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Practical wireless

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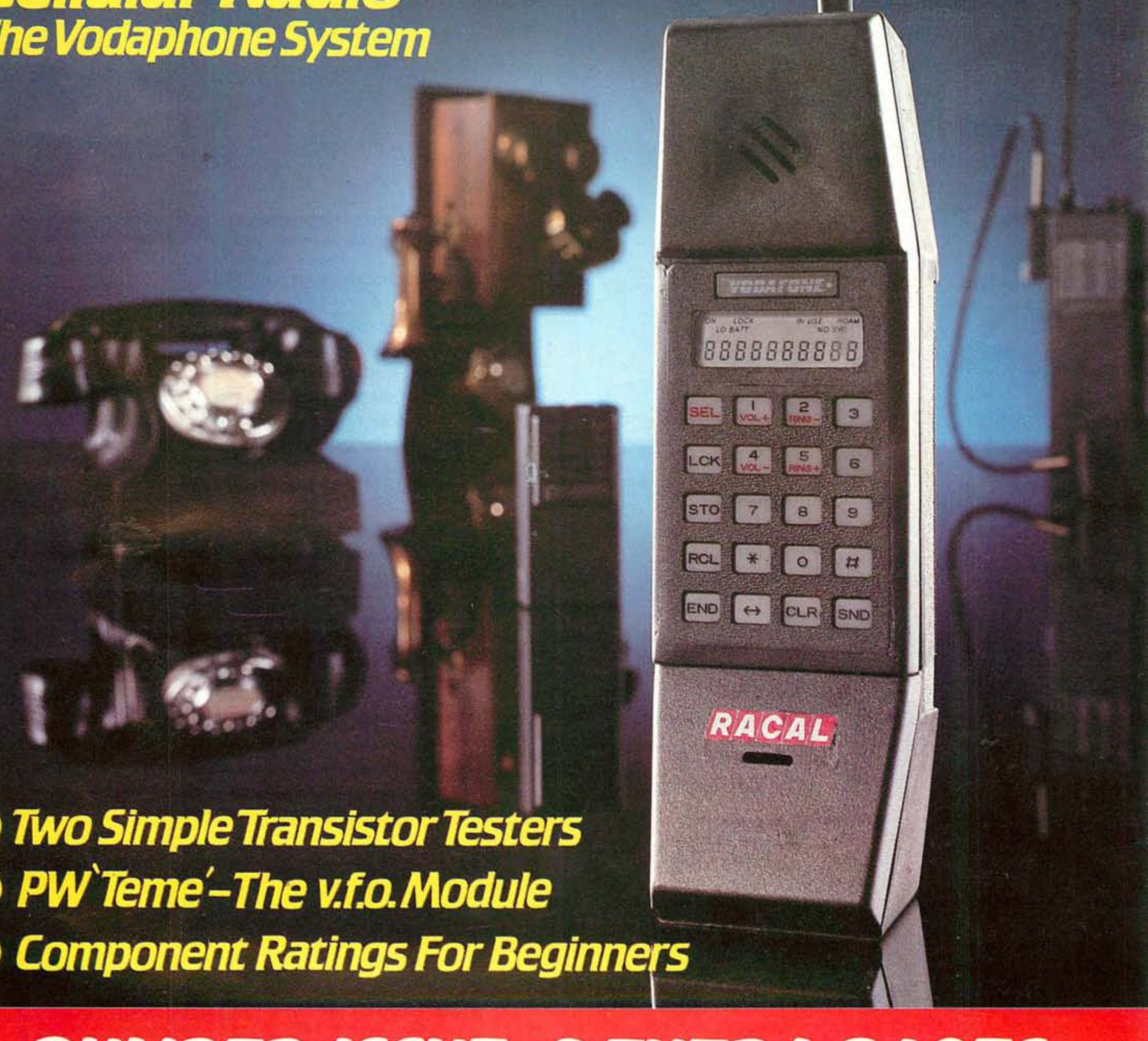
THE RADIO MAGAZINE

Cellular Radio – The Vodaphone System



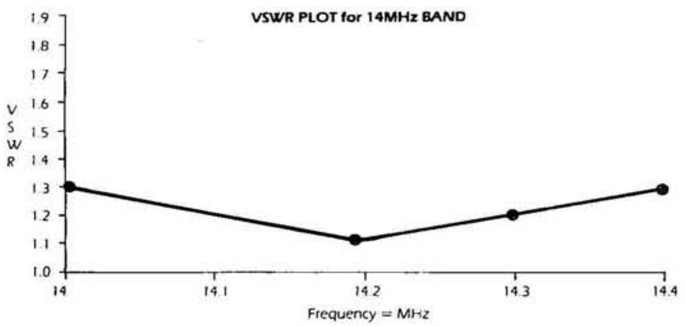
- Two Simple Transistor Testers
- PW 'Teme' – The v.f.o. Module
- Component Ratings For Beginners

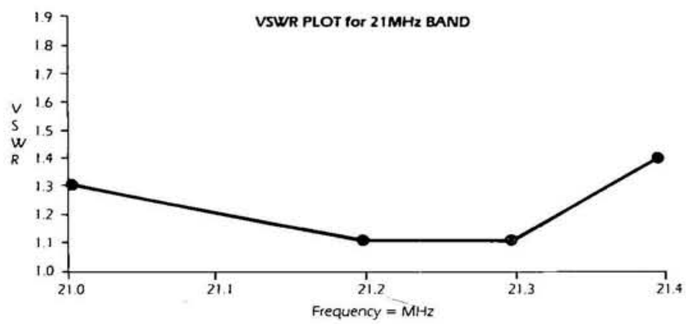
BUMPER ISSUE ~ 8 EXTRA PAGES

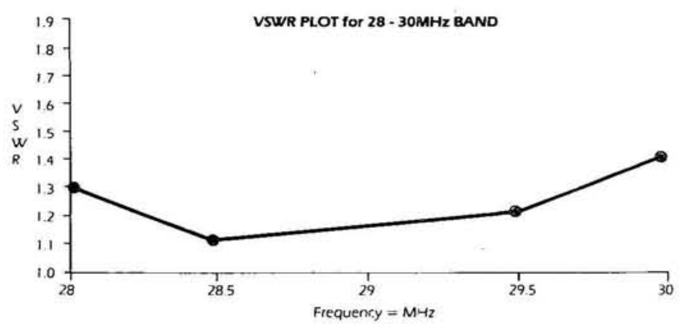
A New Approach to HF Antennae Design

Compare these performance figures of Hightech Antennae's **MBFr80** with the best 3 element antennae available today.

	Typical Spec. for 3 element Tri Band Beam	**Hightech Antennae's Spec for MBFr80**
	No. of Elements — 3	2 Parasitic + 1 Absorber Element
Front to Back Ratio	25dBd	43dBd
Forward gain	6dBd min.	Better than 4.5dBd
VSWR at Resonance	1.5 : 1	1.1 : 1
Max. Power Input	1kW (100% duty cycle)	2kW (100% duty cycle) 5kW peak
Input Impedance	50 ohm	50 ohm
Boom Length	4.2m	4m
Max. Element Length	8.2m	4.6m
Max. Wind Survival	75mph	100mph
Net Weight	16.3kg	8kg
Wind Load	80mph = 47kg	100mph = 23kg







The front to back ratio advantage from Hightech Antennae's **MBFr80** is 18dBd better than other antennae available today. Remember this is a 3 S-unit noise reduction in unwanted directions over and above other antennae.

6dBd = 1 S-unit

Massive front to back ratio. This is more important than forward gain on today's crowded amateur bands.

Flat VSWR across all HF bands.

No need for the purchase of ATU's for those with solid state PA's.

No need for the purchase of baluns.

A complete break with the coil and capacitator trap arrangement with, of course, its associated losses, restricted bandwidth etc.

Expandability: Extra parasitic element (director)
Extra absorber element for even greater front to back ratio.

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24, Gremista Industrial Estate, Lerwick, Shetland Is. ZE2 0PX

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FOR THE Radio ENTHUSIAST ...

Practical Wireless

DECEMBER 1984 VOL. 60 NO. 12 ISSUE 933

Our thanks to Racal-Vodafone for the illustration on our front cover this month

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LOWE SHOPS

Whenever you enter a LOWE ELECTRONICS' shop, be it Glasgow, Darlington, Cambridge, Cardiff, London or here at Matlock, then you can be certain that, along with a courteous welcome, you will receive straightforward advice. Advice given, not with the intention of "making" a sale, but the sort which is given freely by one radio amateur to another. Of course, if you decide to purchase then you have the knowledge that LOWE ELECTRONICS are the company that see the standard for amateur radio after-sales service. The shops are open Tuesday to Saturday and close for lunch 12.30 till 1.30pm.

In Glasgow the LOWE ELECTRONICS' shop (telephone 041-945 2626) is managed by Sim GM3SAN. Its address is 4/5 Queen Margaret's Road, off Queen Margaret's Drive. That's the right turn off Great Western Road at the Botanical Gardens' traffic lights. Street parking is available outside the shop and afterwards the Botanical gardens are well worth a visit . . .

In the North East the LOWE ELECTRONICS' shop is found in the delightful market town of Darlington (telephone 0325 486121) and is managed by Don G3GEA. The shop's address is 56 North Road, Darlington. That is on the A167 Durham road out of town. A huge free car park across the road, a large supermarket and bistro restaurant combine to make a visit to Darlington a pleasure for the whole family.

Cambridge, not only a University town but the location of a LOWE ELECTRONICS' shop managed by Tony G4NBS. The address is 162 High Street, Chesterton, Cambridge (telephone 0223 311230). From the A45 just to the north of Cambridge turn off into the town on the A1039, past the science park and turn left at the first roundabout. After passing a children's playground on your left turn left again into High Street. Easy and free street parking is available outside the shop.

Cardiff now has its own LOWE ELECTRONICS' shop. Managed by Richard GW4NAD, who hails from Penarth, the shop (our telephone number is 0222 464154) is located within the premises (on the first floor) of South Wales Carpets, Clifton Street, Cardiff. Clifton Street is easily found, being a left turn off Newport Road just before the infirmary. Once in Clifton Street, South Wales Carpets is the modern brick building at the end of the street on the right hand side. Enter the shop, follow the arrows past the carpets, up the stairs and the "Emporium" awaits you. Free street parking is available outside the shop.

MOVING . . . MOVING . . . MOVING . . From the 13th September 1984 the LOWE ELECTRONICS' London shop will be located at 223/225 Field End Road, Eastcote, Middlesex (the new telephone number is 01-429 3256). The new shop, managed by Andy G4DHQ is easily found, being part of Eastcote tube station buildings. Immediately behind the shop is a large car park where you can currently park for the day for 20p. There is also free street parking outside the shop.

Finally, here in Matlock, David G4KFN is in charge. Located in an area of scenic beauty a visit to the shop can combine amateur radio with an outing for the whole family. May I suggest a meal in one of the town's inexpensive restaurants or a picnic on the hill tops followed by a spell of portable operation.

the handheld TH21E,

In trying to describe the new 2 metre FM transceiver from **TRIO**, I am faced with a major difficulty. The **TH21E** is small, 2.24 inches wide, 4.72 inches high and only 1.1 inches deep but size alone is not the rig's fascination. Only by holding the transceiver can one begin to appreciate the attention that has been placed on its ergonomics. The way in which the **TRIO TH21E**, once picked up, seems impossible to put down. Its ability to slip into the inside pocket and for you to forget you have it. So far no one who has seen a **TH21E** has been able to resist picking it up, it's as simple as that. There is also a 70 centimetre version of the **TH21E** available, the **TH41E**. I am pleased that I can claim one of the rigs to use at home prior to writing the advertising and let the rest of the company fall out about who is having the other one. Never before can I remember two handhelds that have had such fascination.

Repeater shift, tone burst and reverse repeater on the **TH21E**, repeater shifts (both 1.6 and 7.6 MHz) and tone burst on the **TH41E**.

SPECIFICATION

General

Frequency range . . .TH21E 144 to 146 MHz.
TH41E 430 to 440 MHz.
Mode . . . . .F3 (F3E).
Power requirement .7.2 volts DC.
5.8 to 10V DC operating range.
Current drain . . . . . .less than 25mA (TH21E) 30mA (TH41E) in receive mode with no input signal. Less than 580mA (TH21E) 600mA (TH41E) in High power transmit mode (8.4V DC). Less than 250mA (TH21E) 300mA (TH41E) in low power transmit mode (8.4V DC).
Dimensions . . . . .57 (2.24) × 120 (4.72) × 28 (1.1) mm (inches).
Weight . . . . .260 grams (0.57 lbs).

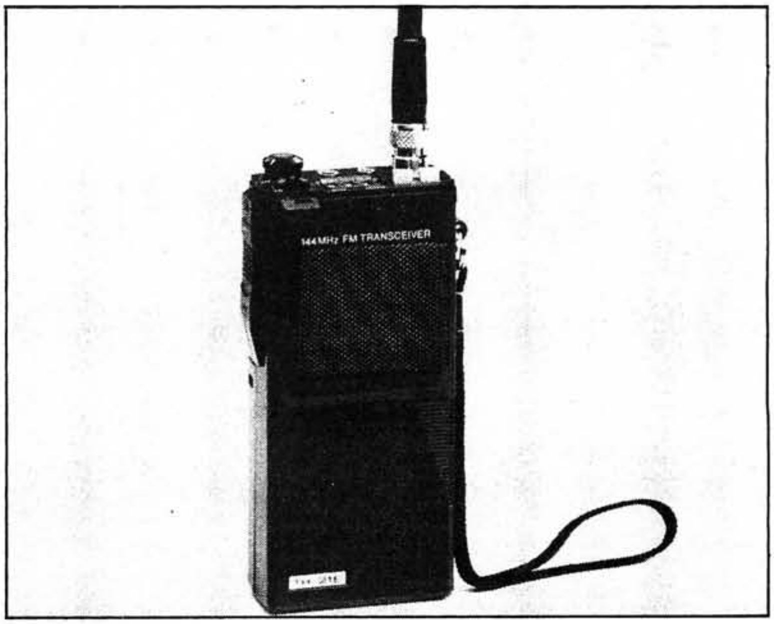
Transmitter

RF power output . . .1 watt high, 150 milliwatts low.
Modulation . . . . .reactance modulation.
Frequency deviation +/− 5kHz maximum.
Spurious radiation .less than −60dB.

Receiver

Circuit . . . . .double conversion superheterodyne.
Sensitivity . . . . .12dB SINAD less than 0.5 uV.
Squelch sensitivity .less than 0.5 uV.
Audio output . . . . . .more than 300mW (8 ohms at 10% distortion).

TH21E	2 metre transceiver	**£175.00 inc VAT**,	carr £7.00
TH41E	70 centimetre version	**£198.00 inc VAT**,	carr £7.00
SMC30	speaker/microphone	**£21.50 inc VAT**,	carr £1.00
HMC1	headset with VOX	**£25.00 inc VAT**,	carr £1.00
DC21	DC power supply	**£18.98 inc VAT**,	carr £1.00
PB21	Nicad battery pack	**£18.58 inc VAT**,	carr £1.00
BT2	Dry battery case	**£9.00 inc VAT**,	carr £0.75
SC8	Soft case	**£9.88 inc VAT**,	carr £0.75
EB2	External battery case	**£14.58 inc VAT**,	carr £1.00



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Chesterfield Road, Matlock, Derbyshire. DE4 5LE.
Telephone 0629 2817, 2430, 4057, 4995. Telex 377482.
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the base station for 2 metres, the TS711E.

Ever since the demise of the **TRIO 700** series of equipment, we, here at **LOWE ELECTRONICS** have been campaigning for the introduction of a new "true base station" transceiver. Those who have used a **TRIO TS700S** or **G** will know what I mean. There is that certain feel which a base station transceiver has which the mobile or portable rig, when taken out of the car or used in the shack, definitely has not. I am pleased to say that **TRIO** have introduced a new 2 metre base station, it is called the **TS711E**. I have been fortunate enough to have used the transceiver over the past couple of weeks and again I am lost for words. Certainly there will be a **TRIO TS711E** in my shack, I have even prepared a space for it!

Having used the rig let me explain some of its features. In size, weight and appearance the **TS711E** is similar to the **TS430S** HF transceiver but unlike the **TS430S** it has its own internal power supply. It also has an inbuilt speech processor and IF shift, both ideal features for today's active 2 metre band. Power output is 25 watts but the rig I have been using produces 32. Typical **TRIO!** The **TS711E** has two VFO's and, wait for it, forty memory channels. Yes, I too wondered how one could use so many memories.

Initially I started to use the rig as I had my dual band **TRIO TS780.** One VFO left on 144.300 and the other on 145.500. Since the rig remembers both frequency and mode there was no problem operating SSB on one VFO and with the electronic click step engaged, FM on the other. Electronic click step? . . . the **TS711E** has been designed so that as a multi-mode rig you can have a free running VFO on SSB and CW and when operating FM, a VFO with 5 or 12.5 kHz click steps. I refer to the click step as electronic because a touch switch instantly changes the VFO function. Of course, I need not tell you that the memories remember which VFO operation has been selected or for that matter whether repeater shift was required. On SSB and CW the **TS711E's** synthesized VFO tunes in 10 Hz steps.

After using the rig for some time without the 40 memories I concluded that since it was possible to move a frequency from memory to VFO it would make sense to program the memories logically and then use them as a basis for operating. Result, the rig is a dream to use. With the **TS711E's** memory carrying a sequence of calling channels, beacon, simplex and repeater frequencies a swift rotation of the VFO (which also serves to change memory channels) and the entire band can be looked at in seconds. To check on OSCAR 10, dial up the correct memory holding say the satellite beacon frequency, if that's audible then move the beacon frequency to the VFO by pushing the appropriate switch and there you are, tuning the correct part of the band, in the right mode and with the VFO running free. The same can be applied to the CW end of the band and with the VFO set to click stop, FM channels also.

There are facilities to put both VFO's on the same frequency, to operate split using one VFO for receive and the other for transmit. A priority call channel is available as is the ability to go back to a predetermined frequency. The **TS711E** will scan the band or the memories holding for a brief period on an occupied frequency. It will also scan the memories looking at only those frequencies entered in a particular mode.

Programmable scan is also included, memory channels 39 and 40 setting the limits. The now standard full repeater facilities are included.

For the blind operator the **TS711E** is a dream come true. Full voice announcement of frequency and whether the rig is set to repeater shift comes by fitting the optional VS1 board. A push button, conveniently located on the bottom corner of the front panel, activates the voice. The careful location of this control shows **TRIO's** attention to detail. How difficult would the switch have been to find for the blind operator had it been located in the middle of the panel. Mode of operation is indicated by switches which when pushed instead of a general beeping, send the morse code letter F for FM, U for USB, C for CW, L for LSB and A for auto. Auto, what's auto? . . . With auto switched on, as you tune across the band the **TS711E** selects the correct mode for the appropriate frequency. You can over-ride this function and as I have said elsewhere, **you too can transmit FM on the SSB part of the band.**

Enough I hear you say. Sorry, one more feature. DIGITAL CODE SQUELCH! The transceiver has as standard an inbuilt selective tone call system incorporating a call alarm. So if you are not in the shack then you will know you have been called. The transceiver will also send up to 6 letters or numbers as part of the selective call. I am sure it will not be long before **TRIO** introduce a **TS711E** accessory (I am told it is called the CD-10 call sign display) which will decode the information. Then will you not only know that you have been called but who has called you, the 6 letters or digits making up the callsign.

What more can I say, what a rig! For the operator who wants the finest two metre base station transceiver **TRIO** have produced the **TS711E**. For the UHF operator there is the **TRIO TS811E**, the 70 centimetre version. Both ideal ways of getting on to the VHF/UHF bands.

TS711E	2 metre base station transceiver with DCS	**£758.00 inc VAT,** carr £7.00
TS811E	70 centimetre base station transceiver with DCS	**£878.00 inc VAT,** carr £7.00
CD10	Callsign display unit	**£105.40 inc VAT,** carr £7.00
SP430	Matching speaker	**£30.99 inc VAT,** carr £2.50

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FT757GX	Transceiver General Coverage Rx	£719.00
FC757AT	Automatic antenna tuner	£254.00
FP757GX	Switch mode PSU (50pc duty)	£145.00
FP757HD	Heavy duty PSU (100pc duty)	£179.00
FIF80	Computer interface for PC8001 NEC	£105.00
FIF65	Computer interface for Apple II	£54.00
FIF232C	Computer interface RS232C	£59.00

FT77 THE IDEAL MOBILE

Employing all the latest engineering and manufacturing techniques the FT77 is intended to offer the essential modern operating features in the most economical, reliable and compact HF transceiver available.

FT77	8 Band Rx/Tx 100W output	£479.00
FT77S	8 Band Rx/Tx 10W output	£449.00
FP700	Matching AC PSU	£145.00
FC700	Matching antenna tuner	£103.85
FV700DM	Digital VFO unit	£209.00
MKT77	Marker unit	£10.85
FMUT77	FM unit	£28.55
AMUT77	AM unit	£24.00

FT980 'COMPUTER COMPATABLE'

FT980	Transceiver General Coverage Rx	£1329.00
SP980	Ext. speaker with audio filter	£61.55
XF455.8MCN	300Hz CW filter (455KHz 8 pole)	£49.00
XF8.9HC	600Hz CW filter	£29.50
XF8.9GA	6KHz AM filter	£29.50
FIF**	Computer interface	(see FT757GX units)
D410004	Interconnect lead FT980 – FC757AT	£26.99
TST980	Technical Supplement FT980	£8.50

FT-ONE 'THE ULTIMATE'

FT ONE	Transceiver HF All Mode	£1569.00
KEYT901	Curtis Keyer	£28.50
DCT1	DC Power Cable	£10.85
RAMT1	Non volatile memory	£14.49
FMUT1	FM unit	£44.99
XF8.9K*	Filter 300Hz or 600Hz or 6KHz each	£19.35

FRG7700 COMMUNICATIONS RX

FRG7700	Receiver 0.15-30MHz AM/CW/SSB/FM	£385.00
FRG7700M	Receiver c/w 12 channel memory	£455.00
MEMG7700	Memory option	£75.00
FRT7700	Antenna tuner/switch	£48.25
FRA7700	Active antenna	£43.95
FF5	Low pass filter 500KHz	£11.25
FRV7700	VHF Convertors, 8 models, each 3 bands. From	£85-£95 each

6 METRE EQUIPMENT

FT680R

FT726R	Main frame unit less modules	£619.00 inc.
50/726	6M module for 726R	£195.00 inc.
FT680R*	6M mobile 10W O/P	£359.00 inc.
FT690R*	6M transportable 2.5W O/P	£259.00 inc.
FL6010*	Matching 10W amplifier for 690R	£49.00 inc.
50TV*	6M module for FTV transvertors	£89.00 inc.
MMC 50/28S	6M down to 10M convertor	£34.90 inc.
MMA50V	6M switched pre-amp	£34.90 inc.
SLNA50S	50 MHz switched pre-amp	£44.90 inc.

**Limited availability on these models*

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Leeds 16, Yorkshire	New Whittington,	Buckley, Clwyd	Talke Pits, Stoke	Grimsby, Lincs	St. Helier, Jersey	Edinburgh EH15 2HN	Bangor, Co. Down
Leeds (0532) 782326	Chesterfield	Buckley (0244) 549563	Kidsgrove (07816) 72644	Grimsby (0472) 59388	Jersey (0534) 77067	Tel: 031 657 2430	Bangor (0247) 464875
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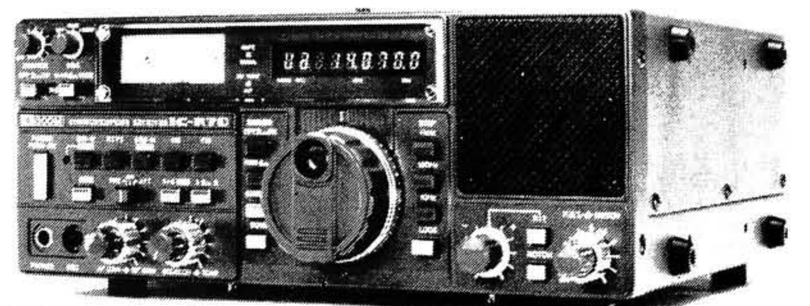
ICOM

FOR THE SWL...

IC-R70



The R70 covers all modes (when the FM option is included), and uses 2CPU-driven VFOs for split frequency working, and has 3 IF frequencies. 70MHz, 9MHz and 455KHz, and a 100dB dynamic range. It has a built-in mains supply. Other features include input switchability through a pre-amplifier, direct or via an attenuator, selectable tuning steps of 1KHz, 100Hz or 10Hz, adjustable IF bandwidth in 3 steps (455KHz). Noise limiter, switchable AGC, tunable notch filter, squelch on all modes, RIT, tone control. Tuning LED for FM (discriminator centre indicator). Recorder output, dimmer control.

The R-70 also has separate antenna sockets for LW-MW with automatic switching, and a large, front-mounted loudspeaker with 5.8W output. The frequency stability for the 1st hour is ± 50Hz, sensitivity – SSB/CW/RTTY better than 0.32 uv for 12dB (S + N) ÷ N, Am – 0.5 uv. FM better than 0.32 for 12dB Sinad. DC is optional.

Ever since its introduction the IC-R70 has proved to be a popular and reliable HF receiver making your listening hours a pleasure. Please contact us for further details on this excellent set.

IC-R71E

For those who like the easy life, the R71E has the option of an infra-red remote control unit, making it a very sophisticated rig indeed, here are some details.

100 KHz – 30 MHz all mode (with FM option). Quadruple conversion superhet. IF frequencies 70MHz,9MHz and 455KHz with continuous bandpass tuning and notch filter. Virtually immune from adjacent channel interference with 100db dynamic range. Adjustable AGC, noise blanker and switchable pre-amplifier. Direct keyboard into twin VFO's with 32 programmable memories. 5 year lithium memory backup cell. Memory and band scan with auto-stop. Tuning rates 10Hz, 50Hz and 1 KHz with 6 digit readout. AC mains operation. Auto squelch tape record function.

OPTIONS:- Synthesized voice readout, infra-red remote controller, 12 V DC kit, mobile mounting bracket, two CW filters 500 and 250 Hz, FM unit, computer interface, headphones.

You can get what you want just by picking up the telephone. Our mail-order dept. offers you: free, same-day despatch whenever possible, instant credit, interest-free H.P., telephone Barclaycard and Access facility and a 24 hour answering service.

Please note that we now have a new retail branch at 95, Mortimer Street, Herne Bay, Kent. Give it a visit, BCNU.

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ICOM

ON THE MOVE.

IC-290D

290D is the state of the art 2 meter mobile, it has 5 memories and VFO's to store your favourite repeaters and a priority channel to check your most important frequency automatically. Programmable offsets are included for odd repeater splits, tuning is 5KHz or 1KHz.

The squelch on SSB silently scans for signals, while 2 VFO's with equalising capability mark your signal frequency with the touch of a button. Other features include: RIT, 1KHz or 100Hz tuning/CW sidetone, AGC slow or fast in SSB and CW,Noise blanker to suppress pulse type noises on SSB/CW.

You can scan the whole band between VFO's/scan memories and VFO's. Adjustable scan rate 144 to 146 MHz, remote tuning with optional IC-HM1 microphone. Digital frequency display, Hi/Low power switch. Optional Nicad battery system allows retention of memory. What a great little transceiver!

IC-02E
IC-04E,(70cm).

The new direct entry microprocessor controlled IC-02E is a 2 meter handheld jam packed with excellent features.

Some of these features include: scanning, 10 memories, duplex offset storage in memory and odd offsets also stored in memory. Internal Lithium battery backup and repeater tone are of course included. Keyboard entry is made through the 16 button pad allowing easy access to frequencies, duplex, memories, memory scan and priority.

The IC-02E has an LCD readout indicating frequency, memory channel, signal strength, transmitter output and scanning functions. New HS-10 Headset, with earphone and boom microphone, which operates with either of the following:- HS 10-SB Switch box with pre-amplifier giving biased toggle on, off and continuous transmit. HS 10-SA Voice operated switch box, with pre-amplifier, mic gain, vox gain and delay. The IC-2E continues to be available.

Agent: Gordon G3LEQ, or telephone Knutsford (0565) 4040. Please telephone first, anytime between 0900 – 2200 hrs.

THANET ELECTRONICS WISH YOU ALL A HAPPY CHRISTMAS & SUCCESSFUL NEW YEAR

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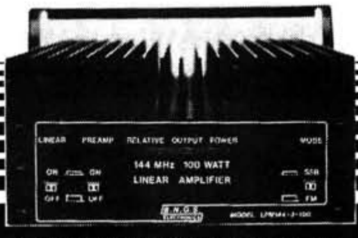

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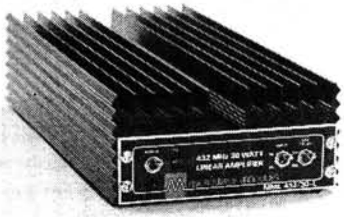

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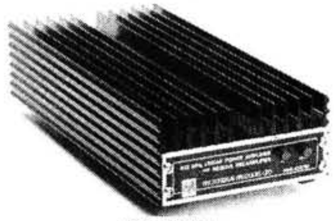

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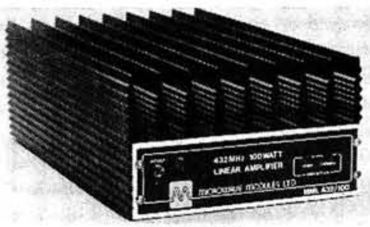

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Comment

Making Plans

IT WAS A GREAT DISAPPOINTMENT to have to announce in our November issue that the first staging of "Leisuretronics", a new exhibition for the radio and electronics hobbyist, has been abandoned for this year. We understand that there was simply not enough support from exhibitors to make the event viable, no doubt because of the present economic situation.

We enjoy having the opportunity to meet our readers face to face at amateur radio exhibitions and rallies during the year, but a more general electronics-based exhibition such as "Leisuretronics" gives us a different sort of opportunity—that of "selling" the delights of amateur radio and short-wave listening to devotees of computing, robotics, radio-controlled models, musical instruments or electronics gadgets. Perhaps it will be possible to put on a "Leisuretronics" in 1985—I hope so.

* * * * *

There are disturbing developments taking place in the area of planning applications for amateur radio antenna masts, and we are closely watching one appeal in our area which is in the nature of a test case.

The purpose of planning control is primarily to try to ensure the protection of the visual amenity, though I often have the feeling that this aim is deflected by the worship of Mammon where office blocks and industrial developments are concerned—the lure of all that additional rates revenue is obviously very strong! Some local authorities have tried to bring the question of potential radio frequency interference (r.f.i.) into the planning process for amateur radio masts, as mentioned in our recent series *Antennas and Planning Law* by J. J. Fields. We understand that the Department of the Environment has issued a circular to local authorities instructing them that they should not introduce into the planning process matters covered by other legislation. However, at least one planning officer has publicly stated that he does not accept this instruction, and as far as he is concerned, potential r.f.i. will always be taken into account by his department.

The relationship between the visual amenity and the r.f.i. aspects of an antenna installation is not a simple one. Good engineering practice and Note (c) of the UK Amateur Licence call for the transmitting antenna to be installed as far as possible from TV or other receiving antennas. This obviously means that the transmitting antenna should be high and at some distance from surrounding houses, exactly the opposite of what the planning officer **and** the neighbours would like.

The imposition of temporary planning permissions for radio masts and large planning application fees on each renewal is going to add considerably to the cost of pursuing the hobby of amateur radio, unless you are able (and prepared) to use antenna systems which do not require planning permission. Far more sensible to insist that domestic radio and electronic equipment should be designed and built to resist r.f.i., which is produced not only by radio transmitters but by the multitude of electronic devices, from dimmers to computers, which are now becoming so common.

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.

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 will be mentioned in the Buying Guide.

INSURANCE

Turn to the "News" pages for details of the PW Radio Users Insurance Scheme, exclusive to our readers.

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.

SUBSCRIPTIONS

Subscriptions are available at £13 per annum to UK addresses and £14 overseas, from **"Practical Wireless" Subscription Department, Room 2816, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

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Limited stocks of some recent issues of *PW* are available at £1 each, including post and packing to addresses at home and overseas.

Binders are available (Price £5.50 to UK addresses, £5.75 overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

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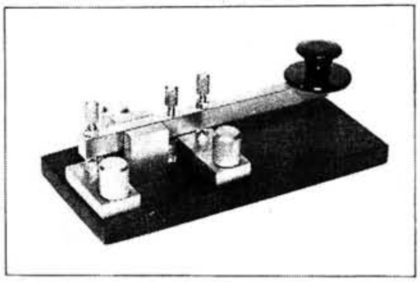
Products

Good Old Pounder

In these days of accelerating high technology, for c.w. operation, radio amateurs have available "bug" iambic, even triambic keys, to keep apace with, yet so often in conversation with OTs they will wax lyrical on those solid, perfectly balanced, fully adjustable, long-armed beauties of yesteryear that allowed the key to become an almost living extension of the operator's arm.

G.W. Morse Keys, of Rhyl in GW-land, have faithfully reproduced such a key, incorporating simplicity of construction, whilst maintaining the feel and reliability of the original design.

Within the construction, the centre pivot bearing is adjusted and set via a tapered pin and lock screw, whilst the other adjustable pins have lock nuts to fix them in place once they are set. An adjustable tension return spring is fitted and the contacts are made from silver/nickel mounted on brass beds.



Finally, the solid brass key is mounted on a felt-lined slate base measuring 202 × 87 × 12mm, to ensure that the key does not move when in use.

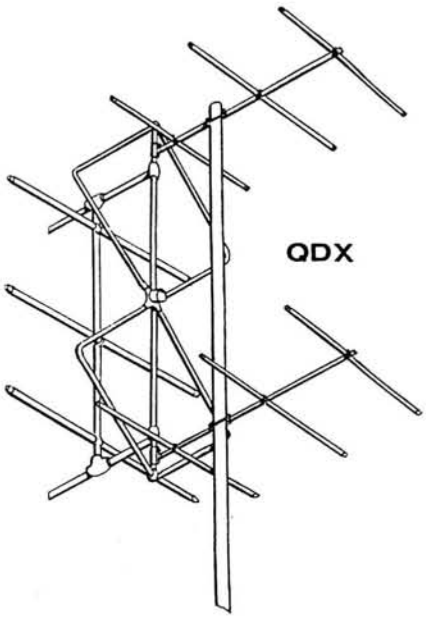
The G.W. Brass Morse Key is available with either a fine brushed or highly polished finish, costs £34.50 (which includes VAT) plus £2.00 p&p, and is obtainable from: *G.W. Morse Keys, 4 Owen Close, Rhyl, Clwyd LL18 2LQ. Tel: (0745) 54763.*

144MHz Double Quad-Yagi

Halbar, the Bedford based antenna manufacturers, have recently introduced what they believe to be the first commercially available 144MHz band Double Quad-Yagi.

This antenna design seems to be highly respected by radio amateurs in Germany, judging by the extensive description in the *UHF Compendium*, but has yet to gain popularity in the UK.

The antenna, entitled the QDX, is a developed variant of the Double Quad-Yagi format that could well set the ball rolling, with its 12dBd quoted forward gain from a 1·32m (52 inches) boom length. Front to back ratio is quoted at 23dB, beamwidth 2 × 20° with an overall weight of 2·5kg and priced at £21.50 plus £3.00 p&p.



Other versions of the QDX antenna, featuring lower gain and shorter beam length, are available, as are many alternative traditional antenna designs, including a 13 element 1·3GHz quad.

For further details, please send an s.a.e. to: *Halbar, Unit 1, Bury Walk, Bedford MK41 ODU. Tel: (0234) 44720.*

Water-Slide Transfers

Most people will remember adding the finishing touches to a model aircraft etc., using beautifully produced transfers.

Kaine Kinetics produce an A4 sheet of water-slide transfers designed specifically with the amateur radio constructor in mind. Each sheet comprises radio equipment legends (four of each) of just about all the control or function markings that the constructor might require.

The legends are produced in white only and printed on a transparent carrier film that releases from its backing paper when floated, face up, in a saucer of tepid water. The legend can then be applied directly to the required surface and dabbed with a tissue to release trapped air bubbles and absorb excess moisture.

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The transfer sheets retail at £1.25 each, which includes p&p and a simple set of instructions, and are obtainable from: *Kaine Kinetics, 74 Camden Mews, London NW1 9BX. Tel: 01-267 1000.*

Morse Code Cards

Any aspiring A-licence student will know very well that learning the Morse code is a complicated, time consuming process demanding great application and much practice.

A product that could assist with this learning process and can be used virtually anywhere, are Flip Cards distributed by Alan Hooker (Electronics) of Doncaster.

The cards have the Morse code symbol embossed on the face of the card, and the corresponding letter or number printed on the reverse.

Basically, the embossed side of the card is "read" by running a finger, from left to right, over the embossed code without looking. This should, with practice, familiarise the student with the dit and dah composition of each character in precisely the same manner as he will receive or send the code when proficient.

The Morse Code Cards are made of thin plastics sheet, approximately the size of a playing card, cost £3.95 inclusive of p&p, and are available from: *Alan Hooker (Electronics), 42 Nether Hall Road, Doncaster DN1 2PZ. Tel: (0302) 25690.*

If you please

Please mention this column when applying to manufacturers or suppliers featured on this page.

an introduction to Antennas

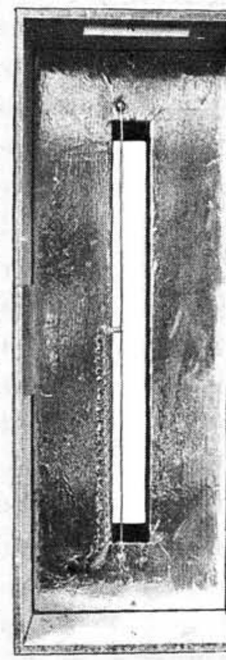
Part 4 by Gordon J. King T.Eng(CEI), AMIERE, G4VFV

The answer to the question put at the end of Part 3 is related to the plane of polarisation of the radio wave. A wave is said to be polarised in the direction of its *electric* vector (see Fig. 4.1) and to achieve maximum response at the antenna its axis must be in the same plane as the signal polarisation. In other words, the antenna must be vertical to respond properly to a vertically polarised signal or horizontal to respond fully to a horizontally polarised signal.

This is because signal is induced into the antenna by the magnetic component of the radio wave cutting at right-angles across the axis of the conductor. There is an exception when, instead of a conducting element the antenna comprises a slot cut into a conducting sheet. This arrangement, known as a slot antenna, responds to the electric component of the radio wave. Although used extensively in stacked arrays for transmitting in the v.h.f. and sometimes u.h.f. bands they are rarely used nowadays for reception, though I have experimented with them myself for reception, Fig. 4.2 showing a prototype of a u.h.f. slot antenna which I designed some time back. Although the slot is here shown in vertical disposition the antenna is responsive to horizontally polarised u.h.f. TV signals. Design included a rear slot reflector and a front decorative grille (something like a loudspeaker front) since the antenna was meant to stand on or near to a TV set!

