leakage of the 10.245MHz signal into the second i.f. amplifier which operates at 455kHz. The four pole ceramic block filter, FL102, defines the overall selectivity characteristic of the receiver.

Integrated circuit IC101 provides the multiple functions associated with an f.m. i.f. strip. These include signal amplification, detection, squelch and signal strength meter drive circuits. Inductor L105, with its internally mounted capacitor, forms the quadrature tuned circuit, damping being provided by R125 and C127 setting the quadrature drive. Audio output from the demodulator system is applied to a simple low-pass de-emphasis circuit, R151/C134. The a.f. amplifier stage is provided by IC102 which operates with a fixed voltage gain of 50 and produces an output of about 1W from a 12V supply.

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.

Modulator

Figure 6 shows the modulator circuit; the basic module employs two operational amplifier stages. The first amplifier, IC200, is a 741 used as a conventional voltage amplifier, the voltage gain being adjustable between 1 and 101 by the preset potentiometer, VR200. This allows a wide variety of different microphones to be used; that selected should have an output impedance of around 10k Ω , however.

The second amplifier, IC201, is another 741 used as a fixed gain stage, producing a gain of 2.2, with a limiting characteristic to remove peaks from the signal; diodes D200 and D201 serve to restrict the maximum amplitude of the signal at the output of IC201. Thus, it can be seen that VR201 provides adjustment of the frequency deviation of the transmitter by setting the proportion of the maximum output level (as determined by the action of IC201) which is applied to the phase modulator stage. Resistor R207 and C204 act as a low-pass filter network to provide the necessary wave-shaping after the clipping action of D200 and D201.

It is important that the action of the microphone gain control (VR200) prior to the limiting stage is not confused with the frequency deviation control (VR201). The adjustment of these two controls will be fully covered in Part 3, which will be mainly devoted to a description of the overall alignment procedure of the *PW* "Nimbus".

Next Instalment

In Part 2, we will be dealing with the fabrication of the printed circuit board and the complete constructional details of the transceiver, including all coil winding information, etc.

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

Modules Rule-OK

The modular concept has been popular for some time in many areas of electronics. A major advantage, particularly in instrumentation, is that servicing is much easier; each module is tested until the "baddie" is found and subsequently unplugged and replaced. This approach seems to have been really taken to heart by a television manufacturer in Germany whose latest colour telly has been modularised throughout. To make the service engineer's job even easier, each module has its own private red and green l.e.d.s that inform immediately which module is working properly and which one isn't. Apart from easy servicing, the manufacturers have really gone for state of the art. Screen size of 27in is available and all peripheral items like Teletext and electronic games can be connected. This also extends to home computers, and TV cameras both colour and black-and-white. Phase-locked loop synthesisers are also included and the set has a memory that can store 30 station numbers and up to 100 different channel frequencies. A very gratifying advantage is the care given to screening which gives protection against r.f. sources such as electrical interference, and QRM from Radio Hams and Citizens' Band users.

Beer Meters

Most motorists work out the petrol consumption of their cherished chariots by filling the tank up, driving till it's almost empty, repeating this and then averaging things out over a period of time. While this method does work it is rather approximate. One possibility might be to use a new photosensor turbine that can be employed to give you, instantaneously, the vehicle's petrol flow-rate. This information, fed to the dashboard, could help a driver regulate his driving to ensure economical fuel consumption. Basically, the idea is simple. The unit is connected into the fuel supply line and comprises a turbine blade that rotates as fuel flows past it. Careful design ensures that turbulence is not set up in the sensor chamber. The turbine blades have a transparent housing and on either side of this is a

light source and photo-transistor. As the tiny blades of the turbine rotate, the light is chopped forming a series of pulses. The faster the flow the faster the pulses. A small computer converts the pulse rate to the practical information needed for the dashboard display. Perhaps beer supplies to Rugby clubs might be monitored in this way, and the bill settled once every quarter when the man comes to read the beer meter?

Lipreading Spectacles

Perhaps the most impressive application of electronics this month is in lipreading. The device, just short of pure genius, uses a microprocessor and analyses spoken words. It then displays these as symbols on two dot matrices of light emitting diodes. Tests so far appear promising. The prototypes have improved the identification of syllables from the normal 25 per cent to around 75 per cent. Note too that a 25 per cent score was for a trained lipreader. The ultimate aim is to have the entire system in the frame of a pair of ordinary glasses. The symbol image would be caused by l.e.d.s in the bowed frame. Their illuminated symbols would then be directed into the lens of the glasses, and these would project an image so that it appeared to the user to be in focus some 1200mm away close to the lips of the speaker. It is thought that the new system could help improve comprehension up to 90 per cent in favourable conditions. The device is only just at the laboratory/experimental stage and is not likely to be available for some time.

Speech Synthesisers

Medical applications of electronics are always nice to report on because it means that circuit ingenuity is serving a very worthwhile purpose. One company has launched two l.s.i. chips to form a programmable digital processor that can be used in a speech synthesiser circuit. This is aimed at the manufacture of a text-to-speech system that should be able to offer blind people a vocabulary of some 200 English words.

Sonic Sinbad

The area of underwater electronics is fascinating. Clearly a field where, to get to the top one must go to the bottom! A French company has developed an underwater ultrasonic flaw detecting system that looks interesting. The system uses an array of transducers arranged as 32 elements in a row, with a total of 5 rows. By special programming of the phasing of coherent energy bursts fed to the transducers, some 32 different focal planes are achieved. The net result is an image in three dimensions with 5120 points. Individual welded joints can be inspected under water, quite a feat. The system is also inspecting the inside of metals at various depths in the metal itself. Could be worth thinking about if you're an underwater treasure hunter, a sort of sonic Sinbad.

Wow!

While home computing continues to boom the professionals are racing ahead to bigger and better—or maybe smaller and better things. In Germany, for example, there's a very interesting single board beastie that can perform 32 million operations in one second. It's quite a clever approach. The idea is to fill the board with microprocessors and memories (plus attendant bits and pieces). The result is a single board with the equivalent computing power of a large mainframe. Organisation of the tasks on the board work out well. Each little module on the board handles one part of a mathematical problem. It can also interact with the others giving up its answers that they need, and taking in their answers in order to continue with its own tasks in the computation. In the original, currently on test, some 128 "microcomputer" modules are employed. The designers believe that a ten times increase in capability is easily possible. Makes you think, doesn't it? But not at 32 million operations a second.

Ginsberg

HI-FI GLOSSARY

5

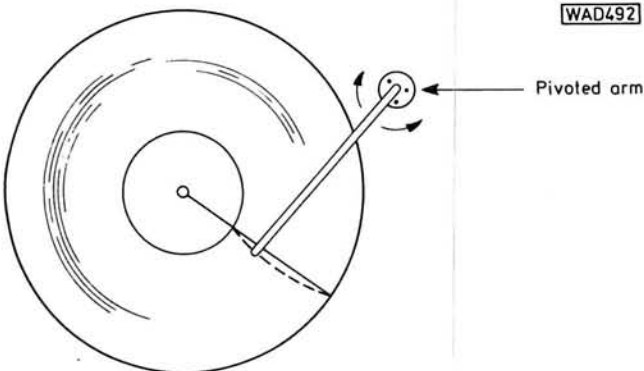
Gordon J KING



OFFSET ANGLE (PICKUP)

When a gramophone record is being cut the cutter head follows a true radial path across the disc as shown by the full line in Fig. 21. However, when a record is played using a conventional pivoted arm the stylus follows a curved path as shown by the broken line. The difference between these two paths results in *lateral tracking error*.

The amount of error is a function of by how much the angle between a line along the axis of the pickup cartridge and a line of disc radius deviates from 90 degrees. For example, in Fig. 22 at (a) the angle is exactly 90 degrees so there is no error. At (b), though, the angle is less than 90 degrees by the amount of the error angle (ϕ) as shown. It will be apparent that the accuracy at (a) is achieved by shifting the axis of the cartridge off the axis of the arm. This is called the offset angle, which is defined at (a). At (b) it is assumed that the axis of the cartridge lies along the axis of the arm. This is not the whole story, however (see below).



WAD492

Fig. 21: When a gramophone record is cut, the cutter head traverses a true radial path across the disc as shown by the full line. When played with the pivoted arm, however, the stylus traverses an arc as shown by the broken line. The deviation from the true radial path is a function of lateral tracking error

OVERHANG (PICKUP)

While an offset angle can be arranged to eliminate lateral tracking error at one groove diameter, the error will start to show again at different groove diameters. This is countered by arranging for the stylus to overhang the turntable spindle by a calculated amount when a conven-

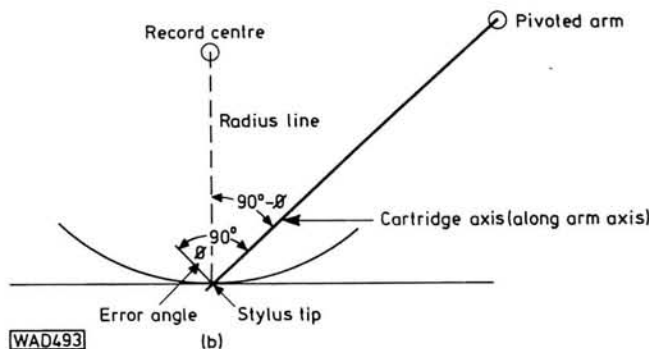
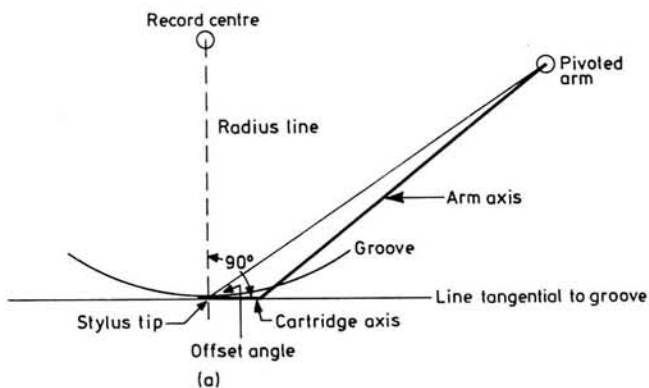


Fig. 22: Lateral tracking error is zero when the angle between a radial line and a line along the axis of the cartridge is 90 degrees, as shown at (a). At (b) is shown significant error since the required angle falls short of 90 degrees by the "error angle" ϕ (see text)

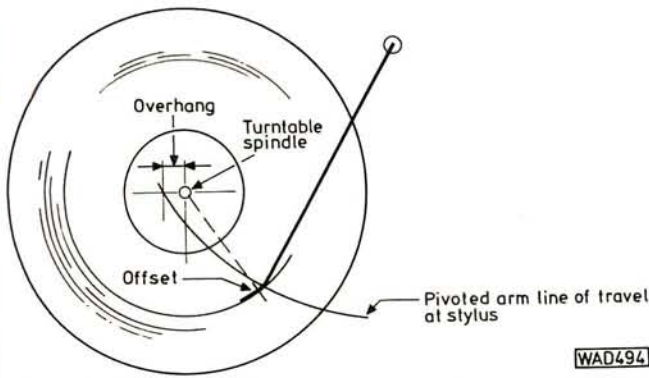
tional pivoted arm is moved to the centre of the record. This is shown in Fig. 23, which also indicates that the least lateral tracking error obtains at all groove diameters when the overhang is carefully combined with the offset.

Overhang and offset are related to the length of the arm, and an alignment protractor of some kind is often used to establish the best value of overhang to use for the least lateral tracking error at the inner groove diameters, where the distortion can be highest owing to the reducing stylus/groove interface velocity and hence the reducing wavelengths of recorded signal.

Lateral tracking error can cause a significant rise in distortion (essentially even-order), particularly on high recorded velocities, so it is highly desirable to ensure the least error by careful adjustment to the cartridge in the headshell. With some arms the offset is provided by a carefully calculated geometric curve.

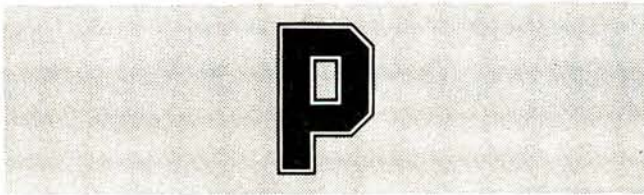
Other rather special arms are engineered for so-called *parallel tracking*, which means that the cartridge moves on a path which is exactly parallel to the recording radius. The artifices just described are not then required. Neither is *side-thrust correction* (see later).

HI-FI GLOSSARY



WAD494

Fig. 23: In Fig. 22(a) the required angle is provided by the offset angle obtained by suitably angling the axis of the cartridge with respect to the effective axis of the arm. To help retain the required 90-degree angle at all groove diameters, the cartridge is positioned in the headshell so that the stylus overhangs the turntable spindle by a specified amount when the arm is brought to the centre of the record, which is usually established by an alignment protractor



PHASING

With hi-fi this applies mostly to the correct phasing of the stereo signals through the left and right channels, all the way from source to the speakers. On a mono source applied simultaneously to the two channels the signals should remain in step over the entire audio spectrum to the two speakers so that their cones also move in and out together. If the signal in one of the channels somehow gets reversed in phase (e.g., the cone of one speaker moving inwards while that of the other is moving outwards on the same signal), then sounds of progressively decreasing frequency will tend towards cancellation, resulting in a bass output deficiency.

Moreover, on a stereo signal the stereo image will fail to resolve precisely; there will appear to be a spread of the *sound stage* either side of the two speakers and "diffused" stereo will result. Special test records are available to assist with phasing tests. If an out-of-phase condition is detected this is easily cured merely by reversing the connections to **one** of the speakers, it matters not which one. Another good test is to place the two stereo speakers side by side and to play a record rich in very low bass notes, such as a large organ rendering, with the amplifier switched to mono mode. With one of the speakers connected one way round the bass output will be very weak. That would be the out-of-phase incorrect condition. By reversing the connections of one speaker the bass will be reproduced far more dramatically. That would be the correct condition.

PHON

This is the unit of *loudness* (see Part 4) which at 1kHz is equal in value to a dB scale; but the unit takes account of the variations in the sensitivity of the human ear at different frequencies and sound intensities.

PHONO PLUG

This type of plug is commonly used on hi-fi equipment to connect the programme sources to the amplifier, which is equipped with corresponding *phono sockets*. There is a centre connector which is connected to the "live" signal circuit and an outer connector surrounding it which is connected to the "earthy" side of the signal circuit and hence the outer braid of the signal lead.

PILOT TONE

This is the 19kHz part of the f.m. multiplex (MPX) stereo signal responsible for synchronously reclaiming or synchronising the 38kHz subcarrier generator in a stereo decoder, which is required for the re-constitution of the separate left and right channels. This signal, along with the residual subcarrier (most of the latter being suppressed at the transmitter), uses up ± 7.5 kHz of the total ± 75 kHz full modulation deviation, thereby leaving a deviation of ± 67.5 kHz available for the audio information.

The pilot tone is also used to activate the stereo decoder and to switch on the stereo indicator or "beacon" as it is sometimes called. Also see under *Multiplex decoder* in Part 4.

PINCH EFFECT

As the stylus of a pickup cartridge traces a recorded record groove it undergoes a vertical motion at twice the frequency of the lateral modulation owing to the groove walls becoming closer together with increasing modulation depth. This, of course, gives rise to 2nd-harmonic distortion, which can be regarded as a kind of *tracing distortion*. The effect is common to both mono and stereo recordings.

PLAYING WEIGHT (ALSO TRACKING WEIGHT)

The correct term is *playing force* since it refers to the downward force applied to the pickup stylus to yield optimum tracking within the capabilities of the cartridge at high amplitudes (low frequencies), and at high velocities and accelerations. The force is that effected by the pull of gravity on a mass and is commonly expressed in grams (e.g., the attraction of gravity on a mass of 1g effects a force of about 980 dynes at latitude 45 degrees and sea level). The SI unit of force is the newton (N), which is equivalent to 10^5 dynes. An approximate conversion is to multiply the gram value by ten and call the result millinewtons (mN). Thus a playing weight of 1g becomes a playing force of 10mN. SI units are **just** beginning to percolate into the hi-fi literature!

HI-FI GLOSSARY

High-flight cartridges in a suitable arm will track as low as 10mN, but it is best to track a shade higher than necessary than too low, for the resulting mistracking of the latter is not only subjectively disconcerting but more damaging to the record than the use of slightly more force. *Side-thrust correction* (see later) also helps to reduce the tracking force for a given tracking performance.

PRE-EMPHASIS

Pre-emphasis refers to the controlled "boosting" of high frequencies with respect to the lower frequencies when transmitting or recording, as shown by curve (a) in Fig. 24. Here the response is +3dB at just over 3kHz (actually 3184Hz) and the ultimate rate of rise close to 6dB/octave. This, in fact, corresponds to the UK and European pre-emphasis of f.m.

It is defined by a time-constant, which in the above example is 50μs. The frequency corresponding to the 3dB point is equal to

$$\frac{1}{50 \times 10^{-6} \times 6.28}$$

or 3184Hz. In American countries the f.m. time-constant is 75μs, corresponding to

$$\frac{1}{75 \times 10^{-6} \times 6.28}$$

or 2123Hz. With a simple time-constant like this the response ultimately reaches a rate of change of 6dB/octave (e.g., as per a single-pole filter).

To restore the response integrity it is necessary to apply the converse type of filtering at the receiver or in the replay amplifier. This is called *de-emphasis*, shown by curve (b).

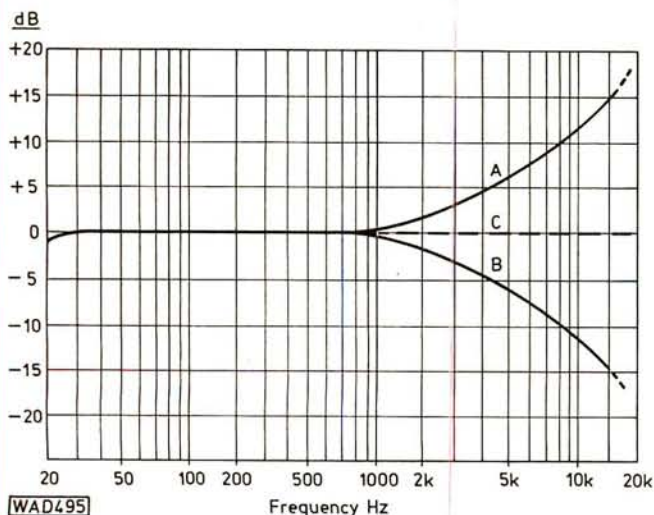
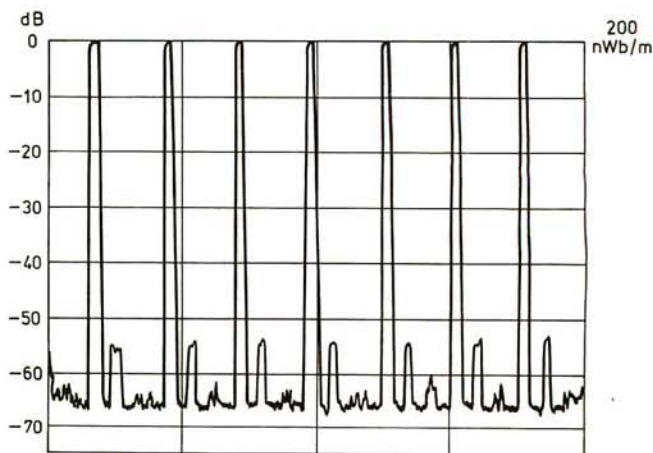


Fig. 24: Pre-emphasis (a) is equalised by de-emphasis (b) to yield a "flat" response (c). Upper-frequency noise is reduced by the attenuation of the de-emphasis. The curves correspond to a time-constant of 50μs, which is the UK and European f.m. time-constant

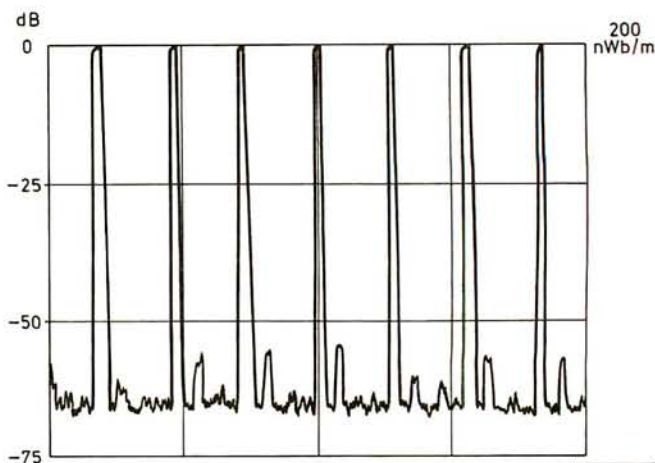
The net result is then a "flat" response shown by curve (c).

What is the point of all this, one might ask! Well, it is one way of improving the signal/noise (S/N) ratio because a fair amount of noise is composed of high-frequency components which are attenuated when the response is equalised by the de-emphasis.

Pre-emphasis (a part of the RIAA recording characteristic—see under *Equalisation* in Part 3) is also used for disc recording, for low-speed reel-to-reel tape recording and for cassette recording. The time-constant is established by the specific recording characteristic, and in the case of the tape (see also under *De-emphasis* in Part 3).



WAD496



WAD497

Fig. 25: Print-through characteristics of Maxell UDXLII cassette tape after 48 hours storage at 20°C. (a) first play, and (b) showing how the average print-through ratio is increased by rewinding the tape before playing. The tape was recorded with 1s 1kHz pulses at a recording level corresponding to 200nWb/m with approximately 10s intervals between the pulses. Replay was through a 1kHz bandpass filter to the pen-chart recorder to decrease the swamping tape noise. The signal before the main pulse is pre-echo and that after the main pulse post-echo. The overall length of each recording is about 100 seconds

HI-FI GLOSSARY

PRINT-THROUGH

Owing to the intimacy of adjacent layers of spooled magnetic tape, information print-through can occur which, in severe cases, manifests as pre- and post-echo effects during replay, particularly related to heavily-recorded passages of music and high-amplitude transients.

Chromium dioxide (*Cr*) tape seems to be more prone to the effect than lower *coercivity* ferric (*Fe*) or modified *Fe* formulations. Measurements that I have made in my own lab also indicate that the metal particle tapes are less prone to the effect than *Cr* brands. However, environmental storage of a recorded spool of tape can have a marked effect on the print-through, which becomes worse as the storage temperature is increased. Humidity, too, would also appear to play a rôle.

It is also possible to reduce the print-through by rewinding a recorded tape before playing, as can be seen by comparing pen-chart recording (b) in Fig. 25 with that at (a). See caption for details. In general, I have not personally found cassette tape print-through particularly troublesome when the ratio is around 50dB or more. However, incorrect storage of *Cr* tape (in the rear window of a car, for example!) can lead to lower print-through ratios which are subjectively apparent.



QUIETING

With f.m. receivers, the level of background noise decreases as the aerial signal level increases. Starting at very low input signal level, the noise decrease is at first very swift, after which it slows down, ultimately reaching

the mono *noise floor* with an input of 1 or 2mV, depending on the receiver's sensitivity. The amount in dB by which the noise falls when the receiver is fed with a v.h.f. signal of given voltage is the quieting. For a quieting of 50dB, the aerial input signal usually needs to be about ten times (20dB) stronger in stereo than mono mode.



RECORDING CHARACTERISTIC

This refers to the nature of signal boost or cut applied during recording, usually to an agreed standard (see under RIAA). When replaying, an inverse characteristic is used to achieve a "flat" frequency response (see also under Equalisation in Part 3).

Index of Partly Defined Jargon

- Coercivity
- De-emphasis
- Equalisation
- Lateral tracking error
- Loudness
- Multiplex decoder
- Noise floor
- Parallel tracking
- Phono socket
- Playing force
- Side-thrust correction
- Sound stage
- Tracing distortion

TO BE CONTINUED

HAVE YOU SEEN
THE NEW
PW QSL CARD?

Then turn to page 30

KINDLY NOTE!

Burglar Alarms Part 3, Dec. 1979

Readers should note that the GDHM microwave module and antenna are available from the author P. J. Wales, PO Box 88, Aylesbury, Bucks. under a special arrangement with the manufacturer. Orders and queries should *not* be directly addressed to Plessey Ltd.

AF Speech Processor, Jan. 1980

In the circuit diagram, Fig. 6, the junction of C3 and R6 should be connected to the emitter of Tr1. The p.c.b. (Fig. 9) is correct.

**SPECIAL
PRODUCT
REPORT**

8022A

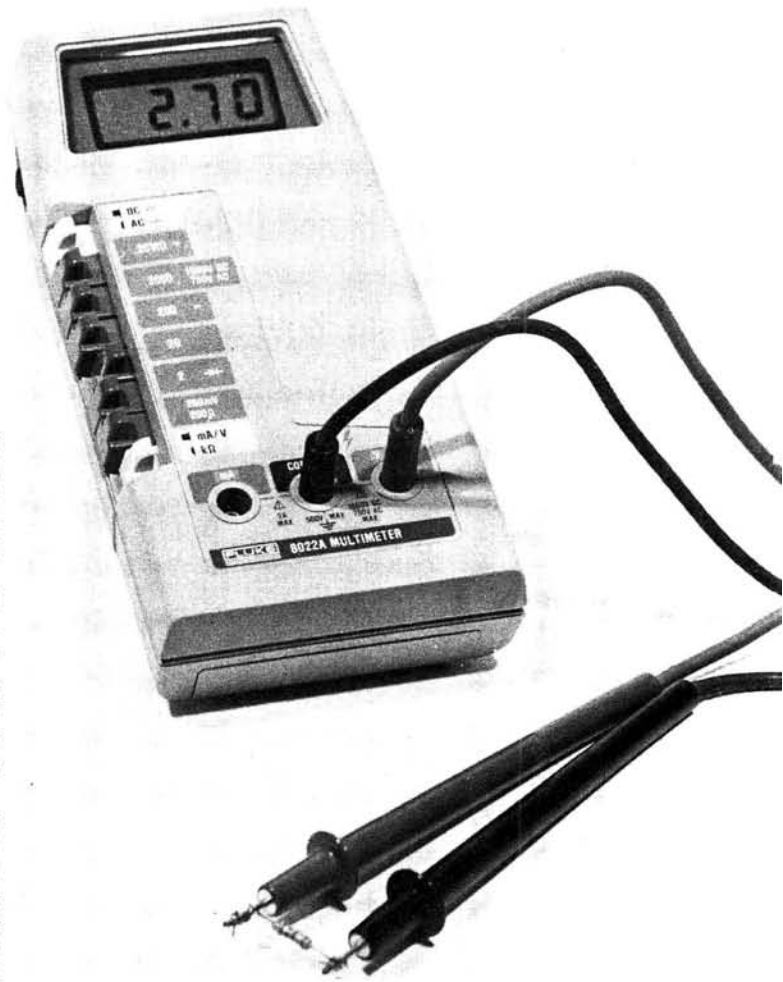
FLUKE

DIGITAL MULTIMETER

Not very many years ago, digital measuring instruments came in 19 inch, rack-mounting, steel cases, and consumed considerable quantities of power. Since then, in common with calculators, they have got smaller, cheaper, more versatile and more reliable, and the day of the "personal" digital multimeter is with us.

The Fluke 8022A is such an instrument, pocket-sized and offering a comprehensive range of measurements at a standard of accuracy far surpassing that of an analogue multimeter. The shape and size, and the arrangement of the push-button range selectors, make possible one-handed operation of the instrument, even by someone with quite small hands. The case moulding is ribbed around the centre section to provide a firmer grip.

The display is a $3\frac{1}{2}$ -digit liquid crystal type with digits approximately 11mm high and good contrast even in low light levels, though it is a pity that a non-reflective material could not have been used for the display window, to obviate irritating glare from overhead lighting when the instrument is used on the bench top. In this position, the display is tilted about 10° up from the horizontal. The glare problem can be largely overcome by using the tilt-bail built into the back of



continued on page 47 ▶▶▶

★ specification

DC Volts:

Ranges: 200mV, 2, 20, 200, 1000V
Accuracy: $\pm(0.25\%$ of reading + 1 digit)
Input Impedance: $10M\Omega$
Overload Protection: 1000V d.c. or peak a.c.

AC Volts:

Ranges: 200mV, 2, 20, 200, 750V
Frequency Range: 45–450Hz
Accuracy: $\pm(1\%$ of reading + 3 digits)
Input Impedance: $10M\Omega$ in parallel with $<100pF$
Overload Protection: 750V r.m.s. or 1000V peak

DC Current:

Ranges: 2, 20, 200, 2000mA
Accuracy: $\pm(0.75\%$ of reading + 1 digit)
Burden Voltage: 250mV r.m.s. max (700mV r.m.s. on 200mA range)
Overload Protection: 2A/250V

AC Current:

Ranges: 2, 20, 200, 2000mA
Frequency Range: 45–450Hz
Accuracy: $\pm(2\%$ of reading + 3 digits)
Burden Voltage: 250mV r.m.s. max (700mV r.m.s. on 200mA range)

Resistance:

Ranges: 200, 2k, 20k, 200k, 2000k, $20M\Omega$
Accuracy: $\pm(0.2\%$ of reading + 1 digit)
 $\pm(0.3\%$ of reading + 3 digits) on 200Ω range
 $\pm(2\%$ of reading + 1 digit) on $20M\Omega$ range
Overload Protection: 500V d.c. or r.m.s. a.c.

Size: 1800 x 860 x 450mm

Weight: 0.37kg

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EXTRA

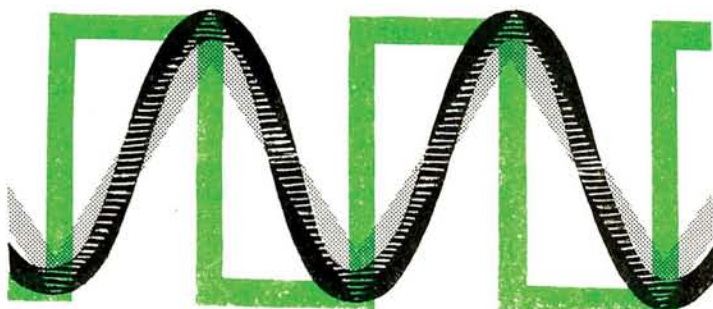
PULL-OUT 8-PAGE SUPPLEMENT

RADIO SERVICING AND ALIGNMENT PROCEDURE



Written by an author with years of experience in servicing, and in teaching it to others, this special supplement tells you how the professionals do it—logically, swiftly and accurately.

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Based on the ubiquitous Intersil 8038 waveform generator, this unit provides sine, square or triangular waves from 10Hz to 70kHz, with an output of up to 4V peak-to-peak

Stereo Automatic Fader

Add automatic 'ducking' to your disco or tape recording system. This handy gadget fades the music down when you speak, and restores normal volume when the announcement or commentary is over.

Model Radio Control

Part 4

THE PW FM-80 SYSTEM



J. BURCHELL & W.S. POEL

Although a standard servo mechanism such as that described last month can be used to operate a variable resistance motor controller this is very wasteful both of a servo and also of power.

A simple electronic speed and direction controller can be built using a Signetics NE544 servo amplifier chip which will give good speed control with forward and reverse direction as well.

The unit described in this article is suitable for use in electric boats and cars and gives excellent control over the speed of the model from full ahead to full astern with a distinct centre-off position.

The block diagram of the speed controller is shown in Figure 1 and this shows it to be essentially the standard servo system with the mechanical part of the feedback loop broken and extra output drive capability added to cope with the high motor currents encountered in electric boats and cars.

The internal pulse width is set up to be 1.5ms wide as long as the input signal pulses are also 1.5ms wide. In this condition there is no output from the circuit hence the voltage across the motor is zero.

As the input signal is increased in length the resultant error signal is amplified by the pulse stretcher and the resulting pulses applied to the output stage.

