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MAR 1980

FREE INSIDE

BEGINNING THE

Modular 2m Transceiver System

PW NIMBUS

& YAESU FT-7B REVIEW (Part 1)

The VINTAGE YEARS OF RADIO

QUARTZ LCD 5 Function

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

£6.65

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

M1

SOLAR QUARTZ LCD 5 Function

Genuine solar panel with battery back-up. Hours, mins., secs., day, date. Fully adjustable bracelet. Back-light. Only 7mm thick.

£8.65

Guaranteed same day despatch.

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

£10.65 Thousands sold!
Guaranteed same day despatch.

M3

QUARTZ LCD ALARM 7 Function

Hours, mins., secs,. month, date, day. 6 digits, 3 flags plus continuous display of day and date or seconds. Back-light Only 9mm thick.

£12.65

Guaranteed same day dispatch.

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

6 digits, 5 flags,
22 functions.
Constant display of hours and mins., plus optional seconds or date display.
AM/PM indication, month, date.
Continuous display of day.
Stop-watch to 12 hours 59·9 secs., in 1/10 second steps.
Split and lap timing modes.
Dual time zones.
Only 8mm thick.
Back-light. Fully adjustable open bracelet.
Guaranteed same day dispatch

£22.65

M6

SOLAR QUARTZ LCD Chronograph with Alarm Dual Time Zone Facility

6 digits, 5 flags.
22 functions.
Solar panel with battery back-up.
6 basic functions.
Stop-watch to 12 hours 59·9 secs., in 1/10 sec., steps.
Split and lap timing modes.
Dual time zones.
Alarm. 9mm thick. Back-light.
Fully adjustable bracelet.

£27.95

M 7

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

£12.65

Guaranteed same day despatch.

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

£105.00

M10

SEIKO MEMORY BANK

Calendar watch M354
Hours, mins., secs.
Month, day, date in 12 or 24 hour format all indicated continuously.
Monthly calendar display month, year and all dates for any selected month over 80 year period.
Memory bank function.
Any desired dates up to 11 can be stored in advanced.
2 year battery life.
Water resistant.
List Price £130

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.

£35.00

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 11mm x 60mm).
Weight: 1.43 lbs (0.65 kg).

AC power 220V.

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M13

HANIMEX portable LCD clock radio

- Time set & alarm controls.
- Snooze & sleep controls.
- Wake to music or alarm.
- AM/PM indicator.
- Battery operated. No plug required.
- Receives all standard AM radio broadcasts.
- Drawstring carrying case included.
- Back-light.
- Batteries supplied free.
- Quartz crystal controlled.

£17.95

M14

QUARTZ LCD Ladies 5 Function

Only 25 x 20mm and 6mm thick.
5 function. Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£9.95

Guaranteed same day despatch.

M15

Price breakthrough only £18.95

OUTSTANDING FEATURES

- **DUAL TIME.** Local time always visible and you can set and recall any other time zone (such as GMT). Also has a light for night viewing.
- **CALENDAR FUNCTIONS** include the date and day in each time zone.
- **CHRONOGRAPH/STOPWATCH** displays up to 12 hours, 59 minutes, and 59.9 seconds.
- On command, stopwatch display freezes to show **intermediate (split/lap) time** while stopwatch continues to run. Can also switch to and from timekeeping and stopwatch modes without affecting either's operation.
- **ALARM** can be set to anytime within a 24 hour period. At the designated time, a pleasant, but effective buzzer sounds to remind or awaken you!

Guaranteed same day dispatch. M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and the order details clearly, enclose 30p for post and packing or the amount stated. We do not wait to clear your cheque before sending the goods so this will not delay delivery. All products carry 1 year guarantee and full money back 10 day reassurance. Battery fitting service is available at our shops. All prices include VAT.

Trade enquiries: Send for a complete list of trade prices – minimum order value £100.
Telephone Orders: Credit card customers can telephone orders direct to Daventry or Edgware Rd., 24 hour phone service at both shops: 01-723 4753 03272-76545.

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Northamptonshire
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practical WIRELESS

MARCH 1980
VOLUME 56
NUMBER 3
ISSUE 877

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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

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

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***PW* Datacard—Resistors & Capacitors**

Our April issue will be published on 7 March
(for details see page 37)

MORE BIG VALUE FROM YOUR TANDY STORE

1000 OHMS/VOLTS AC/DC 8 RANGES

Handy multitester for home and work-shop. Easy-to-read two colour 5cm meter, pin jacks for all 8 ranges. Reads AC and DC volts: 0-15-150-1000 DC current; 0-150 mA. Resistance: 0-100,000 ohms. Accuracy: ± 3% full scale on DC ranges, ± 4% on AC ranges. Complete battery. **22-027.** REG. PRICE

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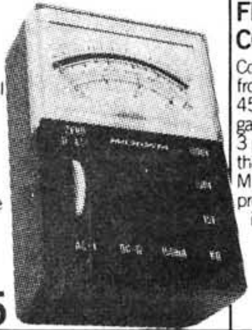

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REG. PRICE **£29.95**

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Spot circuit troubles and check RF, IF and audio signals from aerial to speaker on all audio equipment. With 9V battery, instructions. **22-010.**

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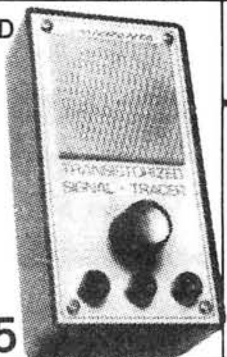

DIGITAL IC LOGIC PROBE

Unique circuitry makes it a combined level detector, pulse detector and pulse stretcher. Hi-LED indicates logic "1". Lo-LED is logic "0". Pulse LED displays pulse transitions to 300 nanoseconds, blinks at 3 Hz for high frequency signals (up to 1.5 MHz). Input impedence: 300K ohms. With 36" power cables. **22-300.**

REG. PRICE **£19.95**

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For RF, IF, AF circuits. Maximum accuracy. Easy pushbutton operation. Needs two "AA" batteries. **22-4033.**

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AC/DC CIRCUIT TESTER

Accuracy in 1-300 volts ranges. Safe in live/dead circuits. Needs two "AA" batteries. **22-4034.**

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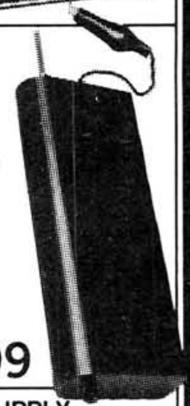

REALISTIC DX 300

General coverage receiver. Quartz-synthesised tuning, digital frequency readout. 3-step RF Attenuator. 6-range preselector with LED indicators. SSb and CW demodulation. Speaker. Code oscillator. Batteries (not included) or 12V DC. **20-204.**

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Shows current gain and electrode open and short circuit. Tests low, medium or high power PNP or NPN types. Go/no-Go test from 5-50mA on power types. **22-024.**

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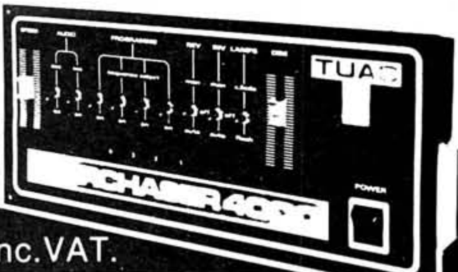

● 4 channels 750W each ● over 1000 different sequence patterns and effects ● 3 alternative sound triggers ● A.G.C. ● simulated strobing ● zero reference triac firing ● superb TUAC quality and reliability **£99.00** inc. VAT.

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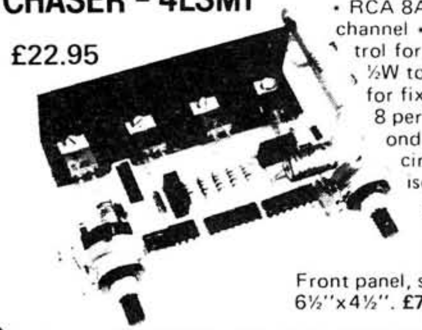
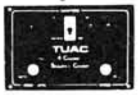
£22.95



• RCA 8A Triacs • 1000W per channel • Switched master control for sound operation from ½W to 125W • Speed control for fixed rate sequence from 8 per minute to 50 per second • Full logic integrated circuitry with optical isolation for amplifier protection.

Front panel, size: 6½"x4½". £7.75.



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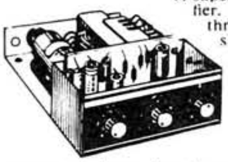
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200 250V. PRICE **£18·40,** P. & P. £1·35.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in wide × 5in high × 7¼in deep.

Special introductory price **£29·00** + £2·75 carriage and packing.

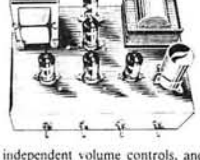
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14 11/16" × 1 7/16" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only **£8·80** each + p. & p. (one £1, two £1·25).
Now available in 8" round version. 10 watts RMS 60Hz 20KHz **£6·30.**
P. & P. (one 72p, two 82p).

STEREO MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1¾" × 2⅛" × ⅝" H. **£3·20** + 22p P. & P.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State FM/AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz.
Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8½"w × 4"h × 9½"d approx.
LIMITED NUMBER ONLY at **£29·00** + £1·65 P. & P.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple intruction booklet **50p** + SAE (Free with parts). **All parts sold separately.** ONLY **£18·40,** P. & P. £1·55. Also available ready built and tested **£22·50,** P. & P. £1·55.

STEREO DECODER MK.II
SIZE 1½" × 2.5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied **£7·00** plus 22p P. & P. Stereo beacon light if required **40p** extra.

Mullard LP1159 RF IF module 470kHz **£2·50** +P. & P. 22p. Full specification and connection details supplied.
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HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT .. .. **£14·95** P. & P. 88p
(Magnetic input components 33p extra)
POWER PACK KIT .. **£6·20** P. & P. £1·05
CABINET .. .. .. **£6·20** P. & P. £1·05

SPECIAL OFFER—only £25·80 if all 3 items ordered at one time plus £1·40 p. & p.
Full after sales service
Also avail. ready built and tested **£32·20,** P. & P. £1·65.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec. play socket are mounted on the printed circuit panel, size approx. 9½" × 2¾" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£10·40** plus 55p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£2·15** + 44p P. & P. if required. Full connection details supplied.

All prices and specifications correct at time of press and subject to alteration without notice.

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HARVERSON SURPLUS CO. LTD. (Dept. P.W.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985

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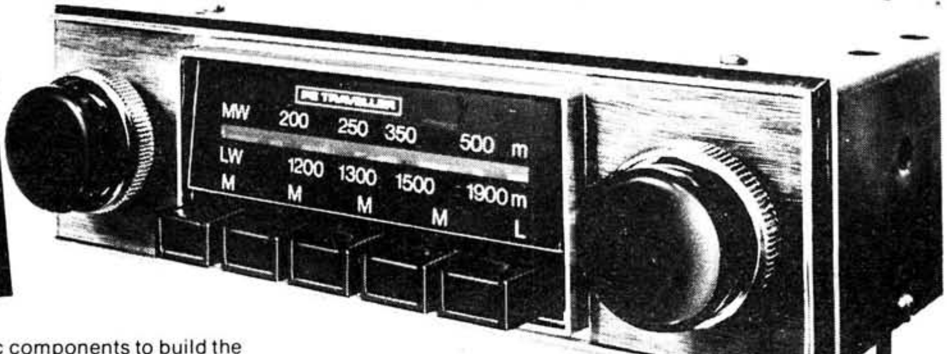
NEW CONSTRUCTORS PACK 7

ALL THE PARTS TO BUILD THE PE TRAVELLER CAR RADIO

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



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

£10.50 p&p £1.50

CONSTRUCTORS PACK 7A
Suitable stainless steel fully retractable locking aerial and speaker (approx 6" x 4") is available as a kit complete.
£1.95 Per Pack, p & p £1.00.
Pack 7A may only be purchased at the same time as Pack 7.

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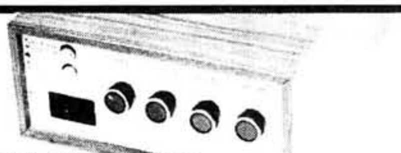
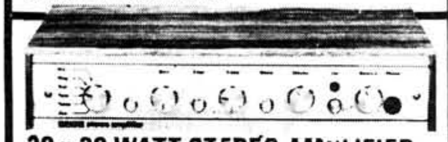


10 + 10 AMPLIFIER KIT

An opportunity to buy a 10 watts per channel stereo amplifier kit which is suitable for use with a ceramic cartridge. The amplifier utilises proven Mullard modules and is available at a very competitive price. The amplifier kit comes complete with instructions and includes: a Mullard LP1183 stereo preamplifier module, two LP1173 power amplifiers with integral heatsinks, a power supply, Zobel networks, front and back mounting panels, a finished fascia panel, all contol potentiometers (bass, treble, volume and balance) switches, input, output and headphone sockets, wire, and an easily assembled wrap around cabinet to house the finished unit.
Size approximately 9¼" x 8¾" x 4"
p&p £2.25 **£12.25**

50 WATT MONO DISCO AMP

£30.60
p&p £2.70
Size approx. 13⅜" x 5¼" x 6¾"
50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.



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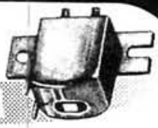

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VALVES

EL81	1.20
EL82	0.70
EL84	0.90
EL86	1.05
EL90	0.90
EL91	3.25
EL95	0.80
EL500	1.85
EL504	1.85
EL802	1.70
EL822	7.50
EM31	1.60
EM80	0.70
EM81	0.70
EM84	0.70
EM87	1.15
EY51	0.55
EY81	0.65
EY86/87	0.65
EY88	0.65
EZ80	0.65
EZ81	0.70
GY501	1.05
GZ32	0.75
GZ33	3.95
GZ34	2.30
GZ37	2.80
KT66	6.30
KT88	8.95
MH4	1.15
ML6	1.15
N78	10.45
OA2	0.65
OB2	0.70
PABC80	0.60
PC85	0.60
PC86	0.95
PC88	0.85
PC900	1.45
PCC84	0.75
PCC85	1.05
PCC89	0.65
PCC189	0.75
PCF80	0.95
PCF82	0.70
PCF84	0.75
PCF86	0.80
PCF200	1.05
PCF201	1.05

PCF801	1.05
PCF802	0.75
PCF805	2.10
PCF806	0.95
PCF808	2.05
PCH200	0.95
PCL81	0.70
PCL82	0.75
PCL84	0.80
PCL86	0.80
PCL805/85	0.85
PD500	4.35
PFL200	2.80
PL36	0.95
PL81	0.85
PL82	0.60
PL83	0.60
PL84	0.75
PL504	1.60
PL508	1.50
PL519	5.50
PL509	3.65
PL802	3.15
PLL80	3.45
PY33	0.70
PY80	0.70
PY81/800	0.70
PY82	0.60
PY83	0.60
PY88	0.80
PY500	1.55
PY809	6.45
PY801	0.70
QQV03/10	2.85
QQV03/12	2.85
QQV03/20A	14.40
QQV03/25A	21.20
QQV06/40A	16.10
QV03-12	2.80
SCL/400	4.50
SCL/600	4.50
SP61	0.95

TT21	11.80
TY2-125	52.80
U25	1.15
U26	1.00
U27	1.15
U191	0.85
U281	0.65
U301	0.65
U600	11.50
U801	0.90
UBC41	1.20
UABC80	0.90
UAF42	0.85
UBF80	0.70
UFB89	0.60
UBL1	1.15
UBL21	2.50
UCC84	0.75
UCC85	0.80
UCF80	0.90
UCH81	0.70
UCL82	0.85
UF41	0.90

1R5	0.65
1S4	0.45
1S5	0.45
1T4	0.45
1U4	0.80
1X2B	1.30
2D21	0.80
2K25	12.40
2X2	0.90
3A4	0.70
3D6	0.50
3D21	23.00
3E29	6.60
3S4	0.60
4PR60B	106.80
5B/254M	8.80
5B/255M	8.80
5B/258M	8.80
5R4GY	1.30
5U4G	1.10

V.A.T. INCLUDED

UF80	0.60
UF85	0.70
UL41	1.20
UL84	0.85
UM80	0.70
UM84	0.70
UY82	0.65
UY85	0.60
VR105/30	2.15
VR150/30	1.45
X66	1.05
X61M	1.70
XR1-6400A	82.90
Z759	9.00
Z800U	3.45
Z801U	4.00
Z803V	3.90
Z900T	2.55
1A3	0.70
1L4	0.50

5V4G	0.80
5Y3GT	0.80
5Z3	1.15
5Z4G	0.85
5Z4GT	0.90
6AB4	see EC92
6AB7	0.70
6AC7	0.70
6AH6	1.15
6AK5	0.95
6AK8	0.60
6AL5	0.50
6AL5W	0.80
6AM5	3.25
6AM6	1.30
6AN8	3.60
6AQ4	6.20
6AQ5	0.90
6AQ5W	1.45
6AS6	0.90
6AT6	0.85
6AU6	0.65

6AV6	0.60
6AX4GT	0.95
6AX5GT	1.15
6B7	0.85
6BA6	0.50
6BE6	0.60
6BG6G	1.15
6BH6	0.95
6BJ6	1.25
6BQ7A	0.70
6BR7	2.70
6BW6	5.18
6BW7	1.15
6C4	0.70
6C6	0.70
6CH6	7.50
6CL6	1.70
6CY5	1.15
6D6	0.85
6EA8	3.20
6F6GB	0.85
6F8G	0.85
6F12	0.90
6F14	0.90
6F15	1.30
6F17	1.15
6F24	4.75
6F33	4.75
6H6	1.90
6J4	1.60
6J4WA	2.00
6J5GT	1.35
6J6	0.85
6J7	0.90
6J7G	0.60
6K7	0.80
6K7G	0.50
6K8GT	0.65
6L6M	2.15
6L6GT	1.75
6L7GT	0.75
6L18	0.70
6LD20	
6Q7G	0.95
6SA7	0.65
6SG7	0.90
6SJ7	0.80
6SJ7GT	0.60
6SK7	1.05
6SL7GT	0.85
6SN7GT	0.85
6SQ7	0.85

6V6GT	0.95
6X4	0.70
6X5GT	0.65
6Y6G	1.10
6Z4	0.75
6-30L2	2.05
7B7	0.90
7V4	0.90
9D2	0.70
9D6	0.85
10C2	0.70
10F18	0.70
10P13	1.20
11E2	12.40
12A6	0.70
12AT6	0.55
12AT7	0.65
12AU7	0.60
12AV6	0.80
12AX7	0.65
12BA6	0.60
12BE6	1.25
12BH7	1.10
12C8	0.65
12E1	4.95
12J5GT	0.55
12K7GT	0.70
12K8GT	0.80
12Q7GT	0.65
12SC7	0.65
12SH7	0.85
12SJ7	0.65
12SQ7	0.85
12Y4	0.55
13D6	0.70
14S7	1.15
19AQ5	0.90
19G3	11.50
19G6	6.90
19H5	19.55
20D1	0.75
20F2	0.75
20E1	1.30
20P1	0.65
20P3	0.80
20P4	1.30
20P5	1.30
25L6GT	0.95
25Z4G	0.85
30C15	1.15
30C17	1.35
30C18	2.10

(see PCF805)	
30F5	1.15
30FL2	1.70
30FL12	1.45
30FL14	2.05
30L15	1.15
30L17	1.15
30P12	1.15
30PL1	1.15
30PL13	1.25
30PL14	1.25
35L6GT	1.15
35W4	0.80
35Z4GT	0.85
50C5	1.35
50CD6G	1.45
75	1.25
75C1	1.05
76	0.95
78	0.95
80	0.90
85A2	1.45
723A/B	12.80
803	6.95
805	20.70
807	1.15
813	13.30
829B	16.00
832A	5.20
866A	3.20
931A	12.00
954	0.60
955	0.70
956	0.60
957	1.05
1625	1.15
1629	0.85
2051	1.20
5763	4.40
5842	7.50
5933	3.50
6057	1.05
6060	105
6064	1.05
6065	1.40
6067	1.15
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6146	4.95
6146B	5.20
6360	2.30
6550	6.60
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POSTAGE: £1-£2 20p; £2-£3 30p; £3-£5 40p; £5-£10 60p; over £10 free, minimum order £1.