It is possible to produce radio waves that are not plane polarised and hence devoid of a unique orientation defining the direction of the electric vector. This sort of polarisation, circular or elliptical, is equivalent to two plane polarised waves at right-angles to each other and having a suitable phase-angle between them.

When v.h.f. TV broadcasting began in the UK it was considered that vertical polarisation provided better local coverage than horizontal polarisation and as a consequence vertical polarisation became the standard. Eventually, co-channel interference even between widely separated stations, made it necessary to adopt orthogonal polarisation to help reduce the risk of shared channel stations causing interference during a tropospheric lift. Hence horizontal polarisation also came into use and orthogonal polarisation has followed through to u.h.f. TV. It is noteworthy that circular polarisation, used extensively for v.h.f. f.m. broadcasting, has been mooted for TV; but the need for it here is less than for v.h.f. f.m. where vertical antennas are commonly used for car radios and on battery portables incorporating Band II.



With this sort of polarisation, sometimes called "slant polarisation", a good response is obtained from both horizontally-mounted home-base f.m. antennas and vertical car and portable radio antennas. However, signal loss can be high when the receiving antenna is at right-angles to the plane of a linearly polarised wave—hence the reason for the enhanced protection provided by the use of an orthogonal polarisation system for TV stations.

As an interesting aside, if two matching dipoles were disposed orthogonally and coupled with a 90-degree phase displacement between them to a common feeder the response of the system to a signal of circular polarisation would be as effective as that of either dipole immersed in the same signal strength field but of corresponding linear plane of polarisation.

So much then for the horizontally-mounted dipole; but

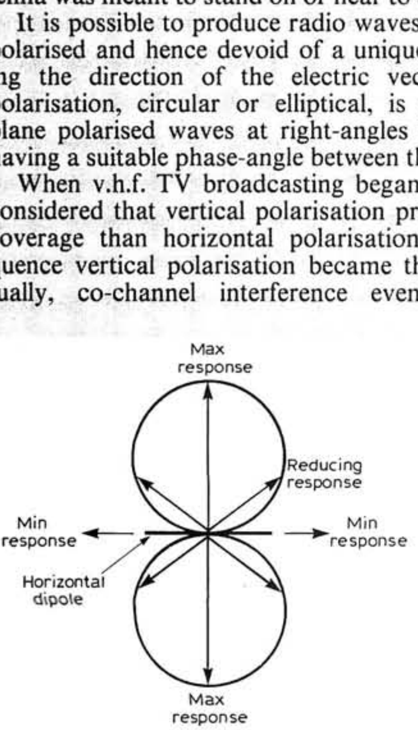


Fig. 4.1

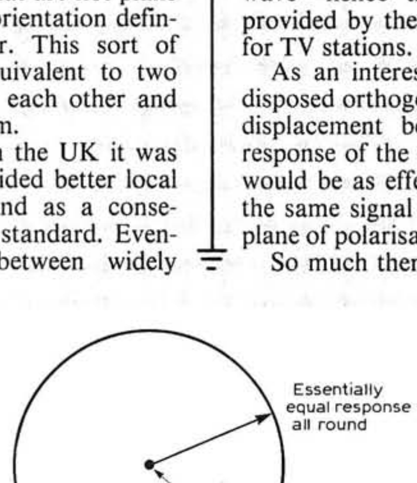


Fig. 4.3

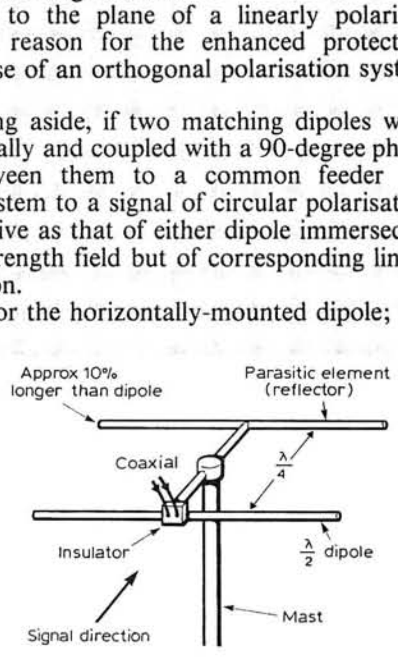


Fig. 4.4

Fig. 4.2 (Top)

what happens when it is vertically-mounted? Well in this case there is essentially an equal response all round the antenna as shown in Fig. 4.3. CBers and 144MHz f.m. amateurs almost always use vertical polarisation because their antennas are engineered to be vertically-mounted. This applies even though the antenna is a shortened quarter-wave with a ground plane configuration of some sort and resonated by an inductor at the lower end as required by the Home Office. They thus transmit and receive vertically polarised signals. This is useful because it provides an essentially omnidirectional transmitting and receiving field, avoiding having to turn the antenna to work stations from different bearings.

Some CBers I know have mounted their antennas horizontally and then wonder why it is that their signals are neither transmitted nor received as strongly as those of other "breakers" whose antennas are vertically-mounted! A mild tilt is of minimal consequence; but playing horizontal against the vertical can lead to substantial shortfalls, especially at v.h.f.

Directionality

It is desirable for v.h.f. and u.h.f. receiving antennas to be as directional as possible in the horizontal plane for two reasons: one to achieve the highest power gain possible in the interest of signal/noise ratio, bearing in mind that the effective length of a $\lambda/2$ dipole decreases with increasing frequency as does the signal voltage that it abstracts from the radio wave (see the formulae under Antenna Voltage in Part 3): and two to provide adequate discrimination against unwanted signals arriving from directions other than that of the wanted signal.

A happy thing once you have a resonant $\lambda/2$ dipole is that you can easily make it more directional than its basic figure-of-eight horizontal polar diagram or, indeed, its omnidirectional vertical one by adding a parasitic element. This can be regarded as an extra dipole but without a centre discontinuity for connecting a feeder, the term parasitic, in fact, implies that the element is not electrically connected to the dipole feeder.

Adding a Reflector

Now, what happens to the polar diagram then depends on the length of the parasitic element and its distance from the dipole. The basic configuration is given in Fig. 4.4. The parasitic element in this case is called a reflector because the plan is for it to re-radiate energy back to the dipole to reinforce that intercepted by the dipole itself. The dipole, of course, is connected to coaxial feeder in the usual way, and with a horizontal antenna it matters not to which $\lambda/4$ section the outer braid is terminated with a vertical antenna, though there is some advantage when the braid is connected to the lower $\lambda/4$ section.

For the two-element antenna to work properly the re-radiated signal must be phase coincident with the dipole's signal. This is achieved by the combined effects of the phase delay on reflection and the phase lag resulting from the spacing of the parasitic element behind the dipole. A common spacing for the director is $\lambda/4$ and because it is non-terminated most of the wave energy it intercepts is re-radiated. Length of the reflector can correspond to the signal $\lambda/2$, but the nature of the resulting polar diagram can be changed by altering the length of the reflector, its spacing from the dipole or both.

When the reactive component of the director is zero ($X = 0$) and spaced $\lambda/4$ from the driven dipole the polar diagram resembles that shown in Fig. 4.5 at (a). The broken-line circle represents the horizontal polar diagram of a single vertical dipole for comparison, while point A corresponds to the driven dipole and point B the reflector. Diagrams (b) and (c) give an impression of what happens when the reactive component of the director is made slightly more positive (e.g. $+jX$) progressively which, as we have seen, is when the element is larger than resonance. Diagram (b) towards (c) occurs when the reflector is about 8 to 12 per cent longer than the dipole, but this is influenced by the length/diameter ratio of the reflector.

Anyway, you will see that the advantage of the two-element reflector type of antenna (sometimes called an "H" antenna) is that there is greater response at the front than at the back. To provide maximum discrimination against signals arriving from the back, the reflector is invariably made longer than the dipole, thereby approximating the polar diagram at (c). The increase in field strength over that of a solitary dipole is around 1·6:1 (4dB) in the forward direction.

Dipole/parasitic element spacing of less than $\lambda/4$ is sometimes used and a different, though similar, set of polar diagrams emerge. With a spacing of, say, $0{\cdot}1\lambda$ the results approximate those in Fig. 4.6. Here you will see that when the parasitic element has a reactive component of zero (its length same as dipole) then the antenna exhibits the greatest sensitivity in the direction of the parasitic element (a). Forward gain in the direction of the driven dipole resumes as the parasitic element is made longer and $+jX$ obtains, as shown by (b) and (c). It would, of course, be possible to achieve $+jX$ by adding inductance at the centre of the parasitic element.

Adding Directors

Increasing sensitivity in the direction of the parasitic element occurs when this element is made shorter than the driven dipole such that its reactive component is capacitive, or $-jX$. This is more apparent when the spacing is $0{\cdot}1\lambda$, as shown by (a) and (b) in Fig. 4.7. At (c) is shown the approximate effect when the parasitic element is spaced $\lambda/4$ from the driven dipole and has about the same value $-jK$ as (b).

Both forward gain and directivity can be enhanced by using a rear reflector and a front director—or directors—such an antenna then being known as a Yagi array after the name of its inventors Yagi and Uda, and this is the sort

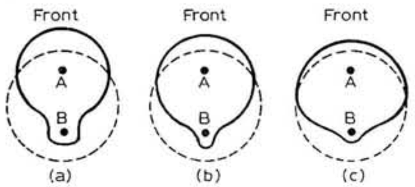


Fig. 4.5

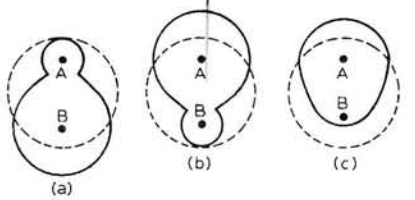


Fig. 4.6

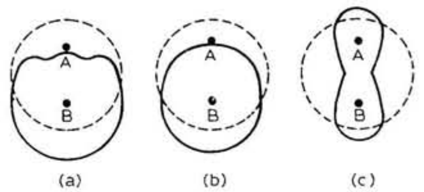


Fig. 4.7

of antenna which we use for getting the best from our v.h.f. receivers. Except for a three-element array (dipole front director and rear reflector), it is difficult to explain the working of a multi-element Yagi array mathematically. However, from first principles the director system can be regarded as a "wave guiding" configuration such that the wave energy arriving at the diple is progressively increased as a function of the directors. It should be noted, though, that this effect does not occur by the addition of extra reflectors: the first reflector reduces the response at the back of the antenna to a sufficiently low value that extra directors would barely make any difference—except a different reflector system, such as an array of elements in "V" formation or a parabolic dish reflector, mainly applicable to u.h.f./s.h.f. and above, which we shall be using before long no doubt to receive satellite-relayed signals here on earth!

Yagi Antennas

There is no theoretical limit to the number of directors that can be employed. Main problem is a mechanical one—supporting windage etc.—and in any case as more and more are added so the return in signal gain diminishes. The first directors would be about 0·1λ spacing with the remote ones rising to 0·4λ spacing for optimum results. Both length (within the –jX realm) and spacing are adjusted in design to provide the required degree of directionality, bandwidth, beamwidth, forward gain and front/back ratio.

An impression of the nature of polar diagram that can be achieved from a critically-designed six-element vertical Yagi antenna is given in Fig. 4.8. Less critical designs can exhibit rather large side lobe responses and asymmetry of the polar diagram. An example of the polar diagram of a well designed multi-element Yagi array, Wolsey's "Quicksilver" HG36 u.h.f. TV antenna, is given in Fig. 4.9. This has 18dB forward gain referred to λ/2 dipole, while beamwidth is ±15 degrees. It is obvious that the antenna will deliver maximum signal voltage when it is pointing to the transmitter, but what the diagram also shows is that a signal arriving at, say 30 degrees off the main beam will produce very much less output since the sensitivity of the antenna at that angle is only around 10 per cent.

Hence with an antenna of good directivity it becomes possible to orientate it carefully to secure maximum discrimination against an unwanted signal as an aid to reducing co- or adjacent-channel interference or the response of the antenna to reflected signals (which cause multipath distortion on f.m. and image ghosting on TV), even though this means turning the antenna slightly away from the wanted signal. Signal arriving at the rear of the "Quicksilver" is reduced relatively by 25 to 30dB (front back ratio). Beamwidth of horizontally polarised f.m. antennas is rarely down to ±15dB (ref. −3dB points), but it is possible to obtain a narrow beam by using a sufficient number of elements or, possibly better, by baying two arrays.

Although not specifically related forward gain increases and beamwidth decreases as more elements are added as indicated roughly in the table.

Number of elements	Forward gain (ref. λ/2 dipole)	Beamwidth (ref. −3dB)
3	4/5dB	106deg.
6	6/7dB	74deg.
9	8/9dB	48deg.
12	10/11dB	39deg.

Note the number of elements includes the driven dipole.

The polar diagram shows the radiation pattern in the horizontal plane as looking down on the antenna. Pattern in the vertical plane is different, and some idea of this is shown by the diagrams in Fig. 4.10, where θ is the radia-

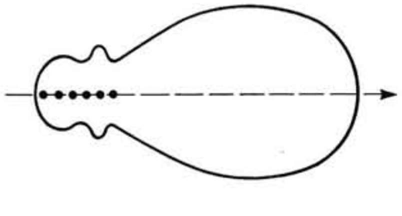
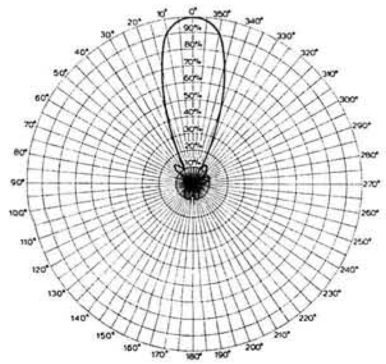
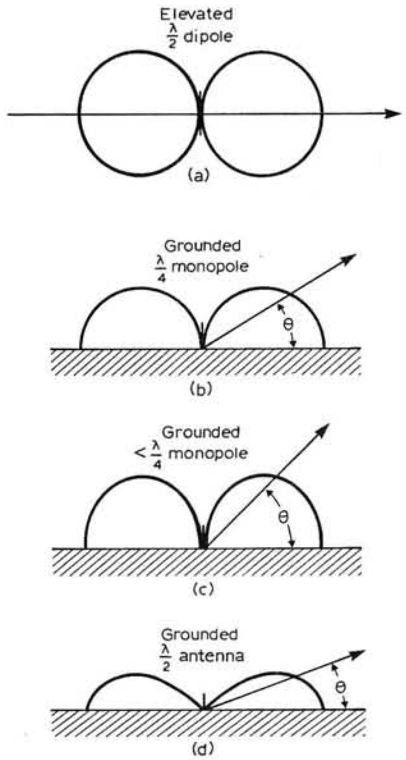


Fig. 4.8

Fig. 4.9





◀ Fig. 4.10

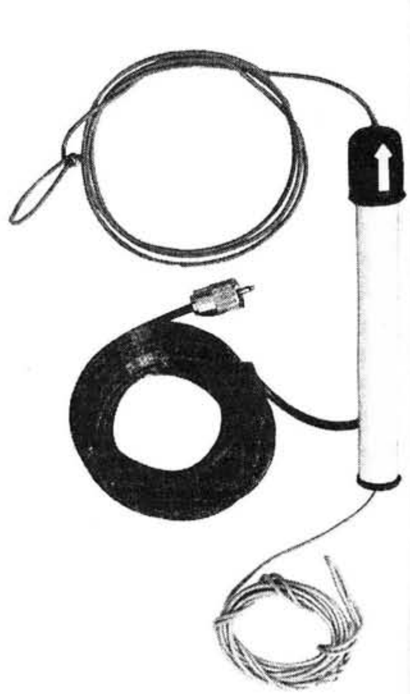


Fig. 4.11

tion angle. A free-radiating centre-fed dipole (a) gives maximum beam almost parallel with the earth, while the radiated beam is higher from groundplane antennas as shown by (b) and (c). The radiation angle is more important for transmitting. CBers and mobile amateurs for instance, like to keep their radiation-angle fairly low except, perhaps, when using the skywave for DXing, to maintain maximum signal energy in the "local copy" space-wave beam. Sadly, with the type of antennas prescribed by the HO for CB the radiation angle is elevated (Fig. 4.10(c)) so quite a lot of the available energy is directed skywards where, under skip conditions, it undoubtedly ends up on shores far away from our own. Such antennas, reciprocally, respond to ionospheric-returned waves and add to the general bedlam on CB when skip conditions obtain!

I can't understand why the HO don't give their blessing to well-designed single dipoles for CB. Nearest legal antenna is possibly the Wot Pole, Hot Wire (Fig. 4.11) or similar which represent an asymmetric dipole whose radiation angle is less elevated than a 1·5m base-loaded monopole.

I find it difficult to draw three-dimensional radiation patterns but, hopefully after enhancement by our artist, Fig. 4.12 gives a rough impression of what you could expect from a well-designed Yagi array. For receiving in the v.h.f. and u.h.f. bands we are mostly concerned with the horizontal pattern, but a low angle of radiation can be desirable for response minimisation from passing aircraft or, perhaps from high altitude tropo effects. The transmitting antennas themselves of course, are designed for low radiation angle on the TV and f.m. bands to avoid wasting power; but high-angle radiation is adopted on the h.f. bands for the ionospheric circuits.

There are other factors regarding the design of multi-element Yagi antennas than so far disclosed. Bandwidth decreases as more elements are added so to create a respectable directional antenna for the broadcast services the design becomes a tight compromise with respect to such things as element lengths, spacings and length/diameter ratio of the conductors, consistent with maintaining a symmetrical main beam with minimal side and rear lobes. Thus there is more to the design of this type of antenna than might have been imagined. Fig. 4.13 shows the bandwidth of Wolsey's f.m. antennas over Band II in terms of dB gain ref. $\lambda/2$ dipole for 2, 4 and 6 element models.

Another thing is that as more elements are added so the centre terminating impedance of the driven dipole falls. This is sad for unless countering steps are taken the resulting high s.w.r. could well diminish the signal gained by the extra elements.

Folded Dipole

Fortunately, the designer has at his disposal a neat scheme whereby the centre impedance can be increased by folding the dipole back on itself, as shown in Fig. 4.14. This has the effect of dividing the signal current between the two sections, thereby stepping up the centre impedance by four times. With several parasitic elements, the dipole impedance of a Yagi antenna could drop to around 18 ohms so the four-times impedance step-up by folding restores the impedance to a good match for 75 ohm coax. There are other methods of impedance matching, some based on connecting up from the centre of the dipole (delta-match), others using a $\lambda/4$ coaxial stub, and one or two using transformer arrangements. The most common method, however, is by folding.

Coupling Balun

Owing to the symmetry of an elevated dipole it should really be connected to symmetrical balanced twin feeder. However, so far as domestic receiving antennas are concerned the advantages of using coaxial cable over twin feeder outweigh the technical disadvantages, though some critical designs combat the coupling asymmetry by the use of a balun between the dipole centre points and the coaxial cable. When direct connection is made from the dipole to coaxial cable some of the signal energy is transferred to the outer braid. This tends to unbalance the dipole and affect its response pattern, and the signal in the outer braid is lost.

There are numerous ways of attaining a balun function and "decoupling" the antenna from the feeder, one being shown in Fig. 4.15 where the coaxial cable is passed through the folded dipole. This is called a "self balancing" feeder system. Readers requiring more information on baluns are referred to my book *The Practical Aerial Handbook,* published by Newnes-Butterworths.

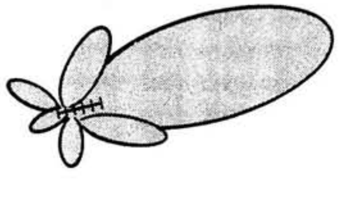
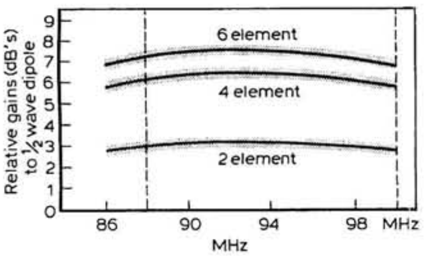
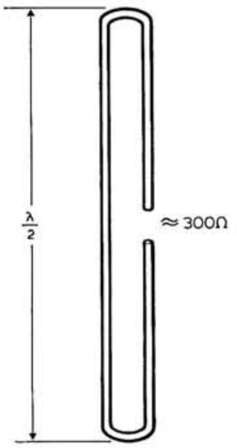


Fig. 4.12



◀ Fig. 4.13



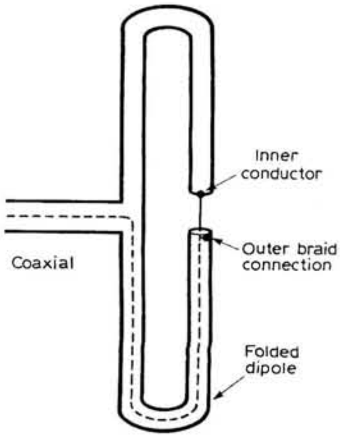


Fig. 4.14 Fig. 4.15

It is also possible to connect the feeder to the end of a dipole. This cannot be done directly because the impedance here is very high (several thousand ohms!). Some sort of matching arrangement is required to provide the necessary impedance transformation. Either a transformer or coaxial matching stub is used, the $5\lambda/8$ antenna being a case in point, this sometimes being used illegally for UK CB.

Matching Stubs

Coaxial matching stubs or matching sections are commonly used to couple two (or more) antenna arrays to reduce the beamwidth (baying) or the angle of radiation (stacking). It is certainly not possible merely to connect the antennas in parallel with the common downlead using 75 ohm coaxial cable all round. Happily, we can easily obtain the requirements by using a $\lambda/4$ stub of calculated Z_o as shown in Fig. 4.16. The formula for working out the stub Z_o is: $Z_o = Z_{in} \times Z_{out}$
When feeders 1 and 2 are connected in parallel the impedance becomes 37·5 ohms. Somehow, then, we have to transform this to 75 ohms so that we can connect the normal run of 75 ohm coaxial downlead without causing a mismatch. The plan is to connect a $\lambda/4$ length of coaxial cable of suitable Z_0 between the junction and the downlead. By substituting the figures involved we get: $Z_0 = 37{\cdot}5 \times 75$ which works out to 53 ohms, and you would have to settle for coaxial cable of the nearest Z_0 to this you can readily acquire (possibly 50 ohms). To calculate the length of the stub you will need to know the cable's velocity factor (typically around 0·83) and, of course, the wavelength of the signal. If the antenna array is for f.m. then we could take 94MHz as a centre frequency, the wavelength of which is 300/94 or 3·19m. Quarter of this is 0·798m and by multiplying it by the velocity factor we get close to 0·66m. Easy really!

With an array of four antennas you can, in fact, use 75 ohm coaxial cable throughout as shown in Fig. 4.17. The antennas are phased at two points to obtain 37·5 ohms so by using two $\lambda/4$ stubs of 75 ohms coaxial cable the system resolves to two 150 ohm terminations in parallel which of course, correspond to the required 75 ohms coupling for the coaxial downlead!

Baying

One arrangement for a co-phased broadside array is shown in Fig. 4.18. This is based on two three-element Yagi antennas and some idea of the resulting polar diagram is given in Fig. 4.19 (a) horizontally polarised and (b) vertically polarised. The polar diagram is affected by the spacing of the two antennas and altering the spacing between the antenna axes is one way of introducing nulls at angles coresponding to unwanted or reflected signals. A null at angle θ with respect to the front of the array is related to the spacing distanced in wavelengths by:

$$d = \frac{\lambda}{2 \sin \theta}$$

However, some care needs to be taken over this because when two high-gain broadside antennas are involved the forward gain can be significantly affected if the spacing is too small. With large arrays a spacing of, at least, one wavelength is recommended to avoid forward gain deterioration.

Stacking

Vertical stacking (one array above the other) makes it possible to introduce vertical nulls and, as already noted, to reduce the sensitivity of the antenna to sky-returned signals. With four antennas in a "box" array you can have lots of fun and games and really tailor your own polar diagram for virtually any requirement.

It is also possible to enhance the front/back ratio by advancing one antenna relative to the other in the forward direction by a free-space $\lambda/4$ and then increasing the length of the matched impedance cable from that antenna by $\lambda/4$ but this time taking account of the cable's velocity factor. This can be handy if you are plagued by a very strong signal hitting your antenna at the back. By careful adjustment it is possible to obtain virtually infinite front/back ratio and hence cause the interference to vanish completely.

With two correctly terminated and coupled arrays it is surprising what can be done to rid a receiver of interfering signal merely by leaving one of the two properly orientated and then adjusting the orientation, height and position of the other until the interference is nulled out. ●

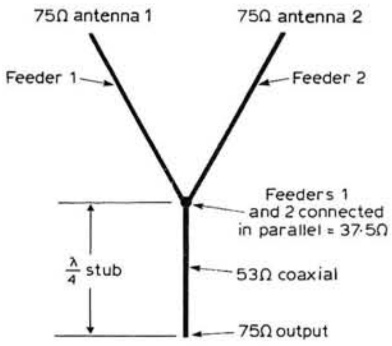
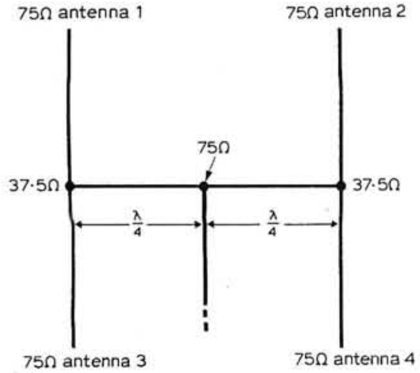


Fig. 4.16



◀ Fig. 4.17

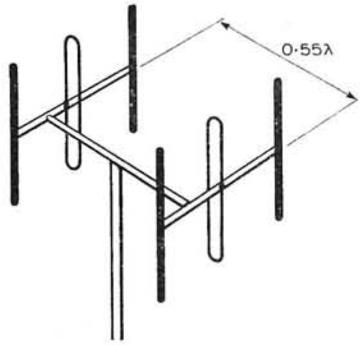


Fig. 4.18 ▲

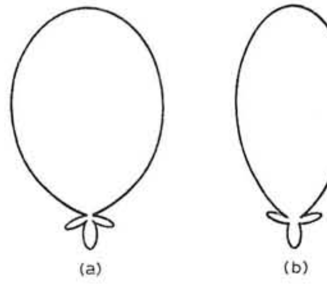
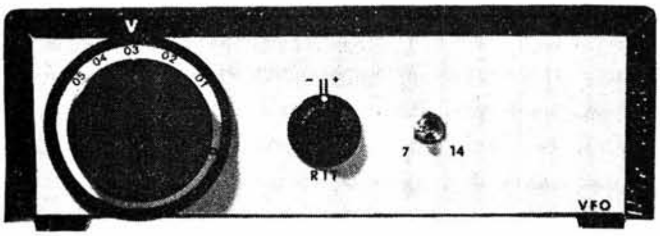


Fig. 4.19

PW 'TEME' Modular QRP Transceiver

Part 2 by Rev. George Dobbs G3RJV

THIS MONTH- VARIABLE FREQUENCY OSCILLATOR



The first part of this series described the construction of a useful little transmitter module for the 7 and 14MHz bands. Although capable of useful excursions on the amateur bands, the transmitter is VXO controlled. That is, the oscillator frequency source is a crystal with a small range of adjustment in frequency. It is much more exciting to be able to take the transmitter anywhere on the c.w. portion of the band to find contacts. The module to be described here is an add-on variable frequency oscillator (v.f.o.) and doubler that allows the whole of the 7 or 14MHz c.w. bands to be used with the transmit module. The v.f.o. doubler module matches the transmit module and can be stacked on top of it with interconnecting leads at the back of the cases.

VFO/Doubler Circuit (Module 2)

The circuit is shown in Fig. 2.1. A lot has been written about the design of variable frequency oscillators and many amateurs have tales of woe about drifting, jumping or chirping oscillators. Experience has shown me that, provided a few sensible rules are observed, the average amateur can easily build a stable, reliable v.f.o. Stability usually has more to do with the way the oscillator is built rather than the circuit employed, but more about that later. This v.f.o. has a standard Colpitts f.e.t. oscillator, 2Tr1, followed by an f.e.t. buffer amplifier, 2Tr2. The tuning circuit inductor, 2L1 (see coil chart in Fig. 2.2), uses a conventional coil former of 4·8mm ($\frac{3}{16}$in) diameter with an iron dust core. Many constructors eschew the use of cores in v.f.o. tuning coils in the interests of stability. But a core is a very convenient way of adjusting the frequency of the circuit when setting up the v.f.o. In practice, trimming and padding with capacitors can cause just as many problems as including a core in the coil former. The value of 2L1 is such that only a small portion of the core needs to enter the windings to adjust the frequency. It is stable.

The output from the v.f.o. is on 7MHz as is the buffer amplifier. The output from the buffer, 2Tr2, is tuned at 7MHz by 2L2 and 2C10. The 7MHz output from the buffer is taken from the collector of 2Tr2 via 2C11. This output is switched against the 14MHz output from the doubler.

The doubler uses a balanced push-pull circuit. Many other types of circuit could be used and indeed were tried. A doubler requires good suppression of the fundamental, a reasonable output and low spurious outputs. Integrated circuit doublers were tried but rejected for lack of simplicity in what is designed to be a simple project, and diode doublers, although clean in operation, give very low outputs. The best practical circuit proved to be the one shown in 2Tr3 and 2Tr4 of Fig. 2.1.

The centre-tapped coil 2L3 is a link winding around 2L2 and provides signals 180° out of phase for the inputs of 2Tr3 and 2Tr4. Potentiometer 2R8 is a preset variable resistance used to balance the output which appears on the collectors of 2Tr3 and 2Tr4. Coil 2L4 with 2C17/18 tune out the 14MHz signal. The tuned circuit on the output is damped by R9 to give broadband characteristics. The capacitance in the output tuned circuit, provided by 2C18 and 2C17, is split to lower the impedance of the output signal. It is commonly assumed that an oscilloscope is essential for setting up push-pull doubler circuits. That is the ideal method, if one has an oscilloscope that can see 14MHz, but adequate balancing can be obtained using a diode r.f. probe and a meter.

One of the very useful facilities that can be added to a variable frequency oscillator in a transceiver is receiver incremental tuning (r.i.t.). This allows a small degree of independent tuning to be added to the v.f.o. during receive conditions, to tune in stations slightly off the transmit frequency. Another name used for such a control is a clarifier. The r.i.t. facility has been added to this circuit in anticipation of the receiver module to be added later. Even without the receiver module, when the transmitter is being used with a separate receiver this facility will still be used to offset the transmit signal on receive.

The offset tuning is achieved by 2C20 and 2D1 which add capacitance across the tuned circuit of the v.f.o. Diode 2D1 is a Varicap diode, the capacitance of which varies with the amount of d.c. bias voltage applied. The voltage to set the capacitance, and hence the frequency of the v.f.o., comes from a choice of voltages controlled by variable resistors. The frequency-determining components, 2C20 and 2D1, are part of the structure of the v.f.o., and to prevent long leads affecting the stability of the oscillator, the d.c. voltage is r.f.-decoupled by 2L5 and 2C21. Differing voltages are applied to the v.f.o. on transmit and receive by the 12TX and 12RX control lines

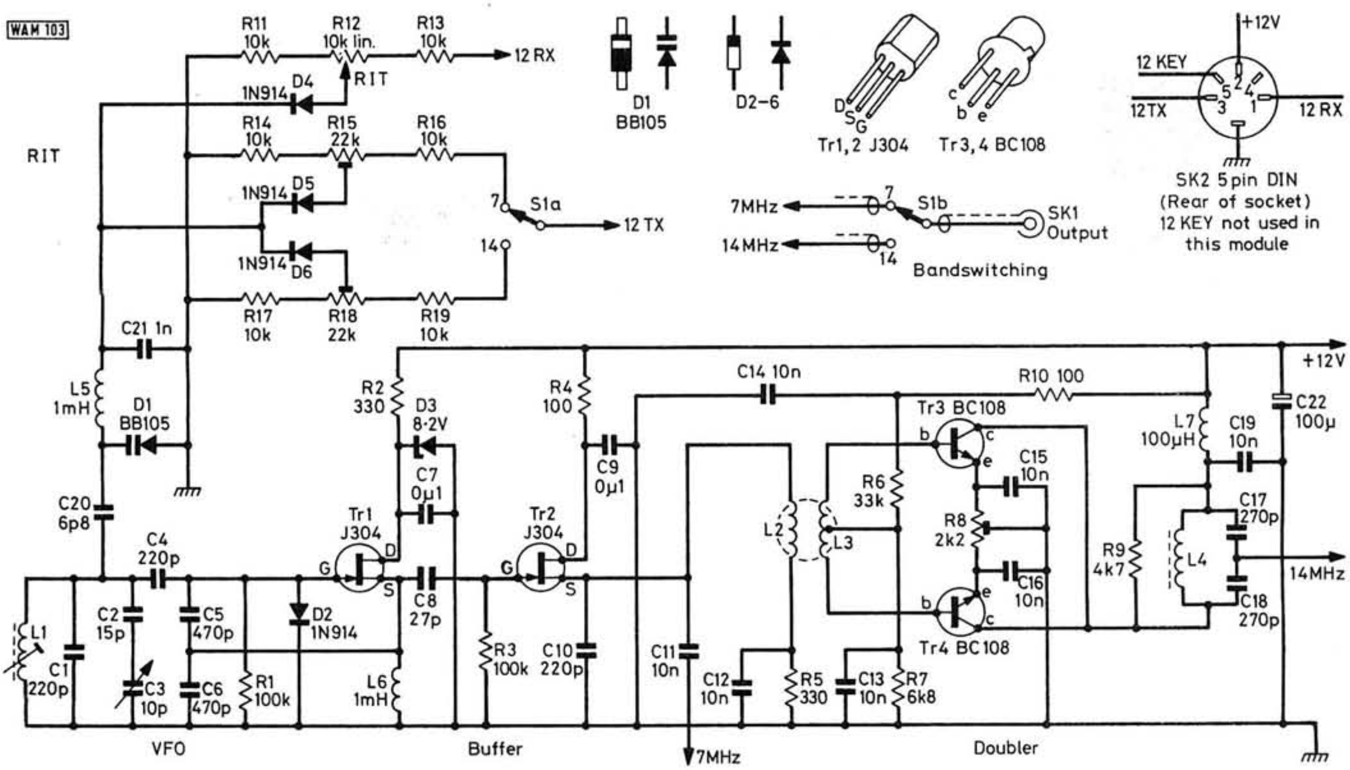


Fig. 2.1: Circuit diagram of Module 2, the VFO/Doubler

available from the transmit module. On transmit the voltage is preset by either 2R15 or 2R18 and on receive a front panel control, 2R12, comes into use to give a manual offset of the frequency. If 2R15 and 2R18 are set to about mid-travel on transmit, the RIT control 2R12 will allow tuning either side of the transmit frequency. Separate presets are required for the 7 and 14MHz bands so that the RIT control can be set to the same position on both bands to equalise the transmit and receive frequencies.

Construction

The v.f.o. and doubler are built on one board and housed in a Minffordd J6 case. The layout of the board is shown in Fig. 2.3. Good construction techniques are essential in building variable frequency oscillators. Most of the problems associated with oscillators built by amateurs may be traced to poor construction. The circuitry around the oscillator stage must be firmly and securely built so that no components or leads can move about. The purists write about the use of NPO capacitors in v.f.o. tuned circuits but I can never get hold of them when I want them. For most practical purposes polystyrene types of good quality are also capable of good results. In the v.f.o. circuit 2C1, 2C4, 2C5 and 2C6 are polystyrene. Because of their values, 2C2 and 2C20 had to be silvered mica and this type of capacitor was also used in 2C8, 2C10, 2C17 and 2C18.

The tuned circuit section must be carefully and sturdily built. Coil 2L1 is made from details shown in Fig. 2.2. The method of mounting the slow motion tuning drive for 2C3 is shown in Fig. 2.4(a). A direct drive on 2C3 would give too rapid a tuning rate, so a small in-line epicyclic reduction drive is used. This is attached to the front panel and a bent aluminium bracket holds the control shaft of 2C3. Just behind the 6mm ($\frac{1}{4}$in) shaft which takes the knob is a collar which moves at the same rate as the reduced drive. Usually these drives give a reduction of some 6 to 1. Onto this collar is mounted a tuning scale, marked with frequency divisions. Almost any disc could be used for the dial; the prototype used the top from a Colman's Mustard jar, cut down and sprayed with matt black paint. The scale is made from white card glued on the front of the disc.

The buffer stage may then be built as far as 2L2/3, which is wound to details given in Fig. 2.2. An iron dust toroid core must be used for 2L2/3; most surplus toroids (being ferrite) would not be suitable. The winding 2L3 is wound over 2L2 and has a centre tap. Wind on half of the winding, twist out a little of the wire and then wind on the rest. The whole assembly fits onto the printed circuit board as shown in Fig. 2.3.

When completed as far as 2L3, the buffer and oscillator stages may be tested for their 7MHz output. Using the r.f. probe described in Part 1 of this series, the r.f. output is measured from the top of 2L2. It should be around half a volt. The signal may be listened for on a receiver. This will give an opportunity for an initial setting of the core in 2L1 to reach the band edge (7·0MHz) with the vanes of 2C3 closed. The core will require re-adjustment when all the stages are completed.

The remainder of the circuit board is completed by adding the circuitry around 2Tr3 and 2Tr4. Ideally the output from the doubler should be balanced, using 2R8, by observing the waveform on an oscilloscope. What this achieves is to balance 2Tr3 and 2Tr4 so that the combined outputs at 2L4 are equal. This can also be done with the simple diode r.f. probe and a meter. Read the r.f. voltage from the 14MHz output at the junction of 2C17 and 2C18. Adjust 2R8 for the minimum output and the balance should be just about correct. The value of 2R8 has been chosen to give a similar r.f. output from the doubler and the buffer output points. If the doubler output reads higher it is probably due to the frequency-conscious nature of the r.f. probe.

The r.i.t. circuitry and switching is added as shown in the layout drawing in Fig. 2.4(b). The switch which selects the 7 or 14MHz output is also used to select the voltage

BUYING GUIDE

J304 field effect transistors may be obtained from J. Birkett, 25 The Strait, Lincoln (0522) 20767.

Coil formers suitable for 2L1 are the Maplin type 722/2.

Please note the toroids are iron powder, **not** ferrite cores. Most unmarked surplus toroid cores are ferrite.

See also the Buying Guide in Part 1 of this series.