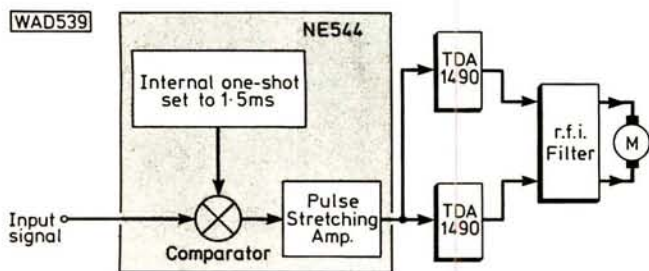


Fig. 1: Block diagram

The gain of the pulse stretcher is such that when the error pulse is 1ms wide the output is continuous in nature and the motor is driven as hard as possible.

For input signals with a width of less than 1.5ms the output signals are in the opposite phase and the motor direction is reversed.

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

Circuit

Figure 2 shows the circuit of the speed controller. Component values around the NE544 have been altered from the standard servo circuit to give the correct pulse stretcher gain and a definite off position. The output drive is provided by two TDA 1490 quasi-complimentary dual darlington devices, as it is beyond the capability of the NE544 to sink these sort of currents. The power supply is adequately decoupled by the 100µF capacitors (C9, 10) and the output of the TDA 1490 devices decoupled to 0V by the 47nF capacitors (C11, 12). The NE544 receives its power from the receiver NiCad batteries keeping the high current motor supply separate.

Output currents larger than 5A can be accommodated by using output bridges built from discrete transistors, but this requires the use of special low saturation voltage devices and as these are rather expensive no details of this sort of output bridge are provided here.

One potential trouble with this sort of controller is the production of r.f.i. noise, but this has been kept under control by the inclusion of a special π filter across the motor.

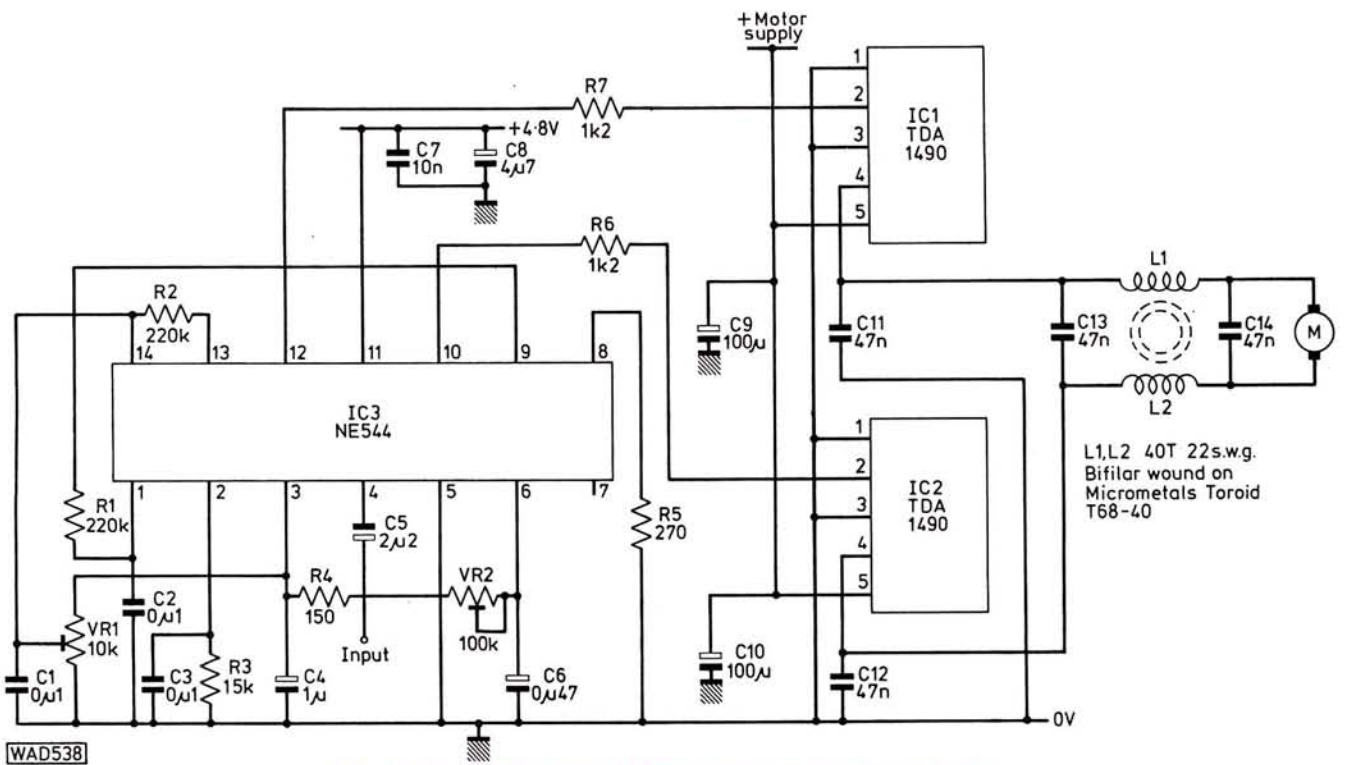


Fig. 2: Circuit diagram of the electronic speed controller

Construction and testing

The p.c.b. and component overlay are shown in Figure 3. Construction is straight-forward and simple. The TDA1490 i.c.s must be insulated from the metal heatsink.

The toroidal choke (L1, L2) consists of 40 turns bifilar wound on a Micrometals toroid, and should be located,

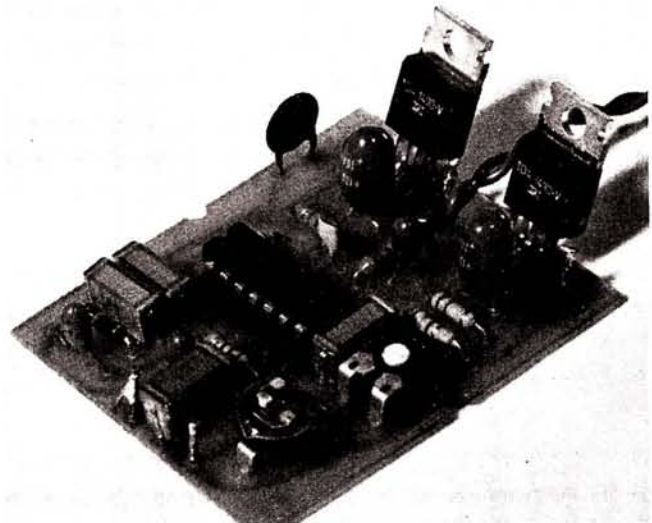
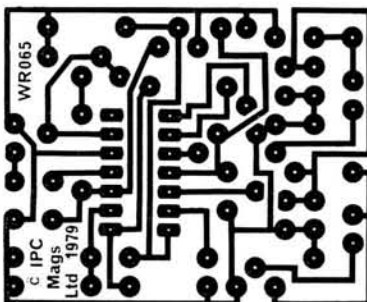
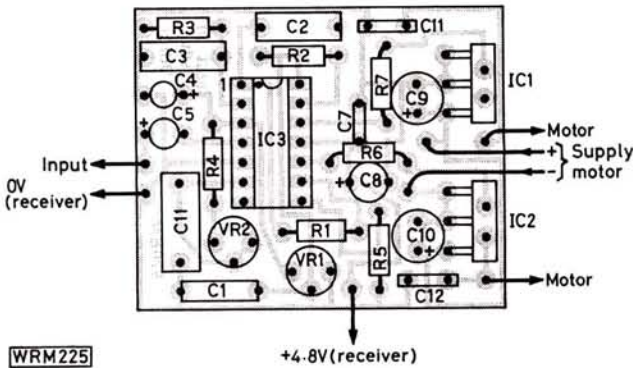
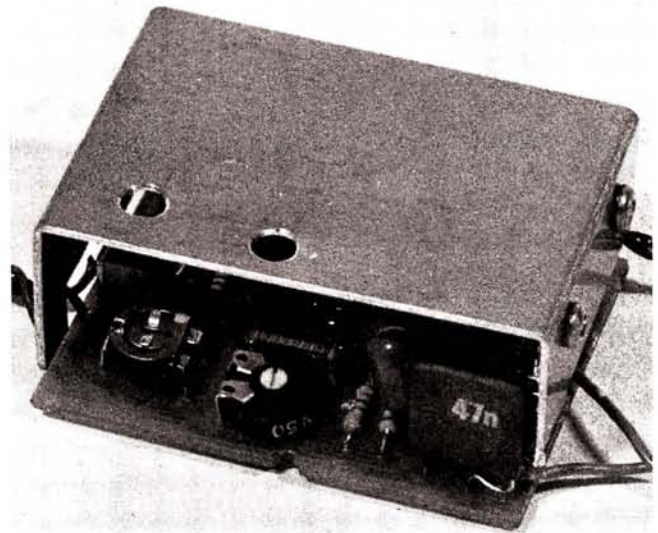
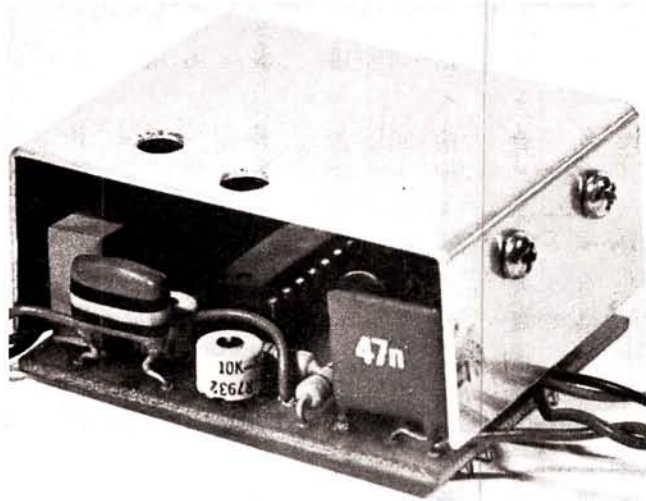
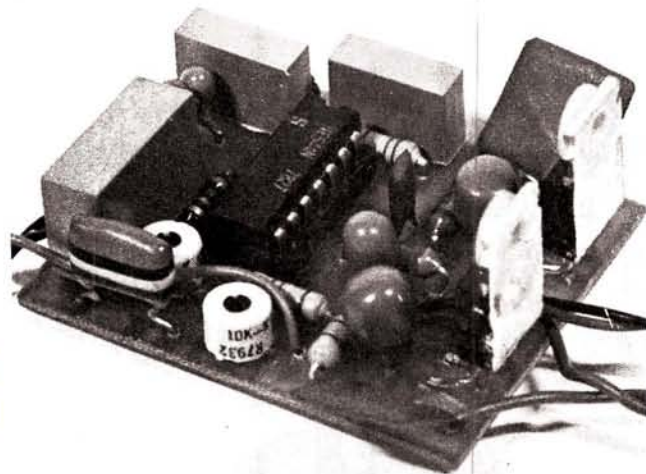


Fig. 3: (Top) component layout of the p.c.b. shown full size above

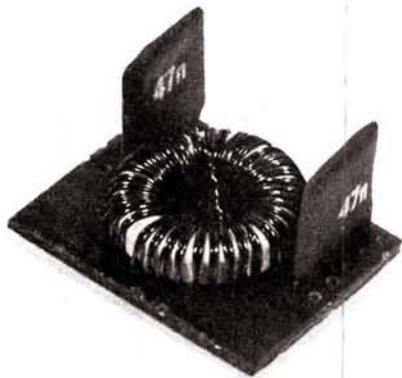
★ components



The finished speed controller showing the aluminium heat sink covering the components. The output transistors must be insulated from the heat sink



The component side of the finished p.c.b. without the heat sink. Compare this with the photographs of the prototype unit shown on the previous page



The radio frequency interference (r.f.i.) filter showing the bifilar wound toroidal inductors and the way in which the unit can be built on a small piece of Veroboard

Resistors

$\frac{1}{4}$ W 5%

150 Ω	1	R4
270 Ω	1	R5
1.2k Ω	2	R6,7
15k Ω	1	R3
220k Ω	2	R1,2

Potentiometers

Cermet trimmers top adjusting

10k Ω	1	VR1
100k Ω	1	VR2

Capacitors

Tantalum

1 μ F 25V	1	C4
2.2 μ F 35V	1	C5
4.7 μ F 35V	1	C8
100 μ F 10V	2	C9,10

Ceramic

10nF	1	C7
47nF	4	C11,12,13,14

Polyester

0.1 μ F	3	C1,2,3
0.47 μ F	1	C6

Semiconductors

Integrated Circuits

NE544	1	IC3
TDA1490	2	IC1,2

Inductors

L1, L2. 40T bifilar wound on Micrometals toroid type T68-40.

Miscellaneous

Printed circuit board; 22 s.w.g. aluminium 40 x 80mm for heat sink; power transistor mounting kit (2).

together with two 47nF capacitors (which must be disc ceramic types) as close as possible to the motor and not on the main p.c.b. A heatsink for the output devices is easily made from thin sheet aluminium folded so as to cover the p.c.b. Two small holes will need to be drilled in the heat sink to allow VR1 and VR2 to be adjusted.

Setting up

The only setting up needed is of the *set centre* (VR1) and *set full power* (VR2) presets. With the transmitter joystick at the centre of its travel adjust the *set centre* potentiometer so that the motor is stationary. Now move the joystick fully one way at which point the motor should start to revolve. The *set full power* preset should now be adjusted until the point at which the motor speed no longer increases is reached.

Next month we will cover the installation of the FM-80 system in different types of models including aircraft, boats and electric cars.

Letters

The Editor,
PRACTICAL WIRELESS,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG

Novice: Phone — 10W mean a.m., 30W p.e.p. s.s.b.
CW — 10W

3.525–3.625MHz, 21.125–21.200MHz,
28.100–28.600MHz.

Limited: RTTY, SSTV, ATV, f.s.k., f.m., a.m., p.m. s.s.b.
150W mean, 400W p.e.p.
No c.w.

52–54MHz, 144–148MHz, 1215–1300MHz,
2300–2450MHz, 3300–3500MHz, 5650–5850MHz,
10 000–10 500MHz, 24 000–24 250MHz.

Full: As for Limited, plus c.w. and the following bands:
1800–1860kHz, 3.500–3.700MHz, 7.000–7.150MHz,
14.000–14.350MHz, 21.000–21.450MHz,
28.000–29.700MHz.

I have had the good fortune to work 3 "G" stations on 15m, one contact lasting 30 minutes. The rig used was a TS120V, feeding simple dipoles only eight feet above ground level, and without baluns.

We now have a second CB service which uses 40 channels in the 50cm band, 476–477MHz with F3 (f.m.) modulation. If the UK ever looks to a CB service, this is where to put it. There is no DX QRM, but contacts up to 200 miles have been achieved with 5W into a vertical gain antenna.

*Phil Perry VK3NAY,
Wantirna South,
Victoria,
Australia*

The Australian Scene

Sir: I thought your readers might be interested in the licensing requirements for radio amateurs in this country, since I understand that the UK does not have a "Novice" amateur certificate of proficiency.

Amateur radio here in Australia has seen a tremendous boost since the advent of CB (Citizens' Band) radio, which uses a slot between 27.015 and 27.225MHz. Most amateur operators licensed within the last two years have experienced CB radio—indeed it was probably CB which gave them their first experience of two-way communications. I was involved for around a year in CB, which taught me a few basic principles about antennae, propagation of radio waves, v.s.w.r. and so on. So, the next logical step for me was the Novice certificate.

The Novice certificate of proficiency entails three exams, these being: 1. THEORY—a basic test of transmitting and receiving principles; valves; transistors and their operation; propagation and antennae. 2. REGULATIONS—a written (multiple choice) test on current rules and regulations governing the safe and legal operation of an amateur radio station. 3. MORSE CODE (CW)—the candidate must satisfy the examiner that he/she is proficient in the sending and receiving of numerals and plain language at a speed of five words per minute.

On passing these exams, the candidate is then given a callsign with the prefix VK (Australia) followed by a number which signifies the State of residence:

- VK1—Australian Capital Territory (Canberra)
- VK2—New South Wales
- VK3—Victoria
- VK4—Queensland
- VK5—South Australia
- VK6—West Australia

My callsign is VK3NAY. The "N" signifies a Novice station, "VK3" signifies that I reside and operate in the State of Victoria, in the Melbourne area. If your short-wave listeners or amateurs have heard calls having a suffix starting with "V", e.g. VK3VAA, these are also Novice stations, it's just that we've run out of "N—" suffixes. The series will be VAA–VZZ, but what will be used next I do not know. YAA–YZZ and ZAA–ZZZ are Limited licence holders, limited to 6 metres and above.

Our full licence holders, who must achieve 10 w.p.m. c.w. proficiency and pass a much stiffer theory exam, have suffixes AA–ZZ, AAA–AZZ, BAA–BZZ and DAA–DZZ. We're about halfway through the "D" calls at present. A "VK-C—" callsign indicates a station that moves around Australia a lot, and uses the area or State number with his call.

Bands, modes and powers for the various classes of operator are as follows:



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Dual Trace Unit



Ian HICKMAN

for the
Pu 'PURBECK'

Part 2

Construction

The unit is mounted in a standard Bazelli case. Drilling details can be taken from the front panel markings as detailed in Fig. 8. Four holes are also needed in the base of the box for the stand-offs which support the p.c.b. These can be marked through using the board as a template, remembering that the rear of the finished board should fit 4.5mm forward from the back of the case to clear the grommets. If fitted too far forward, the p.c.b. will foul the front panel controls, see photographs. Three grommets are fitted in the rear panel, 3mm higher than the p.c.b. and placed to take the three flying leads, i.e., the coaxial output lead to the Purbeck Y input, the lead to the EXT TRIG socket and the lead from the ALT GATE socket. The 180° 5 pin DIN supplies socket is also mounted on the back panel, but higher up, clear of the p.c.b. The exact position is not important. Note that one pin is not used, and ensure that the metal shell of the socket makes good contact to the metal case. A short jumper lead with a 180° 5-way DIN plug at each end connects the Dual Trace Unit to the Purbeck.

Although only four pins are used (the Dual Trace Unit does not use the +150V STAB supply), all five should be wired to match the socket on the Purbeck front panel.

A sixth wire connects the metal shells of the two plugs together and should on no account be omitted.

Having completed all the drilling and prepared the metalwork generally, check that the controls, p.c.b. and power sockets all fit; much better find out now if they don't, rather than later on! All being well, it is time to load the p.c.b. Before fitting any components, fit the board pins, of which there are 28. As in the Purbeck, the 733 video amplifier chips must mount direct on the board to keep lead lengths to a minimum. The four c.m.o.s. chips however can be accommodated in i.c. sockets; on balance this is well worth doing, even though the sockets cost nearly as much as some of the i.c.s! As the design does include c.m.o.s. devices, make sure before you start that you

have a soldering iron with a three core mains lead and that the earth lead is in good order and properly earthed. The small amount of point to point wiring should be completed after all the components have been fitted.

With the p.c.b. complete and carefully checked, it is time to turn to the attenuators. The two input attenuator switches S501 and S502 are constructed similarly to that of the Purbeck, but with one less position. The Y2 channel attenuator S502 is mounted rotated 180° relative to S501, to bring the trimmers to the right hand side where they can be easily reached for adjustment. With the attenuators complete and visually checked, the loading of the front panel components can begin. A transparent film overlay is available for this unit marked in a matching style to the Purbeck.

Fit the p.c.b. stand-offs in the base of the case and the grommets in the rear panel. Then fit all front panel controls and sockets *except* the four rotary switches. The two 400V working 0.1μF capacitors C501, 502 should now be mounted on the a.c./d.c. coupling switches S501, 502. Also wire R501, 502 between these switches and the input sockets.

Fit the printed circuit board onto the four stand-offs, feed the coaxial lead through the grommets and connect them to the appropriate board pins. Wire the Variable gain controls R517, 518 and the SHIFT controls R519, 520 to the appropriate pins on the p.c.b. as in Fig. 11 noting carefully which wires cross over.

Next fit the front panel rotary switches, having pre-wired them as far as possible—e.g., R523 and C522 ready mounted on S505, using spare contacts as anchoring points for the other ends of these components. C522 is grounded to the p.c.b. ground plane via the outer of the short length of coaxial cable whose inner connects R523 to R648 and C621. R521 and 522 mount between the board and S505a as in the photographs. Wiring up the mode switch S506, the two input attenuators, and the supplies from the rear panel socket to the p.c.b., concludes the constructional work. Do not fit the cover at this stage, but carefully centre all the pre-set potentiometers.

★ components

Resistors

$\frac{1}{4}W$ 5%

10 Ω	4	R607,608,611,612
47 Ω	3	R633,644,648
68 Ω	2	R501,502
330 Ω	4	R605,606,609,610
510 Ω	1	R642
680 Ω	1	R662
1k Ω	10	R515*,516*,603,604, 619,620,639,640, 641,656
1.2k Ω	4	R623,624,625,626
1.3k Ω	1	R643
1.8k Ω	5	R613,614,615,616, 654
2k Ω	1	R647
2.2k Ω	3	R521,522,523
2.4k Ω	1	R655
2.7k Ω	4	R645,657,663,665
3.6k Ω	1	R652
3.9k Ω	1	R638
4.7k Ω	1	R666
5.6k Ω	1	R646
7.5k Ω	1	R660
8.2k Ω	1	R653
10k Ω	4	R511*,512*,627,628
15k Ω	1	R636
18k Ω	1	R651
22k Ω	4	R631,632,650,657
27k Ω	1	R649 (select on test)
47k Ω	2	R635,644
100k Ω	5	R507*,508*,658,661, 664
470k Ω	2	R601,602
910k Ω	2	R505*,506*
1M Ω	6	R503,504*,509*, 510*,513*,514*

*1% tolerance

Potentiometers

Min. horizontal skeleton preset

100 Ω	2	R617,618
470 Ω	2	R621,622
2.2k Ω	1	R637
10k Ω	2	R629,630

Min. $\frac{1}{4}$ inch shaft potentiometers

1k Ω (lin.)	2	R517,518
10k Ω (lin.)	2	R519,520

Capacitors

Ceramic

47pF	2	C509,510
330pF	2	C601,602
470pF	2	C515,516
1nF	1	C630

Ceramic Disc

10nF	3	C625,627,628
0.1 μ F	10	C603,604,605,606,611, 612,615,616,619, 620

Polyester

4.7nF	2	C521,522
0.1 μ F (400V)	3	C501,502,626

Tantalum

4.7 μ F (10V)	1	C629
17 μ F (16V)	12	C607,608,609,613, 614,617,618,621, 622,623,624

Min. Trimmer

22pF	14	C503,504,505,506,507, 508,511,512,513, 514,517,518,519,520
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Semiconductors

Transistors

E421	2	Tr 601,602
BC107	4	Tr 607,608,609,610
BSV81	4	Tr 603,604,605,606

Integrated Circuits

CD4001	1	IC606
CD4047	1	IC604
CD4052	1	IC607
CD4081	1	IC605
CA3018	1	IC603
LM733	2	IC601,602

Switches

Min. s.p.s.t. toggle	2	S501,502
Rotary 2p4w	1	S505
Rotary 3p4w	1	S506
Rotary 2p4w	2	S503,504 (see text)

Miscellaneous

Case, Bazelli B16; Printed Circuit Board; 50 Ω b.n.c. sockets UG1094/U(2); 5 pin 180° DIN socket (1); 5 pin 180° DIN plug (2); Sifam collet knobs with nut covers, 15mm wing (4), 15mm plain (4); p.c.b. mounts (4); 50 Ω b.n.c. plug (1); Min. coaxial cable 50 Ω (300mm); Front panel overlay (1). Sockets 14 pin d.i.l. (3), 16 pin d.i.l. (1).

Purbeck modifications

Whilst construction of the Dual Trace Unit is now complete, there are some necessary modifications to be performed on the Purbeck itself. These are shown in Fig. 10. The reason for changing S6's circuitry lies in the nature of the signal in the 'scope's Y amplifier when the Dual Trace Unit is in the Chopped mode. The Y signal switches rapidly between the two traces displayed, at approximately a 100kHz rate. The two traces may be displaying no

waveform at all—just two straight lines—but the Y signal in the Purbeck is still a 100kHz square-wave with a peak-to-peak amplitude equal to the separation between the traces, which could be up to full screen. With the original/single pole INT/EXT trigger select switch, the fast edges of this square-wave are partially coupled via the small capacitance of the open contacts into the trigger circuit. Although much attenuated, they are still sufficient to

upset the trigger signal fed in via the external trigger socket from the Dual Trace Unit, tending to make the trace synchronise to the chopping frequency. The modified arrangement with the double pole switch entirely avoids this problem. In fact, it is a worthwhile modification for any Purbeck owner who has experienced problems when using external trigger, even if they have no intention of building the Dual Trace Unit. Note also the changed components associated with the external trigger input sockets.

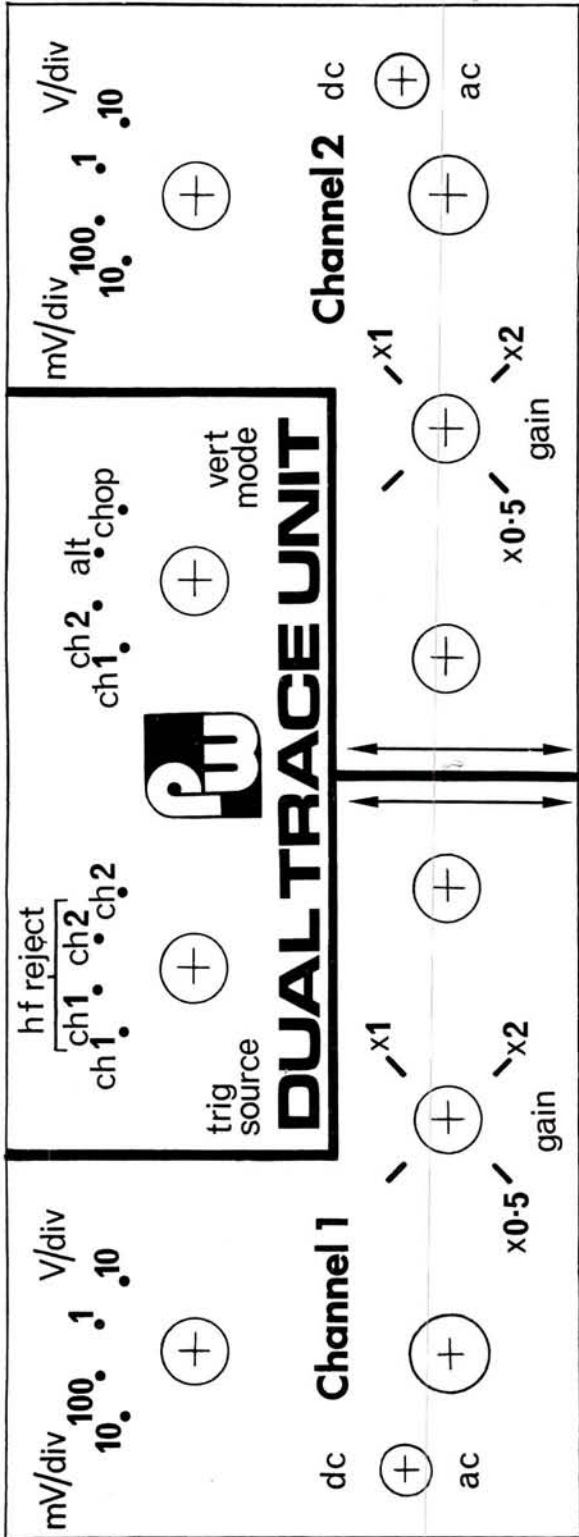


Fig. 8: The front panel of the Dual Trace Unit shown full size

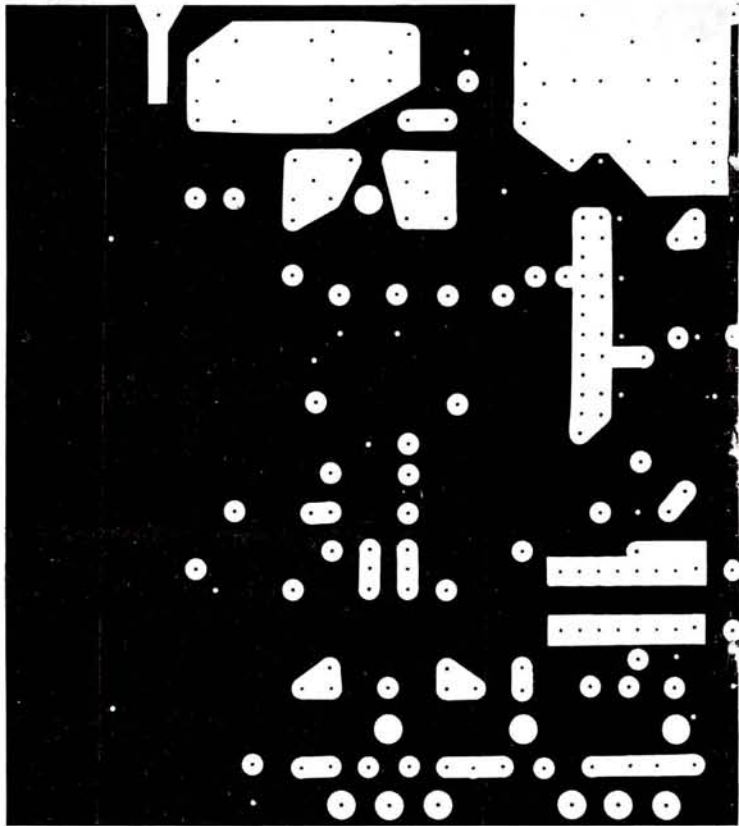
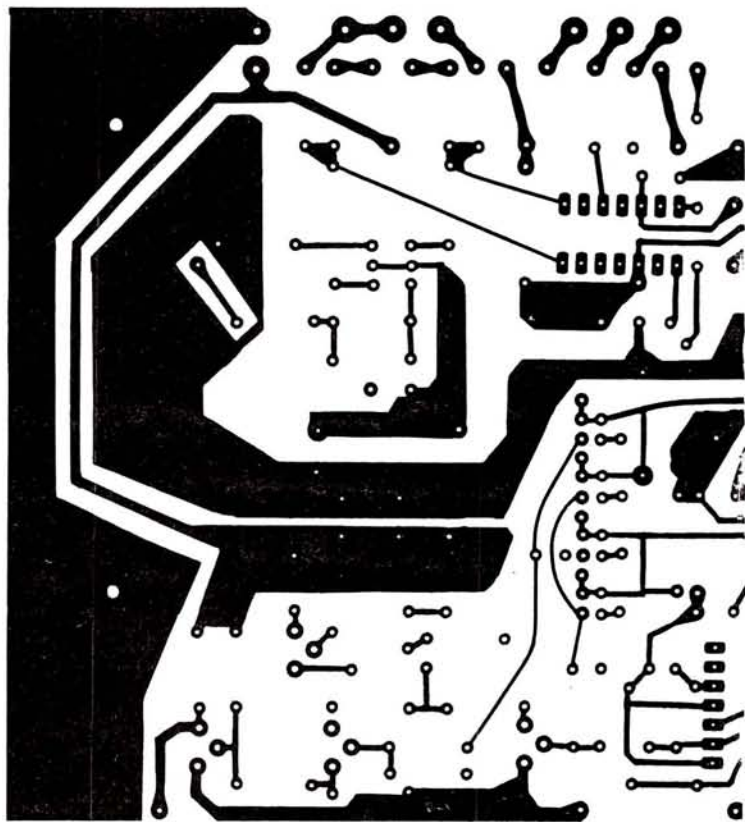
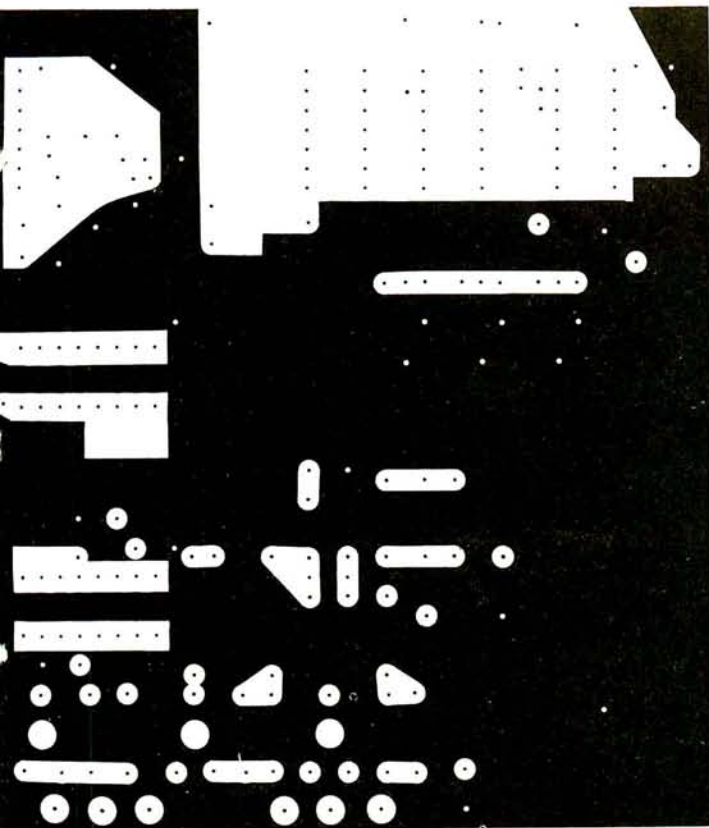


Fig. 9: The double-sided printed circuit board is used for the D shown full size above with the track pattern





Dual Trace Unit. The ground plane pattern (component side) is for the opposite side shown full size below



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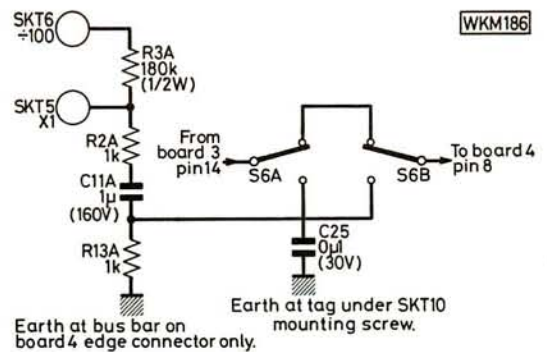


Fig. 10: Modifications needed to the PW Purbeck oscilloscope to enable the Dual Trace Unit to be used with it

Testing

Check with a multimeter that the shell of the 5 pin DIN socket and the p.c.b. ground plane are both connected to the metalwork (ground) and that none of the supply pins of the DIN socket is short-circuit to ground. The unit should now be connected to the Purbeck oscilloscope, which should be set to 100mV/div, $\times 1$, a.c. coupled, and the 'scope switched on. Check straight away that the +12V, +5V, -6V and -12V supplies at the pins of the Dual Trace Unit's supplies socket are present and correct. (If not, switch off immediately and investigate.) Set the trigger selector S505 and the mode switch S506 to Y1, the Y1 input attenuator S503 to 100mV/div and the Y1 gain control to maximum, i.e., fully clockwise. The Y1 shift control should be centred, and the d.c. conditions set up as follows.

