DECEMBER 1984 99p

Amateur RADIO

For all two-way radio enthusiasts

Loaded whip design using CAD

10m conversions

Propagation explained

Soldering irons

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On test: Tau Systems SPC 3000 ATU

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OA 90	8p
IN 60	5p
IN 541	5p
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IN 2069a	10p
IN 2070	10p
IN 4001	3p
IN 4002	3p
IN 4003	4p
IN 4004	4p
IN 4005	4p
IN 4006	4p
IN 4007	5p
IN 4148 x 40	£1
IN 4448 x 40	£1
IN 4742	10p
IN 4722	10p
IN 4751	10p
IN 5235	10p
IN 5254	10p
IN 5349	10p
IN 5392	10p
IN 5393	10p
IN 5928B	10p
1AV 30	10p
IM 72Z55	10p
IR 106a	20p
IR 3051	10p
IS 164	10p
IS 921	10p
IS 3011a	10p
IS 3072a	10p
IS 5024a	50p
IS 5030	50p
ITT 210	10p
ITT 921	10p
ITT 923	10p
ITT 1075	10p
ITT 2001	10p
ITT 2002	10p
ITT 4150	10p
ZE 1.5	10p
ZF 3	10p
ZF 3.3	10p
ZF 4.3	10p
ZF 10	10p
ZF 11	10p
ZF 12	10p
ZF 15	10p
ZF 33	10p
ZF 43	10p
ZF 47	10p
ZF 82	10p
ZPD 3.9	10p
ZPD 4.7	10p
ZPD 5.6	10p
ZPD 10	10p
ZPD 47	10p
ZPY 8v2	10p
ZPY 12	10p
ZPY 16	10p
ZPY 24	10p
ZPY 43	10p
ZPY 47	10p
ZPY 56	10p
ZTE 2	10p
ZTK 22	10p
ZTK 33	10p
ZTK 33a	10p
ZW 13	12p
ZW 27	10p
ZW 4.3	10p
ZW 310	10p
ZX 68	30p
ZY 47	10p
ZY 72	10p
AA 113	10p
AA 119	8p
AA 144	10p
BA 102c	10p
BA 157	8p
BA 159	8p
BA 173	8p
BA 182	8p
BA 201	8p
BA 202	8p
BA 243	8p
BA 248	8p
BA 316	8p
BA 318	8p
BAV 10	10p
BAV 21	10p
BAW 21	10p
BB 103	10p
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BB 105G x 12	£1
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BZX 46c22	15p
BZX 61 9.1	8p
BZX 61c110	8p
BZX 61c20	10p
BZX 61c30	10p
BZX 61c220	10p
BZX 70c6v2	8p
BZX 70c12	20p
BZX 70c33	8p
BZX 79c3v9, 4v7, 5vl, 5v6, 6v2, 6v8, 7v5, 11, 12, 30, 47	10p each
BZX 83c4v3, 5v6, 8v2, 12, 13, 24, 27, 33,	10p each
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R 2396	50p
R 2461	80p
R 2030	50p
R 2443 = BD124	40p
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BU 205	£1
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TIC 116n/Y 1003	35p
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TIC 225S	40p
TIC 226E	40p
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TICV 106D (T092 case 2A/400V)	10p
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TIP 30	35p
TIP 30A	35p
TIP 30B	40p
TIP 30C	45p
TIP 31	30p
TIP 31A/RCA 16334	35p
TIP 32	25p
TIP 33B	50p
TIP 33C	70p
TIP 34A	50p
TIP 34B	60p
TIP 34C	70p
TIP 35B	50p
TIP 35C	70p
TIP 35D	80p
TIP 36	50p
TIP 36C	70p
TIP 41B	40p
TIP 41D	70p
TIP 42/BRC 6109	30p
TIP 48	40p
TIP 49	30p
TIP 57	30p
TIP 100	30p
TIP 102	30p
TIP 112	30p
TIP 115	50p
TIp 117	50p
TIP 120	35p
TIP 125	35p
TIP 130	30p
TIP 131	25p
TIP 136	30p
TIP 140	50p
TIP 147	50p
TIP 640	50p
TIP 2955	35p
T 6032	30p
T 6036	40p
T 6040	40p
T 6047	40p
T 6049	40p
T 6051	40p
T 6052	40p
T 9004	40p
T 9005	40p
ZTX 102c	10p
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ZTX 109k	5p
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BYX 71/350	20p
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BYX 72/300	20p
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BVY 95C	12p
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BZY 93c75	50p
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BY298 3 amp/fast/R	20 for £1.50
BD239	20 for £2.00
MR856	25 for £1.50
BU126	10 for £6.00
BU205	10 for £8.00
BU105	10 for £6.00
2SC2122A	10 for £8.00
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BD136	10 for £1.25
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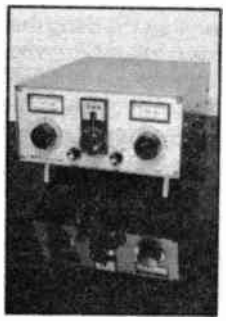
Amateur RADIO



Editor:
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01-684 3157
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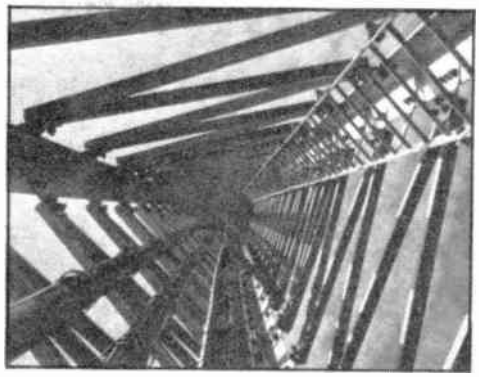
On sale: Fourth Thursday of the month preceding cover date
Next issue: Cover date January 1985 on sale 27 December 1984
Published by: Amateur Radio Magazines, Sovereign House, Brentwood, Essex CM14 4SE, England
(0277 219876)
Printed: In England
ISSN: 0264-2557
News Trade Sales by: Argus Press Sales & Distribution Ltd, 12-18 Paul Street, London EC2A 4JS.
01-247 8233
Front cover: TAU SPC3000 ATU reviewed this month (p19). Photo by Jay Moss-Powell G6XIB



SERVICES

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 set the standard for amateur radio shops and after-sales service. The shops are open Tuesday to Friday from 9.00 to 5.30 p.m., Saturday from 9.00 to 5.00 p.m. and close for lunch each day from 12.30 till 1.30 p.m.

In Glasgow the LOWE ELECTRONICS' shop (the telephone number is 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 (the telephone number is 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 (the telephone number is 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, signposted Chesterton. After passing a children's playground on your left turn left again (between the shops) into Green End Road. Very quickly, and without you noticing it, Green End Road becomes High Street. Easy and free street parking is available outside the shop.

For South Wales, the LOWE ELECTRONICS' shop is located in Cardiff. Managed by Richard GW4NAD, who hails from Penarth, the shop (the 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 red 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.

LOWE ELECTRONICS' London shop is located at 223/225 Field End Road, Eastcote, Middlesex (the telephone number is 01-429 3256). The shop, managed by Andy G4DHQ is easily found, being part of Eastcote tube station buildings and as such being on the Metropolitan and Piccadilly lines (approximately 30 minutes from Baker Street main junction). For the motorist, we are only about 10 minutes' driving time from the M40, A40, North Circular Road (at Hangar Lane) and the new M25 junction at Denham. 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.

Although not a shop there is on the South Coast a source of good advice and equipment — John G3JYG. His address is 16 Harvard Road, Ringmer, Lewes, Sussex. (telephone 0273 812071). An evening or weekend telephone call will put you in touch with John.

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.

For many years.....

I have found much pleasure in slowly tuning a receiver across the short wave bands. I remember discovering that the new wireless, just purchased by my Grandfather, had on it a short wave section. So, after the family had listened to ''The Archers'' and set about the evening's activities, I was left with the set to myself, able to tune around and listen to the world. I am certain that the thing that fascinated me then is still the same today; the fact that transmissions from such exotic places so far away could be heard in my own surroundings. Perhaps I am a romantic at heart but to imagine the sights and sounds of the countries originating the transmissions was special. I find it difficult to describe the feeling. I have since spoken to many people who have shared the same experience, they too find it difficult to explain.

Since those days.....

things have changed and many receivers have come and gone. When compared with the large pieces of surplus equipment once used by the short wave listener in his shed at the bottom of the garden, today's equipment looks ''very HI-FI''. Most of the receivers carry the description ''general coverage'' meaning that it will tune without gaps frequencies from around 100 kHz to 30 MHz. Such wide coverage means that not only can you listen to amateurs and short wave broadcast stations worldwide, you can also hear Radios 1, 2, 3 and 4 and Laser on.588 kHz. To the short wave listener this is a great advantage over rigs which only have selected bands. It is usually the band you particularly want that the manufacturer had decided you could do without. The receivers which I now describe are all ''general coverage'', and I might add are each capable of giving you the satisfaction which I describe above.

the R600.....

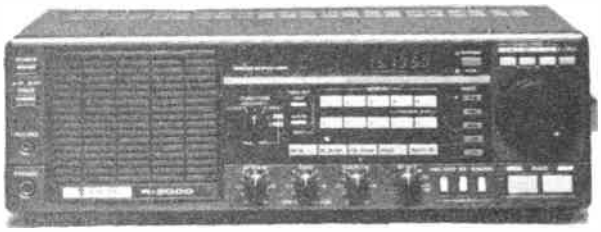
TRIO R-600

At the start of the range is the **TRIO R600 which costs £272.83 including VAT.** This is the receiver for the beginner, the person of limited means or the cynic who does not really believe my enthuse. The R600 is a basic receiver covering from 150 kHz to 30 MHz and having switched upper and lower sidebands, wide and narrow am and cw. It has a 20 dB attenuator and a noise blanker fitted as standard. Operation is simple, select the mode of operation, turn the MHz dial to the correct band and, by using the VFO knob, tune to the desired frequency. The clear digital readout makes station selection simple. The TRIO R600 is an ideal receiver for shack, bedroom or lounge.

LOWE ELECTRONICS
Chesterfield Road, Matlock, Derbyshire. DE4 5LE.
Telephone 0629 2817, 2430, 4057, 4995. Telex 377482.

the R2000.....

Moving upward from the R600 we find the TRIO R2000. The receiver covers frequencies from 100kHz to 30MHz and has, in addition to the facilities found on the R600, a ten channel memory to hold for quick access your favourite stations. Memory operation is versatile, each memory retaining not only the frequency but the mode of operation. Each memory can be also used as a separate VFO. In addition to AM, USB, LSB and CW the R2000 is fitted with FM which, when used



TRIO R-2000

with the VC10 internal vhf converter, enables the amateur 2 metre band to be fully listened to. Another advantage over the R600 is that the R2000 tunes continuously up the band and not in 1 MHz sections. Three rates of tuning are provided enabling the band to be either searched diligently or quickly "scanned". With the optional VC10 fitted the R2000 adds to its frequency range the VHF section from 118 to 174 MHz and, of course, operates on AM, FM. USB, LSB and CW. Fast or slow AGC can also be easily selected using a front panel switch. Altogether a fine receiver and ideal for today's listener. **The TRIO R2000 costs £436.75 including VAT.** The optional VC10 costs £117.00 including VAT and is easily fitted inside the receiver.

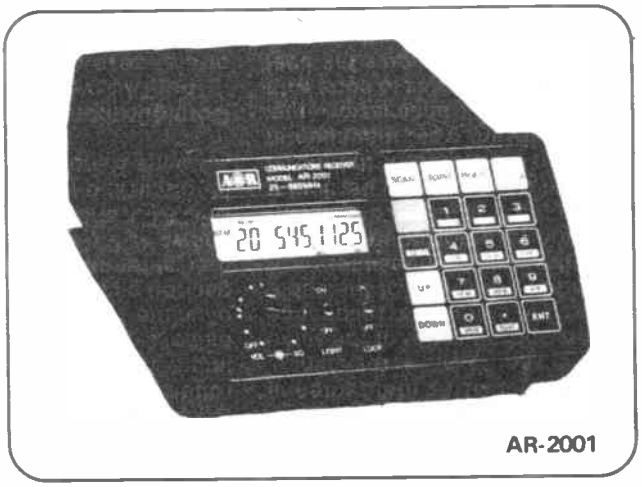
from JRC, the NRD515.....

JCR NRD-515

There are amongst us a discerning few for whom only the best is good enough. For them there is only one receiver: this is the NRD515 manufactured by the JAPAN RADIO COMPANY. The receiver is built to professional standards and is designed to give its owner the ultimate in listening pleasure. Covering 100kHz to 30MHz the NRD515 has pass band tuning, slow and fast AGC and a preselector covering the broadcast bands from 600 kHz to 1.6 MHz. Optional accessories include a 96 channel memory unit (NDH518 £264,00 inc VAT), a remote frequency controller giving keyboard frequency entry, plus an additional four memories (NCM515 £169.75 inc VAT) and a matching speaker (NVA515 £45.41 inc VAT). **The NRD515 short wave monitor receiver costs £965.00 inc VAT.**

and the AR2001....

It is rare to use a piece of equipment so refreshingly new as to be devastating. Although it has been my pleasure to use numerous receivers over the past years nothing has so captured my attention as has the AR2001 from the company AOR. Authority On Radio, AOR, sums them up exactly. In the past there have been several receivers covering parts of the HF/VHF/UHF spectrum but never before a receiver



AR-2001

tuning continuously from 25 MHz to 550 MHz. Never before a receiver having AM, narrow band FM and wide band FM. Never one that could be afforded by all enthusiastic listeners. The AR2001 is the new concept in receiver design combining user friendly controls to aid listening with a carefully designed receiver that actually works. The receiver with its continuous coverage between 25 and 550 MHz enables its owner to listen to a multitude of transmission sources. The provision of three modes, AM, narrow band FM and wide band FM are essential when one considers the variety of information that can be received. AM for the VHF/UHF airband channels, narrow band FM for amateur radio, CB and business radio and finally wide band FM for broadcast and TV sound. Digital frequency readout is combined with visual reminders of receiver state and for night time listening the panel is illuminated. Scanning, memories, memory scan, programmable band scan are all part of the receiver and to aid operating the memory not only remembers the frequency but the mode of operation. **The AR2001 receiver costs £345.00 inc. VAT.**

CURRENT COMMENT

SOMETHING FOR NOTHING

This year's Leicester Amateur Radio Show took place on 26-27th October at the Granby Halls in Leicester. A large number of trade stands, combined with a bring-and-buy and a large gathering of special interest clubs and societies, all went together to make the show a success, with total attendance over the two days exceeding six thousand five hundred.

Launch

As usual at this show, there were new products on sale or display. Important amongst these were three new Yaesu items received by South Midlands Communications the day before the exhibition, on display for the first time. These were the FRG8800 general coverage receiver, the FT270RH high power 2m mobile and the amazing FT2700R 2m/70cm full duplex rig (pictured).

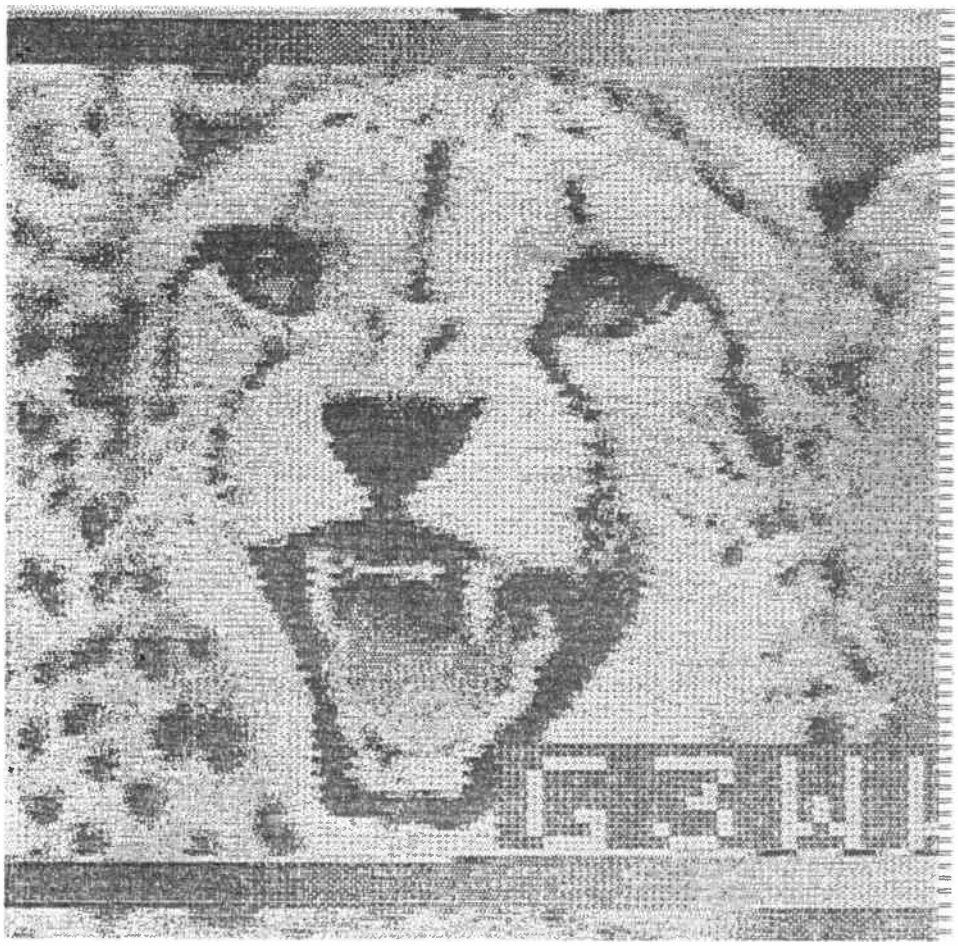
Another product launched will be of special interest to readers of this magazine: TAU Systems introduced their new SPC3000 ATU.

The unit is reviewed for us this month by Angus McKenzie G3OSS, who this month extends the genre of reviews into a new dimension, with a full explanation of the problems encountered in matching and filtering, before passing a critical eye over the TAU itself. The extensive figures which accompany the article make fascinating reading. The result is an extensive look at this aspect of LF and HF systems, the like of which has rarely been seen before.

And it does not end there, because TAU have actually given us one of these units to offer as a prize in a competition, details of which can be found on page 25. Cirkit Holdings, UK distributor of the ATU in kit form, got wind of the idea and offered us one of these kits to give away as a runners-up prize, after which TAU themselves matched their offer by providing another.

So there you have it, a complete new ATU and two in kit form. A thorough read of the review should help you decide which features of the unit are most important, and after that you will need to employ a bit of verbal wit to make up something clever enough to wake up the Editor! Otherwise, he may keep the ATU!

Thanks, of course, to TAU and Cirkit for donating the prizes.



G3WW

Richard Thurlow is a regular correspondent to ***Amateur Radio***, his frequent letters spotlighting news and views in SSTV and amateur radio in general.

It seemed appropriate, therefore, for John Heys to turn the spotlight on 'the slow-scan man'. From your letters we know that features on 'famous' amateurs are popular, and certainly reading of the achievements of Richard over more than 50 years should appeal to many.

The picture here is a printout by G3WW of a transmission received fro I8XQW earlier this year.

Get it!

Occasionally we hear from people who are having difficulty in obtaining a copy of ***Amateur Radio*** regularly. This is mainly due to the fact that there are so many specialist magazines on the market that few newsagents can manage to stock them all.

However, if you have any difficulty at all in obtaining a copy ask your newsagent to order one each month, or fill in the *newsagents order form* on page 18. Alternatively, if you wish to be one of the first to see the magazine each month, complete the *subscription order form* on page 67, and enjoy the luxury of having it delivered to your door, post free.

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Western

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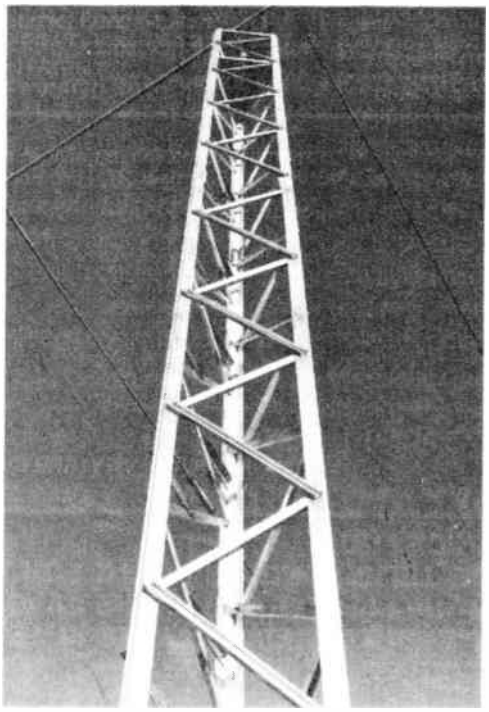

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1086 DX-32/33	Conversion Kit	£65.15
1087 DX-33/34	Conversion Kit	£80.50
1089 DX-103	3 element 10m Yagi	£90.85
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1093 DX-4K	Converts DX-31/2/3/4 to 40m dipole	£69.00
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1095 DX-27/3	3 ele. Beam for 27MHZ. Gamma matched	£40.25
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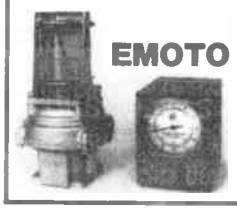

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L·E·T·T·E·R·S

CORRECTION

I found Peter Dodson's article on reference and reading for the radio amateur very interesting.

May I, however, correct him on one point – M G Scroggie did not publish his original *'Foundations of Wireless'* in 1936. Why? Because the author was A L M Sowerby, MSc.

Scroggie took over the revision and authorship of later editions (starting, I believe, with the 3rd), presumably on Sowerby's death.

A J Wall, Warwickshire

AIRBORNE RADAR IN WWII

Congratulations to contributor Brian Kendal, G3GDU, for his fascinating account of the development and use of airborne radar by the RAF some forty years ago.

It was of special interest to me for I was actively involved, and a member of 77 Squadron which was mentioned particularly. Wing Commander Bennett, however, had left the Squadron when I joined up with them at Elvington near York early in 1943.

I was on one of the early GEE courses at Prestwick in the summer of 1942 and later was led into the mysteries of H2S and centimetre radar at Bomber Command HQ, High Wycombe.

Another adaptation of the H2S equipment was called *Fishpond*. This was an additional PPI display at the rear of the Halifax bombers which could be used by the tail gunner to keep an eye open for approaching German night fighter planes. For a while we also used a device codenamed *Monica* which gave an audible train of 'dots' over the intercoms when an aircraft was coming up from behind. The dot rate was determined by the distance from the target and practically became a steady tone when the enemy was very close and within gun range.

Another airborne radar 'looked after' by the writer was called *Mandrell*. This was nothing more than a high powered jamming device which had a powerful VHF oscillator tuned to the frequency of the enemy searchlight radars with an enormous bandwidth. This was achieved by modulating its output with white noise generated by a noise diode, and must have been a most unpleasant signal!

Although not strictly 'amateur radio', G3GDU's article was certainly appreciated. Thanks to all concerned.

John Heys G3BDQ, Hastings.

THE AMATEUR AND CB

I think that it is time for everyone to get off their high horses about CB. There is no denying that it has got off to a very bad start, but it is here to stay, and no good will be done if the ham fraternity just wash their hands of it. An urgent job is waiting to be done, and I believe that radio amateurs, led by the RSGB, are the right people to do it.

In my opinion, the DTI is right – CB is a short-range means of communication for the non-technical, but I also think that there is, as yet, a great source of untapped potential, if a firm lead could be given.

As a medium of assistance for mobiles, it should be a tremendous asset; but it isn't, because the general public are as yet unaware of what it can offer. As an aid to the housebound, the handicapped, and those who have no telephone, it could be a wonderful link with the outside world; but it isn't, because the image most people have of CB is that it is a trivial plaything for bored teenagers.

Most amateurs seem to hold a view of CB that is negative and defeatist. Granted, it is easy to criticise CB at the moment, but this state of affairs is largely due to neglect. Surely what is more important is to improve it, and hams are in the best possible position to do this.

Of course, there are bound to be wallies in any sphere where the general public is let loose, but if they are outnumbered by sensible, dedicated operators who are determined to see CB used properly then the situation cannot help but get better. Indeed, what better breeding ground for future radio amateurs, where beginners can let off steam QRP, and get it out of their systems, before they are allowed on to the international wavebands!

I should like to urge the RSGB to consider giving a lead. The authorities have tended to dissociate themselves from the whole subject, which is why CB is so under-developed at the moment. The RSGB has tended to do the same. Yet surely they have overlooked that CB is just as much part of amateur radio as SWLing – you don't *have* to hold a licence if radio is your hobby.

If the RSGB were to include CB as part of its constitution, and were prepared to set up a sub-committee to deal with it, backed by a group of sensible hams and breakers who really care, there would be sufficient pressure to get CB off its knees.

David Harding, Kent Coast Monitors

ENJOYING SWLing

I have been a SWL for about 3 years and I thoroughly enjoy the hobby; my son also enjoys to sit at the rig and tune around the bands, although he is mainly a mobile CB enthusiast.

I was operating on 27MHz but have now given up due to the number of wallies and several nasty phone calls and QSL cards. I'm now awaiting delivery of a 934MHz rig and hoping it will be a little better up there.

I thought I would write and say that I think Trevor Morgan's (*SWL*) efforts are very good (keep up the good work).

I will not enter the QSL card competition as I have my own but I think it's an excellent idea for newcomers to the hobby.

Both my son and myself have a fair collection of QSL cards from around the world from licensed hams and broadcast stations including Asia and Vietnam.

Our equipment this end is a Trio R1000 and a Grundig Satellit 1400 with a home brew ATU and 60m of wire with half-size G5RV. The G5RV seems to make the Rx more selective; perhaps Trevor could comment on this in his column at a later date.

I have not taken the RAE as at 54 years, although I feel I could tackle most of it, I don't think I could handle the maths; this has always been my weak subject. Never mind, I still enjoy being a listener.

I have made a good friend in G6HD through being an SWL and have learnt a lot about radio from him. Most of his equipment is valve and home brew, and I love getting into his shack.

Den Marriott, Bealeyhead

EDITOR AN ACCESSORY?

I was always under the impression that you could not monitor transmissions not intended for general reception, and now the new act states that even possession of equipment capable of transmission, and apparently reception, is an offence. So how is it that all the emporia advertising in your fine magazine are offering just that?

One can buy VHF & HF rigs capable of covering protected frequencies, the FT290R being a prime example. Are the emporia committing an offence? Is the editor an accessory?

You may state that the laws are unenforcable, or that it's a victimless crime, maybe, but what of the campaign to *'Stop the city'?* Remember? There were rumours of transmitters (freely available from some magazines, although not your own) being used to jam certain frequencies; happily it did not occur.

The disclosure of protected frequencies can and will cause damage to us all, I have heard precise frequencies and their origin stated on GB3NL. This flippancy could lead to radio amateurs being treated as members of the public not to be trusted.

The play 'CQ' did not exactly show us in a bright light, Norman, of course, being a liar.

Dino Bragoli G6RBY, London N20

STRAIGHT & LEVEL

All the latest news, comment and developments on the amateur radio scene

REVIEW OF ORYX SOLDERING IRONS

This month we take a look at various selections from the Greenwood Electronics Oryx range of soldering irons, kindly supplied to us by the manufacturers in Reading.

The various types discussed here illustrate the variety of soldering irons available to the amateur constructor and the following is intended as a guide for the would-be buyer to assist him or her in making a choice appropriate to their needs.

The main items from the Greenwood range examined here are the Oryx TC82 45W and Micro P-66 miniature iron, both supplied with power supply/soldering stations. The Super 30 and M3 (miniature) irons which plug straight into the mains, and the new Portasol portable gas soldering iron.

Oryx Super 30

Super 30

The first iron examined was the Oryx Super 30 younger brother (are soldering irons made?) of the more expensive Oryx 50, which additionally features temperature control.

The iron was supplied with a long-life tip, replacements for which are available in a range of shapes and diameters. We would immediately recommend these iron-coated tips over ordinary ones, since the former should resist pitting and are easily cleaned with a damp cloth, with no need for filing. A safety stand with bit cleaning sponge trough is available for this unit and is also highly recommended for both safety and convenience. The hook supplied on the iron is sufficient, but for regular bench use the stand, price £5.00, is a desirable accessory.

The iron itself is rated at 27W and certainly seemed to 'chuck out' enough power for quick and easy soldering. A small light on the handle indicates when it is switched on.

The power was quite sufficient for some 'hard-work' soldering jobs, such as RF screening of completed construction projects when necessary, and the iron would easily cope with the PCB work inside the unit as well!

The one drawback would appear to be the rather short lead, necessitating a bit of thought about the placing of extension leads/power points, either for comfortable regular bench use, or for specific jobs around the house or shack.

The Super 30 with 3.2mm long-life tip costs just £6.50 with other long-life tips of various dimensions costing £1.44 each.

M3

The next iron we looked at was the Oryx M3 miniature soldering iron. We particularly liked this iron, although the proviso about lead length mentioned for the Super 30 also applies here.

It was, however, very neat and well-balanced, and being lightweight it had a lovely 'feel' during use. The iron is rated at 17W, with replaceable push-on 1.6, 3.2 or 4.8mm tips, and would seem perfectly adequate for much hobby construction work, although perhaps not as happy with some of the more 'heavy duty' applications.

One particularly admirable feature is the 12V version, fitted with a cigarette lighter plug for in-car use. This will no doubt interest many amateurs who do a lot of mobile operating, especially for repairs and adjustment in the field or at 'the rally'.

In such instances the stainless steel hook is quite sufficient for slinging over the steering wheel while in use, but ensure that when you've unplugged it and are about to drive off that you DO NOT sit on it (ie don't forget to let it cool).

The elegant stream-lined design of the M3 definitely lends itself to in-car use, particularly since most such jobs take place in less than comfortable positions somewhere underneath the dash, where the combination of a twisted-neck, ham-fist (?) and a clumsy iron can lead to problems, mistakes, or (lest we forget) fraying tempers.

The M3 costs £5.95, and the required voltage – 210/240V (for use from mains); 220V or 12V (for mobile use with plug) should be stated when ordering. Replacement tips are available, priced at 72p.

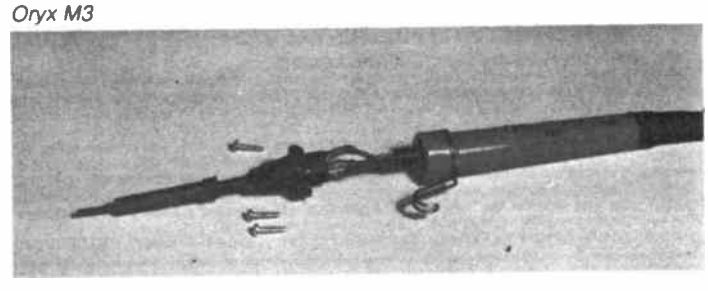
Micro series

The next unit we looked at was the Oryx-Micro PSU-6 soldering station which must surely feature one of the smallest soldering irons generally available today. The iron is only 166mm long, the tip taking up roughly half this length, and it weighs in at around 4gms.

The power supply is housed in a plastic case which features a station stand and cleaning sponge. Inside the case the transformer and wiring is safely laid out and well constructed. The power supply provides a stable 6V output to the 6W iron, whose tip is around 360°C. Even at only 6W the iron is quite sufficiently powered for many hobby applications, particularly when dealing with minute or intricate jobs, and its small overall size makes it suitable for many domestic applications where there is only limited room to manoeuvre.

The problem with its relatively low power rating is

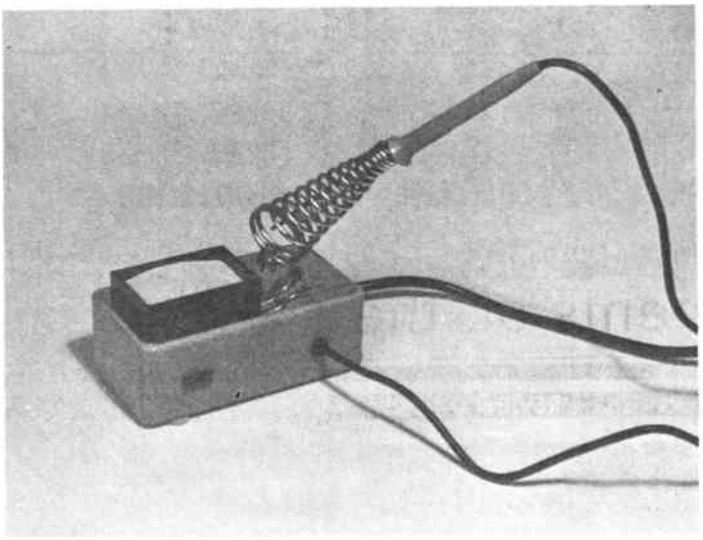
Oryx M3



that if the iron is intended for regular 'heavy' use over long periods, a question mark must be placed against its ability to avoid burning out.

Certainly if you do a lot of delicate work this iron is worth considering for the convenience which its amazingly small size and light weight provide, and its construction cannot be faulted. If, however, you are only going to buy one soldering iron for general purpose work, it is unlikely that this will be the one for you.

The PSU-6 6W iron costs only £13.45, and if you are considering a lot of delicate work, the advance temperature controlled version, the PSU-6TC, at a price of £23.95 may well appeal, offering the versatility of tip temperature variable between 175 and 400°C by a switch on the PSU, and external tip earthing.



Oryx Micro

TC82

For the serious amateur looking for a soldering station which is versatile, heavy duty and which will last for a long time despite regular tough use, then the Oryx TC82 soldering station is one to consider.

The iron itself is robust (yes we dropped it!) and solid, without being too large or heavy. There is also sufficient chord (1.5m) between the handle and the PSU, and the PSU mains.

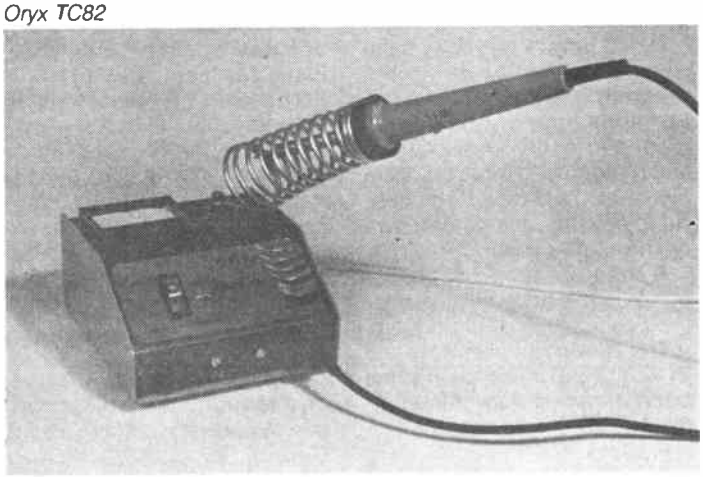
The PSU itself is of sturdy metal construction, giving 24V output to the iron from the mains. Its assembly is neat and includes internal fusing, and provision is made for additional grounding with an earth terminal on the back of the box.

The outside of the case features a rocker switch which is illuminated when the mains is switched on, and provision for switching between two irons using one of two socket arrangements is also provided.

The unit also has the tip cleaner and the useful station stand mounted on top of it, providing a functional and attractive set-up for any workshop. The TC82 iron offers a healthy 45W from its 24V supply, as good a power-rating as one should require in almost any soldering situation. The iron also features temperature control by means of a small socket on the handle which is adjusted with the aid of an Allen key.

By this means temperatures between 260 and 240°C can be selected by the user for special applications. No internal adjustment in either the iron or PSU is required to do this, and changes can be made while the iron is on – so if you think you're a bit short on tip heat you just turn it up. 13 styles of iron-plated tip are available.

Oryx TC82



The TC82 iron with power supply cost £41.50, but it will last you for years even under persistent regular use. The 240V mains version cost £16.50, but in this case the safety stand with tip cleaner at an additional £5.00 is recommended for ease of use and to reduce the risk of self-soldering (this is not a revolutionary new technique, it is literally soldering oneself when you or a visitor find the tip of the iron hooked to the side of the workbench, normally done with your bare arm or elbow).

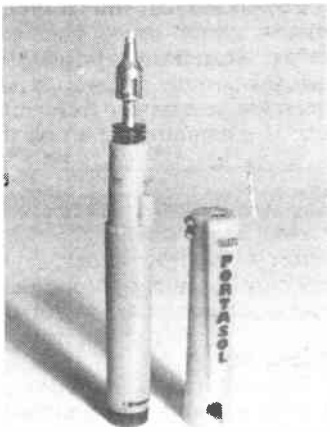
Portasol

And now for something completely different. Greenwood also sent us the Oryx Portasol, a soldering iron which runs off lighter fluid! Filling is achieved without an adaptor from a normal lighter refill can, after which the iron is ignited using a flint in the cap. After a brief period, in which the tip flames the catalytic converter, the tip heats almost immediately and there is no flame during operation.

The temperature at the tip can be adjusted by a small dial on the base, and the range available is between 250 and 450°C. Amazingly, the iron will run for one hour on one fill of gas, and can then be re-filled immediately in seconds for continued operation.

There are two drawbacks in use that are worth noting. Firstly, the sample we had occasionally flamed up on ignition which could catch your unsuspecting hair or eyebrows – although this may have been due to the valve on the review sample. The other problem is that when switched on, but temporarily out of use, it must either be stood on end (on a flat surface) or placed on its side on something which it will not roll off of and which will not be damaged by the heat of the clip at close proximity. In the latter case a hook might be improvised, and in the former common sense and care should prevent any problem, although we do feel that if this is a regular occurence a warning to that effect should be included.

Despite these minor (but worth noting) problems, the applications for this instrument are mind-boggling. In appearance it is like a jumbo felt-tip pen and can be easily and safely carried in a pocket, brief case, glove compartment or tool kit. Refilling is so easy that it really is 100% portable. The tip heat is equivalent to 60W output, so it is not just a toy.



Its applications in /M, /P or even /MM operation, as well as other uses in normal life (remember that?) such as DIY or outside work should be obvious to all.

The Portasol costs just £17.25, with replacement tips including the converter in three sizes (2.4, 3.2 and 4.8mm) priced at £4.00. With the provisos mentioned above, this unit is very highly recommended indeed.

We hope that this review has been of help to those contemplating the purchase of a soldering iron, and illustrated the pros and cons of the different irons available for different applications.

The Oryx range is available from Greenwood Electronics, Portman Road, Reading, Berks RG1 NE. Tel: (0734) 595844.

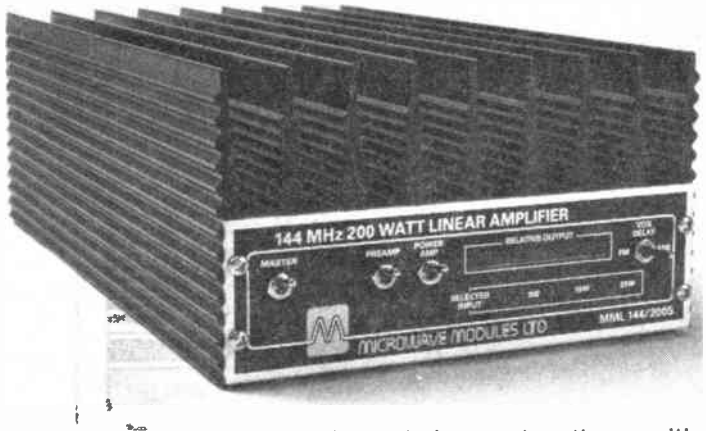
STRAIGHT & LEVEL

MML144/200-S

Microwave Modules' new product has been introduced to cater for the growing requirements for a highpower 144MHz solid-state amplifier. The amplifier provides an output power of 200 watts and is fully compatible with transceivers having output powers of 3, 10 and 25 watts. The input power level is manually selected to suit the transceiver in use, and in this way this single product is suited for use with mobile, portable or base station equipment.

Several front panel mounted switches controlling the internal switching circuitry allow the unit to be left in circuit at all times. Thus the linear power amplifier and the GaAsFET receive preamplifier can both be independently switched in and out of circuit. In this way, all four operational combinations are possible.

