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NOVEMBER 1980

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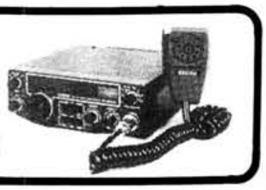

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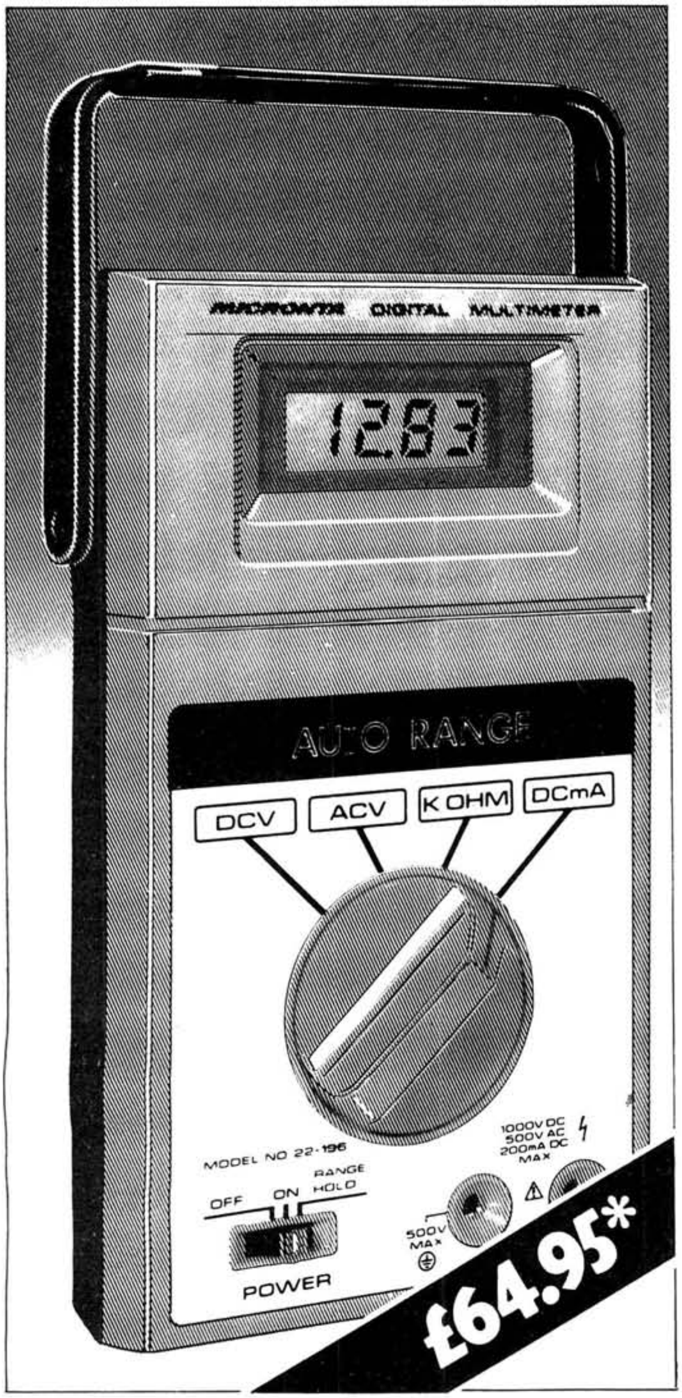

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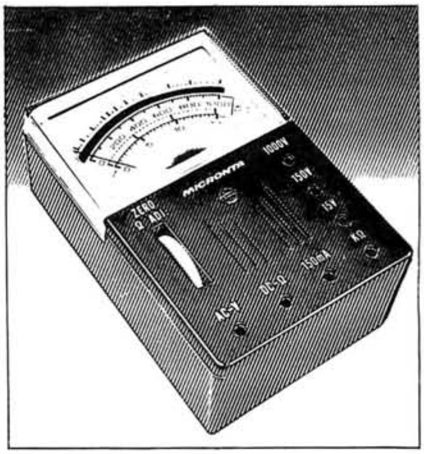

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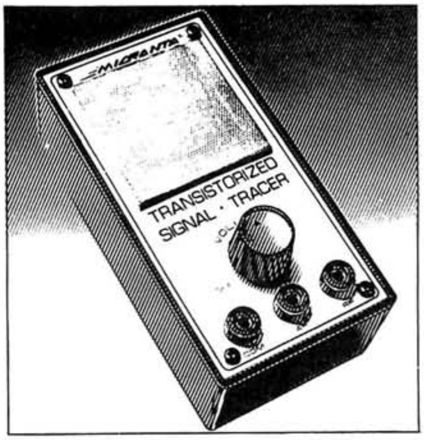

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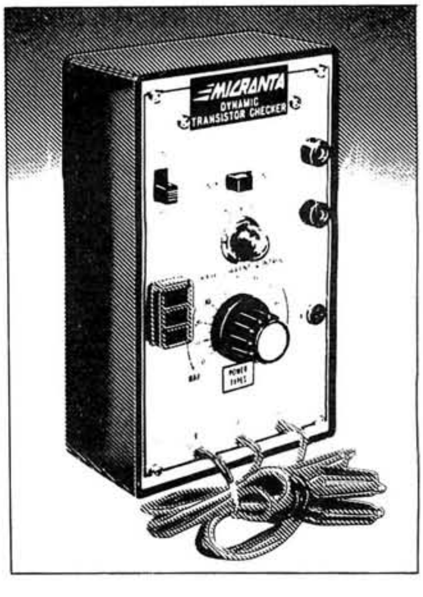

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- BA244 0.17
- BA379 0.35
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- 1N4001 0.06
- 1N4002 0.07
- 1N5402 0.15
- OA91 0.07
- AA112 0.25
- BRIDGES:
- 1A/50V 0.35
- 6A/200V 0.75

TRANSISTORS

AUDIO DEVICES

- BC237 0.08
- BC238 0.08
- BC239 0.08
- BC307 0.08
- BC308 0.08
- BC309 0.08
- BC413 0.10
- BC414 0.11
- BC415 0.07
- BC416 0.08
- BC546 0.12
- BC556 0.12
- BC550 0.12
- BC560 0.12
- BC639 0.22
- BC640 0.23
- 2SC1775 0.18
- 2SA872A 0.14
- 2SD666A 0.30
- 2SB646A 0.30
- 2SD668A 0.40
- 2SB648A 0.40
- 2SD760 0.45
- 2SB720 0.45
- 2SC2546 0.19
- 2SA1084 0.20
- 2SC2547 0.19
- 2SA1085 0.20

AUDIO POWER DEVICES

- 2SB753 2.34
- 2SB723 2.34
- 2SK133 3.00
- 2SJ 48 3.00
- 2SK134 3.10
- 2SK135 3.75
- 2SJ 50 3.75
- BD535 0.52
- BD536 0.52
- BD377 0.33
- BD378 0.33
- BD165 0.30
- BD166 0.31

SMALL SIGNAL RF DEVICES

- BF194 0.18
- BF195 0.18
- BF224 0.22
- BF241 0.18
- BF274 0.18
- BF440 0.21
- BF441 0.21
- BF362 0.49
- BF395 0.18
- BF479 0.66
- BF679S 0.55
- BFR91 1.33
- BFW92 0.60
- BFT95 0.99
- BFY90 0.90
- 40238 0.85

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- 2N3866 0.85

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- 2SK168 0.35
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- 3SK45 0.49
- 3SK51 0.54
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- MEM680 0.75
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LCD Module

CM161. Miniature clock, 12/24 hr., alarm, day, date, backlight. All for......9.95

CAPACITORS

All 5mm or less spacing

CERAMIC 50v
- 2P2,3P3,4P7,6P8
- 8P2,10P,15P,18P..0.04
- 22P,27P,33P,47P
- 56P,68P,82P,100P.0.05
- 150P,220P,270P
- 330P,390P,470P...0.055
- 1N0,2N2,3N3,4N7..0.06
- 10N (0.01uF)....0.05
- 22N,47N.........0.06
- 100N,220N........0.09

MONOLITHIC CERAMIC
- 10N,100N.........0.16

FEEDTHRU
- 1N0 SOLDER IN....0.09

POLYESTER (SIEMENS)
10mm LEAD SPACING
- 10N,22N,33N......0.17
- 47N,68N,100N.....0.19
- 220N,470N........0.22
- 1uF..............0.29

POLYESTER (GENERAL)
10mm LEAD SPACING
- 10N,15N,22N,33N..0.06
- 47N,68N,100N.....0.08
- 220N.............0.11

20mm LEAD SPACING
- 220N,330N,470N...0.18

MYLAR
5mm LEAD SPACING
- 1N0,10N,22N,33N..0.08
- 100N.............0.09

20mm LEAD SPACING
- 220N,470N....... 0.17

POLYSTYRENE
- 10P,15P,18P,22P,
- 27P,47P,56P,68P..0.08
- 100P,180P,220P,
- 270P,330P,390P...0.09
- 470P,680P,820P...0.10
- 1N0,1N2,1N5,1N8..0.11
- 2N2,2N7,3N3,3N9..0.12
- 4N7,5N6,6N8,10N..0.13

TANTALUM BEAD CAPS
- 16v: 0.22,0.33,
- 0.68,1.0.........0.18
- 16v: 2.2,4.7,10..0.19
- 6v3: 22,47.......0.30
- 10v: 22,100......0.35

ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT)

(uF/voltage)
- 1/63,2.2/50,4.7/35
- 10/16,15/16,22/10
- 33/6.3...........0.08
- 22/16,33/10,
- 47/10............0.09
- 10/63,22/50,33/50,
- 47/16,100/16.....0.10
- 47/63,100/25,220/16
- 470/6.3..........0.12
- 100/63,470/16,
- 1000/10..........0.18
- 1000/16,470/63...0.23
- 1000/63,2200/16..0.30
- 3300/25..........0.69
- 1000/100.........0.88
- 10000/70.........3.00

AXIAL (HORIZ. MOUNT)
- 1/25,4.7/16,6.4/25
- 10/16............0.08
- 4.7/63,22/10,22/16
- 33/16............0.09
- 47/25,100/16.....0.10
- 100/25...........0.11
- 1000/16..........0.25
- 2200/16,1000/25..0.36
- 1000/35,4700/16..0.45
- 1000/50..........0.58

RESISTORS

- 0.25W, 5% E12 CARBON
- 1ohm-10M.........0.02
- 0.25W 1% E12 METAL FILM
- 1.1ohm-1M........0.05

HORIZ CARBON PRESETS
- 10mm TYPE
- 100ohms-2M5......0.12

HORIZ CERMET PRESETS
- 1k, 10k..........0.27

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- AM TX:-
- 3rd OT 30pF HC25U 1.65
- AM/FM RX:-
- 3rd OT 30pF HC25U 1.65
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- Fund 20pF HC25U 1.85
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- 3.2768MHz 2.70
- 4.000MHz 2.00
- 4.19439MHz 2.30
- 6.5536MHz 2.10
- 10.0MHz 2.50
- 10.6985MHz 2.50
- 10.7015MHz 2.50
- 10.245MHz 2.50
- 10.7MHz 3.00
- 11.52MHz 2.50
- 100MHz 3.00

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- 3MM RED CLEAR 0.15
- 3MM RED 0.15
- 2.5 X 5MM RED 0.17
- 5MM GREEN 0.15
- 3MM GN CLEAR 0.16
- 3MM GREEN 0.16
- 2.5 X 5MM GN 0.20
- 5MM YELLOW 0.15
- 3MM YELLOW CL 0.16
- 3MM YELLOW 0.18
- 2.5 X 5MM YE 0.20
- 5MM ORANGERED 0.20
- 5MM ORA CL 0.29
- 3MM ORANGERED 0.19
- 2.5 X 5MM ORA 0.24
- 5MM INFRA RED 0.56
- BPW41 IR DET 1.51
- IR OPT CPLR 1.44
- 5MM CLIP 0.04

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Ersin Multicore 5-core solder. Contains non-corrosive flux for electrical applications.
1.2mm dia. 200g Econopak. Size 13A. **£4.14 per reel.**

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40/60 tin/lead. 1.6mm dia. Size 3. **£3.91 per reel.**

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Multicore 5-core solder for radio, T.V. and similar work. Reduces copper erosion. Suitable for service engineers and manufacturers using small quantities of solder.
1.2mm dia. Size 12. **£3.91 per reel.**

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Arax Multicore 4-acid-core solder for metal fabrication (not aluminium) and repairs.
40/60 tin/lead. 1.6mm dia. Size 11. **£3.91 per reel.**

Multicore Wick.
Multicore solder-wick for removing solder from virtually any joint.
1.7mm dia. Size AB10. **£1.38 per reel.**

Tip Kleen.
Multicore Tip Kleen.
Soldering-iron tip wiping pad.
Replaces wet sponges. (Should not be used above 350°C).
81p per pack.

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General purpose solder suitable for all electrical joints.
40/60 alloy. 1.2mm dia. Size 6. **58p per handy plastic dispenser.**

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Alu-Sol Multicore 4-core solder for soldering most types of aluminium. No extra flux needed.
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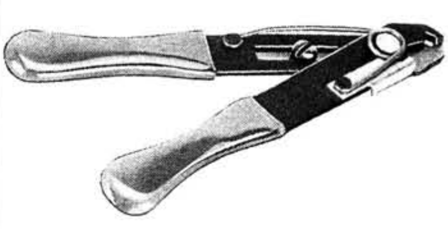
Multicore soldering flux paste. Extra fast, non-corrosive, rosin-flux for electrical and general purpose soldering.
Rosin R.F.10. 35g net. **69p per pack.**
Multicore soldering flux paste for soft metals (except aluminium) and stainless steel. Non-electrical.
Arax A.F.14. 35g. **69p per pack.**



Wire Stripper and cutter.
Wire stripper and cutter with precision ground and hardened steel jaws. Adjustable to most wire sizes. With handle locking-catch and easy-grip plastic covered handles.
Ref: 9. **£2.69 per pair.**

Bib Hi-Fi Accessories Ltd., (Solder Division),
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Telephone: (0442) 61291.

All recommended retail prices shown are inclusive of VAT. If you have difficulty in obtaining any of these products send direct with 40p for postage and packing. For free colour brochure send S.A.E.

comment...

Open Channel

THE long-awaited Home Office Green Paper on the UK version of Citizens' Band—*Open Channel, a Discussion Document*—has proved to be something of a non-event. It devotes fourteen pages to saying what could equally well be said in about four, the sum total of which is:

1. To minimise interference with domestic radio and TV, a frequency just above 928MHz is favourite. It says that some other countries are looking at CB in the same band, but neglects to point out that they are also looking at the effects on the human body of radiation at those frequencies. There appears to be a definite link with cataracts of the eye, a significant point when considering the use of hand-portable transceivers with integral microphones.
2. An ultimate allocation of 40 channels at 25kHz spacing is envisaged, though the question of what modulation mode should be used is ignored completely.
3. A range of 15km (just over 9 miles) is thought adequate and desirable. However, the paper then goes on to quote test results from several sources to prove that in practice, ranges are likely to be between 10 and 50 per cent of this distance.
4. The Home Office intends to wash its hands of any involvement whatsoever in trying to control in-band interference, so the jammers, the music players, the heavy breathers, etc., etc., will have a free rein!

Send for your copy of *Open Channel* to: Officer in Charge, Home Office, Supply and Transport Branch, Royston Road, Cambridge CB2 8PN, and get your comments in to the Radio Regulatory Department of the Home Office by November 30 at the latest.

THIS month we are introducing several changes and new features to *Practical Wireless*, largely as a result of suggestions and requests from our readers. And there will be more new features coming into the magazine over the next few months. We hope that they will turn out to be just what you wanted, and would like to say a big thank you to all who took the trouble to send us their views.

For an explanation of the new "Rating" system for constructional articles, see below.

I AM sorry that some readers writing to us with queries in the past few months have had a very long wait for answers. Two of our technical staff recently decided that journalism was not for them, and have left us to resume their careers in industry, leaving us very short-staffed. We have now filled the gaps, and hope that we shall be well on the way to clearing the backlog of letters by the time this issue is published.

Geoff Arnold

services

QUERIES
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", Westover House, West Quay Road, Poole, Dorset BH15 1JG,** giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components for our projects are usually available from advertisers. For more difficult items, a source will be suggested in the "Buying Guide" box included in each constructional article.

SUBSCRIPTIONS
Subscriptions are available to both home and overseas addresses at £11.80 per annum, from **"Practical Wireless" Subscription Department, Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

BACK NUMBERS AND BINDERS
Limited stocks of some recent issues of *PW* are available at 95p each, including post and packing to addresses at home and overseas.

Binders are available (Price £4.30 to UK addresses and overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.** All prices include VAT where appropriate. Please make cheques, postal orders, etc., payable to IPC Magazines Limited.

PROJECT COST
The approximate cost quoted in each constructional article includes the box or case used for the prototype. For some projects the type of case may be critical; if so this point will be mentioned in the Buying Guide.

CONSTRUCTION RATING
Each constructional project will in future be given a rating, to guide readers as to its complexity:

Beginner
A project that can be tackled by a beginner who is able to identify components and handle a soldering iron fairly competently. Generally this category will be used for simple projects, but sometimes for more complicated ones of wide appeal. In this case, construction and wiring will be dealt with in some detail.

Intermediate
A project likely to appeal to a wide range of constructors, and requiring only basic test equipment to complete any tests and adjustments. A fair degree of experience in building electronic or radio projects is assumed.

Advanced
A project likely to appeal to an experienced constructor, and often requiring access to workshop facilities and test equipment for construction, testing and alignment. Constructional information will generally be limited to the more critical aspects of the project. Definitely not recommended for a beginner to tackle on his own.

NEWS NEWS NEWS

Amateur Radio Supplies

As from 1 August 1980, a new amateur radio communications shop has been opened at Kempston near Bedford.

The new company, named Bedford Audiocom, at present hold agencies for Yaesu, FDK, Jaybeam and Bantex, and others will follow. Bedford Audiocom intend to specialise in mobile and portable rigs and a wide range of aerials and accessories.

Further information from: *Bedford Audiocom, 76 Bedford Road, Kempston, Beds. MK42 8BB. Tel: Bedford (0234) 854133.*

New Component Centre

A new component shop has recently been opened by Riscomp Ltd. in order to supply a wide range of components, test equipment and books to the amateur and enthusiast.

In addition, the full range of audio modules from Autona Ltd. will be stocked.

Opening hours are, Monday to Saturday 9.00am to 5.00pm, closed all day Wednesday.

Riscomp Ltd., 21 Duke Street, Princes Risborough, Bucks. Tel: (084 44) 6326.

Solent Audio 80

Hamilton Electronics Ltd. of Southampton are the host exhibitor at Solent Audio 80. which is being held on 25 and 26 October.

Solent Audio is now established as a major regional Hi-Fi show and this year is supported by thirty leading manufacturers.

Three complete floors have been booked at the Post House Hotel, Southampton, and each exhibitor will have an individual demonstration room. Representatives of the manufacturers will be in attendance throughout the show.

Further details from: *Hamilton Electronics Ltd., 35 London Road, Southampton SO1 2AD. Tel: (0703) 28622.*

Bandstand Monthly

"Bandstand", the monthly publication of a group promoting the legalisation of CB Radio, is having to increase its cover price.

I understand from its Editor, Mike Evans, that the circulation of "Bandstand" is increasing very nicely.

The new price for "Bandstand" is 25p per copy, or a 12-month subscription for £4.44 (1st Class Post) and £4.20 (2nd Class Post). Applications should be sent to: *B.M. Bandstand, London WC1V 6XX.*

Special Event

Ormskirk Amateur Radio Club will be operating a special amateur radio station GB2MS, for the Jamboree on the Air, to be held on 18 and 19 October 1980, from the 8th Sefton East Scout Group HQ, United Reformed Church, Horthway, Maghull, Nr Liverpool.

Operation will be on all h.f. bands between 1300 and 1700, on both days. It is hoped to interest the scouts in the hobby with various constructional projects, demonstrations and to run a course for the Scout "Communications" badge.

Further details from: *P. J. Kay G4GCB, "Norin", 6 Shireoaks, Belper, Derbyshire.*

Diary Date

The British Amateur Television Club are holding their "BATC Convention 80" on 5 October 1980 at the Post House Hotel, Braunston Way, Leicester.

The hotel is located off the A46 about one mile from the M1 motorway.

There will be many attractions for the amateur TV buff.

Details from: *Mike Cox G8HUA, 16 Woodclose Road, Scunthorpe, South Humberside DN17 1RU.*

Nascom Exercise Programs

A booklet of BASIC games programs for the Nascom 1 and 2 microcomputers entitled "BASIC Programs Book 1" has been produced by the International Nascom Microcomputer Club priced £2.50 plus 40p postage.

Ten programs have been "LISTed" from programs running in a Nascom using the 8K BASIC and are primarily intended as exercises in learning how to use the machines. Although they all run, the INMC recommends users to enter the programs and not only to make them work but also to study how they work.

The booklet, additionally, lists a number of sub-routines and a complete table of HEX codes for reserved words and graphics, and offers guidance on overcoming two minor bugs and dealing with "Listening to Tape" in BASIC using NAS-SYS 1 and NAS-BUG.

The booklet is available from the: *INMC, c/o Oakfield Corner, Sycamore Road, Amersham, Bucks.*

Disco D.I.Y. Centre

Roger Squire's have recently opened their sixth outlet in Ilford, Essex.

As usual with all Squire's shops a big range of spares and d.i.y. products will be available for the Disco operator.

The product range will include, speaker chassis, turntables, cartridges and stylli, plugs, sockets, bulbs, spots of many different types, and all types of cable for Discos and lighting rigs.

The new Roger Squire's shop is at: *415 Ilford Lane, Ilford, Essex. Tel: 01-478 1153.*

PRODUCTION LINES

ALAN MARTIN G8ZPW

If you please

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

More on pages 73 and 74

New Scanning Receiver

The SX-200 Scanner covers the bands 26–88MHz, 108–180MHz and 380–514MHz on both a.m. and f.m. modes, and incorporates a digital clock.

Frequency entry is by keyboard, and the SX-200 will scan the channels stored in its 16 memories or search any band between user-programmed limits. Two-speed scanning or searching, and optional scan delay are featured.

Either the integral whip or external 50–75Ω antennas may be used, and there is a switched 20dB attenuator for local reception. The power supply is 12V d.c., or a.c. mains via an external adaptor.

The SX-200 measures just 75 × 210 × 235mm and weighs around 2·8kg. It is priced at £241·50 which includes VAT and p&p, and is available from: *Gareth Electronics, 7 Norvic Road, Marsworth, Tring, Herts. HP23 4LS. Tel: Cheddington (0296) 668684.*

Cassette Eraser

S.G.I. Ltd. is marketing a video eraser which will erase video and audio cassettes and tapes in seconds.

Called the Videoraser, it is used instead of the recorders own internal mechanism and leads to a reduction of wear on the video head and consequently their costly replacement.

It is claimed to erase 100 times better than a recorder thus enabling higher re-recording standards to be achieved and prolong the usable life of the tape. The Videoraser measures 120 × 114mm, weighs 2 kilos, is powered by a.c. mains and provides a magnetic flux of 1400 gauss which makes it possibly the most powerful eraser of its type and can erase a two inch cassette.

Costing £56.93, VAT included, it is a worthwhile investment for the domestic user and can be obtained on a cash-with-order basis from: *S.G.I. Ltd., Fircroft Way, Edenbridge, Kent TN6 6HA. Tel: (0732) 864111.*

Portable Cap. Meter

The recently introduced Model 820 portable capacitance meter from Havant Instruments Ltd., is an economical multi-range instrument combining digital accuracy with complete portability. Its ten ranges cover capacitances from 0·1pF to 1 farad.

Accuracy is 0·5% or 1% of full scale, and resolution down to 0·1pF according to range.

In use, the capacitor leads are simply inserted into a pair of slots and the capacitance is indicated on the clear 4-digit l.e.d. display. A flashing display provides overrange indication. Provision is also made for using jack plugs when measuring in-circuit capacitances.

Housed in a robust moulded case, the 820 weighs only 675g (1·51lb) and is powered by either rechargeable or disposable cells, facilities for using a charger are provided. A tilt stand, spare fuse and 26-page operating manual are also supplied.

Costing £80 plus VAT, the unit is obtainable from: *Havant Instruments Ltd., Unit 3, Westfields, Portsmouth Road, Horndean, Hants. Tel: (0705) 596020.*

Safety Tape

An increasing number of yachts and small boats are being fitted by their owners with v.h.f radiotelephone equipment, as a means of keeping in touch and of summoning help in an emergency. As the marine v.h.f. band gets busier, it is more important than ever that the correct operating procedure is used. In fact, life could depend on it.

A novel way of learning that procedure is from a pre-recorded stereo tape cassette, part of a package called the "VHF Guide". The cassette covers just about every eventuality, including making a link telephone call, talking to coastguards, marinas and port operations stations, listening to weather and navigation warning broadcasts, and, most important, making emergency and distress (Mayday) calls. There is also information on licensing the station and operators.

A handy reference booklet and a Mayday "prompt" card complete the package, which was prepared in close co-operation with HM Coastguard, the British Post Office and the Royal Yachting Association.

The VHF Guide costs £5·95 plus 45p postage and packing from: *Double-Tee Productions, 35 Mall Road, London W6 9DG.*

linear scale resistance meter

Robert GOFFIN

No doubt most readers are already equipped to measure resistance since resistance measuring ranges are a feature of every multimeter. However, analogue test meters normally use a very simple form of resistance meter circuit which basically just consists of adding the meter, a battery, a variable resistor, and the test resistor in series. The variable resistor is adjusted for full-scale deflection of the meter with the test prods shorted together, and adding a resistor across the test prods then results in reduced current flow and a correspondingly lower meter reading.

This produces the familiar and rather inconvenient reverse reading resistance scale. The scale is also non-linear with severe cramping at the high-resistance end, and this also tends to be a little inconvenient and with rather poor accuracy.

Linear Scale

The conventional method of obtaining a forward reading linear resistance-scale is to feed the test resistor from a constant current source and measure the resultant voltage using a high impedance voltmeter, which will not draw a significant proportion of the constant current generator's output.

The voltage needed to drive a given current through a resistance is obviously dependant upon the value of the resistance, and will rise in proportion to the value of the resistance. For example: 1 volt is needed in order to drive 1 ampere through 1 ohm. Doubling the resistance to 2 ohms would require 2 volts for the same current flow, 3 ohms would need 3 volts, and so on. Thus a forward reading linear scale is produced.

Circuits of this type often use current source and meter circuits which fall clearly into two separate sections, but

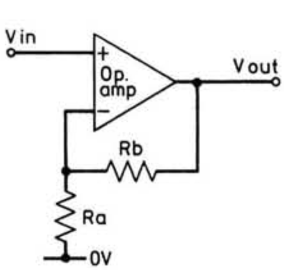


Fig. 1(a)

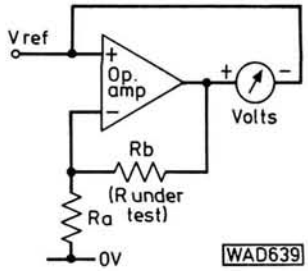


Fig. 1(b)

others use a disguised form of circuit which employs operational amplifier techniques. The unit described in this article falls into the latter category, and this enables an extremely simple circuit to be used. In fact this circuit is not really much more complicated than the ordinary resistance meter circuit, and the unit is well within the scope of any constructor, including the beginner.

Circuit Operation

The unit is based on an operational amplifier connected in the non-inverting amplifying mode. The circuit of Fig. 1(a) shows this basic amplifying arrangement. The input is applied to the non-inverting (+) input and a negative feedback loop consisting of two resistors is connected between the output and inverting (—) input.

The voltage gain of this circuit is equal to (Ra + Rb) divided by Ra. This is because the output voltage is equal to the voltage difference across the inputs multiplied by the open loop voltage gain of the operational amplifier.

Theoretically an operational amplifier has infinite gain

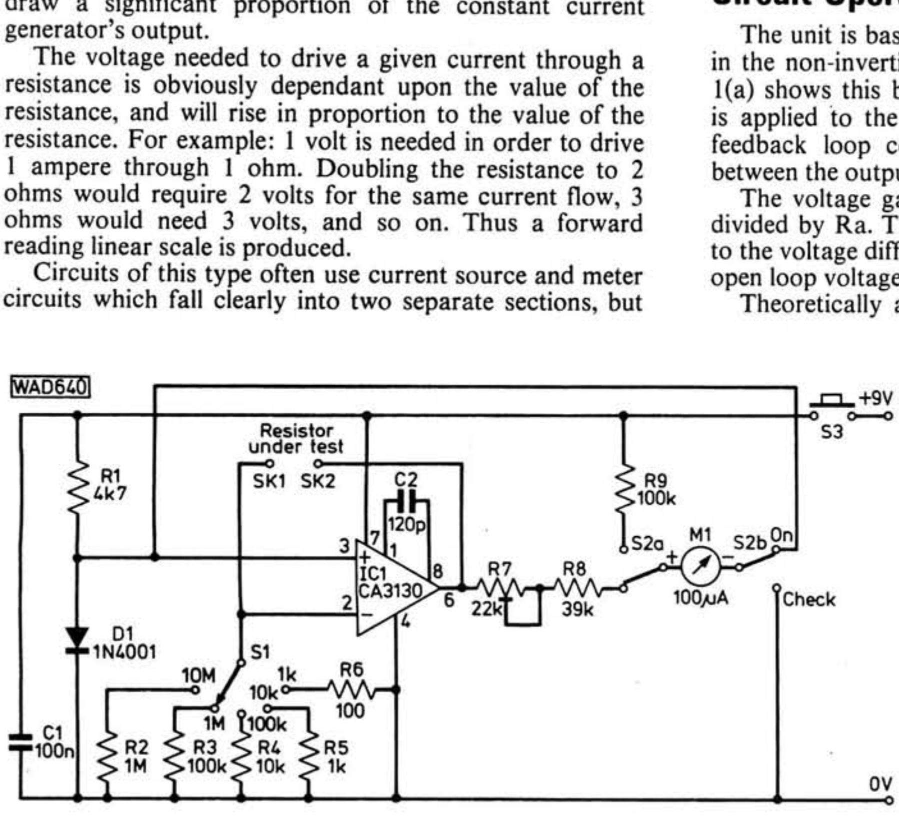
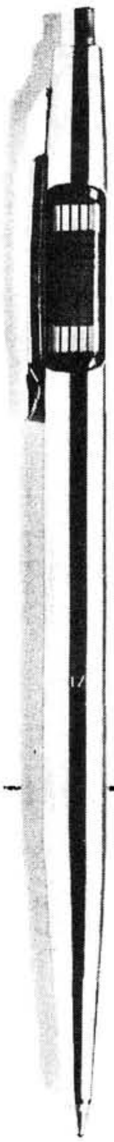


Fig. 2: The complete circuit diagram of the resistance meter



and any difference between the input voltages will result in the output going fully positive if the (+) input is at the higher potential, or fully negative if the (—) input is at the higher voltage. Practical operational amplifiers do not achieve theoretical perfection of course, but their open loop gain is normally in the region of 200 000 times and can be regarded as infinite for most practical purposes.

In the circuit of Fig. 1(a), applying an input voltage will unbalance the inputs and cause the output voltage to rise or fall, depending upon the polarity of the input signal. As it does so, due to the coupling through Rb it will raise or lower the voltage at the inverting input, as appropriate, and once again balance the inputs.

If Rb has a value of zero, the output will assume the same potential as the non-inverting input in order to balance the input potentials. If Ra and Rb have the same value, then due to a potential divider action the output must be double the input voltage in order to balance the inputs. Making Rb two times the value of Ra will produce an output voltage three times that of the input voltage, since the potential divider action across Ra and Rb will result in only one third of the output voltage appearing at the inverting input. It will be apparent from this that the equation given earlier is, therefore, correct.

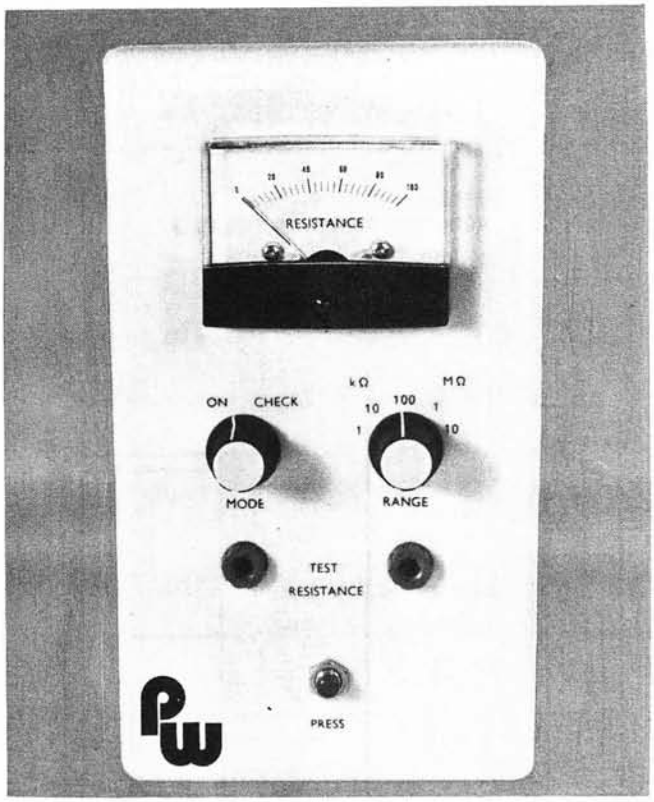
This resistance meter circuit uses the basic configuration shown in Fig. 1(b). Here a stable reference is applied to the non-inverting input, and Rb is the test resistance. A voltmeter is connected between the operational amplifier output and the reference voltage.

If, for the sake of this example, we assume that the reference voltage is 1 volt and Ra is 1kΩ, with Rb at zero the circuit will have unity gain and the meter will read zero because 1 volt will be present at both its terminals. If Rb is raised to 1kΩ, the circuit will have a voltage gain of two, 2 volts will appear at the amplifier output, and the meter will register the 1 volt developed across its terminals. With Rb at say 5kΩ, the circuit will have a voltage gain of six, 6 volts will appear at the output of the amplifier, and the meter will register the 5 volts present across its terminals.

This gives the required forward reading linear scale resistance meter action with the meter reading being proportional to the test resistance. Note that the current through Ra and Rb is constant and does not vary with changes in the value of Rb, and that the voltmeter reading is equal to the voltage across Rb. The circuit is therefore really using the constant current generator/high impedance voltmeter system mentioned earlier, but in a disguised form.

The complete circuit diagram is shown in Fig. 2.

A reference voltage of about 0·6 volts is provided by



forward biased silicon diode D1. R7, R8 and M1 comprise the voltmeter circuit which has a sensitivity of about 6 volts f.s.d. (i.e., ten times the reference voltage). The voltmeter sensitivity can be varied to some extent by adjustment of R7 for calibration purposes. R2 to R6 are the equivalent of Ra in Fig. 1(b), and one of these is selected by S1. This provides the unit with five measuring ranges of 0–1kΩ, 0–10kΩ, 1–100kΩ, 0–1MΩ, and 0–10MΩ.

C2 is the compensation capacitor for IC1, which is a CA3130 device. This particular operational amplifier has been chosen because it has an extremely high input impedance of typically 1 500 000MΩ, and this removes inaccuracies on the higher ranges due to the input impedance of the amplifier shunting the lower feedback resistor. It is also necessary to use a device, such as the CA3130, that operates with its inputs and output close to the 0V rail.

With S1 in the position shown, the circuit works normally, but when it is in the alternative position the meter is disconnected from the main circuitry and is connected across the supply lines via R9. This converts M1 to a

★ components

Resistors		
¼W 5%		
4·7kΩ	1	R1
39kΩ	1	R8
½W 2%		
100Ω	1	R6
1kΩ	1	R5
10kΩ	1	R4
100kΩ	2	R3, R9
1MΩ	1	R2
0·1W horizontal preset		
22kΩ	1	R7

Capacitors		
Polyester		
100nF	1	C1
Ceramic Plate		
120pF	1	C2
Semiconductors		
Integrated Circuits		
CA3130	1	IC1
Diodes		
1N4001	1	D1

Switches		
1 pole 5 way	1	S1
2 pole 2 way	1	S2
S.p.s.t. push-to-make	1	S3

Miscellaneous
188 × 110 × 60mm plastic case; Printed circuit board; Meter 60 × 45mm moving coil 100μA f.s.d.; PP3 battery and connector to suit; Knobs (2); 4mm terminals, red (1), black (1).