1. Centre the trace on the screen of the Purbeck, then switch the Purbeck's input to d.c. coupled.
2. The trace will almost certainly move off centre and possibly off screen. If this happens set the Purbeck to 1V/div. Using the Y1 shift control of the Dual Trace Unit R519, re-centre the trace, switching back to 100mV/div to enable this to be completed exactly. If the trace cannot be completely centred leave the Y1 shift control at the end of its travel where the trace is nearest centred and complete centring with SET ZERO control R637 on the board.
3. Y1 balance control is now set up as follows: Rotate the gain control RV1, and it will, almost certainly, be found that the trace moves up and down. Adjusting R617 one way or the other will increase or decrease the amount of movement and R617 should be carefully set so that rotating the gain control over its whole travel results in no vertical movement of the trace. Note that the setting of R617 to achieve this will of course result in the trace not being centred.
4. Having set R617 the Y1 balance control, the SET ZERO control R637 should now be set such that the Y1 shift control R519 produces, at the extremes of its travel, an equal shift in the upwards and downwards directions relative to the centre of the screen. R629, the pre-set SHIFT CAL control should then be adjusted so that the full range of the front panel shift control just shifts the trace from the top to the bottom of the graticule.
5. Set the mode switch to select Y2 only and set up the Y2 balance pre-set R618 so that varying the Y2 gain control R518 does not change the vertical position of the trace. This is carried out as in 3 (above). Also adjust the Y2 pre-set SHIFT CAL control R630 to set the range of the Y2 front panel shift control R520 to eight vertical divisions. This range may not be centred equally above and below the graticule centre line; this is due to differing offsets in

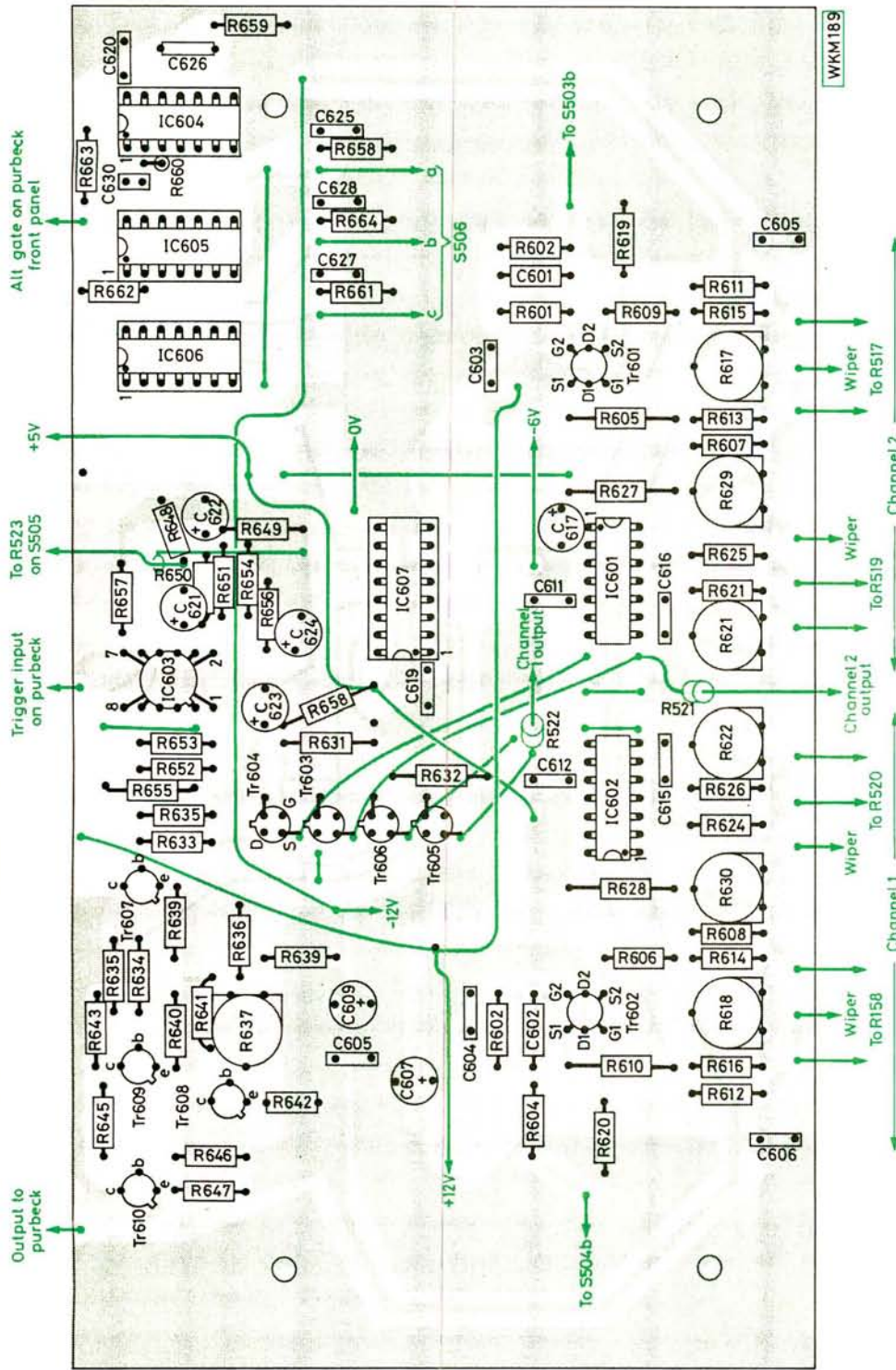


Fig. 11: The component placement diagram for the Dual Trace Unit. Note that the components are fitted to the ground plane side of the p.c.b. taking great care to ensure that connections are only made to the ground plane where indicated. The components are numbered odd for Channel 1 and even for Channel 2



Fig. 12: These links must be made using insulated wire, on the opposite side of the p.c.b. to the components

the 733 video amplifiers IC601 and 602. Any off-centring of the Y2 shift range can be halved by slightly re-adjusting the SET ZERO pre-set control R627. This splits the difference between the Y1 and Y2 shift controls. It also completes the setting up of the d.c. conditions.

Input attenuators

The next step is to set up the input attenuators for correct frequency response, and this requires a square-wave generator at say 5kHz, with adjustable output. The calibrator described in "Passive 10:1 divider probe for the PW Purbeck" in the June 1979 issue is very suitable, but arrangements will need to be made to "tee" it into the +12V STAB supply as you can't plug both it and the Dual Trace Unit into the Purbeck's accessory power socket at once!

It is assumed in the following that the 10:1 divider probe, which is currently used with the Purbeck, is correctly set up for use with that instrument, and that it will also be used with the Dual Trace Unit. This being so, it would clearly be inconvenient to have to re-adjust the probe every time it is changed over from the scope to the Dual Trace Unit and vice-versa, and the following procedure is designed to avoid this.

Probes

Check using the calibrator that the 10:1 divider probe really is correctly set up for use with the Purbeck. Now unplug the probe from the latter and connect up with the Dual Trace Unit.

Always switch the 'scope off whilst plugging in or disconnecting anything from the accessory power socket.

Connect the probe to the Y1 input of the Dual Trace Unit which should be set to Y1 only, Y1 trigger source. Set the Y1 VAR GAIN control to maximum, the Y1 input attenuator to 10mV/div, and the calibrator to 20mV output.

The resultant square-wave on the screen will probably not have square leading edges (see Fig. 3 of the June 1979 article on the 10:1 passive probe). Adjust C503 to obtain the correctly compensated waveform of Fig. 3a.

Now remove the probe and with the square-wave generator connected directly to the Y1 input set up C507, 513 and 519 in turn at the 100mV/div, 1V/div and 10V/div settings of S503, using an appropriate output from the calibrator and setting of Y1 VAR GAIN for each range. Now re-connect the 10:1 probe between the calibrator and the Y1 input socket and adjust C505, 511 and 517 in turn similarly.

This completes the setting up of the Y1 input attenuator, and the whole procedure should now be repeated to set up the Y2 input attenuator. With the Y1 gain control at maximum (counter clockwise) set the gain by adjusting GAIN CAL preset R621. Similarly set the Y2 gain with R622, and mark the $\times 0.5$, $\times 1$ and $\times 2$ settings on the panel. This finally completes the setting up of the unit, which is now ready for use.

The final part will cover using the Dual Trace Unit with the Purbeck oscilloscope.

A transparent front panel overlay is available to fit the case recommended. This overlay can be obtained from the editorial offices, price £1.60 including postage. It is understood that Watford Electronics will be supplying ready punched and printed cases for this project.

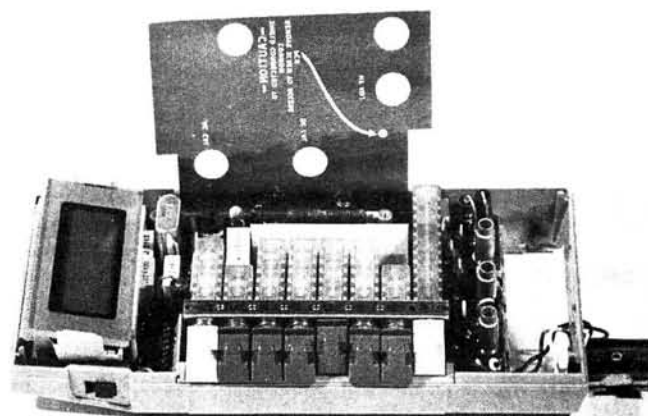
FLUKE 8022A DMM REVIEW

▶▶▶ continued from page 36

the case. This raises the display to around 45° to the bench. Automatic polarity indication is included in the display, as is overrange.

The manufacturers claim a battery life on continuous operation of typically 200 hours for an alkaline battery, or 100 hours for a zinc carbon, the type used being a standard 9V, NEDA 1604 ("PP3" size). A "battery low" indication is given on the display when approximately 20 per cent of the battery life remains. A battery eliminator is available for mains operation.

Of the six resistance ranges provided, three have a full-scale voltage of less than 250mV, and therefore will not turn on a silicon diode junction, while the remainder have a terminal voltage of at least 700mV (1V on the 2k Ω range) and will turn silicon diodes on. By the selection of an appropriate range, it is therefore possible to ignore the effect of diodes on in-circuit measurements, or not, as desired.



Internal view of the multimeter. The flexible p.c.b. material acts as a screen

The test leads provided are 1.2m long, terminated in special safety-shrouded 4mm connectors, but standard 4mm banana plugs will also fit the meter sockets. Only test prods are included, but other clips with a 4mm socket could be substituted for these.

Handbook

The measurement ranges of the instrument are summarised in the specification table, but full details are given in the handbook, which is among the most comprehensive seen for an instrument of this type. Subjects covered include full specification, operating instructions, check-out list, and measurement techniques (including conversion tables for various input waveforms). A detailed description of the theory of operation (the dual-slope integration technique is used, with a quartz crystal clock running at a multiple of the mains supply frequency) is given, plus maintenance, calibration, and trouble-shooting procedures, with circuits, component layouts, etc., provided.

The handbook is rounded off with a list of optional accessories available. These include carrying case, temperature probe, high voltage probe, two r.f. probes, current transformer, current shunt and battery eliminator.

The 8022A is covered by a full two year Warranty, and is available, price £102.35 including VAT, plus £2.50 p. and p., direct from **Fluke International Corporation, Colonial Way, Watford, Herts WD2 4TT, telephone (0923) 40511**, or from their distributors.

PRODUCTION LINES

alan martin

New Bench/Portable d.m.m.

Microprocessor techniques have allowed Fluke to incorporate some very useful features in their latest low cost 4½ digit 8050A d.m.m. For, apart from being a very compact and highly accurate bench/portable model with 39 measurement ranges and nine functions, the 8050A also provides unique dB computing and offset modes in addition to a high performance true r.m.s. capability.

In the dB mode, the 8050A d.m.m. allows the user to call up any of the 16 reference impedance levels from 8 to 1200 ohms and to display the readings directly in dBs.

Additionally, a reference/offset mode allows any input signals to be stored either as a reference value for relative dB readings or as an offset against any reading. In offset mode, the user can zero-out any lead resistances for really high resolution impedance measurements or set up a reference offset and display only the variance from that reading.

These absolute and relative dB modes with offset greatly simplify measurements in audio, amplifiers and telecommunications circuits as well as in production testing where only the variance from the stored value may be required. The offset facility is available on all functions such as a.c./d.c. Volts or Amps, Resistance or Conductance.

The high resolution 4½ digit l.c.d. display is matched by a basic d.c. accuracy of 0.03% specified over a full year. Measurements can be made down to 10µV, 10nV, 10mΩ with Fluke's true r.m.s. hybrid circuit providing excellent spectral response

on a.c. In addition to its comprehensive volts, ohms and amp ranges, the 8050A also has two conductance ranges for really high impedance measurements to 100 000MΩ, as well as low power ranges for in-circuit measuring of diodes and resistors.

An additional safety feature is an h.v. display whenever a dangerous voltage over 40V is present on the probes. This is especially useful in the dB or relative modes where the displayed reading does not show the actual input value. Further safeguards protect against overloads or misuse and the instrument is conservatively rated to withstand transients to 6kV.

A wide range of accessories such as high voltage probes, current transformers, shunts, temperature and r.f. probes, remote hold probe, battery pack, and safety leads make the 8050A a complete measurement system for the bench or field.

The 8050A is available as a mains only version costing £199 plus VAT and a mains/battery version which incorporates a built-in rechargeable battery pack and costs £239 plus VAT.

Further details from: *Fluke International Corporation, Colonial Way, Watford, Herts WD2 4TT. Tel: (0923) 40511.*

600MHz Mini Counter

From Sota Communication Systems Ltd., comes the Davis 7208 v.h.f.-u.h.f. Frequency Counter which incorporates the latest l.s.i. technology in a wide range portable instrument at a reasonable price.

Among the outstanding features of the 7208 are, an all metal case for r.f. shielding, large 10mm 8-digit l.e.d. display, built-in prescaler, gate light, proportional control crystal oven (optional), automatic decimal point, and with the built-in v.h.f.-u.h.f. preamp the 7208 can directly measure low level r.f. signals from r.f. generators. The 7208 can be operated completely portable with the NiCad battery option.

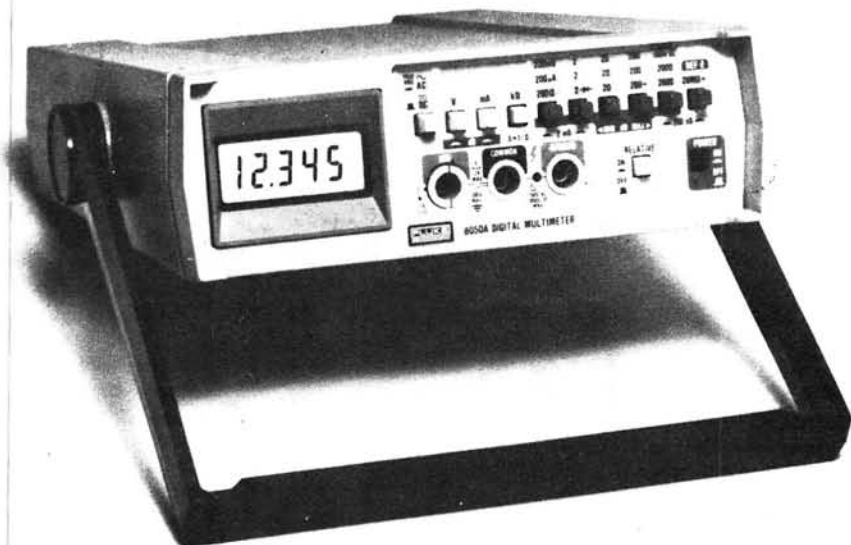
Priced at £145.00 plus VAT, the 7208 is available from the exclusive UK distributor: *Sota Communication Systems Ltd., 26 Childwall Lane, Bowring Park, Liverpool L14 6TX. Tel: 051-480 5770.*

More Bits/Tips

Adcola Products has announced the extension of their range of iron plated soldering bits/tips to include soldering tips suitable for the Weller Magnastat tools. Available in ten different profiles and three different temperatures rated 316°C, 370°C and 426°C.

Adcola has formed a Plated Products Division whose aim is to solely concentrate on the production of iron plated bits, at realistic prices, with an ever widening range of profiles and types to suit every requirement of the user of electrically heated soldering tools.

Further information from: *Adcola Products Limited, Gauden Road, London SW4 6LH. Tel: 01-622 0291/3.*



If you please

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

New Radio I.C.s

Two new circuits which will considerably increase the level of integration possible in professional radio equipment have been introduced by Plessey Semiconductors. Both products, the SL6270 and SL6310, are additions to the recently introduced SL6000 series of radio linear circuits.

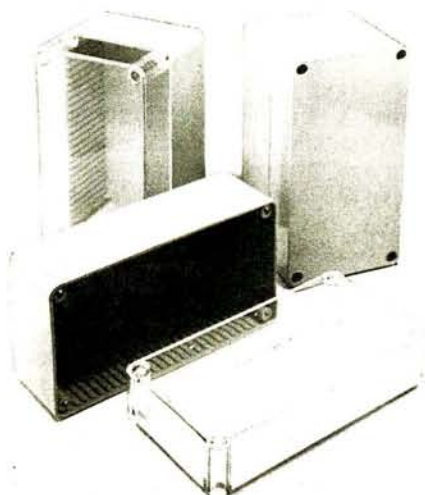
The SL6270 is a microphone amplifier with integral gain control. The circuit provides a constant output level whether the speech into the microphone is very loud or soft and therefore applications are anticipated in the tape recording and public address systems fields.

One of the limitations of battery life in hand-portable receivers is the high quiescent power consumption of the audio amplifier. The SL6310 is designed to avoid this excessive consumption by means of a novel feature which allows the circuit to be switched off in weak or noisy signal conditions by application of a 'mute' signal. Even when operating normally, the standby current is only 5mA, half that of comparable products, but the SL6310 is still capable of 500mW output power.

Plessey Semiconductors Ltd., Cheney Manor, Swindon, Wiltshire. Tel: (0793) 36251.

Look in

Augmenting their existing Bim 2000 range of Bimboxes, Boss Industrial Mouldings Limited have now introduced a new, 2 part, deep profile version, available with base and lid colours in black, grey, orange, or blue plus the added attraction of optional clear lid.



Manufactured in ABS with optional clear lid in SAN, as with all Bimboxes, 5.08mm spaced slots are incorporated on all sides of the base section capable of supporting 1.5mm thick p.c.b.s.

Both the coloured and the transparent versions of the lid are

Power Supply/Charger

The PS1200 is a power supply designed primarily for use with Trio TR2200G, TR2200GX, TR3200, TR2300 and Icom IC-202S and IC402 transceivers. The unit provides a 13.8V regulated d.c. output at 750mA and also a constant current charging supply (45mA) for the optional battery pack. This enables the operator to use the transceiver as a base station whilst at the same time charging the transceiver battery pack for portable use.

Powered by the a.c. mains supply, the unit is protected by inbuilt circuitry against short-circuit and thermal overload. The antisurge fuse is rated at 1 amp.

Sommerkamp 2m Transceiver

The Sommerkamp TS280 FM 2-metre VHF mobile transceiver is probably the world's most compact 80 channel 50 watt 2-metre FM transceiver. The high output power (quoted in the manufacturer's literature as 75 watt input) is achieved by adding the high power amplifier section at the back of the transceiver unit, thereby achieving a total depth of 290mm excluding controls, enabling the unit to be fitted under dash in most vehicles.

Of course, the high power capability means that the unit provides an excellent base station when used with a good high current regulated supply. The high power transistor output switch is fully protected against adverse load conditions, the p.a. shutting down immediately in the case of excessive s.w.r., etc.

80 channels at 25kHz spacing from 144-146MHz are achieved by using a pull switch on the squelch control to select lower end of the band. Repeater



The PS1200 is housed in an attractive metal case which measures 150 x 75 x 97mm deep, and weighs 1.35kg.

Obtainable either direct or through dealers, the VAT inclusive price is £29.50, postage and packing £1.25.

LAR Modules Ltd., 27 Cookridge Street, Leeds LS2 3AG. Tel: (0532) 452657.

selection is automatic thereby making this unit extremely easy to operate in mobile conditions. The bright green digital display directly reads the channel in use with the exception that RO reads as 40.

The receiver sensitivity is quoted 0.4µV for 12dB sinad with a squelch threshold less than 0.1µV. The total current drain of the unit on full power transmit is 8 amps at 13.8V d.c.

Also available for the TS280 is a variety of microphone options such as telephone handset with p.t.t. switch, a selective tone calling microphone, a loudspeaker microphone and a mobile hand microphone with built-in volume control.

Attractively finished in metallic blue with a dark green front panel, the transceiver is economically priced at £203.55 including VAT and delivery charge.

The TS280 is available from: *Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN. Tel: (0277) 219435 and 226470.*



secured by 4 screws running into base corner bosses, and, with the lid incorporating a small flange which sits recessed into the base, these boxes exhibit excellent water repellent properties.

Ideal for use in a wide variety of timer/control type applications, the

clear lid version in particular of this 150 x 80 x 76mm deep Bimbox is eminently suitable where viewing of, but not necessarily access to, internal components is required.

Boss Industrial Mouldings Ltd., 2 Herne Hill Road, London SE24 OAU. Tel: 01-737 2383.

THE VINTAGE YEARS OF RADIO

Chas E. MILLER



names today (although they have been swallowed up by large groups and exist only by virtue of “badge engineering”), but in the early '30s there were only two major examples of this practice—the “His Master’s Voice” and “Marconiphone” trademarks of the giant EMI concern. Later, Philips marketed an almost identical range, both under their own name and under that of Mullard. But the rest of the multitude of brand names were largely independent and individualistic. Some were offshoots of firms long-established in the electrical or entertainment fields (such as GEC, Ferranti and Decca) while others were set up by pioneers like Frank Murphy, E. K. Cole and Leslie McMichael.

This vast array of firms, large and small, were served by appropriately extensive component and valve industries. In this favourable climate, competition flourished and bore fruit: one of the first advances was that the town-dweller, at least, was freed from the drudgery of carrying accumulators to be charged as the new range of all-mains sets appeared. For the country folk, who as yet had no electricity supply, it was common for similar battery-operated versions to be supplied; these had the virtue of looking as modern, even if they didn’t perform as well! Indeed, it was not unusual for *three* variants of a basic chassis to be produced as the mains types had to be further sub-divided to suit either a.c. or d.c. supplies. The development of the universal a.c./d.c. sets came somewhat later.

For the domestic radio receiver, the '30s stand out as the vintage years. When the decade opened, the “wireless” was still emerging from the mahogany and ebonite cabinet plus separate horn loudspeaker stage; when it closed, very sophisticated sets with such features as motor-driven tuning, a.f.c., variable-selectivity i.f. amplifiers and high quality push-pull output stages were widely available. They were housed in cabinets with plastic and chrome fittings which emphasised the upsurge in the new technology.

This article examines the general development of receivers and the circumstances which helped to bring it about.

Evolution

The evolution of the radio receiver was phenomenally rapid. To draw a parallel, it’s rather as if the sixty year interval between the World War One biplane and the Concorde had been compressed into less than a fifth of that time! That it should have been accomplished at a time of chronic economic recession makes it all the more astonishing. But in spite of, or perhaps because of, the Depression there was a huge demand for the latest form of home entertainment and hundreds of firms sprang up to fulfil it.

Many of these early manufacturers are still household

Superhets

Another early advance was the widespread adoption of the superheterodyne receiver. True, some t.r.f.s continued in production (notably by A. C. Cossor, with their loftily-named “Super-Ferrodynes”), but the superiority of the superhet was soon clearly established—particularly as the number of radio stations and the power radiated by them increased. Good selectivity became an essential selling point.

For a number of years, the favoured i.f. lay in the 110–130kHz band and the amplification possible at these comparatively low frequencies with even the earliest h.f. pentodes and tetrodes can be an eye-opener to anyone lucky enough to be able to find a working set of the period. With this increased gain, however, came the need for some form of automatic gain control, then termed “automatic volume control”. It didn’t take long for simple a.v.c. to develop into delayed and squelch versions.

Sometimes, the two would be combined and the characteristic could be adjusted according to the listener’s requirements. The Ekco “Silent Tuning” models, for example, had a small knob which could be set for either “all stations” (minimum delay), through to a point where only the strongest signals would be received; in between, there would be complete silence in place of the usual jumble of music and speech.

**The “Melody Maker”, from A. C. Cossor Ltd., was a popular domestic receiver in the '30s and was available ready-assembled or in kit form, powered either from the mains or batteries. Our heading is reproduced from an advertisement in the “Practical Wireless” of 3rd December, 1932. “Volume is enormous, quality is excellent,” wrote one Yorkshire user—his aerial consisted of 25ft of wire tastefully arranged around the picture rail!*

Selectivity Problems

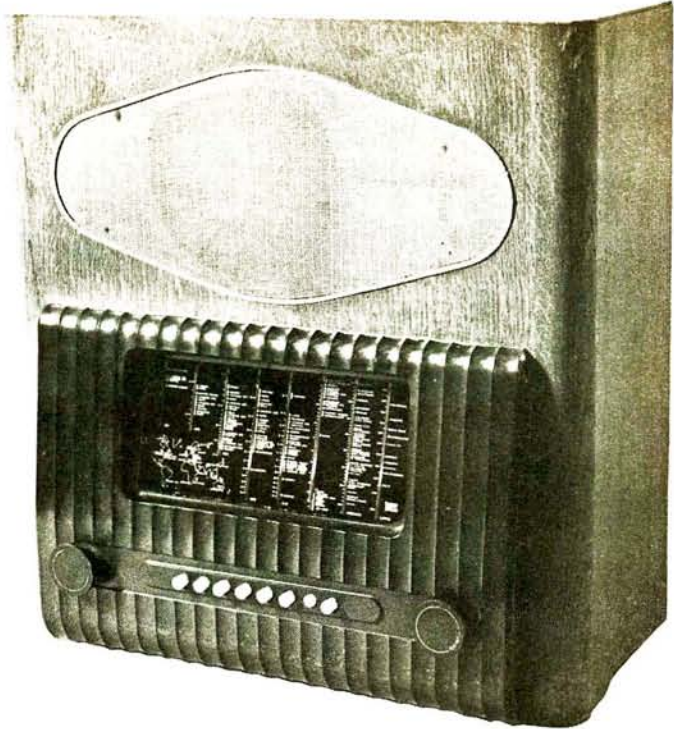
Improved selectivity brought with it extra problems for the designers, one of which was the need for accurate tuning if the harsh reception resulting from working on the edge of the acceptance band was to be avoided. Improved dials were a partial answer and, from having simple markings of 0-100, they advanced to having wavelengths and station names displayed; still something more was needed, however. Thus, tuning indicators were introduced which sensed the drop in h.t. current drawn by the i.f. amplifier valves when the correct tuning point, and therefore the point of maximum a.v.c. bias was attained. The indicator might take the form of a small meter or, more commonly, a long neon lamp mounted beside the dial. In due course, that famous gimmick the “magic eye” (a miniature c.r.t.) displaced both types.

Another line of thought was that it would be better to take the tuning out of the hands of the listener altogether and make it entirely automatic. There were three main approaches to this proposition: (a) electrical; (b) mechanical; and (c), a combination of both. Bush and EMI preferred method (a) and used a bank of push switches to select one of a number of pre-tuned groups of tuning coils. If the system was not to become too elaborate, however, it had to be restricted to “simple” superhets which did not possess r.f. amplifiers.

This was quite a drawback at a time when this feature was popular and did not apply to the mechanical method (b) favoured by, amongst others, GEC and Decca. Here, the push-buttons operated on cams which turned the gang capacitor to the correct position thus requiring no extra sets of coils; a small clutch meant that manual tuning could be instantly selected if desired. It must have been a good design, because it survives 40 years later in many of today’s car radios!

Ekco and Plessey went for method (c)—the electromechanical solution. These two concerns (who made the “Defiant” range for the Co-op) came up with what is perhaps the ultimate method using light-action push switches to control a small electric motor which did the actual work of turning the capacitor. To ensure accuracy, an a.f.c. system was incorporated and, once again, the basic design is still in use today.

Another problem was the attenuation of the upper audio frequencies caused by the narrow-bandwidth i.f. amplifiers. To alleviate this, some high quality designs (such as the RGD, for example) had a switch which broadened



A Murphy Type A92 a.c. mains receiver (1939), still going strong!

the i.f. response curve when reception conditions allowed. RGD (Radiogram Development Company) and EMI were probably the market leaders in this field, with concerns producing massive multi-valve sets with ponderous auto-change record-players which gave the impression of having been built in a shipyard!