Approximate Cost £27

Construction Rating Intermediate

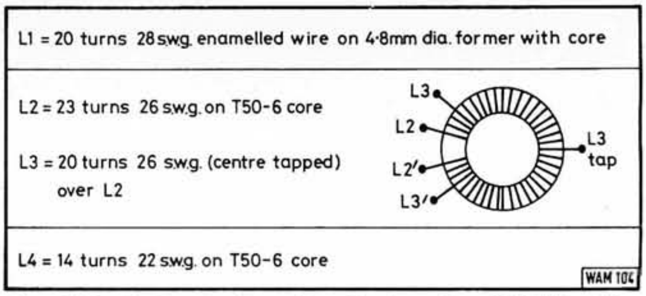


Fig. 2.2: Coil winding details for the VFO/Doubler module

for the offset on transmit for 7 and 14MHz. It should be possible to check the effectiveness of the r.i.t. circuit by listening for the signal on a receiver and adjusting 2R12. The setting up of 2R12, 2R16 and 2R18 is not critical at this stage as they are only required when the receiver module is added. But if the transmitter and v.f.o. are to be used in conjunction with a separate receiver, the v.f.o. will be heard during the receive periods because it is switched on the whole time. It is not a good idea to keep switching the v.f.o. on and off as this will certainly mean instability. Although the oscillator is stable, like most f.e.t. oscillators, there is an initial warm-up drift as the f.e.t. junction attains a stable operating temperature. In the transmit board, the

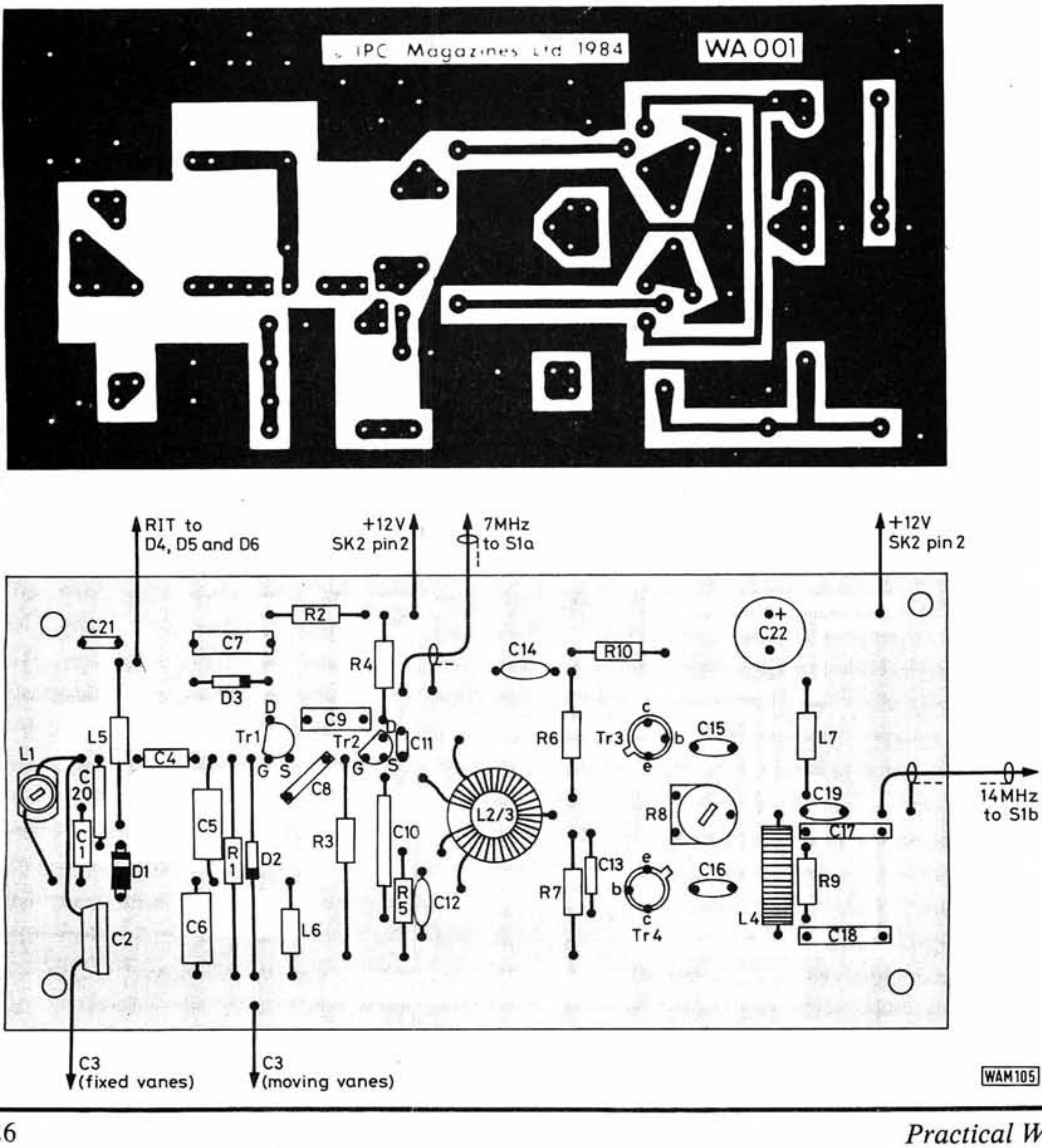


Fig. 2.3: Full size p.c.b. track pattern and component layout for Module 2, the VFO/Doubler

★ components

MODULE 2 VFO/DOUBLER

Resistors

¼W 5% carbon film		
100Ω	2	R4,10
330Ω	2	R2,5
4·7kΩ	1	R9
6·8kΩ	1	R7
10kΩ	6	R11,13,14, 16,17,19
33kΩ	1	R6
100kΩ	2	R1,3
Sub-min. horizontal pre-set		
2·2kΩ	1	R8
22kΩ	2	R15,18
Lin. law pot., ¼in spindle		
10kΩ	1	R12

Capacitors

Polystyrene or silvered mica		
6·8pF	1	C20
15pF	1	C2
27pF	1	C8
220pF	3	C1,4,10
270pF	2	C17,18
470pF	2	C5,6
Variable, airspaced		
10pF	1	C3
Ceramic		
1nF	1	C21
10nF	7	C11–16,19
Polyester		
0·1μF	2	C7,9
Electrolytic, 25V p.c. mounting		
100μF	1	C22

Inductors

Min. axial r.f. chokes		
100μH	1	L7
1mH	2	L5,6

L1–L4 see text and Fig. 2.2

Semiconductors

Transistors		
BC108	2	Tr3,4
J304	2	Tr1,2
Diodes		
BB105	1	D1
1N914	5	D2,4,5,6
BZY88C8V2	1	D3

Miscellaneous

Phono socket; 5-pin DIN socket; Switch, d.p.c.o. min. toggle; Slow-motion drive, 6:1 in-line epicyclic type (for C3); Printed circuit board; Case, Minffordd J6; Feet, knobs (2), dial, etc.

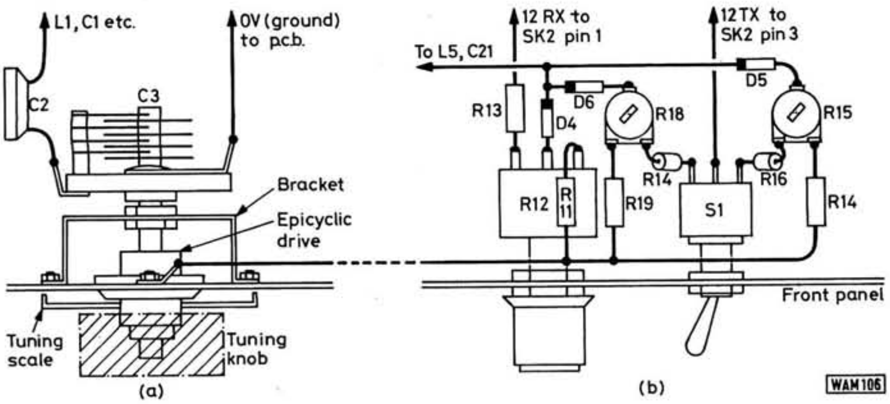
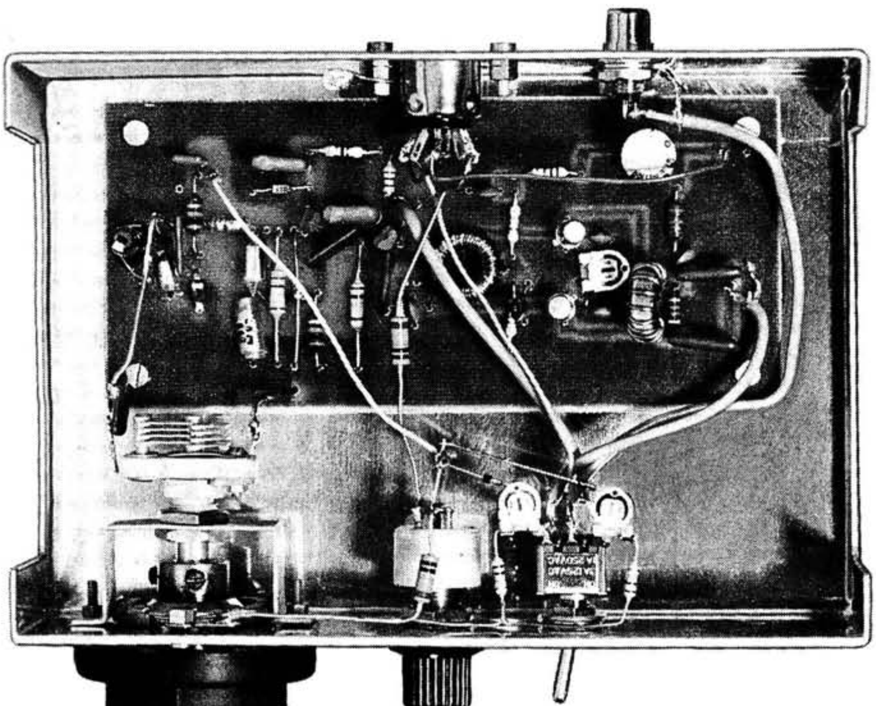


Fig. 2.4: (a) Slow motion tuning drive assembly. (b) Wiring of the RIT and BANDSWITCH controls



oscillator stage was arranged to switch on only in the transmit mode. That stage is now being used as a predriver on the transmit chain and the link in the printed circuit board must be restored to place 12 volts on the stage and the 12TX line removed.

A good way to prevent the v.f.o. being heard in the receiver during receive conditions is to offset the frequency of the v.f.o. out of the passband of the receiver. This can be done by setting 2R15 and 2R18 at one end of the preset travel and 2R12 at the other end of its travel. This will mean that the r.i.t. is set to give the maximum offset of the oscillator between transmit and receive. The oscillator should now be far enough away from the transmit frequency (to which the receiver is tuned) not to be heard on the receiver.

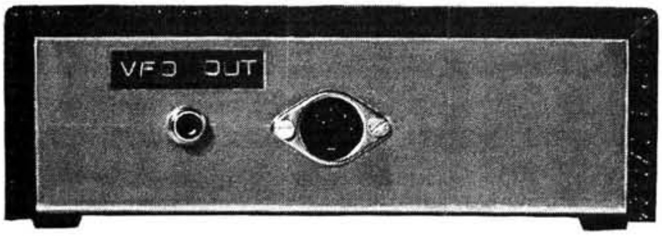
The layout for the v.f.o./doubler module is shown in the photographs. The case is the same type as that used for the transmit module. The finish is also applied in the same manner with a cardboard false front covered with sticky-backed plastics film. The v.f.o./doubler circuit requires the +12V, 12TX and 12RX control lines from the transmitter board which are brought into the case via the 5-pin DIN socket.

The v.f.o. is connected to the transmit module using the 5-pin DIN control line leads plus a single screened lead, terminated with phono plugs and sockets, which takes the signal from the v.f.o. case to the transmitter case. The changeover from transmit to receive is controlled

To avoid confusion between the several modules making up the PW "Teme" project, each has been numbered as follows:

Transmitter	Module 1
VFO/Doubler	Module 2
Receiver	Module 3
ATU and SWR Bridge	Module 4
Power Supply	Module 5
Digital Clock	Module 6

Each drawing and components list will state which module number it refers to. In the text, component references will be prefixed by the module number. For example, resistor R9 in the Transmitter Module would be called 1R9, while R9 in the Receiver Module would be 3R9.



Rear view of the completed VFO/Doubler module

by the transmit board and the antenna and receiver are connected exactly as if using the transmit board in its basic form. The v.f.o./doubler arrangement will give somewhat less output from the transmitter than the crystal oscillator, but the drive control ought to be able to give at least 3 watts of r.f. output on both bands.

The resulting transmitter will now cover the whole c.w. portions of the 7 and 14MHz bands. The transmitter will have to be netted to the station to be called by depressing the key, to defeat the r.i.t. offset. This transmitter should be capable of quite exciting results on 7 and 14MHz. Low power (QRP) stations usually congregate around 7030kHz or 14 060kHz and it is worth calling "CQ QRP" on these frequencies from time to time. Other than that, the best results with low power are rarely obtained by calling CQ. Seek stations out, instead, and call them. Some of the best QRP contacts can be had by "Tail-ending" an existing QSO and quickly calling one of the stations at the end of their contact. Have a go—it is fun!

NEXT MONTH
THE RECEIVER MODULE

multiple choice... multiple choice...
QUESTIONS
multiple choice... multiple choice...

If you are an aspiring RAE candidate or just feel like testing your knowledge of amateur radio these multiple choice style questions will fill your needs. The questions are typical of those appearing in both the RAE papers, but they are not taken from these papers. For the answers, together with explanatory notes to help you, please turn to page 48.

Paper 1 Section 2. Transmitter Interference—filters

Question 3–1

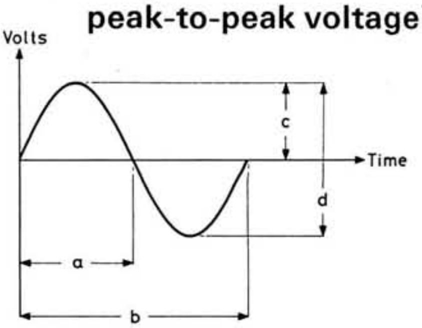
On most bands from 3·5 to 28MHz your transmissions are causing the picture on your neighbour's u.h.f. TV set to break up. What could you put in the antenna lead of his set to try and prevent this?

☐ **a.** a mains filter
☐ **b.** a low-pass filter
☐ **c.** a high-pass filter
☐ **d.** a band-pass filter

Paper 2 Section 2. Electrical Theory—define terms describing a sine wave

Question 3–2

Which letter of the diagram indicates the peak-to-peak voltage?



☐ **a.**
☐ **b.**
☐ **c.**
☐ **d.**

Paper 2 Section 5. Transmitters—crystal oscillators

Question 3–3

One advantage of a crystal oscillator is that

☐ **a.** it does not need any feedback
☐ **b.** it can be tuned over a wide range of frequencies
☐ **c.** it is capable of delivering a large power output
☐ **d.** it has good frequency stability

Paper 2 Section 3. Solid State Devices

Question 3–4

An amplifier is said to be linear if

☐ **a.** it is producing power into an antenna
☐ **b.** it produces no distortion
☐ **c.** it is constructed in a straight line
☐ **d.** it is connected to a regulated power supply

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SP102 Speaker	£55.00
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FT77 HF Tx/Rx	£479.00
MRKT77 marker	£10.85
FP700 PSU	£145.00
FC700 ATU	£103.00
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FP757HD PSU	£179.00
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FT290R 2m Tx/Rx	£279.00
FT790R 70cm Tx/Rx	£259.00
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NC nicads	£22.00
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IC271H 2m 100w	£819.00
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IC290D 2m 25w	£499.00
IC471E 70cm base	£735.00
IC490E 70cm	£495.00
ICO2 2m h/held	£239.00

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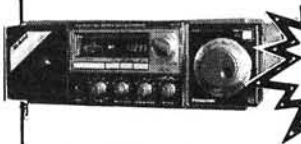

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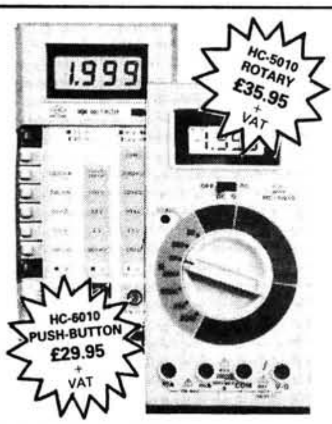

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FOLLOW UP

by Ken Buck

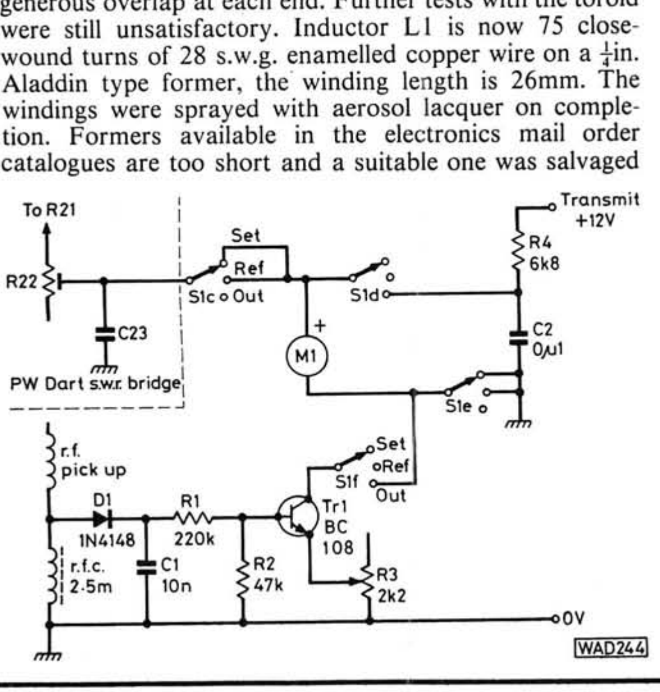
The author found the v.f.o. coverage on the PW "Dart" to be inadequate with L1, C1 and C3 in the original circuit diagram and could only be moved up and down the band with C2. An attempt was made to expand the frequency coverage using the 100pF tuning capacitor with disappointing results.

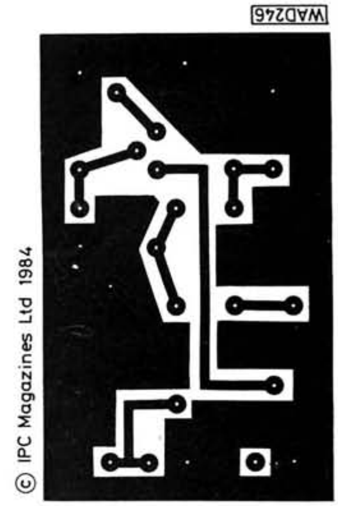
Many amateurs frown upon toroids in v.f.o.s but it was quite stable, however the author decided to discard the toroidal inductor and the 100pF tuning capacitor. A conventional inductor together with a 150pF tuning capacitor gave full coverage of the 1·8MHz (160m) band with a generous overlap at each end. Further tests with the toroid were still unsatisfactory. Inductor L1 is now 75 close-wound turns of 28 s.w.g. enamelled copper wire on a ¼in. Aladdin type former, the winding length is 26mm. The windings were sprayed with aerosol lacquer on completion. Formers available in the electronics mail order catalogues are too short and a suitable one was salvaged from a scrap dual-standard television chassis. A tuning core is not required and this will aid the general stability of the v.f.o., C3 was still required in series with C1 and C2.

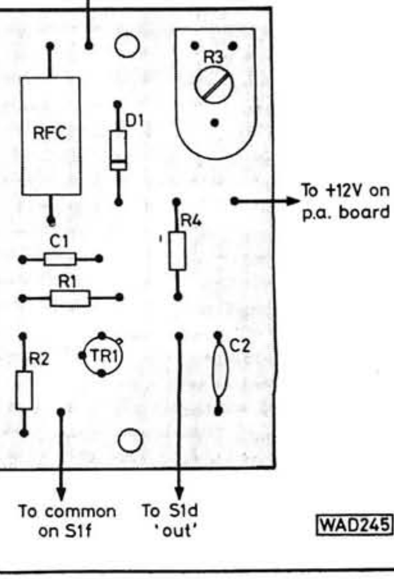
Capacitor C2 was nearly at maximum capacitance after setting the band edges, so this component should be changed from 3-30pF to 3-90pF. The problem here being that the pin spacing may be different. Inductor L1 should be connected to C1 and the p.c.b. with a single length of 16 s.w.g. copper wire using as short a path as possible.

The two lugs of C1 fixed vanes need to be bridged and substantially soldered. A small hole was drilled at the top front of L1 former and the 16 s.w.g. wire end was stuck into this using an epoxy resin. Calibration of the v.f.o. tuning scale should be carried out last on completion of the transmitter with the p.a. running into a 50Ω dummy load.

The d.c. input to Tr5 and Tr6 is not measured in the usual manner because of the keyed d.c. supply from R32 unbalancing X1 on c.w. An add-on circuit was developed







to simulate p.a. d.c. input which I have called an **r.f. Meter Monitor.** It is a variation of another G3RJV circuit (1) which consists of a diode detector and a single transistor d.c. amplifier. The meter did not give a full scale deflection without this extra amplification.

The meter switching arrangement is quite straight forward, but the original switch had insufficient contacts. A suitable one with two wafers was obtained very cheaply from a surplus stall at a rally and the s.w.r. bridge was rebuilt onto this switch. Two turns of 28 s.w.g. enamelled copper wire overwound at the start and finish of winding B gave sufficient link coupled r.f. input to the meter monitor. All four windings on the p.a. toroid should be secured with spots of glue. Components on the monitor p.c.b. should be mounted low as the board was fitted in the space behind the wafer switch with the r.f. choke close to the toroid. A small board was etched for this toroid and it was then mounted vertically by two solder pins at the edge of p.a. board in front of Tr6. Before testing the meter monitor, ensure the transmitter supply is 12 volts and plug in a 50Ω dummy load to the transmitter antenna socket. With S1 in the SET position and S2 in the CW position, short the key contacts. Adjust C21 for maximum meter reading, turn S1 to OUT and trim R3 for meter full scale deflection. Resistors R1 and R4 may require adjusting for meter movements greater than 200μA, all that is required is the meter to read full scale deflection on key down. The monitor can also be used to verify maximum output when transmitting without having to turn S1 back to SET. It will give the setting for R32 on control board as the variable voltage adjusts the carrier level output from port 3 of X1. A net switch on the cabinet front panel will be useful to c.w. only operators, as the plugging in of a microphone with p.t.t. will be inconvenient. The addition of tuning scale and meter illumination with T-1½-20mA bulbs, and l.e.d. indicators for transmit and receive make the PW "Dart" an ideal starter project for the newly licensed amateur. A visit to one of the rallies will yield many of the components at a considerable saving. ●

1) *A Perf Dipper*. G3RJV. *Shortwave Magazine* August 1982

★components

Resistors

¼W 5% Carbon film

6·8kΩ	1	R4
47kΩ	1	R2
220kΩ	1	R1

Horizontal skeleton preset

2·2kΩ	1	R3

Capacitors

Monolithic

10nF	1	C1
0·1μF	1	C2

Semiconductors

Diodes

1N4148	1	D1

Transistors

BC108	1	Tr1

Miscellaneous

Printed circuit board; 2·5mH r.f. choke; 6p 3w wafer switch

FM Demodul Deviatio

by N.D.N. Belham G2BKO

A previous article[1] described experiments which showed that f.m. signals could be sent through narrow communication type filters, provided that the deviation was much reduced. Reduced deviation means, of course, reduced recovered audio. Experiments were therefore started to discover the relative sensitivity of the various types of f.m. demodulators and then to see if the sensitivity of any could be increased.

Three types are in common use. The first depends upon a phase locked voltage controlled oscillator, the second on a quadrature tuned circuit and the third (the ratio detector) on a bridge circuit.

Measurements

1. A block diagram of the 4046 p.l.l. integrated circuit is shown in Fig. 1. There is no tuned circuit as the voltage controlled oscillator is of the multivibrator type whose frequency is set by the capacitor between pins 6 and 7 and the two resistors connected to pins 11 and 12. The natural frequency is set just below that on which the demodulator is to operate. The input frequency range over which the device will operate in a linear manner is very great—at least 100kHz when used with an intermediate frequency of 455kHz, see Fig. 2.

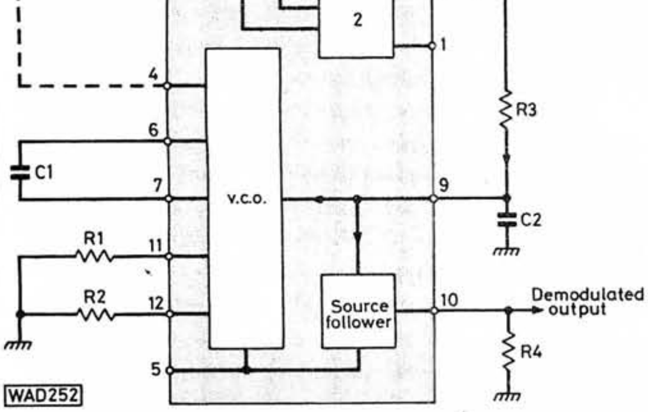


Fig. 1: Block diagram of the 4046 p.l.l.

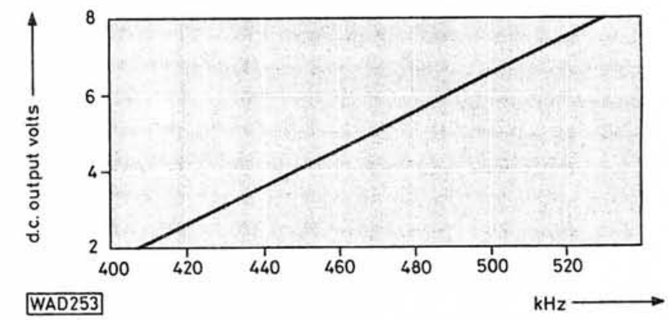


Fig. 2: Linear operating range of the 4046 demodulator

2. Two quadrature types were tested, the TBA 120 and the MP 5071. The first is a balanced device but the second is single-ended. As a result the TBA 120 needs a low Q tuned circuit and the MP 5071 a higher Q tuned circuit. The block diagrams of these devices are shown in Figs. 3 and 4; performances were found to be very similar.
3. Two ratio detectors were tested, one made from discrete components and the other a ceramic type, the SFD455S4, as fitted to the FT227 transceiver. Circuit diagrams are shown in Figs. 5 and 6—sensitivities were similar but the linear ranges very different.

In each of the foregoing cases the output from the same 455kHz oscillator was used and the d.c. output of the demodulator measured as the carrier frequency was slowly changed. Results are shown together in Table 1.

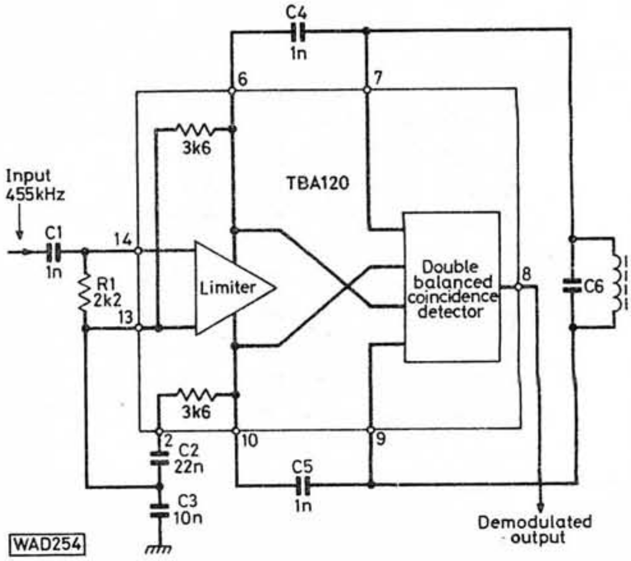


Fig. 3: The TBA120 demodulator

ators For Low n Signals

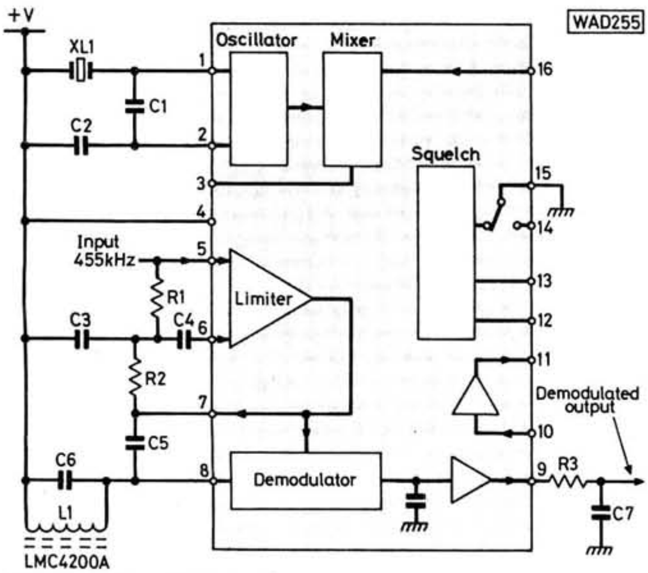


Fig. 4: The MC3357/MP5071 demodulator system. Oscillator and mixer circuits are available to convert other i.f. frequencies to 455kHz

The Linear Range Required

Assuming that the station can be tuned in accurately (i.e. to give a final i.f. 455kHz) the linear range required of the discriminator will depend upon the number of f.m. sidebands needed to be included for communication quality. As has been mentioned elsewhere[2] sidebands having an amplitude relative to the carrier of one tenth or below (−20dB) can be neglected. Table 2 shows the range required, according to this criterion, for various modulation frequencies and deviations.

Table 1

Type	Output (mV/kHz)	Linear range (kHz)
4046 pin 13 p.l.l.	88	103
TBA120 Quadrature	89	37
MP5071 Quadrature (15kΩ shunt)	80	30
Discrete component Ratio	20	7·5
SFD455S4 Ratio	21	28

Relative characteristics of the f.m. demodulators

Table 2

Mod. frequency	Mod. index	Sideband order	Bandwidth (±kHz)
Deviation ±5kHz			
500Hz	10	14th	7
1kHz	5	8th	8
2kHz	2·5	5th	10
3kHz	1·67	3rd	9
Deviation ±1kHz			
500Hz	2	4th	2
1kHz	1	2nd	2
2kHz	0·5	1st	2
3kHz	0·33	1st	3
Deviation ±500Hz			
500Hz	1	2nd	1
1kHz	0·5	1st	1
2kHz	0·25	1st	2
3kHz	0·17	none	0·5

Maximum sideband order required (20dB criterion) for various deviations and modulation frequencies

It is clear that for amateur purposes when reduced deviation is used the linear range required of the demodulator is also much reduced. This in turn allows the *Q* of the quadrature tuned circuits to be increased, so increasing the demodulator sensitivity.

Further Measurements

The relative sensitivities were again measured for the quadrature types using ceramic resonators with results given in Table 3. Greatly increased sensitivities are shown

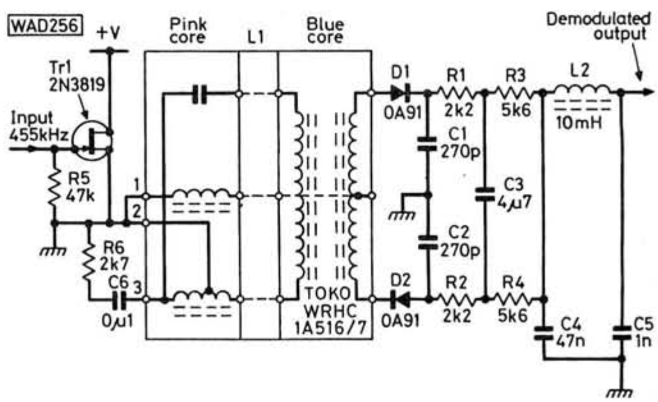


Fig. 5: Discrete component ratio detector

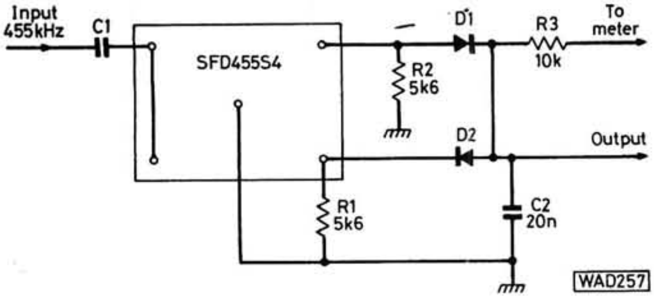


Fig. 6: Ceramic ratio detector using the SFD 455S4 (Toko/Yaesu FT 227)

when ceramic resonators are used and small linear ranges required. It is only possible to use the ceramic resonators in the series mode with the TBA120 so producing a peaked response curve instead of the usual "S" type, see Fig. 7. There are, therefore, two possible operating regions, on the l.f. and h.f. sides of the peak. In the case of the MP5071 the reverse is the case and the usual S type response curve is obtained. A variable shunt would allow the sensitivity to be adjusted according to the linear range required.

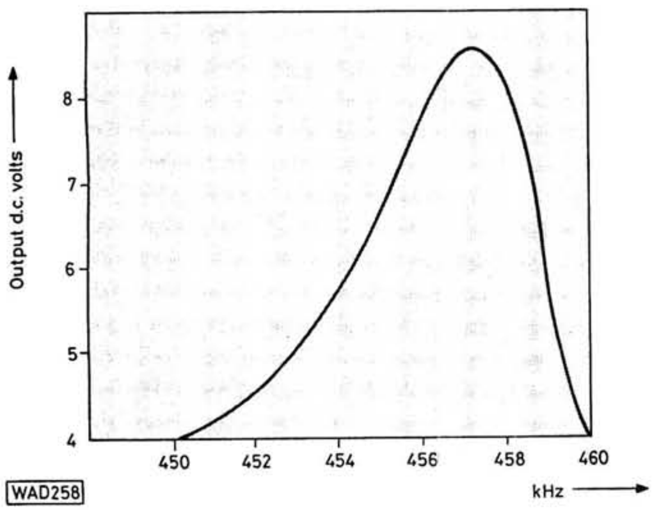


Fig. 7: Response of the TBA120 with 8008 ceramic resonator

Tunable Quadrature Demodulator

The modern f.m. transceiver which tunes in fixed steps will only produce a final i.f. output of 455kHz if both receiver and transmitter are exactly tuned to the stated frequency. Even with repeater stations the i.f. output from a receiver can vary by several kHz. It is not surprising therefore that such transceivers have a bandwidth of some ± 10kHz and their demodulators a similar range in linear response. If extra narrow band f.m. is to be used, as has been suggested, then a tunable demodulator is necessary.

This facility is easily obtained, when using the MP5071, by connecting a suitable Varicap from pin 8 to ground. The circuit is shown in Fig. 8 and enables the tuning of a 455kHz version to be moved some 20kHz. The circuit also shows a variable shunt across the quadrature tuned circuit that will enable the linear range to be altered from ±5kHz to ±1·5kHz, with a corresponding change in sensitivity.

Table 3

Type	Output (mV/kHz)	Linear range (kHz)
TBA120		
series resonant		
ceramic resonator		
l.f. side	933	3
h.f. side	2375	1·6
MP5071		
parallel resonant		
ceramic resonator		
10kΩ shunt	2000	1
4·7kΩ shunt	640	2·5

The effect of using ceramic resonators with quadrature demodulators

Preceding Limiter

Amplitude variations need to be removed before the signal reaches the demodulator. The ratio detector has a measure of self limiting but the other types need a separate limiter, which is often included in the i.c. package. As shown in Fig. 3 the TBA120 has internal negative d.c. feedback between pins 6 and 13 but it is also possible to fit positive a.c. feedback externally between pin 10 and pin 13. If this is sufficient it will cause oscillation which will lock to the incoming signal when this is large enough. By the use of positive feedback the full output of the limiter is always obtained, with consequent hard limiting. The MP5071 also contains an internal limiter.

Alternatively, limiting may be achieved by using a large enough number of tuned i.f. amplifying stages. An arrangement which has been found to be very satisfactory with up to four stages and which is very easy to construct on Veroboard is shown in Fig. 9. Due to the presence of the tuned circuits the output is a sine wave and not square topped. The limiting shows up by an apparent loss of gain by the last stages.

To Squelch or not to Squelch

The need to fit a squelch circuit depends upon whether there is an oscillator in the circuit which looks on to the incoming signal or not. Such an oscillator may be in the limiter, as already described, or in a p.l.l. demodulator.

When there is no locking input to the oscillator it runs quietly and the audio output from a demodulator is negligible. However, when there is appreciable noise the oscillator "locks" at random to this noise and the full os-

continued on page 56▶▶▶

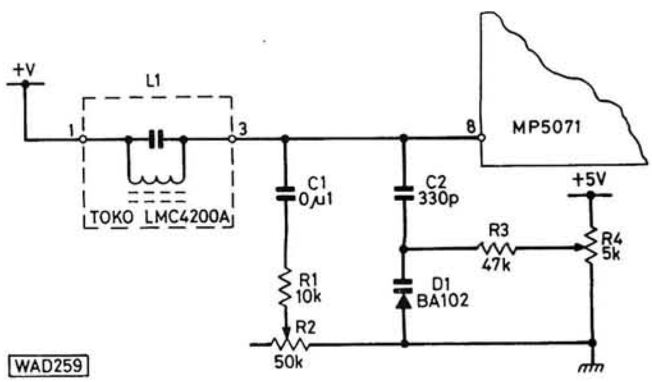


Fig. 8: A tunable 455kHz demodulator using the MP5071

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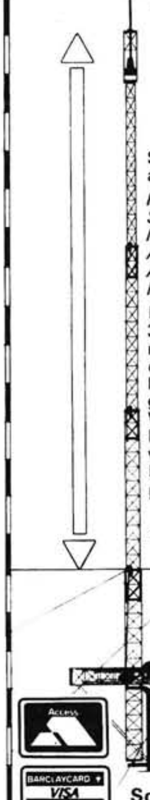

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Simple DC Transistor Tester

by Basil Spencer G4YNM

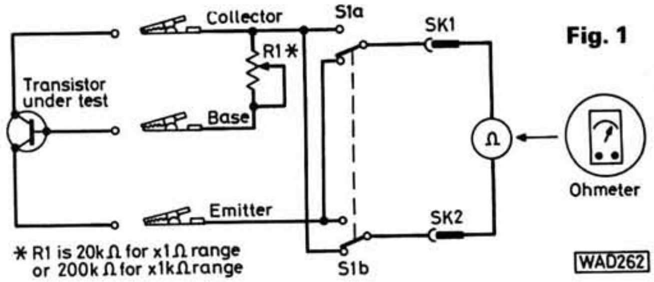


Fig. 1

* R1 is 20kΩ for x1Ω range or 200kΩ for x1kΩ range

The author spends a large amount of time constructing home-brew equipment and required a transistor tester for *npn* and *pnp* types. Having considered the costs of commercially available units for this purpose it was decided to build a simple d.c. tester for the minimum outlay possible.