By means of an RF Vox circuit the linear will automatically switch on to transmit when 144MHz drive is applied to the input socket. It is possible to override this facility by connection of an earth



to the phono socket located on the rear panel. This connection is compatible with all current transceiver PTT lines. The RF Vox has switch delay times for SSB and FM modes.

The quality design of this amplifier ensures highly reliable and ultra linear performance, thus making the unit ideal for all modes of communication (SSB, FM, AM and CW).

The receive pre-amplifier uses one of the latest dual-gate GaAsFETS in a noise-matched configuration. This technique, together with careful optimisation of overall gain, makes the pre-amplifier ideal for use ahead of any popular 2 metre transceiver.

All circuitry is constructed on a high quality glass-fibre printed circuit board, and the unit is housed in a highly durable extruded aluminium enclosure.

For further information contact Microwave Modules, Brookfield Drive, Aintree, Liverpool, L9 7AN. Tel: 051-523 4011.

MULTIMODE TRANSVERTER

The MMT144/28-R is a new transverter from Microwave Modules designed to allow users of HF transceivers to achieve a first-class transceive facility on the 144MHz band.

The rugged receive section uses a GaAsFET in a noise-matched configuration feeding a high level double balanced mixer. In combination with the JFET amplifier for IF gain, this gives a good signal to noise ratio, with excellent immunity to overload and cross modulation.

There are two separate low noise oscillators, selection of which is made using a quad op-amp circuit. Simplex, repeater and reverse repeater operation are provided. Design of the unit is such that the high level injection is extremely pure and free from harmonics.

The transmit section incorporates an ALC circuit in order to produce a totally clean signal from the transverter. The 28MHz input, of ¼-300mW, is amplified after the RF Vox, ALC control and input level control circuits to an output power of 25 watts.

Indication is given on the front panel of power on, transmit, and relative output power.

Microwave Modules Ltd, Brookfield Drive, Aintree, Liverpool L9 7AN. Tel: (051)523 4011.

MORSE TUTOR

PNP Communications are announcing the release of a *Morse tutor* program for the Amstrad CPC 464 computer. The program, which is available on cassette, takes a structured approach to the problem of gaining proficiency in the sending and receiving of Morse code. Five modes of operation are possible: structured tutor, specify letters to be practiced, select random words from internal library, type in text to be coded and load text from data cassette.

Over two hundred words are available in the standard internal library and they have been chosen to cover a wide range of letter combinations. Further words or text can be loaded into the program from a previously prepared data cassette. This feature is useful in setting up a dummy-run of the Morse test.

A separate program is supplied on the tutor cassette for the preparation of data tapes.

The speed range is from 4 to 24 words per minute and has been timed using the standard 'PARIS' test word.

Figures are included as a separate section in the structured tutor and can be intermixed with letters in the 'text' modes. Punctuation characters may also be mixed with text and figures in the 'text' mode.

The program is available on cassette, price £6.90 including VAT and post and P&P.

PNP Communications are also bringing out a new 'matched-filter' type RTTY/CW receive only terminal unit.

The terminal unit comprises two active filter chains. One fixed at 1275Hz for SPACE and the other is Electronically Switched to either 1445Hz for 170Hz shift or 1700Hz for 425Hz shift or 2125Hz for 850Hz shift MARK signals. This channel is used for Morse reception. The TU also has the PNP ALC system to cater for a wide range of input signals and to compensate for signal fading. A 'bargraph' tuning indicator is provided to ensure accurate tuning which is necessary for the reception of RTTY.

The TU is suitable for the reception of signals in excess of 200 Baud and for the reception of AMTOR etc. TTL level outputs are provided for *'normal'* and *'inverted'* signals and power is available for a transmit tones generator.

The TU is priced at £32.50 plus VAT, including P&P.

PNP Communications, 62 Lawes Avenue, Newhaven, East Sussex BN9 9SB. Tel: (0273) 514465.

SUTTON & CHEAM RS

The Sutton & Cheam Radio Society meet on the third Friday of each month between 7-8pm at Downs Lawn Tennis Club, Holland Ave, Cheam. In addition to the club meetings, talks and demonstrations are organised for members.

The club operates nets on Tuesdays at 10.30am – SSB 3.770MHz, Thursdays at 8pm – SSB 144.390MHz, and Sunday at 10.30am – FM rendezvous on 144.500MHz. The newsletter, which is brought out monthly, includes all the club news and club contest results.

Anyone requiring further information please contact the Secretary, Alan Keech G4BOX, 26 ,St Albans Road, Cheam.

STRAIGHT & LEVEL

150th ANNIVERSARY

A special commemorative callsign VI3WI will be on the DX bands until at least 30th April 1985. The callsign is part of the 150th Anniversary celebration of European settlement in Victoria, Australia.

VI3WI will be activated on a roster basis by selected members of the Wireless Institute of Australia and its affiliated clubs. All DX bands and all modes will be used – a commemorative QSL is available, either direct or via the VK3 QSL Bureau.

A special award certificate is also available if you contact (SWLs log) one station in VK3 during the period November 1984 and 30th April 1985.

A QSL card for the qualifying contact, endorsed with a congratulatory message on Victoria's 150th Anniversary, plus $2 or equivalent, should be sent to the address below.

The Wireless Institute of Australia is also running an International RTTY Art Competition as part of its own 75th Anniversary celebrations.

Entries must not contain more than three overlinings, and be submitted with a hard copy printout and baudot tape.

There are three categories of entry: best hand generated original submitted by its author outside VK; best hand generated original submitted by its author who is a VK; best non-original hand or computer generated RTTY picture.

QSL's and/or entries for the RTTY competition should be sent to: Wireless Institute of Australia, 412 Brunswick Street, Fitzroy, 3065, Victoria, Australia.

HASTINGS RC

Hastings Electronics & Radio Club meet on the third Wednesday of each month at 7.45pm in the Westhill Community Centre, Downey Close, at which they have a variety of talks and demonstrations.

The club magazine, *Vital Spark*, is brought out monthly, and includes a variety of club news and comment.

It also includes construction projects which are written and illustrated by the members, an example of which is a very good construction project on a mobile mount for the FT290R, which was included in the most recent magazine.

Anyone requiring further information please contact Derek Edwards G4KMJ. Tel: Hastings 752383.

RTTY PROGRAM

Pearsons Computing are announcing new software – the G1FTU RTTY program. This program allows the 48K Spectrum computer to transmit and receive RTTY with *no* interface or terminal unit. The user simply connects the EAR and MIC sockets on the Spectrum to the external speaker and audio input (MIC) of his transceiver.

The program features split screen operation with full type-ahead during receive and transmit, and the user has his own personalised CQ memory and eight other memories, of up to 255 characters each, which may be saved on cassette.

Features include baud rate variable between 45 and 110 baud, variable transmit tones, on-screen tuning indicator, unshift-on-space, and the capability to receive reversed 'mark' and 'space' tones.

The program also provides the user with a unique 'clarifier' facility for tuning accurately to FM RTTY tones.

Prospective buyers of the program can be assured that it will run correctly on *all* issues of the 48K Spectrum, including those fitted with microdrives, printer, joystick interfaces etc – so that you don't have to dismantle the system in order to use the program – as with some of the software on the market today.

The program costs just £10 inclusive and orders from licensed amateurs should be accompanied by a callsign for the CQ memory. Non-amateurs will be allocated a 'dummy' callsign.

Further details may be obtained from John Pearson. Tel: (0246) 810652.

DX DIARY

News for HF operators compiled by Don Field G3XTT

I write this column in the aftermath of the CQ WW SSB Contest at the end of October. This year's contest produced the kind of propagation which might have been anticipated, with fair conditions on the lower bands but very little on 10 metres. I did, however, manage some QSOs with Africa and South America on 10m including some relatively rare ones such as FH8CB, FR0FLO and 3D6DX.

At the other end of the spectrum, 160 metres produced some interesting DX in the UK including CN8ES, D44BC, VP2EC, VP2VCW, VP9AD, Z21EV and 5B4EP. Unfortunately I wasn't able to work them all!

Ten metre FM

With the falling off of propagation on 10 metres, interest is beginning to focus on ways in which the band can be used during the sunspot minimum years. Already we have seen satellites in which the uplink is on 2 metres and the downlink on 10. There have also been FM repeaters along similar lines to those many of you will be familiar with on 2 metres. There are many such repeaters in the USA, and several have now been established in Europe. There are also moves afoot to establish such repeaters in the UK. The frequencies used would probably be in the same part of the band as other 10 metre FM operation, though there is a question as to whether they should occupy exactly the same channels as the US repeaters or whether different channels should be found.

The argument for different channels is that interference can be avoided at times when the North Atlantic path is open. On the other hand we can assume that, in due course, every country will have 10 metre repeaters and there will not be enough channels to go round. Perhaps the solution is to recognise that repeaters are there to aid users of the band when ionospheric propagation is not possible, and at times when such propagation is possible the repeaters should be turned off.

I suspect that the very idea of repeaters on one of our HF bands will raise the hackles of many readers of this magazine. However, 10 metre FM is already with us (often by way of converted CB rigs) and repeaters seem almost inevitable. It is certainly arguable that we must do everything possible to keep up 10 metre occupancy during the sunspot minimum to avoid the less scrupulous CB operators muscling-in on our hard-earned frequencies.

Flounder

A Japanese suggestion for linear repeaters on 10 metres (to handle SSB, etc) looks set to flounder however, which I believe is just as well because such a repeater would require a wide frequency split between input and output which would produce very difficult band-planning problems.

Whatever your views, I would be interested to hear them. In particular it would be interesting to hear of any other suggestions for encouraging 10 metre activity. As far as this is concerned, it is worth remembering that there is a very extensive beacon network operating on 10 metres which permits a quick appreciation of propagation conditions even when no non-beacon stations can be heard. It is surprising how often ten does open up to distant parts of the world, and at such times a CQ call can lead to some interesting contacts.

The recent CE0AA operation has been a salutory lesson in this respect. Many UK stations were eventually able to work CE0AA on 10 metres, sometimes as late as 2200 GMT when the CE0 was the only station to be heard on the band.

Alan T31AT while in the UK recently

News

Having just mentioned CE0AA, let me go on to give you the latest news on this one. The Chilean operators eventually left San Felix Island in late October, having made many people happy with a new contact. The majority of their operation appears to have been on SSB, though some UK operators report CW QSOs on 15 metres. The QSL route is as given in last month's column, so let's now keep fingers crossed for some speedy work by the Chileans to get the cards organised.

KL7Y, one of Alaska's best-known amateurs, has written to G4ISK with the news that many Alaskan amateurs will be looking for low band QSOs with Europe this winter. KL7Y himself has a 40 metre beam at 38 metres high, plus loops at the same height for 80. KL7U has a similar set-up. KL7AF has a big vertical antenna on Kodiak Island and in previous years has often been able to give European stations their first 80 metre contact with Alaska. Other stations expected to be active include KL7NT, KL7H, AL7BL

and KL7KJ. KL7Y does, however, make the point that he frequently hears European stations at the top end of 80 metres ragchewing with the louder East Coast USA stations, totally unaware that they could be working Alaska.

Maldives

I4ALU sends news that he will be holidaying in the Maldive Islands from December 27 to January 7 and expects to be active (CW only) as 8Q7BX. Last time he went there he was able to work into Europe on 40, 20 and 15 metres, so it will be well worth looking for him around the usual CW DX frequencies if you need this one.

F6GXB and F6AJN (ex-FB8ZQ) are currently in Chad and expect to be there for 'a few months'. They have already been worked on 15, 20 and 40 metres, both with SSB and CW, and are very good operators. All that remains to be seen is whether their operation is acceptable to the ARRL for DXCC awards purposes. The fact that they appear to have been issued with a TT8 call rather than operating as /TT8 (as F6BFN/TT did earlier in the year) is probably a good omen. QSL cards go to F6GXB who will, presumably, deal with them on his return to France.

Over-turned

In the September issue I mentioned the matter of Baker, Howland and American Phoenix Islands and whether this would become a deleted country. Although such a move was recommended by the ARRL DX Advisory Committee, the recommendation was overturned by the ARRL Awards Committee by a 6-1 vote. In consequence the status quo prevails and those who were waiting in the wings to activate the 'new' country of Baker, Howland and Phoenix Islands will have to find somewhere else to go.

VE special

Yet more Canadian special prefixes are in the pipeline, this time to commemorate the centennial of the Greenwich meridian and standard time signals, the main advocate of which was a Canadian, Sir Sandford Fleming. These special prefixes commenced on October 13 and run until December 13, and many of them were in evidence in the CQ WW Contest. VE1-8 becomes XN1-8, VY1 becomes XO1, and VO1-2 becomes XL1-2.

Special prefixes seem to me to be rather like commemorative stamps; they are very nice from time to time but lose all meaning if used at the drop of a hat.

Two well-known DXers, F6BEE (left) and F6GXB (right) – currently active as TT8CW

Far East

JE1JKL was due to be active as 5W1EZ from November 20-21, and as NH6J/NH8 from November 22-25. If you caught him, QSL to his home address: Saty Nakamura, 3-16-6 Shibakubo, Tanashi City, Tokyo, 188 Japan.

BV0BG was also due to be operational from Taiwan in late November (20-29), including operation in the CQ WW CW Contest. The suffix 'BG' indicates Senator Barry Goldwater, K7UGA, one of America's best known amateurs. Unfortunately the Senator had to pull out of the trip, but K3ZJ, K2TT, K3ZR, W3LPL, K3TW, K4YT and, possibly, K4FJ were expecting to go.

I have an interesting letter from JA2GQO giving details of 160 metre activity from Japan. It is not very many years since the Europe-Japan path was first cracked on 160 metres, but JA2GQO reports that Japanese stations have now worked a total of 36 European countries on the band, which represents an enormous achievement on the part of all concerned. Usual practice is for the Japanese stations to operate between 1907.5 and 1912.5KHz (this is the total Japanese allocation on 160!) and to listen lower down the band.

JA2GQO reports that some frequencies are clearer than others when listening from Japan and recommends European stations to use 1826, 1828 and 1831KHz. He notices two peaks in propagation, one between 1900-1930 GMT, and one at his sunrise. Even by mid-October he had heard a number of European stations, although the best time of the year from the UK in the past has been from November to January. Stations in western Japan have an easier propagation path to Europe than those in the east, so you are more likely to hear JA3, 4, 5 and 6 stations than other prefixes, and JA6 stations are especially favoured.

Wallis Futuna and ZL1AMO

ZL1AMO showed up from Wallis and Futuna Islands as FW0BX in the latter part of October and was worked in the UK on both 20 and 40 metres. This was his second major expedition this year as he was a member of the Kermadec expedition earlier in the year. Ron has in fact operated from many islands in the Pacific and is a super operator, especially on CW. It is often assumed that DX operators such as Ron must be millionaires with nothing better to do than visit out-of-the-way islands. Ron, however, is a taxi driver who happens to be very keen on DXpedition operating (he has now participated in roughly 16 expedition operations). When away from New Zealand he apparently leases his taxi to a friend so that at least it is still bringing in some revenue.

Wallis Island, the latest of Ron's DXpedition venues, is named after its European discoverer, Captain Samuel Wallis of HMS Dolphin, who discovered the island in 1767. It had, however, already been colonised by natives from Tonga who received subsequent visits from Europeans in 1781, 1791 and 1837. On this last occasion the visitors were missionaries who converted the islanders to Christianity.

Protectorate

In 1887 the island became, after an earlier request by its king, a French protectorate, and was joined with Futuna Island for administrative purposes in 1909. In 1913 the group of islands became a fully fledged French colony. Following a referendum in 1959 it became an overseas territory of France. Futuna Island (and its companion Alofi) was settled initially from Samoa, and received its first European visitors in 1616. Its development continued quite independently of Wallis Island until 1842, from which time its political development has run parallel to that of Wallis Island.

Geographically, Wallis and Futuna Islands are 125 miles apart and are linked by an inter-island air service. Wallis has the greater population; 6000 to Futuna's 3200. The islanders live off subsistence agriculture, supplemented by funds sent back by relatives working abroad, a situation common to many of the Pacific islands.

Contests

The principal international contest in December has tended to be the ARRL 10 metre contest which takes place over the weekend of 8/9 December and is a 48 hour affair, with both CW and SSB allowed. Participating stations are not limited to working the USA, but just what will be workable this year depends almost entirely on the vagaries of the sun. Also, don't forget the TOPS 80 metre CW contest the previous weekend (see last month's column for details).

Finale

That concludes for another month. I may be moving house in the near future so, rather than send mail to my home address with the risk of its getting lost, write to PO Box 146 Cambridge.

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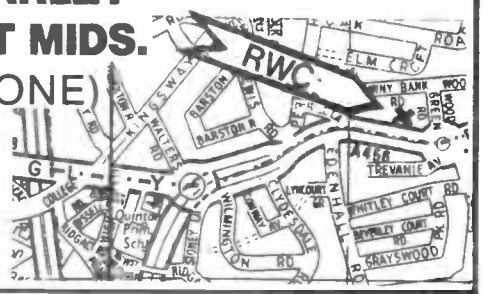

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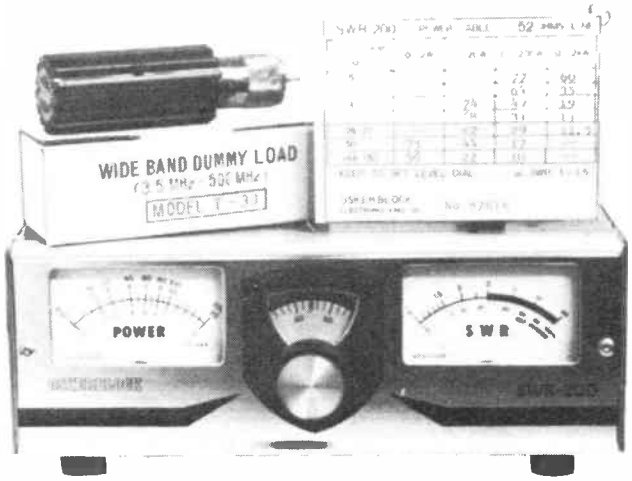

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ON TEST: TAU SYSTEMS SPC3000 TRANSMATCH ATU

Reviewed by Angus McKenzie G3OSS

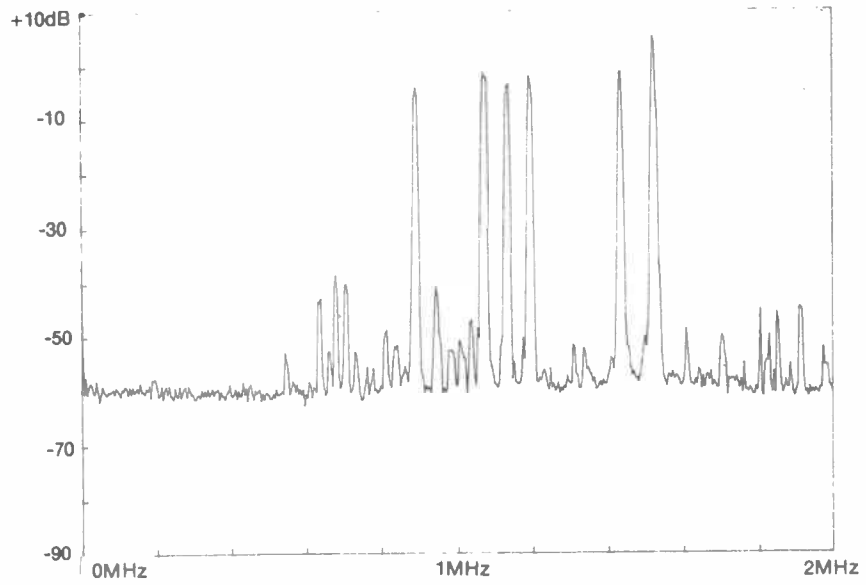


Fig 1 *Top band dipole via balun direct into analyser. Scan 0-2MHz. Resolution bw 3KHz*

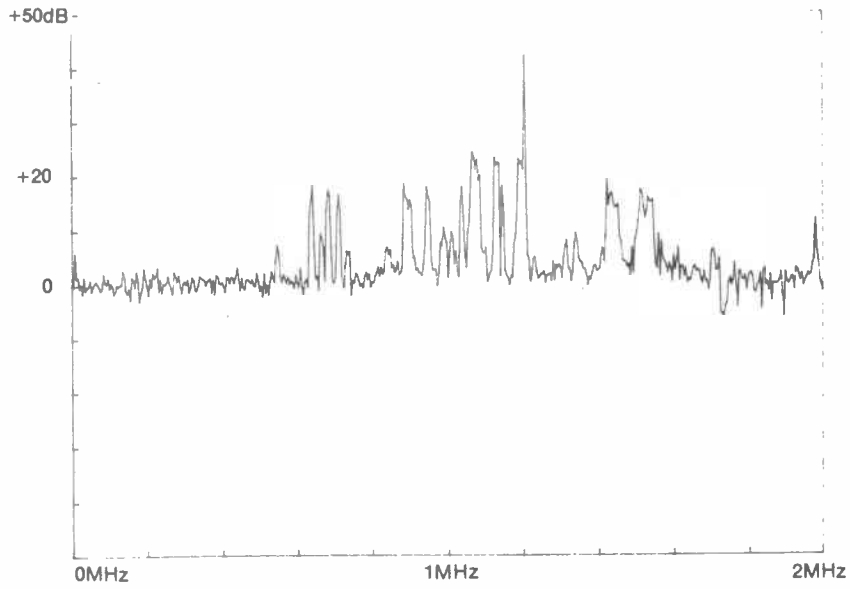


Fig 2 *Rejection given by Drake MN2700 when perfectly matched at 1.9MHz. Scan 0-2MHz. Rejection in positive dBs. Resolution bw 3KHz*

One might well ask the question, 'Why does one need an ATU with today's rigs and aerials designed to match comparatively well?'. A brief answer would be that whilst most aerials should match well in the centre of their designed frequency bands, at the edges the SWR can reach alarming proportions. Just as important though if you are an LF band operator, is the fact that a well designed ATU can act as a good high pass filter to supplement the rather inadequate filters on most modern rigs.

Before detailing the new TAU Systems ATU, let us have a look at the receive problems typified at my own location in Finchley. I have a three band trapped dipole which is resonant at the centres of 160, 80 and 40 metres. This antenna was described nearly a year ago by me in this magazine. The antenna is within around 3:1 across the three bands, and is as low as 1.25:1 or so in the centres.

Connecting this antenna via a 1:1 balun into a very esoteric spectrum analyser, the problem can be seen in *Figure 1*, which is an analysis of the power levels received from 0 to 2MHz. Several MW stations can be seen to give alarming levels around 0dBm (1mW) into the 50ohm input of the analyser, and two stations give an alarming +7dBm into the 50ohm input. Just imagine how these levels can punish a receiver front end!

The user, almost in panic, puts in 20dB input attenuation, but the levels are still –13dBm, though of course reduced by any high pass filtering present in the radio. Such filtering though is often no more than 10 or 15dB in the area of MW that seems to cause most trouble. The result is the production of intermodulation products in Top Band from strong medium wave stations.

Figure 2 shows the effect of putting in a Drake MN2700 ATU, tuned for a perfect match at 1.9MHz, between the antenna and the spectrum analyser. The match was achieved using a Wiltron VSWR bridge combined with the analyser's sweeper output. In order to make the effect more easily visible, the analyser was set to the A-B mode so that *Figure 2* represents the amount of rejection in

dBs given by the ATU across the 2MHz coverage. The maximum rejection shown is around 25dB, just above 1MHz.

This is a useful attenuation, but it is not good enough for many receivers. When the rejection analysis of the TAU ATU was charted *(Figure 3)*, it could be seen that it achieved 50dB rejection of strong signals in the same frequency region, which is fantastic. *Figure 4* represents the actual received signals in the same coverage with the TAU ATU switched in and tuned for a 1.9MHz match; thus *Figure 3* represents *Figure 1* minus *Figure 4*.

Shocking

I hope I will have shown by now not only how remarkably effective the TAU is at removing stations below the tuned frequency, but also the shocking nature of one of the typical problems encountered with strong signals getting into a receiver.

I do not feel that an ATU should be designed to give a low pass filter action to improve harmonic radiation if this provision makes the ATU less flexible. Surely the ideal situation is to always use a proper low pass filter in the output of the transmitter which is 50ohm input and output impedance. One of the best filters is the Drake TV3300LP, the passband ripple performance being shown in *Figure 5* (0.5dB per vertical division) from 0-50MHz. Only 0.25dB drop can be seen at 30MHz, but by 40MHz the response is many tens of dBs down.

To show the full dynamic range cut-off of a filter, a 20 year old KW Electronics 50ohm filter was checked, this time the performance being plotted out on a Hewlett Packard plotter showing 60dB range *(Figure 6)*. Although the filtering at 40MHz is good at around -45dB, note that the filter approaches 1dB loss, ie nearly 25% power loss, at the top end of 10 metres. I suggest that modern components are rather better than old ones in many cases!

Prime purpose

The prime purpose of the ATU on transmit is to allow a good SWR to be achieved from almost any antenna likely to be used, within reason! Antennae are anything but pure resistances, and the reactive component can be highly capacitive or inductive. An ideal antenna on resonance should be a resistance, and if the appropriate cable of the same impedance as the antenna at resonance is used, then the other end of the cable should have the same impedance.

This situation is unfortunately rarely achieved, and the resistance and reactance of an antenna at any particular frequency when measured at the aerial input is very different from that seen at the other end of the transmission line. The antenna tuning unit has to cope with whatever is slung at it and give the best possible match to the transmitter.

Let us have a look at what the TAU SPC-3000 ATU offers and how it works. The basic circuit is shown in *Figure 7*. It will

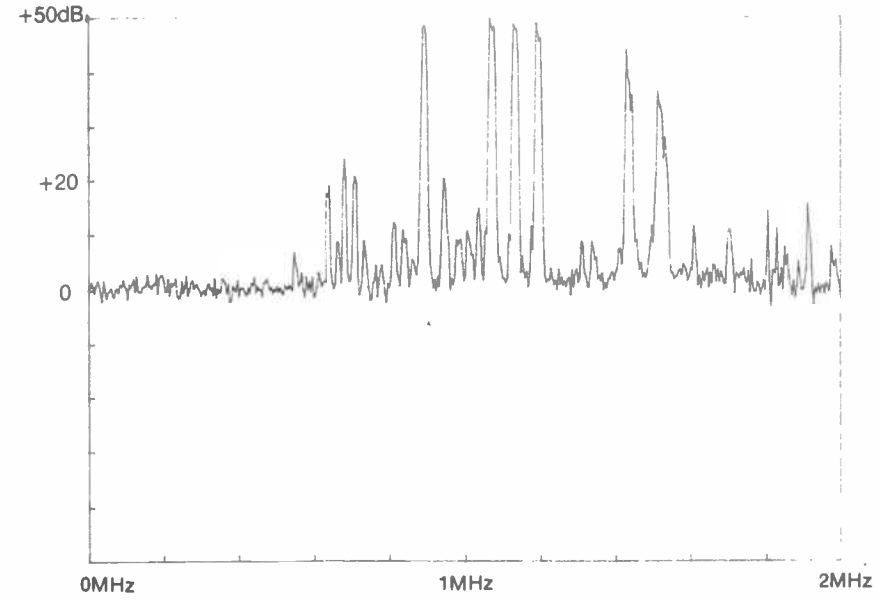


Fig 3 *Rejection given by TAU SPC3000 when perfectly matched at 1.9MHz Scan 0-2MHz Resolution bw 3KHz*

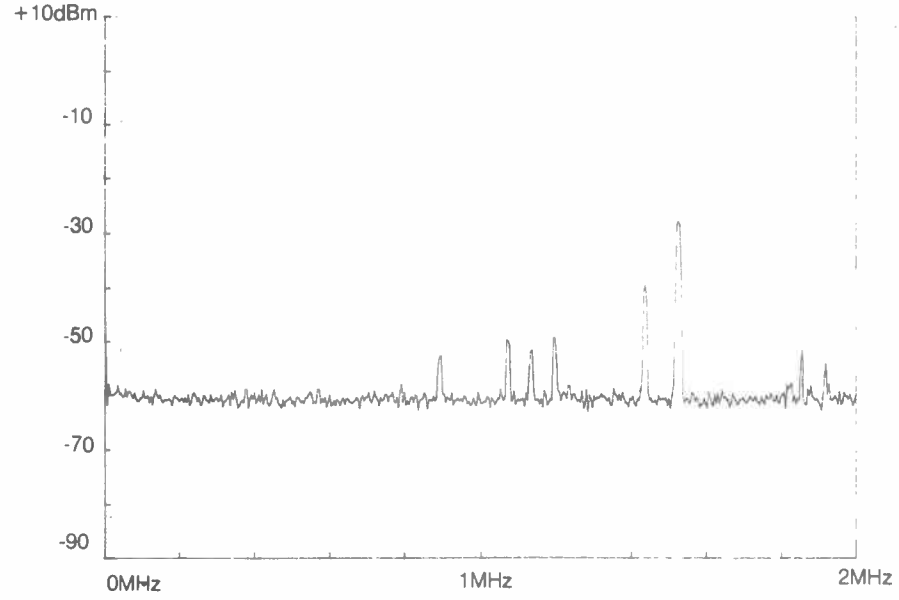


Fig 4 *TAU ATU switched in, showing high pass filter action (Fig 3 = Fig 1 – Fig 4)*

be seen that the transmitter feeds through a variable capacitance C1 (200pF) into a centre point which has a rollercoaster inductance to deck (maximum value 28μH) in parallel with one half of a ganged capacitor, with each half of value 200pF. The other half of the ganged capacitor feeds in series out to the antenna section. This circuit is known as the series parallel capacitor or SPC ATU, and its operation is detailed at length in the latest edition of the *ARRL Antenna Handbook*.

Configurations

The TAU version of the SPC circuit offers several output configurations, switched by a very high quality five position ceramic rotary. Antenna 1 and 2 interconnections are on SO239s mounted on the rear panel, a third one being provided for a dummy load connection.

Built in to the unit is a 1:4 balun, made by TAU, which has a toroidal core mounted on a flat plate, rather than the more usual ferrite rod type construction. TAU's type of design here is claimed to give a greatly improved saturation performance, and above 3MHz they claim that it should not saturate at all into a very wide range of impedances, whilst below 3MHz it should perform very well at the full ratings allowed by the British licence. The output from this balun is available on two spaced wing nut terminals.

The balun is in effect a form of auto-transformer in which the centre tap is at earth potential, whilst the live 50ohm unbalanced input is fed to the bottom end, balanced outputs being from bot-

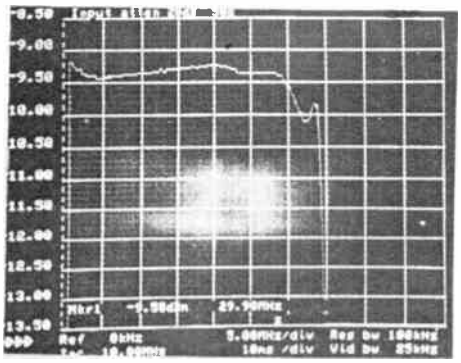


Fig 5 Drake TV3300 LP showing ripples in passband. NB O.5dB per div. scan 0-50MHz

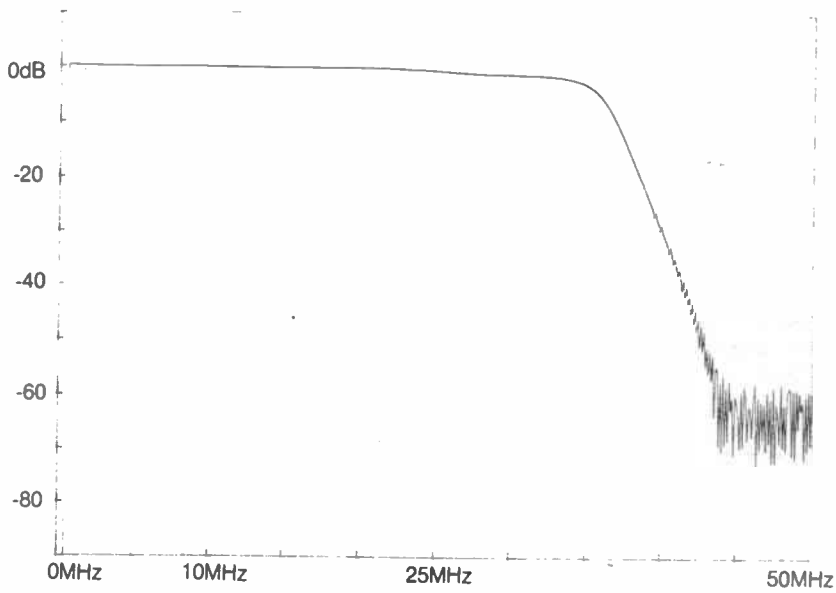


Fig 6 Overall response, KW TV filter

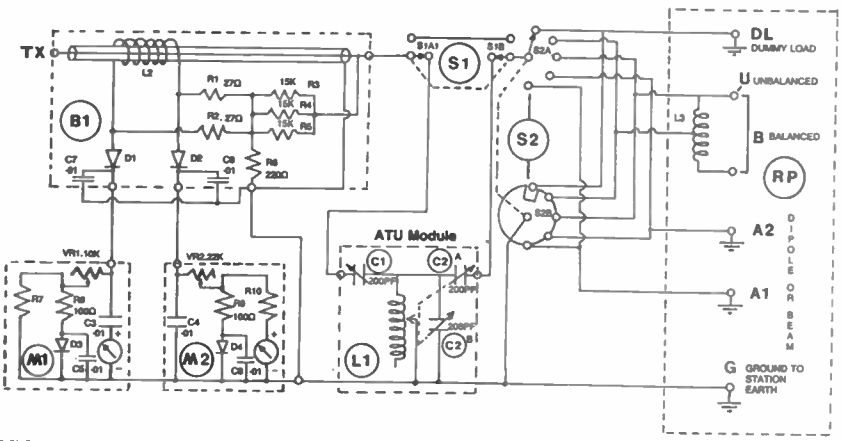
tom to top. The top end of the inductance obviously swings in the opposite polarity to the bottom end as the entire coil is mutually coupled. TAU can also supply a very similar balun for 1:1, in which the nominal 50ohm output balanced line is given by taps either side of the earth line.

The equivalent balun circuitry is shown in *Figure 8, Figure 9* representing the unbalanced balun connections for feeding a long wire against earth, again with a 1:4 step up to the antenna. *Figure 10* shows the equivalent circuit of a 1:1 balun which is optional. Within the ATU all the interconnections to the 1:4 balun are changed around as appropriate, whilst in dummy load, antenna 1 and 2 positions, balun-connections, including the balanced antenna nuts, are all earthed to case.

Output

The output antenna feed switch and the direct/ATU in switch are mounted on the front panel underneath and either side of the rollercoaster inductor turning knob assembly, whilst above this is a mechanical numerical display counting up to 44, the maximum number of turns of the tuning mechanism. Between each indicated whole turn the tuning knob itself is marked 0 to 10 with ten subdivisions, thus giving 100 points per rotation. To the left and right of the rollercoaster control are the input and output variable capacitor controls, with panel markings from 0 to 10, with half divisions also marked.

Two meters at the top of the front panel indicate output power in watts (FSD 1.5KW) and VSWR from 1:1 to infinity. In my opinion there are nowhere near enough markings between 1:1 and 2:1 on the SWR meter, and again insufficient markings on the power meter between 50 and 400W, (no 100W marking being given, for example). TAU have told me that in later versions they hope to greatly improve the meter markings.



LEGEND

B1 SENSE BOARD
M1 SWR METER BOARD
M2 FWD METER BOARD
L1 ROLLER INDUCTOR
C1 SINGLE STATOR CAPACITOR
C2 (A&B) SPLIT STATOR CAPACITOR } SPC FORMAT ATU MODULE

S1 TRANSCEIVER SWITCH
S2 (A&B) ANTENNA SWITCH
RP REAR PANEL SHOWING CONNECTIONS (includes but not shown, Tx connection)

Fig 7 The block diagram

Subjective tests

I have been using the TAU ATU for the last few weeks in my normal LF and HF station and have found that it will match virtually anything that I throw at it, even some very absurd loads. It could cope with various verticals, dipoles and beams on frequencies far away from their design ones, SWR always coming right down to virtually 1:1 when measured on an external VSWR set-up.

As delivered, the power meter overread about 20%, and the SWR meter was badly inaccurate, but TAU informed me that not only was the review sample a

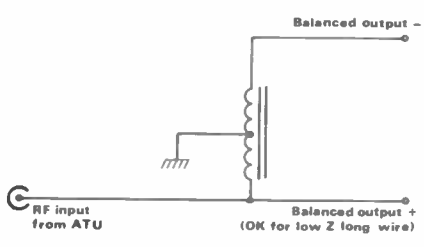


Fig 8 1:4 balun feed (balanced output)

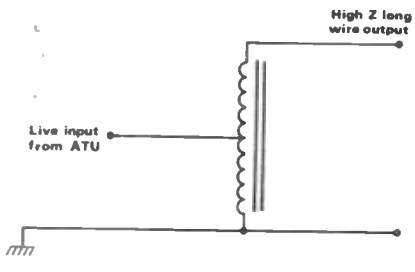


Fig 9 Unbalanced 1:4 use of balun

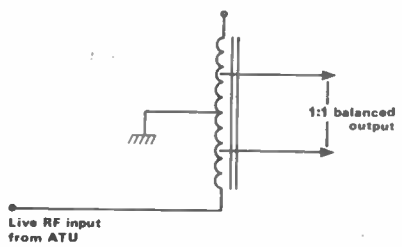


Fig 10 1:1 balun

prototype, but they now supply a preset variable resistor instead of a fixed one to set the working impedance of the bridge correctly.

The rollercoaster tuning was a sheer delight to use, and with the two variable capacitors set to around 12 o'clock it was usually possible to get a usable match from 1.81MHz up to 21.45MHz. At worst, the two capacitors did not need too much trimming for a usable match, but for an optimum match at as near 1:1 as practicable, considerable fiddling was necessary, but this was thought worthwhile.

Stiffness

For normal use, the slight stiffness and tendency to stiction of the two capacitors was not of too much concern, but when making very fine adjustments, especially for awkward loads, I found the lack of reduction gearing a little unfortunate, as the provision of really smooth gearing would gild the lily.

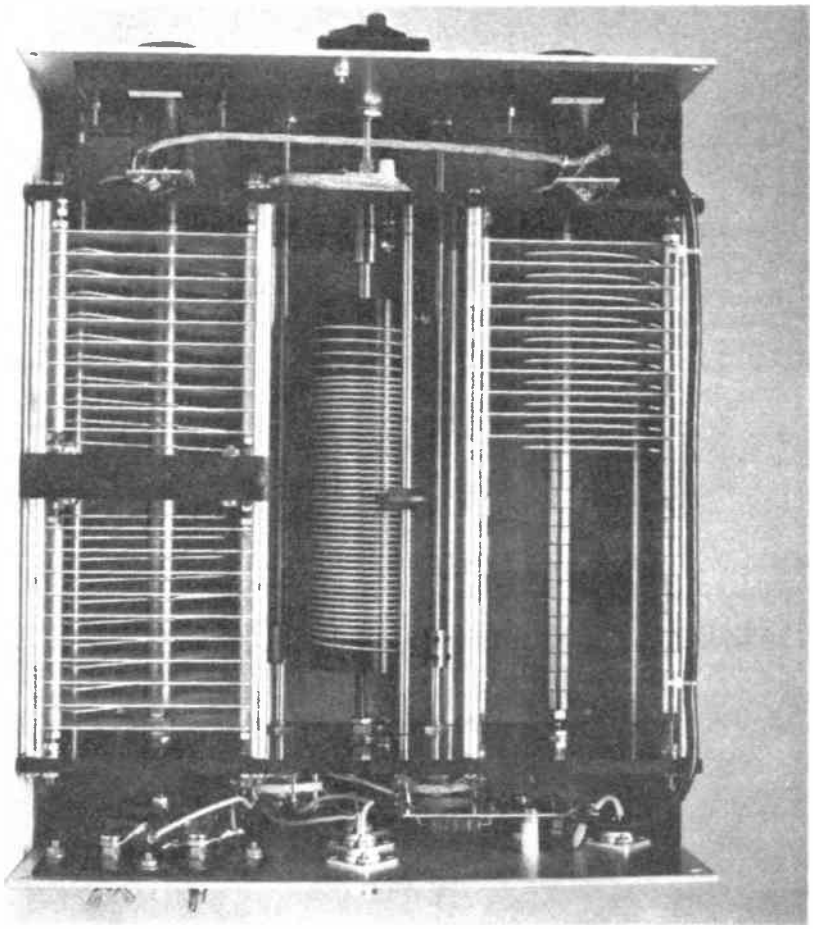
The rollercoaster inductor could not be taken down to a low enough value to obtain an absolutely first class match for many loads above 29.0MHz, although it was possible to get an acceptable match right up to 29.7MHz. When using the ATU for receive matching, it was possible to tune most antennae down to well below 1.5MHz, the lowest frequency that could be matched reasonably being around 1.3MHz.