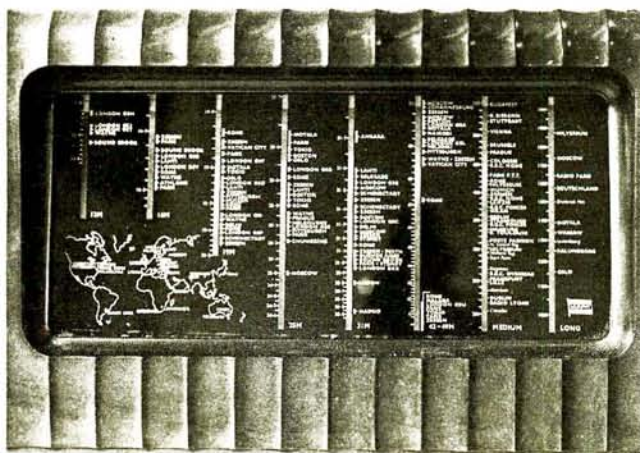
Wide Range

Nevertheless, not all radios in the '30s were on such a large scale. As the decade drew to its close a wide range of types was available, right down to semi-miniature sets which, having regard to the big valves that they used, were masterpieces of design.

Portable sets were, at last, becoming really *portable* thanks to the advent of 1.4V filament valves; before this, there was little difference in size and weight between a “portable” and a normal domestic model!

Thus, in 1939, there was an enormous range of radios on offer to the public and every taste and pocket was catered for. There were, however, two clouds on the horizon—one small, the other very large. The small cloud was television, by now well out of the experimental stage but still very much the poor relation of sound broadcasting—the second cloud was, of course, the prospect of war. With the outbreak of the Second World War the British radio industry was reduced to making just two standardised domestic models; one for mains use and the other powered by batteries.

Thus, the vintage years of radio came to an end, in the words of T. S. Eliot, “not with a bang, but a whimper”.



The informative tuning scales of the Murphy Type A92

continued on page 65▶▶▶

Ideas

DEPARTMENT

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

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

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

LOGIC LAMP DIMMER

This circuit is for adding a dimming facility to "sound-to-light" disco lighting systems. With coloured lamps of a given wattage, yellow and red usually seem to be brighter than blue and green, but conventional triac light dimmers cannot be readily interfaced with disco lighting equipment.

The circuit shown in Fig. 1 is that of a logic lamp dimmer which can be included in the final stage of many of the recently published lighting circuits.

The quadruple NAND gate IC1 is fed at one input with a full-wave rectified signal of 5V amplitude (see Fig. 2(a)) and the disco lighting control signal is fed to the other input. The full-wave signal (*unsmoothed*) may be taken from a suitable point in the lighting system p.s.u. When enabled by the control signal, the output of the gate gives a series of short positive pulses synchronised to the 50Hz mains. These pulses are integrated by the RC network (R1 VR1 and C1), resulting in a waveform having some resemblance to a sawtooth. This signal is then converted into a square-wave via the Schmitt trigger IC2. As VR1 is varied the slope of the sawtooth waveform is altered, and consequently the point in the cycle at which the Schmitt trigger will operate; thus the pulse width at the output is increased or reduced.

Up to four channels can be simultaneously controlled simply by using all four NAND gates of IC1, and the time-constants of the RC networks can be varied until the desired effect is achieved. With the values shown, the output pulse width may be adjusted to have a duration of up to 8ms—it should never exceed 10ms however.

R. C. Baker,
West Ewell,
Surrey.

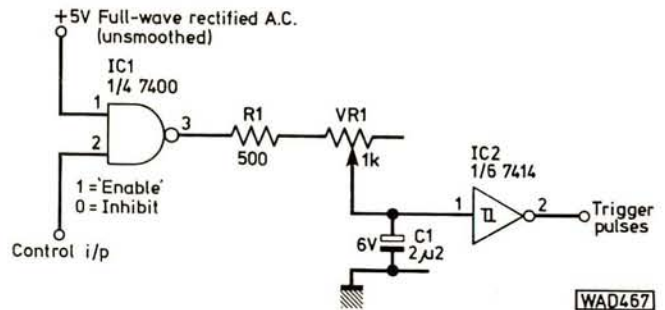


Fig. 1

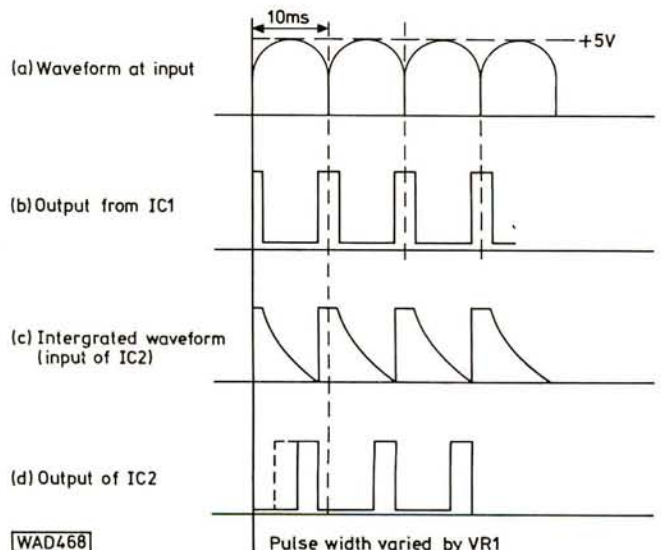


Fig. 2

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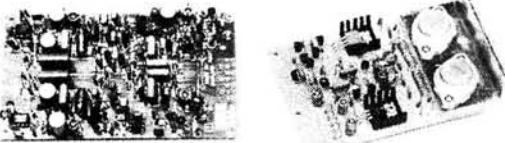


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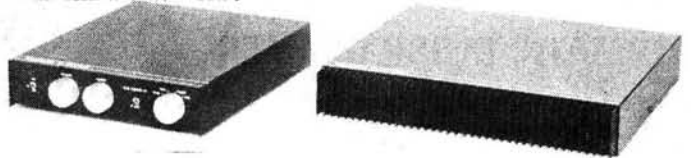
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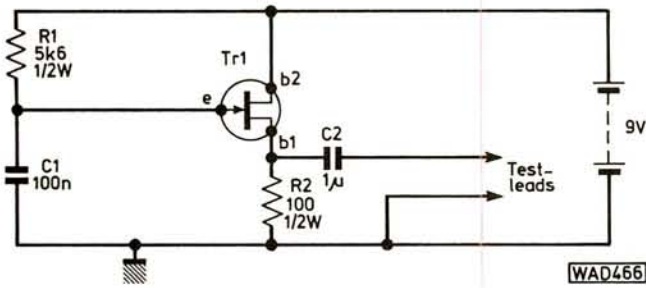
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"MINIC TELEPRODUKTOR

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SIGNAL INJECTOR



This simple signal injector can be used to test radios, amplifiers, loudspeakers, etc. Capacitor C1 charges up through R1 until the uni-junction transistor conducts: the capacitor is immediately discharged and, of course, the cycle starts again.

This results in a series of positive-going spikes at the output, possessing energy at both a.f. and r.f. The components can be mounted to correspond with the layout of the circuit diagram—capacitor C2 may be fairly bulky as it is a non-electrolytic type, but this is to isolate the circuit from high bias voltages which may be present on the equipment under test.

If a 220Ω resistor is connected between the test-leads, and the resulting wire loop is held near a working radio, the tone should easily be heard (not on f.m.).

*A. P. Cooper,
Wimborne,
Dorset.*

SOUND EFFECTS GENERATOR

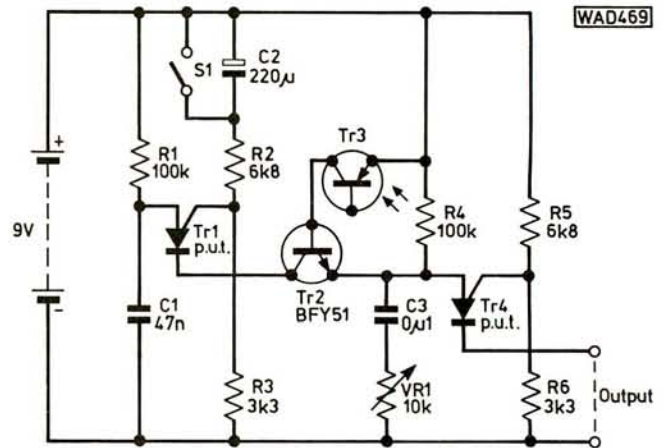
Although the “programmable uni-junction transistor” (p.u.t.) is a generally available device, there are relatively few circuits around which use it despite its similarity to the u.j.t.

In this circuit, two relaxation oscillators have been coupled together via a transistor biased by a photo-transistor. The frequency of the oscillations associated with Tr4 is varied by VR1, while those associated with Tr1 progressively decay due to the discharge of C2 (recharged by closing S1).

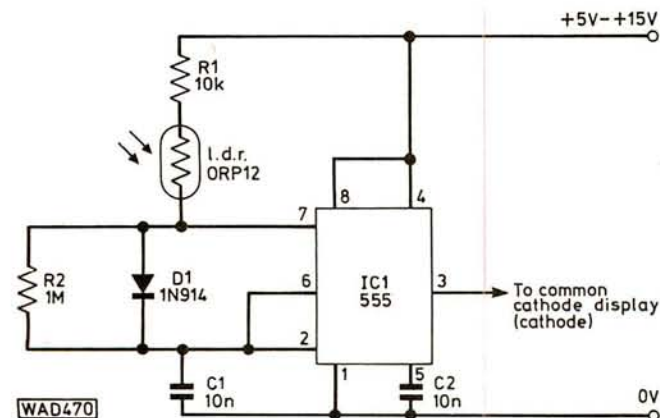
The p.u.t.'s can be either MEU21 or 2N6027 devices, and the photo-transistor was an OCP71.

By varying the values of the components, a wide range of eerie and interesting audio effects can be produced.

*P. Gatehouse,
Stowe,
Bucks.*



AUTOMATIC CLOCK DIMMER

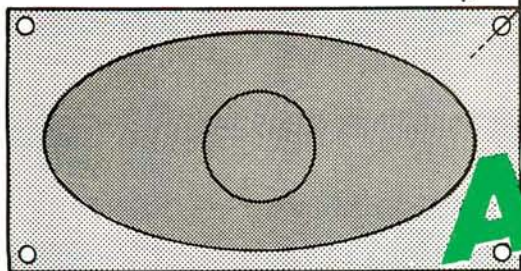


This circuit consists of a 555 timer connected as a variable duty cycle oscillator. Capacitor C1 charges via R1, D1 and the l.d.r. and subsequently discharges through IC1 pin 7 via R2. As the ambient light level increases, the resistance of the l.d.r. falls and thus the length of the charge cycle decreases. Since the output of the i.c. at pin 3 is positive during the charge cycle, the display is switched on for a proportionately longer part of the charge-discharge cycle as the ambient light level increases. Similarly, the display dims as the light fades.

To drive common anode displays, replace R2 with the l.d.r. and a diode connected in series, and increase the value of R1 to 1M. The anode of the new diode should be connected to C1.

The supply voltage can range between 5 and 15V, and the output of the i.c. can drive 200mA. The l.d.r. should be positioned adjacent to the clock display.

*D. A. Akerman,
Dagenham,
Essex.*



tweeter ATTENUATOR

T. P. Hopkins

It is useful to be able to adjust the level fed to the tweeter unit of a home-built loudspeaker system without affecting the main driver units. Some expensive commercial systems have a switched attenuator network to control the tweeter level; the unit described here allows the home constructor to add such an attenuator to his speakers.

No constructional details are given as this will obviously depend on the design of the speakers themselves.

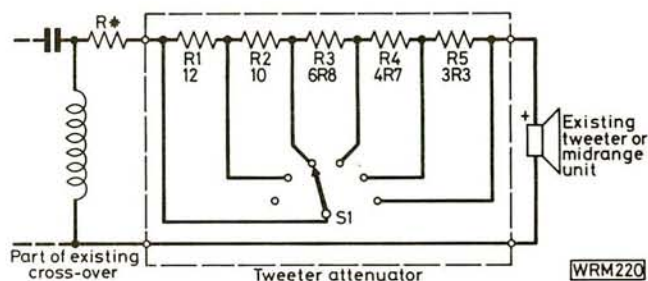


Fig. 1: Circuit diagram

Table 1

	1.5dB steps			3dB steps			5dB steps		
R1	4Ω	8Ω	16Ω	4Ω	8Ω	16Ω	4Ω	8Ω	16Ω
R2	1.5	3.3	6.8	6.8	12	27	33	68	120
R3	1.2	2.7	4.7	4.7	10	18	18	33	68
R4	1.0	2.2	3.9	3.9	6.8	12	10	18	39
R5	1.0	1.8	3.3	2.2	4.7	10	5.6	10	22
R5	1.0	1.5	3.3	1.5	3.3	6.8	3.3	6.8	12

All values in ohms

R1 to R5 are 2.5W wirewound resistors

Alternative Steps

The resistor values shown on the circuit diagram are for 3dB steps with an 8Ω speaker system but alternative values for other steps are given in Table 1.

Many cross-over networks have a resistor in series with the tweeter. If this is reduced in value, or removed, boost as well as cut is produced.

Resistors R1-R5 may be fixed to the rear of the switch. If this is mounted on a recessed plate (such as is normally used for a jack) and fitted with a matching knob, a neat finish suitable for baffle mounting is obtained.

★ components

Resistors

2.5W wirewound

3.3Ω	1	R5
4.7Ω	1	R4
6.8Ω	1	R3
10Ω	1	R2
12Ω	1	R1

Switches

1p6w rotary	1	S1
-------------	---	----

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FT~7B



PART 1

Mobile HF TRANSCEIVER



The Yaesu Musen Company of Japan introduced a mobile rig some years ago—the FT-75. Limited in its applications in fixed station use, it has been replaced by similarly sized, all-solid-state transceivers—first the FT-7 with ten watts output, and now the FT-7B, rated at 100 watts d.c. input. Although designed primarily for mobile use, the addition of c.w. facilities suggests that some thought was given in the design to possible portable use. The transceiver runs off a nominal 12 volt d.c. supply, and, as is usual with h.f. solid-state p.a. stages, is a wideband device. The only front panel tuning control is for the preselector, marked on the front panel as TUNE.

The bands covered are 80–10 metres, and provision is made for the coverage of the whole of the 10m band, although the crystal provided is for the 28.5–29.0MHz segment. Modes of operation are u.s.b., l.s.b. and a.m. on telephony, and c.w. A noise blanker is fitted, and provision is made for crystal controlled operation. A 100kHz crystal marker is provided, as is an aerial attenuator, and a clarifier, or independent receiver tuning control.

Construction of the equipment is very compact. Most of the circuitry is contained on "daughter" boards, which plug in to a "mother" p.c.b. There are two of these mother boards, and maintenance is almost impossible without a suitable set of extender cards. Although the average amateur has probably not got sufficient test equipment to be able to maintain the transceiver, nevertheless, reducing the maintainability to almost zero by the lack of extender cards is not a particularly good feature.

Generally, the standard of construction is reasonably good—slightly better than the usual middle quality range domestic equipment, except for the p.a. stage. This was very poorly built, and comments from professional radio designers on it were surprising—the writer didn't realise that some of his colleagues knew words like that!! Especially poor here was the method of thermal coupling between the

p.a. transistors and the temperature compensating diodes in the bias network. These diodes are attached to the p.c.b. over the transistors in such a way as to get some sort of thermal coupling, and suitably coated in heatsink "goo" to help. During measurements of the transmitter, it was noticed that the power setting tended to drift slightly, which is probably caused by this poor thermal coupling. The wiring to the p.a. stage was very poorly done, with several of the connecting leads suffering from soldering iron burns. Certainly the standard was not that which the writer would expect of prototype equipment, let alone production.

Technical Description

The transceiver is of the single conversion type, using a 9MHz intermediate frequency. The injection to the main mixer is derived from a pre-mixer system, in which the v.f.o. is mixed with a crystal oscillator, and the desired output is filtered and fed to the signal mixer, via a wide-band amplifier. The v.f.o. covers 5.0–5.5MHz, and so no mixing occurs on 80 metres.

The signal input is fed via the switchable r.f. attenuator unit to a tuned circuit, controlled by the front panel TUNE control. A dual-gate MOSFET amplifier acts as the r.f. amplifier, and this is followed by a coupled pair of tuned circuits. This coupled pair acts as a bandpass filter, and requires no tuning by the operator. An emitter follower provides a step down in impedance to drive a diode ring mixer using Schottky diodes, followed by a monolithic crystal filter, which provides some narrowing of the bandwidth and also delays impulse interference, allowing the noise blanker time to act. The monolithic filter is followed by an f.e.t. amplifier, a single diode as the noise gate, and an f.e.t. source follower driving the main crystal filter, which is a 6-pole filter. This is followed by the i.f. stages and detectors, all of which are built from discrete transistors—mainly MOSFETs. The noise

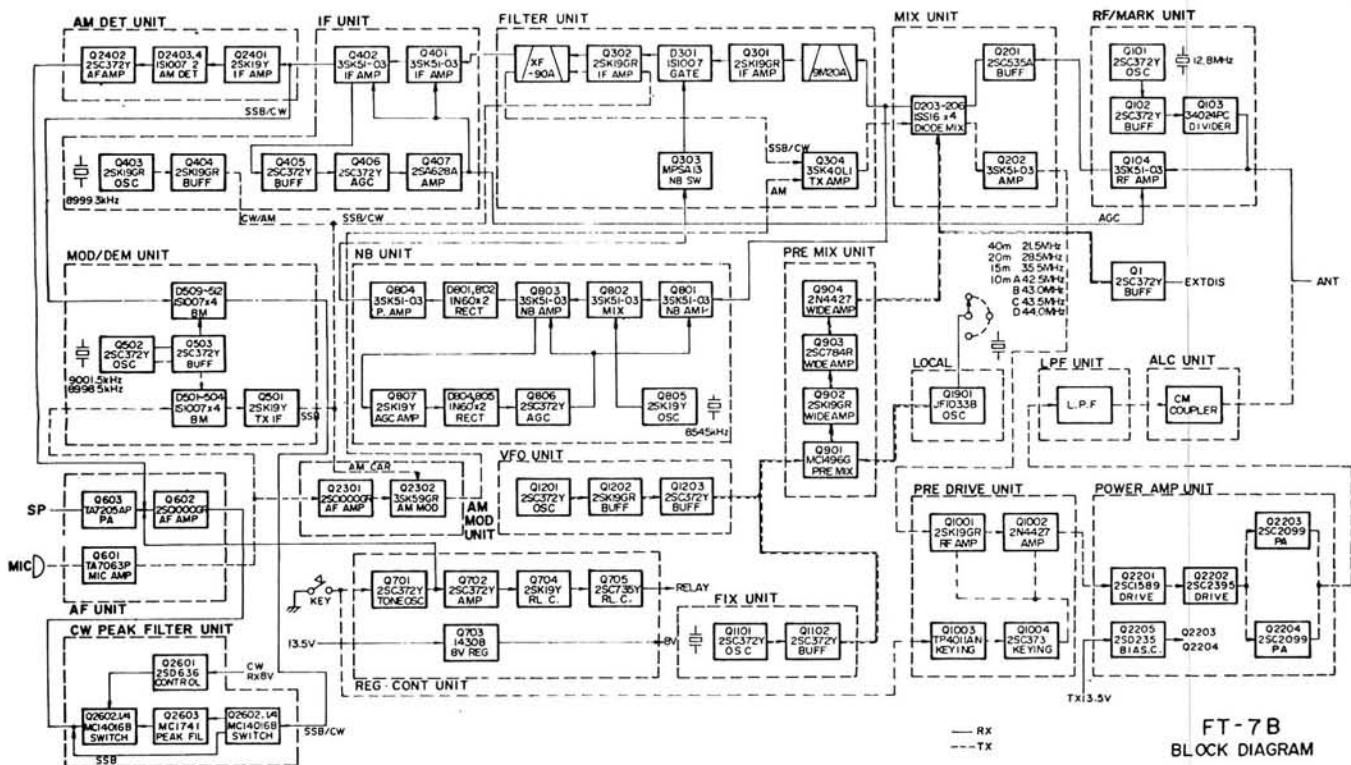


Fig. 1: Block diagram of the FT-7B

blinker is fed from the output of the Schottky mixer, and consists of an amplifier—mixer—amplifier—detector—d.c. amplifier chain, all of which, excluding the detector, use dual-gate MOSFETS. An a.g.c. loop is built into the amplifier chain, and the mixer converts the 9MHz input to 455kHz. The output from the detectors in the main signal path is fed to the audio stages, one of which is an active filter on c.w., with a bandwidth of some 80Hz. The a.f. output stage uses an i.c.—one of the relatively few in the set.

The transmitter is conventional, with an i.c. microphone amplifier feeding either a MOSFET a.m. modulator, or a diode balanced modulator for s.s.b. The signal is then amplified and filtered to produce s.s.b., amplified, mixed in the Schottky mixer with the local injection, and then via the bandpass pair referred to in the receiver description, fed to the pre-driver stage. This stage has a tuned circuit controlled from the front panel TUNE control to select the required signal, which is then amplified in various stages up to the 50 watt output level. Quite complex a.l.c. and s.w.r protection is provided, and a set of low-pass filters reduces the harmonic output of the p.a. stage.

Capability is provided for crystal controlled operation, with a different crystal for each band. The rest of the circuitry is concerned with power distribution, regulation, and switching, except for the crystal calibrator. This uses a 12.8MHz crystal, and a divide-by-128 CMOS divider. Automatic switching between transmit and receive, with a delay circuit, is used on c.w. transmission, but VOX is not provided. Fig. 1 is the block diagram from the handbook.

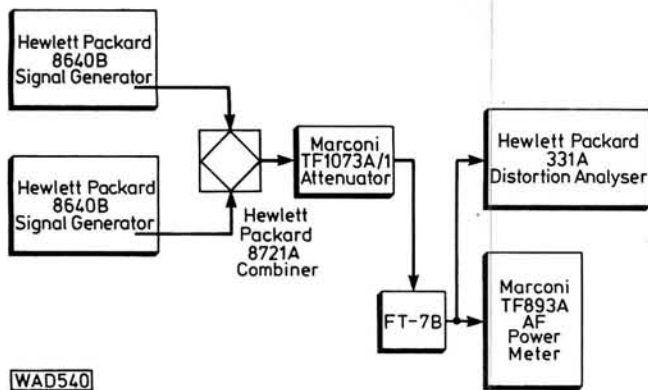
Measurement Techniques

Measurements can be split into two basic groups—transmitter and receiver. Receiver measurements are made with the system set up as in Fig. 2, while transmitter measurements are made as in Fig. 3. A somewhat sobering thought arises when it is realised that the cost of the test equipment to make these measurements to the accuracy

desired is about £35 000! Even then, the answers obtained on the air were required to complete the picture.

The transmitter measurements were fairly straightforward, and in general have been based on the applicable clauses and methods used for marine radio transmitters, which are probably the nearest thing commercially to the amateur equipment. Two audio frequency tones were fed into the microphone socket, and the output from the transmitter fed via the attenuator to the spectrum analyser. The following were then measured: power output; 3rd order intermodulation products; 5th order i.p.s; harmonics, and spurious. This was done for each band, and the results are in Table 1. The transmitter was then set up on 14.2MHz, and carrier suppression, hum and noise measured. As usual, there was a change in the level of carrier suppression with sideband, being -73.9dB on l.s.b. and -76.4dB on u.s.b, and also a slight change with power level. Hum and noise were better than -55dB. Application of a single tone 6dB down from p.e.p allowed measurement of transmitter passband, and the unwanted sideband suppression, while the final test is based upon the commercial tests aimed at limiting adjacent channel interference.

In general, it seems that the higher order sidebands in a solid-state transmitter tend to be slightly worse than those in a valve linear, and certainly at full output, the sidebands extend some way from the signal. The test for this is to apply two audio tones to the transmitter of such frequencies that the intermodulation products fall (for u.s.b) above +3.1kHz and below -200Hz relative to the suppressed carrier. The marine specification requires that products between +2.7 and +6.2kHz, and between -200Hz and -3.4kHz be at -31dB or lower relative to peak envelope power. From +6.2 to +9.4kHz, and from -3.4 to -6.6kHz, the requirement is -38dB, and beyond these limits it is 43dB, without exceeding 50mW. It is a particularly valid specification limit (reproduced graphically in Fig. 4) with transmitters that have appreciable higher order products; for Sunday mornings on 80m, however, a more stringent one could be considered



WAD540

Fig. 2: The receiver measuring system used by the author

necessary if anti-social emissions are to be avoided!

The final transmitter tests are of the c.w. keying. Again, the marine specifications are taken as a guide, and the transmitter is keyed by a 50% duty cycle signal derived from a pulse generator. The spectrum resulting, and the envelope distortion were measured with an oscilloscope and the spectrum analyser. The marine limits are for 30 baud keying (about 40 w.p.m.), and the bandwidth is limited to -24dB at $\pm 100\text{Hz}$, -37dB at $\pm 200\text{Hz}$, and -47dB beyond $\pm 400\text{Hz}$. Again, this is not a particularly tight specification, but does put limits on the anti-social behaviour of the transmitter (see Fig. 5).

Receiver Measurements

Receiver measurements are a much more lengthy process. To start with, it is necessary to ensure the method of coupling the signal generators to the equipment under test is satisfactory on the following points:

(a) Isolation of the generators from each other. This requires a suitable combining network, and a good matched load for the combiner, so an attenuator is used. Since the loss in the combiner is 6dB, it is convenient to use a 14dB attenuator after the combiner, thus giving a total loss of 20dB.

(b) Limiting the external attenuation of the signal to the practicable minimum thus reducing the amount of cable carrying high level signals and restricting the effects of leakage.

(c) Keeping the cable length from the final attenuator as short as possible to prevent inaccuracy caused by any s.w.r. on the cable—this s.w.r., of course, being caused by the receiver input not being exactly 50 ohms.

The measurements fall into three categories, viz: **Sensitivity-based checks.** These include signal-to-noise, S meter sensitivity, signal to noise improvement, ultimate signal to noise, a.g.c., and audio power output.

Two Signal Tests. These cover intermodulation, cross modulation, blocking and reciprocal mixing.

Spurious Responses. These cover internal whistles, and external spurious responses.

The sensitivity series of tests are easy to carry out. They measure the ability of the receiver to distinguish weak signals, and its ability to apply gain control correctly. Obviously, an attenuator in front of the receiver would give gain control by making all signals equally weak, but would also cause the signals to have an equally poor signal-to-noise ratio. The SINAD measurement measures distortion as well—SINAD stands for the ratio of Signal plus Noise plus Distortion to Noise plus Distortion only. For mobile use, an

Table 1. Output Power, Intermodulation and Spurious Outputs

Frequency	Output Power	3rd IMP (rel. p.e.p.)	5th IMP (rel. p.e.p.)	Spurious	Level (rel. p.e.p.)				
3.72MHz	45W	-31dB	-46dB	1.45MHz	-72.5dB				
				2.08MHz	-64.7dB				
				5.32MHz	-60.5dB				
				5.85MHz	-74.6dB				
				7.44MHz	-66.5dB				
				11.16MHz	-75.6dB				
7.20MHz	66W	-30.3dB	-43.7dB	14.88MHz	-75.6dB				
				5.4MHz	-74.2dB				
				7.092MHz	-65.6dB				
				7.308MHz	-67.0dB				
				9.0MHz	-68.2dB				
				10.8MHz	-74.6dB				
14.2MHz	45W	-29.9dB	-38dB	14.4MHz	-72.5dB				
				21.6MHz	-62.5dB				
				28.4MHz	-64.6dB				
				42.6MHz	-62.5dB				
				21.2MHz	45W	-29.1dB	-40.8dB	30.3MHz	-59.7dB
				42.4MHz	-60.4dB				
62.6MHz	-57.8dB								
94.8MHz	-58.9dB								
28.7MHz	42W	-30.3dB	-41.8dB	19.63MHz	-65.3dB				
				23.41MHz	-51.1dB				
				25.02MHz	-64.6dB				
				27.18MHz	-59.1dB				
				30.91MHz	-63.2dB				
				32.47MHz	-63.5dB				
				34.19MHz	-65.0dB				
				37.81MHz	-62.1dB				
				57.4MHz	-59.9dB				
				86.1MHz	-59.3dB				

Table 2. Modulation—Frequency Characteristics

Tone Frequency Hz	Level
-1000	below -70dB
-700	below -70dB
-400	below -65dB
-300	below -65dB
300	-11.5dB
400	-2.67dB
700	-0.42dB
1000	-0.45dB
1300	0
1900	-1.87dB
2400	-2.72dB
2700	-5.70dB
3200	-35.1dB
3500	-53.0dB
4000	-74.7dB
8000	below -88dB
10000	below -88dB

Table 3. Out of Channel Radiation

Measured at 14.2MHz at 45W p.e.p., modulated by tones of 700 and 2400Hz

Frequency relative to carrier frequency	Level relative p.e.p.
-7.75kHz	-42.9dB
-6.15kHz	-44.8dB
-4.4kHz	-38.2dB
-2.7kHz	-42.6dB
-1.05kHz	-29.3dB
4.1kHz	-28.4dB
5.85kHz	-45.1dB
7.45kHz	-38.6dB
9.20kHz	-48.9dB
10.95kHz	-44.3dB

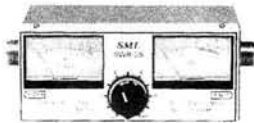
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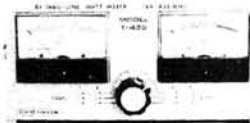
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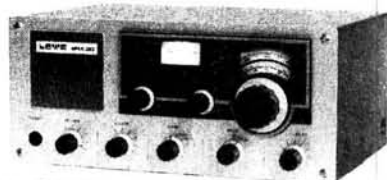
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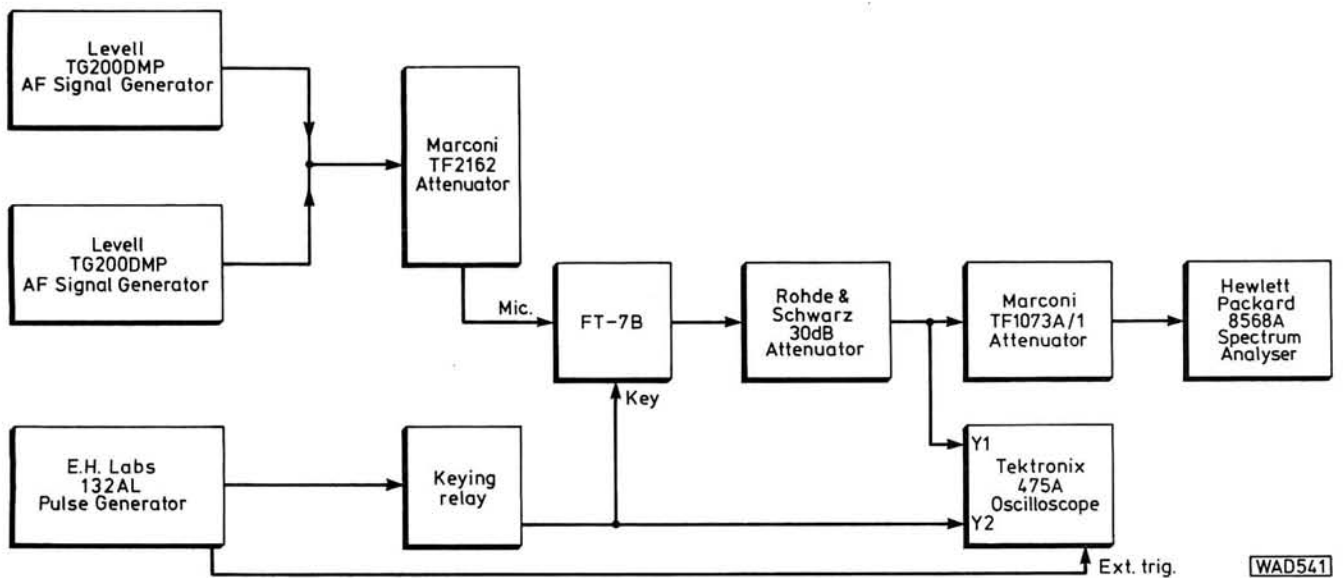
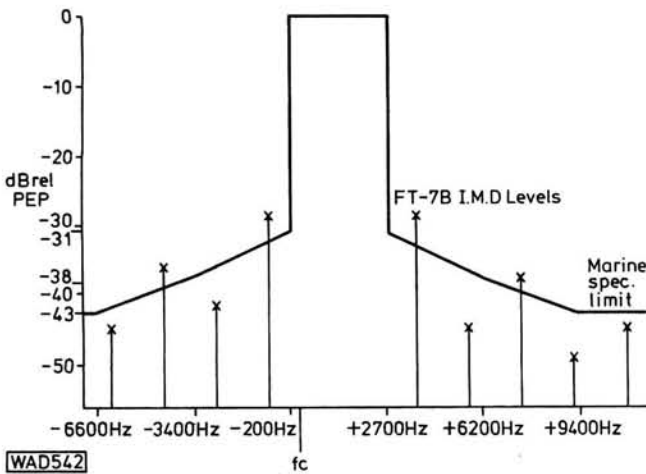
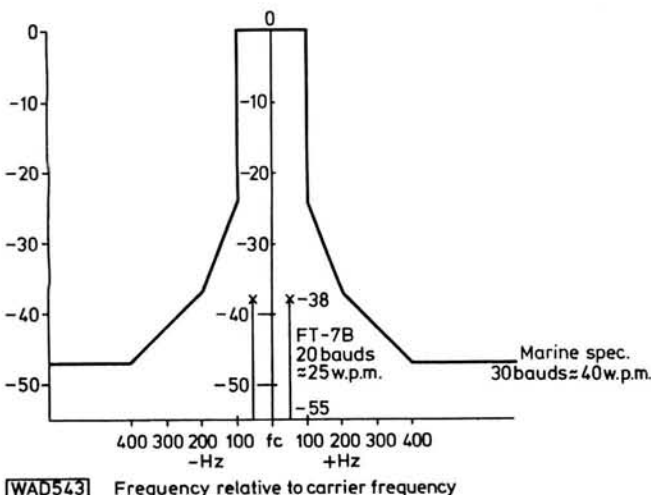


Fig. 3: The transmitter measuring system



WAD542

Fig. 4: Out-of-band radiation on s.s.b., compared with the UK Marine Transmitter Specification limit



WAD543

Fig. 5: Out-of-band radiation on c.w., compared with the UK Marine Transmitter Specification limit

Table 4. Receiver Sensitivity, Ultimate SINAD, Output Power and S meter

Frequency MHz	AF a/p @ 10dB SINAD	Input for 10dB SINAD	Input for 20dB SINAD	Ultimate SINAD at 1W output	Input for 3W a/p	Input for S9
3.7	200mW	0.075μV	0.23μV	27dB	0.3μV	14μV
7.2	150mW	0.1μV	0.35μV	29dB	0.55μV	20μV
14.2	250mW	0.15μV	0.4μV	29dB	0.5μV	20μV
21.2	150mW	0.15μV	0.6μV	29dB	0.8μV	30μV
28.7	35mW	0.23μV	0.7μV	27dB	2.2μV	90μV

Table 5. AGC Performance

Input Level	AF a/p @ 3.7MHz	AF a/p @ 28.7MHz
10mV	1W	0.93W
1mV	0.93W	0.93W
100μV	0.88W	0.82W
10μV	0.72W	0.45W
3μV	0.51W	0.15W
1μV	0.2W	15mW
0.3μV	30mW	1.5mW

important point is audio power output, and this is measured at the same time. The results of these tests are shown in Table 4.