A lot of these valves are imported and prices vary for each delivery, so we reserve the right to change prices for new stock when unavoidable.

VALVES AND TRANSISTORS
Telephone enquiries for valves, transistors, etc.: retail 749 3934, trade and export 743 0899.

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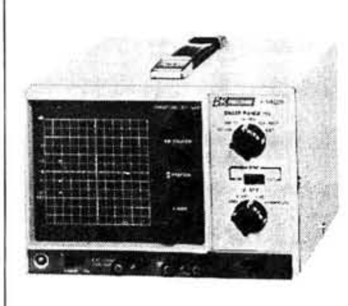

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16161	24 ceramic caps	100pf-390pf
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16213	60 ¼w resistors	100ohm-820ohm
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16216	60 ¼w resistors	100K-820K

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16217	40 ½w resistors	100ohm-820ohm
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16219	40 ½w resistors	10K-82K
16220	40 ½w resistors	100K-820K

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SJ36	14	8 pin
SJ37	12	14 pin
SJ38	11	16 pin
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SJ40	7	20 pin
SJ41	6	22 pin
SJ42	5	24 pin
SJ43	4	28 pin
SJ44	3	40 pin

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uA7824	£0.65	uA7924	£0.70
UA723 14 pin DIL	£0.35		
LM309K T03	£1.10		

OPTOELECTRONICS
DISPLAYS

1510	707 LED Display	Price each	£0.70
1511	747 LED Display	Price each	£1.50
1512	727 LED Display	Price each (dual)	£1.55

L.E.D.'s

				Price each
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SJ79	.2	LED Diffused	RED	£0.08
S120	.125	LED Bright	RED	£0.09
S121	.2	LED Bright	RED	£0.09
1502	.125	LED Diffused	GREEN	£0.11
1505	.2	LED Diffused	GREEN	£0.11
1503	.125	LED Diffused	YELLOW	£0.11
1506	.2	LED Diffused	YELLOW	£0.11
SJ80	.2	LED Bright	YELLOW	£0.14
SJ82	.2	LED Clear illuminating RED		£0.10
SJ83	.125	LED Clear illuminating RED		£0.10

2nd QUALITY LED PAKS

1507	10	assorted	colours & size	£0.65
S122	10	.125	RED	£0.50
S123	10	.2	RED	£0.50

LED CLIPS

1508/.125	.125	5 for £0.10
1508/.2	.2	5 for £0.12

SJ81	1	Infra RED emitter – Fairchild FP100	£0.25
SJ98	5	Photo Detector MEL11 + Data	£1.00
ORP12		NORP12 Cad Cell	£0.45
SJ99	4	ITT 5870 ST Nixie Tubes	£1.00

SJ29 Texas NPN silicon transistors 2S503=BC108 T0-18 metal can – perfect & coded
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AL60	15-25 watt Audio Amplifier Module 30-50v supply	£5.39
AL80	35 watt Audio Amplifier Module 40-60v supply	£8.44
AL120	50 watt Audio Amplifier Module 50-70v supply	£13.74
AL250	125 watt Audio Amplifier Module 50-80v supply	£20.49

STEREO PRE-AMPLIFIERS

PA12	Supply voltage 22-32v input sensitivity 300mv suit: AL10/AL20/AL30	£7.78
PA100	Supply voltage 24-36v inputs:– Tape, Tuner, Mag P.U., Suit: AL60/AL80	£16.05
PS200	Supply voltage 35-70v inputs:– Tape, Tuner, Mag P.U., Suit: AL80/AL120/AL250	£16.59

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MM100	Supply voltage 40-65v inputs: Mag. P.U., Microphone Max. output 500mv	£11.30
MM100G	Supply voltage 40-65v inputs: 2 Guitars, Microphones Max. output 500mv	£11.30

POWER SUPPLIES

PS12	24v Supply suit 2 · AL10, 2 · AL20, 2 · AL30 & PA12/S.450	£1.50
SPM80	33v Stabilised supply – suit 2 · AL60, PA100 to 15 watts	£4.40
SPM120/45	45v Stabilised supply – suit 2 · AL60, PA100 to 25 watts	£5.80
SPM120/55	55v Stabilised supply – suit 2 · AL80, PA200	£5.80
SPM120/65	65v Stabilised supply – suit 2 · AL120, PA200, 1 · AL250, PA200	£5.80
SG30	15-0-15 Stabilised power supply for 2 · GE100MKII	£3.80

MISCELLANEOUS

MPA30	Stereo Magnetic Cartridge Pre-Amplifier-input 3.5mv Output 100mv	£2.98
S.450	Stereo FM Tuner Supply Voltage 20-30v – Varicap tuned	£23.24
STEREO30	Complete 7 watt per Channel Stereo Amplifier Board – includes amps, pre-amp, power supply, front panel, knobs etc – requires 2050 Transformer	£19.18
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GE100MKII	10 channel mono-graphic equaliser complete with sliders and knobs	£23.00
VPS30	Variable regulated stabilised power supply 2-30v 0-2 amps	£7.60
PS250	Consists – 1 capacitor & 4 diodes for constructing unstabilised power supply for AL250 to 125 watts	£3.78

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			P&P
2034	1.7 amp 35v suit SPM80	£5.40	£1.21
2035	2 amp 55v	£6.35	£1.47
2036	750mA 17v suit PS12	£3.20	
2040	1.5 amp 0-45v-55v suit SPM120/45, SPM120/55v	£5.20	£1.21
2041	2 amp 0-55v-65v suit SPM120/55, SPM120/65v	£6.80	£1.47
2050	1 amp 0-20v suit Stereo 30	£3.25	£0.75
1725	150mA 15-0-15v suit SG30	£1.77	

ACCESSORIES

139	Teak Cabinet suit Stereo 30, 320 · 235 · 81mm	£5.45
140	Teak Cabinet suit STA15 425 · 290 · 95mm	£7.50
FP100	Front Panel for PA100 & PA200	£1.80
BP100	Back Panel for PA100 & PA200	£1.60
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2240	Kit of parts including Teak Cabinet, chassis sockets, knobs to build 15 watt stereo amplifier	£19.95

DIODES

Type	Price	Type	Price	Type	Price
AA119	£0.06	OA70	£0.06	IN4004	£0.06
BA100	£0.08	OA79	£0.08	IN4005	£0.07
BA148	£0.13	OA81	£0.08	IN4006	£0.08
BA173	£0.13	OA90	£0.08	IN4007	£0.09
BAX13	£0.05	OA91	£0.08	IN5400	£0.12
BAX16	£0.06	OA95	£0.08	IN5401	£0.13
OA200	£0.06	IN34	£0.06	IN5402	£0.14
OA202	£0.07	IN60	£0.07	IN5404	£0.15
BY100	£0.18	IN4148	£0.05	IN5406	£0.19
BY126	£0.12	IN4001	£0.04	IN5407	£0.23
BY127	£0.14	IN4002	£0.04	IN5408	£0.28
OA47	£0.06	IN4003	£0.05	IS44	£0.03

LINEAR

Type	Price	Type	Price	Type	Price
CA270	£0.95	SL414A	£1.75	TBA810	£0.85
CA3089	£1.70	SN76013N	£1.65	TBA820	£0.65
CA3090	£3.00	SN76023N	£1.60	uA703	£0.20
LM380	£0.80	SN76115	£1.60	uA709C	£0.25
LM381	£1.35	TAA550	£0.30	uA710	£0.25
LM3900	£0.50	TAA621A	£1.80	uA711	£0.26
MC1310P	£0.85	TBA120B	£0.60	741P	£0.16
NE555	£0.18	TBA641A	£1.10	TAA661	£1.25
NE556	£0.55	TBA800	£0.75	TAA661B	£1.25

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COMPONENT PAKS

O/NO	Quantity	£ p
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SJ2	200 Carbon resistors ¼-½ watt preformed	0.50
SJ3	100 ⅛ watt miniature resistors mixed values	0.50
SJ4	60 ½ watt resistors mixed values	0.50
SJ5	50 1-2 watt resistors mixed pot values	0.50
SJ6	50 Precision resistors 1-2° tol. mixed	0.50
SJ7	30 5-10 watt wirewound resistors mixed	0.50
SJ11	150 Capacitors mixed types & values	0.50
SJ12	60 Electrolytics all sorts mixed	0.50
SJ13	50 Polyester/polystyrene capacitors mixed	0.50
SJ14	50 C280 type capacitors mixed	1.00
SJ15	40 High Quality electrolytics 100-470mf	1.00
SJ16	40 Low Vts Electrolytics mixed up to 10v	0.50
SJ17	20 Electrolytics transistor types mixed	0.50
SJ18	20 Tantalum bead capacitors mixed	0.50
SJ20	2 large croc clips 25A rated	0.30
SJ21	Large 7½" 'Mains Neon Tester' screwdriver	0.85
SJ22	Small pocket size 'Mains Neon Tester'	0.55
SJ23	Siemens 220v AC Relay DPDT contacts 10amp rating – housed in plastic case	1.00
SJ24	Black PVC tape (⅝) 15mm · 25m – strong tape for electrical & household use	0.35 per roll 1.50 5 rolls
SJ25	100 Silicon NPN transistors all perfect & coded – mixed types with data & equivalent sheet	2.50
SJ26	100 Silicon PNP transistors all perfect & coded – mixed types and cases data and equivalent	2.50
SJ27	50 Assorted pieces of SCR's diodes & rectifiers incl. stud types all perfect – no rejects fully coded – data incl.	2.50
SJ28	20 TTL 74 series gates – assorted 7401 – 7460	1.00
SJ33	PC Board – mixed bundle PCB fibreglass/paper single & double sided – super value!	0.75
SJ34	200 sq. ins. (approx) copper clad paper board	0.80
SJ35	100 sq. ins. (approx) copper clad fibre glass	0.80
SJ49	8 dual gang carbon pots log & lin mixed values	1.00
SJ50	20 assorted slider knobs – chrome/black	1.00
SJ51	1 Switchbank 5 way incl. silver knobs	0.50
SJ52	1 pak of vero board approx 50 sq. ins mixed	1.00
SJ53	1 Mammoth I.C. Pack. approx. 200pcs assorted fall-out integrated circuits including logic 74 series, linear-audio and D.T.L. many coded devices but some unmarked – you to identify	1.00
SJ54	20 slider pots mixed values & sizes	1.00
SJ56	6 100K lin 40mm slider pots	0.50
SJ57	6 100K log 40mm slider pots	0.50
SJ58	6 1K lin 40mm slider pots	0.50
SJ59	6 5K lin 40mm slider pots	0.50
SJ60	4 5K log 60mm single	0.50
SJ61	4 100K log 60mm single	0.50
SJ62	5 15mm chrome knobs standard push fit	0.50
SJ63	1 Instrument knob – black winged (29 · 20mm) with pointer ¼" standard screw fit	0.15
SJ64	1 Instrument knob – black/silver aluminium top (17 · 15mm) ¼" standard screw fit	0.12

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SJ65	10K log	0.25 each
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SJ67	Chrome slider knobs to fit	0.10 each
SJ68	30 ZTX300 type transistor NPN pre-formed for P/C Board colour coded blue – all perfect	1.00
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SJ70	25 BC107 NPN TO106 case perfect transistors code C1359	1.00
SJ71	25 BC177 PNP TO106 case perfect transistors code C1395	1.00
SJ72	4 2N3055 silicon power NPN transistors TO3	1.00
SJ73	6 TO64 SCRs 5Amp assorted 50v – 400v all coded	1.00
SJ74	8 way ribbon cable – colour coded individually PVC insulated solid tinned copper conduction	0.20 meter
SJ75	FM coax cable – plain copper conduction cellular polythene insulated and plain copper braided PVC sheath – impedance 75 ohms	0.10 meter
SJ76	1 Board containing 2 · 5 pin DIN sockets 180° 0 2-2 pin DIN loudspeaker sockets	0.30
SJ77	A 5 pin DIN 180° chassis/normal socket incl. DPDT switch	0.20
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SJ86	5 PNP TO-3 germ. power transistors at VLTS10-20VCB	0.50
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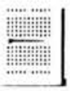

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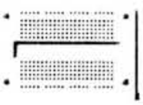

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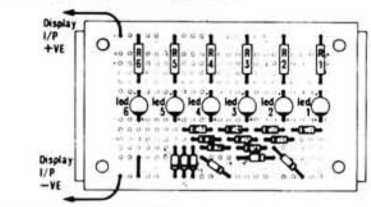

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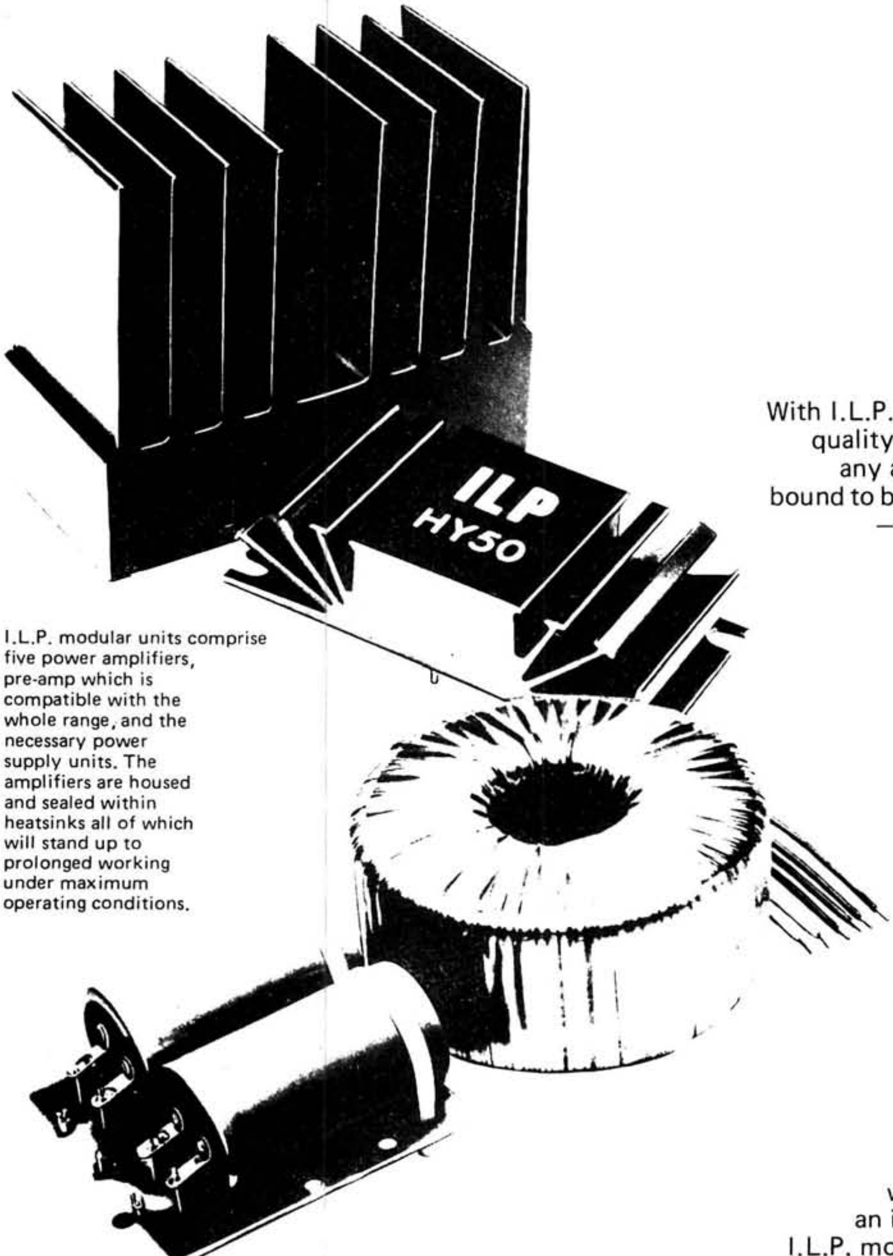

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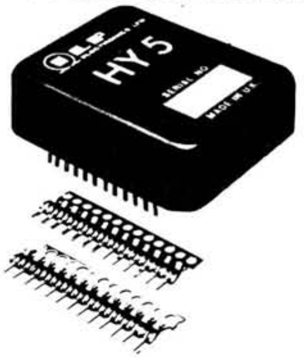

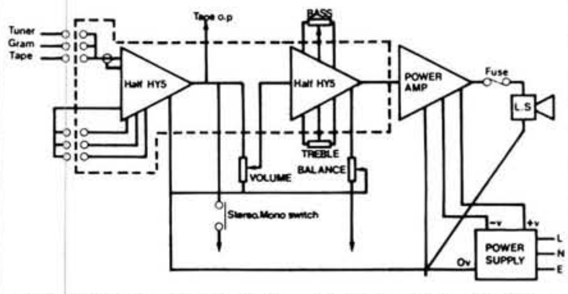

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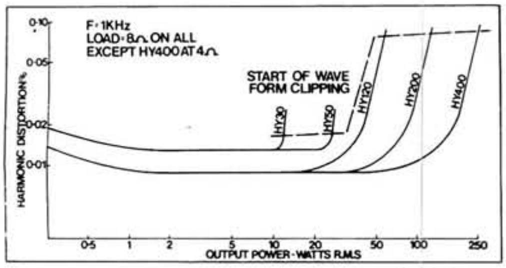

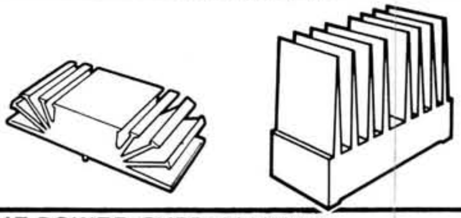

Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into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

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Input impedance – all models 100KΩ
Frequency response – all models 10Hz - 45Hz - 3dB

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NEWS... NEWS...