Considering that *Figure 1* shows the signals that can be given on medium wave without the ATU from my dipole, the reader can well imagine the fun I had peaking up Capital Radio on 1.548MHz into the analyser to see how much level we could get. I retired gracefully when we reached +18dBm (62.5mW), high enough to burst your ears from headphones! You can thus see that this ATU is ideal for stealing a radio company's electricity, but do not forget that you will be sucking out RF from your immediate neighbourhood, thus causing a reduction in local field strengths!

Improvement

There was a very significant improvement in the reception capability on several AM communication receivers that I tried with the TAU when using it for short wave listening. Receivers with a poor intercept point showed a dramatic improvement if I used the antenna attenuator on the receiver with care. Obviously, the use of this ATU just for listening purposes must be considered a dramatic overkill, but it was jolly good fun!

Returning to the performance on amateur bands, I found that I could use the full RF gain on 160, 80 and 40 metres of my Icom IC751 with no trace of any problems, and distant stations were that much more easily discernible with LF stations out of band reduced in intensity. I tried the ATU with my trapped dipole system both with normal balanced connections and as a Marconi T type connection, treating the feed wires as a long wire tuned against earth. The ATU coped with all bands in this latter configuration adequately.

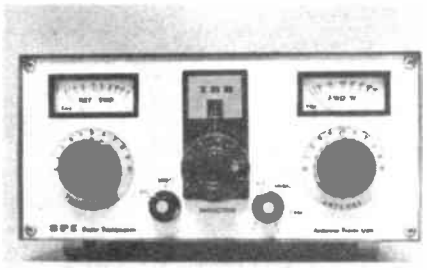


Interior view showing rollercoaster and spaced capacitors

Front panel

Although the front panel switches are of excellent quality, I did note that if I switched from ATU 'in' to 'direct', and then back again, the SWR shifted very marginally, showing that the rollercoaster was subject to very slight jogging. In practice, this should make no difference to transmission or reception, but the return loss changed typically from an amazing -50dB to perhaps -30dB, academic but fascinating.

The ATU has already been available as a kit (£149.95 excluding metres case and sockets from Cirkit Holdings Ltd), but TAU can also supply the ATU made up without the in/out and antenna switches, and also omitting the metering circuits. This, of course, is much cheaper (£249.95), and many potential purchasers may find that they do not need the extra functions. The complete system costs £349.50.



Now for some absurdities! I found that the TAU even managed to tune up into 6ft of wire plugged into the aerial 1 socket with its other end tied round a window catch. It was lousy as a receiving aerial, but it did match! We then connected the TAU to the Top Band aerial and tuned up its output via a diode into a pair of headphones and found that we had a magnificent crystal set which worked perfectly at the top end of medium wave, the rollercoaster acting as the tuning mechanism, excellent separation occurring between BBC Radio London and Capital Radio – but what an expensive crystal set!

Laboratory tests

We first undertook some very basic measurements using the IC751 as a transmitter sending carrier through a Bird 4266 bi-directional coupler, then through a Bird watt meter, through the ATU and out from the antenna 1 socket into another Bird watt meter and thence to a Rohde and Schwarz 30dB power attenuator load. A Racal 9303 microprocessor-controlled power meter was used both with the directional coupler and with the output of the attenuator load for measuring very accurate return losses and power losses.

At 14.2MHz, the loss with ATU switched to the bypass mode was around 0.2dB,

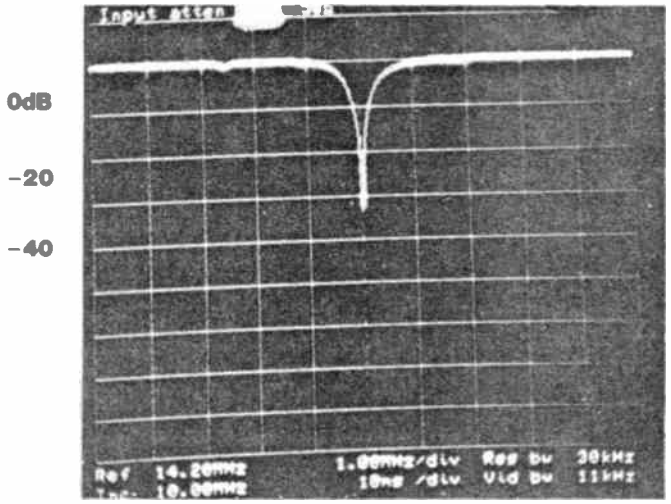


Fig 11 *TAU ATU return loss in dBs versus frequency when tuned at 14.2MHz into 1000 ohm resistive*

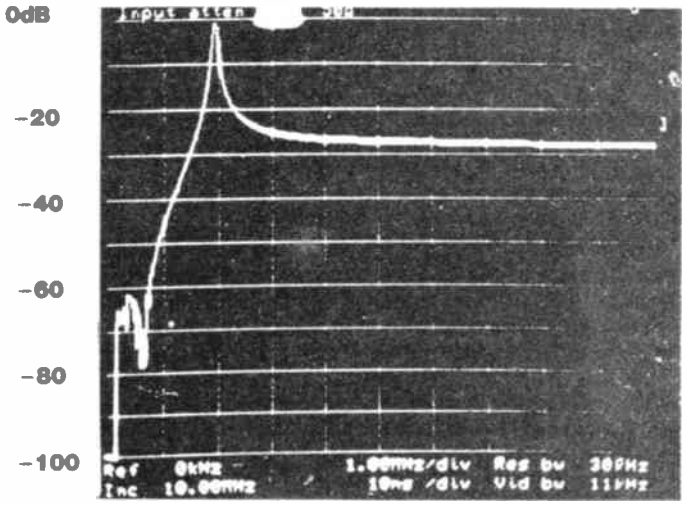


Fig 12 *Frequency response through TAU when matched 1 9MHz into 114 ohm/1000pF. RF probe across load. 0 - 10MHz*

whilst with ATU in and adjusted for the best possible match the loss was around 0.5dB. I consider these losses minimal, and it is hardly likely to be of any real concern. With a normal Bird throughline power meter we found it easy to obtain no visible return power on the meter, but this system can only be used to obtain SWRs reliably down to around 1.1:1, fine for all normal use, but not sufficient for testing purposes.

I therefore connected my audio gimmick, which is very sensitive at HF, and which incorporates an oscillator in which the pitch increases as the RF input to the gimmick goes up, to the return port of the bi-directional coupler, the other end of the line having been loaded with an extremely accurate 50ohm termination. The coupler gives an output, both forward and reverse, 30dB lower than the main levels through the primary.

I nulled the bridge sending more and more power from the transmitter as the match improved until finally I was convinced that at 100W up I was not hearing any reverse power from the gimmick. We then used the Racal power meter to measure the ratio between the forward and reverse powers through the coupler, and were astonished to find a power ratio of 500,000:1, ie 57dB return loss which works out at an SWR of 1.003:1!

Too critical

This tells me that I have been much too critical for years, and I shall now use an attenuator in front of the gimmick to reduce its sensitivity! The point that this little experiment brings out is that it was actually possible to achieve such a remarkable match. I have no doubt that I could match with equal accuracy anything within the capability of the TAU.

We checked the power reading accuracy of the meters in the prototype, and found that 100W throughput was indicated as 120W. When the match was perfect, the internal SWR reading showed 1.6:1, and if we adjusted the ATU for a 1:1 indication on its own SWR meter, the TAU presented, unfortunately, approximately 1.9:1, showing the SWR meter circuitry to be way out.

We then switched the TAU to direct, and then measured the SWR on the transmitter input socket of the ATU, using the external bridge. We were a little surprised to see 1.28:1, and this is evidently due to too much lead inductance within the ATU. TAU were informed of this, and have now tidied up many of the internal connections to make them shorter.

Main tests

For the main tests we used a set-up including a Marconi 2019 signal generator feeding the RF input port of a very accurate Wiltron bridge having the return loss port interconnected with an esoteric spectrum analyser having 100dB dynamic range. Various frequencies at a level of 0dBm (1mW) were sent through the system with various loads applied to the antenna 2 socket on the rear of the ATU. Having set up the ATU for the particular load in use, we interconnected the tracking generator output of the analyser into the RF input port of the Wiltron bridge in order to see a plot of VSWR return loss in dBs ref frequency.

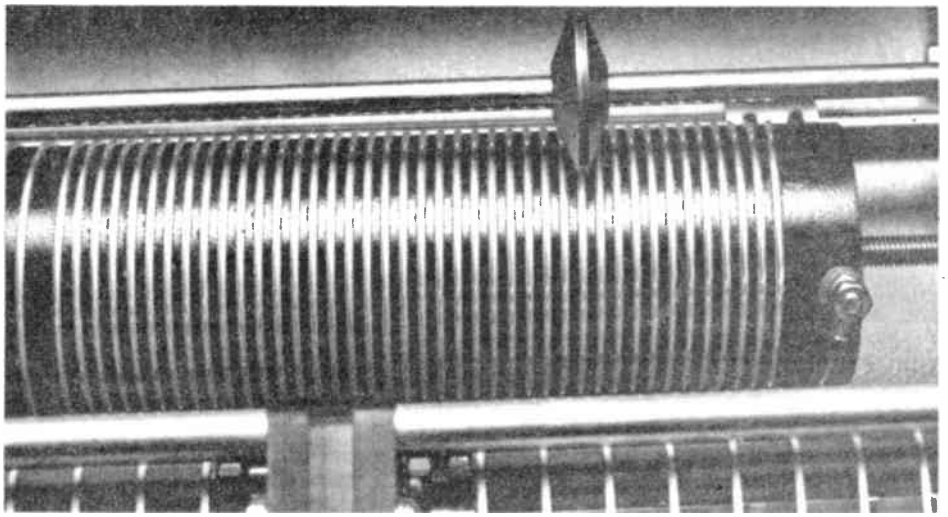
A typical example was taken around 14.2MHz *(Figure 11)* in which the ATU was adjusted fairly quickly for a good SWR in practice. The figure shows the rate of degradation of return loss as the frequency is changed from 14.2MHz. The figure spans 9.2 to 19.2MHz. Looking carefully at this photograph you will see that return loss is approximately 10dB at ±200KHz, 10dB representing approximately 2:1 SWR. The load in this example was 1000ohm resistive.

We also checked return loss curves on other frequency bands, and with a variety of purely resistive and partly reactive loads saw return loss curves that were basically very similar.

Match

We then decided to match the TAU into various reactive loads at 1.9 and 14.2MHz, and plot responses through the system. For these tests we used a B & K probe which incorporates a very high impedance active input, across the load in use, the probe input interconnecting with the input of the spectrum analyser.

Figure 12 shows the overall response from 0-10MHz with a 1.9MHz matched tuning. The high pass action of the TAU below 1.9MHz can easily be seen, together with the slower cut off above 1.9MHz, reaching a long valley. However, the same plot was taken with the HF end extended to 50MHz, thus exposing some



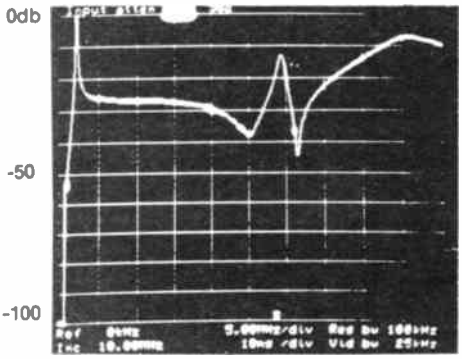


Fig 13 *Same as Fig 12, except 0/50MHz*

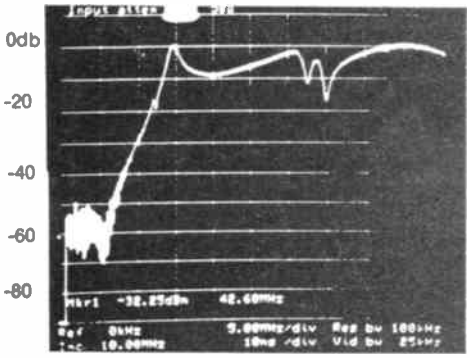


Fig 14 *Frequency response through TAU matched into 10ohm/1000pF at 14.2MHz 0/50MHz*

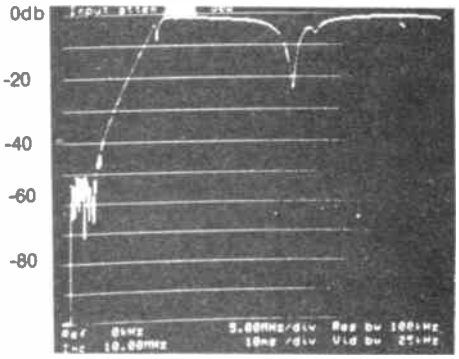


Fig 15 *Same as Fig 14 though matched into 50ohm resistive*

strange resonances in the TAU system above 30MHz *(Figure 13)*. These additional resonances are clearly due to stray capacitances and inductances within the TAU. The load used for the 1.9MHz plots was 114ohms with 1000pF in parallel.

For the 14.2MHz response check, plotted from 0 to 50MHz, we used 10ohms in parallel with 1000pF, a particularly vicious load! Whilst the high pass action was good, the TAU does not perform as an effective low pass filter, and in fact the third harmonic at 42.6MHz reached almost the same level as the fundamental *(Figure 14)*.

Basic shape

We looked at many other loads at 14.2MHz, and whilst the bumps above the tuned frequency were in different areas, the basic shape remained the same. *Figure 15* represents the response of the TAU into a 50ohm pure resistive load, in fact that of the spectrum analyser, and you can see the same basic shape.

In contrast, *Figure 16* shows exactly the same frequency range plotted through the Drake MN2700 ATU, examination showing that the latter gives a good low pass filtering action, but the high pass is nowhere near as good as that of the TAU.

We checked several parameters on the second sample, which had been used for some of the photographs. A plotted response chart, with the TAU tuned to 14.2MHz as before, was very similar. Slight changes had been made by TAU to the wiring which actually did result in an improvement of the direct through SWR at 14.2MHz to 1.2:1.

It was clear that it had been knocked in transit for the rollercoaster was very stiff, but the capacitors were easier to set, having less stiction. I easily obtained 1.01:1 using my audio gimmick. The through loss with ATU in was marginally lower, at 0.46dB. Once again, the meters were inaccurate, but it was easy to set the power meter up accurately, both 50 and 100W then reading correctly. The SWR meter, however, was again inaccurate even after fiddling, for it read the direct SWR about right, but the tuned SWR read 1.2:1 when it should have been virtually at unity. The preset had to be fully clockwise for the best accuracy, showing that some further fiddling is required!

Conclusions

I am full of admiration for the principles behind this unit, and can certainly recommend purchase for those who want to be able to match virtually anything. The high pass filter action is quite amazingly useful, and most receiving systems will show a clear improvement in subjective performance with the TAU switched in, especially at low frequencies. For transmission filtering though I strongly recommend a filter such as the Drake low pass one placed in between the transmitter and the TAU.

I am sure you will get used to tuning three knobs instead of two, and it was fascinating that for acceptable results I found that adjustment of only the rollercoaster on most antennae which already had a reasonable match of better than 2:1 reduced the SWR to quite low levels.

The unit is very well constructed internally, although it may be worth your while to fiddle with earth routing to reduce losses even further. TAU use quite a clever circuit for the SWR meter which allows it to read without an FSD adjustment. I could not properly check this because of the circuit design errors, but TAU assure me that when they have sorted out the problem it should give useful SWR readings from as low as 10W throughput.

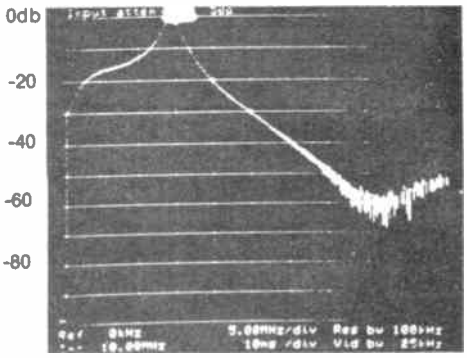


Fig 16 *Drake ATU, same test conditions as Fig 15 0-50MHz*

You will have a lot of fun using the TAU for general short wave listening, for it will help bring in HF stations that might otherwise be too weak to receive from a normally mismatched antenna. At no time did I experience any trace of intermittencies with the rollercoaster contact wheel, which is held tight against the inductance with quite a powerful spring. I must admit that I have never tried a rollercoaster before, but now I see its advantages it will be fascinating to try many unconventional antennae with all sorts of strange impedances.

Interest

There is one final point of interest: the highest voltages in the system are likely to be across the ganged capacitor. In some SPC circuits this ganged unit is on the transmitter side whilst the single capacitor is in series with the antenna. This can have advantages in reducing the required size of the ganged unit. However, TAU claim that they have put 1KW through this unit into all manner of impedances without any arcing over, and the capacitors really are enormous, having a very wide spacing so you should not encounter any problems.

Strongly recommended then, even if it is rather expensive.

Very many thanks to TAU for lending the review sample, and to Jonathan Honeyball for his patience in taking all the plots, and helping me with the measurements.

FREE COMPETITION

WIN A TAU SPC3000 ATU

(DONATED BY TAU SYSTEMS)

SPECIAL FEATURES

A – Renowned SPC transmatch circuit

B – Tau innovative composite design®

C – Large spaced capacitors rated 5KV, tested to 7KV

D – Roller coaster inductor infinitely variable

E – Balun built in, 1KW, 4 to 1 impedance ratio

F – Transmitter switch, through ATU or direct to antenna

G – Five position antenna switch to 5 input/outputs

H – Twin meter automatic readout of SWR and Power

I – Unsurpassable transmission strength and clarity

J – Solid, traditional precision radio engineering

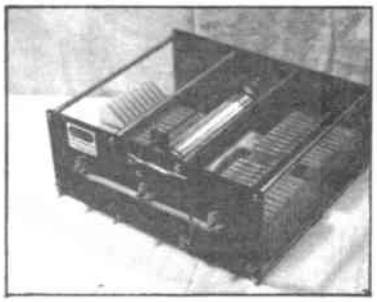
K – Heavyweight long-life construction

L – Superb ultra-compact cabinet design with tilt feet

M – Superlative finish and looks – compatible with all rigs

N – Will tune any transmitter/aerial combination to optimum

O – Lifetime investment – will never need replacing



PLUS TWO RUNNERS-UP PRIZES OF THE ATU IN KIT FORM DONATED BY TAU SYSTEMS AND CIRKIT HOLDINGS

All you have to do to win one of these super prizes is to list the five most important features of the ATU in order of merit in the boxes below, and say, in not more than 20 words, why you would like to win the prize. Pure greed, really!

AMATEUR RADIO – FREE COMPETITION

Name:..... **Address:**.....

.....

My five choices in order of preference are: **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐
I would like to own a TAU SPC3000 ATU because (20 words or less):

.....

.....

Entries, which must be received no later than 30 January 1985, should be posted to: ***Amateur Radio***, Sovereign House, Brentwood, Essex CM14 4SE. This competition is not open to employees of *Amateur Radio Magazines* or their relatives.

A HIGH-STABILITY CRYSTAL-CONTROLLED RECEIVE CONVERTER

DESIGNED BY E VAUGHAN

No doubt many readers are still using one of those marvellous old communication receivers, such as the HRO or Eddystone 640. These will still provide a good performance on the LF bands, but often they lack stability and/or sensitivity on the HF bands.

One answer to this problem, giving them an additional lease of life and bringing them back to their former glory, is to use the main receiver as a tunable IF in conjunction with a sensitive crystal-controlled convertor as a front end at around 3.5MHz.

Single crystal

Many such convertors require a separate crystal for each band. This design uses only a single 3500KHz crystal and tunes the 7,14 and 21MHz amateur bands, as well as performing as a straight pre-amp for 3.5MHz.

A FET is used for the RF stage, as this is less prone to cross-modulation than a bipolar transistor, and a common gate configuration is used to provide a low input impedance for the antenna or ATU (this does not require neutralizing).

A dual-gate FET is used as a mixer. The signal input is applied to G1 as for an RF amplifier, but instead of just a de-coupled bias supply to G2, the de-coupling is omitted and the oscillator voltage is applied to this gate. The output at the drain is then controlled by the two inputs and contains the usual intermodulation products between them. This type of mixer is important so that the signal-handling capability of a G1 is not reduced by the presence of a local oscillator signal, and quite a high overhead level results.

Easy

The mixer is easy to set up, since the various bias oscillator and signal level adjustments can be separate and the tuned circuits do not interact. The local oscillator uses a FET in a stable-type Vackar circuit.

For 3.5MHz reception the oscillator is switched off and the remaining stages act as a pre-amp. On other bands the crystal oscillator frequency is always 3.5MHz lower than the band being received, so that the signal frequency rises as the main receiver is tuned higher across the 3.5MHz band.

For 7MHz the crystal oscillates on its fundamental frequency of 3500KHz, for 14MHz on its third 'overtone' of about 10.5MHz, and for 21MHz on its fifth overtone of 17.5MHz.

Overtone

Note that for 'overtone' operation the output is not precisely at the exact harmonic of the crystal fundamental, although close to it, so a small correction may be needed to the original receiver calibration. Otherwise the 3.5MHz calibration applies in terms of tens and hundreds on all bands, and the tuning rate will be the same on all bands. So 7.1, 14.1 or 21.1MHz signals should be received on about 3.6MHz, with 7.2, 14.2 or 21.2MHz on 3.7MHz, etc.

Note that only two adjustable coils are used to tune the four bands, with L1 left in parallel with L2 on 14 and 21MHz.

Construction and layout are not critical, provided that RF leads are kept short and output circuits are kept well away from input circuits.

Alignment

After checking all wiring, the oscillator circuits must be adjusted so that the crystal operates on the correct overtone frequencies. This can best be done with a GDO used as an absorption wavemeter. With the absorption device, check and adjust the cores of L3, L4 and L5, until the oscillator is operating on the required frequencies.

Then set the convertor to 7MHz and connect it to the main receiver, set at 3.5MHz. Without switching on, adjust L1 for coverage of 7-7.5MHz in conjunction with VC4, a 35pF tuning capacitor. Switch to 3.5MHz and check that the RF tuning range now covers 3.5-4.0MHz. If the tuning range is incorrect, it may be necessary to replace or parallel VC1 (150pF capacitor) with other values.

Once the 3.5MHz tuning range has been established, switch to 14MHz and adjust L2 so that the tuning range covers 14-14.5MHz. It should then be possible to tune the 21MHz band without any further adjustment (the full tuning range will probably exceed the amateur band, but 'not to worry').

In practice it will probably prove necessary to change the convertor tuning only when tuning right across the band: when searching around only a small section of the band, the control can be left unaltered.

Once all the above has been done (phew!) the unit should now be ready for use. Signals can be peaked with the convertor tuning control if necessary, otherwise all tuning is done on the main receiver.

A BC108 (Tr4) is used as an emitter follower to give a broadband output of about 75Ω to feed into the main receiver. Should the gain of the convertor be excessive on some signals, a gain control can be fitted on the emitter follower stage.

The RF selectivity section is a worthwhile addition as it is capable of about 40dB of attenuation to signals 10 per cent off-tuned.

Certainly this design should enhance the performance of many older receivers on the HF bands, and thus extend the life of many beautiful old models.

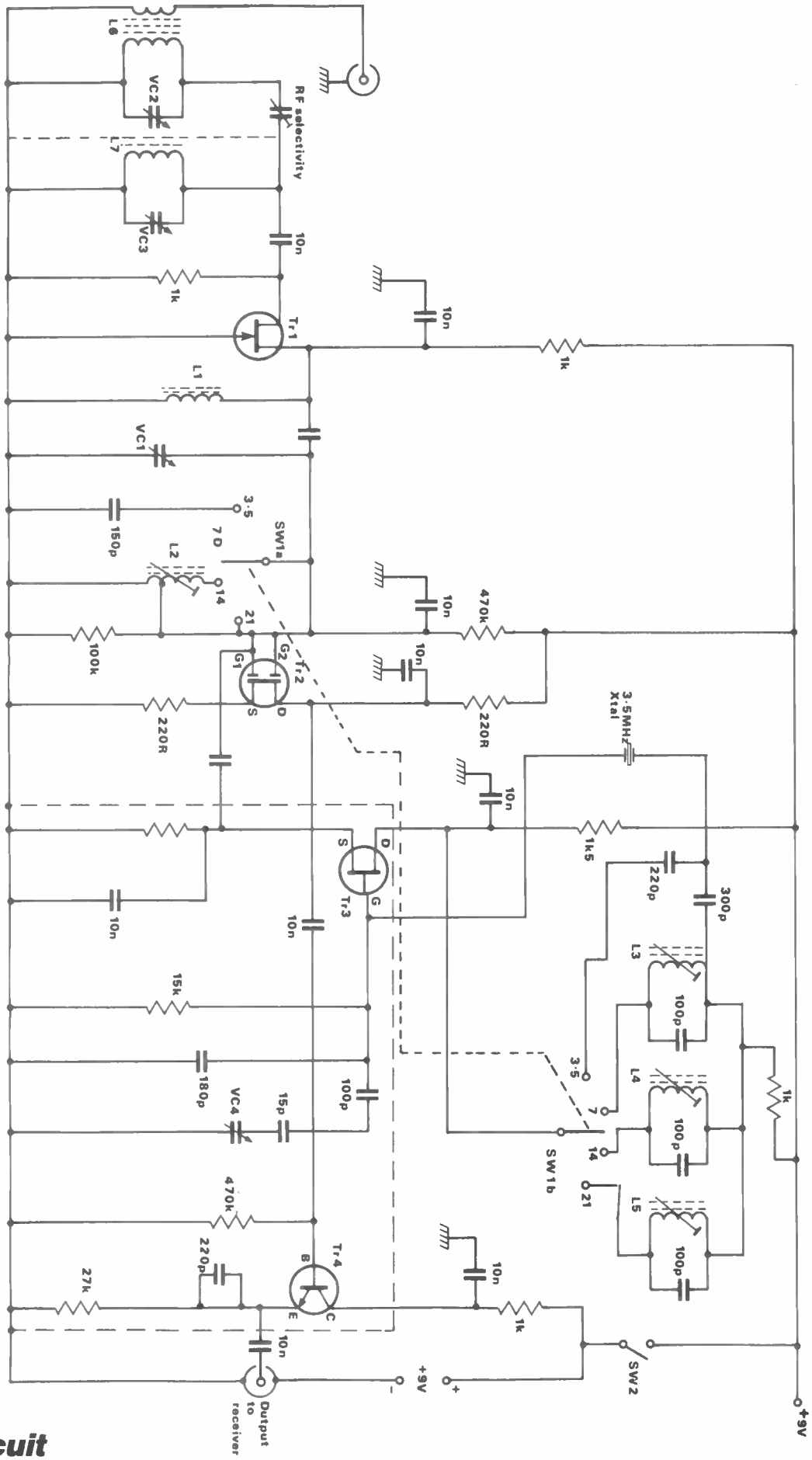
COIL DETAILS

L1 – 42 turns
L2 – 26 turns; tapped at 17 turns from earthy end
L3 – 35 turns
L4 – 13 turns
L5 – 8 turns; spaced over ⅜in
L1 – 5: 30 swg enamelled wire
L5, L7 – 14 turns; 38 swg enamelled wire
ALL coils wound on ¼in diameter slug-tuned unshielded formers

PARTS NOT LISTED ON DIAGRAM

Tr1, Tr3	2N3819
Tr2	40673
Tr4	BC108
VC1	150pF
VC2, VC3	100/120pF
VC4	35pF
SW1a/b	2p-4w ganged
SW2	on/off

XTAL CONTROLLED CONVERTER



The circuit

INTEGRATED CIRCUITS

AN124	2.50	MC1349P	1.20	STK439	7.95	TBA750Q	2.65
AN214Q	2.50	MC1350P	0.95	STK461	11.50	TBA800	0.89
AN239	2.50	MC1351P	1.50	TA7061AP	1.50	TBA810AS	1.65
AN240P	2.80	MC1357	2.35	TA7108P	1.50	TBA810P	1.65
AN264	2.50	MC1358	1.55	TA7120P	1.65	TBA820M	0.75
AN612	2.15	MC1495	3.00	TA7129P	2.50	TBA820O	1.45
AN362L	2.50	MC1496	1.25	TA7130P	1.50	TBA890	2.50
AN7140	3.50	MC145106P		TA7137P	1.00	TBA920	1.65
AN7145	3.50		7.95	TA7146	3.95	TBA950/2X	
AN7145M	3.95	MC1723	0.50	TA7176AP	2.95		2.35
AN7150	2.95	MC3357	2.75	TA7193P	3.95	TBA970	2.95
BA521	3.35	MC3401L	2.50	TA7203	2.95	TBA990	1.49
CA1352E	1.75	ML231B	1.75	TA7204P	2.15	TBA990Q	1.49
CA3086	0.46	ML232B	2.50	TA7205AP	1.15	TBA1441	2.15
CA3123E	1.95	MSM5807	8.75	TA7222AP	1.80	TCA270	1.10
CA314OT	1.15	PLL02A	5.75	TA7227P	4.25	TCA270SQ	
ETT6016	2.80	SAA5500A	3.50	TA7310P	1.80		1.10
HA1339A	2.95	SAA1025	7.25	TA7313AP	2.95	TCA650	2.50
HA1366W	2.75	SAA5010	6.35	TA7314P	2.95	TCA800	2.95
HA1377	3.50	SAS560S	1.75	TA7137P	1.00	TCA830S	1.95
HA1156W	1.50	SAS570S	1.75	TA7314P	2.95	TCA900	2.50
HA1551	2.95	SAS580	2.65	TA7321P	2.25	TCA940	1.65
LA1230	1.15	SA/SB/T/U		TA7609P	3.15	TDA440	2.20
LA4102	2.95		1.00	TA7611AP	2.95	TDA1001	1.95
LA4140	2.95	SL901B	4.85	TAA550	0.25	TDA1002A	1.95
LA4031P	1.95	SL917B	6.65	TAA570	1.95	TDA1003A	3.95
LA4140	2.95	SL1310	1.60	TAA661B	1.20	TDA1004A	3.25
LA4461	3.95	SL1327	1.10	TAA700	1.70	TDA1006A	2.50
LA4250	2.95	SL1327Q	1.10	TBA120AS/B/-		TDA1010	2.15
LA4420	1.95	SN76003N	1.95	C	1.00	TDA1035	2.50
LA4430	2.50	SN76013N	1.95	TBA231	1.25	TDA1037	1.95
LA4400	4.15	SN76023N	1.95	TBA395	1.50	TDA1044	2.15
LA4422	2.50	SN76033N	1.95	TBA396	0.75	TDA1170	1.95
LC7120	3.25	SN76110N	0.89	TBA440N	2.55	TDA1190	2.15
LC7130	3.50	SN76115N	1.25	TBA480Q	1.25	TDA1270O	3.95
LLC7131	5.50	SN76131N	1.30	TBA510	2.50	TDA1327	1.70
LC7137	5.50	SN76226DN		TBA510Q	2.50	TDA2002	1.95
LM1011	3.15		2.95	TBA520	1.10	TDA2003	2.95
LM324N	0.45	SN76227N	1.05	TBA520O	1.10	TDA2010	1.95
LM380N	0.95	SN76533N	1.65	TBA530	1.10	TDA2020	2.95
LM383T	2.95	SN76544N	1.95	TBA530O	1.10	TDA2030	2.80
M51513L	2.30	SN76570N	1.00	TBA540	1.25	TDA2140	3.95
M5155L	2.95	SN76650N	1.15	TBA540Q	1.35	TDA2151	1.95
M51521L	1.50	SN76660N	0.90	TBA550Q	1.95	TDA2160	2.50
MB3712	2.00	STK014	7.95	TBA560C	1.45	TDA2190	2.95
MB3756	2.50	STK015	5.95	TBA560O	1.45	TDA2522	1.95
MC1307P	1.00	STK043	9.50	TBA570	1.00	TDA2523	2.95
MC1310P	1.95	STK415	7.95	TBA641A12		TDA2524	1.95
MC1327	0.95	STK433	5.95		2.50	TDA2530	1.95
MC1327Q	0.95	STK435	7.95	TBA651R	2.50	TDA2532	1.95
MC1330P	1.10	STK437	7.95	TBA720A	2.45	TDA2540	1.95
						TDA2541	2.15
						TDA2560	2.15

TDA2571	2.95						
TDA2581	2.25						
TDA2582	2.95						
TDA2593	2.95						
TDA2600	5.50						
TDA2610	2.50						
TDA2611A	1.95						
TDA2640	2.60						
TDA2680A	2.75						
TDA2690	2.45						
TDA3310	2.95						
TDA4600	2.50						
TDA9503	3.15						
TDA3560	3.95						
TEA1009	1.35						
UPC566H	2.95						
UPC575C2							
	2.75						
UPC1025H							
	1.95						
UPC1028H							
	1.95						
UPC1032H							
	1.50						
UPC1156H							
	2.75						
UPC1158H							
	0.75						
UPC1167C2							
	1.15						
UPC1181H							
	1.25						
UPC1182H							
	2.95						
UPC1185H							
	3.95						
UPC1191V	1.50						
UPC1350C							
	2.95						
UPC1353C							
	2.45						
UPC1365C							
	3.95						
UPC2002H							
	1.95						
555	0.35						
556	0.42						
723	0.50						
741	0.35						
747	0.50						
748	0.35						
7808	0.60						
7805	0.65						
7815	0.65						

SEMICONDUCTORS

AAY12	0.25	BC178	0.15	BD237	0.40	BFW92	0.85	TIP30C	0.43
AC126	0.45	BC182	0.10	BD238	0.40	BFX29	0.30	TIP31C	0.55
AC127	0.20	BC182LB	0.10	BD242	0.65	BFX84	0.26	TIP32C	0.42
AC128	0.28	BC183	0.10	BD246	0.75	BFX85	0.32	TIP33B	0.75
AC128K	0.32	BC183L	0.09	BD376	0.32	BFX86	0.30	TIP34B	0.75
AC141	0.28	BC184LB	0.09	BD410	0.65	BFX88	0.25	TIP41A	0.45
AC141K	0.34	BC204	0.10	BD434	0.65	BFY50	0.21	TIP41C	0.45
AC142K	0.30	BC207B	0.13	BD437	0.75	BFY51	0.21	TIP42C	0.47
AC176	0.22	BC208B	0.13	BD438	0.75	BFY52	0.25	TIP47	0.65
AC176K	0.31	BC212	0.09	BD520	0.65	BFY90	0.77	TIP120	0.60
AC187	0.25	BC212L	0.09	BD538	0.65	BLY48	1.75	TIP125	0.65
AC187K	0.28	BC212LA	0.09	BD597	0.95	BR100	0.26	TIP142	1.75
AC188	0.25	BC213	0.09	BD701	1.25	BR101	0.49	TIP146	2.75
AC188K	0.37	BC213L	0.09	BD702	1.25	BR103	0.55	TIP161	2.95
AD142	0.79	BC214	0.09	BD707	1.90	BR303	0.95	TIP2955	0.80
AD143	0.82	BC214C	0.09	BDX32	1.50	BRC4443	1.15	TIP3055	0.55
AD149	0.70	BC214L	0.09	BOY57	1.85	BT100A/020	0.85	TIS91	0.20
AD161	0.39	BC237B	0.09	BF115	0.35	BT106	1.49	TV106/2	1.50
AD162	0.39	BC238	0.09	BF119	0.65	BT116	1.20	ZRF0112	16.50
AD161/2	0.90	BC239	0.12	BF127	0.39	BT119	3.15	2N1100	6.50
AF106	0.50	BC251A	0.12	BF154	0.20	BT120	1.65	2N1711	0.30
AF114	1.95	BC252A	0.15	BF158	0.22	BU105	1.22	2N2110	4.50
AF121	0.60	BC258	0.25	BF160	0.27	BU108	1.69	2N2219	0.28
AF124	0.65	BC258A	0.39	BF167	0.27	BU124	1.25	2N2905	0.40
AF125	0.35	BC284	0.30	BF173	0.22	BU125	1.25	2N3053	0.40
AF126	0.32	BC300	0.30	BF177	0.38	BU126	1.60	2N3054	0.59
AF127	0.40	BC301	0.30	BF178	0.26	BU204	1.55	2N3055	0.52
AF139	0.40	BC303	0.26	BF179	0.34	BU205	1.30	2N3702	0.12
AF150	0.60	BC307B	0.09	BF180	0.29	BU208	1.39	2N3703	0.12
AF178	1.95	BC327	0.10	BF181	0.29	BU208A	1.52	2N3704	0.12
AF239	0.42	BC328	0.10	BF182	0.29	BU208D	1.85	2N3705	0.12
AU106	4.50	BC337	0.10	BF183	0.29	BU326	1.20	2N3706	0.12
AU107	3.50	BC338	0.09	BF184	0.28	BU326S	1.50	2N3708	0.12
AU110	2.00	BC347A	0.13	BF185	0.28	BU407	1.24	2N3733	9.50
AY102	2.95	BC461	0.35	BF194	0.11	BU500	2.25	2N3773	2.75
BC107A	0.11	BC478	0.20	BF195	0.11	BU526	1.90	2N3792	1.35
BC107B	0.11	BC527	0.20	BF196	0.11	BU807	2.25	2N4280	3.50
BC108	0.10	BC547	0.10	BF197	0.11	BUY20	2.15	2N4427	1.50
BC108A	0.11	BC548	0.10	BF198	0.16	BUY69B	1.70	2N4444	1.15
BC108B	0.12	BC549A	0.10	BF199	0.14	MJ3000	1.98	2N5294	0.42
BC109	0.10	BC550	0.14	BF200	0.40	MJE340	0.40	2N5296	0.48
BC109B	0.12	BC557	0.08	BF241	0.15	MJE350		2N5298	0.60
BC109C	0.12	BC557B	0.08	BF245	0.30	MJE520	0.48	2N5496	0.65
BC114	0.11	BC558	0.10	BF257	0.28	MJE2955		2SA329	0.95
BC116A	0.15	BC639/10	0.30	BF258	0.28	MPSA13	0.29	2SA715	0.60
BC117	0.19	BCY33A	1.60	BF259	0.28	MPSA92	0.30	2SC495	0.80
BC119	0.24	BO115	0.30	BF271	0.26	MRF237	3.45	2SC496	0.80
BC125	0.25	BO116	0.60	BF273	0.18	MRF450A		2SC931D	0.95
BC139	0.20	BO124P	0.59	BF336	0.34		12.50	2SC1096	0.80
BC140	0.31	BO131	0.42	BF337	0.29	MRF453	17.50	2SC1106	2.50
BC141	0.25	BO132	0.42	BF338	0.32	MRF454	23.50	2SC1172Y	2.20
BC142	0.21	BO133	0.40	BF355	0.37	MRF475	2.50	2SC1173	1.15
BC143	0.24	BO135	0.30	BF362	0.38	MRF477	10.00	2SC1306	1.00
BC147	0.09	BO136	0.30	BF363	0.65	OC16W	1.95	2SC1307	1.50
BC147B	0.09	BO137	0.32	BF371	0.25	OC23	1.50	2SC1364	0.50
BC148A	0.09	BO138	0.30	BF394	0.19	OC29	2.25	2SC1449	0.50
BC148B	0.09	BO139	0.32	BF422	0.32	OC36	2.25	2SC1678	1.25
BC149	0.09	BO140	0.30	BF423	0.25	OC42	0.55	2SC1909	1.45
BC153	0.30	BO144	1.10			OC44	0.75	2SC1945	2.65
BC157	0.12	BD150C	0.29			OC45	0.55	2SC1953	0.95
BC158	0.09	BO159	0.65	BF457	0.32	OC70	0.45	2SC1957	0.80
BC159	0.09	BO160	1.50	BF458	0.36	OC71	0.55	2SC1969	1.95
BC160	0.28	BO166	0.55	BF467	0.68	OC75	0.95	2SC2028	1.15
BC161	0.28	BO179	0.72	BF595	0.23	OC81	0.50	2SC2029	1.95
BC170B	0.15	BO182	0.70	BF597	0.25	OC16W	2.50	2SC2078	1.45
BC171	0.09	BO201	0.53	BFR39	0.23	R2008B	1.70	2SC2091	0.85
BC171A	0.10	BO202	0.65	BFR40	0.23	R2010B	1.70	2SC2098	2.50
BC171B	0.10	BO203	0.78	BFR41	0.28	R2322	0.58	2SC2166	1.95
BC172	0.10	BO204	0.70	BFR81	0.25	R2323	0.66	2SC2314	0.80
BC172B	0.10	BO222	0.48	BFR88	0.30	R2540	2.48	2SC2371	0.36
BC172C	0.10	BD223	0.59	BFR90	1.50	RCA16334	0.90	2SC931D	0.95
BC173B	0.10	BO225	0.48	BFR91	1.75	RCA16335	0.80	1SD234	0.50
BC174	0.09	BC232	0.35	BFT42	0.35	S2060D	0.95	2SD325E	1.65
BC174A	0.09	BO233	0.35	BFT43	0.35	SKE5F	1.45	3N211	1.95
BC177	0.15	BO234	0.35	BFW61	0.60	TIP29	0.40	3SK45	0.70
		BO236	0.49			TIP29C	0.42	3SK88	0.55