The idea of a.g.c. is to keep the audio output of the receiver constant with changing input signal, and the results of this test are given in Table 5. The measurements were made on 3.7 and 28.7MHz.

The remainder of the receiver measurements will be described next month, together with comments on the measurement results and on tests "on the air"

A Battery

Eliminator

“Old Timers” will remember the “Eliminator” from the good old battery-valve days. With the ever increasing cost of dry batteries coupled with a seemingly ever shortening life of the things, it seems that now is the right time to build a modern version of the “Eliminator”.

The unit described in this article was evolved as a project for a group of secondary school teachers attending a basic electronics course at Brunel Technical College. During this course the elements of components, circuitry, colour-coding, and the Safety at Work Act as it affects school workrooms were made known.

The cuts in spending on educational matters made it imperative to “count the pennies” and make each part of the project cost effective.

Almost every project needs a battery or similar power supply, and the PP9 variety is one of the more popular types. The case of the PP9 makes a convenient cabinet for the “Eliminator”, after the old spent cells have been removed.

The circuit of the “Eliminator” is shown in Figure 1 and consists of a simple half-wave rectifier circuit coupled to a Zener diode stabiliser. The transistor Tr1 serves to amplify the current handling capability of the stabiliser.

continued on page 65 ▶▶▶

★ components

Resistors			
$\frac{1}{4}$ W 5%			
470 Ω	1	R1	
Capacitors			
1000 μ F 16V	1	C1	
Semiconductors			
<i>Diodes</i>			
BZY88C9V1	1	D2	
1N4001 or BY126	1	D1	
<i>Transistors</i>			
BFY50 or 2N696	1	Tr1	
Miscellaneous			
Transformer 9V 6VA, PP9 battery (spent), PP3 connector, 6V 0.3A lamp, 6BA nuts and bolts.			

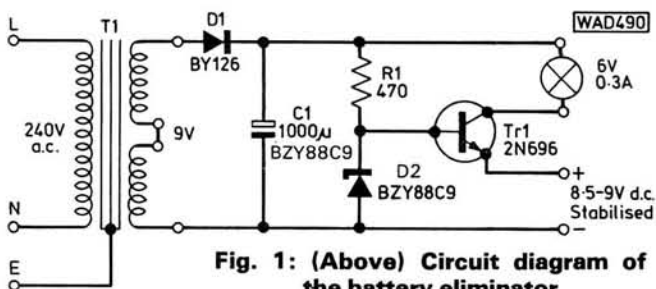
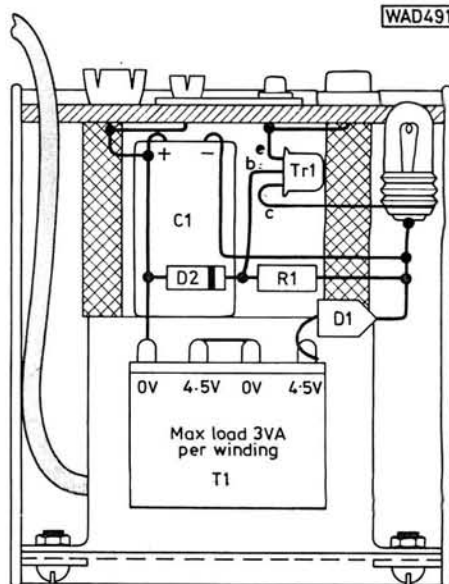
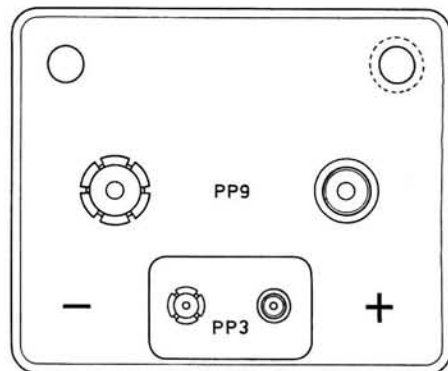
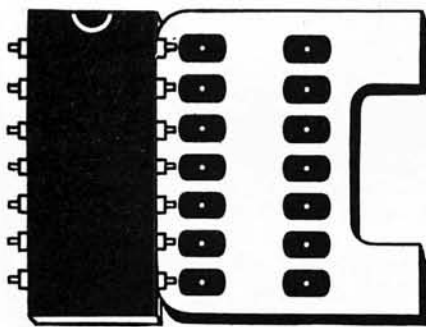


Fig. 1: (Above) Circuit diagram of the battery eliminator

Fig. 2: (Below) The constructional details of the unit





OF THE MONTH

Brian DANCE M.Sc

TEXAS INSTRUMENTS TL496 REGULATOR

Voltage regulator integrated circuits are commonplace nowadays (indeed, the TL497 from Texas Instruments was the subject of this series in December's *PW*) but the TL496 is unique, for it contains two separate regulator circuits within a compact 8-pin d.i.l. package. One circuit is a switching regulator accepting an input from either one or two NiCad rechargeable cells which it then converts into a regulated output of 7–9V at a maximum current of 80mA. The other circuit, which is a series regulator, provides an output of 8.6–10V when a mains supply is available—thus both regulator and charging circuit are conveniently accommodated within a single i.c!

Calculators and battery-powered toys for which one requires a 9V supply without going to the expense of seven or eight rechargeable cells, are just two obvious applications for the TL496. It is naturally much cheaper to employ one or two cells and to convert the voltage upwards to 9V, than it is to connect NiCads in series until the same e.m.f. is achieved. The TL496 can also be used to “step up” the output voltage of conventional “dry” (Leclanche) or alkaline cells; both of these types are not, of course, rechargeable.

The device could also be used to power a *small* radio receiver from one or two cells. Remember, however, that the small maximum output current (voltage up = current down!) means that there is insufficient power to drive the radio unless the volume is kept low. Any attempt to gain a high audio output will merely result in distortion. Despite this, the device certainly has interesting applications for small receivers of the hand-held variety.

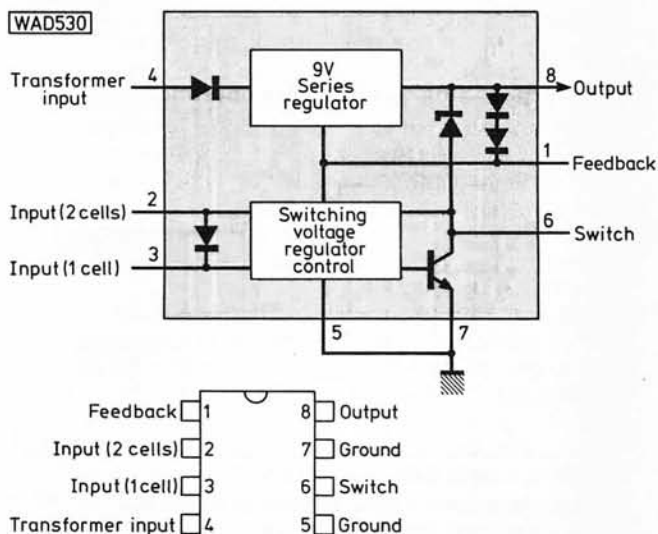
Internal Circuit

The internal circuit of the TL496 and the external pin connections are shown in Fig. 1. It should be noted that although pins 5 and 7 are connected internally, both must be connected to the zero voltage line in order to ensure correct operation. If only one cell is to be used, it should be connected with its positive side to pin 3 and its negative side to ground, while pins 2 and 3 should be connected together in order to short-circuit the internal diode (Fig. 3). Similarly, pins 1 and 8 should also be connected together for the same reason; when used with a single cell, note that the cell used should provide an e.m.f. of 1.1–1.5V.

When used in the two-cell configuration (Fig. 3), the total input voltage should be 2.3–3V; note that the internal diodes should *not* be short-circuited for two cell operation.

The circuits are simple but do involve the use of an inductor; optimum efficiency (power output divided by

power input) is achieved when this inductor has a value of 40–50 μ H. The Fig. 2 circuit provides a maximum output of 40mA at 7.2V, and 80mA at 8.6V can be obtained from the Fig. 3 circuit.



Decoupling

The importance of adequate decoupling cannot be over-emphasised. The author, for example, tried fairly long leads to the cells and found that the circuit would simply not operate when the decoupling capacitor between pin 2 and ground was removed. Both capacitor negative returns (pins 5 and 7) should be connected together with quite short lengths of wire.

As the switching frequency is approximately 10kHz and peak currents of about 1A occur, the filter capacitors should be of reasonable quality and should not have an unusually high equivalent series resistance; this comment applies equally to all of the circuits to be discussed.

Battery Operation

The circuits shown in Figs. 2 and 3 operate purely as a boost circuit switching regulator. The cycle commences when the potential at pin 1 falls below a certain threshold value, namely about 7.2V. In the circuit of Fig. 2, this will occur when the output is about 7.2V but, in the Fig. 3 circuit, the cycle will begin when the output is greater than

this by the voltage developed across the two internal forward-biased diodes shown in Fig. 1. Thus the threshold for "turn on" in the Fig. 3 circuit is about 6.8V.

As the output voltage falls below one of these values, the output transistor is turned off and the energy stored in the inductor is delivered to the output reservoir capacitor.

The output transistor remains in the non-conducting state until the output voltage sensed by the feedback input (pin 1) again falls below the threshold value for the circuit concerned.

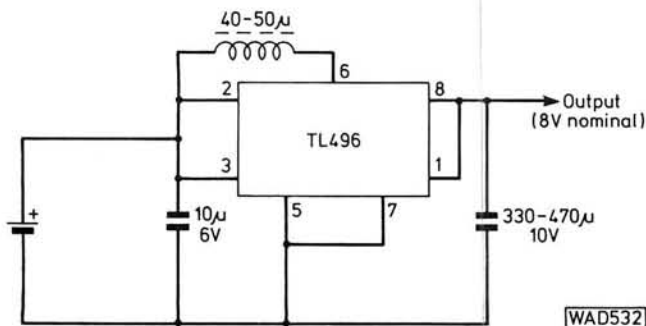


Fig. 2: Single cell battery operation

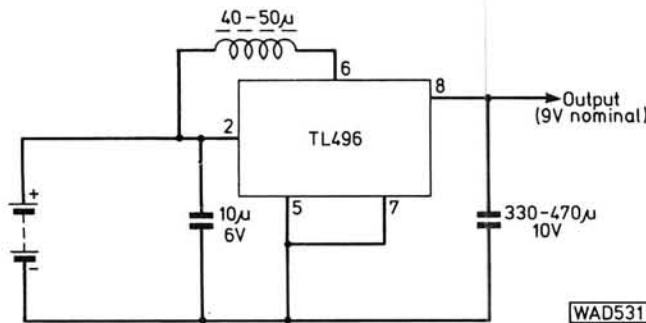


Fig. 3: Battery operation with two cells

Mains Operation

The circuits of Figs. 4 and 5 show how a small transformer with its input connected to the mains supply can be used to power the TL496, and charge the cells connected in the circuit. If the mains fails or the equipment is disconnected from the mains, the cell or cells will automatically and instantly maintain the output voltage without even a momentary interruption of the power output.

The series regulator of the TL496 device accepts its power input from the mains transformer during the half cycle when the lower end of the transformer secondary winding (as it appears in the circuit diagrams) is positive with respect to the upper end. The output voltage from the series regulator circuit is slightly higher than that from the switching circuit; thus, when mains voltage is present, the output voltage always exceeds the threshold level at pin 1, and the output transistor is kept in a non-conducting state. When mains power is being used, the output voltage is typically 10V for the two-cell circuit of Fig. 5 and about 8.6V for the one-cell circuit of Fig. 4.

During the succeeding half cycle of the mains input, the series regulator will not operate because the applied polarity is such that no current can pass through the internal diode connected in the pin 4 circuit (Fig. 1). However, diode D1 clamps the negative-going side of the transfor-

mer secondary winding to ground so that the positive-going side can supply current to the positive terminal of the cell or cells; thus charging takes place.

There is an absolute peak voltage rating at pin 4 of 20V, therefore the output r.m.s. voltage of the transformer secondary winding should not be in excess of 12V. In practice, a transformer with a 6.8V r.m.s. secondary output voltage and a secondary resistance of 11Ω was found to be quite satisfactory.

The secondary resistance is not critical but does affect the charging current which can flow; an excessive charging current will, of course, ruin any cells that are subjected to it!

Performance

The TL496 has *not* been designed for applications which require the highest possible voltage stability. There is some change of output voltage as the swap from battery to mains operation occurs (an increase of approximately 1.4V), but this is unimportant in the type of application for which this device has been designed.

Care should be taken to ensure that the absolute maximum voltage ratings of 3.5V at pin 2 and 2.5V at pin 3 are not exceeded, and that the switching current at pins 6 and 8 does not exceed 1.2A. The TL496 is designed for use at temperatures in the range 0–70°C.

A noteworthy feature of this device is the low supply current drawn during stand-by operation—typically 125μA. In most circuits, this allows the battery to be

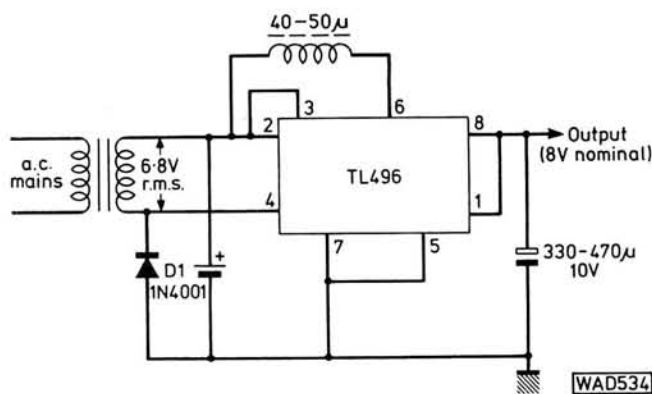


Fig. 4: Single cell mains operation

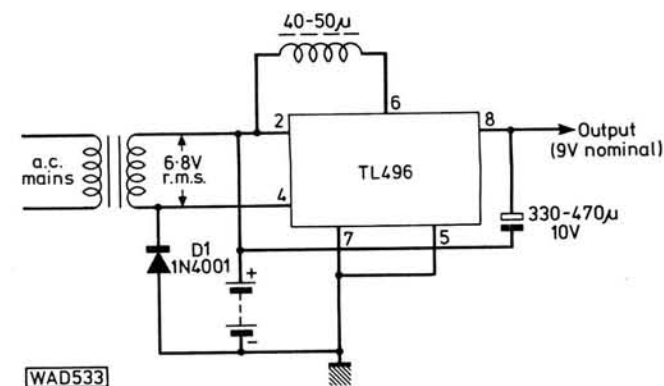


Fig. 5: Mains operation with two cells

connected at all times as, at this rate of discharge, the estimated period between charges is 60 days for the single-cell configuration and 166 days for the two-cell arrangement!

When an output current is drawn, the input current in the case of battery operation must obviously exceed the output current since the output voltage exceeds the input voltage—one, after all, cannot create energy from nothing! The typical efficiency for battery-powered operation is 66% in all cases. With a 120Ω load connected across the output, the current drawn from a single cell is approximately 525mA, and that from two cells approximately 405mA.

Table 1. Performance of TL496 circuit used by the author. In all cases the input voltage was 2.5V

V _{out}	Load (Ω)	I _{in} (mA)	I _{out} (mA)	Power I/P (mW)	Power O/P (mW)	Efficiency %
9.72	—	0.17	—	0.425	—	—
9.72	2.2M	0.27	0.004	0.675	0.039	5.8
9.72	100k	1.3	0.097	3.25	0.94	28.9
9.71	39k	3.05	0.248	7.62	2.41	31.6
9.70	10k	10.2	0.97	25.5	9.41	36.9
9.65	2.2k	31	4.39	77.5	42.3	54.6
9.52	1.0k	75	9.52	187.5	90.6	48.3
9.0	200	370	45	925	405	43.8

The Inductor

Unlike other passive components, inductors can be difficult to wind to a definite specification as one has to consider not only the value of inductance but several other factors as well: the resistance and thickness of the wire to be used; the core material; Q factor and its variation with change in frequency, etc. No particular inductor is stipulated by Texas, but it is recommended that the resistance of the inductor winding should not exceed 0.15Ω for high efficiency in the battery-operated mode.

The author chose a Mullard RM6 ferrite core which has an inductance factor (known as A_L) of 250nH/(turns)²—a single turn of wire on this type of core therefore has an inductance of 250nH. Because the inductance increases as the square of the number of turns, it is easy to calculate that 13½ turns of wire are required in order to achieve the required value of about 45μH. The part number of the RM6 ferrite core is LA4146; you will also require a DT2467 coil former and two DT2398 retaining clips (alternatively, the DT2498 retaining clips with an earthing tag may be used). The copper wire used must, of course, be of the enamelled variety.

The tables in the Mullard Technical Handbook (Book 3, Part 4) indicate that 13½ turns of 0.85mm diameter wire could be accommodated on this former, but 0.56mm diameter (24 s.w.g.) was used in practice. The coil former was supported during the winding operation; it was then necessary only to mount the ferrite parts onto the former and fix the retaining clips in order to complete the inductor.

The performance that resulted from using two cells and this inductor is shown in Table 1.

Availability

The TL496 and the above-specified inductor components are available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN. ●

The Vintage Years of Radio

▶▶▶continued from page 51

Peacetime

When peace returned, the lessons of miniaturisation that had been learned in wartime, were applied to the new domestic radios—"small is beautiful" became the order of the day. A few attempts were made to revive the luxury radiogram, but the writing was on the wall; the giant strides made by television would soon relegate sound to second place as a home entertainment medium.

In the '50s the mergers and take-overs started to shrink the numbers of the actual manufacturers—perhaps the most symbolic withdrawal was that of EMI and RGD. Some good-looking sets of excellent performance continued to be made but somehow they lacked the character which, in another field, makes the modern mass-produced car far less interesting to an enthusiast than the older hand-built job.

An incident recalled from a few years ago might serve as an example. The author used to carry out trade service work for a well known radio store in Stoke-on-Trent when one day a pre-war radio (by then about 35 years old!) was brought in for repair. It still possessed its original valves, the fault was minor and, although it hadn't been a particularly notable model in its day, it brought murmurs of approval from the people in the shop when it triumphantly burst into life. One of the half dozen or so customers had been listening to a modern transistor radio—by comparison, it sounded strangely "tinny". He shook his head sadly and placed the set back onto the counter.

It was perhaps the best tribute he could have made to the long-defunct maker of that truly vintage receiver! ●

A BATTERY ELIMINATOR

▶▶▶continued from page 62

Construction

The top edges of the metal PP9 case were squeezed using large pliers until the bottom could be pushed up to expose the layered cells, the connectors and the moulded plastics base. The spent cells were carefully removed and discarded and the base drilled to allow the transformer to be secured with two 6BA nuts and bolts. The reservoir capacitor C1 was mounted on a blob of Araldite which both insulated and fastened it on top of the transformer.

Blocks of wood were used to support the connector board at the correct height and also to reform the PP9 shaped outline. Two holes in the back corners of the connector board allow the three-core mains cable to exit and the overload bulb to be seen. If desired a PP3 connector can be fitted to the top, while, for teaching purposes, the sides could be cut away and clear plastics sheet fitted to allow the components to be seen.

The performance of the supply is comparable to a PP9 giving 8.4V at up to 100mA while the ripple is about 10mV peak-to-peak. Short-circuit conditions cause the bulb to light and this also gives a measure of protection against overload.

The prototype models have easily earned their keep and should be able to pay their way in about three or four battery lives. ●



AMATEUR BANDS

by Eric Dowdeswell G4AR

I get rather het up, as they say, when I hear from a reader who has bought an XYZ receiver on which to listen to the amateur bands and, please, what do I think of it? Generally it is a cheap and almost nasty contraption that performs moderately well on the medium- and long-wave bands with its ferrite rod aerial but is a bit of a failure on the s.w. bands with only its telescopic aerial.

I get angry not because it's a lousy receiver but because the writer has not bothered to get some advice before spending his money. At the very least the receiver should have been tried out before buying.

One of the advantages of belonging to a radio club is the vast amount of practical knowledge that exists there waiting to be tapped just for the asking. Mention almost any receiver and someone is bound to be an expert on it, just waiting to pour forth at the slightest pretext, and all for free.

The newcomer may very well be able to get a suitable receiver from a member of the club, secondhand, and maybe even valved although that is by no means a disadvantage, especially when one considers the performance of some of the solid-state sets of today. What is more, advice on operating the set will be forthcoming and should it go wrong the answers will be readily available, which is more than one can say about some suppliers of receivers.

The lone buyer of a s.w. receiver does have to rely to some extent upon the blurb in the ads but it shouldn't take much common sense to realise that a cheap set that professes to cover all bands from v.h.f. to the long-wave band must be something of a compromise as far as performance is concerned. None of the ads tell us outright lies these days but the copywriters certainly have a vivid imagination in some cases! If you just want the amateur bands don't go for a set that promises the trawler, police and air bands (as well as all the s.w. broadcast bands), because, for one thing, it is illegal to listen to them and they rapidly become rather boring, which the amateur bands never do.

Having been lumbered with a poor set a writer will often ask how he can improve it and how does he go about connecting up an outside aerial to make reception better. Firstly, it's almost impossible to do anything to the set to make matters better and the cost of the necessary parts to do it would be prohibitive considering the price of the set

in the first place. Give it away to some small friend! Adding an aerial just compounds the problems by causing severe cross-modulation on any strong signal because of the cheap and poor transistors being used and the fact that there is certainly no r.f. stage fitted.

So, what to do? Look at the ads and see what the more popular receivers are, compare the prices although these won't vary much between reputable suppliers. Make every effort to locate someone already using the set you fancy and ask them for their views on it. Ask a supplier for the address of someone in your area who has bought that particular set and arrange to visit them after dropping them a line.

As a last resort there are always nutcases like myself willing to stick their necks out and give advice!

In General

By the time that this appears in print there may be some definite news of the three new bands which are to be allocated to the amateur service, according to two very reputable sources. However, don't let's get all excited because by the time any such allocation has been ratified by all the countries concerned and existing occupants have moved out, presuming the allocations are exclusive, it could be a matter of three years or so.

It's good luck and good DX to **Bill Kerr** of Aldershot, Hants, who has become G8UNV, at least until he has taken the code exam. For the time being Bill is using a Storno valve rig with seven channels, run from a car battery. It's a start, anyway. In West Wickham, Kent, **John Dainty** is busy swotting for the RAE which he hopes to take this year, so he has not been listening around too much. He did shorten his aerial to around 130ft which enabled his a.t.u. to work properly and give better results generally.

An appeal from **Chris Mousley** of 6 Queens Road, Aldershot, Hants, for any info on a power supply for the R1155B that he has recently acquired, or even a manual if anyone can help. A more specialised appeal from **Alex McLennan**, 6 Christie Street, Dunfermline, Fife, for a wavechange switch for his Hallicrafters S38 receiver.

Using an SRX-30 in Leeds, **Basil Woodcock** is only just finding the amateur bands but he has made up an a.t.u. for the couple of aerials so far erected. He's on a hill 400ft a.s.l. so the DX outlook is good. Another listener to write in for the first time is **Arthur White** living in Grantham, Lincs, who sports an Eddystone 888 receiver with a 66ft wire and a.t.u., with an inverted "V" aerial for the 40m band where he found ZL4BO after a lot of patience. **Dick Barker** (Canterbury, Kent) has a "warm glow of confidence" after taking the RAE and hopes the examiner is in a good mood when marking the paper. Well, let's hope the multiple choice system will eliminate any such bias in the



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future! Space for aerials is Dick's problem, without even enough for a 10m dipole but I doubt if it is really as bad as that! Even a wire round the room will be effective on several bands given an a.t.u. to bring it to resonance.

DXers' Corner

Dave Coggins (Knutsford, Cheshire) keeps going strong on his DX160, covering all the h.f. bands on s.s.b., although the set seems to be suffering from modulation hum on the 10m band. He comments: "I reckon listening is one half of the hobby, and building gear the other half" and how true that is! The satisfaction of building a bit of equipment and then going on the air with it takes a lot of beating. The 10m band provided FK8CK, FR7BE, HM000, TA2AS. XT2AW with AP2KS, VP2VFO (Tortola, QSL AA6RX) and YB0ADW. 40m came up with HH2BM for quite a rare country, VK7BC, 5N0AAS while 160m meant UA3ACE.

Collecting books and manuals for the RAE is keeping **Bill Rendell** of Truro, Cornwall, busy at the moment and he has mentioned the May RAE as his target. The lure of the VK/ZL gang has been too much for Bill and he continues to collect them daily; for nearly 200 days now. His valued AR3 plus lots of gadgets found CM1RH, VK3XI and ZL4BO on 7MHz with 14MHz supplying C5ABK, FG7TD, FK8DH, M1D, VP2SAX, VP8SI on Argentine Is., and XT2AU. Also heard were ZL1, 2, 3 and 4 in a space of 20 minutes, 8Z4A (also found on the 15m band) with HK3LT on c.w., a change of mode for Bill.

Dennis Sheppard (Sheerness, Kent) is getting famous! He got a letter from another reader sent to just that address, which shows the power of *PW!* Dennis has prepared some notes on getting started on RTTY which I'll be covering next month. A new receiver in the shape of a Lafayette HA350 now graces Dennis's shack, the narrower i.f. filter proving a big advantage. On 20m Dennis had copy from JA3RBG, OD5AO, OX3FG, VE1WG and ZS6AEC, with just JA1JDD and W1MX on 15m. The 10m band came up trumps this month with JA1JRK, many US stations, several VEs plus VK8HA (a fine catch on any mode), YO2IS, YV1DG, ZS6AKO, 3B9RS, 4X4MR, 5Z4RT and 9H79ET.

A long letter from **Graham Mutton** of Tasmania, Australia, editor of *DX Panorama*, a bulletin of the Australian Radio DX Club, comments on the popularity of the Yaesu FRG-7 receiver there as well as the Panasonic DR49 with its digital readout. He has a laugh at the YJ8 and H44 type of DX which we get excited over, being fairly commonplace in VK land. Some DX news includes P29JS going to C21 (Nauru) shortly and VK0KH replacing VK0PK on Macquarrie Is., by the time this appears in print. Mellish Reef could also be activated again by VK2BJL, while Heard Is. may also be back with us this coming summer. Thanks Graham and let's hope they all come off. Among DX logged by Graham was T3KC on Kiribati, YJ8NGR, both on 10m, with FK8BT, FK8DE, LU3ZY (South Sandwich Is.), P29BS, P29DJ, S79NLB, S79RD, VR3AR on Christmas Is., VK9CGR on the Cocos Is., ZK2VE, 3C0AB (Annobon), 8Z4A and 9N1MM.

Allan Stevens also comments from Crowthorne, Berks, on the strength of VK3MO on 20m who was still 57 when a short whip aerial was substituted for the long wire. Allan went on to log all VK areas except VK0 with others including HI1JE and TR8DX (QSL F6ESH + 3 IRCs). On 10m South Americans LU6DZG and HR3JR came up, with 15m revealing 3B8CF, 5Z4CW and 8Z4A.

Another letter from John Dainty shows how 80m is now brightening up with logging of KP4AAO, VU2DPK,

WA2IUO, YA2CDO and YV3AZC. An unusual one on 20m was HP6KY. From Stourbridge, W. Mids. **Peter Hawkes** has done a good job on all bands from 10 to 80m s.s.b., his main listening period being around 0330 onwards when on early shift. Anyway he found VS6BF, VP2AZG, and C6ACY on 10m QSL to K4ZGB. Goodies on 21MHz included YB0ADW, 8Z4A, VU2TF 8P6KB, and P29KK in Port Moresby. On 14MHz it was HP3JAT, 8Z4A again, ZD8AI (QSL N3WM) and 3C1AC. CM1RH cropped up again on 7MHz as did G2ACK/VP2 on Montserrat, with 80m coming good with 5B4IJ (QSL via OE8HFL), HH2V a nice rarity, FM7WS and HI8JLB. All this on a 55ft wire plus DX160 and a.t.u.

Clubbing

David G2FKS had sent me info on the **Cambridge & District ARC** only to tell me in a later letter that the club had lost access to its meeting spot. So no more meetings until something in the area turns up.

Events in February for the **West Kent ARS** include G4BOO comparing receiver performances on the 15th and Terry Sadler talking on modern radio control equipment on the 29th, both at the Adult Education Centre, Monson Road, Tunbridge Wells. Informal meetings take place at the Drill Hall, Victoria Road on alternate Tuesdays throughout the year. Contact: Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks or try 0732 56708.