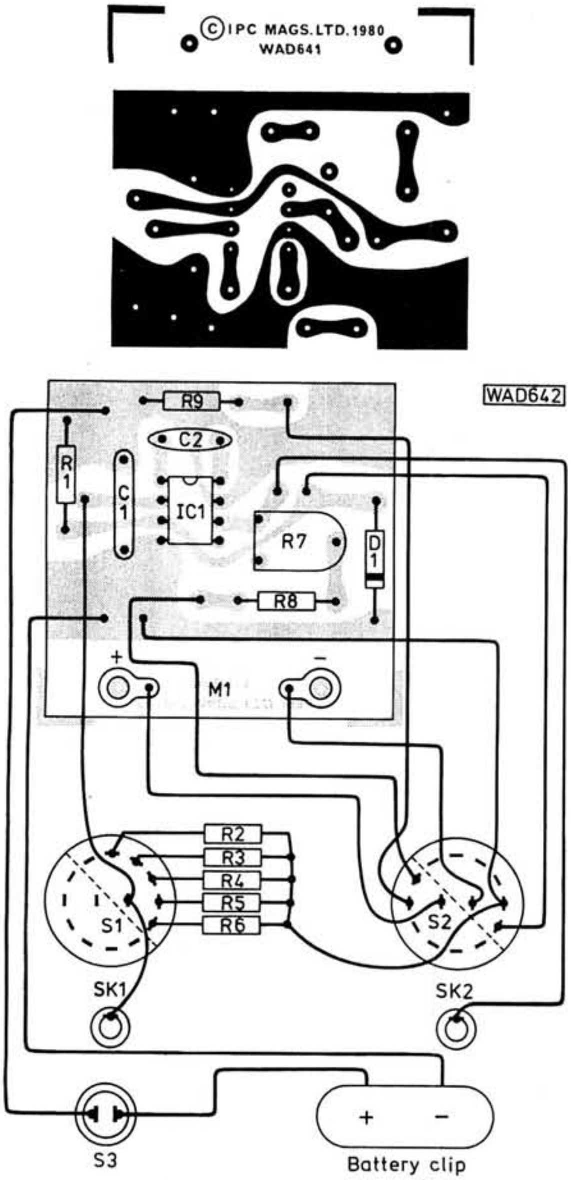
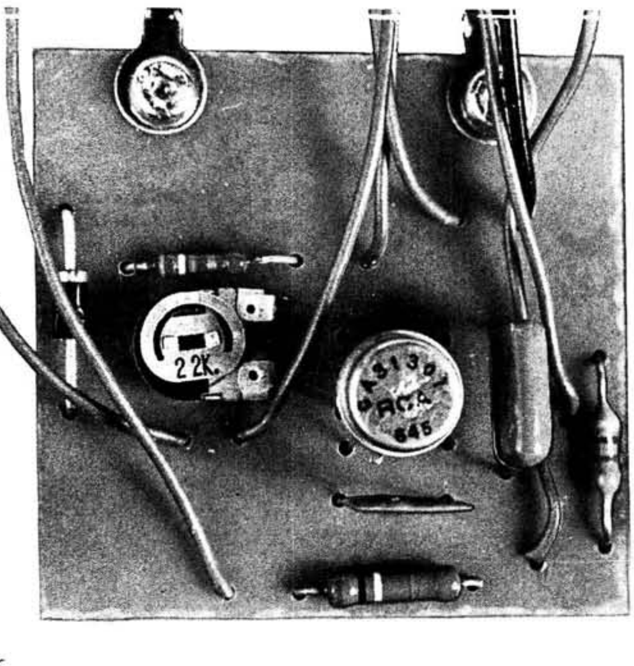
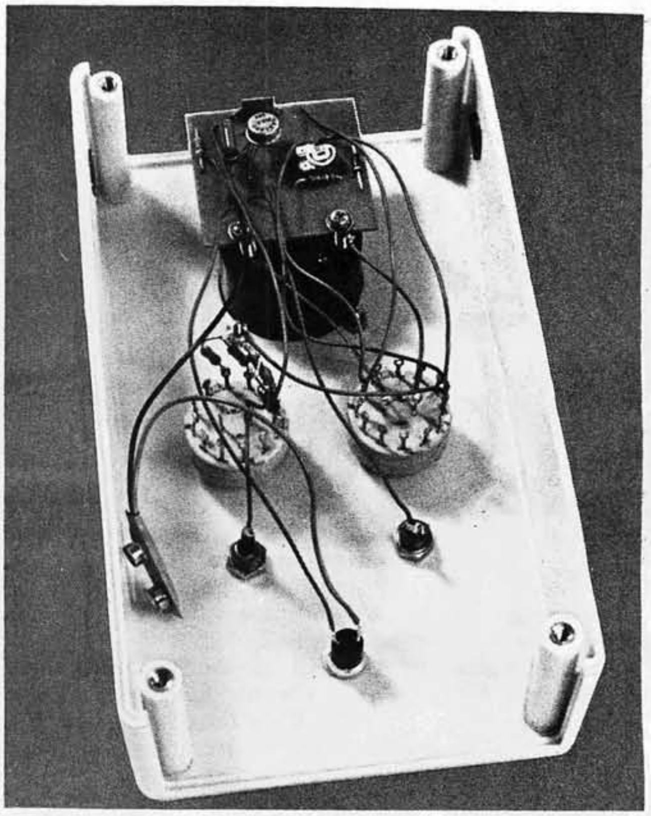


Fig. 3: The p.c.b. copper track pattern is shown full size at the top. The component placement is indicated, together with the other wiring above





0–10V voltmeter which can be used to check the loaded supply potential. The battery should be replaced when this falls much below 8V.

C1 is a supply decoupling capacitor and S2 is the on/off switch. A non-locking push-to-make type is used here as the supply should only be connected when a test resistor is connected into circuit and a measurement is actually to be made. This is because the meter will be driven beyond f.s.d. with no test resistor in circuit. The circuit has been designed so that a maximum meter overload of only about 50 per cent can occur, and while this is unlikely to damage the meter it is not advisable to risk this.

Current consumption is about 4mA, or so on all ranges except 1kΩ when it is approximately 9mA, and this can be supplied by a PP3 or other small 9 volt battery.

Construction

A 188 × 110 × 60mm plastic case is used to house the prototype, but the unit could be fitted into a much smaller case if desired. The general arrangement of the unit is not critical and any sensible layout can be used.

R2 and R6 are mounted direct onto S1 and the other small components are assembled on a small printed circuit. Once this board and the other wiring have been completed, the p.c.b. is mounted on the meter terminals. Details of the p.c.b. and wiring are illustrated in Fig. 3.

Calibration

In order to calibrate the unit a close tolerance resistor, 1 per cent or better, having a value equal to the f.s.d. value of one range of the unit is required. With this connected across the test clips, S1 switched to the appropriate range, and with R7 initially set for maximum resistance (fully clockwise), S3 is depressed and R7 is adjusted for precisely full scale deflection of S1. The resistance meter is then ready for use. ●

introducing RTTY part 3

Jeff MAYNARD G4EJA

We have already seen in Part One of this series that the simplest method of generating RTTY for transmission is with an AFSK unit. This can then produce AFSK or FSK by modulating the appropriate transmitter. Accordingly, it is not proposed to discuss any FSK circuits in detail. Various suggestions for producing AFSK are given below; however, before that is done it will be helpful to consider interface circuits again so that the AFSK units need only be designed for TTL-compatible input operation.

The most common terminal output arrangement is the two-way switch biased to mark as shown in Fig. 21. In a TTY system this could be arranged with −80V on the mark contact and +80V on the space so that the tongue switched between these two values. It is just as easy, however, to arrange for the tongue to be grounded and the mark and space contacts used to switch a flip-flop as shown in Fig. 22 (which also serves to debounce the input).

Conversion of 80V signals can be done simply by using a potential divider as shown in Fig. 23. A safer method is to isolate the 80V supply completely from the TTL circuitry by means of an opto-isolator as shown in Fig. 24.

Fig. 21: The most common terminal output arrangement, a switch biased in the marked condition

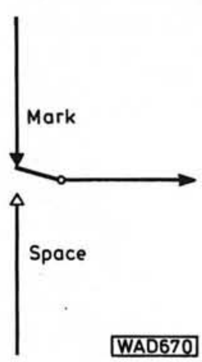


Fig. 22: An alternative form of terminal output, a flip-flop which also "de-bounces" the switch contact

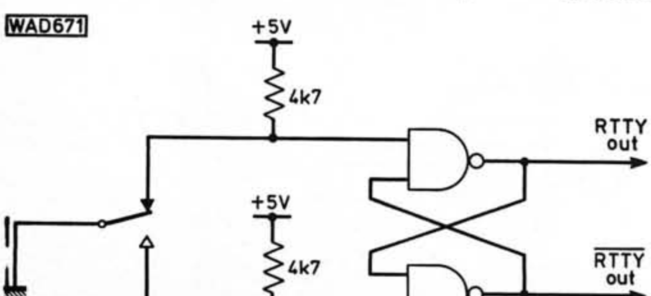
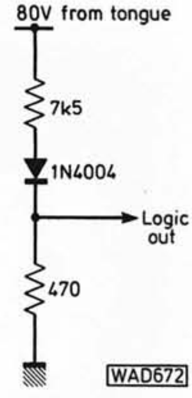


Fig. 23: The simplest method of converting 80 volt signals down to TTL levels, but not the safest. Consider, for instance, the result of the 470Ω resistor going open-circuit



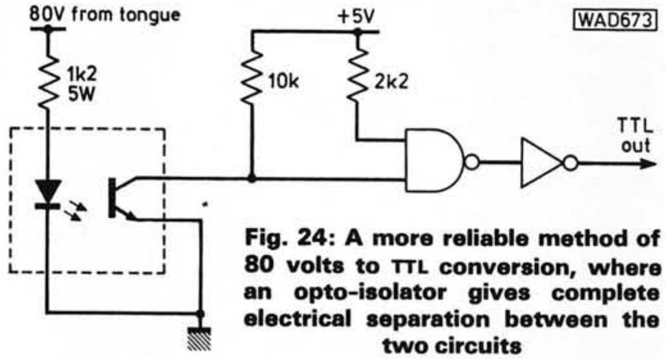


Fig. 24: A more reliable method of 80 volts to TTL conversion, where an opto-isolator gives complete electrical separation between the two circuits

In these methods only the +80V supply is needed and is connected to the space contact. An advantage of using 80V is that the terminal contacts are "wetted" at each changeover and are thus, as intended, kept free of oil and other contamination from the mechanical parts of the terminal. The opto-isolation method can of course be changed for other voltages, simply by altering the value of the resistor in series with the l.e.d.

Generating AFSK

Having developed a TTL-compatible signal as the output of the terminal (with 1 representing mark and 0 representing space), the next task is to produce an AFSK signal, with an output of 1445Hz for mark and 1275Hz for space. Four basic methods are available for the generation of AFSK signals: switching betwen two oscillators; switching the frequency-determining element of a single oscillator; variable division of a crystal-controlled oscillator and use of a special integrated circuit.

For the first method, almost any type of audio frequency oscillator can be used—f.e.t., multivibrator, 555 and so on. For example, two circuits based on Fig. 25 could be used with a suitable switching mechanism.

A reduced component count is one advantage of the second method—using a single oscillator with alternative frequency-determining components, rather than two distinct oscillators. Again, any number of different types of oscillator can be employed. *RTTY The Easy Way* uses a simple two-transistor multivibrator that the author used for many successful QSOs. This circuit is shown in Fig. 26. The pre-set potentiometers should be of the multi-turn variety. With a mark input, the 10kΩ pot is adjusted for 1445Hz output; then the 5kΩ pot is adjusted for 1275Hz output with a space input, the latter pot being switched in and out of circuit by the BC108 transistor.

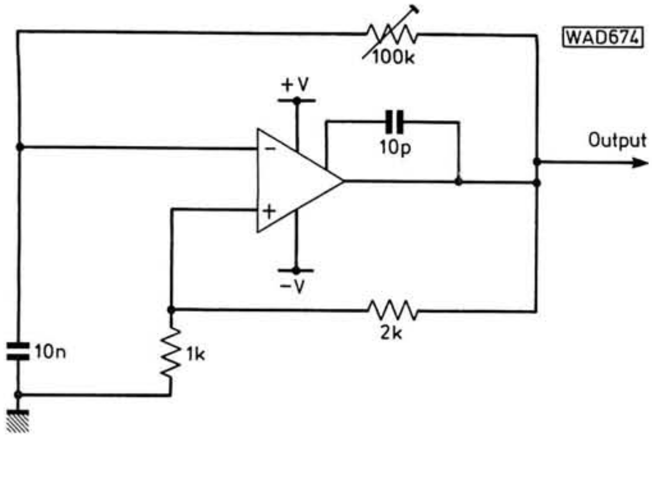


Fig. 25 ▲

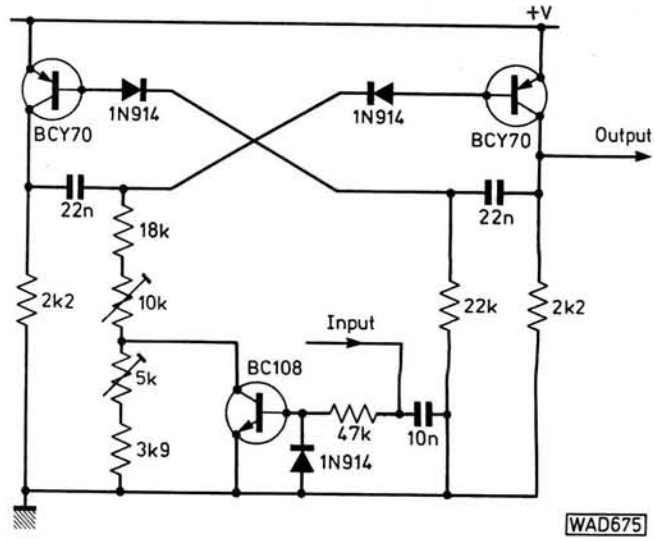
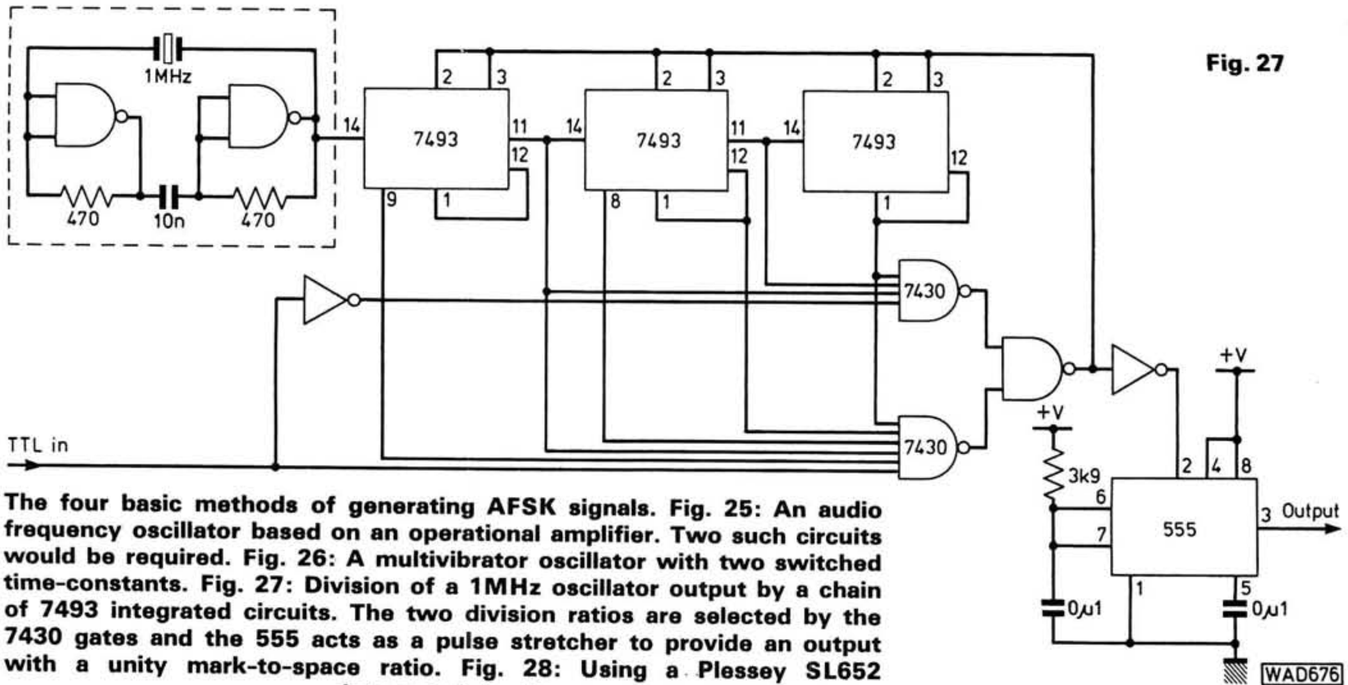


Fig. 26 ▶



The four basic methods of generating AFSK signals. Fig. 25: An audio frequency oscillator based on an operational amplifier. Two such circuits would be required. Fig. 26: A multivibrator oscillator with two switched time-constants. Fig. 27: Division of a 1MHz oscillator output by a chain of 7493 integrated circuits. The two division ratios are selected by the 7430 gates and the 555 acts as a pulse stretcher to provide an output with a unity mark-to-space ratio. Fig. 28: Using a Plessey SL652 integrated circuit

Generating AFSK tones by division of a crystal-controlled oscillator is a useful method, particularly if an accurate source of, say, 1MHz is already available from a counter, MPU or other test oscillator.

Division of 1MHz by 784 and 692 respectively will produce outputs of 1275Hz and 1445Hz, both within 1Hz of the desired frequency. This is easily done with 7493 dividers as shown in Fig. 27, which also shows an optional crystal-controlled oscillator. The 555 timer is used to lengthen the very short reset pulses from the gate, in order that the ouput waveform has an even mark-to-space ratio. Unused inputs of all the gates should be taken to the positive 5V rail via 2·2kΩ resistors. This circuit has the advantage that, given an accurate source of 1MHz pulses, the constructor can produce an AFSK unit that does not require any line-up procedure.

Several "custom" i.c.s can be used to produce AFSK with minimum external components. The author has experimented with the Plessey SL652, which may be used as a stable tone source as shown in Fig. 28. The 10kΩ preset

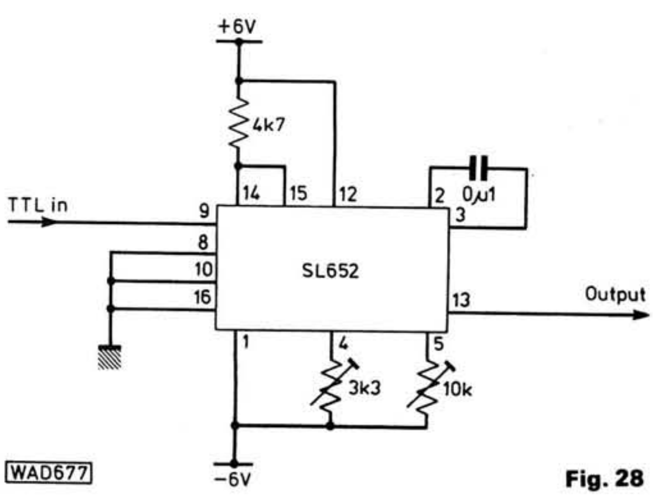


Fig. 28

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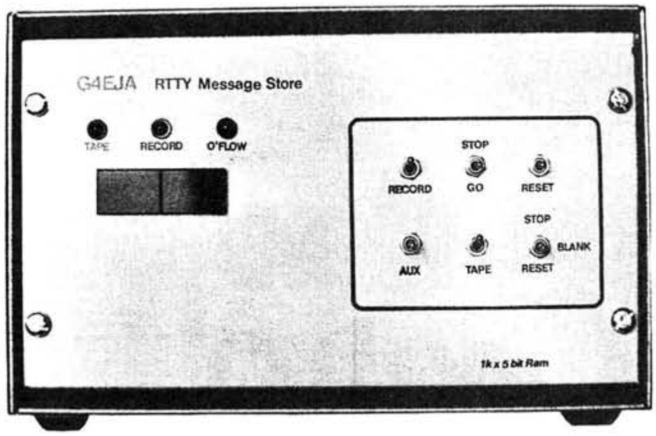
(which should be multi-turn) sets the mark frequency (pin 9 high), after which the 3·3kΩ preset (also multi-turn) is used to set the space frequency (pin 9 low). For a minimum-chip terminal unit for transmission and reception the reader is referred to *Radio Communication Handbook* by Plessey Semiconductors, which suggests a method by which a single SL652 may be used for both functions. If experimenting with the SL652, great care must be taken not to exceed 6 volts on either power rail. Op. amps., for an active filter say, can be run from ±6V in conjunction with an SL652.

Each of the AFSK circuits described above produces a squarewave output. This should not be fed directly to a transmitter but should first be passed through a low-pass filter. A simple CR network such as shown in Fig. 29 will suffice, although the user may care to add an active band-pass filter based on a 741 if desired.

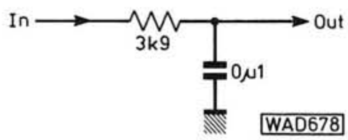


The control panel of the author's 1K RTTY message store

Storing Messages

Using a combination of circuits discussed so far, the licensed amateur can very easily join the ranks of active RTTY enthusiasts, assuming of course he has some form of terminal. However, with the exception of microprocessor owners (dealt with in a later article), it will soon become evident that some additional equipment is highly desirable. This is because of the difficulty of sending repetitive messages from a keyboard—particularly for the one-finger typist. The most obvious message that needs to be sent repeatedly is CQ, although even this has variants (CQ DX, CQ CONTEST, etc.). Other messages can include test patterns, one's own callsign (particularly when beset by QRM) and RTTY pictures.

Fig. 29: A simple CR low-pass filter to limit the AFSK generator output spectrum



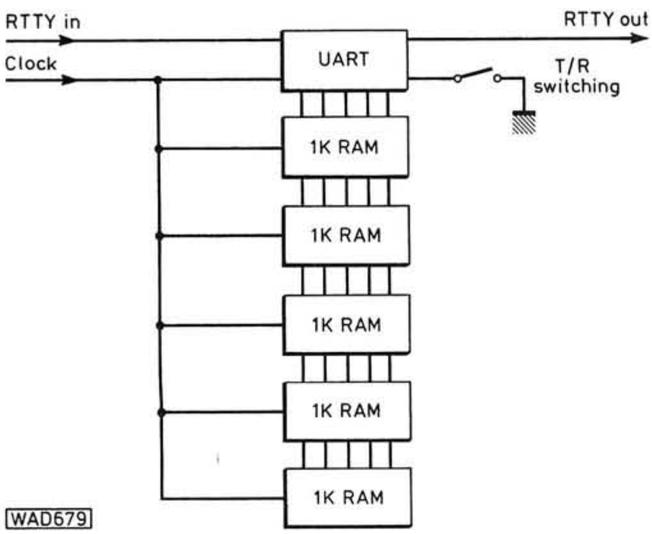


Fig. 30: Basic block diagram of a 1K RTTY store

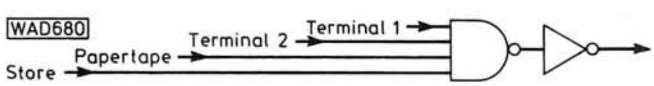


Fig. 31: Combining several message-originating devices onto a single TTL bus

Incidentally the two most common test patterns are the "fox" message (the quick brown fox jumped over the lazy dog in the stable), because it includes every letter of the alphabet, and a string of RYs because this is the resulting output when keying alternate mark/space.

Traditionally the source of such standard messages has been paper tape. Many of the older TTY terminals include a paper-tape reader and punch, and stand-alone units are still readily available if rather cumbersome. Messages on tape can be made into continuous loops and sent as required. For example, a tape might contain:

CQ CQ CQ CQ DE G4EJA G4EJA

followed by a carriage return and line feed. This can be formed into a loop and sent about ten times as a means of initially establishing a contact.

A favourite tape-loop subject is a description of one's particular station, which would normally be sent during each QSO. Many terminals have an auxiliary contact that is made or closed when figure J (or bell) code is received. This can be used to stop the paper tape reader when, for example, some variable information has to be inserted into the transmission (such as a contest report and number).

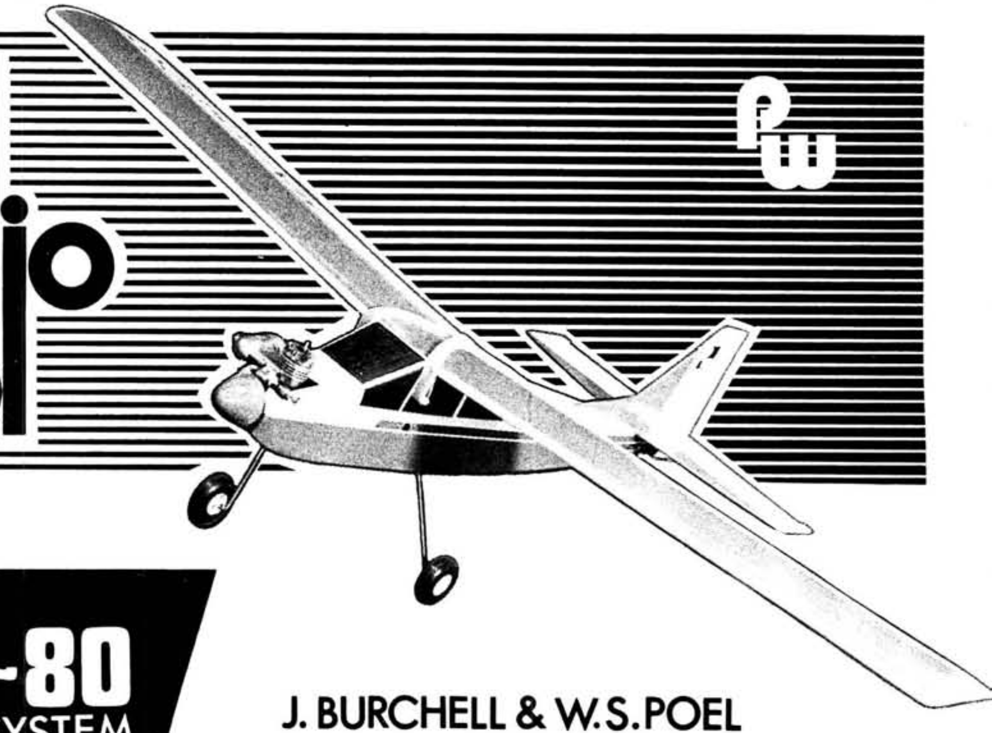
Two electronic alternatives to paper tape are available (excluding microprocessors). These are the diode matrix and RAM (Random Access Memory). The former is not really a good idea for anyone starting from scratch because it is cumbersome to set up, difficult to change, and no cheaper now than using some form of semiconductor storage.

An RTTY message can be started in RAM such as the 2102. If five 1K chips are used then 1K RTTY characters can be stored. A UART (Universal Asynchronous Receiver Transmitter) is used to convert from serial RTTY to the parallel mode needed to load the RAM. A block diagram of such a system is shown in Fig. 30, where the necessary clock—at 16 times the baud rate—can be derived by further division if a crystal-controlled AFSK generator is used. A detailed circuit description is beyond the scope of this article; interested readers are referred to a design by G3PLX in the *BARTG Newsletter,* December 1977.

Remembering that any RTTY device is in the mark condition when idle, it is easy to see how a number of message-originating devices can be paralleled onto a single TTL bus (Fig. 31).

Part 4, next month, deals with some proprietary terminal units, providing a method of getting into RTTY with minimum delay.

Model Radio Control



Part 8

THE PW FM-80 SYSTEM

J. BURCHELL & W.S.POEL

Most radio modellers rely on very simple equipment for setting up and checking the performance of their radio gear. This unit is a sophisticated test system which provides all the facilities for alignment and checking of almost any modern digital radio control system, and while it is sophisticated it is also relatively easy to put together, thanks to the availability of pre-aligned modules.

The absorption wavemeter is rather novel and is in reality a very simple spectrum analyser enabling the wanted 27MHz output to be peaked while keeping an eye on the unwanted crystal fundamental frequency and the dreaded 54MHz harmonics.

Circuit

The circuit diagram of the wavemeter is shown in Fig. 1 and, as can be seen, is simply three parallel tuned circuits connected in series. The output of each parallel tuned circuit is taken to an individual 0–200μa meter, which provides an indication of the r.f. signal level at that particular frequency.

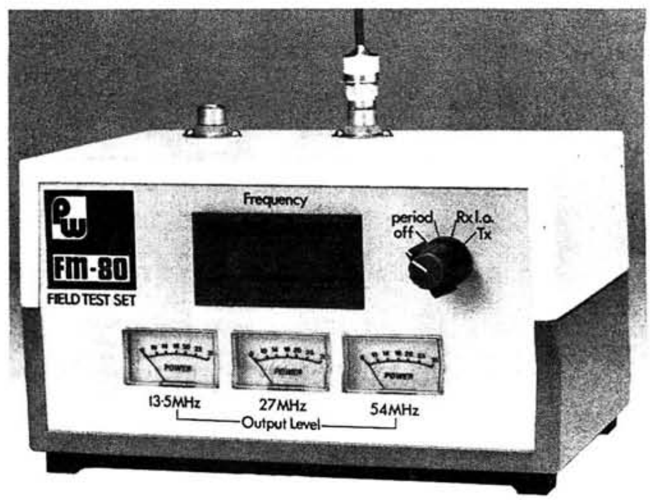
Several other circuit configurations were tried, including some in which the 13·5MHz and 54MHz components were subtracted from the 27MHz component and displayed on a single meter. This meter then showed a representation of the overall "goodness" of the transmission.

However, it was found that having simultaneous display of all three components made it a great deal easier to tune up the transmitter for the best output, and imparted somewhat more of an intuitive feel to the user as to how to tweak the coils for the optimum signal out. In fact, it is a "poor man's" spectrum analyser and the design could be extrapolated to cover as many frequencies as the user desired.

The digital frequency meter (d.f.m.) is based around a commercially available l.c.d. readout unit which is in two parts. A front panel unit consists of the l.c.d. readout, the timebase crystal and an Oki i.c. Type MSM 5527 which contains all of the display and measuring electronics for a d.f.m. with a basic range of 3999·9kHz.

A prescaler board, which offers ÷ 10 and ÷ 100 facilities, thus extending the range of the basic unit to 399·9MHz, plugs onto the front panel. The prescaler board also contains a matrix board on which diodes may be placed to select the various options and i.f. offset values of the front panel unit.

The unit used in the FM-80 Field Test Set was programmed to read Frequency directly with the prescaler selected to ÷ 10, thus giving a resolution of 1kHz to 39·999MHz and is used in this mode to check both the Tx and Rx frequency. The Rx frequency should, of course, be 455kHz below the Tx frequency. One of the programming options available on the unit allows the subtraction of 455Hz from the input frequency whilst in the short-wave mode. This facility can be used to enable a reading of what the Rx Local Oscillator frequency should be whilst actually measuring the Transmitted Frequency.



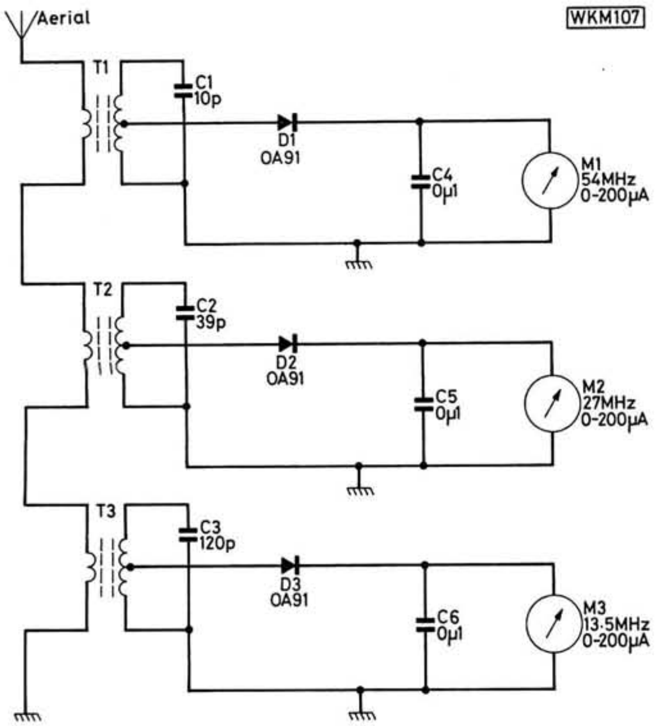


Fig. 1: The circuit diagram of the three frequency wavemeter

Period Measurement

One of the modes available on the front panel unit is event count. In this mode, transitions on the input are counted and displayed on the l.c.d. until the rest line is pulsed, when the display is set to zero. Due to the fact that within the MSM5527 all pulses being applied to the display counter are divided by eight, it actually takes eight transitions on the input to increase the display reading by one.

Fig. 2 shows a block diagram of the period measuring add-on unit. The rising edge of the incoming pulse is used to reset the counter to zero, the rest of the pulse being delayed whilst this is happening. The delayed pulse is then applied to the gated oscillator and is used to turn it on for a period of time equal to itself. The gated oscillator thus presents a series of pulses, for as long as the input signal is high, to the front panel module, which are counted and displayed. Nothing further happens until the next pulse arrives, when the whole process repeats itself. If the oscillator is set to a frequency of 800Hz the display will count to 100 in 1ms giving adequate resolution for our purposes.

The unit is capable of displaying the period of any single input pulse providing the count from the gated oscillator does not exceed 39999. If, however, the input is a pulse train then the mark to space ratio should not be less than about 5:1 as the display is not blanked during the actual measuring time of the input pulse and must therefore be allowed to remain stationary for most of its time in order to be read properly by the user.

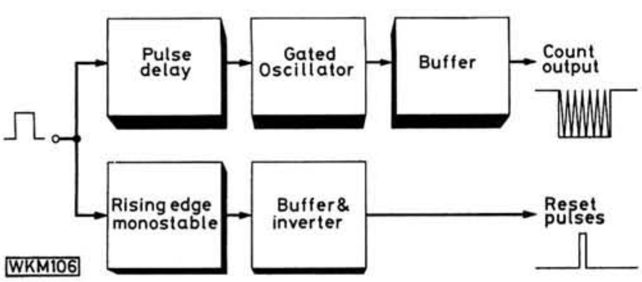
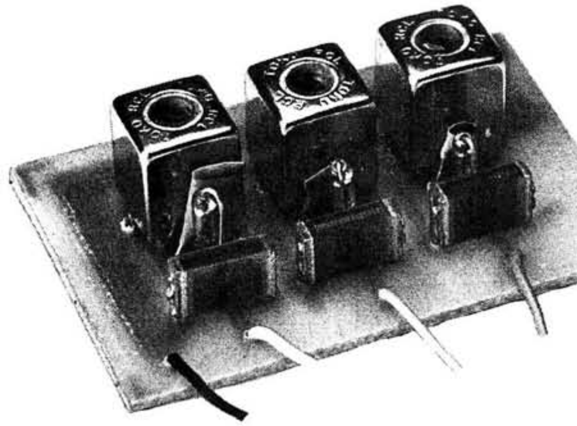


Fig. 2: Block diagram of the add-on period measuring unit

The original unit gave an unambiguous display for input signals up to 8ms at a repetition rate of 70Hz which means that it is more than capable of measuring the typical servo output pulse train.

The circuit diagram of the period measuring add-on is shown in Fig. 3, and is constructed from a single CD4093 with the barest minimum of external components. The rising edge detector is formed from C1, R1, IC1a. This is then buffered, inverted and applied to the reset input of the MSM5527. While this is going on the pulse is delayed by R2, C2 and then applied to the gate of the oscillator formed from IC1c, C3, VR1. The output is then buffered and applied to the input of the MSM5527. IC1 must be a schmitt device in order to enable the oscillator circuit to function and provide good recovery of the pulse after it has been delayed by C2, R2.



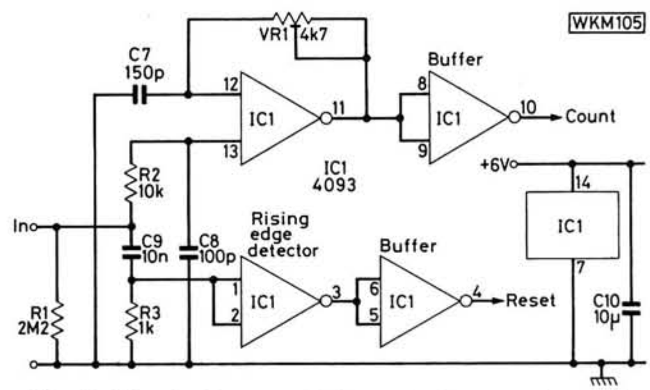


Fig. 3: Circuit diagram of the period measuring unit

Construction and Testing

Although, providing good r.f. practice is followed, it is possible to build the wavemeter on plain matrix board, it is strongly recommended that the printed circuit board is used, as the exact layout, and hence the stray capacitance, will affect the values of the parallel tuning capacitors particularly at 54MHz. The only way to set the wavemeter up is with the aid of a signal generator capable of being tuned to 13·5MHz, 27MHz and 54MHz—you can of course use the digital frequency readout to check it—then rotate the cores of T1, T2 and T3 to give maximum deflection on the relevant meter. It should be found that the ranges do not interfere with each other.

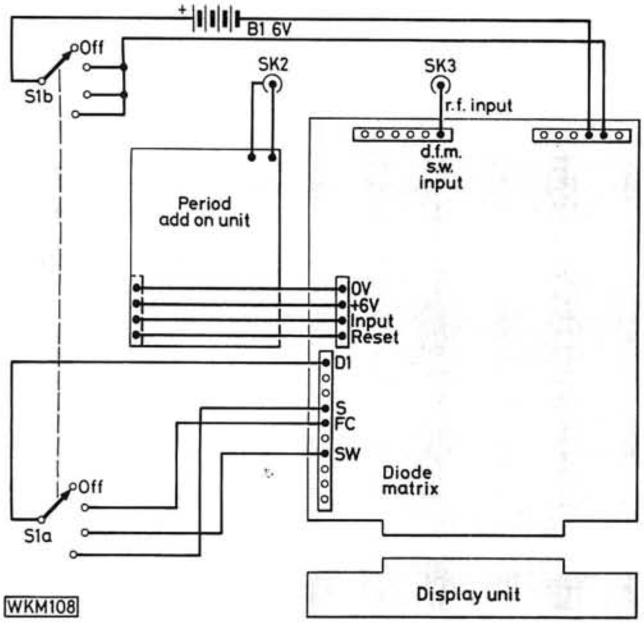
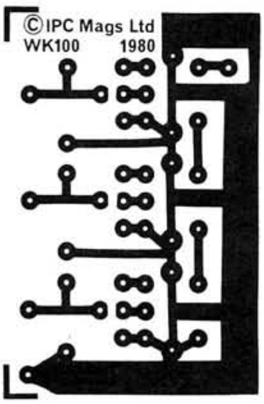


Fig. 4: Connections of the d.f.m. board and display showing the switching arrangements and power supply connections used in the prototype unit. Other arrangements are possible to allow the d.f.m. to be used for other purposes and these are detailed in the comprehensive instruction booklet supplied with the d.f.m. module



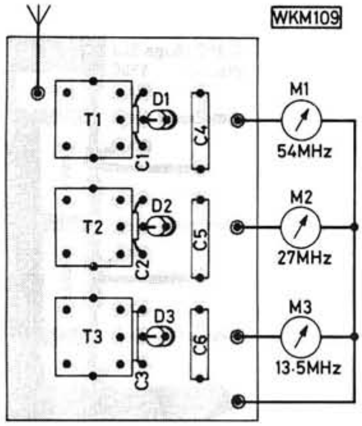
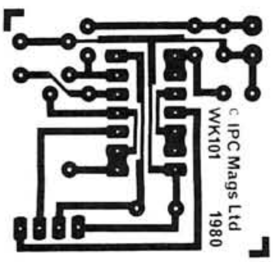


Fig. 5: The copper track pattern of the wavemeter p.c.b. shown here full size. Fig. 6 (above right): The component placement drawing of the wavemeter p.c.b. Ambit International will be able to supply ready built and aligned boards for those constructors without the necessary gear



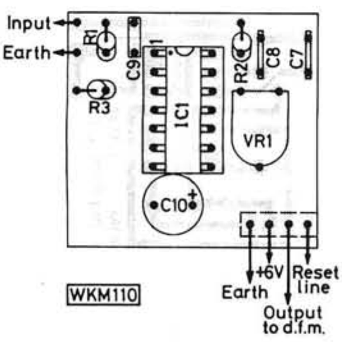
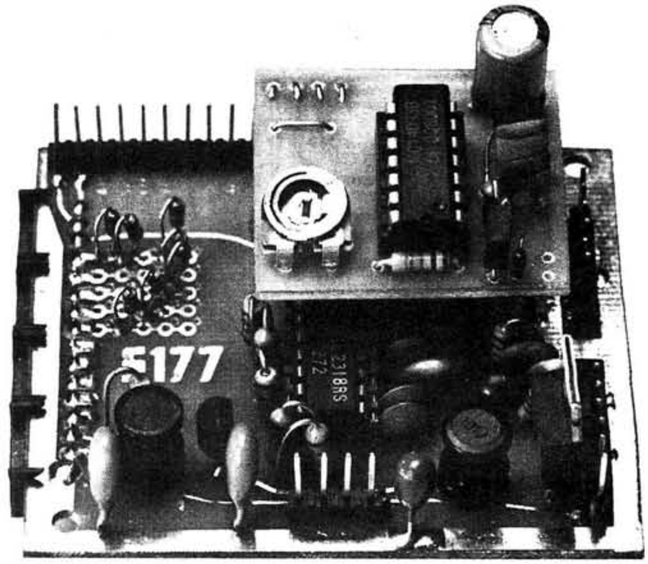


Fig. 7: The copper track pattern of the add-on period measuring unit shown here full size. Fig. 8 (above right): The component placement drawing for the add-on unit. This board plugs directly onto the main d.f.m. board as shown in Fig. 4



The main d.f.m. board with the add-on unit in position. Note that some extra support for the add-on board will be needed and could be provided by the use of "Sticky Fixers"

Period Measuring Add-on Unit

This is designed to be built on a small p.c.b. which then connects to a purpose-designed connector on the prescaler module. To test its operation connect the period measuring board to a +6V supply and connect the input to a logic high (+6V) for the time being. The gated oscillator will now be turned permanently on and it should be possible to measure its frequency at the output of IC1d. Using VR1, adjust to between 810–815kHz (N.B.—it is set somewhat high compared to its theoretical value due to some pulse shortening which occurs in the pulse delay network). You can use the digital frequency unit in its frequency mode to do this. Now connect up a suitable signal source (1–2ms pulses every 20ms from the Tx encoder output) and check that everything works. The display should be stable and for 1·5ms pulses will show 15·0, e.g., the display must be divided by ten to obtain the reading in milliseconds.