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 0BS. 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.*

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

Versatile Chips

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

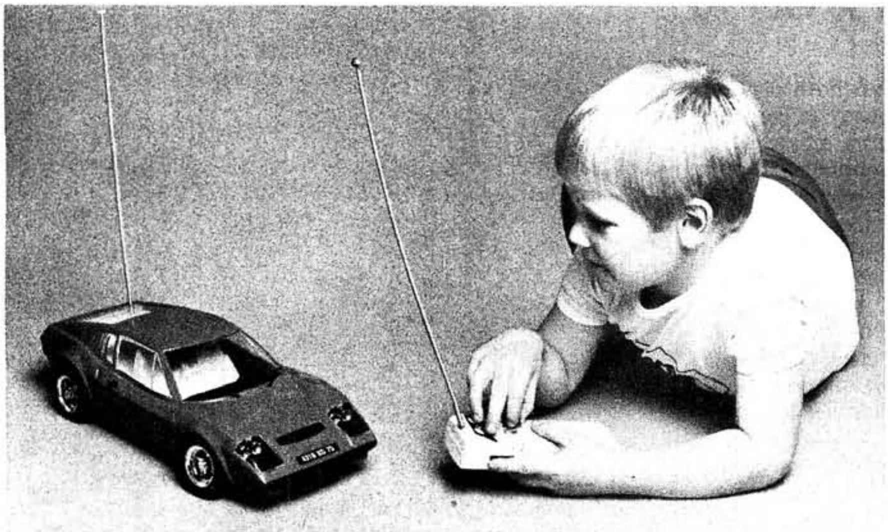
The i.c.s have been designed into Joustra's latest remote controlled model car which is being sold in French toy shops now.

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, infra-red 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.



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.*

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.*

Ring Their B.E.L.

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.*

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, Tettenhall, 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.*

BEGINNING THE PW 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 × 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

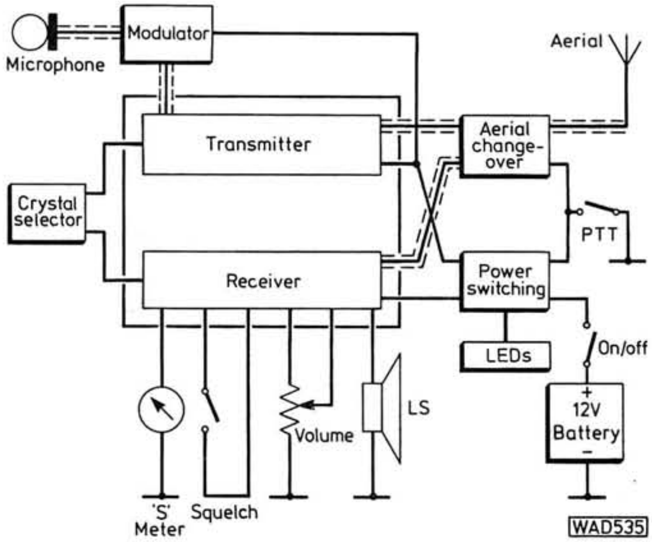


Fig. 1: System block diagram for a portable v.h.f. f.m. transceiver

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,

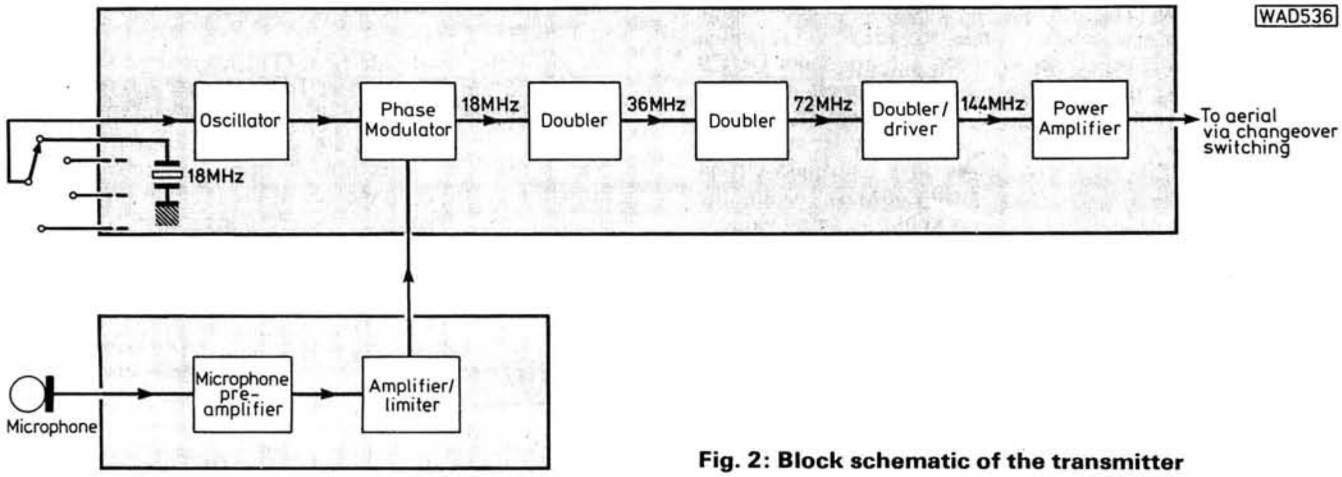


Fig. 2: Block schematic of the transmitter

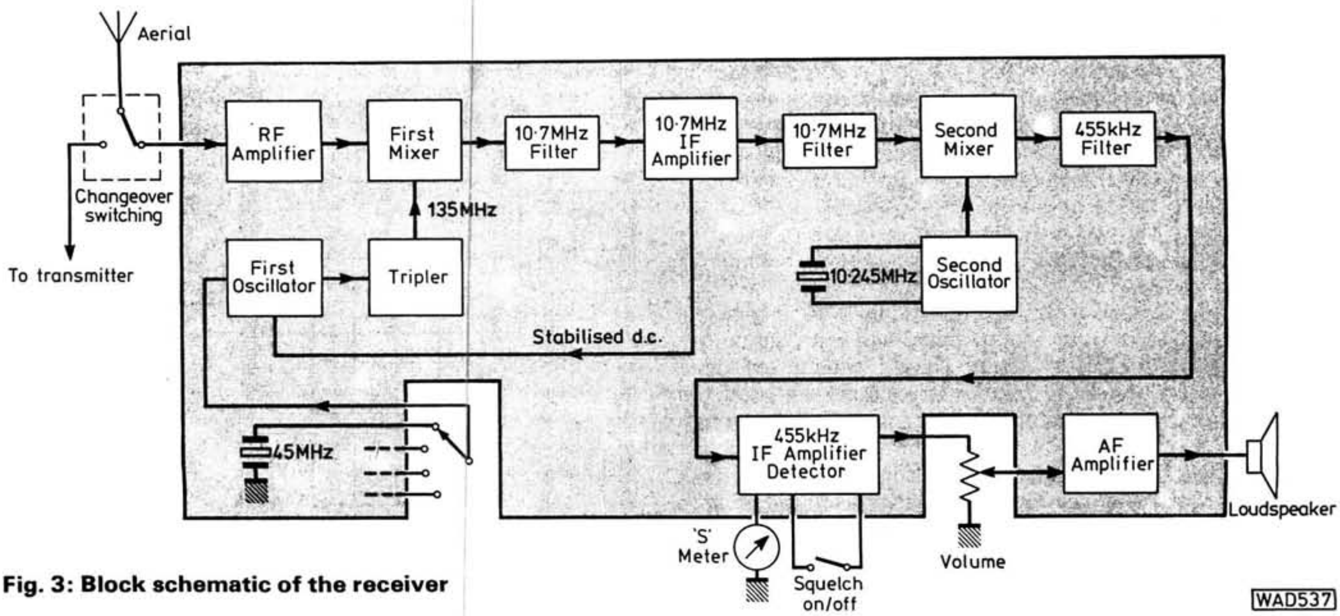


Fig. 3: Block schematic of the receiver

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.

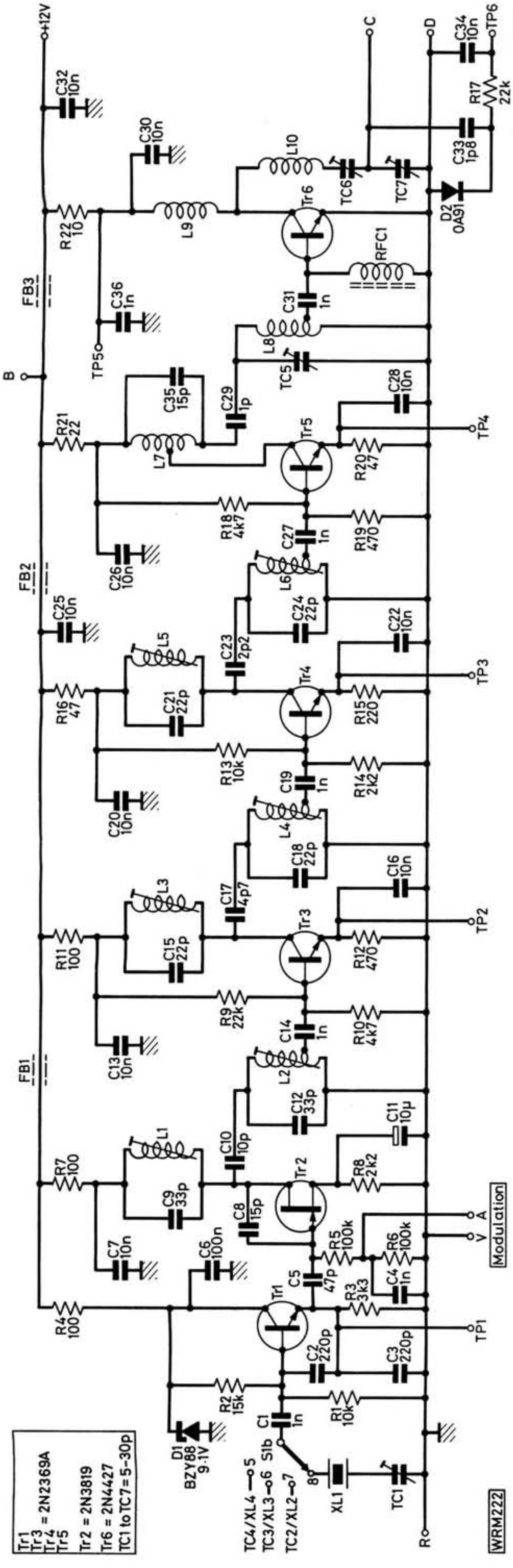
Alignment of the multiplier stages is facilitated by means of test points TP1 to TP4 where the emitter current of successive stages may be monitored and TP5, which allows for measurement of the collector current (either directly or by calculation involving the voltage drop across R22), and hence d.c. 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
¼W 5% carbon

10Ω	1	R22
22Ω	1	R21
47Ω	2	R16, 20
100Ω	3	R4, 7, 11
220Ω	1	R15
470Ω	2	R12, 19
2·2kΩ	2	R8, 14
3·3kΩ	1	R3
4·7kΩ	2	R10, 18
10kΩ	2	R1, 13
15kΩ	1	R2
22kΩ	2	R9, 17
100kΩ	2	R5, 6

Semiconductors
Transistors

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

Diodes

BZY88C9V1	1	D1
OA91	1	D2

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

10μF	1	C11

Ceramic trimmers, miniature

5–30pF	7	TC1, 2, 3, 4, 5, 6, 7

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.

MODULATOR

Resistors
¼W 5% carbon

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

Potentiometers
Min. preset (vertical mounting) 0·1W

10kΩ lin.	1	VR201
1MΩ lin.	1	VR200

Capacitors
Ceramic

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

Electrolytic 16V

1μF	1	C203
2·2μF	1	C202
47μF	1	C201

Semiconductors
Diodes

1N914	2	D200, 201

Integrated circuits

741	2	IC200, 201

GENERAL ASSEMBLY

Resistors
¼W 5% carbon

1kΩ	2	R300, 301

Potentiometers

47kΩ 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 270°	1	SK1
SO239 u.h.f.	1	SK2

Relay

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

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

RECEIVER

Resistors
¼W 5% carbon

47Ω	1	R124
100Ω	1	R114
220Ω	4	R100, 103, 109, 111
390Ω	1	R115
470Ω	3	R107, 121, 129
680Ω	1	R122
1kΩ	1	R106
1·5kΩ	1	R133
2·2kΩ	2	R117, 120
3·3kΩ	1	R116
4·7kΩ	3	R128, 131, 132
10kΩ	2	R113, 123
12kΩ	3	R125, 126, 127
47kΩ	4	R101, 102, 108, 130
100kΩ	5	R104, 105, 112, 118, 119

Potentiometers
Miniature preset (vertical mounting) 0·1W

10kΩ	1	VR101
47kΩ	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

1µF	1	C135
2·2µF	1	C130
10µF	2	C132, 139
47µF	1	C129
470µF	1	C140

Ceramic trimmers, miniature

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

Semiconductors
Transistors

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

Integrated circuits

µA753	1	IC100
CA3189E	1	IC101
LM380N	1	IC102

Crystal filters

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

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

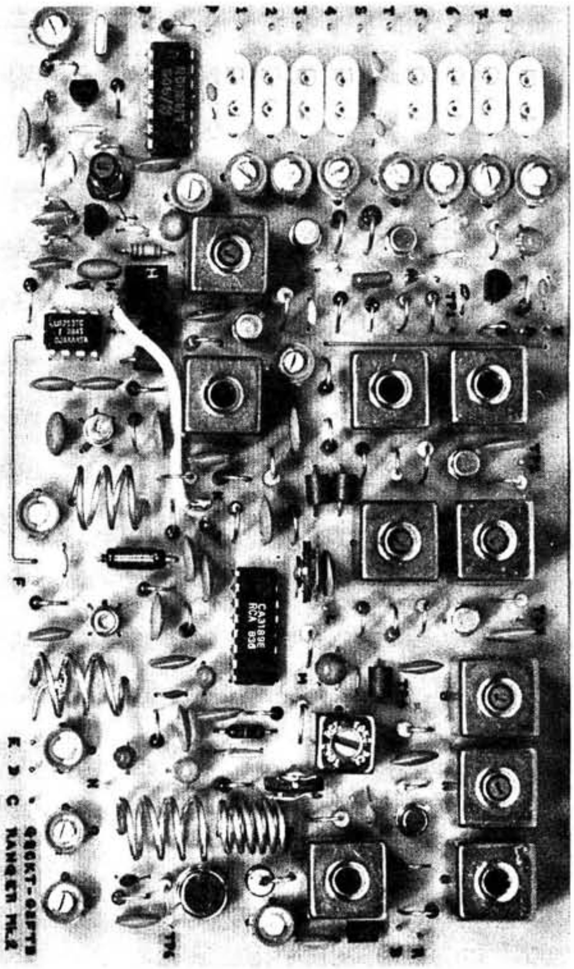
Crystal

10·245MHz wire ended	1	X104

Coils

YRCS 11098 AC2 (Toko)	1	L105
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); 8Ω loudspeaker (1); 500µA signal strength meter (for test purposes) (1).