Stevenage & District ARS meets first and third Thursdays in Senior Staff Canteen, British Aerospace Site B, Gunnels Wood Road, Stevenage, Herts at 8.15pm or call in on the net Mondays 1930 on 144.550MHz. Otherwise Peter Byrne G8MCV will be glad to answer your questions at 21 High Plash, Stevenage, alternatively ring 0438 64624.

February looks like being a busy month for the **Liverpool & District ARS** according to Hon Sec Al Neilson G4CVZ of 78 Ackers Hall Avenue, Liverpool. February 5 has E. Birch G8HLQ giving forth on antique telephones (ideal s.s.b. communications quality?) while on the 12th there is an RSGB tape/slide lecture, with E. Grossmith discoursing on parabolic aerials on the 19th. Finally, on February 26 the secretary himself will talk on the annals of Liverpool's history. All this activity at 8pm, Conservative Rooms, Church Road, Wavertree, but it doesn't matter really what colour flag you wave! Just go along.

West of Scotland ARS every Friday evening at 22 Robertson, Glasgow with GM4AGG on v.h.f. and h.f. bands. Programmes of talks and the like alternate with chat-nights. More info from: Sec Ian McGarvie, 3 Kelso Avenue, Paisley. If you can get to the Bradshaw Tavern, Bradshaw, Halifax on a Wednesday at 8pm you'll find the **Northern Heights ARS** in session. On February 13 there is a demonstration of gear by Northern Communications/G3UGF while the 27th sees Jonathan Stockwell perform his dual fade slide show. The year's construction competition will be judged on March 12 next, so even if you are a newcomer there is time to make an entry. Sec is Marcus Topham G8NUC, 1200 Great Horton Road, Bradford or ring 73721.

The club room at 119 Green Lane, Derby sees the **Derby & District ARS** having a jolly "bring and buy" sale on February 6 with the 13th devoted to a night on the air with stations G3ERD, G2DJ and G8DBY! Back to normal on the 20th with a visit to the PO sorting office and, finally, a talk by a member of the Derbyshire Royal Infirmary "Flying Squad" on February 27. Incidentally, light

refreshments are available at all meetings so no need to go home first for your tea and crumpet. Hon Sec is Jenny Shardlow G4EYM on Derby 56875.

Visitors and potential members of the **Torbay ARS** are welcome to meetings at Bath Lane, rear of 94 Belgrave Road, Torquay, especially on February 23 when Peter Wakeham talks on Dartmoor, and you might as well know the annual dinner is on March 8 which is as good a place as any to meet all the gang. However, the editor of *Tars Talk*, the society's magazine, can tell you more at 2 Lower Coombe Road, Blindwell Park, Kingsteignton, Newton Abbot, Devon and the name is F. Bolton G3VTQ.

Brief details of the **Lincoln SW Club** meetings at the Corporation Social Club, Waterside South at 8pm second and fourth Wednesdays. More info from: Sec Mike Wells G8PNU, 4 Horner Close, Brant Road, Lincoln or 0522 721277. North Londoners ought to be interested in the old-established **Edgware & District RS**, meeting second and fourth Thursdays at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware at 2000. Local net Mondays 2150 on 1875kHz. Write to: Hon Sec Dennis Lisney G3MNO, 119 Draycott Avenue, Kenton, Middx or try 01-907 1237.

The newsletter of the **Irish Radio Transmitters Society** is an immensely interesting journal and very well produced and full of information for the EI fraternity and others. Readers in Eire might like to contact the Society at PO Box 462, Dublin. One snippet is that our DM friends will be using calls in the series Y2 to Y9 in future.

One last note: if anyone else wants a copy of the G3IMI notes on the replacement filter for the FRG-7 then please send a decent sized envelope; there are three A4 sheets and you should have seen me trying to get them into 4 x 3in envelopes sent by some readers!

Late News

The World Administrative Radio Conference has agreed to amateur bands at 10.10 to 10.15MHz, 18.068 to 18.168MHz and 24.890 to 24.990MHz, the first being a secondary allocation, the other two exclusive amateur allocations.

Bands 3.5 to 28MHz remain the same with 3.5MHz now being a shared primary service. On Top Band 1.810 to 1.850 will be exclusive amateur with national administrations able to allocate another 200kHz if they so wish.

It has also been agreed that the requirement for a c.w. qualification will apply only to bands above 30MHz. This would apply to the 70MHz band if it is re-allocated by the UK, and to a proposed 50MHz allocation.

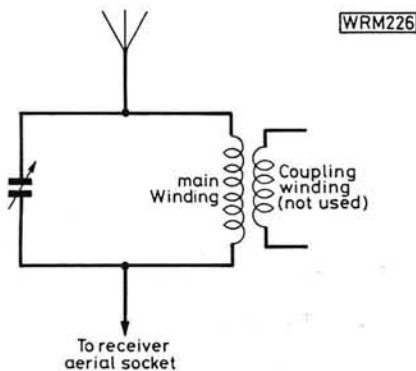


Fig. 1. Circuit arrangement of a wavetraps

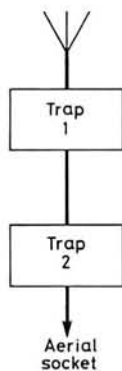


Fig. 2. Cascading wavetraps

MEDIUM WAVE DX

by Charles Molloy G8BUS

When I referred to the Piccadilly Radio transmitter at Ashton-under-Lyne in the November issue I little realised that we had a reader living only a few hundred yards away from it. He is **Roy Haynes** who is struggling away trying to DX under really adverse conditions. The problem is that the strong signal from the IBA transmitter overloads the early stages in the receiver causing spurious responses to be generated, and Piccadilly Radio to appear at a number of points on the dial.

Normally I would say, use a loop with the null pointing towards the offending signal. Unfortunately this is not possible as the receiver is a Realistic DX300 which has an internal aerial for the medium waves. Consequently a loop cannot be used with it, so for m.w. DXing Roy has to use a long wire.

Another solution is to fit an attenuator between the aerial and receiver. A simple attenuator can be made with a 1kΩ potentiometer, as described in this column in the December *PW*. The trouble with attenuators is that they attenuate everything, DX and QRM but they can be of value none-the-less.

Wavetraps

A better solution is to use a frequency-selective attenuator such as a wavetraps. The trap is simply a parallel tuned circuit which has a high impedance at its resonant frequency and a low impedance at other frequencies. You connect the wavetraps between the aerial and the receiver aerial socket, preferably fitting it into a small box. The lead from the trap to the receiver should be as short as possible otherwise it may act as an aerial and pick up the station you are trying to suppress. If there is room inside then fit the trap behind the aerial socket.

The circuit of a parallel tuned wavetraps is shown in Fig. 1. Any medium-wave tuning coil will do, for example the Denco Maxi Q range 2 Blue. Ignore the coupling winding as it is not required. The tuning capacitor should have the value specified by the coil manufacturer and it can consist of a trimmer and fixed capacitor in parallel if you do not want to use a variable capacitor. The Denco coil requires a 350pF variable to cover the medium waves. Connect the tuning capacitor across the main winding, e.g. with the Denco, tag 2 goes to one side of the capacitor and tag 3 to the other.

It is very easy to use the trap. Rotate the tuning capacitor until the spuri disappear. The wavetraps is now set and should not be adjusted any more.

If you have trouble from two strong stations then two wavetraps can be used in series (Fig. 2). One is tuned to one of the offending stations and the second trap to the other. Wavetraps were in general use in the early days of radio as they were of value with the unselective receivers of the day, but they can still be of service to the DXer who has trouble with strong local QRM.

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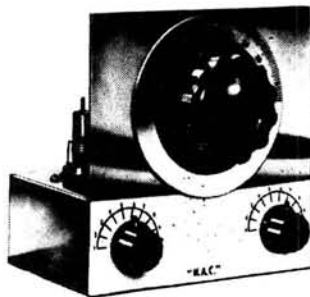
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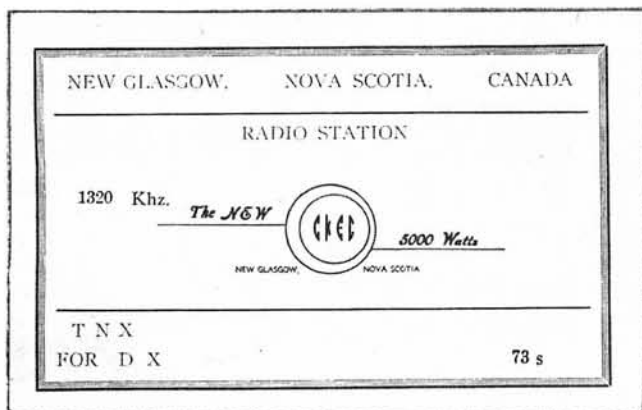
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Beginners' Corner

The 1000kW transmitter on 1323kHz at Nauen in East Germany usually goes off the air just before 2300. If you stay on the channel for a few minutes until the carrier is switched off you should be able to hear the BBC World Service in English. The programme comes from the BBC Eastern Mediterranean Relay at Zyyi in Cyprus and continues until 2315 when the station gives its identification and signs off. If you want a QSL, no need to write to Cyprus, just send your report to BBC External Services, Bush House, London WC2B 4PH.

When Cyprus has gone off, tune down slightly to 1320kHz and if you are lucky you may hear CKEC which is in New Glasgow, Nova Scotia on the western seaboard of Canada. At this time of year as the days are lengthening it may be a little late in appearing so if you are unsuccessful at 2315 then try again at midnight but remember, reception of North American DX is variable and what you hear one night may be inaudible the next. CKEC does QSL and reports should go to Box 519, New Glasgow, NS, BZH 5E7, Canada.



QSL card of CKEC, New Glasgow, Nova Scotia

Long Waves

"I have been experimenting with l.w. loops and have found that 500pF and 25 turns work well", writes David Hyams from Finchley who is referring to the "40 inch" box loop. When used with a Realistic DX160 it pulled in ten long wave stations including Tipaza in Algeria. The date was November 14 and the time 1320 which prompted David to ask if reception could have been by ground wave.

Long wave signals do travel a long way as the ground wave is not attenuated as much as medium-wave signals. The range of the ground wave is inversely proportional to frequency and you can observe the effect by tuning across the medium waves during daylight, starting at the l.f. end. As you progress across the band, stations become fewer and fewer, and by the time you pass 1200kHz only locals will be heard.

During the winter, the D layer of the ionosphere, which absorbs both medium- and long-wave signals, does not always re-form completely at sunrise, and when this occurs semi night-time conditions can persist for most of the day. North American DX has been heard as late as 1000 in mid-winter. The short answer to David's question is that there was probably a mixture of ground and sky wave when listening to Algeria.

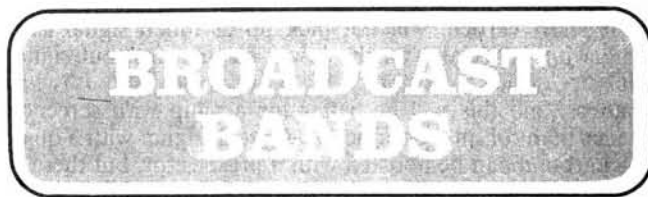
North American DX

In spite of the expected sunspot maximum, North American DX was quite good during the autumn with

some interesting DX reported during September and October. John Faulkner writes from Mansfield to say that among his best catches during October were: KMOX St Louis on 1120kHz at 0140, WOAI San Antonio Texas on 1200 at 0210, WERE (5kW) in Cleveland at 0048, WCSC Charleston South Carolina on 1390 at 0021 and CFCY Charlottetown, Prince Edward Island on 630 at 0138. Details of receiver and aerial were not given.

"What is the sunspot minimum like, as I have only been DXing since 1978?" asks David Hyams who has just succeeded in hearing his first two North Americans; CJYQ on 930 and WINS on 1010. They were logged on a Realistic DX160 and m.w. loop. Since David's version of the DX160 has an internal aerial for the medium waves, the loop was placed close to the receiver so that the signal could be transferred by induction. You can boost a signal this way but the loop's null will be masked by the receiver's aerial and you will not be able to null-out QRM, which is the main purpose of using a loop.

At sunspot minimum, North American DXing is a lot easier, some signals being conspicuous on the band nearly every night and a few being strong enough to be picked up occasionally on a portable with internal aerial. At the moment, reception of NA can really be classed as DX and it requires a good receiver, persistence and some luck to pull in your first transatlantic station. The situation will gradually improve though, as we pull away from the sunspot maximum and solar activity declines. I hope this answers Bradley Wilson who is a Canadian living in Bristol.



SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

There are two good reasons for using an outdoor aerial. The first is to obtain maximum signal pick-up, which means erecting the aerial as high as possible above the ground and nearby buildings. The second reason is to avoid or reduce electrical noise from electrical equipment within the house, or from elsewhere via the mains wiring. Where there is insufficient space to erect a long wire then a vertical aerial attached to the outside of the house should be considered.

Vertical Aerials

One hears occasionally of a wire with a weight on the end being lowered from a window, or of a vertical wire suspended between insulators fixed to the eaves and some point near the ground, but these are not the type of verticals I have in mind. They do not meet the criteria mentioned above, though they are probably a shade better than an indoor aerial.

A mast, fixed to but insulated from the roof would be ideal, a whip with insulated base, fixed to a chimney or to a window ledge if access to the roof is not available, is what will be used in practice. The construction of a home-made vertical rod antenna some 3 to 4m long is shown in

the *Aerial Data Chart* presented with the November 1979 issue of *PW*.

It is essential to use screened feeder such as coaxial cable to connect the whip to the receiver, as an unscreened lead will act as an aerial and pick up interference on the way down. Earth the feeder screen at the receiver end; i.e. join it to the receiver earth socket which should be connected to earth. Connect the inner conductor to the whip and to the receiver aerial socket. An a.t.u. between the coaxial cable and receiver may be found useful, see the *Aerial Data Chart* for details.

TV Aerials

If you have an outdoor TV aerial then you have a ready-made vertical. The directional effect of the aerial is only apparent at TV frequencies, and in the h.f. part of the spectrum it will act as a short vertical. All you have to do is to unplug the lead from the TV and connect it to the receiver or a.t.u.

It is a lot more convenient to use a switch so that the TV aerial can be switched for DXing or TV reception. The Antiference Aerial Switch will do; I use one to connect an aerial to either of two receivers. There is a coaxial socket at the top of the switch and the aerial is plugged in there. At the bottom of the switch there are a couple of holes leading to a saddle and two screw terminals. The new leads to the receiver and the TV come in at these points. The saddle secures and connects together the two screens, while each of the inner wires goes to a screw terminal. You will need another coaxial plug to join up to the TV and whatever plugs are required at the receiver or a.t.u. Do not get the cables crossed and join the TV to receiver—neither will like it!

A short vertical will not pick up as much signal as a long wire, especially on the lower frequencies, but signal pick-up is not everything. Signal-to-noise ratio is what matters, and this will be better for a whip with screened feeder than for an indoor aerial. A weak signal with a quiet background can be boosted with a preselector, but there is little that can be done with a weak signal and a noisy background.

DX Programme

This is the title of a weekly programme for DXers, broadcast from Madrid by the Spanish Foreign Radio. It starts with the interval signal of a broadcasting station and you are given to the end of the programme to identify it. In the meantime you will hear a talk on one of a wide range of subjects of interest to DXers, or excerpts from club magazines plus up-to-date tips on the state of the bands.

I have become a regular listener to *DX Programme* as I find it both refreshing and informative. It is compiled by Ambrosio Wang and is on the air every Sunday at 2100 on 7105, 9685 and 11 840kHz with a repeat at 2150. The station QSLs with a colourful pennant.

DX

Reports of Japan in the late evening come from several readers. **George Smith** (Liverpool) has an FRG-7 and 70ft long wire and he logged NHK on 15 270 at 2345 while **K. H. Smith** (Ross-on-Wye) picked it up at 2200 in the 25m band with a very strong signal. The **Rev A. E. Whyatt** (Walsham) was kind enough to send me an up-to-date schedule which shows 15 195kHz with programming in English in the Asian Service from 2200–2230 and 2300–2400. There is also a simultaneous broadcast to Europe on 9585kHz in the 31m band. **A. Dodsworth** (Liverpool) reports reception of Japan on 21 610kHz at



The QSL pennant of Spanish Foreign Radio

the more normal time of 0800 using a Vega 206 and a short length of wire wound round the picture rail.

There have been a number of requests for help with countries that are not conspicuous on the international bands. At the time of writing, Argentina can be heard on 11 710kHz during the evenings and there is a programme in English at 2300 Mondays to Fridays. Brazil can be heard on 15 265 around 2100. Try for Sri Lanka on 15 120, for R Uganda on 15 250, and for Bangladesh on 11 765 or 15 285, all between 1800 and 1900. Has anyone logged Saudi Arabia, Kenya, Zambia, Rhodesia, Libya, recently on the international bands?

A report of Africa No. 1 which is currently testing on a number of frequencies, comes from **P. N. Kirkup** of Burnley. The address for reception reports is Radio Africa No. 1, BP1, Libreville, Gabon. Reader **H. L. Nyman** refers to the report in the October *PW* of the simultaneous reception on the 16m band of the English and Hebrew transmissions from Israel. IBA broadcasts in Hebrew all day on 17 630kHz and in English on 17 685 at midday and on 17 645 at 2000 hours all of which are near to each other.

Readers' Letters

"Is it possible to use the umbrella-type clothes line as an aerial and what type of cable is used," asks **A. B. Cooper** of Plumstead. Use coaxial cable just as you would with a whip and make sure the metal parts are insulated from the

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, Ashted, 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.

ground. In reply to **Mick Ballamy**, the transmissions you heard on 8MHz are commercial stations not intended for reception by the general public.

Sixteen-year-old **Mark Godden** is looking for spares for his ex-WD R107 communications receiver and he wonders if anyone has a scrap R107 for stripping down. He would also like to contact anyone of his own age in his area with an interest in radio. Replies to: 27 Southwell, Portland, Dorset DT5 2DP. **Joseph Pritchard**, who is a student at UMIST (Manchester), is constructing a 5-transistor t.r.f. for use on the tropical bands. Hope to have a log from you soon. In the meantime he is using his ITT CD108 and telescopic aerial and he mentions hearing Australia on 11 800 at 1849 and Pakistan on 11 672 with this rig.

Fourteen-year-old **Richard Everitt** has started DXing with a Vega 206, which he considers excellent value for money, but when he uses a 40ft long wire he finds that performance is only improved on the lower frequencies. Try a small capacitor between the aerial and receiver. Richard would like to contact other DXers in his area or to join a local DX club. Replies to: 15 St Mary's Road, Blun-tisham, Huntingdon, Cambs PE17 3XA.

exceptional tropospheric opening, on November 28 and 29, came as the high pressure began to fall. I first noticed a lift at 1400 on the 27th when signals from the Bristol Channel GB3BC, R6 and the Kent GB3KR, R4, repeaters were opening the squelch on my TM 56B receiver and pictures were appearing from the IBA transmitter at Lichfield on channel 8, 189MHz.

As both these receivers are fed with dipole aerials the strength of the signals, from east, west and the Midlands, suggested that an extensive opening was brewing up and by midday on the 28th, the big lift had begun. At 1319, I heard G5SD in nearby Littlehampton, work G8HYT, Weston-super-Mare, via the Bristol Channel repeater, pictures from Lichfield were very strong and about 12 f.m. broadcast stations (predominantly French), mixed with the BBC transmissions in Band II. Around this time, co-channel interference was beginning to effect Band V television and I received a 539 signal from the 70cm beacon at Emley Moor GB3EM. During the evening I heard several northern-G stations, including my old friend **Jack Hum** G5UM, working continental stations on 70cm and another old friend, **Harry Gratton** G6GN, Bristol, working into London.

My aerial for 70cm is a north/south horizontal dipole and to show how good u.h.f. conditions were, I heard a QSO between ON4HU and a G station in Devon, though both stations were well off direction for this tiny aerial. Conditions like this continued throughout the 29th and although some bands were beginning to clear before midnight, the last DX I heard was at 0059 on the 30th when DD3LN worked a PA0 via GB3KR, and at 0105 DC5QH/A worked a PE1 through the London repeater GB3LO, R7.



by Ron Ham BRS15744

In the world above 30MHz, we become familiar with the various disturbances which increase the range of signals and provide the DX, which, after all, is the thrill of the exercise. Periodically, however, up comes the big one, as it did in late November, and the enthusiasts are faced with relatively super DX on all bands from 3m to 3cm.

Tropospheric

The atmospheric pressure, measured in Sussex, rose from 30.1in on November 26 to a peak of 30.35in during the afternoon of the 28th and was back to 30.15in by midday on the 30th. Fig. 3. True to form, the real peak of the

Band II

While, during the evening of the 28th, **Ken Smith** BRS20001, Horsham, Sussex, was receiving full stereo from Dutch and German f.m. stations, **Adrian Corbett**, Bookham, Surrey, heard French and German stations taking turns to blot out LBC and **Guy Stanbury**, Chelmsford, received very strong signals from Belgian, Dutch and French stations, many from West Germany and said that all stereo programmes were of excellent quality with little or no noise. **Harold Brodribb**, St. Leonards-on-Sea, Sussex, using a Bush VHF 80 and a loft aerial heard one Dutch, 21 French, and BBC stations from many parts of the UK. At 0122 on the 29th **Ian Rennison**, Horsham, logged about eight Dutch and German stations in stereo, some of which he heard again during the evening.

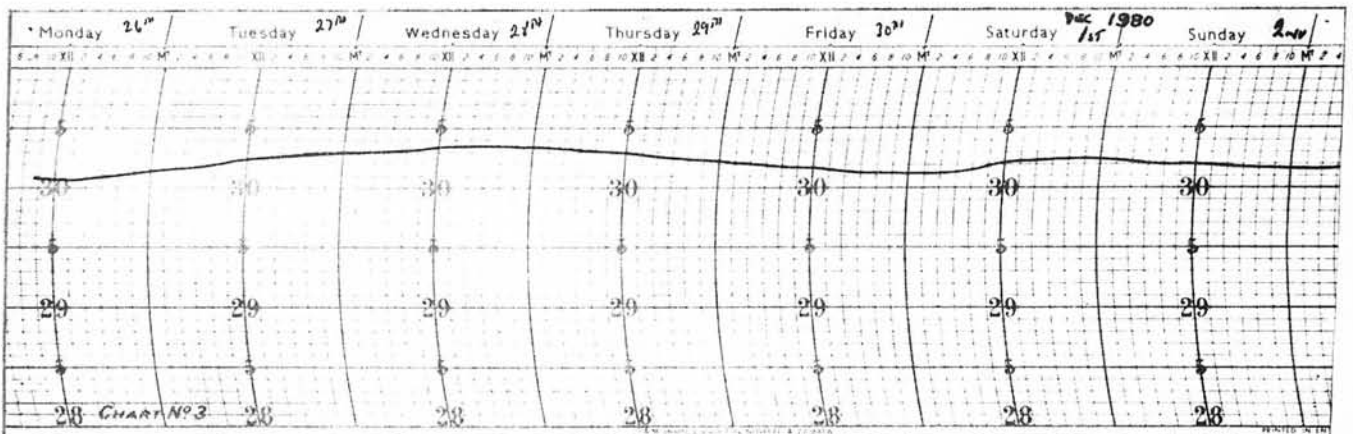


Fig. 3: Atmospheric pressure recorded by the author, 27-30 November 1979

At 1800 on the 28th, **Tony Skitt**, Heslington, Yorks, heard a BBC1 weather man say that the high pressure was causing TV reception problems in the south east and, indeed, many of my local viewers were complaining bitterly as the co-channel interference built up and ruined their pictures. Very soon both the BBC and IBA were warning people about the disturbance, which was no surprise to Ken Smith because at 1800 he was watching a weather report and commercials from a French TV station around channel 21. **Arthur White**, Aisby, Grantham, writes: "I watched part of a John Wayne film in German, a news broadcast from Austria, and the film *Rebecca* apparently with Dutch sub-titles."

At 0045 on the 29th, Ian Rennison watched pictures from ZDF (Zweites Deutsches Fernsehen) on channel 45, his first u.h.f. TVDX and using only a set-top loop aerial. Around 0120, I received a test card from Oostvleteren, Belgium (RTB, network-2) on channel 55 and the end of the news, clock and test card from ZDF on channel 21. Between 0800 and 1000 I saw test cards from East Germany, DDR-F1, followed by a sports programme on European channel 11, Holland on channels E5 v.h.f. and 29 u.h.f., Fig. 4(a) and (b), and Dortmund on channel 25.

By 1313 the word Dortmund on the test card was changed to ZDF and the Nederlands test cards (also seen by Tony Skitt using a Labgear wide-band u.h.f. set-top aerial) were replaced by an Open University type of programme. The v.h.f. transmissions from Holland were received on my National Panasonic 5001G and the u.h.f. signal on my JVC 3060, both sets being fed from vertical dipole aerials. Periodically the Dutch educational programme was interrupted with a fixed caption and at 1313, PA0ZE was seen. Guy Stanbury reported: "Very clear pictures obtained from all of the north European stations" and Adrian Corbett, using a Waltham W 154, with his aerial on an outside window-sill, did some home DXing and received pictures varying in strength from the BBC at Wenvoe, the IBA at Sutton Coldfield, and erratic signals on other channels, not easily identified. **Parmjit Singh**, Leicester, hopes to start TV DXing; good idea Parmjit, it is openings like this that make all the routine monitoring, that a DXer must do, worth while. Tony Skitt also picked up a strong test card marked (RTBF Tele 2 Liege Canal 45) and both BBC and IBA pictures from southern England.

At 0105 on the 29th, I watched the end of the ATV programme *Telespots* on channel 61, advertising for the Coventry and Nottingham areas followed by the station close-down announcement given by Mike Prince. **Andy Martin** G3UDR, was duty transmission controller during the evening of the 28th and said: "I have not experienced so much of a problem with co- and adjacent-channel interference before. The link from London on *This is Your Life* and *London Night Out* actually faded out on us." Although this tropospheric disturbance was the hot news, my readers have been keeping an eye on channel R1, 49-75MHz. for television pictures via the F2 layer of the ionosphere. A mixture of pictures were received on this channel during the early mornings of November 19, 20, 21, 23, 24, 27 and December 2, 3, 4, 8, 9, 11, 12 and 13, and although individual pictures are difficult to identify, I did make out a group of dancers or skaters at 0850 on December 2. **John Branegan** saw a blurred announcer on October 22, Fig. 5, and I received strong bursts of test card from TV1-Sverige at midday on November 23. This mixture of pictures on R1 was exceptionally strong on December 11; at 0900 a clock appeared but there were too many images to tell the time. This was also the case with a test card which followed.

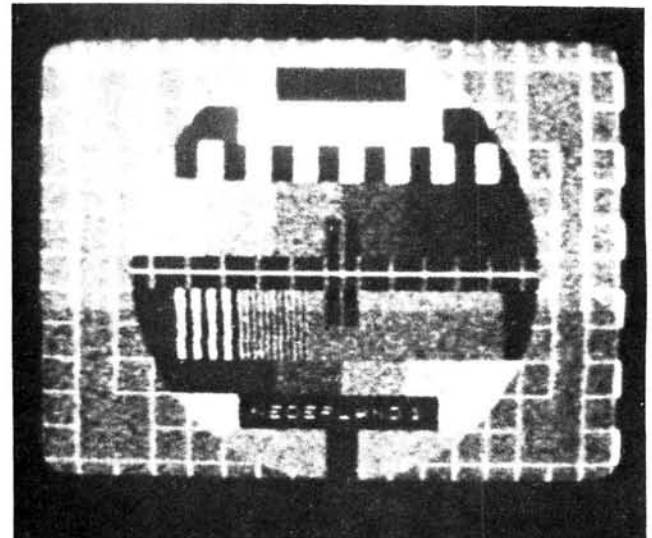
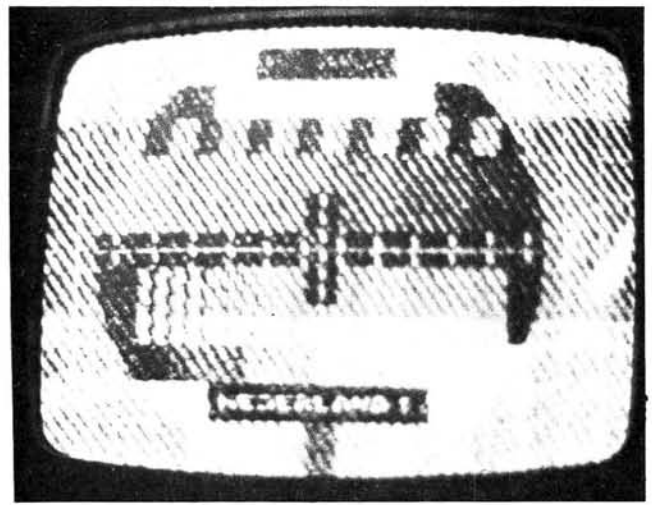


Fig. 4: Dutch TV received by the author simultaneously on Ch.E5 (top) and Ch.E29 (bottom), on the morning of 29 November 1979

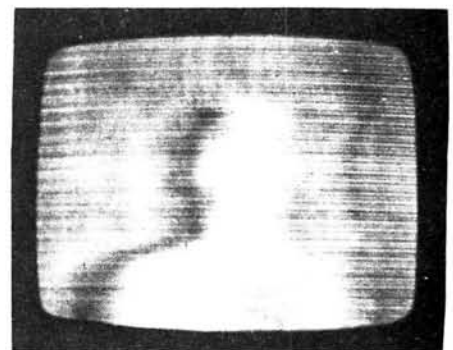


Fig. 5: Announcer on Ch.R1, received via F2

The 2m and 70cm Bands

During the big tropo event, **John Cleaton** G4GHA, Wareham, Dorset, made his first LX contact on 2m and filled over four sides of his log book with DX, among which he heard stations in EI, GI, HB and OZ, worked stations in D, EA, F, GJ, GU, GW, LX, ON and PA, and said that EA2HX, on the 28th, was 40dB over S9. **George Grzebieniak** RS41733, London, said: "Conditions were fantastic" and is very pleased because he heard G6GN, Bristol; G8DJW, Dorset; six PEs and DK3OL on 70cm

and has now heard a greater distance on 70cm than on 2m. **Arthur White**, Grantham, Lincs, heard many Dutch, French and German stations on 2m using only the telescopic aerial attached to his set.

Between 1800 and 2100 on the 28th, **Mike Rowe** G8JVE, near Littlehampton, Sussex, worked nine Ds, 20 Fs, one HB, one LX, one ON and three PAs on 2m s.s.b. and **Alan Baker** G4GNX, Newhaven, Sussex, worked one EA and one F on 2m c.w. and one DB and two PEs on s.s.b. Like others, Alan said that all repeater channels, R0-9 were full of signals and some were three and four deep.


DJs were among the DX working through the Brighton repeater GB3SR, R3, and at one time Alan worked a GW, near Swansea, who was getting in to SR with only 1 watt. **Keith Leggett** G8MLT, also worked an EA on 2m and at 0104 on the 29th, Alan worked DK8SG from home on 2m s.s.b. and while mobile, at 1100, he had a QSO with DC1BN via the Belgium repeater, ON0WR, R2. Between 1600 and 1640 he contacted stations in D, EA, F and PE via the French repeater FZ3VHF, R7 and while he worked DC5CW/M at 1745 via GB3SR, **Roy Bannister** G4GPX, in nearby Lancing, heard the German station direct on the repeater's input frequency. Alan said: "Early on the 29th it was difficult to decide which 2m channel or system to use because everything was packed with DX and the Leicester repeater GB3CF, R0, was heard and worked from the Sussex coast throughout the day." **Ron Aitkenhead**, G8DPP, London, worked six Dutch and 16 German stations on 2m s.s.b. between 2300 on the 28th and 0202 on the 30th. **David Rennison**, Horsham, using his NR56 receiver and ground-plane aerial, heard numerous PAs on the 29th and at 1742 he heard DC5CW/M through the Brighton repeater and from 2045 received signals from DC2BE, F1CUO, ON1OW, and OZ1ZB via unidentified French repeaters.