If all is not well, check for the presence of bursts of 800kHz on the count line and for reset pulses on the reset line. Also check that the right value components have been used.

Digital Frequency Meter

There is, of course, no construction or testing to be carried out here and all that one must do is decide which programming options are desired and install the relevant diodes. The unit comes with a four-page booklet which fully describes its working and method of connection. As stated earlier, the unit used in the prototype was programmed into the frequency count mode with the prescaler selected to ÷ 10 giving a display range of 3999·9kHz × 10 and to read short-wave minus 455kHz, allowing one to see what the Rx local oscillator frequency should be whilst measuring the transmitter frequency. The unit was also programmed into the event count mode for use with the period measuring add-on. Fig. 4 shows the switching employed in the prototype.

It is, of course, possible to use the unit as a general piece of testgear in which case suitable switching of the input source and prescaler will have to be arranged by the constructor.

WAVEMETER

Capacitors		
Ceramic		
10pF	1	C1
30pF	1	C2
120pF	1	C3
Polyester		
0·1µF	3	C4,5,6
Semiconductors		
Diodes		
OA91	3	D1,2,3
Inductors		
KXNK3335 (Toko)	3	T1,2,3

Miscellaneous
200µA f.s.d. meters (3); p.c.b.; sockets for aerial and leads (3).

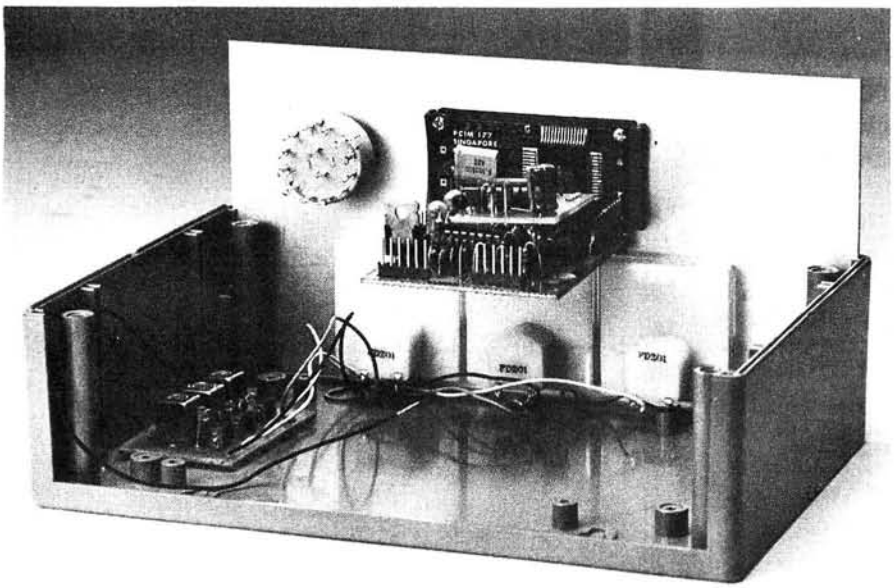
The following items are only available as ready made modules:
Display unit MSM5527 (Ambit)
Prescaler board (Ambit)

The wavemeter board is available ready built and pre-aligned from Ambit International at a special price of £5.50 complete with 3 meters.

PERIOD MEASURING ADD-ON UNIT

Resistors		
¼W 10%		
1kΩ	1	R3
10kΩ	1	R2
2·2MΩ	1	R1
Potentiometers		
Min. Horizontal present		
4·7kΩ	1	VR1
Capacitors		
Ceramic		
100pF	1	C8
150pF	1	C7
10nF	1	C9
Electrolytic p.c.b. type		
10µF 16V	1	C10
Semiconductors		
Integrated Circuits		
4093	1	IC1

Miscellaneous
14-pin d.i.l. socket (1); p.c.b.; Midget Wafer Switch 3p4w (1); 6V battery and connector; Knob (1); suitable case (see text); Bezel.



Internal view of the test set before final wiring. Note that the d.f.m. main p.c.b. has yet to have its extra support pillar fitted. This will be fitted between the bottom of the Verobox and the hole drilled in the rear corner of the p.c.b. and will consist of a suitable length pillar

The prototype was built into a large Verobox as this was the only case to hand with a large enough front panel to accept the three meters and the d.f.m. Any suitable box can be used, and either the wavemeter or the d.f.m. could be built into a smaller box on its own.

The d.f.m. display unit is mounted onto the bezel using the four screws and two plastic clamps supplied with the bezel. The four outer screws holding the display p.c.b. to the plastic front of the display must be carefully removed and the four holes in the p.c.b. carefully enlarged and continued right through the plastic panel to clear the bezel screws. Extra support is needed for the added board and the main p.c.b. to prevent strain.

The wavemeter aerial is a suitable length of thick copper wire soldered into a standard TV type of plug. The length is not particularly critical.

Three TV coaxial sockets are mounted on the top of the case and one is used for the wavemeter aerial while the other two are the inputs for the period counter and the digital frequency meter.

Power is supplied to the d.f.m. from a PP7 6V dry battery but a 9V battery could also be used by feeding the 9V into the appropriate pin on the d.f.m. board. Rechargeable NiCad cells could also be used and there is plenty of room in the box to accommodate the battery charger and servo tester described earlier in the series.

2 metre mobile multi-mode transceivers

	FDK Multi-750E	**ICOM IC-260E**
Synthesiser steps	100Hz, 5kHz	100Hz, 1kHz (c.w./s.s.b.) 1kHz, 5kHz (f.m.)
Frequency stability	<500Hz (1–30min, <200Hz (1hr)	<±1·5kHz
Frequency read-out	5-digit green fluorescent	7-digit red l.e.d.
Reverse repeater mode	No	Yes
Memories	None	3 channels
Non-standard offsets	Yes (2 v.f.o.s)	Yes (2 gangable v.f.o.s)
Supply requirements(2)	Transmit: 3A/2A(3) Receive: 0·4A/0·8A(4) Memory back-up 1·5mA	Transmit: 3·1A/1·6A(3) 2·2A s.s.b. Receive: 0·6A/0·8A(4) Memory back-up: ■
Case size (H × W × D)	73 × 163 × 260mm	64 × 185 × 223mm
Weight	2·6kg (approx.)	2·7kg
TRANSMITTER		
Power output(3)	10W/1W	10W/1W
Spurious emissions	Below −60dB	Below −60dB
Microphone	500–600Ω dynamic	1·3kΩ dynamic(6)
Repeater access tone	Auto burst	Auto burst
Satellite frequency unlock	No	No
RECEIVER		
Intermediate frequencies	10·7MHz and 455kHz (c.w./s.s.b) 10·7MHz (f.m.)	10·75MHz and 455kHz (c.w./s.s.b.) 10·75MHz (f.m.)
Sensitivity: c.w./s.s.b. f.m.	0·4μV for 10dB S/N 0·6μV for 20dB quieting	0·5μV for 10dB S+N/N 0·6μV for 20dB quieting
Selectivity(7)**:** c.w./s.s.b. f.m.	2·2kHz/6kHz 15kHz/25kHz(8)	2·4kHz/4·8kHz 15kHz/30kHz
Spurious response rejection	>60dB	>60dB
RF Gain control	Yes	No
AGC Fast/Normal switch	No	Yes
Audio output into 8Ω	>1·2W at 10% t.h.d.	>2W
Programmable band scan	No	Yes
Scan for vacant or busy channel	No	No
Priority channel monitor	No	No
PRICE **Including standard accessories and VAT**	£299 **Waters and Stanton Electronics Ltd.**	£339 **Thanet Electronics Ltd.**

2 metre mobile multi-mode transceivers

Trio TR-9000	Yaesu FT-480R (FT-280)
100Hz, 10kHz(1) (c.w./s.s.b.) 100Hz, 12·5kHz, 25kHz (f.m.)	10Hz, 100Hz, 1kHz (c.w./s.s.b.) 1kHz, 25kHz, 100kHz (f.m.)
<±500Hz (1–60min) <50Hz any 30min thereafter	■
5-digit red l.e.d.	7-digit blue fluorescent
No	No(9)
5 channels	4 channels
Yes (Memory channel 5)	Yes (2 v.f.o.s)
Transmit: 2·9A/1·3A(3) Receive: 0·4A Memory back-up: 2·5mA	Transmit: 3A Receive: 0·5A Memory back-up: ■
68 × 170 × 234mm	60 × 180 × 240mm
2·5kg	2·6kg
10W/1W(5)	10W/W
Below −60dB/−46dB(3)	Below −60dB
500Ω dynamic	600Ω dynamic
Auto burst	Manual from front panel or microphone(9)
No	Yes
10·695MHz and 455kHz (c.w./s.s.b.) 10·695MHz (f.m.)	■ ■
0·2µV for 10dB S/N 0·2µV for 10dB S/N	0·5µV for 20dB S/N 0·5µV for 20dB S/N
2·2kHz/4·8kHz 12kHz/25kHz	2·4kHz/4·1kHz 14kHz/25kHz
>70dB	>60dB
Yes	No
No	No
>2W at 10% t.h.d.	2W at 10% t.h.d.
Yes(10)	No
No	Yes(9)
No	Yes
£365	£359
Lowe Electronics Ltd.	**South Midlands Communications Ltd. (FT-280 from Amateur Radio Exchange)**

Notes:

1. In "Decade Scan" mode.
2. All rigs run on 13·8V d.c. nominal (negative ground).
3. The first figure is for full power, the second for low power.
4. The first figure is on standby (receiver squelched), the second for full audio output.
5. Low power not available on s.s.b.
6. Built-in pre-amplifier.
7. The first figure is the minimum −6dB bandwidth, the second the maximum −60dB bandwidth.
8. Maximum −70dB bandwidth.
9. The FT-280 is imported direct from Japan by Amateur Radio Exchange, and modified by them to suit the European market. It differs from the FT-480R only in that: (a) It has auto toneburst. (b) It has reverse repeater facility from front panel and microphone controls. (c) It does not have the "Vacant/Busy" scan mode selection switch.
   We understand that stocks of the FT-280 are very limited.
10. Any kilohertz decade can be scanned on c.w./s.s.b.

Common Features

All the rigs listed are based on digital p.l.l. v.c.o. synthesisers, and cover the range 144·0000–145·9999MHz, recycling at the band edges. Emissions available are: A1 (c.w.), A3J (u.s.b. and l.s.b.), and F3 (f.m.). Maximum deviation of F3 is ±5kHz. Aerial impedance is 50Ω in all cases. On A3J, suppression of the carrier and unwanted sideband is greater than 40dB, and all rigs are provided with impulsive noise blankers and r.i.t. controls.

Each transceiver can retain the frequencies set on the dial and memories, so long as 13·8V d.c. remains available. None incorporates a separate back-up battery, though, so all programmed frequencies are lost when shifting from house to car, etc.

▶▶▶

▶▶▶

2 metre mobile multi-mode transceivers

All the data given is extracted from the instruction manual specification tables, presented in a way to allow sensible comparison, so far as practical. A black square (■) denotes that no information appears in the manual.

The memory systems, etc., in all sets but the FDK, are somewhat complex in the facilities they provide, more so than we have space to deal with here, and we have simply tried to summarise the salient features.

First Impressions

FDK Multi-750E

The FDK Multi-750E is a somewhat more basic rig than the others listed in this survey; it has no memory facilities, for example, but this is well reflected in the price. It is very easy to drive.

The transmitter audio quality was reported by distant stations to be marginally less good than that from the other sets. The frequency read-out is big and bright, but the little "14" indicating the tens of megahertz seems an unnecessary embellishment, looking almost like a channel number. The "MHz" shift button provides a quick and easy way of hopping between the f.m. and sideband sections of the band. The push-buttons, by the way, are a most unusual shape, and handle very well. The "High/Low" power switch is on the rear panel, which has the effect of encouraging you to use full power all the time. The instruction manual is very basic.

One feature of interest to 70cm devotees is the ability to transvert or even work cross-band with an optional 430-440MHz transverter unit which will be available shortly.

ICOM IC–260E

The ICOM IC-260E is a very versatile rig, having two independent v.f.o.s which can be ganged together if required, tracking across the band at a given separation for non-standard frequency offsets. The tuning control has a decidedly "gritty" feeling and has a very low rate. In fact, a little clip-on handle is supplied which can be fitted to speed things up. An optional microphone with scanning and frequency step controls makes a useful substitute to the main tuning knob.

Scanning of a limited portion of the band is possible, by programming the two band limits into memory positions 2 and 3, and the IC-260E is unusual in that it will auto-stop on a station on all modes, rather than just f.m. as all the other sets do.

All controls are on the front panel, and the frequency read-out is large and reasonably bright for daylight use. The mobile mounting bracket is of the quick-release type, with catches on each side.

The instruction manual is very comprehensive, with a detailed operational guide, trouble-shooting and voltage charts, block diagram, circuit diagram and printed circuit board layouts.

Trio TR-9000

The most unusual feature of the Trio TR-9000 is its decade scan, which allows any selected 10kHz segment of the band to be scanned rapidly in 100Hz steps when operating on c.w. or s.s.b. The same control allows the band to be scanned rapidly in 25 or 12·5kHz steps when on f.m. On c.w./s.s.b. you can hear the station(s) being swept through, but punching the button at the right moment to stop the scan actually on the station is rather akin to trying to hit the target in those video shooting gallery games.

All the controls are on the front panel, and easy to operate (apart from the above).

The frequency read-out is nowhere near bright enough, and on a bright sunny day in the car it just about completely disappears.

The receiver audio output has got plenty of punch, and of all the sets tested, is most easily heard above the usual mobile background.

The instruction manual is in the usual Trio format, with lots of information, but somewhat disjointed and therefore hard to follow in places.

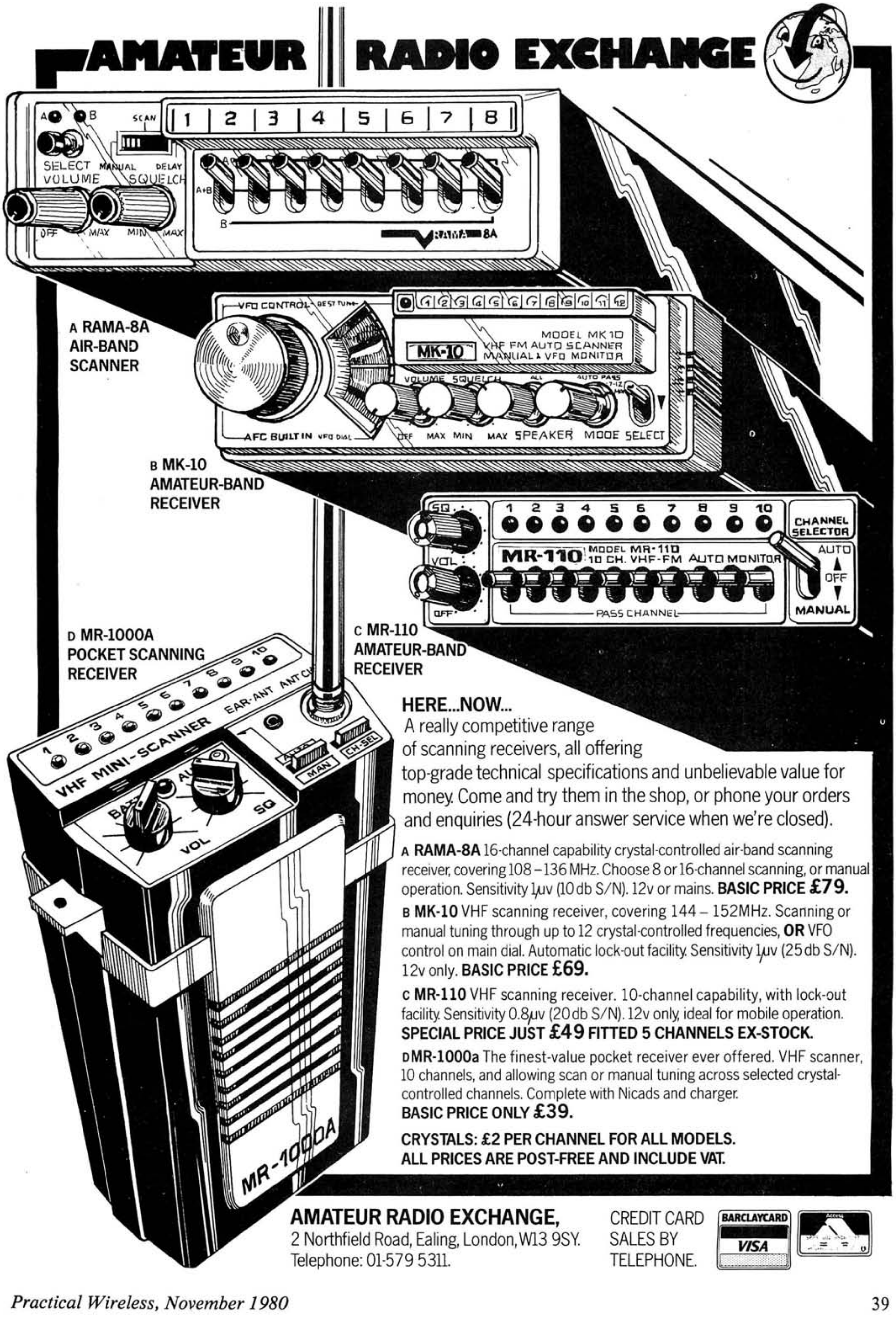
Yaesu FT-480R/FT280

The Yaesu FT-480R (and its half-brother the FT-280—see Note 9) are the very latest arrivals in multi-modes, and incorporate a couple of novel features. The frequency read-out is a small and very bright fluorescent display, no problems on bright sunny days here. If anything, Yaesu have gone to the other extreme, and should perhaps incorporate a dimmer for night-time use, since the display has a tendency to "halo" in dull surroundings. The l.e.d. power/"S" meter is bright and easily readable, though it has a disconcertingly long decay time. The r.i.t. is digital, and the shift is added into the receive frequency read-out. Control is by means of the main tuning knob. For some reason, Yaesu call this facility a clarifier, which does not accord with the normal use of the term. The memory selector and frequency step controls are concentric and are fitted with rather unsuitable knobs, so that we found we tended to turn the wrong one nearly every time in our tests. A very thoughtful feature is the "F-SET" button, which zeroes the frequency in on the selected step when changing from, say, 100Hz to 25kHz, without having to wind off all the redundant digits manually.

Both the '280 and the '480 which we had on test had a very occasional tendency to switch suddenly to 144·900MHz when you tried to QSY off a calling channel. It was generally necessary to switch the set off to restore normal operation, which could be somewhat inconvenient.

The front panel on this rig is small, not much bigger than the average f.m.-only mobile. This has been achieved at the cost of a bulge underneath, to house the loudspeaker, and more significantly three switches under the front lip (two in the FT-280). These are the "Satellite" switch, which allows the transmitter frequency to be changed whilst actually transmitting, the "Busy/Manual/Open" scan control switch, and the "Simplex/+/–" mode switch. It is annoying, to say the least, to have to peer under the rig to operate the last two, although I suppose you would eventually get used to them.

The instruction manuals were provisional and very sketchy. No doubt the final ones will be to the usual Yaesu standard.


AMATEUR RADIO EXCHANGE
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B MK-10 AMATEUR-BAND RECEIVER
C MR-110 AMATEUR-BAND RECEIVER
D MR-1000A POCKET SCANNING RECEIVER
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'SLIM JIM' for 28MHz

FRED JUDD G2BCX

Since the publication of my article on the "Slim Jim" omni-directional aerial for 2 metres, many readers have written about its possible use for the 28MHz (10 metre) band. Indeed, quite a number have already tried it for themselves by scaling up the dimensions, and have discovered that excellent results are possible.

It is appreciated that a version for 10 metres cannot be constructed to exactly the same format as that for 2 metres. The general configuration is the same, however, and a suggested design is shown in Fig. 1. For the benefit of new readers, and as a reminder to others, Fig. 1(a) shows the electrical behaviour of the aerial. It consists simply of a half-wave folded radiator, fed at one end from a quarter-wave stub which is used to obtain an impedance transfer from 50 or 70 ohm coaxial cable to the high impedance connection to the half-wave section of the aerial. Fig. 1(b) gives the required dimensions of the elements, which may be of heavy gauge copper wire (14 or 16 s.w.g. or multi-strand copper "aerial" wire). Tinned or enamelled wire would be preferable.

The main support could be a bamboo pole which is quite light in weight and strong, although finding a single pole this long is not easy. It might be possible to acquire a couple of the 15ft canes used to roll carpets on and join them end-to-end. Whatever method is used to join them (wooden dowel glued down the centres, or plastics water pipe used as a sleeve, are two suggestions), it will then be necessary to stay the pole at top and centre. The stays (three at each level, spaced at approximately 120° intervals) should be either of non-conducting rope, or of wire rope broken up with "egg" insulators. The lengths of the stay sections should be around one third of a wavelength (3·3m) and preferably not all exactly the same length.

An alternative way of erecting the aerial, if you have a couple of support points at around 10m above ground level, would be to suspend the "Slim Jim" from a stay run between them.

Small wood spreaders fitted with miniature stand-off insulators are used to support the wire elements. The feed cable can be 50 or 70 ohms impedance, and the correct tapping points to the stub section, about 300mm up from the bottom, are found by temporarily connecting the cable with crocodile clips, and moving them up and down until minimum v.s.w.r. is obtained. This should be less than 1·5 to 1. This adjustment can be made with the bottom of the aerial a metre or so off the ground, but standing vertically of course.

In a situation where there are a lot of buildings around, the operational height should be such that the bottom of the aerial is 3 to 5 metres above ground. The theoretical optimum vertical angle of radiation of about 15° to 20°, as in Fig. 1, is obtained when the centre point of the radiating section is about $\lambda/2$ above ground, but this applies only where the soil beneath has good conductivity and the aerial is situated in very clear surroundings. It would be worthwhile to experiment with height. Radiation is of course vertically polarised and omni-directional, but

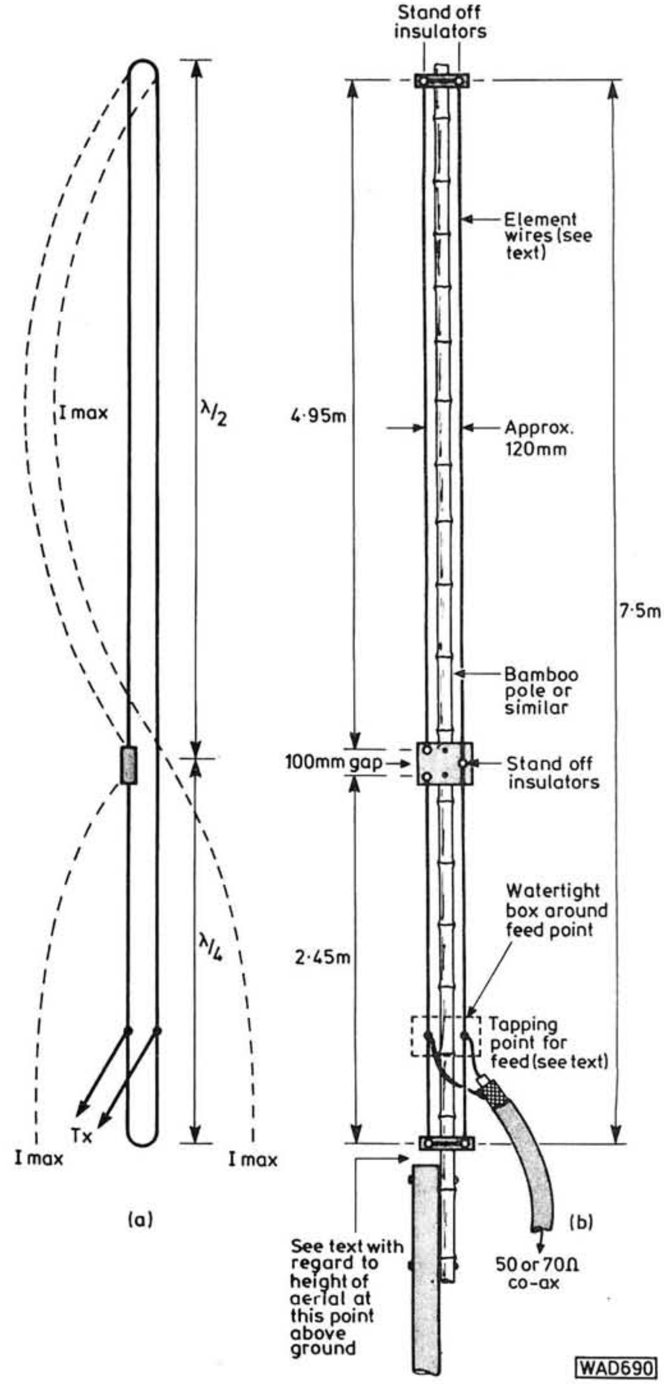

Fig 1: (a) Electrical function of the "Slim Jim" aerial. (b) Suggested method of constructing a "Slim Jim" for 28MHz (10 metres)

continued on page 86 ▶▶▶

PW HELFORD

Part 1

HF SSB TRANSCEIVER

Vic Goom G4AMW

Back in 1974, when the first SL600 board designed by G3ZVC was published, a rather primitive single band (20 metres) transceiver was built. Although only pushing out 5 watts this was a great success, even working into VK and W6—ultimately adding another dimension to Continental motoring, as being quite small it sat happily on the armrest between the seats.

When the *PW* Helford was in the early design stages, James Bryant, Plessey's applications manager offered to produce a new board, tailor-made for the job. It was therefore possible to press on with a completely compatable design, and for good measure Peter Chadwick, Plessey's applications engineer produced the power amplifier filters. Thanks are also due to the late Col Geoff Cole for the information on the driver and the p.a. which were obtained from T.R.W. of California.

In order to harness the G4CLF Board satisfactorily certain criteria have to be observed. The first essential is a stable v.f.o. and a very effective layout for this was drawn up by Peter Trowbridge. Secondly, the mixer must have a drive of 500mV from the buffer. A slightly modified cascade amplifier from a Plessey handbook provided this.

Although the *PW* Helford is presented here as a transceiver for 80 and 20 metres, it is intended to develop an oscillator and second-mixer board to convert it into a Five Band rig, already allowed for in the preselector.

The popular choice appears to be five wide-band double-tuned sets of coils a lot of wire and wave-change wafers with no means of tuning them. Thanks to the production of a four-gang tuning capacitor a rather neat solution was arrived at. By connecting the 80 metre pair of coils to two gangs and the 20 metre pair of coils to the remaining two gangs it was possible, with no top coupling switching, to put on the nose any frequency from 80 to 10 metres. It is felt that this can only enhance the dynamic range of the hot carrier diode mixer.

On the transmit side there can be no doubt that the ability to actually put 100W plus into the aerial, coupled with the Voice Operated Gain Adjusting Device (VOGAD) facility, does give the operator considerable talk power. Indeed when this rig was only at the drive stage so potent was the signal that it was difficult to get off the air to actually build the p.a., as Phil Ciotti, builder of the original Helford would readily admit.

The basic straight-forward simplicity of this transceiver is to some extent displayed by the block diagram (Fig. 1), but to a greater extent by the fact that the wavechange switch has only three wafers—as opposed to 12 to 15, which seems to be the going rate for commercial rigs.

Possibly the biggest shock to the proposed constructor is that the cost of the case is on a par with the filter. Of course a cheaper case could be used, but the precision and

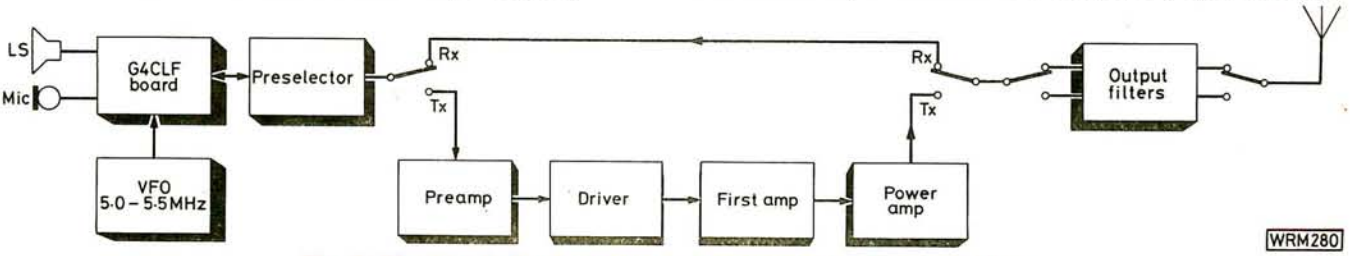

Fig. 1: The block diagram of the complete Helford transceiver

CONSTRUCTION RATING Advanced

BUYING GUIDE

Builders of the *PW* Helford should have little difficulty in obtaining the components. The case is available from West Hyde, the meter and knobs from Sifam, while the variable tuning capacitors are by Jackson Bros and can be obtained from Watford Electronics. The components for the G4CLF Board can be obtained from Ambit International.

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accessibility of the West Hyde case does give the whole thing a stable, well-engineered feel.

It is obviously important to follow all the construction details closely but this is particularly so with regard to the preselector, a little bit of double checking before it is all fitted into the box is a very good idea, as shorts in this area are very difficult to trace—practically everything is grounded through the coils!

In practical terms what is the *PW* Helford capable of? When it was put on 20 metres for the first time, during the second week in June, conditions were generally reckoned to be pretty poor as at the time radio contact with the transatlantic yacht race was causing concern. However, working only the odd hour or so in the evening between June 9 and 15 the following stations were worked. PY1ZBS (5/7). ZS61W (5/5). CTIEL (5/8). CN8CW (5/8). 4NIU (5/9). WA9DJQ/M/M (5/9). VK2DM (5/6). PY4AH (5/8). J28AA (5/9). (DJIBOUTI) VP8HZ (5/6). (The antenna used was a 2-element beam at 30ft). The fact that this quite interesting collection of DX was worked on a relatively poor band with the European QRM in full spate, displayed not only the punch of which the Helford is capable, but that the receiver selectivity is not wanting either.

This first part of the series deals with the G4CLF Board designed especially for the *PW* Helford by James Bryant.

The G4CLF Board

This is a direct descendant of the SL600 transceiver described by Brian Comer, G3ZVC, in "Radio Communication" for September 1974 and afterwards in a number of other journals around the World. The original design used the Plessey SL600 series of communications integrated circuits and consisted of a single-sided board measuring 127 × 83mm and carrying nine integrated circuits, two transistors and a diode ring mixer. The board contained the entire works of an s.s.b. transceiver capable of working at any frequency from 10kHz to 500MHz with the exception of the local oscillator, preselector, r.f. power amplifier, power supply, microphone and loudspeaker.

This new version is smaller, only 102 × 76mm, and contains a number of improvements but uses an extra integrated circuit and three extra transistors. The major improvements are increased sensitivity (0·2μV against 0·5μV), higher audio output (800mW against 100mW), tailored audio response (24dB/octave above 3·5kHz), on-board supply regulation (in fact two of the integrated circuits used in this design are regulators so the new version may, in one sense, be considered to have one less integrated circuit rather than one more), better filter matching and higher r.f. output. Minor improvements include the location of all input and output interfaces along one side of the board, trimmers on the sideband oscillator crystals, a better partition of gain between the i.f. and a.f. stages and lower oscillator radiation.

The circuit diagram of the transceiver is shown *in Fig.* 2 and may be broken down into six sections: the mixer, the bi-directional amplifier, the sideband filter, the receiver, the transmitter and the sideband oscillators.

The Mixer

The mixer consists of an Anzac MD-108 hot carrier diode ring mixer, identical to that used in the previous design. These mixers have three parts, each of 50Ω impedance, an upper frequency limit of 500MHz and a lower limit on two parts of 5MHz and on the third of d.c. This transceiver uses the d.c. part as its r.f. port to permit operation at r.f. frequencies below 5MHz so that the 5MHz limit is unimportant on the other two ports.

The MD-108 has a third-order intercept point of +15dBm and an insertion loss of 7dB. It requires a local oscillator power of about +7dBm (500mV r.m.s.). The MD-108 has an elder, and more expensive, brother called the MD-138 which has a higher third-order intercept point but there is no point in using it in this particular design since the intermodulation performance of the system is set by the mixer, the bi-directional amplifier and the filter and improving one without improving the other will do little for the overall performance of the system.

Since the MD-108 is a passive device it is bi-directional and no switching is necessary between transmission and reception. It is important, however, that it is driven from 50Ω sources and drives 50Ω loads, otherwise its gain and intermodulation performance will suffer. On the board this 50Ω match is performed by the bi-directional amplifier.

Table 1. G4CLF Board Performance

RECEIVE (+12V, +7dBm, Local Oscillator at 90MHz)	
Sensitivity:	Less than 0·3μv for 10dB SINAD
Dynamic Range:	114dB (Wanted Signals) 88dB (Off-frequency Signals)
Third-order Intercept:	+7dBm
Audio Output:	800mW
Current Consumption:	60mA (Minimum Audio Output)
TRANSMIT (+12V Supply, + 7dBm, Local Oscillator at 90MHz)	
Output Level:	−5dBm (Single Tone)
Carrier:	−49dBm
Intermodulation Products:	−50dBm (Two tones 1·2kHz and 1·4kHz)
Dynamic Range of Audio a.g.c.:	(Without R32) 40dB (R32 = 1kΩ)
Current Consumption:	45mA

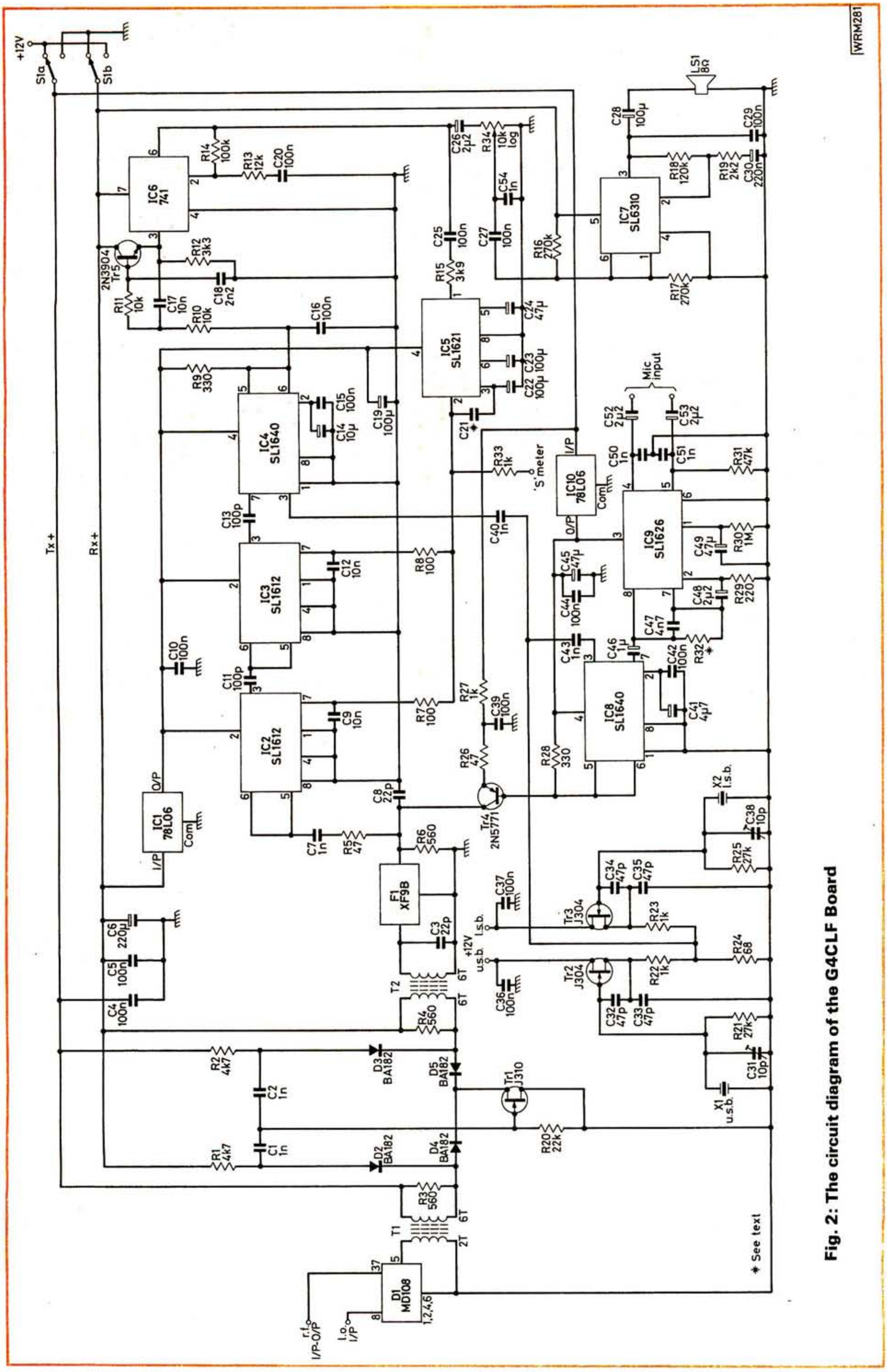


Fig. 2: The circuit diagram of the G4CLF Board

The Bi-Directional Amplifier

The bi-directional amplifier consists of a field-effect transistor, Tr1, four low capacity switching diodes, D2–D5, two transformers, T1 and T2, two capacitors, C1 and C2, and five resistors, R1–R4 and R20. The transformers act as impedance matching devices, together with resistors R3 and R4, and ensure that the mixer and the crystal filter are correctly terminated.