The completed printed circuit board for the Nimbus transceiver

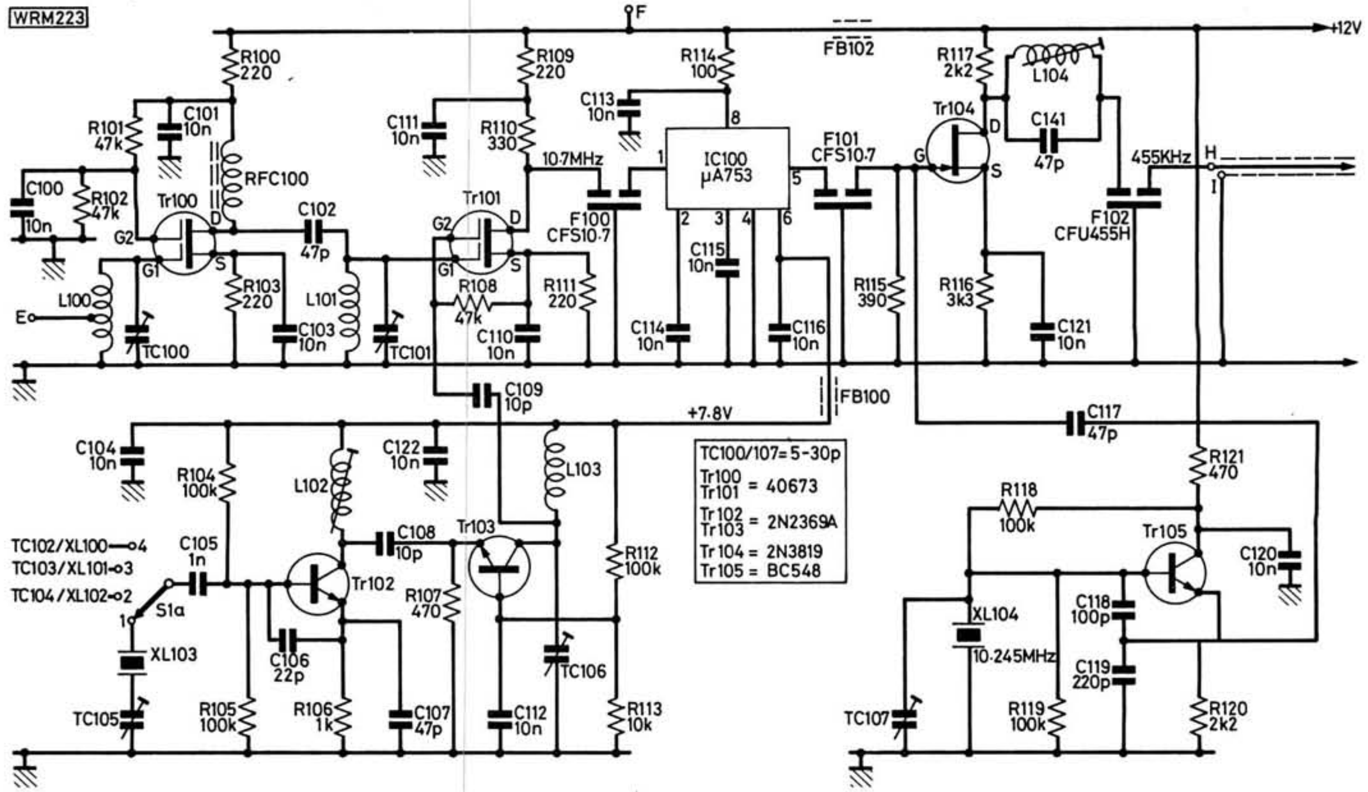


Fig. 5(a): Receiver module circuit diagram Section 1

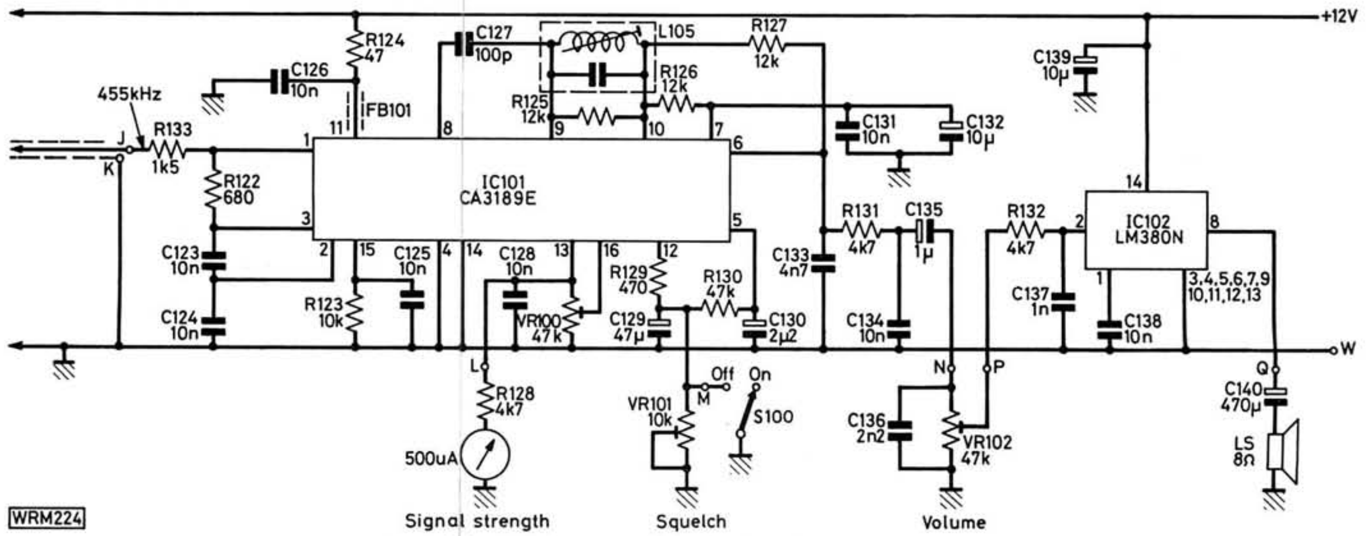


Fig. 5(b): Receiver module circuit diagram Section 2

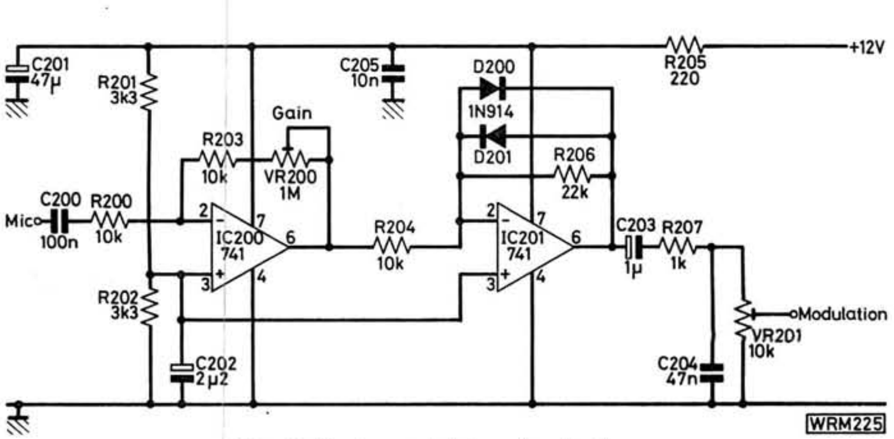


Fig. 6: Basic modulator circuit diagram

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 JUGFET 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 10kΩ, 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

O

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 (Ø) 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

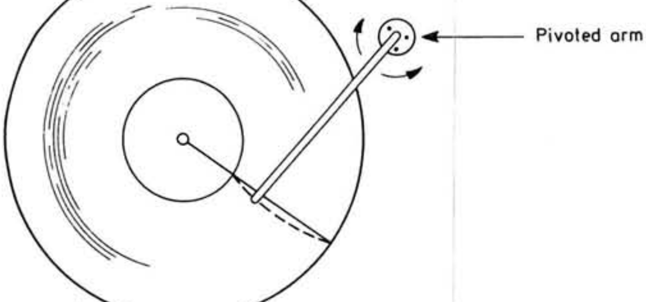
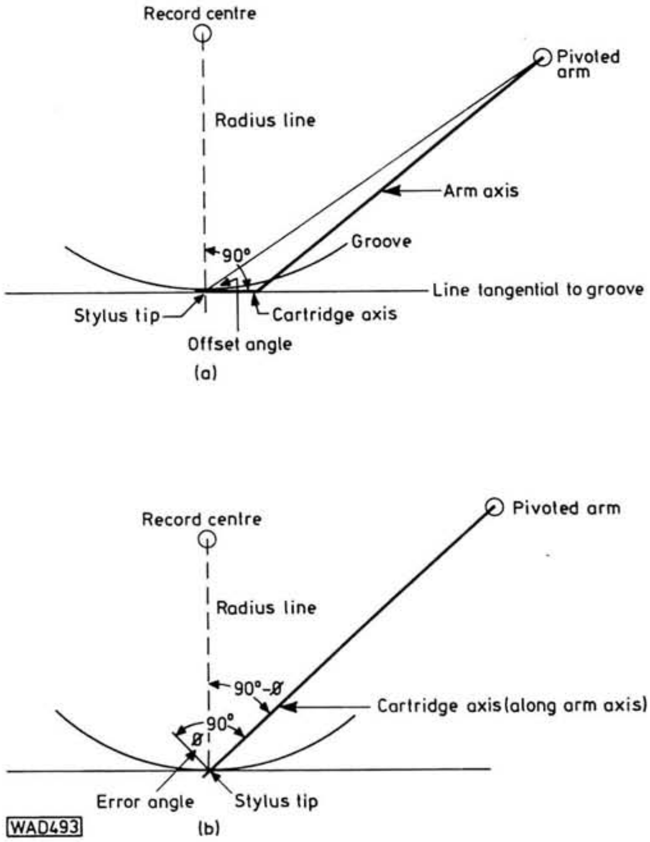


Fig. 21: When a gramophone record is cut, the cutter head traverses a true radial path across the disc as shown by the full line. When played with the pivoted arm, however, the stylus traverses an arc as shown by the broken line. The deviation from the true radial path is a function of lateral tracking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



WAD493

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" Ø (see text)

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 conventional 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

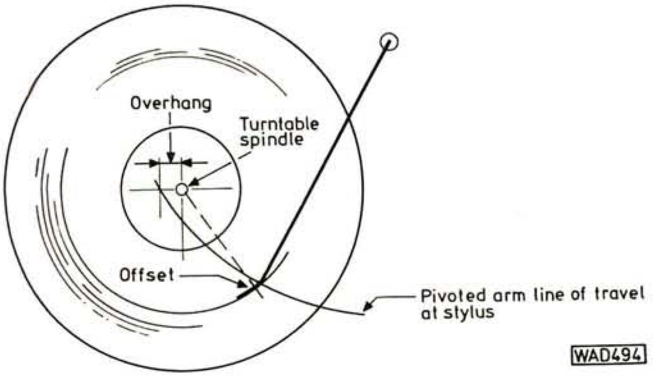


Fig. 23: In Fig. 22(a) the required angle is provided by the offset angle obtained by suitably angling the axis of the cartridge with respect to the effective axis of the arm. To help retain the required 90-degree angle at all groove diameters, the cartridge is positioned in the headshell so that the 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

P

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 $\pm 7 \cdot 5$kHz of the total ± 75kHz full modulation deviation, thereby leaving a deviation of $\pm 67 \cdot 5$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

$$\frac{1}{50 \times 10^{-6} \times 6{\cdot}28}$$

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

$$\frac{1}{75 \times 10^{-6} \times 6{\cdot}28}$$

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).

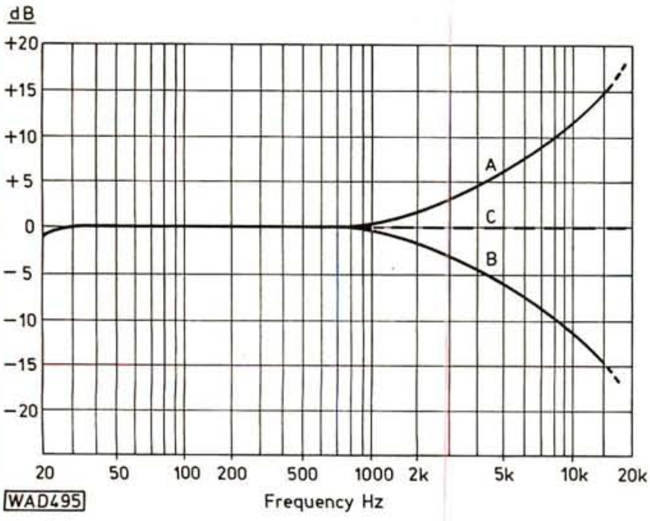


Fig. 24: Pre-emphasis (a) is equalised by de-emphasis (b) to yield a "flat" response (c). Upper-frequency noise is reduced by the attenuation of the de-emphasis. The curves correspond to a time-constant of 50µs, which is the UK and European f.m. time-constant

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).

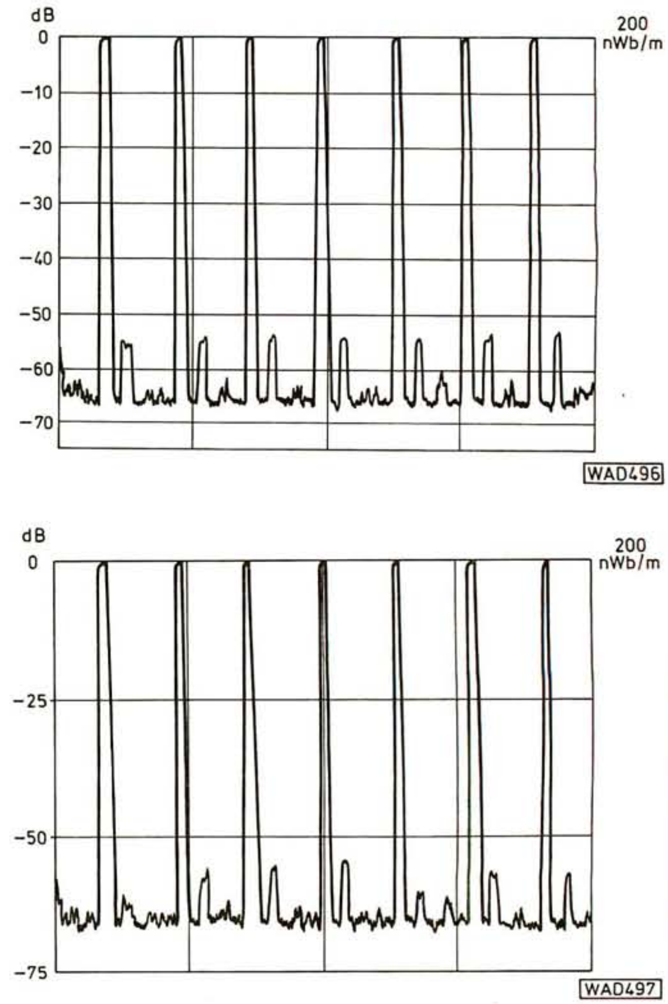


Fig. 25: Print-through characteristics of Maxell UDXLII cassette tape after 48 hours storage at 20°C. (a) first play, and (b) showing how the average print-through *ratio* is increased by rewinding the tape before playing. The tape was recorded with 1s 1kHz pulses at a recording level corresponding to 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.

Q

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.

R

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

Then turn to page 30

KINDLY NOTE!

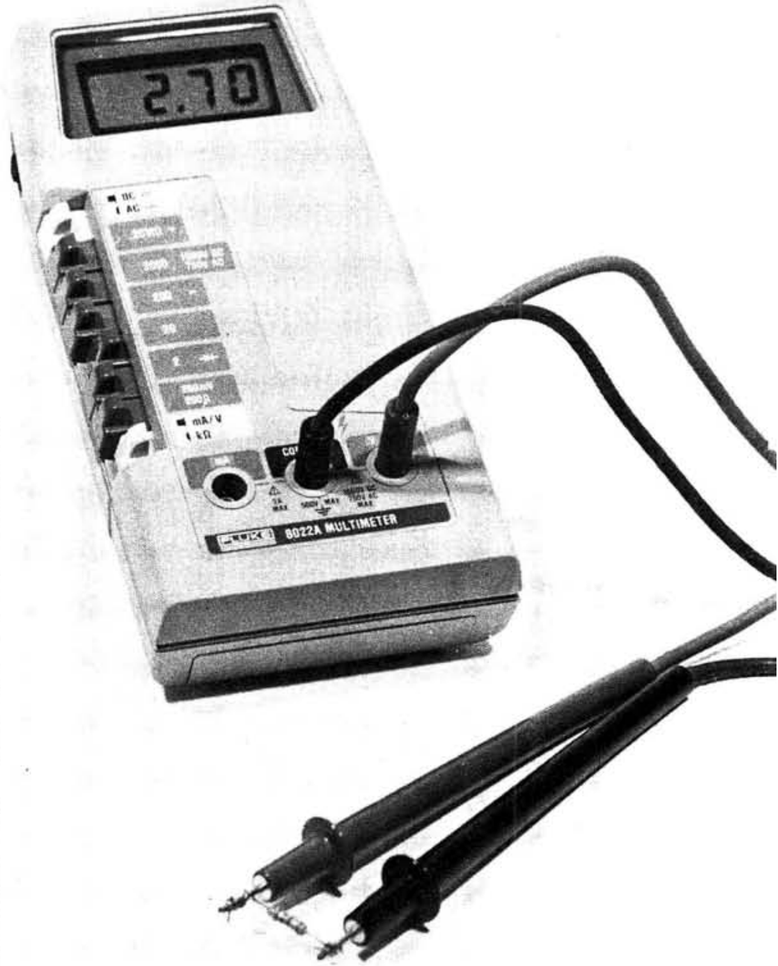
Burglar Alarms Part 3, Dec. 1979
Readers should note that the GDHM microwave module and antenna are available from the author P. J. Wales, PO Box 88, Aylesbury, Bucks. under a special arrangement with the manufacturer. Orders and queries should *not* be directly addressed to Plessey Ltd.

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: ±(0·25% of reading + 1 digit)
- Input Impedance: 10MΩ
- Overload Protection: 1000V d.c. or peak a.c.

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

DC Current:
- Ranges: 2, 20, 200, 2000mA
- Accuracy: ±(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: ±(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, 20MΩ
- Accuracy: ±(0·2% of reading + 1 digit)
  ±(0·3% of reading + 3 digits) on 200Ω range
  ±(2% of reading + 1 digit) on 20MΩ range
- Overload Protection: 500V d.c. or r.m.s. a.c.

Size: 1800 × 860 × 450mm

Weight: 0·37kg

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EXTRA

PULL-OUT 8-PAGE SUPPLEMENT

RADIO SERVICING AND ALIGNMENT PROCEDURE

Written by an autho with years of experienc in servicing, and o teaching it to others, thi special supplement tell you how the profes sionals do it—logically swiftly and accurately

LOW FREQUENCY SIGNAL GENERATOR

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.

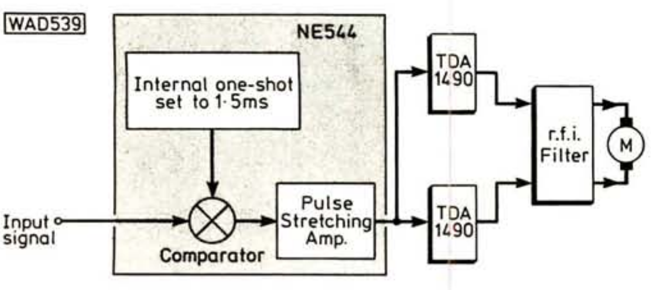


Fig. 1: Block diagram

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.

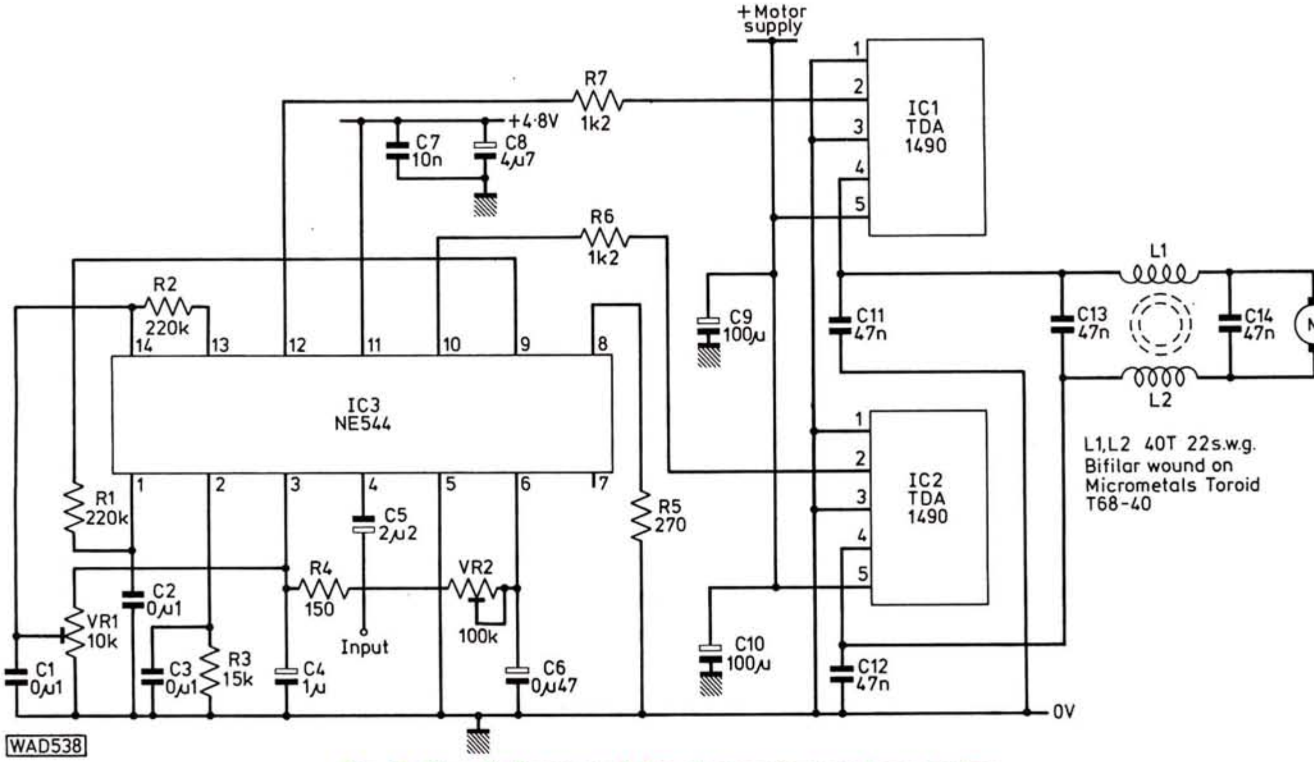


Fig. 2: Circuit diagram of the electronic speed controller

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 biflar wound on a Micrometals toroid, and should be located,