NEW BRANDED CATHODE RAY TUBES

A1865/20	65.00	D14-200GM	75.00	M28-11LA	49.00	SE42BP31AL	55.00
AW36 11	25.00	D14-210GH	75.00	M28-12GH	55.00	SE42BP31	55.00
CME822W	19.00	D14-270GH/50	75.00	M28-12LC	55.00	SE52AP31AL	55.00
CME822GH	25.00	D14-310W	110.00	M28-13LC	49.00	SE5Fp31	55.00
CME1428GH	45.00	D14-320GH	85.00	M28-13LG	49.00	T937	65.00
CME1428W	39.00	D14-320GH/82	65.00	M28-13GR	49.00	T948N	65.00
CME1523GA	39.00	D14-340GH/KM	45.00	M28-13WA	49.00	T948H	65.00
CME1523W	39.00	D14-340KA	45.00	M28-131GR	55.00	V3191	59.00
CME1431GH	39.00	D16-100GH	65.00	M28-132GM	55.00	V4150LC	55.00
CME1431W	39.00	D16-100GH/65	69.00	M28-133GH	55.00	V4254B	65.00
CME202GH	45.00	D16-100GH/67	65.00	M31-100GH	55.00	V4274GH	65.00
CME2024W	45.00	D16-100GH67A	75.00	M31-101GH	55.00	V4283W	65.00
CME2325W	45.00	D16-100GH/79	69.00	M31-182GR	55.00	V5002LD	65.00
CME3126GH	45.00	D16-100GH79A	75.00	M31-182GV	53.00	V5004GR	59.00
CME3128GH	45.00	D16-100GH97	65.00	M31-183W	55.00	V5004LD	59.00
CME3128W	45.00	D18-130GH/70	69.00	M31-184W	65.00	V6001GH	68.00
CME3132GH	45.00	D18-160GH	69.00	M31-184GH	65.00	V6006GH	65.00
CME3155W	45.00	D21-10GH	65.00	M31-184P31	65.00	V6007DP31	59.00
CRE1400	25.00	D21-10GJ	69.00	M31-185GH/VR	69.00	V6007GW	65.00
CV429	89.00	D21-10LD	69.00	M31-186W	69.00	V6008GH	59.00
CV1450	35.00	DB7 36	35.00	M31-190GH	55.00	V6008W	65.00
CV1526	19.00	DB7 36	45.00	M31-190GR	55.00	V6034WA	59.00
CV2185	15.00	DG7 32	45.00	M31-190LA	55.00	V604CLA	59.00
CV2191	19.00	DH7 11	95.00	M31-190W	59.00	V6048F	65.00
CV2193	15.00	DH7 91	45.00	M31-191GH	59.00	V6048J	49.00
CV2328	65.00	DP7 5	35.00	M31-191GR	59.00	V6052GH	65.00
CV5119	85.00	DP7 6	35.00	M31-191GV	55.00	V6052GR	65.00
CV5320	85.00	DP7 11	45.00	M31-191W	59.00	V6064BLA	65.00
CVX389	55.00	DN13 78	35.00	M31-192W	59.00	V6064BP31	55.00
D9-110GH	39.50	F15-101LC	49.00	M31-195GH	59.00	V6064CLA	55.00
D9-120	45.00	F16-101GM	55.00	M31-210GH	59.00	V6069GH	55.00
D10-210GH	45.00	F16-101LD	55.00	M31-220W	59.00	V6070P31	49.00
D10-210GH68B	65.00	F21-130GR	55.00	M31-270GY	65.00	V7016A	65.00
D10-210GH72	65.00	F21-130LC	55.00	M31-271P31	65.00	V7030	59.00
D10-230GH	35.00	F21-131GR	79.00	M31-271GW	65.00	V7031GH	59.00
D10-230GM	35.00	F31-10GM	65.00	M31-271W	65.00	V7031/67A	59.00
D10/293GY/90	55.00	F31-10GR	65.00	M36-12W	75.00	V7035A	49.00
D13-27GH	49.50	F31-10LC	65.00	M36-141LA	75.00	V7037GH	45.00
D13-30GH	49.50	F31-10LD	65.00	M36-141LG	75.00	V8004GR	65.00
D13-33GM	49.00	F31-12LC	65.00	M36-141W	75.00	V8006GH	65.00
D13-47GH/26	55.00	F31-12LD	65.00	M36-170LG	75.00	V8010A	65.00
D13-47GH/34	55.00	F31-13GR	65.00	M38-103GR	65.00	2BP1	9.00
D13-47GH	55.00	F31-13LD	65.00	M38-113GH	65.00	3BP1	13.50
D13-51GL/26	85.00	F31-13LG	65.00	M38-120W	65.00	4EP1	30.00
D13-51GM/26	85.00	F41-123LC	160.00	M38-120WA	65.00	3H/OBM	55.00
D13-450GH/01	55.00	F41-141LG	160.00	M38-121GR	65.00	5BP1	9.00
D13-471GH/26	55.00	F41-142LC	185.00	M38-121GHR	65.00	5BHP1	30.00
D13-550GH	65.00	M7-120W	19.00	M38-121LA	65.00	5BHP1FF	30.00
D13-600GM	59.00	M14-100GM	45.00	M38-121WA	65.00	5BHP31	30.00
D13-610GH	59.00	M14-100KA	55.00	M38-122GH	65.00	5CP1	10.00
D13-610GM	59.00	M14 100LC	45.00	M38-122GW	65.00	6EP7/S	39.00
D13-611GH	59.00	M17-151GVR	175.00	M38-140LA	65.00	13BP1	13.50
D13-611GM	59.00	M17-151GR	175.00	M38-141LA	65.00	13BP4	17.50
D13-630GH	59.00	M19-100GY	55.00	M38-142GR	65.00	17DWP4	25.00
D14-120GH08	65.00	M19-101GR	55.00	M38-142LA	65.00	32J/1085	69.00
D14-150GH	75.00	M19-103W	55.00	M38-340P31	65.00	1273	39.00
D14-150GM	75.00	M23-110GH	55.00	M38-341GR	65.00	1564	39.00
D14-172GH/84	59.00	M23-111W	55.00	M38-341P31	65.00	1844	45.00
D14-172GR	55.00	M23-111GH	55.00	M38-344P39	65.00	55451GM	75.00
D14-172GV	55.00	M23-111GM	55.00	M40-120W	59.00	9442E1	80.00
D14-173GH	55.00	M23-112GM	55.00	M43-12GM/01	65.00	95447GM	75.00
D14-173GM	53.00	M23-112GV	55.00	M43-12LG/01	65.00	95449	75.00
D14-173GR	55.00	M23-112GW	55.00	M44-120LC	65.00	7709631	79.50
D14-181GH/62	85.00	M23-112KA	55.00	M44-120GR	65.00		
D14-181GH/98	65.00	M23-112LD	55.00	M47-25GR/22	65.00	**ELECTRO-OPTICAL**	
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D14-181GM	53.00	M24-120GM	59.00	M50-120GR	65.00	9558B	25.00
D14-181GM50	59.00	M24-120GR	59.00	M50-120GV	65.00	9677M	22.00
D14-181W	55.00	M24-120LC	59.00	M50-120LC	65.00	P4231BAM	19.00
D14-182GH	59.00	M24-120WAR	59.00	M61-120LC	75.00	XP1002	29.00
D14-182GM/98	65.00	M24-121GH	55.00	M61-120W	75.00	XP1117M	24.00
D14-200BE	89.00	M24-121LC	59.00	S6AB	45.00	XP2040	35.00
D14-200GA/50	85.00	M24-121WA	59.00	SE4/D-P7	45.00		

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BA148	0.17	BY299-800	0.22	1N23WE	2.95
BA154	0.06	BYX10	0.20	IN4001	0.04
BA156	0.15	BYX36-150R		IN4003	0.04
BA157	0.30		0.20	IN4004	0.05
BAX13	0.04	BYX38-600R		IN4005	0.05
BAX16	0.06		0.60	IN4007	0.06
BB105B	0.30	BYX55-600	0.30	IN4148	0.02
BT151	0.79	BYX71-600	1.10	IN4448	0.10
BY126	0.10	BZX61	0.15	IN5401	0.12
BY127	0.11	BZY88	0.10	IN5402	0.14
BY133	0.15	BZY95C30	0.35	IN5403	0.12
BY164	0.45	CS4B	4.50	IN5406	0.13
BY176	1.20	CS10B	8.45	IN5407	0.16
BY179	0.63	OA47	0.09	IN5408	0.16
BY182	0.55	OA90	0.05	ITT44	0.04
BY184	0.35	OA91	0.06	ITT923	0.15
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BY206	0.14	OA202	0.10		
BY208-800	0.33	1N21OR	2.95		

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BUILDING LOADED VERTICAL WHIPS USING CAD

DUNCAN WALTERS G4DFV

This article describes the way in which practical, working, inductively-loaded antennae for mobile or stationary use can be built, utilising CAD (Computer Aided Design) techniques to simplify the calculations necessary to achieve the required information for construction.

The loaded antenna

Basically, the main idea behind *loading* an antenna is to effectively increase its electrical length whilst retaining its physical length within manageable limits. For instance, the physical length of a resonant 1/4 wavelength antenna for 3.5MHz is approximately 67ft, so it would prove a little difficult if we wanted to operate mobile using such an antenna mounted on the car roof!

Apart from VHF, the only HF band where a 1/4 wave antenna is of a manageable size (approximately 8½ft), is the 10 metre band. That's alright if you only wish to operate on ten or above, but to operate on the other HF bands, down to and including Top Band, things would be very difficult if the loaded antenna was not around.

The basic type of antenna we will be dealing with here is the 1/4 wave, mainly for frequencies of 1.8 to 30MHz. The end product of the design is suitable for either mobile or home use.

There are three main categories of inductively-loaded antennae (as distinct from helically-wound antennae); (a) base loaded, (b) centre loaded or (c) top loaded. The two most popular forms (a) and (b) will be dealt with. The three different types are shown in *Figure 1* for clarification.

Due to the fact that inductively-loaded antennae present lower feed impedances than the full-size versions, it becomes necessary to devise ways of matching the impedance of the antenna feeder to the antenna, in cases where the difference between the feed impedance, and that of the feeder, would show a high enough mismatch to create an undesirably high VSWR.

A simple but effective way of matching is shown in *Figure 2*. This uses a tapped inductance in a kind of auto-transformer situation. The antenna is tapped into the coil, and the feeder is tapped into the same coil. The feeder and bottom end of the coil share a common earth connection. This coil is called a matching inductor and will be dealt with later.

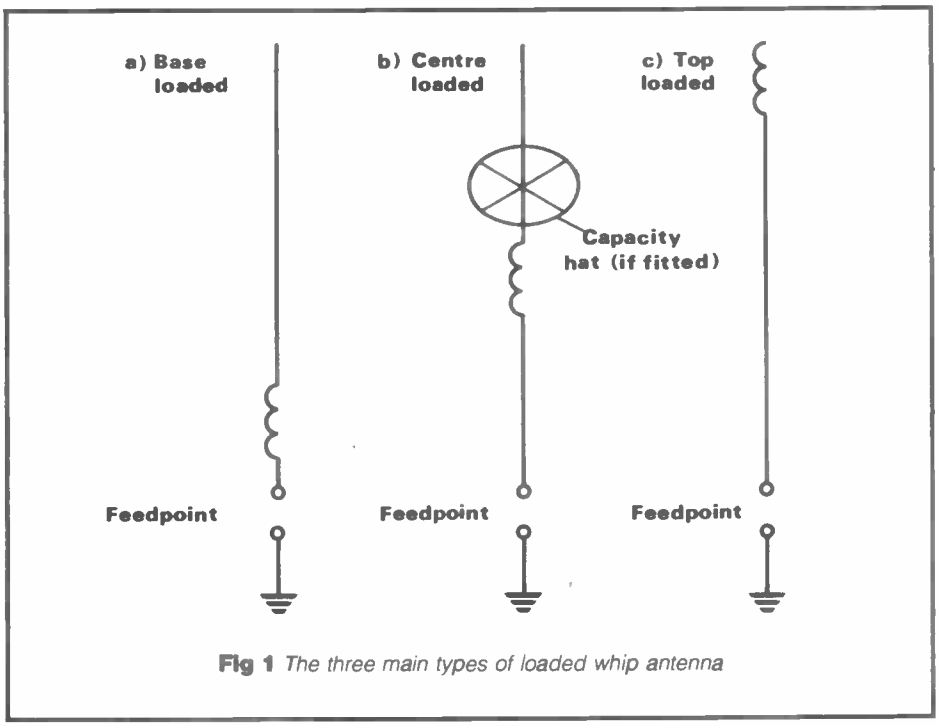


Fig 1 *The three main types of loaded whip antenna*

The program

As mentioned earlier, CAD simplifies and speeds up the necessary calculations to get the facts needed to make a loaded antenna. This program, designed to run on the 16K ZX81, can be modified to run on other Basic language machines with little alteration.

The first part of the program (lines 97-150), asks the operator to feed information into the computer relating to the physical dimensions and operating frequency of the antenna. From these facts the computer calculates the capacitance presented, and works out the capacitive reactance (X_C) of the antenna (lines 212-270). With these figures known, it then calculates the inductance necessary to bring the antenna to resonance if either base or centre loaded (lines 300-390).

The program then asks what value of Q would be required. The two limits of Q are shown typically as 50 and 300. The higher the Q factor, the sharper the frequency response will be and consequently the lower the bandwidth, so it's a case of swings and roundabouts. However, the bandwidth can be broadened by fitting a 'capacity hat' to the antenna to reduce the effect of a high Q loading coil.

Also, less turns will be needed on the loading coil of an antenna fitted with a capacity hat. With the value of Q known, the computer then gives the operator limits to which the dc resistance of the coil must be near, to keep the value of Q to the designed factor (lines 420-580).

Included in the program is a helpful sequence of calculations (lines 710-900) which, after asking the operator for the physical dimensions of the loading coil, works out how many turns are required for the desired inductance, and also gives the winding pitch in turns per inch.

LOADED WHIPS: PROGRAM LISTING

```
5 REM "LVA"
6 CLS
10 PRINT "LOADED VERTICAL ANTENNAS"
20 PRINT "   (24 EQUALS SIGNS)    "
30 PRINT
40 PRINT "THIS PROGRAM WILL ENABLE YOU TO"
50 PRINT "WORK OUT ALL THE NECESSARY FACTS"
60 PRINT "REQUIRED TO CONSTRUCT LOADED"
70 PRINT "ANTENNAS WHICH ARE SHORTER THAN"
80 PRINT "AN ELECTRICAL 1/4 WAVELENGHT AT"
90 PRINT "THE OPERATING FREQUENCY"
92 PRINT
95 PRINT
97 PRINT "ENTER ANTENNA HEIGHT IN FEET"
98 INPUT L
99 PRINT
100 PRINT "ENTER ANTENNA DIAMETER IN INCHES"
105 INPUT D
130 PRINT
140 PRINT "ENTER OPERATING FREQ IN MHZ"
150 INPUT F
160 CLS
170 PRINT "ANTENNA HEIGHT: ";L;" FEET"
180 PRINT
190 PRINT "ANTENNA DIAMETER: ";D;" INCHES"
200 PRINT
210 PRINT "FREQUENCY: ";F;" MHZ"
212 LET N:(24*L)/D
216 LET B:1-((F*L)/234)
217 LET C:B*B
220 LET X:2.3*(LN N/LN 10)
222 LET A:X-1
225 LET CA:(17*L)/(A*C)
230 PRINT
240 PRINT
250 PRINT
270 LET XC:1/(PI*2*(F*1E6)*(CA/1E12))
280 PRINT
300 LET XL:XC
310 LET LA:(XL*1E6)/(PI*2*(F*1E6))
320 PRINT
330 PRINT "BASE LOADING COIL: ";LA;" UH"
340 LET CB:CA/2
350 LET XC:1E12/(PI*2*(F*1E6)*CB)
360 LET XL:XC
370 LET LB:(XL*1E6)/(PI*2*(F*1E6))
380 PRINT
390 PRINT "CENTRE LOADING COIL: ";CB;" UH"
400 PRINT
410 PRINT
420 PRINT "ENTER REQUIRED VALUE OF Q"
430 PRINT
440 PRINT "TWO TYPICAL VALUES OF Q ARE 50"
450 PRINT "AND 300"
460 INPUT Q
470 CLS
475 LET RA:(PI*2*F*LA)/Q
480 LET RB:(PI*2*F*LB)/Q
490 CLS
500 PRINT "FOR A BASE LOADING COIL OF"
501 PRINT LA;" UH"
510 PRINT "WITH A Q OF";Q;" THE DC"
520 PRINT "RESISTANCE MUST BE AS NEAR TO"
530 PRINT RA; " OHMS AS POSSIBLE"
535 PRINT
540 PRINT "FOR A CENTRE LOADING COIL OF"
550 PRINT LB;" UH"
560 PRINT "WITH A Q OF";Q; " THE DC"
570 PRINT "RESISTANCE MUST BE AS NEAR TO"
580 PRINT RB;" OHMS AS POSSIBLE"
590 PRINT
600 PRINT "ENTER C FOR COIL WINDING DETAILS"
610 INPUT C$
620 LET C$:INKEY$
630 IF INKEY$:"C" THEN GOTO 700
700 CLS
710 PRINT "COIL WINDING DETAILS"
720 PRINT " (20 EQUALS SIGNS)  "
730 PRINT
740 PRINT "ENTER VALUE OF INDUCTANCE IN UH"
750 INPUT L
760 PRINT
770 PRINT "ENTER COIL DIAMETER IN INCHES"
780 INPUT D
790 PRINT
800 PRINT "ENTER COIL LENGTH IN INCHES"
810 INPUT B
820 CLS
825 LET A:D/2
830 LET N:(L*((9*A)+(10*B))/(A*A))
835 LET N:SQR N
840 PRINT "INDUCTANCE: ";L;" UH"
850 PRINT
860 PRINT "COIL DIAMETER: ";D;" INCHES"
870 PRINT
880 PRINT "COIL LENGTH: ";B;" INCHES"
890 PRINT
900 PRINT "TURNS REQUIRED: ";N
910 LET TPI:N/B
920 PRINT
930 PRINT "WINDING PITCH: ";TPI;" TPI"
940 PRINT AT 19,0;"START AGAIN? Y/N"
950 INPUT Q$
955 IF Q$:"Y" THEN GOTO 6
960 IF Q$:"N" THEN STOP
```

KEY: * is multiplication sign, should be asterisk. *
+ is addition sign, should be plus. (+)
$ is Dollar sign. $
: is equals, should be equals sign. (=)

The program will work with any range of frequency, sizes of coils etc, but of course the details inputted to the computer should be within manageable limits so the resultant figures quoted will not be impossible to achieve in practice.

Details of suitable matching coils are given in the table. Some experimentation will be needed with the exact number of turns and tapping points, the figures given being for guidance only. The part of the program dealing with coil winding details could be used to calculate the necessary number of turns, etc, for the matching coil.

Approximate inductance of matching coils for loaded whip type antennae
(Feeder impedance of approximately 50 ohms) Length of whip in all cases: 8ft

Centre Loaded		Base Loaded	
Freq Band (MHz)	Matching Coil (μH)F	Freq Band (MHz)	Matching Coil (μH)
1.8	3.7	1.8	3
3.8	1.4	3.8	1.2
7.1	0.75	7.1	0.6
14.2	0.35	14.2	0.28
21.25	0.29	21.25	0.28
28.5	0.25	28.5	0.25

Tuning procedure

The final antenna design will be entirely at the choice of the individual, but should be built along the lines of *Figure 2,* which shows the general concept. The top section of the antenna is made telescopic for adjusting the antenna to resonance. The matching coil at the bottom is used for final adjustment of the VSWR.

The decision of whether a capacity hat is required will depend on the desired bandwidth of the finished antenna, but as a guide, it could be made from stiff wire, such as is obtainable by cutting up wire coathangers, and after fitting, giving it a copious covering of paint or other water inhibiting coating.

The loading coil itself should also be protected from the entry of moisture, as this will tend to de-tune it. A useful idea here is to mount the coil inside a plastic washing-up liquid bottle, by cutting the bottle across the centre, sliding both halves over the coil and fixing in place, not forgetting to seal both the join and the open ends of the bottle against the ingress of moisture. See *Figure 3* for details.

A practical example

As an example, we will design a centre-loaded whip antenna for use on the 40 metre band, with a physical height of 8ft and a diameter of ⅜ inch.

Thus we input into the computer: height 8, diameter 0.375, frequency (midband) 7.05.

The computer tells us the inductance required for both base and centre loading coils, in this case, base loading coil: 11.29 microhenries, centre loading coil: 22.58 microhenries.

The computer asks us to input a value of Q. Choosing 300 as an example it tells us that the dc resistance of our centre loading coil needs to be 3.33ohms. In practice, the resistance may be less. If so, the Q will be higher, which is acceptable for most applications, but could be lowered by the addition of a capacity hat. If the dc resistance is higher, the Q will be accordingly lower.

The computer then asks us to tell it whether or not we wish coil winding details. Taking this option, it then asks us to input suitable physical coil dimensions. As an example, we shall let the coil diameter be 2 inches and the coil length 4 inches. Inputting these figures gives the results: 33.26 turns of wire on the former with a pitch of 8.32 turns per inch.

Table

From the above figures we can build our antenna. The matching coil can be worked out using the approximations in the table.

Fig 2 *Method of matching antenna to feeder – the top section is made telescopic for adjusting the antenna to resonance*

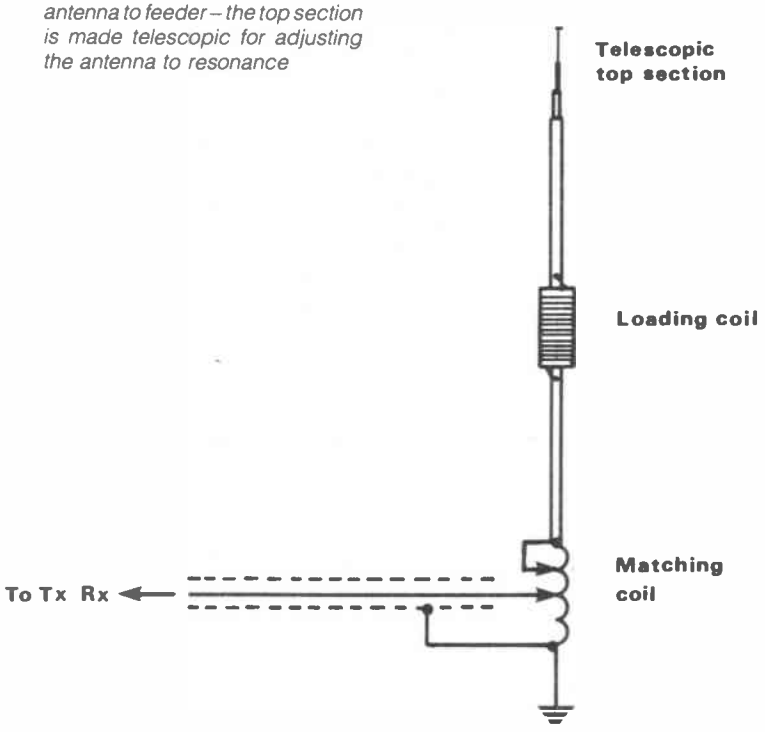
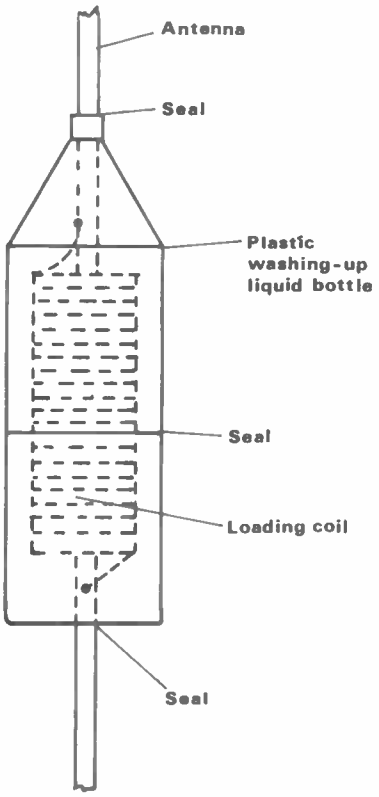


Fig 3 *One method of protecting the loading coil against weather*



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500mW to 10W	70FM10	41.45	33.45
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1.5W to 10W (No Changeover)	144FM10A	24.15	18.50
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2.5W to 25W (SSB/FM) (Auto-Changeover)	144LIN25B	40.25	29.95
1.0W to 25W (SSB/FM) (Auto-Changeover)	144LIN25C	44.25	32.95
Pre-Amplifiers			
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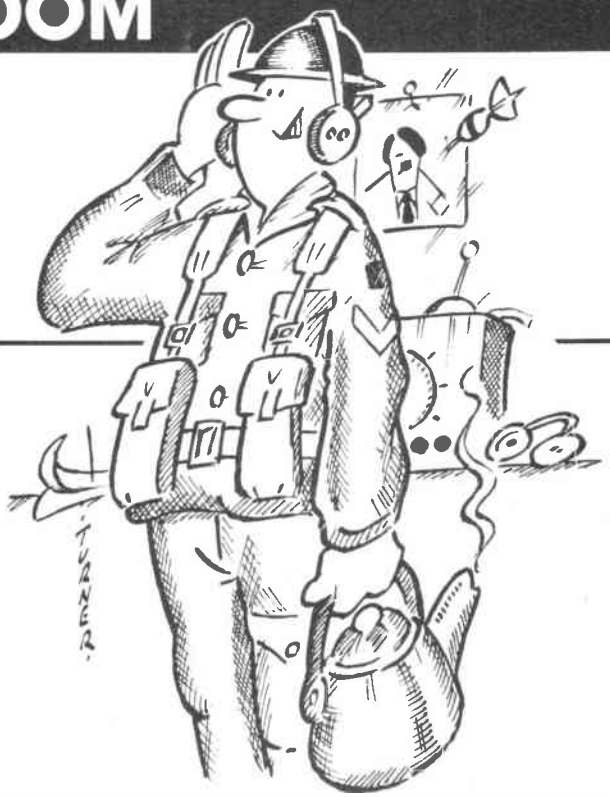
DODSON AT RANDOM

Working in radio — *a look back at 43 years with the 'cans' on*



Perhaps the most startling revelation about completing nearly half a century in the communications racket has been the eventual realisation that I never really wanted to be in it! It could be said that a lifetime of mainly fruitless effort, mindless repetition and endless night-duties have soured my judgement, but the fact remains that the end-product of my life's work has emerged as precisely, and completely, nothing.

For me, it all began at the tender age of 17 when, in 1942, I was encouraged to lie about my age in order to join a pseudo-military establishment with an HQ near London, of which much has been written in earlier editions of *Amateur Radio* magazine.

At the time it was all very exciting; there I was, a lad from Lancashire with nothing more in the way of credentials than a Flight Sergeant's stripes from the Air Training Corps and the ability to read 20wpm Morse, down in 'the Smoke', with seven quid a week in my pocket – big money back in 1942!

Real soldiers

In the best interests of good order and military discipline some attempt was made to make us raw recruits at least resemble soldiers, if only to prevent the entire unit from being impounded by the Military Police, but by and large the operational aspects of the job took precedence. As for London, I don't know which scared me the most – the MPs at Euston or the ladies of pleasure at Leicester Square tube station: it was never like that in Preston!

In the beautiful houses that now constitute the stockbroker belt of North London we did our training; houses denuded of their elegant furniture and deep-pile carpets replaced by bare floorboards, trestle tables and stairways protected by wooden laths against the ravages of countless army boots. Looking out over long, trim lawns, we recruits were tethered like goats by phones through which endless groups of five-letter and five-figure code poured until, at last, the more successful passed the final test to emerge as 'signalmen'.

The wartime operational environment was designed with a view to enclosing the maximum number of personnel in the smallest possible area, on chairs designed not only to discourage night-time dozing, but even daytime sitting! Big was definitely beautiful in the design of the radio equipment of the day, with receivers painted the inevitable army puke-green and built to withstand dropping from aircraft by (or even without) parachute!

The phones of that era were made of a diabolical combination of steel bands and bakelite – surgical appliances to be fitted to the head like leg-irons; hasty removal was something to be discouraged as it inevitably led to the removal of part of the old 'barnet' unless suitably protected by a layer of Brylcream!

Equipment layout was, and for that matter still is, designed with the convenience of the operator as a minor consideration; prolonged dial turning is much more comfortably achieved with a receiver tilted back by some 40° than in an upright position. On some stations military requirements impinged on operational territory to the extent that two clips of .303 ammunition were issued to each operating position. Such was our knowledge of firearms that they became a convenient place to balance your fag if you got busy!

Cuppa

The one redeeming feature about wartime wireless operating was the abundant supply of tea – one of the 'perks' of the business that remains to this day. In the army, the mixture consisted of 2lbs of sugar, ¼lb of tea and a tin of condensed milk mixed with two gallons of water in a stainless steel bucket and served in pint mugs.

On the move, no self-respecting driver of a 'gin palace', or mobile signals office, would have been seen dead without his 'brew-tin' (an empty margarine tin fitted with a wire handle) hanging on the tow bar. Heat was provided from a jerry can with the side smashed in, half filled with sand like a cat litter to which petrol was added and lit. If the flame died before the water boiled, more petrol was thrown on from a separate container. Novices could be easily identified by the fact that they didn't let go of the container!

Going abroad with my Dad's Army came as a bit of a shock – we had to mix with real soldiers! We were posted as replacements for one of our stations in Italy and disembarked at Naples, from where we were shunted into a transit camp. Now a transit camp is a sort of holding unit, or pool, from which personnel are dispatched as and when required at the discretion of the Officer in Command.

Classification

Part of the conditions of membership of our strange outfit was our classification as B1 trade-rated operators – a standard of proficiency normally only attained by long serving peace time senior NCOs and Warrant Officers after years of experience on all types of communications equipment.

You can well imagine the confusion of the transit camp commanding officer when confronted with twenty fresh-faced kids who didn't know one end of a teleprinter from the other, all of whom were B1s and who knew not only where they were going, but when! Our camp guard duty had to be seen to be believed!

Operating in near-tropical conditions in southern Italy brought new problems. Ears were transformed into limp, red cabbages due to constant perspiration beneath phones, forearms stuck with the tenacity of fly-paper to message pads and log forms, and I am convinced that countless haemorrhoids were born on the fetid chairs of radio operators working in the Middle East! Life went on in an insanitary environment of limp shirts and hot boots that was in no way

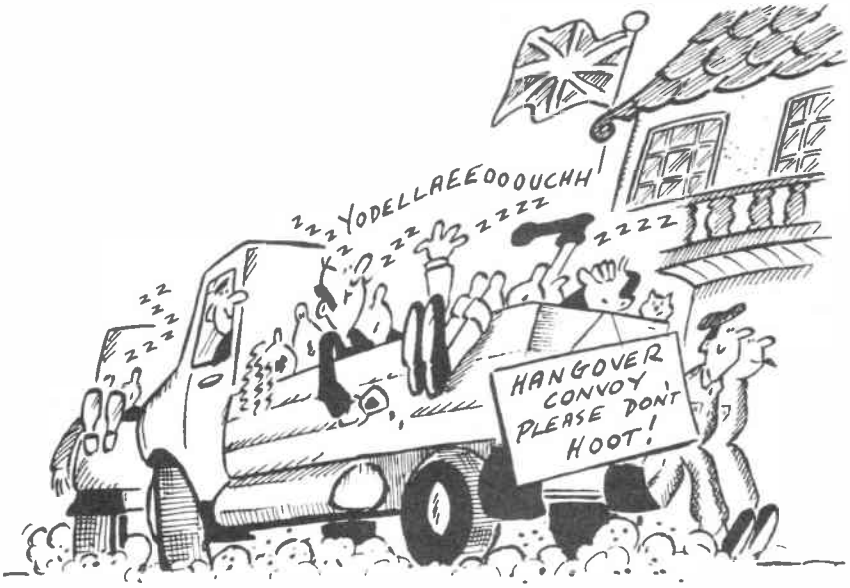
improved in the 'cool' of the night when the claustrophobic effect of mosquito netting did as much to keep the little sods in as it did in keeping 'em out!

A move to northern Italy, and cooler climes, made for a considerable improvement in working conditions, and it was there that we celebrated VE day. Some of us, however, marked the occasion with more enthusiasm than others and one operator, having tanked-up on vino, took off in a jeep and completely disappeared for days. He was subsequently discovered in the Russian sector of Vienna and promptly returned to his unit under guard for a court martial, not so much with a view to punishment, but more to find out how he was clever enough to manage it!

But we were on the move again, this time bound for Austria and a contrast in scenery. Nestling in a valley between lofty mountains, our unit had been established in a school where we could enjoy an all-but British climate. In order to create a favourable relationship with the villagers, our OIC promptly despatched a couple of six-tonners to Italy to pick up a load of wine, and laid on a dance to which all the local talent was invited. He even engaged some entertainment in the form of a team of yodellers!

Ravages

However, on the pretext of protecting their daughters' honour from the ravages of licentious British soldiery, all the parents turned up to the knees-up as well, to enjoy our hospitality to the full. Their 'daughters' honour' was a bit of a laugh anyway, as that particular village had previously been occupied by the Russians, and an emergency abortion centre had been set up to deal with rape cases: patients were still turning up a year after the Russians left! But I digress. The outcome of the station dance was that the entire village, yodellers and all, who had been weaned on weak Austrian beer, got smashed out of their tiny minds on the relatively strong Italian wine and had to be carted home in the back of our three-tonners! I have never seen anything like it – an entire village with a kingsize hangover!



Due to a lack of main-stream communication services at our Austrian station, all contact with our UK headquarters was handled in-house. By then I had risen to the dizzy heights of full corporal with six operators at my disposal. Under the direction of an enthusiastic if misguided Signals Officer, we were provided with a two-position operating console which bore a striking resemblance to a double commode-chair, a pair of bug-keys and a dial-a-transmitter selection system to remote equipment, 'remote' in this instance meaning 300 yards down the road! Some of the transmitters were housed in the back section of an American Studebaker signal-truck mounted on heavy trestles, whilst the remainder lived in an adjacent wooden hut with a tin roof.

As can be appreciated, operating from a mountainous area caused problems of transmission and reception, and frequent adjustment of transmitters was necessary – which rather put the mockers on our fantastic 'remoting' system! The result was that one member of my staff spent a lot of time down at the transmitter area, tweaking the gear. It was, perhaps, unfortunate that he chose to relieve himself through the door of the un-earthed Studebaker unit at the precise moment that I pressed the key in the operations room, and for which I incurred his immediate and intense displeasure!

Sloper

However, we achieved more success from the gear in the hut. Having struggled with the poor signal emanating from us for weeks, our UK counterpart suddenly announced that he was getting us QSA5! An immediate investigation revealed that our antenna had fallen down on the sloping tin roof of the shed which, by a fortunate chance, just happened to be pointing his way! We left it like that, much to the consternation of the local wildlife until the Signals Officer found out, after which we went back to struggling!

More about tea

By virtue of the fact that we in communications constituted the sole link with our HQ, my little detachment considered itself something of an elite band within the unit – an opinion, I should add, that was not necessarily shared by the remainder of the staff! We were, nevertheless, an independent lot and objected, for instance, to having to queue up for tea at break and mealtimes. Immediately outside our office window were the trailer-mounted generators from which the station derived its power. Why not, we thought, strap a couple of big dry-battery carbon poles together with wooden spacers, attach a mainslead across them and lower the whole shebang into a margarine tin of water and make our own tea?

In theory it should have worked. In practice, however, the water boiled in ten seconds flat, by which time the generator had nearly ground to a halt, smoke was pouring out of the power-board and the technicians were tearing their hair out! We went back to queueing after that!

Back in the UK prior to demobilisation, I found that a lot of things had changed. Not the least was the fact that many of the aspiring operators from the training days who had failed the Morse test had been quietly beavering away at home carving little niches for themselves in analytical departments to make themselves all-but indispensable to any equivalent civilian organisation.

Now in those days there was no such thing as career advisory bodies: in a post-war struggle for survival, you took what you could get and were grateful. So as a wireless operator, I duly presented myself in my sparkling demob suit before a panel of gentlemen with a view to becoming a radio officer, working for the government.

DODSON AT RANDOM

The title might have sounded grandiose, but it didn't mean a lot. RO on paper might have signified radio officer, but to my betters it still meant radio operator. In the same way as I had been indoctrinated over the previous five years to a mental acceptance of a lowly service situation, so my military superiors entered the service on a correspondingly higher level to maintain the status quo. Top management in my new government department was stiff with Rear Admirals, Lt Cols and Wing Commanders, many of whom were not entitled to use the rank, and whom I delighted in addressing as 'Mister'.

Inevitable

By and large, the situation was accepted as inevitable by the majority of newly appointed ROs, along with many of the diabolical shift-systems imposed upon us and conditions of service: as virgin Civil Servants we had no 'establishment' rights and the trade unions were yet to take us under their wing.

With five quid a week, in 1945, we were scattered to the far corners of the realm and told to get on with it. However, on the principle that when you're at the bottom, the only way is up, conditions gradually improved. Even at the training establishment – perhaps the last stronghold of the supervisory 'heavies' – they began to act like human beings, the accommodation taking on a more homely atmosphere and looking less like Pompey barracks! Furthermore, either by design or by natural wastage of the service diehards, a more friendly atmosphere developed between top management and the lower echelons; all of a sudden the Officer in Charge was calling you by your first name!

By 1960, even the cosmetic aspects of the operational environment had improved. The regulation dark-green and brown painted brickwork of government establishments had given way to tasteful pastel shades, lowered ceilings – and even carpet! No longer were operators expected to work in battery-hen conditions – they had air conditioning and typewriters.

Although there was considerable speculation as to whether the former was primarily intended to be of benefit to staff or the computers they used, the latter did take some getting used to. There was definitely a physical difference between associating Morse symbols with the written word, and Morse symbols with a key on a typewriter.

Parkinson's law

But in accordance with Parkinson's law, it all grew and grew – particularly at departmental headquarters. To the lowly operator, the organisation 'at the top' was very much a jungle, the path through which was known only to the lucky few. The principle for the headquarters hot-shot appeared to be to aspire to a 'title', being an arrangement of letters and figures designating his particular department and section, together with his relative importance to and association with his departmental head. All very complicated, but the general idea was to progress gently over the years from being the holder of a title of some four or five digits to one of a single letter – by which time he had arrived at the pinacle!