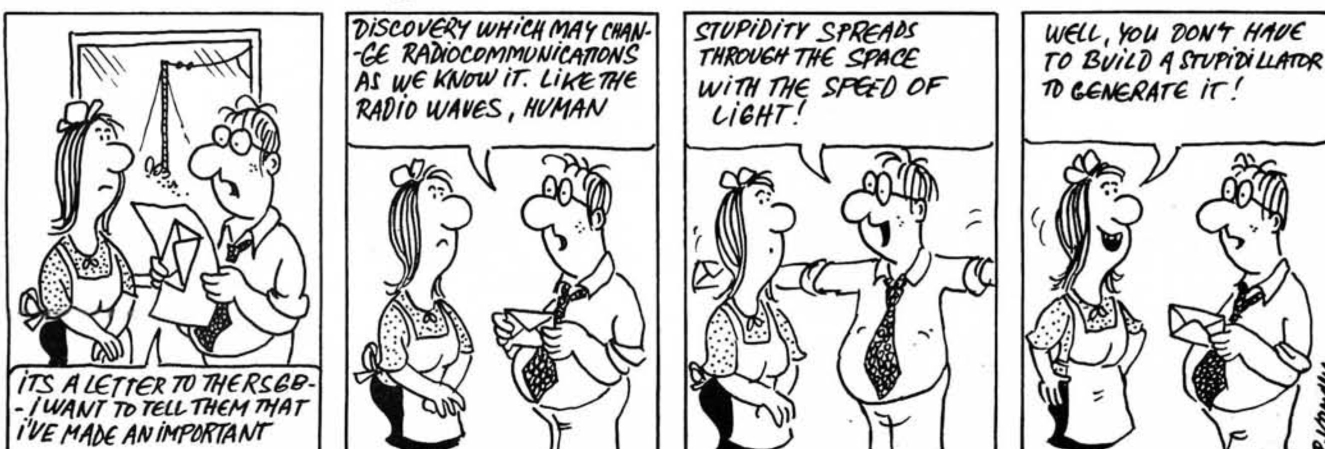
This aim was achieved by utilising the resistance range on the author's analogue multimeter, which serves two functions: the first is to supply power to the tester, negating the need for a separate battery. The second function is that the resistance reading on the multimeter corresponds to the condition of the transistor and so there is no requirement for a meter to be purchased, reducing cost to the minimum.

The simple circuit diagram is shown in Fig. 1, the multimeter connects up to the tester via small studs which hold the leads firmly. It should be noted that some multimeters have reversed polarity when on resistance range and that the terminal marked positive becomes negative and vice versa. The only switch in the tester (S1) changes the polarity over so that both types of transistor can be checked without having to disconnect the multimeter, it also provides a reverse bias check on the transistor at a flick of this switch. The variable resistor, R1, provides biasing for the base connection and the d.c. gain of a transistor can be estimated from the deflection of the meter in a rough and ready manner. The test leads to the transistor under test are terminated with miniature crocodile clips so that all types of transistor cases can be accommodated, with the other ends of these leads connecting to a small piece of stripboard inside a plastics case used to house the project.

With this very modest unit a surprising number of tests can be carried out. For example by connecting up only the collector and emitter leads, the leakage can be checked and by flicking S1 with still only these two leads connected a reverse bias check is also completed. The d.c. gain can be checked by connecting up the base as well and the deflection is proportional to the gain. Incidentally if no reading is obtained with the foregoing test the device is open circuit! By a number of different combinations of these tests it is possible to fully test a device for open or short circuits and to identify the terminals of a working unknown type of transistor. (It must be noted that this tester is **not** suitable for f.e.t.'s which appear to be short circuit across the source/drain terminals.)

Whilst this tester cannot do some of the more comprehensive checks that professional testers will it is nonetheless a very useful item to have in the shack. ●

Benny



Simple RF Transistor Tester

by Basil Spencer G4YNM

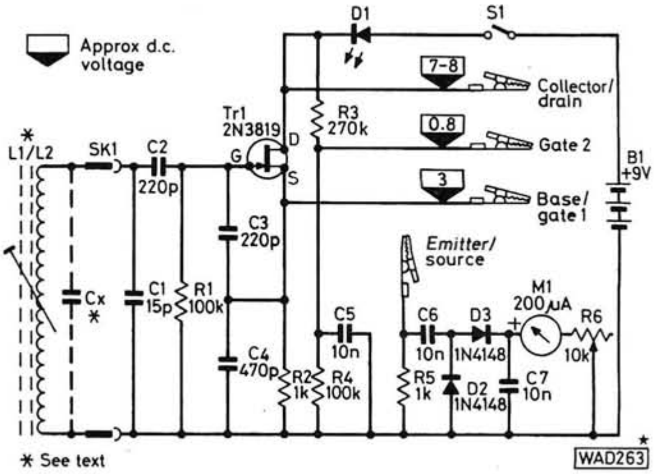


Fig. 1: Circuit diagram of the simple r.f. transistor tester

The author uses an f.m. CB radio with a modified 28MHz to 144MHz homebrew transverter to work on the 144MHz band; however, the receiver strip suddenly gave up and the 3SK88 m.o.s.f.e.t. in the r.f. amp was suspected of being at fault.

As a result this modest r.f. transistor tester was designed. Essentially it is a standard Colpitts oscillator that uses the transistor under test (be it *npn* bipolar, f.e.t. or dual-gate f.e.t.), to act as a buffer amplifier, the output of which is fed to diodes D2 and D3. These rectify and double the voltage, feeding the raw d.c. into the meter M1 and sensitivity control R6. The deflection of the meter corresponds to the state of the transistor being tested.

Construction

A Veroboard layout is shown in Fig. 2 using 0·1 inch matrix board measuring five tracks by nineteen pitches long. The four cuts in the tracks should be made where indicated by use of a 3mm drill or a Vero cutting tool: ensure the tracks are not bridged by whiskers of copper. All the components fit directly into the board and should not cause any problems, the diodes and the f.e.t. (Tr1) must be inserted in the way shown or to suit the package pin-out, i.e. the 2N3819 is available in a Silect package with many pin-out options—always check with the supplier.

As this tester uses plug-in coils these should be constructed next; these are formed from 36s.w.g. enamelled copper wire wound onto 6mm formers of the type found in cheap CB radio p.a. stages. Coil L1 consists of about 30 turns and in conjunction with a subminiature 150pF ceramic capacitor, C_x, soldered across the base of the former, will be roughly resonant on the 3·8MHz (80m) band when the ferrite core is adjusted. The second coil, L2, is again approximately 30 turns of 36s.w.g. wire wound on a similar former but without any additional capacitance. When the ferrite core is adjusted, it should resonate at the bottom of the 7MHz (40m) band. Once wound the formers are soldered to modified DIN plugs, which have had the outer plastics and metal shielding removed so that the former will fit into the pins that normally have wires soldered to them—Fig. 3 shows the general idea. A DIN socket is fitted to the plastics case used to house the unit as shown in Fig. 4; coils can be plugged in and out depending upon the frequency required. Incidentally this tester can be used as a crude external b.f.o. for 3·8 and 7MHz and also as a cheap signal source when tuning-up a receiver.

When fitting the unit into the plastics case make sure that the two pins on the DIN socket which correspond to the coil are soldered across the tracks which have capacitor C1 across them. If the holes for the meter and l.e.d. are cut carefully they will not require glue. Four leads are taken from the Veroboard out through the top of the case and it is to these that the transistor under test is connected. These leads are terminated with miniature crocodile clips enabling all types of case to be accommodated. Do not make these leads more than 50mm long or problems may appear due to stray inductance. Finally the 9 volt 6-F22 (PP3) battery is held in place with BluTak or Sticky Fixers.

Testing and Uses

To test the completed unit fit a known good *npn* transistor into the circuit using the terminal leads marked Base, Collector and Emitter (which are also used for the Gate, Drain and Source for an f.e.t.) and switch on, the l.e.d. should light up and a reading should be obtained on the meter. Adjust this for approximately 60 per cent deflection and check the voltages at the points shown in Fig. 1. If no reading is obtained then the output at the two diodes D2/3 can be checked by use of a digital frequency meter and if there is a reading one or both of the diodes are the wrong way around. Alternatively a flick around the h.f. bands will confirm if the oscillator is running. Once this has been established then adjust the ferrite cores so that the output falls in the 3·8MHz band for L1 and the 7MHz band for L2.

★components

Resistors

¼W 5% Carbon film

1kΩ	2	R2,5
100kΩ	2	R1,4
270kΩ	1	R3

Potentiometers

¼ inch spindle, ½W carbon track

10kΩ	1	R6

Capacitors

Monolithic Ceramic

15pF	1	C1
150pF	1	C_x
220pF	2	C2,3
470pF	1	C4
10nF	3	C5–7

Semiconductors

Transistors

2N3819	1	Tr1

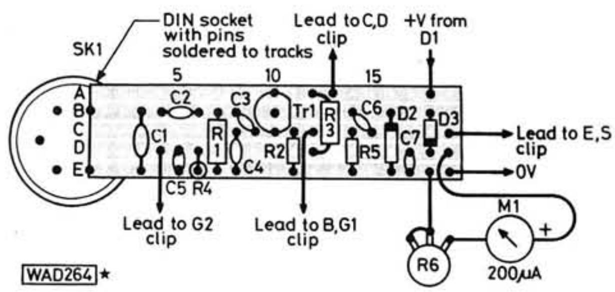
Diodes

Red l.e.d.	1	D1
1N4148	2	D2,3

Miscellaneous

Coil formers (6mm) with ferrite cores (2); 36s.w.g. enamelled copper wire; 200μA moving coil meter; DIN plugs (2); DIN socket (1); plastics box 100 × 70 × 35mm; Veroboard

Fig. 2: (Below) Full size Veroboard layout of the r.f. transistor tester



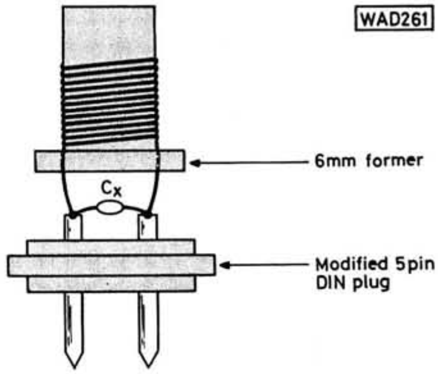
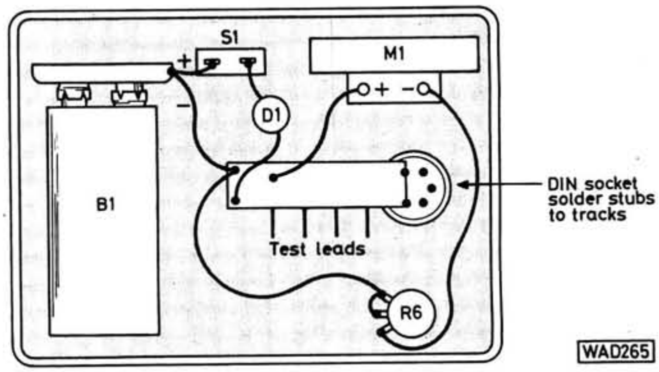


Fig. 3: (Above) Details of the plug-in coils. Fig. 4: (Below) Suggested layout of the unit in a plastics box



Carry out the same checks using an f.e.t. or dual-gate m.o.s.f.e.t.—the fourth terminal marked Gate 2 on Fig. 1 provides a fixed d.c. bias. If a transistor under test does not produce any output once the unit is functioning properly it is either unserviceable or has a low f_t and therefore should be tested on a d.c. transistor tester as described on page 37.

In conclusion this unit can be used for three functions—to test transistors of *npn* bipolar type, *n* type f.e.t.s or m.o.s.f.e.t.s and also, by tweaking the coil cores, as a signal source of crude b.f.o. Finally, the 3SK88 in the author's transverter was working—it was a fine wire coil that was open circuit, you can't expect to win them all! ●

Swap Spot

Have linear MM144/100/S, very little used. Would exchange for car radio cassette or screw telephoto. Ex–G8AKN. Tel: 061-336 3182. *W303*

Have R1132A v.h.f. receiver and power pack from Lancaster bomber, g.w.o. Would exchange for stereo reel-to-reel tape recorder. R. Tickner, 9 Kneller Road, Brockley, London SE4. *W319*

Have frequency meters, Army Class D and W1119 mains operated. Would exchange for crystals near 1760 to 1810kHz or 3515 to 3535kHz or cabinet for AR88 RX. G3HVI, QTHR. Tel: 0782 393349 (Stoke-on-Trent). *W336*

Have ZX Spectrum 48K computer plus cassette recorder and software. Would exchange for a good h.f. receiver, FRG–7 or similar. Simon Lexton, 29 Priory Avenue, Cheam, Surrey. Tel: 01-644 8977. *W378*

Have Lowe Colour Genie computer, perfect order. Would exchange for 100W MM 144MHz linear, w.h.y. Also have Yaesu FT–7 plus 4–band multimobile antenna, as new. Would exchange for Icom 451E. Tel: 0670 855953 (Stakeford). *W383*

Have Ex-Army 62 Set, transceiver installation, with headphones, mic, Morse key, 4m whip, antenna base. Needs mains p.s.u. and attention, but can be heard working. Would exchange for 19 Set, full details needed. Letter first please owing to shift work. Callers then only. Heslop, 75 Alder Park, Brandon, Durham DH7 8TJ. *W384*

Have two time recorders/totalisers, paper chart readout, with input and output counters, by Standard Instrument Corp., New York. Brand new with rolls chart paper and pens. Also have GEC valved table radio type BC5541, 9·5–26·8MHz in 3 bands plus bandspread. Would exchange for computer with RTTY terminal, or with any radio terminal or w.h.y. Mr N. Mayes. Tel: 0933 650121. *W388*

The Cellular Radio~ VODAFONE System

by Chas. E. Miller

The British electronics group Racal have announced that field trials of their Vodafone radio-telephone service will commence this December in the Greater London area. It is claimed that the new system will revolutionise the radio-telephone market by giving subscribers a degree of versatility and freedom hitherto unknown in the UK.

The Vodafone unit will be a personal telephone which may be taken almost anywhere by the subscriber, either in a vehicle or as a fully portable version, which may be carried in a briefcase. At the same time the system will be allied to the existing public telephone network, thus enabling Vodafone subscribers to contact conventional telephones virtually anywhere in the world. Racal further claim that the quality and reliability of their new system will surpass that of present-day radio-telephone services.

Cellular Radio

The Vodafone system will operate using cellular radio techniques whereby the traditional idea of having a given service area covered by a single, high power base station is abandoned in favour of splitting the region into a number of cells, honey-comb fashion, with each cell having its own low power base station. Cells will not be regular in size, but will vary in accordance with the type of territory involved. In heavily built-up areas the cell radius may be as little as 2km, whilst in open country the radius may be as much as 16km (area 256sq.km). Intermediate radii of 4 and 8km will also be used.

Each cell will be allocated a group of radio frequencies lying in the 890–960MHz range. Full duplex f.m. operation being used, each numbered channel will have two frequencies, with 45MHz separation. Channel spacing will be 25kHz, with a 12·5kHz off-set. Frequencies for base-to-mobile will lie in the 935–960MHz range, and mobile-to-base between 890–915MHz. As an example, channel 1 of the system will be on 890·0125MHz and 935·0125MHz. Base stations will have e.r.p.s of around 100W, whilst mobiles will have varying e.r.p.s as follows:

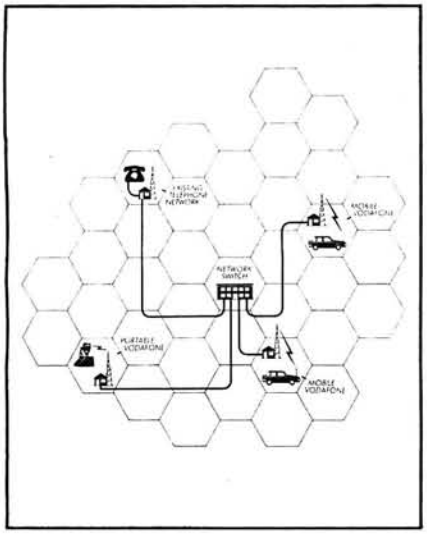
Class 1 (in-car)	10W
Class 2 (in-car/transportable)	4W
Class 3 and 4 (fully portable)	1·6W and 0·6W respectively

In addition, the e.r.p.s of the above units are variable in 4dB steps from maxima down to −22dBW to suit particular cell conditions. This is achieved automatically in response to command signals sent out by the base stations—of which more later.

It will be seen that 1000 duplex channels are theoretically possible. In practice cells are expected to share, initially, between 156 and 216 channels for speech, plus another 21 channels dedicated to paging and control data work. Cells will be formed into clusters, the ideal number for the sharing of frequencies being stated as seven cells per cluster. The clusters in turn build up into regional networks, which will eventually serve 90 per cent of the UK population. The full UK service will have the general name of Total Access Communication System or TACS.

Computerised Switching Centres

At the heart of the networks will be Mobile Radio Switching Centres (MSCs) which will be controlled by powerful computers. The MSCs will be located at major centres of population and will connect TACS to the conventional telephone network amongst their other duties. Each MSC will serve a large number of cells, being connected to their base stations by dedicated land lines. As



The Vodafone Service. A group of cells, each with a low-power transmitter at its centre, are controlled by a network switch acting as a multi-function control switchboard, transferring calls from mobile units as they move from one cell to another

well as handling the call traffic between Vodafone subscribers and the conventional network, the MSC will transmit and receive data (at 8k baud) to and from subscribers' units via a duplex radio channel, to enable it to carry out essential switching and control functions. Certain control data may also be sent out by "blank and burst" on the speech channels.

Making a Vodafone Call

When the subscriber first switches on his unit a search routine is initiated of the 21 control channels; when that providing the strongest signal is located the unit locks onto its frequency. An identifying signal is then sent out on the "access" channel, received at the base station and passed on to the local or "home" MSC. The subscriber's telephone is then placed on an "active" file by the MSC computer, which can and does request re-registration from time to time to keep the file up-to-date. When a call comes through for the subscriber from a telephone on the conventional network, it is directed to the MSC nearest its point of origin. This may not, of course, be the MSC that controls the cell in which the Vodafone subscriber happens to be at that moment, in which case the call is re-routed to the "home" MSC. Paging signals are then sent out by the appropriate base station until the subscriber's unit responds on the "access" channel. The MSC then issues instructions to the Vodafone unit as to what speech channel is to be used, and at what level of transmit power. The unit carries out these instructions and the call is connected. All this takes place very swiftly and automatically so that the parties to the call will not be aware of the activity or of any undue delay. Whilst the call is in progress a signal known as the Supervisory Audio Tone (SAT) is sent out by the base station and transponded by the subscriber's unit to indicate that all is well. The speech channel is used for this purpose; SAT frequencies are either 5·97kHz, 6kHz or 6·03kHz. Should the Vodafone fail to transpond for more than five seconds at a time the call will be disconnected automatically.

The subscriber's unit can transmit independently an 8kHz signal tone (ST) which serves two distinct purposes. In the first instance when a call is terminated a 1·8 second burst of ST is sent out to indicate (to use a conventional telephone expression) that the unit is now "on hook", i.e. ready to receive another call. The second use of ST occurs during the process known as "hand-off", which is the term for what happens when a subscriber moves from one cell to another.

Hand-off

The base station for each cell is constantly monitoring the signals of Vodafone units within its boundaries. When any signal falls below a certain specified level (as will happen when a subscriber crosses a boundary) the MSC is informed and it in turn instructs neighbouring base stations to monitor the signal in order to determine which new cell has been entered by the subscriber. The MSC then orders the unit to change to a new channel appropriate to the new cell. The burst of ST from the unit will confirm that it has identified both the new speech channel and a new SAT. Once again the subscriber will not be aware of the changes taking place.

Roaming

Inevitably a subscriber undertaking a long journey will pass from one MSC area to another. This is known as "roaming". When it occurs the subscriber's unit will automatically register with the new MSC and will be placed on its roamer file. At the same time the home MSC is informed so that incoming calls for the subscriber will be re-routed via the new MSC.

Racal anticipate that initially a typical cell will be able to cater for up to 700 subscribers. The number will rise to over 1500 when the system is developed more fully.

The Equipment

Development of the equipment used in the system has been an eclectic process involving co-operation with other companies in the UK, USA, Japan and Finland.

An agreement has been signed between Racal and Thorn-Ericsson for the transfer of manufacturing information concerning base station equipment. This will enable production to commence in Racal UK plants in 1985.

Manufacturing rights for the vehicle telephones have been secured from Panasonic of Japan, and from Mobira of Finland. The latter firm has also supplied rights for transportable telephones. Production of these various units will also commence next year.

The fully portable Vodafones have been developed by a team of Racal engineers working in partnership, in the USA, with the E.F. Johnson Company of Waseca, Minnesota, and will now be produced in this country.

It will be seen from the foregoing that a large proportion of the Vodafone network and subscriber equipment will be manufactured in the UK, satisfying objectives shared by Racal and the Government, who have granted the Group a 25-year licence to operate the system.

All subscriber units will have such features as push-button dialling, in the handset, automatic re-dialling of engaged numbers, storage of frequently-used numbers, plus something that many conventional telephone users would no doubt like to have—a "do not disturb" warning! (Although one might be tempted to ask why it should be needed by a person who has elected to take a telephone around with him!)

What It Will Cost

Racal have issued price lists giving what they call start-up costs (i.e. obtaining equipment and joining the system) plus monthly running costs. These show that a Class 1 mobile will cost £1,275 (outright purchase) or £26·25 per month on a 5-year lease. The figures for a fully portable unit will be £1,750 and £36·75 respectively. All units will be subject to a £50 connection fee, and in addition those permanently fitted in vehicles will attract a £95–£120 installation charge. Thereafter, the running costs will be as follows: (all figures per month).

For the initial six month trial period a standing charge of £12·50 will be made, plus a minimum call charge of £10. When the full phase 1 service becomes available these charges will rise to £25 and £15 respectively. The actual call charges will be for both periods 25p/minute on peak, 10p/minute off peak. Peak time will be between 7.30 am and 7.30 pm. All the figures quoted will be subject to VAT at the rate imposed at the time.

The initial trials will be held in a 380sq.km area centred around Greater London. The service area will be expanded during 1985 to cover the shaded portions of the map, with further development to follow.

Acknowledgements

The author would like to thank Steve Phillips of Racal-Vodac and Ian McCann of Racal Group Services for their kind assistance with technical information and illustrations.

At the time of writing another cellular radio-telephone system has just been announced by British Telecom and Securicor, working in partnership. It is understood that "Callnet" will commence operations in January next year, initially covering Heathrow and Gatwick airports and much of London. Costs so far announced are £1,552 for a vehicle unit and "under £2,000" for a portable. Leasing is available, but prices are not yet known. There will be a £75 quarterly charge plus call charges of 25p/minute at full peak, dropping to 10p/minute and 8p/minute at the lowest, between 10 pm and 8 am. ●

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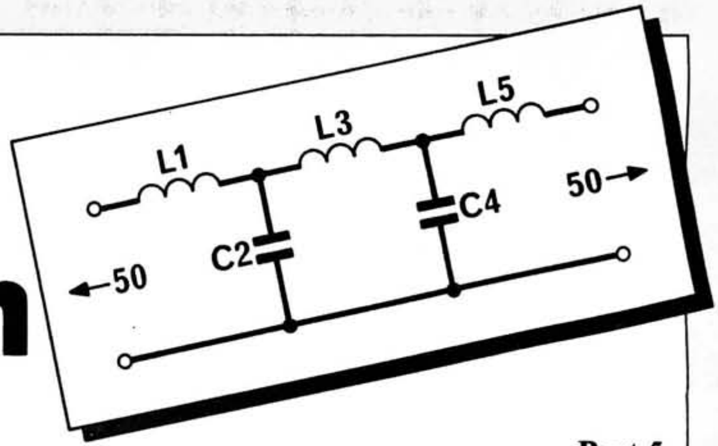


by Edward Wetherhold W3NQN

Part 5

NOTES

1. Reference in this series of articles to a filter design such as: "design 5.1-12" means line 12 of Table 5.1.

2. Throughout this series on *LC* filter design, for ease of reading, v.s.w.r. values are quoted as single numbers instead of in the usual ratio form. For example a v.s.w.r. of 1·52 as quoted for design 5.1-12 would normally be written as 1·52:1

In previous instalments, we discussed standard-value capacitor (SVC) designs for the 5- and 7-branch Chebyshev lowpass and highpass filters. In this instalment we will discuss the 5-branch Cauer lowpass and highpass SVC filters. The Cauer filter (also known as the elliptic function) is one of the most important types of modern filter designs. It has a response that is similar to the Chebyshev in the passband where there is equi-ripple attenuation (two ripples for the 5-branch design) that does not exceed a specified maximum level. In the stopband, instead of the attenuation increasing continuously as in the Chebyshev, the Cauer stopband has two attenuation peaks, and the attenuation does not fall below a minimum level that can be specified by the designer. This minimum stopband attenuation level is typically between 40 and 50dB for the 5-branch SVC Cauer designs. The advantages of the Cauer filter are its more abrupt rise in attenuation as compared to the Chebyshev and the ability of the designer to specify a minimum level of stopband attenuation. The disadvantage of this filter type is that the two resonant circuits must be correctly tuned to obtain the desired stopband response.

Cauer Configurations and Responses

The Cauer 50 ohm lowpass the highpass filter configurations and responses are shown in Figs. 5.1 and 5.2 respectively, and Tables 5.1 and 5.2 list the component values and performance parameters of the designs. Each configuration requires only two inductors and five capacitors. The alternative configurations, requiring five inductors and two capacitors, were not considered because of the greater number of inductors. Inductors are usually more costly, more bulky and more lossy than capacitors, and therefore those designs having a minimum of inductors are preferred.

You will note that of the five capacitors in the lowpass and highpass filters only three capacitors (C1, C3 and C5) have standard preferred values of the 10 per cent tolerance series (20 per cent steps of 10, 12, 15, 18, etc.). This is a consequence of the mathematics associated with the programming of this SVC filter type and only three capacitor values were available for selection. The capacitors most suitable for standard values were in the non-resonant branches of the filter. The remaining two capacitors, C2 and C4, are in the resonant branches, and either the capacitors or inductors may be varied to tune the branches to their required frequencies. Because C2 and C4 probably will be varied anyway to tune the resonant branches, it is unnecessary that these capacitors have standard values.

Lowpass SVC Designs

The lowpass filter schematic diagram and attenuation response are shown in Figs. 5.1(a) and 5.1(b), respectively.

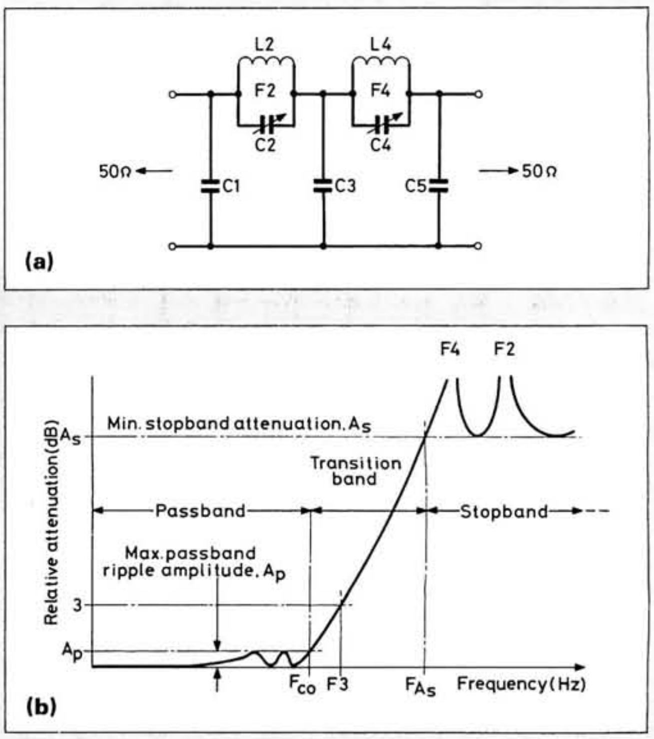


Fig. 5.1: Circuit diagram and attenuation response of 5-branch Cauer lowpass filter. Tune C2/L2 to *F2*, C4/L4 to *F4*

TABLE 5.1

50-OHM 5-BRANCH CAUER LOW-PASS SVC-FILTER DESIGNS, 10% SERIES FOR C1, C3 & C5.

No.	F-co	F-3	F-As	As	MAX.	C1	C3	C5	C2	C4	L2	L4	F2	F4
	-------(MHz)	-------		(dB)	VSWR	------------(pf)			------------		---(uH)---		---(MHz)---	
1	.795	.989	1.57	47.4	1.09	2700	5600	2200	324	937	12.1	10.1	2.54	1.64
2	1.06	1.20	1.77	46.2	1.23	2700	4700	2200	341	982	9.36	7.56	2.82	1.85
3	1.47	1.57	2.15	45.4	1.59	2700	3900	2200	364	1045	6.32	4.88	3.32	2.23
4	.929	1.18	1.91	48.0	1.08	2200	4700	1800	257	743	10.2	8.59	3.11	1.99
5	1.27	1.45	2.17	46.7	1.21	2200	3900	1800	271	779	7.85	6.39	3.45	2.26
6	1.69	1.82	2.54	45.9	1.49	2200	3300	1800	287	821	5.64	4.42	3.96	2.64
7	1.12	1.44	2.41	49.8	1.07	1800	3900	1500	192	549	8.45	7.25	3.95	2.52
8	1.49	1.73	2.70	48.8	1.18	1800	3300	1500	200	570	6.75	5.62	4.33	2.81
9	2.11	2.27	3.27	47.8	1.51	1800	2700	1500	213	604	4.55	3.64	5.12	3.40
10	1.28	1.66	2.63	46.3	1.06	1500	3300	1200	192	561	7.20	6.00	4.28	2.74
11	1.79	2.06	2.99	44.8	1.20	1500	2700	1200	204	592	5.52	4.42	4.75	3.11
12	2.52	2.70	3.63	43.8	1.52	1500	2200	1200	220	636	3.71	2.82	5.58	3.76
13	1.56	2.08	3.55	50.1	1.06	1200	2700	1000	127	363	5.88	5.07	5.83	3.71
14	2.23	2.59	4.04	48.8	1.18	1200	2200	1000	133	380	4.50	3.75	6.50	4.22
15	3.17	3.41	4.90	47.8	1.51	1200	1800	1000	142	402	3.03	2.42	7.68	5.10
16	1.94	2.52	4.15	48.4	1.06	1000	2200	820	115	331	4.79	4.06	6.78	4.34
17	2.73	3.14	4.73	47.0	1.20	1000	1800	820	121	348	3.66	2.99	7.56	4.93
18	3.73	4.02	5.63	46.2	1.49	1000	1500	820	129	368	2.56	2.01	8.76	5.85
19	2.39	3.11	5.20	49.4	1.07	820	1800	680	89.3	256	3.91	3.35	8.51	5.44
20	3.26	3.79	5.85	48.2	1.18	820	1500	680	93.6	267	3.07	2.54	9.39	6.10
21	4.83	5.17	7.30	47.2	1.57	820	1200	680	100	286	1.95	1.54	11.4	7.58
22	2.85	3.71	6.15	48.8	1.06	680	1500	560	76.6	220	3.26	2.78	10.1	6.43
23	4.16	4.74	7.14	47.3	1.22	680	1200	560	81.3	233	2.40	1.97	11.4	7.44
24	5.72	6.13	8.58	46.5	1.55	680	1000	560	86.3	246	1.65	1.30	13.3	8.91
25	3.67	4.69	7.95	50.5	1.08	560	1200	470	57.6	164	2.59	2.23	13.0	8.31
26	5.02	5.77	9.01	49.4	1.21	560	1000	470	60.3	171	2.01	1.68	14.5	9.40
27	7.18	7.68	11.1	48.6	1.58	560	820	470	64.1	181	1.32	1.06	17.3	11.5
28	4.40	5.60	9.24	49.3	1.08	470	1000	390	51.4	147	2.16	1.84	15.1	9.66
29	6.17	7.01	10.6	48.0	1.24	470	820	390	54.2	155	1.63	1.34	17.0	11.1
30	8.63	9.20	12.9	47.3	1.60	470	680	390	57.6	164	1.09	.857	20.1	13.4
31	5.47	6.91	11.8	51.3	1.09	390	820	330	38.5	109	1.76	1.52	19.3	12.3
32	7.55	8.59	13.5	50.2	1.24	390	680	330	40.4	114	1.34	1.12	21.7	14.1
33	10.9	11.5	16.8	49.5	1.66	390	560	330	42.8	120	.862	.695	26.2	17.4
34	6.59	8.17	13.0	47.7	1.10	330	680	270	39.0	112	1.46	1.22	21.1	13.6
35	9.10	10.2	15.0	46.5	1.27	330	560	270	41.2	118	1.09	.881	23.7	15.6
36	12.4	13.2	18.1	45.8	1.63	330	470	270	43.9	125	.741	.573	27.9	18.8

The component designations (C1, C3, C5, etc.) and response parameters (*F-co, F-3* (3dB point) *F-As,* etc.) in Fig. 5.1 are associated with similarly labelled column headings in Table 5.1. Each lowpass design has an identification number, and the designs are arranged in groups of three in which the values of C5 are identical. The number of designs are limited to 36 because the 10 per cent capacitor tolerance series was used in selecting the designs. If the 5 per cent series had been used (increments of 10 per cent steps for values of 10, 11, 12, 13, 15, 16, 18, etc.), about four times as many designs would have been possible. Also, the v.s.w.r. limit was selected to be about 1·7 which further restricted the number of designs available for tabulation. In spite of these restrictions, there are sufficient designs to cover the 1 – 10MHz decade with a small enough increment from one cutoff frequency to the next so that almost any cutoff requirement can be satisfied. The graph Fig. 5.3 provides a convenient summary of the cutoff frequencies and associated v.s.w.r.s that are available in the lowpass tables.

The column with the *F-co* heading gives the ripple cutoff frequency, *F-Ap*. The *F-3* and *F-As* columns give the frequencies associated with these attenuation levels. The next column gives the minimum stopband attenuation, *As,* and this level varies from a minimum of 43·8dB for design 5.1–12 to a maximum of 51·3dB for design 5.1–31. The maximum v.s.w.r. and the component values of each design are given in the next eight columns. The two concluding columns give the resonant frequencies of the two tuned circuits. One of the advantages of this tabular format is that all the important parameters of the Cauer lowpass filter are available for easy reference.

An interesting characteristic of the table is that in each group of three designs the filter v.s.w.r. is lowest in the first design of the group, and becomes increasingly larger in the second and third designs. The first two designs are therefore recommended for r.f. transmitter filtering applications where it is important to minimise filter v.s.w.r., and the third design is recommended for audio filtering applications where a high v.s.w.r. is not important and a more abrupt rise in attenuation is preferred.

The relative abruptness of attenuation rise for different Cauer designs (where the *As* values are similar) can be compared by determining the ratios of *F-As/F-co*. The closer the ratio is to unity, the more abrupt is the attenuation rise, and the smaller is the transition band. For example, designs 5.1–1 to 3 have stopband-to-cutoff frequency ratios of 1·975, 1·670 and 1·463 for corresponding v.s.w.r.s of 1·09, 1·23 and 1·59. These ratios can be compared because the *As* values of these designs are similar (between 45·5 and 47·4dB). Note how the filter response becomes more selective (the *F-As/F-co* ratio becomes smaller) as the v.s.w.r. increases. Consequently, for audio frequency filtering applications, use a design with the highest v.s.w.r. for best selectivity.

Highpass SVC Designs

The highpass filter schematic diagram and attenuation response are shown in Figs. 5.2(a) and 5.2(b), respectively. The component designations and response parameters are associated with similarly labelled column headings in Table 5.2 in the same manner as in Fig. 5.1 and Table 5.1. The highpass designs are arranged in groups of three (except for designs 5.2–22 to 25 and 5.2–29 to 32 where there are four designs per group) in which the values of C3 are identical. The number of designs are limited to 38 because the 10 per cent capacitor tolerance series and a v.s.w.r. limit of about 1·7 are used to calculate the table. In spite of these limitations, there are sufficient designs to cover the 1 – 10MHz decade with a small enough increment from one cutoff frequency to the next, so that virtually any cutoff frequency requirement can be satisfied. The graph Fig. 5.3 provides a convenient summary of the highpass filter cutoff frequencies and v.s.w.r.s that are available in Table 5.2.

The minimum stopband attenuations, *As,* of the highpass designs vary from 43·7 to 51·6dB, which are almost identical with that of the lowpass table. It is interesting to note that the v.s.w.r. of the highpass designs is largest in the first design of each group, and becomes progressively smaller in the second, third and fourth designs. This v.s.w.r. change is opposite to that of the lowpass table. Also, the resonating capacitors, C2 and C4, of the highpass table are greater than the non-resonating capacitors, whereas in the lowpass table, the opposite is the case. Because the values of C2 and C4 in the highpass table are so large they are more conveniently given in nanofarads (1nF = 1000pF), and the column heading for all the capacitor values is in "nF". When used for receiver preselection, the highpass filter with the highest v.s.w.r. is recommended for best selectivity. In this application, a filter with high v.s.w.r. causes no problem because there is no r.f. power involved.

As in the lowpass designs, the relative selectivity of highpass designs can be determined by calculating the *F-As/F-co* ratios. The closer the ratio to unity, the more abrupt will be the attenuation rise; however, for the highpass designs, the *F-As/F-co* ratios will be less than unity. For example, the relative selectivities of highpass designs 5.2–1 to 3 are:
0·670/1·01 = 0·663; 0·608/1·14 = 0·533 and 0·604/1·30 = 0·465. Because the ratio of design 5.2–1 is closest to unity, it has the most abrupt attenuation rise of these three designs. And as expected, it also has the highest v.s.w.r.

How to Use the SVC Tables

An appropriate 50 ohm lowpass or highpass filter is easily selected for a particular application with Fig. 5.3 and Tables 5.1 and 5.2. You must first be able to specify the filter type required (lowpass or highpass), the frequency range of application (audio or radio frequency) and the cutoff frequency. A stopband attenuation between 40 and 50 dB is assumed to be adequate.