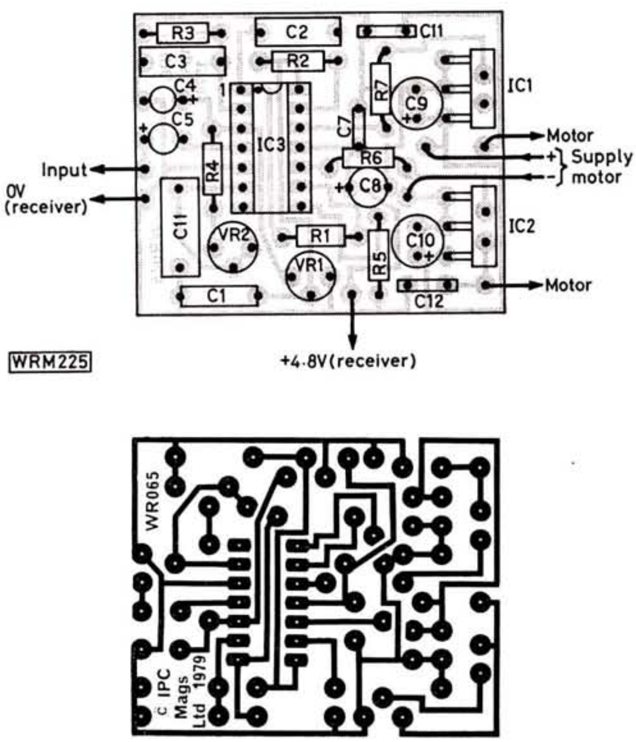
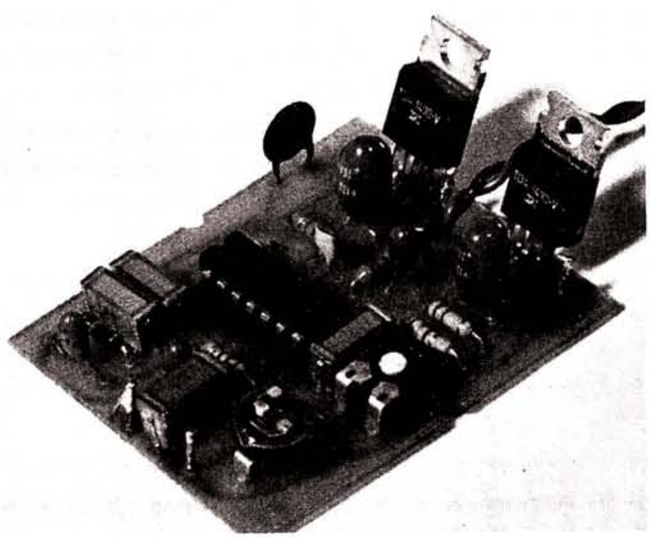
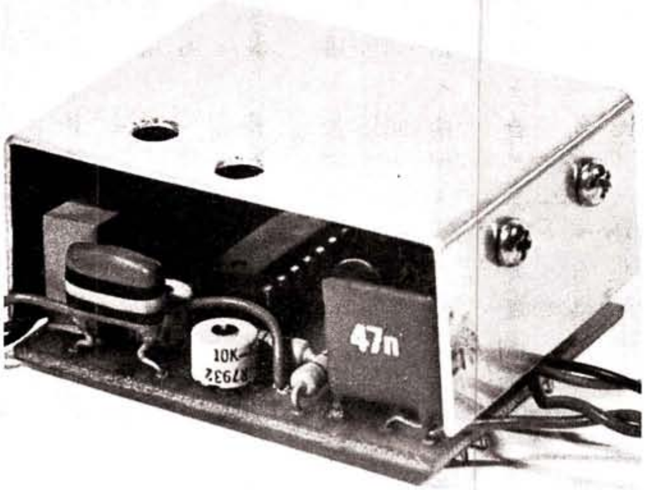
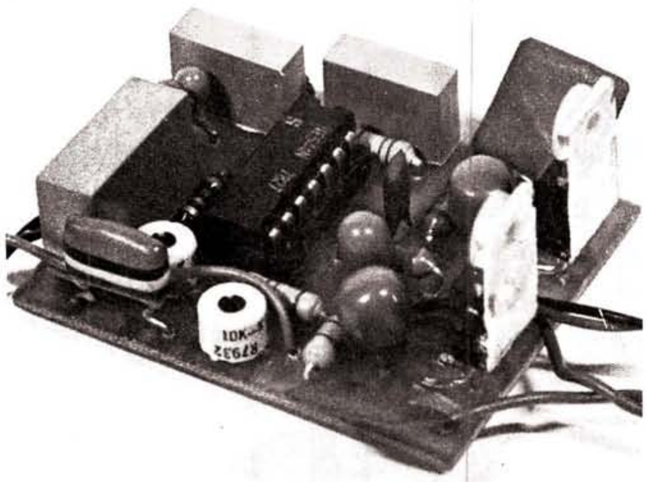


Fig. 3: (Top) component layout of the p.c.b. shown full size above

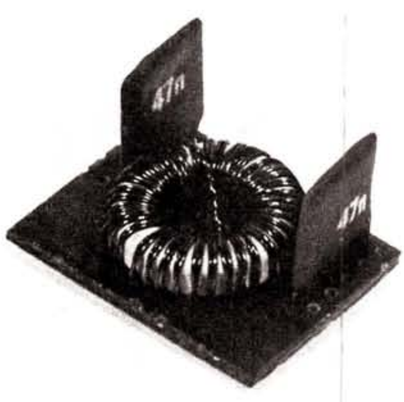




The finished speed controller showing the aluminium heat sink covering the components. The output transistors must be insulated from the heat sink



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 toriodal inductors and the way in which the unit can be built on a small piece of Veroboard

★ components

Resistors
¼W 5%

150Ω	1	R4
270Ω	1	R5
1·2kΩ	2	R6,7
15kΩ	1	R3
220kΩ	2	R1,2

Potentiometers
Cermet trimmers top adjusting

10kΩ	1	VR1
100kΩ	1	VR2

Capacitors
Tantalum

1μF 25V	1	C4
2·2μF 35V	1	C5
4·7μF 35V	1	C8
100μF 10V	2	C9,10

Ceramic

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

Polyester

0·1μF	3	C1,2,3
0·47μF	1	C6

Semiconductors
Integrated Circuits

NE544	1	IC3
TDA1490	2	IC1,2

Inductors
L1, L2. 40T biflar wound on Micrometals toroid type T68–40.

Miscellaneous
Printed circuit board; 22 s.w.g. aluminium 40 × 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

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:

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

dual trace unit for the PW 'PURBECK'

Ian HICKMAN

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

¼W 5%

10Ω	4	R607,608,611,612
47Ω	3	R633,644,648
68Ω	2	R501,502
330Ω	4	R605,606,609,610
510Ω	1	R642
680Ω	1	R662
1kΩ	10	R515*,516*,603,604, 619,620,639,640, 641,656
1·2kΩ	4	R623,624,625,626
1·3kΩ	1	R643
1·8kΩ	5	R613,614,615,616, 654
2kΩ	1	R647
2·2kΩ	3	R521,522,523
2·4kΩ	1	R655
2·7kΩ	4	R645,657,663,665
3·6kΩ	1	R652
3·9kΩ	1	R638
4·7kΩ	1	R666
5·6kΩ	1	R646
7·5kΩ	1	R660
8·2kΩ	1	R653
10kΩ	4	R511*,512*,627,628
15kΩ	1	R636
18kΩ	1	R651
22kΩ	4	R631,632,650,657
27kΩ	1	R649 (select on test)
47kΩ	2	R635,644
100kΩ	5	R507*,508*,658,661, 664
470kΩ	2	R601,602
910kΩ	2	R505*,506*
1MΩ	6	R503,504*,509*, 510*,513*,514*

*1% tolerance

Potentiometers

Min. horizontal skeleton preset

100Ω	2	R617,618
470Ω	2	R621,622
2·2kΩ	1	R637
10kΩ	2	R629,630

Min. ¼inch shaft potentiometers

1kΩ (lin.)	2	R517,518
10kΩ (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
0·1μF	10	C603,604,605,606,611, 612,615,616,619, 620
Polyester		
4·7nF	2	C521,522
0·1μF (400V)	3	C501,502,626
Tantalum		
4·7μF (10V)	1	C629
17μF (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

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; 50Ω 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); 50Ω b.n.c. plug (1); Min. coaxial cable 50Ω (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.

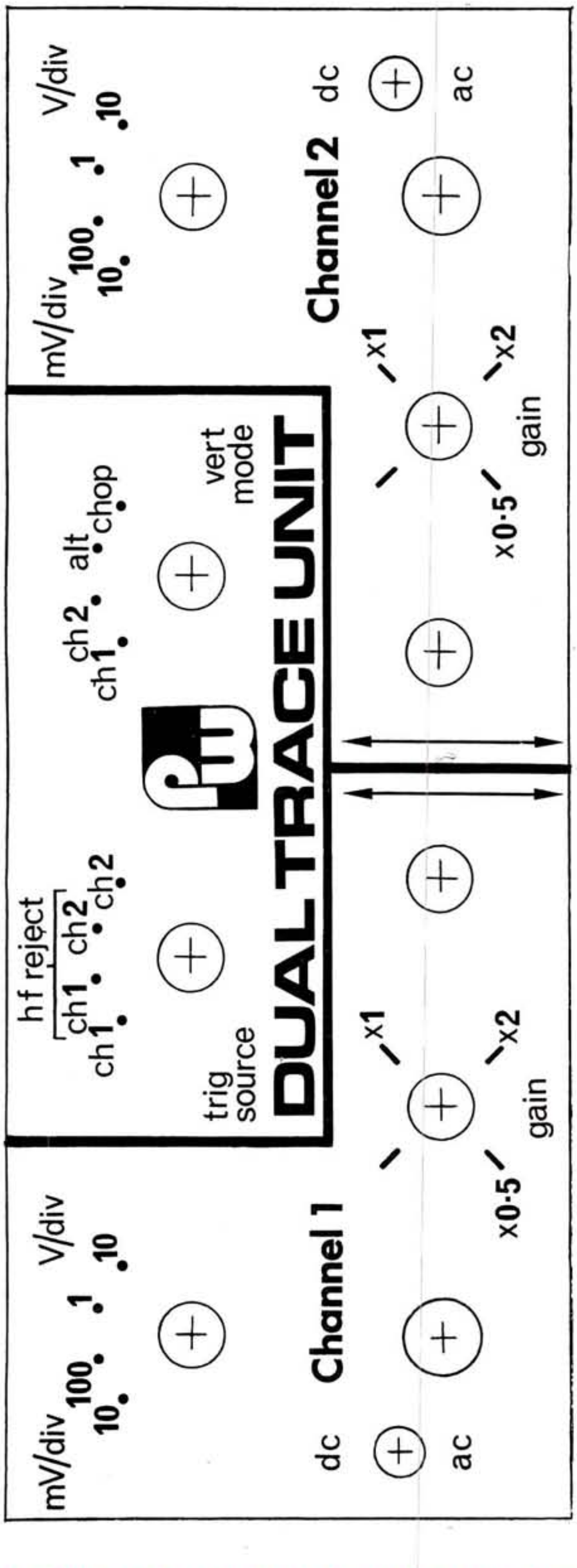


Fig. 8: The front panel of the Dual Trace Unit shown full size

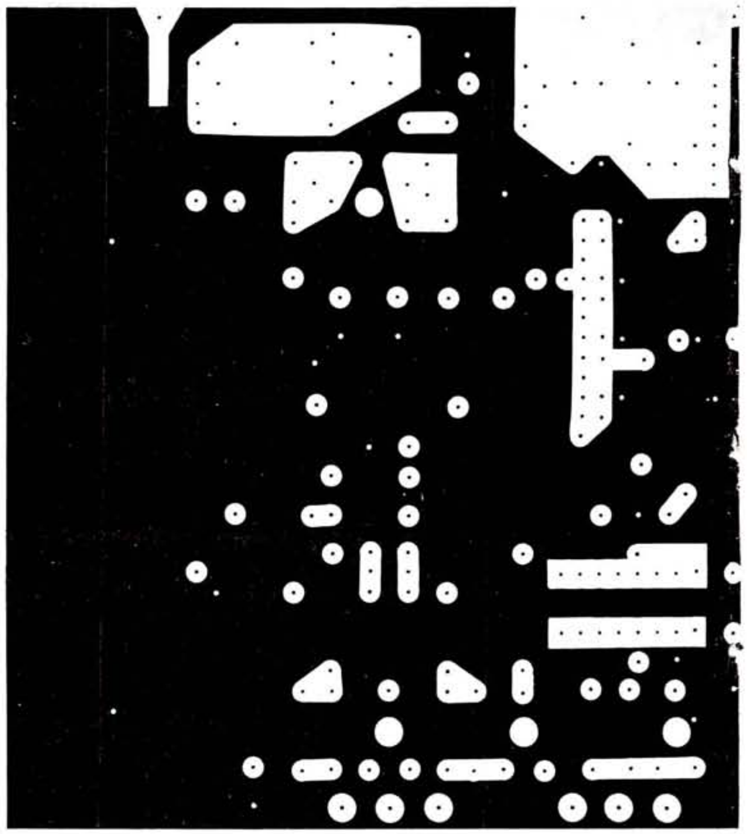
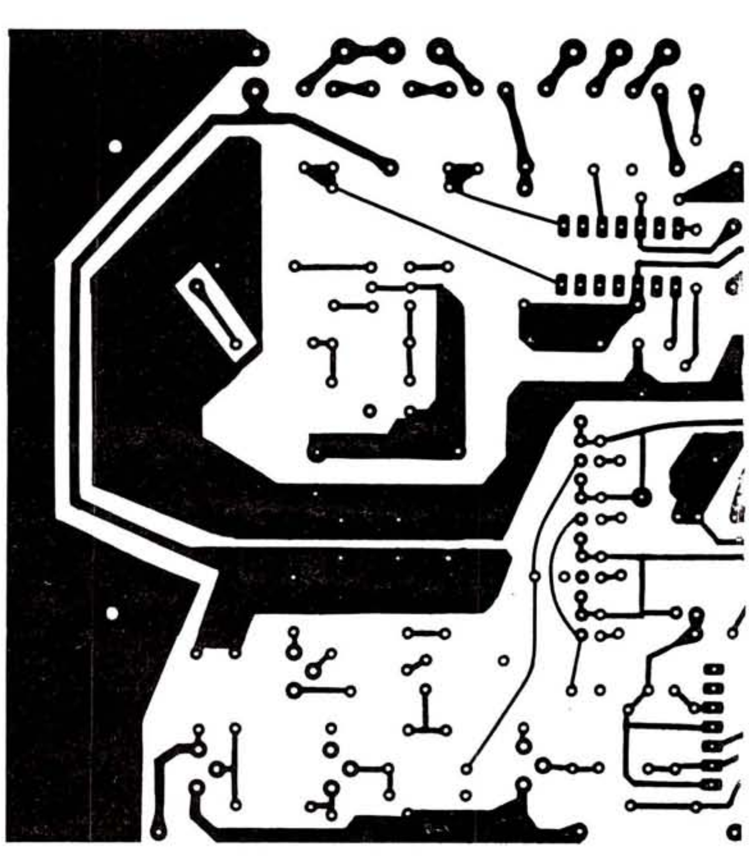
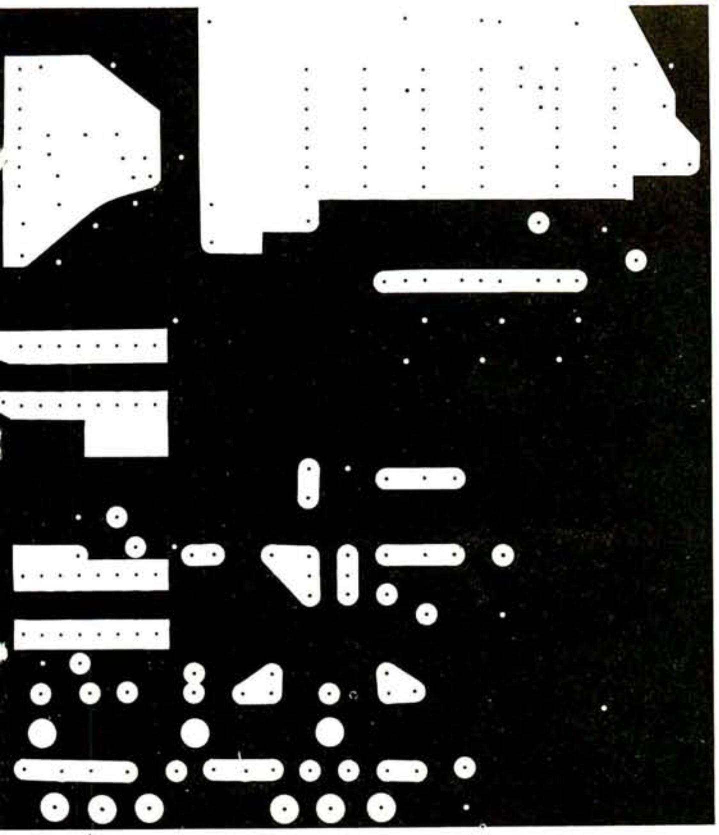


Fig. 9: The double-sided printed circuit board is used for the D
shown full size above with the track pattern





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

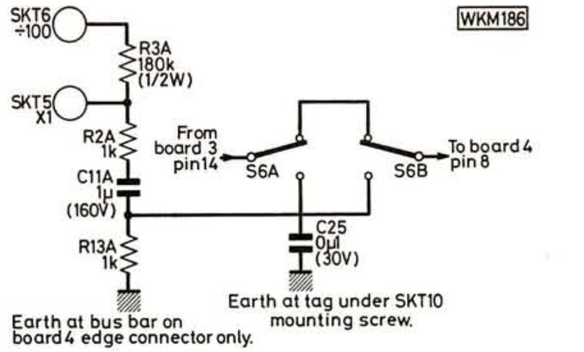


Fig. 10: Modifications needed to the *PW* Purbeck oscilloscope to enable the Dual Trace Unit to be used with it

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, ×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

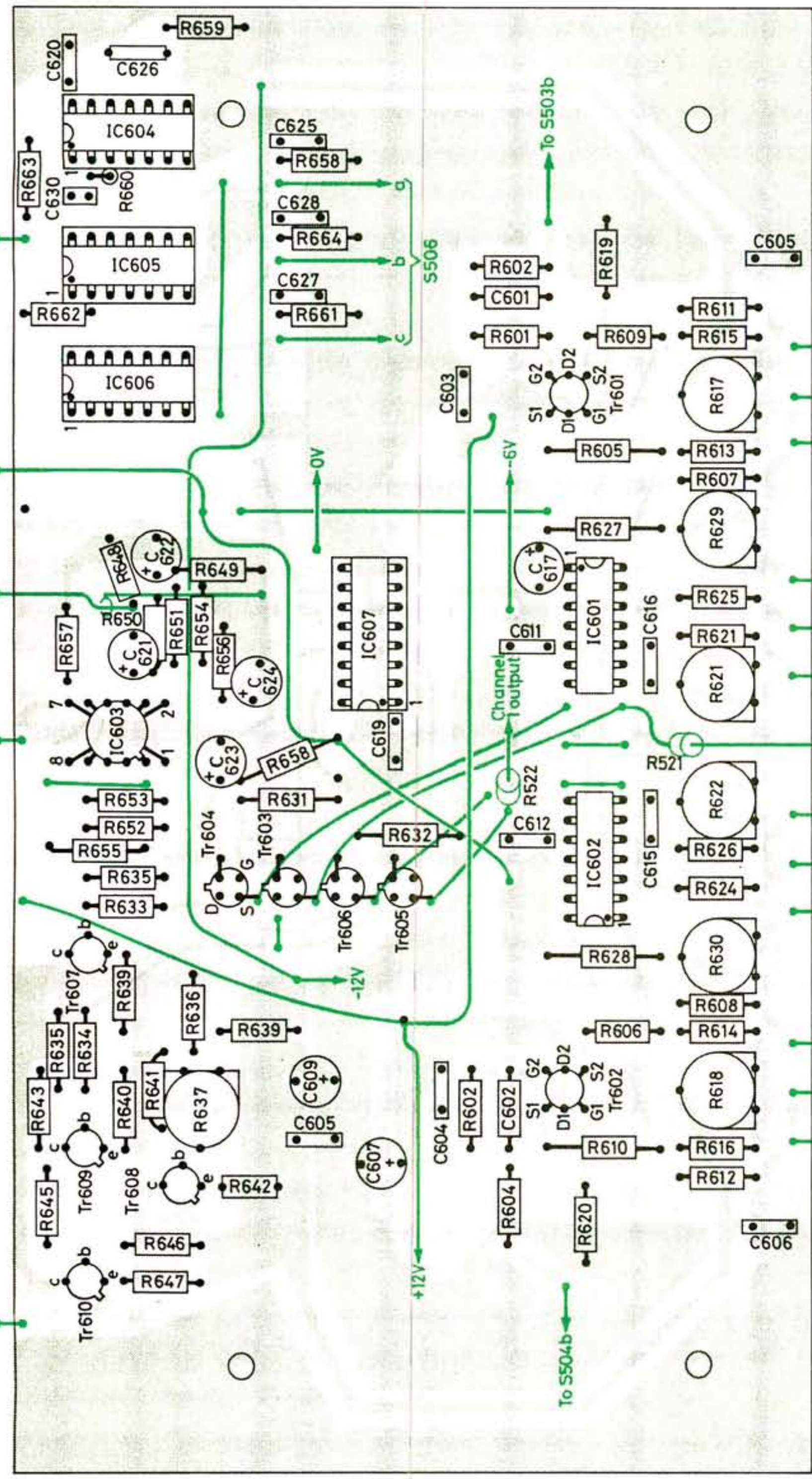


Fig. 11: The component placement diagram for the Dual Trace Unit. Note that the components are fitted to the ground plane side of the p.c.b. taking great care to ensure that connections are only made to the ground plane where indicated. The components are numbered odd for Channel 1 and even for Channel 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 ×0·5, ×1 and ×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.