Demanding

In the 1980s, advances in communications technology have demanded a broadening of the scope of the radio officer; a knowledge of, and the ability to operate a vast range of sophisticated equipment designed to process transmissions varying in content from scrambled speech to those with multi-channel, multi-mode content is necessary. We have come a long way since the tools of the radio operator were a pair of phones, a pencil and the ability to read Morse; today, an understanding of computers and a highly technical background are the basic prerequisite. Perhaps that mug of tea, on the hour, every hour, remains the only common denominator between the radio officer of today and the wireless operator of by-gone days!

TALL TALES FOR SHORT WAVERS

by David Lazell

A timely hint of doom for the world of short wave bulletins

Ten years ago and the other side of my nervous breakdown, I was involved in retailing the latest marvels in hi-fi, short-wave, audio and TV. Video was just coming in, but the manager would not trust me with it. Fantastic leaps forward in electronics came by every post (and certainly whenever a rep came in).

Customers sometimes gazed at the sales staff askance, assuming the fervent description of Dolby B a mere tall story. Yet when we invented weird gadgetry for the benefit of after-lunch time-wasters playing truant from a factory just up the road, the purple patches were swallowed as real science. To this day, there must be locals still awaiting our literature on a world radio no larger than a ball-pen and operating off carrot juice.

Since a government sponsored tall tale during World War Two spread the idea that Britain was using carrots and not radar (or 'radio-location' as it was known) to spot aircraft, exaggerations should not be under-estimated. As they say, it happens all the time in short-wave.

Tall tales

A stalwart in this area of tall tale short-wave is Joe Ventolo of Enon, Colorado. For some years now, Mr Ventolo has been reporting such important events as the White House's plan to sell the 15 metre band to Saudi Arabia, and new plans to use telepathy to transmit Morse code. But you have to think *hard!*

His lively bulletin of pseudo-reports, 'GEARVAK-f', was sparked off as an attempt to parody some of the short-wave club newsletters circulating in the USA. Joe's pen proved so popular that his satirical style caught the mood of many short-wave users. He invented his organization, GEARVAK-f, to lampoon bureaucratic goings on.

Proving that there is always a thin line between fiction and fact, GEARVAK-f started getting membership requests. So in 1979, Joe Ventolo had some certificates printed and enrolled around fifty members. It's entirely *ad hoc* (and maybe even *'hic, haec, hoc'* if it comes to that) and the bulletin keeps going on the basis of occasional donations.

Scoops

The latest issue points out that its belated publication was caused by the editor's *real* job of punching a typewriter for eight hours a day. Handling such scoops as the refurbishment of the Harnishe-Lishnus Effect, or the kidnapping of the 10MHz band, obviously calls for a lot of mental energy. The reports are prepared by hams who feel they have something to share.

Given the hullaballoo in Britain about the commercial cable services, the piece by N8JR in the winter 1983 issue of GEARVAK-f might be worth studying. It reports the plan of the Federal Communications Commission (FCC) to permit hams to sell advertising on their QSOs.

This new scheme from the hard-up FCC is glowingly described: 'Before long, we can expect to hear more and more QSOs like this: 'Thanks, OM for the call, but before I fill you in on the QTH and the RST, let's take time out for a word from Little Crusties, the ham-flavoured breakfast cereal for real hams.' Last word in from the GEARVAK-f Newsroom says that the League of Radio Relaying Americans has volunteered to act as an agency for all hams in the placement of advertising on their stations'.

Believable

Trouble here is that the air of authenticity may prompt hams to go ahead and recommend Grandma's knitting patterns at a quid a throw. In these ecology conscious times, one could be forgiven for believing another report in the same issue. 'Letters of the alphabet to be recycled' describes the opening of a recycling centre which will permit owners of copying machines to save on costs. Machines are operated with cans full of old letters instead of ink and chemicals.

Not only can you save money on photo-copying, but mental telegraphy permits CW communication without the use of expensive equipment. You merely think hard in Morse and point your eyebrows in the right direction.

Here, the GEARVAK-f spoof may be less spectacular. A 1933 issue of *'The Wireless Constructor'* – a monthly with extensive short-wave intelligence – ran a feature entitled 'Uncanny Radio'. A 'straight' piece of reportage, the article described how certain metal lamp-posts in London picked up the BBC signal. Additionally, some people picked up the London station through their water pipes, the volume being increased with water flow.

Bowler hat front end

Pre-war copy also referred to unusual gentlemen who could 'hear' the radio transmission without any apparatus. Bowler hats were very popular in those days, of course, as were starched collars. There was obviously a good, scientific explanation.....somewhere!

This whole idea of thought-waves has enthused the vast army of GEARVAK-f researchers (both of them). It must be two years or more since the *Bulletin* heralded the launch of 'The Thought-Plexer by Wierdley Electronics'.

This was the 'first thought transmission-reception system available for hams. Completely safe from the hazards of non-ionizing radiation, the Thought-Plexer uses no RF and is not subject to other types of interference. Thought-Plexer is wonderful fun on dates, and is great in class for reading the thoughts of all the smart people'.

Uncertainties of modern life are recognised as what they are by GEARVAK-f readers, ie the fault of government.

The Morse code has been freezing up during the recent cold spells in the USA, and even Californians have been forced to chip parts of frozen communication off outside antennae. As for California itself, the state has had its problems!

California missing after earthquake

Local DX hounds, Luigi Antenna and Edgar Aerial claim that QRM was down on the 15 metre band last week after a severe earthquake caused the disappearance of California. 'Its really much easier to work the Far East now',

said Antenna. 'I agree' said Aerial.

Such tough times have prompted the setting up of a Texas Task Force to prevent the radio spectrum from 'blowing up' through over-loading by hams and other enthusiasts.

'The public is urged to cover the roofs of buildings with aluminium foil, but remove the turkey wrapped in it first'. Further trouble may be avoided by the FCC's decision to take anti-conflagration measures on the 20 metre band!

FCC to install sprinklers on 20m

To preclude a repetition of the near disastrous fire which struck the 20 metre band last year, the FCC plans to install a sprinkler system on the band sometime in the fall. According to an announcement made last week by FCC special frequency safety engineer, Marvin Larpsnogg, the new sprinkler system will 'sense the build-up of excess thermofrequency heating (TFH) and cool down the band before a conflagration can break out'. Mr Larpsnogg added that successful operation of the system could lead to the sprinkling of all ham bands by 1985, 'provided water damage doesn't get to be a big problem'.

'Do not smoke solder flux! It can cause your leaves to turn brown'

'Safety tip fatalities can be dangerous to your health. Do not smoke solder flux! It can cause your leaves to turn brown' – GEARVAK-f Committee on Ageing.

Given the style of some official handouts, it is hardly surprising that they get sent up. Even the excellent US short-wave monthly FRENDX has its 'BLANDX' which, like GEARVAK-f, focusses on unlikely devices. FRENDX is published by the North American Short-Wave Association (NASWA) and is a model of intelligence, reflection and up-to-date information on frequencies and stations world-wide.

Bill Eddings

At one time, NASWA was little more than a club for DX enthusiasts. Its good work was considerably advanced by a DX great-heart named Bill Eddings. This diligent short-waver died in October 1970, at the early age of 51, but is recalled as a self-effacing character out to share a hobby rather than his opinions. When Don Jensen wrote a three-part history of NASWA last year, he paid tribute to Eddings' flair:

'I never was, and never claimed to be a top DXer' Bill Eddings

'Bill Eddings loved to write homely little editorials in support of his view of the hobby and people in general. His style had odd quirks, filled with coined words and exclamation marks. Sometimes, he seemed to think that NASWA was growing beyond his depth.

Did a bit of good

'I never was, and I never claimed to be, a top DXer', he wrote. 'Somehow, I hope to think I did a bit of good somehow.....that in the days to come, there will be those who remember that NASWA was once run by a humble OM who wanted nothing but friendship and goodwill between those he came to know as brothers'.

The workload on Eddings was growing with membership (beyond 500 members, a very large club a decade ago). It was later estimated that in the years of producing FRENDX bulletins by mimeograph, the executive editor-publisher cranked the handle one hundred thousand times'. Bill Eddings handled all the mail, too.

Don Jensen estimated that Bill Eddings devoted more than forty hours to NASWA mail, every month, working from a two-room apartment in Altoona, Pennsylvania. From just two hundred members, NASWA has grown to an international membership of well over two thousand – and is still growing.

Short-wave send-up

To Bill Eddings, we owe the appearance of another short-wave send-up in the person of Charlie Loudenboomer. Don Jensen recalled that *this* Charlie was 'a satirical columnist with a wicked pen, poking fun at the foibles and fakes in the hobby. He never revealed his identity. Some readers spent years trying to figure out who Charlie really was. Many names were suggested. No-one confessed. Some said they were just as happy not knowing'.

Some readers spent years trying to work out who Charlie really was

Presumably, Loudenboomer was the *nom-de-plume* of a NASWA member, and as the columns continued to appear after Bill Eddings' death, the hard-working editor did not write them.

Short-wave mystery

This mystery of short-wave came into focus again during 1982, and Loudenboomer was invited to write in with more purple prose on short-wave. However, apart from an alleged sighting in London – where a large, check suited veteran tried to enter Buckingham Palace in order to tell the Prince how short-wave *really* works – there was no reply.

Professor Goop – every inch a professor and every centimetre a misunderstood husband

Perhaps Loudenboomer has joined the other short-wave spoofers and immortals, like Professor Goop of *'The Wireless Constructor'*. Every inch a professor, and every centimetre a misunderstood husband, Professor Goop enlivened the pages with merry tales from the frequency fraternity, usually while his wife was trying to clean the place up.

I must confess that I have added to the confusion, though at the time unaware of Charlie Loudenboomer, Professor Goop, and the other whizz-kids. In the mid 1970s, my tales of 'The Radiogram Kid' featured an academic hard-head who travelled through the old west, selling worn-out radio sets to the denizens.

Fiction?

I little realised that the unlikely adventures of 'The Radiogram Kid' were to come true in some of the abuses of Citizens Band radio a few years later – which also had its (wild) western flavour.

I can only assume that, at the time, I was being struck by some of that mental telegraphy coming from the marble halls of GEARVAK-f. Yes – GEARVAK-f is still there. They haven't lost their marble yet.

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BACK TO BASICS

Bill Mantovani G4ZVB gets down to the serious business of 0-level physics and examines

ELECTRICAL THEORY AND CALCULATIONS

Last month we gave you a fairly gentle introduction to studying for the RAE; now it's time to get down to some real work. Turning to Chapter 2 in your *Radio Amateurs' Examination Manual* you come to what at first sight always appears to be the most daunting subject in the whole syllabus – electrical theory. Don't, however, let all the formulae, graphs and theory put you off. The RAE is not like an 'O' or 'A' level exam where you have to prove how certain formulae are derived, you simply have to know how to use them.

Terms

You will need to be able to define basic electrical terms such as resistance, conductor, power or parallel circuit and know of their use, so read the chapter carefully.

Also you will be expected to recognise the various units for those terms, and their relationship to each other. The table below gives a list of the more commonly used terms and units.

Let's now look at the basics of electricity itself very briefly. We all know that matter is composed of *molecules*, of which there are many different sorts. A molecule itself is composed of particles called *atoms* and if you cast your mind back to those long forgotten school days (for some!), you will recall that there are over 100 different types of atom known, such as hydrogen and oxygen which combine in a 2-to-1 ratio to form one molecule of water (H_2O).

To explain why a substance may be a good or bad electrical conductor, let's see what constitutes an atom. An atom is made up of a core, called the *nucleus*, around which orbit a number of much lighter particles called *electrons*. The nucleus is said to be positively charged and the electrons negatively charged.

If a substance contains electrons that move freely from atom to atom then it is said to be a conductor, for if that substance was made into a piece of wire for example, and a voltage applied to the two ends, the electrons would all begin to move along the wire. This movement is called an *electric current* and by convention is said to flow from *positive* to *negative*. In reality, it has been discovered that it does in fact flow from negative to positive, but rather than rewrite all of the text books we simply call it the conventional current flow.

If the electrons in a substance are all firmly bound to their respective atoms and do not move about freely then the substance is said to be an *insulator*. The table at right gives a list of insulators and conductors.

Materials commonly used as insulators and conductors

Insulators	Conductors
Mica	Silver
Ceramics	Copper
Quartz	Brass
Plastics	Aluminium
Glass	Steel
Air	Carbon (graphite)
Oil	Various liquids

Generating electricity

There are a number of ways in which an *electromotive force* (EMF) can be generated. The simplest is by chemical action when two dissimilar metals are placed in a certain solution. This is called a *simple cell*, but the chemical change also produces side effects which reduce the efficiency of the cell. A practical cell in which electricity is produced by direct chemical action is called a *primary cell*. A number of these cells may be connected in series to form a *battery*, producing a higher voltage than that obtained from a single cell.

A primary cell, however, suffers the disadvantage that some of the chemicals in the cell are used up whilst it generates electricity, and the current available is also limited.

A *secondary cell* cannot only generate electricity, but when it is spent can be recharged by applying an EMF back into it. An example of such a cell, or *accumulator*, is the car battery. Another advantage of the secondary cell is that it can provide a fairly high current.

Table of common abbreviations and symbols

Quantity	Symbol used in formulae	Unit	Abbreviation	Abbreviations for multiples and sub-multiples		
charge	Q	coulomb	C	G	giga	10^9
current	I	ampere	A			
EMF	E	volt	V	M	mega	10^6
voltage	V	volt	V			
time	t	second	S	K	kilo	10^3
resistance	R	ohm	Ω			
capacitance	C	farad	F	c	centi	10^{-2}
inductance	L	henry	H			
mutual inductance	M	henry	H	m	milli	10^{-3}
power	W	watt	W	μ	micro	10^{-6}
frequency	f	hertz (one cycle per second)	Hz	n	nano	10^{-9}
wavelength	λ	metre	m	p	pico	10^{-12}

Electrical units

The unit of charge or quantity of electricity is the *coulomb* (symbol Q). In measuring the flow of electricity, a current of one coulomb per second is called an *ampere* or amp, and is denoted by the symbol I. If 't' is the time of flow of electricity, then the relationship between these three units can be written as:

$$Q = It \text{ or } I = \frac{Q}{t}$$

The unit of electrical pressure is known as the *volt* (symbol V) whilst the measure of the opposition of a circuit to the flow of electrical current is called the *resistance* of the circuit (R). Resistance is measured in *ohms* (Ω), and in a dc circuit *(Figure 1)* the resistance R will be 1Ω if the voltage across the circuit is 1 volt and the current flowing through it is 1 amp. This is known as *Ohm's Law* and the formula:

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

should be remembered as it is used in many of the calculations in the exam.It should be noted that in the circuit in *Figure 1,* the battery will also have an internal resistance which then makes the total resistance of the circuit R + battery internal resistance. The best battery is therefore one with a low internal resistance.

Power

Passing a current through a resistance causes electrical energy to be converted into heat. The power in the dc circuit can be expressed as power (watts) = volts x amps or W = V x I. Using Ohm's Law, we can also say that:

$$W = I^2 \times R \text{ and } W = \frac{V^2}{R}$$

In practice, some of the above units are too large (or small) to conveniently express the actual current or resistance, say, in a circuit. Only fractions of an amp may be flowing through a circuit, or the value of a resistor may be many thousands of ohms, so it is more common to refer to current in milli- and micro-amps and resistance in kilohms. The table shows the various terms and abbreviations.

Resistors

Assuming that you are still with us (the above wasn't too heavy going after all was it), we now look at resistors, which come in various forms such as carbon and wire-wound. Each has its own particular application but it should be remembered that wire-wound resistors must not be used in circuits where they would act as inductors and radiate, such as a transmitter dummy load. There may be a question about that in the exam.

Resistors may be connected in a number of ways to produce a different value of resistance. *Figure 2a* shows resistors connected in series, from whence the effective resistance (R) can be determined as follows:

$R = R_1 + R_2 + R_3 (+ R_4 + R_5 + \text{etc}).$

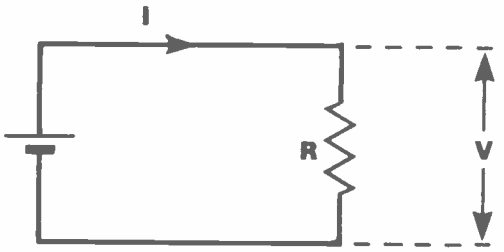


Fig 1 *A simple dc circuit*

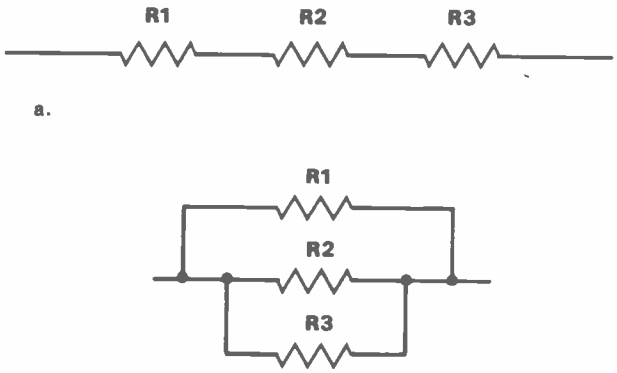


Fig 2 *Resistors in (a) series and (b) parallel*

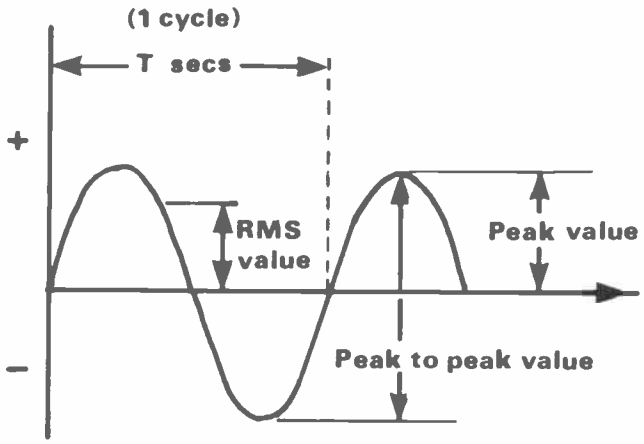


Fig 3 *An ac waveform*

When connected in parallel as in *Figure 2b,* the effective resistance is:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{etc},$$

$$\text{therefore, } R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{etc}}$$

Where there are only two resistors in parallel, the following formula is used:

$$R = \frac{R_1 \times R_2}{R_1 + R_2}$$

The alternating current circuit

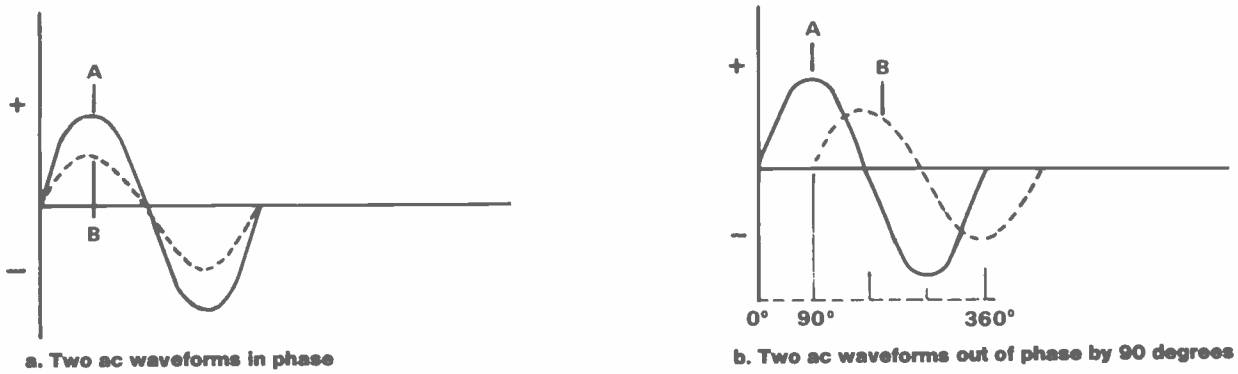
Figure 3 shows an ac waveform. Unlike a dc circuit, the voltage and current in an ac circuit is not constant but alternates between positive and negative peaks. The waveform in *Figure 3* is called a *sinewave* and has two values, a peak value and an RMS value, as shown. The RMS or root mean square value is 0.707 times the peak value. Two other useful values are the average value (0.636 times the peak value) and the instantaneous value, that is the actual value of the voltage or current at a particular point in the ac cycle.

The frequency (f) of the waveform can be found by the formula:

$$f = \frac{1}{T}$$

where T is the time period occupied by one complete cycle.

The terms *in phase* and *out of phase* often confuse examination candidates, but they can be readily explained as follows.



a. Two ac waveforms in phase

b. Two ac waveforms out of phase by 90 degrees

Fig 4

Figure 4a shows two waveforms that despite different peak values have the same frequency and begin at the same point. They are thus said to be in phase with each other. In *Figure 4b*, the two waveforms no longer start at the same point in time and so are out of phase. The amount by which they are out of phase is stated in degrees, one complete cycle being taken to be 360 degrees. Therefore, as waveform B in our diagram is a quarter of a cycle out of phase, it is said to be 90 degrees out of phase, or conversely waveform A leads waveform B by 90 degrees.

Bearing the above in mind, careful reading of the section on ac circuits and phasor diagrams in your RAE manual should enable you to fully grasp the term phase.

Inductance and capacitance

Two elements which have significance in an ac circuit are the inductor and the capacitor. The unit of inductance is the henry (H) and the symbol for inductance is L. A circuit has an inductance of one henry if a current in it, changing at the rate of one amp per second, induces an EMF of one volt.

Energy stored in an inductor = $\frac{1}{2}LI^2$ joules.

Energy stored in a capacitor = $\frac{1}{2}CV^2$ joules.

The symbol for capacitance is C and its unit is the farad (F). A circuit has a capacitance of one farad if a charge of one coulomb sets up a voltage of one volt across it.

Ignoring the effect of resistance, the opposition to the flow of an ac current is termed the reactance, which can be inductive or capacitive. For inductive reactance,

$$X_L = 2\pi fL$$

and for capacitive reactance:

$$X_c = \frac{1}{2\pi fC}$$

When resistance is also taken into account, the total opposition to the flow of an ac current is called impedance (Z). By Ohm's Law,

$$Z = \sqrt{R^2 + X^2}$$

where X is the effective reactance for a series circuit with both X_L and X_C.

When connecting inductors in series or parallel, the total inductance can be calculated as for resistors, that is:

$$L = L_1 + L_2 + L_3 + \text{etc}$$

for inductors in series and:

$$\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \text{etc}$$

for inductors in parallel.

For capacitors in *series*, the total capacitance is determined by the formula:

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{etc}$$

and for capacitors in parallel:

$$C = C_1 + C_2 + C_3.$$

Magnetism is fully covered in the *RAE Manual* and requires no further explanation. Read carefully however the section on inductance and inductors in radio equipment on pages 11 and 12.

Most of what you need to know about working out capacitance has already been covered but the section on capacitors in radio equipment tells you how capacitors work, how they are made and the different types of capacitors that exist. Most of the RAE questions involving capacitors though will involve using the formulae previously discussed. However the syllabus does expect you to know the factors affecting capacitance (and inductance).

Inductors and capacitors can be connected in series or parallel to form tuned circuits, as shown in *Figure 5*. You will remember that the formulae for determining X_L and X_C both use frequency f so they vary as f varies. When a tuned circuit is at resonance, X_L will equal X_C, so that:

$$2\pi fL = \frac{1}{2\pi fC}$$

From this we get that:

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

where f is now called the *resonant frequency* of the tuned circuit. This is a particularly useful formula to remember.

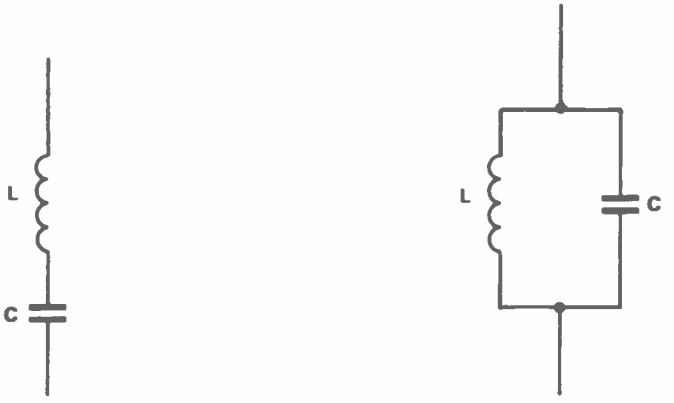
The majority of the formulae that you need to know for the RAE have now been covered, but the rest of the section on electrical theory in Chapter 2 of the *RAE Manual* should be carefully read so that you have some understanding of tuned circuits and how they work.

Transformers

This section is self-explanatory and easy to understand. Make a note though of the term *turns ratio* and of the impedance calculations.

A brief word should be mentioned about filters, as there could well be a question on this in the exam.

A *high-pass filter* is used to attenuate frequencies *below* a specified frequency. A *low-pass filter* attenuates frequencies above a specified fre-



Series-tuned circuit

Parallel-tuned circuit

Fig 5

In both circuits, $X_L = X_C$ so the resonant frequency (f) of each circuit can be found from $f = \frac{1}{2\pi\sqrt{LC}}$

quency. A combination of low and high-pass filters in series is termed a *bandpass filter* and all three types are commonly used in amateur radio circuits. One use of the low-pass filter is to reduce the audio bandwidth of a phone transmitter to the minimum required for intelligible communication, or to remove unwanted frequencies in the output of an HF band transmitter. The high-pass filter can be used in the antenna lead of a TV receiver to cut out frequencies in the HF amateur bands and thus reduce TVI (TV interference). Mixing will be dealt with in a future issue when we cover receivers.

The effect of temperature on components is plainly discussed on page 19 of the *RAE Manual* and needs no further comment, as is the tolerancing of components. You will not be expected to memorise the preferred values but you should know of preferred values, how tolerance can alter the *actual* value of, say, a resistor of nominal value (ie, 10,000Ω ± 10%), and the types of components used and their applications in electronic equipment.

Calculations

This now brings us to the end of Chapter 2 in the RAE manual and to the sample calculations involving the formulae just learned. As these are worked out for you as well, you can in fact check your answers. Few of the formulae should be new to you, if you think back to your school physics lessons!

If you would like to tackle some more sample questions then you can do no better than to send off for a copy of R Petri's book *'The Radio Amateurs Question and Answer Reference Manual'* (price £5.95) which was reviewed in the October issue of *Amateur Radio'*.

It is an excellent book to have because all of the questions and answers are in multiple choice format, just like the exam, and the first 9 chapters all contain questions on what we have covered in this issue.

You'll be pleased to know that we have now tackled what is usually termed the worst part – the theory and all its formulae. Something a little easier on the brain next month – solid-state devices. Good studying till then.

References and acknowledgments

The Radio Amateurs' Examination Manual – RSGB
City and Guilds of London Institute
The Radio Amateurs Question and Answer Reference Manual – REG Petri (G8CCJ)

Schedule

For the guidance of those readers who propose to follow this RAE feature all the way through, here is a list showing how the series will progress over the next twelve months or so.

Issue date	Topic
November 84	Becoming a radio amateur
December 84	Electrical theory and calculations
January 85	Solid-state devices
February 85	Radio receivers
March 85	Transmitters
April 85	Power supplies
May 85	Propagation and antennae
June 85	Transmitter interference
July 85	Measurements
August 85	Licence conditions
September 85	Operating practices and procedures
October 85	Tackling the RAE and supplementary information
November 85	Sample RAE paper

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THE PURSUIT OF EXCELLENCE:

G3WW

THE SLOW-SCAN MAN

TOLD BY JOHN HEYS G3BDQ

G3WW Richard Thurlow

It is hoped that this will be the first of a short series of articles to be written around the lives and amateur radio activities of a few outstanding British amateurs. The writer has often wondered why only a select few seem to achieve such fantastic results in their chosen fields of interest. Their achievements often instil ordinary mortals with awe or even disbelief when they read or hear of outstanding exploits from that select band of brethren!

These in depth studies will perhaps help to illuminate the backgrounds of these amateur radio 'pace setters' and may induce us lesser mortals to try harder and do better (see the BDQ School Report circa 1936!).

My first 'victim' just had to be Richard Thurlow G3WW. I well remember an arranged meeting that Richard had with my XYL and myself in Cambridge more than twenty years ago. He whisked us off at high speed in his latest VW to do a lightning tour of the district.

This trip included a specially arranged visit to the Brampton birthplace and family home of Samuel Pepys which was used as a Circuit Judge's Residence and was certainly not open to the public. Richard always had a knack for pulling strings!

We had lots of QSOs on the HF and two metre bands and Richard visited my Hastings shack when he was down in my patch. All this was before his 'conversion' to SSTV work; work which now dominates his amateur activities.

Should you ever meet Richard you may be almost overwhelmed by the sheer *enthusiasm* for whatever project he had got in hand. This extraordinary motivation, drive and singlemindedness is an important part of his character and must be the key to his success in his chosen special interests through the years since he was first licensed in 1938.

Early days

Born on 28.June 1905 (yes Richard is now 79 years young!) the son of the Rector of Widford near Chelmsford, Richard Thurlow was a Prep-School friend of the son of the Managing Director of Marconi's at Chelmsford. Visits to the huge masts of station 5XX (and an attempt to climb them) and also the Marconi Research Laboratory were no doubt factors which triggered off the later adoption of amateur radio as his hobby.

Only fifteen

When only a fifteen year old and still at school in Leatherhead Richard managed to obtain a coveted Experimental Receiving Licence in 1920. His receiving of 'six of the best' from his Housemaster for skipping evening prayers in order to listen clandestinely to a special broadcast programme did not steer him away from his hobby, and he says that the brilliant light from the filaments of the French 'R' valves were what gave him away!

Richard qualified as a solicitor in 1928 and the pressures of study together with the discovery of such interesting and time consuming diversions as girls and dancing meant that he then had little time for radio. He married in 1930 and from 1935 was employed by the former Isle of Ely County Council as Clerk of the Peace. The late G3BK joined the staff of that Council in 1937. He re-kindled an interest in radio and also inspired Richard to work for the GPO Morse Test. Morse was the only requirement for a transmitting licence at that time and Richard was soon granted the call G3WW on 11 November 1938.

War

War came soon afterwards and in September 1939 his transmitting gear was seized by the Post Office. He was allowed to keep his 'posh' RME-70 receiver which was used by one of the two VI radio intelligence groups, Richard having been installed as its leader by the late Lord Sandhurst. This radio monitoring work was a spare time activity undertaken when the numerous daily problems and extra duties which beset a Wartime Deputy County Controller had been overcome.

After the war his transmitting activities began again in March 1946. Some HF band DX working using an AM rig with an 813 PA valve and also some 56 MHz work in 1947 was followed by a stab at the new 2 metre band after May 1949. Richard was one of the first G stations to have a Mobile Licence in 1952. These licences were issued following a successful Demo in central London which had been organised by the late G2CDN, (what a character Rex was!) who was using imported American mobile gear.

Richard was a well known face at all the early Mobile Rallies and the signals from his VW Beetle were always outstanding. When one of a team involved in a mobile tour of our rarer British counties in 1956 I worked G3WW/M on Top Band at a distance of at least 50 miles in daylight whilst we were haring up the A1!

WAB awards

Richard naturally became interested in the new WAB Awards for which many rare 'squares' had to be worked. He became the third person to gain the Diamond WAB Award in 1969. To get this he had to work stations in 3,000 different squares. He amusingly tells of the way some of the trickier squares were hooked.

It seems that the technique was to take another licenced amateur along with you when you visited a rare and wanted square. This passenger then went off out of voice range with a walkie-talkie and worked the /P station in the car! There was, however, an unwritten rule that before you gave yourself the rare square in this way it was normal to work some outside station first! Now we know!

Richard's home QTH in the village of Wimblington, just south of March in Cambridgeshire, is set in the 'Bedford Levels' and is in the middle of one of the flattest and most low lying parts of England. This would not seem to be an ideal location for VHF work, but surprisingly it is possible to work DX in all directions from Wimblington as there are no natural obstructions or hills. Richard's house is set upon the only hill for miles around; a mere *pimple* just 16 feet above sea level.

G3WW

A good antenna (a pair of vertically stacked 16 element Tonnas with Dressler masthead pre-amp) atop a 19 foot scaffold pole which is itself atop a 56 foot Western 3HD Tower, together with an FT221R plus Mutek Board, and a NAG 144 (4CX350F valve) Linear all help him to put down very strong signals over a large area regardless of band conditions. This 2 metre set-up at G3WW's fine XVI Century house beautifully illustrates what is needed for a top of the line station; a superb site, an antenna, having more than average gain, well elevated, a low noise bomb proof transceiver and a bucketful of watts. With this kind of arrangement you will certainly be heard!

One earlier success was when G3WW worked OZ2FR in 1950 for the first G/OZ contact on 144 MHz. For many years he was one of our leading DX workers on the band but Richard is now not interested in the normal DX seeking and his VHF gear is used in the main to extend his SSTV capability.

G3WW's shack earlier this year

Retirement and a new interest

Full retirement from the post of Clerk of the Peace for the then new County of Cambridgeshire and the Isle of Ely took effect from 1 January 1972. General DX work on the HF bands had by that date raised Richards DXCC phone score to 295 (he later called it a day when he had lifted this to 317 countries some four years ago) and he had also been having regular Sunday night skeds on 14 MHz SSB with K2BH and K4EA. These followed 'eyeball' encounters with them in the United States in 1960. Eventually both these gentlemen inspired G3WW to think seriously about taking up Slow Scan TV on the amateur bands.

Dalton Pritchard, K2BH is the colour TV expert of the RCA David Sarnoff Research Centre at Princeton, and in 1971 he showed Richard some SSTV in operation. A 70-5FP long persistence tube monitor was brought back to Cambridgeshire and the SSTV *Bug* then bit quickly and deeply!

After using a Robot Co CQ picture tape (customised) G3WW then went on to use a pictures tape recorded on a normal C-90 cassette as supplied by GW2ADZ. Still not satisfied Richard then went the whole hog and acquired a Robot 80 TV camera to produce his own picture material.

Special permit

At that time a special permit was required from the Post Office for SSTV transmission, so an application was duly made to that body enclosing details of the intended equipment. 'Sorry, no Permit' said the authorities, for UK Regulations only allowed 120 lines and the American gear used a 128 line standard. Eventually with the help of Arthur Milne G2MI and the late G2BVN an interview with the appropriate GPO staff was arranged and the regulations were then altered to read, '120±8 lines'! A two year permit soon arrived and SSTV operations commenced.

By the mid-70's digital SSTV converters had appeared. WB9LVI demonstrated probably the first of this type at a Dayton, Ohio, Hamvention and then soon afterwards Volker Wrasse. DL2RZ showed a similar system at the first BATC SSTV Convention in Birmingham in 1975. The late Howard Waton, G3GGJ built Richard what was probably the first WB9LVI design digital scan converter to appear in Europe. The design in QST Magazine was for 60 Hz Amercan AC mains, but the G3GGJ version worked perfectly on our domestic 50 Hz supplies.

Colour

Colour SSTV was the next obstacle and challenge to be surmounted by amateurs and our GW2ADZ was a pioneer in this field. Soon after this the USA firm Robot produced a digital scan converter with a single memory (Model 400) which was soon modified by W9NTP to give an additional memory to handle red green and blue colours. Again G3GGJ got to work and added *two* additional memories to the basic *Robot* 400! Volker Wrasse added a third memory to his digital scan converter in 1982 and in 1983 his model SC-1 appeared which provided a pair of three colour memories, six black and white memories and a line sequential facility of 24 seconds for full colour single frame pictures.

Richard has one of these units which also sends and receives FAX with printout. He is experimenting at the present time with frame speed control.

Computer software is becoming available in the USA which will allow the sending and receiving of SSTV by computer control. It is said that Robot will have 12 seconds colour which they hope will become the new World Standard. Only recently Richard purchased a Seikosha GP 250X Printer and after some assistance from G4NJI he can now print out pictures transmitted or received after memory storage.

Mention has already been made of Richard's fine DXCC score. His achievements on SSTV are perhaps more remarkable bearing in mind the problems that manifest in the mode. In September 1979 G3WW gained SSTV DXCC number three in the World and his score is now 113 countries worked.

Since November 1972 when he first took up SSTV operation Richard has worked 1,971 different stations (two way contacts) in those 113 countries. This is thought to be a World Record!

An efficient HF station is needed in order to achieve such results and G3WW now has quite an impressive aerial *farm* on his 1½acre plot. His 56 foot Tower supports a five element 20 metre monobander (a three element Elan Beam for 10 and 15m is being stored in the garage until 'ten' opens up fully again). The tower also holds up an inverted dipole for 40 metres and the southern end of a 'Lazy H' for 40 and 80 metres.

This last antenna also works on Top Band when connected to a suitable ATU. Over the years a long line of transceivers have been used; the latest being an IC 740. This drives a vintage (1971) Heath SB220 Linear. There is also a standby SB401 TX and an SB 303 solid state receiver which Richard says he finds superb.

Determination

Richard has gear to receive weather maps etc and was able to receive live pictures (via W6VIO at the Jet Prop Lab in Pasadena) of the Planet Saturn sent from Voyager 2. His activity and his relentless striving for more effective gear and better results can put many of us to shame. Despite his 79 years Richard Thurlow remains young in spirit and retains a determination and drive which is sadly so often lost by many in advancing years.

I say 'Hats off' to G3WW and long may he continue to push forward our communication frontiers. The writer is grateful for all the help offered by Richard during the preparation and writing of this article and would like to publicly express a warm 'thank you' to his old friend. When on earth does he find the time to cut the grass on those 1½acres?

BCNU Richard OM!

SHORT WAVE LISTENER

TREVOR MORGAN GW4OXB

Here we are again with Christmas on top of us; it certainly doesn't seem like over a year since my first offering was published in *Amateur Radio*.

Thanks

May I take this opportunity of thanking those who took the trouble to write in to me or the Editor on different subjects – both pro and anti. We've enjoyed reading your letters and comments and I have been able to be of help to quite a few newcomers to the hobby over the past year. This has given me a lot of pleasure, enabled me to make new friends and made the column worthwhile.

I would like also to thank the various companies who have been so helpful in loaning equipment and offering advice over the past year. Thanks a lot, all of you.

Last month I reviewed two of the many Morse code computer programs available for decoding 'off air'. Of course, this is not the only use that computers have in the amateur radio hobby and there are many programs that have been developed by software houses and radio orientated magazines on a variety of subjects. These include QRA location, aerial measurement and propagation, enabling a substantial library to be built up.

Vu-file

There are, however, many general purpose programs that, although not written for radio use, can be put to good use by the short wave listener. One of these, which I have found extremely useful, is Vu-File, which is generally available through computer outlets or newsagent chains.

The program presents you with index cards which can be arranged to suit the individual needs of the user. The number of cards available depends on the amount of information stored on each card, ie the number of 'bytes' used.

For many years I kept a faithful record of stations heard on the standard 5 x 3 index cards, stored in boxes. Over a period of time I used literally thousands of these cards which, if bought in one go, would have cost a small fortune. There were also problems of storage and quick reference to a particular card, despite alpha-numerical storage.

INFORMATION PANEL

Callsign	Zone
Name	WAB
QTH	QRA
First contact	
SSB CW FM RTTY	
3.5 7 14 21 28	
QSL sent	
received	

The titles can be in various colours as an aid or to emphasise a particular item. The information can be entered at any time or altered as needed. The layout can be varied to suit your own requirements and any reference can be used to call up a card

Loading

On loading Vu-File, you are presented with the main menu or list of available options. When the first 'card' is presented you can plan out your subtitles as required, and once set up the layout is 'saved' and re-displayed each time you enter the program.

Vu-File scores highly in my view because of the ease with which you can look up a card – the computer will select a card using almost any reference. For instance, if you wanted to know which of your stored stations was using an FRG7 or a G5RV, or was situated in SS69 WAB square, all you would have to do is enter the reference (G5RV, WAB etc) in the 'string select', 'enter' the code and the computer will present the first card available with that item listed on it.