For example, assume a filter is desired to reduce the harmonic levels of a 1·8MHz (160m) band transmitter, and the desired cutoff frequency is to be just above 2·0MHz. For this application, a lowpass filter with a low v.s.w.r. is appropriate. Referring to the lowpass portion of Fig. 5.3, we see that there are two suitable low v.s.w.r. designs with cutoff frequencies at about 2·2 and 2·4MHz. From Table 5.1, we find the exact cutoff frequencies are 2·23MHz (for design 5.1–14) and 2·39MHz (for design 5.1–19). These designs have v.s.w.r.s of 1·18 and 1·07, respectively, and are suitable for this particular filtering application. By checking the *F2* and *F4* frequencies, we can see the position of the attenuation peaks relative to the

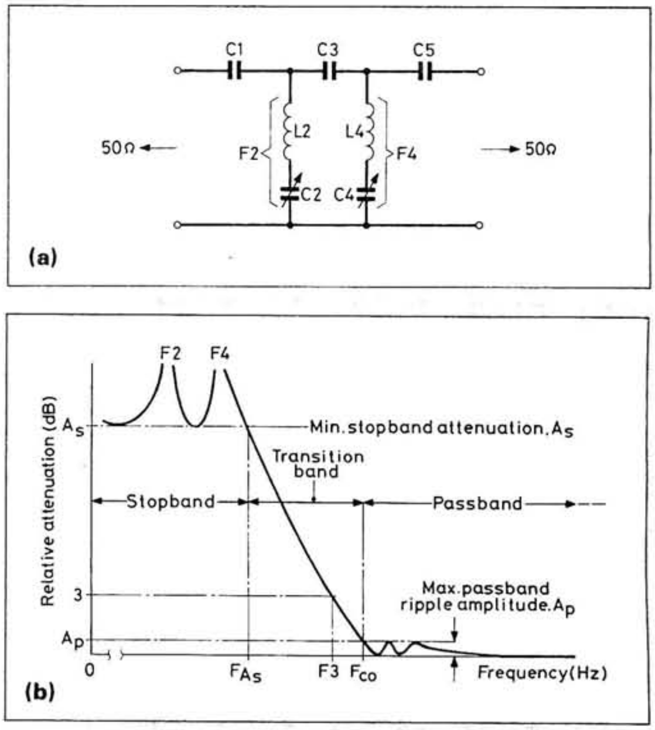


Fig. 5.2: Circuit diagram and attenuation response of 5-branch Cauer highpass filter. Tune C2/L2 to *F2*, C4/L4 to *F4*

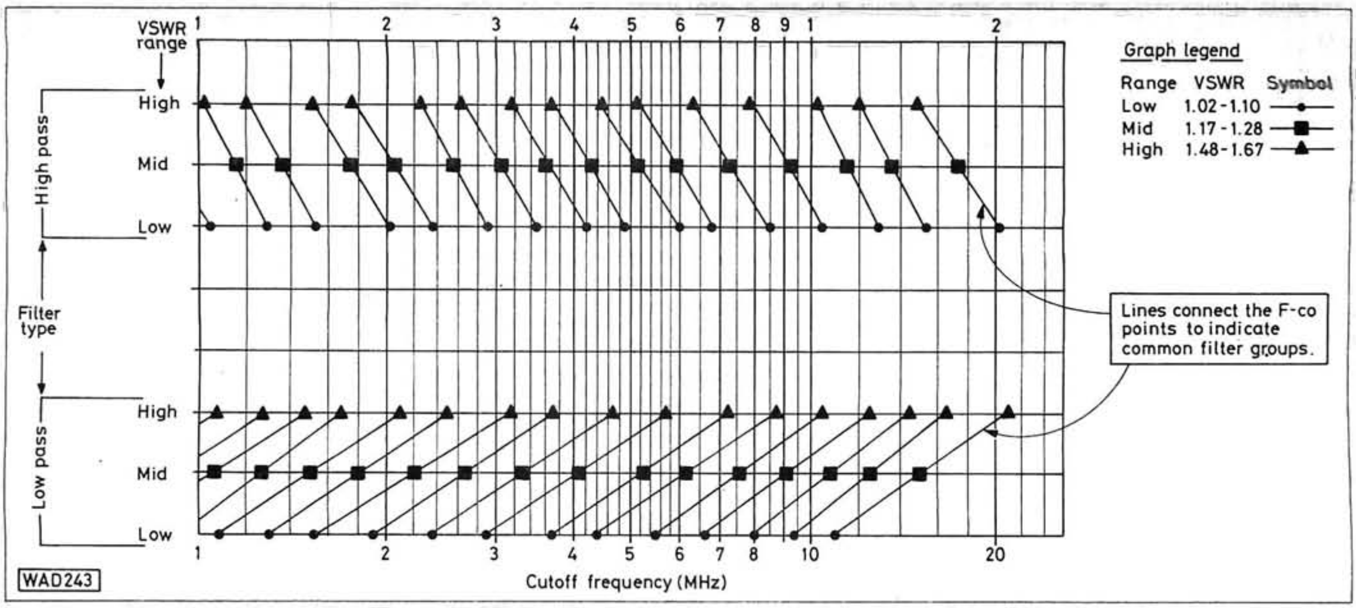
TABLE 5.2

50-OHM 5-BRANCH CAUER HIGH-PASS SVC-FILTER DESIGNS, 10% SERIES FOR C1, C3 & C5.

No.	F-co	F-3	F-As	As	MAX.	C1	C3	C5	C2	C4	L2	L4	F2	F4
	-------(MHz)-------			(dB)	VSWR	-----------(nF)-----------					---(uH)---		---(MHz)---	
1	1.01	.936	.670	45.9	1.49	2.7	1.8	3.3	20.7	7.24	6.58	8.40	.431	.646
2	1.14	.976	.608	50.4	1.19	3.3	1.8	3.9	32.3	11.4	5.53	6.54	.377	.582
3	1.30	1.01	.604	49.4	1.07	3.9	1.8	4.7	35.8	12.5	5.19	6.07	.369	.578
4	1.19	1.11	.810	45.4	1.54	2.2	1.5	2.7	16.4	5.71	5.65	7.28	.523	.780
5	1.38	1.20	.797	46.8	1.20	2.7	1.5	3.3	22.0	7.66	4.61	5.65	.499	.765
6	1.56	1.19	.685	51.6	1.06	3.3	1.5	3.9	33.7	11.9	4.32	4.97	.417	.655
7	1.51	1.40	1.01	45.9	1.49	1.8	1.2	2.2	13.8	4.82	4.39	5.60	.646	.968
8	1.75	1.51	1.00	46.6	1.18	2.2	1.2	2.7	17.7	6.14	3.65	4.47	.627	.961
9	2.02	1.52	.920	48.3	1.06	2.7	1.2	3.3	23.4	8.09	3.44	4.04	.562	.880
10	1.78	1.65	1.15	47.8	1.51	1.5	1.0	1.8	12.7	4.47	3.71	4.64	.733	1.10
11	2.07	1.80	1.20	46.8	1.20	1.8	1.0	2.2	14.7	5.11	3.07	3.77	.749	1.15
12	2.38	1.83	1.13	47.8	1.06	2.2	1.0	2.7	18.6	6.43	2.87	3.40	.689	1.08
13	2.22	2.08	1.55	43.7	1.53	1.2	.82	1.5	8.19	2.83	3.05	4.02	1.01	1.49
14	2.52	2.17	1.39	48.7	1.19	1.5	.82	1.8	13.5	4.73	2.51	3.01	.865	1.33
15	2.89	2.23	1.36	48.2	1.07	1.8	.82	2.2	15.5	5.37	2.36	2.78	.833	1.30
16	2.57	2.40	1.68	47.8	1.56	1.0	.68	1.2	8.40	2.96	2.60	3.27	1.08	1.62
17	3.05	2.68	1.85	44.7	1.22	1.2	.68	1.5	8.77	3.02	2.10	2.64	1.17	1.78
18	3.48	2.66	1.57	49.9	1.06	1.5	.68	1.8	14.1	4.94	1.96	2.28	.957	1.50
19	3.17	2.96	2.13	46.1	1.55	.82	.56	1.0	6.31	2.21	2.13	2.72	1.37	2.05
20	3.62	3.16	2.05	48.6	1.21	1.0	.56	1.2	8.93	3.14	1.74	2.10	1.28	1.96
21	4.19	3.30	2.11	46.1	1.08	1.2	.56	1.5	9.30	3.19	1.61	1.94	1.30	2.02
22	3.68	3.45	2.45	47.2	1.60	.68	.47	.82	5.53	1.95	1.84	2.33	1.58	2.36
23	4.30	3.79	2.55	46.9	1.23	.82	.47	1.0	6.69	2.33	1.48	1.82	1.60	2.45
24	4.89	3.84	2.31	49.7	1.08	1.0	.47	1.2	9.34	3.27	1.36	1.59	1.41	2.21
25	5.87	3.89	2.31	47.4	1.02	1.2	.47	1.5	9.71	3.32	1.35	1.58	1.39	2.20
26	4.44	4.17	3.01	46.5	1.62	.56	.39	.68	4.37	1.53	1.54	1.97	1.94	2.90
27	5.14	4.52	2.99	48.0	1.24	.68	.39	.82	5.88	2.06	1.23	1.50	1.87	2.87
28	5.88	4.67	2.90	48.0	1.09	.82	.39	1.0	7.05	2.45	1.13	1.34	1.78	2.78
29	5.07	4.77	3.35	48.5	1.67	.47	.33	.56	4.07	1.44	1.35	1.69	2.15	3.22
30	5.99	5.34	3.60	47.1	1.27	.56	.33	.68	4.63	1.62	1.06	1.31	2.27	3.46
31	6.81	5.48	3.37	49.0	1.10	.68	.33	.82	6.15	2.15	.961	1.13	2.07	3.22
32	8.07	5.50	3.17	49.3	1.03	.82	.33	1.0	7.33	2.54	.945	1.09	1.91	3.02
33	6.38	5.99	4.26	47.3	1.61	.39	.27	.47	3.18	1.12	1.06	1.34	2.74	4.10
34	7.34	6.47	4.18	49.2	1.24	.47	.27	.56	4.33	1.53	.856	1.03	2.61	4.01
35	8.39	6.73	4.17	48.4	1.09	.56	.27	.68	4.90	1.71	.784	.930	2.57	4.00
36	7.92	7.36	4.98	49.6	1.52	.33	.22	.39	3.05	1.08	.828	1.02	3.17	4.79
37	9.21	8.05	5.27	48.1	1.22	.39	.22	.47	3.40	1.19	.686	.832	3.30	5.06
38	10.4	8.18	4.84	50.5	1.08	.47	.22	.56	4.56	1.60	.636	.740	2.95	4.62

1·8MHz band transmitter harmonics. Design 5.1–19 had one of its attenuation peaks (5·44MHz) at the third harmonic of 1·8MHz, and if this harmonic is to be greatly attenuated, this design will do it. Unfortunately, the second harmonic will be attenuated by only about 9dB, and this may be inadequate. In this case, design 5.1–14 should be considered. Its second harmonic attenuation is about 30dB at 3·6MHz, and the attenuation above 4·04MHz will always be greater than 48·8dB. The v.s.w.r. of 1·8 is not excessive for this application.

Attenuation versus frequency can be closely approximated by connecting the *F-co,* the *F-3* and the *F-As* frequency points given in the table with a smooth curve drawn on semi-log or linear graph paper. Using this curve,



you can estimate the attenuation at any frequency between the 3dB frequency and the start of the stopband at the *F-As* frequency.

As with the Chebyshev SVC tables presented in previous instalments, the SVC Cauer design tables were calculated for the 1 – 10MHz frequency decade and equal source and load impedances of 50 ohms. However, these designs can be scaled to any frequency decade and any impedance level while still maintaining the advantages of the SVC designs and the "scan mode" of filter selection.

Fig. 5.3: Distribution of cutoff frequencies for lowpass and highpass filters over one decade. Use this graph for a summarisation of all possible cutoff frequencies and v.s.w.r.s of the filters in Tables 5.1 and 5.2

NEXT MONTH

The theoretical section of this series concludes with a look at frequency and impedance scaling, and the relationship between v.s.w.r., reflection coefficient and passband attenuation

multiple choice... multiple choice... ANSWERS multiple choice... multiple choice...

Are you cheating? If you are reading this page before page 29 then you are. Please turn to page 29 for the questions.

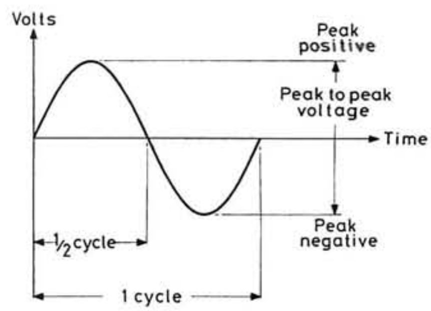
Question 3–1. Answer–c.

The u.h.f. TV frequencies are much higher than the transmissions that are causing the problems, so we want a filter that will allow the higher frequencies to pass into the TV set, i.e. a high-pass filter. Theoretically it would be possible to use a band-pass filter, but this would be unnecessarily complicated because

—the u.h.f. TV bands are very wide (470 to 854MHz)
—we are not interested in frequencies above the TV signals.

Question 3–2. Answer–d.

The peak-to-peak voltage is measured from the peak positive to the peak negative voltage.



Question 3–3. Answer–d.

The frequency of oscillation depends almost entirely on the physical dimensions of the quartz crystal. There is some change of frequency with temperature, so for extreme stability the crystal can be housed in a constant temperature oven.

Question 3–4. Answer–b.

In an a.m. telephony transmitter (that is, one designed for speech rather than Morse) all the stages after the modulator need to be linear otherwise the audio will be distorted.

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NEWS & VIEWS

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We are substantial stockists of TRIO/KENWOOD equipment with full stocks of all major sets & accessories and have taken steps to see that our service & spares backup is as good as any dealer. What a pity the excellent ICOM products are often priced above the market. We are saving you some money this month on the 2M Base Station. (Backup on ICOM is very good indeed but we wish they would produce the excellent comprehensive technical manuals a bit sooner.)

And now some NEWS

Rumours have abounded for months about the new Yaesu receiver. Hopefully we shall have stocks of **FRG8800** by the time you read this. Please 'phone for price . . .

The popularity of **FT757GX** may be dented a little by the base station version, might be called **FT103**. Send SAE & we'll send details as soon as available.

The new **FT209R** Handy from Yaesu has been around for a month or so by the time you read this. We took the first one home on 20th June (Yes that's how long we wait for the adverts to appear) and had excellent reports through our local GB3DA repeater which is only 3 miles from the shop at Hatfield Peverel.

Soon we expect to have the 70CM version **FT709R** and the companion to the FT203R for 70cm — Yes you guessed **FT703R**.

We hope by the time you read this to have stock of the **NEW FT20/700** FM 2M & 70CM Mobile station. Send us an SAE for details and a quote.

NEW from Trio/Kenwood the **TR711E** 2M base station — we ordered a pile as soon as we heard of it, so we should have stocks just as soon as it's released. Send SAE for details & quote.

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UOSAT—The News from Space

From time to time odd rumblings occur amongst the amateur radio fraternity regarding the rights of pseudo-amateur/scientific experiments occupying amateur allocated spectrum. Data transmitted by UOSAT vehicles can at times be confused with cipher groups and appear meaningless to those not in possession of the relevant de-coding equipment/routines. It is therefore pleasing to remind readers of the ready availability of the weekly bulletin service transmitted on 145·825MHz from UOSAT-1. The bulletin is compiled and edited by the UOSAT team and loaded into the spacecraft each Friday afternoon from the UOSAT Control Centre at the University of Surrey. The bulletin is subsequently transmitted, interspaced with 1200 b.p.s. digital and Digitalker spacecraft systems telemetry, continuously throughout the following Saturday, Sunday and Monday. The bulletin is transmitted using f.s.k. on f.m. at 1200 b.p.s. A recent example of the UOSAT 1 bulletin amounted to 5 A4 sized pages of general space and spacecraft news items together with comprehensive orbital data updates on all current AMSAT vehicles.

Apart from UOSAT 1 (OSCAR 9), AMSAT-UK broadcast a news bulletin, via OSCAR 10, compiled from taped text supplied by the RSGB's GB2RS news service. These transmissions are time adjusted to allow wide coverage. The table indicates the schedule for the remaining weeks of 1984.

Any radio amateur or AMSAT group wishing to input news items into this service which is of interest to Region 1 members or other AMSAT-UK groups should send this information in English to RSGB HQ or *AMSAT-UK, 94 Herongate Road, Wanstead Park, London E12 5EQ* before the Thursday prior to the Bulletin. Transmissions from OSCAR 10 use the H2 channel (145·962MHz). Stations wishing to contact the news service should call in after the bulletin approximately 10kHz below this frequency, i.e. 145·950–145·952MHz.

The UOSAT programme recently received a donation of £1500 from AMSAT-UK which will be used to provide much needed ground station equipment for the spacecraft control centre.

Date Times (Corrected to 51°N 00°E/W)				
1984	GMT/UTC	Range km	Elevation	Azimuth
11 Nov	1500	37 812	37	122
18 Nov	No transmission			
25 Nov	1700	37 197	47	190
2 Dec	1130	38 336	22	100
9 Dec	1930	38 908	25	247
16 Dec	1400	37 006	44	153
23 Dec	0930	40 680	7	92
30 Dec	1630	37 856	36	221

Interested in 1·3GHz ATV?

In the wake of interest being expressed in the construction of a 1·3GHz (23cm) ATV repeater covering the Bournemouth/Southampton area, local amateur radio enthusiasts would like to draw this interest together, so that concrete proposals can be compiled.

Suggestions have been made that the area might be better served by two repeaters—one for the Poole/Bournemouth area and one for the Southampton area, which would permit more effective cover of the low-lying areas of the three towns.

It would be most helpful if interested parties, who live in the areas concerned, contact: *Nick Foot G4WHO, 47 Mallard Road, Colehill, Wimborne, Dorset.*

The Morse Test

We are reliably informed that it is no longer acceptable to pay for the Morse Test with postage stamps (£15).

Should readers have one of the old forms of application, they are advised to check with the examining authority as to the mode of payment they prefer.

UK 50MHz Beacon

The latest (and second) UK 50MHz beacon GB3NHQ, which became operational at the end of August, is currently providing a very useful service to propagation monitors throughout the UK and Europe. Operational on a continuous 24 hour basis the 15W e.r.p. 50·050MHz signal has been reported by numerous stations including someone in AC square in southern France (Best DX yet?), S7 at mid Yell on the Shetland Isles and also via Auroral enhancement at a BBC monitoring station near Stockholm. Meteor scatter bursts are also providing reports from the far North. Down here in deepest Dorset the signal received using a 3 element Yagi and evaluation model *PW* upconverter (144MHz i.f.) has averaged out at 5/2 during the first weeks of operation. Signals are subject to prevailing tropospheric conditions and have included periods at up to 5/9 corresponding to decaying high pressure systems. What is fascinating is to compare the enhancement effects with 144MHz band signals over the same path which often exhibit the same QSB, but time delayed! Reception reports will be welcomed by the RSGB who are currently co-sited with the beacon at Potters Bar.

Catalogues

Barenco, the Leicester based antenna mast and accessories supplier, have their latest mail order catalogue available.

The catalogue is entitled Barenco Mast Supports and lists all their products, with prices, and each item is illustrated with a line drawing.

Barenco attend many rallies and shows throughout the year where their products are displayed, but to obtain your personal copy of the catalogue, apply to (sae appreciated): *Barenco, 8 Healey Close, Leicester LE4 2DH. Tel: (0533) 353012.*

Bernard Babani (publishing) Ltd. have prepared a new catalogue listing all the computer titles they publish.

The catalogue is available free, to any reader who cares to send their name and address to: *Bernard Babani (publishing) Ltd., The Grampians, Shepherds Bush Road, London W6 7NF. Tel: 01-603 2581/7296.*

Insurance

Readers who are interested in applying to the *PW Radio Users Insurance Scheme* are advised to use the coupon published on page 18 of a previous issue.

Special Event Stations

For the fourth year, a hands-across-the-sea Commemorative station WA1NPO, will be on the air on America's Thanksgiving Day, Thursday 22 November. The station will be located in the Plimoth Colony, near Plymouth, Massachusetts, site of the first permanent English settlement to be established in the New World.

On the UK side a complementary station GB2UST, will be operated by Sidmouth (Devon) Amateur Radio Society from the astronomical observatory 61m (200ft) above the town.

Both stations will be on air between 1300 and 2000GMT, via s.s.b. on 14·180, 14·255 and 14·345MHz, also on 21·260 and 21·385MHz. WA1NPO will be looking for calls from any UK station, and an attractive certificate featuring the *Mayflower* will be available for confirmed contacts.

Further details from: *Peter Jackson G3ADV, 32 Brown Avenue, Parkfield, Nantwich, Cheshire CW5 7DH. Tel: (0270) 627149.*

McMichael Amateur Radio Society will be operating a special event station GB0LMC, on 17 and 18 November from their clubhouse at Stoke Poges, Bucks., to commemorate the centenary of the birth of Leslie McMichael.

Further details are available from: *R. F. Muggleton G6AMN, 23 Randolph Road, Langley, Berkshire SL3 7QF.*

Repeater News

144MHz: Repeater developments on 144MHz within the UK have now reached the point where most populated areas now enjoy some form of coverage. Any additional repeaters required to "fill in" removing gaps face problems in respect of channel availability, so such schemes in the near future will probably have to be accomplished by inter-group co-operation, requiring channel changes and the use of non-hilltop low power installations to avoid co-channel interference. The alternative solution to develop a 12·5kHz channel system has yet to be justified as a workable solution and in the longer term may well see the introduction of narrow bandwidth systems similar to the pilot tone s.s.b. experiment now being conducted on GB3SF. This installation was switched on for the first time on 14 Aug 84 and operates on channel RS37 (output 145·78MHz, input 145·185MHz). The input and output modes are both pilot s.s.b. (p.s.s.b.) with the pilot carrier at 16dB below total p.e.p. output. Operational reports from users of GB3SF would be appreciated by the beacon keeper Dr. A. Whitaker G3RKL, QTHR.

A letter of intent to establish a v.h.f. repeater at Hemel Hempstead has been lodged with the RMG. The Barnoldswick (Yorks) repeater GB3AE, which was conceived and licensed as an alternative energy (solar/wind) experiment has now received the go-ahead to change callsign to GB3TP (Trans-Pennine) and become operational on R5 from a site near Keighley. GB3YJ (R7) changed its callsign to avoid RAYNET and user services confusion with the local Police installation, also using the YJ as an identifier. The on-frequency coverage extension of GB3HG has been dropped due to lack of local support. Two separate groups have expressed interest (but need to submit proposals) to re-establish London repeater GB3EL.

430MHz: The promotion of repeater and general operations on the 430MHz band and above is a current cornerstone of RMG policy. GB3PT the UK's first RTTY repeater is now handling DATA traffic, once again making this a UK first. The Data format uses 300 baud V.21 protocol. Site changes have been cleared or are waiting DTI approval for GB3NN, now at Wells-next-the-sea, Norfolk, GB3GR Grantham, GB3SW Salisbury, GB3DT, Bullbarrow Hill, North Dorset and GB3WU Wakefield. A site change for GB3LA (Leeds) is also being considered—the block of flats housing the unit are due to be demolished!

1·3GHz ATV: At the time of this report 3 ATV repeaters are operational on 1·3GHz, GB3TV (Luton) and GB3VR (Brighton) using f.m. video and GB3GV (Leicester) a.m. video. In early 1985 the RMG will be evaluating operational feedback from these and hopefully the remaining licensed units, before submitting proposals to the DTI for 1·3GHz ATV, Phase II.

In Memory of a Pioneer

"A super day", said Jim Kimpton G4WAO, one of the Chichester and District Amateur Radio Club's operators. They were using the radio shack at the Chalk Pits Museum on September 9, to commemorate the work of the late Gerald Marcuse G2NM, past President of the RSGB and the Chichester Club and pioneer of Empire Broadcasting.

The club's h.f. station, using the special event callsign GB2NM and with Chris Bryan G4EHG and Dave Parsons G4BZB taking their turn at the controls of a FT101ZD, made 120 QSOs on 3·728MHz, a frequency used by Gerald in his active days. Following an announcement on RSGB news earlier in the day, many stations were on the listen out for GB2NM and among the QSOs were 13 two-letter calls, and Gerald's widow Irene was present in the shack and heard most of them. The 3·5MHz band contacts ranged from coast to coast of Great Britain, with GM their best DX. From a caravan outside the museum's radio building, club members Nigel Holmes G1DSO and Henry Kaminski G5NBX exchanged television pictures with Robin George G6AII/P, Eric Clarke G6CSX and the Worthing club station G6WOR/P on the 430MHz band.

Inside the museum, Henry and Nigel used JVC GX78E video cameras, with 1·3GHz QRP links between their portable units and the caravan, to take pictures around the site. Also John Chappell G6NUG, Kevin Hodges G6ZVH and John Francis G8ZTD operated a FT221B on the 144MHz band. Among the station's antennas were a trap dipole for the 3·5MHz band, a colinear for the 144MHz band, a MBM 48 for the 430MHz band and a 23-element Tonna for the 1·3GHz band. In the caravan equipment by Hitachi, Microwave Modules, Wood and Douglas and G8CMQ was in constant use along with a ZX Spectrum computer, with a programme by Robin Stephens G8XEU, for generating television graphics and callsigns.

Racal User Group

Peter Barker G8BBZ, writes to inform us of the formation of the Racal User Group, a non-profit organisation the aim of which is to provide a mutual service to amateurs who own Racal equipment, much of which is available on the surplus market.

An 8-page quarterly newsletter is already available, annual subscription £2.80, which contains operational and technical details of featured equipment, a technical corner, sales and wants, and a column for available and wanted technical information.

For further details, contact: *Peter Barker G8BBZ, 8A Alwyne Place, London N1 2NL.*

More on page 76

Part 1 by Roger Lancaster

COMPONENT RATINGS FOR BEGINNERS

Many books and articles are written giving extensive details of ratings for a specific type of component but these can be rather daunting for the beginner and the very basic information he or she requires to know may be difficult to locate. This article is intended to provide the reader with an understanding of the reasons for considering component ratings at all. It should also give sufficient grounding to appreciate the more in-depth articles, to decide whether or not the components to be used are safe for a particular job and to purchase components which will not fail in use.

Suppose you are building a project and you decide you must use, among other components, a 1kΩ resistor and a *pnp* transistor. Will **any** resistor do, provided its resistance is 1kΩ? Will **any** transistor do, provided it is a *pnp* and not an *npn*? And if not, why not? After all, you have a good 1kΩ resistor and a good *pnp* transistor in your junk box already and you don't want to go out and buy others if these will do. So why shouldn't you use them?

The reason is that, unless your components are properly **rated** for the task you have in mind for them, your finished project could catch fire! Even if the result was not so dramatic, your components could overheat and be destroyed, possibly causing other (properly rated) components to suffer the same fate as a consequence of the initial failure. Your components may well be quite satisfactory, but you must **check** that this is so.

The key factor is that when current flows in a component heat is produced in that component. If too much power is developed in the component for too long a time, it will get too hot for its own good, with the results previously mentioned.

When a current I flows through a resistor of R ohms, a voltage V is developed across the resistor. According to Ohm's Law, these are related by the formula:

$$I = \frac{V}{R} \text{ or } V = IR \text{ or } R = \frac{V}{I}$$

From this we can see that if the voltage across the resistor is increased, the current through it increases in proportion, since R is fixed.

As the current flows, the electrical energy from the source providing the current is converted into heat energy within the resistor. This is unavoidable. The formula for the amount of heat generated is:

Heat energy (joules) = power (watts) × time (seconds)

Power is given by the formula:

$$P = V \times I$$

For a resistor, substituting I × R for V, we see that

$$P = I \times R \times I \quad \text{or } I^2R$$

Alternatively, substituting V/R for I, we see that

$$P = V \times \frac{V}{R} \quad \text{or} \quad \frac{V^2}{R}$$

So the heat energy can be expressed in three ways:

$$VIt \text{ or } I^2Rt \text{ or } \frac{V^2t}{R}$$

A most important factor in the formula is the **time** (t). The generation of this heat takes time. So a high power can be developed in the resistor provided it is only for a short time.

All components behave, at least partly, like resistors, in that when a current flows through them a voltage is produced across them and power is developed in them, which creates heat over a period of time.

We normally want our circuits to continue to operate indefinitely, however. We want to be able to switch them on and leave them on continuously without fear of burning the house down.

The formula for heat energy would seem to make this impossible. If t is large (i.e. after a long time), the heat energy will be large, whichever version of the formula is used and no matter how low the power developed. In other words, as time goes on the heat produced simply grows and grows, so that if the current were allowed to keep on flowing the component would be sure to overheat **eventually.**

Fortunately, this does not happen, for while heat energy is continually being **produced,** heat energy is also continually being **removed** from the component. As long as the heat is being removed as fast as the current can produce it, the component will not overheat.

Heat removal occurs as a result of three separate phenomena: heat **conduction** along the connecting wires or other objects which may be in contact with the component, heat **convection** whereby the heat is carried away by the currents of air surrounding the component and heat **radiation** directly from the component in the form of heat rays.

If the heat removal achieved by these natural phenomena is as rapid as the heat generated by the power developed then all is well and the component will not overheat. However, if the heat is generated faster than it can be removed (or "dissipated") then one or more of these natural processes must be enhanced by artificial means.

Conduction can be improved by mounting the component on a piece of highly conductive (heat-wise) material, such as metal. Convection can be improved by fan cooling, or more simply by giving the component a larger surface area for the air currents to act upon (in other words by choosing a component which is physically bigger). Radiation can be improved by colouring the component matt black (a good radiating colour).

By doing any of these things, the **power rating** of the component can be increased. The power rating is defined as the maximum power the component can develop **indefinitely** without overheating. Any increase in this power developed will cause overheating in time. There is no disadvantage in operating a component so that it develops less than its power rating.

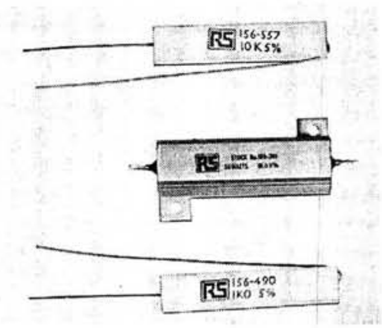
Resistors

As far as resistors are concerned, increased power (or "wattage") rating is usually achieved simply by choosing a bigger one. Thus, resistor power ratings are proportional to their size and an approximate guide for carbon (colour-coded) resistors is as follows:

Length (modern type)	Length (old type)	Power Rating
6mm	10mm	$\frac{1}{4}$W
10mm	12mm	$\frac{1}{2}$W
16mm	20mm	1W

(Don't assume a "modern" type unless you know the resistor was purchased within the last ten years).

Wire-wound resistors are not so easy to classify, although the general rule still applies: the bigger the resistor the higher its wattage rating. Wire-wound resistors vary from 2W to 20W or even more. Their power rating should be printed on the body together with their resistance value.



Wire-wound resistors with power ratings from 7 to 50 watts

In order to determine the required power rating for a resistor it is necessary to first calculate the power it will develop when in use from one version of the formula (VI, I^2R or V^2/R). You will know the resistance, so you must calculate either the voltage across it or the current through it. Having estimated the power you must then add a generous **safety factor** (e.g. 100 per cent) to arrive at a suitable power rating.

Examples:

i) A 1kΩ resistor will have 10V across it under normal working conditions.

$$\frac{V^2}{R} = \frac{10 \times 10}{1000} = 0{\cdot}1W$$

Doubling this for safety gives 0·2W, so a $\frac{1}{4}$ watt resistor will do here.

ii) A 10kΩ resistor will have 10mA flowing through it under normal working conditions.

$$I^2R = 0{\cdot}01 \times 0{\cdot}01 \times 10\,000 = 1W$$

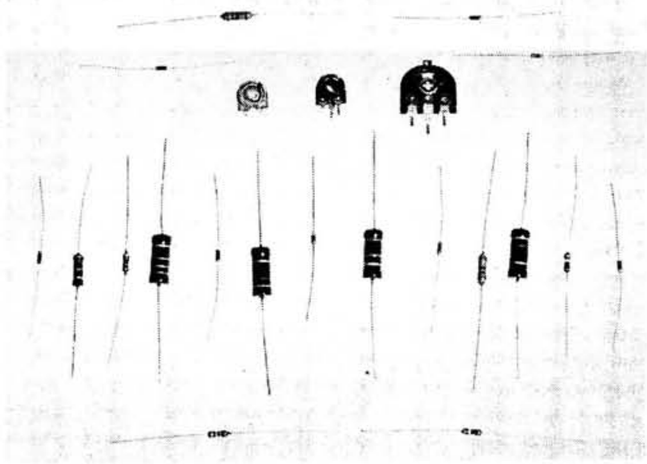
Doubling for safety gives 2W, so a 2W resistor will be necessary here.

The safety factor is to allow for abnormal conditions, perhaps caused by a rise in ambient temperature or by a fault condition.

Should you want to be extra safe, you can increase the safety factor as much as you wish. However, it may not be convenient to use too large a resistor and also the higher wattage resistors are naturally more expensive.

If the voltage and current are varying in normal use, strictly speaking the voltage or current you should use for the calculation is the **r.m.s. value** (root mean square). This will often be difficult to calculate, however, so take the likely **maximum** value. This makes the estimation much simpler and gives additional safety factor as well.

Sometimes you will be unable to estimate the voltage or current at all. In these cases you can connect in a resistor of any rating temporarily and measure the voltage across it when the circuit is switched on. Remember, the heat takes time to be generated, so it is quite all right to do this



Different types of resistors and potentiometers with between 0·125 and 2 watts power ratings

even if the chosen resistor turns out to be under-rated, **provided the measurement is carried out reasonably quickly.** Connect your meter before switching on, then switch on for just long enough to take the reading, then switch off again. An incorrect resistor rating will not affect other components, only an incorrect **resistance value** could do this. This procedure should not be followed with other types of component, as these can burn out much more quickly than resistors.

The voltage can usually be estimated, however, but always err on the side of caution. For instance, you could use the total supply voltage in your calculation initially, even if this is unlikely to be all across the resistor all the time: if this gives a reasonably low power (say 0·2W) then use a $\frac{1}{2}$W resistor without further investigation, but if it gives much more than this it will pay you to do a more careful calculation or measurement.

Fuses

A fuse is a special kind of resistor, consisting of a single piece of wire. Its resistance is very low, ranging from a tiny fraction of an ohm to about 30 ohms, depending on its rating.

Since the resistance is very small, the voltage across the fuse when a current flows will also be very small (V=IR). The heat generated is once again given by:

$$VIt \text{ or } I^2Rt \text{ or } \frac{V^2t}{R}$$

but because R and V are so small, it is I and t which almost exclusively determine the heat generated. For this reason, fuses are rated by current rather than by power.

A fuse rated at 1A is believed by many to "blow" (i.e. the wire melts, breaking the circuit and thus protecting it) as soon as the current through it exceeds 1A. This is not true, however, because of the **time** factor. The 1A fuse should carry a current of up to 1A indefinitely without heating up to the extent of melting the wire, but when the current exceeds 1A the heat generated will start to build up as time progresses and **eventually** the wire will melt and the fuse will have "blown".

The time this takes will depend on the actual current flowing. For example, if 1·001A flows, the fuse could take half an hour to blow; if 1·01A flows the time might reduce to 2·5 minutes; if 1·2A flows perhaps 7 seconds may elapse before the wire melts; if the current is 2A the fuse will blow in about a second: if 10A, 30ms; and so on. But always an element of time is necessary, however small. A 1A fuse will carry a current of a million amperes without blowing—but not for long!

Unfortunately, semiconductor devices tend to be destroyed by excessive current rather more quickly than fuses, and for this reason the fuse has lost much of its appeal as a protector of equipment, and semiconductor-based overload protection devices are more appropriate in most cases. However, the fuse continues to protect wiring and the more robust components, such as resistors.

To select a fuse, first determine the normal maximum current it will be expected to carry—the power consumption of an equipment is often quoted and the formula

$$I = \frac{P}{V}$$

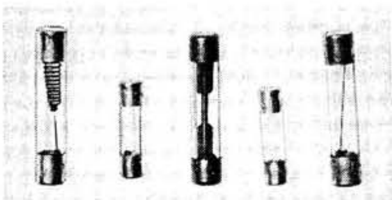
can be used for this purpose. Choose the value of fuse rating available **closest** to this current, but always slightly above the estimated current rather than below it. Safety factor is not applicable to fuses—you **want** them to blow if the current is excessive.

Example:

i) A transceiver working from 240V r.m.s. mains has a total maximum power consumption of 1·1kW. For the main fuse (between mains and equipment), the current required is

$$\frac{1100}{240} = 4{\cdot}6\text{A}$$

You won't find a 4·6A fuse anywhere, so you will have to use a 5A one. A 4A fuse would blow too often, even when nothing was wrong.



Fuses should be carefully chosen for both the job to be done and the current expected in the circuit

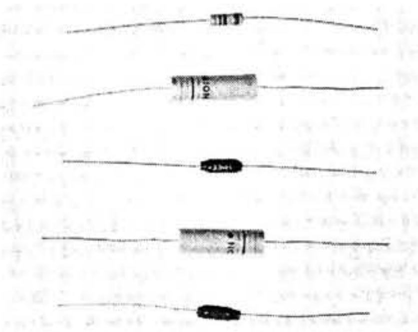
It is, of course, very foolish to use a fuse whose rating is much higher than is necessary. Nevertheless, a higher fuse rating than that estimated may have to be used because of the possibility of "surges", that is currents in excess of normal loading yet quite "normal" in the sense that they are not caused by a fault and do not persist for long enough to cause a fault themselves. These surges often occur at switch-on or during changes in loading (e.g. switching a transceiver from "receive" to "transmit"). Special anti-surge (or "slow-blow") fuses are available but the use of standard fuses of slightly higher rating is common practice.

The general rule is to use the lowest rating of fuse which will not blow under any of the normal, fault-free operating conditions.

Coils and Chokes

These are similar to fuses in that they are composed of wire with low resistance. Again (apart from the inductance value) it is the current rating which is usually quoted, but this time you should make sure the inductor rating chosen allows for a generous safety factor. You don't want it to blow like a fuse! Allow 100 per cent for safety, so that if the inductor is likely to have to carry up to 500mA, choose a 1A rated coil.

In some applications, unlike fuses, coils can have high voltages across them (a.c. rather than d.c.) and even between individual turns or between coil and surrounding components or chassis, so that the wire forming the coil has to be adequately insulated against the possibility of such voltages causing arcs, insulation breakdown and consequent damage. Sometimes a safe working voltage will be specified and any voltage across the coil resulting from normal operation should be well below this rating. Voltage ratings of less than a few hundred volts are unlikely to be quoted, as virtually any coil will withstand voltages of this order.