The diodes D2–D5 are used to reverse the direction of amplifier gain between reception and transmission. During reception the receiver power line is at +12 volts and the transmitter line is grounded. Diodes D2 and D5 are conducting and diodes D3 and D4 are biassed off. Signal then passes from T1 via D2 and C1 to the gate of the f.e.t., whose output goes to T2 via D5.

When the power supplies are reversed during transmission the system works in exactly the same way but now diodes D3 and D4 conduct and the signal from T2 is amplified and passed to T1—and hence to the mixer.

The choice of diodes and f.e.t. in this amplifier is critical. If the diodes have too large a capacity when in the "off" state the amplifier can become unstable. The diodes chosen, Mullard BA182s, were designed for switching r.f. in television tuners and are ideal for this application.

The f.e.t. must have a high gain and also good intermodulation performance. To some extent as the gain increases the intermodulation performance falls off but this may be compensated by using a high current device. The f.e.t. finally chosen was a Siliconix J310, a junction f.e.t. in a TO92 plastic package, which has a standing current at zero gate bias of between 20mA and 60mA.

The original G3ZVC design used a single transformer between the mixer and the filter. The bi-directional amplifier offers a number of advantages: both the mixer and the filter are better matched, giving improved intermodulation and passband ripple; losses in the mixer are regained before further losses take place in the filter (in fact during reception there is 8dB gain from the input of the mixer to the output of the filter as opposed to about 9dB loss in the original design): and the gain during transmission allows a greater r.f. drive to the p.a. The improved performance seems to be worth the increased complexity.

The Filter

This design uses an XF9-B or a QC1246AX crystal filter, manufactured by KVG and Salford respectively. These are 8-pole 2·4kHz filters with a centre frequency of 9MHz. They require termination of 500Ω in parallel with 25pF which is provided by T2, R4 and C3 on the mixer side of the filter and R6 and C8 on the other side.

Many other filters might be used in this transceiver but there are a number of points to be considered. If a 4-pole or 6-pole filter is used the stopband suppression is reduced from over 90dB to as little as 50dB. This can degrade adjacent channel performance and lead to intermodulation problems in the i.f. from very strong local signals but there are compromises which may be accepted. Another problem can arise from the use of cheaper 4-pole or 6-pole filters which is not acceptable—blocking due to local oscillator leakage. The MD-108 has local oscillator attenuation of about 40dB which means that there may be 5mV r.m.s. of local oscillator signal present at its output and therefore some 25mV at the input to the filter. If the filter attenuation is 90dB this leakage is reduced to less than 0·8μV, which is unimportant, but if it is only 50dB then the i.f. strip sees 80μV of local oscillator leakage. If the transceiver is being used at v.h.f. this is unimportant since the SL1612s in the i.f. strip have no gain at v.h.f. But in an h.f. transceiver this 80μV may be sufficient to block the i.f. strip, particularly if no a.g.c. is present. The problem was far worse in the original design which had three i.f. stages but it can cause trouble even with the present design.

The solution is simple. At v.h.f. lower performance filters may be used—at h.f. they may not!

Intermediate frequencies other than the 9MHz used here are perfectly acceptable. The system will work unchanged at 5·3MHz and 10·7MHz but i.f.s of over 15MHz or under 5MHz cannot be used. Above 15MHz the gain of the i.f. amplifier starts to drop and below 5MHz the MD-108 mixer loses gain. There is no way of extending the upper frequency limit but the lower one may be reduced by either of two methods.

One is to use the d.c. port of the MD-108 as the i.f. port. This allows the use of any i.f. down to 100kHz but prevents the use of r.f. or local oscillator frequencies below 5MHz which may or may not be a disadvantage. It will also be necessary to modify the p.c.b.

The other method is to replace the MD-108 with an MD-109. This is a lower frequency version of the MD-108 which is rather more expensive but has a frequency response from 200kHz to 200MHz. Of course with an MD-109 while it is possible to use i.f.s down to 200kHz it is not possible to work with r.f.s above 200MHz. This is unlikely to be a problem since the use of i.f.s below 5MHz with r.f.s above 200MHz is likely to lead to image problems and thus will tend to be avoided anyway.

If the transmitter performance is not to be degraded the bandwidth of the filter must not exceed 2·7kHz and the shape factor should be as good as possible.

Finally, if the filter is changed it may be necessary to change R4 and R6 and C3 and C8 to match it with the correct impedance. The resistors should be 10 per cent higher than the value given in the filter specification and the capacitors should be about 3pF lower and the circuit is not suitable for use with filters having impedances much greater than 1kΩ. If R6 is increased then R27 must be increased in the same ratio to preserve the d.c. levels on the transmitter driver transistor Tr4.

The Receiver

The receiver consists of two i.f. stages, a product detector, a low-pass filter, an audio amplifier, an audio-derived a.g.c. system and an audio output stage.

The i.f. amplifier uses two SL1612 circuits. These are similar to the SL612 circuits used in the original design but are supplied in 8-lead plastic minidip packages instead of metal ones. This lowers the price and makes the circuits easier to mount but has negligible effect on performance. All the circuits used in this transceiver, with the exception of the TO92 voltage regulators, are in 8-lead minidips.

Each SL1612 has a voltage gain of 34dB and an a.g.c. range of 70dB. The i.f. strip therefore has a gain of 68dB (2500 times) and an a.g.c. range of 140dB which cannot, of course, be used since the strip would overload with an input of 250mV r.m.s.—equivalent to dynamic range of about 114dB.

Each SL1612 has its own internal supply decoupling but the supply line is also decoupled near to them by C10, a ceramic 0·1μF capacitor. Interstage coupling capacitors are kept low to minimise the l.f. gain of the strip and eliminate possible interaction of the a.g.c. circuitry and the detector.

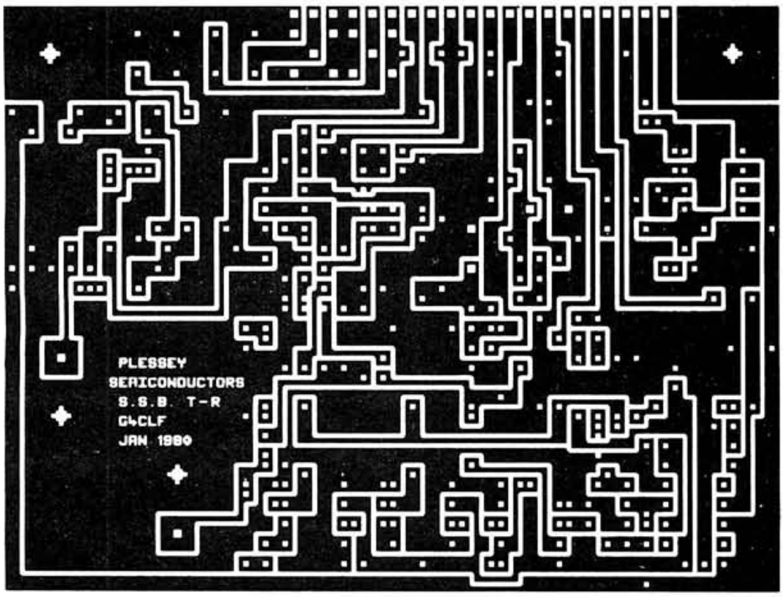
The detector, IC4, can use an SL1640 or an SL1641 as a product detector. These are both "transistor tree" double-balanced modulators and differ only in their output circuitry—the SL1640 has an internal load resistor as its output on pin 5 and an emitter follower output on pin 6, the SL1641 has a free collector output on pin 5 and no connection to pin 6. In this application pins 5 and 6 are joined so that if an SL1640 is used its emitter follower is turned off. If an SL1641 is used an external load resistor of 330Ω is necessary (R9) but with an SL1640, R9 must not be used, and the position on the board must be left open-circuit.

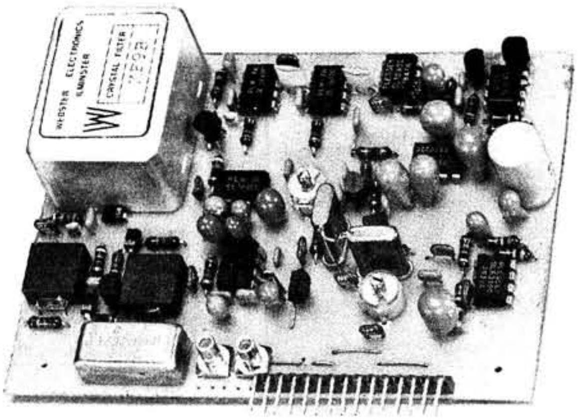
The detector uses only two other components, the bias decoupling capacitors C14 and C15. The entire i.f. strip and detector therefore uses only three integrated circuits, three or four resistors, and eight capacitors. Being a broad-band system it does not use any further coils or filters and needs no set-up adjustment.

The output of the detector contains the sum and difference of its two inputs (signal from the i.f. strip and carrier from the sideband oscillator). The signal from the i.f. strip consists mainly of a 9MHz signal but there is a certain amount of broad-band noise in the range 100kHz to 20MHz. The sideband oscillator signal consists of a single frequency of 8·9985MHz or 9·0015MHz depending on the sideband in use, there is some noise here too, but it is low enough to be disregarded. The output therefore consists of a low frequency signal (the difference output) which is the output we want, a high frequency signal around 18MHz (the sum output), and broad-band noise extending from d.c. to at least 30MHz. It is necessary to remove the h.f. output before the audio stages, and will give a more pleasant output signal if as much of the audio noise as possible is also removed.

This is done by a low-pass filter which is placed between the detector and the audio amplifier. This filter is designed to have 18dB/octave roll-off above 3·5kHz and consists of a single-pole filter formed by C16 and R9 (or the internal resistor equivalent to R9 if an SL1640 is used) followed by a two-pole Sallen and Key filter formed by R10, R11, C17, C18 and Tr5. The original design used a 2N3904 as Tr5 but if ever there was an application where the exact transistor used was unimportant this is it—all that is needed is a silicon *npn* transistor with a beta of over 80 and a V_{ceo} of over 9V.

The filter has a gain of unity and since the audio is still at a very low level (about 5 to 10mV r.m.s.) it is then amplified by 18dB in a 741 operational amplifier. Since the audio level is so low there is no possibility of clipping in this amplifier so bias is obtained by directly coupling the audio path from the detector through the low-pass filter to the 741. This saves components but provides no l.f. roll-off so that all subsequent audio coupling capacitors should be chosen to give roll-off below 300Hz, as should the





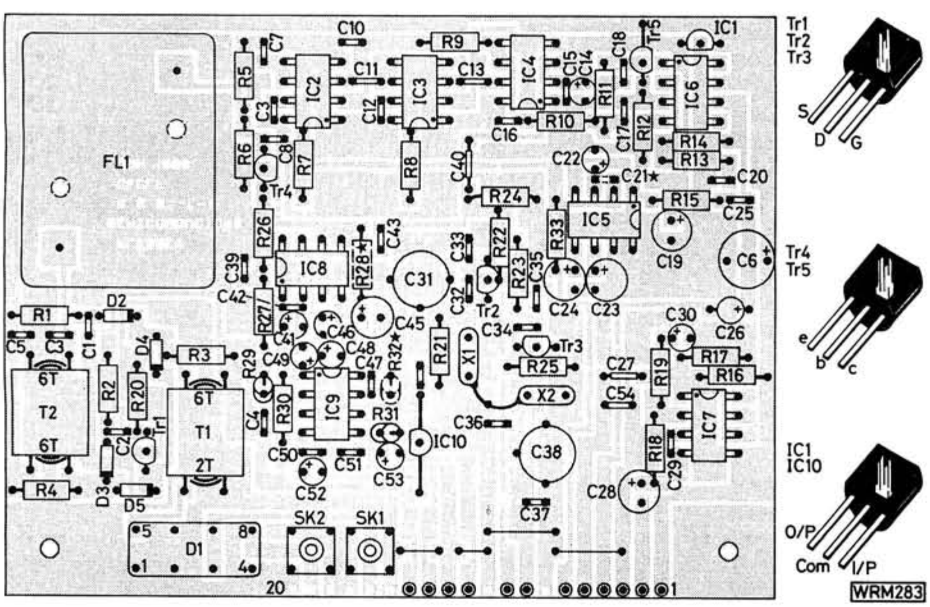


Fig. 3 (Top left): The copper track pattern shown full size, for the G4CLF Board

Fig. 4 (Left): The component placement details of the G4CLF Board. The photograph above shows the completed G4CLF Board before installation into the *PW* Helford

★ components

G4CLF Board

Resistors

10% ¼W

47Ω	2	R5,6
68Ω	1	R24
100Ω	2	R7,8
220Ω	1	R29
330Ω	2	R9,28 (SL1641 only)
560Ω	3	R3,4,6
1kΩ	4	R22,23,27,33
2·2kΩ	1	R19
3·3kΩ	1	R12
3·9kΩ	1	R15
4·7kΩ	2	R1,2
10kΩ	2	R10,11
12kΩ	1	R13
22kΩ	1	R20
27kΩ	2	R21,25
47kΩ	1	R31
100kΩ	1	R14
120kΩ	1	R18
270kΩ	2	R16,17
1MΩ	1	R30

Semiconductors

Diodes

BA182	4	D2,3,4,5
MD-108 (Anzac)	1	D1

Transistors

J304 (Siliconix)	2	Tr2,3
J310 (Siliconix)	1	Tr1
2N3904	1	Tr5
2N5771	1	Tr4

Integrated Circuits

741	1	IC6
78L06	2	IC1,10
SL1612	2	IC2,3
SL1621	1	IC5
SL1640 or SL1641	2	IC4,8
SL1626 or SL6270	1	IC9
SL6310	1	IC7

Capacitors

Ceramic Sub-miniature Plate

22pF	2	C3,8
47pF	4	C32,33,34,35
100pF	2	C11,13

Monolithic Resin-Dipped Ceramic

1nF	8	C1,2,7,40,43,51,54
2·2nF	1	C18
4·7nF	1	C47
10nF	3	C9,12,17
100nF	14	C4,5,10,15,16,20,25,27,29,36,37,39,42,44

Tantalum

220nF 35V	1	C30
1μF 35V	1	C46
2·2μF 35V	4	C26,48,52,53
4·7μF 35V	1	C41
10μF 16V	1	C14
47μF 16V	3	C24,45,49
100μF 10V	4	C19,22,23,28

Electrolytic P.c.b. Mounting

220μF 16V	1	C6

Miniature Trimmers

2–10pF	2	C31,38

Potentiometers

10kΩ log	1	R34

Miscellaneous

XF9-B or QC1246AX filter F1 (1); Crystals 30pF X1, X2 (see text); P.c.b.; B1 ferrite double aperture cores 11·3 × 11·3 × 5·8mm Mullard FX2249 (2); Min. coaxial sockets "smb" p.c.b. type (2).

decoupling capacitors in the feedback of the amplifiers IC6 (the 741) and IC7 (the ouput stage). The output from the audio amplifier goes to a volume control, which is off the board, and then to the audio output stage. It also goes directly to the a.g.c. system.

In the best s.s.b. receivers the a.g.c. is derived from the detected audio, and this technique is used here. The audio is applied, via a dropper resistor (R15), to the input of an SL1621 audio a.g.c. circuit. In this circuit, which requires only three external components, C22, C23 and C24, forms a sophisticated audio a.g.c. system which adopts quickly to new signals, tracks rising or fading signals at up to 20dB/s, holds a.g.c. constant during speech pauses, and reverts almost instantly to full system gain if a speech pause continues beyond one second—indicating a probable end of transmission.

The a.g.c. output from IC5 is applied to the two i.f. stages via 100Ω resistors (R7, R8) and is also taken off the board to act as the "S' Meter drive. The a.g.c. line has a value of about 2V at the a.g.c. threshold and increases by about 12·5mV for each dB increase in signal (80dB/V). The 2V threshold is temperature dependant and may be compensated by three silicon diodes. A simple "S" Meter is generally adequate as shown in Fig. 6. This is another circuit where the actual transistors used are unimportant—any small-signal silicon *npn* transistors and small silicon diode will do. The 1·5kΩ resistor (R35) may need some slight adjustment to give the correct range.

The capacitor C21, shown in the circuit diagram, should not be necessary if the receiver is to be used for speech only and will probably not be necessary with c.w. But under some circumstances it is possible to find low frequency instability in the a.g.c. system during the reception of c.w. The insertion of C21, which may have a value between 0·1μF and 1·0μF, cures the problem.

The audio output stage uses a new circuit, the SL6310, which is an audio power amplifier in an 8-lead minidip package capable of delivering between 800mW and 1W into 8Ω with a 12V supply. As can be seen the SL6310 uses few components (R16 and R17 are at present needed to provide input bias but may not be needed with later versions of the SL6310) and no adjustments. If more than 800mW of audio is desired the SL6310 should be omitted from the board and an external high power amplifier used.

The Transmitter

This section is more accurately described as the sideband exciter. It uses two integrated circuits and a transistor. The first integrated circuit is an audio amplifier with a.g.c. which is used to ensure that the output of the transmitter is substantially unchanged by varying audio input levels. Such a circuit is known as a VOGAD.

Two different VOGADs may be used in this equipment—the SL1626 or the SL6270. The SL1626 has been available for several years while the SL6270 is more recent. They are identical in pin connections and functions but the SL6270 has better performance when used with an unbalanced input. A balanced input is when the two terminals of the microphone are connected to the two input terminals of the VOGAD, an unbalanced input is when one of the microphone terminals is grounded and the other is connected to one terminal of the VOGAD, the other being unused. If a balanced microphone input is used then either circuit will give equally good performance. R29 (220Ω) need only be used with the SL1626 and R31 (47Ω) need only be used with the SL6270, but both resistors may be used with either circuit without any problems occurring.

These circuits require the use of a low impedance microphone (500Ω or less) with an output in the range 1mV to 30mV. The a.g.c. range is about 60dB and this may be too large for some applications where high levels of background noise are present, but may be reduced by shunting C47 with a 1kΩ resistor (R32). If this resistor is used C47 should be increased from 4·7nF to 47nF to preserve the h.f. roll-off characteristic of the VOGAD.

The two capacitors C52 and C53 isolate the VOGAD inputs at d.c. and the capacitors C50 and C51 decouple any r.f. which may be induced on the microphone leads. The audio from the VOGAD is coupled to the double-balanced modulator by C46.

As in the receiver the double-balanced modulator may be either an SL1641 and again a 330Ω resistor is required only if the SL1641 is used (R28).

The principle of a single-sideband generation used in this transmitter is simple. Audio and carrier are applied to a double-balanced modulator, the output of this modulator consists of a d.s.b.s.c. (double-sideband suppressed carrier) signal which is filtered in a narrow filter to remove one sideband. Which sideband is selected depends on the carrier frequency chosen.

The d.s.b. signal from the double-balanced modulator is amplified and buffered by Tr4 and applied to the crystal filter. Tr4 is a high frequency *pnp* transistor, the original design used a 2N5771 but any high frequency silicon *pnp* transistor with a low C_{ob} would be suitable. A transistor is used in this buffer rather than an integrated circuit because it does not present any load to the filter when it is turned off during reception. The gain of the transistor amplifier is set by R26 and may be altered if necessary. Bias for the transistor is obtained by direct coupling from the double-balanced modulator.

The Sideband Oscillators

One might expect the title of this section to be "The Sideband Oscillator" but there are in fact two separate oscillators. The original design used a single oscillator and diode switching of two crystals but varying capacity between diodes from different manufacturers led to a number of problems. When this design was started we investigated various ways of switching one oscillator between two crystals and decided in the end that the most reliable solution was the use of two separate oscillators. Interestingly enough, this solution was also as cheap as any other.

Each oscillator uses a Siliconix J304 f.e.t. in a Colpitts circuit. The quartz crystals supplied with the XF9-B or QC1246AX filters are 30pF parallel resonant types and the oscillators are designed to work with these. If 20pF parallel resonant types are used it is probably sufficient to reduce C32, C33, C34 and C35 to 33pF each, but if series resonant crystals are to be used more changes will be necessary. The trimmer capacitors C31 and C38 are used for fine adjustments of the u.s.b. (8·9985MHz) and l.s.b. (9·0015MHz) crystals respectively.

The output voltage from both oscillators is developed across R24. In the prototypes R24 and 68Ω and the output voltage is about 80mV r.m.s. If this voltage falls outside the range 60–200mV r.m.s. then R24 should be adjusted until the voltage is within this range but this is not very likely to happen since the prototype boards all had outputs lying between 70mV and 100mV and they used f.e.t.s from a number of batches and crystals of widely varying activity.

The oscillator to be used is selected by applying a 12V supply to its power input pin. The other oscillator's power supply should be off and, preferably, grounded.

Construction

The p.c.b. layout for this transceiver is shown in Fig. 4 and the component placing in Fig. 5.

Resistors are carbon or metal film ¼W types, capacitors below 1nF are miniature Mullard or RS ceramic types, between 1nF and 100nF miniature monolithic ceramic types with 0·1 inch lead spacing. All capacitors above 100nF with the exception of C6 which is an aluminium electrolytic are miniature resin dipped tantalum electrolytics. The transformer T1 and T2 are wound on blocks of B1 ferrite 11·3 × 11·3 × 5·8mm (½in × ½in × ¼in) with two holes. (Mullard Part No. FX2249 "Double Aperture Core.") These blocks are glued to the circuit board with epoxy resin and then wound with 32–36 s.w.g. self-fluxing

Table 2. G4CLF Board Connections

Pin	Function	RFC details
1	+12V Rx/Earth Tx	2½T on FX1115
2	Audio output to 8Ω speaker	=
3	Earth	=
4	Volume control potentiometer (Top)	3½T on FX1115
5	Volume control potentiometer (Wiper)	3½T on FX1115
6	'S' Meter output	=
7	Earth	=
8	+12V (l.s.b.)	2½T on FX1115
9	+12V (u.s.b.)	2½T on FX1115
10	Earth	=
11	Microphone input (500Ω)	=
12	Earth	=
13	Microphone input (500Ω)	=
14	+12V Tx/Earth Rx	3½T on FX1115
15	Earth	=
16	Mixer port (r.f.) d.c. to 500MHz	=
17	Earth	=
18	Earth	=
19	Mixer port (l.o.) 5 to 500MHz	=
20	Earth	=

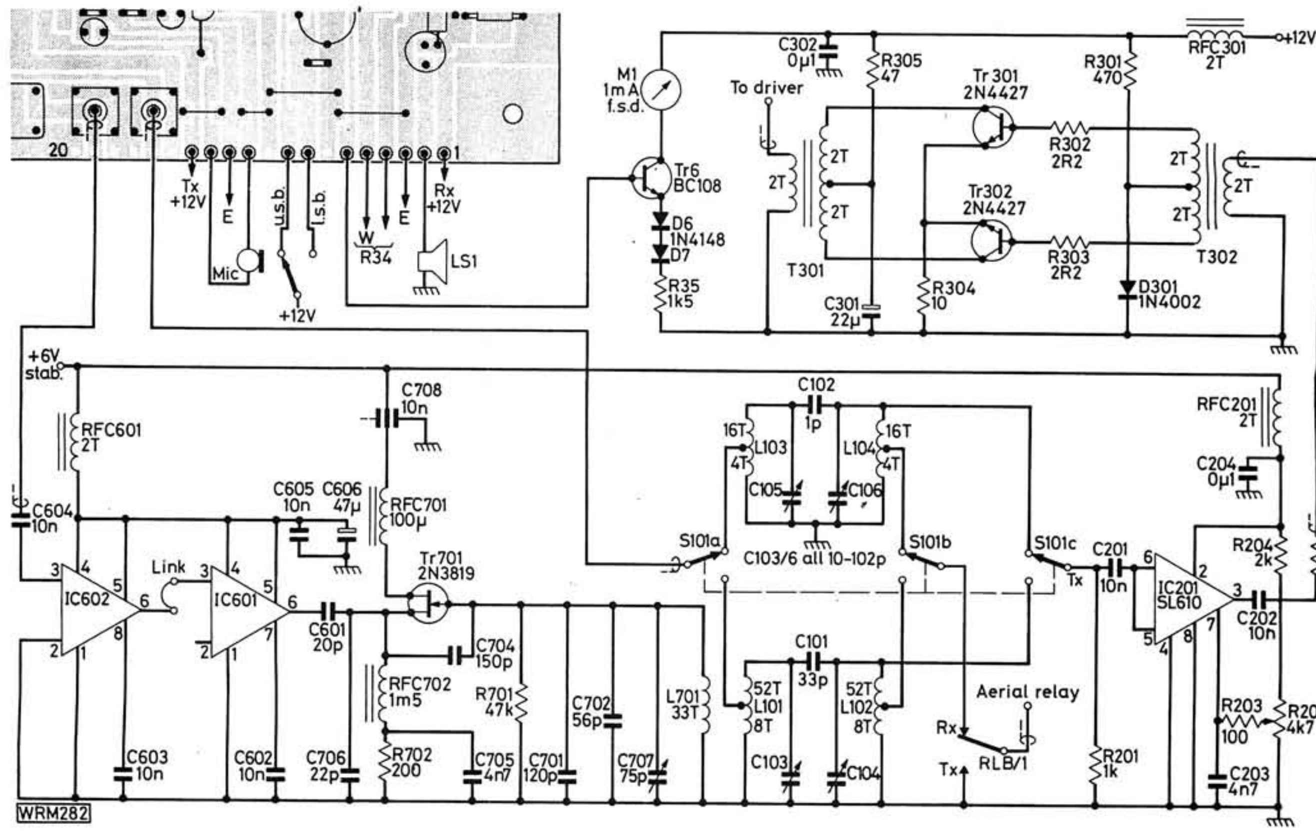


Fig. 5: The circuit diagram of the external circuitry needed to operate the G4CLF Board. This is the complete *PW* Helford with the exception of the power supply and relay switching circuits

copper wire. T1 has a two-turn primary (on the D1 side) and a six-turn secondary, T2 has six turns on both windings.

There are four wire links on the board to connect various earth tracks together for minimum h.f. impedance. There is also a hole near to the quartz crystals through which passes a piece of wire which is soldered, as quickly as possible, to avoid damage to the crystal cans to ground them. If this is not done the crystals tend to radiate.

All components must be mounted with the shortest possible leads and i.c. sockets must not be used.

Assembly of the board should be in the following order:

1. Glue down the ferrite cores. When the glue has set wind the transformers T1 and T2.
2. Insert Tr1 and diodes D2, D3, D4 and D5. Mount D1 and F1. Insert the resistors and capacitors of the bi-directional amplifier.
3. Insert IC2, IC3, IC4 and IC6, checking that they are inserted the correct way round. Insert resistors R5 to R15, insert capacitors C7 to C18 and C20, then Tr4 and Tr5.
4. Insert IC5, and C22 to C26 and C6.
5. Insert crystals X1 and X2 and trimmer capacitors C31 and C38. Solder and cut leads and solder wire to ground cans. Insert resistors R21 to R25, capacitors C32 to C37, and Tr2 and Tr3.
6. Insert IC7, resistors R16 to R19, capacitors C27 to C30 and the four wire links.
7. Insert IC8 and IC9, resistors R26 to R31, and capacitors C39 to C53 (the ceramic capacitors should all be mounted first, then the tantalum electrolytics).
8. Finally insert IC1 and IC10, the remaining components, and the pins, sockets or wires, which are to be used to make the connections to the board.

The connections to the board are given in Table 2. The r.f. and l.o. signals may either be connected via the same 0·1 inch pitch connections, as the rest of the signals and supplies, or via miniature co-axial sockets. The latter are used in the Helford.

The board is powered from a single +12V supply but will work between +10V and +15V without damage or significant change in performance. It is essential to ground the transmitter supply during reception and the receiver supply during transmission. This is not merely to prevent spurious transmission of signals as was the case in the original design, but is because these other lines are actually used as d.c. return paths.

When the board is complete the sideband oscillators should be set up by connecting a frequency meter across R24 and connecting power to each oscillator and adjusting its trimmer until its frequency is within 10Hz of nominal.

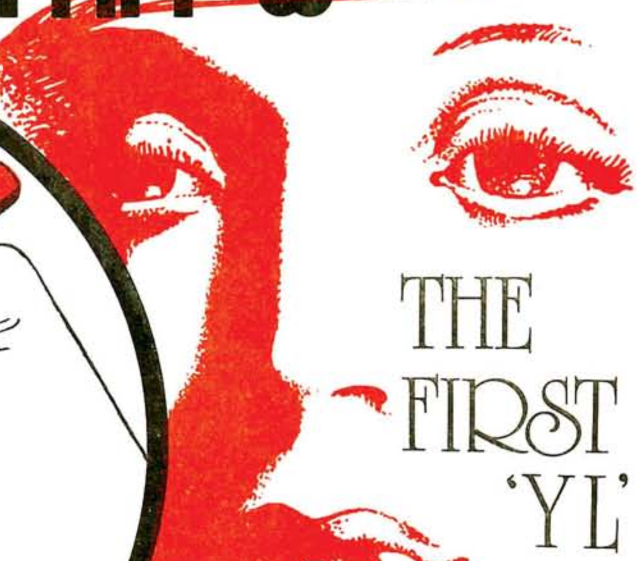
If for any reason the board does not perform properly when first connected it should be checked for short-circuits and then the integrated circuits should be checked with a high impedance voltmeter for correct operating voltages. (The correct operating voltages are given in the *"Plessey Semiconductor's Radio Communications Handbook"*, available from any Plessey Semiconductor Office or distributor.) If this method also fails then signals must be traced through the board with the aid of a signal generator and an oscilloscope or spectrum analyser.

Readers who intend to operate the Helford 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.

Next month in PW

FREE WORKSHOP TWEEZERS

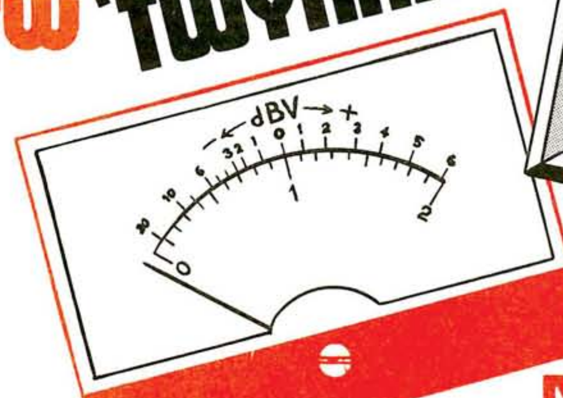
You wouldn't believe us if we told you how much a pair of tweezers cost these days, so we won't. Just remember, every home should have a pair of our orange ones—free of course.



THE FIRST 'YL'

One of the most active of the early amateur YL operators was Barbara Dunn 6YL (later G6YL), who was involved in monitoring the famous Southern Cross on its transatlantic flight 50 years ago. Ron Ham recounts 6YL's achievements.

PW 'TWYNHAM'



DIGITAL/ANALOGUE MULTIMETER

Combining two instruments appears to be an attractive idea—until you want to measure, say, voltage and frequency together!

The *PW* "Twynham" is a mains powered multimeter which gives you simultaneous analogue and digital readouts for both accuracy and trend watching.

Twelve ranges plus a constant current test facility for semiconductor junctions are all part of the specification.

plus

index to vol. 56

ON SALE 7 NOV

THE PW 'SHERBORNE' SYNTHESISED AM/FM TUNER

PART 2 **W. S. POEL**

The synthesiser has so far been described in isolation from the radio hardware of the complete tuner. This is partly because the synthesiser itself is suitable for use with a variety of different tuner configurations—and partly because the entire circuit would appear impossibly complicated. This would be unfortunate, as it falls neatly into a series of building blocks that may be considered "jointly and separately" in the context of this article, or as "separates" for substitution or addition into existing designs.

The synthesiser unit is replacing the following traditional features:

1. Tuning potentiometer
2. Preset station selection
3. Frequency indication/readout

and takes care of these less obvious aspects:

4. All tuning voltage stabilisation cared for
5. Requirement for a.f.c. non-existent
6. Greatly simplified switching
7. A plethora of otherwise unattainable features.

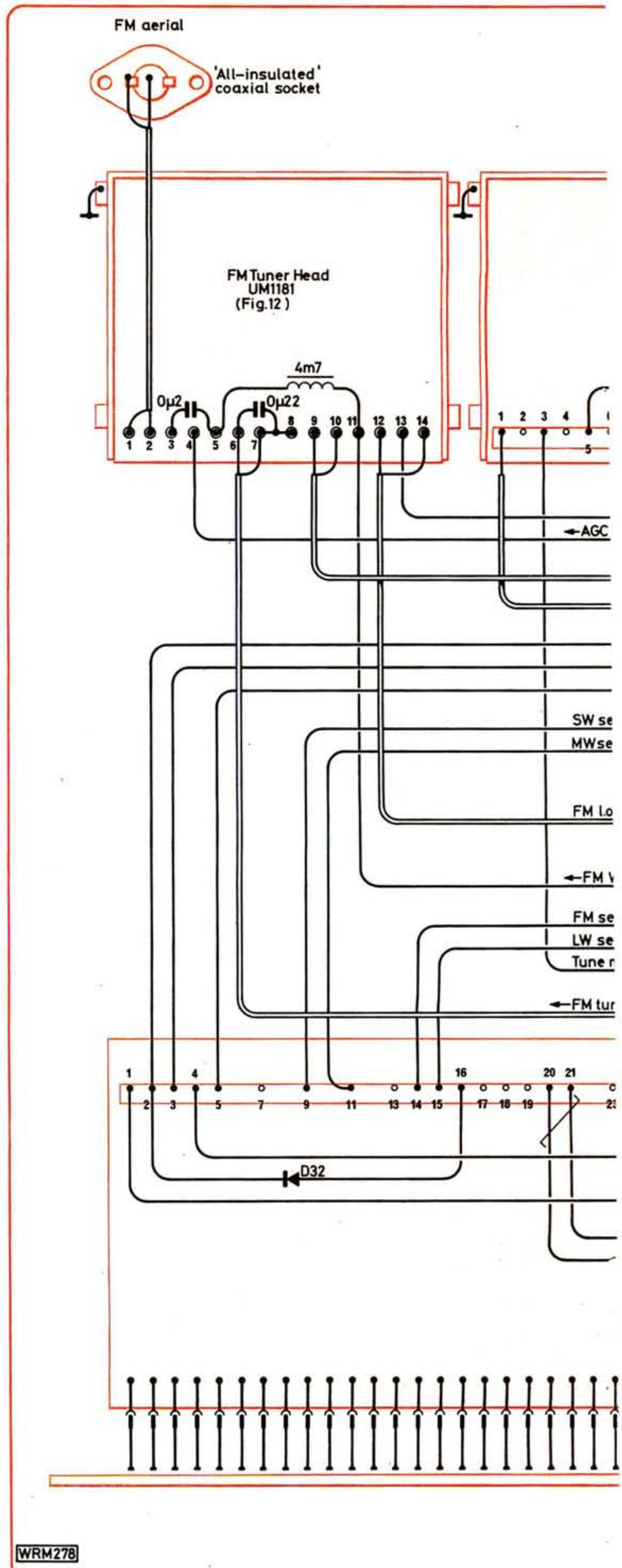
Those features fulfilled by the synthesiser are also vastly improved by the fact that everything is referred to a quartz crystal for frequency determination. The penalty is the close proximity of digital processing to a sensitive radio environment, so some care is needed to avoid radiation of the harmonics into the broadcast bands.

The tuner design must take into account the signals required by the MPU when operating in the scanning mode, and thus must provide:

(a) Local oscillator output for both a.m. and f.m.
(b) Scan stop information
(c) Simple bandswitching
(d) Stereo decoder with v.c.o. defeat
(e) High impedance tuning voltage lines.

The interconnections required between the synthesiser and tuner modules are shown in detail in Fig. 10, which will also serve later as the inter-unit wiring diagram for the complete tuner.