Planning

Also, when the cards are originally loaded, you can decide in which order the cards are sorted; alphabetically by callsign, name, square etc.

A readout of what cards are available or how many 'bytes' have been used (and how many are left) can be displayed by asking the computer to 'inform'. The information is displayed in the top panel and is available at any time.

If you have a variety of interests, you can make up cards for each interest on a separate tape and just load them as required after loading the original Vu-File program. My son has pinched a tape to store his stamp collection information on! The instruction leaflet provided is excellent and easy to follow, and the 'on screen' information likewise. A very useful program indeed.

More wire

In the October issue I spoke about experimenting with wires and gave a few basic designs to start from. This area of the radio scene is the subject of more discussion, argument and pure controversy than any other topic in radio.

There has also been a lot of nonsense written about aerials, especially over the past four or five years, by people who don't know a dipole from a hole in the ground, and many a Citizen's Band enthusiast has been led astray by badly written, ill informed articles on the subject. Some of the gain figures quoted for CB aerials were astonishing, as well as impossible to obtain!

Occasionally however, someone comes up with a new idea or a development of an old one that, although seemingly far fetched, actually works. Many of the claims put forward by those clever figure manipulators marketing the best antenna since sliced bread can be taken with the proverbial 'pinch of salt', and only an 'on air' trial will prove or disprove the claims made.

As one of the breed of enthusiasts (translate as desired to read idiots, nutters etc), who spend more time chucking miscellaneous bits of wire and metal up into the air than they do eating, I was more than intrigued to read of the introduction of a new and highly praised (at least, by the developer!) aerial.

Dipole of delight!

Being advertised as the 'Dipole of Delight' didn't exactly endear me to the new aerial (can you imagine trying to explain that one to a Russian/Greek/Swedish station over the air – especially the Swedish one!).

However, being the aforesaid enthusiast, I was intrigued by the claims being made and sent off to Hately Antenna Technology for a trial antenna. In this case I chose the one for 14MHz as this is my favourite band – especially as the little spare time I have is when this band is open. The antenna arrived two days later in a padded bag which I opened to find a simple dipole consisting of a centre piece fitted with an SO239 socket and 36 feet of wire (white plastic coated).

Well, I thought, this has just got to be a con, or a joke! I literally threw up the ends of the antenna, looping one end of the dipole to the guttering of my house with the other end fixed to the mast by my shack; a distance of 40 feet. The centre piece was about 12 feet above the garden among the branches of our flowering cherry tree. The coax was taken straight into the shack in a steady curve.

My usual set up consists of a TET MV5BH five band vertical, a G5RV with open wire feeder at 30ft, and a 130ft end-fed in the garden. These are fed through an LAR Omni-match to the Kenwood SW200 SWR/power meter.

Bypassing the matcher as recommended, I just kept the meter in line. Firing up the TS130V (QRO at 10 watts!), I checked the meter to find the SWR steady at 1.5 to 1. Tuning along the band from 14.001 to 14.250MHz I found the SWR dipped down to about 1.3 at 14.175MHz, rising back to 1.5 at the top of the band. I was very pleasantly surprised!

Having gone by the old adage 'never read the instruction book 'til you've tried it your own way', I decided it was time to put my specs on and read the considerable literature supplied. This consisted of detailed instructions on how to put up the aerial, emphasising the point that the screen of the coaxial feeder acted as a pure screen and subsequently should be 'grounded' before entering the shack, and a full resumé of the theory behind the design, including Smith Chart diagrams and measurements.

The antenna, coded the DDM14 (much nicer than the advertised name), was then put up in the prescribed manner with the coax dropping vertically from the centre piece to ground, which in this case was the garden wall, and then running along the wall for about 15ft to the shack. The set up was as before, with the meter in circuit to keep an eye on the readings.

First contact

The first contact made was with W2CXM in New York, who gave a 5/6 report. A bit further up the band I found W4GXT in North Carolina, who was intrigued by the experiment and gave me a solid 5/1 – 2 and commented on the signal quality, despite the meter reading. During the QSO I had the opportunity of comparing received signals with my vertical and G5RV and was pleasantly surprised to find the DDM14 showing two 'S' points over the vertical, and more than one point over the G5RV.

Being a keen QRP operator, I was very pleased with a two-way CW contact with SP9MRO using less than 3 watts both ways and a 5/8 report back on 10W SSB from SV1RU. During these contacts, the SWR reading remained at less than 1.2 to 1 throughout the band!

I don't know exactly what Mr Hately has put into the centre piece as it's a sealed unit, but the theory certainly works in practice and the DDM 14 has proved to be no con trick but an antenna that works.

Distinct advantage

There is one distinct advantage that it has over the usual dipole. As the coax braid acts as a pure screen, a metal mast has no effect on the performance, so inverted V layouts can be used in difficult locations. Another advantage of the grounded screen is that local interference is minimised, as the braid no longer acts as an aerial.

My thanks to Hately Antenna Technology for the opportunity to try out this antenna. I wonder if their multi-band antennae perform as well? We'll have to find out.

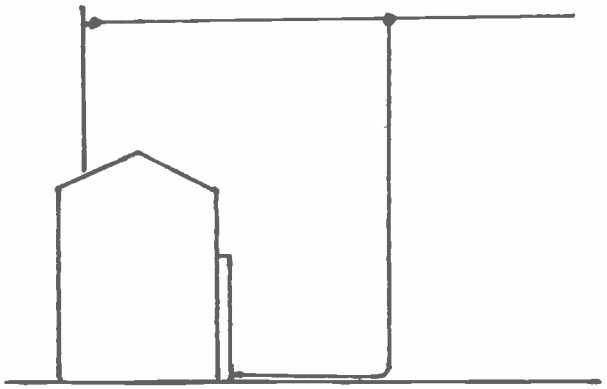
Xmas

We'll soon be hanging up the stockings and hoping that Santa will leave the goodies we've been hinting about these past weeks. That automatic noise filter would look nice on the shelf alongside the receiver and cut down on the noise coming from the shack!

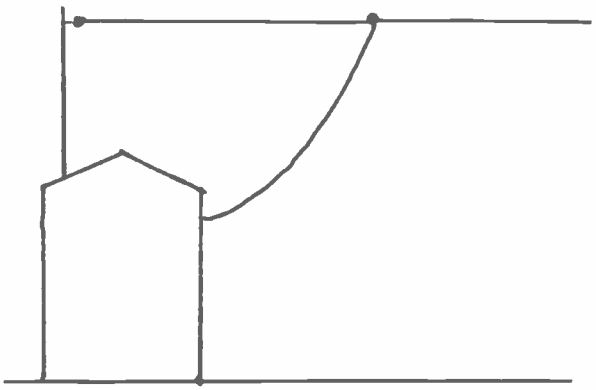
After all, I don't *really* need a new sweater.

Merry Christmas and a prosperous and peaceful 1985.

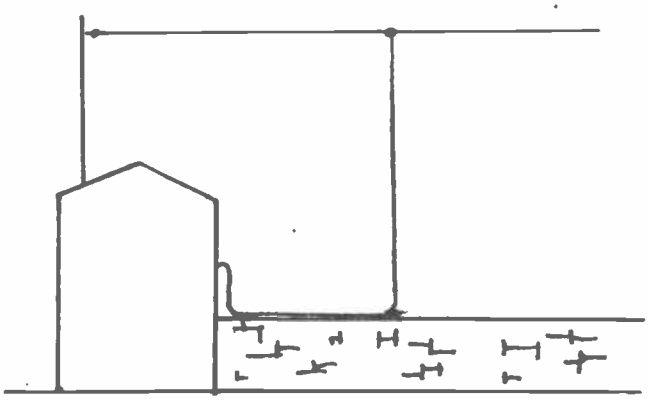
Models for 7, 10, 14, 18, 21 and 28MHz are available and multi band versions are also made for different ranges. Reception quality was found to be excellent on the band for which the dipole was designed but fell off when tried on another band. The DDM 14 costs £15.50 inc



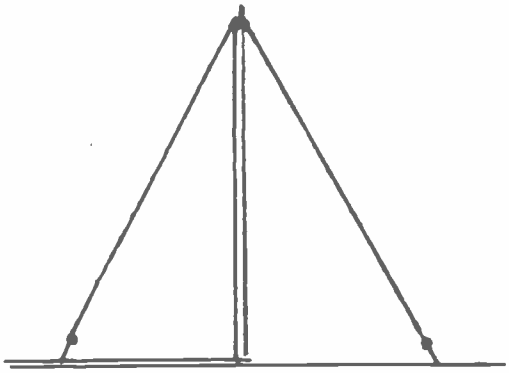
Screen grounded (recommended)



Screen not grounded (not advised)



As used at GW4OXB screen grounded on garden wall



Inverted V using metal mast. Note grounding of screen

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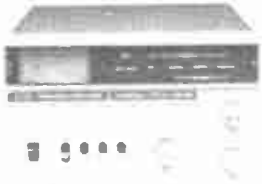

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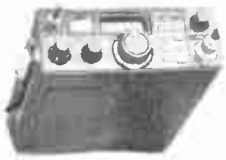

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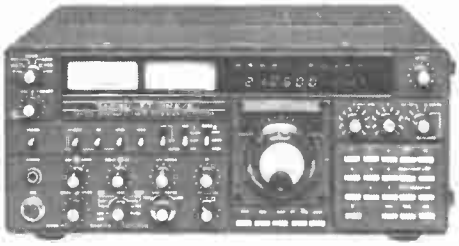

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THE 11m CB TO 10m AMATEUR BAND CONVERSION GUIDE

ROGER ALBAN GW3SPA
BSc. C ENG, MIEE

PART ONE

An explanation of the principles of phased lock loop operation in frequency generation systems

Introduction

With the sunspot cycle close to its lowest point on the curve, it appears that amateur activity on the 10m band has almost ceased to exist. There is a growing danger that unless radio amateurs make more use of the 10m band in times when the commercial communications users are pressing for additional frequencies, the band will ultimately be occupied by other users.

Indeed, within the USA, because of the lack of air space for use by commercial traffic and CB, piracy has taken over to such an extent that it is now beyond the control of the FCC. Along with other frequencies, the 10m band is being used by small businesses such as taxis and CB operators who find themselves unable to use their designated frequency bands.

It is said that in general terms we are only a few years behind the USA in catching on to new trends. The writing is on the wall. If amateurs wish to retain the 10m band then it is going to have to be occupied by them. The easiest method of getting on to this band is to convert existing CB sets as described in the following series of articles.

Principles

This article sets out to explain the principles of operation of a phase lock loop. Later we shall examine in detail the various changes that have been made in technology in CB rigs using phase lock loops. The history of the technology surrounding the development of CB sets both in the USA and the UK is also dealt with. Examples will be given of the frequency conversion of various designs of CB set to the 10m band.

I have also attempted to standardise so that the calling frequency of 29.6MHz should correspond with channel 30 on the rig. This standardisation will be useful when transferring from the calling channel to a working channel. You will not necessarily have to remember the frequency/channel relationship. The information given in this article will assist the reader to design circuitry for the conversion.

It was not my intention to spoon feed the reader. Towards the end of the series examples are given of an all-singing, all-dancing memory board which should give the maximum flexibility of frequency control. Examples are also given of suitable FM modulators and demodulators which can be used in American AM rigs.

The advent of CB in the USA during the late 70s has furthered the development of synthesised frequency generation techniques. Today, modern transceivers use phase lock loop (PLL) frequency generation instead of individual crystal oscillation to generate the carrier frequency and injection to the receiver 1st mixer.

Early PLL design

The early phase lock loops were complicated because they were constructed out of a large number of discrete components. They proved unreliable, required a highly skilled method of setting up with specialised test equipment, and often produced an unwanted spurii on both transmit and receive.

The volume of sales of CB sets in the USA encouraged integrated circuit manufacturers to design and manufacture customised PLL circuits for use in American CB rigs with all the components integrated onto one single twenty pin chip. Following this large scale integration, and technical developments ensuring an improvement of frequency handling from the previous maximum of 5MHz to a new maximum of 20MHz, general purpose integrated PLLs were developed, and are available for use in the construction of radio equipment.

Before I look in detail at the various designs that can be achieved by using readily available PLL chips, it may be as well to refresh ourselves with the basic operation of a phase lock loop.

Basic operation

Figure 1 represents a PLL chip connected to other discrete components to complete the loop. The chip comprises three main components: a 'divide-by-R' frequency divider which is used to divide the reference frequency, usually by a

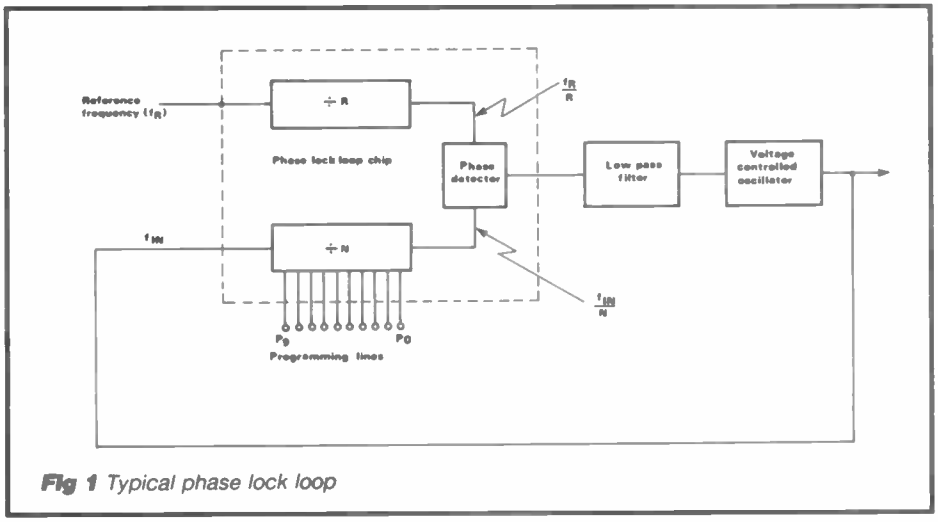


Fig 1 *Typical phase lock loop*

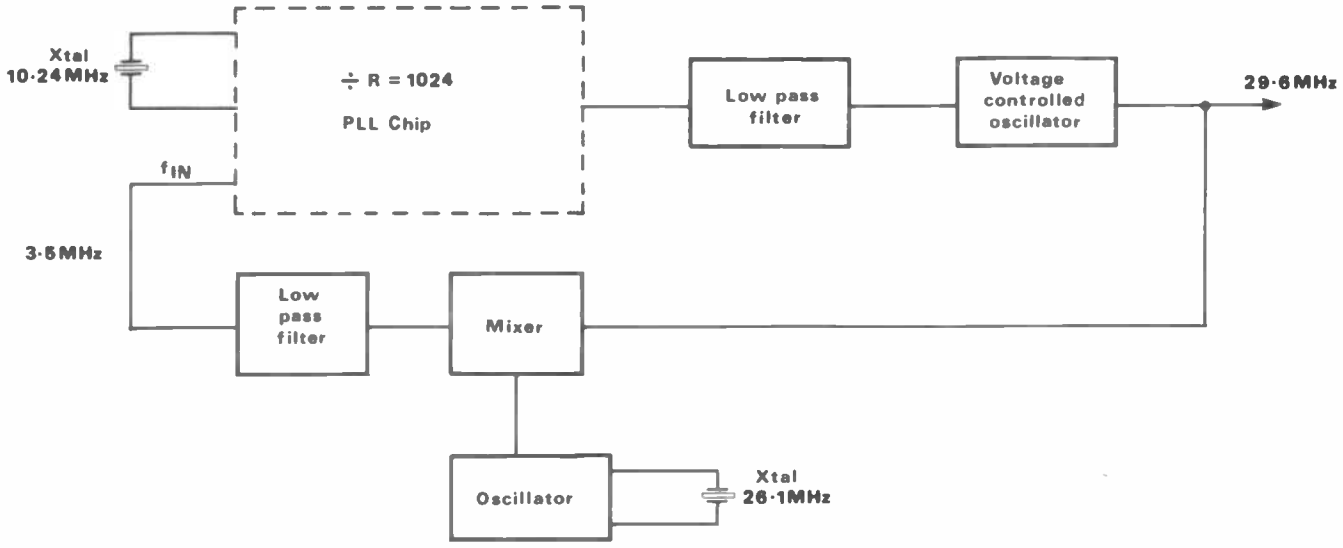


Fig 2 *Phase lock loop with down mixing*

fixed amount, to arrive at a reference frequency which is fed to the phase detector. This frequency is usually the channel space frequency or a sub-multiple of it, but more of this later.

VCO frequency

The frequency of the voltage-controlled oscillator (VCO) is fed into the chip at 'F*in*' and is divided by a pre-determined number, 'N', to arrive at the same frequency as the reference frequency divided-by-'R'. When this occurs the phase detector will produce an output voltage which is fed via a low pass filter to the VCO to hold it steady at that frequency. The loop is then said to be 'locked'.

The stability of the VCO frequency is only as good as the stability of the reference frequency. It is usual for the reference frequency to be generated by means of a crystal oscillator. The frequency of the VCO may be changed by altering logic levels to the 'divide-by-N' frequency divider and changing the value of 'N'. You can now see that it is possible to generate a number of different frequencies with crystal oscillator frequency stability employing only one crystal oscillator.

PLL logic

Before we look at an example, it is worthwhile refreshing our memories about the logic that is used by the PLL chip. The 'divide-by-N' number can be altered by adjusting the logic code on the programming lines. For example, if a 'divide-by-N' number of 282 is required then we set P_8, P_4, P_3, P_1 to logic level 1 (+5V) and the remaining pins at logic level 0 (0V). From the logic table the 'divide-by-N' number is arrived at by adding ($P_8 = 256 + P_4 = 16 + P_3 = 8 + P_1 = 2$) = 282.

With the PLL chip shown in *Figure 1* it can be seen from the table that the maximum 'divide-by-N' number is achieved when all programming lines are set to logic 1, giving a 'divide-by-N' of 1023. Should you need to revise your understanding of logic, the G3FAB articles' are well worth reading.

Now for the example, using the PLL chip illustrated in *Figure 1*. The 'divide-by-R' reference divide number is usually fixed at a pre-determined value. A common 'divide-by-R' number used is 1024. If the reference crystal frequency is chosen to be 10.24MHz then the reference frequency appearing at the phase detector is the reference frequency 'divide-by-R' 10KHz.

Locked

For the loop to be locked, it is required that the frequency being sampled by the phase detector following the 'divide-by-N' network is 10KHz. If we want to lock the PLL on 3.5MHz the 'divide-by-N' number must be 'F*in*' divided by 10KHz, or 350. To obtain this value of 'N' (*Figure 2*) the programme line P_8, P_6, P_4, P_3, P_2 and P_1 must be set to logic 1 and the remaining programme lines to logic 0.

If we now increase the 'divide-by-N' number by 1 to 351, obtained by setting the programme lines P_8, P_6, P_4, P_3, P_2, P_1 and P_0 to logic 1, then the VCO will lock on a frequency given by 'N' x 10KHz, or 3.51KHz. It should be noted that the frequency of the VCO has been increased by 10KHz (this being the loop reference frequency), and that altering the 'divide-by-N' number will alter the frequency of the VCO in 10KHz incremental steps.

If we required the VCO to oscillate at, for example, the frequency of 29.6MHz (the calling frequency for 10m FM), then the 'divide-by-N' number must be 2960. The maximum 'N' value being 1023, this presents a problem. There are two solutions to this problem.

The reference frequency of the crystal oscillator can be altered to, for example, 30.768MHz, giving a phase detector reference frequency of 32KHz, which from the previous example, will result in the VCO frequency being incremented in 32KHz steps. The 'divide-by-N' number will now be 925, to lock the VCO on 29.6MHz.

Apart from the inconvenience of having 32KHz steps, in practice there are not many PLL chips operating at frequencies above 30MHz.

An alternative method is to introduce a mixer between the VCO and the 'F*in*' pin on the PLL chip and mix down as shown in *Figure 2*: with a mixer, an oscillator running at 26.1MHz produces a frequency at 'F*in*' of 3.5MHz. From a previous example, the loop will be locked if 'N' is equal to 350.

The low pass filter

It can be seen from *Figures 1 and 2* that a low pass filter is inserted between the PLL chip and the VCO. Under lock condition, a steady dc output from the phase detector is required to hold the VCO on its specified frequency. Besides the dc voltage produced by the phase detector, unwanted products are generated by the PLL chip. The low pass filter also performs another important function. It provides a short term memory for the PLL, and ensures a rapid recapture if the loop is thrown out of lock due to a noise transient.

'Divide-by-N' logic table

P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	P0
1024	512	256	128	64	32	16	8	4	2	1

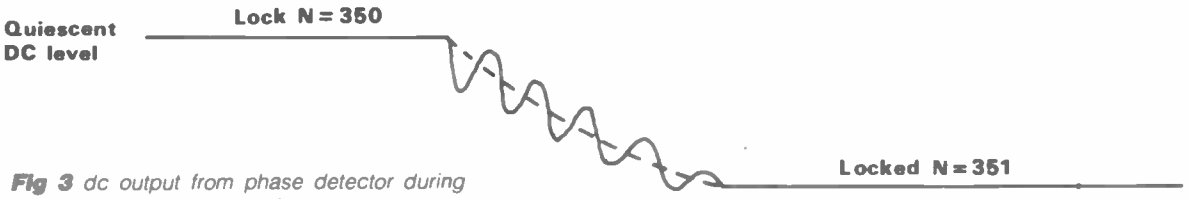


Fig 3 *dc output from phase detector during change in divide-by-N number*

The low pass filter bandwidth has certain effects on the loop performance. The time it takes for the PLL to become locked is determined by the bandwidth of the low pass filter. *Figure 3* shows a typical response of the dc output from the phase detector when the 'divide-by-N' number is changed. The narrower the bandwidth of the filter, the longer it will take for the loop to become locked. The greater the change in step of VCO frequency, the longer it takes for the loop to become stable and the condition of lock to exist.

Further reading on this subject is available from *Technical Notes* published by Mullard[2].

It can therefore be seen that the low pass filter performance has an important role in maintaining the stability of the loop, so care should be taken in its design. A number of examples will be given later to enable readers to experiment.

Voltage controlled oscillator

Figure 4 shows a typical circuit for a VCO. R_1, R_2 and C_1 form the low pass filter. D_1 is a capacitance diode which with C_1 and L_1 forms the tuned circuit of the oscillator. When a dc voltage is applied across the diode, the PN junction is reverse biased and the capacitance of the diode is reduced. The frequency of the oscillator is increased. By altering the value of C and choosing a suitable capacitance diode, the operating frequency range of the VCO can be determined. C_1 also performs another function of blocking the dc voltage across D_1 from being short circuited to earth through L_1.

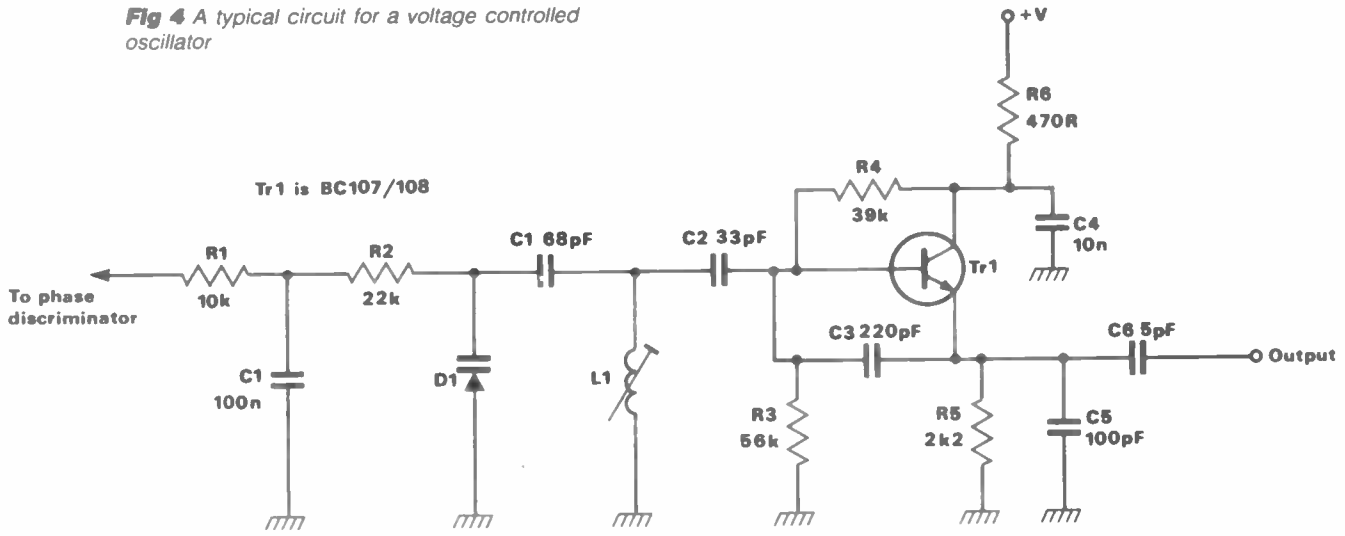
Next month

Next month I will look at two particular PLL chips, the MC145106 and the PLL02, as well as detailing specific modifications to the DNT M40FM, Colt 295 and Binatone Route 66 rigs for ten metre amateur use.

References

1: Learning about Logic, by P J Horwood, Radio Communications June 1976 onwards.
2: Mullard, Signetics Technical note 82 – Phase locked loops.

Fig 4 *A typical circuit for a voltage controlled oscillator*



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PART 3

A look at the effects of solar radiation and ionised layers on radio waves of different frequencies

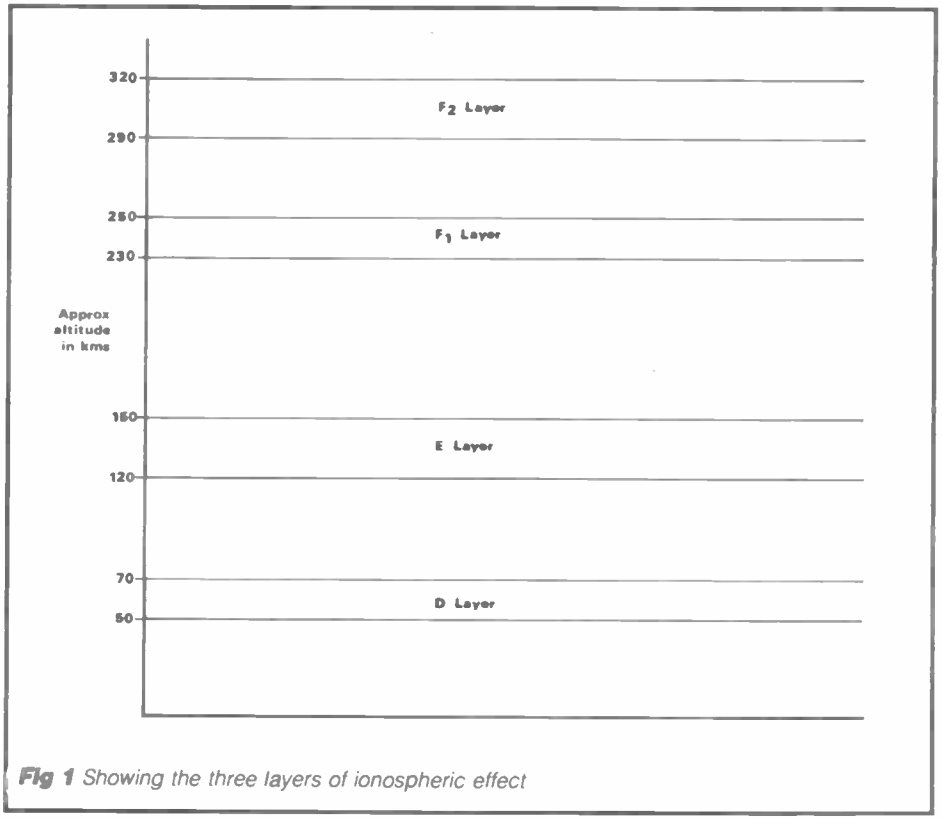

Fig 1 Showing the three layers of ionospheric effect

Before discussing any further conditions of propagation it is perhaps advisable to look into the actual effects of the sun's radiation in true life. Initially one layer only was discussed in detail and this was to enable a clearer picture of the circumstances prevailing to be established, and in addition only ultra violet rays were mentioned.

Other forms of radiation exist which can affect the ionosphere; infra red, gamma rays, X rays and other radiated waves together with corpuscular particles ejected by the sun during violent solar flares can enter the earth's magnetic field. Since the ionisation takes place because of solar radiation it follows that absence of sunlight will cause recombination of the particles into neutral air molecules. This does occur to some degree so that ionisation levels drop to a very low level during periods of darkness and may even fall to zero in maximum darkness periods (mid-winter).

We have established so far the concept of an ionized layer in the outer limits of the earth's atmosphere which has the property of bending radio waves. It is obvious that a large degree of bending will re-direct the wave back to earth. This bending back to earth is the method by which radio waves are transmitted for long distances or over long distance paths.

Different layers

The existence of the ionospheric effect is not limited to one layer only. Basically three layers exist, known as the D, E, and F layers *(Figure 1)*, although the F layer does split into two parts, F1 and F2, during daylight hours; however in the absence of sunlight these will recombine and form a single F-layer. This single layer gradually loses its intensity during periods of darkness until reactivated as the earth rotates into the sun's rays again.

The D-layer exists at some 50-70Km altitude and the E-layer starts at around 120Km, dying out after about 150Km. The lower of the two F-layers starts at around 230-250Km, while the upper F2-layer exists between 290/320Km. It should be understood that the degree of ionisation in the layer will be highest at the face projected to the sun and will gradually reduce through the layer.

The E-layer

The lowest layer usually affecting HF propagation is the E-layer. Due to the increased density of the air in this region the particles do not have far to travel before re-combination, and from our earlier analysis we can see that the probability of higher frequencies being refracted completely in this layer is remote.

Under normal circumstances in periods of daylight, frequencies of up to 6/7MHz will be refracted, and any higher frequency will penetrate the layer. In combination with the D-layer, which will disappear almost immediately when sunlight is removed, lower frequencies of up to around 2MHz cannot penetrate through the D-layer so the only bands which are really affected are the 7MHz and 3.5MHz bands. Since the 7MHz band will penetrate more deeply, it follows that the distances worked on this band in daylight hours will obviously be greater than those available to 3.5MHz operators.

F-layers

The F-layers carry the greatest concentration of amateur traffic since they offer the chance of a returned wave travelling a greater distance over the earth's surface than a lower altitude reflecting layer.

As discussed previously, the wave front approaches the layer at an angle and the upper part of the wave is tilted by the action of the layer particles so that the top of the wave is, in effect travelling faster than the bottom. Since the effect appears to cause the wave centre to divert from its straight path into a curved path, the eventual effect is to cause the wave to re-emerge from the layer and be directed down to earth at an angle depending on the amount of curvature experienced in the second part of its bending.

The effect is not reflection since a reflected wave is always returned from the mirror at the same angle at which it met the mirror (angle of incidence = the angle of reflection is a standard law of optics); instead, in the situation

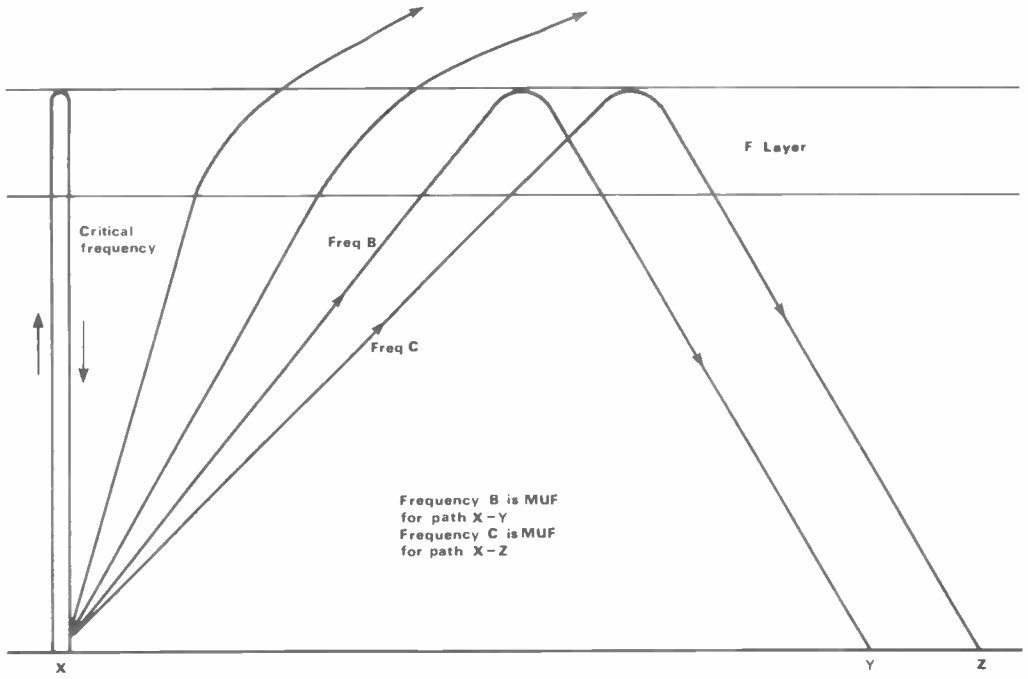

Fig 2 *Showing effect of propagation*

described above the layer density may vary at the point of exit from the point of entry due to variation in the sun's intensity, so that it does not follow that the wave will always return at the angle at which it entered.

From the diagram it is clear that the radiated wave from the earth must enter the layer at an optimum angle, and that the maximum value of the angle together with the frequency will determine the possibility of the wave returning to earth or passing through the layer into outer space *(Figure 2)*.

The desirable angle for any one frequency will obviously depend upon the condition of the layer at a specific time. This angle is known as the *critical angle* and the *critical frequency* is the frequency which just fails to be returned to earth when propagated with a critical angle of 90 degrees at *a specific time.* In other words, the critical frequency is that frequency which just fails to return to earth when directed vertically upwards.

MUF

The *maximum usable frequency* is determined by two designated points and the maximum possible usable frequency to maintain contact between those points. *Figure 2* will illustrate the fact that the maximum usable frequency for X-Y is B, whereas for X-Z it will be C. We can therefore state that the frequency producing this condition is known as the maximum usable frequency for that specific path.

Figure 3 shows that for a lower angle of radiation signals transmitted at a higher frequency will be capable of refraction, and that the first point of return to earth is a greater distance away than a signal transmitted at a lower frequency (X-Z being greater than X-Y). However, in both cases the frequency is that which just fails to penetrate the layer: B having a shorter path in the layer than C will penetrate at a lower frequency. The MUF is therefore the highest frequency that can be used between *two designated points.*

Since this situation can vary at different times of the day, MUF is shown for specific time periods. The progressive degree of sunlight radiation affecting the layer will always be greater to the west than to the east due to the rotation of the earth with effect to the sun.

The distance between the transmitted point and the point at which the first refracted wave returns to earth is known as the skip distance, and *Figure 3* shows the relationship for the angle of radiation, and the path distance for both the E and F layers and is reproduced from the *Radio Communication Handbook, Volume 2.*

Multi-path

Due to the characteristic of a transmitted wave having a fairly small beam width, up to 180 degrees in the case of a

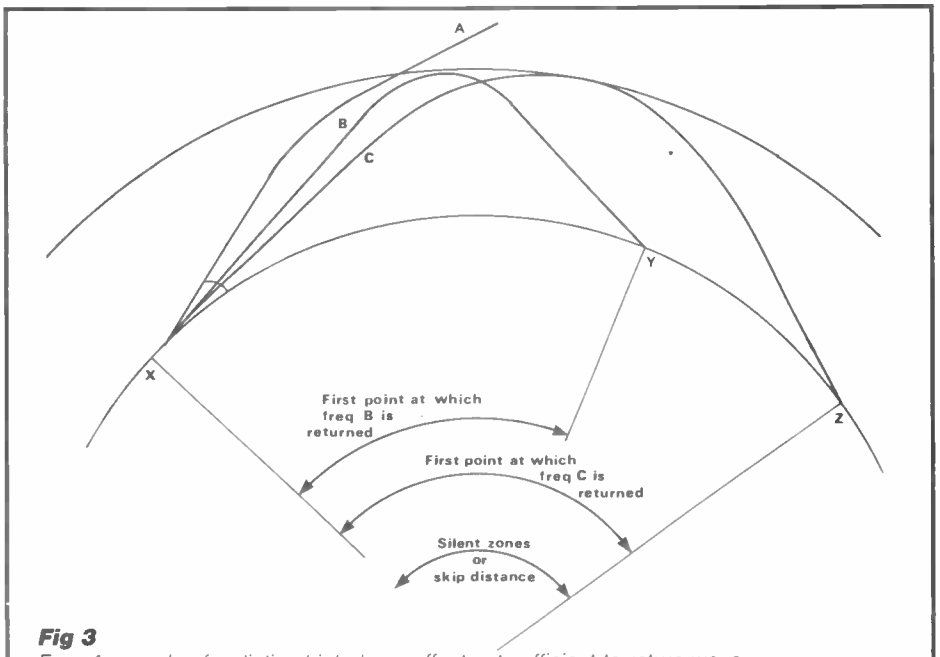

Fig 3
Freq A – angle of radiation high; layer effect not sufficient to return wave
Freq B – same freq as A; layer effect enough to cause refraction
Freq C – higher freq than A; lower angle required to create return
NB – Freq B is MUF from X-Y, Freq C is MUF between X-Z

non-directional, aerial, the possibility exists of multiple path radiation occuring, and for the received wave to have travelled by any one of a variety of paths. The wave presented to the receiver usually consists of an accumulation of waves 'arriving from' different directions, and the possibility exists of certain waves arriving out of phase with their neighbours due to the different distances travelled.

Fading

This *multi-path* reception can cause fading, due to differences in phase between the signals causing phase addition or subtraction and affecting signal strength. *Figure 4* shows the possible sources of two distinct causes of fading.

In *4b*, the wave refracted back from the F-layer may not fully penetrate the E-layer and will be reflected back to the F-layer before finally returning to earth. This is a form of transmission known as chordal ducting.

The form shown in *4a* is conventional propagation and the effect of the two waves arriving at the receiver would give a differential in distance travelled and a possible *out of phase* situation.

The out of phase situation in an AM signal could cause audio distortion, since the upper and lower sidebands cound be affected at different rates. This is known as selective fading creating audio distortion whereas an out of phase variation on a single sideband signal would cause an alteration in the amplitude of the incoming signal only, due to varying degrees of absorptive fading.

There are other forms of fading outside the scope of this article and the *Radio Communication Handbook Volume 2* is a very good reference for further study.

Sun spot cycle

One further effect of the sun's activities creating variations in ionospheric states is that, over a 22 year period, there appears on the sun's surface a series of eruptions. Basically the sun can be considered as a continuously exploding hydrogen bomb and there occurs, at random periods in the short term but cyclically in the long term, a form of super internal eruption like a 'super hiccough'.

The effect is for holes or spots to appear on the sun's surface which create intense radiation.

For the purpose of explanation we can assume that the sun has an equator and a southern and northern hemisphere in the same manner as the earth. During the first eleven years of the twenty two year cycle mentioned previously the eruptions, or sun spots as they are called, occur mainly in the northern hemisphere and appear in an increasing and decreasing number spread over eleven years, reaching a maximum at a point between 4½ and 6½ years. The approach and decline do not always have the same periods, although the total is always eleven years.