Inductors' current ratings should be chosen allowing for a generous safety factor

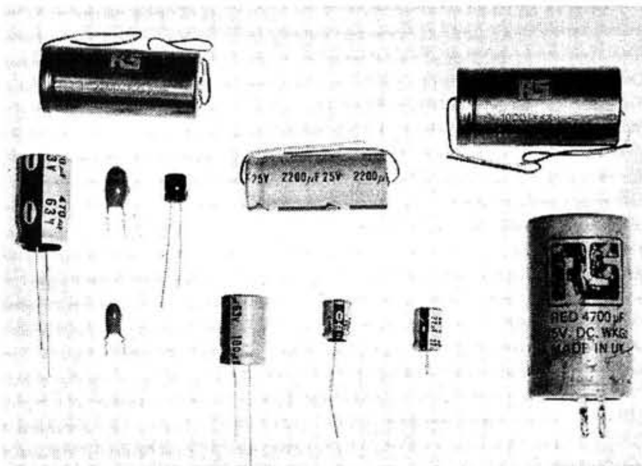
Many other components which simply carry current from one part of a circuit to another will have current and voltage ratings similar to those for inductors, e.g. wiring, switches, plugs and sockets. Generally, even the flimsiest of these will carry up to half an ampere without overheating and we don't need to worry too much about these in small-transistor circuits. However, in power supplies, power amplifier circuits and any application where higher currents are involved, thicker wiring and bigger components should be used which are capable of carrying considerably more than the expected maximum current. Compare the size of the intended component with that of one which you know carries a similar current at a similar voltage.

Any bad connection (e.g. dry joint, dirty switch or plug contact) will have higher resistance than intended and these can heat up to the point of burning, so be sure all connections you make are clean and sound.

Capacitors

The power developed in a good capacitor in normal use is insignificant, so there is no danger of overheating because of this in the same sense as with resistors.

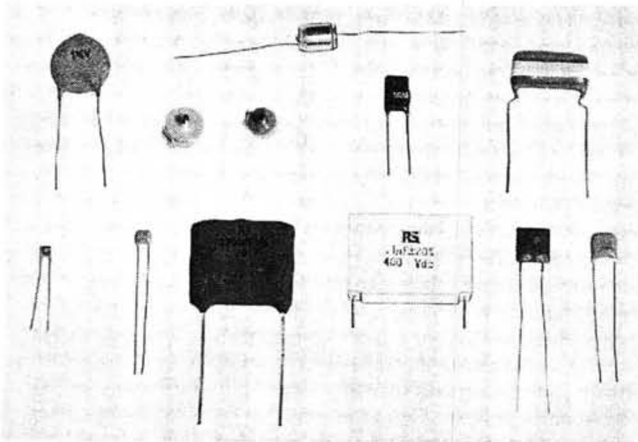
The chief danger to a capacitor lies in excessive **voltage** across its plates. The voltage across the capacitor creates



Electrolytic capacitors usually have their capacitance value and working voltage printed on the body of the component

an electrostatic field within the insulation (dielectric) between the plates and if this becomes too intense (e.g. due to excessive voltage applied) the insulation will be broken down by an arc between the plates and this usually causes the capacitor to become a short-circuit, the arc having welded the plates together. If this happens, not only will the capacitor be useless and damaged beyond repair, but the short-circuit is likely to cause excessively high current to flow through the wiring and other components and cause serious damage to these.

The maximum capacitor voltage advisable is called its "working voltage". Under no circumstances should a capacitor be used in a situation where a greater voltage than this is ever likely to exist across it, although there is no disadvantage in using it at lower voltages. Having said



Capacitors should be chosen with a working voltage well in excess of what they will have to withstand

this, however, there is a built-in safety factor here, as a capacitor will normally withstand more than its rated working voltage before breaking down. Nevertheless, it is still good practice to choose a capacitor with a working voltage well in excess of what it will normally have to withstand in use, provided this does not mean using an unduly large or expensive capacitor. For a given capacitance value, the higher the working voltage the larger the physical size of the component, and the more expensive it will be.

Some capacitors are "polarised", i.e. have positive and negative connections marked on them. The positive end must be connected to the more positive part of the circuit.

Both capacitance value and the working voltage will normally be printed on the body of the component, although small ceramic types may not show working voltage, these having working voltages usually in the thousands.

NEXT MONTH

A look at the ratings applicable to transformers, semiconductors and valves

FM Demodulators For Low Deviation Signals

▶▶▶*continued from page 34*

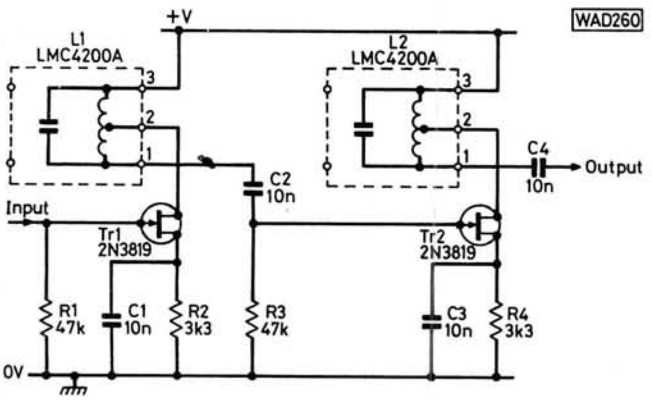


Fig. 9: Circuit diagram of a 455kHz i.f. amplifier

cillator output becomes just noise, i.e. the noise has been vastly amplified! In that case a squelch cut-out is essential. As soon as the signal is large enough to produce a lock, independently of noise spikes, the oscillator runs quietly once again and varies only with the signal variations.

A limiter made up of stable tuned amplifiers will amplify very small signals but add little to the signal-to-noise ratio. Thus when f.m. stations are tuned in one gets the gentle "breathing noise" as the carrier amplitude rises, just as with an a.m. signal. Nothing can be done in this direction with a p.l.l. demodulator.

If a control is inserted in the positive feedback loop of the TBA120, e.g. a 10kΩ variable resistor, the noise bursts between signals can be reduced as much as desired. The price paid is reduced gain.

FM DX Reception

The last sun spot maximum demonstrated the possibility of f.m. DX on 28MHz but the top part of that band became very crowded when amateurs in the USA began to enjoy the excellent quality of f.m. DX. Extra narrow-band f.m. with narrow filters and suitable demodulators would seem a goal worth striving after. The writer always fits a final i.f. outlet to his equipment to allow for such experimental work. ●

References

1. *Is your present f.m. bandwidth really necessary.* N.D.N. Belham G2BKO. *Practical Wireless,* June 1984
2. *A simple method of measuring the frequency deviation.* C. Grey VE2AQX. *VHF Communications,* February 1971

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We are proud to announce that the well known RF consultant Timothy Edwards has given us the exclusive marketing rights to his new 2 metre pre-amp. Timothy Edwards RF designs are used by British Telecom amongst others and so you can be sure that this pre-amp will perform to perfection. It employs the incomparable BF981 which has a better noise figure at 2M than the often used 3SK88. Spec. Size (tiny) 34mm x 9mm x 15mm (same as Mk1) Noise figure 1.0db Gain 26db **Kit Price £4.95** (inc VAT & P&P).

TRANSISTOR BARGAINS

	mHz	PoutW	Pin W	Volts	Price
2 N6456	30	60	1.25	13.8	£5 (inc)

Not 3SK88 but BF981 Better 2M noise figure -0.6db £1.40 (inc) ZTX 501 Gen. purpose PNP 0.5A, 20 for £1.25 (inc)

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LNA144. OUR ace RF designer Timothy Edwards has done it again! In line 144MHz RF switched pre amp which needs no modification to any rig. Just put it in the co-ax feed, supply 12V and your deaf rx will have ear ache. Uses the BF981 with a total of 4 tuned circuits for the best out of band rejection. The relays are 50ohm gas filled with earthed metal cans and are good to over 800MHz. This was originally designed for 'British Telecom Satellite Division' hence the provision for gold 14GHz SMC connectors. 1dB noise figure and 18dB gain is guaranteed to improve all standard rigs on 144-146MHz. Will fit in standard diecast box (not supplied). Try one in the car under a wing mounted aerial and be surprised. LNA144 kit £14.95. Built and tested module £24.95.

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WHO IS TIMOTHY EDWARDS? He's 32, licenced for 14 years, was a senior design engineer at Pye Telecomm and now works full-time for Timestep. He's also responsible at Timestep for designing the synthesizers and down convertors for British Telecom used on the current ECS satellite system. He also specified and uses our new Spectrum analiser and signal generators costing over £40,000. Now you can see why our amateur modules always work properly and have full meaningful specifications..

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Access

Communications '84 Report

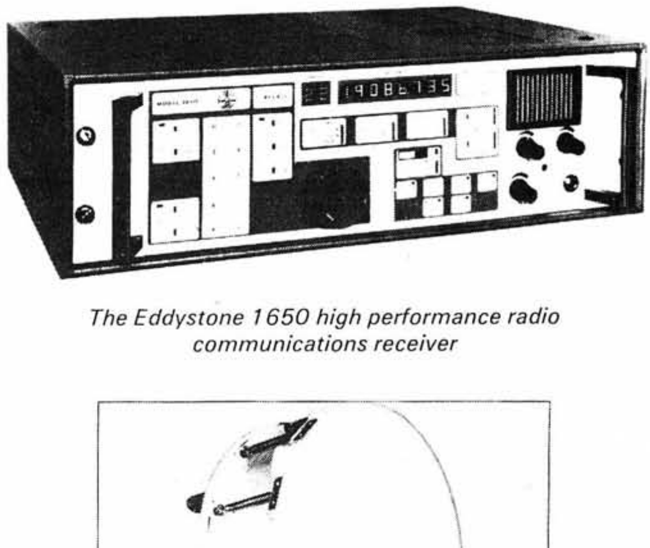
The Communications '84 Show held at the National Exhibition Centre from 15th to 18th May was devoted to all aspects of professional communications including radio, fibre optics, data, facsimile and telephone systems. Admission to this event, which is held every two years, is limited to those with a professional interest in communications work, although there was a great deal of interest for the amateur enthusiast.

The Direction Generale des Telecommunications (the French telephone authority) had a display of their experimental videophone system, which started in Biarritz this May with fibre optic connections to the homes of 1500 subscribers. It includes an interactive videotext network with 15 channel cable TV (any two channels may be selected simultaneously) together with 12 high fidelity sound channels. Interactive distribution of moving picture programmes from a local video bank is also included in the system. Biarritz is becoming known as the first "optically wired city" in this experiment which is unique in the world. The telephone authority has very ambitious plans for running optical fibres into millions of French homes with a target of 6 million by 1992 so as to provide a full video service, including facilities for seeing the person to whom one is speaking on the telephone. Its future development will obviously be very dependent on the market demand created by the Biarritz work which will be under trial for at least two years.

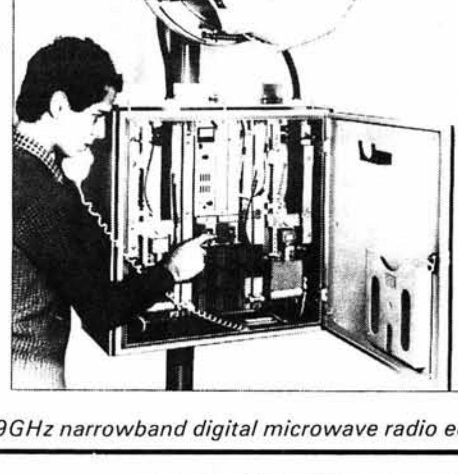
British Telecom had a major stand with many new facilities including a videoconference demonstration. In a nearby car park they had a couple of parabolic dishes of approximately 3m diameter working with an Atlantic Intelsat V satellite and the European satellite. The signals were received at 11GHz, demodulated in a mobile ground station and piped into the exhibition hall.

GEC Telecommunications Ltd. of Coventry displayed a 19GHz narrow band microwave radio system which is housed in a weatherproof case allowing mounting, with its antenna, on a pole or similar structure. It is designed for use at data rates of 2 or 8Mbit/s over distances of 0·5 to 15km from any rooftop or highrise location. This manufacturer also showed 140Mbit/s optical fibre equipment.

Eddystone Radio Ltd. (one of the Marconi Communications Group of Companies) of Birmingham announced the new 1650 series of communications receivers for a.m., c.w. and upper sideband with versions available for frequency shift keying and lower sideband reception. Designed mainly for the professional user, these receivers are intended to satisfy the demand for highly sophisticated equipment which is simple to operate. Frequency coverage is from 10kHz to 30MHz in synthesised steps of 5kHz, each with seven available bandwidths (400Hz to 14kHz)



The Eddystone 1650 high performance radio communications receiver

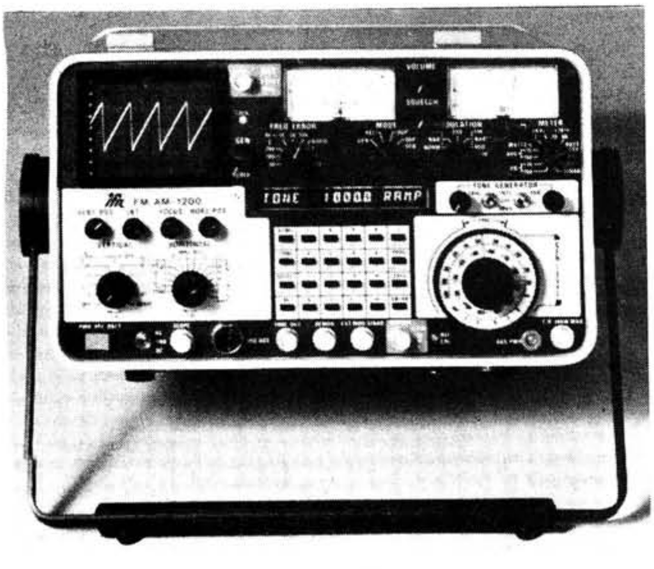


GEC 19GHz narrowband digital microwave radio equipment for optimum interference rejection. A built-in microprocessor enables a very wide range of operational features to be called upon by single keying actions. Up to 100 frequencies can be stored in numbered channels. Stored channels can be scanned or two adjacent channels can be swept at adjustable rates. Remote control is possible and the store can be programmed by sources such as bar-code readers or mimic receiver control units. The received frequency is shown on an 8-digit display to ±5Hz.

A much simpler new receiver is the Eddystone 1590 model for general purpose applications in the 150kHz to 30MHz range, including mobile installations. The 1590 is suitable for c.w. and a.m. reception and also has provision for upper and lower sideband reception of A3A, A3H and A3J transmissions. It incorporates a 5-digit display of the frequency being received. Ten crystal positions are provided for high stability working. Both f.e.t. and m.o.s.f.e.t. devices are used in the front-end stages, which comprise a cascode r.f. amplifier and a dual-gate m.o.s.f.e.t. mixer. An l.e.d. indicator is provided to show which of the six frequency ranges are in use.

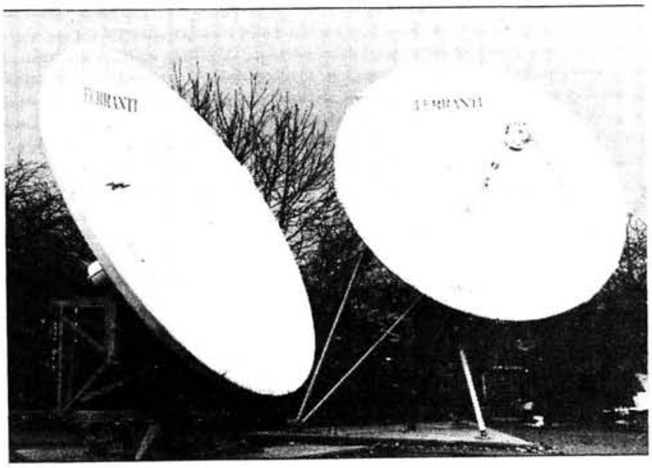
Microwave Modules Ltd. of Liverpool displayed many interesting products including linear amplifiers for 144–146MHz and 430–440MHz (although these ranges can be extended to 100–180MHz and to 410–480MHz respectively). The MTV435 is a 20W transmitter specifically intended for 430MHz amateur TV applications; it incorporates a video modulator with a sync pulse clamp to ensure maximum output and will accept either colour or monochrome signals. The complementary MMC435/600 receive converter is intended for use with a standard domestic TV receiver to produce a high reliability receive capability for amateur TV communication. A silicon bipolar input transistor provides an overall noise figure of better than 1·9dB, with further amplification provided by a BFY90 stage before the signal is passed to a 3N204 dual-gate m.o.s.f.e.t. mixer. Apart from transverters for 28, 70, 144, 430 and 1296MHz, special purpose modules are available such as a 169MHz weather satellite converter and a 1691MHz Meteosat GaAsf.e.t. pre-amplifier, while another module allows the reception of the v.h.f. 136–138MHz satellite band on a conventional 28–30MHz receiver.

Preselector units for the 406–512MHz range were shown by NACOM Land Mobile Communications Inc. This company also offers low pass filters to minimise the effect of second harmonics in communications systems. Dale Electronics Ltd. displayed a wide range of r.f. power amplifiers, the frequencies ranging from 10kHz to 1GHz—although not in a single unit.



The IFR FM/AM 1200

Instrumentation for communications equipment naturally formed a prominent part of the Show. Isotropic broadband field strength meters for the 500kHz to 6GHz range were shown on the Dale Electronics stand. Fieldtech of Heathrow displayed the IFR FM/AM1200 unit, developed to meet the requirements of most radio maintenance applications throughout the r.f. frequency range of 250kHz to 1GHz. This device is a multi-function, microprocessor controlled communications service monitor incorporating such measurement facilities as an r.f. wattmeter and a SINAD/distortion meter. In the sophisticated instrument range, the new Tektronix microwave spectrum analysers cover an input frequency range from 10kHz up to an amazing 325GHz!



Television receive-only systems (TVRO). The right hand antenna has a Cassegrain structure

ZS Electroniques Ltd. of Aylesbury had a very wide range of mobile antennas on their stand. At the other end of the antenna range, Ferranti Microwave Division showed 3·7m diameter TVRO (Television Receive Only) dishes for the reception of a single analogue TV signal from the ECS 11GHz satellite. The system can be easily extended to provide simultaneous reception of up to 12 channels. The figure of merit, G/T, is quoted as 24dB/K in still air with a typical clear sky. Scientific Atlanta and other companies had details of larger earth stations available.

Although the next Communications Show will not be held until 1986, a new Communications-London event for professional and business users will take place in Earls Court, London, from 23rd to 25th April 1985. ●

Kindly Note

Multiple Choice Questions—October 1984
Our apologies to readers—in common with the real exam, question 1–3 contained an error. The correct version of this question should read "This series resonant circuit is in resonance when its impedance is".

Remote-tuned MF Loop Ant—October 1984
Readers requiring the ferrite ring for L5 can obtain this from Bredhurst Electronics. The dimensions are 38·1mm o/d, 25·4mm i/d and 6·3mm thick.

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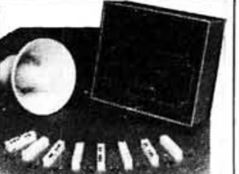

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Produces a loud penetrating sliding tone which, when coupled to a suitable horn speaker, produces S.P.L.'s of 110dbs at 2 metres. Operating from 9-15V. **Price £2.95 + V.A.T.**

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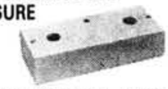
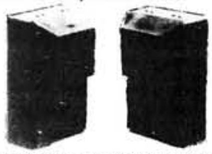


Suitable metal enclosure for housing an individual ultrasonic module type US 5063 or US 4012. Supplied with the necessary mounting pillars and screws etc. For US 5063 order SC 5063; for US 4012 order SC 4012.

INFRA-RED SYSTEM IR 1470 only £25.61 + V.A.T.



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AMATEUR BANDS

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR, 57 The Kingsway, Ewell Village, Epsom, Surrey, KT17 1NA.
Logs by bands in alphabetical order.

IMPORTANT NOTE! I have been asked to extend the coverage of this feature by including a section on v.h.f./u.h.f. matters in a similar vein to the present h.f. bands. So if you keep an ear open on the 144MHz band or the u.h.f. bands please drop me a line on what you are hearing and doing in these fields. Remember the monthly deadline is the 15th of the month, direct to me at the QTH given above. News from both s.w.l.s and licensed amateurs will be most welcome.

The vagaries of s.w. reception are perhaps the reason why one never gets tired of listening, or transmitting, on the h.f. bands. One day a band may be full of exotic stations from around the world and a day or so later the band is virtually dead, quite annoying but intriguing nonetheless. With *PW* attracting new readers all the time it is a good idea to recap on the various methods of propagation of radio waves, albeit in a general way. Once an understanding of radio waves is built up a lot less time will be wasted looking for signals on a dead band. Only exceptionally are all the h.f. bands dead at any given time.

Although Fig. 1 has already appeared countless times in radio magazines it is worth repeating again in order to visualise what is happening to a radio wave. The very wide range of h.f. bands available to the amateur (1·8 to 29·7MHz, roughly 160 to 10m in nine bands) means that each has different characteristics. Radiation from the sun creates hollow spheres or shells round the earth as shown in Fig. 1, all varying in density and depth, and comprising particles of rarified air that have been ionised by the sun. When the influence of the sun goes the layers tend to become more rarified and to disappear, sometimes leaving only patches of ionisation.

It is fairly well known that the eruptions that take place continually from the sun's surface (sunspot activity) follow a very rough cycle of 11 years from one activity maximum to the next, hence the intensity of ionisation follows this pattern. We have passed the last peak and are now on the downward trend. The general effect is that the higher frequencies become less and less useful to the benefit of the lower frequencies, as we slide down the sunspot cycle.

During sunspot maximum the very popular 14MHz band (20m) can stay open for 24 hours a day but towards minimum it will be pretty useless during hours of darkness. Conversely the low frequency bands will become better and better as we approach sunspot minimum. As will be seen from Fig. 1 the F layer is responsible for working over great distances when the layer is highly ionised during daylight, with multiple hops giving even greater range. It should be apparent that the lower the angle of radiation from the transmitter the longer each hop will be, this always being the aim, achieved by suitable design of the antenna system. In general this also applies to antennas designed for DX reception. If the ionisation of a layer is insufficient to sustain reflection of the signal, the signal will pass through the layer and be lost in space. The seas and oceans make the best reflectors for multiple hop signals which explains why so many Australian and New Zealand stations can be heard in the UK, particularly on the 14MHz band in the mornings, taking the signal over the South Atlantic and Pacific oceans. The alternative path over Europe and Asia is best in the evenings but signals over this path are seldom as strong as those over the longer route.

In this context it is worth remembering that signals are propagated over great circle routes so that a globe is necessary to visualise the path of a radio signal. The old Mercator map of the world of our schooldays gives a completely erroneous idea of true direction and distance of one point from another. The RSGB can supply a great circle map which is invaluable to the DXer.

During the daytime the D layer absorbs signals on the 1·8 and 3·5MHz (160 and 80m) bands so that only ground wave signals are received, but when the D layer disappears DX signals go up to the F layers and DX conditions occur. That is why these bands seem so dead in the daytime as far as DX is concerned, the 1·8MHz band in particular. At the other extreme the 28MHz band is excellent during sunspot maximum when the upper layers of the ionosphere are intensely ionised and act as good reflectors, but once on the sunspot downward path only occasional DX can be worked except for times of sporadic intense sunspot activity.

Next month I will go through the bands discussing their individual characteristics.

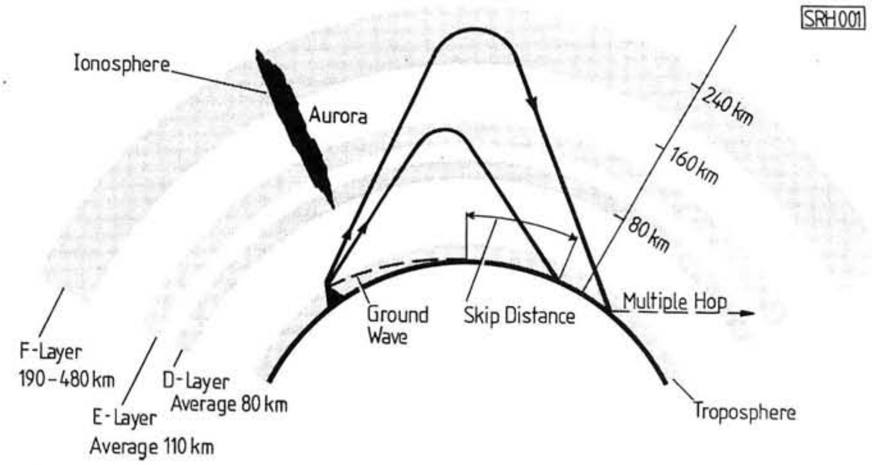


Fig. 1

In General

For those readers wanting to polish up their Morse code before taking the test the following transmissions could be most useful:

	w.p.m.			w.p.m.	
0830	10	GXI	1045	16	GXI
0845	20	GZU	1100	14	GZU
0910	10	GZU	1130	16	GZU
0915	12	GXI	1330	12	GXI
0945	14	GZU	1400	14	GXI
0950	11	GZU	1500	18	GXI
1030	12	GZU	1530	18	GZU

Station GZU is on 2·2175MHz and 5·4MHz while GXI is on 2·196MHz. The above information courtesy of the Royal Naval ARS *Summer News Letter*. The time is presumed to be local clock time.

It is worth remembering that a great deal of experience in copying DX signals can be gained by taking part in the many contests that take place during the year, both on s.s.b. and c.w. Since most of these contests are multiband it gives the s.w.l. a good chance to utilise the receiver to its maximum advantage, moving from band to band as conditions change. One does not have to send in an entry but it is interesting to check the score made against the contest results when they are published.

Initially it will be difficult to copy all the info that stations exchange in a contest but with experience it becomes more easy. The standard phonetic code is used a great deal on s.s.b. with many variations with which one can soon become familiar. For best results a multiband antenna is a must if the receiver is to perform well. A long wire plus a.t.u. is probably the simplest answer, tuning up the antenna for the band in use.

It goes, almost without saying, that headphones should be used especially for the weaker signals, and to cut out extraneous noises. Contests are the time to build up the number of countries heard or worked and bands which may normally appear to be inactive spring to life during a contest. Supposed bad conditions are often no more than a lack of activity on a band.

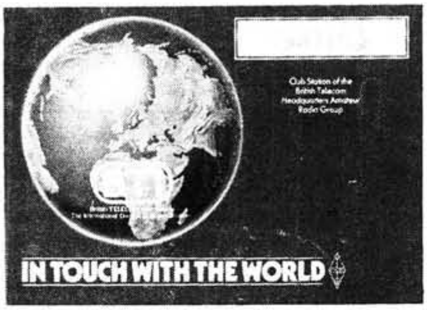
A mass of information on forthcoming contests on all bands as well as the results of past contests can be found in the RSGB's monthly journal *Radio Communication* issued to members.

QRP Corner

While most people found the 28MHz band pretty dead **Phil Dykes** G4XYX was not only hearing good DX but working a lot of it, too, all on his modified CB rig with its 10W p.e.p. output and a half-wave dipole only 5m above ground. He worked CE3DNP with a solid 15-minute QSO, EA6VT, EA8AHT, DH/KA2VSI, PY1YT with an S-7 report, and ZP5JY for another new country. Phil also heard 9L, EL, ZS, A2, CX, LU and UA9.

Listeners may be puzzled by the odd callsign like that mentioned above DH/KA2VSI which is the KA operating in Germany. This is now the new way of expressing the use of one's callsign in another country. Personally I don't like it at all, much preferring the old KA2VSI/DH format. In fact in the latest RSGB callbook the stroke sign has been omitted and we are left with sillies like G4VK4AIZ and suchlike. Who are the unseen faces that dream up these ridiculous practices?

Bill Stevenson G4KKI of Swinton, Greater Manchester, goes from strength to strength with his low-power operations, around 3W output on c.w., working N2DAN, VE3AX and W2AG all on 14MHz c.w. The receiver is a Lowe SRX30 and the antenna a 20m-long wire, centre-fed with 300Ω flat feeder and a.t.u. Stations heard on s.s.b. included



G4THQ is the club station of the British Telecom HQ Amateur Radio Group

CE3EEO and LU5FCI on 3·8MHz, then OA4CDG and ZL4KE around 7·05MHz, and on 14MHz AP2AU, TA2RA, 5N3RTF and 9H1BB.

DX Bands

A striking increase in logs received this month seems to indicate that the holiday period has come to an end! Opinion is that the h.f. bands have been fairly dismal of late with the lower frequency bands carrying more and more traffic.

Paul Price in Merthyr Tydfil, Mid-Glam, comments on the excellent net on 7·045MHz with PY's, 6Y5, A92 and many other delectable calls to be heard on s.s.b. but cautions against falling into the trap of listing all the calls bandied about on the frequency without actually hearing the stations concerned. Paul's Sony ICF2001 with a telescopic whip brought in HK0HEU and VE1CHG/4U (Golan Heights) on 14MHz, plus A92NH, PY7ZZ, 4X4JO, 6Y5IC and the HK0 again, on 21MHz.

Newcomer to the column is **David Richardson** of Peterborough who has acquired an FRG-7 used with a 15m-long wire with an old CB a.t.u. which only covers the 21 and 28MHz bands. On 3·5MHz he logged C31SD in Andorra, on to 7MHz and JY9WR, YB2BLI, VK6IR and 5X5GK. On 14MHz it was C6ANU, J73CB (Box 389, Roseau, Dominica, Windward Is), SJ9WL at Morokulien on the borders of SM and LA with cards to SM4FTF, T77C in San Marino, V85GA on Brunei, YT2P on the Palagruza Islands and cards to YU2CBM, special event station 4X75TA, 9M2HB and 9Y4MP (QSL W3HIK). C53FG came up from the Gambia, plus JY9CL (QSL G3MUL) and YB0BST were found on 21MHz.

Roger Edwards of Barnes, London SW13, is now active as G1IWZ. He has started on the 430MHz band (70cm) with an FT-790R and a 19-element Tonna beam but retains his FRG-7700 and long wire. DX logged on the h.f. bands included HH2WL, XT4BR, VP8ADR, and 6T2TR which looks like the Sudan. Only catch on 28MHz was Vatican station HV3SJ.

Following promotion at work **Andy Durrant** now reports from a new QTH, in Swindon, Wilts, with a 47m garden for his antennas. At the moment he has two long wires feeding into an a.t.u. On 14MHz he found A92DQ, V85GA, TK5BF (Corsica), A71AO and 3W1P of Vietnam.

Bob Parsey BRS85875, of New Malden, Surrey, uses the receive side of an SB101 transceiver with a 40m-long end-fed antenna. On the 1·8MHz band he caught EA4KL, and a couple of SPs on s.s.b.; on to 7MHz and SV1UN, VU2CVP, YV2NY, ZD7DW and 5B4JA. Up to 14MHz and A71AD, HL4CCM, KL7Y, JY5CI, YB4FU (QSL Box 27, Bangka Island), 5U7LD and 5V1BJ. Of interest on 21MHz were C53EK (QSL to Box 2596, Banjul, Gambia), VP8AXJ (QSL G4NFT) and 6W1NM.

After thinking that **Dave Coggins** had deserted this column for another he came good this month with another of his excellent logs from Knutsford in Cheshire. The work load is shared between an AR88D and an SRX30 with an end-fed wire antenna. The 3·5MHz finds show how this band is really coming into its own now and it should continue to improve as we move into the winter period. So around 3·8MHz he logged A92P, CE8ABF down in Tierra Del Fuego, VK6HD, ZS3HL and Z21EV a rare catch on this band. The CE8 was found around 0530Z, the remainder between 2000 and 2230Z. The 7MHz band produced CP8HD, OA2AGR, TI1HP and 4K1CEY in Russian Antarctica on 7·048MHz at 2240Z, plus VK2,3,5 and 7. Old timer KH6IJ came up on 14MHz as well as KL7Y, VE8RCS at Alert, near the North Pole, and YI1BGD. Only Europeans and a few W's were found on the 10MHz band and Euros only on 18MHz, all c.w. of course. It is a pity that the restrictions on these two bands seem to have damped down any interest that these new allocations might have engendered. These restrictions should be lifted in due course when the bands may be fully exploited by amateurs.

In Harrogate, N. Yorks, **Marcus Walden** has been joined by his brother Dominic in the quest for DX on their DX302 and 20m-long wire antenna in the attic. They both enjoyed a stint in the Cray Valley SWL contest managing some 8000 points. Marcus is now busy swotting up the Morse code with an eye on the future. Marcus concentrated on three bands 3·8/14/28MHz with C31OF, EA8KE, JY9CL of Box 2353 Amman, and YV1BVO on 3·8 or thereabouts. On 14MHz he found A92P, KL7NT, S79WHW, VP9LD, V2AZM with cards to WB8SSR or direct to Box 330, Antigua, XT2BR, YB6MF (Box 232 Medan), 4K0B thought to be in Russian Antarctica with cards to UA1MU, 4S7EA, 5H3VB, 8Q7AV and 9M2CW.

The 21MHz band came up with A22WZ, HH2Q, OE8AJK/YK, TZ6FE (QSL DL4BC), VP8AOB, VQ9CI, V2AN (QSL to WB8SSR), WB3KBZ/VP9, ZS6BCR, Z21BN, 3D6AL (Box 64, Manzini), 5Z4JD of Box 6, Migwani, near Kitui, Kenya, 9J2DX (Box 71979, Ndola), 9U5JB (QSL ON5NT). Brother

Part of the 4-day summer camp site of the Wimbledon ARC at Chessington, Surrey, operating on all bands from 1·8MHz to an OSCAR 10 set-up on v.h.f./u.h.f. The special callsign GB0WIM was used to celebrate the club's 21st anniversary

Dominic found VQ9CI, YB3DC and 9M2DC all on 14MHz.

Congratulations are in order for regular **David Price** of Wellington, Somerset on getting his callsign G1JDS and he has been busy on the 144MHz band with a borrowed rig. I'm glad to report that David is now hard at it learning the Morse code for a rapid change to an "A" licence. Good luck on the air OM. On the h.f. bands David has a Yaesu 7700 plus a Hygain 12AVQ vertical antenna catching TR8JYC and LE4A on 21MHz but concentrating on 14MHz for OD5AS, HH2Q, HH2WL (QSL KA7Z), 9Q5MA, VP8LP (QSL G3VPW), VP8AXJ, VU2VS, XT2BR, KL7RA and EL7W.

Yet another reader goes the way of all flesh, namely **Paul Martin,** faithful servant over the years, is now G1JOU, residing in Dartford, Kent. He intends to start off with an FT-101 driving a transverter to the 430MHz band. Code practice is under way so the FT-101 will be handy on the h.f. bands in due course.

At the recent IARU Conference the DX window on the 3·5MHz band between 3·790 and 3·8MHz was extended to 3·775MHz. According to the RSGB's *Council Letter* there is no objection to local QSOs within the window when no DX is possible. One should assume that DX working is possible from two hours before sunset until two hours after sunrise except during December and January when DX working is possible throughout the 24 hours.

Denis Norton's set-up in Shepherds Bush, London W6 comprises an FRDX-500 receiver plus SST-T6 a.t.u. and Datong FL2 audio filter all fed from either an all-band 14AVQ or a 20m-long wire. The short log is due to other commitments rather than bad conditions! On 14MHz Denis logged VU2DDJ at 0700Z, 6Y5MJ, 9Y4NP, 3A2EE, XT2BR, 4K0B who is presumably in Antarctica, and VQ9CI on Diego Garcia Island.

Club News

The steadily increasing amount of information received from clubs every month and the limited amount of space that can be given to this feature means that only basic information on club activity can be included. For potential members of clubs or visitors it is usually sufficient to have the telephone number of the secretary or PRO and the meeting place, dates and times. Either ring the sec for further information beforehand or simply go along to a meeting. Either way, you will be most welcome.

Acton, Brentford & Chiswick ARC G3IIU The new amateur licence schedule and the IARU Region 1 conference will be the subject of the meeting on Tuesday, November 20, at 7.30pm, Chiswick Town Hall, High Road, Chiswick, London W4. Sec is W. G. Dyer G3GEH, 188 Gunnersbury Avenue, London W3.

East Antrim ARC GI4KKK Second Tuesday at Fairview Primary School, Hillmount Avenue, Ballyclare, at 8pm. Ballyclare 41655 will find the sec D. C. Simpson GI4PRH.

Aycliffe & Shildon ARC A new club meeting at the Sunnydale Leisure Centre, Middridge Lane, Shildon, Co. Durham, at 8pm Tuesdays, with RAE and code classes available. E. W. Bates is sec on (0388) 774466, or try (0325) 314638.

Banbury ARS Last Thursday at St. Paul's Church Hall, Banbury, time unknown but imagine 7.30 would be fine. Sec J. Burrell G8OZH is on (0280) 702900.

Blackmore Vale ARS The old coach house behind the Bell & Crown at Zeals, Somerset, with second Tuesday the main meeting with lectures, demos, films, etc., and fourth Tuesday a chat and projects evening. RAE classes begin in December. Sec is Bill Bailey G1GRG on Templecombe (0963) 70969.

Braintree & District ARS G4JXG G6BRH Don't overlook new venue of St. Peter's Church Hall, St. Peter's Close, B'tree, first and third Wednesdays at 8pm, with own car park and talk-in on S15. Sec Jeff Roberts G6OIX can be found on (0376) 47525 in the daytime or on 44847 in the evenings. November 7 meet deals with h.f. antennas, with a junk sale on the 21st.

Basingstoke ARC G3TCR G8JYN Second Tuesday at the Swan Inn, Sherbourne St. John, near Basingstoke, Hants, at 7.30. November 13 is the Constructors' Contest, with the Christmas Social on December 11. Sec Eddie Thompson G4SQZ resides at 21 Wigmore Road, Tadley, B'stoke, Hants.

Biggin Hill ARC G4RQT G6TBH Third Tuesdays at 8.30pm, St. Mark's Church Hall, Church Road, Biggin Hill, Kent, with a winter junk sale on December 18. Sec is Ian Mitchell G4NSD on Westerham (09598) 376.

Bridgend & District ARC Third Fridays at the YMCA, Angel Street, Bridgend, at 7.30 for main meetings with first Fridays allotted to nattering and on-the-air with the club's h.f. rig. Sec is Trevor Morgan GW4SML, 4 Rhiw Tremaen, Brackla, Bridgend, Mid-Glam.

North Bristol ARC G4GCT A display by the club at the local library runs on until November 10. Otherwise every Friday at 7pm at the Self-Help Enterprise, 7 Braemar Crescent, Northville, Bristol. Features are an RAE class and advanced code classes for those above 12 w.p.m. Sec is Ted Bidmead G4EUV of 4 Pine Grove, Northville, Bristol.

South Bristol ARC G4WAW Wednesdays, 7.30, the Whitchurch Folk House, East Dundry Road, Whitchurch, Bristol, with a 28MHz band activity evening on November 14 and Top Band the subject on the 21st. The 28th deals with pocket 'fones, while December 5 has a lecture on test equipment. Sec is Len Baker G4RZY, on (0272) 834282.

British Telecom HQ AR Group G4THQ Not a club in the strict sense but a group net on 3·75MHz s.s.b. on Wednesdays at 8pm run by G3BYW with the club call G4THQ, open to all B. Telecom employees or of the Post Office, with retired PO amateurs most welcome. Sec is Jeff Clarke G3TIS, on 01-621 5569.