A medium-priced tuner is described here. Considerable efforts have been made to develop a design that can be repeatably assembled and made to work by a wide range of enthusiasts with different levels of experience. The result is an a.m./f.m. tuner that will out-perform any previously published design, so it can scarcely be described as a compromise. Much of the credit must go to the advances made in the past year or so in the state of component technology—such as new linear-phase ceramic i.f. filters,



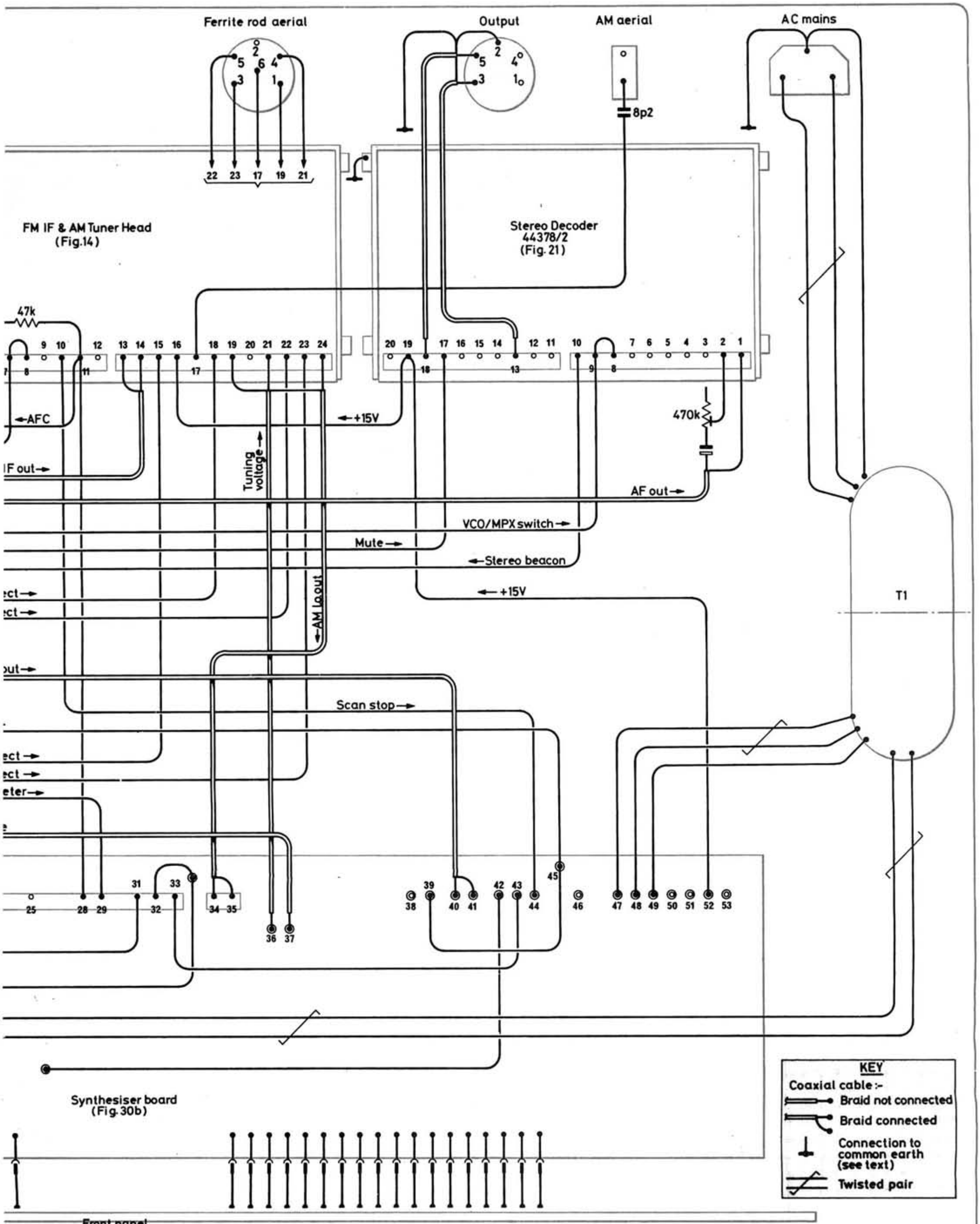


Fig. 10: System wiring diagram of the complete tuner, identifying signal flows and control requirements

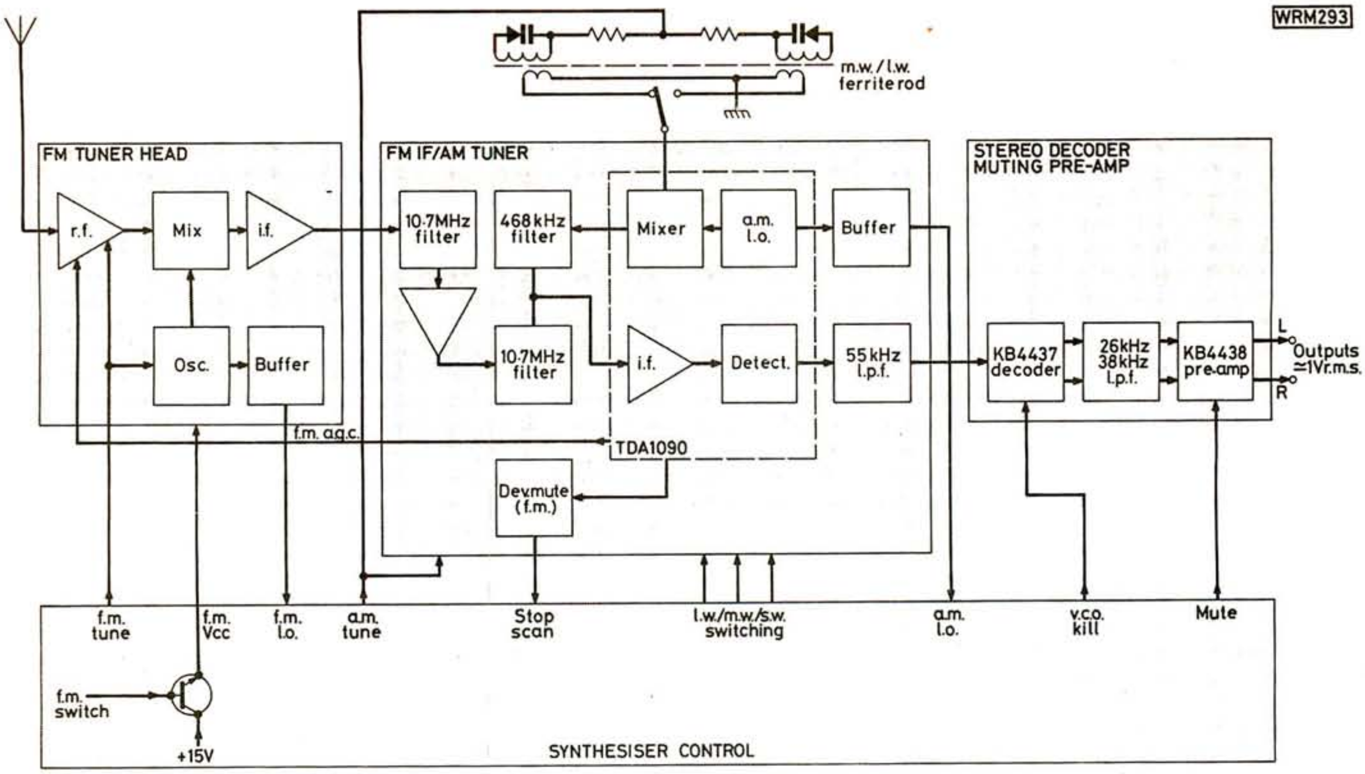


Fig. 11: Simplified block diagram of the complete tuner system

very low-noise members of the universally appreciated CA3089/3189 families of f.m. i.f. amplifier and detector i.c.s, MOSFETS, etc.

A higher specification tuner system was considered unsuitable, since accurate alignment of a more complicated i.f. would not be feasible for anyone without access to thousands of pounds worth of advanced test equipment. Nevertheless, the tuner synthesiser described last month is quite capable of driving alternative r.f./i.f. designs if required.

The Tuner

The tuner divides down into three blocks as shown in the simplified system diagram of Fig. 11: a front end (the UM1181 and the Alps FD811UX are described); a combined f.m. i.f. amplifier and detector, with three-band a.m. tuner section built around the Sprague ULN2242A; and a stereo decoder common to both designs that uses the Toko KB4437 pilot-cancel stereo decoder, followed by the KB4438 matching muting audio pre-amplifier.

The front ends are available only as prebuilt and tested items, but the circuit diagrams are nonetheless relevant to a comprehensive description of the circuit function. The UM1181 and FD811UX adopt similar circuitry although the Alps unit is perhaps constructed more thoughtfully.

In the UM1181 (Fig. 12) the antenna circuit is a single-stage-tuned coil, feeding gate 1 of v.h.f. MOSFET r.f. amplifier. Automatic gain control (a.g.c.) is provided on gate 2 of this MOSFET (via R2) although if left open circuit, R3 will pull the gate bias up to ensure maximum gain. The filter between the r.f. and mixer stages is an interesting feature, being basically a triple-tuned stage and bottom inductance coupled. The advantage of this method of coupling is that the coupling points are at a far lower impedance than with top-capacity coupling, enabling some of the fastidious screening to be omitted inside the can. However, although the small-signal selectivity is impressive at 90dB or better, really strong signals at the antenna can leak across—but these are levels rarely experienced under UK conditions, unless a beam antenna is employed in an already strong signal environment.

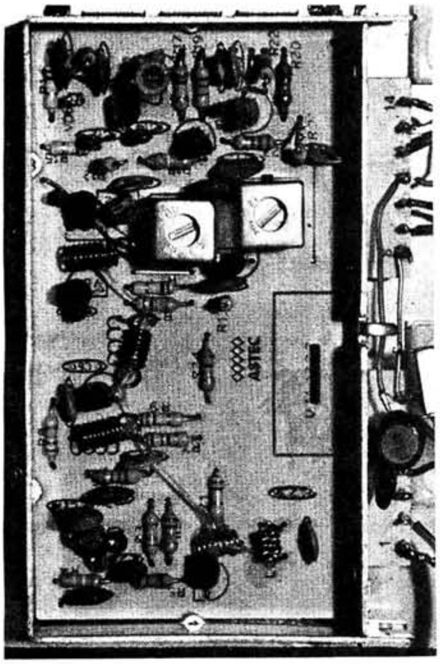
The mixer is a common source JFET, with source injection of the local oscillator, and a JFET i.f. pre-amp in common-gate mode (high stability/medium gain/broad-band) between the drain load i.f. coil and the output matching coil. The local oscillator (10·7MHz high) is the classical Colpitts design, with feed taken from the relatively low-impedance emitter to both the mixer and the oscillator buffer amplifier. Approximately 300mV of l.o. is thus available for the input of the prescaler on the synthesiser control board.

In the FD811 (Fig. 13) a similar input arrangement exists, although the physically larger construction of the coils used in the FD811 series enables a higher Q to be achieved at each stage, thus enhancing selectivity. The a.g.c. system in this tuner is not returned to the positive supply rail, and unless an external bias is applied to the a.g.c. terminal, the r.f. stage will be operating under conditions of minimum gain.

A quadruple-tuned filter is used between the r.f. and mixer stages, the input and output couplings being via inductive proximity, and the centre two via capacitor top coupling. Capacitor coupling is avoided at the input and output sections because of the capacitive loading effects of the drain on the r.f. stage and the gate of the mixer—these "unknowns" will affect the calculation of the ideal coupling capacitor for the correct coupling constants. The capacitive coupling section with the coils well screened from one another enables the filter to provide excellent strong-signal selectivity. In designs with a second r.f. stage (Ambit EF5800), the excess gain can be used to iron out the lumps in entirely top-coupled filter sections, since slightly staggered tuning will be far less serious to the overall tracking of the system.

The output of the mixer goes through a double-tuned i.f. filter stage before reaching a f.e.t. buffer amplifier; the load presented is resistive (R22), which is more suitable for the following f.m. i.f. filter stage in many instances.

The local oscillator (10·7MHz high), is again the



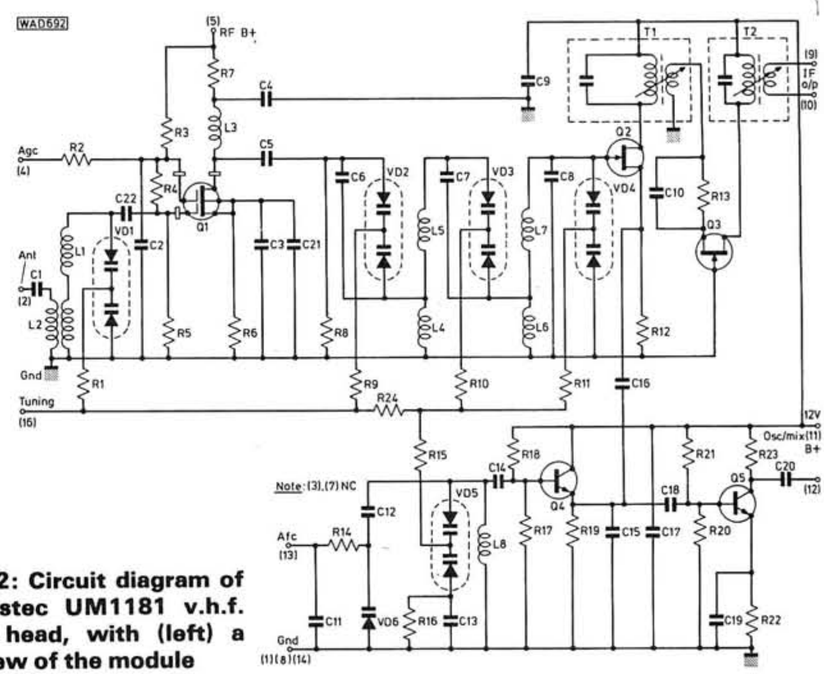


Fig. 12: Circuit diagram of the Astec UM1181 v.h.f. tuner head, with (left) a view of the module

Colpitts circuit, used at a lower level. This reduces oscillator drift due to the heating of tuned circuit components, and prevents the local oscillator causing nonlinearities in the tuning diode characteristics. As it happens, the synthesiser can take care of drift anyway (since the only drift possible occurs in the reference oscillator, which is crystal controlled), but it also provides a very low-noise signal, subsequently raised in level by a common-base transistor amplifier (Tr6), and fed to the gate of the mixer MOSFET via an emitter-follower buffer. Thus a very high degree of isolation is maintained between the l.o. and mixer signals. A second emitter-follower buffer is used to provide l.o. signal for the synthesiser system.

The FM IF/AM 3-band Tuner Module

As can be seen from Fig. 14, the TDA1090 is used for both these major functions. The i.c. was described in some detail in conjunction with the *PW* "Dorchester" multi-band broadcast tuner, so only a brief resumé is offered here.

The device (Fig. 15) uses the same basic i.f. amplifier for both f.m. and a.m., although the detector for f.m. is a quadrature coil system (as in the CA3089 families) fed from a phase correction choke. Under f.m. conditions, the i.f. amplifier is driven into limiting by grounding the a.g.c. terminal, providing a squarewave i.f. output rich in harmonics. The quadrature coil helps to restrain this somewhat, but the whole assembly is placed inside a screening can to prevent unwanted radiation.

Listeners in the London area may have noticed that many tuners give an unaccountably high level of hiss or birdy response when tuned to 95·8MHz (Capital Radio). The answer is simple, since 95·8 = 9 × 10·64, some 60 kHz away from the i.f. centre of 10·7MHz, and well within the filter pass-band. The noise is very mushy and warbly, since in the process of being multiplied nine times, the deviation is also increased nine times—so at no time

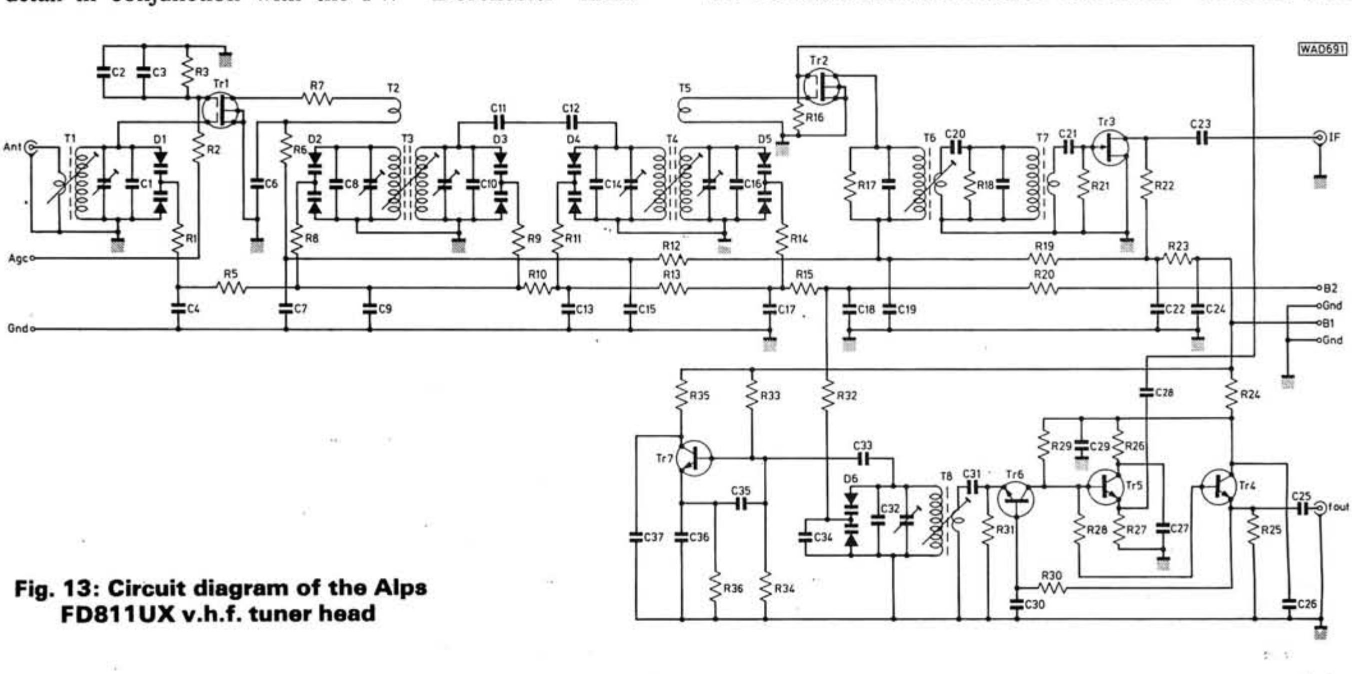


Fig. 13: Circuit diagram of the Alps FD811UX v.h.f. tuner head

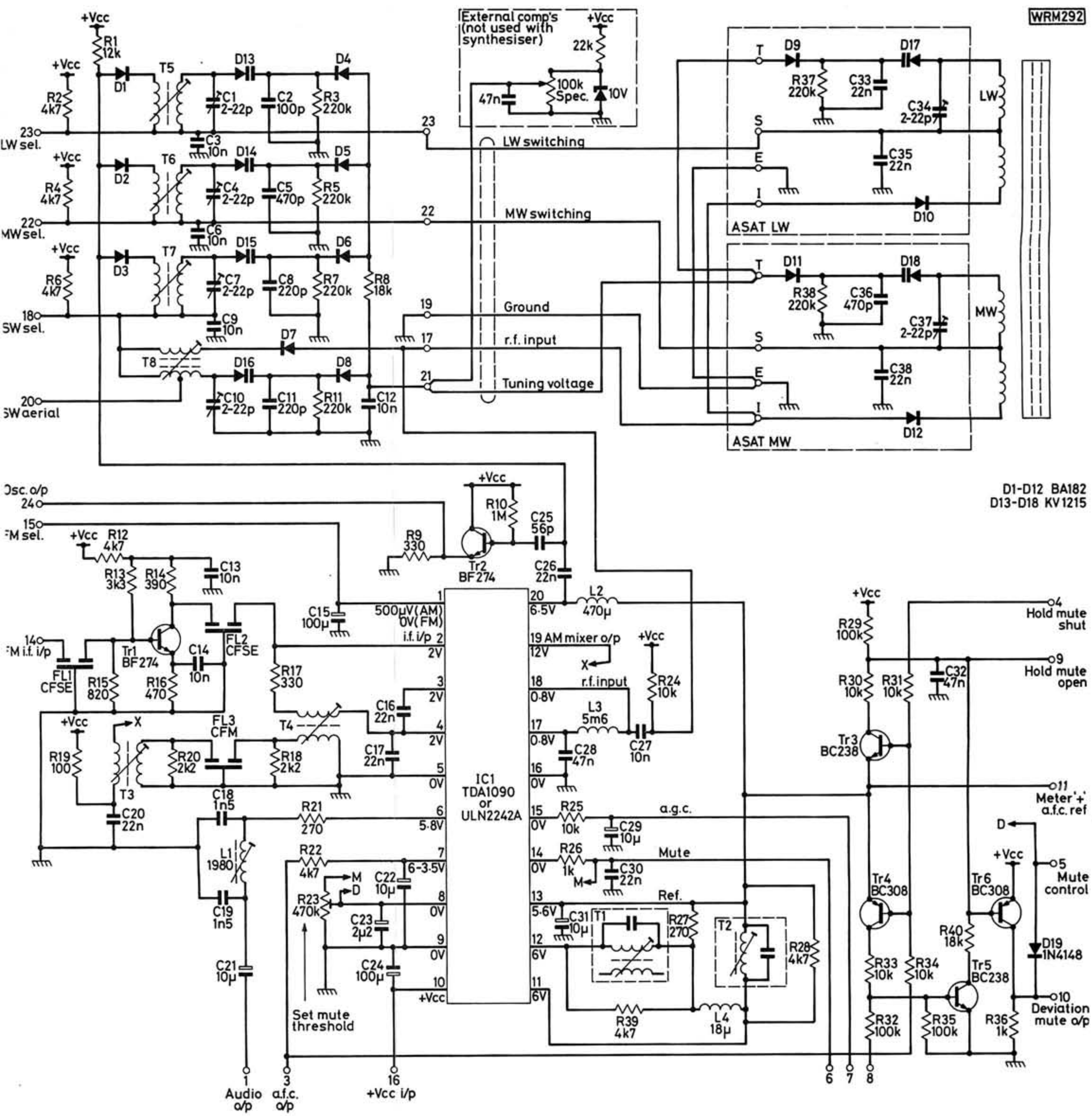


Fig. 14: Circuit diagram of the f.m. i.f./a.m. tuner module, with associated remote tuned and switched ferrite rod aerial

will such a harmonic provide an intelligible signal to the detector.

Careful decoupling and earthing of the f.m. i.f. and detector system is required, for the same reasons as discussed in connection with the prescaler on the input to the synthesiser's phase-locked loop in last month's article.

The f.m. section of the TDA1090 possesses a signal level mute (as does the CA3089E)—but no deviation muting. This shortcoming is easily rectified with a few external transistors, using the a.f.c. voltage to operate a "window" through which the f.m. mute will be allowed to open. The same signal is used in this design to provide the scan-stop information for the tuner, since it can be set to give a signal when the synthesiser has stopped precisely on a wanted f.m. signal. The behaviour of this signal with regard to detuning effect is shown in Fig. 16. The actual bandwidth is determined by the voltage developed across the a.f.c. output and the reference voltage. The a.f.c. output is basically a current source, and so the larger the value of the resistor used, the larger will be the a.f.c. voltage developed for a given degree of detuning. Ohm's Law states that $V = IR$ (within the limits of the supply available on the i.c.).

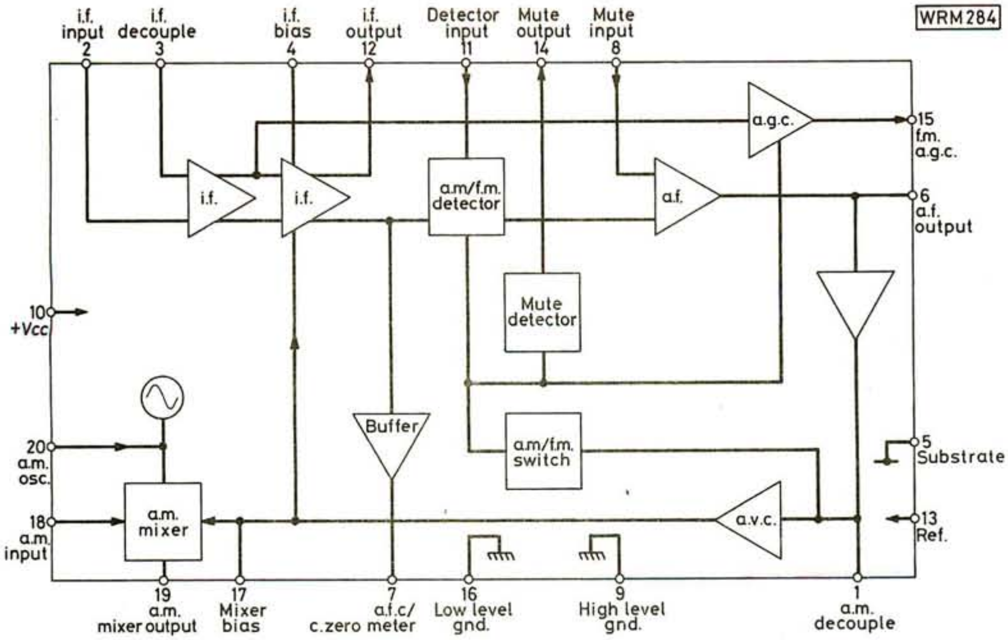


Fig. 15: Block diagram of the ULN2242A/TDA1090 integrated circuit

An output is also available from the TDA1090 in a form suitable to drive the front end. If required, this a.g.c. signal can be used to drive the muting signal system (both signals go low with increasing input), since the a.g.c. operates somewhat after the standard noise-operated muting, enabling selection of strong signals only, without any background hiss under critical stereo listening conditions.

The FM IF Amplifier

The TDA1090 provides the same facilities as the CA3089E with the exception of a signal level indicator output. However, the a.g.c. output of the TDA1090 may be regarded as a reference of signal level, albeit the onset of the indication occurs at greater input levels than with the CA3089 type of circuit. However, the gain of the front end and i.f. pre-amp is such that the a.g.c. indication starts at about 70µV input.

In f.m. mode, the a.m. local oscillator is turned off and the i.f. amplifier is turned into a limiting amplifier by ground pin 1 of the i.c. In this application, the f.m. tuner-head supply voltage is also switched—since the module would still be susceptible to the output of the f.m. tuner-head when in the a.m. mode, as the i.f. amplifier is common to both a.m. and f.m. A single transistor i.f. pre-amplifier provides some 20dB of additional gain at 10·7MHz, as well as providing matching for the ceramic filters.

Various types of ceramic filter are available these days, and the technology has come a long way since the first types were introduced. The Toko CFSE series is used here, although the Murata ultra-linear phase i.f. filters in the SFE10·7ML series could be used. However, the extreme tuning accuracy of the synthesiser makes the choice of filter easier, since it is no longer necessary to worry about a fairly broad detuning tolerance. In fact, a narrower filter can be used if desired. Under UK band-listening conditions, this is of little benefit except under sporadic-E conditions, and might possibly cause unnecessary problems during alignment.

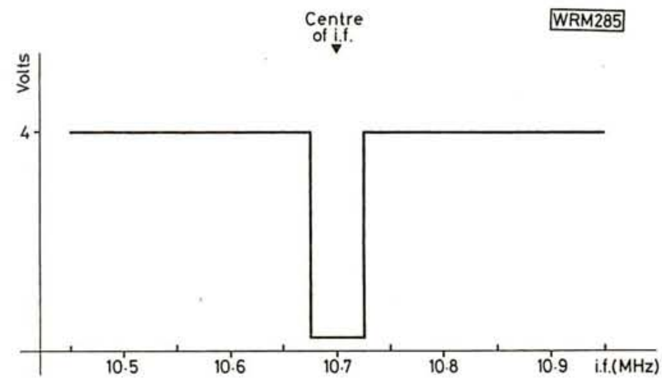


Fig. 16: Operation of the deviation mute circuit

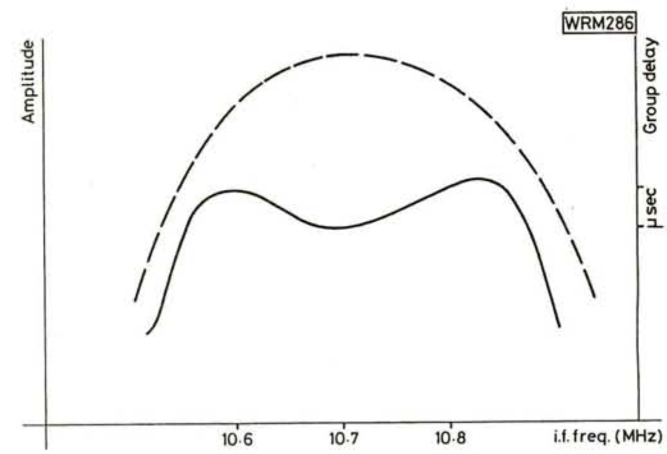


Fig. 17 (bottom): Amplitude and group delay characteristics of an i.f. filter. The solid line is the group delay

The crucial feature of any f.m. filter is the group delay (see Fig. 17)—which is related to the phase linearity by: Group Delay = Phase change/frequency change. The ideal phase change from one side of the filter to the other is a straight line. This is the same as the slope of the f.m. detector, which uses exactly the same principle when demodulating f.m. signals in a quadrature system, to convert frequency change into amplitude change.

Distortion at the extremes of the slope will cause ripples in the group delay, causing these parts of the modulation spectrum to arrive at the detector at slightly different times. This phase error will cause problems in the Zenith-GE multiplex stereo system, where the phase accuracy between the 19kHz pilot tone and the 38kHz subcarrier is the cornerstone of the theory. A full analysis of the theory of f.m. and multiplex is beyond the scope of this feature—but suffice it to say the composite f.m. stereo signal, with an audio bandwidth of 53kHz, requires approximately 220kHz of r.f. i.f. linear phase bandwidth. As f.m. sidebands theoretically extend to infinity (but diminishing to an infinitesimally small amplitude quite quickly), opinions as to the ideal bandwidth for stereo f.m. vary from 180kHz (favoured by some applications notes written at Philips) to 280kHz. A compromise value of 220kHz does not adversely affect stereo programme material in any way that can be detected using current broadcast standards.

The detector in the TDA1090 uses a form of quadrature—with the signal fed to the phase-shift coil via a fixed choke of 18μH. This choke is used to compensate for delays in the signal path of the other input to the quadrature detector—so the midpoint of the detector slope is exactly in the middle of the d.c. characteristic (Fig. 18). This also applies to the CA3089E families. If the signal path correction is wrong, then the detector exhibits a d.c. offset, although the demodulation characteristic will not be adversely affected by even quite a large d.c. offset.

As this d.c. characteristic is used to drive the a.f.c., it may appear to be irrelevant in a synthesised tuner—but in this instance, the a.f.c. is used in the deviation muting system to provide a signal to stop the tuning synthesiser from scanning, and so must be accurate and fast in operation.

The a.m. i.f. transformer T1 is apparently in the way of the f.m. i.f. signal, but the reactance of the 180pF capacitor in the a.m. i.f.t. is a low value at 10·7MHz, and thus does not affect operation at f.m. However, this i.f. is in a sensitive path for the f.m. signal with regard to the detector time delay mentioned above. Any extra capacity

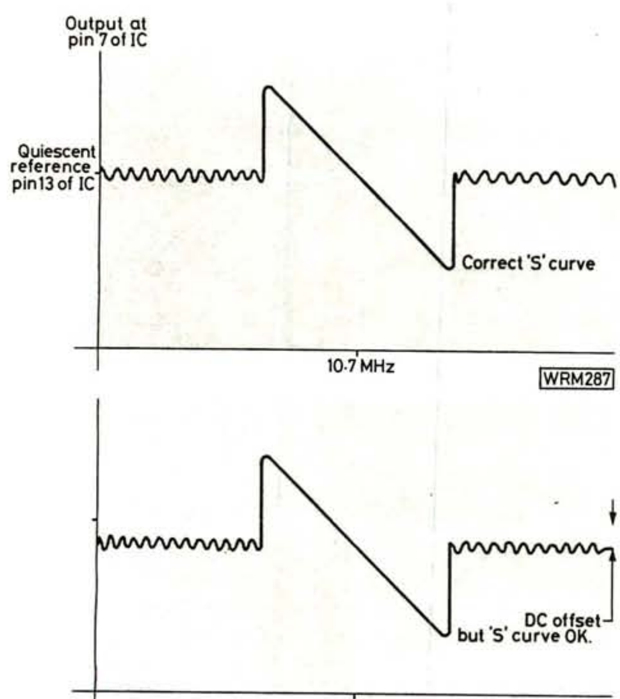


Fig. 18: The effect of a d.c. level shift at the f.m. detector

CONSTRUCTION RATING
Advanced

BUYING GUIDE

Some of the component types for this project, especially in the f.m. i.f./a.m. tuner module, are critical from the point of view of physical size. The specialised semiconductors and all the filters and inductors are available from Ambit International (see Advertisers' Index). Ambit are also able to supply the ready-built f.m. tuner modules, and kits for the remainder of the modules and units.

The non-specialised components and the printed circuit boards should also be available from regular suppliers among our advertisers.

The cost quoted below is for the parts required to build the complete tuner, in the case shown in our photographs.

APPROXIMATE COST
£150

here will cause d.c. offset to occur, and will confuse the choice of choke. No part of the secondary of the a.m. i.f.t. should be grounded, since the capacity between the i.f. primary and secondary will be enough to cause an incurable offset if the secondary is more than just a couple of turns.

Such stray capacity effects may be compensated by changing the value of the choke feeding the f.m. quadrature coil, but then the amplitude of the i.f. signal passing through would be attenuated if the choke value were increased. The signal level muting of the TDA1090 relies on the i.f. signal at pin 11 being 160mV r.m.s. under limiting conditions.

The original aim of offering the a.m. i.f. with a secondary was to provide an undetected output of the 468kHz i.f. signal for use in such things as product detectors, n.b.f.m. ratio detectors, etc. In a number of applications, the d.c. offset created by grounding one side of the secondary may not adversely affect the f.m. audio quality—but absolute accuracy of the a.f.c. output is necessary for the correct operation of the scan detector circuitry.

As the TDA1090 does not possess internal deviation (detune) muting, it is necessary to provide these facilities externally. Transistors Tr3 and Tr4 form a differential amplifier with their emitters referred to the i.c. reference voltage at pin 13. Transistor Tr5 is driven from either the signal muting (pin 14) or the a.g.c. (pin 15). Using the muting signal from the a.g.c. source enables selection of only the high-level input signals, to avoid stopping at each of those signals recognised by the standard muting system, since many will be noisy under stereo listening conditions. This option has been "hardwired" in the tuner described here, although it could be switched if required. The excep-

★ components

FM IF & AM TUNER MODULE

Resistors

¼W 5% carbon film

100Ω	1	R19
270Ω	2	R21,27
330Ω	2	R9,17
390Ω	1	R14
470Ω	1	R16
820Ω	1	R15
1kΩ	2	R26, 36
2·2kΩ	2	R18, 20
3·3kΩ	1	R13
4·7kΩ	7	R2,4,6,12,22,28,39
10kΩ	5	R24,25,30,31,34
12kΩ	1	R1
18kΩ	2	R8,40
47kΩ	1	R33
100kΩ	3	R29,32,35
220kΩ	6	R3,5,7,11,37,38
1MΩ	1	R10

0·1W min. horizontal preset

470kΩ	1	R23

Semiconductors

Integrated circuits

ULN2242A or TDA1090	1	IC1
Transistors		
BC238	2	Tr3,5
BC308	2	Tr4,6
BF274	2	Tr1,2
Diodes		
BA182	12	D1–12
KV1215-100*	2	D13–18
1N4148	1	D19

*Triple discrete varicap (Toko)

Miscellaneous

IC socket, 20-pin × 0·3in d.i.l. P.c.b. connectors, 0·1in pitch, board/wiring: 2 off 12-way. Printed circuit board. Screening box assembly.

Capacitors

Polystyrene		
100pF	1	C2
220pF	2	C8,11
470pF	2	C5,36
1·5nF	2	C18,19
Sub-min. plate ceramic		
56pF	1	C25
Low voltage disc ceramic		
10nF	8	C3,6,9,12,13,14,27
22nF	7	C16,17,20,26,30,33,35,38
47nF	3	C28,32
Tantalum bead, 10V		
100μF	1	C24
Tantalum bead, 25V		
2·2μF	1	C23
10μF	2	C22,31
Electrolytic, p.c. mounting, 16V		
10μF	1	C21,29
100μF	1	C15
Trimmers, foil (Dau TC2)		
2–22pF	6	C1,4,7,10,34,37

Filters & Inductors

FL1, FL2	CFSE (2 off, must have same colour group)
FL3	CFM2 468B
L1	7mH Can 1980
L2	470μH 8RB 471J
L3	5·6mH 8RB 562K
L4	18μH 7BA 180JE
T1	7E LMC4102A
T2	10K KACSK586
T3	Can 4718
T4	Can 4786
T5	RWO 6A 7752
T6	YXRS18576AQ 78443
T7	154AN 7A 6441
T8	154FN 8A 6439

tionally keen can even arrange for the muting level to be switched from a circuit that checks to see if the signal is stereo or mono, and selecting the muting level rate accordingly.

The emitters of Tr3 and 4 are held at reference (approx. 5·6V); their bases are commoned and monitor the decoupled a.f.c. output from pin 7 of the i.c. The a.f.c. swing centres on the reference voltage, thus if the a.f.c. voltage goes approximately 0·6V either high or low of the reference, then either Tr3 or Tr4 conducts (respectively). If Tr3 conducts, Tr6 conducts holding the deviation muting output (pin 10 of the module) in a high state. If Tr4 conducts, then Tr5 also conducts, thus Tr6 conducts—and the muting output stays high. Transistor Tr5 also monitors either the a.g.c. (by linking pins 7 and 8 on the module)—or mute (link 6 & 8). If a.g.c./mute is high (low signal level), then Tr5 conducts, Tr6 conducts, and once again the mute output stays high.

Only if the a.g.c. or mute is low (signal tuned in) and the a.f.c. is centred within 0·6V on the reference can Tr6 turn off, driving the deviation mute output low. Applying this to the muting input of the i.c. on pin 8 via diode D19, means that the deviation mute signal cannot hold the mute shut (audio off) when the signal is high. However, it can assist in holding the mute open (audio on) when the signal is low.

The full deviation muting facility is available when a 47kΩ resistor is applied between pins 5 and 11 of the module. This holds the mute open if the deviation mute output is high. Thus, manual override of all deviation mute facilities is available at pin 5 of the module.

The operational bandwidth of the deviation muting system is set by the voltage at the bases of Tr3 and Tr4. The swing of the a.f.c. voltage at pin 7 is determined by the resistance from pin 7 to V_{ref} (i.c. pin 13), since the a.f.c output is a current source/sink, and not a voltage in its own right. Values are chosen for a ±20kHz bandwidth of operation (or "window"), to enable the scan detection to operate accurately with the synthesiser selecting the f.m. band in 50kHz steps (Fig. 19).