Between 1055 and 1240 on the 29th, **Jack Brooker** G3JMB, Hassocks, Sussex, worked DF, DK, F, G, ON and PA0, from his car, while stationary on Ditchling Beacon, a high spot near Brighton. During the afternoon he worked DF8JM and DG4EH, from home, via the Leicester repeater giving Jack his first German QSO from the home QTH. During the early hours of the 29th, **Andy Martin** G3UDR, Evesham, worked a PA0 direct, on 2m, while travelling home. Andy is also a member of the ATV Network Ltd Amateur Radio Club, Fig. 6, and says that they have many members among the presentation and engineering staffs.

Another, but far less intense, tropospheric opening occurred on December 4 and 5 when I received strong signals from the Bristol Channel, Birmingham GB3BM, R5, and Kent repeaters. Watchable pictures were received from Lichfield on channel 8 and several foreign stations were predominant in Band II. G4GNX heard many repeater signals and worked a mobile station in Birmingham, via GB3BC, while he was driving through Uckfield in Sussex.

The 10m Band

Signals, averaging 539, were heard daily between November 19 and December 13 from the International Beacon Project stations A9XC, DK0TE, DL0IGI, and from 5B4CY and VP9BA around midday on most of the days. Although conditions were generally good throughout the period, with strong signals from Canada, Japan, Russia and the USA, I noted an echo on two DJ signals at 0915 on November 21, on some Russian signals at 0851 on December 5, on DL0IGI at 0815 on the 8th and on G4AYW as he worked SM4DNK around 0930 on the 13th.



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Fig. 6: ATV Network Ltd. QSL card



Fig. 7: Picture via Leonids MS on 16 November 1979

The 6m Band

John Branegan GM4IHJ, Saline, Fife, has worked more than 45 VEs and Ws in crossband, 6m to 10m, QSOs and has regular contacts with K5EFW, Albuquerque, New Mexico and W5VY, San Antonio, Texas. John has built a 50MHz, high-Q, MOSFET pre-amplifier for his Eddystone 770R receiver and is delighted with its performance. "I have also tried it on E2 and R1 on the TV, it really pulls in the meteor scatter," writes John on November 22 (Fig. 7), "As a result I am now enjoying a new breakfast treat nearly every day, Meteor Scatter TV with my cornflakes".

I am still using my R216 and vertical dipole on 6m and received strong s.s.b. signals from WB1FVS and W2UTH at 1345 on November 19, K8NSS and VE1AVX at 1350 on the 20th, a QSO between VE1AVX and W2UTH at 1427 on the 21st, and the same Canadian again, around the same times on the 22nd, 23rd, 29th and December 7 and 8, and around 1400 on the 10th. I also heard KA4GCM and WB4HJF around 1400 on the 11th, K8EFS working John Branegan, WA8OGS, W8BJY and W8ULC and several weaker ones around 1500 on the 12th.

News Items

I hope to hear more in the future from **Jonathan Rose**, Ashted, Surrey, a newcomer to amateur radio who is at present repairing a CR100 receiver and intends joining the RSGB.

Congratulations to five Sussex amateurs; G8MIM, G8OUK, G8TMX, G8TTT and Charles Ormerod, who, on November 30, all passed their Morse tests at North Foreland and will soon be sporting those G4 calls.

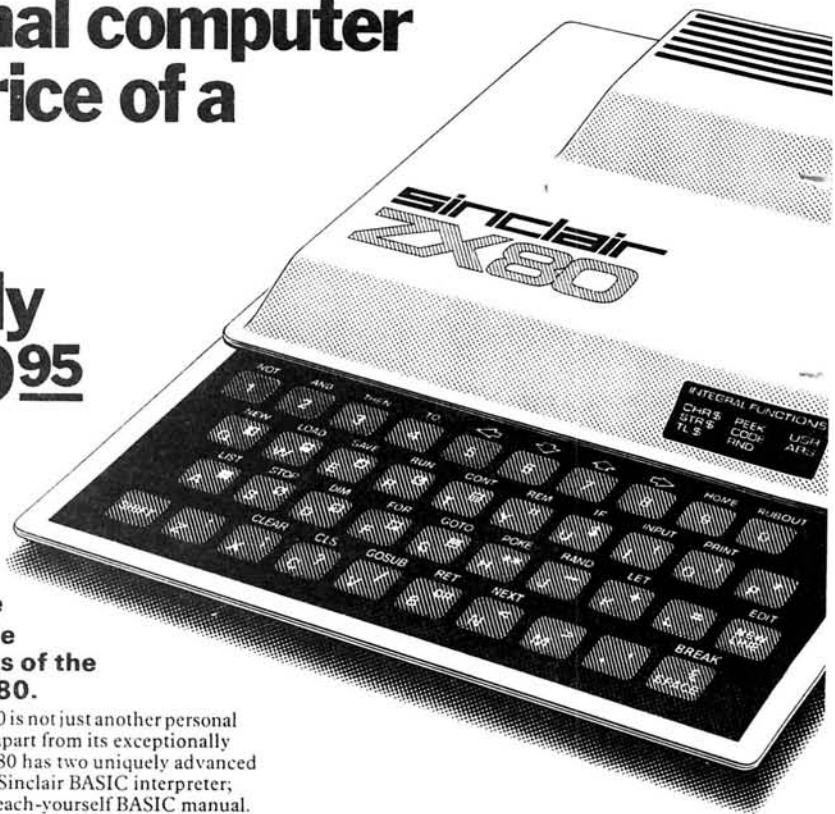
RSGB Council member **Robin Bellerby** G3ZYE, has been elected president of the Brighton and District Radio Society for 1980, and **Nigel Hewitt** was given the Bill Pitfield Memorial Award by the BDRS, for outstanding services to amateur radio, especially for teaching the RAE.

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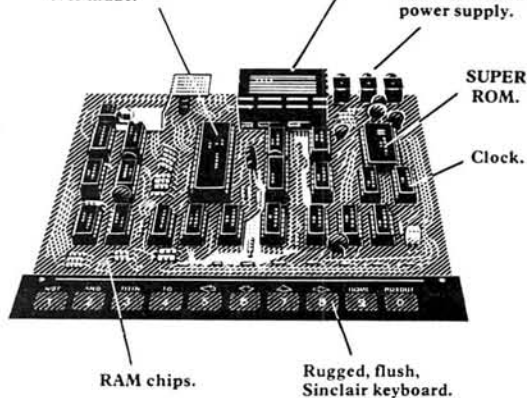
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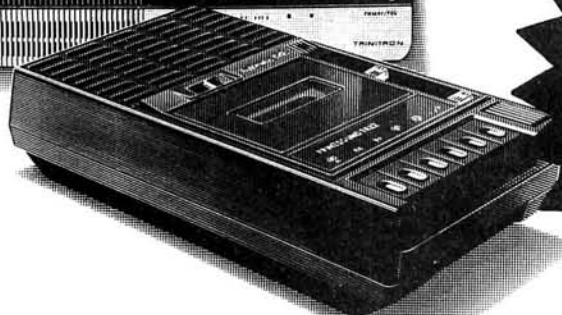
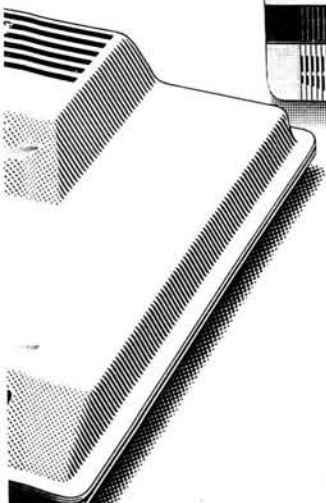
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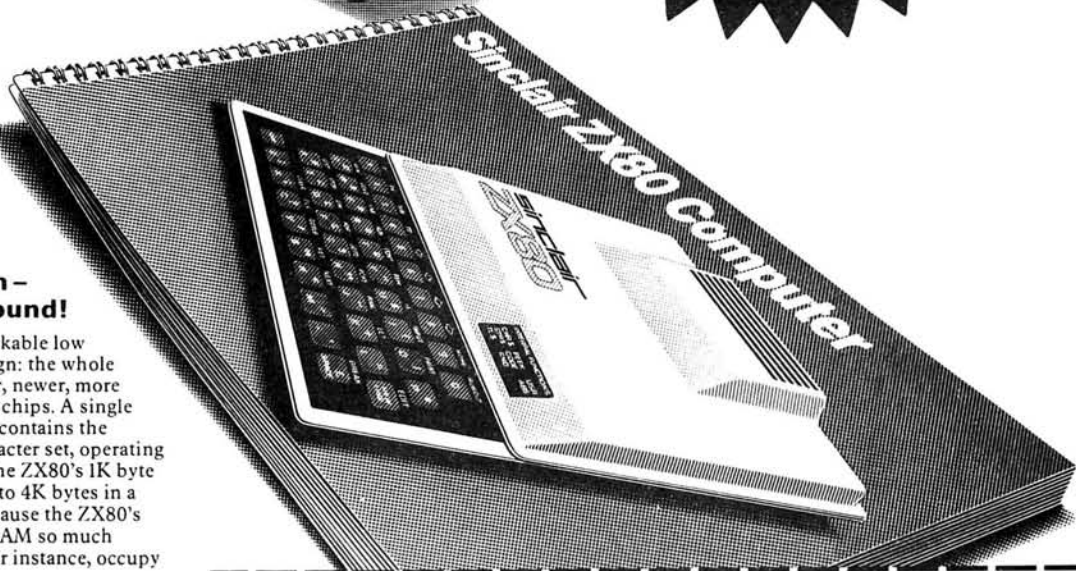
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6.3V 1.5A £3.00; 3A £4.15; 6A CT £7.90; 12V 1.5A £3.75; 3A CT £7.90; 6A CT £9.75; 15V 0.5A £3.00; 18V 1.5A CT £7.90; 24V 1.5A CT £7.90; 3A CT £9.75; 5A CT £18.00; 8A CT £29.25; 12A CT £37.50; 40V 3A CT £13.50

TWIN SEC TRANSFORMERS: Prim 240V ac.
6V 0.6A - 6V 0.6A; 9V 0.4A - 9V 0.4A; 12V 0.3A - 12V 0.3A; 20V 0.15A - 20V 0.15A; all at £4.15 each; 15V 0.75A - 15V 0.75A £6.40; 15V 1.5A - 15V 1.5A £8.25; 18V 1A - 18V 1A £7.90; 18V 1.5A - 18V 1.5A £9.75; 20V 1.5A - 20V 1.5A £9.75; 12V 4A - 12V 4A £12.00; 25V 2A - 25V 2A £12.00

MIDGET RECTIFIER TRANSFORMERS: Prim 240V ac.
6.0-6V 1.5A or 9.0-9V 1A £3.40 each; 12-0-12V 1A or 20-0-20V 0.75A £4.15 each; 9-0-9V 0.3A or 12V-0-12V 0.25A or 20V-0-20V 0.15A £3.00 each

LT TRANSFORMERS TAPPED SEC: Prim 240V ac.
0-10-12-14-16-18V 2A £7.50; 5A £9.40; 0-12-15-20-24-30V 2A £8.25; 4A £12.00; 0-20-30-60V 1A £9.00; 2A £12.00; 0-40-50-60-80-100-110V 1A £12.00

AUTO & ISOLATION TRANSFORMERS 240/110V a.c.
30 to 4000 watts, many types ex stock. Lists.

MAINS TRANSFORMERS, SPECIAL OFFER: Prim 240V ac.
250-0-250V 60 Ma 6.3V 1A £2.50; 250V 100Ma, 6.3V 2A £3.50; 9V 3A £2.50; 25V 300 Ma 90p.

LOUDSPEAKERS
1" 12", 2" 24", 2 1/2" 36" Bu £1.25 each; 3" 35u, 3 1/2" 3.8, 16, 80u, 5" 4" 3.8, 16 or 25u £1.50 each; 7" 4" 3" or 80u £1.75; 8" 5" 2.5u £2.50

"INSTANT" BULK CASSETTE/TAPE ERASER
Instant erasure of cassettes, and any diameter of tape spools, demagnetises tape heads, 200/240V ac. leaflet £7.50.

EDGWISE LEVEL METER FSD 200/1A
Size 19 x 18 x 20mm 8000 £1.50

CHARGING METERS 1 1/2 in diameter
2A or 3A £1.25 each; 5A or 10A £1.50 each

SINGLE STRANDED WIRE PVC COVERED
32/0.2mm (10A) black or blue, £6.50 100m, 0.5mm £2.50 100m special prices per 1000m and over.

O/P TRANSFORMERS FOR VALVE AMPLIFIERS
P.P. sec tapped 3 B-150 A-A 6K0, 30W £17.50; A-A 3K0 50W £26.00; 100W IEL 31 K 188 etc £35.00

G.E.C. MANUAL OF POWER AMPLIFIERS
Covers valve amplifiers 30W to 400W £1.25.

MULTIWAY SCREENED CABLE, PVC COVERED
36 way £1.00; 25 way 75p; 14 way 50p; 6 way 25p; 4 way 20p; 2 way 10p; 1 way 8p; 4 way indiv screened 30p.

CONDENSERS
Electrolytic 400µ - 400V 75p; 2000/30V 30p; 2200/40V 40p; 8 - 8mfd 450V 40p; Paper tubular, W/E, 4/160V 6/160V 30p each, 2mfd 150V 25p, 0.1mfd 300V a.c. 25p.

CARRIAGE EXTRA ON ALL ORDERS
ALL PRICES INCLUDE V.A.T.

Callers by appointment only. S.A.E. Enquiries, Lists.

46, Kenilworth Road, Edgware, Middx.
HA8 8YG. Tel: 01-958 9314

MAIL ORDER PROTECTION SCHEME

INTRODUCTION
The Office of Fair Trading have agreed that the notice of the Mail Order Protection Scheme to appear in periodicals carrying mail order advertising should appear as follows:-

"MAIL ORDER ADVERTISING

British Code of Advertising Practice
Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfil orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

Mail Order Protection Scheme
If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, Practical Wireless will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

- (1) You have not received the goods or had your money returned; and
- (2) You write to the Publisher of Practical Wireless summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues etc, received as a result of answering such advertisements. Classified advertisements are excluded.

Codespeed Electronics

P.O. BOX 23, 34 SEAFIELD ROAD, COPNOR, PORTSMOUTH, HANTS., PO3 5BJ

8 DIGIT 0.1" LED DISPLAY multiplexed, common cathode, 99p each. **DIGITAL ALARM CLOCK MODULE** with 0.7" display. With data £5.99 each. **4 DIGIT CLOCK L.C.D.** 0.5" digits, supplied with data, £4.99 each. **MM5316** digital alarm clock chip, with data £2.29 each. **REJECT CALCULATORS** Untested, but good value for spares. £2.50 each. **LED WRISTWATCH I.C.** Mostek MK5030, with data 95p each. **LED WRISTWATCH DISPLAY** type DIS501, 0.1" digits. With data 95p each. **SUPER SAVER** Purchase an MK5030 and a DIS501 for only £1.50 the pair. **NOTE** The MK5030 and DIS501 are housed in a 'tegluss flatpack' style package and require some fairly fine soldering. **20 KEY KEYBOARDS** calculator keyboards, 2 for 99p (not for use with NORTEC4204 calc. chips). **4 DIGIT 0.8" LED DISPLAY** common cathode, with data £3.75 each. **DIGITAL MULTI-METER CHIP** MM5330 I.C. to build a 4 1/2 digit multimeter. With data £3.49 each. **SUPER QUALITY JACK SOCKETS** 1/4" (6.35mm) jack sockets, mono 23p each, stereo 25p each. **SLIDE POT KNOBS** please state colour required, 11p each. **ROTARY VOLUME CONTROL KNOBS** nice style, 18mm diam. Black with coloured cap. Please state colour required, 18p each. **10 LED DISPLAYS** Untested multimeter, 0.1" digits, common cathode, 95p. **6 DIGIT 0.1" LED DISPLAY** multiplexed, common cathode, 99p. **555 TIMER I.C.** with data and applications booklet, 23p. **POLARIZING FILM** max. 19" wide any length. Only 2p per sq. inch. Any size cut. **SLIDER SWITCHES** 2 pole, change over, 15p each. **PUSH BUTTON SWITCHES** spring loaded (momentary) with one n.o. contact 14p each. **CALCULATOR CHIP** Nortec 4204, 4 function and constant. With data 80p. **2102 MEMORIES** Dynamic memories for your micro's. With data 95p each. **MM5314** digital clock chip, with data £1.99 each. **WRISTWATCH L.C.D.** supplied with polarizers and data sheet, 99p each.

NEW CATALOGUE AVAILABLE FROM JANUARY.
SEND S.A.E. FOR YOUR FREE COPY.
POST & PACKING PLEASE ADD 35p
(OVERSEAS ORDERS ADD 90p)

V.A.T. ADD 15% TO THE TOTAL OF GOODS AND P.P.
Full SATISFACTION GUARANTEE on all items.

IT'S HAPPENED AGAIN!

THE PART THREE CATALOGUE IS PUBLISHED & WE HAVE MOVED TO BIGGER PREMISES.

Yes, it's here at last - the all new Part Three Catalogue. Fun for all the family, and the usual update on all that is new, worthwhile and exciting in the world of Radio and Communications. A big section on frequency synthesis techniques covering broadcast tuners, to communication quality transmitter systems. More new products than ever - RADIO CONTROL parts, crystal filters, ceramic filters for 455kHz and the new range of TOKO CFSH low temperature coefficient types for 10.7MHz. Details on new radio ICs, including the new HA11225, the CA3189E look-alike with 84dB signal to noise, and adjustable muting threshold. Radio control ICs - and an updated version of the RCM&E 8 channel FM receiver - now with an Ambit designed screened front end, with 27MHz ceramic bandpass filter. LCD panel clock timer modules - the neatest and best LCD panel DVM yet (only £19.45 each + VAT), the new 5 decade resolution DFM3 for LW HF VHF with LCD readout. The DFM6 with fluorescent display to 10kHz resolution on VHF, 1kHz on SW. A 1kHz HF synthesiser with five ICs - the list is endless. Get your copy of the catalogue now. Post publication price is 60p (inc PP etc). The previous two sections are also required for a complete picture. Parts 1 & 2 £1 the pair. All 3 £1.50. And don't miss our spot the gibbon contest, together with a quiz to see if you can spot the differences between a neolithic cave drawing and a circuit diagram of one of our competitor's tuners. (* Yes, we still haven't learnt how to spell.)

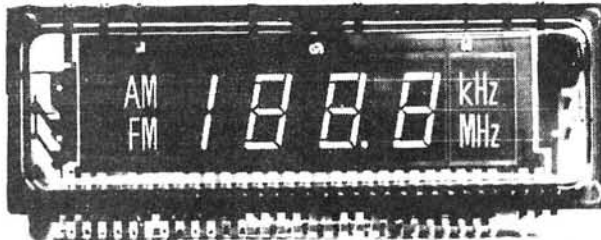
FM radio control RX kit



- 8 Channel IC receiver (FM)
- Single IC RF/IF/Detector
- Single IC decoder
- 27MHz ceramic filter input
- FET RF stage with double tuned bandpass filter
- Dual ceramic filter IF
- Best quality SLM servo connector block
- ONLY £16.10 inc VAT (kit) (includes new SLM case)

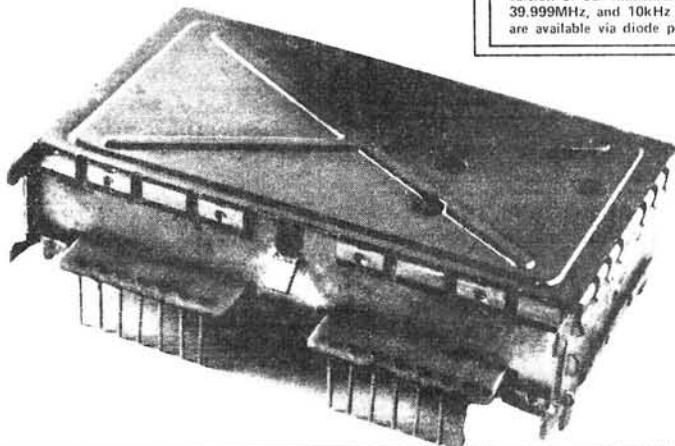
DOES YOUR ONE GLOW GREEN IN THE DARK ??

Our DFM4 does, since it uses a vacuum fluorescent display for direct readout of MW/LW/FM. Basically the same as the DFM2, (LCD Version), £24.45 kit (inc VAT). Transformer with all necessary windings for DFM4 - £2.50 inc VAT.



Not illustrated here - but also now available is the DFM6. This is a vacuum fluorescent display version of our immensely popular DFM3 (LCD). Resolution is 100Hz to 3.9999MHz, 1kHz to 39.999MHz, and 10kHz to 200.00MHz+; all standard IF offsets (inc. 10.7MHz on shortwave) are available via diode programming.

New series of radio modules in fully screened cans:



UM1181 VHF band 2 VARICAP TUNERHEAD

5 tuned circuit, with image/spurrs better than -80dB, buffered LO output, MOSFET RF stage, FET IF preamp, tunes with only 1% to 8v, -9dBm 3rd order intercept. 10ft price £12.00 inc VAT, (100off) OAI

911225 FM IF strip with all mod cons for the HiFi tuner:

All types use 80+dB S/N Hitachi IC, with muting, AFC, AGC, meter outputs for signal level and centre zero. IF preamp stage
'A' Dual linear phase ceramic filters, with MOSFET 'AGC'd' IF preamp and a 3rd narrow filter with DC filter selection. Dual tuned FM detector stage. £23.95 inc VAT (built)
'B' Dual ceramic filters, single tuned detector stage £14.95 inc VAT (All 'A' series units are set up with a spectrum analyzer for best THD)

91072 AM RADIO TUNER MODULES - DC TUNED and DC SWITCHED Available February '80

All include buffered LO output, mechanical IF filter (TOKO CFMQ) 1.10v tuning bias, switching by a single pole to earth
A MW/LW (150 to 350kHz LW range) with ferrite rod antenna
B As 'A' but also including SW1 or SW2 (specify.)
SW1 - 1.8 to 4MHz SW2 - 5 to 10MHz
C With both SW ranges
Prices one off INC VAT
'A' £14.43 'B' £15.90 'C' £17.50 (Custom types OAI)

There is a danger - when advertising in some magazines - that because we do not find space to list everything we sell in every ad., that some readers forget about half the ranges we stock. So to summarize the general ranges:

- TOKO**
Chokes, coils for AM/FM/SW/MPX, Audio filters etc
Filters: Ceramic for AM/FM, LC for FM, MPX etc.
Polyvaricons
ICs for radio, clock LSI, radio control, MPX decoders etc
- Micrometals**
Dust iron cores for toroids for resonant and EMI filters
Toroid mounts
- Hitachi**
Radio/audio/mpx linear ICs
100W MOSFETs, small signal FETs, MOSFETs and bipolar

And the following groups of products from a broad range of sources:

- Semiconductors** - specializing in radio devices, Plessey SL1600, EUROPE's best selection of AM/FM and communications devices. Power MOSFETs, WORLD'S LOWEST NOISE AUDIO small signal transistors, BAR graph LED drivers for linear and log.
- CD4000 series CMOS, TTL/LPSNTTL, standard linears (741, 301, 3080 etc), MPUs, memories.**
- Small signal transistors from AEG BC237/8/9 families etc. (1000 off BC239C : 5.2p ea)**
- LEDs: AEG 3mm/5mm round, 2.5x5mm flat, red, green, orange, yellow. The best prices you will find for quality products.**
- MOSFETs for RF signal processing, including the BF960 UHF device, and 3SK51 for VHF.**
- Varicap diodes for 17:1 capacity ratio tuning**

FREQUENCY READOUT LSI from OKI, with a one-chip answer to most digital frequency display needs (and various modules).

Crystal and ceramic ladder filters from leading manufacturers, ferrite rods, various ferrite beads and a range of crystals for 'standard' frequencies and both AM and FM radio control at 27MHz. Trimmer capacitors.

METERS - a new range of linear movement types, plus many 'indicator' types for VU, all types of tuning indicators etc.

SOCKETS - a new range that are better quality than Texas low profile, yet better priced.

Modules for AM/FM/STEREO, complete kits for tuners, audio amplifiers from Larsholt.

SWITCHES - complete low cost DIY systems for push button arrays, keyboard switches.

DOUBLE BALANCED MIXERS MCL SBL1, replacement for MD108 etc. And cheaper.

OUR LATEST MOVING EXPERIENCE :: At last, we have moved to the address below. There is car parking for customers approaching via North Service Road (an extension of North Road Avenue, entrance opposite the Brentwood Fire Station.) Pedestrian access from the High Street (alongside 117 High Street). The new building is six times bigger than our Gresham Road offices, and we will be installing a much expanded sales counter in the fullness of time. **NEW TELEPHONE NUMBER (0277) 230909. TELEX NUMBER (as before) 995194 AMBIT G.** See you there!

200 North Service Road, Brentwood, Essex.



Receivers and Components

Southern Valve Co., 2nd Floor, 6 Potters Road, New Barnet, Herts.

Tel: 01-440 8641 for current prices & availability, all popular valves stocked. **NO CALLERS**, SAE Lists. Cash with order. Same Day Postal Despatch.

Valves, Tubes, Aerials etc by LEADING-MAKERS. Send SAE Lists or Phone for current prices. Counter or MAIL ORDER. NO COD. Speedy Despatch assured. No order under £1.

Phil Bearman, 6 Potters Road, New Barnet, Herts.
Tel: 01-449 1934/5 (1934 Recording Machine).

10 LEDS. Mixed colours-sizes £1.15. Lists 15p. Sole Electronics. (P.W.) 37 Stanley Street, Ormskirk, Lancs.

SURPLUS TO INDUSTRIAL REQUIREMENTS

100 mixed Min. Electrolytics	£3.00
300 pack 220mfd 10V	£1.50
25 mixed Large Can	£3.00
10 4700mfd 40V Tag 3 × 1 1/2	£1.20
10 200mfd 70V Tag 1 1/2 × 2 1/2	£1.20
10 200mfd 450V Tag 4 1/2 × 1 1/2	£1.20
100 mixed Preset Spindle Pots.	£3.00
10 100K Dual 1/2 watt Lin. Pots.	£2.00
24 mixed Voltage S/pole Relays	£3.00

Add 30p per item P&P. All prices inc. VAT.

BLORE-BARTON

Reedham House, Burnham, Bucks.

TUNBRIDGE WELLS COMPONENTS, BALLARD'S, 108 Camden Road, Tunbridge Wells, Tel: 31803. No Lists. Enquiries S.A.E.

BRAND NEW COMPONENTS BY RETURN

Electrolytic Capacitors 16V, 25V, 50V.
0.47, 1.0, 2.2, 4.7, & 10 mtds. — 5p.
22, 47—51p. (50V—6p.), 100—7p. (50V—8p.).
220—8p. (50V—10p.). 470—11p. (40V—16p.).
1000/15V—15p. 1000/25V—18p. 1000/40V—35p.

Subminiature bead tantalum electrolytics.
0.1—0.22, 0.47, 1.0—35V 4.7—6.3V—14p.
2.2/35V, 4.7/25V—15p. 10/25V, 15/16V—20p.
22/16V, 33/10V, 47/6, 68/3V & 100/3V—30p.
15/25V, 22/25V, 47/10V—35p. 47/16V—60p.

Mullard Miniature Ceramic E12 Series 63V 2%.
10 pf. to 47 pf.—3p. 56 pf. to 330 pf.—4p.

Vertical Mounting Ceramic Plate Caps 50V.
E12 22 pf.—1000 pf. E6 1500 pf.—47000 pf.—2p.

Polystyrene E12 Series 63V. Hor. Mounting.
10 pf. to 820 pf.—3p. 1000 pf. to 10000 pf. 4p.

Miniature Polyester 250V. Vert. Mtg. E6 Series.
01—068—4p. 1—5p. 15, 22—6p. 33, 47—10p.
68—12p. 1.0—15p. 1.5—22p. 2.2—24p.

Mylar (Polyester) Film 100V. Vertical Mtg.
001, 002, 005—31p. 01, 02—41p. 04, 05—51p.

Miniature Film Resistors Highstab. E12 5%.
0.125 watt 10 Ω 2M20. 1p
0.250 watt 1 Ω to 10MΩ (10% over 1M). 1p
0.500 watt 10 Ω to 2M70. 2p
1.000 watt 10 Ω to 10MΩ. 2p

1N4148—2p, 1N4002—4p, 1N4006—6p, 1N4007—7p
BC107/8/9, BC147/8/9, BC157/8/9, BF194 & 7—10p.

8 Pin Dil ic's 741's—18p. 555's—24p.

20mm. fuses 15, 25, 5, 1.0, 2.0, 3.0 & 5A—3p.

20mm. fuseholders P.C. or Chassis Mtg—5p.

Post 10p (Free over £4). Prices VAT inclusive.

THE C. R. SUPPLY CO.

127, Chesterfield Road, Sheffield S8 0RN

VHF TUNERS. 45-220MHz. 30MHz IF. Ideal feed HF receiver. £6.00 60p post. 50-80. 100-175. 160-300MHz tuner £11.50. 60p post. SAE data & lists. H. Cocks, Bre Cottage, Staplecross, Robertsbridge, E. Sussex. Tel: 058083-317.

SMALL ADS

The prepaid rate for classified advertisements is 24 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £8.00 per single column centimetre (minimum 2.5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance should be sent to the Classified Advertisement Manager, Practical Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846)

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.

VALVES

Radio - T.V. - Industrial - Transmitting
Projector Lamps and Semiconductors

We Dispatch Valves to all parts of the world by return of post. Air or Sea mail. 4000 Types in stock. 1930 to 1976. Obsolete types a speciality. List 50p. Quotations S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves, Projector Lamps and Semiconductors.

COX RADIO (SUSSEX) LTD.

Dept. P.W. The Parade, East Wittering,
Sussex PO20 8BN
West Wittering 2023 (STD Code 024386)

ELECTRONIC COMPONENTS. Quick delivery, wide range from stock catalogue on request. J. R. Hartley Electronic Components, 78B High Street, Bridgnorth, Salop WV16 4DY.

AM/CW/SSB COMMUNICATION RECEIVER and preselector modules. The cheapest way to good amateur and BC DX.

CRYSTALS Brand new high-precision. You benefit from very large stocks held for industrial supplies. All normal freq standards, baud rates, MPU, and all magazine projects inc: HC33/U: 1.0, 1.008, 2.5625 MHz. £3.50, 1.280 MHz. £4.15, HC18/U: 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 10.7, 10.7, 12.0, 15.0, 16.0, 18.0, 20.0, 6.9375, 38.6667, MHz. £3.25. Selected freqs stocked in Glider, Marine and 27 MHz bands. Any freq made to order in 6 weeks from £3.90.

FILTERS Your best source for 6 and 8 pole and monolithics for AM, CW, SSB, FM, on 455 kHz: 1.6, 9.0, 10.7, 21.4 MHz, etc. Prices inc. VAT and UK post. SAE lists.

P. R. GOLLEGE ELECTRONICS

G3EDW, Merriott, Somerset, TA16 5NS.
Tel: 0460 73718

Aerials

AERIAL BOOSTERS

Improves weak VHF Radio and Television reception.

B45-UHF TV, B11-VHF Radio. B11A-2 metres For next to the set fitting. Price £6.

SIGNAL INJECTOR

A complete range of AF and RF frequencies up to the UHF Band. Price £5.00.

S.A.E. for Leaflets. ACCESS

ELECTRONIC MAILORDER LTD,

62 Bridge Street,
Ramsbotton, Bury, Lancs, BLO 9AG.

COPPER AERIALS WIRE 14swg hard drawn 70' £3.50.