Bury ARS Tuesday evenings at 8pm, the Mosses Centre, Cecil Street, Bury, principal gathering being on the second Tuesday. November 13 deals with home-brew p.c.b.s, with the AGM slated for December 11. Sec is Brian Tyldsley G4TBT, on Burnley 24254.

Cheltenham ARA G5BK In the Stanton Room, Charlton King's Library, C'ham, with a natter night on Friday, November 16, and the AGM on Friday, December 7. Contact Gillian Harmsworth on C'ham 525162.

Cheshunt & District ARC G4ECT G6CRC Wednesdays at 8, the Church Room, Church Lane, Wormley, near Cheshunt, Herts; with Peter Tingey of the BBC talking on TV receiver design on November 7, the AGM on the 21st, and a natter night on the 28th. Make a note of the following meeting, on remote imaging by G8LOK on December 5. Sec is Roger Frisby G4OAA, on Hoddesdon 464795.

Chichester & District ARC Fernleigh Centre, 40 North Street, Chichester, first Tuesday and third Thursday at 7.30pm. November sees a junk sale with the seasonable social on December 20. Sec C. Bryan G4EHG is to be found on Chichester 789587.

North Cornwall RC Established just a year, this club reports in for the first time. Many outside visits have been a feature, as have the code classes under G4WMJ producing eight new G4's. First Wednesdays at the RAOB HQ, Fore Street, Camelford, at 7.30pm and all welcome. Sec is John Hessom G4FHL on Camelford 770406 or the PRO John West G6ICW on Bude 4976. The 4CX-250 amplifier is the subject for November 7.

Coulsdon Amateur Transmitting Society G4FUR Second Monday and last Thursday at St. Swithun's Church Hall, Grovelands Road, Purley, Surrey, at 8. An RSGB video or film show will take place on November 12, with code tuition on the 29th. Make a special note of the bazaar on Sunday, December 2, with trade stalls, refreshments, and a Christmas flavour all round. More on this and the club generally from Richard Goring G6VYT on Downland 54319.

Dartford Heath DF Club Pre-hunt meeting Tuesday, November 6 for hunt on Sunday, November 11, at the Horse & Groom, Leyton Cross, Dartford Heath, Dartford, Kent, with ditto on December 4 and 9. Pete G8DYF is hunt organiser on Greenhithe 844467.

Dunstable Downs RC Fridays at 8, Chews House, 77 High Street South, D'stable, Beds.

The SEGB gives a talk on November 9 and there are two films on the 23rd, *Aerial Circus* and *Secret Listeners*. P. A. Morris G6EES is sec on (0582) 607623.

Ealing & District ARS G3UUP Tuesday evenings at 7.30pm, the Hanwell Community Centre, 71a Northcroft Road, London W13, with a wide range of interests from RTTY to micros. More from Anton Berg G4SCR on 01-997 1416.

Edgware & District RS G3ASR Second and fourth Thursdays at 8, 145 Orange Hill Road, Burnt Oak, Edgware, Middx. November 8 is an "Emmett" key evening, while G3PSP talks on professional video tape recording on the 22nd. Prepare yourself for the junk sale on December 13. Sec is John Cobley G4RMD, 4 Briars Close, Hatfield, Middx, or H'field 64342.

Exeter ARS Inter-club quiz on Monday, November 12 at the Community Centre, St. David's Hill, Exeter, time unknown but sec Hugh Edwards G4RUT on Exmouth 273157 ought to be able to help.

Fylde ARS First and third Tuesdays at the Kite Club, Blackpool Airport, to which members of the club automatically belong. G3KEN will talk on radio astronomy on December 4, with the Christmas party on the 18th. Meeting time is 7.45pm. Sec H. Fenton G8GG is on Lytham St. Annes 725717.

Glossop & District Radio Group Seems to meet at the Nag's Head at 8pm with the AGM on Thursday, November 29. Only contact supplied is that of the treasurer Eric Calvert G4EIC at 6 Barber Street, Padfield, Hadfield, via Hyde, Cheshire.

Hastings Electronic & RC G6HH G1HHH Main meeting third Wednesday at 8, West Hill Community Centre, with Ron Fulton speaking on image processing on November 21. The Christmas social is on December 19. The micro group meets every other Tuesday, which I make to be November 13 and 27, at the Ashdown Farm Community Centre at 7pm. Fridays are chat nights for the club with a film show on the last Friday. Complicated, isn't it? Sec is Dave Shirley G4NVQ on Hastings 420608.

Hilderstone RS Founded only in July, the club is looking for members, including beginners, to amateur radio, with constructional work to the fore. Your contact is Ken Smith G3JIX, Staple Farmhouse, Staple, Canterbury, Kent. The club evolved from an RAE course run at the Hilderstone adult education centre, with meetings there at 7.30 on Fridays. Location: St. Peters, Broadstairs.

Hornsea ARC G4EKT G6EKT Weekly on Wednesdays, the Mill, Mill House, Atwick Road, Hornsea, at 7.30, starting with lectures and Morse code classes. Sec is Norman Bedford G4NJP on (0262) 73635.

Inverness ARC The Cameron Youth Club, Planefield Road, Inverness, Thursday evenings at 7.30 with the accent on constructional matters. Sec is David Jones GM4SXD on (08083) 240.

Ipswich RC G4IRC Second and last Wednesdays in the Club Room of the Rose & Crown, 77 Norwich Road, Ipswich. November 14 has G4BJO talking on weather fronts and radio propagation, with the annual social event on the 21st. Make a note of the inter-club quiz due to take place on December 12. Hon sec is Jack Tootill G4IFF, available on (0473) 44047.

East Lancashire ARC First and last Tuesdays with a lecture or demo on the first, the second being more informal. All at the Conservative Club, Cliffe Street, Rishton, at 7.30. So says PRO Stuart Westall G6LXU, on Accrington 393457.

Leith Nautical College AR & Electronics Club GM4AXG Mondays at 6pm in T2–4, the electronics lab, where there is plenty of gear available for use by members, so construction takes a prominent place at the club. Sec Susan Beech is GM4SGB and is to be found at the College located at 24 Milton Road East, Edinburgh.

Lincoln SW Club G5FZ G6COL Second and fourth Wednesdays at the City Engineer's Club, Central Depot, Waterside South, Lincoln, at 8, with code and RAE classes for the members. Of note is the Christmas Family Get-together and home-made wine competition on December 12. Contact Pam Rose G4STO at the club's address.

Mansfield ARS First Friday and third Tuesday at the Victoria Social Club, Princes Street, Mansfield, with sec Keith Lawson G3AAH at 233 Southwell Road West, Mansfield, Notts, around to assist. A buffet disco will be held at the club on December 7.

Newark & District ARC Formal meetings on first Thursdays at 7.30, the Palace Theatre, Appletongate, Newark. Informal meetings at a "local pub" around the middle of the month, says sec Roger Hiscock G4MDV of East Stoke 539.

ARC of Nottingham G3EKW G6CW G8IUT Thursdays at 7.30, in the Sherwood Community Centre, Mansfield Road, Nottingham, with G3KDQ holding forth on antenna experiments on November 8, G2FUB talking on keyers on the 22nd and "the other man's shack" is the subject for the 29th. Jim Towle G4PJZ is the sec available on N'ham 624764.

Oldham ARC The Bunker, Wheatsheaf Hotel, Derker Street, Oldham, on Mondays at 8.30. More on the club from Fiona Butterworth G4SPX on 061-652 8862.

Salop ARS G3SRT A change of venue has been announced. Now it's the Olde Buck's Head, Frankwell, every Thursday evening at 8. Planning permission is the subject for G4HFX on November 8, otherwise natter nights. The pre-Christmas event is scheduled for December 20. In the fourth and final d.f. event of the year, two as yet unlicensed XYL's beat their respective husbands to the catch! However, a mere OM won the trophy for the year. Your YL secretary is Diane Parslow G4XBI, 1 Willington Close, Little Harlescott Lane, Shrewsbury.

Southdown ARS First Monday at the Chasely Home, Southcliffe, Eastbourne, with G2LL dealing with OSCAR 10 on November 5, starting at 7.30. PRO is P. Henley G8IQO on E'bourne 763123.

Southend & District RS Gathers every Friday at the Council Offices, Rayleigh, Essex, opposite the church, starting at 7.30. More from Brian Wood G4RDS on (03745) 50494.

Southgate ARC G3SFG Second Thursdays at the St. Thomas' Church Hall, Prince George Avenue, Oakwood, London N14, and close to the Oakwood underground station. There will be a construction contest on November 8 plus a film show, with the AGM on December 13. PRO is Robert Snary G4OBE on 01-360 6555.

Spalding & District ARS G4DSP Second Friday of the month at the White Hart Hotel, Spalding, Lincs, at 8pm. There is a constructional project contest on November 9, and in December there is the Christmas Social and junk sale on the 14th. Hon sec Betty Whitley G6YBL can be found on (0775) 2781.

Spen Valley ARS G3SVC Thursdays at 8, the Old Bank Working Men's Club, Mirfield, with Aldis lamps the subject for November 15 and G4DZU on Moonbounce (e.m.e.) operating on the 29th. The Christmas gathering is down for December 13. Sec T. J. Clough G4PHR can be found on Mirfield 499397.

Stockton & District AR Group G4XXG Every Wednesday at 7.30 in the Billingham Community Centre. Morse code and RAE classes are under way. Sec John Walker G6NRY responds to (0642) 582578.

Stowmarket & District ARS The Maltings Entertainment Complex, opposite the railway station in Stowmarket, first Mondays of the month. The social will just be over now, but make a note of the presidential lecture by G4BJO on weather and propagation, on January 7. Club sec is J. Lowe G8SCB, "Bulan", 35 Barking Road, Needham Market, Suffolk.

Street & District ARS First Tuesdays at Strode College with full details of events from Colin Webber G4SCD on (0458) 45145.

Sutton & Cheam RS Third Fridays at the Downs Lawn Tennis Club, Holland Avenue, Cheam, Surrey, at 7.30pm, with natter nights at the club on the first Mondays. The Christmas get-together is down for Friday, December 21. Your sec for further info is Alan Keech G4BOX of 26 St. Alban's Road, Cheam, Surrey.

Todmorden & District ARS A crime prevention officer will address the club on Monday, November 5 at the usual meeting spot, the Queen's Hotel, Todmorden, at 8pm, normally the first Monday of the month. Social sec is E. Tipping, 3 Cliffes Villas, Longfield Road, Todmorden, Lancs.

Torbay ARS G3NJA G8NJA Every Friday at Bath Lane, rear of 94 Belgrave Road, Torquay, plus the last Saturday of the month. New sec is Brian Wall G1EUA of 48 Pennyacre Road, Teignmouth, Devon, or T'mouth 78554.

Vange ARS G3YCW Every Thursday at 8pm, the Barstable Community Centre, Basildon, Essex, with junk sales every month plus talks and lectures. Sec is Mrs D. Thompson on (0268) 552606.

Verulam ARC RAFA HQ, New Kent Road, off Marlborough Road, St. Albans, on the second and fourth Tuesdays, with G4DJX speaking on operating techniques on November 27. Club sec is Hilary Claytonsmith G4JKS on St. Albans 59318.

Wakefield & District RS G3WRS Meeting on Tuesday, November 13 is a pie-and-pea supper at the Rose & Crown at Methley, with an on-the-air and natter night on the 27th. You can work out the club's "alternate Tuesdays" from that. Normally meets at Holmfield House, Denby Dale Road, Wakefield, at 8pm, with Morse tuition beforehand. Details from

Walter Parkin G8PBE on W'field 378727.

Mid-Warwickshire ARS At 61 Emscote Road, Warwick, at 8pm on second and fourth Tuesdays. November 13 is natter night and on the 27th are some RSGB films. The Christmas "do" is scheduled for December 11. Further info from sec Carol Finnis G4TIL on Southam 4765.

West Bromwich Central RC G4WBC Sunday evenings at 8, the Victoria, Lyng Lane, W. Brom, with RAE assistance and code classes. John Bates G6ZLW on 021-553 0531 is your contact man.

Wimbledon ARC Second and last Fridays of the month at St. John Ambulance HQ, 124 Kingston Road, Wimbledon, London SW19. Meetings start at 8 with refreshments around 9pm. Sec Geoff Mellett G4MVS of 26 Paget Avenue, Sutton, Surrey, is giving up the job of sec and a new face will be around by the time this appears in print. Thanks for all your help in the past, OM.

Wirral ARS G3NWR Get along to the new venue, the Parish Hall, Heswall, said to be behind the church off Milner Road, Heswall, on the first and third Wednesdays at 7.45, with the likelihood of a talk-in on 144·725MHz. It's the Chairman's night on November 7 so anything may happen. On November 21 it's computers and amateur radio, a talk. On December 5, G3CSG deals with the Japanese "Morse" code. Sec is Cedric Cawthorne G4KPY, on 051-625 7311.

Wirral & District ARC G4MGR G8WDC Second and fourth Wednesdays at the Irby Cricket Club, Irby, Wirral, with club net on S13 (145·325MHz). More from sec Gerry Scott G8TRY on 051-630 1393.

Yeovil ARC G3CMH G8YEO Thursdays at 7.30, the Recreation Centre, Chilton Grove, Yeovil, with G3MYM dealing with "magnetoionic" splitting of radio waves on November 8, the same speaker on a v.f.o. QRP transmitter on the 15th plus G6XME explaining the use of Smith charts in designing gamma matches on the 22nd. The 29th is RAE revision and natter night. More from sec Eric Godfrey G3GC on (0935) 75533.

MEDIUM WAVE BROADCAST BAND DX

by Charles Molloy G8BUS

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

The antenna tuning unit (a.t.u.) used by the s.w.l., otherwise known as a pi (π) network or a Collins Filter, is essentially an impedance matcher. A bewildering collection of names guaranteed to confuse and frighten off the uninitiated. All the device does is to ensure that the energy picked up by the antenna goes into the receiver and none is reflected back to be re-radiated and wasted. The a.t.u. goes between antenna and receiver (Fig. 1) and since it does not have a power supply one has the impression of getting something for nothing.

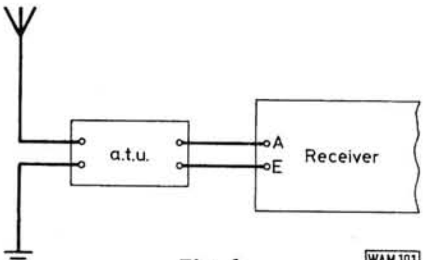


Fig. 1

Resonating the Antenna

Short wave listeners use their a.t.u. to match a random wire to the receiver but problems arise on the medium and longwaves when the antenna is short. I have been trying to improve m.w. reception on a small boat where the antenna is about one hundredth of a wavelength at the middle of the medium wave band. Antennas can be electrically lengthened by placing an inductor in series (Fig. 2) and it can be tuned with a variable capacitor in series or parallel with the inductor. This way we can resonate the antenna to the desired frequency and peak up a weak station.

It was while thinking along these lines that I came across the note in the Products section of the July *PW* about the Cambridge Kits Antenna Tuner. "The device has switched series and parallel tuning to suit long and short end-fed antennas." It covered 100kHz to 30MHz and appeared to be just what I was looking for, so I sent for the kit. The small physical size of quite large value inductors brought back memories of my first home made tuning coil wound on a length of postal tubing. Technology has come a long way.

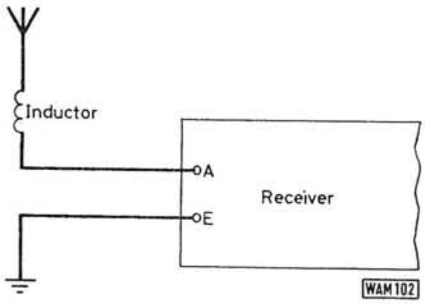


Fig. 2

The a.t.u. certainly improved reception on the boat. Signals could easily be peaked up and the sharpness of the tuning surprised me. The kit does require soldering to assemble it though. I can never understand why some people shy away from soldering. It is a technique that can be learned in a few minutes, but do not practise on expensive gear. Try soldering a few short pieces of wire together for a start. Use a modern soldering iron (electric) with cored solder intended for electrical work. Plumbers' solder and a 2lb iron heated on the gas are out.

Local Radio DXing

My total of daytime, groundwave DX has now passed 30, some of the latest being Radio Cornwall (Redruth) on 630kHz, Radio Leeds on 774, Radio Foyle 792, Severn Sound 774, Radio Wyvern 954 (not 990 as listed last month), Signal Radio in Stoke 1170, Radio 210 in Reading 1431. Radio Foyle in Londonderry with 1kW is interesting as it carries its own programme for part of the day, relaying BBC Radio Ulster for the remainder.

Readers may be interested in my set up for daytime DXing, which does require an outdoor antenna. Since there is little interference during the day a loop is not so useful as it would be after dark. I decided to get right out of the house away from electrical noise and TV buzz. A table was fixed up at the far end of the garage some 6m from the house. The receiver, a DX160, is powered from a car battery instead of the mains. The antenna, about 12 metres long and 4 metres above the ground, is fed to the set via the Cambridge Kits a.t.u. The earth is a Tandy earth rod driven into the ground outside the garage.

To my surprise, TV buzz disappeared but it could be brought back by running the set from the mains. The antenna, though shorter than I would have liked, runs from the garage away from the house well clear of electrical noise. It is not the length of the antenna so much as its location that counts.

Latin American DXing

Continuing from last month and Caribbean DX, we move onto mainland South America. The long seapath across the Atlantic seems to favour propagation to the UK, while fadeouts are less frequent than on more northerly tracks. One can often hear DX from South America when North America is inaudible.

Brasil comes in well in the UK. Listen after 2300 on 1220kHz for Radio Globo in Rio de Janeiro. Identification is easy as the language is Portuguese while the style of programming and the music, once heard, is not likely to be forgotten. Others to search for are Radio Bahia in Salvador on 740, Radio Jornal in Rio on 940, Radio Globo in Sao Paulo on 1100.

Venezuela too, comes in well. Listen on 750kHz for Caracas, on 1020 for Radio Margarita, on 1120 for Ondas del Lago in Maracaibo, on 1210 for Radio

Coro and on 1220 for Radio Aeropuerto International in Maracaibo. Radio el Mundo in Argentina can sometimes be heard on 1070, Radio Sutatenza in Colombia on 960 (you will need a loop to catch this one), Radio Monte Carlo in Montevideo Uruguay on 930kHz. All of these have Spanish programming.

Reception Reporting

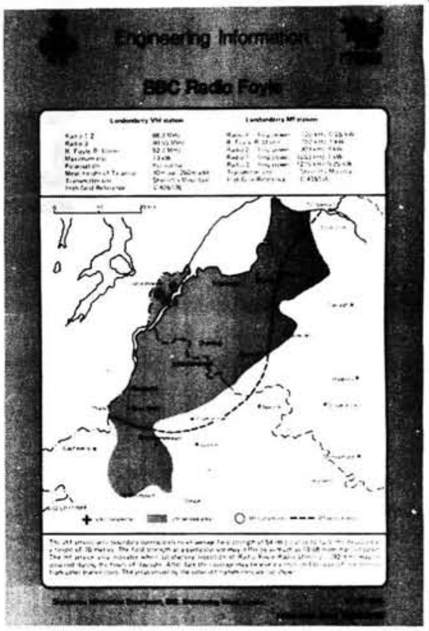
Sending a reception report to a medium wave station and hopefully receiving a QSL requires a different approach from what we are used to on the short waves, where stations expect their signal to travel great distances. All but a few medium wave broadcasters are aimed at a local audience so the station does not expect and may not even want to hear from distant listeners. A report giving SINPO or SIO ratings is unlikely to be of any value. What we have to do is to convince the station that we really heard it and then to rely on goodwill for a reply. We have to supply programme details that can be checked and we must send return postage. An international reply coupon, obtainable at a main post office, is acceptable in most countries, but for Latin America unused postage stamps of the country concerned, obtainable from stamp dealers (philatelists), are better.

North American m.w. stations are good verifiers. They are easy to write to as the language is English and we can compile an address out of the callsign and the location. Who do we write to? Send the report to the Chief Engineer. The reason for doing this is that there will be a logbook at the transmitter, updated by the duty engineer, giving some details of what goes out over the air. It is against this log that the reception report will be checked. The log does not list titles of pieces of music but it should include times of station identification, weather reports, news bulletins, names of programmes and of sponsors. The time to collect this data is on the hour and the half hour and a tape recorder is invaluable as a lot of the information may come over too quickly to copy longhand. Quote the times (and the date) in that appropriate to the station e.g. Eastern Standard Time (EST) for eastern USA in winter. If you don't know their local time zone then give UTC (GMT).

The principles outlined above can be applied when writing to any major broadcaster where English is likely to be understood. A few DX clubs produce report forms that enable the user to compile a report in a foreign language using a number of phrases and a vocabulary appropriate to DXing. It is when writing to small, local low powered stations in Latin America that problems arise. The station may not understand what you want. It may not have QSL cards. It may not be the job of anyone in particular to deal with reception reports. Try a personalised letter as well as a report saying that you listen to distant stations as a hobby. Enclose a photo of yourself and gear if you can. With a few stations you may have to be content with a tape recording of your rare DX!

Readers' Letters

"Heard on 930kHz at 0100 Radio Newfoundland" writes **Bill Kelly** from Belfast who was listening to CJYQ, using an NRD515 receiver with random wire antenna. On 933kHz between 0209 and 0315 our reader picked up a voice transmission in English giving out numbers, each repeated about 30 times in the range 310 to 415. Sounds like some sort of speaking clock. Has anyone heard this one? Some broadcasters like to keep their frequency in use after the programme has ended and this would explain it if the exact frequency were 936kHz, a European channel.



BBC Radio Foyle in Londonderry

Close by on 927kHz I recently came across a moderately strong programme in Portuguese which announced itself as Emissora Catolica Portuguesa, which is the call of Radio Renascena. Whether this is a new station or a change of frequency is not clear. There is always something happening on the medium waves.

SHORT WAVE BROADCAST BANDS

by Charles Molloy G8BUS

Reports: as for Medium Wave DX, but please keep separate.

"I would be grateful if you would advise me how to improve reception of Radio Athens on the 31 metre band (9MHz)" writes *PW* reader **C. G. Street,** who is a student of the Greek language. Sure enough on checking 9·420MHz (last August) at 1900, which is the beginning of their one hour transmission aimed at Europe, reception was poor with some interference. On checking the other two frequencies used by Radio Athens at that time, 11·645MHz (in the 25m band) was a better signal while 15·635MHz (19m) was strong and clear of QRM. Obviously our reader was unaware that there was a choice.

Multiband Broadcasting

Major broadcasters on the short waves and a few of the less conspicuous as well, transmit their programme simultaneously on several frequencies in different bands. Even if more than a single target area is involved, the listener will still have a choice, but usually two, three or more channels are beamed to a single though perhaps large area such as Europe. There is no doubt that this practice is wasteful of band space but under the conditions prevailing at the moment it does provide the listener with a chance of avoiding interference and optimising reception.

How do we find out which frequencies are in use? If the programme is in English then they will be listed in the *International Listening Guide* (see March issue of *PW*). *The World Radio and TV Handbook* covers all languages and lists those frequencies normally used by a broadcaster. Perhaps the easiest way of obtaining information is to write to the station of interest, asking for a copy of the Programme/Frequency schedule, which is free of charge to listeners. Alterations occur during the year as a result of seasonal changes in propagation. In winter, Greece drops the highest frequency in the 15MHz band but brings in 7·370 (41m band) in its place, following the general trend downwards in frequency as we move from summer to winter.

It is worth tuning to the start of the Radio Athens broadcast, just to hear their interval signal which is among the more attractive. It is made up of a melody played on a flute accompanied by sheep bells. The slot for the English language programme in this transmission for Europe is from 1920 to 1930 except Sundays.

The 15MHz Band

Many would regard 15MHz, also known as 19 metres, as the main long distance band. It is certainly a popular

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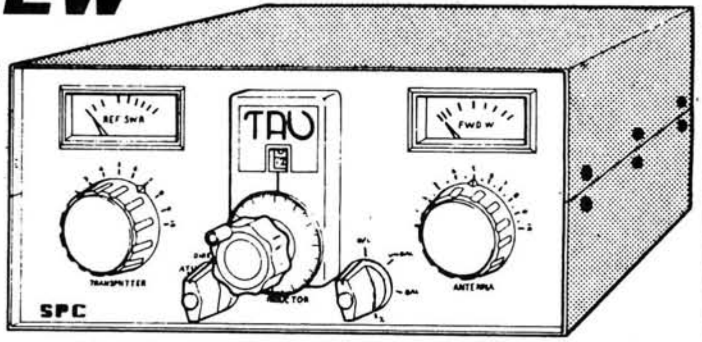

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band. The frequency limits are from 15·100MHz to 15·450MHz though as usual, there is some spill over beyond the edges. The frequencies are high enough for good long distance reception during the day but not so high that the band closes down entirely after dark. There is DX on the 15MHz band during the evening if you take the trouble to look for it.

During the day, DX from the east is dominant. Typical of what can be heard is China on 15·165, Sri Lanka on 15·425, Voice of Malaysia 15·295, Dubai on 15·300, KYOI Saipan on 15·190. The letters KYOI make up the callsign of this broadcaster which is located on the American Marianas Islands. Africa puts in an appearance on the 15MHz band in the early evening with the Voice of Nigeria on 15·120, Tenerife in the Canary Islands on 15·365, Brazzaville on 15·190.

North America is conspicuous during the evening. Listen for Canada on 15·325, AFRTS (American Forces) on 15·430, WYFR Family Radio in California on 15·440, WINB Red Lion in Pennsylvania on 15·145 or 15·185, the Voice of America on 15·205/15·410/15·445. WYFR and WINB are gospel stations. So too is HCJB the Voice of the Andes on 15·295.

Radio France International QSL card sent in by Glen Hocking

Located in Ecuador, HCJB is often a powerful signal in the UK, with slots in English at 1900 and 21.30.

The late evening is the time to hunt for Latin America DX. Listen for Chile on 15·140, Argentina on 15·345, French Guyana on 15·180, Cuba on 15·230, Colombia on 15·333, Brasil on 15·290. Radio Australia is sometimes audible after 2100 on 15·240, signals travelling on the long route round Cape Horn on a track not very different from the one followed by old time sailing vessels. Latin America is rarely strong on the 15MHz band. There is a spin off, as one can risk using a longer than usual antenna without having trouble with receiver overloading.

Audio Notch Filter

"I solved the selectivity problem with an audio filter" says reader **B. Isaacs** of Peterborough while **David Edwardson** (Wallsend) asks for information about notch filters and their use. Well yes, the audio notch filter is a very useful accessory for the s.w.l. but it does not improve receiver selectivity though it may combat some of the ill-effects of poor selectivity.

How does the notch filter work? A rather idealised response "curve" of the audio section of a receiver with an audio notch filter connected to it is shown in Fig. 1. Signals of the same pitch (frequency) are all the same strength except at the notch, where there is a considerable reduction (attenuation) within the narrow band of frequencies covered by the notch. The effect on speech and even music is negligible provided that the notch is narrow. The filter has a tuning control which moves the notch across the audio spectrum, so we now have the means to suppress a whistle, heterodynes or even the tuning note when a transmitter is being adjusted. We can also suppress a Morse signal and one half of a two tone RTTY signal.

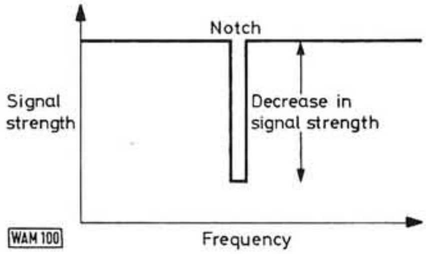


Fig. 1

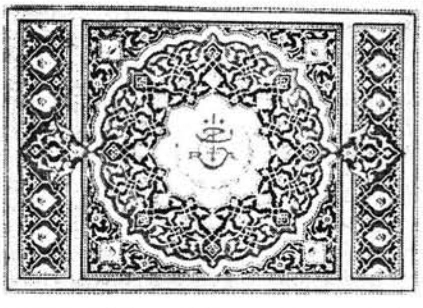
If you use headphones and you should if you are DXing, then plug the notch filter into the phone jack and the phones into the notch filter. You will require a small battery to power the filter. If you still use a loudspeaker then unsolder the two wires at the speaker terminals and join them to a lead going to the input of the notch filter. The filter output goes to the loudspeaker.

I have used a notch filter supplied by Cambridge Kits for a number of years and never cease to be impressed at the ease with which I can tune out an annoying heterodyne. Recently I invested in the more complex, more expensive Multifilter supplied by SEM of the Isle of Man. Now I have two notches to adjust, which is useful when dealing with RTTY or alternatively a single notch plus a low pass or a high pass or a peak filter. It is worth remembering though that the filter is an audio device which cannot do anything to the receiver's selectivity, but one can have the best of both worlds by using an audio filter with a selective receiver. Audio filters are available from Datong, SEM and Cambridge Kits, all of whom advertise regularly in *Practical Wireless.*

Short Wave Crystal Set

"We have always had a soft spot for the short wave crystal set" writes Cambridge Kits who go on to say that their new 0·1–30MHz antenna tuner has a detector output for use as a field strength meter. "It also makes it quite a remarkable crystal set, and our best DX in Cambridge have been HCJB and Israel. However, we are disappointed at not hearing Australia despite much trying, and so we would like to offer a prize to readers of your column to see if it can be done. We will be happy to give £5, or discount £10 from one of our kits, to the first to show hearing Radio Australia in the UK using one of our antenna tuners as a crystal set."

Replies please direct to Cambridge Kits, 45 Old School Lane, Milton, Cambridge, CB4 4BS. Although R.Australia can be heard in the UK at any time of the day its programme beamed to Europe is on the air from 0600 to 0800 usually on 9·570MHz (31m band) during the winter.



Radio Algiers QSL card sent in by Glen Hocking

Readers' Letters

"I have damaged beyond repair, the signal meter MRT33 on my s.w. receiver, an Eagle 60-N—a valve type, it has been a faithful servant over the years" writes **Alan Scott.** Our reader says that he is having difficulty finding a substitute meter and he wonders if any fellow DXer can come to his rescue, "all costs covered". Alan can be reached at 51 Ivanhoe Drive, Saltcoats, Ayrshire, Scotland.

From Buxton comes a note from **Bob Bonsall** who has a Polish s.w. radio called the Tramp WE 100. "All bandspread from 6MHz to 21MHz—this is the best and most powerful radio I've ever bought". Bob would like to obtain the address of the importers of his set so that he can obtain more information about it. Can anyone help?

VHF BANDS by Ron Ham BRS15744

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

In recent years, many people have become dedicated radio enthusiasts through wanting to know more about the amateur stations they heard during a chance twiddle around the short wave bands, or being fascinated by the foreign voices which interrupted their radiotelephone at work or overpowered their favourite broadcast station on the family music centre. Whatever the reason, they are welcome to the ranks of the radio buffs. A large number of these new recruits lean more toward purchasing ready made equipment and operating it, rather than buying the bits and building it. Therefore it is most likely that their main radio excitement comes through working or listening to DX, I hope so! Then, through this column where I write about readers' activities, I hope I can help them better understand why changes in the earth's complex atmosphere can disturb the normal path of radio signals and bring in those long distance stations that we search for.

Solar Activity

Random explosions on the sun, some 150 million kilometres or 93 million miles away, are so often the main cause of ionospheric disturbances which disrupt radio traffic in the h.f. bands and auroral events that can deflect v.h.f. signals hundreds of kilometres off their normal course. To obtain the information about this very variable star, I rely on reports from both optical and radio astronomers, so if any new readers are also interested in astronomy and the sun in particular, I will be pleased to hear from them. "The sun has been very quiet indeed during the past month", writes **Cmdr Henry Hatfield,** Sevenoaks, about the month up to September 16, although he did see some small spots and a few filaments. Henry uses a spectroheliscope as well as a radio telescope to study the sun and often sends in spectacular reports, but like us all, Henry cannot be observing all the time. That is why reports from many people are so important, especially in the next year or so when the sun is expected to go through a really quiet period. **Patrick Moore,** Selsey, observed an interesting group of sunspots between August 31 and September 3, Fig. 1, which were no doubt the cause of the few bursts of solar radio noise that I recorded at 143MHz on August 29 and September 2 and the mild noise storm on the 1st and 3rd. **Andy Steven,** Leith, told Ron Livesey, Glasgow, Auroral co-ordinator of the British Astronomical Association, that he observed weak radio aurora between 1530 and 1930 and 2230 and 0118 on the 27th and 28th and 0005 to 0030 and 2215 on the 28th and 29th and **Peter Brown,** Alberta, told Ron about the visual aurorae that he saw on the 26th and 27th. Like Patrick, **Ted Waring,** Bristol, projects the sun's image through his telescope on to a card and pencils in the spots and shades any penumbra and by this method, he counted 2 sunspots on August 17, 16 on the 28th and 14 on September 4.

Sporadic-E

Although the 1984 sporadic-E season theoretically ended during August there were, as usual, a few late events when very strong signals from eastern Europe f.m. broadcast stations were received in the UK between 66 and 73MHz, a band allocated for v.h.f. broadcasting in such countries as Czechoslovakia, Hungary, Poland and Romania. Although nothing like the events during the peak of the season, I counted 5 such stations at 1327 on August 20, 4 at 1907 on the 31st, 9 at 0825 on September 9 and 19 at 0752 on the 10th. Also on the 10th, I heard several continental radiotelephone signals between 40 and 46MHz.

28MHz Band

The 28MHz band is one of the most interesting of the amateur bands because it can be full of surprises, sometimes round-the-world DX, periodically short skip propagation due to sporadic-E, or on some days, completely dead. "I noticed that the 28MHz band has been open to South America on a few days lately", writes **Peter Lincoln** from Aldershot who adds, "it used to be my favourite band and it seems hard to believe how packed it was a couple of years back". That's propagation Peter, the band is going through a quiet spell, but there is always the unexpected to look out for and although **John Desmond,** Cork City, like the rest of us, found the band very poor he did log signals from DL, EA, OE, OK, HA and a UA1 on August 26 and a couple of stations from South America on September 8. Between 1830 and 1855 on the 3rd, a near neighbour of mine, **Fred Pallant** G3RNM, heard EAs 1, 3, 5 and 7 and at 1935 a LU came up. During a listen-around from 1758 on the 8th, Fred logged signals from South Africa, South America and a couple of Gs. It could be a question of picking your time to listen because **Chris van den Berg,** The Hague, received signals from stations in France, Germany, Sweden, the UK and the USSR during the morning and afternoon, and just after sundown on the 9th, Fred heard signals from EA, EL and PY2. Early in September the RSGB introduced a Cumulative phone contest to run from 1900 to 2100GMT on the 3rd, 11th, 19th and 27th between 28·350 and 28·600MHz. During one of these events, **Dave Coggins,** Knutsford, logged 11 "G" stations including his friend and neighbour Tony Usher G4HZW. Tony uses a half-wave vertical antenna mounted on his chimney and Dave has a similar antenna at ground level with its base earthed to a 2 metre long pole driven into the ground. For the c.w. enthusiast there are more Cumulatives on November 12, 20 and 28 and December 6 and 14 and I will be pleased to hear from those who take part.

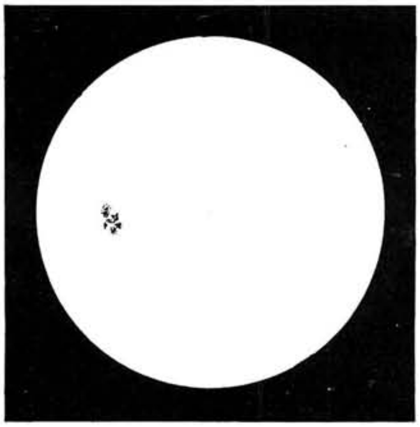


Fig. 1: Sunspots observed by Patrick Moore

28MHz Satellites

At various times between August 25 and 29, **Bill Kelly,** Belfast, heard a large number of European stations active through the Russian amateur radio satellite RS6, a callsign and list of numbers from RS5 and orbital data from RS5, 6 and 8. I received orbital data from RS5 at 0932 on the 31st, the signal "CQ de RS5", "NR 199 OP Robot" at 1934 on September 4, orbital data again for both RS5 and 8 at 1107 on the 5th and I copied, or let's say my Tono-Theta 550 read, "I5YT de RS5" at 1858 on the 11th. "Satellite working has been quite active", writes **John Coulter,** Winchester, who heard G2RO, G2UK, G2BUY, G2CIW, G3CFG, G3DDG, G4OAV, G4OCA, G4PBP, G4PIQ, G4XUF, G4YDE, G4ZHG, G8QS, stations in GI and GW and plenty of American, Canadian, and European amateurs working through the Radiosputniks on 29·331 and 29·341MHz. John also logged F3TP, F9XG, G3DDG, HG5AM, SP9DH, VE1BB and UZ3AXJ via the on board Robot Operator.

"On August 21, many stations were active via the Robot of RS5 including

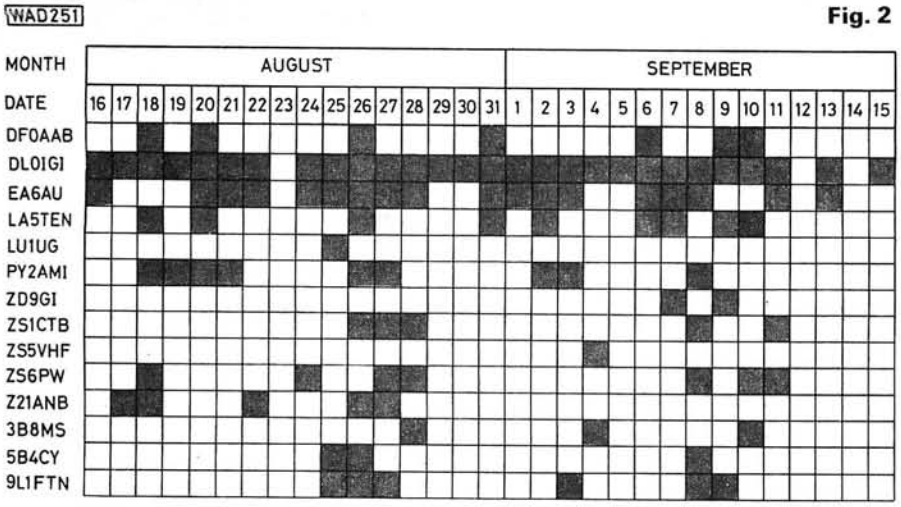


Fig. 2

K4GT, SP9DH, UA0UCW, VE1BB and W1TIF", writes Chris van den Berg who adds, "By observing the RS satellites from August 16 to September 5, I came to the conclusion that they did not suffer from the experienced lack of energy. There are some differences in the power rates of the beacon transmitter before and after the shadow period in RS5, July 10 819mW and September 3 only 88mW, but the Robot transmitter worked normally".