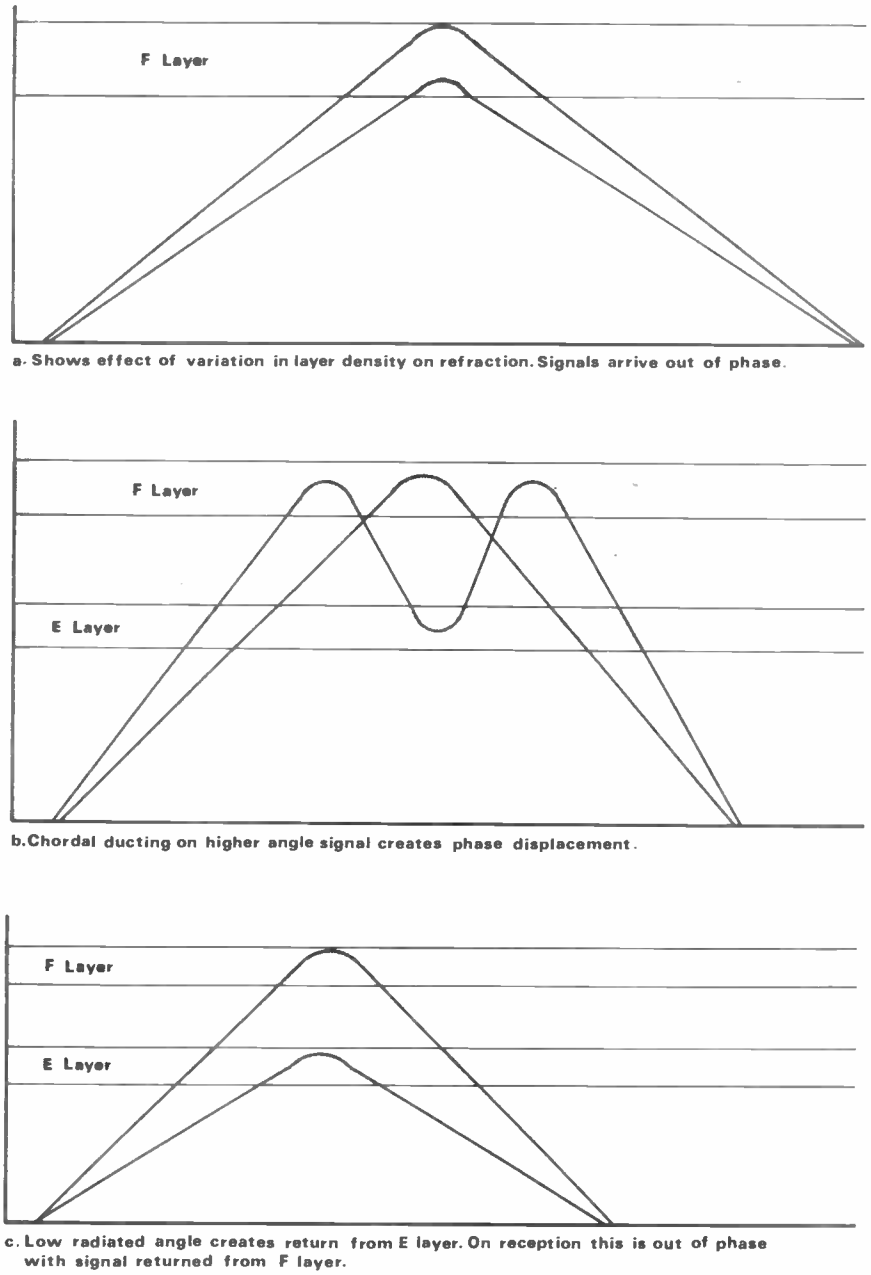

Fig 4 *Fading*
Diagram from Radio Communications. March 1978 courtesy of RSGB

The cycle is then repeated in the next eleven years, although now the spots appear in the lower or southern hemisphere. Plotting the intensity levels against time and against the two hemispheres gives the appearance of a distorted sine wave.

The spots mentioned are considered to be the result of super violent eruptions and result in the release of tremendous amounts of energy. This energy is radiated outwards and the earth intercepts a small portion of it which is absorbed by the ionosphere, thus increasing the degree of ionisation and consequently increasing the maximum frequency which the F-layers can return to earth.

Hence every eleven years sees a peak of activity on the higher frequencies (sometimes up to 50MHz being capable of refraction, but generally 28/30MHz), giving superb signals for relatively low power over substantial path distances.

VHF

As mentioned earlier, VHF waves are affected in a different manner to HF waves, since the frequencies above say, 60MHz are not generally refracted but penetrate the ionospheric layers completely. A form of refraction *does* occur at low altitudes from 1-10Km in an area known as the troposphere.

The general effect is for a slight bending of radio waves to occur in stable conditions, due to a regular decrease in the refractive index of the air as the

altitude increases. This accounts for the so called line of VHF transmissions always being greater than the horizon distance by about 20%. The effective distance covered by a VHF wave can be taken as $d = \sqrt{2h}$, but further consideration is given in greater detail in a future article and the implications of the radio horizon were discussed earlier.

Abnormal

Generally, a warm weather front approaching a cold area or vice versa leads to abnormal VHF conditions. Static situations of high pressure areas over large volumes of water create similar conditions, especially when the pressure gradient is fairly steep at the outer part of the high pressure area. This permits the water content of the air to vary considerably, which can in turn cause wide temperature variations, with the latent heat thus released or absorbed creating abnormal situations.

Diffraction is caused in a similar way to that in which a wave front bends in the ionosphere. It is the effect of a variation in the direction of the wave front due to a change in velocity over the face of the front. The general effect at VHF is for the lower part of the wave front to be retarded, causing a tilting action and thereby a bending of the direction of propagation until a return to earth may arise.

Referring back to the effect of the sun on the ionosphere, it was stated that radiation from the sun created ionisation in the layer. Occasionally the sun has violent surface storms which result in intense radiation of a variety of waves from its surface. These rays can penetrate to the D-layer and cause it to be excited to such a degree that total absorption of all radio waves occurs. These fade-outs can last for several hours and are known as Dellinger fade-outs. They can also effect the E – and F – layers.

Cosmic particles

In many cases these eruptions can cause cosmic (solid) particles to arrive from the sun, usually between 24 and 36 hours later. These particles are taken into the earth's magnetic field and create magnetic storms which will have an effect on the maximum usable frequencies in the F-layer.

The particles can oscillate up and down the earth's magnetic field and, due to the concentration of the lines of force at the poles, can collide with atmospheric particles in these regions, which are known as auroral zones. Such conditions create intense reflecting layers, known as aurorae, due to the absorption of the particles. These layers can reflect VHF waves, and such *auroral path* working is a common aspect of VHF operating and can achieve spectacular results. This is due to the energy, in the form of free electrons, which is released during the absorption.

Excessive

In certain instances excessive ionisation can take place around the E – layer and intense patches of ionised particles can exist in cloud form. These are called sporadic-E conditions and are capable of reflecting VHF signals over very great distances. The clouds are usually up to about 100Km across and about 1Km thick, appearing at about 120Km altitudes.

Sporadic-E does not normally reach VHF past about 60MHz. It is very common on 28MHz and 50MHz, but when it *does* reach 146 or above it can create spectacular results. Normally maximum ranges of some 1400Km are worked on sporadic-E, with the preferred directions generally in an arc from ESE to WSW via south, although some more easterly contacts have been made. As an added bonus, *double-hop* propagation may occur when the returned wave bounces back to the layer and is again reflected down to earth.

Next Month

Next month I shall return to aerials to see how we can maximise their performance in the light of what we have discovered about propagation.

VHF TV GOES QRT

Nigel Cawthorne G3TXF takes a look at the closing down of VHF TV in the UK, and explains what's in store in Bands I and III

After nearly 40 years of service, the UK's VHF 405 line TV transmissions are closing down. All BBC and IBA transmitters in Band I (42-68MHz) and Band III (174-225MHz) will close down by midnight on December 31. The UK's four TV programme channels will then be entirely on UHF.

TVI hazard

Radio amateurs will not be shedding too many tears at the passing of VHF transmissions! In the early days, VHF TV was always a TVI hazard. This applied particularly to Band I.

Channel 1, the lowest channel in Band I, with its vision carrier on 45MHz and its sound carrier on 41.5MHz was the source of much strife for many HF amateur operators before UHF TV coverage came to be as widespread as it is today.

For many years, the two main TV programmes, BBC and ITV – there were no numbers in those days, it was just one of each – were transmitted on Bands I and III only. The BBC generally used channels 1 to 5 in Band I (41-68MHz) and ITV channels 6 to 13 in Band III (174-225MHz). With its direct harmonic relationship to the amateur HF bands, channel 1 used to cause no end of problems. The 100KW VHF TV transmitter at Crystal Palace, London, is also on the dreaded Channel 1!

The third harmonic from a 20 metre transmitter (3 x 14MHz = 42MHz), or the second harmonic from a 15 metre transmitter (2 x 21MHz = 42MHz) fell between the sound carrier on 41.5MHz and the vision carrier on 45.0MHz on BBC Channel 1 (see *Figure 1).* During TV hours, HF band DXing was a non-starter for many amateurs, particularly in areas where the level of the received TV signal was less than over-powering!

The arrival of UHF TV

The start-up of the UHF TV transmissions in the mid-60's, firstly with the then new BBC 2 transmissions, was a turning point for HF operators and their TVI problems. All the new UHF stations were designed from the outset to carry four programme channels. Initially transmitters for BBC 2 only were installed, but planning had allowed room for three further sets of transmitters at each of the transmitter sites. Most UHF TV transmitter sites are shared by the BBC and the IBA. The UHF TV transmitting antennas were all designed as 'multi-channel' antennae capable of carrying four channels of programming at one time.

After BBC 2 was installed, the BBC 1 and ITV UHF transmitters were gradually installed at all the sites in the UK, thus giving greater and greater multi-programme coverage on UHF. For a time the UK suffered the horror of dual-standard TV, capable of receiving both VHF 405 line transmissions as well as the new UHF 625 line transmissions. As all-programme UHF coverage increased, slowly dual-standard TV became less and less common. UHF-only TV sets were soon to take over.

Fourth channel

Finally, when the fourth channel came along about two years ago, everything at the transmitter sites had already been prepared years in advance. All that needed to be done was to install the new transmitters. The space within the trans-

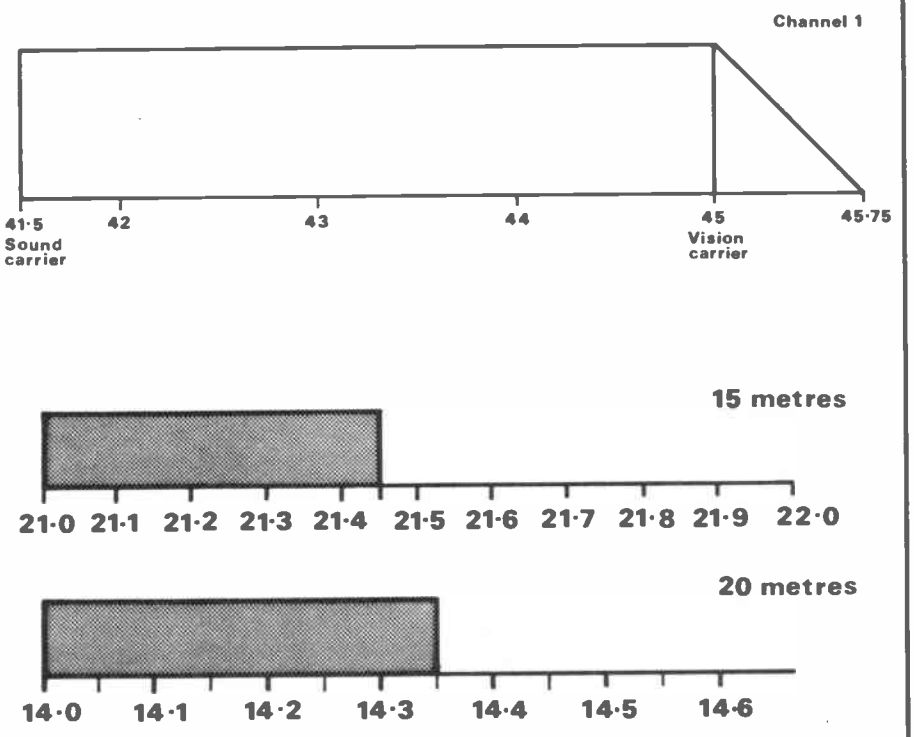

Fig 1 *The third harmonic of 20 metres and the second harmonic of 15 metres fell right in the middle of Band I channel 1. Such TVI problems will soon be a thing of the past*

mitter station buildings and the antenna facilities were already there.

UHF TV meant less TVI!

TV transmissions in the UHF band are much less prone to direct TVI from amateur transmitters because the frequency separation is so much greater. The UHF TV channels run from 470MHz up to 855MHz. Even the lowest harmonic from an amateur HF transmitter that could appear within this frequency range is the 17th harmonic of a 10 metre transmitter (17 x 28MHz = 476MHz). The magnitude of such a high order harmonic is going to be very low indeed in any transmitter, other than one producing square waves at HF!

TVI problems, if they do exist at UHF for the HF operator, are usually of the break-through or over-load type rather than being caused by harmonics. The cure for UHF TVI problems is usually very much easier than it ever was with TVI on VHF TV receivers!

Band I and Band III together total over 70MHz of prime spectrum. Once all the VHF TV transmitters have closed down at the end of the year, these frequencies will be, for a very short while, virtually unoccupied.

In order to seek views on the best use of these newly released frequencies the Government issued a consultative document – 'green paper' – in May this year, inviting all interested parties to make their views known. The main users of the new frequencies will be the professional mobile radio services.

A frequency plan has already been drawn up taking in all of the old Band III (174-225MHz). There will be a variety of mobile services operating within that range. Some of the services which are now accommodated in the VHF FM Broadcast Band II – will eventually be moved into allocations in the new Band III. By 1995, Band II will be entirely for broadcasting in the UK and will cover the range 87.5-108MHz

Professional mobile radio services will be trying out on the new frequencies experimental modes of communication, including such techniques as SSB, spread spectrum, and time and code division multiplexing. The Government has set aside special sub-bands where advanced modes of communication can be tried by professional mobile radio companies and users. Apart from some broadcast ancillary equipment, eg radio microphones and short range programme links, the old Band III will be almost entirely taken up by professional mobile radio services.

Band I

What happens to Band I is of more direct concern to radio amateurs, because there is within the frequency range the 'six metre' band which is in common use in some parts of the world, particularly in the USA and Japan. The Government's consultative document refers directly to the interim Merriman report which recommended that 'subject to detailed planning of Band I, the radio amateur service should be given an allocation in the 50-54MHz band'. The size and location of any allocation to the amateur service will depend upon the demands from other users for the band but it seems probable that an allocation within 50-52MHz would be made.

This all looks quite promising for a future full scale six metre allocation within the UK.

The RSGB will no doubt be preparing a very detailed response to the 'green paper', along with the other bodies that have an interest in the future of these new frequencies. A six metre band would open up exciting opportunities for both local working and DXing. Although we would presumably have to wait until the next sun-spot maximum before trans-atlantic working would be possible on 50MHz.

The professionals and TVI

Although the UK is closing down its VHF TV transmitters, its closest neighbours will be continuing television transmissions in Bands I and III, as indeed will most of the rest of the world. The UK will be one of the very few, if not the only, 'all UHF' TV country in the world. Many countries have one TV service on VHF and another on UHF. It is thanks to the long term planning of the UK's TV authorities that they are now able to vacate the VHF frequencies with no loss of programming.

A direct consequence of the fact that our neighbours will still be transmitting in Band III is that the planning of professional mobile services in that band will have to be done very carefully to minimize the chances of interference being caused, either by the overseas TV services to the professional mobile networks, or by the professional mobile operators to overseas TV viewers. Possible TVI problems in both directions!

Frequency plan

The frequency plan that has been drawn up for the Band III professional mobile services has taken care to avoid getting too close to either vision or sound carrier frequencies of overseas TV transmitters. This will be achieved by keeping transmitted frequencies away from TV carriers and by regulating the geographic location of stations within the UK in such a way that there are no stations operating near the coast likely to cause or to be caused interference. It is hoped that this will minimize professional mobile radio's own TVI problems!

The closing down of the UK's 405 line TV transmitters on VHF will be the end of an era in the history of television broadcasting. The 405 line TV system transmitted in the UK was the first of its type in the world. For amateurs, if all goes well, it could hail the beginning of a new era in the form of a UK six metre band.

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TRANSISTORS DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC126	0.38	BC108	0.10	BC302	0.32	BD244A	0.65	BF258	0.30	BT101/300	1.15	BYX36/150	0.22	TIP32	0.40
AC127	0.30	A B or C	0.12	BC303	0.32	BD375	0.32	BF259	0.32	BT101/500	1.25	BYX36/600	0.28	TIP32C	0.60
AC128	0.30	BC113	0.14	BC307	0.10	BD410	0.76	BF262	0.30	BT102/300	1.35	BYX46/300	0.72	TIP33A	0.63
AC128K	0.34	BC114	0.12	BC308A	0.10	BD434	0.68	BF263	0.30	BT102/500	1.65	BYX49/300	0.47	TIP34A	0.72
AC132	0.55	BC115	0.12	BC323	0.99	BD436	0.68	BF270	0.30	BT106	1.50	BYX55/350	0.29	TIP41C	0.46
AC141	0.26	BC116	0.15	BC327	0.14	BD437	0.76	BF271	0.26	BT108	1.30	BYX55/600	0.33	TIP42A	0.62
AC141	0.26	BC117	0.22	BC328	0.14	BD438	0.75	BF273	0.18	BT109	1.18	BYX71/600	1.18	TIP47	0.60
AC141K	0.40	BC118	0.17	BC337	0.12	BD439	0.68	BF274	0.32	BT116	1.25	BYZ12	0.42	TIP110	0.88
AC142	0.26	BC119	0.30	BC338	0.12	BD507	0.48	BF323	0.92	BT119	3.62	C106D	0.80	TIP2955	0.60
AC142K	0.48	BC125	0.12	BC350	0.14	BD508	0.53	BF336	0.26	BT120	3.60	E1222	0.40	TIP3055	0.60
AC151	0.45	BC140	0.28	BC440	0.30	BD509	0.54	BF337	0.26	BT121	3.02	E5024	0.30	TIS43	0.88
AC152	0.45	BC141	0.42	BC441	0.32	BD510	0.48	BF338	0.26	BT138/600	1.30	GET872	0.48	TIS88	0.40
AC176	0.28	BC142	0.30	BC461	0.32	BD517	0.56	BF355	0.42	BT151/560R	0.90	ITT44	0.04	TIS90	0.25
AC176K	0.46	BC143	0.30	BC547	0.12	BD520	0.66	BF363	0.82	BT151/300R	1.15	ITT2002	0.11	TIS91	0.25
AC187	0.42	BC147	0.08	BC548	0.12	BD699	1.25	BF367	0.24	BTY79/400R	2.80	ME0402	0.20	ZTX108	0.12
AC187K	0.48	A or B	0.10	BC549	0.12	BD707	0.88	BF371	0.27	BU100A	2.30	ME0404/2	0.24	ZTX109	0.12
AC188	0.44	BC148	0.08	BC550C	0.18	BDX18	2.35	BF422	0.36	BU104	2.00	MEU21	0.60	ZTX212	0.28
AC188K	0.80	A or B	0.10	BC550C	0.18	BDX32	2.10	BF450	0.38	BU105	1.20	MJ400	1.25	IN4001	0.05
ACY40	0.88	BC149	0.09	BC557	0.12	BF115	0.32	BF457	0.33	BU105/02	1.56	MJ2955	0.90	IN4003	0.05
AD142	1.10	BC157	0.10	BC558	0.12	BF117	0.54	BF458	0.36	BU108	1.80	MJ3000	1.98	IN4004	0.06
AD143	1.10	BC158	0.10	BCX34	0.27	BF119	0.82	BF459	0.44	BU124	1.75	MJE240	0.60	IN4006	0.07
AD149	0.96	BC159	0.10	BCY70	0.15	BF120	0.38	BFR39	0.22	BU126	1.25	MJE340	0.54	IN4007	0.07
AD161	0.42	BC160	0.30	BCY71	0.17	BF123	0.40	BFR40	0.22	BU133	1.80	MJE370	0.88	IN4148	0.06
AD162	0.42	BC161	0.30	BCY72	0.18	BF125	0.42	BFR41	0.22	BU204	1.35	MJE520	0.48	IN5400	0.12
AD161/AD162	0.96	BC168B	0.12	BCZ10	1.68	BF127	0.38	BFR51	0.30	BU205	1.30	MJE2955	0.99	IN5402	0.15
AF106	0.48	BC169C	0.10	BCZ11	1.45	BF152	0.16	BFR61	0.32	BU206	1.70	MJE3055	0.70	IN5405	.16
AF114	2.10	BC170	0.14	BD124P	0.80	BF154	0.23	BFR62	0.28	BU208	1.55	MPSLO1	0.28	IN5406	0.18
AF115	2.10	BC170B	0.12	BC130Y	0.68	BF157	0.40	BFR88	0.34	BU208A	1.63	OA47	0.10	IN5408	0.20
AF116	2.10	BC171	0.10	BD131	0.34	BF158	0.22	BFR90	1.72	BU208/02	2.05	OA90	0.08	IS920	0.08
AF117	2.10	BC171	0.10	BD132	0.34	BF159	0.24	BFT41	0.38	BU326S	1.75	OA91	0.09	2N697	0.55
AF118	0.85	A or B	0.08	BD131/BD132	0.95	BFR160	0.23	BFT43	0.36	BU407	1.65	OA95	0.18	2N706A	0.33
AF121	0.62	BC172	0.08	BD135	0.32	BF167	0.30	BFW10	0.79	BU407D	1.80	OA200	0.06	2N2904	0.28
AF124	0.48	A or B	0.12	BD136	0.36	BF173	0.25	BFW44	0.76	BUX80	3.70	OA202	0.15	2N2906	0.24
AF125	0.48	BC177	0.20	BD137	0.36	BF177	0.42	BFX29	0.28	BUY20	1.75	OC25	2.10	2N2926G	0.10
AF127	0.48	BC178A	0.22	BD138	0.38	BF178	0.30	BFX30	0.30	BUY69A	2.60	OC26	1.70	2N3053	0.40
AF139	0.68	BC182	0.08	BD139	0.38	BF179	0.32	BFX80	3.56	BUY69B	1.98	OC28	1.50	2N3054	0.56
AF178	0.68	A B or C	0.09	BD140	0.38	BF180	0.35	BFX84	0.24	DBY101	0.48	OC29	2.47	2N3055	0.45
AF239	0.68	BC182L	0.09	BD144	160	BF181	0.35	BFZ85	0.26	BY118	1.10	OC35	1.75	2N3702	0.10
AF279S	0.72	A B or C	0.09	BD145	1.82	BF182	0.32	BFX86	0.26	BY122	0.68	OC36	1.75	2N3704	0.10
AL100	2.80	BC183	0.09	BD150A	0.51	BF183	0.32	BFX87	0.26	BY126	0.12	OC42	0.72	2N3708	0.10
AL102	5.90	A B or C	0.10	BD159	0.65	BF184	0.32	BFX89	0.65	BY127	0.10	OC42K	1.40	2N3772	1.90
AL113	2.20	BC183L	0.06	BD160	1.65	BF185	0.32	BFY50	0.21	BY133	0.16	OC44	0.72	2N3773	2.70
ASY80	1.75	A B or C	0.12	BD165	0.45	BF194	0.08	BFY51	0.21	BY135	0.25	OC45	0.58	2N3904	0.16
AU110	1.40	BC184	0.10	BD175	0.60	BF195	0.10	BFY52	0.21	BY164	.44	OC71	0.50	2N3906	0.16
AY102	4.32	A B or C	0.10	BD182	1.00	BF196	0.10	BFY57	0.40	BY179	0.66	OC72	0.52	2N5294	0.48
BA102	0.34	BC207	0.15	BD183	1.10	BF197	0.10	BFY90	0.90	BY182	0.87	OC81	0.68	2N6107	0.71
BA110	0.67	BC208	0.16	BD184	1.20	BF198	0.14	BFY90S	1.34	BY184	0.40	OC200	2.45	2N6126	0.68
BA121	0.40	BC212	0.09	BD201	0.72	BF199	0.16	BR100	0.20	BY187	0.72	OC202	2.20	2SB337	1.60
BA129	0.38	A B or C	0.10	BD202	0.87	BF200	0.48	BR101	0.44	BY189	4.75	ORP12	0.85	2SC1172Y	2.90
BA148	0.16	BC212L	0.08	BD204	0.80	BF222	0.48	BR103	0.58	BY198	0.44	R2008B	1.50	2SC1173Y	0.82
BA154	0.08	A B or C	0.10	BD222	0.80	BF224	0.20	BRC443	1.76	BY199	0.47	R2010B	1.52	2SC1302	1.40
BA155	0.10	BC213	0.09	BD225	0.86	BF224J	0.16	BRY39	0.38	BY206	0.24	SHG1 5	0.40	40251	0.98
BA156	0.08	A or B	0.10	BD232	0.45	BF240	0.20	BRY56	0.42	BY207	0.24	TAG1/100	1.40	40361	0.58
BA157	0.28	BC213L	0.10	BD233	0.60	BF241	0.26	BRY61	0.86	BY210/400	0.25	TAG3/400	1.78	40362	0.80
BA164	0.14	A or B	0.10	BD234	0.62	BF244	0.26	BSS17	0.56	BY210/600	0.26	TIC44	0.40	40411	3.72
BB104B	0.52	BC237	0.11	BD235	0.63	BF244A	0.28	BSS27	0.92	BY210/800	0.30	TIC45	0.45	40530	0.80
BB105B	0.30	BC236	0.12	BD236	0.63	BF244C	0.24	BSX19	0.34	BY223	1.20	TIC46	0.48	40673	0.80
BB105G	0.48	BC239	0.14	BD237	0.66	BF245A	0.26	BSX20	0.34	BY227	0.26	TIC47	0.70	40964	1.54
BB110B	0.42	BC251	0.12	BD238	0.56	BF254	0.15	BSX59	0.62	BY229	0.30	TIC106A	0.70	2SJ50	8.20
BC107	0.10	A B or C	0.14	BD241	0.60	BF256	0.40	BSX76	0.29	BY238	0.68	TIP30A	0.46	3SK88	0.66
A or B	0.12	BC301	0.30	BD243A	0.80	BF257	0.32	BT100A/02	0.94	BYX10	0.24	TIP31C	0.54	3SK135	0.20

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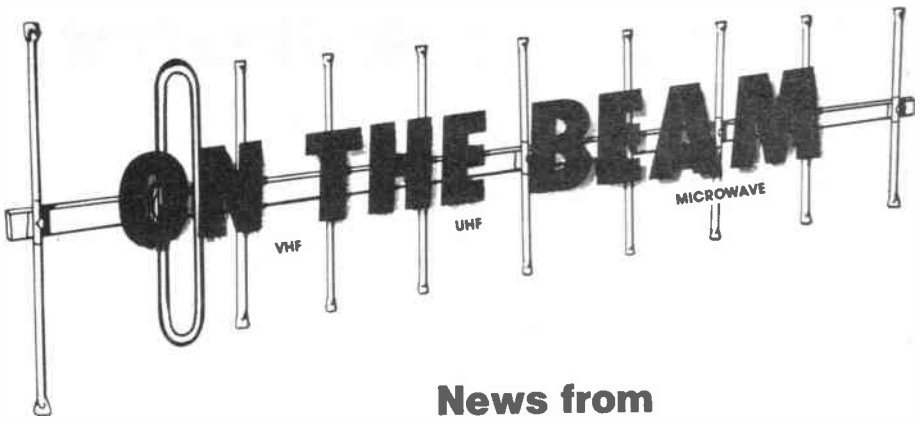


News from Glen Ross G8MWR

Moonbounce

The recent moonbounce tests provided some strong signals, and reported results are very impressive. The established operators with tailor-made systems got the best of things, as was to be expected, but there were also a number of people who decided to give it a go with what we would normally think of as reasonable terrestrial capability.

As an example of what was done we have a report from Dick G1DGO who, fired with enthusiasm, decided to have a go. He enlisted the help of Paul G4DCV, and a set of four 19-element 'MET' aerials were hooked up to an FT221R; the transmitter being rounded off with a 4CX250.

The Saturday session was disappointing with nothing heard (put it down to practice, Dick) but the Sunday was 'IT'. The first station worked was YU3WV, followed later in the day by K1WHS, WA1JXN and KB8RQ; which was not bad for a first attempt. I think there may be a new moonbounce enthusiast in the Folkestone area from now on!

The interesting point is that the receive capability did not include a pre-amp, which would tend to indicate that a good low noise amp and a smaller aerial system would still have produced the goods.

This was in fact proved by Dave G3PBV, using an FT221R with the muTek front-end and a 14-element MET, who copied K9HMB.

The total list of stations known to have been worked or heard is very long but the following prefixes will give some idea: G, K, W, KB8, YU, Y22, SM4, DL8, F6, UA1, ON7, VE7, VE2, K6, LX1, OZ5 and HG1. Plenty to get your teeth into there. Why not give it a try? Even if you can't match the power they used the receive capability should be within most people's reach.

Getting stoned

Not perhaps in the usual way, but more conventionally, the Stone VHF convention in fact.

The group who run this must first be congratulated for setting up such an excellent day. Plenty of opportunity, and space, to meet old and new friends, an excellent lecture stream, plenty of high quality test gear – right up into the microwave spectrum, first class catering facilities and the opportunity to throw a lot of awkward questions at the panel during the 'open forum'.

Much discussion ensued as to the possibility of full crossband working, much of it being based on the fact that if you are allowed to listen on the HF bands, as you are under your normal domestic licence, then why can't you reply using a band that you are licensed to use?

The answer is, of course, that the powers that be say you can't. Much pressure has been put on the men from the ministry and it seems as though good news may be forthcoming in the near future.

This is an area that must be cleared up as a lot of class A operators are working crossband to 50MHz, which under the terms of the licence is not legal. Many class B operators feel justifiably put out that what seems to be condoned when done by one group is strictly 'out of bounds' when attempted by another.

Class B Morse

This was another area that raised a lot of interest, mainly based on the self-training clause in the licence, the argument being that self-training would be a lot easier if you were allowed some on the air practice.

This is a very common sense argument and it seems hard to find any real reason to support the current ban on this activity. It would seem reasonable to allow class B Morse operating provided that the station callsign was given in 'voice' at the start and finish of each transmission.

It looks as though there may also be good news on this one soon.

The splurge

This is the 'funny noise' that appears on 23cm from time to time and seems to provoke correspondence on an annual basis. It appears as a rasping noise which keeps appearing every few seconds and is most noticeable when conditions are good.

This signal is caused by high power radar, and the cyclic nature is due to the rotating aerial at the radar station. People living near an installation have learned to live with it, but to most of us it is an indication that conditions are up again.

Surprisingly, many people have never experienced the noise, and this is due to the fact that most noise limiters do an excellent job of killing it. When conditions are good try switching the noise limiter out and you should be able to hear the noise if your receiver is half-way decent.

Splatter

Talking of noise limiters brings up another interesting point, with regard to stations spreading across the band.

The problems of non-linear 'linears' and overdriving are too well-known to need repeating; being known and being taken into consideration are two very different matters.

Overload of the receiver front-end also causes this problem and is made worse if a pre-amplifier is used. Much of the problem can be eliminated if the pre-amp is switched out unless it is really needed.

A point that is not often realised is that the noise blanker in many rigs is simply a diode in series with the signal path. Now diodes are very non-linear devices, and one use of them is to generate harmonics of whatever order. If a really high signal level is applied to them, with a pre-amp in circuit and a local station running high power, the signal level will be surprisingly high, all sorts of nasties can be generated and give rise to the impression that the other fellow is spreading.

The moral is simple; don't use the pre-amp if it is not needed, and try switching your noise limiter off before criticising the other man too strongly.

You will probably be surprised to find just how much crud can be generated in your own receiver system, but there will always be G . . . . . down the road! How do you deal with him? By giving an honest report of course. If you do not tell him he is causing trouble then he will continue on his way, blissfully unaware of the problems he is causing. You do no-one any favours by giving an incorrect report.

Reciprocal licensing

Some remarks made at Stone and some information in the latest edition of IARU news indicates that some progress has been made towards a general purpose licence. By this we mean one that would be usable in any country, rather like an international driving licence, without having to go through the formality of getting special permission.

It is obviously early days yet, but some progress has been made along the road to achieving this. Most of this seems to have been done in the South American countries, which are perhaps not the greatest tourist area for British amateurs. However, a lot of discussion is going on in the European area and some progress has been made.

A lot of the problem seems to centre on the fact that every country has differing requirements for its licence structure, and until some agreement on a more standardised requirement is obtained very little can be achieved. Provided that agreement on broad principles could be obtained there could still be considerable differences in the small print, and any visiting amateur would have to

operate bearing these differences in mind; this would be a small price to pay for the extra flexibility that would be enjoyed.

Trans-atlantics

For many years it has been an ambition of the VHF world to make direct contact with the USA and Canada on two metres.

This is not as impossible as it might at first appear; one only has to look at the existing DX records on the band to see that greater distances than trans-atlantic have been achieved. The contact between EA8XS and GD8EXI comfortably exceeds the 3000Km from Ireland to Newfoundland for instance, and the distance between G3VYF and 4X4IX (via Es) would get you well into the States.

Older readers may well bring to mind the reception of an American station on two metres in the early 1950s, which was reported by a well known GW station who is now a silent key. It stirred up a lot of argument at the time but the operator concerned always maintained that he was confident that he had heard the W station.

It would not be fair to drag up the whole episode again, and I do not intend to do so, but if there was even a sniff of a signal with the inferior equipment of thirty years ago there has to be a much better chance now. Perhaps the opportunity has been lost in the past because most British operators tend to turn the beam to the Continent when conditions are up, and most east coast Americans would tend to beam to the west; and never the two shall meet!

If the path is to be broken it would probably be done by a combination of tropo and sporadic-E, and could even be assisted over a sea path by ducting. Most of these mechanisms seem to peak around June and July, just nicely in time for the summer holidays. Anybody out there want to be the first to make it?

You will need plenty of power, a good receiver and a really big aerial system plus a lot of luck. It seems time to really give it a try.

Get away

As is probably well known by now the experiment on this one was thought to have failed miserably due to a 'power up anomaly' (the RSGB advises we use this term in the future instead of the more normal 'wire fell off').

Things may not be quite as black as they are painted, because I have received a report from a reliable source in the Midlands that the Digitalker was heard. The person concerned did not log the reception because he felt that with such a well publicised event he was hearing nothing out of the ordinary!

If you heard, or know anyone who reports hearing the voice from space please let me have as much information as possible. It is known that the power came on at switch-on and failed at some stage before the unit was switched off; however, we do not know when the power failed. It seems possible that the system may have operated correctly for a short time and reports would be most welcome.

The big switch

The end of the year is in sight, and what a year it has been for the metrewave operator. As usual the next issue will contain a review of the year and a glance forward to see what we may expect to come.

Please keep your letters coming; as you know this is not a blow by blow account of who worked what three months ago, but we are always interested to hear your news on anything a bit special that you may have done. However, your comments on the current scene, whilst being of great interest, would often require asbestos pages being available. It all helps to form a balanced view of what is going on.

The best wishes of both myself and also my wife Val (G8XAF, who seems to get more involved in telephone calls and correspondence as each month passes), are extended to you and yours, with the wish that next year you may find even more to enjoy in this great hobby.

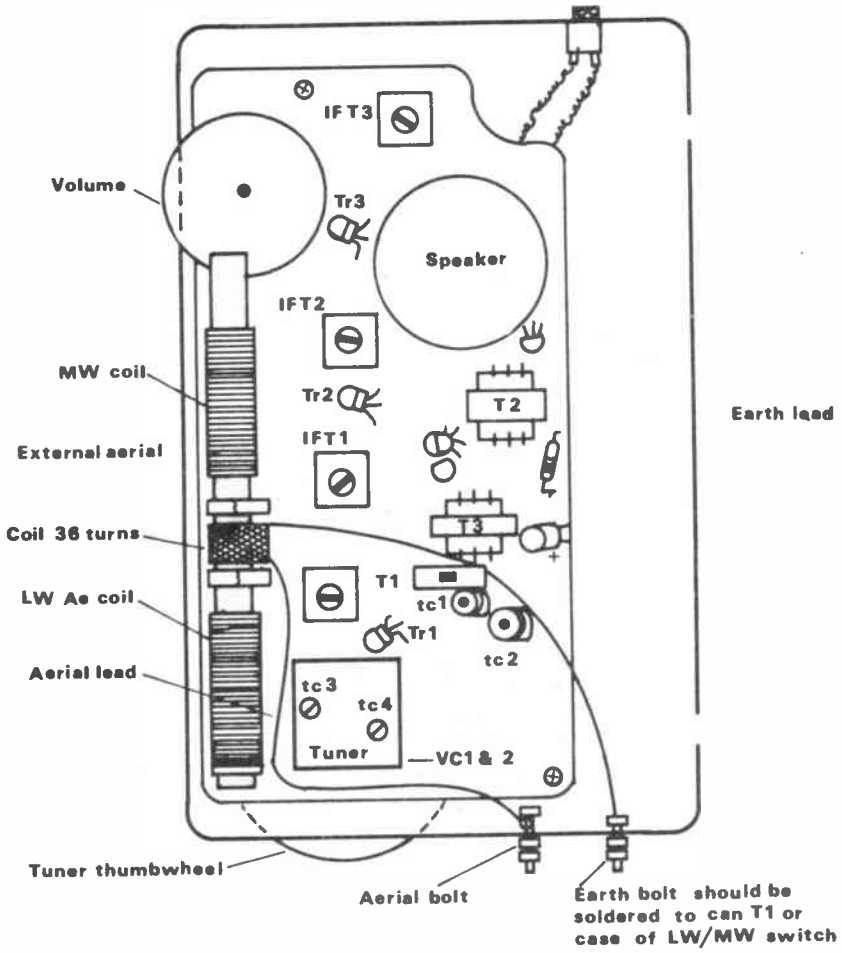
MODIFYING CHEAPER PORTABLES

PAUL WESLEY WARREN

Letters to ***Amateur Radio*** show that many newcomers to this hobby haven't even reached the construction stage yet. This is no disgrace; it takes a lot of guts to spend money on tools, equipment, and spare parts on a hobby that, in the end, may prove too much for you, or be a temporary flash in the pan.

This article's aim is to let the newcomer get his feet wet in the tinkering business of electronics, so that he can decide for himself whether or not he wishes to go deeper into the hobby. The ever dwindling supply of cheap surplus gear on the open market has not made this task easy, so we have to look for other alternatives.

At the higher end of the price range there are the various brands of communication receiver at two to three hundred pounds – very good radios – but I think the best buy I have seen to date has been the Sony IC-7600D, at around £179. However, it's money wasted if, later on, you get deeper into the hobby and want to receive the single side bands of the amateur service.



A steepletone 017 long wave/medium wave. The layout of this type lends itself well to conversion; neat layout, not too cramped for space and easy to follow for later circuit additions. For medium wave DXing, remove mounting screws and circuit board, line inner case and back neatly with impact adheseive and kitchen foil. Replace circuit board. A centre coil of 36 turns of 32swg pile wound. Tr 1 is the transistor mixer. T1 is the long wave/medium wave oscillator coil, with Tc/1 and 2 the trimmers for each band

Add-on

There are, however, several ways of resolving SSB from an external source oscillator which, though not entirely satisfactory to the purists, are nevertheless just about as effective. Circuits for these can be found in several publications at your local library and can be applied to several 'all-banders' on the market. At the same time, this is a cheap and simple way to get your feet wet in the business of home construction.

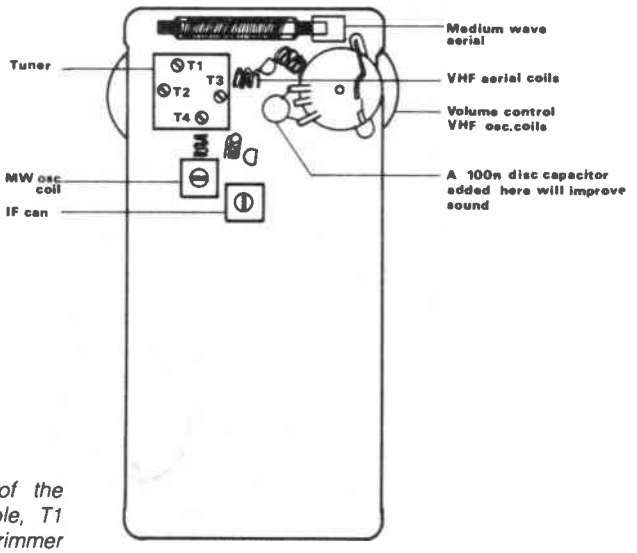
These cheaper short wave sets will cost you around £40 and, ideally, you should look for one that covers from 1 to 30MHz. An example is the 'Vega'. On the other hand, if I had the £40 I think I'd be more inclined to save up the rest for the 7600D.