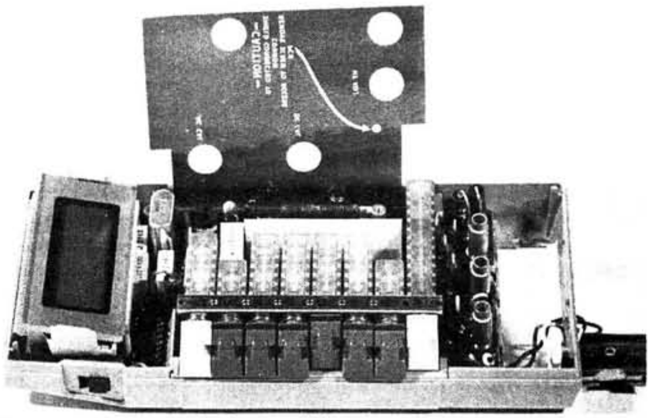
FLUKE 8022A DMM REVIEW

▶▶▶*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 2kΩ 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 voltate 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 $4\frac{1}{2}$ 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 $4\frac{1}{2}$ 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 of field.

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

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

If you please

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

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.

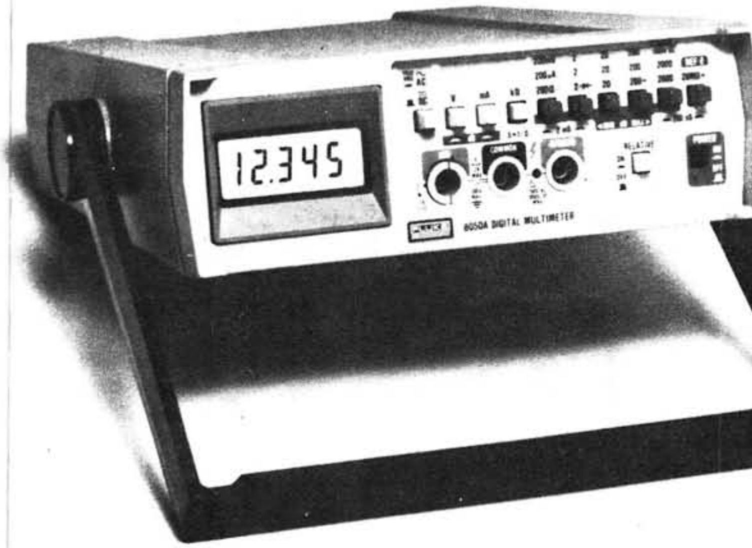
Priced at £145.00 plus VAT, the 7208 is available from the exclusive UK distributor: *Sota Communication Systems Ltd., 26 Childwall Lane, Bowring Park, Liverpool L14 6TX. Tel: 051-480 5770.*

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.*



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.

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.

The PS1200 is housed in an attractive metal case which measures 150 × 75 × 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.

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 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 R0 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.

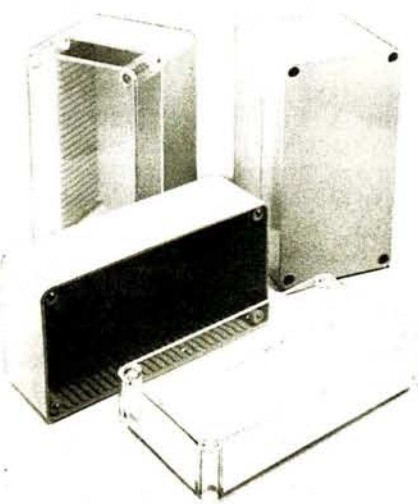
Also available for the TS280 is a variety of microphone options such as telephone handset with p.t.t. switch, a selective tone calling microphone, a loudspeaker microphone and a mobile hand microphone with built-in volume control.

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.*

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.

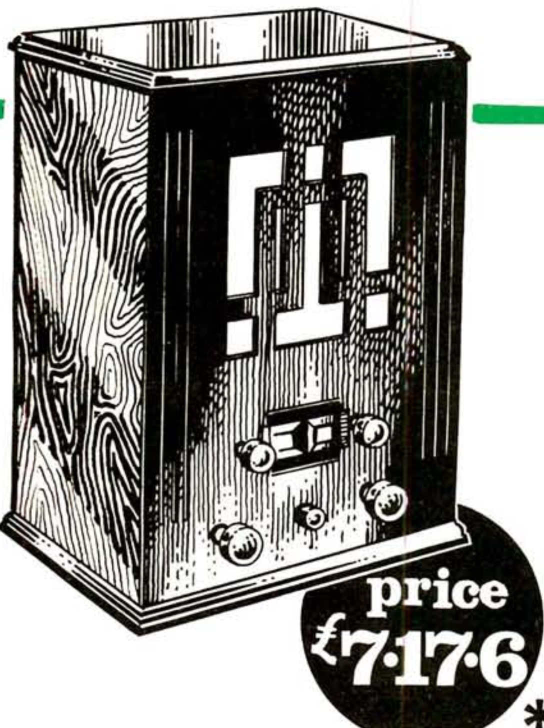
Both the coloured and the transparent versions of the lid are secured by 4 screws running into base corner bosses, and, with the lid incorporating a small flange which sits recessed into the base, these boxes exhibit excellent water repellent properties.

Ideal for use in a wide variety of timer/control type applications, the clear lid version in particular of this 150 × 80 × 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 0AU. Tel: 01-737 2383.

THE VINTAGE YEARS OF RADIO

Chas E. MILLER



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 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.

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 comparitively 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

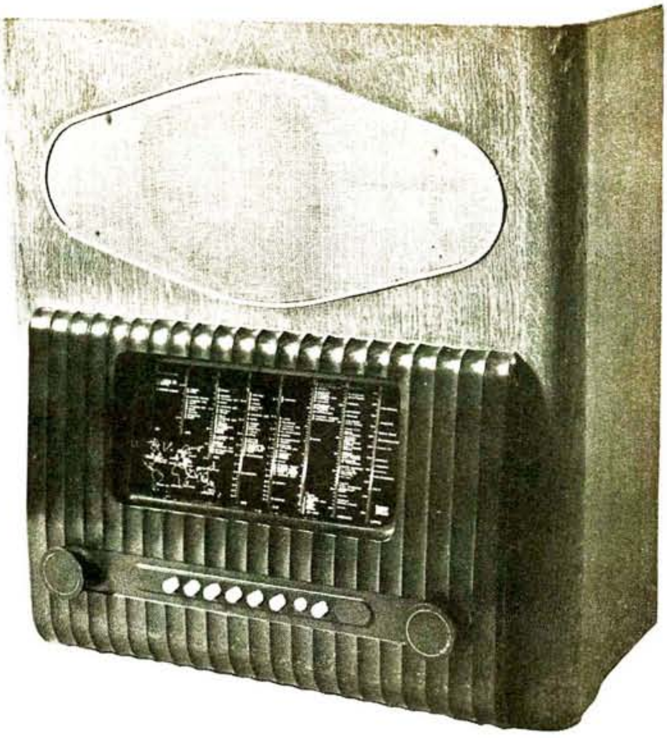
Improved selectivity brought with it extra problems for the designers, one of which was the need for accurate tuning if the harsh reception resulting from working on the edge of the acceptance band was to be avoided. Improved dials were a partial answer and, from having simple markings of 0–100, they 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 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 autochange record-players which gave the impression of having been built in a shipyard!



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

The informative tuning scales of the Murphy Type A92

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".

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

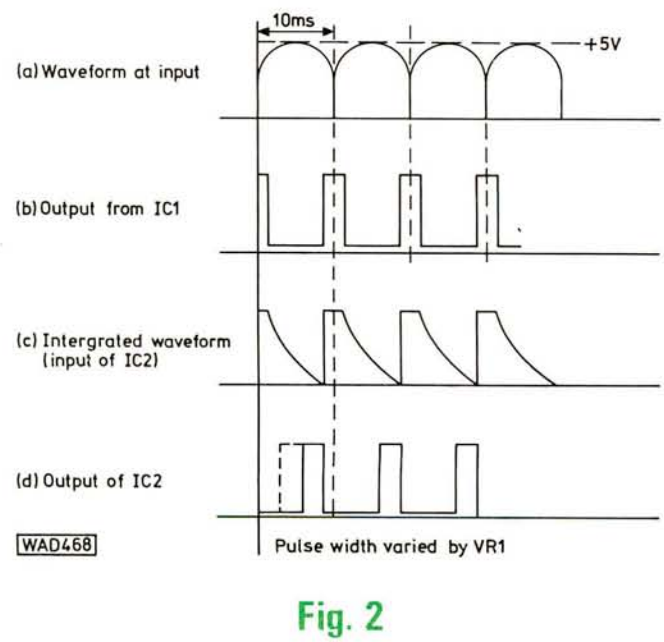
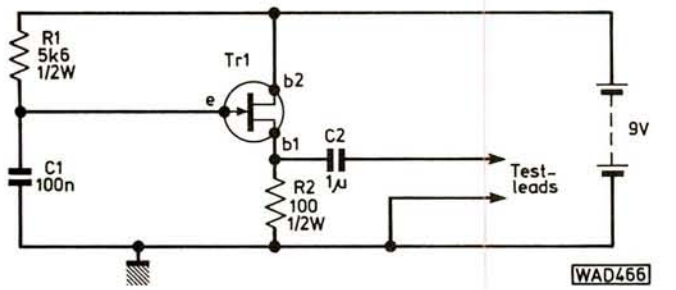


Fig. 2

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

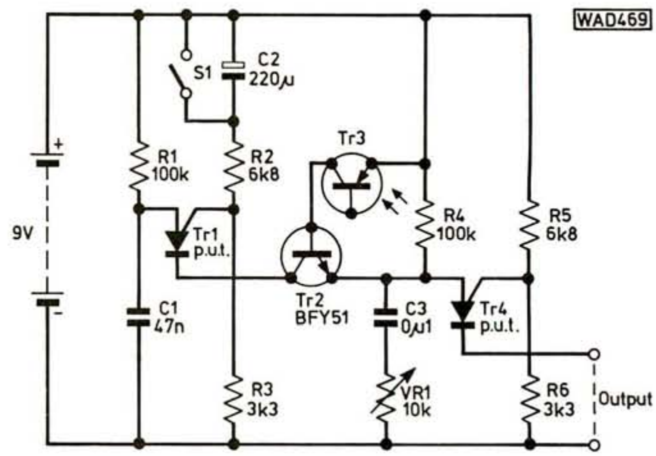
Although the "programmable uni-junction transistor" (p.u.t.) is a generally available device, there are relatively few circuits around which use it despite its similarity to the u.j.t.

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).

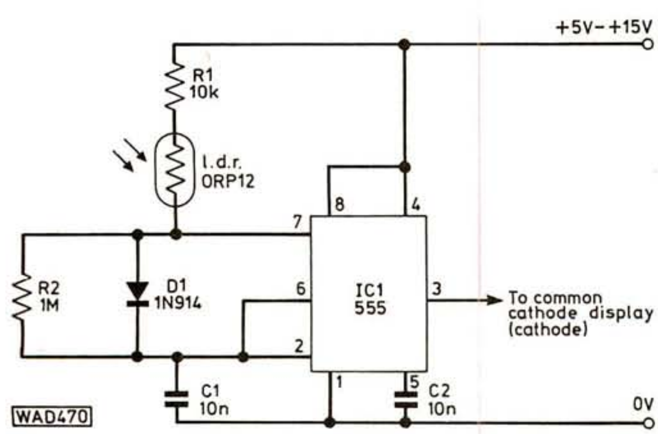
The p.u.t.'s can be either MEU21 or 2N6027 devices, and the photo-transistor was an OCP71.

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

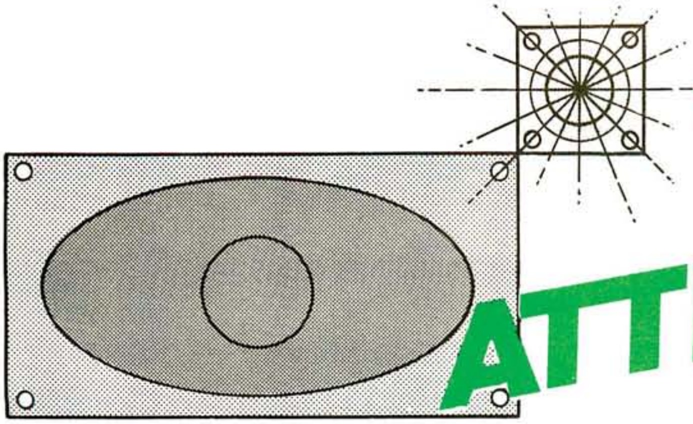


This circuit consists of a 555 timer connected as a variable duty cycle oscillator. Capacitor C1 charges via R1, D1 and the l.d.r. and subsequently discharges through IC1 pin 7 via R2. As the ambient light level increases, the resistance of the l.d.r. falls and thus the length of the charge cycle decreases. 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.

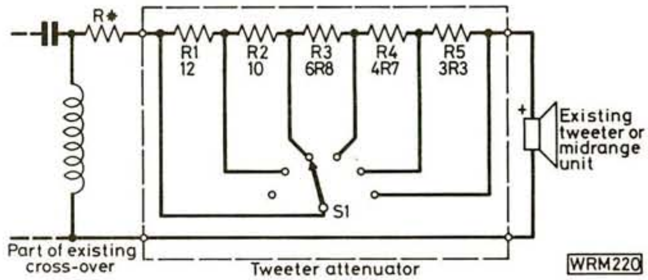


Fig. 1: Circuit diagram

Table 1

	1·5dB steps			3dB steps			5dB steps		
	4Ω	8Ω	16Ω	4Ω	8Ω	16Ω	4Ω	8Ω	16Ω
R1	1·5	3·3	6·8	6·8	12	27	33	68	120
R2	1·2	2·7	4·7	4·7	10	18	18	33	68
R3	1·0	2·2	3·9	3·9	6·8	12	10	18	39
R4	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