The detected audio output appears at pin 6, together with a lot of unwanted i.f. signal, and unless the i.f. is effectively decoupled, it will lead to instability if it gets near the

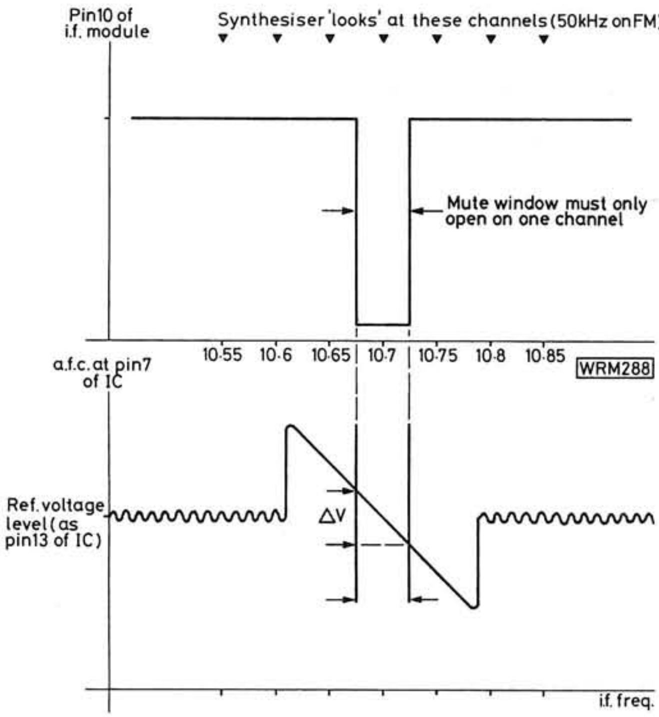
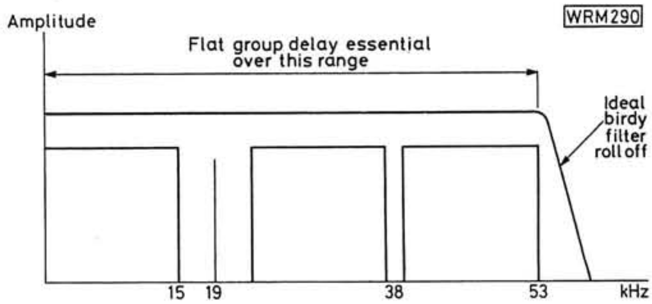


Fig. 19: Deviation mute window determination. The values of R22 and R34 are chosen so that the a.f.c. voltage swing is sufficient to turn on Tr3 and Tr4 (Fig. 14) at the extremes of the mute window

Fig. 20: Requirements for the multiplex birdy filter



10·7MHz input. The usual tricks don't work. A 10nF ceramic disc capacitor will get rid of the i.f. signal, but also reduce the audio bandwidth long before the 53kHz required for a composite stereo signal has passed through. A value of 100pF would be better, but since the TDA1090 is also an a.m. i.c., the 468 kHz i.f. of the a.m. section must be taken out as well, or the a.m. will become unstable. The answer is a correctly designed 55kHz low-pass filter, sometimes referred to in this context as a "birdy" filter, which offers large attenuation at anything above 55kHz, but does not affect the band of frequencies below 55kHz (Fig. 20). This filter also helps to reduce stereo birdy noises brought about by the presence of the extremes of adjacent f.m. signals in the 55kHz composite baseband, since although the centre frequencies of two f.m. signals may be separated by 200kHz (unusual under normal UK listening conditions), there is plenty of scope for the extreme sidebands to mix and produce high frequency products above 55kHz. This filter is formed by C18, L1 and C19.

Next month, we deal with the decoder, a.m. tuner and remote switched/tuned ferrite rod aerial, and begin constructional details.

Follow-up to THE PW NIMBUS

M. TOOLEY & D. WHITFIELD

The next module in the *PW* "Nimbus" series, a 16-channel scanner with lock-out facilities, will commence in our January 1981 issue

It may seem a little odd to publish a follow-up article before the series has even finished, but we thought it would be helpful to pass on some comments and advice which have arisen out of readers' experiences in building the basic *PW* "Nimbus" transceiver and the base-station adaptor.

In general, the comments have concerned the receiver, most constructors having found that the transmitter works satisfactorily, although for some the problems have been the other way around.

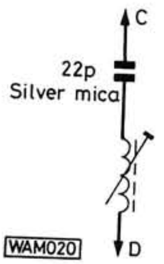


Fig. 1: A 72MHz trap. The coil is 4 turns of 22 s.w.g. enamelled copper wire, wound on a 4·8mm diameter former fitted with a dust iron core

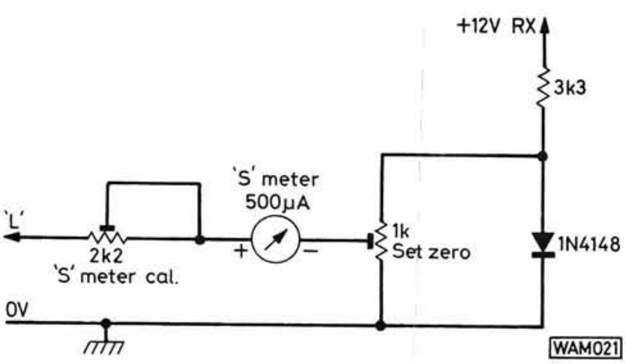


Fig. 2: Suggested "S" meter modification

1. Large transmitter output at half-frequency (72·5MHz). First of all, as most constructors will have realised, coils L7 and L8 are fitted with tuning slugs. Standard "500 grade" cores, as supplied by Maplin Electronics, were used successfully in the prototypes in L1–L8, but increased output could undoubtedly be obtained with v.h.f. "900 grade" cores in L5 onwards.

Very careful alignment of L7, L8 and TC5 is required to provide clean drive at 145MHz to Tr6. If 72MHz radiation is still a problem, then a series-resonant trap circuit (Fig. 1) should be connected across the transmitter output. To set up this trap, simply adjust the core to "suck out" the 72MHz signal. Alternatively, pre-tune it to 72MHz with a grid dip oscillator, connecting the coil and capacitor as a parallel resonant circuit for this adjustment.

2. Instability in the transmitter p.a. stage. The 2N4427 was selected for this stage because of its rather "tame" performance compared with other transistors (e.g., 2N3866), capable of producing a higher output but prone to go into self-oscillation when not correctly tuned. It may well be that there is a variation in performance of 2N4427s from one manufacturer to another, and in very difficult cases a 100Ω $\frac{1}{4}$W **carbon** resistor wired in parallel with RFC1 could be helpful. The resistor should be soldered to the underside of the p.c.b., with the shortest possible leads.

It is, of course, important that all decoupling capacitors (C7, etc.) are ceramic disc types, fitted close to the p.c.b. and with the shortest possible leads. They will otherwise be useless at the frequenies involved.

3. Squelch circuit ineffective. Regrettably, the CA3089/3189 is well-known for its poor squelch system, though it may be adequate for broadcast f.m. tuners! It is advisable to check that the quadrature coil (L105) has been connected correctly, with the primary winding to pins 9 and 10 of IC101, since with less than about 150mV of signal drive at pin 9, the squelch circuit will not operate at all.

On the prototypes, the squelch range was rather limited, and it was for this reason that the control was made a preset, rather than completely variable.

4. Large residual reading on the "S" meter. A large residual reading could be due to incorrect alignment of L104, since it is caused by 10·245MHz leaking into the second i.f. stages. If this cannot be reduced, try the modification shown in Fig. 2, which will provide a zero to full-scale "S" meter reading.

In cases where the residual reading is acceptable (it was about 10 per cent of f.s.d. on the prototypes) but full scale is not reached on an "S9" signal, reduce the value of R128 (try 2·2kΩ) to produce f.s.d.

The calibration of any "S" meter fitted to the *PW* "Nimbus" will be only somewhat arbitrary, and a 0–5 scale may well be preferable to a conventional dB scale.

5. Receiver first oscillator problems. As most constructors will have realised, the contents of Tables 3 and 4 (page 60, *PW* May 1980) have been transposed, although the formulae are correctly placed.

The first oscillator uses 45MHz overtone crystals, but the oscillator is basically a fundamental mode circuit with collector tuned broadly to 45MHz to select the third harmonic of the frequency of the signal at the base of Tr102. The reason for employing this rather unusual arrangement

continued on page 72 ▶▶▶

MODS

IMPORTANT—The ideas presented here are suggestions only, and as they are untried by this magazine, we cannot accept responsibility for any resultant damage, however caused. Before alterations are attempted, care should be taken to ensure that any guarantee is not invalidated, and it should also be borne in mind that modifications usually have an adverse effect on resale prices. In cases where specialist skills or equipment are needed, most dealers will undertake the work for a reasonable fee.

Roger Hall G8TNT (Sam)

No. 1

The title of this feature will be self-explanatory to most amateurs, but for those who think it has something to do with the fitting of chromed bubbles and eight-foot aerials to Vespas, it should be explained that, in this instance, "Mods" has no connection with "Mods & Rockers". It is, of course, an abbreviation of the word modifications, and is used by amateurs to describe alterations that can be made to improve the performance, or to extend the facilities of standard amateur equipment.

Mods come from a variety of sources; some from the manufacturers, some from dealers' workshops, and a large proportion from people who enjoy tinkering with their sets. Whilst some mods are adopted universally, some are known only to the originator and his immediate circle of friends. With this in mind, I hope to use this feature to extend some of the lesser-known ideas to a wider audience. In order to do this, I would like anyone who has modified any piece of amateur equipment, and who would like his idea published, to write to me at the address below. Please don't forget to include your name and address so that you can be given the credit (or the blame) for the idea. Initially we will be publishing dealers' mods, but I would like to use as many readers' ideas as possible, so please write to me if you have any tips to pass on.

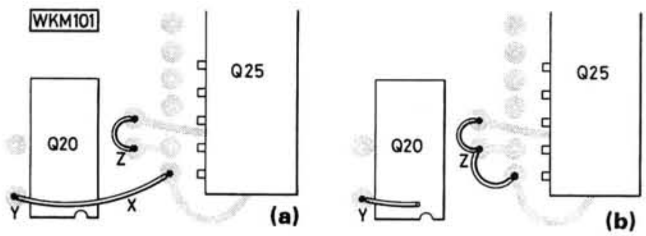
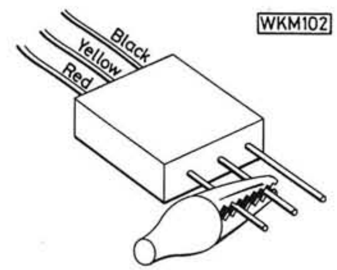


Fig. 1: Extending the frequency range. In some later models Q20 (TC9122P) and Q25 (μPD 651C–13) are numbered Q14 and Q15 respectively

This month, Lowe Electronics have suggested two very useful modifications for the Trio TR2400. The first is for those of you who may be holidaying abroad, and who wish to extend the range of the 2MHz European model to 4MHz, with direct keyboard entry over the entire range. Before starting, please note that although it is very simple electronically, physically it requires a fine-tipped soldering iron and a steady hand. Steve Boler, the Sales Manager of Lowe Electronics, has stressed that he does not want to be inundated with 2400s containing molten microprocessors.

The first step is to remove the faceplate, by undoing the two screws at the top of the back, and the two screws in the battery compartment, underneath the battery pack. Having done this, locate the two integrated circuits, Q20 and Q25, and the link wire X, shown in Fig. 1(a). Cut this wire approximately in the middle, strip back some of the insulation from the end that is still attached to Q25, then resolder it to point Z, see Fig. 1(b). Ignore the end attached to point Y. Now replace the faceplate, because that's all there is to it. It should now be possible to select any frequency between 143·900 and 148·495MHz by pressing the appropriate buttons on the keypad. One more word of caution, again from Lowes, beware of winning the WACS (Worked All Cop Shops) award, as the band above 146MHz is allocated to the police in the UK.



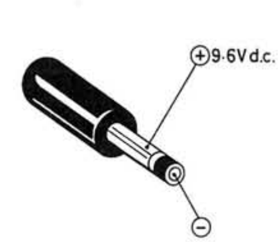


Fig. 2 (left): Identifying leads to be shorted
Fig. 3 (right): Polarity of the external power connector

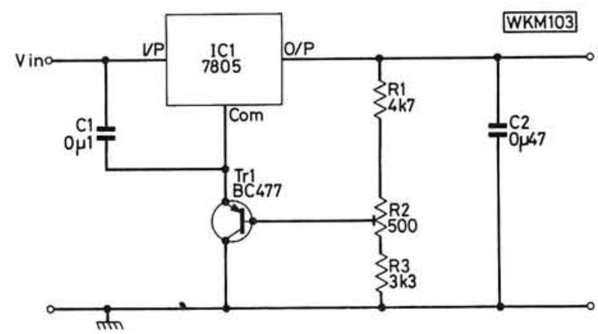


Fig. 4: A stabiliser circuit capable of providing +9·6V at currents up to 1A from a 12V car battery supply

The second modification enables the TR2400 to be run from an external power supply, and is even easier to carry out. The first step is to remove the battery pack and short out two of the pins on the connector inside the set, as shown in Fig. 2. A miniature crocodile clip is adequate, but if repeated use is anticipated, it would be better to obtain a suitable female connector, and to short out the appropriate two sockets, and to use this instead of the clip. With the pins shorted together, a 9·6V power supply can now be plugged into the "Charger" socket. Please note the polarity, see Fig. 3. A circuit for a suitable 9·6V supply is shown in Fig. 4.

A modified TR2400, used with a suitable power supply and a small power amplifier, could make an effective mobile or base station, without the inconvenience of the batteries dying halfway through a QSO.

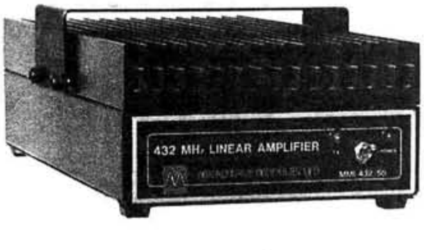
The address to write to if you have any modifications for publication is: R. S. HALL, Practical Wireless, King's Reach Tower (Hatfield House), Stamford Street, London SE1 9LS.

73's
Sam G8TNT

air test

USER REPORTS ON SETS AND SUNDRIES

Microwave Modules MML 432/50



Microwave Modules make a wide range of linear amplifiers and transverter units, and the subject of this report is their 50 watt linear for the 70cm amateur band. They also make a 100W linear, but the 50W version is the more popular, probably because of the price.

The MML432/50 is housed in a substantial sheet steel box with the printed circuit board fitted to the large aluminium finned heatsink which forms the box top. The power switch is fitted to one end of the box, and the connectors for the r.f. input and the aerial are on the opposite end. A robust mounting bracket is attached to the sides, bridging the heatsink to allow the linear to be mounted in a vehicle.

The 13·8V supply is fed to the amplifier via two heavy leads, and the supply is fused by a panel-mounted fuseholder next to the cable entry. When the MML 432/50 is being driven to its full power output of 50W, the current drain from the power supply is 8A, so it is essential to keep the power lines as short and direct as possible.

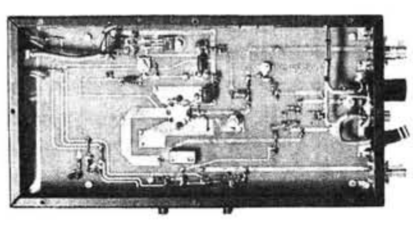
As well as the linear amplifier, the unit contains a 70cm pre-amplifier, the changeover from transmit to receive being carried out automatically by a VOX system operating on the r.f. input to the amplifier. The VOX can be overridden by an external switching system if desired, but the automatic system worked very well, and during the tests it was the only switching used.

Initial tests were carried out using the Standard C7800 f.m. rig to drive the linear. The power supply used for base-station tests was a large car battery, float-charged during use, this being the only means available at the time capable of meeting the high current demands. The C7800 pushes out about 12W, and this should have been more than enough to drive the linear to its full rated output of 50W. However, the maximum output measured was 48W, probably due to voltage drop on the supply lines. Reducing the input power to around 1W reduced the output of the linear to 5W. The 12dB or so of gain in the pre-amplifier section made no difference to the Standard as a base station, but this was put down to the superb performance of its receiver.

When used in the car, the linear did improve the coverage obtained from the Weymouth repeater GB3SD, but the improvements were only marginal with the C7800. Difficulty was found in getting the full rated power output from the linear, in this case definitely due to voltage drop along the wiring from the battery. In fact with the motor turned off and the linear driven by the Standard, the r.f. power output could be seen to fall off rapidly on the wattmeter, as the battery voltage decayed to its off-charge level.

The unit was also tested with a Philips FM321 transceiver, and the improvements here were dramatic. The pre-amplifier gain brought the receiver performance up to the same level as that of the C7800, and the linear improved the 6W output to a healthy 30W. This allowed simplex operation between the Standard as a base station and the Philips run mobile over a range of some 15 miles, compared to about 6 miles or so with the Philips running barefoot.

The MML 432/50 was not tried with s.s.b. equipment, and this is undoubtedly where its benefit would be most noticeable. Obviously it is essential to ensure that the unit is supplied with 13·8V through cable of sufficient size to prevent undue power loss due to voltage drop. Otherwise, the unit is very simple to install and use, and can really transform a rig with an average performance.



The MML 432/50 costs £116.60 including carriage and VAT, from **Microwave Modules Ltd., Brookfield Drive, Aintree, Liverpool L9 7AN, telephone 051-523 4011,** to whom we offer our thanks for the loan of the review unit. It is also available from authorised retail stockists around the UK.

AR-22 PLL FM Receiver

The AR-22 is a pocket-sized v.h.f. f.m. receiver tuning over a range of 141·000MHz to 149·995MHz, which includes, of course, the 2m amateur band. A phase-locked loop synthesiser gives coverage in 5kHz steps, with direct setting and read-out of tuned frequency by three digital push-switches and a slide switch. Sensitivity is quoted as 0·2μV for 12dB SINAD, with a −60dB bandwidth of 24kHz. Dual conversion is used (i.f.s are 10·7MHz and 455kHz) with spurious and image rejection specified as better than 50dB down.

The AR-22's diminutive size (136 × 64 × 25mm overall) also houses a 225mAH 4·8V NiCad battery pack. Consumption is quoted as around 25mA with the receiver squelched, rising to around 100mA when delivering its maximum rated 100mW into an 8Ω load.

Supplied with the set are a 100mm helical whip antenna, a λ/4 wire antenna, an earpiece, a charger unit capable of restoring the battery pack to full vigour in around 10 hours, and an owner's manual.

Results

The AR-22 is a very sensitive receiver with a sound output of very adequate volume and quality. Best results are obtained with the wire antenna, as might be expected, but the more convenient "mini rubber duck"

does well for itself. At the home QTH, some three quarters of a mile from GB3SC, that station comes through, albeit noisily, even with no antenna plugged in. This is obviously due to the lack of any screening in the plastics case, plus a fair length of unscreened wire between the antenna jack and the p.c.b., which although double-sided does not incorporate an earth-plane. The manual in fact warns against using the set in the vicinity of a transmitter, where the field strength might exceed 1V/m.

With its small size and low weight (around 200g) the AR-22 is truly a pocket set. It is a shame that its designers went completely overboard on the arrangement of the controls. Frequency setting arrangements are alright, but the knobs on the Squelch and Volume controls are each 7mm in diameter and 7mm high including the bar on top. The clearance between them is only 2mm, and between the Squelch knob and the base of the helical antenna only 1mm. The controls themselves are stiff anyway, and even using just finger- and thumb-nails on the top bar, are very difficult to adjust sensibly.

The manual gives the specification and operating instructions, but no service information whatever. Looking inside the set, it is so miniaturised and tightly packed that any repairs would be beyond the capabilities and facilities of most owners anyway, so this is perhaps a minor point.

The AR-22 costs £99 including carriage and VAT from **Bredhurst Electronics, Mid Sussex House, High Street, Handcross, West Sussex RH17 6BW, telephone 0444 400786,** to whom we offer our thanks for the loan of the review unit.

Have you seen our survey of Multi-mode 2m mobiles?

OF THE MONTH

Brian DANCE M.Sc

The SG3524 Regulating Pulse Width Modulator

Introduced by Silicon General Inc. in 1976 as the first monolithic switching regulator control device, the SG3524 was soon second-sourced by Texas Instruments Ltd., and is now an "industry-standard" type—which means it is produced by many manufacturers. Containing all of the semiconductor devices required to make a regulated power supply, invertor or switching regulator circuit integrated onto a single chip, it can also be employed as the controlling element of a high power circuit.

The SG3524 was designed for switching regulators of either polarity, transformer-less d.c.-to-d.c. converters, transformer-less voltage doublers and for polarity converter applications employing fixed-frequency pulse-width-modulation techniques, and also for other power control applications.

Encapsulated in a 16-pin dual-in-line package with the connections shown in Fig. 1, the device contains a voltage reference which is used as a standard voltage, an error amplifier, an oscillator circuit, a pulse-width-modulator circuit, a pulse steering flip-flop circuit, a pair of alternating output switching devices together with current limiting and protective shut-down circuitry.

The absolute maximum power supply voltage rating for the SG3524 is 40V, but it is wise to regard the maximum as being about 35V to prevent the possibility of damage with supply fluctuations or transient voltage spikes. The quiescent current is about 8mA, increasing when a load is applied, with a maximum permissible current from collector 1 or collector 2 of 100mA.

The internal reference block provides an output of 4·6V to 5·4V (typically 5·0V) at pin 16, and current of up to 50mA may be taken from this pin. As the input voltage increases from 8V to 40V, the voltage of pin 16 varies typically by 10mV (maximum 30mV) and, as the load current at this pin increases from 0 to 20mA, the voltage varies by about 20mV (maximum 50mV). The variation of the reference voltage with temperature is typically 0·3 per cent (maximum 1 per cent) over the range 0°C to +70°C and the long-term stability at 25°C some 20mV per 1000 hours of use.

The Oscillator

The internal oscillator circuit requires an external resistor R_T from pin 6 to ground and an external capacitor C_T from pin 7 to ground. The charging of the capacitor by a current passing through the resistor provides a linear ramp waveform for timing the oscillator circuit. The charging current is equal to about 3·6V divided by R_T, so the value of R_T should be 1·8kΩ to give 2mA.

It is recommended that the values of C_T should lie in the range 1nF to 100nF, since the value of this capacitor determines the pulse width of the oscillator output pulse; a pulse width of less than about 200ns may allow false triggering of one output by removing the blanking pulse before the flip-flop has reached a stable state. It is possible to synchronise a SG3524 to an external signal or to another SG3524.

In many cases a stabilising network consisting of a resistor and a capacitor in series will be required from pin 9 to ground. A 50kΩ resistor in series with a 1nF capacitor will usually be satisfactory for stabilisation of the error amplifier.

A current of 200μA taken from pin 9 will disable the SG3524.

The output circuit consists of two transistors with both the collectors and emitters available at external pins. Both transistors have anti-saturation circuitry which limits the current through each transistor to a maximum of 100mA for a fast response.

Applications

The SG3524 can be employed in a very wide variety of applications. Broadly speaking these can be classified into three main types:

1. Capacitor-diode coupled voltage multipliers.
2. Inductor-capacitor implemented single ended circuits.
3. Transformer coupled circuits.

Capacitor-diode Circuit

The capacitor-diode circuit of Fig. 3 is a simple polarity converter which produces a −5V supply from a +15V input. This circuit can provide an output of up to 20mA without any additional current boosting transistors.

The output transistors are current limited by the internal circuitry of the device, so no additional protection circuitry is required. A particular feature of this very

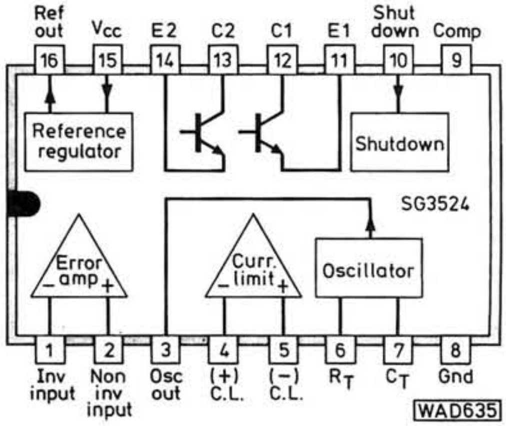


Fig. 1: The connections to the SG3524 device

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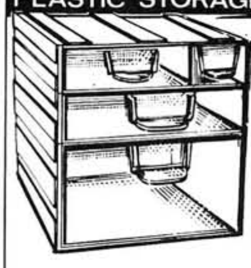

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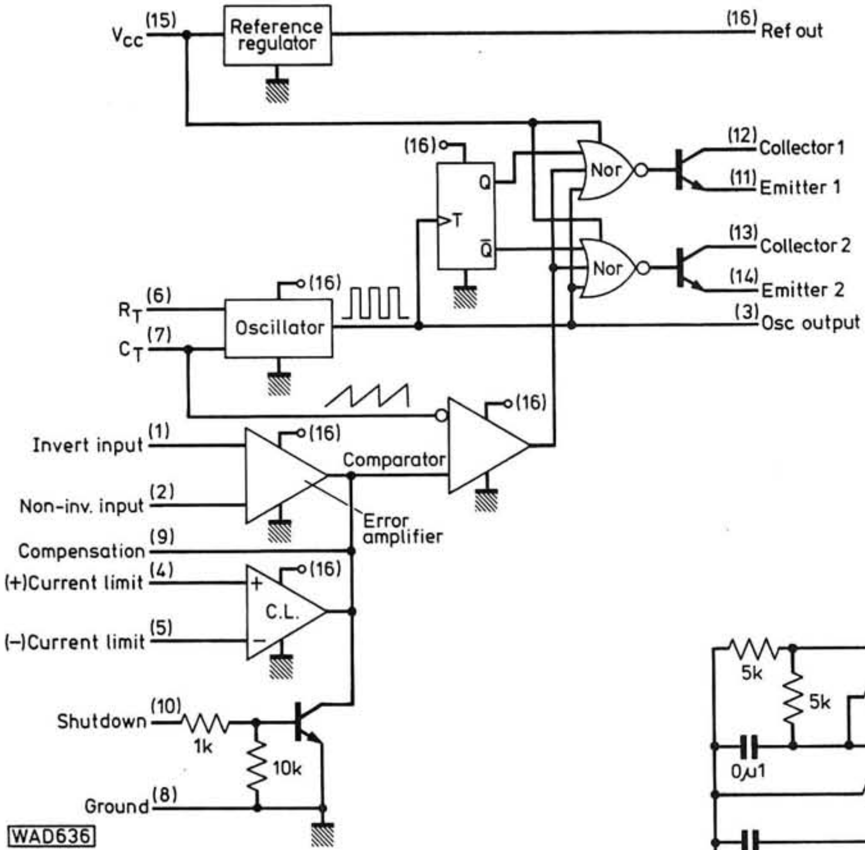


Fig. 2: Internal circuitry, in block form, of the SG3524

simple circuit is the absence of inductions which saves the constructor the problems associated with obtaining components.

During the time a current passes to the collector 1, this current flows from emitter 1 to charge the 20μF capacitor so that its left-hand side is positive. A fraction of a second later transistor 2 conducts; this means that collector 2 is effectively earthed, since emitter 2 is earthed. As the left-hand side of the 20μF capacitor is now earthed and as it is more positive than the right-hand side, the latter must be a negative potential. This negative charge is used to charge the 50μF output reservoir capacitor through a 1N916 diode. This type of circuit with two diodes is known as a diode pump, since charge is pumped through it to be stored in the 50μF reservoir capacitor at the output.

The output voltage is fed back through the 15kΩ resistor, stabilising the output voltage.

More Current

The circuit of Fig. 4 shows how the SG3524 may be used to provide a stabilised output of +5V at a current of up to 1A suitable for driving TTL circuits. The SG3524 cannot itself provide more than 100mA of output current and therefore an additional device is required which can pass the larger current and which is controlled by the collector outputs of the SG3524. In the circuit shown this device is a TIP115 power Darlington manufactured by Texas Instruments Ltd.

As in the circuit of Fig. 3, the inverting and non-inverting inputs of the error amplifier are kept at a potential of +2·5V. In the circuit of Fig. 4, the positive output voltage is divided into two equal parts and fed to the inverting input of the error amplifier, while the +5V reference output is similarly divided. The feedback mechanism maintains the potentials of pins 1 and 2 approximately equal. If the output voltage tends to rise above

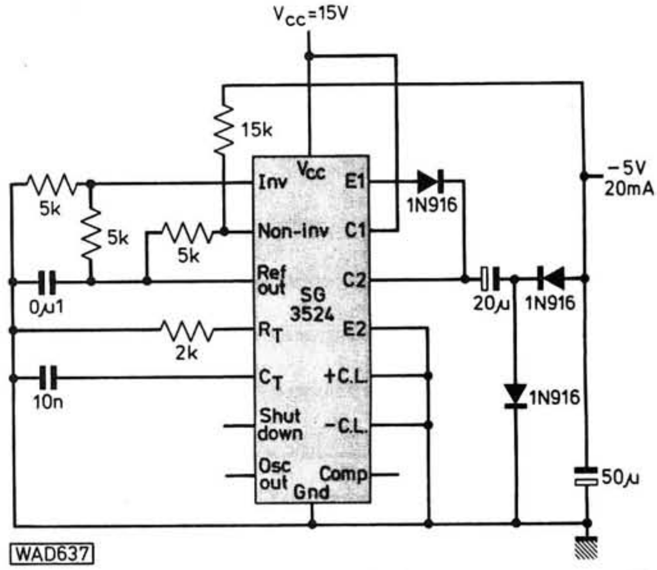


Fig. 3: An invertor circuit providing an output of −5V, 20mA

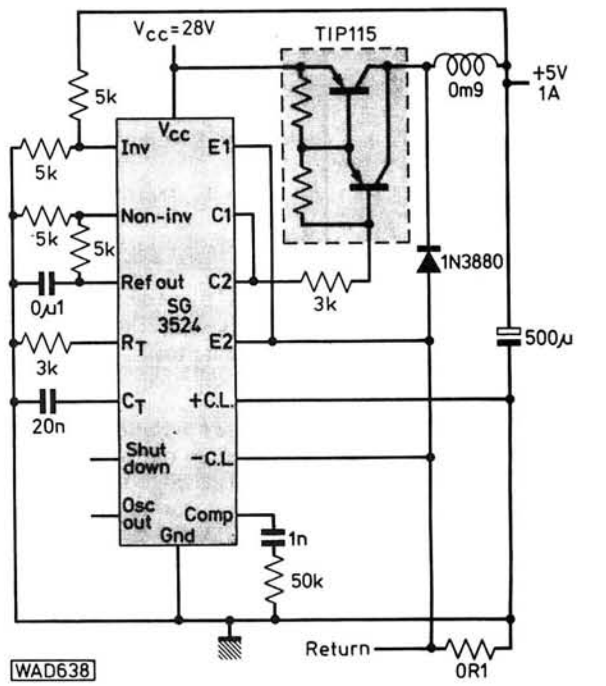


Fig. 4: This circuit uses an external TIP115 Darlington to boost the maximum ouput current to 1A

+5V, less charge will be fed into the 500μF output capacitor per unit time so that the output voltage drops towards +5V. Similarly, if the output voltage falls below +5V, more charge per unit time will flow into the output capacitor to raise the voltage to +5V (in the Fig. 3 circuit, the feedback is taken to the non-inverting input, since the ouput is negative).

The inductor used in Fig. 4 must have a very low series resistance if the circuit is to operate at maximum efficiency. A Mullard "RM" core with an inductance factor of 250nH can be used; this means that the inductance of a one turn coil is 250nH. As the inductance is proportional to the square of the number of turns, 60 turns will provide the required 900μH inductance. The wire diameter should be as large as can be accommodated on the former of a RM10 core; and should be about 0·7 to 0·75mm. Smaller cores of the "RM" series, such as the RM6 type, would result in the use of thinner wire of higher resistance; lowering the power efficiency of the circuit.

Conclusions

In order to avoid interference problems, the output capacitor should be soldered as close to the SG3524 as possible, and must be a good quality component. A capacitor of about 10μF should also be soldered directly between pins 15 and 8 to decouple the power input supply, unless the lead from the raw power supply is very short.

The SG3524 device and the RM10 core are available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex CM14 4BN. ●

PW "NIMBUS" FOLLOW-UP

▶▶▶ *continued from page 64*

was that crystals in the 15MHz region for 2m receivers are not generally available, whilst overtone types at 45MHz are available from several sources, cheaply, and ex-stock.

It was also found that this arrangement, when used with overtone crystals operating on their fundamental (45 ÷ 3), does give quite a large trimming range using capacitor trimmers, rather than the inductor trimmers more commonly used with overtone crystals.

Incidentally, crystals from two sources were tried in the prototypes, and no difficulties were experienced in getting the overtone crystals to oscillate readily in the fundamental (Colpitt's) circuit of the *PW* "Nimbus". The slight error in frequency which occurs when overtone crystals are operated at their fundamental was easily accommodated by means of the series trimming capacitors.

6. Low output from the base-station adaptor. The use of the optional filter unit on the output of the amplifier is strongly recommended, in order to reduce spurious emissions to the absolute minimum. The loss of 145MHz due to this filter should not exceed about 1·5dB. If it does, repeat the alignment process for the filter and check that the coupling capacitor C101 is a suitable type for use in r.f. power circuits. A possible alternative is to replace it by a "gimmick" capacitor, formed by twisting together two short lengths of pvc-insulated solid wire. The value can be adjusted by trimming the length of the wires and repeating the filter alignment process until the insertion loss is acceptable.

DON'T GET CAUGHT BENDING!

A neat printed circuit board is the hallmark of a good radio constructor, but to achieve this, all the leads of axial components such as resistors and diodes need to be accurately bent at precisely the correct hole spacing before being fitted to the board.

With the *Practical Wireless* Lead Bending Gauge, presented free with this issue, you can perform this neat bending simply and quickly.

The tapered end of the tool allows a variety of different hole spacings to be accommodated. Simply select the appropriate groove to give the desired spacing, place the component centrally in the slot, with its leads lying along the groove, and carefully fold the leads over the sides of the tool.

Other lead bending gauges have stopped at folding the leads—ours is different! At the opposite end is a useful set of gauges. The holes have been chosen to enable you to check on the sizes of drills needed to fit commonly-used screws and components such as potentiometers and switches. Around the outside of the tool is a series of slots. To check the gauge of a wire, gently try it for fit in the slots until you find the one that just lets the wire slip through to the inner hole. This slot gives you the wire gauge size. Do not force the wire through the slot, as this will tend to open it up, making it useless for further checks. Note that the slot is the gauge, **not** the inner hole.

★ specification

Component length: 11mm (maximum).
Range of lead spacings: 13mm to 50mm (approximately).
Drill sizes gauged: 0·8mm, 1·0mm, 4mm, $\frac{1}{4}$in, $\frac{3}{8}$in, tapping and clearance sizes for 4, 6 and 8BA screws.
Wire sizes gauged: 16 s.w.g. to 44 s.w.g. (even sizes only).

PRODUCTION LINES

ALAN MARTIN G8ZPW

New Shure Mic.

Over many years the Shure Model 444 has been regarded as the "standard" among fixed-station microphones, now an improved version has been introduced, it is the Shure Model 444D.

Among the new features is a high/low impedance selector switch, located beneath the base of the unit, which will increase compatibility with existing fixed-station equipment, also an easy-to-use slide switch is provided for normal/VOX operation. These new features join the unit's existing momentary or locking p.t.t. switch bar, the Controlled Magnetic microphone, height adjuster and tough Armo-Dur case that is impervious to rust and deterioration.

Other added features are a coiled input cable, personalised nameplate with your station callsign, and a new wiring guide which provides instructions for wiring the microphone to major manufacturers equipment.

Priced at £31·80 plus VAT, the Model 444D is available from most good amateur radio equipment stockists or direct from: *Shure Electronics Ltd., Eccleston Road, Maidstone ME15 6AU. Tel: (0622) 59881.*

Fuelstretcher

Following a mention in "Production Lines" of specialised low-cost fuel conservation and car electronics components in the June issue of *Practical Wireless*. The company concerned, Envirosystems Ltd., announce the availability of kits using these devices.

The FSX20 petrol consumption monitor displays an instantaneous digital read-out of m.p.g., with a choice of two update frequencies to suit individual driving conditions, automatic clear-down under idling and simple owner calibration facility, which makes the system generally applicable to most vehicles with carburettor fuel systems and cable driven speedometer. A unique petrol injection option is available to compensate for fuel returned to the tank.

The FSX10 petrol consumption recorder displays total gallons used, with reset facility to allow determination of overall fuel consumed and average m.p.g. This kit is lower priced as it requires fuel sensor input only.

Both kits are suitable for vehicles employing a 12V d.c. negative earth system and come complete with digital transducers, p.c.b.s and all other components, including an attractive display case. Construction and installation instructions are provided with the kits and a technical back-up service is available.

Prices inclusive of VAT and p&p for the UK are as follows: FSX10 kit £34.80; Basic FSX20 £47.50, and including the petrol injection option £65.90.

Further details from: *Envirosystems Ltd., Hampsfell Road, Grange-over-Sands, Cumbria LA11 6BE. Tel: (044 84) 4233.*

Ring Main Tester

At the very least, an incorrectly wired socket can damage valuable electrical equipment; at its worst it can be physically dangerous.

Martindale, the Neasden-based company that specialises in industrial safety equipment and electrical test instruments, has now introduced its simple Ring Main Tester for use by the householder.

No larger than a conventional plug, the Tester is simply fitted into a standard 13A socket to give instant visual identification of the polarity of the wiring. Correct wiring, faulty earth connections, faulty neutral and reversed live/neutral connections are immediately shown by combinations of the carefully selected neons on the face of the Tester adjacent to explanatory diagrams. A fault in the live connection or supply is indicated when no neons are lit.

The Ring Main Testers are available from local hardware, do-it-yourself and electrical retail outlets at around £4.70 plus VAT. Any difficulty in obtaining the Tester should be referred to: *Martindale Electrical Co. Ltd., Neasden Lane, London NW10 1RN. Tel: 01-450 8561.*

RTTY to TV Converter

Recently introduced by Microwave Modules Ltd. is the MM2000, a RTTY to TV converter which, among others, should be of particular interest to readers of the "Introducing RTTY" series currently running in *Practical Wireless.*

The unit requires only an audio signal link from a receiver, a 12V d.c. supply and a suitable link to a TV, to enable a live display of "off-air" RTTY and ASCII on a domestic standard u.h.f. TV set.

The following modes of reception are accepted by the converter: Amateur Standard ASCII, 300 baud; Murray Coded RTTY, 45·5, 50 and 75 baud. In each of these four modes, the converter will accept FSK and AFSK signals.

Utilising two m.p.u.s and 21 i.c.s, the MM2000 is constructed on two p.c.b.s, all housed in a black diecast enclosure measuring 187 × 120 × 53mm and weighs only 1kg.

The MM2000 costs £169 which includes VAT, and is available from: *Microwave Modules Ltd., Brookfield Drive, Aintree, Liverpool L9 7AN. Tel: 051-523 4011.*

PRODUCTION LINES

ALAN MARTIN G8ZPW

VHF Wavemeter

If you hold an amateur radio licence, one of the conditions of that licence reads something like this, "an absorption device of suitable frequency range and accuracy is necessary . . . and the frequency coverage must extend up to the second . . . harmonic . . .

Packer Communications can supply an accurate and reasonably priced absorption wavemeter, called the WM-2a. The range covered is 130MHz to 300MHz and each unit is individually calibrated, the unit also employs a sensitive 50µA meter.

The WM-2a costs £19.95 plus VAT and 85p p&p, other models are available covering 100kHz to 1GHz.

Further details from: *Packer Communications, Bridge End Barn, Soutergate, Kirkby-in-Furness, Cumbria LA17 7TW. Tel: (022 989) 448.*

Bib Record Clamp

The trouble with plastic records is that they are prone to warp, through bad storage or heat. With delicate stylus tracking pressures it is imperative that the record is not allowed to float up and down the centre spindle, thus creating distortion as the stylus is thrown from one side to the other of the microgroove.