The real heart of amateur radio is in home construction, making a piece of equipment do what it wasn't intended to do. The fact is, that sitting down in front of a black box talking into a microphone day after day becomes a bore; there's simply no real challenge in it. And that's where the old timers with their home-brewed rigs benefitted over today's modern 'amateur'.

If you're already in possession of a Vega, or one of the other cheaper all-banders, don't lose heart; the challenge is there to make it better. There are any number of additions you can make, externally and internally, to modify them and obtain a reasonable performance. Personally, I can't do anything to my all-bander; I've had it for 20 years and it's been in the family so long, my wife thinks of it as a family pet.

I'm therefore forced to construct a short wave convertor and try to make it do the things I want it to. The slide rule scale on some of these range in accuracy from pretty fair to pretty awful, so the first thing you need is a crystal oscillator marker for the 1MHz, 50KHz and 100KHz points. A good circuit for this can be found in Pat Hawker's *A Guide To Amateur Radio;* a good book for the beginner.

MODIFYING CHEAPER PORTABLES



Using a drawing of the Domico as a sample, T1 and T2 are the trimmer capacitors for the medium wave section. T3 is the aerial trimmer for the VHF section, and T4 the oscillator trimmer. The two cans illustrated just below the tuner are intermediate frequency transformers; don't touch these or you may lose more than you gain. On the Ingersol, T1 and T2 are the VHF trimmers. Note the location of the coils.

A bandspread variable capacitor of approximately 25 to 60pF, hooked up in parallel with the main oscillator tuning capacitor and properly calibrated, can do a lot to alleviate scale cramping, and make it easier to tune in weak stations. Again, these are all simple modifications which can go a long way to improve basic all-bander operations.

At a later date the aforementioned beat frequency oscillator (BFO), or even a product detector, can be added to resolve and improve sideband reception, and a simple detector system can be added for frequency modulation (FM). This only leaves the self-oscillating bipolar mixers in the receiver's front end for modification at some time in the future.

Reference

I haven't gone into diagram details on these because by now they are old hat, but they are still useful improvement devices which should be found easily enough in the electronic book sections of your local library.

Most of the British amateur radio information is about 10 or 20 years behind the times. If you really want up-to-date information, you will need to give most of the British publications the go-by and get hold of the *Radio Amateur's Handbook*, published by the ARRL.

Next down the price range (and my favourites) are the pocket and semi-pocket portables, ranging in price from £4 to £13.

Their performance ranges from fair to pretty awful, complete with faulty tuning capacitors that click and crunch on the touchy FM/VHF bands. Also included in this price range are the cheap handheld walkie-talkies.

If you're interested in UK CB, be careful of what you're buying. Those for the UK market have the little white circle with the legend **CB 27/81** stamped somewhere on the outer case. The unstamped ones are usually imports designed mostly for the American market, many of which don't operate on the 27MHz but on the 40MHz bands instead. Yet even these latter examples have scope for modification to UK radio control on 35MHz, or possiblities for those favoured licensed-few on 50MHz.

Other examples of these cheaper radios go under various trade names such as 'Monotone', 'Ingersol', and 'Domico'. Little or nothing has to be done with the Monotone types, since these already cover the medium wave, FM Bands II and III, which include the amateur two metre band, and VHF marine bands (156MHz to 162MHz), among others of the public services. Types like the Ingersol cover MW, FM broadcast/airband, and a useful 40-channel CB band that can be used as a monitor. All of these models have similar circuitry.

Let's have a go

Now, just to whet your taste buds, here are a few simple modifications you can try, if you wish, and you don't even have to purchase a soldering iron!

The first rule of this conversion business is that you don't get something for nothing. But don't panic; I'm referring to frequency coverage, not money. We'll assume you already have a good FM broadcast receiver somewhere in the house, so you won't be missing any important news bulletins if you lose a portion of the broadcast end on the portable. The following procedure allows the airband on such an Rx to be raised from its uppermost limit of 136MHz to the required 144MHz of the two metre amateur bands.

First, set the band selector switch to FM/air. Turn the receiver on and find out what's playing at your highest receivable broadcast, probably around 96.3MHz or so. Listen long enough so that you'll be able to recognise the station again when you hear it, having previously removed the back from the receiver case.

Trimmers

Locate the small square tuning capacitor in the plastic case; on it you will notice four tiny screw heads. These are the trimmer capacitors, two of which are for the aerial and oscillator coils for the medium wave band, and two of the same for the VHF coils. The VHF trimmers will be on the side of the main tuning capacitor nearest to what look like little coils of bare wire.

You have to look for these coils because it's not a right or left situation; they could be on either side. With the tuner capacitor facing down and away from you, the oscillator trimmer will be the screwhead nearest you and nearest those tiny coils of wire.

In any event you will soon know because a small amount of turn on the trimmer makes a big change in the frequency. Having located your broadcast station uppermost around the 96MHz region so that you can recognise it when you hear it again, turn the tuning dial down to 88MHz, about as low as it will go.

Now, slowly open up the oscillator trimmer vanes until you can hear your 96MHz broadcast station again. Turn the tuning dial back up to somewhere between the 130 to 136MHz scale. If the two metre bands are as crowded down there in the deep south as they say they are (I live in Stirling), then you should have little trouble picking up an amateur operator by moving the thumbwheel or tuning dial back and forward between those two upper frequencies.

Once you pick up an operator, duly note the position on the tuning dial, either by marking the tuning scale itself, or jotting its position down on a piece of paper for reference at a later date. This procedure applies to all little receivers with an FM/air band.

The same procedure can be applied to the 40-channel CB section of the Ingersol type, if you're a licensed amateur in need of an economical monitor to test homebrew equipment; or if you're simply a listener hell bent on receiving some two metre operations. However, if you're a complete novice, the CB section alone should satisfy your appetite for now.

Food for thought

I sincerely hope that in its humble way this article has given some of the many newcomers some food for thought concerning amateur radio and its sidelines.

SECONDHAND EQUIPMENT GUIDE

by Hugh Allison G3XSE

Well, you can't please all the people all of the time. I have received several letters in the past asking for mini reviews on secondhand two metre gear, and I've written a few, hopefully with a bias towards the more common faults in the rigs. Now I get letters asking for mini reviews on secondhand HF gear, and rudely asking if I only repair two metre rigs. I can take a hint, so I thought I would review three 'generations' of Trio equipment.

I've picked the following, not only because they are extremely popular rigs, often for sale secondhand, nor because I've repaired dozens of each, but because I've also owned examples of each for a few years and, having lived with them can give some guidance as to their performance 'on the air'. They are reviewed in order of age, and with senior citizens first.

TS510

Often available secondhand between £125 (a bargain) and £220 (you must be joking), this grandfather of the 'Trio' line-up features quite a few valves. This leads to heat and heat leads to drift, not a lot, but enough to be annoying; typically a KHz or two every ten minutes for the first hour. I have had several successes with an 'Oxley' variable capacitor with a variable temperature/capacitance ratio wired into the VFO. If you are competent enough to fit it yourself you ought to be competent enough to read the Oxley blurb and work out how to do it!

Apart from the drift, the rigs are a bit deaf by today's standards, especially on ten metres, but are not to be dismissed by the cost-conscious amateur. Really filthy old examples can look like new after a gentle rub over with a mild detergent, so don't dismiss one on looks alone.

TS520

This is available in a few variants, some without Top Band, so take care if you are buying one and are a devotee of the band. The 'E' suffix meant economy, and that means no PA heater switch amongst other things. A heater switch can be handy if you use a transverter (although there is a screen grid switch, of which more in a moment), and some people turn the heaters off before turning the rig on if only 'listening the bands'. You can bet your life that, if you do this, you will instantly hear a rare DX station calling CQ with no replies until your heaters warm up, and then everyone will be calling him, but I digress.

I have repaired 35 assorted TS520 variants according to my casebook, and have never yet come across one with a duff PA bottle, so I will leave you to make up your own mind about switching off the heaters. Obviously, you could be unlucky.

The rig possesses an 'AUX' band position, and kits were available to convert the rig to cover the 'new' 10MHz band. Some variants have a 12V inverter built in, and again a kit was available to add it on if required, but think carefully about using the rig mobile – it's fairly big by today's mini-car standards, and it knows how to empty out a decently charged car battery! Remember, these rigs have valve drivers and PAs.

Sensitivity is reasonable on ten – although a mild pre-amp is needed to work through oscar – and there is *no* drift. A good range of filters is still available for the keen CW man, but there are two common faults on these rigs, both, fortunately, cheap to cure. To save repetition, the following also applies to the TS830.

'Common Fault No 1' occurs with screen grid switch. This often goes open circuit, especially when never used, and the symptoms are full HT and no RF output. This normally induces the hapless owner to think that the PA valves have gone, and it's good to see owners smile again after a few quick clicks of the switch. Some really difficult cases have involved taking the switch to bits and cleaning it up, but this is rare.

The soldering to these switches is often dodgy and dry jointed, which is strange as the rest of the rig is very workmanlike. I normally re-flow the switch joints as a matter of course.

'Common Fault No 2' is connected with the key socket on the back of the rig. Soldered onto this is a resistor, which is effectively in series with the key, and which is followed by a capacitor to deck. If you use open wire to the key, as distinct from screened lead, you pick up RF on the key lead which may burn out the resistor.

This is more common when the rig is driving a linear, and a dead cert with a linear using a low slung wire antenna running over the shack roof. To cure this, all that is necessary is the replacement of the resistor and the fitting of a screened lead to the key.

You can expect to pay from £220 for an 'E' which is a bit tatty and does not have any new bands, to just over £300 for a good 'un with everything, including CW filters. Perhaps a bit more for one from a dealer with a service back-up.

TS830S

This model is really sensitive (will go great guns on Oscar without a pre-amp), covers all new bands and again has no drift. Everything you would expect from a modern transceiver and more. No mobile PSU is fitted as standard, and the previous comments about size and consumption with the TS520 apply (still valve driver and PAs).

Several amateurs I know were a bit put off by the array of knobs and buttons on the rig when they bought one, but quickly realised that they are not gizmo's as first thought. The tuneable IF can be indispensable when trying to work a weak station through the dog's breakfast that often springs up after I've started a contact, and the noise blanker really works over nine tenths of its travel (at the far end everything limits).

I've had a few less than appreciative comments when getting over enthusiastic with the speech processor, but

otherwise the rigs produce excellent speech quality.

There are a few hidden features in the rig that will delight the SSTV operator. The facility for listening to one's own audio whilst on transmit is invaluable because you can watch the picture as it goes out on the air, and the variable bandwidth control enables a compromise to be reached between picture quality and interference when the QRM starts up a KHz or so off channel. I readily admit that these facilities are available on some other rigs, before I am accused of bias.

On the subject of variable bandwidth control, it should be mentioned that although it is possible to sharpen up the IF for CW work, I dislike the slightly 'dead' sound that this produces. A proper narrow filter can be fitted and obviously improves things all round. Watch out if you have bought a 'Kenwood' variant – some of these will not accept the Trio filters and you will have to shop around for one to fit.

Two comments

Two unrelated comments in conclusion. The notch filter really is the business on CW – it's great to just drop the QRM into a hole at the twist of a knob – and the rigs are very reliable. Apart from the common faults listed above, all failures have been random. In fact your scribe accidentally knocked his rig into CW transmit (full power) with no aerial connected and only realised what was going on 25 minutes later. There was a bit of a smell, but the rig still works perfectly – not bad when you consider the case was so hot it could not be touched.

You can expect to pay £400 to £500 plus secondhand, dependent on age and condition.

OK, that's the low-down on three Trio HF rigs, who's going to write in with a moan next?

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■ Howes dc/Rx PCB module 14MHz in original packing with instructions, mint, £15.00 inc p&p. Also 'Radio Handbook' 18th edition and bound volume. 23 of 'The Radio Constructor'. Offers invited. Flower Avenue, Fernand Labby, 12 B-5989 Bossut, Gottech, Belgium. Tel: (010) 845200.

■ HRO gen cov Rx. Full set of nine coils PSU and handbook. Exchange for AR88 or similar, WHY. Tel: (0361) 82714.

■ Uniden Uniace 100 CB, never used mobile, mint cond, signal squelch fitted by Bury Electronics, responds to signals not noise! Standard squelch can over-ride if you desire realignment and written report by local shop. Sorry to part with it but need cash for HF, £40 ono. Tel: G6RBY on (247) 6097 (day.)

■ Yaesu FT107M transceiver with FC107 tuner and FP107E power supply. Also Shure 444D mic. Very few hours use. Sell complete £600. Tel: Ken, 061-303-8411 (day.)

■ Acorn Atom 12K RAM, FP, VIA, 3 utility roms. 'Atom Calc', 'Atom Test Editor/Processor' and 'A & F Utilikit'. Also PSU all leads, manuals, books and large collection of games software on tapes £135. Also Atom 12K RAM, FP. Needs slight attention £35 ono. Paul King, 16 The Pippins, Westbury Park, Clayton, Newcastle, Staffs. Tel: (0782) 632600.

■ CR tube (3in) with mu-metal screen, base mount and viewing hood £3, Woden UM1 modulation transformer with details of connections £2. RSGB VHF-UHF manual (1969) £1. Surplus radio equipment conversion manual (BC and SCR series 1948) £1. Crystals: 100, 7206, 7070, 7074, 1891, 7050, 1600KHz. £5. Buyer collects or postage extra. Tel: 01-452-7618.

■ Icom IC215 portable 2m t'ceiver. 15 channels (all crystals incl), Nicads, ¼ wave helical, carrying strap. 3½ or ½watt O/P, user handbook included. In good condition. £85 ono. Tel: 061 865 9233. Vik G6TEV QTHr.

■ Cobra 148 GTL DX £100. Tel: 01-851 6876 Bromley Kent.

■ TS510 with PS510 trio SSB/CW pair. Sell or exchange for MM4001 KB. G4YUG QTHr. Tel: (0473) 830147.

■ Astatic D104 crystal microphone with UB8 stand as new £40. Servomex voltage stabilizer AC7 mk2 195-260V ac at 32amps 140lbs, hence buyer collects £60. Ten-Tec Argonaut 509, 80 to 10 transceiver, as new £240. TS900 transceiver with PSU and speaker £650. Martin Wills G3ZZS, 21 Woodford Road, Glenholt, Plymouth PL6 7HX. Tel: Plymouth 707550.

■ KW 2000B Tx/Rx with matching PSU and manual £150. K Parker G3PKR, 21 Lundy Drive, Hayes, Middx.

■ CBM 64 plus C2N cassette vgc 8 months old £175 or swap ham gear. PET computer 2001 series 32K vgc £130 or swap ham gear WHY. Bob, Canvey Island 697906.

FREE CLASSIFIED ADS

FOR SALE

■ FWO vintage Eddystone 840 HF/MF comms Rx covering MW/SW broadcast bands thru' ham (1.8 to 28KHz) and CB (27KHz) AM ANL/BFO for SSB. An efficient and handsome gen cov Rx, £85. DNT 40 channel FM CB rig boxed as new (RRP CB mag £100) £35. 3 function SWR/PWR/FS meter (CB) boxed as new £7.50 or swap/Px all or any item for WHY: Also have VW Beetle car value c.£400 swap/Px for 1.8-28KHz T/cvr. H Walton, 0602 (Nottingham) 606644 day or 268880 ev/wkd.

■ Realistic DX-302 receiver 10KHz – 30MHz digital readout. AM. SSB, CW. Mains or battery operated. Global AT1000 ATU, both boxed and in excellent condition with instructions. Prefer buyer collects. £140. Tel: Oxford (0865) 66075.

■ Fairmate hand held VHF scanner covers 136 – 162MHz. 20 channel memory. Includes Nicads and charger. £55 ono. Tel: 01 444 8872.

■ Latest pair of brand new handheld fully synthesised memory scan transceivers. The Icom ICO2E's are equipped with charger, spare battery pack, speaker mic, carrying case and most other accessories. Over £680 of equip all in original packing. £520 or nearest offer. Please phone David anytime or leave message at 01-458 9723 London.

■ Moonraker four element beam 10m. £65 ono. Mr D Dewar, 311 Gangstead Lane, Hull HU11 4BT. Tel: 811477.

■ Yaesu FT101ZD FM fitted and 902 ATU complete in lockable wooden cabinet, spare PA bottles and AM board. Sell for £500 or exchange for a mobile FT707, FP707 PSU, FC700 ATU or equivalent. Tel: 021 745 3429.

■ Yaesu FRT7700 SWL ATU for FRG7700 Rx nice condition £28. Trio HS4 8Ω headphones original packing £6. Three KT66 valves new no boxes £4 each or £10 the three. Postage extra all items. Mr N Richardson, 2 Edna Road, Ringlestone, Maidstone, Kent ME14 2QJ.

■ Complete home computer system comprising Sinclair Spectrum 48K. Cost £150, sell £75. Microdrive, cost £50, sell £20. Interface 1, cost £50, sell £20. Interface 2, cost £18, sell £8. Full size Maplin keyboard, cost £40, sell £18. Home built amplifier and loudspeaker, cost £20 sell £9. Spectravideo joystick cost £9, sell £4. Brother EP44 computer printer RS232 typewriter with lead and power transformer for use with Spectrum. Cost £249, sell £149. Computer grade cassette recorder cost £49, sell £19. 5 microdrive cartridges and dozens software tapes & odds and ends, cost £50 plus, sell £20. Kit of parts inc PCB and case for speech unit, cost £20 sell £10. All under 6 months old and with original packing etc. Total cost £660 plus, bargain only £299 or will split. FREE black and white portable television (needs fixing) if you buy the lot. May consider a swap for a really good 10MHz+ double beam portable scope. Tel: Kingston Blount (0844) 51694 or write to Mr Small, 8 Cherry Tree Road, Chinnor, Oxfordshire OX9 4QY.

■ Two PYE Motafones £40, one Jaybeam wide-band PMR antenna £40, one FDK hand scanner 140-180MHz £80, one PYE balum with case and mic £30, one Stornafone 500 3ch with battery £10, two PYE Rx homebases, one PYE Tx, the three £60, GL PMR mobile mount 12ch, one Tx crystal, one Rx crystal VHF high band £120 or swap for two PYE PF70s complete. Alistair Graham, 16 Fordell Leader Road, Dalkeith, Scotland.

■ 24GHz directional coupler and detector (with crystal) £28, rotary attenuator £35, SWR meter (£700 new) £190, also bends, twists, couplers etc. 1000-2000MHz wavemeter £18. Mains synchronous motors, various speeds, £1 each. Push buttons, reed contacts, 10 for £8. Mann, Tel: Cambridge (0223) 860150.

■ Selling, microwave modules 144/23cms transverter (new model) as new, 2W out £189. Tonna 23cms yagis (new) £26 each. Cushcraft 70cms cross yagi (new) £38. Also Ringo Ranger II (new) £35. Tel: Paul G4XHF, (0293) 515201 evenings.

■ Drake TR7A with PS7 power supply latest model. Boxed £850, Drake MN7 ATU £125. Drake SP75 speech processor £50. Various drake accessories inc mobile mounts baluns etc. Trio TR9000 2 metre multimode with PSU control unit and matching speaker £250. Dressler D200S 1KW 2metre linear £600 with GaAsfet pre-amp and interface. Bryan, 410 Manchester Road, Sheffield. Tel: (0742) 666169 evenings.

■ TR7010 2mtr SSB. 10 watts output. Xtaled 144.260 to 144.255. Good cond. Mobile mount, orig packing and manual. £110 carriage extra. G6CLP, QTHr. Tel: Ashby de la Zouch (Leics) 414164.

■ Yaesu FT707 HF transceiver and FP707 power supply £360 ono. Derek Brooker, 13 Betsham Road, Maidstone, Kent ME15 8TX. Tel: (0622) 64260.

■ Trio R600 general coverage receiver 0-30MHz mint condition AM SSB CW hand book £175. T Harding, 10 Elm Rd, Ewell, Surrey, KT17 2EU. Tel: 01-394 1971.

■ Saturn Base antenna. 500 watts capability, high performance, still under makers guarantee, 1 metre long. Cost £19, sell £14 post paid, or would part exchange for a Revcone antenna. M Marsden, 205 Moss Lane, Burscough, Ormskirk, Lancs L40 4AS.

■ 2 metre portables, Belcom LS20XE, amp car aerial, Jaybeam roof aerial, vox mic, Nicad batteries. £190 all. Tel: (041 429) 2841.

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We are pleased to be able to offer readers the opportunity to sell your unwanted equipment or advertise your 'wants'.

Simply complete the order form at the end of these ads, feel free to use an extra sheet of paper if there is not enough space. We will accept ads not on our order form. Send to ***Amateur Radio,*** Classified Ads, Sovereign House, Brentwood, Essex CM14 4SE.

DEADLINE AND CONDITIONS

Advertisements will be published in the first available issue on a first come first served basis. We reserve the right to edit or exclude any ad. Trade advertisements are not accepted.

■ Modulation meter Airmec type 210 AM & FM 0-100KHz £50. Calibration receiver MKII, Sanders IF input, 2nd detector. Cathode follower output £40. RC oscillator Marconi 0-200Khz output £35. Two oscilloscopes, telequipment type D53A dual beam one working, one for spares or repair £120 pair. S Muscroft, 31 Chedburgh Place, Haverhill, Suffolk. Tel: (0440) 703932.

■ Multi 700AX 25W 2m FM transceiver £140. 144/28 transverter still under guarantee £75. 10 XY Yargi & AR40 rotator £75. Would exchange for FT480R or IC290E 2m multimode. Buyer collects. Terry, Tel: (0462) 35248.

■ Welz diamond GH22 antenna for sale as new £20. Allen QTHr Tel: 01-947 3914.

■ FT290R complete with Nicads, charger, carry case, manual, unmoded, vgc £180. Tel: (0438) 359428.

■ Standard C5800, 2 metre multimode. 25 watts output, 144 to 148MHz. FM, SSB, CW. Mint condition, little used. £290. G1CFY. Tel: (0303) 38849.

■ Yaesu FT707 HF SSB transceiver, plus YM37 mike, and FP700 PSU. All new and boxed, reason for sale updating equipment. £600 ono. Mr Hamilton, Flat 2, 419 Beverley Road, Hull, East Yorkshire. Tel: 43725 between 6-7pm.

■ Astronomical telescope cost £300 plus books to exchange for a GGW cov receiver (ERG7 or equivalent), or will accept cash. Mr Ogilvie, 'Abbey Sound', Cliff Gardens, Minster Sheerness, ME12 2NB. Tel: (0795) 875973.

■ If you are looking for service data and circuit diagrams for your equipment then I may be able to help. I have a large collection built up over many years for radio's, TV's, vintage wireless, video's etc from the mid 1930's to date. With a strong section on 1950's and 1960's. Tell me what you want and I will try and help. Sae please. Mr Maurice Small, 8 Cherry Tree Road, Chinnor, Oxon, OX9 4QY.

■ 8 dictating machines Grundig, Phillips, Olympia, some headphones, foot pedals and microphones available. £15.00 each or nearest offer. Contact Keith GW4NBY. Tel: (0656) 56576.

■ Acorn Atom computer with G4BMK RTTY program on eprom and cassette complete with instructions £60. Yaesu FRDX400 amateur band receiver +2mtrs, 4mtrs £90. Fuller FDS keyboard for ZX Spectrum (new type keyboard) £40. Prefer buyer collects receiver. G6EJF. Tel: Clevedon 871744 after 6pm.

■ Icom 720A Tx/Rx, gen coverage Rx, CW filter, late 1982 model, used 6 months, £650. G3ZPJ. M Symons, Flat 1, Orchard House, 10 The Fradgen, Newlyn, Penzance, Cornwall TR18 5BE. Tel: Penzance 60636 8am to 9.30am.

■ Trio 2200 GX, 2m FM, portable or base, with charger, Nicads, dc lead, £75. Pet 2001, 32K computer, vgc, £120. Shure 444D base mic vgc, £25. CBM 64 plus C2N cassette unit 8 months old, vgc, £180, or swap computers for ham gear, WHY. Bob, Tel: Canvey Island 697906.

■ G4MH mini beam, 4 months old, good condition £75. G4WUU. Tel: Kings Langley 65823.

■ FTV707R transverter main frame and 2m module. New, has not been used £130.00 ono. Tel: (0239) 614391 evenings.

■ Sansui QSP10 4-chnl rear system synthesiser complete with speakers. Original transit package. Will deliver reasonable distance from Medway. £45 ono. James Bailey, 252 High Street, Rainham, Gillingham, Kent. Tel: (0634) 365053.

■ Panasonic DR31 receiver with Yaesu antenna tuner, all perfect condition. See review in recent issue of 'Amateur Radio'. All just £140. Buyer collects. Tel: 01-440 0476.

■ 70cm crystals £3.50 pair or £1.75 each. For pocket phones, wood and douglas, FDK multi U11. RB2 RB4 RB14 SU8 SU20 Rx. ATV Tx xtal. Converter crystals 38.6666MHz, 42MHz. Tel: (0453 83) 3411.

■ Yaesu FT101 HF Tx/Rx in good cond complete with manual etc 160-10m £310 ono. Also FC902 ATU unused £140. Buyer collects. Tel: Maidstone 0622-26569.

■ Trio TS700G 2m multi, +SP70, +VOX3 £280. Microwave Modules 2m 100W linear, £80. Yaesu FT7 HF rig 80-10m, £200. Trio TR7600 +RM76 (remote) 2m mobile, £170. Datong audio filter FL1, £40. Yaesu FT207R +ACC, £120. 2m w/meter packer comm. £10. All ono. Tel: Martin G8TLA Selby 708025.

■ Exchange MM2001 RTTY converter, as new condition, for Sinclair 48K Spectrum computer, must be in good condition. Also wanted Benkson multiband TR30 receiver, must be in good condition. L T Borthwick, Torwood, Lilliesleaf, Melrose, Borders Region Scotland. Tel: 08357 314.

■ Trio 9130 2m multimode £350; BNOS 6A PSU £35; Hansen FS7 144/432 SWR/power meter £30, or £420 the lot. All 6 months old. Would consider swap for Icom R-70 or similar. I can deliver in South-West, Midlands, London. Striplin, G1FXS. Tel: 07555 7945.

■ NRD505 communications receiver very high-grade. Freq range: 100KHz to 30MHz. (£1,800 new). All filters fitted. Matching speaker and manual. £700 ono. Tel: (021) 588/6594 evenings.

■ Eddystone 750 1.5 – 30MHz offers £55. Wanted FT7B in good condition. Tel: (0283) 221870.

■ For sale Reftec 934MHz radio, £200. Wanted AVO volted test matter. Tel: Farnborough Kent 58825.

WANTED

■ Manual for Ten-Tec Argonaut model 515 (not the earlier model 509). Alan Williams, G3KSU, 11 Grange Ave, Ryde, IOW PO33 3LS. Tel: (0983) 65551.

■ Circuit diagram for Erskine type 13 oscilliscope or photo copy of manual all costs reimbursed. Mr T Heeley, G3SWU, 34 Worlaby Road, Scartho, Grimsby, South Humberside, DN33 3JT. Tel: (751537).

■ RCA 88D receiver and valves no's DW2, IFW1. I also require INFO or R1155 RAF receiver, will buy or copy. Eric Robins, 69 Hart Road, Byfleet, Surrey, KT14 7HL. Tel: Byfleet 40753.

■ VHF/UHF good quality scanner, details, price, ETC to Mr Hunter. 30 Adelaide St, Barrow-in-Furness, Cumbria, LA14 5TX. (No phone).

■ HF Tx/Rx wanted in good order Trio 130V, Yaesu FT707, Yaesu 101Z etc. Would swap for my 2mtr station Icom 290E ICSM5 base mic, HM10 Scanning mic, mobile mount, 9 ele tonna, GWO no mods. Mr Aldridge. Tel: 01-200-3825.

FREE CLASSIFIED ADS

WANTED

■ Urgently required 2 or 3 ele Tri bander Yagi. Quads also considered as well as home brew antennae. Also a 2m transverter, Shure 444 cheap Morse key, SP102 and large 2m antenna. Cash waiting would prefer to collect or arrange postage. Please tel Clive (0279) 28857. After 6pm or Fri afternoons or weekends.

■ Any mods for FT-7 will pay all costs G4YBP not QTHr. P Darcy, 254 James Greenway, Lichfield, Staffs.

■ Yaesu FRG7. Please contact Mr Jones, 45 Barrington Court, Cheltenham Place, Acton, London W3 8PH.

■ Dentron ATU MT3000, Tokyo HC2000 ATU medium duty rotator, Shure 444T. Tel: Bill G4EMG 01-534 3460 evenings. 01-553 7308 days.

■ Old CW Telegraph Morse keys. M E Hess (WB4YQE) 1131B Minnesota Ave, Winter Park, FLA 32789, USA.

■ Clarke or Hilomast pump up telescopic mast. Hand operated or compressor. 50ft minimum. Also 'Great British Spring' professional reverb unit. Offers to G3HWX. Tel: (0704) 840328.

■ Top quality HF Rx R390A, etc. Good working order and condition essential. Cooper, 11 Radical Ride, Wokingham, Berks RG11 4UH. Tel: (0734) 734312.

■ Harvard 410T CB hand held. Must be working. Also any mods for FT208R and FRG7700. Roy Bailey, Great Shefford. Tel: (048839) 441.

■ Disabled B licence holder requires a through type rotator suitable for 9 Ele Tonna Beam in a very windy location and a Creed model 444 in good working order with gear for 45 bauds. Tel: (0795) 876091 anytime.

■ PSU, ATU, for C12 Tansc. ZC1 R216 in any condition. Tel: Nutfield Ridge, Surrey 2888 after 5pm.

■ Valve data book printed for 'Wireless World' 1964 by Kiffe Books Ltd or any other books on valve data. Prices and postage for books in good condition to: Wegg, 23 Kerdane Dane, Park Rd, Hull. Tel: 855052.

■ 1082 1083 ex RAF transmitter receiver. G3DOP. Tel: Helston 290711.

■ Service manual for Lafayetter HE80 to copy and return with costs. Bill Potter, 32 Douglas Road, Clacton on Sea, Essex. CO15 3JT. Tel: 0255 429111.

■ Manuals and alignment instructions for Pye sets, especially Vanguard AM25T or AM25B Cambridge, Bantam Westminster, motophone. Will pay for copying. Also wanted low band sets like above Tel: (03722) 73428.

■ UHF Radio Telephone Pye. ITT etc. Any condition accepted mainly interested in receiver side of the above. B Rutter, 7 West Howe Close, Kinson, Bournemouth, BH11 8AE. Tel: 422286.

■ Early amateur radio equipment, receivers, transmitters. Wireless, amateur radio magazines of the 1920s and 1930s also trade catalogues, valve literature. Clandestine suitcase sets complete or spares. Williamson, Leak, Dynatron, Dynaco valve amplifiers or similar. Early quality hi-fi. Valves of any period and quantity. John Baker, 13 Burrard Road, London NW6 1AB. Tel: 01-794 0823.

■ Power supply Vespa MKII or trans for same QTHr G4BWS. Tel: Orpington 73474.

■ Information required for receiver Marconi Marine 'Dynatron' Mimco 2235. All help will be welcome, ready for overhaul. Circuit diagram or anything of interest about this outfit. Would also have an extra desire for any gen for Trio JR60 in very good working order. All letters answered. No phone. H O Wilkinson, 43 Oliphant Circle, Malpas, Newport, Gwent.

■ 2m SSB/multimode base station rig; ac mains facility. All offers considered, cash available. Details to Roger Hawkins, Hon Sec, Smiths Industries Radio Society c/o 101 Tobysfield Road, Bishop's Cleeve, Cheltenham GL52 4NZ. Tel: (0242) 67 2175.

■ Collins KWM-380 late model no mods. Part exchange ICOM 7S1 bought August 1984 with extras cost £1330. Cash balance for Collins or straight purcase of Collins. Tel: Dronfield 413413

■ Instruction manual or sheets for Codar PR30 RF pre selector, photo copy would be acceptable. Your price plus postage paid first copy received. All others returned postage refunded. Denyer, 26 Wemyss Place, Kyle of Lochalsh IV40 8DE Ross-shire. Tel: (0599) 4538

■ 2 metres complete. FT290R plus case, nicads, charger. 5A PSU, SWR/power meter, 9 element Tonna, rotator, 12ft aluminium pole, mounting brackets, control cable, slim jim, mobile mag mount, power leads etc FT290R only one year old. Operator going HF £350 Robin Caira. G4URD. 12 The Crescent, Southbourne, Emsworth, Hants PO10 8JS Tel: (02434) 77532

■ Short wave comms receiver, eg eddystone EC10 or similar, also 70cm rig mobile/portable cheap. Phone G8RHU 0273 516801 (Newhaven)

■ Wanted hand book Heathkit oscilloscope 10-18V buy or borrow all postages paid R Potter 354 Lodge Avenue, Dagenham, Essex RM9 4QX. Tel: 01 593 5579

■ Yaesu FRG 7 must be in first class order and very reasonable price. Prefer mark II with fine tuning. Also convertor for 2 mtrs. G W Reed, 96 Wootton Road, King's Lynn Norfolk. Tel: King's Lynn (0553) 63428

■ Help! I would love to take up amateur radio but don't know much about it. I would be grateful if any amateurs could give me advice or any criteria on non-expensive Tx Rx, aeriels, licences etc, main interest is long distance, but really settle for any type of amateur radio. Write to: William Matheson, 58 Balfron Crescent, Earnock Estate, Hamilton ML3 9UN, Strath-Clyde

■ Info on ICOM IC215 will buy hand book or pay for photo copies also have double barrel shot gun and fair amount of 00 model railway gear to swop for 2 metre gear. Barrie Hackett, Wellington House, 1 Par Lane, Par, Cornwall, PL24 2DN. Tel: PAR 4986

FREE CLASSIFIED AD FORM

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Classification: (tick appropriate box) If you want to insert ads under more than one classification use separate sheets for second and subsequent ads

For Sale ..... ☐ Wanted ..... ☐

USE BLOCK CAPITALS (One word per box)

To avoid mistakes please write clearly and punctuate your ad

Name/Address Postcode/Telephone							

USE SEPARATE SHEET FOR MORE WORDS

Ensure that you have included your name and address, and/or telephone number

CONDITIONS: Ads will be published in the first available issue on a first come first served basis. We reserve the right to edit or exclude any ad. Trade advertisements are not accepted

Amateur RADIO SMALL ADS

Amateur RADIO SMALL ADS

This method of advertising is available in multiples of a single column centimetres — (minimum 2cms). Copy can be changed every month.

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per single column centimetre:
1 insertion £7.00, 3 — £6.60, 6 — £6.30, 12 — £5.60.

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CHARGE TO MY ACCOUNT.....☐

COMPANY .....

ADDRESS .....

SIGNATURE ..... TELEPHONE.....

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C P I

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Cheques should be made payable to Radio & Electronics World. Overseas payment by International Money Order, or credit card.

CREDIT CARD PAYMENT VISA ☐ ☐

Signature AR1284

ADVERTISERS INDEX

Amateur RADIO

ADVERTISING RATES & INFORMATION

ABC membership approved pending first audit Jan-Dec 1985

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
61 x 90	1/8 page	£66.00	£62.00	£59.00	£53.00
128 x 90 or 61 x 186	1/4 page	£115.00	£110.00	£105.00	£92.00
128 x 186 or 263 x 90	1/2 page	£225.00	£210.00	£200.00	£180.00
263 x 186	1 page	£430.00	£405.00	£385.00	£345.00
263 x 394	double page	£830.00	£780.00	£740.00	£660.00

COLOUR AD RATES

depth mm x width mm	ad space	colour rates exclude cost of separations: 1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
128 x 186 or 263 x 90	1/2 page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£550.00	£530.00	£470.00
263 x 394	double page	£1,130.00	£1,070.00	£1,010.00	£900.00

SPECIAL POSITIONS

Covers: Outside back cover 20% extra, inside covers 10% extra
Bleed: 10% extra [Bleed area = 307 x 220]
Facing Matter: 15% extra

DEADLINES

*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof & small ad	mono artwork	on sale thurs
Jan 85	22 Nov 84*	28 Nov 84*	30 Nov 84*	27 Dec 84
Feb 85	17 Dec 84*	2 Jan 85	4 Jan 85	24 Jan 85
Mar 85	31 Jan 85	6 Feb 85	8 Feb 85	28 Feb 85
April 85	28 Feb 85	5 Mar 85	8 Mar 85	28 Mar

CONDITIONS & INFORMATION

SERIES RATES
Series rates also apply when larger or additional space to that initially booked is taken.
An ad of at least ⅛ minimum space must appear in consecutive issues to qualify for series rates.
Previous copy will automatically be repeated if no further copy is received.
A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.
Display Ad and Small Ad series rate contracts are not interchangeable.

If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

COPY
Except for County Guides copy may be changed monthly.
No additional charges for typesetting or illustrations (except for colour separations).
For illustrations just send photograph or artwork.
Colour Ad rates do not include the cost of separations.

Printed — web-offset.

PAYMENT
All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by the publication date.
Overseas payments by International Money Order.

FOR FURTHER INFORMATION CONTACT
Amateur Radio, Sovereign House, Brentwood, Essex CM14 4SE.
(0277) 219876

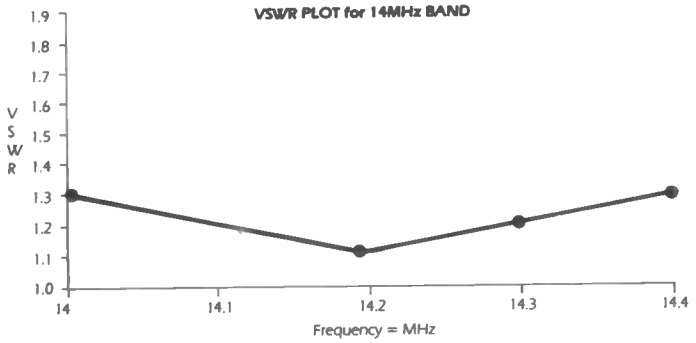
Commission to approved advertising agencies is 10%.

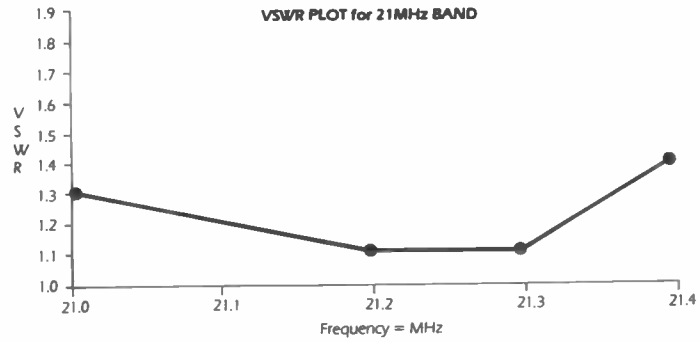
CONDITIONS
10% discount if advertising in both Amateur Radio and Radio & Electronics World.
A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

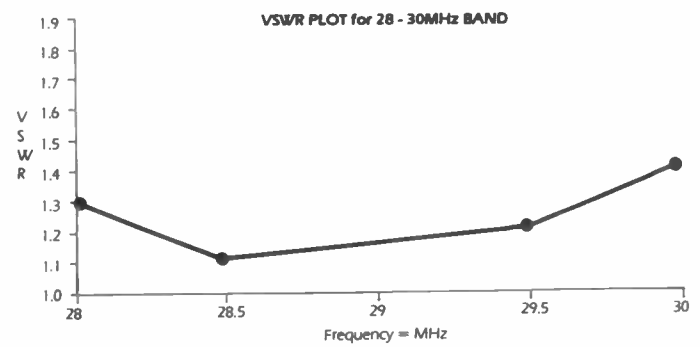
A New Approach to HF Antennae Design

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.

With the conversion kits available, a 3 element, 3 band beam with an enormous front to back ratio will become the standard for others to follow.

HIGHTECH

Antennae (Scotland) Ltd

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