Propagation Beacons

As from this issue I have widened the scope of the beacon section to include propagation beacons on other bands besides 28MHz. Like all people, radio operators, amateur or professional, have to sleep and cannot use their transmitters 24 hours per day to give a permanent, steady and fixed frequency signal for the alignment of antennas, peaking up receivers and the study of propagation. Therefore, various organisations like the Radio Society of Great Britain, and private individuals, have established a large number of beacons on a variety of radio frequencies to get over this problem. A beacon is usually a strategically-sited, low-power transmitter installed to provide an identifiable signal, mainly a continuous tone, frequently interrupted with a callsign and is running unattended for long periods. Early in September, Dave Coggins received signals from the RSGB 144MHz band beacons in Angus GB3ANG 144·975MHz, Cornwall GB3CTC 144·915MHz and Wrotham GB3VHF 144·925MHz. "I am keeping a daily look out for Continental beacons" said Dave, who recently installed an 8-element Yagi for 144MHz, which he tells me "works splendidly". I can just hear the Wrotham beacon with a dipole antenna so this gives me a good idea what conditions are like on the 144MHz band. An interesting experiment is to check such a signal at least twice per day and also note the barometer reading and make a couple of graphs accordingly. "I have noticed that sometimes while the 28MHz band seems dead there are quite a lot of Continental stations on 27MHz, which can give a good indication of what beacons to listen out for on 28MHz," writes John Desmond. **Bert Glass,** Plymouth, says that he heard DF0THD and PA0ETE testing on September 9 and the German beacon again on the 10th. Although John Coulter writes, "A very poor period this time, several days with no beacons heard here", his log, along with those of Chris van den Berg, Dave Coggins, Bert Glass, Henry Hatfield, Ted Waring and my own, provided the information to make up the montly list of beacon signals received on the 28MHz band between 28·2 and 28·3MHz, Fig. 2.

Tropospheric

The atmospheric pressure, measured at my QTH with a recording barograph, began this period on August 16, high, at 30·1in (1019mb), gradually rising to 30·2 (1022) by 0600 on the 18th and then slowly falling to 29·9 (1012) between 1400 on the 19th and 0600 on the 24th. It quickly returned to, and crossed, the 30·0 (1015) line at midday on the 25th and then hovered around 30·1 until 1000 on September 2, when it fell in about 7 hours to 29·9. Another sharp rise from 29·8 (1009) at 0930 on the 4th to 30·1 at 2000 on the 5th was followed by a rapid fall back to 29·8 only 48 hours later. From 0400 on the 11th, the pressure was up again to 30·0 where it hovered until the 15th and the end of this period. In addition to watching his barometer, **Harold Brodribb** always keeps an eye on the weather map in his daily newspaper, but readers wishing to plot the pressure at their home QTH could try reading their household barometer at noon each day and make a graph with the results. I tried this for the month under discussion, Fig. 3, and it could prove very useful. Obviously, a reading taken at noon and midnight would be better. Give it a try and compare it with your 144MHz and 430MHz bands DX.

"Very good openings between August 19 and 22 on 144MHz", writes Bill Kelly, who heard many signals from northern England working through the repeaters in Ayr GB3AY, Caernarfon GB3AR, Caldbeck GB3AS, Stockport GB3MN, Eire EI1DK and all the Northern Ireland repeaters. During the v.h.f. contest on September 1 and 2, Dave Coggins logged signals in the 144MHz band from the Channel Islands to Scotland and the Isle of Man to Belgium including GJ4ICD, GD4GNH, 6 French portables, 2 Belgian and 1 Dutch portable and 4 GMs. I hope you put in a log to the RSGB Dave, you should have a good score there.

Band II

Another good reason for watching the barometer is that when the pressure is high, above 30·0in, even a mild tropospheric opening can bring some DX in Band II. No special equipment is needed, a good domestic radio, radio recorder or music centre, tunable between 88 and 106MHz, will suffice. During a large lift the set's telescopic rod or a loft-mounted dipole may well be adequate, but obviously a rotatable beam, 3- or 4-element, is best for the serious DXer. Between 0915 and 1100 on August 26, **Simon Hamer**, New Radnor, listened to a church service from the Dutch station NOS–1 from Goes 87·85, 95 and 99·8MHz, Smilde 88, 91·8 and 94·8MHz and Wieringermeer 87·7, 89·8 and 92·2MHz. Then at 1100 he logged the Belgian station BRT Studio Brussel a local on 102·8MHz, heard French language and pop music from RTBF from Liege on 102·4MHz and the test transmissions and announcements from the IBA station for Reigate and Crawley

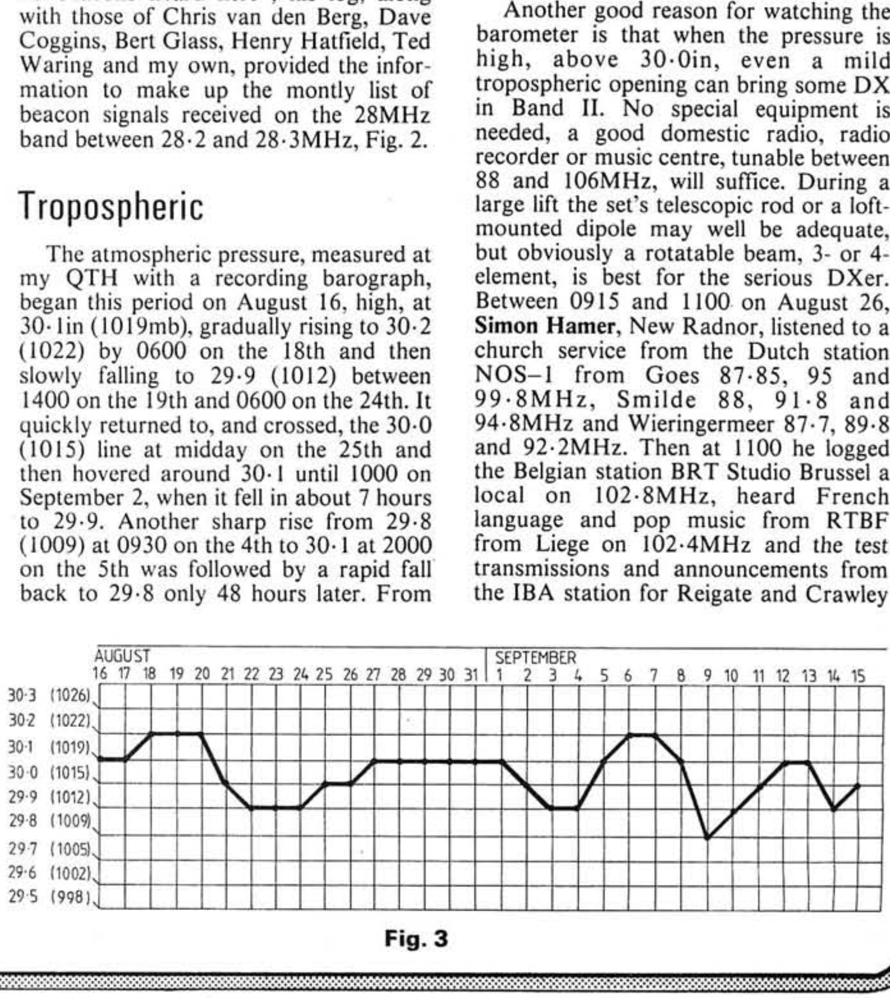


Fig. 3

on 103·6MHz. "It obviously seemed a narrow lift", said Simon, adding "with hardly any other BBC or IBA local station coming in, yet low-power locals from Belgium and the Netherlands were booming in". On August 28, **Andrew Guy, Andrew Potts** and **Damien Read** took a Sony ICF 7600–D receiver on a DXpedition to a high vantage point, with good views in all directions, some 10km from their homes in Newport, and heard, in their log order, Severn Sound, BRMB, Wyvern, Wiltshire, Radio Oxford, West, CBC, Devon, 2CR and possibly Radio Cornwall and Plymouth Sound. From Eire, they received Radio Nova and RTE 1 and 2 and from France, Inter, Culture and Frequence Nord. "It's a really fantastic location, good signals come from most stations", said Andrew Guy, who was surprised to hear the Irish stations, because the transmitters are situated in the northern part of Eire. Like Simon, Andrew heard the tests from Reigate and Crawley and during the opening over the weekend of September 1 and 2, he logged France Culture, Frequence Nord, Inter and Musique, Radio Solent, Southern Sound, Radio Oxford and BRT. At 1040 on August 15, Harold Brodribb received French stations on 11 spots in Band II, Dutch and French stations during the evening of the 26th and the early morning of the 28th and mainly Dutch stations at 1000 on September 2.

RTTY

Although Peter Lincoln did not spend too much time on RTTY during the month prior to September 11, he did copy signals from stations in CE, PY, YB and the USA and a variety of Europeans. Peter has now received a QSL card from VP2MO who told him that he is trying to set up a mailbox system and although he is new to RTTY he has worked 53 countries in just over a month. Peter's RTTY total now stands at 64 countries confirmed.

Between August 16 and September 15, I copied RTTY signals from stations in 28 international call areas, CT, CZ, DL, EA, EI, F, G, HB9, I, OE, OH, OK, OX, OZ, SM, UZ, VE, VK, Ws 1,2,4,5,6 and 8, XE, YV, YO and Y39 on the 14MHz band around 14·090MHz and one SP on the 21MHz band around 21·090MHz.

Unlike the 21MHz band, which appeared dead each time I tried, the 14MHz band was very active and I was delighted to put 3 Australian RTTY stations, VK3OK, VK5UT and VK8DH in the log on September 8, 10 and 13 respectively. As from our next issue, we are planning a separate column for RTTY, so what about it lads and lasses, drop me a line about your activities in this fascinating mode of radio communications.

Tailpiece

Our congratulations to I4BXN who won the 9H Falcon Contest and also to IS0QDV and IT9BBD who were the runners-up. The contest was organised by the 9H VHF/UHF/SHF Group in Malta. From the 31 entries in the transmitting section the winner had over 207 000 points and the last station almost 4000. First and second places with more than 16 000 and 10 000 in the s.w.l. section were taken by two Dutch listeners NL213 and NL7300 respectively. "I have noted with great satisfaction that our contest has gathered popularity, last year we started with 16 participants from three countries and this year we had 31 entries from 6 countries", writes Henry Souchet 9H1CD, contest manager. Details of the 1985 event, 1st to 15th of June, are availabale from Henry at PO Box 144, Valetta, Malta.

TELEVISION *by Ron Ham BRS15744*

Reports: as for VHF Bands, but please keep separate.

Although the 1984 sporadic-E season is theoretically over, there is still the mid-winter F2 DX to look out for in Band I and don't forget, a tropospheric opening can occur at any time when the atmospheric pressure is high and cold clear weather is about to change. This time we have the end of the E-season reports and a mild tropo opening to discuss and it seems that, for the SSTV buffs, swapping memories is the "IN" thing.

Report From India

"There was a definite lack of substantial sporadic-E TVDX in July and there were many dull days when it was felt that the sporadic-E season was over", writes **Major Rana Roy,** from India. Despite the lulls he did receive captions, mainly on Ch. 2 in Band I, from the USSR on July 8 and 20, Figs. 1 and 2 and an advert and an announcer, probably Russian, Figs. 3 and 4, on the 23rd. Early August brought more excellent pictures from Russia and Rana logged a quiz type show at 1910 on the 2nd, Fig. 5 and a programme announcement, Fig. 6, at 1915 on the 3rd. During the few events in July and early August, Rana saw films about agriculture, children and war, programmes on news and sport and a report about a snowbound area with people skiing. Rana also received pictures via tropospheric disturbances from Pakistan on Chs. 5, 8 and 10, in Band III. He tells me that a low-power TV relay station, opened in Bikaner on August 10, relays programmes from Delhi via the INSAT 1B satellite. "It has a dish antenna on a 13m high tower, fed by a colour transmitter with a 2000 sq km coverage and transmits on Ch. 12 in Band III", says Rana. When he last wrote, on September 11, he told me, "There has been no DX for a month now, I am waiting for a tropo opening".

Sporadic-E

As the 1984 sporadic-E season finished around the end of August your final reports have been coming in. "I am extremely pleased with the sporadic-E this month", writes **Philip Hodgson,** Stamford, having received pictures from Austria, Czechoslovakia, Hungary, Italy, Norway, Portugal, Romania, Spain, Sweden, Switzerland and the USSR on August 4 and Iceland, Italy, Poland, Spain and Yugoslavia on the 6th. Philip said that, during this fine haul, he saw the captions ORF FS1, RS-KH, RTP-1, PTT-SRG-1, TVE 1 and 2, RAI and JRT BGRD.

Around midday on the 6th, **Mike Bennett,** Slough, received the ORF-FS1 clock caption from Austria, test cards from Czechoslovakia RS-KH and SR1-TV Bratislava, Denmark and the Norwegian NRK clock and test cards scribed Gamlem, Gulen and Melhus. He also saw the Polish TVP Programme 2 caption, TP1 news in colour and a test card, JRT, from Yugoslavia. Mike reports receiving cartoons and news from Norway around midday on the 11th and test cards from East-Germany DDF-1, Norge Bremanger and Sweden TV1 on the 15th.

During the evening of the 20th, **Simon Hamer,** New Radnor, watched a cowboy film from Italy, sport from the USSR and a subtitled film from Yugoslavia. He saw the captions TVP and dt from Poland at 1838 on the 22nd and adverts from MTV Hungary and a horse show from RTVE Spain between 1845 and 1945 on the 24th.

Just before midday on the 24th, **Keith Chaplin,** Leicester, logged test cards, the caption TVE Aitana and a programme about church architecture from Spain. At 1320 on the 20th, I watched Russian news with the HOBOCTN and TACC COObWAET captions on Ch. R2 59·25MHz and while around 1900 on the 31st, Simon saw the Polish TVP caption and a TSS concert, with a digital clock, 3 hours ahead of BST, on Ch. R1 49·75MHz, I noted an analogue clock at 1800 on R1 showing 2100 followed by Russian news, with a YL newscaster and the BPMER caption. This news bulletin was showing a variety of domestic items with a disc in the top right hand corner enclosing the figures 20 per cent or 30 per cent as the need arose.

Once past the end of August sporadic-E disturbances become very sparse and

Fig. 1

Fig. 2

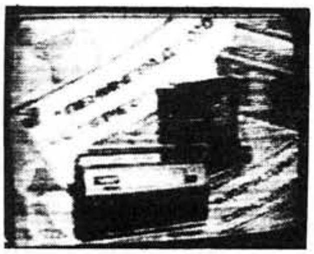


Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

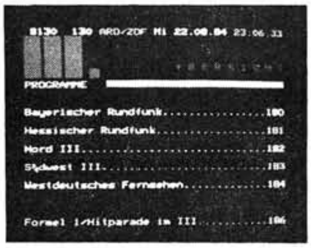


Fig. 8

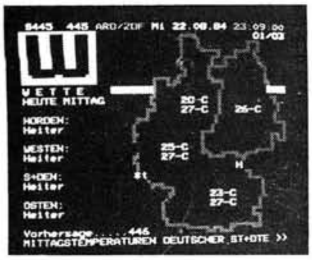


Fig. 9

Fig. 10

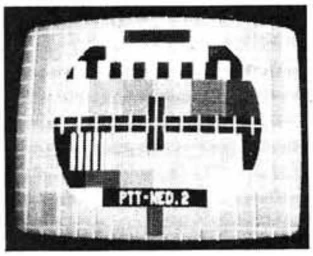


Fig. 11

Fig. 12

are often short-lived and weak. However, at 0804 on September 9 the only signal audible to me on the 28MHz band was the German beacon DF0AAB, at a steady signal strength of 5/8, so quickly on with the TV gear to investigate and there on Chs. R1 and R2 was a cartoon film followed at 0812 by what looked like a programme about garden design. I was not the only one on the look out because between 1100 and 1300, Keith Chaplin watched a number of Russian programmes on these channels including an army officer giving a speech, a variety show with the Red Army Ensemble, ice hockey with Canada vs CCCP and at 1259 a YL announcer appeared along with a digital clock showing 1559. "An unexpected clear picture on Ch. R1 lasting about an hour", said **Harold Brodribb,** St Leonards on Sea, about his TVDXing at 1010 on the 9th, having seen a travel film, frequent cyrillic writing, the YL announcer and the speech by the high-ranking officer.

Tropospheric

Atmospheric conditions were reasonable for TVDX in both the v.h.f. (Chs. 5 to 12) and the u.h.f. (Chs. 21 to 68) bands during the latter half of August. This was when **Tony Palfreyman,** Sheffield, received pictures on several u.h.f. channels from Belgium, Germany (Fig. 7) and Holland. He also saw the captions BRT TV1, ARD/ZDF, Nederlands 1 and 2 and Anglia TV. Then between 2306 and 2311 on the 22nd, Tony received a station list (Fig. 8) and weather and sport (Figs. 9 and 10) from ARD/ZDF in Germany. Tony also received pictures from Belgium on Ch. E10 and Holland on Ch. E6 in Band III.

"The highlight of the month for me was my first tropospheric opening in Band III" writes Mike Bennett. He logged pictures and test cards from Belgium RTBF1 and Holland PTT NED 1 and a cartoon from Germany WDR on the 26th and a test card from Belgium again on the 27th.

I received test cards in Band III scribed BRT TV at 1425 on the 17th, RTBF-1 at 0850 on the 19th and PTT NED 1 and a programme schedule at 0945 on the 26th. Harold Brodribb logged the French test cards AZF, TF1 and FR3 on Chs. E48, E51 and E54 respectively at 0945 on the 17th and again early on the 20th and September 1. Like the other readers, Harold received the test cards from the low countries and saw the captions Kanal 7, RTL Plus, TDF Reseau 4 and Canal Plus.

Keith Chaplin watched a John Wayne film from ARD on Ch. E9 at 2327 on the 25th and the ARD "off air" symbol at 2349. Just after midnight Keith saw the Dutch TROS symbol and the NED-1 clock on Chs. E5, 6 and 7, some in colour. For about an hour after 0800 on the 26th he saw a programme schedule from ARD, the caption Telefiche Perceval RTBF Liege from RTBF, a cartoon film and the test card PTT NED 1, in Band III. Around the same time Keith found coloured test cards in the u.h.f. band from Holland PTT-NED 1 and 2 (Fig. 11) on Chs. 29 and 32 respectively and programme information from ZDF on Chs. 35, 37 and 39.

SSTV

On August 20, **Richard Thurlow** G3WW, March, had a 2-way 8 seconds monochrome QSO with HB9AXG on 14·230MHz, with a signal strength of 5/9 both ways. Then he received FAX in the 144MHz band on 144·5MHz from John Stace G3CCH in Scunthorpe. Early on the 22nd, Richard tuned to 7·038MHz and completed 2-way QSOs with DL1KBP and DJ1SS, both of whom plus DL1MY and OZ3WP were worked again on the 23rd. At 1619 on the 27th Richard received 12 seconds single-frame colour pictures from W8QZ on 14·230MHz, which he stored in the memory of his Robot 450C and then replayed the signals back across the "pond". The stateside station then recorded and stored the reply and, you guessed it, retransmitted the signal back to Richard and still, after all this back and forth the colour was recognisable. W8QZ replayed a similar transmission from W6VLH who was using a new Robot 1200C high-resolution, twin-memory converter. On the 28th Richard was called by UA3QC asking for more video signals and on the

30th he received a 12 seconds single-frame colour portrait, in white robes, etc. of and from Nabeel A92NH through his 450C and Richard retransmitted his signal back to him.

During the tropospheric opening on August 25 and 26, Richard received strong signals from G3CCH and G4NJI, Rotherham on 144·5MHz which enabled the three of them to exchange 24 seconds single-frame colour pictures. G3CCH worked ON7HK and DF8BZ on the 25th and on the 26th, Richard had first time 2-way QSOs with ON7HK and DD9QI and after working PA3BNN, his new stations score increased to 2036. Returning to the 14MHz band, Richard exchanged SSTV pictures with PA0LEM/EA and ZS2AO and next day at 0740 he copied KP4YD calling CQ SSTV which resulted in Richard swapping 24 seconds single-frame colour pictures with him. "The proof of the pudding being that we played back each other's colour transmissions from the equipments' memories to each other" writes Richard.

In Aldershot, **Peter Lincoln** also copied KP4YD calling CQ, Fig. 12. He says that the station LU5NA has been active on the 14MHz band, often around 2300, during the month prior to September 11. Most of the SSTV stations received by Peter in the past month were from Germany and he writes, "I have noticed a signal appearing right on top of 14·230MHz around 2300 which blots out that part of the SSTV band. I phoned a friend in Guernsey and found that he could receive it as well, so, after 2300 on some nights that part of the band is unusable." Let's hope that it clears up soon Peter, it may well be, as you suggest, a harmonic from a strong lower frequency station.

Station Reports

"Thanks to those who attended the meeting on May 19 and to Nick Williams our host. There were a few interruptions for TVDX signals on Band I, including one on Ch. R1 which Rob Kennedy was able to identify as MTV Hungary from the sound channel!" writes Dave Lauder in his editorial in the summer 1984 issue of the Long Distance Television Reception Group's newsletter. Was the DX on the agenda Dave? As usual the Group's newsletter is full of gen for the TVDXer and as Dave explains, "This is the last newsletter in its present form but it is not the end of the group and its activities. The newsletter is to join forces with *Teleradio News*, a magazine for TVDXers published by H S Publications of Derby and edited by Keith Hamer and Garry Smith." Readers interested in more details about the newsletter and membership of the group should send an s.a.e. to Dave at 18 Burnside Close, Barnet, Herts EN5 5LN.

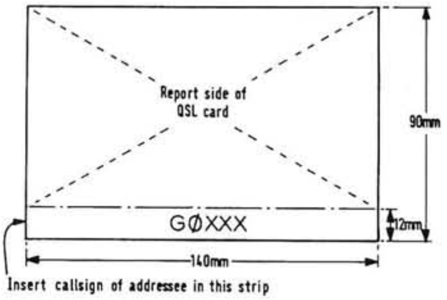
Don't forget the 15th of the month for all your reports

News

QSL Card Standards

With the numbers of licenced radio amateurs and s.w.l.s increasing throughout the world the logistics of hand sorting and the problems of "odd" sized QSL Cards have become more acute.

In the near future many more National Society QSL bureaux's will be forced to adopt optical Card reader/sorters, with attendant problems when faced with varying dimensions. To overcome such problems and to allow an increased efficiency and resulting better service to users the Cefalu Conference adopted a specification for a "standard" QSL card. Dimensions of the card are shown below and require little comment other than the requirement to provide a 12mm high (min.) margin across the base of the report side of the card to contain the addressee's callsign only, i.e. this stripe area must contain the callsign of the station you are sending the card to and nothing else. Paperweight has been specified to be between 190 to 250g/m². This specification has also been adopted by IARU Regions 2 and 3.



Stateside Lifts—(Sept 84 CQ)

The recent troubles with cable TV in Milton Keynes, which were rectified when BT did a rapid (expensive) channel group swap, pale to relative insignificance when compared with the USA.

The ARRL have had a petition requesting cable TV operators to vacate channels covering amateur bands at 144 and 220MHz, refused by the FCC. The licensing authority did however remind the cable industry that they may not radiate signals in **any** band since, by definition, they are (or should be) closed systems. FCC quote total complaints linked to CATV of 105 during 1983 with predictions that they will remain at this level during the next year. US amateurs have been urged to file interference reports—the moral here must be that the authorities can only act on hard evidence in all cases of interference.

Amateur band CATV breakthrough is but one aspect of the US situation. A report in the St. Petersburg Times revealed that sound tracks from adult films distributed on cable, have been enthusiastically received by school bus passengers in Pasco County. This "vocabulary enrichment" was provided for the kids via the two-way radio systems fitted in the school bus fleet! The general manager of the cable system has been quoted as saying a loose connection on the company's cable lines . . . allow the signal to escape.

Meanwhile the other system poised to become the major carrier of TV programs—Direct Broadcast Satellites, has become the subject of legislation debate in the US. Two separate bills have been introduced into Congress to reaffirm the right of all home satellite earth station owners to receive and view for private non-commercial purposes unscrambled satellite TV signals. It is further proposed to prohibit the distribution of authorised scrambled transmission decoders, which are currently big business in the US.

DX on 3·5MHz

We have been asked by the RSGB to remind readers that as a result of agreement reached at the 1984 Cefalu IARU Region 1 Conference, changes to the recommended band plan on 3·5MHz (80m) have occurred. The original Intercontinental DX window allocation 3·790–3·800kHz is now increased to 3·775–3·800kHz.

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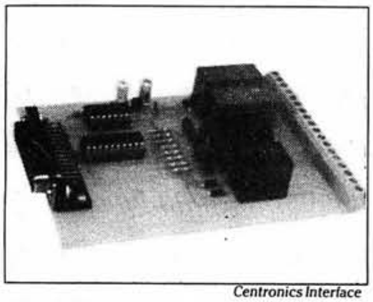

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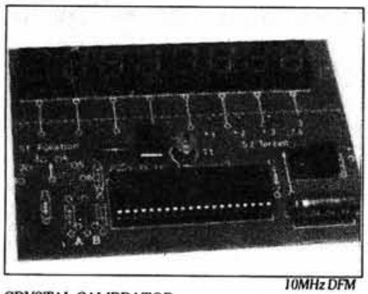

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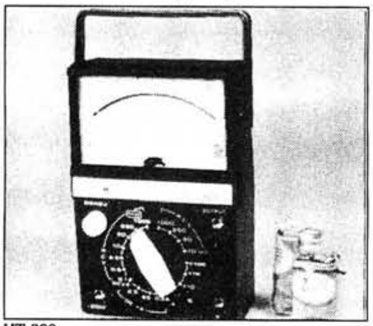

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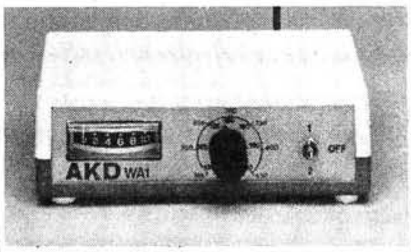

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TR9130	2M Multimode	458.72	(—)
TW4000A	2M/70cm mobile	488.70	(—)
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TM401A	7cms FM 12W	310.32	(—)
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PB25	Spare Battery Pack	26.50	(1.00)
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R600	Gen. Cov. Receiver	272.83	(—)
R2000	Synthesiser 200KHz 30MHz Receiver	436.75	( )
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HS5	Deluxe Headphones	24.48	(1.50)
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TONO (G series)			
2M40G	2m, 1-3 W in, 20-35W out, preamp	79.00	(2.50)
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2M130G	2m, 10-15W in, 110-130W out, preamp	159.00	(2.50)
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MICROWAVE MODULES			
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ML144/100-S	inc preamp (10w i/p)	149.95	(2.50)
MML144/100 HS	inc preamp (25w i/p)	149.95	(2.50)
MML144/100-LS	inc preamp (1/3w i/p)	169.95	(2.50)
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MML432/50	inc preamp (10w i/p)	129.95	(2.50)
MML432/100	linear (10w i/p)	245.00	(2.50)
B.N.O.S.			
LPM 144-1-100	2m, 1W in, 100W out, preamp	172.50	(2.50)
LPM 144 3 100	2m, 3W in, 100W out, preamp	172.50	(2.50)
LPM 144-10-100	2m, 10W in, 100W out, preamp	149.50	(2.50)
LPM 144-25-160	2m, 25W in, 160W out, preamp	207.00	(2.50)
LPM 144-3-180	2m, 3W in, 180W out, preamp	235.75	(2.50)
LPM 144-10-180	2m, 10W in, 180W out, preamp	235.75	(2.50)
LPM 432-1-50	70cm, 1W in, 50W out, preamp	184.00	(2.50)
LPM 432-3-50	70cm, 3W in, 50W out, preamp	184.00	(2.50)
LPM 432 10-50	70cm, 10W in, 50W out, preamp	155.25	(2.50)

— SWR/PWR Meters —

HANSEN			
FS200	1.8-150MHz 20/200 Pep	59.95	(2.00)
FS210	1.8-150MHz 20/200 Auto SWR	59.80	(2.00)
FS5E	3.5-150MHz 20/200/1000W HF	41.00	(2.00)
FS500H	1.8-80MHz 20/200/2000W	77.80	(2.00)
FS710H	1.8-60MHz 15/150/1500W Pep	97.75	(2.00)
WELZ			
SP15	1.8 160MHz PWR/SWR	41.00	(2.00)
SP45	130-470MHz PWR/SWR	59.75	(2.00)
SP10X	1.8 150MHz PWR/SWR	28.75	(2.00)
SP200	1.8-160MHz PWR/SWR	82.00	(2.00)
SP250	1.8-60MHz PWR/SWR	57.75	(2.00)
SP300	1.8 500MHz PWR/SWR	115.00	(2.00)
SP350	1.8-500MHz PWR/SWR	69.95	(2.00)
SP400	130-500MHz PWR/SWR	82.00	(2.00)
SP600	1.8-500MHz PWR/SWR	106.00	(2.00)
TOYO			
T430	144/432 120 W	44.65	(2.00)
T435	144/432 200 W	49.35	(2.00)
YAESU			
YS200	1.8 60MHz	52.90	(2.00)
YS2000	1.8 60MHz	69.79	(2.00)

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— Icom Products —

IC751	HF Transceiver	1239.00	(—)
IC745	HF Transceiver	898.00	(—)
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PS15	P.S. Unit	135.00	(4.00)
PS30	Systems p.s.u. 25A	259.00	(—)
SM6	Base microphone for 751/745	36.50	(1.00)
IC290D	2m 25W M/Mode	469.00	(—)
IC271E	2m 25W M/Mode Base Stn.	699.00	(—)
IC271H	100W version of above	889.00	(—)
IC25H	2m 45W FM	359.00	(—)
IC27E	25W FM mobile	359.00	(—)
IC45E	70c 10W FM	345.00	(—)
ICBU1	B/U Supply for 25/45/290	24.50	(1.00)
ICR70	General Coverage Receiver	599.00	(—)
ICR71	General Coverage Receiver	699.00	(—)
IC02E	2m H/Held	259.00	(—)
IC2E	2m H/Held	199.00	(—)
ML1	2m 10w Linear	69.00	(2.00)
IC4E	70cm H/Held	259.00	(—)
IC04E	70cm H/Held New Model	269.00	(—)
BC35	Base Charger	56.35	(—)
HM9	Speaker mic	18.55	(0.75)
IC3	Carry Case	5.50	[illegible]
ICBP3	Std Battery Pack	27.50	(0.75)
BP5	High Power Battery Pack	52.80	[illegible]
CP1	Car Charging Lead	[illegible]	[illegible]
DC1	12v Adaptor	[illegible]	(0.75)

— Mutek Products —

SLNA 50	50MHz Switched preamp	44.90	(1.50)
SLNA 144s	144MHz Low noise switched preamp	39.90	( )
SLNA 145sb	Preamp intended for 290	27.40	(1.50)
GLNA 432e	70cm Mast head preamp	149.90	(2.50)
RPCB 144ub	Front end FT221/225	[illegible]	(1.50)
RPCB 251ub	Front end IC251/211	[illegible]	(1.50)
BBA 500u	20-5000MHz Preamp	[illegible]	(1.50)
GFBA 144e	2m Mast head preamp	[illegible]	(2.50)
SBLA 144e	2m Mast head preamp	[illegible]	(2.50)
RPCB 271ub	Front end for IC271	[illegible]	(1.50)
TVHF 230c	2M-FM Transverter	334.90	(5.00)

— Datong Products —

PC1	Gen. Cov. [illegible]	137.40	(1.50)
VLF	Very low frequency [illegible]	29.90	(1.50)
FL2	Multimode audio filter	89.70	(1.50)
FL3	Audio filter for receivers	129.00	(1.50)
ASP/B	[illegible] clipper [illegible]	82.80	(1.50)
ASP/A	[illegible] speech clipper [illegible] Yaesu	82.80	(1.50)
ASP	As above with [illegible] conn	89.70	(1.50)
D75	Manual RF speech clipper	56.35	(1.50)
D70	Morse Tutor	56.35	(1.50)
MK	Keyboard morse sender	137.40	(1.50)
RFA	RF [illegible] pre-amp	33.90	(1.50)
[illegible]270-MPU	Active dipole with mains p.s.u.	51.75	(1.50)
[illegible]270-MPU	Active dipole with mains p.s.u.	69.00	(1.50)
[illegible]	Mains power unit	6.90	(1.50)
[illegible]144/28	2M converter	39.67	(1.50)
[illegible]1	Tone squelch unit	46.00	(1.50)
ANF	Automatic notch filter	67.85	(1.50)
SRB2	Auto Woodpecker blanker	86.25	(1.50)

— CW/RTTY Equipment —

Tono 9000E	Reader/Sender	P.O.A.	(—)
Tono 550	Reader	299.00	(2.50)
MICROWAVE MODULES			
MM2001	RTTY to TV converter	189.00	(1.50)
MM4001	RTTY terminal	269.00	(1.50)
MM4001KB	RTTY term with keyboard	299.00	(2.00)
HI-MOUND MORSE KEYS			
HK702	Up down keyer marble base	27.00	(1.50)
HK703	Up down keyer	28.15	(1.50)
HK704	Up down keyer	19.25	(1.50)
HK705	Up down keyer	13.57	(1.50)
HK706	Up down keyer	15.90	(1.50)
HK708	Up down keyer	13.00	(1.50)
HK802	Up down solid brass	82.85	(1.50)
HK808	Up down keyer	39.95	(1.50)
MK704	Twin paddle keyer	12.00	(1.50)
MK705	Twin paddle keyer marble base	24.65	(1.50)
KENPRO			
KP 100	Squeeze CMOS 230/13.8v	79.50	(2.50)
KP200	Memory 4096 Multi Channel	169.50	(2.50)

— Yaesu —

FT1	HF Transceiver	P.O.A.	(—)
FT980	HF Transceiver	1329.00	(—)
SP980	Speaker	61.55	(2.00)
FT102	HF Transceiver	719.00	(—)
FC102	Tuner	185.00	(2.00)
FV102DM	VFO	239.00	(2.00)
SP102	Speaker	55.00	(2.00)
AM/FM	Unit	49.00	(1.00)
FT77	Mobile HF Transceiver	479.00	( )
FP700	PSU	145.00	(5.00)
FC700	Tuner	103.85	(2.00)
FT77s	10w version	449.00	(—)
FMU77	FM Board for FT77	28.55	(1.00)
FT757	HF Transceiver	719.00	(—)
FC757	Auto A T U.	245.00	(2.00)
FP757HD	Heavy Duty PSU	179.00	(2.00)
FP757GX	Switched Mode PSU	145.00	(2.00)
FT480	2m M/Mode Transceiver	399.00	( )
FL2050	Linear Amplifier	119.00	(2.00)
FT290	2m M/Mode Port/Transceiver	279.00	(—)
FT290	With Mutek front end fitted	309.00	(—)
FL2010	Linear Amplifier	66.55	(1.50)
FT790	70cm M/Mode Port/Transceiver	259.00	(—)
MMB11	Mobile Bracket	28.19	(1.50)
NC11	Charger	10.55	(1.00)
CSC1	Carrying Case	4.45	(1.00)
YHA15	2m Helical	5.65	(1.00)
YHA44D	70cm ½wave	9.00	(—)
YM4[illegible]	Speaker Mike	19.25	(1.50)
FT230	2m 25w FM	269.00	(—)
FT730	70cm 10w FM	239.00	(—)
[illegible]15	Mobile Bracket	14.65	(1.50)
FT20[illegible]	NEW 2m H/Held	P.O.A.	( )
[illegible]	NEW 2m H/Held	P.O.A.	( )
FT208	2m H/Held	209.00	( )
[illegible]708	70cm H/Held	189.00	(—)
MMB10	Mobile Bracket	8.45	(1.00)
NC9C	Charger	9.20	(1.00)
NC8	Base/station Charger	56.75	(2.00)
[illegible]A3	Car Adaptor/Charger	16.00	(1.00)
[illegible]	Spare Battery Pack	23.00	(1.00)
[illegible]A	Speaker Mike	22.50	(1.50)
FT726R	2m Base Station	775.00	( )
[illegible]30/726	70cm Module for above	259.00	(2.50)
FRG7700	HF Receiver 15-30MHz	385.00	(—)
FRG7700M	As above with memory	455.00	(—)
FRT7700	A T U for above	48.25	(1.50)
MH1B8	Hand 600 8pin mic	15.70	(1.50)
MD1B8	Desk 600 8pin mic	56.00	(1.50)
MF1A3B	Boom mobile mic	18.95	(1.50)
YH77	Lightweight phones	12.50	(1.00)
YH55	Padded phones	12.50	(1.00)
YH1	L/weight Mobile H/set-Boom mic	15.75	(1.00)
SB1	PTT Switch Box 208/708	17.00	(1.00)
SB2	PTT Switch Box 290/790	14.50	(1.00)
QTR24D	World Time Clock	35.00	(1.00)
FF501DX	Low Pass Filter	28.99	(1.00)
YP150	Wattmeter/Dummy Load 150w	99.00	(2.00)

— Power Supplies —

DRAE			BNOS		
4 amp	34.00	(2.00)	6 amp	52.90	(2.50)
6 amp	53.50	(2.50)	12 amp	95.45	(3.00)
12 amp	79.50	(3.00)	25 amp	138.00	(4.00)
24 amp	110.00	(4.00)	40 amp	276.00	(4.00)

— Aerial Rotators —

9502B	3 core Lighter Duty	57.50	(2.50)
AR40	5 core Medium Duty	98.90	(2.50)
KR400	Med/H Duty	99.94	(3.00)
KR500	6 core Elevation	126.50	(3.00)
KR400RC	6 core Medium Duty	118.45	(3.00)
CD45	8 core Heavy Duty	149.50	(3.00)
KR600RC	8 core Heavy Duty	167.90	(3.50)
HAM1V	8 core Heavier Duty	264.50	(5.00)
T2X	8 core Very Heavy Duty	332.35	(5.00)

— Switches —

Sigma	2 way SO239	11.50	(1.00)
Sigma	2 way 'n' Skts	15.50	(1.00)
Welz	2 way SO239	20.75	(1.00)
Welz	2 way 'n' Skts	37.00	(1.00)
Drae	3 way SO239	15.40	(1.00)

— Miscellaneous —

DRAE	Wavemeter	27.50	(1.50)
T30	30W Dummy load	7.10	(1.00)
T100	100W Dummy load	28.00	(1.50)
T200	200W Dummy load	41.40	(2.00)
CT300	300W Dummy load	58.00	(2.50)
DRAE	2m Pre-set A.T.V.	11.80	(1.50)
	Altai Dip Meter	49.00	(2.00)

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