The Bib Record Clamp, especially designed to overcome the problem, fits over the centre spindle on single play decks and is locked in position, creating a firm bond between the record and turntable. This helps to flatten the warped record and eliminate vibration. The fitted stroboscopic disc allows determination of r.p.m.

The Bib Record Clamp is generally available through most good Hi-Fi dealers and record shops, priced around £2.50 which includes VAT.

Bib Hi-Fi Accessories Ltd., Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ. Tel: (0442) 61291.

DMM Kits

Lascar Electronics are now also selling their digital l.c.d. multimeters in kit form.

The kits are being made especially as an educational aid, giving an insight into design of digital measuring instruments, the constructor also gains practical experience in working with double-sided p.c.b.s and l.s.i. integrated circuits. Being in kit form the instruments also offer a large cost saving.

Both models feature a 0·5in l.c.d. readout with "battery low" warning, five functions (a.c./d.c. volts, a.c./d.c. current and resistance) with ability to check diodes.

Inputs are fully protected against overloads and transients, with ability to withstand mains on any range.

The LMM-200 is a hand-held multimeter with a 0·5% basic accuracy, and 15 ranges. The LMM-100 is suitable for field or bench use, has a 0·1% basic accuracy, and 25 ranges. It also features an adjustable and digital hold facility.

The kits are priced as follows: LMM-200 £39.04, LMM-100 £69.80, both prices include VAT and p&p.

Lascar Electronics Ltd., Unit 1, Thomasin Road, Burnt Mills, Basildon, Essex SS13 1LH. Tel: (0268) 727383.

Soldering Station

The new version of the Antex TCSU1 soldering station, meets the latest requirements for precision temperature-controlled soldering. The station is constructed in one of the toughest and most durable moulding materials available.

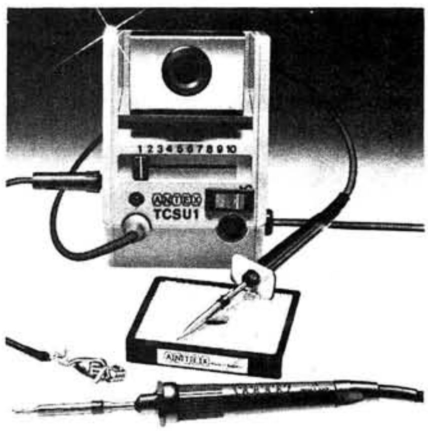
A significant addition is the anti-static earth connection to protect m.o.s. devices from damage caused by static electricity, this is achieved by inserting the jack with the special earthing cable in the socket at the side of the unit, which makes contact to a specifically made "earth", thus eliminating any static charge.

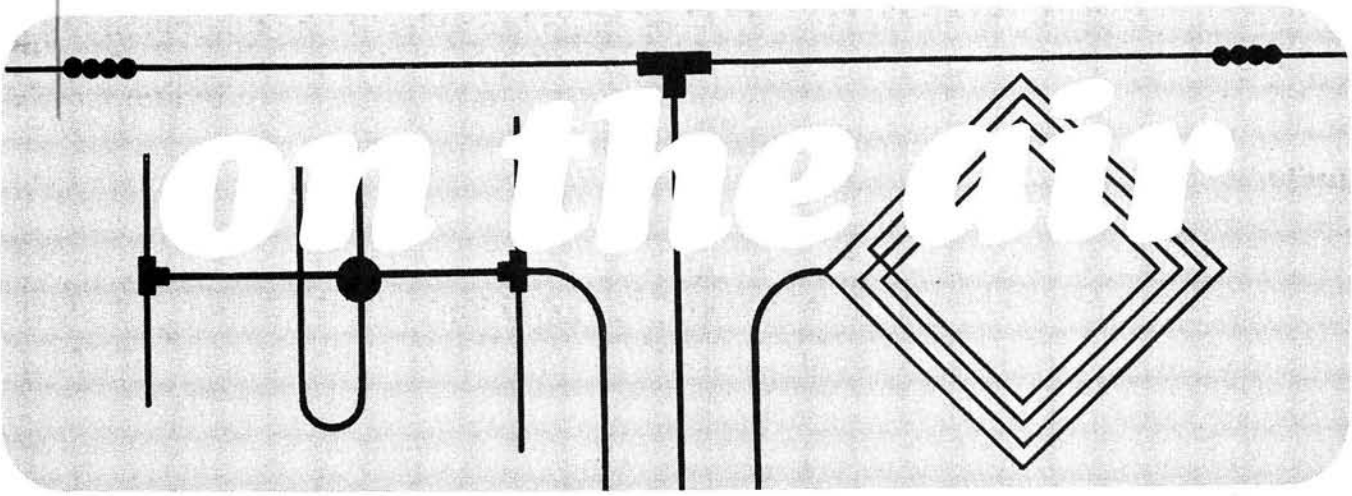
The station is supplied with either the miniature CTC 40 watt iron or the XTC 50 watt model. Both irons are fitted with 5-core, silicone, burn-free cable with 5-pin DIN socket which connects with the 24V supply from the station. Thermocouples, at the front of the irons, sense the temperature which is kept at a pre-set level between 65°C and 420°C with an accuracy of 2%. A range of three long-lasting bits, heavily coated with iron, is included with each iron for micro, miniature or general soldering work. The bits slide easily on or off the iron's stainless steel shaft.

Temperature control switching is done electronically at zero voltage, avoiding such evils as magnetic fields, arcing transients or spikes. A separate sponge tray is supplied with each station.

Like all Antex products, the TCSU1 is made in England to a British design, and costs (with either of the irons) £38 plus VAT and £1.75 p&p. Separately the irons cost £9.75 plus VAT and 45p p&p.

Available from many retail outlets throughout the country, or direct from: *Antex, Mayflower House, Plymouth, Devon. Tel: (0752) 67377.*





Amateur Bands

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR
Silver Firs, Leatherhead Road,
Ashtead, Surrey KT21 2TW.
Logs by bands in alphabetical order.

There is one sure way for the DXer to hear a lot of countries on the h.f. amateur bands in a very short time, and that is to listen to the control station making a "list" of stations wanting to QSO a particularly rare bit of DX who wants to do things the easy way! Readers frequently ask what all this "list" business is about so a brief explanation may help.

DX pile-ups have existed ever since amateurs were interested in working as many different countries or prefixes as possible, usually by calling the DX station on his own frequency, with the strongest signal getting through for a very brief exchange of reports and nothing more. When the big boys have made it, the weaker stations may have a chance, provided conditions haven't changed too much in the meantime. There is a definite technique to be learned in pile-ups if one is to be successful without the aid of high power or expensive aerial systems. Personally speaking, I always enjoy a pile-up but there are many who don't!

The operator at the DX end can handle a pile-up quite expeditiously if at all experienced, but if he happens to be new to the game then all is chaos and he frequently just gives up, which is a pity. The current alternative to the pile-up is for an experienced DXer, generally with a potent, world-wide signal, to take the DX station under his wing and to act as a control station, taking down a list of stations wanting to work the DX station, by inviting them to call in, usually by continents or countries or prefixes. So when control asks: "any G4's?" I just say "G4AR" and if he repeats my call I know I'm on the list!

The eventual length of the list can be quite staggering but when a halt is finally called our controlling hero checks that the DX station is on frequency and asks the first one on the list to exchange reports with the DX fellow, and so on down the list, as called out by the control station. And this is where the first fault in the system raises its nasty head! For the DX station can hear the call of the next bod on the list, which is half the battle normally in getting through! And if there are problems in exchanging reports there is always someone on frequency prepared to pass on the reports! I have even heard control stations do this in order to keep things moving, making a nonsense of the whole idea.

In fact, it is not unlike the repeater systems on v.h.f. and u.h.f. which increase distances covered on these frequencies but have little intrinsic merit as far as the operator's capabilities are concerned. Of course there are those not on the "list" who can hear the DX quite well and want to work him in the normal way, often not realising that the list system is operating but, rightly or wrongly, they are soon told the error of their ways by control or others on the list. In the meantime the clever DX listener should have been taking down all these calls and picking up some new countries or prefixes or whatever, and all quite legitimately.

Just for fun I recently got on the "list" for H44SH in the Solomon Islands with American AD1S acting as control, but it took another 45 minutes before I was "allowed" to contact H44SH with a 5 and 7 each way. Since the control station now has, in effect, the log of the DX station he can send out suitably printed QSL cards for these contacts as requested, which explains why cards are often forthcoming in a matter of days for a QSO with some distant, lonely DX station. Effective? Yes, but it cannot give the thrill that receiving a card direct from the DX station does, complete with a handsome stamp.

In some cases two control stations are involved in different parts of the world. This helps if one cannot get on to a list because of skip problems, if, for example, a G station is one control on the 20m band. In this case one may have to QSO a VK to get on the list!

With such easy world-wide communication on the amateur bands the mere listener should ask himself if there is still any point in spending time and much money on sending QSL cards to stations who already know they cover the world with their signals. Much better to use these valuable assets in achieving a pass in the Radio Amateurs' Examination so that he can join in the fun and get on to a DXer's list!

Happy People!

Yes, the RAE results from the May exam are coming in and the first of the happy people is **Arthur White** of Aisby, Grantham, Lincs, with credits in both parts as a result of being thumped round the ears regularly by G3ZOA, who had the additional satisfaction of learning that his XYL has also passed, not only the RAE but the code test as well. So he won't be able to get his hands on his gear for a while! Good luck Arthur and best wishes with the Morse test he has promised to take 'ere long. Oh, yes, Arthur would still like to get hold of a genuine S-meter for his AR88D, so any offers to me please in the first instance.

Now to **Rod Williams** (Brecon, Powys) who also got credits in the RAE and I must quote from his letter: "I thought the RAE was some nasty exam put there by the Home Office boys to stop one getting on the air. I can now see it is there to help one and to make one aware of the responsibilities one has in upholding a licence." Rod worked entirely on his own from books including, dare I say it, *PW*'s RAE Reprint, studying an hour every night from February to April in spite of mundane jobs like looking after the children! Rod also quotes the golden rules for taking any exam: "Follow the instructions given, read the question paper thoroughly before starting, re-check all answers in good time even if you haven't finished all the questions." It certainly worked for Rod, and so on to the code test!

Third with the good news is **John Sparks** of Darlington with credits yet again (what is it with these *PW* readers?) who supplemented self-study with a weekly forty mile each way journey to RAE classes at a technical college. Ex-RAF op. John should have no trouble now with the Morse exam, blaming me for his re-entry into the operating field!

Can anybody help **C. F. Perham,** PO Box 2042, Kopeopeo, Whakatane, New Zealand with info on an aerial article in magazine *Old Man* of July 1970 by I1BER? Write to me in the first instance if you wish.

Following my comments in the April *PW* on Beverage aerials, I had a long and interesting letter on their operation from **Max Gill** of Gordon, NSW, Australia, who threatens to write an article on the subject for *PW*. I'm sure he wouldn't mind if I statted the letter for anyone interested.

Now for the DX

Some funny callsigns in the log of **Colin Frankland** of Hull until he pointed out that his typewriter's figure 1's look like his letter l's! So with his Trio 9R59DS, a Codar PR30 preselector and two dipole aerials indoors, it was 8P6CS among many on 14MHz s.s.b. with 21MHz producing 3D6BB, 5N0DOG, HM2JN, VU2USE (US Embassy, New Delhi), TU2HG, JR6RYU on Okinawa and HP1XFN.

With a new long wire of 132ft plus indoor 20m dipole **Basil Woodcock** BRS44266 in Leeds has persuaded his SRX-30 to pick up such as CE1BLL, HH2FH, J6LOU, KC6IN, VP2MO, VP2VAG and VS5DD on 15m, and 5N2KY, 9N1MM, 8P6BO, SU1BA, 6W8GT and 9X5AV for his 20m catch. Using his FRG-7 with a 66ft aerial and a.t.u., **David Coggins** of Knutsford, Cheshire, comments on YB0WR working into Europe on 7MHz in the evenings and the Pacific net with goodies like YJ8NPS, H44JB and P29NRL around 21 150kHz between midday and 1500 with DK9KG exercising some sort of control. Other catches include OJ0MA on Market Reef on 160m, LU3AJW, VK6LK and YB0WR on 40m, FO8FI, VK1WB, VK9ZG, VR6TC (Box 1, Pitcairn Is), 5H3FW, and 5W1BP on Samoa all on 20m, with AH8A on American Samoa, A22VP (Botswana), HM0OO, H44JB, VE4AFQ/8 (Ellesmere Is), YC1GJ, 3D2CS and 9M2GZ for 15m and, finally on 10m CE1BLL, J6LB/M (mobile on St Lucia!), ZS3N and 5N2DOG.

Paul Barker G4HPS of Sunderland is still the only reader to send in a c.w. log, in his case all worked with his TS189 transceiver and 18AVT vertical aerial system. Not DX but fairly rare all the same was DJ9GI/HB0 on 10m, plus HK0BKX on San Andres & Providencia Is on 15m for a welcome new one. Chasing US states Paul managed WB7RMI in Wyoming and AI0M in Nebraska but who'd guess that from that call!

From Lee-on-Solent, Hants, **Alec Bell** writes in for the first time with the news that he will be after the RAE in December, in the meantime keeping an eye on things with an FRG-7, a.t.u., trap dipole for 10m to 80m and a 100ft wire. On 20m Alec found HM1HR, HS5DLD, 6Y5HM and 9Y4OV with 15m coming up with CE3OE, JR6BRE, SV0AW and EA8JP. First report also from 13-year-old **Mark Ryder** BRS43580 (Oldham) also with an FRG-7 and wire some 120ft long. He likewise threatens to have a go at the December RAE, in the meantime frequenting the Manchester & District ARS. The all-s.s.b. log reads VO1GK and W1MX on 80m, HI8VBR, KG4KK, 5N0RHK on 40m, C31DV, C5AAA, D4CBC, FB8ZO, J6LOU, VP2VBK and XT2AW on 20m. Nothing of note was found on 10m which has been very patchy of late.

Phil Charlesworth G8SNG kindly keeps me posted as to his activities. Having got his BSc he has decided against going for the jackpot PhD, and to apply for a commission in the RAF, needless to say in electronics and communications. Interesting log entries were OJ0MA on Market Reef, SV6ZA and 4X6AW, all on 80m s.s.b. Phil queries a couple of Y21's which I'm afraid are just East Germany.

Allan Stevens (Crowthorne, Berks) is considering the Datong up-converter feeding into a 10m set-up yet to be built. September's *PW* had a good write-up on this unit. On 15m recently, on what seemed to be a dead band, up popped a number of stations enabling Allan to log all continents in a very short time including a nice one in ZK1AA on Cook Is. Others found on the band included HS1AMM, OH1KB/OH0 on Aaland Is, S79MC, XT2AY, YC1BY and 4S7DJ.

A QSL received here from A4XGR, PO Box 981, Muscat, Oman, says he'd like to renew old acquaintances in G-land after wanderings in the UK area and previous activity as VS6EZ, with A4 as the starting point. Likely frequencies will be 21 150 and 28 490 plus the Sea Net at 1200Z on 14 320kHz. Three IRCs or a 20p postal order will get a QSL by return airmail.

Down in Feoch, Truro, Cornwall, **Bill Rendell** has continued to virtually rebuild his HRO and yet manage to keep it operational. He still likes his preselector in front of it in spite of the two r.f. stages in the set itself. To prove it, Bill made a note of C5ACO, C31MS, OJ0MA, VR6TC and YS9RVE (QSL Box 0543, San Salvador) on 20m s.s.b. and expects me to believe YO0OOO. He must be joking—should have kept that one for next April! 15m came up with C5ACO, N6HR/KX6, TY9ER (where's that?), VP8SB, VS5DD (QSL Box 1200, BSB, Brunei), 5N0DOG and 8Q7AZ.

Club Time

If you have only just come into contact with amateur radio there is no better way to get to know more about it than by visiting or joining a local club of which there are hundreds scattered around the UK. If there is nothing suitable in the list below then try some recent past issues of *PW*. Failing that contact the RSGB at 35 Doughty Street, London WC1N 2AE, to whom the great majority of these clubs are affiliated.

Crawley ARC. Seems from the club's Newsletter that meetings take place at the Trinity United Reformed Church Hall, Ifield, on Wednesdays, like 22 October when Mike Underhill G3LHZ will be holding forth on a.t.u.s

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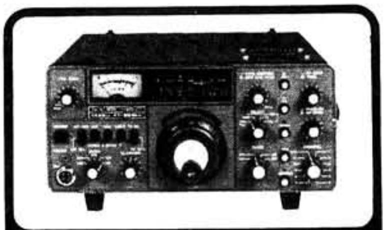

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and aerials, with all standing to attention when RSGB Regional Rep G3MDO and Area Rep G3JMB visit on November 26. CARC celebrated its 21st in September having been started by old friend Ron Vaughan G3FRV, now VK6RV, in 1959. Club competition seeks new name for Newsletter which it seems has been "temporary" for 21 years.

St Neots & District ARS. Newly-formed, welcomes new faces at The Ernulf Community School, Barford Road, Eynesbury, St Neots, Cambs, at 7.30pm Mondays, but contact Sec Paul Herod G8TQI, 49 Luke Road, Eynesbury, St Neots, Cambs, for meeting details or try Huntingdon 74642.

West Kent ARS. The Adult Education Centre, Monson Road, Tunbridge Wells, sees Ambit International talking about choosing the right component on October 10 with G5XB holding sway on the Hellschreiber on the 24th. G3ROO is on the ball with advice on how to get on to the new bands without buying a new rig, on November 7. But Brian Castle G4DYF can tell you more on Sevenoaks 56708.

Bolsover ARS. Wednesdays 8pm, Angel Hotel, Bolsover, with RAE classes already going great guns. Being formed recently, the club particularly welcomes new members whether licensed or newly interested in the hobby. Contact: Allan Turford G8HPQ, 103 Hilltop, Bolsover, near Chesterfield, Derbys S44 6NJ or on Chesterfield 824972.

Bournemouth RS. First and third Fridays at the Dolphin Hotel, Holdenhurst Road, Bournemouth with October 3 being AGM night, or talk with G. R. Freeth G4GQH, 9 South Avenue, New Milton, Hants on New Milton 618092.

Wirral ARS. First and third Wednesdays at 7.45pm at the Sports Centre, Grange Road West, Birkenhead with AGM on 15 October, so go along and see what makes a club tick. Recent interesting Newsletter holds inquest on this year's HF NFD which is always a good way to ensure a better effort next year.

Exeter ARS. Has club stations G4ARE and GB3EX for use by licensed members with code lessons for those wishing to go from B to A! Advance notice of meeting on November 3 when Any Questions will be conducted by an electronics lecturer from Exeter College, and November 10 when surplus gear will be flogged off! Incidentally November 3 will also be the occasion for a discussion on the RAE syllabus with a view to the December exam. Try G. W. Draper BRS44198 at 1 Carlyon Close, Heavitree, Exeter EX1 3AZ or Exeter 37170.

Durham University Radio & Electronics Society at Grey College, Durham, will be organising two special event stations, hopefully GB2DUC and GB8DUC, in connection with the Charities Week in that fair city at the beginning of November with all-band operation promised. Informant Ian Jefferson G4IXT even threatens to get on the key. Write to him at the College for more details.

Mexborough & District ARS. Friday night is meeting night at the Dolcliff Hall, in the road of that name, Mexborough at 7 pip emma (early Roman phonetic code!) with a station on the air, code classes, junk sales and lectures, but not all together! Ian Abel G3ZHI of 9 Grove Terrace, Maltby, Rotherham, Yorks can tell you more or chat on 0709814911 (that's what he wrote! Looks more like my electricity account number).

Derby & District ARS. Chairman Dick Buckby G3VGW expresses pleasant surprise at the amount of amateur radio matter in *PW* these days, which ought to lead to more people getting along to the club on Wednesdays at 7.30pm at 119 Green Lane, Derby, in fact the top floor of the Oddfellows Hall; "Very appropriate!" Dick's words, not mine! Tea, coffee and snacks available! First Wednesday each month is junk sale night on top of which there are code classes on Tuesdays and Wednesdays at the same spot. They must be churning out G4 + 3's like a sausage machine! But more on that from Jenny Shardlow G4EYM, 19 Portreath Drive, Darley Abbey, Derby DE3 2BJ, or if you dare risk the wrath of the OM then its 0332 556875.

Bedford & District RC. Winnie The Pooh conceals the identity of the club station G3WTP located three miles north of Bedford, near the car park, near the barn, near the Ravensden Church. Sorry no QTH, just a map! By a valiant effort Dave Whitty G4FEV has resurrected the club magazine, last heard of in 1970, and a good one it is too with several short but interesting projects, with clear drawings and diagrams, so often the weak point of such newsletters. Dave will be glad to tell you more about the club and its activities if you drop him a line to 16 Fairmead Crescent, Rushden, Northants NN10 9NB or call him on Rushden 56768.

Edgware & District RS. Second and fourth Thursdays at 8pm, Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware with other evenings being filled in by G3ASR and his RSGB slow Morse transmissions on Mondays and first and third Thursdays on Top Band and 2m. If that is not enough there are code classes before each meeting. Vintage Radio is theme of G3IEE on October 9 and November 13 should see G3BNL expounding on microwaves. In the meantime why not tackle PRO Howard Drury G4HMD, 39 Wemborough Road, Stanmore which is also 01-952 6462.

A note to all clubs. Why not help the **Radio Amateur Invalid & Blind Club** by joining as a supporter? Syphoning off a few per cent from those junk sales and dinner/dances could help to get someone on the air or provide a receiver for a new and enthusiastic member. Work can always be found for a willing pair of hands in the many tasks that arise in assisting members. Drop a line to Frances Woolley G3LWY, 9 Rannoch Court, Adelaide Road, Surbiton, Surrey KT6 4TE. She is secretary of the RAIBC.

Medium Wave Broadcast Band DX

by Charles Molloy G8BUS

Reports to: Charles Molloy G8BUS
132 Segars Lane, Southport PR8 3JG.

The medium-wave band is allocated to short-range domestic broadcasting. Propagation is by means of the ground wave which, as the name suggests, travels close to the earth's surface where it is attenuated rapidly. There is some radiation skywards from the transmitting mast, though efforts are made to minimise it. Absorption takes place in the D layer of the ionosphere during the day and nothing returns to ground. After dark the D layer disappears and the radio waves reach higher layers where they are refracted, mainly by the E layer, and returned to earth some considerable distance from the transmitter, well outside the ground-wave service area. This is the reason why many more stations are to be heard at night than during the day and it is also the phenomenon that makes medium-wave DXing possible. Rule number one for the m.w. DXer: Reception can only take place when there is a path of darkness between transmitter and receiver. No use looking for DX in the middle of the day as you won't find any.

North American DX

Readers express surprise when they learn that North American medium-wave stations can be heard in the UK, yet this type of reception is as old as broadcasting itself. In the 1920s, veterans such as WGY in Schenectady were heard regularly with the simple equipment in use at the time. Nowadays, the band is full of Europeans at night, but many do close down around 2300 and since the north Atlantic path will be in darkness this is the time to hunt for DX.

Locate Brussels on 927kHz. The language is French and the station goes off the air between 2250 and 2315. Once the tuning notes are finished and the carrier goes off, tune up-frequency slightly to 930kHz where, if conditions are favourable, you ought to pick up CJYQ which is a 50kW broadcaster at St John's in Newfoundland. Identification is easy since the callsign (CJYQ) or its contraction (Q Radio) is used repeatedly and time checks will reveal a Time Zone $3\frac{1}{2}$ hours behind our own.

Do not be disappointed if you fail to hear CJYQ at the first attempt. Conditions vary a lot and the signal may be strong one night and absent for the following few nights. Be prepared too for the slow cyclic fading that is typical of a m.w. DX signal. Over a couple of minutes it may go from strong to inaudible and then come slowly back. Stay on the channel for a few minutes in case there is a fade.

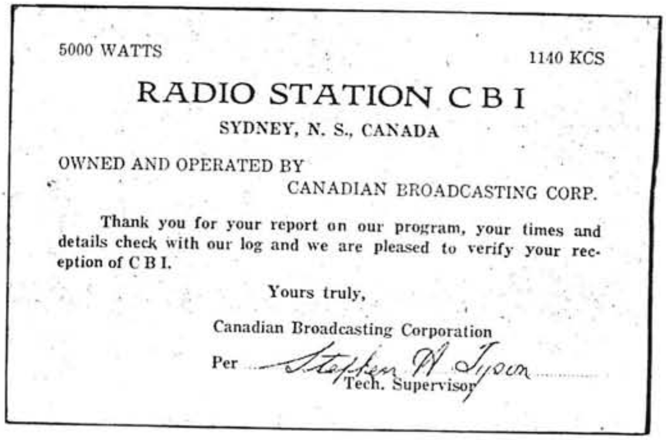
If you do hear CJYQ then try for two other Newfoundlanders; CKVO in Clarenville on 710kHz and CBGY in Bonavista Bay on 750. Look for WHDH in Boston on 850 and for two stations in New York City; WNEW on 1130 and WQXR on 1560.

Beverage Antennas

From Galway in the west of Ireland comes a request for help from reader **Neil Sharkey** who is having difficulty picking up the BBC, particularly Radio 3 on 1215kHz. There are quite a few areas over here where reception is far from good! Neil has tried a simple dipole without much success and he wonders if there is some sort of beam antenna that he could construct that would improve reception on 1215.

The mind boggles at the thought of a multi-element beam for use on 247 metres but what is really required is a Beverage which is a very long, long wire, at least two wavelengths in length. It runs from the receiver in the direction of the transmitter and is joined to earth at the remote end by a 600 ohm resistor.

This aerial is directional along the length of the wire away from the receiver. It gives a substantial increase in signal strength as well as an improvement to signal-to-noise ratio, and the wire need only be fixed a few feet above ground level. I have heard recordings of low-power North Americans made in New Zealand with a domestic radio connected to a mile-long Beverage and the results were quite staggering. Unfortunately the Beverage is not the antenna for the city dweller, nor even for those who live in the country, but where space is available this is the ultimate aerial for m.w. DXing.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A QSL Card confirming transatlantic reception by the author some years ago

Semiconductors

"I have a valve-operated Q Multiplier which has its own power supplies. Can this be used with a transistorised receiver or are the voltages too high?" is the question posed by reader **Vernon Graham** who lives at St Pieters-Leeuw in Belgium.

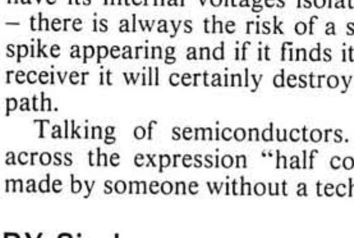
Personally, I would not risk it. On the face of it there is no reason why the two cannot be connected together, since a commercially-made Q Multiplier will certainly have its internal voltages isolated from the "output", **but** – there is always the risk of a short-duration high-voltage spike appearing and if it finds its way into a transistorised receiver it will certainly destroy any semiconductors in its path.

Talking of semiconductors. Some time ago I came across the expression "half conductor" in a translation made by someone without a technical background.

DX Circle

This is the name of a programme in English that can be heard at 1900 every Tuesday over the 600kW West German Deutschlandfunk on 1269kHz. It is written and presented by DXer **Alan Thompson** who says: "The programme has evolved into a five-minute chat-show about things to do with radio." It has been on the air now for some ten years to my knowledge.

Alan has recently acquired an Eddystone 770R v.h.f. communications receiver. He has a copy of the manual but he wonders if any *PW* reader could explain the



"This new Z-match I've got is great—the s.w.r. is better than 1 to 1!"

. . . heard by G3RZP

"I'm not surprised there was no modulation, I never said anything."

. . . Brighton & District RS Newsletter

significance of the S/77R/8 and the two 12-pin sockets fitted to the back panel. Replies direct to Alan please at 16 Ena Avenue, Neath, West Glamorgan SA11 3AD.

Eddystone

Reader **Tony Jover** has drawn my attention to the Eddystone EB35 Mark 3 "Statesman", which does not have an internal aerial for use on the medium wave and can be used with a m.w. loop. My own second receiver, the EB36, is a variant of the original EB35 and I have found it to be remarkably free from overloading on the medium waves, even when used with a 60ft long wire. The EB35 is similar in appearance to the well-known EC10, and details of the EB35 and others in the range are obtainable from the Eddystone main agents who are Sonic Sound Audio of Tottenham Court Road in London.

Saudi Arabia

An up-to-date picture of the high power m.w. transmitters in Saudi Arabia comes from G4BHH. There are two sites, one at Qurayat (Q) and the other at Dhuba (D). Daytime means 0300 to 1600 and night-time means 0300–0500 and 1400–2300, all in GMT.

549kHz (Q) 2MW into a 6-element beam. Daytime.
594kHz (D) 2MW into a 6-element beam. Daytime.
900kHz (Q) 1MW into a 3-element beam. Night-time.
1521kHz (D) 2MW into a 6-element beam. Night-time.

The beam elements consist of 30ft triangular-section masts one quarter wavelength high and those at Qurayat (Q) are on a great circle heading that extends towards the UK. If you have not yet logged Saudi Arabia, try one of the above frequencies.

Short Wave Broadcast Bands

by Charles Molloy G8BUS

Reports: as for medium wave DX, but please keep separate.

"I have difficulty in finding and tuning into stations on the short-wave bands," writes **T. Ernest Hall,** who is referring to his attempts to pick up the BBC World Service while travelling in France and Spain.

This is not an unusual problem when tuning round the short waves on a general-coverage receiver. It occurs because a short-wave tuning scale displays a much larger portion of the frequency spectrum than a medium- or long-wave scale. A receiver tuning from 6MHz to 22MHz covers 16 times the frequency range of the medium waves and inevitably stations are 16 times closer together. What can be done about it?

Bandspread

Bandspread is one solution. The receiver has two scales; a main scale and a bandspread scale. The pointer on the main scale is set to a spot or mark for bandspreading and stations are then tuned in on the bandspread scale where they are spread out more and are easier to tune in and locate. This arrangement is used on some communications receivers but seldom on domestic-type sets.

Another remedy is to have a separate scale for each short-wave broadcast band, so that stations are spread out like they are on the medium and long waves. The Grundig Satellit and similar receivers use this method, but it means a large number of scales and associated circuitry and consequent expense. The snag with this method is that you cannot tune to out-of-band stations, but this should not bother the s.w.l. too much though it could be a disadvantage to the DXer.

My Vega 204 works partly on this principle. It has only a single pointer which travels over eight separate scales, one each for the 13m, 16m and 19m bands, one covering 9·3MHz to 12·1MHz which includes the 25m and 31m bands, one covering 5MHz to 7·5MHz to include 41m and 49m and another tuning over 3MHz to 5MHz to cover the tropical bands. The remaining scales are for the medium and long waves.

Digital Readout

The best and most recent solution to the station location problem is digital readout. The frequency in kHz (MHz × 1000) is shown on a digital clock-type display, and provided the receiver has a reasonable slow-motion drive then you can hardly go wrong. Rotate the tuning control until the frequency you want appears on the display. At the moment, digital display is only available on the more expensive receivers but it cannot be long until every set is equipped with this ultimate aid to easy tuning.

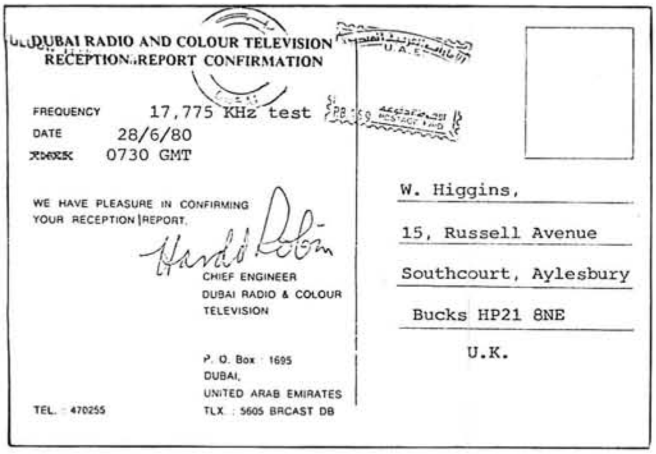
Aerial Tuning Units

"Can I use an aerial tuning unit (a.t.u.) with a receiver that has an aerial trimmer control?" asks **Thomas Glennon** of Cork. The function of the aerial trimmer is to compensate for any loading that the aerial may place on the receiver. The a.t.u. will minimise aerial loading by matching the aerial to the receiver and consequently the aerial trimmer will then have little effect. Of the two, I much prefer the a.t.u. and it is worthwhile using one with a receiver that has an aerial trimmer as such a set-up may occasionally give a boost to a weak signal.

It is always a good idea to experiment with different aerials along with an a.t.u., rather than speculate what might happen. You will not damage a receiver by joining an a.t.u. between the aerial and aerial socket. At worst it will make no difference; at best it will give a valuable boost to a weak signal. Details of how to make an a.t.u. appeared in the Aerial Data Chart contained in the November 1979 edition of *Practical Wireless*, but they are available from advertisers in *PW* and other magazines.

Volmet

My comments about Volmet in the April issue brought an interesting reply from **K. Todd** of Kaiapoi in New Zealand who enclosed an article on the subject from an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U.K.

A QSL Card confirming reception of a test transmission from Dubai Radio by reader W. Higgins of Aylesbury

American magazine. A lot of confusion exists among DXers as a result of differences between the law in the USA and this country. In the UK it is illegal to even listen to anything other than broadcasting stations or amateurs, unless you have a licence and this is not normally issued to private individuals. As a result, information about point-to-point, Volmet, etc., cannot be included in this column. Very sorry but that is the position. Utility DXing is illegal in the UK!

Readers' Letters

"I heard the BBC World Service on approximately 20 460kHz in s.s.b.," says **G. R. Ellis** from Aylesbury, who wonders if he was listening to some sort of freak transmission. You were probably listening to a feeder, which is a transmission to an overseas location for re-broadcasting. It is not intended for direct reception by the public as it merely replaces the usual landline between the studio and transmitter.

"Have fixed the old Rx up again and find things to be quite interesting s.w.l.-wise anyway," says **N. C. Dove** of Lockerbie in Scotland, who first started DXing in 1937. His receiver is a home-made ten valver which covers 3·2MHz to 22MHz in nine switched bands. The station you heard on the 31m band was probably FEBA, the Far East Broadcasting Association which transmits religious programmes from the Seychelles. Listen for Pakistan during the afternoons on the 13m band (21 755kHz and 21 486kHz) and the 16m band (17 910kHz) and during the evening on 21 485kHz and 17 760kHz.

DX Heard

A test transmission from Dubai was picked up on 17 775kHz at 0730 by **W. Higgins** of Aylesbury, who was using his FRG-7 with Joystick System A plus Cambridge notch filter and home-brew noise limiter. A reception report brought a QSL card in less than three weeks.

Reykjavik Radio is reported on approximately 13 910kHz from 2210 until past 2330 on 29 June SIO 454 by **David Wyatt** (Oswestry) using an AR88LF and loft aerial. Although not listed on the short waves, Icelandic Radio does use one of the Post Office transmitters on a part-time basis for broadcasting to fishermen.

Trans World Radio Guam is reported by **Alan Scholefield** of South Shields, who picked it up on 15 365kHz between 1430 and 1459 where it is on the air on Fridays at the time of writing. Reception reports to TWR, PO Box 66, Agana, Guam 96910, USA.

While trying to pick up Radio Australia on 9570kHz in the 31m band with his Marconi Atalanta, **George E. Lee** of Ossett picked up Port Moresby in Papua New Guinea instead. This station transmits on 9520kHz and 9570kHz with a power of 10kW and George wonders if any other *PW* reader has heard this rather rare DX.

VHF Bands

by Ron Ham BRS15744

Reports to: Ron Ham BRS15744
Faraday, Greyfriars, Storrington,
Sussex RH20 4HE.

Very often when reading your letters, I sense the pioneering spirit and the excitement, which I share, when you report that bit of super DX. With that same enthusiasm, the true spirit of amateur radio prevailed during the weekend of August 9 and 10 when many of my Sussex readers, equipped with their 2m gear, played their part with Raynet and joined the hunt on the South Downs for a missing child, which, thanks to all concerned, had a happy ending.

Solar

Both **Cmdr Henry Hatfield,** Sevenoaks, and **Ted Waring,** Bristol, were prevented by the recent bad weather from using their optical equipment as much as they would like. However, Ted managed to see the sun and count 86 sunspots on July 21, 8 on August 1 and 5, and 40 on the 11th and Henry, using his spectrohelioscope on the 9th, saw some activity developing on the eastern solar limb which may well have been responsible for the sudden large burst of radio noise (Fig. 1) which was recorded by **Reg Taylor,** Shillington, Henry and myself, at 151MHz, 136MHz and 143MHz respectively, at 1250 on the 14th. Large individual bursts of noise were also recorded on July 21, 27, 30 and August 12.

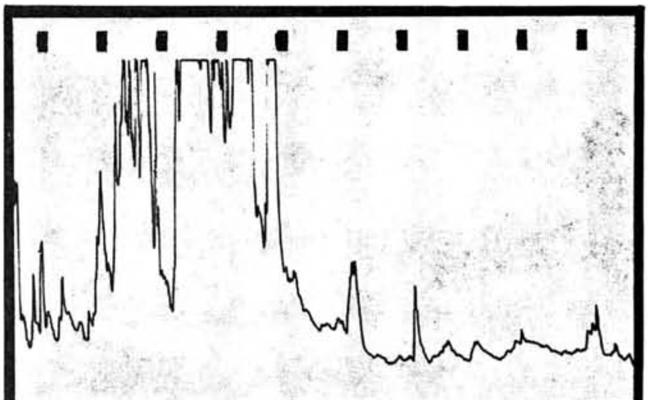
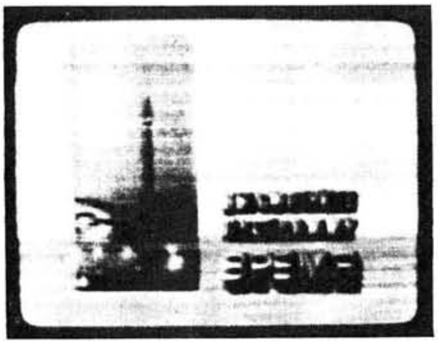


Fig. 1: The author's recording of the burst of radio noise which occurred at 1250 on August 14


Three of the pictures received from Russian Television by the author on July 23

Perseids Meteor Shower

"Meteor scatter has been excellent since August 3, usually from 0800 to 1200 with long pings showing video for up to a minute at a time," writes **John Branegan** GM4IHJ, Saline, Fife. On the 9th and during the evening of the 11th, near the peak of the Perseids, **Mike Hearsey** G8ATK, Farnham, heard brief pings of signals on 2m from amateur stations in F, LA, OE, OK, OY, OZ, SP and YU. It is well worth observing again when the earth passes through the Leonid meteor shower between November 15 and 19, with a predicted peak on the 17th.