RADIO SPECIAL PRODUCT REPORT

FT~7B

YAESU

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

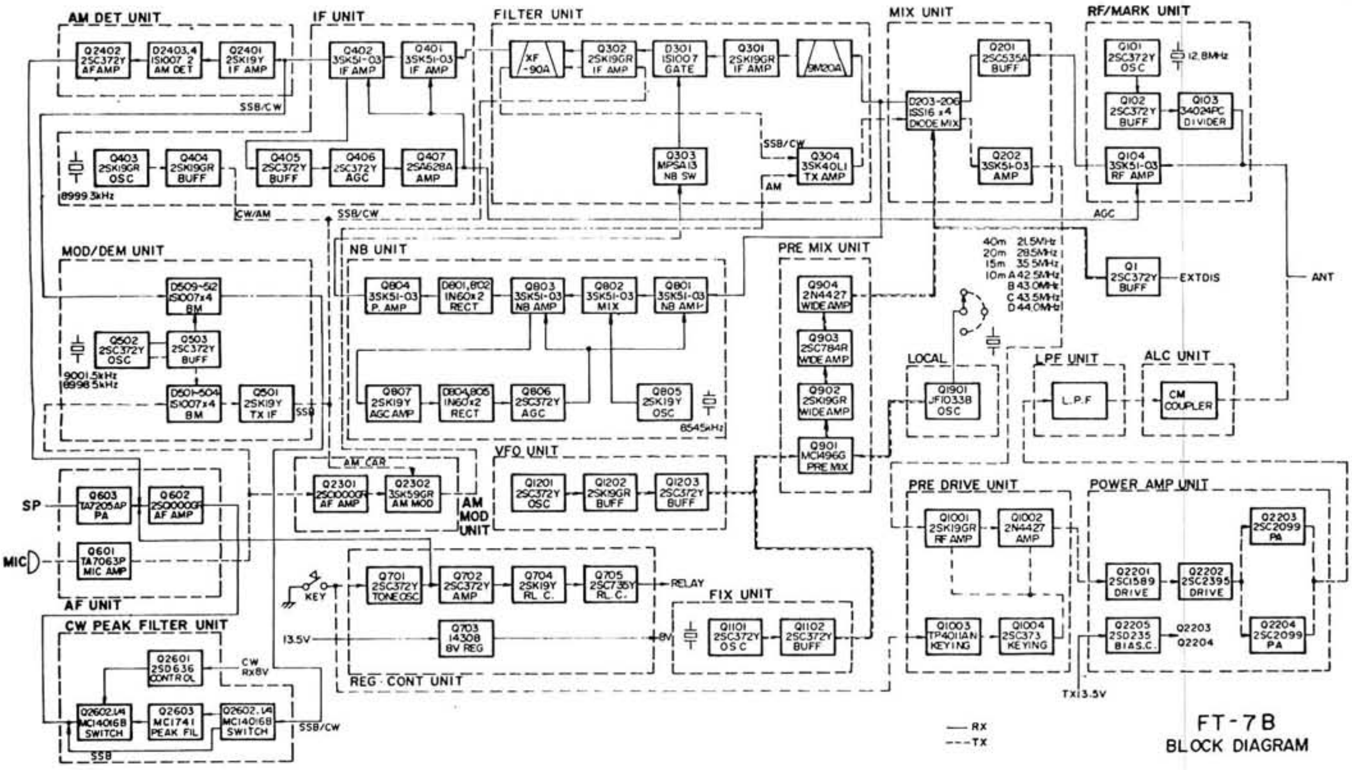


Fig. 1: Block diagram of the FT-7B

blanker 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

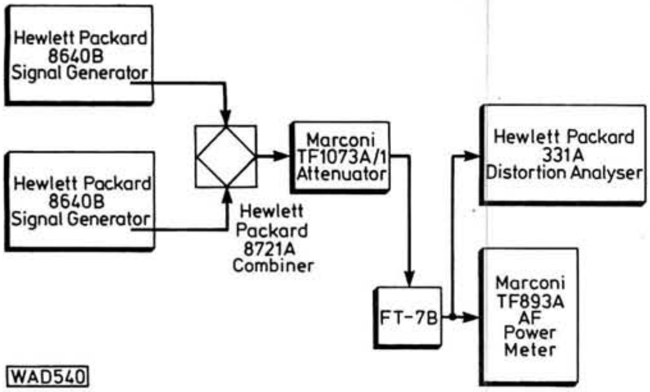


Fig. 2: The receiver measuring system used by the author

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 ±100Hz, −37dB at ±200Hz, and −47dB beyond ±400Hz. 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
				14·88MHz	−75·6dB
7·20MHz	66W	−30·3dB	−43·7dB	5·4MHz	−74·2dB
				7·092MHz	−65·6dB
				7·308MHz	−67·0dB
				9·0MHz	−68·2dB
				10·8MHz	−74·6dB
				14·4MHz	−72·5dB
				21·6MHz	−62·5dB
14·2MHz	45W	−29·9dB	−38dB	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
10 000	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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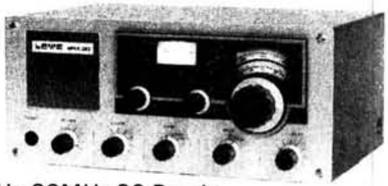

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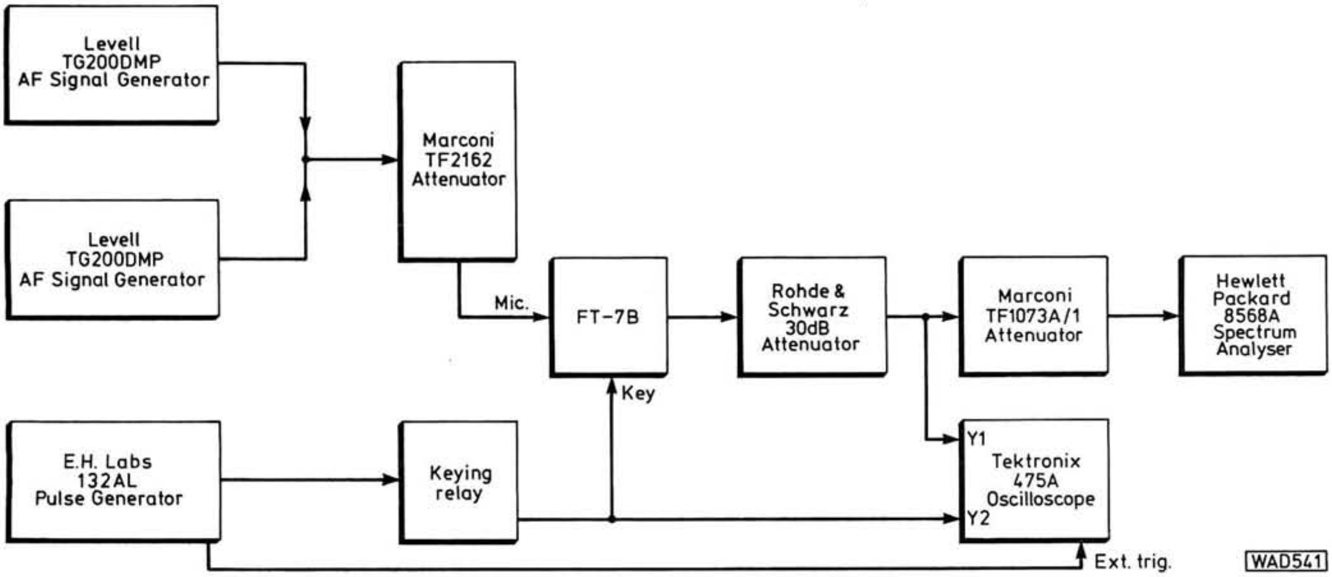


Fig. 3: The transmitter measuring system

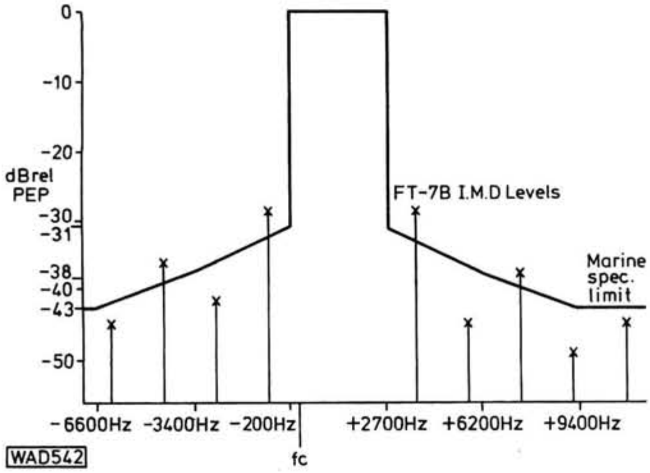


Fig. 4: Out-of-band radiation on s.s.b., compared with the UK Marine Transmitter Specification limit

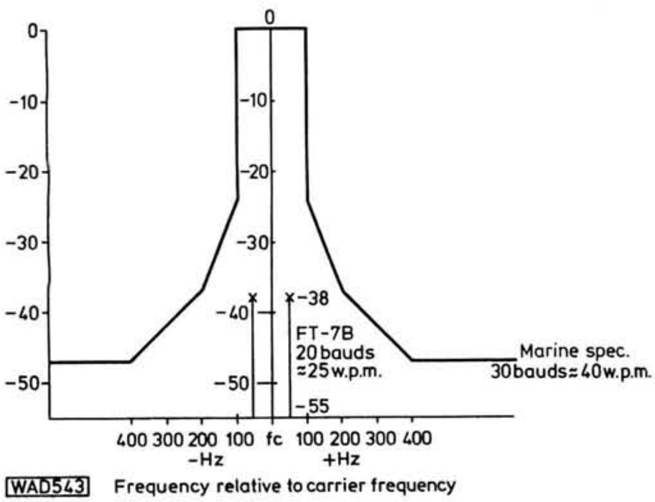


Fig. 5: Out-of-band radiation on c.w., compared with the UK Marine Transmitter Specification limit

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

Frequency MHz	AF o/p @ 10dB SINAD	Input for 10dB SINAD	Input for 20dB SINAD	Ultimate SINAD at 1W output	Input for 3W o/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 o/p @ 3·7MHz	AF o/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"

W. J. MAINWARING

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
¼W 5%

470Ω	1	R1

Capacitors

1000µF 16V	1	C1

Semiconductors
Diodes

BZY88C9V1	1	D2
1N4001 or BY126	1	D1

Transistors

BFY50 or 2N696	1	Tr1

Miscellaneous
Transformer 9V 6VA, PP9 battery (spent), PP3 connector, 6V 0·3A lamp, 6BA nuts and bolts.

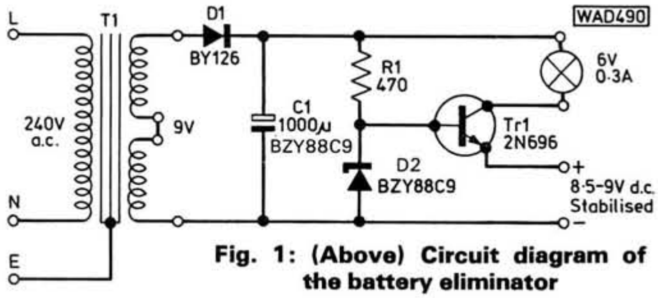
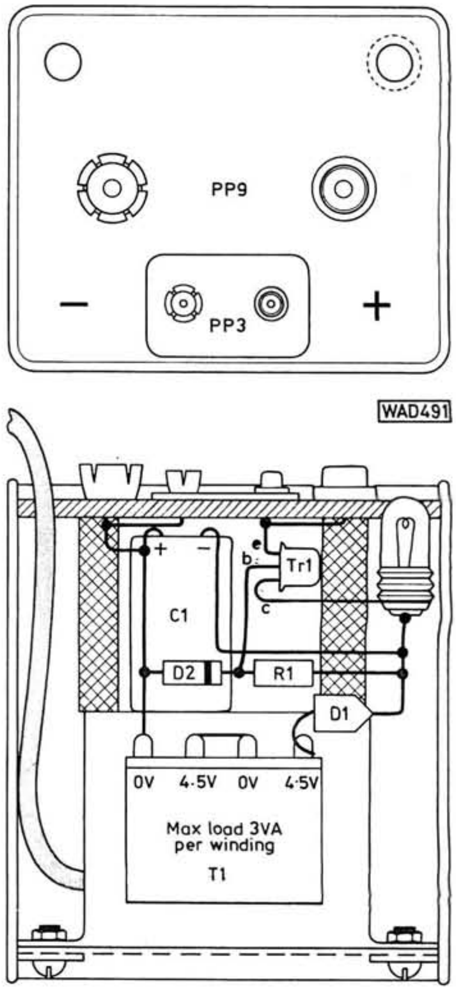


Fig. 1: (Above) Circuit diagram of the battery eliminator

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.

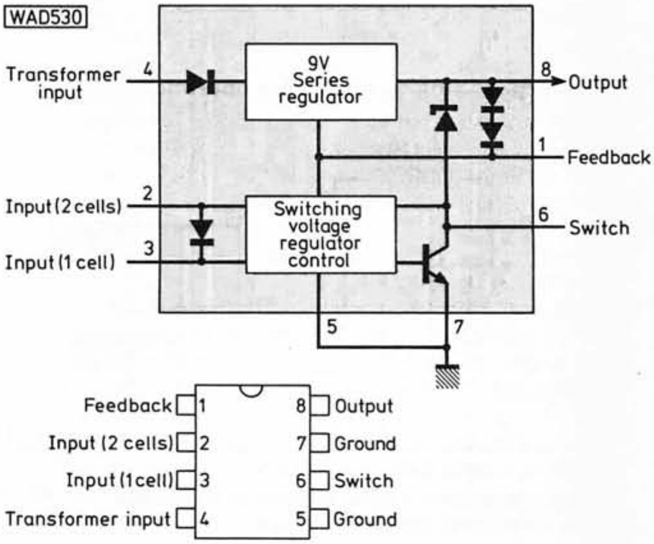
The device could also be used to power a *small* radio receiver from one or two cells. Remember, however, that the small maximum output current (voltage up = current down!) means that there is insufficient power to drive the radio unless the volume is kept low. Any attempt to gain a high audio output 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 40–50µH. 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 overemphasised. 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.

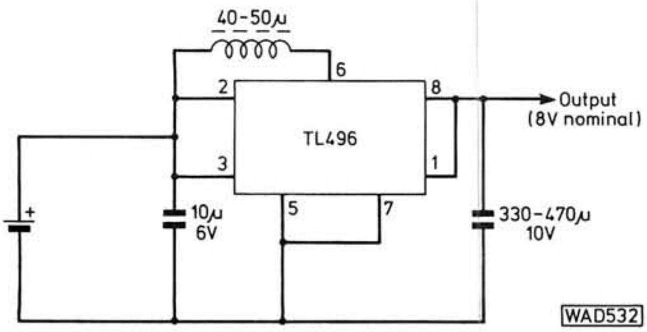


Fig. 2: Single cell battery operation

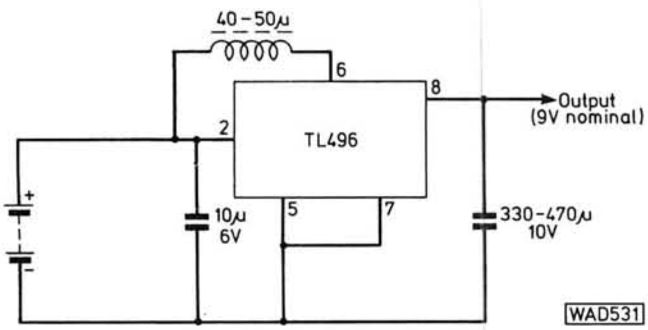


Fig. 3: Battery operation with two cells

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 transformer 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

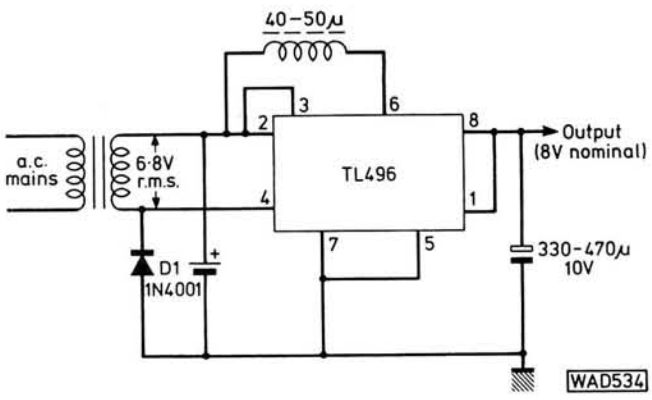


Fig. 4: Single cell mains operation

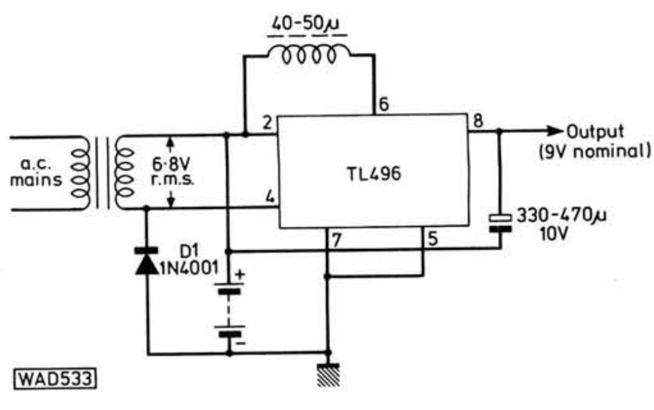


Fig. 5: Mains operation with two cells

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 $13\frac{1}{2}$ 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 $13\frac{1}{2}$ 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. ●

ON THE AIR

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, its 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, HM0OO, 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 valved 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 Layfayette 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 × 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.

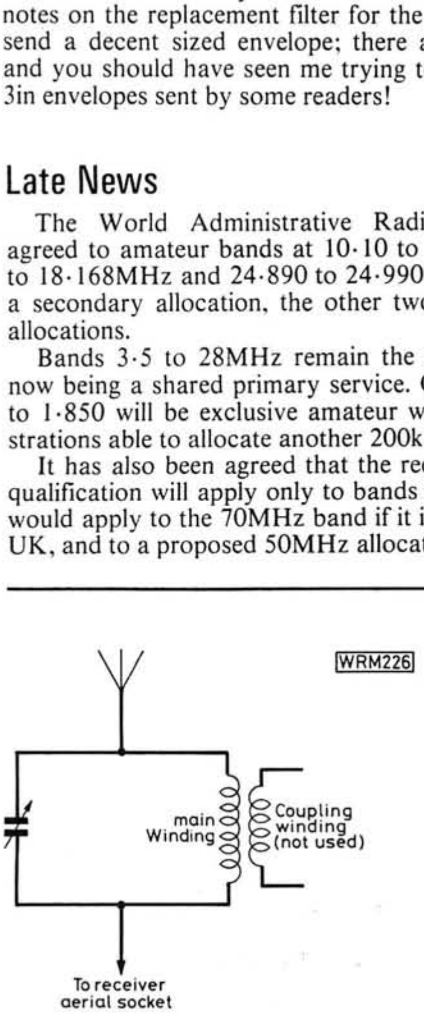


Fig. 1. Circuit arrangement of a wavetrap

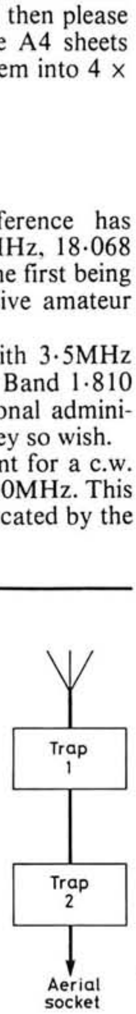
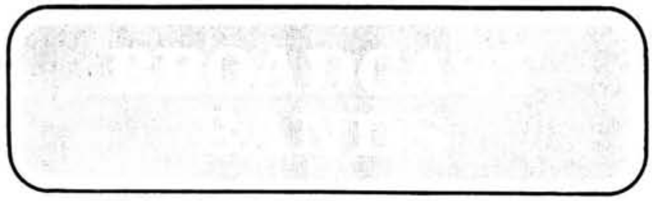


Fig. 2. Cascading wavetraps



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 wavetrap. 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 wavetrap 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 wavetrap 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 spurii disappear. The wavetrap 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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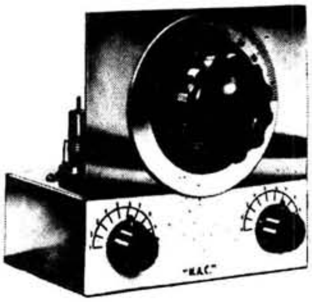

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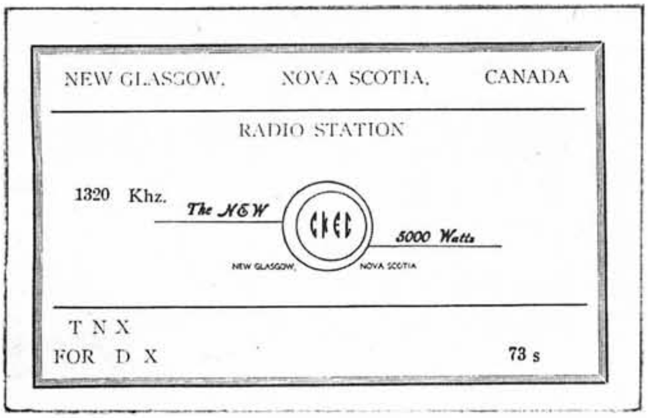
Beginners' Corner

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.