140' £7.00 inc. VAT. Postage £1-15. T.M.P. Electronics, Supplies, Britannia Stores, Leeswood, Nr. Mold, N. Wales.

KILL THAT INTERFERENCE

G2DYM ANTI-T.V.I. TRAP DIPOLES:

S.W.L. Indoor models £14.50 & £27.50

S.W.L. Outdoor models £30.00 & £34.50

Tx-ing models £36.00, £46.00 & £54.75

Lists 10 × Bin SAE. Aerial Guide 50p.

Indoor and invisible aerials for S.W.L.'s £3.50.

G2DYM, Uplowman, Tiverton, Devon.

Situations Vacant

TESTERS Test Technicians. Test Engineers - Earn what you're really worth in London working for a World Leader in Radio & Telecommunications. Phone Len Porter on 01 874 7281 or write - REDIFON TELECOMMUNICATIONS LTD., Broomhill Road, Wandsworth, London SW18.

Educational

COLOUR TV SERVICING

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. S277 Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

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Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers, also self-build radio kits. Full details from:

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Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms, Technicians, Electrical Installations, Radio, TV & Electronics Technicians, Radio Amateurs. Full details from:

ICS SCHOOL OF ELECTRONICS
Dept. S277 Intertext House, London SW8 4UJ
Tel. 01-622 9911 (all hours)
State if under 18

GO TO SEA as a Radio Officer. Write: Principal, Nautical College, Broadwater, Fleetwood, FY7 8JZ.

Courses

COURSES-RADIO AMATEURS EXAMINATION. City & Guilds. Pass this important examination and obtain your G8 licence, with an RRC Home Study Course. For details of this, and other courses (GCE, professional examinations etc) write or phone - THE RAPID RESULTS COLLEGE, DEPT JX 1, Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service) or for prospectus requests ring 01-946 1102 (24hr Recordcall).

For Sale

NEW BACK ISSUES of "PRACTICAL WIRELESS" available at 80p each, post free. Open P.O. Cheque returned if not in stock - BELL'S TELEVISION SERVICE, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0423)55885.

LOUDSPEAKERS COMPONENTS Manufacturers surplus S.A.E. List. TENNEX LTD., Stock Road, Industrial Estate, Southend, Essex.

BACK COPIES Practical Wireless and Practical Television 1955 to 1979 540 issues. Offers: Park Street 72356.

SERVICE SHEETS Radio TV 1945 onwards. Offers per 50 Sheets. Folkstone 58265.

PRACTICAL WIRELESS 1969 to 1977 Approx. 100 copies. Offers Manchester 773-3965.

PRACTICAL WIRELESS, Practical Television. Radio Constructor. 102 copies 1943-1968. Offers. Aylesbury 81563 After 6 P.M.

MULLARD LP1164 AM/FM LF. Modules Guaranteed unused £1.50 P.P. C.W.O. S.A.E. Lists. Tennex Limited, Stock Road, Industrial Estate, Southend, Essex.

PRACTICAL WIRELESS/ELECTRONICS, Radio Constructor. 150 issues 1963-1976. Offers? Colne 866823.

Wanted

ELECTRONIC COMPONENTS PURCHASED. All Types Considered - Must be new. Send detailed list - Offer by return - WALTONS, 55A Worcester Street, Wolverhampton.

WANTED. Information on Lafayette HE-80 receiver, to buy or copy. Tel: Rochdale 50690.

Books and Publications

Build your own

P.A., GROUP & DISCO SPEAKERS

Save money with this practical guide. Plans for 17 different designs, line source, I.B., Horn and Reflex types, for 8"-18" drive units. £3.95 post free (\$8 overseas).

THE INFRA-BASS LOUDSPEAKER

(full construction details for versions using 15", 12" and 10" drive units.) £2.95 post free (\$6 overseas)

THE DALESFORD SPEAKER BOOK

This book is a must for the keen home constructor. Latest technology DIY designs. Plans for I.B., and Reflex designs for 10-100 watts. Also unusual centre-bass system. £2.20 post free (\$5 overseas).

VAN KAREN PUBLISHING

5 SWAN STREET, WILMSLOW, CHESHIRE

FULL REPAIR data any named T.V. £5.30, with circuits, layouts, etc.. £7. (AUSW) 76 Church Street, Larkhall, Lanarks ML9 1HE.

RADIO BOOK SERVICE

WORLD RADIO TV HANDBOOK 1980 Edition	£9-25
Radio Stations Guide	£1-55
Long distance Television Reception for the Enthusiast	£1-55
Popular Electronic Projects	£1-55
Electronic Projects for Beginners	£1-45
Mobile Discotheque Handbook	£1-45
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75	8.50	1.31	64W
150	11.00	1.31	4W
200	12.02	1.67	65W
250	13.39	1.67	69W
500	20.13	1.89	67W
1K	30.67	2.65	84W
1.5K	42.82	O.A.	93W
2K	54.97	O.A.	95W

Continuous Ratings + VAT 15%

60 VOLT RANGE			
Pri 220/240V sec 0-24-30-40-48- 60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V or 30V-0-30V.			
Ref	Amps	Price	P & P
124	0.5	4.27	1.10
126	1.0	6.50	1.10
127	2.0	8.36	1.31
125	3.0	12.10	1.31
123	4.0	13.77	2.12
124	5.0	17.42	1.89
120	6.0	19.87	2.12
121	8.0	27.92	O.A.
122	10.0	32.51	O.A.

END OF LINE OFFERS

Ref	P	P & P
30-Isolator 240V:240V 200VA	£4.62	£1.10
62-Isolator 240V:240V 250VA	£5.72	£1.10
M616 - 0-240V: Screen 1 13-0-13 1A. 2 12V 150ma		£2.10 60p

M489 - 0-240V: 1400V + 150ma, 6.3V + 4A	£5.50	£1.04
M708 - 6K to 3KΩ matching trans. 5 watt	90p	40p
M679 - 0-120V - 2:36V 1 6A	£3.00	78p
M865 - 100V Line to 4Ω 10 watts	£1.90	60p
M973 - 100V Line to 8Ω 40 watts	£2.90	60p
M1015 - Choke 8A + 5mH 150A Surge	£1.50	45p
M1020 - 0-240V 12-0-12V + 50ma	75p	30p
M1126 - 120/240V: 9-0-9V + 1A	£1.79	71p
M1130 - 0-240 4500V + 10ma	£4.86	£1.08
M1165 - 0-115-240V: 14V 50ma	75p	30p

Metal Oxide Resistors 1/2W 5% TR4 (Electrosil)	
390Ω/470Ω/510Ω/560Ω/820Ω/1K/1K1/1K2/1K6	
1K8/2K/2K4/3K/16K/20K/22K/24K/47K/82K/100K	
110K/120K/130K/180K/220K/270K/300K	
£1.50/100 + VAT.	

Antex Soldering Irons 15W & 25W	£4.58 each
Safety Stand	£1.75 P & P 52p each

P.W. Purbeck oscilloscope transformer 250-0-250; 6-3V: 12-9V	£7.51 £1.04
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12 OR 24V OR 12-0-12V Pri 220-240 volts			
Ref	12V	24V	Price
111	0.5	0.25	2.42
213	1.0	0.5	2.90
71	2	1	3.66
18	4	2	4.46
85	0.5	2.5	6.16
70	6	3	6.99
108	8	4	8.16
72	10	5	8.93
116	12	6	9.89
17	16	8	11.79
115	20	10	15.38
187	30	15	19.72
226	60	30	40.41

SPECIAL OFFER Multimeter 20KΩ 8V			
- with combined audio/I.F. test oscillator at 1 KHz and 465 KHz AC/DC to 1000 volts DC current to 500mA resistance to 1KΩ. Size 160x97x40mm			
			£8.50 P & P £1.00
VAT 15%.			

20,000 ohm/V Multimeter, mirror scale			
Ranges AC DC to 1000V DC current to 250mA Resistance to 3 Mohms			
5" x 3 1/2" x 1 1/2" £14.36 P & P £1.00 VAT 15%			

NEW RANGE TRANSFORMERS			
2 windings 0-36V-48V/36V-0-36V 48V-0-48V 72V or 96V.			
Amps	Ref	Price	P & P
1	430	4.88	0.76
2	431	8.12	0.99
3	432	13.35	1.31
4	433	16.17	1.40
5	434	20.65	2.11
6	435	29.30	2.47
8	436	36.69	O.A.
8	437	40.03	O.A.

PANEL METERS			
43mm - 43mm 82mm - 78mm			
0.50mA	6.20	0.50μA	6.70
0.500μA	5.95	0.500μA	6.70
0.1mA	5.95	0.1mA	6.70
0.30V	5.95	0.30V	6.70
VU Ind Panel 48mm x 45mm 2-60			

VU Ind. Edge 54 x 14mm	250.00
750.00 F.S.D.	2.60
Carriage 76p	VAT 15%

SCREENED MINIATURES			
Ref	mA	Volts	£ P&P
238	200	3-0-3	2.83 0.63
212	1A, 1A	0-6-0-6	3.14 0.90
		13 100	2.35 0.44
		9-0-9	2.19 0.44
235	330, 330	0-9-0-9	2.19 0.44
		207 500, 500	3.05 0.89
		0-8-9-0-8-9	3.88 0.90
208	1A, 1A	0-8-9-0-8-9	3.88 0.90
		236 200, 200	2.19 0.44
		0-15-0-15	2.19 0.44
214	300, 300	0-20-0-20	3.08 0.90
221	700 (DC)	20-12-0-12-20	3.75 0.90
206	1A, 1A	0-15-20-0-15-20	5.09 1.10
203	500, 500	0-15-27-0-15-27	4.39 1.10
204	1A, 1A	0-15-27-0-15-27	6.64 1.10
239	50	12-0-12	2.88 0.37

AVO TEST METERS		Price
AVO 8 MK5		£91.50
AVO 71		£38.00
AVO 73		£50.70
AVO MM5 minor		£35.95
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Clamp Meter to 300A		£54.60

All Avos Meggers and accessories available.
P & P £1.32 VAT 15%

15V RANGE (7.5-0-7.5V) 0-CT 15V			
Ref	VA	Price	P & P
171	500 mA	2.30	0.52
172	1A	3.26	0.90
173	2A	3.95	0.90
174	3A	4.13	0.99
175	4A	6.30	1.10

AUTO TRANSFORMERS			
Ref	VA (Watts)	£	P&P
113	15 0 115 210 240	2.73	0.81
64	75 0 115 210 240	4.41	1.10
4	150 0 115 200 220 240	5.89	1.10
67	500 0 115 200 220 240	12.09	1.91
84	1000 0 115 200 220 240	20.84	2.39
93	1500 0 115 200 220 240	25.81	2.81
95	2000 0 115 200 220 240	38.31	3.81
73	3000 0 115 200 220 240	65.13	6.51
805	4000 0 10 115 200 220 240	84.55	8.45
575	5000 0 10 115 200 220 240	88.45	8.84

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POLYESTER RADIAL LEAD CAPACITORS: 250V;
10n, 15n, 22n, 27n 5p; 33n, 47n, 68n, 100p; 150p; 220n
330n 13p; 470n 17p; 680n 19p; 1µ 22p; 1.5µ 30p; 2µ 34p.

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in µF)
500V: 10 40p; 47 68p; 100 65p; 220 65p; 470 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 8, 10, 15, 22 8p; 32, 47, 50 12p; 63, 100, 27p; 50V: 1.0 7p; 50, 100, 220 25p; 470 32p; 1000 50p; 40V: 2.2, 33nF, 100 12p; 220, 330n, 85p; 470, 98p; 35V: 10, 33 7p; 33, 47 32p; 100, 50p; 25V: 1.0, 2.2, 4.7 6p; 8p, 10, 100, 180 8p; 22, 25, 150 13p; 47, 60, 640 25p; 1000 27p; 1500 30p; 2200 45p; 3300 62p; 18V: 10, 40, 47, 85 7p; 100, 125 8p; 200, 330 14p; 470 16p; 1000, 1500 20p; 2200 34p; 15V: 100 6p.

TAG-END TYPE 450V, 100µF 180p; 70V, 470µF 165p; 64V, 3300 130p; 2500 98p; 50V, 3300 105p; 2200 95p; 40V, 15000 399p; 4700 120p; 4000 92p; 3300 93p; 2500 85p; 2200 85p; 2000+2000 120p; 30V, 4700 90p; 25V, 6400 105p; 4700 85p; 3300 80p; 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: 1.5µF, 3.3µF, 10µF, 13p each.
16V: 15p, 22, 25p, 47, 100, 220, 400p.
10V: 15p, 22, 33, 20p; 100 35p; 6V: 47p, 68, 100, 30p; 10µ 20p.

POLYESTER (MYLAR) CAPACITORS
100V: 0.001, 0.002, 0.004, 0.01µF, 6p
0.015, 0.02, 0.03, 0.04, 0.05, 0.056µF, 7p
0.1µF, 8p, 0.2µF, 10p. 50V: 0.47µF, 12p

CERAMIC CAPACITORS 50V
Range: 0.5pF to 10nF 4p
15nF, 22nF, 33nF, 47nF 5p 100nF 7p

POLYSTYRENE CAPACITORS
10pF to 1nF, 6p. 1.5nF to 47nF, 10p.

RESISTORS—5% carbon, High Stab. Miniature, Low Noise
Range: 1-99 100-1000
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1 202-4M7 E12 2p 1p
1W 202-10M E12 5p 3p
2W Metal Film 100-1M
1/8 0.5W 510-1M 10p 8p
NB: 100p price applies to Resistors of each type not mixed values.

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1 (copper clad) 1 (plain)
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2.5 55p 50p 31p
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100 pins 50p; 500 pins £2.00

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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

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Dual Purpose DP
VALVE TYPE
Ranges: 1-5 Bk. YL
Rd. Wht. 92p
6-7 Bk. Y R 82p
1-5 Green 100p
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Ranges: 1-5 Bk. YL
Rd. Wht. 105p

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0.2 365pF with slow motion Drive 345p
0.2 100n 176 285p
1.5 115p motion drive, with slow motion drive, 345p
C804: 5pF: 10, 15p
6.1/36:1 650p
Drum 54mm 30p
0.1-365pF 245p
0.2-365pF 275p
0.0-2.500pF 525p

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350p per pair

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Carbon Track, 0.25W Log & O Gen Linear Values. Rotary Type.
470K, 680K, 1K, 2K (Lin only) Single 27p
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5K to 2M; Single gang; D/P switch 65p
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5K to 500K; Single gang 60p
10K to 500K; Dual gang 80p
Self-Stop graduated Alum. Bezels 30p

PRESET POTENTIOMETERS
0.1W 500-2.2M Mini. Vert. & Horiz. 7p
0.25W 1000-3.3M Horiz. larger 10p
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Grn, Yel 36 TL32 58
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TL78 70
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3°C Anod 99
4°C Cath 120
4°C Anod 120
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6°C Cath 180
6°C Anod 180

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100KHz 385
455KHz 385
1MHz 323
1.000MHz 323
1.6MHz 395

LINEAR IC's
LM301A 23
LM311H 75
LM318B 205
LM324A 45
LM339 17
LM348 90
LM358 125
LM373 375
LM380 80
LM381N 145
LM3812A 248
LM382 125
LM385B 150
LM387 150
LM389 93
LM733 125
LM745 40
LM747 40
LM748 36
LM753 8p
LM758 150
LM765 150
LM767 150
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TRANSISTORS

AC125 20	BC338 12	BSX20 18	TS88A 00	ZN3819 22	LS112 55	74LS399 230
AC126 20	BC339 12	BSV46A 18	T890 20	ZN3820 22	LS113 55	74LS399 276
AC127 20	BC41 36	BU105 140	T902 20	ZN3821 22	LS114 55	74LS447 144
AC128 20	BC47 25	BU205 190	TX107 12	ZN3860 90	LS122 70	74LS490 180
AC142 24	BC516 20	BU208 225	TX108 12	ZN3903 20	LS123 70	74LS668 182
AC176 24	BC517 20	E42 158	TX109 14	ZN3904 18	LS124 180	74LS670 248
ACV17 40	BC517 20	E42 158	TX300 13	ZN3905 18	LS125 60	74LS673 1050
ACV18 40	BC548 12	EA1 168	TX301 13	ZN3906 17	LS126 60	74LS674 1050
ACV19 40	BC549C 13	MJ2955 105	TX302 20	ZN3907 17	LS127 60	74LS675 1050
ACV20 40	BC557 15	MJE340 54	TX303 25	ZN4058 17	LS136 55	
ACV21 35	BC558 20	MJE370 58	TX304 24	ZN4061 17	LS138 55	
ACV22 40	BC559 20	MJE371 60	TX314 24	ZN4062 17	LS139 85	
ACV28 40	BCV70 38	MPP106 66	TX315 24	ZN4063 17	LS141 96	
ACV39 78	BD13 45	MPP103 36	TX501 15	ZN4064 17	LS142 96	
AD149 78	BD132 45	MPP104 36	TX502 15	ZN4065 17	LS143 96	
AD161 42	BD133 45	MPP105 36	TX503 15	ZN4066 17	LS144 96	
AD162 42	BD134 45	MPP106 36	TX504 15	ZN4067 17	LS145 96	
AF114 50	BD135 45	MPP107 36	TX505 15	ZN4068 17	LS146 96	
AF115 50	BD136 36	MPSA05 25	TX531 25	ZN4069 17	LS147 96	
AF116 50	BD137 36	MPSA06 25	TX550 25	ZN4070 17	LS148 96	
AF117 78	BD138 36	MPSA17 42	40311 125	ZN4071 17	LS149 96	
AF118 65	BD139 40	MPSA55 25	40313 125	ZN4072 17	LS150 96	
AF139 35	BD140 40	MPSA56 25	40315 125	ZN4073 17	LS151 96	
AF178 70	BD141 48	MPSA56 25	40317 125	ZN4074 17	LS152 96	
BC107 10	BD145 198	MPSU56 60	40361 42	ZN4075 17	LS153 96	
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BC147B 10	BF180 35	OC72 45	40689 54	ZN4085 17	LS163 96	
BC148 10	BF194 12	OC74 55	40706A 18	ZN4086 17	LS164 96	
BC148C 10	BF195 12	OC76 36	40708 19	ZN4087 17	LS165 96	
BC149 8	BF197 12	OC81 50	40718 18	ZN4088 17	LS166 96	
BC149C 10	BF198 18	OC83 48	40718 22	ZN4089 17	LS167 96	
BC153 30	BF199 18	OC84 48	40730 50	ZN4090 17	LS168 96	
BC157 10	BF200 32	OC140 110	40730 50	ZN4091 17	LS169 96	
BC158 11	BF224 24	OC170 85	40730 50	ZN4092 17	LS170 96	
BC160 42	BF245 24	OC200 85	40730 50	ZN4093 17	LS171 96	
BC168C 12	BF246 60	OC200 85	40730 50	ZN4094 17	LS172 96	
BC169C 14	BF257 30	OC200 85	40730 50	ZN4095 17	LS173 96	
BC170 18	BF258 30	OC200 85	40730 50	ZN4096 17	LS174 96	
BC172 11	BF274 18	OC200 85	40730 50	ZN4097 17	LS175 96	
BC177 18	BF336 35	OC200 85	40730 50	ZN4098 17	LS176 96	
BC178 16	BF594 40	OC200 85	40730 50	ZN4099 17	LS177 96	
BC179 18	BF595 38	OC200 85	40730 50	ZN4100 17	LS178 96	
BC181 20	BF596 25	OC200 85	40730 50	ZN4101 17	LS179 96	
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BC184C 11	BF599 25	OC200 85	40730 50	ZN4104 17	LS182 96	
BC187 28	BF600 25	OC200 85	40730 50	ZN4105 17	LS183 96	
BC188 20	BF601 25	OC200 85	40730 50	ZN4106 17	LS184 96	
BC188C 11	BF602 25	OC200 85	40730 50	ZN4107 17	LS185 96	
BC189 20	BF603 25	OC200 85	40730 50	ZN4108 17	LS186 96	
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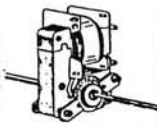
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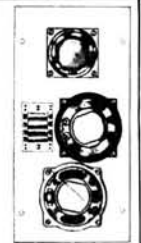
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Spare element Model X25 24V E

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Model SK4 Kit



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Model SK1

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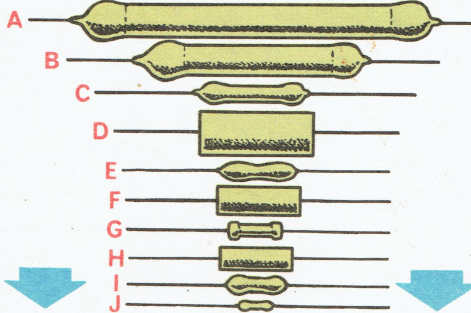
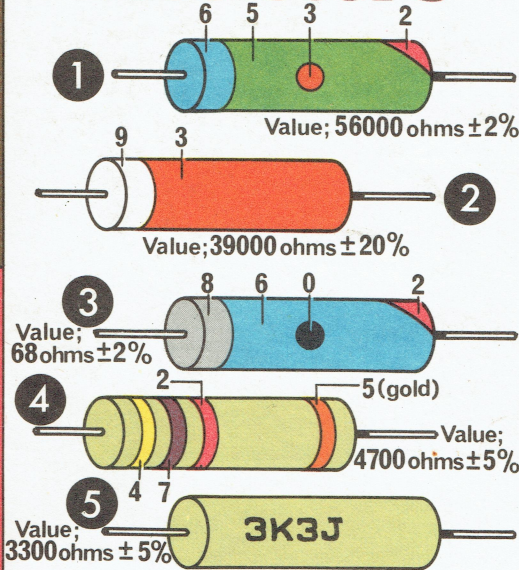
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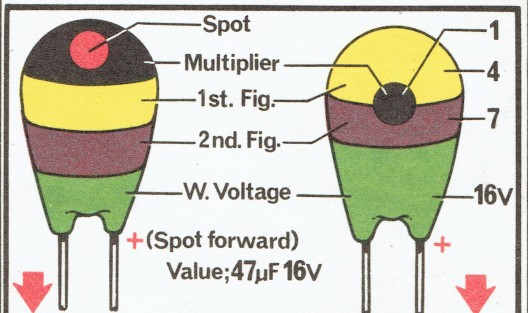
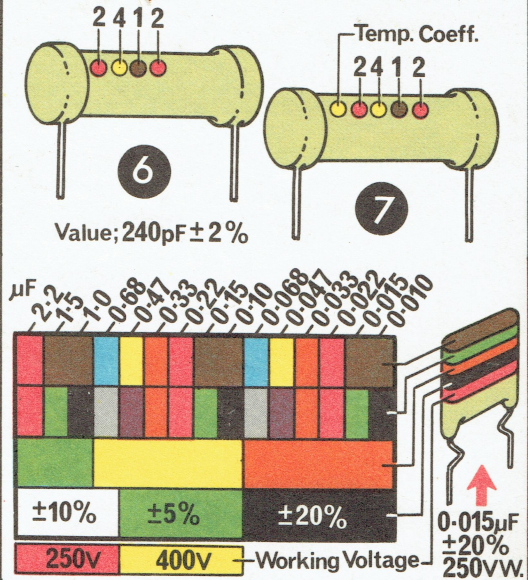


Rating (W)	Length (mm)	Characteristics
7	48	Wirewound
3	29	Wirewound
1	16	Wirewound
1	16	Carbon film. High stability. Low noise
1/2	9.5	Metal oxide. Better stability than c. film
10/11	10/11	Carbon film. High stability. Low noise
0.4	6.5	Metal film
1/4	9	Carbon film. High stability. Low noise
1/4	7/7.5	" " " " " "
20	4	" " " " " "

A
B
C
D
E
F
G
H
I
J

To assist in identification the resistor outline drawings are actual size.

Capacitors



	Multiplier	Voltage		Multiplier	Voltage
Black	× 1 μF	10	Blue		20
Brown	× 10 μF		Violet		
Red	× 100 μF	6.3	Grey	× 0.01 μF	25
Yellow			White	× 0.1 μF	3
Green		16	Pink		35

TABLE 'A'	More than 10pF	Less than 10pF
Black	± 20%	—
Brown	± 1%	± 0.1pF
Red	± 2%	± 0.25pF
Green	± 5%	—
White	± 10%	± 1pF

0

1

2

3

4

5

6

7

8

9

RESISTORS cont.

The colour code, given here at the sides of the card, represents the numbers 0 to 9 which can be used to mark a resistor (or capacitor) to indicate its value, plus such information as its temperature coefficient, tolerance and working voltage. The method is particularly useful on miniaturised components where space for marking is limited.

Older style resistors were marked with their nominal value by colours, on the body, at the tip and a coloured dot on the body. Sometimes a fourth coloured dot was used to indicate the tolerance on the marked value, Fig. 1. Where there is no apparent colour dot on the body of the resistor the dot is taken to be of the same colour as the body, Fig. 2.

READING THE VALUE The body colour of a resistor gives the first figure, the tip colour the second figure and the dot colour the multiplier, or number of zeros after the first two significant figures. In Fig. 1 the body is green (5), the tip is blue (6) and the spot is orange (3) hence the value in ohms is 56 plus 000 or 56000 ohms, generally written as 56k Ω , (k=kilo=1000).

In Fig. 2 the spot is the same colour as the body so it is decoded as orange (3), white (9) and dot orange (3) or 39000 ohms or 39k Ω .

Remember:- If the multiplier dot is black (0) then there are **no zeros** after the first two figures, see Fig. 3. For low value resistors multipliers of gold (X 0.1) and silver (X 0.01) are sometimes encountered.

TOLERANCE A fourth colour, usually a dot towards the end away from the tip colour, is frequently used to show the manufacturing tolerance on the marked value of a resistor. This means that a resistor marked 100k Ω \pm 5% may have any value between 100000+5000 ohms or 105000 ohms and 100000-5000 ohms or 95000 ohms.

Brown = \pm 1% **Red** = \pm 2% **Gold** = \pm 5% **Silver** = \pm 10%
None = \pm 20%

Today many resistors are marked with the value by means of coloured bands, rather than by dots, on a neutral coloured body, Fig. 4. The same code applies in deciphering the value etc of a resistor.

Other resistors may be marked with a number/letter code to indicate their value and tolerance, instead of the colour code, Fig. 5. Here the letter represents both the multiplier and the position of the decimal point in the number on the resistor.

R=1 K=1000 M=1000000

EXAMPLES

Multiplier=1 10R (10 Ω) 470R (470 Ω)
Multiplier=1000 2K2 (2.2k Ω) 33K (33k Ω)
Multiplier=1000000 6M8 (6.8M Ω) 2M4 (2.4M Ω)

The tolerance on this style of resistor is shown by a further letter, following the value, Fig. 5.

F=1% G=2% J=5% K=10% M=20%

EXAMPLES

10RK indicates a value of 10 Ω \pm 10%
2K2G " " " 2.2k Ω \pm 2%
6M8J " " " 6.8M Ω \pm 5%
33KF " " " 33k Ω \pm 1%
470RM " " " 470 Ω \pm 20%

PREFERRED VALUES Resistors are generally marked with values taken from the Preferred Numbers Series, the most popular ranges being the E12 and E24. Resistors in the E6 (6 values) and E96 (96 values) are also obtainable. Sub-multiples and multiples (decimal) of each number give a very wide range of values.

EXAMPLE 27 is the Preferred Number for resistors of 2.7 Ω , 27 Ω , 270 Ω , 2.7k Ω , 27k Ω , 270k Ω and 2.7M Ω .

E12	10	12	15	18	22	27	33	39	47	56	68	82
E24	10	11	12	13	15	16	18	20	22	24	27	30
	33	36	39	43	47	51	56	62	68	75	82	91

Moulded carbon composition resistors are the commonest type in use but they can change in value considerably if affected by heat or age. Carbon film resistors have better stability but they are not so reliable as composition types. Metal oxide resistors have excellent stability and reliability. Carbon film and metal oxide resistors can have appreciable self-inductance so care should be taken in using them at VHF or UHF.

An E12 number represents a 20% increment on the previous number in the series while in the E24 range the increment is 10%. If a \pm 10% tolerance is calculated for the 12 values in the E12 range the result is as shown in the table from which it will be seen that the possible range of values is almost continuous implying that a precise value can be chosen from a range of cheap, low-tolerance resistors.

10	9.0 to 11.0	33	29.7 to 36.3
12	10.8 to 13.2	39	35.1 to 42.9
15	13.5 to 16.5	47	42.3 to 51.7
18	16.2 to 19.8	56	50.4 to 61.6
22	19.8 to 24.2	68	61.2 to 74.8
27	24.3 to 29.7	82	73.8 to 90.2

CAPACITORS cont.

The colour code for resistors is also used on some capacitors, mainly ceramic types, to indicate value in PICO FARADS, and the tolerance, Fig. 6. Occasionally the working voltage may be added, Fig. 7. The tolerance decoding for small capacitors is shown in the table. For other types of capacitor see the appropriate Table 'A'.

The working voltage, when indicated, is the value of the colour spot/band multiplied by 100. A red spot would indicate 200V although in the Mullard C280 range of capacitors red is used for 250V. A white multiplier spot/band is used to indicate a working voltage of 1000V.

The Preferred Values used for resistors are also employed for capacitors except for very high values of capacitor.

Where letters/numbers are used for marking capacitors then the multipliers are p=10⁻¹² n=10⁻⁹ μ =10⁻⁶ and the value is in FARADS. In practice this means that 1 \times 10⁻⁶ F = 1 microfarad (1 μ F), 1 \times 10⁻⁹ F = 1 nanofarad (1nF) and 1 \times 10⁻¹² F = 1 picofarad (1pF).

As with resistors the multiplier is used as a decimal point in marking capacitors.

EXAMPLES

Multiplier \times 1 1p0 = 1pF 330p = 330pF
Multiplier \times 1000 2n0 = 2000pF 4n7 = 4700pF
Multiplier \times 1000000 5 μ 0 = 5 μ F 3 μ 3 = 3.3 μ F

CHARACTERISTICS OF CAPACITORS

Aluminium Electrolytics Available in polarised and non-polarised forms. Values from less than 1 μ F to 50000 μ F. Working voltages from 3 to about 500V. General decoupling in AF circuits and mains power supply units. Wide tolerance on values typically -20% to +50%. Polarised types have high leakage current until 'formed' by applied voltage. Applied voltage should be of same order as rated working voltage.

Ceramic Good for AF and RF up to VHF. Low natural inductance. Temperature coefficient generally not good but where known can be used to compensate for frequency changes in tuned circuits.

Paper Low frequency operation only, in mains power supplies and AF applications. High insulation resistance.

Polycarbonate As polyester. Tolerances to \pm 1%.

Polystyrene High stability, good for RF and AF applications in tuned circuits, decoupling etc. High insulation resistance. Available to close tolerances, typically \pm 2 $\frac{1}{2}$ %.

Polyester AF circuits. Reasonably high insulation resistance. Frequently of 'self-healing' type.

Silver Mica As polystyrene. Tolerances to \pm 1%. Can be suitable for operation in pulse circuits.

Tantalum Bead General AF and LF use in decoupling and filtering. High capacity for size. Low working voltages only, typically between 3 and 35V. Polarised.

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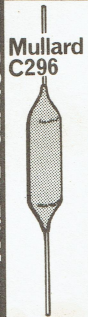
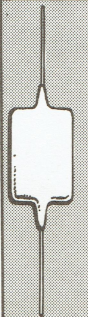
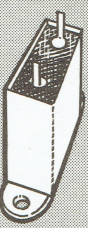
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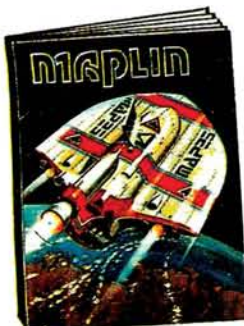
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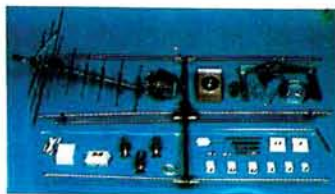


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