The 10 Metre Band

Throughout the period July 21 to August 19, signals from the International Beacon Project stations were relatively sparse, except during sporadic-E events when signals from the two German beacons, DK0TE and DL0IGI and the Norwegian beacon LA5TEN, were prominent and often peaking 599. Under normal conditions both Ted Waring and I periodically heard signals from the beacons in Cyprus 5B4CY, and occasionally the two in South Africa, ZS6DN and ZS6PW. **George Grzebieniak** RS41733, London, commented about the short skip conditions on July 26 when he heard s.s.b. signals from stations in EA, IS and ZS.

Sporadic-E

Strong signals from east-European f.m. broadcast stations were received between 65MHz and 73MHz during sporadic-E disturbances around 0800 on July 24 and August 4 and 12, at midday on July 22 and August 5, and around 1800 on August 10 and 11. The most intense of these events was on the 11th, when I counted 30 such stations with only a dipole feeding my R216 receiver. George Grzebieniak also heard music around 71MHz on August 5, and during the sporadic-E season users of the 4m amateur band and the "low band" commercial frequencies are often pestered by the strength of these signals. At 1809 on the 10th, the disturbance briefly extended its influence into the 2m band and Mike Hearsey nearly completed a QSO with IS0DSQ/P and heard IS0DKU/P.

Tropospheric

The good conditions on 2m during the week July 21 to 27 enabled **John Cooper** G8NGO, Cowfold, Sussex, to work 9 Fs (one of these, F6GQE/P, on the Spanish border was only using 3 watts), 2 ONs and 5 PAs on the 21st, a DD, 25 Fs and 2 ONs on the 22nd, and an F, 2 ONs and 5 PAs on the 23rd. On the 24th, he heard signals from the 2m beacon in Angus, GB3ANG and worked 8 Fs, a GM and a PA. The signals from the Angus beacon proved to John that the opening was changing direction, because on the 26th he worked 2 EIs and a GJ and he finished in style on the 27th by working 2 EAs, 24 Fs, a GJ and a GU.

During that week, George Grzebieniak heard 2m signals from Belgium, France, Holland and both northern and southern Ireland. Mike Hearsey also worked many French stations and several near the Spanish border during that period, and on August 9 Mike worked 25 stations in the south-east of France, 2 EAs, and C31RN in Andorra. On the 10th Mike heard C31VF in QSO with French and Spanish stations but could not get in. To date, while Mike has worked 106 QRA squares on 2m and has only 3 French squares left to work, John Cooper has confirmed 40 squares and 10 countries toward his RSGB award.

Like the others on July 22 and 28, **John Cleaton** G4GHA, Wareham, worked many French stations on 2m, one (F1FJJ) on the French-Swiss border and another (F1DSQ) on the Spanish border. During the evening of August 9, John heard several EAs but although audible, they were not workable from his QTH. He also heard several contacts between EA and GW.

During the brief spell of good conditions on August 19, **Alan Baker** G4GNX, Newhaven heard strong signals from a couple of GW mobiles in QSO on 2m f.m. simplex. Signals from the Cambridge repeater GB3PI, R6, were so strong, said Alan: "That they were overpowering the, almost local, Crawley repeater GB3BP. Strong signals were also heard in Sussex from the Leicester repeater GB3CF, R0.

DXTV

At 0721 on July 23, I watched a cartoon film on Channel R1, 49·75MHz, and at 1723 the prevailing sporadic-E disturbance produced a mixture of pictures on E2, 48·25MHz and R1 where pictures of Olympic swimming were fighting for predominance. Both **Harold Brodribb,** St Leonards-on-Sea, Sussex, and I saw the Olympic swimming on R1 and R2, 59·25MHz, and at 1800 a clock showing 2100, three hours ahead of GMT, appeared suggesting that the signals were coming from the Moscow area. This clock was followed by Russian news on both R1 and R2.

Around 0700 on the 24th I received a strong test card from MTU, Budapest, and a clock showing 0900, two hours ahead of GMT, followed by a YL announcer. Harold told me that at 1110 on the 22nd he received a brief test card from TV1—Sverige and at 1345 a news bulletin from Spain on E2. At 1400, R1 was carrying the large letters "POLSKA 80" and 10 minutes later, on E2, he saw a Spanish picture with a road sign "Barcelona", and later an advert showing a detergent, "Luzil", going into a washing machine and another about the fruit juice, "Fruco". While using his RL85 communications receiver to tune through Band I, Harold heard Spanish sound on E2, 53·75MHz relaying the Olympics with Spanish commentary overlaying the Russian announcements from the Moscow stadium.

David Appleyard, Uppsala, Sweden, was using his equipment during the sporadic-E disturbance between 1000 and 1400 on August 5 and writes: "It started with a brilliant test card from Budapest on R2. The same picture was visible on R1 at half strength, with bursts of Grünten on E2. By 1050 the +PTT-SRG1 test card plus classical music had appeared on E2 and was also coming in on E3 next to the strong Budapest signal on R2." Around 1400 both Harold Brodribb and I watched a mixture of pictures on R1, with the Russian stations becoming predominant as Harold said in his letter: "At times male announcers were seen with brief captions of their names in Russian letters."

Another of our keen TV DXers is **T. Ampi,** London, who tells me that he has, and I think wisely, invested in good equipment for his interests. For Band II reception he uses a National Panasonic DR49, and he has a Nordmende Colorsonic 2400, SK3 series, for television. "The beauty of this set," writes T. Ampi, "is that it picks up very weak signals and it has scanning facilities up to 99 channels (including satellite reception) which helps a lot for DXing. Secondly it has memories from 24 channels so if I find a weak signal I put it in the memory and then, at least for a week or two, I try it often." In addition to his three Fuba aerials, one for each band, he has pre-amplifiers installed as required and a JVC 3660EK video recorder from which he gets very good replay results.

During the 1980 sporadic-E season he has received most European test cards on v.h.f., and since February has seen u.h.f TV signals from Belgium, Germany and Holland.

At 1736 on August 11 I watched part of a film about the Olympic opening ceremony on R1 with the bear "Mischa" very much to the fore. Around 1700 on the 18th, I received a strong test card on E2, made up of small graduated squares, mixing with a test card from RTP, Portugal and a caption from Spain which was headed, RTVE Control Central. Just as the disturbance was fading away I saw the RTP clock followed by a YL announcer.

Electronic Mail Order Ltd. sent me their gen sheet on the pre-amplifiers which they supply for Bands I, II and V, designed with the f.m. and TV DXer in mind. Details available from the firm's office at 62 Bridge Street, Ramsbottom, Bury, Lancs.

"All my receiving equipment has been working overtime during the past few weeks," writes **Andrew Rogers,** Bristol, on August 14. "I had a small party at my house and one of my friends turned on the TV. Wondering what the small stickers on the push-buttons meant, he shunned BBC1 and ITV and pressed R1. I had left the upconverter plugged in and to his surprise, he was greeted with the caption "TB CCCP!" Reception continued all evening and quite spoilt the party." I like that story Andrew, I bet your friends are now envious of you and your TV gear. On July 21 Andrew received TVE all evening on E2 and TV CCCP on R1, test card from RAI, Italy on 1A, 53·75MHz, during the afternoon of the 22nd and again between 0950 and 1100 on the 23rd. An extract from Andrew's log for August shows that he received pictures from Italy and Spain on the 7th and 11th and CST, Czechoslovakia and TVP, Poland, on the 11th.

News Items

David Thorpe G4FKI, Ilford, has prepared an extensive list of amateurs who are active on the 4m band, and by what I have seen it is well worth the 30p he is asking for the document, to cover printing and postage costs. Readers interested should write to G4FKI, QTHR. David is active himself on 4m, all modes.

Congratulations to **Sue Houlihan,** who along with several other students of the Brighton & District Radio Society's RAE class, passed the exam and is now working on her Morse. Sue was out with husband John, G4BLJ, when about 30 members of West Sussex Raynet reported for duty, at the request of the Police, to assist in the hunt for a missing child, code name Operation Elizabeth, on the Sussex downs during the weekend of August 9 and 10. Between two and four Raynet members with their portable sets accompanied each search party, and their control station, supplied by RSGB Council member, **Robin Bellerby** G3ZYE, Hove (also among the searchers), was in a prominent position with an FT-221R feeding a 6-element 2m quad mounted on a 40ft pump-up mast. At the end of the operation Raynet were congratulated and thanked by a senior police officer.

Alan Baker has fitted a 3SK59 MOSFET to the receiver front-end of his FT-221 and is pleased with the results. Alan, who repairs these sets, has had a lot of experience with them and has incorporated a variety of mods to suit his own requirements.

Can anyone help **Herb Bartlett** G5QA, QTHR, with a 3·5MHz to 7MHz coil-pack for an HRO receiver.

Congratulations to George Grzebieniak who through sheer hard listening has received the RSGB 432MHz listeners' award and to **Arthur White,** Grantham, on passing the RAE with credits in both papers.

SLIM JIM for 28MHz

▶▶▶ *continued from page 41*

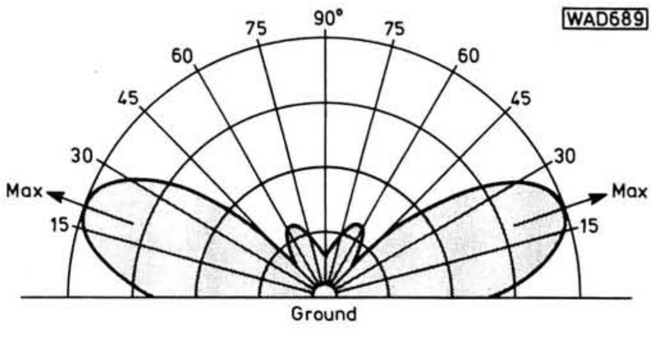


Fig. 2: Approximate vertical radiation pattern when the centre point of the radiating section is λ/2 above ground of good conductivity, and the aerial is situated in very clear surroundings

there is usually sufficient polarisation twist during long-range propagation to effect good transmission and reception to and from stations using horizontally polarised aerials.

One final note, make sure that the feed point is fully protected from rain water. A small plastics box could be used for this, with the element wires passing right through from top to bottom. A couple of coats of paint or varnish should be applied to the support mast and element spreaders. ●

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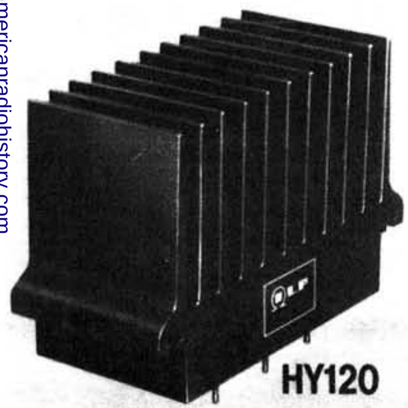
HY120


HY60

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MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

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Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£6.34 + 95p
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.24 + £1.09
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£15.20 + £2.28
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£18.44 + £2.77
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£27.68 + £4.15

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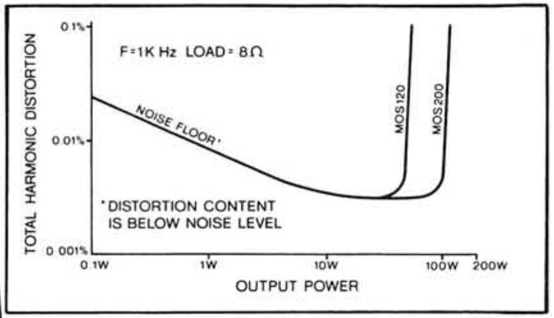
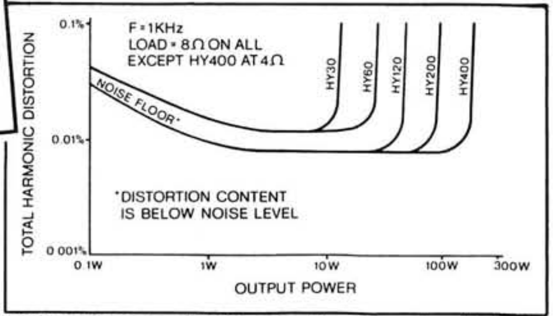


Load impedance both models 4Ω-∞ Input sensitivity both models 500mV
Input impedance both models 100KΩ Frequency response both models 15Hz-100KHz – 3dB



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Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB

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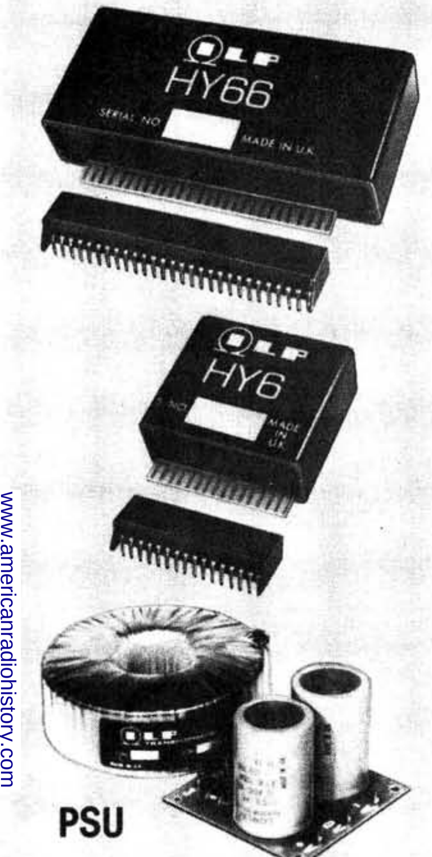

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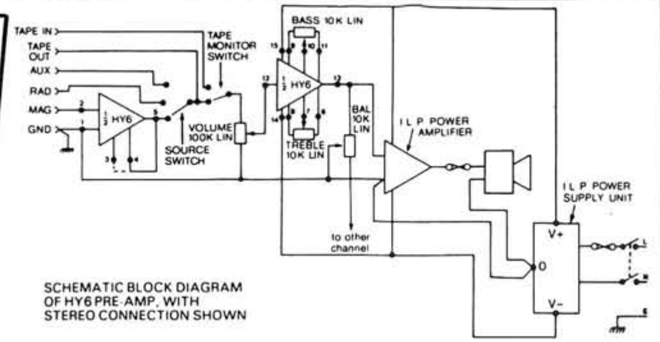

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EBF83	0.60
EBF89	0.80
EC52	0.65
EC91	3.40
EC92	0.85
ECC81	0.65
ECC82	0.60
ECC83	0.65
ECC84	0.60
ECC85	0.60
ECC86	1.40
ECC88	0.80
ECC189	0.95
ECC804	0.90
ECF80	0.85
ECF82	0.65
ECF801	1.05
ECH34	2.25
ECH35	1.70
ECH42	1.20
ECH81	0.70
ECH84	0.80
ECL80	0.70
ECL82	0.75
ECL83	1.40
ECL85	0.80
ECL86	0.90
EF37A	1.50
EF39	1.25
EF40	1.25
EF41	1.30
EF80	0.65
EF83	1.75
EF85	0.60
EF86	0.75
EF91	1.50
EF92	2.90
EF95	0.65
EF96	0.60
EF183	0.80
EF184	0.80
EF804	4.95
EF812	0.75
EFL200	1.85
EH90	0.85
EL32	1.10
EL34	1.80
	2.90
EL37	4.40
EL38	4.60
EL41	1.40
EL81	0.95
EL82	0.70
EL84	0.80
EL86	0.95
EL90	1.00
EL91	4.20
EL95	0.80
EL504	1.70
EL509	2.70
EL802	1.70
EL821	8.20
EL822	9.90
EM31	1.60
EM80	0.85
EM81	0.85
EM84	0.85
EM87	1.15
EY51	0.95
EY81	0.65
EY86/87	0.60
EY88	0.65
EZ80	0.70
EZ81	0.70
GY501	1.30
GZ32	1.05
GZ33	4.20
GZ34	2.30
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PABC80	0.60
PC85	0.75
PC86	0.95
PC88	0.95
PC900	1.15
PCC84	0.50
PCC89	0.85
PCC189	1.05
PCF80	0.80
PCF82	0.70
PCF84	0.75
PCF86	1.50
PCF87	0.50
PCF200	1.60
PCF201	1.65
PCF800	0.50
PCF801	1.75
PCF802	0.85
PCF805	2.45
PCF806	1.20
PCF808	2.05
PCH200	1.35
PCL81	0.75
PCL82	0.95
PCL84	0.90C
PCL86	1.05
PCL805/85	1.25
PD500/510	4.30
PFL200	1.10
	2.80
PL36	1.25
PL81	0.85
PL82	0.70
PL83	0.60
PL84	0.95
PL504	1.45
PL508	1.95
PL509	2.90
PL519	3.20
PL802	3.20
PY33	0.70
PY80	0.70
PY81/800	0.80
PY82	0.65
PY83	0.80
PY88	0.85
PY500	1.70
PY809	6.45
PY801	0.80
uQV03/10	2.85
QQV03/20A	14.40
QQV03/25A	21.20
QQV06/40A	16.10
QV03-12	4.20
SC1/400	4.50
SC1/600	4.50
SP61	1.80
TT21	16.50
U25	1.15
U26	1.15
U27	1.15
U191	0.85
U281	0.70
U301	0.65
U600	11.50
U801	0.90
UBC41	1.20
UABC80	0.75
UAF42	1.20
JBF80	0.70
JBF89	0.70
JBL1	1.25
UBL21	1.75
UCC84	0.85
UCC85	0.70
UCF80	1.30
UCH81	0.75
UCL82	0.95
UF41	1.25
UF80	0.95
UF85	0.95
UL41	1.50
UL84	0.95
UM80	0.90
UM84	0.70
UY82	0.70
UY85	0.85
VR105/30	1.25
VR150/30	1.35
X66	0.95
X61M	1.70
XR1-6400A	82.90
Z759	9.00
Z749	0.75
Z800U	3.45
Z801U	3.75
Z803U	3.95
Z900T	2.45
1A3	0.85
1L4	0.50
1R5	0.60
1S4	0.45
1S5	0.45
1T4	0.45
1U4	0.80
1X2B	1.40
2D21	0.90
2K25	11.90
2X2	1.15
3A4	0.70
3D6	0.50
3D22	23.00
3E29	10.00
3S4	0.60
5B/254M	14.00
5B/255M	11.50
5B/258M	8.80
5R4GY	1.30
5U4G	0.75
5V4G	0.75
5Y3GT	0.80
5Z3	1.50
5Z4G	0.75
5Z4GT	1.05
6/30L2	0.90
6AB7	0.70
6AC7	1.15
6AG5	0.60
6AH6	1.15
6AK5	0.65
6AK8	0.60
6AL5	0.60
6AL5W	0.85
6AM5	4.20
6AM6	1.50
6AN8A	2.50
6AQ4	3.40
6AQ5	1.00
6AQ5W	1.80
6AS6	1.15
6AT6	0.90
6AU6	0.60
6AV6	0.85
6AX4GT	1.30
6AX5GT	1.30
6B8G	0.40
6BA6	0.55
6BE6	0.60
6BG6G	1.60
6BJ6	1.30
6BQ7A	0.85
6BR7	4.40
6BW6	5.20
6BW7	0.90
6C4	0.50
6C6	0.55
6CH6	8.20
6CL6	1.70
6CY5	1.15
6D6	0.70
6EA8	3.20
6F6	1.60
6F6GB	1.10
6F7	2.80
6F8G	0.85
6F12	1.50
6F14	1.15
6F15	1.30
6F17	1.15
6F23	0.75
6F24	1.75
6F33	10.50
6GA8	0.90
6GH8A	0.95
6H6	1.60
6J4	1.35
6J4WA	2.00
6J5	2.30
6J5GT	0.90
6J6	0.65
6J6W	0.90
6J7	1.20
6JE6C	2.95
6K7	0.80
6K7G	0.50
6K8G	0.65
6L6M	2.80
6L6G	2.50
6L6GC	2.10
6L6GT	1.25
6L7G	0.65
6L18	0.70
6LQ6	2.95
6LD20	0.70
6Q7G	1.30
6SA7	1.00
6SG7	1.15
6SJ7	1.05
6SK7	0.95
6SL7GT	0.85
6SN7GT	0.80
6SR7	1.10
6SQ7	0.95
6V6G	1.50
6V6GT	0.95
6X4	0.75
6X4WA	2.10
6X5GT	0.65
6Y6G	0.90
6Z4	0.70
7B7	1.15
7Y4	1.00
9D2	0.70
9D6	2.90
10C2	0.85
10F18	0.70
10P13	1.20

*SPECIAL QUALITY

POSTAGE: £1-£3 30p. £3-£5 40p. £5-£10 45p. £10-£15 60p. Over £15 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.

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COMMUNICATIONS RECEIVERS part of Navy CAS equipment made by Murphy Radio 5 band RX covers 60 to 550Kc two bands and 1.5Mc/s to 30Mc/s three bands. The Rx uses a total of 13 B7g valves as two RF stages, Sep L.O. 3x IF stages at 800Kc Det, Noise Lim, 2x AF stages, BFO, Crystal Cal at 800Kc, the O/P stage matches to 100 ohm phones and a 600 ohm 2 watt speaker line. Controls main tune, band sel, RF gain, LF gain, Phone gain, AGC on/off. Selectivity at 8, 3, 1Kc and 200c/s the 1Kc position uses a bandpass crystal filter, the 200c/s uses crystal plus Audio filter, BFO this swt selects upper or lower beat or tune also selects 800Kc crystal cal, there are two O/P jacks for phones and one for speaker on front panel, provision for 75 ohm Ae I/P or long wire. Complete in steel case size 13×14" front 14" deep these Rx req ext power supplies of 250v HT and 150v Stab total load 100Ma 6.3v AC at 4 amps. There is room inside the case to build internal P.U. supplied Tested with copy of Circuit and 40 page handbook, more details on request. **£115. VIDEO RECORDERS** Philips type LDL100 portable monochrome 625 line recorder reel to reel $\frac{1}{2}$" tape 75 ohm I/P 1v sig .4v sync 75 ohm O/P ext size 42×34×20 cm weight 12Kg we also have a few /2 models these are table case version, both 240v 50c I/P these are supplied in good cond with 80 page handbook untested, fuller spec on request. **£185. ARMY RADIO** station 128 small low power T/Rx covers 2 to 8Mc/s tunable Rx with crystal controlled Tx normally operates from dry batteries 135v and 1.5v supplied with haversack, battery holder, morse key, aerial wire, headphones and circ. **£25. MAINS INVERTORS** small 12v DC I/P 240v O/P at 20 watts square wave at 50c/s in case size $6\frac{1}{2} \times 4\frac{1}{2} \times 3$" stab freq from UJT, okay for Soldering irons or AC/DC razors with rect O/P tested **£15. PANEL VARIAC** small type 200/250v O/P 0 to 240 at 700Ma max ex new equip with knob **£9.50.**

Above prices include Postage and VAT goods ex equipment unless stated new, 2 x 10p stamps for list 25/1.

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Jan. 80.	Nimbus Radio Control Rec.	WR064	Price £2.92 30 pence p&p.
Jan. 80.	A.F. Speech Processor	WR068	Price £2.28 30 pence p&p.
Jan. 80.	Wide Band Pre Amp.	WR067	Price £0.70 30 pence p&p.
Jan. 80.	Nimbus Radio Control T.X.	WR062	Price £2.26 30 pence p&p.
April 80	Signal Generator	WR070	Price £2.71 30 pence p&p.
April 80.	P.W. Nimbus Relay	WR075	Price £0.55 30 pence p&p.
April 80.	P.W. Nimbus Modulator	WR074	Price £0.70 30 pence p&p.
April 80.	Nimbus Transceiver	WR073	Price £5.30 30 pence p&p.
May 80.	Hundred Second Photo Timer	WR078	Price £2.48 30 pence p&p.
June 80.	Audio Limiter Main Board	WK076	Price £2.00 30 pence p&p.
June 80.	Audio Limiter	WK077	Price £1.15 30 pence p&p.
June 80.	Audio Limiter RF Input Board	WR079	Price £1.30 30 pence p&p.
June 80.	VHF/UHF Repeater Timer Main	WR080	Price £1.90 30 pence p&p.
June 80	P.W. Nimbus Base Station Adpt.	WR083	Price £2.60 30 pence p&p.
June 80.	Acoustic Flash Trigger	WRK84	Price £1.25 30 pence p&p.
Aug. 80	Model Railway Controller	WR085	Price £2.17 30 pence p&p.
Sept. 80	Transceiver Power Unit	WR095	Price £0.62 30 pence p&p.
Sept. 80	P.W. Nimbus Toneburst/ Timer Module	WR096	Price £1.85 30 pence p&p.
Sept. 80	Beginners 2m Converter	WAD634	Price £1.08 30 pence p&p.
Sept. 80	P.W. Tamar Board 1	WR086	Price £0.80 30 pence p&p.
Sept. 80	P.W. Tamar Board 2	WR087	Price £1.50 30 pence p&p.
Sept. 80	P.W. Tamar Board 3	WR088	Price £1.71 30 pence p&p.
Sept. 80	P.W. Tamar Board 4	WR089	Price £1.71 30 pence p&p.
Oct. 80	P.W. Tamar Board 5	WR090	Price £3.70 30 pence p&p.
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8"×5" ELLIPTICAL SPEAKERS
£2.30 EACH PLUS 75p p&p.
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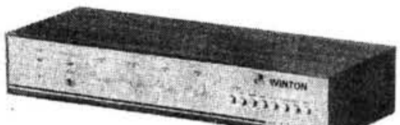
The 'WINTON' 50+50 WATTS



- ★ Power MOS-FET output stage.
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- ★ HF & LF Active Filters.
- ★ Very low noise Disc input stage.
- ★ Easy to build.
- ★ Unconditionally Stable.
- ★ Non-magnetic chassis.

During the past eighteen months the WINTON amplifier has set a new standard in Hi-Fi kits and is highly regarded throughout the world. Taking around twenty hours to build and not requiring special equipment for setting up, it represents incredible value for money and is undoubtedly one of the best kits around today.

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COMPLETE KIT, of all parts necessary to build the P.W. WINTON **£133.50**

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SIX DIGIT COUNTERS

One pulse moves one digit—Type 1 for 230v AC not resettable. Price **80p**—Type 2 for 48v DC or 115v AC and resettable **£1·35.**

DOOR MOVING MOTOR

Franco reversible single phase 240v AC motor with gear box giving final speed 56 rpm very powerful motor, weight approx. 13lb. Price **£15** carriage £3 mainland only.

SIREN OR BLEEPER

American Delta mechanical type, works on 6 to 12v to DC or 12 to 24v AC. Price **75p** or **£60** per 100. Electronic Bleeper **TH3S** emits high pitched wailing note of varying pitch. In red plastic case with fixing bracket. **£5·00.**

CASSETTE PLAYER/RECORDERS

With record and playback heads, all electronics, switches and speaker. Price **£9·95** (surely this must be the bargain of the year). Music centre replacement stereo with heads but not electronics. **£14·95.**

FRUIT MACHINE HEART

4 wheels with all fruits, motorised and with solenoids for stopping the wheels, with a little ingenuity you can defy your friends getting the "jackpot". **£9·95** + £4 carriage.

DESOLDERING PUMP

Ideal for removing components from computer boards as well as for service work generally. Price **£6·35.**

4 CORE FLEX CABLE

White pvc for telephone extensions, disco lights etc. 10 metres **£2,** 100 metres **£15.** Other multicore cable in stock.

HEADPHONE AMPLIFIER (STEREO)

With volume, tone and balance control 9v operation. All made up ready to go. Price **£4·50.**

MUGGER DETERRENT

A high note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. **£2·50** complete kit.

RELAYS

Open type with 2, 10 amp c/o contacts—single screw fixing **£1·25** each, please state the coil voltage you require.

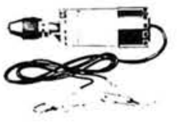
HUMIDITY SWITCH

American made by Honeywell. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive micro-switch, very sensitive—breathing on it for instance will switch it on. Micro 3 amp. at 250V a.c. Only **£1·15.**

SAFE BLOCK

Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit **£1·95.**

VERSA DRILL



A 12 volt battery operated power drill, not just suitable for printed circuit boards but will do all the jobs and is powerful enough to perform all the functions and operations normally expected of Black & Decker and other mains drills. Its chuck accepts up to ⅛" drills. Size approx. 150mm × 50mm. Price **£16·75.**

TWIST DRILLS

Precision Swiss made—normal price 50p each 10 diff. sizes covering $\frac{1}{16}$"-⅛". **£1·99** the lot—don't miss this super bargain.

MAINS SOLENOIDS

All have powerful pull.
TT2 size 1½" × 2¼" × 2". Price **£2·95.**
TT6 size 2¾" × ⅞" × 2". Price **£3·50.**
TT10 size 3" × 2¼" × 2". Price **£4·86.**

MOTORISED DISCO SWITCH

With 10 amp changeover switches. Multi adjustable switches are rated at 10 amps. This would provide a magnificent display. For mains operating. 8 switch model **£6·25.** 10 switch model **£6·75.** 12 switch model **£7·25.**

MULLARD UNILEX

A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy-to-assemble modular form this should sell at about **£30**—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£16** including VAT and postage.
FREE GIFT—Buy this month and you will receive a pair of **Goodman's** elliptical 8"×5" speakers to match this amplifier.

NEW KITS

5 WAVE BAND SHORT WAVE KIT Bandspread covering 13·5 to 52 metres. Complete kit includes case, materials, six transistors and diodes, condensers, resistors, inductors, switches etc. Nothing else to buy, if you have an amplifier to connect it to or a pair of high resistance headphones. Special price is **£11·95** inc.

SUB-MIN MICROPHONE
Size only ⅛" × ⅜" × 3/16" so small enough for a bugging device, ex-hearing aids but guaranteed. Price **£1·50.**

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox—all electronic parts and circuit. **£2·30.**

RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6·90.**

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£3·45**
Made up model **£1·00** extra

VENNER TIME SWITCH mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2·95.** These are new but without case, but we can supply plastic cases (base and cover) **£1·75** or metal case with window **£2·95.** Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2·30.**

THIS MONTH'S SNIP

includes a Free Gift, a desoldering PUMP, the one we are currently selling at £6·35. The snip is perhaps the most useful breakdown parcel we have ever offered, 50 nearly all different computer panels, on these panels you will find over 300 ICs, over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensers, multi-turn pots, rectifiers, etc., etc. You can have the parcel for only £8·50 which when you deduct value of the desoldering PUMP, work out just a LITTLE OVER 4p per panel. Surely this is a bargain you should not miss so send your ORDER today. Add £3·26 for Post and VAT.

SOUND AND LIGHT UNITS

3 CHANNEL SOUND TO LIGHT KIT Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for Disco work.
The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special snip price is **£13·50** in kit form or **£16·50** assembled and tested.

REMOTE CONTROL for Sound to Light (ours or any other circuit) saves connecting to speaker or amp—kit consists of 1 watt amplifier, crystal mike, case, sundries and diagram. Price **£3·95.**

LIGHT EXPANDER AND LATCH for Sound to Light, enables 3000 watts of lighting to be controlled by single channel or each channel and enables lights to be latched on. Kit consists of latching relay, control switch, case, sundries and diagram. Price **£4·25.**
SINGLE CHANNEL KIT still available. Price **£5·18**

DELAY SWITCH

Mains operated—delay can be accurately set with pointers knob for periods of up to 2½ hrs. 2 contacts suitable to switch 10 amps—second contact opens a few minutes after 1st contact. **£1·50.**

MINI-MULTI TESTER

Deluxe pocket size precision moving coil instrument, jewelled bearings—2000 o.p.v. mirrored scale.
11 instant ranges measure:—
DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0-100 mA.
Continuity and resistance 0-1 meg ohms in two ranges.
Complete with Test Prods and instruction book showing how to measure capacity and inductance as well.
Unbelievable value only **£6·75 + 50p** post and insurance.

FREE Amps ranges kit to enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one, send **£2·50.**

TERMS: Cash with order—but orders under **£10** must add **50p** to offset packing, etc.
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BURGLAR ALARM CONTROL PANEL
Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price **£6·00 + 90p.** With complete diagram.

PRECISION MAINS OPERATED CLOCK
For only **£1·50 + 22p.** Sounds unbelievable but that's what you can have if you send your order right away. The clocks which have large clear dials were made by the famous Smiths Company for use with their domestic cooker switch and are brand new and guaranteed.

15-0-15v @ 2 AMP MAINS TRANSFORMER
Mains transformer, upright mounting primary and secondary wound on separate bobbins with fixing lugs. Price **£3 + 45p. Post 60p.**

25-0-25v @ 750 mA MAINS TRANSFORMER
Mains transformer C core construction, heavily varnished for dead quiet operation. Upright mounting with fixing lugs. Price **£2·75 + 41p. Post 50p.**

25 WATT MID-RANGE SPEAKER 5¼"
Made by Goodmans so there's none better. 4 ohm coil. Price **£3·50 + 45p. Post £1·00.**

8 OHM TWEETER
Made by Goodmans. 3½" square, 4" across fixings. Price **£1·50 + 22p. Post 30p.**

NEW KITS

PRECISION PARKING PAD KIT as specified. **£2·50.**
LIGHT FAILURE MONITOR KIT as specified. **£7·50.**

WATERPROOF HEATING WIRE
As used for electric blankets, etc. This has dozens of other applications—in gloves or socks for people with poor circulation are obvious uses. One unusual use suggested by a customer is a 'grow' bag heater. The wire which consists of an element wound on glass fibre then PVC covered has a resistance of 60 ohms per yard. The price is **20p + 3p** per yard.

TELEPHONE PICK-UP coil attaches by suction to phone body, enabling conversation to be recorded, put through amp or headphones. Price **£1 + 15p.**

TRANSDUCERS
As used remote control T.V. receivers. Price **£1·50 + 22p.**

LIGHT CHASER
Gives a brilliant display—a psychedelic light show for discos, parties and pop groupds. These have three modes of flashing, two chase-patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. Price **£14 + £2·10.** Ready made up for **£4** extra.

PRINTED CIRCUIT KIT
4 copper plated boards and the chemical for etching the printed circuits, also 50 interesting designs of all sorts of electronic gadgets which can be made on these boards. Price **£1·70+30p.**

MAINS TRANSISTOR POWER PACK to operate transistor radio, cassettes, amplifiers, etc., take the place of any of the following batteries, PP1, PP3, PP4, PP6, PP9 and others. You can make voltage output anything from 3v to 16v at up to 300 mA. Complete kit but no case **£1·75 + 26p.** Case **75p + 13p.**

TELESCOPIC AERIAL
5 sections, 21" when extended. Nickel plated superior make, one nut fixing, folds over for FM. Price **95p + 15p.**

FISH BITE INDICATOR enables anglers to set up several lines then sit down and read a book. As soon as one has a bite the loudspeaker emits a shrill note. Kit. Price **£4 50+68p.**

6 WAVEBAND SHORT WAVE RADIO KIT
Brandspread covering 13·5 to 52 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit, includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy, if you have an amplifier to connect it to on a pair of high resistance headphones. Special price to get this kit off the ground. is **£11·95** inc VAT and postage.

3" EDGEWISE PANEL METER
0·25 MA moving coil made for the G.P.O. A very useful instrument especially when panel space is limited. **£2·50 + 38p.**

PANEL METER 0·1mA
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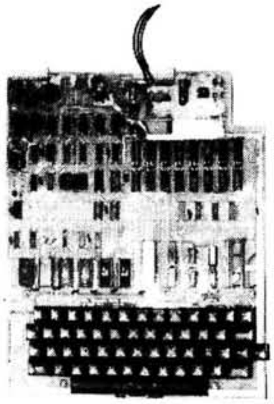

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67	500	0-115-200-220-240	**12·09**	1·91
84	1000	0-115-200-220-240	**20·64**	2·39
93	1500	0-115-200-220-240	**25·61**	0A
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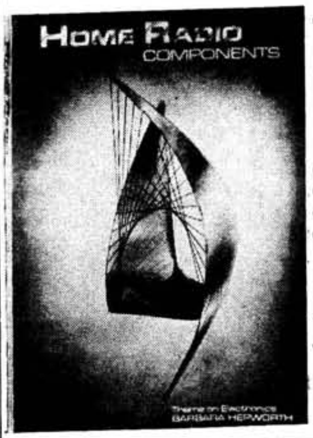

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A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully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

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.

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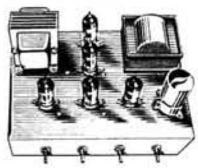

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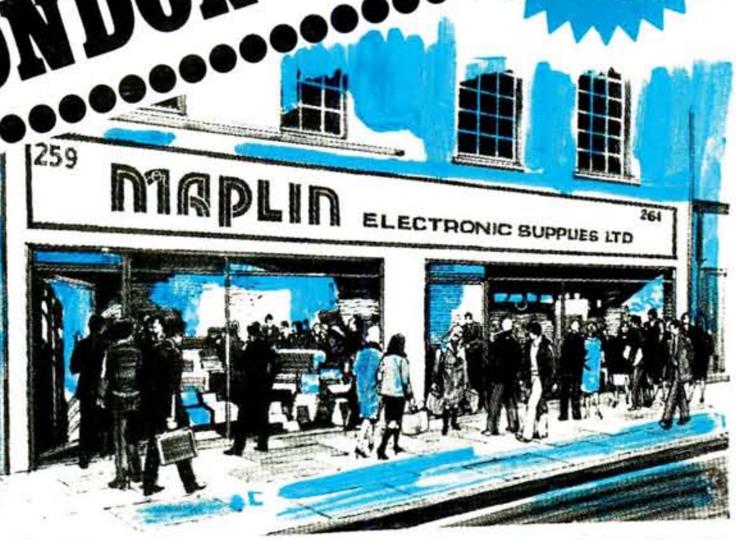

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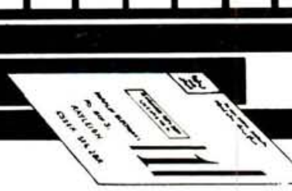

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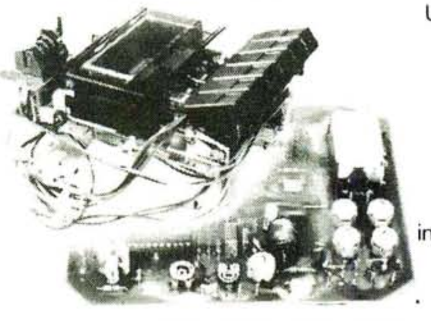

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