BROADCAST BANDS

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, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

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

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

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, Bluntisham, Huntingdon, Cambs PE17 3XA.

VHF BANDS

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 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.

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.

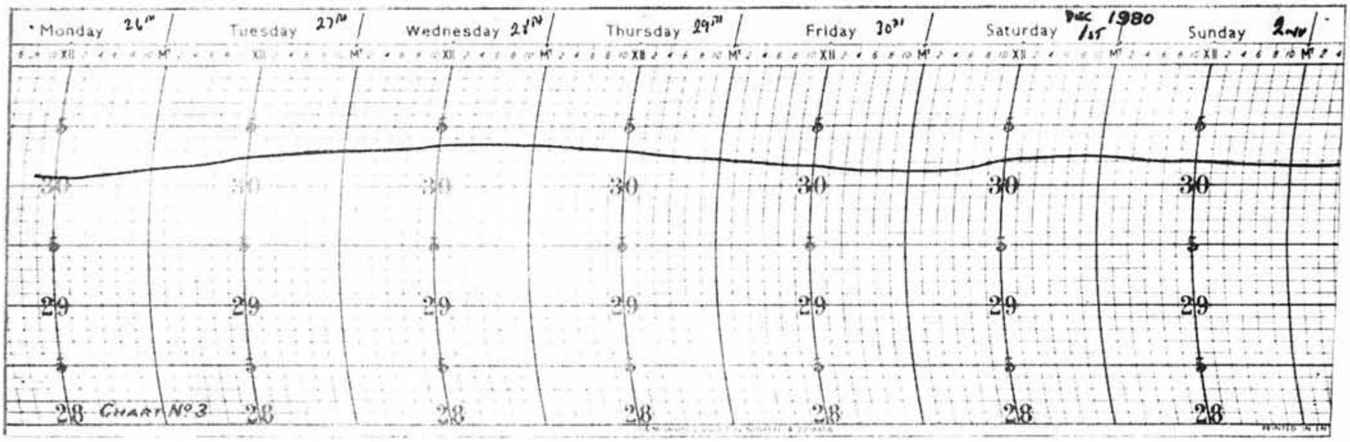


Fig. 3: Atmospheric pressure recorded by the author, 27–30 November 1979

DXTV

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 appeard but there were too many images to tell the time. This was also the case with a test card which followed.

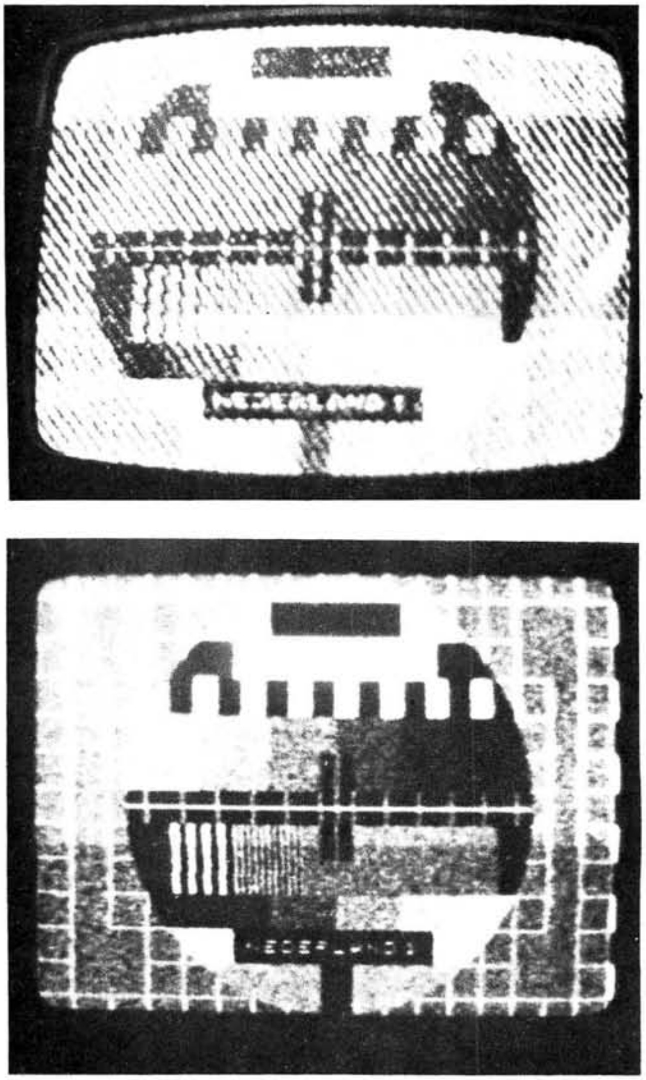


Fig. 4: Dutch TV received by the author simultaneously on Ch.E5 (top) and Ch.E29 (bottom), on the morning of 29 November 1979

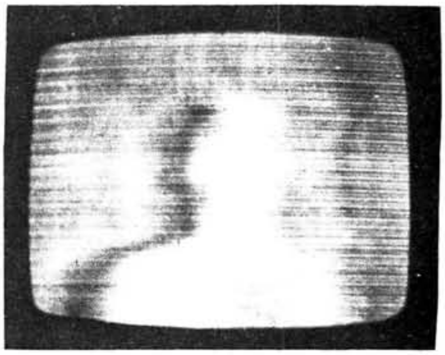


Fig. 5: Announcer on Ch.R1, received via F2

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 Legett** 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.

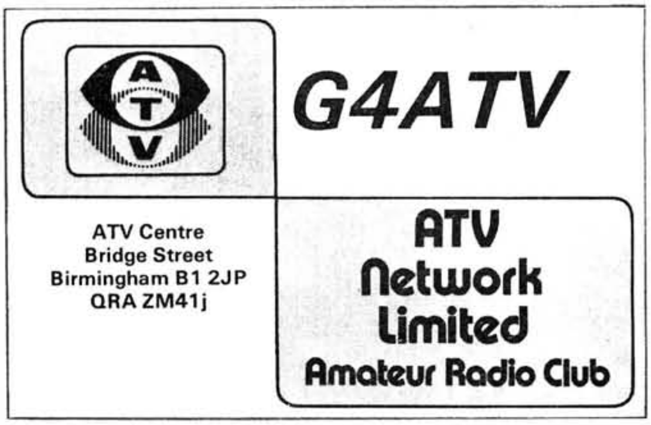


Fig. 6: ATV Network Ltd. QSL card

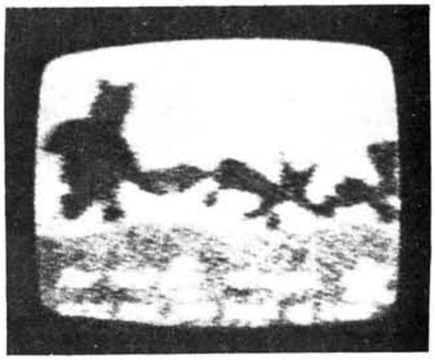


Fig. 7: Picture via Leonids MS on 16 November 1979

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,** Ashtead, 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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(* Yes, we still haven't learnt how to spell.)

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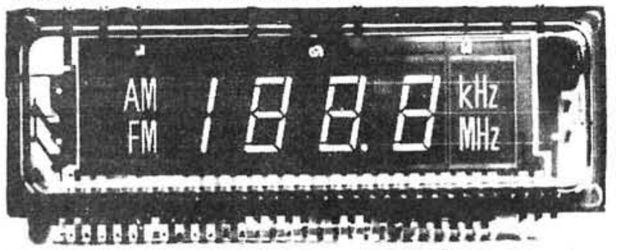

Not illustrated here - but also now available is the DFM6. This is a vacuum fluorescent display version of our immensely popular DFM3 (LCD). Resolution is 100Hz to 3.9999MHz, 1kHz to 39.999MHz, and 10kHz to 200.00MHz+; all standard IF offsets (inc. 10.7MHz on shortwave) are available via diode programming.

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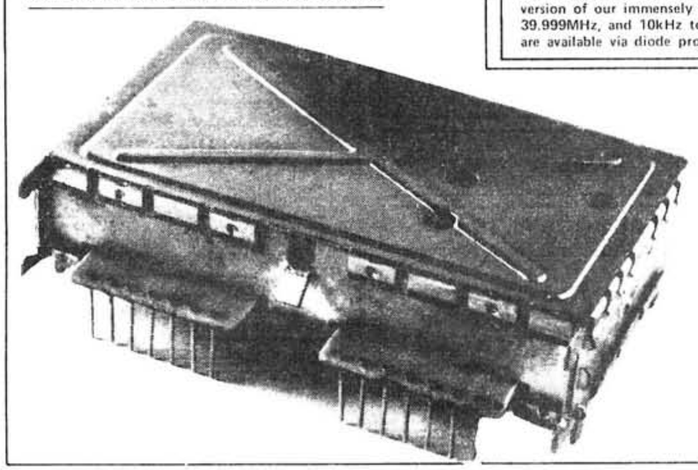

UM1181 VHF band 2 VARICAP TUNERHEAD
5 tuned circuit, with image/spurii better than −80dB, buffered LO output, MOSFET RF stage, FET IF preamp, tunes with only 1½ to 8v, −9dBm 3rd order intercept. 1off price £12.00 inc VAT. (100off/ OA)

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 OA)

There is a danger - when advertizing 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, greem, 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.
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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.

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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.

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

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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)

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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.

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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. Folkestone 58265.

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

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

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Wanted

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

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SOLID STATE SECURITY DEPT. (PW),
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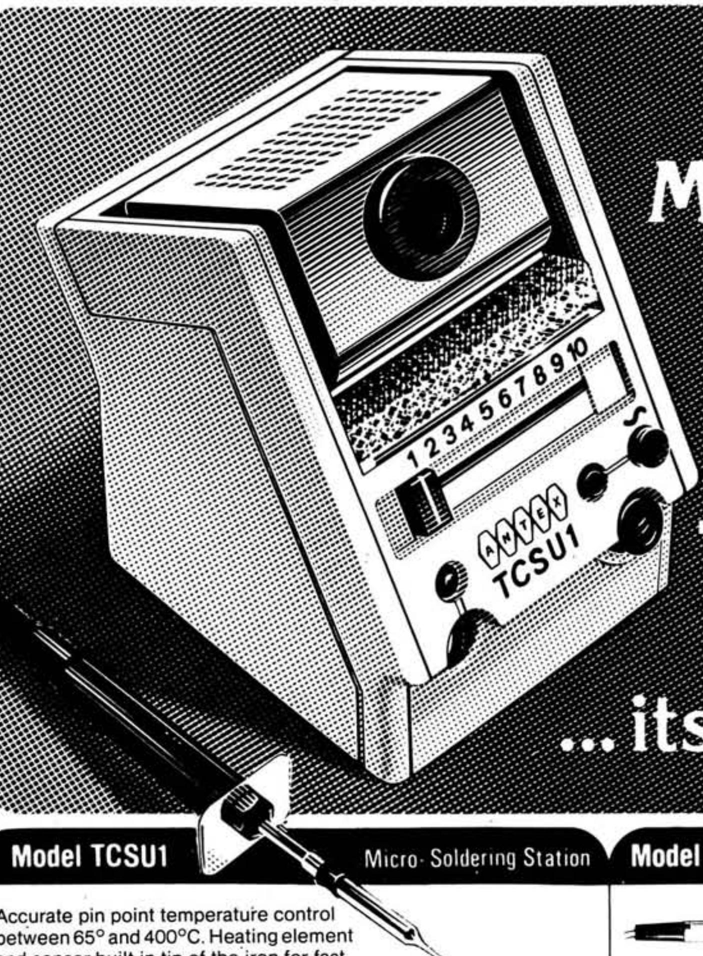


Micro-precision soldering

ANTEX TCSU1 with CTC

...its the perfect kit

Model TCSU1 — Micro-Soldering Station

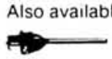
Accurate pin point temperature control between 65° and 400°C. Heating element and sensor built in tip of the iron for fast response. Interchangeable slide-on bits from 4.7mm (3/16") down to 0.5mm. Zero voltage switching, no spikes. No magnetic field, no leakage. Supplied with miniature CTC (35-40watt)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

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

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

Model CX 17watts - 230 volts

A miniature iron with the element enclosed first in a ceramic shaft, then in stainless steel. Virtually leak-free. Only 7" long. Fitted with a 3/32" bit **£4.20** (.98)
Range of 5 other bits available from ¼" down to 3/64"
Also available for 24volts



Spare element Model CX230E

Model X25 25watts - 230 volts

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

Spare element Model X25 240E

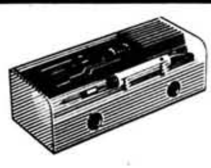
Model SK3 Kit

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

Model SK4 Kit

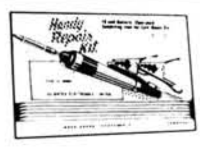
With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£5.70** (1.49)

Model SK1



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

Model MLX 12volts



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

ST3 Stand.

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

✻ VAT + P&P as shown in brackets ( )

ANTEX

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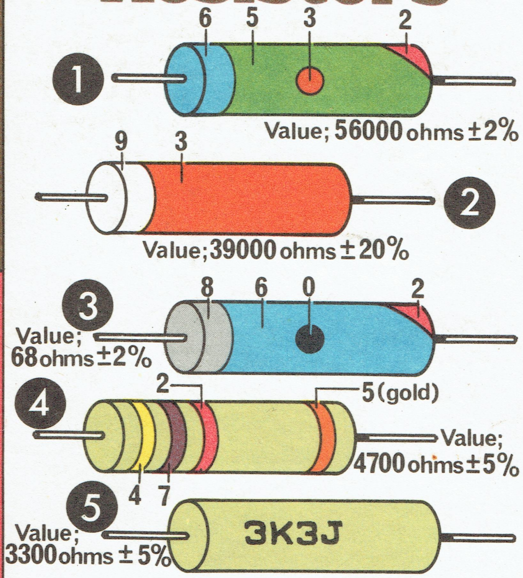
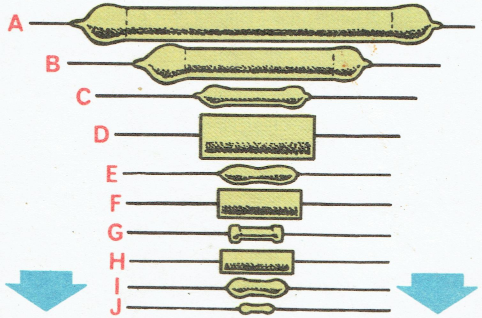
RESISTORS & CAPACITORS

DATACARD

Resistors

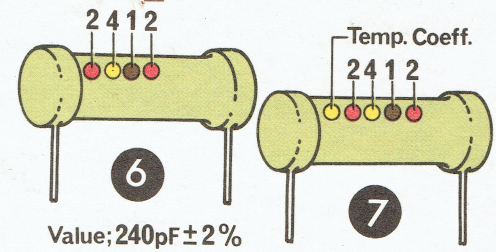


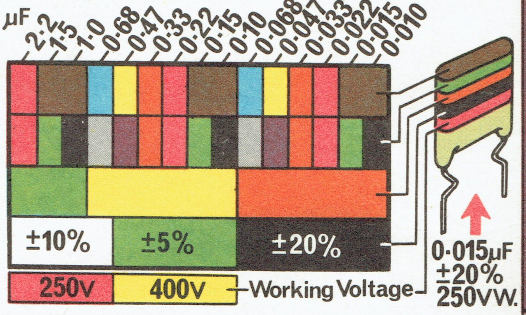


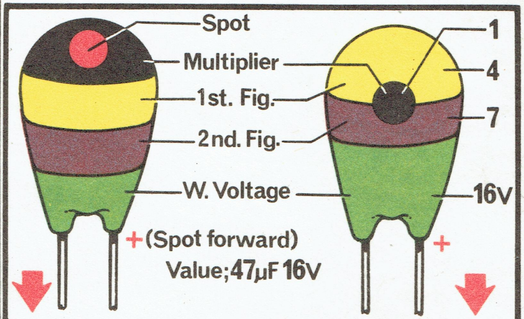
	Rating (W)	Length (mm)	Characteristics
A	7	48	Wirewound
B	3	29	Wirewound
C	1	16	Wirewound
D	1	16	Carbon film. High stability. Low noise
E	½	9.5	Metal oxide. Better stability than c. film
F	½	10/11	Carbon film. High stability. Low noise
G	0.4	6.5	Metal film
H	½	9	Carbon film. High stability. Low noise
I	⅓	7/7.5	,, ,, ,, ,, ,, ,,
J	1/20	4	,, ,, ,, ,, ,, ,,

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

Capacitors

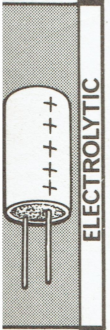


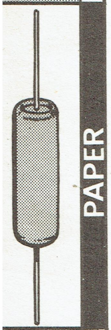


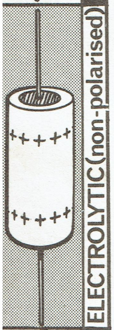


	Multiplier	Voltage		Multiplier	Voltage
Black	×1µF	10	Blue		20
Brown	×10µF		Violet		
Red	×100µF		Grey	×0.01µF	25
Yellow		6.3	White	×0.1µF	3
Green		16	Pink		35

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







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 56kΩ, (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 39kΩ.

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 100kΩ±5% may have any value between 100000+5000 ohms or 105000 ohms and 100000−5000 ohms or 95000 ohms.

Brown=±1% Red=±2% Gold=±5% Silver=±10% None=±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 (10Ω)	470R (470Ω)
Multiplier=1000	2K2 (2.2kΩ)	33K (33kΩ)
Multiplier=1000000	6M8 (6.8MΩ)	2M4 (2.4MΩ)

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 10Ω ±10%
2K2G	,, ,, ,, ,, 2.2kΩ ±2%
6M8J	,, ,, ,, ,, 6.8MΩ ±5%
33KF	,, ,, ,, ,, 33kΩ ±1%
470RM	,, ,, ,, ,, 470Ω ±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. Submultiples and multiples (decimal) of each number give a very wide range of values.

EXAMPLE 27 is the Preferred Number for resistors of 2.7Ω, 27Ω, 270Ω, 2.7kΩ, 27kΩ, 270kΩ and 2.7MΩ.

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 ±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 PICOFARADS, 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 $p=10^{-12}$ $n=10^{-9}$ $\mu=10^{-6}$ and the value is in FARADS. In practice this means that 1×10^{-6} F=1 microfarad (1μF), 1×10^{-9} F=1 nanofarad (1nF) and 1×10^{-12} F=1 picofarad (1pF).

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

EXAMPLES

Multiplier×1	1p0=1pF	330p=330pF
Multiplier×1000	2n0=2000pF	4n7=4700pF
Multiplier×1000000	5μ0=5μF	3μ3=3.3μF

CHARACTERISTICS OF CAPACITORS

Aluminium Electrolytics Available in polarised and non-polarised forms. Values from less than 1μF to 50000μF. 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 ±1%.

Polystyrene High stability, good for RF and AF applications in tuned circuits, decoupling etc. High insulation resistance. Available to close tolerances, typically ±2½%.

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

Silver Mica As polystyrene. Tolerances to ±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.